OKLAHOMA
DEPARTMENT OF ENVIRONMENTAL QUALITY

SCOTT A. THOMPSON
Executive Director

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

KEVIN STITT
Governor

August 25, 2020

CERTIFIED MAIL

Jennifer Sanchez
Environmental Manager
HollyFrontier Tulsa Refining LLC – East Facility
1700 South Union Avenue, P.O. Box 21001
Tulsa, OK 74121-1001

RE: RCRA Corrective Action and Post-Closure Permit – Public Draft Permit; HollyFrontier Tulsa Refining LLC, Tulsa East Refinery (HFTRE), Tulsa, Oklahoma; EPA ID No. OKD990750960, Permit No. 990750960

Dear Ms. Sanchez:

On October 21, 2011, the Department of Environmental Quality's Land Protection Division (DEQ) received the above referenced application. The application was reviewed for administrative and technical completeness in accordance with Title 40 of the Code of Federal Regulations (40 CFR) §§ 264, 270, the Oklahoma Hazardous Waste Management Act (27A O.S. §§ 2-57-101 *et seq.*), Oklahoma Administrative Code (OAC) 252:4 and OAC 252:205. DEQ determined the application to be administratively complete on May 18, 2012, and technically complete on May 26, 2020.

On June 9, 2020, DEQ issued a courtesy draft of the permit to HFTRE for review and comment. On July 9, 2020, DEQ received comments from HFTRE. DEQ has reviewed the comments and prepared the enclosed RCRA Corrective Action and Post-Closure Permit for public comment.

The enclosed draft permit has been finalized for public review and comment. HFTRE is required to publish notice of opportunity to comment and request a public meeting on the draft permit in at least one (1) local newspaper of general circulation. Concurrently, a notice should be broadcast on a local radio station. These notices will announce the opening of a forty-five (45) day comment period. Additionally, HFTRE is to send a notice of the draft permit to all persons on the facility mailing list and to appropriate state and local government agencies as specified in 40 CFR 124.10(c)(1)(ix) and (x). Subsequently, proofs of publication and broadcasts must be furnished to DEQ within twenty (20) days after the date of publication pursuant to OAC 252:4-7-13(d).

A fact sheet is included in the draft permit for public information. Please ensure that a copy of the draft permit is made available at both the Tulsa City County Library and the main gate of the HollyFrontier Tulsa Refining LLC, Tulsa West Refinery. A copy of the draft permit will also be available on the DEQ website at https://www.deq.ok.gov/land-protection-division/permit-public-participation-process/.

If you have any questions, please contact James Wilkins of my staff at (405) 702 – 5171 or james.wilkins@deq.ok.gov.

Sincerely,

Hillary Young

Hillary Young, P.E.
Chief Engineer
Land Protection Division

Enclosure: Draft Permit

cc: Harry Shah (6PD-O) EPA Region VI

Newspaper Notice Text

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY
NOTICE OF DRAFT POST-CLOSURE PERMIT
OF AN EXISTING HAZARDOUS WASTE MANAGEMENT FACILITY

The Oklahoma Department of Environmental Quality (DEQ) has received an application to renew a Resource Conservation and Recovery Act (RCRA) Post-Closure and Corrective Action Permit for HollyFrontier Tulsa Refining LLC – Tulsa East Refinery (HFTRE), 902 West 25th Street, Tulsa, Oklahoma 74107 located in Sections 13, 14, 23, and 24, Township 19 North, Range 12 East, Tulsa County, Oklahoma. The application was filed on October 21, 2011.

DEQ has tentatively found that the application meets the requirements of Title 40 of the Code of Federal Regulations (40 CFR) parts 264 and 270, Title 27A of the Oklahoma Statutes (27A O.S. §§ 2-7-101, *et seq.*), Oklahoma Administrative Code (OAC) 252:4 and OAC 252:205, and has prepared a draft post-closure and corrective action permit for public review.

The draft corrective action and post-closure permit and its conditions propose that the HFTRE facility continue to monitor and maintain the two closed Land Treatment Units and implement corrective actions onsite and offsite (adjacent to the facility boundary) for releases of constituents of concern. The corrective action and post-closure permit would be issued under the authority of the Oklahoma Hazardous Waste Management Act and the federal Resource Conservation and Recovery Act.

The application, the draft permit, and related documents may be reviewed on DEQ's website at https://www.deq.ok.gov/land-protection-division/permit-public-participation-process/; the Tulsa City County Library at 400 Civic Center, Tulsa, Oklahoma 74103; and the main gate of the HollyFrontier West Refinery at 1700 S. Union Avenue, Tulsa, Oklahoma 74107. The DEQ and HFTRE contacts are:

Hillary Young, P.E., Chief Engineer
Land Protection Division,
Oklahoma Department of Environmental Quality
P. O. Box 1677
Oklahoma City, Oklahoma 73101-1677
(405) 702-5100

Arsin Sahba, P.G.
Corporate Environmental Specialist – Remediation
HollyFrontier Tulsa Refining LLC
2828 N. Harwood, Suite 1300
Dallas, TX 75201
(972) 689-8540

Persons wishing to comment on the draft permit should submit their comments in writing to DEQ at the above address or website. Also, any person may request, in writing, a formal public meeting to present written or oral statements and data concerning the draft permit. A request for a public meeting must identify the nature of the issues to be raised in the meeting. If DEQ determines, based on the requests it receives, that there is significant degree of public interest in the draft permit, it will schedule a public meeting and provide notice of the date, time and place.

Written comments and requests for a public meeting must be received by DEQ within forty-five (45) days after the date of this publication at the DEQ address or website given above. More specific information may be obtained by contacting the applicant at the HFTRE contact given above, or by contacting DEQ at the contact listed above.

Radio Broadcast Text

Oklahoma Department of Environmental Quality
Notice of Potential Post-Closure and Corrective Action Permit Conditions
For a Hazardous Waste Management Facility

The Oklahoma Department of Environmental Quality (DEQ) has reviewed a permit renewal application submitted by HollyFrontier Tulsa Refining LLC, Tulsa East Refinery, for a Resource Conservation and Recovery Act Post-Closure and Corrective Action Permit. The East Refinery facility located in Sections 13, 14, 23, and 24, Township 19 North, Range 12 East, Tulsa County, Oklahoma. The street address for the facility is 902 West 25th Street, Tulsa, Oklahoma 74107. DEQ has made a tentative determination to renew a post-closure and corrective action permit for HollyFrontier Tulsa Refining LLC for its East Refinery facility in Tulsa, Oklahoma.

The draft permit and its conditions propose that the HollyFrontier Tulsa Refining LLC, Tulsa East Refinery continue to monitor and maintain the two closed Hazardous Waste Land Treatment Units and implement onsite and offsite corrective actions for releases of constituents of concern. The draft permit would be issued under the authority of the Oklahoma Hazardous Waste Management Act and the federal Resource Conservation and Recovery Act.

Further information, including the application, draft permit, and a fact sheet may be reviewed on the Oklahoma Department of Environmental Quality's website at www.deq.ok.gov.; and the Tulsa City County Library at 400 Civic Center, Tulsa, Oklahoma, telephone number 918-549-7323; and the main gate of the HollyFrontier West Refinery at 1700 S. Union Avenue, Tulsa, Oklahoma 74107.

Persons wishing to comment on the draft permit or to request a public meeting should submit their comments or requests in writing to DEQ no later than forty-five (45) days from the date of this broadcast. DEQ's mailing address is P. O. Box 1677, Oklahoma City, Oklahoma, 73101-1677.

For further information about this notice, please contact Hillary Young with DEQ at 405-702-5100. That number again is 405-702-5100.

HOLLYFRONTIER TULSA REFINING LLC
TULSA EAST REFINERY
TULSA, OKLAHOMA

EPA ID # OKD990750960

CORRECTIVE ACTION AND POST-CLOSURE PERMIT FOR THE REMEDIATION AND MONITORING OF CLOSED HAZARDOUS WASTE MANAGEMENT UNITS

ISSUED BY

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

[MONTH DAY, 2020]

<u>HOLLYFRONTIER TULSA REFINING LLC</u>
<u>TULSA EAST REFINERY</u>
<u>FACT SHEET</u>

Potential Permit Conditions for the renewal of a Resource Conservation and Recovery Act (RCRA) Post-Closure and Corrective Action Permit. This is a Tier II Permit Action.

Type of Proposed Action:	Renewal RCRA Post-Closure and Corrective Action Permit.
Type of Facility:	Hazardous Waste Disposal Facility (Land Treatment Unit and Corrective Action)
Facility Name:	HollyFrontier Tulsa Refining LLC – Tulsa East Refinery
EPA ID Number:	OKD990750960
Location:	902 West 25th Street, Tulsa, Oklahoma 74107
Legal Description:	Sections 13, 14, 23, and 24, Township 19 North, Range 12 East, Tulsa County, Oklahoma.
Geographic Location:	Latitude: 36° 07' 35" North Longitude: 96° 00' 04" West
Landowner:	HollyFrontier Tulsa Refining LLC 2828 N. Harwood, Suite 1300 Dallas, TX 75201
Facility Operator:	HollyFrontier Tulsa Refining LLC 902 W 25th Street, Tulsa, OK 74107
Comment Period:	45 days from the date of publication

<u>Basis of the Draft Permit</u>

HollyFrontier Tulsa Refining LLC, Tulsa East Facility (HFTR-E, also the Permittee), is located within Township 19 North, Range 12 East, Section 13, 14, 23 and 24, Tulsa County, Oklahoma, at 902 West 25th Street, City of Tulsa. HFTR-E is a petroleum refinery located on approximately four hundred seventy-four (474) acres. The refinery has been in operation since approximately 1906. The petroleum products normally produced at the facility include gasoline, diesel fuel, fuel oils, propane, butane and commercial jet fuel.

The RCRA post-closure permit is for two (2) closed hazardous waste treatment units [the Walnut Grove Land Treatment Unit (WGLTU) and the Flare Area Land Treatment Unit (FALTU)], several other recognized solid waste management units (SWMUs) or areas of concern (AOCs) located on the facility property and ongoing onsite and offsite (adjacent to the facility boundary) corrective actions.

Consent Order (CO), Case No. 09-319, was agreed to between the Permittee and DEQ on December 1, 2009. The CO mandated the inclusion of post-closure care requirements for the WGLTU in the FALTU post-closure permit. It also required the inclusion of additional investigation activities in four of the SWMUs and AOCs. These include SWMU-H (landscape area), AOC-2 (former Union Pacific railroad property) and the light non-aqueous phase liquid (LNAPL) and dissolved phase benzene and methyl-tert butyl ether (MTBE) plumes underlying the facility. The expansion of the stated boundaries of SWMU-C and SWMU-E were also to be included in the post-closure permit. The CO, Case No. 09-319 was closed with the completion of all of the tasks.

CO, Case No. 11-100, was agreed to between the Permittee and DEQ on July 1, 2011. The CO required the Permittee to submit a new Part B Application for post-closure and corrective action which would include but not be limited to the Hazardous and Solid Waste (HSWA) amendments of 1984, the regulations promulgated thereunder, and Oklahoma Hazardous Waste Laws and Regulations. The groundwater sampling and analysis was also shifted from Land Treatment Unit (LTU) based to Site wide with approval of DEQ.

CO, Case No. 15-215, was agreed to between the Permittee and DEQ on November 9, 2015. The CO required the Permittee to cease application of wastewater on the Walnut Grove LTU and Flare Area LTU by December 31, 2015. The Permittee was also required to evaluate the soil and groundwater at the LTUs to determine if remediation would be necessary. Based on the results of that evaluation, HFTR-E is required to revisit the position and number of downgradient Point of Compliance wells along the LTUs to ensure that contaminants of concern (COCs) are not present in the groundwater above the applicable groundwater screening level.

The closed Land Treatment Units (LTUs) are areas of the facility that were previously used for land farming operations since the early 1900's. Historically applied wastes consisted of liquid, sludge and solid residues from various refinery operations. The most recent RCRA post-closure permit for the FALTU, Permit # 990750960-PC, was last renewed on July 2, 2008. The FALTU was certified closed and post-closure care began on April 1, 1993. The WGLTU was issued a permit to operate as a hazardous waste LTU on December, 10, 1998, Permit # 990750960-OP. The WGLTU operating permit expired on December 10, 2008. The WGLTU was certified closed on April 24, 2009, and post-closure care began at that time.

The current Permit Renewal Application was initially received on October 21, 2011. This renewal application has been through a series of Notices of Deficiencies and responses. DEQ determined the application to be administratively complete on May 8, 2012. The latest updated revision of the application was received on December 21, 2015, upon which DEQ determined the application to be technically complete. Additional updates to the application attachments were submitted on July 26, 2019, January 31, 2020, May 13, 2020, and May 20, 2020. DEQ reviewed those documents and determined that the application was technically complete. The draft Permit contains all the conditions set forth in CO, Case No. 11-100 and conditions pertaining to the East Refinery in CO, Case No. 15-215. CO, Case No. 11-100 will be closed with the issuance of the final Permit. CO, Case No. 15-215 will remain open due to investigations at HollyFrontier Tulsa Refining LLC –

West (HFTR-W).

The basic requirements of the Oklahoma Hazardous Waste Management Act (OHWMA) 27A O.S. §§ 2-7-101 *et seq*; the Oklahoma Administrative Code (OAC 252:205) as amended; the federal Resource Conservation and Recovery Act (RCRA); and the Hazardous and Solid Waste Amendments of 1984 (HSWA), having been met, DEQ has prepared draft permit conditions. DEQ has the authority to issue permits for these activities and to enforce compliance with RCRA and HSWA programs.

DEQ developed the draft permit conditions and incorporated applicable conditions from OAC 252:205 and 40 CFR 270; additional conditions to enhance compliance with OAC 252:205 and 40 CFR 264; and other conditions (as required) to achieve environmentally sound hazardous waste management.

The administrative record supporting this draft permit consists of the Part B permit application, additional supporting documentation, the draft permit, and this Fact Sheet.

Information Resources

Copies of the proposed draft Permit conditions, this Fact Sheet, and the Part B application are available for review on DEQ's website: https://www.deq.ok.gov/land-protection-division/permit-public-participation-process/.; and during normal business hours at the Tulsa City County Library at 400 Civic Center, Tulsa, OK 74103.

Telephone inquiries may be directed to:
Hillary Young, Chief Engineer
Land Protection Division, DEQ
(405) 702-5100

Comment Period and Procedures

Persons wishing to comment on the draft permit conditions may submit their comments in writing to the agency at the address listed below. Comments should be directed to the appropriateness of the permit decision and the permit conditions and should be of a factual nature. All comments must be received at the Oklahoma Department of Environmental Quality no later than forty-five days (45) after notice of this Permit action has been published, at the address below.

Oklahoma Department of Environmental Quality
Land Protection Division
707 N. Robinson, Oklahoma City, Oklahoma 73102 or
P.O. Box 1677, Oklahoma City, OK 73101-1677

Attn: Hillary Young, PE, Chief Engineer
Land Protection Division

DEQ's comment and public hearing procedures may be found in OAC 252:4 and 40 CFR 124.10

and 124.12. A public meeting will be held by DEQ upon written request when there is a significant degree of public interest. If a public meeting is requested, public notice will be given at least thirty (30) days before the meeting.

Public Meeting

The purpose of any public meeting is to clarify issues involved in the permit decision. Any person may submit oral or written statements and data concerning the draft permit conditions. The public is urged to address the issues set forth in the Notice of Draft Permit Conditions and this Fact Sheet and to present factual, relevant statements on these issues. All such pertinent and material testimony will be considered in reaching a final determination on the permit. A reasonable limit may be set upon time allowed for oral statements, and the submission of statements in writing may be required.

Notice of Final Determination

DEQ will notify the applicant and each person who has submitted written comments or requested notice of the final permit decision. Within thirty (30) days after a RCRA permit decision has been issued, any person who filed comments on the draft permit renewal or participated in the public meeting/hearing may petition the Executive Director of the Department of Environmental Quality to review any condition of the permit decision. The petition shall include a statement of the reasons supporting that review, including a demonstration that any issues being raised were raised during the public comment period, and when appropriate, a showing that the condition in question is based on a finding of fact or conclusion of law which is clearly erroneous, or an exercise of discretion or important policy consideration which DEQ should review. A petition to DEQ is a prerequisite to judicial review under OAC 252:205-3-2 and 40 CFR 124.19 and should be directed to the address listed below:

Scott Thompson, Executive Director
Department of Environmental Quality
707 N. Robinson
Oklahoma City, Oklahoma 73101-1677

If no comments are received during the comment period, the permit will become final and effective immediately upon issuance.

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY
CORRECTIVE ACTION AND POST-CLOSURE PERMIT
FOR A HAZARDOUS WASTE MANAGEMENT FACILITY

Permittee:	HollyFrontier Tulsa Refining LLC – Tulsa East Refinery 902 West 25th Street Tulsa, OK 74107

EPA ID Number:	OKD990750960	**Effective Date**:	xx-xx-2020
Permit Number:	990750960	**Expiration Date**:	xx-xx-2030

Pursuant to the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976, as amended (42 U.S.C. §§ 6901 *et seq*., commonly known as RCRA), including the Hazardous and Solid Waste Amendments of 1984 (HSWA), and regulations promulgated thereunder by the U.S. Environmental Protection Agency (EPA) (codified in Title 40 of the Code of Federal Regulations) and the Oklahoma Hazardous Waste Management Act (OHWMA), 27A O.S. §§ 2-7-101, *et seq*., as amended) and regulations promulgated thereunder in the Oklahoma Administrative Code (OAC) 252:205, the Oklahoma Uniform Environmental Permitting Act at 27A O.S. § 2-14-101 *et seq*., and rules promulgated thereunder in OAC 252:4-7, this Permit to perform post-closure care for closed hazardous waste management facility is hereby issued by the Oklahoma Department of Environmental Quality (DEQ) to HollyFrontier Tulsa Refining LLC – Tulsa East Refinery (hereafter called the Permittee). The facility is located within Township 19 North, Range 12 East, Section 13, 14, 23 and 24, Tulsa County, Oklahoma, at 902 West 25th Street, City of Tulsa, at latitude 36° 07' 35" North and longitude 96° 00' 04" West.

HollyFrontier Tulsa Refining LLC – Tulsa East Refinery, Tulsa facility is an approximately 474-acre parcel. The refinery has been in operation since approximately 1906 under several operators. The petroleum products normally produced at the facility include gasoline, diesel fuel, fuel oils, propane, butane and commercial jet fuel.

The RCRA post-closure and corrective action permit is for two (2) closed hazardous waste land treatment units (LTUs) and several other recognized solid waste management units (SWMUs) or areas of concern (AOCs) located on the facility property.

A CO, Case No. 09-319, was agreed to between the Permittee and DEQ on December 1, 2009. The CO mandated the inclusion of post-closure care requirements for the Walnut Grove Land Treatment Unit (WGLTU) in the Flare Area Land Treatment Unit (FALTU) post-closure permit. It also required the inclusion of additional investigation activities in four of the SWMUs and AOCs. These include SWMU-H (landscape area), AOC-2 (former Union Pacific railroad property) and the light non-aqueous phase liquid (LNAPL) and dissolved phase benzene and methyl-tert butyl ether (MTBE) plumes underlying the facility. The expansion of the stated boundaries of SWMU-C and SWMU-E were also to be included in the FALTU post-closure permit. The CO, Case No. 09-319 was closed with the completion of all the tasks.

CO, Case No. 11-100, was agreed to between the Permittee and DEQ on July 1, 2011. The CO required the Permittee to submit a new Part B Application for post-closure and corrective action which would include but not be limited to the Hazardous and Solid Waste (HSWA) amendments of 1984, the regulations promulgated thereunder, and Oklahoma Hazardous Waste Laws and Regulations. The groundwater sampling and analysis was also shifted from LTU based to Site wide with approval of DEQ. CO, Case No. 11-100 will be closed with the issuance of the final Permit.

CO, Case No. 15-215, was agreed to between the Permittee and DEQ on November 9, 2015. The CO required the Permittee to cease application of wastewater on the WGLTU and FALTU by December 31, 2015. The Permittee was also required to evaluate the soil and groundwater at the LTUs to determine if remediation is necessary. Based on the results of that evaluation, HFTR-E is required to revisit the position and number of downgradient Point of Compliance (POC) wells along the LTUs to ensure that contaminants of concern (COCs) are not present in the groundwater above the applicable groundwater screening level. The Permittee proposed a revised POC well network in the updated application (Permit Attachment 3) submitted on July 26, 2019.

The closed Land Treatment Units (LTUs) are areas of the facility that were previously used for land farming operations since the early 1900's. Historically applied wastes consisted of liquid, sludge and solid residues from various refinery operations. The most recent RCRA post-closure permit for the FALTU, Permit # 990750960-PC, was renewed on July 2, 2008. The FALTU was certified closed and post-closure care began on April 1, 1993. The WGLTU was issued a permit to operate as a hazardous waste LTU on December, 10, 1998, Permit # 990750960-OP. The WGLTU operating permit expired on December 10, 2008. The WGLTU was certified closed on April 24, 2009, and post-closure care began at that time.

The current Permit Renewal Application was initially received on October 21, 2011. This renewal application has been through a series of Notices of Deficiencies and responses. The latest updated revision of the application was received on December 22, 2015, which completed the permit application. The Permittee submitted additional revisions to the Permit Attachments on July 26, 2019, January 31, 2020, May 13, 2020, and May 20, 2020. DEQ reviewed those documents and determined that the application was technically complete. The draft Permit contains all the conditions set forth in CO, Case No. 11-100 and conditions pertaining to the East Refinery in CO, Case No. 15-215. CO, Case No. 11-100 will be closed with the issuance of the final Permit. CO 15-215 will remain open due to investigations at HollyFrontier Tulsa Refining LLC – West (HFTR-W).

The Permittee must comply with all terms and conditions of this Permit. This Permit consists of the conditions contained herein (including those in any attachments), and the applicable regulations contained in 40 CFR Parts 124, 260 through 264, 266, 268, and 270, as specified in the Permit. Applicable regulations are those which are in effect on the date of issuance of the Permit, in accordance with 40 CFR 270.32(c). Primary responsibility for the enforcement of the provisions of this Permit lies with DEQ.

This Permit is based on the assumption that all the information submitted in the Part B Permit application attached to the Permittee's letter dated October 21, 2011, as modified through December 22, 2015, July 26, 2019, January 31, 2020, May 13, 2020, and May 20, 2020 (hereafter referred to as the application) is accurate and that the facility will be operated as specified in the application.

Any inaccuracies found in the submitted information may be grounds for the termination, revocation and reissuance, or modification of this Permit in accordance with 40 CFR 270.41, 270.42, and 270.43.

This Permit is effective as of ------, --, 2020 and shall remain in effect until ------, --, 2030 unless revoked and reissued under 40 CFR 270.41, terminated under 40 CFR 270.43, or continued in accordance with 40 CFR 270.51(a), and the Oklahoma Rules and Regulations for Hazardous Waste Management [Oklahoma Administrative Code (OAC 252:205)] and the Oklahoma Administrative Procedures Act.

Issued this --th day of --- 2020.

____

Hillary Young, P.E. Date
Chief Engineer
Land Protection Division
Oklahoma Department of Environmental Quality

____

Kelly Dixon Date
Director
Land Protection Division
Oklahoma Department of Environmental Quality

TABLE OF CONTENTS

HOLLYFRONTIER TULSA REFINING LLC – TULSA EAST REFINERY
TULSA, OKLAHOMA

TABLES

PERMIT ATTACHMENTS

SECTION I. GENERAL PERMIT CONDITIONS

A. GENERAL

The Permittee shall monitor and maintain the permitted facility in compliance with the provisions of the Oklahoma Hazardous Waste Management Act (OHWMA), 27A O.S. §§ 2-7-101, *et. seq*., as amended, the Oklahoma Department of Environmental Quality rules for Hazardous Waste Management (OAC 252:205), the Federal Resource Conservation and Recovery Act (RCRA), the Hazardous and Solid Waste Amendments of 1984 (HSWA), the federal rules for hazardous waste management (40 CFR 260-270) and this Permit as specified through the permit conditions set herein.

B. BASIS OF PERMIT

This Permit is issued based on the information submitted and the design criteria presented in the application. Any inaccuracies found in this information could provide cause for the termination or modification of this Permit, and for enforcement action. The Permittee is to inform the Land Protection Division (LPD) of DEQ of any deviation from or changes in the design or operation of the facility which could affect the Permittee's ability to comply with the applicable regulations or permit conditions.

This Permit may be reviewed by DEQ at any time after the date of permit issuance and shall be modified as necessary, as provided in 40 CFR 270.41 and 27A O.S. § 2-7-127(B). Except as provided in condition I.F.3. (40 CFR 270.51), the term of this Permit shall not be extended by modification beyond the expiration date appearing on the face of this Permit [40 CFR 270.50(b)].

C. INCORPORATION BY REFERENCE

All the referenced Code of Federal Regulations (40 CFR - Parts 124, 260 through 266, 268, and 270) as specified in the permit are, unless otherwise stated, incorporated in their entirety by OAC 252:205-3-2.

D. DEFINITIONS

For purposes of this Permit and the special conditions pursuant to the 1984 Hazardous and Solid Waste Amendments to RCRA, terms used herein shall have the same meaning as those in 40 CFR Parts 124, 260 through 266, 268, and 270; and OAC 252:205-1-2 through OAC 252:205-3-6; unless this Permit specifically provides otherwise. Where terms are not defined in the Oklahoma Administrative Code or the permit, the meaning associated with such terms shall be defined by a standard dictionary reference or the generally accepted scientific or industrial meaning of the term.

"**Action Levels**" means health and environmental-based levels of constituent concentrations determined by DEQ to be indicators for protection of human health and the environment.

"**Alternate Concentration Limit**" (**ACL**) means a risk-based action or cleanup level derived from a site-specific risk assessment established under 40 CFR 264.94.

"**Area of Concern**" (**AOC**) means any discernable unit or area which, in the opinion of DEQ, may have received solid or hazardous waste or waste containing hazardous constituents at any time. DEQ may require investigation of the unit as if it were a SWMU. If shown to be a SWMU by the investigation, the AOC must be reported by the Permittee as a newly-identified SWMU. If the AOC is shown not to be a SWMU by the investigation, DEQ may determine that no further action is necessary and notify the Permittee in writing.

"**CAP**" means Corrective Action Plan, as further described in Permit Sections III and IV, and to be developed by the Permittee after issuance of this Permit.

"**CMS**" means Corrective Measures Study.

"**DEQ**" means Oklahoma Department of Environmental Quality.

"**Director**" means the Executive Director of the Oklahoma Department of Environmental Quality, or his/her designee or authorized representative.

"**Division Director**" means the Director of the Land Protection Division of the Oklahoma Department of Environmental Quality, or his/her designee or authorized representative.

"**EPA**" means the United States Environmental Protection Agency.

"**Facility**" means all contiguous property under the control of the owner or operator seeking a permit under Subtitle C of RCRA.

"**GWPS**" means Groundwater Protection Standard which will be site-specific risk-based levels as established under 40 CFR 264.94.

"**HSWA**" means the 1984 Hazardous and Solid Waste Amendments to RCRA.

"**Hazardous constituent**" means any constituent identified in Appendix VIII of 40 CFR Part 261, or any constituent identified in Appendix IX of 40 CFR Part 264.

"**Hazardous Waste**" means any waste that is identified in 40 CFR Part 261.31-261.33.

"**Land Protection Division**" (**LPD**) means the Land Protection Division of the DEQ.

"**MCL**" means maximum contaminant level as required by the Safe Drinking Water Act and codified in 40 CFR 142.

"**Permittee**" means HollyFrontier Tulsa Refining LLC – Tulsa East Refinery, 902 West 25th Street, Tulsa, Oklahoma 74107, EPA ID # OKD990750960.

"**Point of Compliance**" (**POC**) means the vertical plane in the uppermost aquifer located at the hydraulically downgradient limit of the HFTR property boundary at which the applicable GWPS applies and at which monitoring must be conducted.

"**Point of Exposure**" (**POE**) means the location(s) within an environmental medium where a human or ecological receptor could potentially come into contact with constituents of concern.

"**RCRA**" means the Resource Conservation and Recovery Act of 1976 as amended by HSWA in 1984.

"**RFA**" means RCRA Facility Assessment.

"**RFI**" means RCRA Facility Investigation.

"**RSL**" means Regional Screening Levels established by U.S. EPA.

"**Regional Administrator**" means the Regional Administrator of EPA Region VI, or his/her designee or authorized representative.

"**Release**" means any spilling, leaking, pouring, emitting, emptying, discharging, injecting, pumping, escaping, leaching, dumping, or disposing of hazardous wastes (including hazardous constituents) into the environment (including the abandonment or discarding of barrels, containers, and other closed receptacles containing hazardous wastes or hazardous constituents). RCRA section 3004(u) corrective action authority does not routinely reevaluate permitted releases.

"**Risk-Based Screening Level**" (**RBSL**) means a health-based screening value derived using risk assessment approaches, which combine toxic potency estimates, acceptable target risks and hazards, and default exposure values.

"**Solid Waste Management**" means the systematic administration of activities which provide for the collection, source separation, storage, transportation, transfer, processing, treatment, and disposal of solid waste.

"**Solid Waste Management Unit**" (**SWMU**) means any discernible unit at which solid wastes have been placed at any time, irrespective of whether the unit was intended for the management of solid or hazardous waste. Such units include any area at a facility at which solid wastes have been routinely and systematically released. The definition includes regulated units (i.e., landfills, surface impoundments, waste piles and land treatment units) but does not include passive leakage or one-time spills from production areas and units in which wastes have not been managed (e.g., product storage areas).

If, subsequent to the issuance of this Permit, regulations are promulgated which redefine any of the above terms, DEQ may, at its discretion, apply the new definition to this Permit by modifying the Permit in accordance with 40 CFR 270.41.

E. EFFECT OF PERMIT

The Permittee is required to monitor and maintain the facility in accordance with the conditions of this Permit. Any treatment and/or storage of hazardous waste not authorized in this Permit are prohibited, unless exempted from permit requirements.

Pursuant to 40 CFR 270.4, compliance with this Permit constitutes compliance, for purposes of enforcement, with Subtitle C of RCRA except for those requirements not included in the permit which:

1. Become effective by statute;

2. Are promulgated under 40 CFR 268 restricting the placement of hazardous wastes in or on the land; or

3. Are promulgated under 40 CFR 264 regarding leak detection systems for new and replacement surface impoundment, waste pile, and landfill units, and lateral expansions of surface impoundment, waste pile, and landfill units. The leak detection system requirements include double liners, CQA programs, monitoring action leakage rates, and response action plans, and will be implemented through the procedures of 40 CFR 270.42 Class 1 permit modifications. Issuance of this Permit does not convey any property rights of any sort or any exclusive privilege, nor does it authorize any injury to persons or property, any invasion of other private rights, or any infringement of state or local laws or regulations.

Except as set out in the previous paragraphs, compliance with the terms of this Permit does not constitute a defense to any order issued or any action brought under the OHWMA; Sections 3008(a), 3008(h), 3013, or 7003 of RCRA; Sections 104, 106(a) or 107 of CERCLA, or any other law providing for protection of public health or the environment from an imminent or substantial endangerment. [40 CFR 270.4, 270.30(g)]

F. PERMIT ACTIONS

1. Permit Modification, Revocation and Reissuance, and Termination

   This Permit may be modified, revoked and reissued, or terminated for cause, as specified in 40 CFR 270.41, 270.42, and 270.43. The filing of a request for a permit modification, revocation and re-issuance, or termination, or the notification of planned changes or anticipated noncompliance on the part of the Permittee, does not stay the applicability or enforceability of any permit condition. [40 CFR 270.4(a), 270.30(f)]

2. Permit Renewal

   This Permit may be renewed as specified in 40 CFR 270.30(b) and permit condition

I.H.2. Review of any application for a permit renewal shall consider improvements in the state of control and measurement technology, as well as changes in applicable regulations. [40 CFR 270.30(b), HSWA Sec. 212]

3. Permit Expiration

Pursuant to 40 CFR 270.50 and OAC 252:205-3-2, this Permit shall be effective for a fixed term not to exceed ten (10) years.

a. Notwithstanding the expiration date or the ten year life of this Permit, the conditions of this Permit will continue in full force and effect ("Continued Permit") until the effective date of a new permit or issuance of a final denial of the new permit pursuant to 27A O.S. §§ 2-14-304, if the following conditions are met and an enforcement action pursuant to subparagraph (b) below has not been instituted:

i. The Permittee has submitted an application for a new permit that is both complete and timely pursuant to 27A O.S. §§ 2-14-101 *et seq.*; OAC 252:4-7-1 *et seq.*; 40 CFR § 270.10(c), § 270.14 and the applicable sections in §§ 270.15 through 270.29; and

ii. DEQ, through no fault of the Permittee, does not issue a final denial of the new permit or does not issue a new permit with an effective date under 27A O.S. § 2-14-304 on or before the expiration date of the expiring permit.

b. Enforcement. When the Permittee is not in compliance with the conditions of the Continued Permit, DEQ may do any or all of the following:

i. Pursuant to 27A O.S. § 2-7-126, § 2-7-127, § 2-7-129, § 2-7-130, § 2-7-131 and/or § 2-7-134, issue an order with penalties; require corrective action; temporarily suspend the Continued Permit; revoke the Continued Permit and/or cause proceedings to be instituted in the district court for civil or criminal penalties, and;

ii. Issue a final denial of the new permit. If the permit is denied, the owner or operator shall cease the activities authorized by the Continued Permit or be subject to enforcement action for operating without a permit; or

iii. Take other actions authorized by 27A O.S. § 2-1-101 *et seq.*, OAC 252:205-1-1 *et seq.* or other applicable laws or regulations.

4. Transfer of Permits

This Permit is not transferable to any person, except after notice to DEQ as required by 40 CFR 270.40. DEQ may require modification or revocation and re-issuance of the permit pursuant to 40 CFR 270.40. Before transferring ownership or operation of the facility during its operating life, the Permittee shall notify the new owner or operator in writing of the requirements of 40 CFR Parts 264 and 270 and this Permit. [40 CFR 270.30(l)(3), and 264.12(c)]

G. SEVERABILITY

The provisions of this Permit are severable, and if any provision of this Permit, or the application of any provision of this Permit to any circumstance, is held invalid, the application of such provision to other circumstances and the remainder of this Permit shall not be affected thereby. [40 CFR 124.16(a)]

H. DUTIES AND REQUIREMENTS

1. Duty to Comply

The Permittee shall comply with all conditions of this Permit, except to the extent and for the duration that noncompliance is authorized by an emergency permit. Any permit noncompliance, other than noncompliance authorized by an emergency permit, constitutes a violation of OHWMA and RCRA and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application. [40 CFR 270.30(a)]

2. Duty to Reapply

If the Permittee wishes to continue an activity allowed by this Permit after the expiration date of this Permit, the Permittee shall submit a complete application for a new permit at least 180 days prior to permit expiration. [40 CFR 270.10(h) and 270.30(b)]

3. Monthly Reports

The Permittee shall submit monthly reports in accordance with OHWMA, 27A O.S. § 2-7-101 and OAC 252:205-9-2, if applicable.

4. Biennial Report

The Permittee shall comply with the biennial reporting requirements of OAC 252:205-3-2 and 40 CFR 264.75, if applicable.

5. [Reserved]

6. Need to Halt or Reduce Activity Not a Defense

It shall not be a defense for the Permittee, in an enforcement action, that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this Permit. [40 CFR 270.30(c)]

7. Duty to Mitigate

In the event of noncompliance with this Permit, the Permittee shall take all reasonable steps to minimize releases to the environment and shall carry out such measures as are reasonable to prevent significant adverse impacts on human health or the environment. [40 CFR 270.30(d)]

8. Proper Operation and Maintenance

The Permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the Permittee to achieve compliance with the conditions of this Permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance/quality control procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems only when necessary to achieve compliance with the conditions of this Permit. [40 CFR 270.30(e)]

9. Duty to Provide Information

The Permittee shall furnish to DEQ, within a reasonable time, any relevant information which DEQ may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this Permit, or to determine compliance with this Permit. The Permittee shall also furnish to DEQ, upon request, copies of records required to be kept by this Permit. [40 CFR 270.30(h)]

10. Inspection and Entry

Pursuant to 40 CFR 270.30(i), the Permittee shall allow DEQ, or an authorized representative, upon the presentation of credentials and other documents, as may be required by law, to:

a. Enter at reasonable times upon the Permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this Permit;

b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this Permit;

c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this Permit; and

d. Sample or monitor, at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by RCRA, any substances or parameters at any location.

11. Monitoring and Records

a. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity. The method used to obtain a representative sample of the waste to be analyzed must be the appropriate method from Appendix I of 40 CFR Part 261 or an equivalent method approved by DEQ. Laboratory methods must be those specified in the most recent edition of Test Methods for Evaluating Solid Waste: Physical/Chemical Methods SW-846, *Standard Methods for the Examination of Water and Wastewater*, *Fifteenth Edition, 1980, and 1981 supplement, or current adopted edition; RCRA Ground-Water Monitoring: Draft Technical Guidance, 1992*, OSWER Directive 9950.1 or an equivalent method approved in writing by DEQ. [40 CFR 270.30(j)(1)]

b. The Permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports and records required by this Permit, the certification required by 40 CFR 264.73(b)(9), and records of all data used to complete the application for this Permit for a period of at least three (3) years from the date of the sample, measurement, report, record, certification, or application. These periods may be extended by request of DEQ at any time and are automatically extended during the course of any unresolved enforcement action regarding this facility. [40 CFR 270.30(j)(2)]

c. Pursuant to 40 CFR 270.30(j)(3), records of monitoring information shall specify:

i. The date(s), exact place, and times of sampling or measurements;
ii. The individual(s) who performed the sampling or measurements;
iii. The date(s) analyses were performed;
iv. The individual(s) who performed the analyses;
v. The analytical techniques or methods used; and
vi. The results of such analyses.

12. Reporting Planned Changes

The Permittee shall give notice to DEQ, as soon as possible, of any planned physical alterations or additions to the permitted facility [40 CFR 270.30(l)(1)]. This requirement is only applicable to the remediation and monitoring equipment directly associated with the Corrective Action Plan to be developed in accordance with

Permit Condition III.I and the Post-Closure Care Plan provided in Permit Attachment 2.

13. Reporting Anticipated Noncompliance

The Permittee shall give advance notice to DEQ of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements. [40 CFR 270.30(l)(2)]

14. [Reserved]

15. Monitoring Reports [40 CFR 270.30(l)(4)]

a. The Permittee shall conduct the sampling at the intervals specified elsewhere in the permit.

b. The Permittee must report the results of all environmental monitoring to DEQ per the schedules set forth in the Permit or other DEQ approved time frame.

16. Incident Reporting [OAC 252:205-13-1, 40 CFR 270.30 (l)]

Upon discovery of a release of materials that are or become hazardous waste whether by spillage, leakage, or discharge to soils or to air or to surface or groundwaters (outside the limits of a discharge permit), or by other means, and which could threaten human health or the environment, the owner or operator shall immediately notify DEQ and take all necessary action to contain, remediate, and mitigate hazards from the release. The Permittee is not required to notify DEQ of a release if it is completely contained in a secondary containment area.

a. The report shall include the following:

i. Information concerning release of any hazardous waste that may cause an endangerment to public drinking water supplies.

ii. Any information of a release or discharge of hazardous waste, or of a fire or explosion from the hazardous waste management facility which could threaten the environment or human health outside the facility.

b. The description of the occurrence and its cause shall include:

i. Name, address, and telephone number of the owner or operator;
ii. Name, address, and telephone number of the facility;
iii. Date, time, and type of incident;

iv. Name and quantity of materials involved;
v. The extent of injuries, if any;
vi. An assessment of actual or potential hazards to the environment and human health outside the facility, where this is applicable; and
vii. Estimated quantity and disposition of recovered material that resulted from the incident.

c. A written submission shall also be provided within five (5) days of the time the Permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period(s) of noncompliance (including exact dates and times); whether the noncompliance has been corrected; and, if not, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance. DEQ may waive the five-day written notice requirement in favor of a written report within fifteen (15) days.

17. Other Noncompliance

The Permittee shall report all other instances of noncompliance not otherwise required to be reported above in permit conditions I.H.12-16 at the time monitoring reports are submitted. The reports shall contain the information listed in permit condition I.H.16 [40 CFR 270.30(l)(10)].

18. Other Information

Whenever the Permittee becomes aware that it failed to submit any relevant facts in the permit application, or submitted incorrect information in a permit application or in any report to DEQ, the Permittee shall promptly submit such facts or information. [40 CFR 270.30(l)(11)]

19. Force Majeure

The requirements of this Permit shall be followed as set forth herein and in any approved future Plans, unless the performance or progress is delayed by events which constitute a “Force Majeure”, defined here as an event that is caused by an Act of God, labor strike, or work stoppage, changed business conditions, changed economic circumstances or other circumstance beyond the Permittee's control that could not have been prevented by reasonable due diligence.

The occurrence of a "Force Majeure" event that justifies the missing of one deadline shall not automatically justify the missing of later deadlines unless there is a cumulative effect due to such an event. The Permittee shall keep a record of any delaying events.

If the Permittee anticipates or experiences an inability to comply with any of the conditions of this Permit due to a "Force Majeure" event, the Permittee shall notify the DEQ as soon as possible, but not later than within 24 hours. A written notice must be submitted to the DEQ within ten (10) days, which describes the nature, cause, and anticipated length of the delay and all steps which the Permittee has taken and will take, with a schedule for their implementation, to avoid or minimize the delay. In the event that performance of any of the activities required by this Permit is affected by a "Force Majeure" event, then the Permittee shall propose a plan for the DEQ's approval, for achieving the objectives of this Permit by alternative means in the most timely manner.

I. SIGNATORY REQUIREMENT

All applications, reports, or information submitted to or requested by DEQ, its designee, or authorized representative, shall be signed and certified in accordance with 40 CFR 270.11 and 270.30(k).

J. REPORTS, NOTIFICATIONS, AND SUBMISSIONS TO DEQ

All reports, notifications, or other submissions which are required by this Permit to be sent or given to DEQ should be sent by certified mail or given to:

Chief Engineer
Land Protection Division
Oklahoma Department of Environmental Quality
707 North Robinson
P.O. Box 1677
Oklahoma City, Oklahoma 73101-1677
Phone Number (405) 702-5100

K. CONFIDENTIAL INFORMATION

In accordance with 40 CFR 270.12 and OAC 252:205-1-4, the Permittee may claim confidential any information required to be submitted by this Permit. Any such claim must be asserted at the time of submission in the manner prescribed on the application form or instructions, or in the case of other submissions, by stamping the words "confidential business information" on each page containing such information. If no claim is made at the time of the submission, EPA and DEQ may make the information available to the public without further notice. If a claim is asserted, the information will be treated in accordance with the procedures in 40 CFR Part 2 (Public Information). Claims of confidentiality for the name and address of any permit applicant or Permittee will be denied.

L. DOCUMENTS TO BE MAINTAINED AT THE FACILITY

The Permittee shall maintain at the facility, until corrective action is completed, and certified by an independent, registered professional engineer, as needed, the following documents and all amendments, revisions and modifications to these documents:

1. Post-Closure Care Plan (Permit Attachment 2), as required by 40 CFR 264.118(a);

2. Groundwater Monitoring and LNAPL Management Plan (Permit Attachment 3), as required by 40 CFR 264.97(d);

3. Sampling and Analysis Plan and Quality Assurance Project Plan (Permit Attachment 3, Appendix 3.1), as required by 40 CFR 264.97(d) (hereafter referred to as the Sampling and Analysis Plan);

4. Inspection and Maintenance Plan (Permit Attachment 4), as required by 40 CFR 264.15(b)(2);

5. Annually-adjusted cost estimate for corrective measures (Permit Attachment 5); and

6. All other documents required by Permit Condition I.H.

SECTION II. GENERAL FACILITY CONDITIONS

A. DESIGN AND OPERATION OF FACILITY

The Permittee shall monitor and maintain the facility to minimize the possibility of a fire, explosion, or any unplanned, sudden or non-sudden release of waste constituents to air, soil, groundwater, or surface water which could threaten human health or the environment, as required by 40 CFR 264.31.

B. REQUIRED NOTICES

The Permittee is not authorized to receive any hazardous waste from any source either on-site, offsite or from a foreign source, as required by 40 CFR 264.12.

C. SECURITY

The Permittee shall comply with the applicable security provisions of 40 CFR 264.14 and the approved Post-Closure Care Plan (Permit Attachment 2).

D. GENERAL INSPECTION REQUIREMENTS

The Permittee shall follow the inspection provisions of 40 CFR 264.15 and the inspection schedule set out in Permit Attachment 4. The Permittee shall remedy any deterioration or malfunction discovered by an inspection, as required by 40 CFR 264.15(c). Records of inspections shall be kept, as required by 40 CFR 264.15(d).

E. PERSONNEL TRAINING

The Permittee shall conduct personnel training, as required by 40 CFR 264.16. The Permittee shall maintain training documents and records, as required by 40 CFR 264.16(d) and (e).

F. SPECIAL PROVISIONS FOR IGNITABLE, REACTIVE, OR INCOMPATIBLE WASTE

The Permittee shall comply with the requirements concerning the management of ignitable, reactive, and incompatible wastes as required by 40 CFR 264.17.

G. PREPAREDNESS AND PREVENTION

The Permittee shall follow the provisions of 40 CFR 264, Subpart C, and the Preparedness and Prevention Plan provided in Permit Attachment 1.

1. Required Equipment

At a minimum, the Permittee shall maintain at the facility the equipment required by 40 CFR 264.32.

2. Testing and Maintenance of Equipment

The Permittee shall test and maintain the equipment specified in permit condition II.G.1, as necessary, to assure its proper operation in time of emergency.

3. Access to Communications or Alarm System

The Permittee shall maintain access to the communications or alarm system.

4. Arrangements with Local Authorities

The Permittee shall maintain arrangements with state and local authorities. If state or local officials refuse to enter into preparedness and prevention arrangements with the Permittee, the Permittee must document this refusal in the operating record.

SECTION III. POST-CLOSURE AND CORRECTIVE ACTION

A. SCOPE OF REQUIREMENTS

This Section addresses post-closure for the closed Land Treatment Units (LTUs), and corrective action for the identified Solid Waste Management Units (SWMUs), Areas of Concern (AOCs), any newly-identified SWMUs and potential AOCs, and the hydrocarbon/dissolved phase plume. This section also includes the recovery requirements for the Light Non-Aqueous Phase Liquids (LNAPL).

B. UNIT IDENTIFICATION

Waste Unit	Description of Wastes Contained	Hazardous Waste No.
Flare Area LTU (FALTU) Certified Closed : April 1, 1993. Present Condition: Post-Closure Care.	FALTU is situated in the southeast corner of the refinery in Section 23 of T 19 N and R 12 E. Approximate area is 29 acres. The FALTU is divided into three (3) application plots.	D001 D008 K049 K050 K051 K052
Walnut Grove LTU (WGLTU) Certified Closed: April 24, 2009. Present Condition: Post-Closure Care.	WGLTU is situated in the northeast corner of the refinery in Section 14 of T 19 N and R 12 E. Approximate area is 20 acres. WGLTU is divided into four (4) application plots.	F037 K050 K051
SWMU-A: Former Land Farm. Present Condition: No Further Remedial Action Required.	SWMU-A was used for the disposal of rust scale from unleaded tank bottoms from 1947-1970. Lead (Pb) and Chromium (Cr) have been identified in the subsurface.	
SWMU-B: Former Land Farm. Present Condition: No Further Remedial Action Required.	SWMU-B historically received oily tank bottom sludges until 1966 and was reported to have a one-time crude oil spill. Lead (Pb) and Chromium (Cr) have been identified in the subsurface.	

SWMU-C: Former Land Farm (Tetraethyl Lead Area). <u>Present Condition:</u> Soil and Groundwater Investigation.	SWMU-C historically received leaded tank bottom sludges in 1973. Pb has been identified in the subsurface. Elemental Mercury (Hg), Lead (Pb), and petroleum hydrocarbons were identified in the SWMU-C subsurface in July 2008.
SWMU-D: Former Landfill (Off-Unit Storm Pond). <u>Present Condition:</u> No Further Remedial Action Required.	SWMU-D historically received oily tank bottoms and heat exchanger bundle cleaning sludge from prior to 1947 until 1976. These wastes were reportedly excavated and land farmed at FALTU. SWMU-D is currently a lined active storm water holding reservoir.
SWMU-E: Former Landfill; current Waste Water Treatment Plant (WWTP). <u>Present Condition:</u> Investigation of SWMU-E will be performed when the Refinery ceases operations or the WWTP is taken out of permanent service.	A five-acre site, SWMU-E reportedly was an active landfill where American Petroleum Institute (API) separator sludge was disposed of sometime prior to 1947 and ending in 1976. These wastes have been reportedly excavated and land farmed at the FALTU. Currently, SWMU-E houses the Refinery WWTP including a Storm Water Pond, two API separators and tanks 400 and 401 (designated as slop oil tanks). In July 2008, additional waste materials were reportedly encountered during the cleaning of the north storm water pond located at the WWTP.
SWMU-F: Former Land Farm <u>Present Condition:</u> Investigation of SWMU-F will be performed when the Refinery ceases operations or the naphtha hydrotreater and associated units are taken out of permanent service.	Solid waste material, identified as coke, was found approximately three feet below ground surface (bgs) inside an old concrete foundation. A total of approximately 3,875 cubic yards of waste material was reportedly excavated from SWMU-F and disposed of off-site.

SWMU-G: Former Land Farm; Alky Unit. <u>Present Condition:</u> Further investigation of SWMU-G will be proposed when the Refinery ceases operations or the Alky Unit is taken out of permanent service.	SWMU-G was identified as a SWMU in August 2007 as a result of Refinery personnel evaluating the integrity of buried sections of the process wastewater sewer system located at the alky unit.
SWMU-H (Former Waste Disposal Site). <u>Present Condition:</u> Soil and Groundwater Investigation.	An approximate 9.5-acre tract of land adjacent to the Arkansas River located between the east tank farm fence and the east property fence. SWMU-H (Former Waste Disposal Site) was identified as a SWMU in May 2008 when buried drums were discovered during Refinery landscaping and grading activities. The waste materials were excavated to a depth of approximately three feet below the ground surface. Reportedly during excavation activities deteriorated drums, petroleum impacted soils and potential asbestos containing materials (ACM) were identified. SWMU-H was apparently used as a waste disposal site. Reportedly shallow pits approximately 18 to 20 feet wide by approximately 20 to 25 feet long and 8 to 12 feet deep were dug and then filled with a variety of waste material (e.g., asbestos, wood scraps, glass, scrap metal, dirt, bricks, coke, granite, spent catalyst, residual materials, and tank bottoms). The disposal area was apparently operational prior to 1951 and closed sometime prior to 1982.
AOC-1: Former Landfill; Dredge Pond. <u>Present Condition:</u> No Further Remedial Action Required.	The AOC was designated an area of concern resulting from the disposal of spent catalyst and tank bottom wastes; associated impacts were Pb and hydrocarbons.

AOC-2: Former Union Pacific Railroad Property. Present Condition: Soil and Groundwater Investigation.	An approximate 0.4-acre site. The buried waste was encountered near the surface to depths ranging from approximately four to six feet bgs. The waste was comprised primarily of fire brick, scrap metal, construction debris, glassware, insulation and asbestos containing materials. Asbestos was subsequently removed from an excavation in AOC-2 that was approximately 600 feet long by 30 feet wide by five to six feet deep. The Permittee also identified an oil seep on the ground surface in a remote area of AOC-2 during a pre-investigation site inspection. The oil seep will be further investigated as part of the Light Non-Aqueous Phase Liquid (LNAPL) investigation.

C. LAND TREATMENT UNITS (FALTU and WGLTU)

1. The Permittee began post-closure- care for the FALTU on April 1, 1993 and for the WGLTU on April 24, 2009, when the units were certified closed by DEQ. Post-closure care shall continue for thirty (30) years from the date of closure certification, except that the 30-year post-closure care period may be shortened upon application and demonstration approved by DEQ that the facility is secure, or may be extended by DEQ if necessary to protect human health and the environment. [40 CFR 264.117(a)]

2. The Permittee shall maintain and monitor the groundwater monitoring system and comply with all other applicable requirements of 40 CFR Part 264 Subpart F during the post-closure period. [40 CFR 264.117(a)(1)]

3. The Permittee shall not allow post-closure use of the property to disturb the integrity of the final cover or any other components of the LTUs (other than routine surface or intrusive maintenance activities performed per the Post-Closure Care Plan, Permit Attachment 2), the run-on/run-off containment system or the function of the FALTU and WGLTU monitoring systems. [40 CFR 264.117(c)]

4. The Permittee shall comply with the requirements for the FALTU and WGLTU as follows [40 CFR 264.280(c)]:

   a. Continue all operations (including pH control) necessary to enhance degradation and transformation and sustain immobilization of hazardous constituents in the treatment zone to the extent that such measures are consistent with other post-closure care activities;

   b. Maintain a vegetative cover over closed portions of the FALTU and WGLTU;

c. Maintain the run-on control system required under 40 CFR 264.273(c);

d. Maintain the run-off management system required under 40 CFR 264.273(d);

e. Control wind dispersal of hazardous waste as required under 40 CFR 264.273(f); and

f. Continue to comply with any prohibitions or conditions concerning growth of food-chain crops required under 40 CFR 264.276.

5. The Permittee shall comply with all security requirements, as specified in 40 CFR 264.117(b).

6. The Permittee shall implement the Post-Closure Care Plan, Permit Attachment 2. All post-closure care activities must be conducted in accordance with the provisions of the Post-Closure Care Plan [40 CFR 264.117(d) and 264.118(b)]. The Permittee shall amend the Post-Closure Care Plan in accordance with 40 CFR 264.118(d) and 40 CFR parts 124 and 270, whenever necessary.

D. INSPECTIONS OF LTUs

The Permittee shall inspect the components, structures, and equipment at the site in accordance with the Inspection Schedule, as provided in the Inspection and Maintenance Plan, Permit Attachment 4. [40 CFR 264.117(a)(1)(ii)]

E. NOTICES AND CERTIFICATION FOR LTUs

1. If the Permittee or any subsequent owner or operator of the land upon which the LTUs are located wishes to remove hazardous wastes and hazardous waste residues or contaminated soils, or propose the land for reuse, then it shall request a modification to this post-closure permit in accordance with the applicable requirements in 40 CFR Parts 124 and 270. The Permittee or any subsequent owner or operator of the land shall demonstrate that the removal of hazardous wastes will satisfy the criteria of 40 CFR 264.117(c). [40 CFR 264.119(c)]

2. No later than sixty (60) days after completion of the established post-closure care period for the LTUs, the Permittee shall submit to DEQ, by registered mail, a certification that the post-closure care was performed in accordance with the specifications in the approved Post-Closure Care Plan. The certification must be signed by the Permittee and an independent, registered professional engineer. Documentation supporting the independent, registered professional engineer's certification must be furnished to DEQ upon request until DEQ releases the Permittee from the financial assurance requirements for post-closure care under 40 CFR 264.145(i). [40 CFR 264.120]

3. No later than sixty (60) days after certification of completion of post-closure care of LTUs or corrective action for SWMUs and AOCs (if applicable), a notice must be placed in the property deed and record. This notice must state that the land was used for hazardous waste management (if appropriate); that the use of the land is restricted per Part 264/265, Subpart G (if appropriate); and that the survey plat and record of closure were submitted to the local zoning authority and DEQ.

F. FINANCIAL ASSURANCE

The Permittee shall maintain financial assurance for corrective action. The Permittee shall maintain financial assurance under this Condition III.F during the ten year term of this Permit and any period of continuance prior to re-issuance. In all other respects, the financial assurance shall be consistent with all applicable requirements of 40 CFR Part 264 Subpart H as if the costs were post-closure care costs [40 CFR 264.145], including the following:

1. The Permittee shall submit updated cost estimates for the financial assurance required by Condition III.F, which, subject to any changes required by Conditions II.F.2, 3 or 4, shall be used as the basis of the financial assurance.

2. Within sixty (60) days of DEQ's approval of any new corrective measure, the Permittee shall submit a cost estimate consistent with 40 CFR 264.145. Within sixty (60) days of DEQ approval of such cost estimate, the Permittee shall update the financial assurances to include the estimated costs.

3. The cost estimates shall be adjusted annually consistent with 40 CFR 264.144 and 264.145.

4. The Permittee shall submit the information required in 40 CFR 264.143(f)(3) within ninety (90) days after the closing of each fiscal year. [40 CFR 264.143(f)(5)];

5. If the Permittee is no longer able to meet the requirements of the financial test, the Permittee shall send notice to DEQ of intent to establish alternate financial assurance as specified in 40 CFR 264.143. The notice must be sent by certified mail within ninety (90) days after the end of the fiscal year for which the year-end financial data show that the Permittee no longer meets the requirements. The Permittee must provide the alternate financial assurance within one hundred and twenty (120) days after the end of such fiscal year.

G. INCAPACITY OF OWNERS OR OPERATORS, GUARANTORS, OR FINANCIAL INSTITUTIONS

An owner or operator must notify DEQ by certified mail of the commencement of a voluntary or involuntary proceeding under Title 11 (Bankruptcy), U.S. Code, naming the owner or operator as debtor, within ten (10) days after commencement of the proceeding. A guarantor of a corporate guarantee as specified in 40 CFR 264.143(f) and 40 CFR

264.145(f) must make such a notification if he is named as debtor, as required under the terms of the corporate guarantee (40 CFR 264.151(h)). [40 CFR 264.148(b)]

An owner or operator who fulfills the requirements of 40 CFR 264.143, 264.145, or 264.147 by obtaining a trust fund, surety bond, letter of credit, or insurance policy will be deemed to be without the required financial assurance or liability coverage in the event of bankruptcy of the trustee or issuing institution, or a suspension or revocation of the authority of the trustee institution to act as trustee or of the institution issuing the surety bond, letter of credit, or insurance policy to issue such instruments. The owner or operator must establish other financial assurance or liability coverage within sixty (60) days after such an event. [40 CFR 264.148(b)]

H. LIABILITY REQUIREMENTS

The Permittee shall demonstrate continuous compliance with the requirement of 40 CFR 264.147(a) to have and maintain liability coverage for sudden accidental occurrences in the amount of at least $1 million per occurrence, with an annual aggregate of at least $2 million, exclusive of legal defense costs.

I. CORRECTIVE ACTION PLAN (CAP)

Upon issuance, this permit authorizes development of a CAP that will holistically address facility wide corrective action for releases from multiple sources within the Tulsa East facility boundary. The CAP may include a risk-based strategy developed to focus corrective actions on areas (on-site) that may exhibit risk to refinery employees and for areas where there may be the potential for off-site migration of constituents of concern (COCs) subject to DEQ approval. The CAP may consider corrective actions for both the permitted LTUs and SWMUs/AOCs as necessary, including facility wide groundwater impacts, and with consideration of current and future land use which is subject to DEQ approval.

If SWMUs or AOCs are discovered subsequent to issuance of this permit and CAP, the Permittee will review and revise the CAP as necessary to address any new COCs, complete pathways or other exposure concerns. If DEQ or the Permittee determines that the CAP no longer satisfies the requirements of 40 CFR 264.100, then within ninety (90) days the Permittee will submit a revised CAP as applicable for DEQ review. Changes to the CAP related to adoption of the final remedy and those items specifically listed in 40 CFR 270.42, Appendix I will require a permit modification with applicable public notice and DEQ approval.

J. SPECIFIC CONDITIONS

1. Investigation of AOC-2 and SWMU-H

AOC-2 and SWMU-H have been investigated per the approved “AOC-2 and SWMU-H Investigation Work Plan” submitted on May 16, 2011, and approved on

June 28, 2011.

On December 31, 2015, the Permittee submitted an "Areas of Interest Screening Investigation Summary Report - SWMU-H and AOC-2". The Report summarized the findings of the Areas of Interest (AOI) Investigation screening activities, examined the nature and extent of subsurface impact, provided an updated conceptual site model (CSM), and identified potential data gaps that may require additional investigation and delineation.

DEQ has noted that the sources of impacts to the subsurface soils beneath AOC-2 and SWMU-H include:

a. Asbestos Containing Material (ACM), buried construction debris, and impacted soils (AOC-2 and SWMU-H), and potential refinery waste (SWMU-H);
b. Dissolved phase VOC and Semi-Volatile Organic Compounds (SVOC) plumes; and
c. LNAPL plumes.

Supplemental work plans were submitted to DEQ for SWMU-H, as follows: (1) "SWMU-H Supplemental Investigation Work Plan" dated January 2017 and (2) "SWMU-H Supplemental Investigation Work Plan - River Parks Authority Leased Area Investigation Addendum" dated April 2017. In February 2018, "Solid Waste Management Unit-H / River Parks Authority Perimeter Investigation Report" was submitted to DEQ. DEQ responded to the report in correspondence dated February 12, 2019. In June 2019, "Soil Remediation Report for Surface Soil at River Parks Authority Leased Area" was submitted. DEQ approved the report on September 19, 2019.

The Permittee shall identify and delineate or evaluate, as appropriate with the approval of DEQ, contaminants of concern (COCs) above MCLs, RSLs, or DEQ approved RBSLs, in all media (as appropriate) that are present within the current AOC-2 and SWMU-H boundaries.

The Permittee has proposed a Risk Assessment at AOC-2 and SWMU-H to evaluate whether the site presents risk and whether additional work is warranted. The Risk Assessment shall be conducted in accordance with the *Revised Work Plan for the Development of Soil and Groundwater Risk-based Cleanup Levels for AOC-2, SWMU-H, and SWMU-C Areas* submitted to DEQ in April 2019 and approved by DEQ in correspondence dated June 19, 2019. Any Risk Assessment must be approved by DEQ.

LNAPL investigation at AOC-2 and SWMU-H was completed as part of the facility wide LNAPL investigations [Section III.J.4].

Due to presence of ACM in both AOC-2 and SWMU-H, the Permittee shall include proper asbestos safety practices and air monitoring in the Health & Safety Plan followed during any excavations in either AOC-2 or SWMU-H.

2. Investigation of River Parks Authority (RPA) Leased Area

The Permittee submitted the following work plan dated April 2017: "SWMU-H Supplemental Investigation Work Plan - River Parks Authority Leased Area Investigation Addendum".

The Permittee submitted an investigation report ("Solid Waste Management Unit-H / River Parks Authority Perimeter Investigation Report") on February 28, 2018. The scope of the investigation included soil, groundwater, and LNAPL in the RPA Leased Area.

HFTR-E has conducted an investigation for surface soil at fourteen (14) additional locations. Based on this investigation, the Permittee has proposed an interim remedy consisting of excavation of surface soil in the vicinity of soil borings RPASB-12, RPASB-35 and RPASB-36.

The Permittee shall delineate or evaluate, as appropriate with the approval of DEQ, COCs above MCLs, RSLs, or DEQ approved RBSLs, in all media (as appropriate) at the RPA Leased Area.

The Permittee has proposed a Risk Assessment at the RPA Leased Area to evaluate whether the area presents risk and whether additional work is warranted. The Risk Assessment shall be conducted in accordance with the *Revised Work Plan for the Development of Soil and Groundwater Risk-based Cleanup Levels for AOC-2, SWMU-H, and SWMU-C Areas* submitted to DEQ in April 2019 and approved by DEQ in correspondence dated June 19, 2019. Any Risk Assessment must be approved by DEQ.

LNAPL investigation at the RPA Leased Area was completed as part of the facility wide LNAPL investigations [Section III.J.4].

3. Investigation of SWMU-C

SWMU-C has been investigated per the approved "SWMU-C Screening Investigation Work Plan" submitted on March 8, 2013, and approved on May 28, 2013.

On November 13, 2015, DEQ received "Soil Investigation Summary Report - SWMU-C". DEQ noted that Inorganics, Volatile Organic Compounds (VOCs), Semi-Volatile Organic Compounds (SVOCs), and LNAPL impacts to the soils and groundwater at SWMU-C are likely attributed to cumulative effects of historic operations and singular releases from facility equipment, tanks and process lines over time. No specific SWMU-C point sources were identified during the investigation (with the exception of historically identified mercury in the Linde Pump House area).

The Permittee shall complete:

a. The permittee shall conduct additional soil and groundwater investigation, if necessary, to delineate or evaluate, as appropriate with the approval of DEQ, surface and subsurface inorganics, VOC, and SVOCs in locations where COCs above MCLs, RSLs or DEQ approved RBSLs are present within the current SWMU-C boundaries, in accordance with the future sitewide CAP.

b. Additional investigation in the vicinity of test pits TP-49 and TP-55 to evaluate potential solid waste in this area.

c. Additional investigation of soil and groundwater for organic lead.

d. If SWMU-C is considered in the future as a location for an occupied operational building, the vapor intrusion exposure pathway will be required to be evaluated prior to building design.

e. Any other investigative work deemed necessary by DEQ.

The Permittee has proposed a Risk Assessment at SWMU-C to evaluate whether the site presents risk and whether additional work is warranted. The Risk Assessment shall be conducted in accordance with the *Revised Work Plan for the Development of Soil and Groundwater Risk-based Cleanup Levels for AOC-2, SWMU-H, and SWMU-C Areas* submitted to DEQ in April 2019 and approved by DEQ in correspondence dated June 19, 2019. Any Risk Assessment must be approved by DEQ.

4. Investigation of LNAPL Plume

A facility wide LNAPL investigation work plan was submitted to DEQ in April 2012, and approved on June 26, 2012. Initial investigations activities were performed and a supplemental LNAPL investigation work plan for perimeter and off-site evaluation was submitted to DEQ in September 2016 and approved on November 14, 2016.

The Permittee submitted a "Facility Wide LNAPL Investigation Report" on March 31, 2018.

5. Investigation of Off-Site Dissolved Phase Plume

The Permittee shall conduct an off-site investigation and report of the dissolved phase impacts according to the schedule in Table IV-2. Off-site dissolved phase reports for six (6) perimeter locations were submitted during the first quarter of 2018.

The Permittee shall continue to monitor dissolved phase constituents according to the approved Groundwater Monitoring and LNAPL Management Plan, Permit Attachment 3, during the life of the Permit.

6. Hydrocarbon Sheening in the Arkansas River

HFTR-E shall conduct weekly inspections for hydrocarbon sheening along the Arkansas Riverbank Areas 1-6, as described in the Inspection and Maintenance Plan, Permit Attachment 4, Section 3.3, to detect the presence of hydrocarbon discharge to the Arkansas River. Inspections will be conducted during representative flow conditions.

If hydrocarbon sheen is identified during an inspection, the Permittee will undertake the following actions:

a. File an initial report via email with the DEQ's Land Protection Division (LPD) and Water Quality Division (WQD) within 24 hours of discovery of a hydrocarbon sheen; and

b. Determine whether the source of the hydrocarbon sheen is from the Refinery and if confirmed, then perform the following actions:

   i. Modify the inspection frequency at the location of the observed hydrocarbon sheen to three times per week (generally Monday, Wednesday and Friday);

   ii. Commence remedial actions, as appropriate (including placement of sorbent booms);

   iii. File monthly reports via email with the DEQ's LPD and WQD until the hydrocarbon sheen is no longer observed during inspections; and

   iv. File a summary report with the DEQ's LPD and WQD and return to once a week inspections once the hydrocarbon sheen is no longer observed for four (4) consecutive weeks of three (3) times a week inspections.

K. GROUNDWATER MONITORING

The Permittee implemented a facility wide groundwater monitoring system (with the approval of DEQ) instead of Land Treatment Unit (LTU) based groundwater monitoring through CO, Case No. 11-100, on July 1, 2011, and shall follow the detailed procedures outlined in the Groundwater Monitoring and LNAPL Management Plan (Permit Attachment 3) and the

Sampling and Analysis Plan (Permit Attachment 3, Appendix 3.1) . As allowed under 40 CFR 264.90(f), the facility wide program is operated in lieu of a monitoring program established per the requirements of 40 CFR 264.97 and 98. The permittee may evaluate and modify the groundwater monitoring system, with approval of DEQ, based on changed conditions, new information, or results of risk assessments, as appropriate.

The gauging network wells to evaluate groundwater elevations and apparent LNAPL thickness beneath the facility are listed in Permit Attachment 3 of this permit. The Point of Compliance (POC) wells listed in Permit Attachment 3 of this permit will be sampled for the modified EPA Region 5 Skinner List parameters including VOCs, SVOCs and inorganics provided in the Groundwater Monitoring and LNAPL Management Plan, Permit Attachment 3, Table 1, until a list of Indicator parameters, prepared by the Permittee as part of the CAP to be developed per Permit Condition III.I, is approved by DEQ. The Permittee may request a modified parameter list as part of the CAP, subject to DEQ approval; however, the Permittee shall use the U.S. EPA Region 5 Skinner List parameters at least every five (5) years.

L. WELL LOCATION, INSTALLATION AND CONSTRUCTION

The Permittee shall maintain and operate the groundwater monitoring system as specified below:

1. Monitoring Wells:
   The Permittee shall maintain groundwater monitoring wells at the locations specified in the Permittee's Groundwater Monitoring and LNAPL Management Plan, Permit Attachment 3. The gauging network wells and the POC wells are listed in the Permittee's Groundwater Monitoring and LNAPL Management Plan, Permit Attachment 3, Tables 2 and 3 .

2. Well Maintenance:
   The Permittee shall maintain the monitoring wells in accordance with the detailed plans and specifications presented in the Post-Closure Care Plan, Permit Attachment 2, and the Groundwater Monitoring and LNAPL Management Plan, Permit Attachment 3, as applicable.

3. Monitoring Well Removal:
   The Permittee must apply for a permit modification, as applicable, to request a change in the number, location, depth, or design of monitoring wells in the facility wide groundwater monitoring system as required under 40 CFR 270.42 Appendix I(C)(1).

   All wells deleted from the monitoring program shall be plugged and abandoned in accordance with procedures specified by the Oklahoma Water Resources Board (OWRB). A list of plugged wells and corresponding certification shall be submitted to DEQ at least semi-annually, as appropriate.

4. Well Log Submission:
The Permittee shall submit all well logs to DEQ in the report following the work element performed.

M. GROUNDWATER PROTECTION STANDARD (GWPS)

1. Initially, as part of the work proposed in the CAP to be developed per Permit Condition III.I, the Permittee may develop site-specific risk-based levels as part of a formal risk assessment which will serve as interim on-site GWPS. The off-site and perimeter GWPS will be the MCL for drinking water set by EPA or if there is no established MCL, then the RSL for Tap Water for each indicator parameters or an Alternate Concentration Limit (ACL, e.g., a RBSL) if approved by the off-site landowner through an institutional control (where applicable) and DEQ. The interim on-site GWPS is to be set by the CAP to be developed per Permit Condition III.I, such that the off-site or Perimeter GWPS will not be threatened. The Permittee shall determine whether there is an exceedance over the GWPS for each parameter identified in the modified EPA Region 5 Skinner List provided in the Groundwater Monitoring and LNAPL Management Plan, Permit Attachment 3, Table 1, until indicator parameters proposed in the CAP are approved by DEQ, each time groundwater quality is determined at the compliance points.

2. The Permittee shall monitor the monitoring wells at the point of compliance as designated in the Post-Closure Care Plan, Permit Attachment 2; and the Groundwater Monitoring and LNAPL Management Plan, Permit Attachment 3. [40 CFR 264.95]

N. SAMPLING AND ANALYSIS PROCEDURES

The Permittee shall use the techniques and procedures described in the Permittee's Groundwater Monitoring and LNAPL Management Plan, Permit Attachment 3 and the Sampling and Analysis Plan, Permit Attachment 3, Appendix 3.1, when obtaining and analyzing samples from the groundwater monitoring wells.

O. ELEVATION OF THE GROUNDWATER SURFACE

1. Groundwater Elevation:

   The Permittee shall evaluate groundwater elevations and apparent LNAPL thickness beneath the facility at the gauging network wells that are listed in Permittee's Groundwater Monitoring and LNAPL Management Plan, Permit Attachment 3. The Permittee shall also determine the elevation of the groundwater surface at each well each time the groundwater is sampled.

2. Groundwater Elevation Recording:

   The Permittee shall record the surveyed elevation of the monitoring well(s) when installed (with as-built drawings). In the event that a monitoring well is damaged, the Permittee shall re-survey the monitoring well after it is repaired. The total depth of the well and the elevations of the groundwater surface, the top of casing, ground surface and/or apron elevation, and the protective casing shall be included in all groundwater monitoring reports.

P. MONITORING PROGRAM AND DATA EVALUATION

The Permittee shall determine groundwater quality as follows:

1. The Permittee shall collect, preserve, and analyze groundwater samples pursuant to Permit Condition III.N.

2. The Permittee shall evaluate groundwater quality at each monitoring well semi-annually. The Permittee shall determine the concentration of hazardous constituents (as specified in Permit Condition III.N) in groundwater at each POC well. These determinations shall be made semi-annually.

3. The Permittee shall determine the groundwater flow rate and direction in the uppermost aquifer at least annually.

4. The Permittee shall determine whether there is an exceedance as described in the Permittee's Groundwater Monitoring and LNAPL Management Plan, Permit Attachment 3, and the Sampling and Analysis Plan, Permit Attachment 3, Appendix 3.1, each time groundwater quality is determined at the POC wells.

5. The Permittee shall perform the statistical evaluations described in Permit Attachment 3, Groundwater Monitoring and LNAPL Management Plan, Section 2.0; Permit Attachment 3, Appendix 3.1, Sampling and Analysis Plan and Quality Assurance Project Plan, Section 1.6; and Permit Attachment 3, Appendix 3.2, Output of Mann-Kendall Statistical Analysis, as needed..

6. The Permittee may propose ACLs, as part of the CAP to be developed per Permit Condition III.I, which, if approved by DEQ, would replace the use of previously approved standards in groundwater evaluations.

Q. RECORDKEEPING AND REPORTING

1. The Permittee shall enter all monitoring, testing, and analytical data obtained pursuant to Permit Conditions III.K-III.Q in the operating record.

2. The Permittee shall submit a semi-annual groundwater monitoring report to DEQ within forty-five (45) days of the end of each six-month period (January 1 – June 30) and (July 1 – December 31) for a given sampling event [40 CFR 264.97(j)]. The report shall include the following:

a. Groundwater monitoring results;
b. Groundwater elevations;
c. Groundwater flow direction map;
d. Any noted changes or trends in the groundwater quality;
e. LNAPL recovery and interim measures;
f. Plume maps; and
g. Reporting requirements as described in Permit Condition IV.F.1.

3. If the Permittee determines, pursuant to the Permittee's Groundwater Monitoring and LNAPL Management Plan, Permit Attachment 3 and the Sampling and Analysis Plan, Permit Attachment 3, Appendix 3.1, that there is an exceedance at a POC well or facility boundary well above the GWPS for the parameters specified in Permit Condition III.M, the Permittee shall

   a. Notify DEQ in writing within seven (7) days of receipt of data. The notification must include the list of wells having exceedance and list of parameters or constituents that have exceedance in the corresponding wells.

   b. The Permittee shall resample within thirty (30) days of discovery of the exceedance and repeat the analysis for those compounds detected. If the results from this second analysis confirm the initial results, then these constituents will be considered as an exceedance and will form the basis for investigation. If the Permittee chooses not to resample, the hazardous constituents found during the initial analysis will form the basis for the following actions:

      i. If resampling confirms the exceedance, or if the Permittee chooses not to resample, then the Permittee shall follow Permit Condition III.Q.3.c below.

      ii. If the exceedance is not confirmed, the Permittee shall notify DEQ and the exceedance will be considered an anomaly.

   c. Within thirty (30) days after receiving the result of exceedance confirmation, the Permittee shall notify DEQ of the confirmed exceedance and the path forward following the procedures in the CAP to investigate the exceedance. Alternatively, the Permittee may make the demonstration specified in Permit Condition III.Q.3.f. below.

   d. The Permittee shall execute any proposed investigation with the approval of DEQ and submit the investigation report to DEQ within sixty (60) days after completion of all field work.

   e. Within sixty (60) days of receiving the response from DEQ regarding the investigation report, the Permittee shall submit to DEQ, if needed, a modification of the CAP and/or Permit (as determined by DEQ) meeting the requirements of 40 CFR 264.100. The Permit modification shall include at a minimum: [40 CFR 264.99(h)(2)]

i. Detailed description of corrective actions that will achieve compliance with the GWPS; and

ii. A plan for a groundwater monitoring program that will demonstrate the effectiveness of the corrective action.

f. The Permittee may make a demonstration that the GWPS was exceeded due to sources other than the facility or errors in sampling, analysis or evaluation.

i. The Permittee must notify DEQ in writing, within seven (7) days, that a demonstration will be made.

ii. The Permittee must submit a report to DEQ, within 90 days, that demonstrates that a source other than the facility caused the GWPS to be exceeded or that the apparent non-compliance was a result of an error in sampling, analysis or evaluation.

R. REQUEST FOR PERMIT MODIFICATION

If the Permittee or DEQ determines the groundwater monitoring program no longer satisfies the requirements of 40 CFR 264.99, then DEQ may direct the Permittee to make a permit modification or revise the CAP to be developed per Permit Condition III.I as appropriate.

[Note: Submittal is required within ninety (90) days if an engineering feasibility study has been previously submitted to DEQ; within one hundred and eighty (180) days otherwise. The application content is described in 40 CFR 264.99(h)(2).]

SECTION IV. SPECIAL CONDITIONS PURSUANT TO HAZARDOUS AND SOLID WASTE AMENDMENTS (HSWA) - CORRECTIVE ACTION STRATEGY (CAS)

A. STANDARD CONDITIONS

1. Waste Minimization

The Permittee shall place into the facility operating record, a certification according to 40 CFR 270.11(d) annually by December 1, for the previous year ending September 30, as required by 40 CFR 264.73(b)(9), specifying that:

a. The Permittee has a program in place to reduce the volume and toxicity of hazardous wastes generated by the facility's operation to the degree determined by the Permittee to be economically practicable; and

b. The proposed method of treatment, storage, or disposal is that practicable method currently available to the Permittee which minimizes the present and future threat to human health and the environment.

2. Dust Suppression

a. As stated in 252:205-3-2 (m), the use of used oil as a dust suppressant is prohibited.

b. Pursuant to 40 CFR 266.23(b), and the Toxic Substances Control Act, the Permittee shall not use waste or used oil or any other material which is contaminated with dioxins, polychlorinated biphenyls (PCBs), or any other hazardous waste (other than a waste identified solely on the basis of ignitability), for dust suppression or road treatment.

3. Permit Modification

a. DEQ Initiated Modifications:

If at any time for the reasons specified in 40 CFR 270.41, DEQ determines that modification of this Permit is necessary, DEQ may initiate Permit modification proceedings in accordance with the regulations set forth at 40 CFR 270.41.

b. Permittee Initiated Modifications:

The Permittee may, where appropriate, initiate permit modifications in accordance with the regulations set forth at 40 CFR 270.42. All applicable requirements and procedures as specified in 40 CFR 270.42 shall be followed in initiating such proceedings.

c. Modification of Corrective Action Schedules of Compliance (CASC) for SWMUs:

i. The Permittee shall adhere to CASCs developed for newly identified and previously identified SWMUs covered by this Permit. If at any time the Permittee determines that such schedules cannot be met, the Permittee shall, within fifteen (15) days of such determination, notify DEQ and submit a request for a permit modification under 40 CFR 270.42, with a justification as to why the current CASC cannot be met and revise the CAP to be developed per Permit Condition III.I accordingly.

ii. If DEQ determines that a modification of the CASC is required, the following procedure will apply. CASC Modifications made under this procedure are not subject to administrative appeal.

1. DEQ will notify the Permittee in writing of the proposed modification. Such notice will:

a. Describe the exact changes to be made to the permit conditions;

b. Provide an explanation of why the modification is needed;

c. Provide notification of the date by which comments on the proposed modification must be received. Such date will not be less than twenty (20) days from the date the notice of proposed modification is received by the Permittee, or after the public notice is published;

d. Provide notification that supporting documentation or data may be available for inspection at the State or EPA Regional office; and

e. Include the name and address of a representative of DEQ to whom comments may be sent.

2. The Permittee shall:

a. Publish a notice, approved by DEQ, of the proposed modification in a newspaper distributed in the locality of the facility, which includes notice of items in 40 CFR 124.10(d);

b. Mail a notice of the proposed modification to all persons on the facility mailing list maintained according to 40 CFR 124.10(c)(1). Such notice will include items in 40 CFR 124.10(d) and shall be mailed concurrently with notice to the Permittee; and

c. For facilities which have established an information repository, the Permittee shall place a notification of the proposed modification, including items under Permit Condition 40 CFR 124.10(d) in the information repository concurrently with actions taken under those items.

iii. DEQ's Decision Regarding Modification

1. If DEQ receives no written comment on the proposed modification, the modification shall become effective five (5) calendar days after the close of the comment period. DEQ shall:

a. Notify the Permittee in writing of the final decision.

b. Notify individuals on the facility mailing list in writing that the modification has become effective and shall place a copy of the modified Permit in the information repository, if a repository is required for the facility.

2. If DEQ receives written comment on the proposed modification, DEQ shall make a final determination concerning the modification after the end of the comment period. DEQ shall:

a. Notify the Permittee in writing of the final decision.

b. Provide notice of the final modification decision in a locally distributed newspaper and place a copy of the modified permit in the information repository, if a repository is required for the facility.

4. Permit Review

This Permit may be reviewed by DEQ five (5) years after the date of permit issuance and may be modified as necessary as provided for in Permit Condition IV.A.3. Nothing in this section shall preclude DEQ from reviewing and modifying the Permit at any time during its term.

5. Compliance with Permit

Compliance with a RCRA permit during its term constitutes compliance, for purposes of enforcement, with Subtitle C of RCRA except for those requirements not included in the permit which:

a. Become effective by statute;

b. Are promulgated under 40 CFR 268 restricting the placement of hazardous wastes in or on the land; or

c. Are promulgated under 40 CFR 264 regarding leak detection systems for new and replacement surface impoundment, waste pile, and landfill units, and lateral expansions of surface impoundment, waste pile, and landfill units. The leak detection system requirements include double liners, CQA programs, monitoring action leakage rates, and response action plans, and will be implemented through the procedures of 40 CFR 270.42 Class 1 permit modifications.

6. Specific Waste Ban

a. The Permittee shall not place in any land disposal unit the wastes specified in 40 CFR 268 after the effective date of the prohibition unless the Administrator has established disposal or treatment standards for the hazardous waste and the Permittee meets such standards and other applicable conditions of this Permit.

b. The Permittee may store wastes restricted under 40 CFR 268 solely for the purpose of accumulating quantities necessary to facilitate proper recovery, treatment, or disposal provided that it meets the requirements of 40 CFR 268.50(a)(2) including, but not limited to, clearly marking each tank or container.

c. The Permittee is required to comply with all requirements of 40 CFR 268.7 as amended.

d. The Permittee must comply with requirements restricting placement of hazardous wastes in or on land, which become effective by statue or promulgated under Part 268, regardless of requirements of Permit. Failure to comply with the regulations may subject the Permittee to enforcement action under Section 3008 of RCRA.

7. Information Submittal

Failure to comply with any condition of the Permit, including information submittal, constitutes a violation of the Permit and is grounds for enforcement action, Permit amendment, termination, revocation, suspension, or denial of Permit renewal application. Falsification of any submitted information may also constitute grounds for termination of this Permit (40 CFR 270.43).

The Permittee shall ensure that all plans, reports, notifications, and other submissions to DEQ required in this Permit are signed and certified in accordance with 40 CFR 270.11. Two (2) hard copies and one (1) Windows compatible soft copy of each of these plans, reports, notifications or other submissions shall be submitted to DEQ by Certified Mail or hand delivered to:

Chief Engineer
Land Protection Division
Oklahoma Department of Environmental Quality
707 N. Robinson
P. O. Box 1677
Oklahoma City, Oklahoma 73101-1677
Phone Number (405) 702-5100

8. Plans and Schedules Incorporated into Permit

All plans and schedules required by this Permit are, upon approval by DEQ, incorporated into this Permit by reference and become an enforceable part of this Permit. Since required items are essential elements of this Permit, failure to submit any of the required items or submission of inadequate or insufficient information may subject the Permittee to enforcement action under Section 3008 and under the OHWMA which may include fines, suspension, or revocation of the Permit.

Any noncompliance with approved plans and schedules shall be termed noncompliance with this Permit. Written requests for extensions of due dates for submittals may be granted by DEQ in accordance with Permit Condition IV.A.3.

If DEQ determines that actions beyond those provided for, or changes to what is stated herein are warranted, DEQ may modify this Permit according to procedures in Permit Condition IV.A.3.

9. Data Retention

All raw data, such as laboratory reports, drilling logs, bench-scale or pilot-scale data, and other supporting information gathered or generated during activities undertaken pursuant to this Permit shall be maintained at the facility during the term of this Permit, including any reissued Permits.

10. Management of Wastes

All solid wastes which are managed pursuant to a remedial measure taken under the corrective action process or as an interim measure addressing a release or the threat of a release from a LTU or SWMU or AOC shall be managed in a manner protective of human health and the environment and in compliance with all applicable Federal, State and local requirements. Regulations under Subpart S - Corrective Action for Solid Waste Management Units - 40 CFR 264.550 *et seq*, shall be applicable as guidance for managing these wastes. Approval of units for managing wastes and conditions for operating the units, if approved, shall be granted through the permitting process.

B. SPECIFIC CONDITION - INFORMATION REPOSITORY

1. Within thirty (30) days of the effective date of this Permit, the Permittee must establish and maintain an information repository to provide the public an opportunity to review and comment on the corrective action activities specified in this Permit. This repository shall be established at a local public library or similar facility that is easily accessible to the public.

2. Within thirty (30) days of the effective date of this Permit, the Permittee shall mail a notice of public repository availability to all individuals on the facility-specific mailing list maintained by DEQ, including all individuals that submitted oral or written comments on the Permittee's draft permit during the public comment period. The Permittee shall amend this mailing list as necessary to include those individuals that submit a written request to DEQ and the Permittee for inclusion in this list.

3. This notice shall state the location, purpose, and content of the repository. A copy of this notice shall be provided to DEQ, for approval, prior to mailing to the public.

4. Once established, the Permittee shall place into the repository, on or before the date due to DEQ, all corrective action documents (e.g., workplans and final reports) as specified in this Permit. The Permittee shall specify within the text or cover letter of each document the date each submittal was placed in the repository.

C. SPECIFIC CONDITION - INVESTIGATION OF AREA(s) OF CONCERN

Within 180 days of the identification of newly identified Areas of Concern (AOCs), the Permittee shall submit a plan to determine if the AOCs are SWMUs. The work plan shall describe the objective of the investigation and the overall technical and analytical approach to completing all actions necessary to determine if activity at the AOC resulted in solid waste management at any time. If such determination is made, the AOC shall be designated as a newly-identified SWMU. If hazardous wastes including hazardous constituents are determined to be managed at the SWMU or potential AOC, and if DEQ determines that further investigation is necessary, a plan for the investigation shall be prepared according to Permit Condition IV.G.

D. SPECIFIC CONDITION – CONCEPTUAL SITE MODEL (CSM)

The Permittee shall provide a CSM consistent with the applicable requirements of the EPA Region 6 CAS, and shall incorporate the CSM into the CAP to be developed for the facility in accordance with Permit Condition III.I.

The CSM shall identify the known or potential constituent source(s), routes of constituent migration, exposure media, exposure points and pathways, receptors and source media. The CSM shall be considered as the "base document" to be prepared and updated by the facility as new information is gathered during investigations. The Permittee shall evaluate the CSM periodically for necessary changes and inform DEQ in writing of its recommendations, if any. The CSM shall be used by the facility to make decisions regarding risk management options, ecological risk, and any needed changes to the remedy applications as site conditions change or when deemed appropriate by DEQ.

E. CORRECTIVE ACTION USING THE CAS

The EPA Region 6 Corrective Action Strategy (CAS) is a streamlined corrective action approach, which has been adopted by the State of Oklahoma and that can be implemented during any phase of corrective action. The Permittee shall use the CAS approach as guidance for development and implementation of the facility wide corrective action program, and shall compare all contaminants in the soil and groundwater to the current MCLs, RSLs, or DEQ approved RBSLs for screening new releases to determine if additional action is warranted. Screening should use the most conservative levels based on the chosen receptors or scenario, unless otherwise directed by DEQ. Work plans and reports completed as part of the corrective action program are subject to DEQ approval and shall be submitted according to the schedule provided in Table IV-1.

1. Performance Standards and Corrective Action Objectives (CAOs)

   Expectations for the outcome of corrective action at a facility are established in the CAS by three performance standards. Through the application of the performance standards and screening with the current EPA Regional Screening Levels, the Permittee and DEQ shall determine whether a release must be addressed through corrective action, and whether implemented corrective actions are protective of human health and the environment.

   The three CAS performance standards approved by DEQ are defined below. The order in which the performance standards are listed does not imply that one performance standard takes priority over another. CAOs are described under each performance standard. All CAOs must be achieved by the Permittee.

a. Source Control Performance Standard

Source control refers to the control of materials that include or contain hazardous wastes or hazardous constituents that act as a reservoir for migration of contamination to soil, sediment, ground water, surface water, or air, or as a source for direct exposure.

The facility must determine if source material is present. Removal, containment, and treatment, or a combination of the three, must be evaluated on a case-by-case basis. Controlling source material is a predominating issue in the CAS, and must be addressed to ensure protectiveness over time.

b. Statutory and Regulatory Performance Standard

Applicable statutory and regulatory requirements (Federal, State, and local) must be identified. These requirements may dictate media-specific contaminant levels (e.g., maximum contaminant levels (MCLs) in drinking water) that must be achieved and may become a performance standard for the Permittee.

c. Final Risk Goal Performance Standard

The final risk goal is the level of protection to be achieved and maintained by the Permittee. The final risk goal shall be based on site-specific issues including land use, special subpopulations, contaminant concentrations based on acceptable risk, location at which the levels are measured, and the remediation time frame.

2. Corrective Action for Releases Beyond Facility Boundary

Section 3004(v) of RCRA as amended by HSWA requires corrective actions beyond the facility property boundary, where necessary to protect human health and the environment, unless the Permittee demonstrates that, despite the Permittee's best efforts, the Permittee was unable to obtain the necessary permission to undertake such actions. The Permittee is not relieved of all responsibility to clean up a release that has migrated beyond the facility boundary where off-site access is denied.

F. REPORTING REQUIREMENTS

1. The Permittee shall submit signed semi-annual progress reports of all activities conducted pursuant to the provisions of this Permit on the schedule and incorporated in the semi-annual groundwater monitoring report described in

Condition III.Q.2. These progress reports shall contain information not otherwise reported or submitted to DEQ in other documentation. These reports shall contain:

a. A description of the work completed and an estimate of the percentage of work completed;

b. Summaries of all findings, including summaries of laboratory data;

c. Summaries of all problems or potential problems encountered during the reporting period and actions taken to rectify problems;

d. Projected work for the next reporting period;

e. Summaries of contacts pertaining to corrective action with representatives of the local community, public interest groups or State government during the reporting period; and

f. Summaries of all changes made in implementation of CAP (to be developed per Permit Condition III.I) during the reporting period.

2. Copies of other reports relating to or having bearing upon the corrective action work, (e.g., inspection reports), drilling logs and laboratory data shall be made available to DEQ upon request.

3. In addition to the written reports as required in Permit Condition IV.F.1 and 2, above, at the request of DEQ, the Permittee shall provide status review briefings.

G. NOTIFICATION REQUIREMENTS FOR AND ASSESSMENT OF NEWLY IDENTIFIED SWMUs AND POTENTIAL AOCs

The Permittee shall notify DEQ, in writing, of any newly-identified SWMU(s) and potential AOCs (i.e., a unit or area not specifically identified during the RFA), discovered in the course of groundwater monitoring, field investigations, environmental audits, or other means, no later than thirty (30) calendar days after discovery. The Permittee shall also notify DEQ of any newly-constructed land-based SWMUs (including but not limited to, surface impoundments, waste piles, landfills, land treatment units) and newly-constructed SWMUs where any release of hazardous constituents may be difficult to identify (e.g., underground storage tanks) no later than thirty (30) days after construction. The notification shall include the following items, to the extent available:

1. The location of the newly identified SWMU or potential AOC on the topographic map required in 40 CFR 270.14(b)(19). Indicate all existing units (in relation to other SWMUs);

2. The type and function of the unit;

3. The general dimensions, capacities, and structural description of the unit (supply any available drawings);

4. The period during which the unit was operated;

5. The specifics, to the extent available, on all wastes that have been or are being managed at the SWMU or potential AOC; and

6. Results of any sampling and analysis required for the purpose of determining whether releases of hazardous waste including hazardous constituents have occurred, are occurring, or are likely to occur from the SWMU or whether the AOC should be considered a SWMU.

Based on the results of this Notification DEQ will designate the newly identified SWMU(s) or AOC(s). Based on the results of this notification or investigation conducted, DEQ will determine the need for further investigations or corrective measures at any newly-identified SWMU(s) or AOC(s). If DEQ determines that such investigations are needed, DEQ may require the Permittee to prepare a plan for such investigations.

H. NOTIFICATION REQUIREMENTS FOR NEWLY DISCOVERED RELEASES AT SWMU(s) AND AOC(s)

The Permittee shall notify DEQ in writing immediately of any release(s) from a SWMU or AOC of hazardous waste or hazardous constituents discovered during the course of groundwater monitoring, field investigation, environmental auditing, or other means as described in OAC 252:205-13-1. Such newly-discovered releases may be from newly-identified SWMUs or AOCs, newly-constructed SWMUs, or from SWMUs or AOCs for which, based on the findings of the RFA, completed RFI, or investigation of an AOC(s), DEQ had previously determined no further investigation was necessary. The notification shall include information concerning actual and/or potential impacts beyond the facility boundary and on human health and the environment, if available at the time of the notification. DEQ may require further investigation and/or interim measures for the newly-identified release(s), and may require the Permittee to prepare a plan for the investigation and/or interim measure. The plan will be reviewed for approval as part of the RFI Workplan or a new RFI Workplan. The Permit will be modified to incorporate the investigation, if required.

I. INTERIM MEASURES

1. If during the course of any activity initiated under this permit, DEQ determines that a release or potential release of hazardous constituents from a SWMU or AOC poses a threat to human health and the environment, DEQ may require interim measures. DEQ shall determine the specific measure(s) or require the Permittee to propose a measure(s). The interim measure(s) may include a permit

modification, a schedule for implementation, and a written plan. DEQ shall notify the Permittee in writing of the requirement to perform interim measures. DEQ may modify this permit to incorporate interim measures into the permit.

2. The Permittee may propose interim measures at any time. The proposal shall include a written plan and a schedule for implementation. Depending upon the nature of the interim measure, a permit modification may not be required.

3. The following factors will be considered by DEQ in determining the need for interim measures and the need for permit modification:

   a. Time required to develop and implement a final remedy;

   b. Actual and potential exposure to human and environmental receptors;

   c. Actual and potential contamination of drinking water supplies and sensitive ecosystems;

   d. The potential for further degradation of the medium in the absence of interim measures;

   e. Presence of hazardous wastes in containers that may pose a threat of release;

   f. Presence and concentration of hazardous waste including hazardous constituents in soil that have the potential to migrate to groundwater or surface water;

   g. Weather conditions that may affect the current levels of contamination;

   h. Risks of fire, explosion, or accident; and

   i. Other situations that may pose threats to human health and the environment.

J. DETERMINATION OF NO FURTHER ACTION

1. Based on the results of the site investigations, screening, risk evaluations, and risk management activities, the Permittee may submit an application to DEQ for a Class 3 Permit modification under 40 CFR 270.42 to terminate further corrective action for a specific unit. This permit modification application must contain information demonstrating that there are no releases of hazardous waste including hazardous constituents from a particular SWMU at the facility that pose threats to human health and/or the environment, as well as additional information required in 40 CFR 270.42.

If, based upon review of the Permittee's request for a permit modification, the results of the site investigations, and other information, including comments received during the sixty (60) day public comment period required for Class 3 Permit modifications, DEQ determines that releases or suspected releases which were investigated either are non-existent or do not pose a threat to human health and/or the environment, DEQ may grant the requested modification.

2. If necessary to protect human health or the environment, a determination of no further action shall not preclude DEQ from requiring continued or periodic monitoring of air, soil, groundwater, or surface water, when site-specific circumstances indicate that releases of hazardous waste or hazardous constituents are likely to occur.

3. A determination of no further action shall not preclude DEQ from requiring further investigations, studies, or remediation at a later date, if new information or subsequent analysis indicates a release or likelihood of a release from a SWMU, or AOC at the facility that is likely to pose a threat to human health or the environment. In such a case, DEQ shall initiate a modification to the permit according to 40 CFR 270.41.

Table IV-1: RFI/CMS SUBMISSION SUMMARY AND SCHEDULE

Below is a summary of the planned reporting requirements pursuant to this Permit which may be required by DEQ. Note that this table is subject to change based on DEQ approval of the CAP to be developed per Permit Condition III.I:

ACTION	**DUE DATE (examples)**
Corrective Action Plan (CAP)	180 days after permit issuance, or at later date with approval from DEQ
Progress reports on all activities	Semi-annual (in conjunction with routine semi-annual groundwater reporting)
RFI Workplan (if required)	180 calendar days after the effective date of the Permit
Revised RFI Workplan (if required)	As determined by DEQ, not less than ninety (90) calendar days after receipt of DEQ comments
RFI Report and Summary (if required)	Ninety (90) calendar days after completion of RFI
Revised RFI Report and Summary (if required)	As determined by DEQ, not less than ninety (90) calendar days after receipt of DEQ comments
Risk Assessment Work Plan	As determined by DEQ
Notification of newly identified SWMUs	Thirty (30) calendar days after discovery
Notification of newly discovered releases	Fifteen (15) calendar days after discovery
Interim Measures Plan	As determined by DEQ
Revised Interim Measure Plan	As determined by DEQ
CMS Plan (If required)	One-hundred eighty (180) calendar days after notification of requirement to perform CMS
Revised CMS Plan (If required)	As determined by DEQ, not less than ninety (90) calendar days after receipt of DEQ comments
CMS Final Report and Summary (If required)	One-hundred eighty (180) calendar days after completion of CMS
Revised CMS Final Report (If required)	As determined by the DEQ, not less than ninety (90) calendar days after receipt of DEQ comments
Demonstration of Financial Assurance at the facility	60 calendar days after permit modification to implement corrective measures

Table IV-2: COMPLIANCE SCHEDULE

Note that this table is subject to change based on DEQ approval of the CAP to be developed per Permit Condition III.I:

ACTION	DUE DATE
Semi-Annual Groundwater Monitoring Report	Within forty-five (45) days from the end of each six-month period (January 1 – June 30) and (July 1 – December 31)
Investigation Workplan (Pursuant to the permit condition III.Q.3.c)	Within thirty (30) days after receiving the final result(s) of exceedance confirmation
Alternate Source Demonstration	Within thirty (30) days after receiving the final result(s) of exceedance confirmation
Investigation Report (Pursuant to the permit condition III.Q.3.d)	Within sixty (60) days after receipt of final analytical report regarding delineation
Corrective Action Workplan (Pursuant the permit condition III.Q.3.e)	Within sixty (60) days after receiving DEQ response to investigation report
AOC-2 and SWMU-H Risk Assessment (RA) Workplan	HFTR-E submitted the RA Workplan on April 30, 2019, which DEQ approved on June 19, 2019.
AOC-2 and SWMU-H RA Summary Report	Within ninety (90) days of completion of RA workplan or receipt of final analytical report regarding AOC-2 and SWMU-H
SWMU-C RA Workplan	HFTR-E submitted the RA Workplan on April 30, 2019, which DEQ approved on June 19, 2019.
SWMU-C RA Summary Report	Within ninety (90) days of completion of RA workplan or receipt of final analytical report regarding SWMU-C
Facility Wide LNAPL Investigation Report	HFTR-E submitted the Report on March 31, 2018.
Off-site Dissolved Phase Groundwater VOC Screening Investigation	HFTR-E submitted the reports during the 1st quarter of 2018.
LNAPL Perimeter Investigation Summary Report	HFTR-E submitted the Report as a Part of March 2018 Facility Wide LNAPL Investigation Report.

ACTION	DUE DATE
RA Workplan	Pending HFTR-E submittal and DEQ approval
RA Report	180 days from approval of RA Work plan
Vapor Intrusion Investigation Workplan (following June 2015 EPA guidance)	Within 90 days of approval of Facility Wide LNAPL Investigation Report
Vapor Intrusion Investigation Summary Report	Within 180 days of VI Investigation workplan approval

Table IV-3: SWMUs REQUIRING AN RFI

There are no newly identified solid waste management units at the facility presently requiring an RFI. Should new units be found in the future, the CAP to be developed per Permit Condition III.I will be modified and a modification of this permit may be necessary to include such units in the corrective action process of this section.

HOLLYFRONTIER TULSA REFINING LLC
TULSA EAST REFINERY
TULSA, OKLAHOMA

PERMIT ATTACHMENT 1

PREPAREDNESS AND PREVENTION PLAN

NOTE: ALL THE PAGES FOR THE ATTACHMENTS ARE TAKEN FROM THE PERMIT APPLICATION AND PAGE NUMBERS MAY NOT BE IN SEQUENCE.

PREPAREDNESS AND PREVENTION PLAN

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HollyFrontier Tulsa Refining LLC
Tulsa East Refinery
Attachment #1
Preparedness and Prevention Plan
July 2019

1.0 PREPAREDNESS AND PREVENTION

HollyFrontier Tulsa Refining LLC (HFTR), Tulsa East Refinery (the Refinery) will not seek a waiver from the requirement to provide information related to Refinery preparedness and prevention measures specified in Title 40 of the Code of Federal Regulations, Part 264 (40 CFR 264), Subpart C, as allowed under 40 CFR 270.14(b)(6). This Preparedness and Prevention Plan (P&P Plan) has been submitted as an attachment (Permit Attachment 1) to the Refinery's Resource Conservation and Recovery Act (RCRA) Part B Permit (Permit) and summarizes the procedures taken to prevent and prepare for hazards at the portions of the Refinery covered by the RCRA Permit (i.e., the Hazardous Waste Management Units [HWMUs], Solid Waste Management Units [SWMUs], and Areas of Concern [AOCs]).

The Refinery maintains an Emergency Response Plan (ERP) that addresses the prevention of hazards in detail, as well as Refinery-wide procedures and equipment to be used in response to emergencies (e.g., fires and explosions, releases of hazardous substances, natural or man-made disasters). Prevention of hazards and emergency response procedures at the HWMUs (i.e., the closed land treatment units [LTUs]) and SWMUs/AOCs will be followed in accordance with these Refinery-wide documents.

Per 40 CFR 270.28, Part B, Information Requirements for Post-Closure Permits, HFTR is not submitting a copy of the Refinery ERP in lieu of a full Contingency Plan, since that is not a requirement for a post-closure permit. Instead, HFTR has provided these requirements for preparedness and prevention as required by 40 CFR 264, Subpart C. HFTR also maintains a Contingency Plan for non-permitted (<90 day) waste activities at the Refinery.

In accordance with 40 CFR 264.31, the Refinery is designed, constructed, maintained, and operated to minimize the possibility of a fire, explosion, or any unplanned sudden or non-sudden release of hazardous waste or hazardous waste constituents to air, soil, or surface water which could threaten human health or the environment. This P&P Plan provides an overview of the preventative procedures and equipment available in case of a hazardous waste emergency within the Refinery. The Plan addresses the following topics[1]:

[1] Note that a discussion of aisle space per 40 CFR 264.35 is not applicable to this Renewal Application since the Refinery does not operate any RCRA-permitted container storage units. Emergency response personnel and equipment can easily access the closed LTUs and SWMUs/AOCs using Refinery roadways. Refinery security guards and environmental department staff can provide access to fenced areas. Emergency preparedness and prevention procedures related to the Refinery's operations as a large quantity generator of hazardous waste are addressed in the Refinery's ERP.

- Required emergency equipment;
- A testing and maintenance schedule for all emergency equipment;
- Employee access to communication or alarm systems; and
- Existing arrangements with local authorities.

1.1 Required Equipment

Per the requirements of 40 CFR 264.32, HFTR maintains equipment for internal communication, external communication, fire control, spill control, and decontamination at appropriate locations throughout the Refinery, including in areas that can provide emergency response at the LTUs, SWMUs, and AOCs. Additional information on the emergency response equipment is provided in the subsections below.

1.1.1 Internal Communication

The Refinery internal communication systems include emergency alarms, radios, and telephones. Radios can be used to alert personnel and emergency responders. Emergency responders and operators are required to carry a portable radio. Maintenance personnel and other Refinery personnel carry portable radios as needed or as required by work permits. On-site visitors receive an orientation and introductory safety training prior to accessing the Refinery, including training regarding the meaning of various Refinery alarms and reporting emergencies. Visitors are also assigned to an employee escort within the Refinery; the employee escort is then responsible for informing the visitor of any emergencies and for taking action as necessary. Two-way internal communication is possible using the Refinery's landline telephone system or cellular phones.

Refinery alarms will sound in the event of critical emergencies (including fire, spill and weather emergencies). Prior to beginning work assignments, HFTR and contractor personnel receive training that covers identifying emergency alarms and evacuation protocols.

1.1.2 External Communication

Communication between the Refinery and local Emergency Response Agencies is possible via personal cellular phones or the Refinery's landline phone system. Landline phones are located in all of the Refinery emergency response facilities.

1.1.3 Portable Fire Extinguishers, Fire Control, Spill Control, and Decontamination Equipment

The Refinery is equipped with handheld fire extinguishers, fire hydrants, on-site fire-fighting teams, fire-fighting foam and water pumps appropriate for Refinery hazards, sorbents and booms to control and clean up spills, safety showers, and hydrocarbon gas detectors. Further details of Refinery-wide emergency procedures are included in the Refinery's ERP. It should be noted that since the LTUs are in post-closure care (PCC), there are no active hazardous waste management activities at those regulated units with the potential to cause fires or spills.

1.1.4 Available Water Volume and Pressure

Fire hydrants supply water at appropriate pressure and volume for fire-fighting. In addition, the Refinery has fire trucks with self-contained firewater capacity. The Refinery also has an on-site firewater pond for additional water supply.

1.2 Testing and Maintenance of Equipment

Refinery emergency equipment is inspected and maintained on a regular schedule to ensure proper performance in time of emergency. The typical inspection frequency for response equipment maintained at the Refinery is detailed in Table 1. Note that the inspection frequencies discussed in this P&P Plan are typical inspection frequencies and may vary slightly as determined by the Refinery's management and/or policy changes.

1.3 Access to Communication or Alarm Systems

Whenever hazardous waste is handled in any way (at non-permitted units or satellite accumulation areas), personnel involved in the operation have immediate access to internal communication systems, either directly or through visual or voice contact with other personnel with access to communication systems. This includes all employees working at the LTUs, SWMUs and/or AOCs. In case of an emergency, emergency notifications are given to the first responders (operators, the Emergency Response Technician (ERT), safety personnel, etc.) and move up through the Incident Commander (IC) chain of command. The ERT and/or the Shift Foreman act as the IC until the emergency is resolved or they are relieved. At least one person with the necessary qualifications to act as the IC is on call 24 hours per day. Employees can contact the IC via landline, cell phone, or radio.

The IC then notifies the appropriate personnel that an emergency exists by means of telephone, radio, home-alert pagers, or emergency alarm. Details of the Refinery's emergency procedures are included in the Refinery's ERP.

During regular business hours, the Fire Chief or Assistant Fire Chiefs have the initial responsibility to classify an event in accordance with the Emergency Classification System (located in the Refinery's ERP) and notify the on-call IC as appropriate. Outside of regular business hours, it is the responsibility of the on-shift supervisor to classify an event in accordance with the Emergency Classification System. Classification of an event into one of the three emergency categories (Unusual Events, Site Emergency, or General Emergency) determines the extent to which the Incident Command System (ICS) is activated.

For a Site Emergency, the ICS may or may not be fully activated based upon the decision of the Fire Chief (or Assistant Fire Chiefs) during regular business hours or the on-shift supervisor outside of regular business hours. For a General Emergency, the ICS will be fully activated.

1.4 Arrangements with Local Authorities

HFTR cooperates and coordinates with Local Emergency Planning Committees (LEPCs); local elected officials; police, fire, civil defense, public health, environmental, hospital, and transportation officials; and representatives of industrial facilities, community groups, and the media as needed to assist in emergency response operations at the Refinery. HFTR has shared copies of the Contingency Plan with local officials and LEPCs and maintains documentation of existing arrangements or attempts to make arrangements with LEPCs and other local emergency response organizations in the Refinery's RCRA operating record.

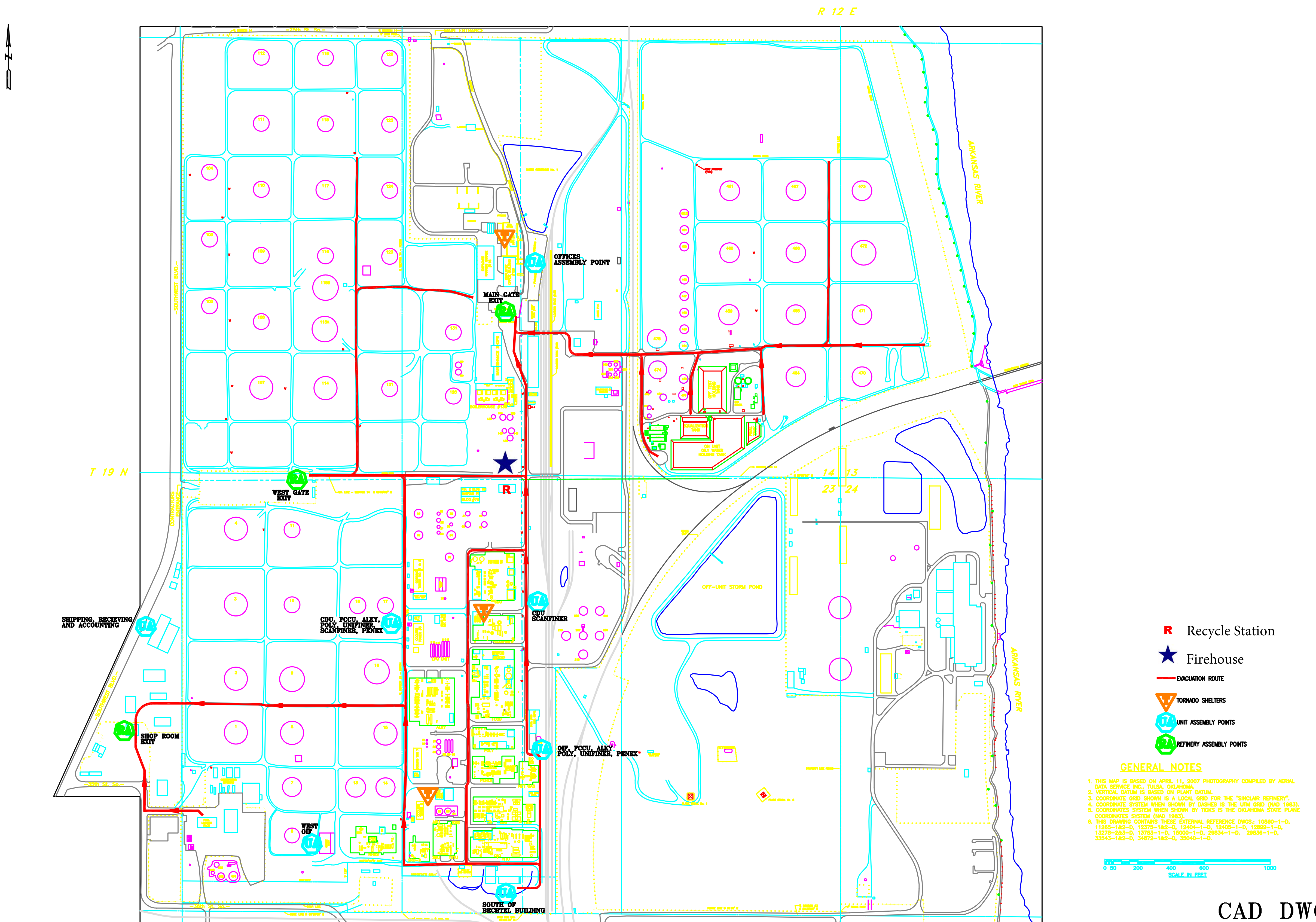
Tables

Table 1. Typical Equipment Inspection and Maintenance Schedule

Equipment Description	Inspection Frequency
Emergency Alarm	Weekly
Radio System	Weekly
Telephones	Daily
Unit Alarms	Monthly
Emergency Vehicle Equipment	Monthly
Fire Extinguishers	Monthly
Fire Hydrants	Flowed and maintained annually
Fire-Fighting Foam	Weekly and after incidents
Water Pumps	Run weekly, tested annually
Sorbents	Weekly and after incidents
Booms	Weekly and after incidents
Safety Showers	Monthly
Hydrocarbon Gas Detectors	Monthly
Firewater Monitors	Annually

NOTE: The inspection frequencies discussed in this P&P Plan are typical inspection frequencies and may vary slightly as determined by the Refinery's management and/or policy changes.

Figures



CAD DWG

VENDOR DWG#
DWG.SIZE C | UNIT 050 | CATEGORY

NOTES	REV	DATE	DWN	CHK	EJ	DESCRIPTION
	6					
	5					
	4					
	3					
	2					
	1					PICK THE REV LETTER TO ADD REVISIONS

Figure 1

REFERENCE DRAWINGS	
TITLE	NO.
PICK THIS LINE TO ADD REF DRAWINGS	

SCALE	NOTED
WO. NO.	
ENG. JOB	
DRAWN	GMK
CHECKED	JS
APPROVED	JS
VENDOR	SUN
PLOT DATE	

HOLLY
Refining & Marketing
TULSA LLC

GENERAL PLANT: MAPS:
REFINERY EVACUATION MAP AND TORNADO SHELTERS

DATE 6-10-10 | 1 OF 1 | REV

HOLLYFRONTIER TULSA REFINING LLC
TULSA EAST REFINERY
TULSA, OKLAHOMA

PERMIT ATTACHMENT 2

POST-CLOSURE CARE PLAN

POST-CLOSURE CARE PLAN

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HollyFrontier Tulsa Refining LLC
Tulsa East Refinery
Attachment #2
Post-Closure Care Plan
July 2019

1.0 INTRODUCTION

HollyFrontier Tulsa Refining LLC (HFTR), the Permittee, owns and operates the Tulsa East Refinery (The Refinery), which includes two (2) closed land treatment units (LTUs), the Walnut Grove LTU (WGLTU) and the Flare Area LTU (FALTU), where hazardous wastes remain in place after closure of the LTUs. Accordingly, Resource Conservation and Recovery Act (RCRA) regulations state that a Post-Closure Care (PCC) Plan must be included in the Refinery RCRA Part B Permit. This PCC Plan has been prepared to meet the submittal requirements of a RCRA Part B Permit pursuant to general PCC regulations in Title 40 of the Code of Federal Regulations (40 CFR), Part 264.118 (40CFR264.118).

1.1 Objectives and Scope

This PCC Plan has been submitted as an attachment (Permit Attachment 2) to the Refinery's RCRA Part B Permit (Permit) per 40 CFR 270.14(b)(13). The objective of the PCC Plan is to identify the activities being continued after closure of each LTU and detail the frequency of those post-closure activities which include the use, operation, maintenance, and monitoring of the units. LTU specific requirements for PCC are detailed in 40 CFR 264.117-120 for general PCC and 264.280(c) specifically for LTUs.

The Plan is required to provide procedural information with respect to the following:

- Groundwater monitoring activities and frequencies;
- Planned maintenance and inspection activities and the frequencies at which these will be performed;
- Managing post-closure uses of the LTU areas (i.e., surface use and temporary intrusive and maintenance activities); and
- Refinery contact information and Refinery reporting over the duration of the PCC period.

Activities outlined in the PCC Plan are being implemented for a period of thirty (30) years from the date of certified closure of each specific LTU.

2.0 REGULATORY STATUS AND HISTORY

Permit No. 990750960-PC, renewed on July 2, 2008, is the most recent RCRA post-closure permit for the FALTU. This permit was a renewal from a previous FALTU post-closure permit which had an effective date of May 26, 1995. A Certification of Closure for the FALTU was submitted on March 3, 1993 and the monitoring activities of the Closure Plan were implemented at that time. The FALTU was officially closed on April 1, 1993. PCC for the FALTU began on April 1, 1993 after submittal of the required Notice of Closure Report and fulfillment of applicable regulatory requirements. A total of approximately 26 years of post-closure monitoring activities have already been completed at the FALTU.

The WGLTU was originally issued a permit to operate as a hazardous waste LTU with an effective date of December 10, 1998, Permit No. 990750960-OP. The WGLTU operating permit expired on December 10, 2008. Subsequently, Sinclair Oil Company (SOC), a previous owner/operator of the Refinery, submitted a Certification of Closure on April 24, 2009 in accordance with 40 CFR 264.115 and began implementation of the Post-Closure Plan contained within the expired WGLTU Operating Permit (Permit No. 990750960-OP). In 2009, SOC submitted a request to the Oklahoma Department of Environmental Quality (DEQ) for a RCRA post-closure permit modification to add the WGLTU to the FALTU post-closure permit. The Permittee has continued to conduct PCC of the WGLTU under the FALTU Post-Closure Plan until a new RCRA Part B Permit can be completed. A total of approximately 11 years of post-closure monitoring activities have been completed at the WGLTU. HFTR submitted a draft RCRA PCC Permit application for the FALTU and WGLTU to the DEQ on April 30, 2010, as required by the Consent Order in Case No. 09-319. All tasks required by said Consent Order have since been fulfilled.

Both units stopped receiving K-listed hazardous waste by November 8, 1990, as a result of the RCRA Land Disposal Restrictions (LDRs). Establishment of LDRs for D-listed wastes ended land application of all D-listed waste streams by August 24, 1998. The land application of all hazardous wastes stopped at the FALTU by February 1988 (SOC, October 27, 1992) and the WGLTU by June 2001 (SOC, April 24, 2009).

HFTR previously used biosolids wastewater for irrigation at the LTUs. In accordance with Consent Order 15-215, this practice ceased in December 2015. HFTR submitted a final work plan for the soil investigation to DEQ in June 2017 (*Revised Biosolids Irrigation Impact Land Treatment Unit Evaluation Work Plan)* that also provided an evaluation of groundwater at the LTUs and demonstrated that the application of biosolids at the LTUs has had little to no impact to groundwater quality. DEQ approved the work plan and groundwater evaluation on July 26, 2017. HFTR conducted the soils investigation at the LTUs according to the work plan and subsequently submitted a report to DEQ on September 29, 2017 (*Evaluation Report on Biosolids Irrigation Impact at Land Treatment Units - HollyFrontier Tulsa Refining LLC – Tulsa East Refinery)* summarizing the results of that sampling event to DEQ. The report concluded that leaching from the LTU soils is not adversely impacting groundwater and that additional actions are not required to address concentrations of metals in the LTU soils. DEQ responded to these findings on May 17, 2018.

In September 2010, HFTR presented a preliminary conceptual site model (CSM) to the DEQ, including a review of current environmental subsurface conditions which suggest the LTUs do not appear to be a source of the light non-aqueous phase liquid (LNAPL) and dissolved phase groundwater plumes underlying the Refinery. Additionally, no statistically significant groundwater detections were exhibited over almost 20 years of compliance monitoring at the FALTU and WGLTU. As such, HFTR proposed that a Facility-wide permitting approach would be more appropriate for the Refinery than the current LTU-based permit(s). The DEQ agreed to this approach and a new Consent Order for the Refinery (Case No. 11-100) was filed on July 6, 2011, requiring submittal of a new RCRA Post-Closure and Corrective Action Permit application for the Refinery by October 21, 2011.

The current Refinery RCRA post-closure permit requires the Permittee to monitor and maintain the LTUs in accordance with requirements of the Oklahoma Waste Management Act (OWMA), 27 O.S. 1993, Sec. 2-7-101 et seq., as amended, the Oklahoma Administrative Code Title 252 Chapter 205 (Rule or Rules), the Federal RCRA and Hazardous and Solid Waste Amendments of 1984 (HSWA), and their associated regulations contained in 40 CFR.

3.0 FACILITY DESCRIPTION

The Refinery is located in Township 19 North, Range 12 East in Tulsa, Tulsa County, Oklahoma. The Refinery is located on approximately four hundred seventy-four (474) acres and has been in operation since approximately 1906 under several operators. The Refinery is one of the Permittee's two (2) refineries operating in Tulsa, Oklahoma. These refineries include the Tulsa East Refinery formerly owned by SOC and the Tulsa West Refinery formerly owned by Sunoco. The combined refining capacity of the Permittee's East and West Tulsa Refineries is approximately 125,000 barrels of oil per day. The petroleum products normally produced at the Refinery include the following:

- Gasoline;
- Diesel fuel;
- Fuel oils;
- Asphalt;
- Sulfur;
- Propane; and
- Butane.

The location of the Refinery is shown on the topographic map of the Refinery provided as Figure 1 in the Sampling and Analysis Plan and Quality Assurance Project Plan (SAP-QAPP), Permit Attachment 3.1. Additionally, a Facility Base Map showing the Refinery features is provided as Figure 2 in the SAP-QAPP.

3.1 Site Description

3.1.1 General LTU Description

The FALTU and the WGLTU are closed hazardous waste LTUs located entirely within the secured boundaries of the Refinery. The LTU areas are where land treatment operations have been conducted since the early 1900s. Historically applied wastes consisted of liquid, sludge and solid residues from various Refinery operations. The FALTU is located in the southeast portion of the Refinery. The WGLTU is located in the northeast corner of the Refinery. The locations of the LTUs are shown on Figure 1 in this PCC Plan (Permit Attachment 2).

3.1.2 FALTU Description

The FALTU is situated in the southeast corner of the refinery in Section 23 of Township 19 North, Range 12 East and occupies two adjacent areas totaling approximately twenty-nine (29) acres. The area surrounding the FALTU is industrial to the east, north and west and residential/recreational to the south, though some of the property to the south is owned by the Refinery. The Public Service Company of Oklahoma (PSO), Tulsa Power Station (American Electric Power [AEP]) borders the FALTU on the east; railroad spurs and Refinery property border the LTU on the west with Refinery property further west of the tracks and north of the LTU. The Arkansas River is located farther to the east beyond the PSO/AEP property. The wastes historically applied at the FALTU were Refinery wastes D001, D008, and K049 through K052. No hazardous wastes have been applied to the FALTU since February 1988. Non-hazardous wastewater was applied for irrigation purposes until 2015. The vegetative cover of the FALTU continues to be maintained by HFTR.

The FALTU is generally underlain by a silty or sandy loam followed by very fine sand ranging in color from reddish brown to dark and light brown at approximately 5 feet below ground surface (bgs). The fine sand generally grades to a medium sand that is brown to light gray in color by 15 feet bgs. The medium sand grades to a coarse sand which is generally encountered from 15 to 20 feet bgs. Bedrock in this area is encountered at approximately 20 to 30 feet bgs and consists of either a gray shale or gray-green sandstone.

3.1.3 WGLTU Description

The WGLTU is situated in the northeast corner of the refinery in Section 14 of Township 19 North, Range 12 East and occupies an area of approximately twenty (20) acres. The area surrounding the WGLTU is industrial to the north, west and south with Refinery property located to the west and south of the LTU. Refinery property containing the Arkansas River levee and the Arkansas River are present to the east. Wastes historically applied to the WGLTU, as allowed by the 1998 permit, were refinery wastes F037, K050 and K051. Wastes applied to the WGLTU since 2001 have been non-hazardous waste from various Refinery sources; the wastes were tested for ignitability, corrosivity, reactivity and toxicity characteristics which determined the non-hazardous classification. No hazardous wastes have been applied to the WGLTU since June 2001. Non-hazardous wastewater was applied for irrigation purposes until 2015. The vegetative cover of the WGLTU continues to be maintained by HFTR.

The WGLTU is generally underlain by silty or sandy loam followed by very fine sand ranging in color from reddish brown to dark and light brown at approximately 5 to 10 feet bgs. The fine sand generally grades to a medium sand that is brown to light gray in color by 15 feet bgs. The medium sand grades to a coarse sand which is generally encountered from 15 to 20 feet bgs. Boring logs in the WGLTU did not indicate the presence of bedrock within the depths that were drilled; therefore, depth to bedrock cannot be determined specifically in the WGLTU area. However, throughout the Refinery, bedrock is generally encountered within 30 feet of the ground surface. It can be assumed that bedrock in the WGLTU would likely be encountered within 30 feet of the ground surface.

4.0 GROUNDWATER MONITORING PROGRAM

4.1 Objectives and Scope

The objective of the Facility-wide groundwater monitoring program is to provide chemical data on the nature and extent of the dissolved phase and LNAPL plumes underlying the Refinery (as well as the LTUs) and to assess any remedial progress or corrective action measures that have been implemented.

Groundwater monitoring for the two closed LTUs is incorporated into the Facility-wide groundwater monitoring program. HFTR has committed to conducting groundwater monitoring across the entire Refinery, as described in Permit Attachment 3 (Groundwater Monitoring and LNAPL Management Plan).

HFTR performs semi-annual groundwater monitoring, typically in the spring and fall of each calendar year. The elements of the groundwater monitoring program include:

- Semi-annual sampling of point of compliance (POC) wells situated around the Refinery boundary;
- Semi-annual gauging of wells for depth to groundwater and LNAPL;
- Semi-annual reporting of gauging data and sample results; and
- Semi-annual reporting of LNAPL recovery progress and any modifications to the LNAPL recovery systems.

Details regarding the groundwater monitoring program, including inspection and maintenance of the monitoring well network, are provided in Permit Attachment 3 (Groundwater Monitoring and LNAPL Management Plan), and Permit Attachment 3.1 (SAP-QAPP).

4.2 Sampling and Analysis Plan (SAP)

Groundwater monitoring for the Refinery will be performed according to the detailed procedures outlined in the Permit Attachment 3.1 (SAP-QAPP).

5.0 POST-CLOSURE CARE PROGRAM

5.1 Objectives and Scope

This Plan outlines the PCC of the FALTU and the WGLTU, including:

- The necessary maintenance and monitoring activities (in addition to the Facility-wide groundwater monitoring program) to be completed at each LTU, and the frequencies at which they will be performed; and
- The authorized post-closure uses for each LTU, including descriptions of those uses and how they are to be managed.

General requirements for the PCC of the LTUs include the following:

1. Continued activities (including pH control, as needed) as necessary to enhance degradation and transformation and to sustain immobilization of hazardous constituents in the treatment zone to the extent that such measures are consistent with other post-closure activities;

2. Maintain vegetative and/or gravel covers over the LTUs;

3. Maintain the surface water run-on/run-off control and management systems;

4. Control wind dispersion of hazardous waste (as applicable – the LTUs are covered with vegetation or gravel and therefore, the potential for wind dispersal is minimal);

5. Continue to comply with prohibitions on the growth of food chain crops; and

6. Manage authorized routine post-closure maintenance and use to prevent environmental or human health concerns.

In addition, the Refinery will continue to address groundwater monitoring for the LTUs, including inspection and maintenance of the groundwater monitoring well network, as part of the Facility-wide groundwater monitoring program (see Permit Attachment 3).

5.2 Site Inspections

5.2.1 Inspection Activities

Inspections will be performed semi-annually at each LTU and will include inspection of those portions of the Facility-wide groundwater monitoring network for each LTU. More frequent inspections may be performed on an as-needed basis contingent on weather conditions (e.g., after a major storm event yielding seven or more inches of precipitation within 24 hours or less). Items to be inspected will include, but are not limited to, the following:

- Perimeter inspections, where the LTU boundary is at the Refinery boundary, will include observation and documentation of the integrity of the perimeter fences, gates and locks.

Signage, as well as ingress and egress into the LTUs will also be reviewed during these inspections.

- LTU maintenance inspections will involve visually inspecting the vegetative cover of each LTU for adequate coverage, animal burrows, erosion, settlement, subsidence, and plant growth. Gravel-covered areas will be inspected for adequate cover and depressions. The surrounding dike systems will be also be inspected.
- The groundwater monitoring network will be visually inspected for damage to the monitoring wells and pads during the inspection process.

The full detailed inspection program and schedules for the LTU inspections are outlined in the Inspection and Maintenance Plan, Permit Attachment 4. LTU inspections will be performed on a semi-annual basis and inspection forms will be completed for each post-closure inspection. An example inspection form can be found in Permit Attachment 4.

Any changes, concerns or sub-standard conditions observed during the inspections will be brought to the attention of the Refinery Environmental Department. The Environmental Department will arrange to have any deficiencies corrected as soon as practical by the Refinery maintenance staff or contractors.

5.3 Maintenance

5.3.1 Site Maintenance

Site maintenance activities will be performed with the primary goal of maintaining the integrity of the vegetative and gravel cover at the LTUs. Activities which could temporarily disturb the integrity of the final cover will be limited to the authorized uses discussed in Sections 5.4 and 5.5.

Routine maintenance practices to preserve the integrity of the cover include the following:

- Localized reseeding and fertilization will be performed as necessary to maintain appropriate vegetative ground cover;
- Maintenance of features will be conducted to prevent excessive run-on and run-off of stormwater;
- Gravel will be added to fill in depressions or other areas to improve gravel cover;
- Irrigation will be performed as necessary to maintain the appropriate vegetative cover;
- Mowing of the vegetative cover will be performed as necessary; and
- Routine maintenance and repairs to the cover and engineered dike systems will be made as necessary to correct and control the effects of settling, subsidence, erosion, etc.

5.3.2 Maintenance Corrective Actions

Any changes, concerns or substandard conditions observed during the maintenance inspections will be brought to the attention of the Refinery Environmental Department. The Environmental

Department will arrange to have any maintenance deficiencies corrected as soon as practical by the Refinery maintenance staff.

5.3.3 Groundwater Monitoring Well Network Maintenance

The groundwater monitoring well network will be inspected semi-annually. The condition of all monitoring wells, locks, protective covers, protective concrete pads, etc. will be noted.

5.3.4 Groundwater Monitoring Well Network Corrective Actions

Any changes, concerns or substandard conditions observed during the groundwater monitoring well network inspections will be brought to the attention of the Refinery Environmental Department. The Environmental Department will arrange to have any groundwater monitoring well network deficiencies corrected as soon as practical by the Refinery maintenance staff or contractors.

5.3.5 Security

All existing Refinery security features will remain in place during the PCC period and will be maintained as required to prevent unauthorized entry. The security system for the Refinery consists of a metal wire fence in good repair with locked gated entrances and warning signs. Routine surveillance will be provided by Permittee's security personnel. Each LTU is wholly contained within the surrounding perimeter security fencing with a locked gate. Access into the LTU must be approved by designated area supervisors and/or security. Signage at the Refinery entrance gates is visible from at least twenty-five (25) feet and indicates "Danger—Unauthorized Personnel Keep Out" or equivalent language. Numerous signs located at the perimeter of both LTUs are visible from at least twenty-five (25) feet and indicates "Danger Unauthorized Personnel Keep Out, Closed Land Treatment Unit, Notify Environmental Before Entry, Permit Required for Entry".

Any changes or concerns that are observed during the perimeter and security inspections will be brought immediately to the attention of the Refinery Environmental Department and the Refinery Security Manager. They will arrange to have any security concerns resolved immediately.

5.4 Routine Maintenance and Use

The routine maintenance of the LTUs may include surface and/or subsurface disturbance such as removal/installation of bollards, signage, repair and inspection of surface and subsurface utilities and/or hydrocarbon lines, etc. The Refinery Environmental Department will be contacted for any intrusive maintenance. For any planned intrusive maintenance that is considered non-routine, the Refinery Environmental Department will be contacted to determine whether a permit modification is needed, as appropriate. If a permit modification is required, the work will be scheduled pending approval of the permit modification by DEQ.

Details of how the routine intrusive maintenance of the LTUs will be managed to protect the environmental and human health is described in the Permit Attachment 4, Inspection and Maintenance Plan.

5.5 Lysimeter Removal

The LTUs currently have lysimeters that consist of the lysimeter and riser pipe (located underground) and aboveground pipe. These lysimeters are not a part of the post-closure monitoring program and the Refinery would like to abandon these in place, which would also facilitate more efficient mowing of the LTUs.

The 2008 FALTU Permit, 2009 Consent Order, 2011 Consent Order and 2011 Permit Application make no mention of lysimeters or soil pore monitoring. The 1998 WGLTU Permit does reference soil pore monitoring but this Permit was superseded by the 2008 FALTU permit and subsequent Consent Orders. There are no current (post-closure) requirements for soil pore monitoring using the lysimeters.

The Refinery proposes the following actions at each lysimeter:

- Excavate to approximately 1 foot bgs to expose the underground riser pipe.
- Cut the riser pipe at approximately 1 foot bgs (the pipe below the 1-foot cut will remain in place within the LTU).
- Decontaminate the pipe to LDR debris standards.
    - Decontamination to LDR debris standards (40 CFR §268.45). Decontamination would take place on the LTU using water pressure to remove contaminated debris surface layers resulting in a "clean debris surface" based on visual inspection. A "clean debris surface" means the surface, when viewed without magnification, shall be free of all visible contaminated soil and hazardous waste except that residual staining from soil and waste consisting of light shadows, slight streaks, or minor discolorations, and soil and waste in cracks, crevices, and pits may be present provided that such staining and waste and soil in cracks, crevices, and pits shall be limited to no more than five percent of each square inch of surface area. The water generated during decontamination will remain on and infiltrate into the LTU.
- Dispose of the decontaminated pipe as non-hazardous waste at a permitted off-site facility or recycle as applicable.
- Seal the remaining underground pipe by filling with bentonite chips and capping the pipe.
- Replace the excavated material and revegetate the area.

The workers will be Hazardous Waste Operations and Emergency Response (HAZWOPER) trained per 29 CFR § 1910.120 and will wear appropriate personal protective equipment (PPE).

5.6 Record Keeping and Site Contact

The Refinery will continue PCC for a period of at least thirty (30) years after the certified closure of each LTU.

During the post-closure period, the Refinery Environmental Manager will serve as the Refinery's PCC contact. The contact information is provided below:

Refinery Environmental Manager
HollyFrontier Tulsa Refining LLC
PO Box 21001
Tulsa, OK 74101-1001
918-594-6000

This PCC Plan will be amended subject to the approval of the DEQ when operating plans or Refinery design changes affect the PCC Plan. A copy of the PCC Plan for the LTUs and any amendments will be maintained in electronic or hard copy in the Refinery Environmental Department files.

References

Consent Order No. 15-215 between HollyFrontier Tulsa Refining LLC and Oklahoma Department of Environmental Quality, November 9, 2015.

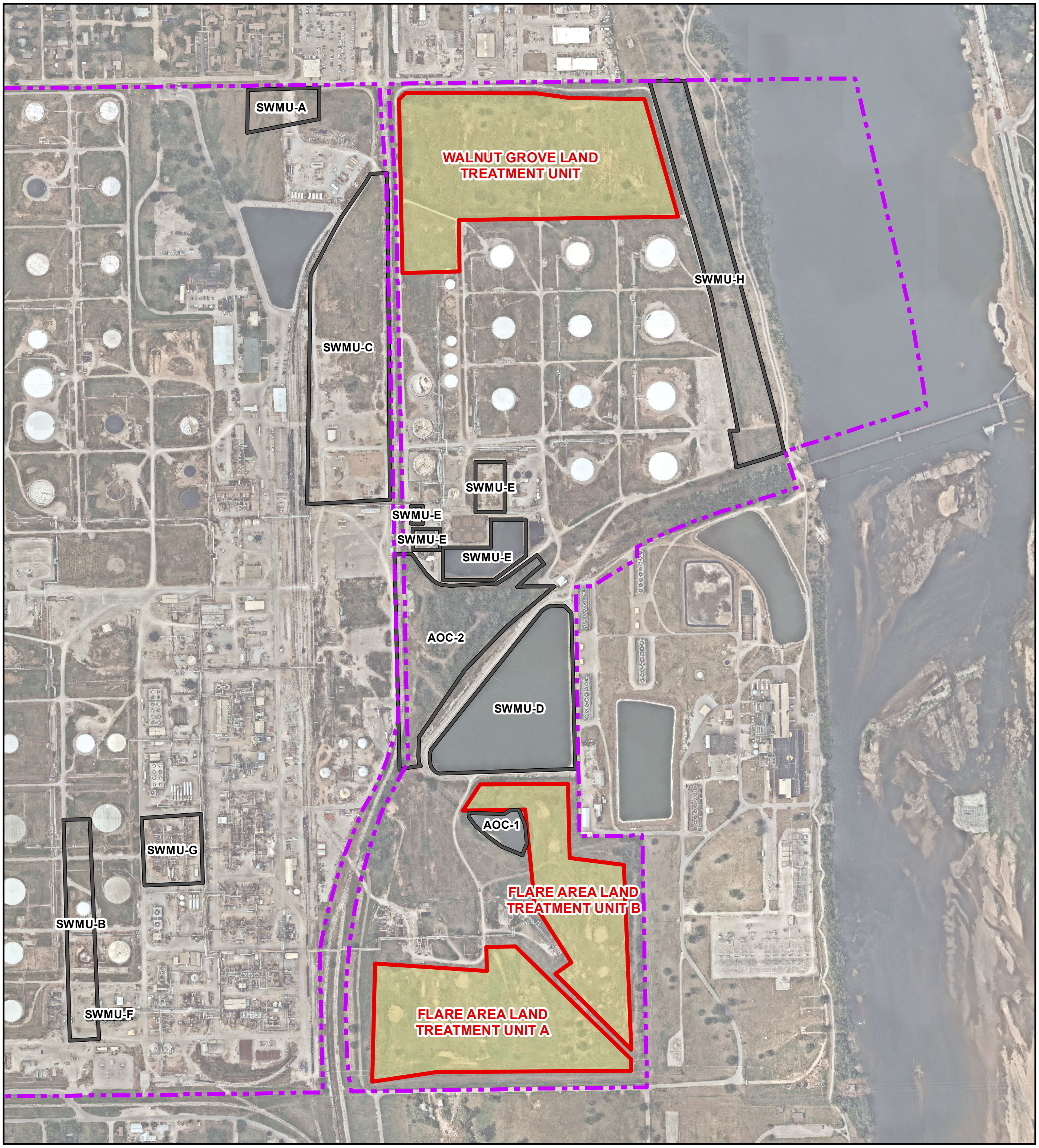
HollyFrontier Tulsa Refining LLC, *Revised Biosolids Irrigation Impact Land Treatment Unit Evaluation Work Plan,* submitted to DEQ June 2017.

HollyFrontier Tulsa Refining LLC, *Evaluation Report on Biosolids Irrigation Impact at Land Treatment Units - HollyFrontier Tulsa Refining LLC – Tulsa East Refinery,* submitted to DEQ September 29, 2017.

Sinclair Oil Corporation, *Flare Area Land Treatment Unit Certificate of Closure, Tulsa Refinery*, Terracon report dated October 27, 1992, report submitted to DEQ March 3, 1993.

Sinclair Oil Corporation, *Walnut Grove Land Treatment Unit Closure Report and Certification, Tulsa Refinery*, April 24, 2009.

Figures



BASEMAP IMAGERY: NEAR MAP AND THEIR DATA PARTNERS, JULY 2018.

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1 " = 750 '
1:9,000

0 750 1,500 FEET

LEGEND

LTU BOUNDARY
REFINERY PROPERTY
SWMUs

TRC

505 East Huntland Drive
Suite #250
Austin, TX 78752
Phone: 512.329.6080

TRC - GIS

PROJECT:

HOLLYFRONTIER TULSA REFINING LLC (TULSA EAST REFINERY) PERMIT NO. 990750960-PC

TITLE:

ATTACHMENT #2 – POST CLOSURE CARE PLAN – FACILITY MAP WITH FLARE AREA LAND TREATMENT UNIT AND WALNUT GROVE LAND TREATMENT UNIT

DRAWN BY:	MHORN
CHECKED BY:	CSMITH
APPROVED BY:	CSMITH
DATE:	MAY 2020
PROJ. NO.:	328720
FILE:	328720_2_letter.mxd

Attachment 2 - Figure 1

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HOLLYFRONTIER TULSA REFINING LLC
TULSA EAST REFINERY
TULSA, OKLAHOMA

PERMIT ATTACHMENT 3

GROUNDWATER MONITORING AND LNAPL MANAGEMENT PLAN

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Tables

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Appendices

1.0 INTRODUCTION

This *Groundwater Monitoring and LNAPL Management Plan* (Plan) details the groundwater monitoring program and light non-aqueous phase liquids (LNAPL) recovery program at HollyFrontier Tulsa Refining LLC (HFTR), Tulsa East Refinery (the Refinery) located at 902 West 25th Street in Tulsa, Oklahoma. The Refinery currently operates under a Resource Conservation and Recovery Act (RCRA) Post-Closure Permit (Permit No. 990750960-PC) for the Flare Area Land Treatment Unit (FALTU). The Refinery previously held an additional permit number 990750960-OP for operation of the Walnut Grove LTU (WGLTU). This permit expired on December 10, 2008, prior to HFTR taking ownership of the Refinery. The Refinery also operates under two Consent Orders (Case No. 11-100 and Case No. 15-215) issued by the Oklahoma Department of Environmental Quality (DEQ) on July 6, 2011 (2011 Order) and November 9, 2015 (2015 Order), respectively.

In accordance with Title 40, Section 270.14(c) of the Code of Federal Regulations (40 CFR § 270.14(c)), HFTR is including this Plan as part of the RCRA Part B Permit Application. This Plan describes programs in place at HFTR to promote the protection of groundwater in compliance with applicable Federal and State rules and regulations and to support remedial activity at the Refinery. The Plan replaces the applicable sections in the Part B RCRA Permit Attachment #3, Sampling and Analysis Plan - Quality Assurance Project Plan (SAP-QAPP) that was previously submitted to DEQ in September 2011. The new SAP-QAPP is now provided in Appendix 3.1 of this Plan.

This Plan provides one integrated, Facility-wide groundwater monitoring and LNAPL recovery program that details the performance monitoring necessary for compliance with applicable regulatory programs. The Plan includes the following items:

- A description of the proposed Facility-wide groundwater monitoring program to be implemented, as required, per the 2011 Order (which will be terminated upon issuance of the new RCRA Permit for the East Refinery);
- Location of groundwater gauging wells and point of compliance (POC) wells;
- Description of the HFTR semi-annual monitoring report (SMR) submittals to DEQ documenting the implementation of this Plan; and
- Summary of LNAPL programs and recovery progress at the time of this application submittal.

As allowed under 40 CFR § 264.90(f) (adopted by the United States Environmental Protection Agency [U.S. EPA]) on October 22, 1998 and incorporated by reference by DEQ) and in adherence with applicable federal RCRA policy guidance (U.S. EPA, 2001 and 2015) relevant to appropriate alternative groundwater monitoring priorities and requirements during overarching corrective actions at RCRA facilities, HFTR is proposing to implement a Facility-wide groundwater monitoring program, as opposed to maintaining a groundwater monitoring program in accordance with 40 CFR § 264.91 through 264.100 specific to the LTUs.

As provided in 40 CFR § 264.90(f), the standard groundwater monitoring requirements for regulated units provided in 40 CFR § 264.91 through 264.100 may be replaced with alternative requirements when:

- The regulated unit is situated among solid waste management units (SWMUs) (or areas of concern [AOCs]), a release has occurred, and both the regulated unit and one or more SWMUs (or AOCs) are likely to have contributed to the release; and
- It is not necessary to apply the groundwater monitoring and corrective action requirements of sections 264.91 through 264.100 because alternative requirements will protect human health and the environment.

A review of current environmental subsurface conditions showed that the LTUs do not appear to be sources for the Facility-wide LNAPL and dissolved-phase plumes that are present in underlying portions of the Refinery. HFTR submitted the *Revised Biosolids Irrigation Impact Land Treatment Unit Evaluation Work Plan* to the DEQ in June 2017 which showed that operation of the LTUs has had little to no impact on groundwater quality beneath the units (HollyFrontier, 2017). HFTR conducted the soils investigation at the LTUs according to the work plan and submitted a report to DEQ in September 2017 (*Evaluation Report on Biosolids Irrigation Impact at Land Treatment Units - HollyFrontier Tulsa Refining LLC – Tulsa East Refinery)* concluding that leaching from the LTU soils is not adversely impacting groundwater and that additional actions are not required to address concentrations of metals in the LTU soils. HFTR has committed to conduct groundwater monitoring at the Refinery in accordance with this comprehensive Plan to protect human health and the environment.

Monitoring under this Plan will provide the necessary information for HFTR to evaluate current conditions and the effectiveness of ongoing remedial activities at the Refinery and will provide information for developing additional or modified corrective measures, if warranted, as environmental conditions change. This Plan will also result in data collection that can be used to prioritize projects and resources in areas that require attention to provide ongoing protection of human health and the environment.

2.0 GROUNDWATER CONDITIONS AND SCREENING STANDARDS

The 2011 Order required a set of modifications to the groundwater monitoring program; it expanded the number of wells and size of the area monitored by POC wells, and increased the chemical parameters required to be analyzed in groundwater. Groundwater sampling was only to be conducted at the newly designated Facility-wide POC well network, and statistical analysis of LTU-focused samples was no longer required for groundwater (or soil). Figure 1 is a topographical map of the Refinery. Figure 2 presents the wells located at the Refinery.

The 2011 Order additionally required HFTR to submit a Facility-wide Sampling and Analysis Plan (SAP) within 60 days of the effective date of the Order; HFTR submitted the SAP on September 27, 2011. The purpose of the SAP was to bridge the time gap until the Refinery RCRA Part B Post Closure and Corrective Action Permit was approved providing a DEQ-approved sampling and analysis program for the Refinery. The SAP includes analysis for select chemicals of concern (COCs) set forth in the U.S. EPA Region 5 Skinner List and other constituents including pH, specific conductivity, temperature, and total dissolved solids (TDS). This Plan provides a revised analyte list for the POC wells that was modified from the Skinner List using the historical interim POC well data and the recent perimeter monitoring results to establish an analytical list that is representative of the Facility-wide groundwater monitoring program; the analyte list is provided in Table 1.

Since the approval of the 2011 Order there have been seventeen (17) semi-annual sampling events, with the most recent report submitted to DEQ on February 14, 2019. Results from the most recent sampling event reported to DEQ (November 2018) showed detected exceedances of the screening levels (U.S. EPA Maximum Contaminant Levels (MCLs) or U.S. EPA Tapwater Regional Screening Levels (RSLs) where an MCL was not available) or method detection limits above the screening levels for the following constituents:

- 1,2-dichloroethane;
- Benzene;
- Methyl tert-butyl ether (MTBE);
- Naphthalene;
- 1-methylnaphthalene;
- Benzo(a)anthracene;
- Bis(2-ethylhexyl)phthalate; and
- Arsenic.

Thirty-nine (39) of the forty-one (41) POC wells were sampled in the last event. Two of the POC wells (MW-250 and MW-276) were observed with measurable LNAPL and were not sampled. Of the thirty-nine

(39) wells sampled, there were seven (7) wells that had exceedances for benzene, and ten (10) wells that had exceedances for arsenic. Arsenic concentrations that exceeded the MCL seem to be indicative of natural conditions (i.e., "background"), such as the naturally occurring mineralogical composition of the underlying geologic media, and do not appear to be related to a source from the Refinery.

Trend analysis of benzene, toluene, xylene and MTBE concentrations at select Interim POC wells was conducted using Mann-Kendall analysis, which is a non-parametric statistical procedure used for analyzing trends in data over time (Gilbert, 1987). Statistical analysis of ethylbenzene was not performed due to the limited number of detected concentrations historically including the November 2018 event. Ethylbenzene was detected in eight wells during the November 2018 event, in two wells during the May 2018 event, and in one well during the November 2017 sampling event, but none of the detected concentrations exceeded the MCL.

The statistical analysis was performed on Interim POC wells which contained detected concentrations of the applicable parameter in at least three of the last twelve sampling events. The data range used for the analysis includes samples collected from May 2008 through November 2018. The analysis was conducted with the GSI Mann-Kendall Toolkit developed by GSI Environmental, Inc. The software uses a Microsoft Excel® spreadsheet platform, using the Mann-Kendall plume stability methodology that was previously developed for the MAROS software (Aziz et al., 2003; AFCEE, 2004). The GSI Mann-Kendall Toolkit spreadsheet is a system for analyzing time series groundwater monitoring data to quantitatively determine if the measured concentrations of a chemical are increasing, decreasing, probably increasing, probably decreasing, or stable over time, based upon use of the Mann-Kendall statistical method. The output from the Mann-Kendall statistical analysis is provided in Appendix 3.2. The following summarizes the trends calculated for benzene, toluene, xylene and MTBE concentrations from May 2008 through November 2018:

- Benzene concentrations exhibit a decreasing trend in three (3) of the ten (10) wells analyzed and an increasing trend in one (1) of the ten (10) wells analyzed, while the other six (6) wells analyzed indicated no discernable trend. The one (1) well (MW-324) with an increasing trend is located on the American Electric Power (AEP) property to the east of the Refinery.
- Toluene and xylene concentrations in general have no obvious trends though toluene and xylene concentrations appear to be decreasing in well SX-168.
- MTBE concentrations indicate increasing trends in three (3) of the seven (7) wells analyzed, while the other four (4) wells analyzed indicated no discernable trend. Well AEP-07 is located on the AEP property to the east of the Refinery. The other two (2) wells (SX-168 and SX-161) with increasing trends are located on Refinery property along the clay bentonite barrier wall upgradient from the AEP property.

The above analytical data summary is a snapshot of Refinery conditions as reflected in the most recent SMR. Data from future sampling events will be presented in the SMRs.

The 2015 Order required HFTR to evaluate the soil and groundwater at the LTUs to determine if remediation is necessary due to the irrigation of biosolids wastewater. Therefore, HFTR submitted the *Revised Biosolids Irrigation Impact Land Treatment Unit Evaluation Work Plan - HollyFrontier Tulsa Refining LLC – Tulsa East Refinery* to the DEQ in June 2017. The DEQ approved the above work plan and the included groundwater evaluation in July 2017. As stated in the work plan, operation of the LTUs, including application of biosolids, has had little to no impact on groundwater quality beneath the units (HollyFrontier, 2017). HFTR conducted the soils investigation at the LTUs according to the work plan and subsequently submitted a report to DEQ on September 29, 2017 (*Evaluation Report on Biosolids Irrigation Impact at Land Treatment Units - HollyFrontier Tulsa Refining LLC – Tulsa East Refinery)* summarizing the results of that sampling event to DEQ. The report concluded that leaching from the LTU soils is not adversely impacting groundwater and that additional actions are not required to address concentrations of metals in the LTU soils. DEQ issued an approval letter on May 17, 2018 stating that "…HFTR is required to revisit the position and number of downgradient POC wells along the LTUs to ensure that COCs are not present in the groundwater above the applicable GSL". HFTR reviewed the placement of POC wells along the LTUs and feels the POC well network around the LTUs is sufficient and effective to monitor groundwater with exception of the northeast corner of the FALTU. Therefore, HFTR proposes to include existing well AEP-04 as an additional POC well for monitoring the FALTU to address this comment. HFTR is also proposing to conduct a groundwater risk assessment to develop site-specific risk-based screening levels (RBSLs) for ongoing groundwater evaluation. Until such time as the site-specific RBSLs are developed and approved by DEQ, HFTR will continue to screen semi-annual groundwater monitoring data using the MCLs or RSLs, as has been done previously and documented in the SMRs.

3.0 PROGRAM SCHEDULE AND PROCEDURES

3.1 Schedule

The proposed groundwater monitoring program will consist of well gauging, groundwater sampling, monitoring of LNAPL recovery systems, and reporting. HFTR will perform semi-annual groundwater monitoring in April and October of each year. Elements of the groundwater monitoring program include the following:

- Semi-annual sampling of Facility-wide POC wells;
- Semi-annual gauging of wells for depth to groundwater and LNAPL, if present;
- Semi-annual reporting of gauging data and sample results; and
- Semi-annual reporting of LNAPL recovery progress, and any modifications to the LNAPL recovery systems.

3.2 Field Documentation

Portable equipment will be utilized to measure pH, temperature, specific conductivity, oxidation-reduction potential (ORP), and dissolved oxygen (DO) prior to sample collection from each monitoring well. Field documentation will be recorded each day in a bound field logbook and associated field sampling forms. Each page of the logbook and field sampling forms will be signed by the person(s) making entries on that page and will be reviewed daily to ensure completeness.

3.3 Well Inspection and Maintenance

The HFTR well network consists of a combination of gauging wells and POC wells (collectively known as Program Wells) as shown on Table 2. The POC Wells and their primary functions are included in Table 3. The Program Well list was reviewed and revised to remove older wells that have been replaced by nearby newer wells and to remove wells that are geospatially located close enough to another well that they were duplicative. These changes will not be implemented until Permit approval and reissuance.

During each gauging and sampling event, the Program Wells will be inspected for well integrity. The information will be recorded on the groundwater gauging form. Each inspection will include:

- Inspection of the condition of the protective well casing and well covers;
- Inspection of the condition of the well locking lids and expandable well cap;
- Inspection of the condition of the well casing;
- Inspection of the presence or absence and condition of padlocks; and
- Inspection of concrete pads for cracks and settling.

Personnel will ensure each well lid is sealed with an expandable well cap and locked upon completion of sampling.

The Program Wells will be gauged for total depth, redeveloped (if > 12 inches of sediment is measured), and surveyed every five (5) years. The most recent total depth measurement, survey, and redevelopment activities were conducted in 2017.

3.4 Well Gauging

During each semi-annual monitoring event, sampling personnel will complete fluid level gauging at all Program Wells prior to any groundwater sampling. Wells will be gauged for depth to water and depth to LNAPL (if present). Table 2 provides a list of wells to be gauged for depth to water and depth to LNAPL (if present). Total monitoring well depth will be measured every five (5) years. Prior to gauging, each well cap will be removed to allow groundwater to equilibrate. Fluid level measurements will be collected using a decontaminated electronic water level meter or oil/water interface probe with an accuracy of 0.01 feet.

For wells with a measurable accumulation of LNAPL, additional data analysis will be conducted to calculate a groundwater elevation value corrected for the presence of LNAPL and a corrected LNAPL thickness value.

The gauging well network will provide comprehensive Facility-wide groundwater and LNAPL elevation data, sufficient to evaluate groundwater flow conditions and extent of apparent LNAPL thickness. If LNAPL is encountered in a well, the corrected groundwater elevation will be incorporated into the groundwater potentiometric surface maps. LNAPL apparent thickness maps for each event will be compared to previous data to evaluate trends in extent, thickness and potential migration of the LNAPL plume. HFTR may add or delete specific wells in this gauging network without a Permit modification, although such changes will be noted in the next SMR described in Section 7.0.

<u>LNAPL Evaluation</u>

Gauging data will be corrected per the following equation:

- Depth-to-Water – (Measured LNAPL Thickness x LNAPL specific gravity) = Corrected Depth-to-Water

LNAPL specific gravity was determined from samples collected from specific wells, or if data was not available an average specific gravity of 0.84 is used.

3.5 Groundwater Sampling

Groundwater will be sampled in accordance with HFTR's SAP-QAPP, which is presented in Appendix 3.1. Forty-two (42) wells are included in the Refinery's sampling well network, presented in Table 3. All POC wells will be sampled on a semi-annual basis in April and October of each year and analyzed for the Refinery-specific Modified Skinner List (MSL) parameters, including volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), inorganics, and cyanide, as well as TDS. Analytes were chosen from the MSL by utilizing the 10 percent frequency of detection criterion developed in concurrence with the DEQ and based on groundwater monitoring data from 2010 to November 2018. The wells have been sampled a minimum of 10 times; therefore, a 10% detection frequency is reasonable and consistent with the USEPA's *Risk Assessment Guidance for Superfund* (EPA/540/1-89/002, December 1989) and USEPA Region 8's *Superfund Technical Guidance, No. RA-03: Contaminants of Concern*, *Evaluating and Identifying Contaminants of Concern for Human Health* (September 1994) guidance documents as the detection frequency equates to one detection in a minimum of 10 samples. MSL VOCs which were detected less than 10 percent of the time and not in the last two (2) years included chlorobenzene, 1,4-dioxane, ethylene dibromide, styrene, 1,1,1-trichloroethane, and tetrachloroethene. MSL SVOCs which were detected less than 10 percent of the time and not in the last two (2) years included 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, cresols, dimethyl phthalate, 2,4-dinitrophenol, 4-nitrophenol, phenol, pyridine, quinoline, indene, benzenethiol and dibenz(a,h)acridine. These MSL VOCs and SVOCs were not included in the revised COC list. Inorganic analytes included in the MSL were not changed. A review was also performed of exceedances of soil leaching RSL values for historical soil samples collected at SWMU-C, SWMU-H and AOC-2. In addition, MSL analytes collected during Refinery perimeter investigations were reviewed. Any MSL analytes which exceeded their respective RSL were added to the COC list. This evaluation resulted in including tetrachloroethene, cresols and phenol, which were detected during the perimeter investigations. The following precursors to vinyl chloride were also added: 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene and 1,1,1-trichloroethane. A list of the COCs proposed for analysis is included in Table 1. A summary of the COC selection criteria is included in Table 5.

HFTR will not typically collect a groundwater sample from any monitoring well determined during the monitoring event to contain any measurable LNAPL (0.01 feet or greater). In such cases, HFTR will report the occurrence, measured thickness, and corrected thickness of LNAPL in the well in the subsequent SMR. The report will also include an evaluation and recommendations of the need to replace such wells in the monitoring network.

3.6 Sample Handling and Quality Assurance/Quality Control

Detailed sampling, gauging and quality assurance/quality control (QA/QC) procedures are included in the Refinery's SAP-QAPP (see Appendix 3.1). The procedures are intended for use in the field. The SAP-QAPP will be updated periodically without modification to the Permit; as such, in the future there may be minor changes to the groundwater sampling and analysis procedures, which will be noted in the routine SMRs described in Section 7.0. A Class 1 Permit Modification without prior approval is required when using an updated method appearing in the SAP-QAPP or an alternate method published by the U.S. EPA that has been approved for use. This provides the necessary flexibility to use the most recently updated sample preparation and/or analysis methods after new updates to SW-846 are promulgated, and/or when field methods are added or updated, while safeguarding data comparability.

4.0 PROGRAM MODIFICATIONS

Changes to Program Wells and monitoring parameters may occur as new data are evaluated, and as corrective measures advance or are completed. Changes such as number of wells, new well location(s), or changes to well depth or design are Class 2 permit modifications. The installation of replacement wells without changing location, and without changes to design or depth is a Class 1 modification. POC wells can only be removed from the monitoring program following approval of a Class 2 Permit Modification by the DEQ. Well plugging and abandonment methods and certification shall be submitted to the DEQ within 90 days from the date the wells are removed from the monitoring program. Changes in groundwater sampling or analysis procedures or monitoring schedule, with prior approval from the DEQ, are Class 1 modifications.

5.0 LNAPL RECOVERY ACTIVITIES

The following section outlines the LNAPL recovery program in place at HFTR. The *Facility Wide LNAPL Investigation Report* was submitted to the DEQ in March 2018. Since that time, modifications to the previous recovery plan have been made and this document reflects current site conditions and practices.

The Refinery LNAPL recovery program consists of eight (8) separate, active, LNAPL recovery tank batteries as listed on Table 4. Through the first quarter of 2019, the LNAPL recovery systems most recently consisted of 37 recovery and monitoring wells being used for LNAPL recovery.

In June 2018, the following updates were made to the LNAPL recovery systems:

- MW-250, MW-251, MW-252, MW-253 and MW-292 were modified for LNAPL recovery and added to LNAPL recovery tank battery 12; and
- MW-297 was modified for LNAPL recovery and added to LNAPL recovery tank battery 1.

During the first quarter of 2019, the following updates were made to the LNAPL recovery systems:

- MW-362 was added to LNAPL recovery tank battery 2,
- MW-363 was added to LNAPL recovery tank battery 4,
- MW-365 was added to LNAPL recovery tank battery 7,
- MW-366 and MW-367 were added to LNAPL recovery tank battery 8,
- MW-359, MW-360 and MW-361 were added to LNAPL recovery tank battery 9A; and
- MW-368 and MW-369 were added to LNAPL recovery tank battery 10.

The LNAPL recovery tank batteries are shown on Figure 3. In addition, MW-276, located on the south boundary of the Refinery, was equipped with an absorbent sock to address the presence of heavy straight-run naphtha, and the absorbent sock is checked and replaced as needed. LNAPL recovery volumes are affected by fluctuation of groundwater levels beneath the Refinery. LNAPL recovery generally decreases during periods of high or fluctuating groundwater levels and increases during periods of low or stable groundwater levels.

To maximize efficiency in LNAPL recovery, HFTR will continue to operate existing LNAPL recovery systems, and conduct LNAPL recovery enhancements, if and where advisable. Optimization efforts may include:

- Installation of new recovery wells; and
- Installation of LNAPL skimmer pumps into existing wells.

5.1 Arkansas Riverbank Areas 1-6 Hydrocarbon Sheen Inspection

Attachment 4 (Inspection Plan) describes plans and procedures for routine inspection of the Arkansas Riverbank Areas 1-6, as shown on Figure 2. HFTR shall conduct weekly inspections for hydrocarbon sheening along the riverbank Areas 1-6, which is property owned by HFTR and American Electric Power/Public Service Company of Oklahoma, to determine the presence or absence of hydrocarbon sheen along the Arkansas River. Inspections will be conducted during representative flow conditions[1]. If hydrocarbon sheen is observed, HFTR will undertake actions as outlined in Attachment 4.

5.2 Riverbank LNAPL Containment and Recovery Systems

There is currently one Riverbank Area LNAPL containment system along the Refinery riverbank frontage. The system consists of one approximately 2,000-foot-long bentonite-clay barrier wall along the southern border of the east tank farm and two approximately 1,000-foot-long bentonite-clay barrier walls (one along the eastern border of SWMU-H and the other east of SWMU-H). Three (3) of the eight (8) LNAPL recovery tank batteries are associated with the Riverbank Area including recovery tank batteries 7, 8 and 10. Batteries 7, 8, and 10 are all located between SWMU-E and SWMU-H. Sixteen (16) LNAPL recovery wells (SR-08, WTP-11, MW-365, SR-26, SR-27, TX-154A, MW-282, MW-366, MW-367, SR-28, SR-32, WTP-10, TX-153A, MW-283, MW-368, and MW-369) compose the three (3) Riverbank Area batteries.

Recovered LNAPL is pumped into a holding tank located at each battery. Each tank has secondary containment and automatic shut-off valves to prevent overfilling. The recovered LNAPL is transferred from the holding tank using a vacuum truck and then reinserted into the refining process.

5.3 Interior LNAPL Recovery Systems

The interior recovery systems are generally located in areas throughout the Refinery where recoverable LNAPL is present. Recovery tank battery 1 is located adjacent to AOC-2; recovery tank batteries 2 and 4 are near SWMU-C; and recovery tank battery 12 is located on the western property boundary. Associated wells are summarized in Table 4. Recovery may be conducted at additional existing wells, if/where conditions warrant. Performance of these systems is evaluated by the volume of LNAPL recovered. Changes in which wells are pumped, installation of new recovery wells/recovery systems, and description of design and operation are provided in the SMRs.

Recovered LNAPL is pumped into a holding tank located at each battery. Each tank has secondary containment and automatic shut-off valves to prevent overfilling. The recovered LNAPL is transferred from the holding tank using a vacuum truck and then reinserted into the refining process.

[1] To ensure representative flow conditions during riverbank inspections, HFTR will record the river flow, water level, and wind direction/strength.

5.4 Supplemental LNAPL Recovery Systems

In addition to the LNAPL containment and recovery efforts described above, the Refinery will also employ other methods on an as-needed basis to supplement the routine LNAPL recovery program. These methods may include the following:

- LNAPL removal via industrial vacuum truck;
- LNAPL removal via hand bailer;
- LNAPL removal via belt skimmer;
- Mobile solar powered air compressor units for use where plant air or nitrogen gas cylinders are unavailable; and/or
- LNAPL removal with absorbent socks deployed in dedicated stainless-steel cages.

6.0 LNAPL SYSTEM OPERATION AND MAINTENANCE

The following section details the routine operation and maintenance (O&M) performed by HFTR to keep LNAPL recovery and containment systems operational. In general, riverbank containment and recovery systems and interior recovery systems are inspected regularly and as necessary to optimize system performance. This includes measurement of recovered LNAPL volumes, adjusting LNAPL recovery rates, and performing maintenance of critical mechanical and electrical system components. Recovered LNAPL volumes for all systems are monitored and reported to the DEQ in the SMRs.

6.1 Containment and Recovery Systems O&M

Operation of the riverbank containment and recovery systems and the interior recovery systems requires monitoring and maintenance to optimize performance. Recovery systems will be operated and managed to optimize protection of the river and enhance LNAPL recovery. Additions, modifications, enhancements, deletions, and maintenance will be conducted at the discretion of HFTR provided the overall effectiveness of the system(s) is (are) not reduced. Prior approval from the DEQ for these modifications will not be required; however, all changes will be communicated to the DEQ in SMRs. Replacement of equipment with equipment which is of a comparable or similar type, function or design is typically considered a Class 1 permit modification; however, the Refinery will report these types of changes in the SMRs.

Prior to any other system alterations, including proposed (planned) system shutdown, HFTR will submit a written request to the DEQ proposing the alteration and providing justification for the change. The type and scale of the proposed system(s) alteration may trigger a permit modification under 40 CFR § 270.42. The request(s) will include technical reasons for the proposed modification, as well as a schedule for implementation. Upon receiving approval from the DEQ, HFTR will implement any such modification, pursuant to the schedule included in the request to the DEQ. Where a shutdown is related to conditions beyond HFTR control (such as power failure, extreme weather, labor disruption, terrorist activity, etc.), there will be no violation of the Permit, and the system(s) will be made operational as soon as practical.

A system or a portion of a system may be shut down under the following conditions:

- If/where recovery is below a practical endpoint;
- If/where there have been no recent ongoing detections of hydrocarbon sheen in the river;
- If/where declining groundwater concentrations indicate it is appropriate; and
- If/where fluid level measurements indicate it is appropriate.

7.0 SEMI-ANNUAL MONITORING REPORT

Groundwater monitoring from each calendar year will be documented in SMRs. The report will include gauging data, groundwater analytical results from the respective gauging events, and LNAPL containment and recovery efforts during the applicable six-month period. At a minimum, the SMRs will include the following:

- Text describing sampling and analysis activities (including any changes from this Plan and the SAP-QAPP), activities conducted at the regulated units, LNAPL recovery activities, and groundwater and LNAPL monitoring data;
- Figures showing property location, property boundaries, and location of sampling and gauging points;
- Summary table of semi-annual groundwater and LNAPL gauging data during the reporting period, with corrected groundwater elevation data for all wells containing LNAPL;
- Potentiometric surface maps depicting the groundwater gradient for each semi-annual monitoring event of the reporting period, including site features and the direction and magnitude of the hydraulic gradient;
- Summary of laboratory analytical data during the reporting period including groundwater concentration maps;
- Summary of LNAPL recovery system performance including:
  - LNAPL thickness isopleth maps for each semi-annual monitoring event during the reporting period;
  - Tabulation of the monthly and cumulative volume of LNAPL removed from recovery wells or containment systems during the reporting period;
  - Detail of each LNAPL recovery system including well numbers and information on wells; and
  - Evaluation of the Refinery's recovery systems during the reporting period, and any significant changes to the systems during the reporting period.
- Conclusions regarding:
  - The effectiveness of ongoing LNAPL recovery;
  - Observed trends relative to the quality of groundwater at the POC wells; and
  - Observed trends relative to the subsurface distribution of LNAPL.
- Recommendations regarding:
  - Proposed changes to the COCs to be sampled and analyzed under this Plan;
  - Proposed changes to the numbers or locations of monitoring or gauging wells;

  - Proposed modification of the sampling procedures, QA/QC, or other written details of this Plan; and
  - Proposed system alterations and improvements to optimize the recovery systems for the next semi-annual period.
- Summary of expected tasks to be completed in the upcoming reporting period;
- Summary descriptions of interim measures completed during the reporting period (unless captured in a separate report);
- Summary of community interaction, if any, regarding corrective actions;
- Complete laboratory data reports; and
- A list of references and appendices of supporting documents.

Tabulated laboratory analytical and well gauging data are due by electronic mail to the DEQ forty-five (45) calendar days from the completion of sampling event. The SMRs are due to the DEQ on or before February 14 and August 14 following each sampling event, each calendar year.

8.0 GROUNDWATER CORRECTIVE ACTION PLAN

After comparing the groundwater results to the generic MCLs/RSLs (or RBSLs, once approved) and evaluating groundwater data using statistical methods as outlined in the SAP-QAPP, if downgradient wells are observed to have concentrations exceeding the MCLs, RSLs or RBSLs, HFTR will follow the procedures in the Permit, Condition III.Q.3.

Any changes, concerns, or substandard conditions observed during the groundwater monitoring assessment will be brought to the attention of the Refinery Environmental Manager. The Environmental Manager will arrange to have any groundwater monitoring network deficiencies corrected as soon as practical by the Refinery maintenance staff, and the corrective actions will be noted in the following SMR.

9.0 REFERENCES

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U.S. EPA, 2001. Environmental Protection Agency/530/R-01/015, Handbook of Groundwater Protection and Cleanup Policies for RCRA Corrective Action, Chapter 14, September 2001.

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Tables

Table 1

Summary of Analytical Methods[a] and Chemicals of Concern for Semi-Annual Groundwater Sampling Events

HollyFrontier Tulsa Refining LLC, Tulsa East Refinery
Region 5 Waste Management Branch
(Modified) "Skinner List" Constituents of Concern for Wastes from Petroleum Processes

Inorganics EPA Methods 6010, 7470 and SM 4500-CN-E			
Antimony	Cadmium	Lead	Silver
Arsenic	Chromium	Mercury	Vanadium
Barium	Cobalt	Nickel	Zinc
Beryllium	Cyanide	Selenium	
Volatile Organics EPA Method 8260			
Benzene	1,1-Dichloroethene	Methyl tert-butyl ether	Vinyl chloride
Carbon disulfide	Cis-1,2-Dichloroethene	Toluene	Xylenes (total)
Chloroform	Trans-1,2- Dichloroethene	1,1,1-Trichloroethane	
1,1-Dichloroethane	Ethylbenzene	Trichloroethene	
1,2-Dichloroethane	Methyl ethyl ketone	Tetrachloroethene	
Semivolatile Organics[b] EPA Method 8270			
Acenaphthene	Bis(2-ethylhexyl)phthalate	Di-n-butyl phthalate	1-Methylnaphthalene
Anthracene	Chrysene	Diethyl phthalate	2-Methylnaphthalene
Benzo(a)anthracene	o-Cresol	2,4-Dimethylphenol	Naphthalene
Benzo(b)fluoranthene	m-Cresol	Fluoranthene	Phenanthrene
Benzo(k)fluoranthene	p-Cresol	Fluorene	Phenol
Benzo(a)pyrene	Dibenz(a,h)anthracene	Indeno(1,2,3-cd)pyrene	Pyrene
Groundwater Quality Parameters[c]			
pH	Temperature	Oxidation-reduction potential	
Dissolved oxygen	Total dissolved solids[d]	Specific conductivity	

Notes:

a. Laboratories will use the most current method version for which they are accredited.
b. Polycyclic Aromatic Hydrocarbons (PAHs) will be analyzed by Selected Ion Monitoring (SIM) methodology.
c. pH, specific conductivity, dissolved oxygen, oxidation-reduction potential and temperature are field parameters.
d. Total dissolved solids by EPA Method 160.1

TABLE 2

HOLLYFRONTIER TULSA REFINING LLC
TULSA EAST REFINERY

Summary of Facility-Wide Monitoring Wells to be Gauged Semi-Annually

Well ID	Grid Location	Primary Well Purpose
AEP-01	H-2	Point of Compliance (POC)
AEP-03	H-1	POC
AEP-04	G-2	POC
AEP-07	G-3	POC
MW-250	A-4	POC
MW-265	A-6	POC
MW-266	A-6	POC
MW-267	A-5	POC
MW-268	A-4	POC
MW-269	A-3	POC
MW-270	A-2	POC
MW-271	A-2	POC
MW-272	A-1	POC
MW-273	A-1	POC
MW-274	A-1	POC
MW-275	B-1	POC
MW-276	C-1	POC
MW-277	D-1	POC
MW-278	H-6	POC
MW-279	H-5	POC
MW-280	H-5	POC
MW-322	H-3	POC
MW-323	H-2	POC
MW-324	H-2	POC
MWII-A4	E-6	POC
MWII-C7	F-6	POC
MWII-D6	G-3	POC
SOC-005	H-6	POC
SOC-006	H-6	POC
SOC-010	F-2	POC
SOC-012	H-1	POC
SOC-013	H-6	POC
SOC-016	G-6	POC
SOC-166/SX-166	H-4	POC
SOC-166R	H-4	POC
SOC-167/SX-167	H-4	POC
SX-002	B-6	POC
SX-160	F-1	POC
SX-161	H-4	POC
SX-168	H-4	POC
WTP-05R[a.]	H-1	POC
WTP-07R[b.]	H-2	POC
AEP-02	H-1	Gauging Network
AEP-06	G-3	Gauging Network
AOC2-PZ1s	F-3	Gauging Network
AOC2-PZ2s	F-4	Gauging Network
AOC2-PZ4s	F-3	Gauging Network
MWAPI-2	F-4	Gauging Network
MWAPI-3	F-4	Gauging Network
MWII-A2	D-6	Gauging Network
MWII-B1	B-1	Gauging Network
MWII-D7R	G-3	Gauging Network
MW-256	A-4	Gauging Network
MW-264	A-4	Gauging Network
MW-284	H-5	Gauging Network
MW-285	G-5	Gauging Network
MW-286	F-4	Gauging Network
MW-287	E-6	Gauging Network
MW-289T	C-5	Gauging Network
MW-290	B-5	Gauging Network
MW-291T	C-4	Gauging Network
MW-294	E-4	Gauging Network
MW-295	C-3	Gauging Network
MW-296	C-4	Gauging Network
MW-297	E-3	Gauging Network
MW-298	F-4	Gauging Network
MW-300	C-2	Gauging Network
MW-301	D-3	Gauging Network
MW-302	C-1	Gauging Network
MW-303	H-2	Gauging Network
MW-305	F-1	Gauging Network
MW-307	H-5	Gauging Network
MW-308	H-4	Gauging Network
MW-310	H-4	Gauging Network
MW-311	H-4	Gauging Network

Well ID	Grid Location	Primary Well Purpose
MW-312	H-4	Gauging Network
MW-314	F-1	Gauging Network
MW-316	G-2	Gauging Network
MW-317	F-3	Gauging Network
MW-320	G-4	Gauging Network
MW-325	E-5	Gauging Network
MW-326	E-4	Gauging Network
MW-327	D-3	Gauging Network
MW-329	A-3	Gauging Network
MW-331	B-5	Gauging Network
MW-333	C-5	Gauging Network
MW-334	G-4	Gauging Network
MW-335	G-4	Gauging Network
MW-336	H-4	Gauging Network
MW-337	H-4	Gauging Network
MW-338	F-5	Gauging Network
MW-339	D-1	Gauging Network
MW-340	D-1	Gauging Network
MW-341	C-1	Gauging Network
MW-342	H-4	Gauging Network
MW-343	H-4	Gauging Network
MW-344	H-4	Gauging Network
MW-345	H-4	Gauging Network
MW-346	H-4	Gauging Network
MW-347	C-1	Gauging Network
MW-348	A-3	Gauging Network
MW-349	A-3	Gauging Network
MW-350	A-3	Gauging Network
MW-351	A-4	Gauging Network
MW-352	A-5	Gauging Network
MW-353	H-3	Gauging Network
MW-354	G-3	Gauging Network
MW-355	H-3	Gauging Network
MW-356	H-3	Gauging Network
MW-357	H-3	Gauging Network
MW-358	H-2	Gauging Network
MW-359	E-3	Gauging Network
MW-360	E-3	Gauging Network
MW-361	E-3	Gauging Network
MW-362	C-4	Gauging Network
MW-363	C-3	Gauging Network
MW-364	D3	Gauging Network
MW-365	F-4	Gauging Network
MW-366	H-4	Gauging Network
MW-367	H-4	Gauging Network
MW-368	G-4	Gauging Network
MW-369	G-4	Gauging Network
MW-370	G-4	Gauging Network
SOC-002	E-6	Gauging Network
SOC-008	E-1	Gauging Network
SOC-011	F-2	Gauging Network
SOC-014	H-6	Gauging Network
SR-06	E-3	Gauging Network
SR-15	D-4	Gauging Network
SR-19	D-5	Gauging Network
SR-20	C-3	Gauging Network
SR-22	D-2	Gauging Network
SR-23	D-2	Gauging Network
SR-26	H-4	Gauging Network
SR-30	E-2	Gauging Network
SWMUH-PZ1s	H-6	Gauging Network
SWMUH-PZ2s	H-6	Gauging Network
SWMUH-PZ4s	H-5	Gauging Network
SWMUH-PZ5s	H-4	Gauging Network
SWMUH-PZ6s	H-4	Gauging Network
SX-156	D-1	Gauging Network
SX-158	D-1	Gauging Network
TX-002	F-4	Gauging Network
TX-010	E-3	Gauging Network
TX-047	E-2	Gauging Network
TX-065	E-3	Gauging Network
TX-068	E-4	Gauging Network
WTP-04	E-6	Gauging Network
WTP-06	H-1	Gauging Network
WTP-13	F-4	Gauging Network
WTP-14	F-6	Gauging Network

a. WTP-05 replaced by WTP-05R on 6/21/18, future SMR's will reference WTP-05R
b. WTP-07 replaced by WTP-07R on 6/21/18, future SMR's will reference WTP-07R

TABLE 3

HOLLYFRONTIER TULSA REFINING LLC
TULSA EAST REFINERY

Summary of Point of Compliance Wells and Functions

Sorted by Well Name		
Well ID	**Purpose**	**Grid Location**
AEP-01	Downgradient	H-2
AEP-03	Downgradient	H-1
AEP-04	Downgradient	G-2
AEP-07	Downgradient	G-3
MW-250	Upgradient	A-4
MW-265	Upgradient	A-6
MW-266	Upgradient	A-6
MW-267	Upgradient	A-5
MW-268	Upgradient	A-4
MW-269	Upgradient	A-3
MW-270	Upgradient	A-2
MW-271	Upgradient	A-2
MW-272	Upgradient	A-1
MW-273	Upgradient	A-1
MW-274	Upgradient	A-1
MW-275	Crossgradient	B-1
MW-276	Crossgradient	C-1
MW-277	Crossgradient	D-1
MW-278	Downgradient	H-5
MW-279	Downgradient	H-5
MW-280	Downgradient	H-5
MW-322	Downgradient	H-3
MW-323	Downgradient	H-2
MW-324	Downgradient	H-2
MWII-A4	Crossgradient	E-6
MWII-C7	Interior - LTU	F-6
MWII-D6	Downgradient	G-3
SOC-005	Downgradient	H-6
SOC-006	Downgradient	H-6
SOC-010	Interior - LTU	F-2
SOC-012	Downgradient	H-1
SOC-013	Downgradient	H-6
SOC-016	Downgradient	G-6
SOC-166/SX-166	Downgradient	H-4
SOC-166R	Downgradient	H-4
SOC-167/SX-167	Downgradient	H-4
SX-002	Upgradient	B-6
SX-160	Downgradient	F-1
SX-161	Downgradient	H-4
SX-168	Downgradient	H-4
WTP-05R[a.]	Downgradient	H-1
WTP-07R[b.]	Downgradient	H-2

Sorted by Function		
Well ID	**Purpose**	**Grid Location**
MW-250	Upgradient	A-4
SX-002	Upgradient	B-6
MW-265	Upgradient	A-6
MW-266	Upgradient	A-6
MW-267	Upgradient	A-5
MW-268	Upgradient	A-4
MW-269	Upgradient	A-3
MW-270	Upgradient	A-2
MW-271	Upgradient	A-2
MW-272	Upgradient	A-1
MW-273	Upgradient	A-1
MW-274	Upgradient	A-1
MWII-C7	Interior - LTU	F-6
SOC-010	Interior - LTU	F-2
MWII-A4	Crossgradient	E-6
MW-275	Crossgradient	B-1
MW-276	Crossgradient	C-1
MW-277	Crossgradient	D-1
AEP-01	Downgradient	H-2
AEP-03	Downgradient	H-1
AEP-04	Downgradient	G-2
AEP-07	Downgradient	G-3
MW-322	Downgradient	H-3
MW-323	Downgradient	H-2
MW-324	Downgradient	H-2
MWII-D6	Downgradient	G-3
SOC-005	Downgradient	H-6
SOC-006	Downgradient	H-6
SOC-012	Downgradient	H-1
SOC-013	Downgradient	H-6
SOC-016	Downgradient	G-6
SOC-166/SX-166	Downgradient	H-4
SOC-166R	Downgradient	H-4
SOC-167/SX-167	Downgradient	H-4
SX-160	Downgradient	F-1
SX-161	Downgradient	H-4
SX-168	Downgradient	H-4
WTP-05R[a.]	Downgradient	H-1
WTP-07R[b.]	Downgradient	H-2
MW-278	Downgradient	H-5
MW-279	Downgradient	H-5
MW-280	Downgradient	H-5

a. WTP-05 replaced by WTP-05R on 6/21/18, future SMR's will reference WTP-05R

b. WTP-07 replaced by WTP-07R on 6/21/18, future SMR's will reference WTP-07R

Table 4
HollyFrontier Tulsa Refining LLC
Tulsa East Refinery

LNAPL Recovery System Wells Organized by Recovery Tank Battery

Tank	Area	Associated LNAPL Wells	Map Grid Locations
1[a]	Ball Tanks - North	SR-01, SR-06, SR-12, MW-297	E-3
2[c]	Tank 131 – North	SR-02, SR-19, TX-14, SR-09, MW-362	D-4, D-5, C-4, C-5
4[c]	Tank 128 - Southeast	TX-105, SR-07, MW-363	D-3
7[c]	WWTP – East	SR-08, WTP-11, MW-365	F-4
8[c]	Tank 470	SR-26, SR-27, TX-154A, MW-282, MW-366, MW-367	H-4
9A[c]	Northeast of Ball Tanks	MW-359, MW-360, MW-361	E-3
10[c]	Tank 464 – South	SR-28, SR-32, WTP-10, TX-153A, MW-283, MW-368, MW-369	G-4
12[b]	Former Tank 100	MW-250, MW-251, MW-252, MW-253, MW-259, MW-292	A-3, A-4

Notes:

a. Monitoring Well MW-297 was added to Recovery Tank Battery 1 in June 2018.

b. Monitoring wells MW-250, MW-251, MW-252, MW-253 and MW-292 were added to Recovery Tank Battery 12 in June 2018.

c. Monitoring wells MW-359, MW-360, MW-361, MW-362, MW-363, MW-365, MW-366, MW-367, MW-368 and MW-369 were added to Recovery Tank Batteries in 1st quarter of 2019.

Table 5

HollyFrontier Tulsa Refining LLC

Tulsa East Refinery

Summary of COC Analysis

Analyte (Skinner List from HULL's 2011 original SAP-QAPP)	% Detected in all samples	Detected >10% results all historical data	Detected in Soil Leaching Data (SWMU-C, SWMU-H, AOC-2)	Detected in 2017 - 2018 data	Detected in Perimeter Data	Keep on List of COCs
Inorganics U.S. EPA Method 6010D						
Antimony	0.80%			X		X
Arsenic	48.03%	X	X	X	X	X
Barium	99.89%	X	X	X	X	X
Beryllium	8.92%			X	X	X
Cadmium	6.64%		X	X	X	X
Chromium	19.93%	X		X	X	X
Cobalt	20.50%	X		X	X	X
Lead	12.99%	X	X	X	X	X
Nickel	23.46%	X	X	X	X	X
Selenium	5.61%		X	X		X
Silver	0.34%		X	X		X
Vanadium	25.62%	X	X	X	X	X
Zinc	10.13%	X	X	X	X	X
Analyte (Skinner List from HULL's 2011 original SAP-QAPP)	**% Detected in all samples**	**Detected >10% results all historical data**	**Detected in Soil Leaching Data (SWMU-C, SWMU-H, AOC-2)**	**Detected in 2017 - 2018 data**	**Detected in Perimeter Data**	**Keep on List of COCs**
Inorganics U.S. EPA Method 7470A						
Mercury	1.02%		X	X		X
Analyte (Skinner List from HULL's 2011 original SAP-QAPP)	**% Detected in all samples**	**Detected >10% results all historical data**	**Detected in Soil Leaching Data (SWMU-C, SWMU-H, AOC-2)**	**Detected in 2017 - 2018 data**	**Detected in Perimeter Data**	**Keep on List of COCs**
Inorganics Method SM 4500-CN-E						
Cyanide	20.44%	X		X	X	X
Analyte (Skinner List from HULL's 2011 original SAP-QAPP)	**% Detected in all samples**	**Detected >10% results all historical data**	**Detected in Soil Leaching Data (SWMU-C, SWMU-H, AOC-2)**	**Detected in 2017 - 2018 data**	**Detected in Perimeter Data**	**Keep on List of COCs**
VOCs U.S. EPA Method 8260B						
Benzene	24.92%	X	X	X	X	X
Carbon Disulfide	0.80%			X		X
Chlorobenzene	0.00%					
Chloroform	11.01%	X		X	X	X
1,1-Dichloroethane	0.11%			X	X	X
1,2-Dichloroethane	6.70%			X	X	X
cis-1,2-Dichloroethene	8.76%					X

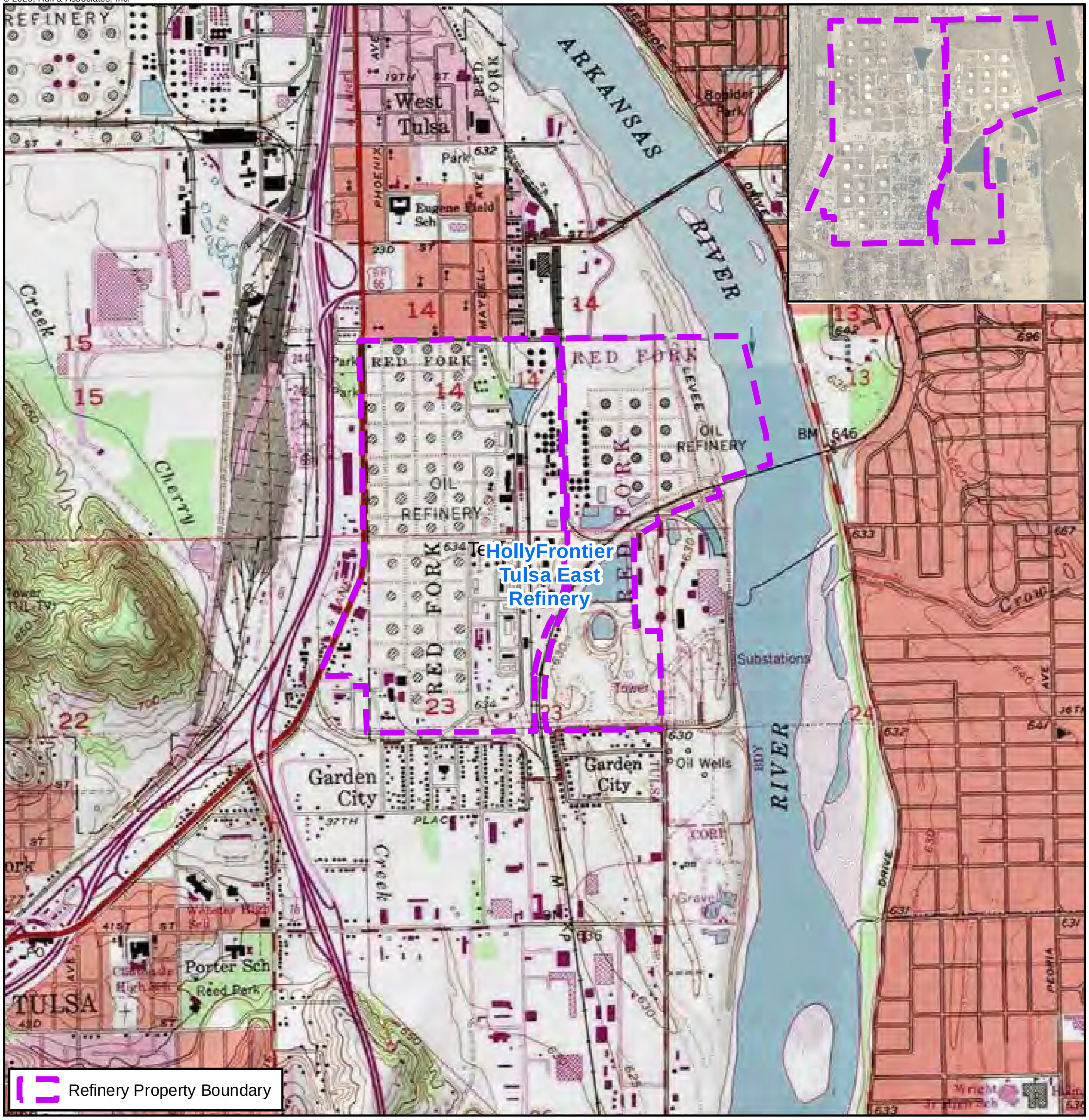
Table 5
HollyFrontier Tulsa Refining LLC
Tulsa East Refinery
Summary of COC Analysis

Analyte (Skinner List from HULL's 2011 original SAP-QAPP)	% Detected in all samples	Detected >10% results all historical data	Detected in Soil Leaching Data (SWMU-C, SWMU-H, AOC-2)	Detected in 2017 - 2018 data	Detected in Perimeter Data	Keep on List of COCs
VOCs U.S. EPA Method 8260B						
trans-1,2-Dichloroethene	5.18%					X
1,1-Dichloroethene	0.20%					X
1,4-Dioxane	0.34%					
Ethylbenzene	10.28%	X	X	X	X	X
Ethylene Dibromide (EDB)	0.00%					
Methyl Ethyl Ketone (MEK)	2.85%			X	X	X
Methyl-tert-butyl ether (MTBE)	16.48%	X		X	X	X
Styrene	0.00%					
Toluene	13.90%	X	X	X	X	X
1,1,1-Trichloroethane	0.00%					X
Trichloroethene	2.66%			X		X
Tetrachloroethene	0.23%				X	X
Vinyl Chloride	12.45%	X		X	X	X
Xylene (Total)	17.74%	X	X	X	X	X
Analyte (Skinner List from HULL's 2011 original SAP-QAPP)	**% Detected in all samples**	**Detected >10% results all historical data**	**Detected in Soil Leaching Data (SWMU-C, SWMU-H, AOC-2)**	**Detected in 2017 - 2018 data**	**Detected in Perimeter Data**	**Keep on List of COCs**
SVOCs U.S. EPA Method 8270C						
Acenaphthene	10.79%	X	X	X	X	X
Anthracene	15.53%	X		X	X	X
Benzo(a)anthracene	10.07%	X		X		X
Benzo(b)fluoranthene	3.02%			X	X	X
Benzo(k)fluoranthene	1.52%			X		X
Benzo(a)pyrene	3.11%			X		X
bis(2-Ethylhexyl)phthalate	7.31%			X	X	X
Chrysene	5.61%		X	X		X
2-Methylphenol (o-Cresol)	0.46%				X	X
3,4-Methlyphenol (m-,p-Cresol)	0.46%		X		X	X
Dibenz(a,h)anthracene	0.87%			X		X
Di-n-butylphthalate	0.11%			X	X	X
1,2-Dichlorobenzene	0.00%					

Table 5
HollyFrontier Tulsa Refining LLC
Tulsa East Refinery
Summary of COC Analysis

Analyte (Skinner List from HULL's 2011 original SAP-QAPP)	% Detected in all samples	Detected >10% results all historical data	Detected in Soil Leaching Data (SWMU-C, SWMU-H, AOC-2)	Detected in 2017 - 2018 data	Detected in Perimeter Data	Keep on List of COCs
SVOCs U.S. EPA Method 8270C						
1,3-Dichlorobenzene	0.00%					
1,4-Dichlorobenzene	0.00%					
Diethylphthalate	0.70%			X		X
2,4-Dimethylphenol	0.46%			X	X	X
Dimethyl phthalate	0.00%					
2,4-Dinitrophenol	0.00%					
Fluoranthene	13.48%	X		X		X
Fluorene	10.36%	X	X	X	X	X
Indeno(1,2,3-cd)pyrene	0.65%			X		X
Naphthalene	20.90%	X	X	X	X	X
4-Nitrophenol	0.00%					
Phenanthrene	16.86%	X		X	X	X
Phenol	0.57%				X	X
Pyrene	13.38%	X	X	X	X	X
Pyridine	0.00%					
Quinoline	0.00%					
1-Methylnaphthalene	33.52%	X		X		X
2-Methylnaphthalene	28.24%	X	X	X		X
Indene	0.00%					
Benzenethiol	0.00%					
Dibenz(a,h)acridine	0.00%					
Notes: cis-1,2-dichloroethene (cis-DCE), trans-1,2-dichloroethene (trans-DCE), 1,1-DCE and 1,1,1-trichloroethane added as precursors to vinyl chloride						

Figures



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0 500 1,000 2,000 Feet
1:24,000

Quad: Sand Springs, Tulsa, Sapulpa North, Jenks

Source: The topographic map was acquired through the USGS Topographic Map web service.

The aerial photo in the inset was acquired through the Indian Nations Council of Governments (INCOG). Aerial photography dated February 2016.

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HollyFrontier Tulsa Refining LLC
(Tulsa East Refinery)
Permit No. 990750960-PC
Attachment #3 - Groundwater Monitoring and LNAPL Management Plan

Site Location and Topographic Features

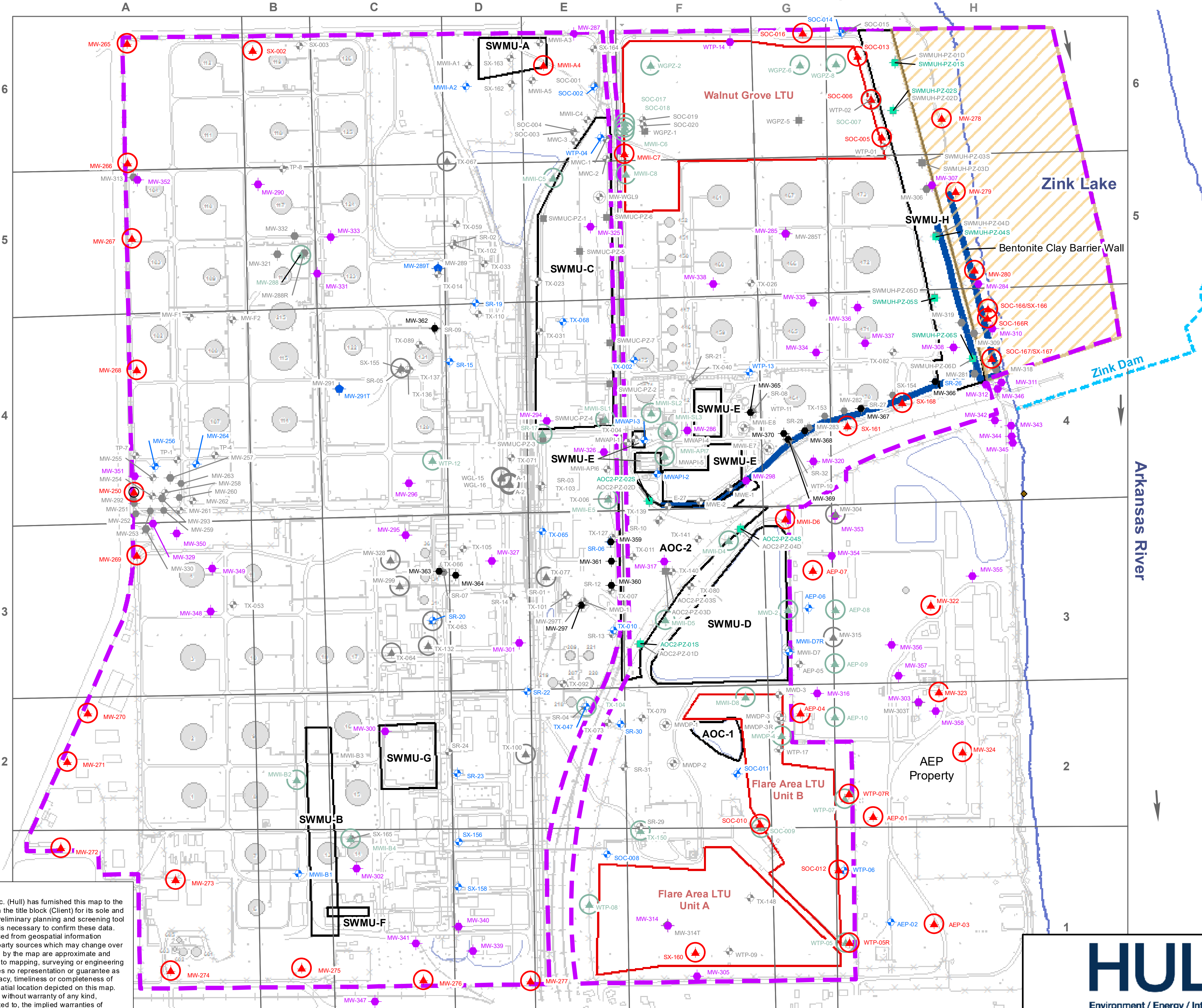
902 West 25th Street
Tulsa, Tulsa County, Oklahoma

Date: May 2020

File Name: HRM319_11_Fig01_SiteLocMap.mxd
Edited: 5/19/2020 By: rkaip

Figure 1

Produced using ArcGIS 10.7



- Refinery Property Boundary
- Property Leased to River Parks Authority
- LTUs
- SWMUs & AOCs
- Tanks
- Low Water Dam
- Bentonite Clay Barrier Wall
- Railroad
- Fence
- Stream/Pond
- Riverbank
- Outfall

Monitoring Locations

- Point of Compliance Well
- Point of Compliance Well operating as LNAPL Recovery Well
- Program Gauging Wells and Piezometers:
  - Program Monitoring Well
  - Program LNAPL Recovery Well
  - Program LNAPL Transmissivity Monitoring Well
  - Program LNAPL Investigation Monitoring Well
  - Program Piezometer
- Non-Program Double Cased Well With Screen Below Top Groundwater Level
- Non-Program Monitoring Wells
- Abandoned Well
- Destroyed Well
- Non-Program LNAPL Recovery Well
- Non-Program LNAPL Transmissivity Monitoring Well
- Non-Program LNAPL Investigation Monitoring Well
- Non-Program Piezometer

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May 2020

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Permit No. 990750960-PC
Attachment #3 - Groundwater Monitoring and LNAPL Management Plan

Figure 2

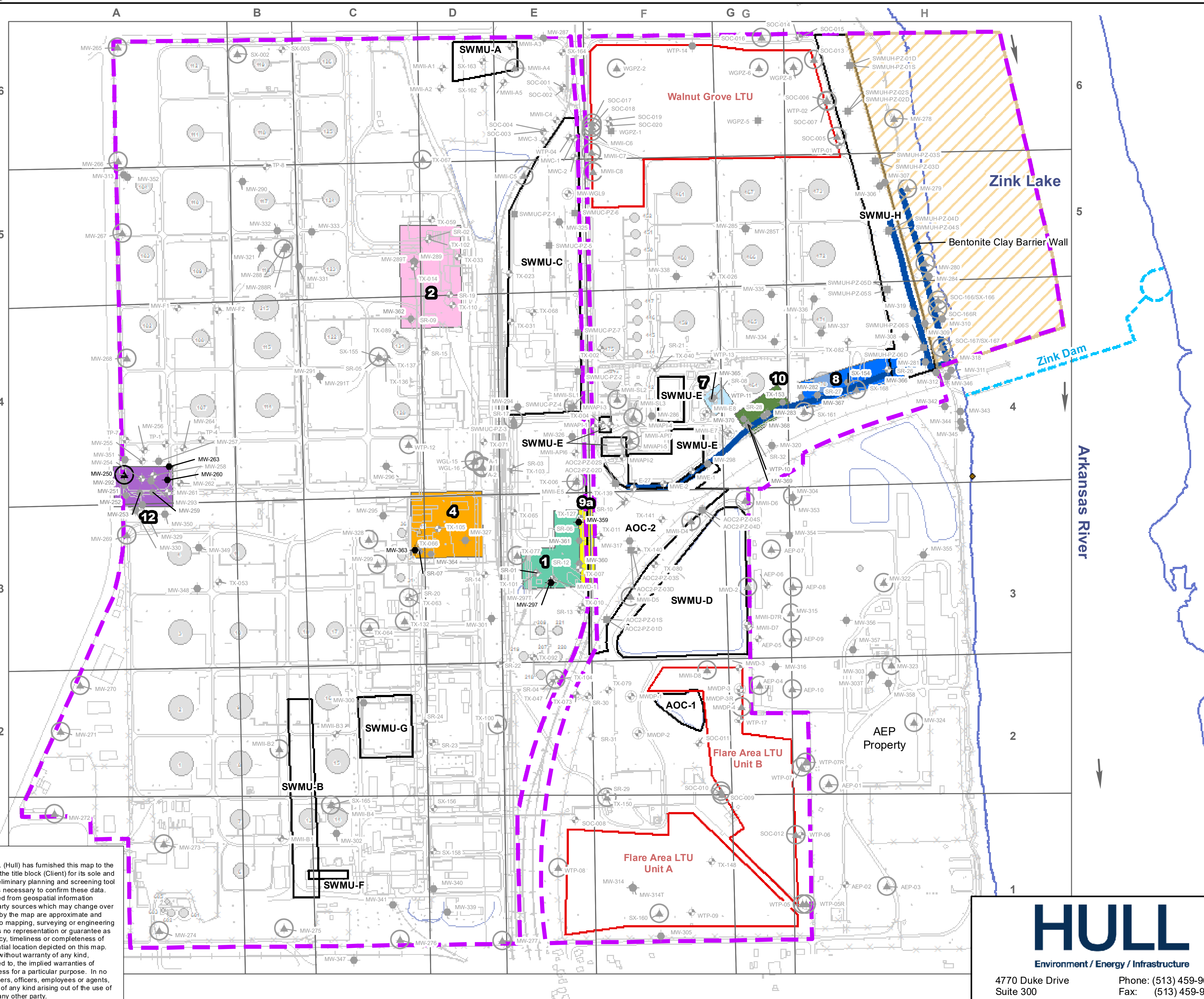
Facility Base Map

902 West 25th Street
Tulsa, Tulsa County, Oklahoma

Produced using ArcGIS 10.7

File Name: HRM319_11_Fig02_FacilityMap.mxd

Edited: 9/14/2020 By: rkalp



Refinery Property Boundary
Property Leased to River Parks Authority
LTUs
SWMUs & AOCs
Tanks
Low Water Dam
Bentonite Clay Barrier Wall
Railroad
Fence
Stream/Pond
Riverbank
Outfall

Monitoring Locations
- Double Cased Well With Screen Below Top Groundwater Level
- Monitoring Wells
- Point of Compliance Well
- Abandoned Well
- Destroyed Well
- LNAPL Recovery Well
- LNAPL Recovery Evaluation Well
- LNAPL Transmissivity Monitoring Well
- LNAPL Investigation Monitoring Well
- Piezometer

LNAPL Recovery Tank Battery #
1
2
4
7
8
9a
10
12

Produced using ArcGIS 10.7

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Permit No. 990750960-PC
Attachment #3 - Groundwater Monitoring and LNAPL Management Plan

Active LNAPL Recovery Systems

902 West 25th Street
Tulsa, Tulsa County, Oklahoma

Figure 3

File Name: HRM319_11_Fig03_LNAPLRec.mxd
Edited: 9/14/2020 By: rkaip

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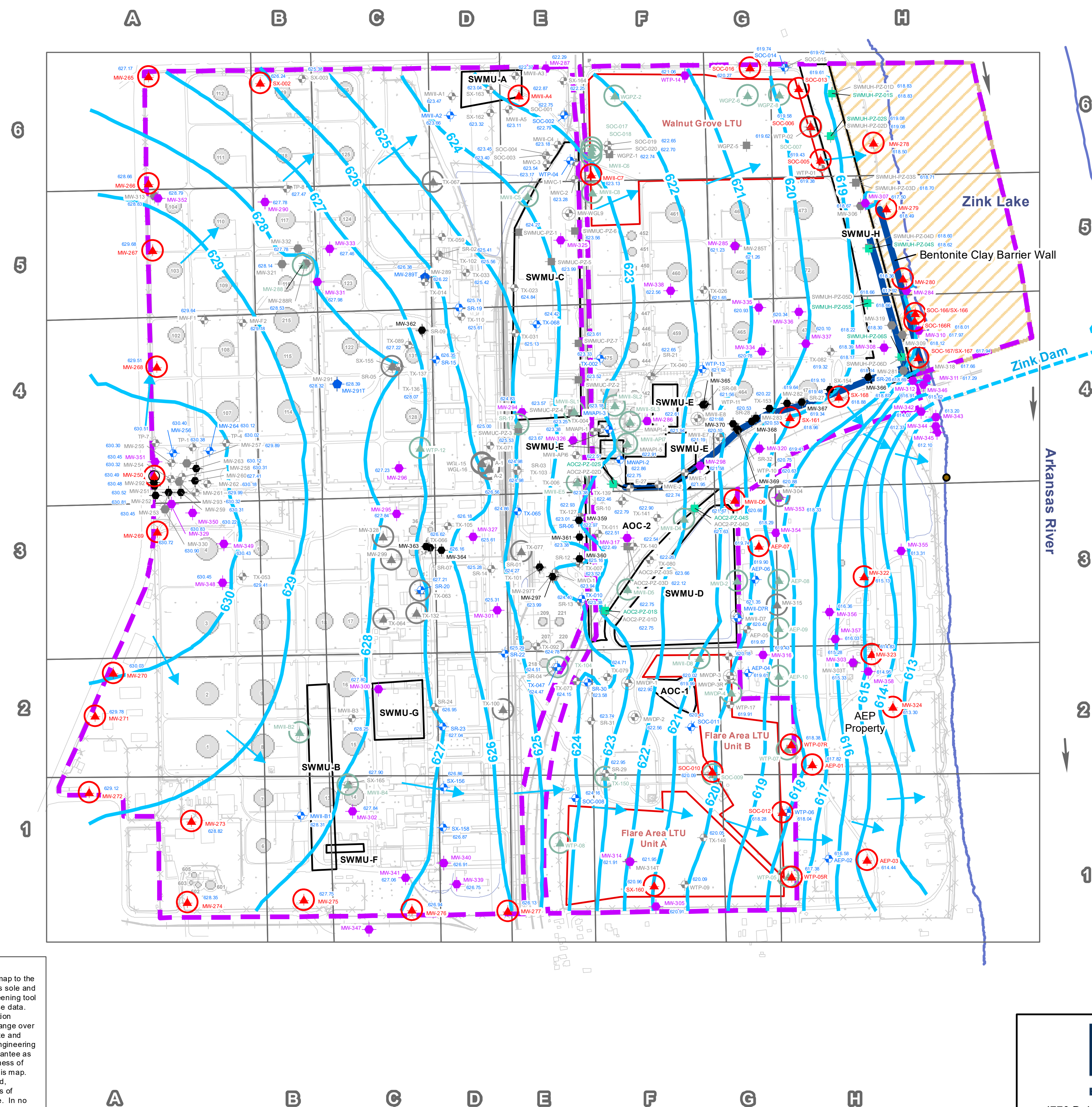

Notes:

1. Contour Interval = 1.0 ft.
2. Potentiometric surface generated using Surfer 8 contouring software, modified by Hull where appropriate.
3. Potentiometric elevations corrected for weight of LNAPL using a specific gravity of 0.84 where specific data is unavailable.
4. Groundwater elevations recorded in LNAPL Recovery Wells and LNAPL Recovery Evaluation Wells were not included in the creation of the Potentiometric Surface.

Refinery Property Boundary
Property Leased to River Parks Authority
LTUs
SWMUs & AOCs
Tanks
Potentiometric Contours (Contour Interval - 1 Foot)
Groundwater Flow Direction
617.35 Groundwater Elevation (Feet)
Zink Dam
Bentonite Clay Barrier Wall
Railroad
Fence
Stream/Pond
Riverbank
Outfall
Interim Point of Compliance Well
Interim Point of Compliance Well operating as LNAPL Recovery Well

Program Gauging Wells and Piezometers:
- Program Monitoring Well
- Program LNAPL Recovery Well
- Program LNAPL Transmissivity Monitoring Well
- Program LNAPL Investigation Monitoring Well
- Program Piezometer

Non-Program Double Cased Well With Screen Below Top Groundwater Level
Non-Program Monitoring Wells
Abandoned Well
Destroyed Well
Non-Program LNAPL Recovery Well
Non-Program LNAPL Transmissivity Monitoring Well
Non-Program LNAPL Investigation Monitoring Well
Non-Program Piezometer

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HollyFrontier Tulsa Refining LLC
(Tulsa East Refinery)
Permit No. 990750960-PC
Attachment #3 - Groundwater Monitoring and LNAPL Management Plan

Groundwater Potentiometric Surface Map (Corrected Elevations - November 2019)

902 West 25th Street
Tulsa, Tulsa County, Oklahoma

Figure 4

File Name: HRM319_11_Fig04_PSMNov19.mxd
Edited: 9/14/2020 By: rkalp

APPENDIX 3.1
SAMPLING AND ANALYSIS PLAN AND
QUALITY ASSURANCE PROJECT PLAN

HOLLYFRONTIER TULSA REFINING LLC
TULSA EAST REFINERY

APPENDIX 3.1
SAMPLING AND ANALYSIS PLAN AND QUALITY ASSURANCE PROJECT PLAN

TITLE AND APPROVAL PAGE

Sampling and Analysis Plan and Quality Assurance Project Plan, for HollyFrontier Tulsa Refining LLC, Tulsa East Refinery

Document Title

Oklahoma Department of Environmental Quality

Lead Organization (Agency, State, Tribe, Federal Facility, PRP, or Grantee)

Prepared By:
TRC Environmental Corp.
123 N. College, Suite 206
Fort Collins, CO 80524
Phone: (970) 484 3263

SAP-QAPP Date: May 2020
SAP-QAPP Revision Number: 2

The signatures below indicate approval of this SAP-QAPP.

HollyFrontier Corporation
Environmental Specialist - Remediation: 5/14/2020
Signature/Date

Arsin Sahba, PG/HFC Corporate Environmental Department
Printed Name/Organization

HollyFrontier Tulsa Refining LLC
Project Manager/Quality Assurance Manager: Brian Moore 5-14-2020
Signature/Date

Brian Moore/HFTR Environmental Department
Printed Name/Organization

Environmental Consultant Project Manager: Catriona V. Smith 05/18/2020
Signature/Date

Catriona V. Smith/TRC Environmental
Printed Name/Organization

Environmental Consultant Project Manager: Bruce McKenzie 5/14/2020
Signature/Date

Bruce E. McKenzie/Equus Environmental LLC
Printed Name/Organization

Environmental Consultant Project Manager: E J Montgomery 5/14/2020
Signature/Date

Eric Montgomery/HULL & Associates, Inc.
Printed Name/Organization

Laboratory Project Manager: 5/15/2020
Signature/Date

Angie Brown/Pace Analytical
Printed Name/Organization

Laboratory Project Manager:________________________
Signature/Date

RJ Modashia/ALS
Printed Name/Organization

DEQ, RCRA Permit and Project Manager: ________________________
Signature/Date

____
Printed Name/Title

Oklahoma Dept. of Environmental Quality
Approval Authority

Laboratory Project Manager:________________________________
Signature/Date

Angie Brown/Pace Analytical
Printed Name/Organization

Laboratory Project Manager: Raj. P. M. 05/14/2020
Signature/Date

RJ Modashia/ALS
Printed Name/Organization

DEQ, RCRA Permit and Project Manager: Hillary Young 5/26/20
Signature/Date

Hillary Young, Chief Engineer LPD
Printed Name/Title

Oklahoma Dept. of Environmental Quality
Approval Authority

TABLE OF CONTENTS

Tables

Figures

Attachments

LIST OF ACRONYMS

AOC	Area of Concern
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
COC	Chemical(s) of Concern
CPE	Corrected Potentiometric Elevation
CSM	Conceptual Site Model
DEQ	(Oklahoma) Department of Environmental Quality
DO	Dissolved Oxygen
DOT	Department of Transportation
DQO	Data Quality Objectives
FID	Flame Ionization Detector
FOC	Field Operations Coordinator
GC	Gas Chromatograph
GC/MS	Gas Chromatograph/Mass Spectrometer
GD	Groundwater depth
GFAA	Graphite Furnace Atomic Absorption
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HFC	HollyFrontier Corporation
HFTR	HollyFrontier Tulsa Refining LLC
Holly	Holly Refining & Marketing – Tulsa LLC
ICP	Inductively Coupled Plasma
ICPMS	Inductively Coupled Plasma Mass Spectrometry
LCS	Laboratory Control Sample
LIMS	Laboratory Information Management System
LNAPL	Light non-aqueous phase liquids
LTU	Land Treatment Unit
LT	LNAPL Thickness
MS/MSD	Matrix Spike/ Matrix Spike Duplicate
OK	Oklahoma
ORP	Oxidation-Reduction Potential
OSHA	Occupational Safety and Health Administration
PARCC	Precision, Accuracy, Representativeness, Comparability, Completeness
PD	Product depth
PID	Photoionization Detector
PM	Project Manager

POC	Point of Compliance
QA	Quality Assurance
QAM	Quality Assurance Manual
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
QCI	Quality Control Indicators
RCRA	Resource Conservation and Recovery Act
RPD	Relative Percent Difference
RSD	Relative Standard Deviations
SIN	Sample Identification Number
SAP	Sampling and Analysis Plan
SAP-QAPP	Sampling and Analysis Plan and Quality Assurance Project Plan
SG	Specific gravity
SMR	Semi-annual Monitoring Report
SOP	Standard Operating Procedure
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
WWTP	Waste Water Treatment Plant

HollyFrontier Tulsa Refining LLC
Tulsa East Refinery
Appendix 3.1
Sampling and Analysis Plan and
Quality Assurance Project Plan

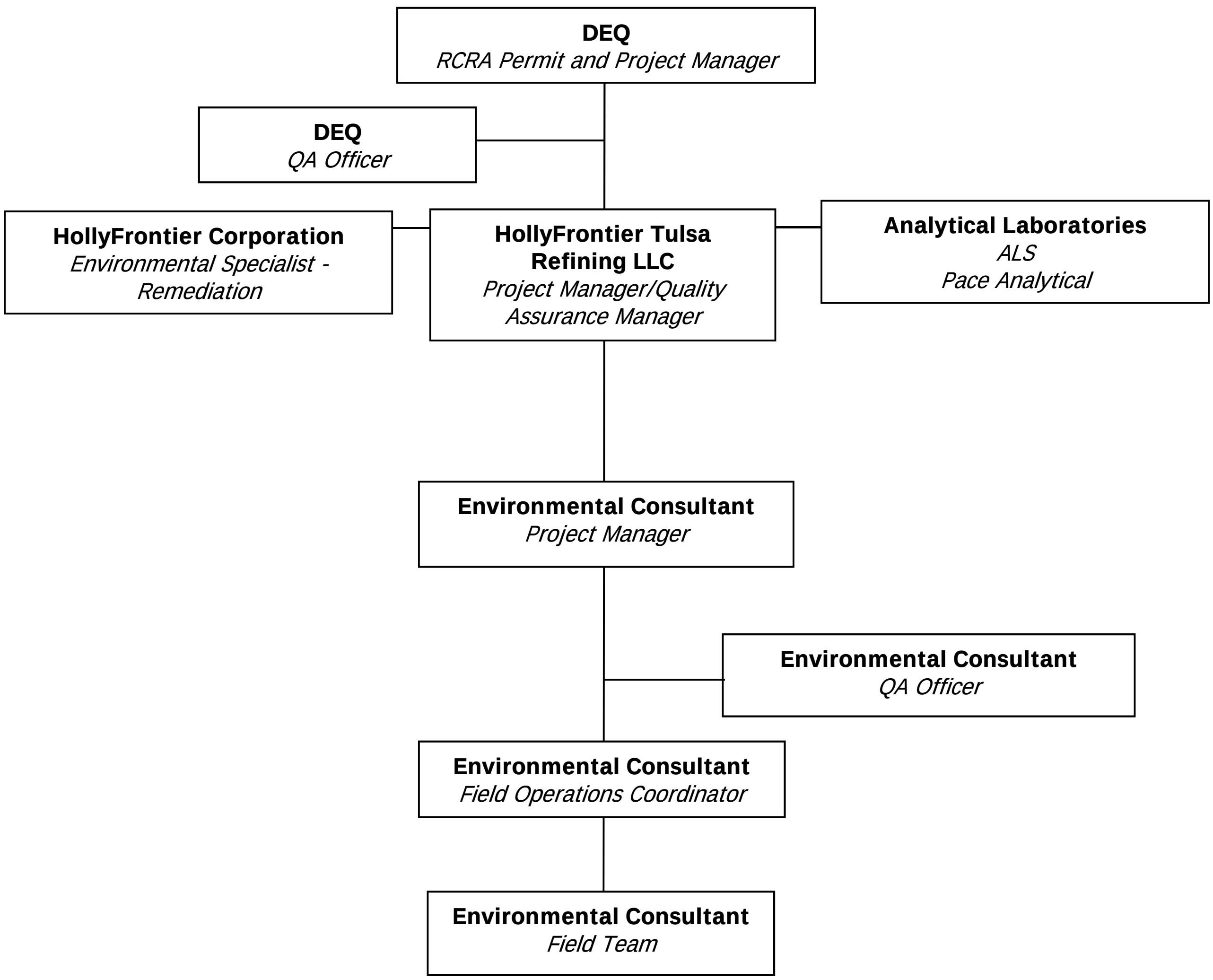
1.0 PROJECT MANAGEMENT

1.1 Project Organization and Responsibilities

This Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP) has been prepared to identify the scope, procedures and Quality Assurance/Quality Control (QA/QC) protocols for the collection of supporting data for the semi-annual groundwater sampling and monitoring program occurring at the HollyFrontier Tulsa Refining LLC (HFTR), Tulsa East Refinery (the Refinery), in Tulsa, Oklahoma (OK). The semi-annual sampling activities include collection of groundwater samples from a select list of point of compliance (POC) wells and the collection of groundwater and light non-aqueous phase liquid (LNAPL) levels from the gauging monitoring well network. The scope of the monitoring program is presented in the Resource Conservation and Recovery Act (RCRA) Corrective Action and Post-Closure Care permit application, Attachment 3 *Groundwater Monitoring and LNAPL Management Plan* (July 2019).

HFTR's environmental consultant will be responsible for performing, or providing oversight of subcontractors completing the field investigations, preparing required reports, and performing any subsequent work required to complete the semi-annual groundwater sampling. The Oklahoma Department of Environmental Quality (DEQ) is responsible for review and approval of this combined SAP and QAPP (hereafter referenced as SAP-QAPP). The various quality assurance and management responsibilities of key project personnel are defined below.

Project Organization Chart



1.1.1 Management Responsibilities

RCRA Permit & Project Manager, Oklahoma Department of Environmental Quality

The DEQ appointed RCRA Permit and Project Manager(s)(PM) is/are responsible for oversight of RCRA permitting and compliance pertaining to the Refinery. The DEQ will provide review and approval of RCRA permit-related reports and other relevant documents.

Arsin Sahba, PG, HollyFrontier Corporation (HFC) Environmental Specialist – Remediation

Mr. Sahba (or a designated representative) has final responsibility for environmental remediation-related issues at the Refinery. Mr. Sahba provides overall direction for this project to the Refinery environmental remediation staff. Mr. Sahba serves as one of the primary communication links between the DEQ and HFTR for this project.

HollyFrontier Tulsa Refining LLC, Project Manager/Quality Assurance Manager

The HFTR Project Manager/Quality Assurance Manager (PM/QAM) is responsible for coordinating Environmental Consultants and providing oversight for all project activities. Duties and responsibilities of the HFTR PM/QAM will be to:

1. Assure adherence to project plans and obtain approvals for any changes to these plans;
2. Assure that approved procedures meet project objectives;
3. Review and approve all sampling procedures;
4. Implement recommendations made by the Environmental Consultant Project Manager;
5. Initiate corrective actions;
6. Monitor schedules for field, analytical, and data validation activities associated with the field sampling program; and
7. Assure work conducted by Environmental Consultant meets all project quality standards.

Environmental Consultant Project Manager

The Consultant PM (or equivalent staff) will be involved in the planning and implementation of the semi-annual sampling events, and the evaluation of the resultant data. The Consultant PM is responsible for meeting technical, financial, and scheduling objectives for the project and is the primary communication link between HFTR, any subcontractors, and the laboratory. The Consultant PM will be involved in planning and project update meetings and will provide senior technical quality control and project oversight. Duties and responsibilities of the Consultant PM will be to:

1. Administrate and supervise all phases of the project;
2. Ensure project objectives are met within financial and time constraints;
3. Provide technical support to project team;
4. Work with the Consultant quality assurance officer (QAO) and field personnel to plan and conduct project operations, progress meetings, etc.;
5. Review reports and other work products prior to their issuance; and
6. Participate in project meetings held with HFTR and the DEQ.

1.1.2 Quality Assurance Responsibilities

Environmental Consultant Quality Assurance Officer

The Consultant QAO will be responsible for implementing and ensuring compliance with the provisions of the SAP-QAPP and will remain independent of direct job involvement and day-to-day operations. Duties and Responsibilities of the Consultant QAO will be to:

1. Establish QA/QC procedures for the project;
2. Evaluate data quality and maintain QC records;

3. Provide the final quality control review of analytical data;

4. Provide a communication link between project personnel and the laboratory;

5. Revise work practices or identified procedural deviations to align work with approved SAP-QAPP procedures and guidelines; and

6. Ensure that proper data handling equipment is used, and that data handling procedures are followed.

1.1.3 Field Responsibilities

<u>Environmental Consultant Field Operations Coordinator</u>
The Consultant Field Operations Coordinator (FOC) will be responsible for overseeing the day-to-day project activities. Duties and responsibilities of the Consultant FOC will be to:

1. Ensure the sampling activities are conducted in a manner that follows the procedures outlined in this plan and the site-specific Health and Safety Plan (HASP), and within refinery policy and permitting requirements;

2. Coordinate the sampling activities with the Consultant QAO and field personnel;

3. Oversee the use, maintenance and operation of sampling equipment;

4. Report daily activities, problems, etc. to the Consultant QAO; and

5. Obtain critical supplies and consumables for field activities.

The Consultant FOC will be in daily communication with field support personnel and may conduct field audits over the duration of the project. The Consultant FOC may also operate as the site or project health and safety officer.

Field personnel from the Environmental Consultant and/or subcontracted services and labor will be used to complete the semi-annual groundwater sampling events.

1.1.4 Laboratory Responsibilities

The laboratory will have its own project organization with responsibilities similar to the field operations personnel. An HFTR-contracted laboratory will be used to support the semi-annual groundwater sampling and analysis work.

Copies of applicable laboratory standard operating procedures (SOPs) for laboratory analyses will be supplied by the contracted laboratory selected to perform the work.

Any laboratory selected for supporting semi-annual groundwater sampling and analysis will be ODEQ accredited. The primary laboratories utilized are ALS (State ID# 9937), and Pace Analytical Services, LLC (State ID# 9205); however, other ODEQ accredited laboratories may be used as deemed necessary.

Laboratory Director

The Laboratory Director will be primarily responsible for the overall operation of the laboratory including all samples analyzed and data reported. The Laboratory Director (or their designee) will provide final review of all data deliverables prior to issuing laboratory reports and will be responsible for initiating corrective action measures when analytical data do not meet the requirements of this plan or the laboratory's Quality Assurance Manual (QAM).

Laboratory Project Manager

The Laboratory PM will be the primary communications link between the laboratory and the Environmental Consultant's QAO/PM. Duties and responsibilities of the Laboratory PM will be to:

1. Communicate any special needs of field operations personnel to the laboratory;
2. Obtain critical supplies and consumables for laboratory activities; and
3. Provide the final review of all data deliverables, ensuring they meet the requirements of this SAP-QAPP, prior to issuing laboratory reports.

Laboratory Quality Assurance Officer

The Laboratory QAO will be primarily responsible for implementing the laboratory's QAM within the laboratory, and monitoring compliance with the laboratory's QAM. Duties and responsibilities of the Laboratory QAO's will be to:

1. Conduct laboratory audits;
2. Review all QC data;
3. Ensure that proper data handling equipment is used and that data handling procedures are followed; and
4. Report problems to the Laboratory Director for corrective action.

1.1.5 Special Training Requirements / Certifications

HFTR Project Manager/Quality Assurance Manager is responsible for ensuring project personnel are qualified and trained in the project tasks for which they are responsible.

1.1.5.1 Field Personnel

It is not anticipated that the completion of this project will require any uniquely trained personnel. However, all field personnel must complete the mandatory site-specific safety classes required by HFTR. If specialized training is required for any portions of the project, training will be provided by a qualified trainer and the date and type of training will be documented. The site-specific HASP specifies the training necessary for compliance with the Occupational Safety and Health Administration (OSHA) requirements. All field personnel will have completed OSHA 40-hour and annual 8-hour refresher Hazardous Waste Operations and Emergency Response (HAZWOPER) standard training, as required for personnel potentially exposed to hazardous substances, as specified in Title 29 of the Code of Federal Regulations, Section 1910.120 (29 CFR § 1910.120). If hazardous materials or waste are moved off-site, compliance with the Department of Transportation (DOT) training requirements for shipping hazardous materials or waste will be required.

1.1.5.2 Laboratory Personnel

Every employee has direct access to the QAM and training to help each employee apply the QAM to his or her specific responsibilities. Records of relevant qualifications, training, skills and experience of the technical personnel are maintained by the laboratory.

Analysts that operate Graphite Furnace Atomic Absorption (GFAA), Inductively Coupled Plasma (ICP), Inductively Coupled Plasma Mass Spectrometry (ICPMS), Gas Chromatography (GC), or Gas Chromatography Mass Spectrometry (GC/MS) equipment must satisfactorily complete a short course offered by an equipment manufacturer, professional organization, university, or other qualified training facility (formal in-house training is acceptable). A minimum experience requirement for the operation of GFAA, ICP, ICPMS, GC, and GCMS equipment is one (1) year.

1.2 Refinery Background Information

The Refinery has been in operation since 1906 as a petroleum products refinery. The Refinery occupies approximately 474 acres and includes petroleum products processing areas, raw and bulk products storage, historical and current waste treatment areas, and other operations and storage areas. Typical products produced at the refinery include gasoline; diesel fuel; fuel oils; fuel gases; asphalt and sulfur.

The Refinery has been owned and operated by several operating companies throughout its history. Through various acquisitions in the Refinery's first few decades of operation, the Refinery was eventually acquired by Sinclair Oil Company/Sinclair Tulsa Refining Company (Sinclair). Holly Refining & Marketing – Tulsa LLC (Holly) purchased the Refinery on December 1, 2009. On January 1, 2016, Holly's legal name was changed to HollyFrontier Tulsa Refining LLC (HFTR), and HFTR is the current owner and operator of the Refinery.

A Refinery base map showing pertinent Refinery features including the land treatment units (LTUs), solid waste management units (SWMUs), areas of concern (AOCs), monitoring well gauging network, and POC wells is presented on Figure 3.A-1.

1.3 Project Description and Schedule

The *Groundwater Monitoring and LNAPL Management Plan* summarizes the monitoring requirements for the Refinery. As part of the RCRA permit, the Refinery is required to conduct groundwater and LNAPL fluid level gauging, conduct groundwater sampling, and submit Semi-annual Monitoring Reports (SMRs) summarizing the results obtained from monitoring. The semi-annual groundwater sampling schedule is provided below. Task details, chemicals of concern (COC) lists, wells to be gauged and sampled, base maps showing the locations of monitoring wells, Facility-wide gauging well network, LTUs, LNAPL recovery systems, and other pertinent site features are provided in the *Groundwater Monitoring and LNAPL Management Plan*.

HFTR Tulsa East Refinery Requirements

Task	Purpose	Frequency	Schedule	Compliance Deadline
Facility-wide monitoring well gauging (Program Wells)	Evaluate LNAPL apparent thickness, groundwater elevations and flow patterns	Semi-Annually	During April and October sampling events, each year	Tabulated well gauging data due 45 days from completion of the sampling event. Results reported in SMRs due by February 14 and August 14, annually.
POC well sampling	Evaluate dissolved phase plume condition and stability; identify potential off-site/upgradient sources impacting the Refinery	Semi-Annually	During April and October sampling events, each year	Tabulated analytical data due 45 days from completion of the sampling event. Results reported in SMRs due by February 14 and August 14, annually.
LTU inspections and maintenance	Post-closure care; maintain integrity of closed LTUs to mitigate environmental impacts	Semi-Annually; after significant storm events; and as warranted by site conditions	In conjunction with April and October sampling events, each year	Results reported in SMRs due by February 14 and August 14, annually.

Note: The semi-annual monitoring reports are due to the DEQ on or before February 14 and August 14 of each calendar year.

1.4 Data Quality Objectives

1.4.1 Project Quality Objectives

The Data Quality Objectives (DQO) process is a mechanism to translate general project goals into specific tasks, which are conducted to produce data needed to support decision making for the project. The DQO process typically comprises a seven-step process. The first step is to develop a Conceptual Site Model (CSM) to provide an understanding of the Site based on available data, such as analytical results, historic use, exposure pathways, cleanup concerns, and future land use. The model is refined as additional data are added. With a well-defined CSM, the goals of the investigation are translated into qualitative and quantitative statements that define the type of data required. These data needs include the number and type of samples to be collected, analytical detection limits, and certainty. Based on the outputs of the DQO process, a detailed work plan can be prepared.

The following provides the general DQO steps that will be involved for the collection of semi-annual monitoring data.

1.4.1.1 Stating the Problem

Routine groundwater sampling is required to monitor the conditions of the dissolved phase and LNAPL plumes in the subsurface, and the potential effects of such conditions on human health and the environment, as set forth in the applicable RCRA permit(s).

The purpose of this SAP-QAPP is to document groundwater sample collection methodologies, laboratory analytical methods, data evaluation methodologies and procedures, and resultant changes in sampling protocol for the semi-annual groundwater sampling events at the Refinery. These data will be used to evaluate current conditions of groundwater and LNAPL in support of remedial strategy development, evaluation of remedial progress, and compliance with post-closure care and corrective action requirements set forth in the effective RCRA permit.

1.4.1.2 Identifying the Decision

Data collected during routine groundwater monitoring will be used to determine the following:

1. What is the current groundwater table elevation, flow direction and estimated hydraulic gradient? Is this consistent with historical groundwater flow patterns?
2. Have the COC concentrations increased or decreased within the POC well network since the last monitoring period(s)?
3. Are COCs migrating?
4. Do the dissolved phase plumes and/or LNAPL plumes appear to be migrating, expanding or shrinking?
5. Are any new compounds exhibited in groundwater analytical results not generally detected in historic data?
6. What is the current estimated LNAPL footprint(s) and thickness(es)?
7. Do(es) the LNAPL plume(s) appear to be expanding, shrinking or stable compared to the previous reporting period(s)?
8. Do groundwater quality parameters suggest an environment conducive to natural attenuation of persistent COCs?
9. Are changes to the POC monitoring network and/or the well gauging network warranted to fill data gaps or eliminate redundancies?
10. Are additional groundwater quality, chemical or geochemical parameters necessary to further evaluate plume effects, natural attenuation characteristics, and/or potential remedies?
11. Do the results of the groundwater sampling event validate the current CSM?
12. Is the Refinery in compliance with the effective RCRA Permit(s)?
13. Are additional investigations or actions warranted based on the findings to the above items 1 through 12?

1.4.1.3 Identifying Inputs to the Decision

Groundwater samples will be collected and analyzed, and wells will be gauged to support the decision and answer the questions posed in DQO step 2. The decision inputs include:

1. Spatial and temporal variation in groundwater COC data under current conditions;

2. Spatial and temporal variation of LNAPL;

3. Spatial and temporal variation in groundwater level data;

4. Spatial and temporal variation in groundwater gradients;

5. Spatial and temporal variation in water quality parameter data, including, at a minimum, pH, temperature, specific conductivity, oxidation-reduction potential (ORP) and dissolved oxygen (DO).

1.4.1.4 Defining the Boundaries of the Study

The boundary of the study refers to both the spatial and temporal boundaries. The boundaries are defined to ensure that samples are representative of the area for which decisions will be made. Practical constraints on data collection need to be recognized. These constraints include meteorological conditions that would preclude sampling; inability to secure necessary access agreements; or the unavailability of personnel, time, or equipment.

The groundwater monitoring protocol includes wells located on HFTR property, as well as off-property wells located outside of HFTR's property boundaries.

1.4.1.5 Developing a Decision Rule

A decision rule usually compares an output parameter to an action level, which then is used to determine course of action for the Site. A series of "if…then" statements has been developed to define the conditions that assist in choosing a course of action.

Based on analytical results obtained from previous groundwater samples, the following "if…then" statements will be applied to the data obtained during each groundwater sampling event:

- *If* analytical results demonstrate COC concentrations greater than applicable groundwater screening levels at POC wells, select wells may be re-sampled and/or additional remedial measures may be implemented.

- *If* analytical results demonstrate increasing COC concentrations in upgradient POC wells, additional investigations may be implemented to assess potential new release(s) from on- or off-site sources.

- *If* data gaps or redundancies are identified, additional monitoring wells may be installed and sampled, or select wells may be recommended to be eliminated from the monitoring or sampling plans.

- *If* evaluations of the dissolved phase and/or LNAPL plume(s) indicate plume expansion, mobility or migration, additional investigations, remedial measures, or modifications to any existing corrective action may be implemented.

1.4.1.6 Specifying Limits on Decision Errors

The monitoring well spacing and placement have been developed, in part, from current groundwater COC concentrations and predominant groundwater flow directions. The number of POC and gauging program wells were also determined with respect to the DEQ requirements.

Sampling may not capture all the variations in concentrations and analyses can only estimate the “true” value. Sampling “error” occurs when the sampling scheme does not adequately detect the variability in the amount of contaminant in the environmental matrix from point to point across the Site. The potential for these errors may be reduced by implementing the DQO process when outlining the monitoring plan.

Data may also be questionable due to measurement errors. Measurement errors can happen during sample collection, handling, preparation, analysis, data reduction, or data handling. There may be corrective steps that can be taken or additional qualifying information that can be collected that will allow for the full or limited use of the data. Corrective actions are discussed in Section 2.6.4 of this document.

1.4.1.7 Optimizing the Design

The purpose of this step is to identify the most resource-effective sampling design that generates data to satisfy the DQOs specified in the preceding steps. The sampling and analysis program designed for this project was developed by considering overall cost and ability to meet the previously defined DQOs.

1.5 Quality Assurance Objectives for Measurement Data

The overall QA objective for each project is to develop and implement procedures for field sampling, Chain-of-Custody, laboratory analysis, and reporting that will provide legally defensible results. Specific procedures for sampling, Chain-of-Custody, laboratory instrument calibration, laboratory analysis, reporting of data, internal quality control, audits, preventive maintenance of field equipment, and corrective action are described in other sections of this SAP-QAPP.

Data quality objectives for measurements collected during the semi-annual sampling events will be addressed in terms of precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters. The collection of data used in this project will require that the sampling and testing be performed using standard methods, with properly operated and calibrated equipment, and conducted by trained personnel.

The following sections provide detailed discussion of PARCC elements.

1.5.1 PARCC Element – Precision

1.5.1.1 Definition

Precision is a measure of the mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. The overall precision of measurement data is a mixture of sampling and analytical factors. Precision is evaluated through field and laboratory duplicate samples. The precision of analytical data can be evaluated by calculating the relative percent difference (RPD) between duplicate samples. The RPD is calculated according to the following formula:

$$RPD = \frac{|C_1 - C_2|}{0.5*(C_1 + C_2)}*100$$

Where:
C_1 = the first sample value and
C_2 = the duplicate sample value

1.5.1.2 Field Precision Objectives

Field precision will be assessed through the collection and measurement of field duplicates for groundwater samples. Field duplicate samples will be collected at a rate of one duplicate per twenty (20) investigative samples. Field duplicate RPDs must be < 30 percent for aqueous samples if one or both results are greater than five times the quantitation limit, otherwise results must be within +/- the absolute difference of the quantitation limit.

1.5.1.3 Laboratory Precision Objectives

Precision in the laboratory is assessed through calculation of the RPD for duplicate and spike duplicate samples, and by calculation of relative standard deviations (RSD) if three or more replicate samples are analyzed. Precision control limits for the subcontracted analytical laboratory will be provided in laboratory SOPs to be supplied by the contracted laboratory selected to perform the work.

1.5.2 PARCC Element - Accuracy

1.5.2.1 Definition

Accuracy is the degree of agreement between an observed value and an accepted reference or true value.

1.5.2.2 Field Accuracy Objectives

Accuracy in the field is assessed using field and trip blanks and through the adherence to all sample handling, preservation, and holding times. A trip blank will consist of a laboratory-prepared sample of deionized water. Trip blanks will accompany sample shipments which contain samples requiring volatile organic compound (VOC) analysis and will be subjected to the same procedures as the investigative samples. Trip blanks are only required when VOCs will be analyzed. Trip blanks will be submitted for analysis at the rate of one trip blank per shipping container containing samples for VOC analyses.

Field blanks (equipment blanks) will be collected by pouring laboratory-prepared deionized water or distilled water over or through the sampling equipment and collecting the rinsate in the proper analytical containers. Field blanks are required at a rate of one field blank per twenty (20) investigative samples with a minimum of one per each day of sampling, when non-dedicated equipment is used in sampling procedures.

1.5.2.3 Laboratory Accuracy Objectives

Laboratory accuracy shall be assessed by the preparation and analysis of method blank analyses for each analytical sequence. Laboratory accuracy is also assessed through the analysis of Matrix Spike/Matrix Spike Duplicate (MS/MSD) samples, laboratory control samples (LCSs) and surrogate compounds, and the determination of percent recoveries. Enough sample containers will be provided to allow for the collection of one MS and MSD sample per twenty (20) samples collected. Accuracy control limits will be provided in laboratory SOPs to be supplied by the contracted laboratory selected to perform the work.

To assure the accuracy of the analytical procedures, one environmental sample will be collected for every twenty (20) primary samples and designated as the MS/MSD sample. The increase in concentration of the analyte will be observed in the spiked sample, due to the addition of a known quantity of the analyte, compared to the reported value of the same analyte in the unspiked sample to determine the percent recovery. Daily control charts will be plotted for each commonly analyzed compound and maintained on instrument-specific, matrix-specific, and analyte-specific bases.

Percent recovery for MS/MSD results is determined according to the following equation:

$$\%R = \frac{(\text{Spiked Sample Conc.} - \text{Sample Conc.})}{\text{Known Conc. Added}} \text{ x } 100$$

Percent recovery for LCS and surrogate compound results is determined according to the following equation:

$$\%R = \frac{\text{Experimental Conc.}}{\text{Known Amount Added}} \text{ x } 100$$

Additional information on laboratory accuracy will be provided in the method specific SOPs to be supplied by the contracted laboratory selected to perform the work.

1.5.3 PARCC Element - Completeness

1.5.3.1 Definition

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount expected under normal conditions.

1.5.3.2 Field Completeness Objectives

Field completeness is a measure of the amount of valid measurements obtained from all the measurements taken during the project. The field completeness objective for this project will be greater than ninety percent.

1.5.3.3 Laboratory Completeness Objectives

Laboratory completeness is a measure of the amount of valid measurements obtained from all the measurements taken during the project. The laboratory completeness objective for this project will be greater than ninety percent.

Completeness is the ratio of the number of valid sample results to the total number of samples analyzed with a specific matrix and/or analysis. Following completion of the analytical testing, the percent completeness will be calculated by the following equation:

$$\text{Completeness} = \frac{\text{Number of Valid Measurements}}{\text{Number of Measurements Planned}} \text{ x } 100$$

1.5.4 PARCC Element - Representativeness

1.5.4.1 Definition

Representativeness expresses the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition within a defined spatial and/or temporal boundary.

1.5.4.2 Measures to Ensure Representativeness of Field Data

Representativeness will be achieved by insuring that sampling locations are properly selected and that a sufficient number of samples are collected. Representativeness is dependent upon the proper design of the sampling program and will be accomplished by ensuring that this SAP-QAPP and all relevant SOPs are followed. The QA goal will be to have samples and measurements representative of the media sampled. Field testing for pH, temperature, specific conductivity, DO and turbidity stabilization prior to groundwater sampling will help ensure that representative samples are collected.

1.5.4.3 Measures to Ensure Representativeness of Laboratory Data

Using the proper analytical procedures, appropriate methods, meeting sample holding times and analyzing and assessing field duplicate samples, ensures representativeness in the laboratory.

1.5.5 PARCC Element - Comparability

1.5.5.1 Definition

Comparability is an expression of the confidence with which one data set can be compared with another. Comparability is also dependent on similar QA objectives.

1.5.5.2 Measures to Ensure Comparability of Field Data

Comparability is dependent upon the proper design of the sampling program and will be satisfied by ensuring that this SAP-QAPP is followed and that proper sampling techniques are used.

1.5.5.3 Measures to Ensure Comparability of Laboratory Data

Planned analytical data will be comparable when similar sampling and analytical methods are used and documented in the SAP-QAPP. Comparability is also dependent on similar QA objectives.

1.6 Documentation and Reporting

Data collected in support of on-going dissolved phase plume assessment and LNAPL containment evaluation will be submitted to the DEQ semi-annually and will, at a minimum, include:

1. Text describing sampling and analysis activities (focusing on deviations from the GWMP and SAP-QAPP); regulated units; LNAPL recovery activities; and groundwater and LNAPL monitoring data;
2. Figures showing property location, property boundaries, and sampling locations;
3. Tables or Figures summarizing groundwater and LNAPL gauging data;
4. Potentiometric surface maps based on the gauging event data;
5. Tables summarizing analytical results;
6. Parameter concentration maps;
7. Summary of hydrocarbon (LNAPL) recovery system performance;
8. A summary of findings and recommendations for future activities;
9. Complete laboratory data reports;
10. Other relevant materials required to support the DQO objectives; and
11. A bibliography of references and appendices of supporting documents.

HFTR may perform statistical analysis of groundwater data to determine compliance with the risk-based screening levels (RBSLs) or background, if higher (pending approval by DEQ) as follows:

1. Direct comparison of the value of each constituent to its RBSL; or,
2. The Confidence Interval Procedure for the mean concentration based on a normal, log-normal, or non-parametric distribution. The 95 percent confidence coefficient of the t-distribution will be used in constructing the confidence interval (Chapter 21 of Statistical Analysis of Groundwater Data at RCRA Facilities-Unified Guidance, U.S. EPA, March 2009), and subsequent updates acceptable to the Executive Director. The confidence interval upper limit for each constituent shall be compared with the corresponding RBSL. To be considered in compliance, the confidence interval upper limit for a well in question must not exceed the RBSLs. A confidence interval upper limit above the RBSLs shall be considered as evidence of statistically significant contamination; or,

3. An alternative statistical method proposed by HFTR and approved by the DEQ. Any proposed alternative method must be appropriate with respect to distributional assumptions and must provide reasonable control of both false positive and false negative error rates.

All records generated during these investigations will be kept on file by the Environmental Consultant. These records will be considered part of the Refinery remediation files and will at a minimum include: field logbooks; field data and data deliverables; photographs; drawings; soil boring logs; laboratory data deliverables; data validation reports; data assessment reports; progress reports, QA reports; project reports, etc.; and all custody documentation (tags, forms, shipping receipts, etc.). Refinery remediation files are discussed in detail in Section 2.3.8.8 of this SAP-QAPP.

2.0 FIELD SAMPLING AND ANALYSIS PLAN

2.1 Sampling Process and Design

The purpose of this section is to describe the general sampling procedures that will be used during this project. SOPs that are likely to be employed during this project have been included in Appendix A. Additional SOPs will be included on an as-needed basis. Sampling efforts will be uniform and follow the SAP-QAPP and SOPs to ensure the quality of the data collected.

The groundwater sampling plan for the Refinery consists of the following tasks:

1. Semi-annual gauging of Facility-wide monitoring well network and POC wells (collectively known as Program Wells);
2. Semi-annual sampling of POC wells;
3. SMRs summarizing groundwater monitoring results and LNAPL recovery system operations, including modifications to the SAP-QAPP or LNAPL system operations.

Primary COCs are listed on Table 1 of the *Groundwater Monitoring and LNAPL Management Plan*. QA/QC samples will be submitted in accordance with the protocols presented in the following sections of this SAP-QAPP. Requirements for QA/QC samples are identified in Sections 2.3 and 2.4.

2.2 Task 1 – Groundwater and LNAPL Gauging

The purpose of this section is to describe the methods and procedures that will be used during semi-annual groundwater and LNAPL gauging events. Groundwater and LNAPL levels and LNAPL thickness measurements will be collected as described in Section 2.2.1. The purpose of a semi-annual gauging event is to assess current horizontal groundwater flow and LNAPL plume characteristics.

2.2.1 Groundwater Level and LNAPL Measurements

Groundwater and LNAPL level and LNAPL thickness measurements will be collected using manual methods.

2.2.1.1 Measurement Locations and Frequency

Groundwater and LNAPL level and LNAPL thickness measurements will be collected from the Facility-wide gauging Program wells on a semi-annual basis. The complete list of wells to be gauged during each semi-annual event is presented in Table 3 of the *Groundwater Monitoring and LNAPL Management Plan*.

2.2.1.2 Equipment and Procedures

In general, manual groundwater and LNAPL level and LNAPL thickness measurements will be collected using an electronic water level indicator or an oil-water interface probe. Each measurement shall be to the nearest hundredth of one foot from the reference point of each well. The reference point, unless otherwise marked, shall be the north side of the top of the well casing. A detailed description of the procedures for water level measurements is included in groundwater sampling SOP-009.

For wells in which LNAPL is detected, measured LNAPL thickness (LT) will be recorded via measurements of product depth (PD) and groundwater depth (GD); LT will then be calculated as:

$$LT\ (\text{measured}) = GD - PD$$

To correct groundwater elevations for wells in which LNAPL is detected, the following formula shall be used:

$$CPE = \text{Well Datum} - GD + (LT \times SG)$$

Where:
CPE = Corrected Potentiometric Elevation
GD = Groundwater Depth (measured)
LT = LNAPL Thickness (measured)
SG = Specific Gravity of the LNAPL

Historical LNAPL specific gravity measurements shall be used to best approximate the specific gravity of LNAPL in individual wells, as outlined in the *Groundwater Monitoring and LNAPL Management Plan*.

2.2.1.3 Documentation

Groundwater level and LNAPL level measurements will be recorded on task-specific forms, where appropriate. These forms include site groundwater and LNAPL level measurement forms and groundwater sampling data sheets. Groundwater and LNAPL level data may also be recorded in the field notebooks.

2.2.1.4 Decontamination

The electronic water level indicator and oil-water interface probe will be decontaminated in accordance with SOP-001.

2.2.1.5 Investigative Derived Waste

All decontamination fluids will be processed through the on-site Waste Water Treatment Plant (WWTP) or disposed off-site in accordance with SOP-024.

2.3 Task 2 – Groundwater Sampling

2.3.1 General Sampling Requirements

The purpose of this section is to describe the general sampling procedures to be employed during semi-annual groundwater monitoring events. Appendix A contains the current SOPs relevant to the field activities described herein. The SOPs may only be updated following approval by DEQ of a Class 1 Permit Modification, to maintain most up-to-date sampling and field data collection methodologies. Sampling efforts will be uniform and follow the SAP-QAPP and SOPs to ensure the quality of the data collected. Routine groundwater monitoring includes laboratory analysis for site-specific COCs on Table 1 of the *Groundwater Monitoring and LNAPL Management Plan*, and field data acquisition of pH, temperature, specific conductivity, ORP and DO.

2.3.2 Monitoring Wells Requiring Groundwater Sampling

During each semi-annual groundwater sampling event, all POC wells listed in Table 3 of the *Groundwater Monitoring and LNAPL Management Plan* will be gauged to evaluate groundwater and LNAPL elevations and apparent LNAPL thicknesses, as described in Section 2.2. Sampling program wells (POC wells) will then be sampled for target COCs listed on Table 1 of the *Groundwater Monitoring and LNAPL Management Plan*. Well location, designation and sampling frequency are listed on Table 2 of the *Groundwater Monitoring and LNAPL Management Plan*.

Low flow sampling techniques, as discussed in Section 2.3.5, will be used to collect the groundwater samples during each semi-annual sampling event. The groundwater sampling results will be used to evaluate current conditions of the dissolved phase plumes, maintain compliance with the RCRA permit and to evaluate the need for modifications to any corrective actions and/or sampling protocol.

Passive samplers may be evaluated for use in the future, pending comparability trials and DEQ approval.

2.3.3 Laboratory Analysis

Environmental samples and QA/QC samples will be collected and submitted for laboratory analysis of the COCs listed in Table 1.

Table 1 provides a summary of practical quantitation limits (PQLs) and method detection limits (MDLs) for COCs. The laboratory SOPs, referenced on Table 1, are to be supplied by the contracted laboratory selected to perform the work. Information regarding the project target compounds and quantitation limits is provided in Table 1 and will be in accordance with the SW-846 Analytical Methods. Sample QA/QC requirements are listed in Table 2.

Samples will be analyzed on standard turn-around times.

2.3.4 Sampling Equipment Preparation and Decontamination

Sampling equipment that is to be reused (e.g., submersible pumps, probes) will be thoroughly decontaminated between sampling locations and at the beginning and end of each day. Decontamination will consist of washing equipment with mild, non-phosphate soap such as Liquinox, and thoroughly rinsing with distilled water. If complete cleaning of any piece of sampling equipment is not possible, then it will be discarded, and a clean article substituted. For non-dedicated electronic well purging equipment, non-phosphate soapy water will be run through the pump and hose (if reused) followed by a thorough rinsing with distilled water. For a more detailed explanation of decontamination procedures see SOP-001 (Appendix A).

2.3.5 Groundwater Sampling Methodology

Groundwater samples obtained during the semi-annual sampling events will be collected using low-flow sampling techniques in accordance with SOP-028 (Appendix A).

If passive samplers are proposed in the future, a comparability trial will be conducted, and DEQ approval sought prior to incorporation in this SAP-QAPP and the GWMP.

2.3.6 Sample Containers and Preservatives

Sample containers for environmental analysis will consist of certified laboratory supplied glass and plastic bottles. Table 3 lists the sample containers, preservatives, and hold times for COCs for the semi-annual sampling events. The subcontracted analytical laboratory will supply unpreserved and pre-preserved sample containers and VOC trip blanks as needed to complete the scope.

2.3.7 Sample Storage and Transportation

Field samples will be packaged and shipped according to SOP-019 (Appendix A). Coolers are the most common package or containment device used to ship samples. Coolers are also used during sampling efforts to store and transport samples prior to shipping. Samples will be placed in an iced cooler immediately after collection. Any samples not placed on ice immediately upon collection will be discarded and a new sample will be collected.

2.3.8 Sample Handling and Custody Requirements

Custody is one of several factors that are necessary for the admissibility of environmental data as evidence in a court of law. Custody procedures help to satisfy the two major requirements for admissibility: relevance and authenticity. Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final files. Refinery remediation files, including originals of all laboratory reports and purge files, are maintained under document control in a secure area. A sample or file is under your custody if:

1. The item is in actual possession of a person;
2. The item is in view of the person after being in actual possession of the person;
3. The item was in actual physical possession but is locked up to prevent tampering; and/or,
4. The item is in a designated and identified secure area.

2.3.8.1 Chain-of-Custody Procedures

The Chain-of-Custody document records the history of the sample custody from acquisition to ultimate disposal. Samples collected may be used as legal evidence. As such, the hand-to-hand custody from the point of collection to delivery at the laboratory must be clearly documented. For more detailed information regarding Chain-of-Custody procedures refer to SOP-022 (Appendix A).

2.3.8.2 Field Custody Procedures

The sample packaging and shipment procedures summarized below will ensure that the samples will arrive at the laboratory with the Chain-of-Custody intact. The protocol for specific sample numbering and other sample designations are included in Section 2.3.8.5 of this SAP-QAPP.

1. The field sampler is personally responsible for the care and custody of the samples until they are transferred or properly dispatched. Field procedures have been designed to limit the handling of the samples to as few people as possible.

2. All bottles will be identified using sample labels with unique sample numbers, sampling locations, date/time of collection, and type of analysis. The sample numbering system is presented in Section 2.3.8.5 of this SAP-QAPP.

3. Sample labels will be completed for each sample using waterproof ink unless prohibited by weather conditions. For example, a logbook notation would explain that a pencil was used to fill out the sample label because the ballpoint pen may not function appropriately under certain freezing weather.

4. A properly completed Chain-of-Custody form will accompany all samples. The sample numbers will be listed on the Chain-of-Custody form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person, to a mobile laboratory, to the permanent laboratory, or to/from a secure storage area.

5. Samples will be properly packaged and shipped according to procedures found in SOP-019 (Appendix A).

2.3.8.3 Sample Collection

Samples will be collected following SOP-028 provided in Appendix A of this SAP-QAPP. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected (if applicable), volume and number of containers.

2.3.8.4 Sample Labeling

All sample containers will be labeled at the time of sampling. Each label will be completed with the required information and then secured to the container to prevent accidental loss or damage from water or mishandling. Required information on the sample label includes: sample identification number, date, time, and requested analyses. Additionally, any preservatives or special handling instructions will be clearly displayed on the label and the Chain-of-Custody.

2.3.8.5 Sample Identification Numbers

A unique sample identification number (SIN) will identify each sample collected for chemical analyses. These SINs include several key pieces of information such as the well name, and the sampled depth interval (if applicable) or date sampled.

<u>Groundwater Samples</u>
Some examples of nomenclature for water samples follow:

MW-267

Monitoring Well MW-267

MW-267 Duplicate

Duplicate sample from Monitoring Well MW-267

FB-1

Field blank (QA/QC sample)
Nomenclature: Sample type = FB, 1 = first FB collected per event, 2 = second, 3 = third, et. cetera.

TB-

Trip Blank (QA/QC sample)
Nomenclature: as labeled by the analytical laboratory.

2.3.8.6 Field Sampling Notes

All field notes will be recorded in the appropriate field notebooks and will be completed for each sampling location. The following tasks/data shall be recorded in the field notebook, per SOP-002:

1. Daily field report will be completed for each day summarizing that day's activities and observations;

2. Groundwater and LNAPL level measurement data will be recorded for each well gauged; and

3. Groundwater sampling data will be recorded for each monitoring well sampled.

A copy of all field notebook pages with data entries, daily reports, and field notes will be given to the PM after returning from the property, while the originals will be maintained in the field/project notebook for that property. No one shall, at any time, remove information from job files, QA files, or the project notebook for field use or other use. If copies of previous work are required, then arrangements will be made with the Consultant PM or Consultant QAO to copy a portion of the file.

Field notebooks, and/or daily field reports will not be obscured, destroyed, or discarded, even if they contain errors or are illegible. Entries will be described in as much detail as possible so that persons going to the Refinery could reconstruct a particular situation without reliance on memory. All entries will be made in permanent ink, signed, and dated and no erasures will be made. Corrections will be made by drawing a single line through the error and writing in correct information. The use of white-out, obliterating, or writing directly over the erroneous entry will be prohibited. All corrections will be dated and initialed by the person making the correction. Field notebooks, field data sheets, or daily field reports will follow requirements and procedures listed in SOP-002.

2.3.8.7 Laboratory Documentation

Workbooks, bench sheets, instrument logbooks, and instrument printouts are used to trace the history of samples through the analytical process and to document and relate important aspects of the work, including the associated quality controls. All logbooks, bench sheets, instrument logs, and instrument printouts are part of the permanent record of the laboratory. Laboratory supervisors will periodically review laboratory notebooks for accuracy, completeness, and compliance with internal QA/QC procedures. Completed workbooks and instrument logbooks will be submitted to the Laboratory QAO (or designee) for storage.

In general, good laboratory practices require that the following (or equivalent) procedures be used. Each page, or as required, each entry, will be dated and initialed by the analyst when the record is made. Errors in entry will be crossed out in permanent ink with a single stroke. The use of white-out, obliterating, or writing directly over the erroneous entry will be prohibited. The individual making the correction will initial all corrections.

2.3.8.8 Refinery Remediation Files

The Refinery remediation file(s) will be the central repository for all documents, which constitute evidence relevant to sampling and analysis activities as described in this SAP-QAPP. The Refinery and the Environmental Consultant are the custodians of the remediation file(s) and maintain the contents of files for the investigation, including all relevant records, reports, logs, field notebooks, pictures, subcontractor reports and data reviews in a secured, limited access area.

The Refinery remediation file(s) may include hard copies or electronic copies of:

1. Field logbooks;
2. Field data and data deliverables;
3. Photographs;

4. Drawings;
5. Soil boring logs/well construction logs;
6. Laboratory data deliverables;
7. Data validation reports;
8. Data assessment reports;
9. Progress reports, QA reports, project reports, etc.; and
10. All custody documentation (tags, forms, shipping receipts, etc.).

2.3.9 Investigative Derived Waste

Purged water will be collected and processed through the Refinery WWTP or disposed off-site in accordance with SOP-024.

2.4 Quality Control Requirements

2.4.1 Level of Quality Control Effort

Field blanks (if applicable), trip blanks, method blanks, field duplicates, laboratory duplicates, laboratory control, and matrix spike samples will be analyzed to assess the quality of the data resulting from the field sampling and analytical programs.

Field (equipment rinsate) and trip blanks consisting of distilled water will be submitted to the analytical laboratories to help assess the quality of the data resulting from the field sampling program. Field blanks are analyzed to check for procedural decontamination at the Refinery that may cause sample contamination and will be collected if non-dedicated equipment is used for sampling. If required, field blank samples will be collected at a frequency of one per every twenty (20) samples with a minimum of one per each day of sampling.

Trip blanks are used to assess the potential for contamination of samples due to contaminant migration during sample shipment and storage. Trip blanks pertain to samples with VOC analyses only. Trip blanks are laboratory-prepared prior to the sampling event and are kept with the investigative samples throughout the sampling event. They are then packaged for shipment with other VOC samples and sent for analysis. There should be one trip blank included in each sample shipping container that contains bottles for VOC analysis. At no time after their preparation will the sample containers be opened before they reach the laboratory.

Method blank samples are generated within the laboratory and used to assess contamination resulting from laboratory procedures.

Field and laboratory duplicate samples are analyzed to check for sampling and analytical reproducibility. Field duplicates are collected at a frequency of one per twenty (20) samples.

Laboratory control samples provide information on analytical system biases.

Matrix spikes and matrix spike duplicates (MS/MSDs) provide information about the effect of the sample matrix on the digestion, extraction, and/or measurement methodology. All matrix spikes will be performed in duplicate and are referred to as MS/MSD samples. Sample containers will be filled to allow for the collection of one MS and MSD sample per twenty (20) samples collected.

All samples will be sent to the designated approved laboratory for analysis. All analyses will be completed in accordance with the specified methods. The level of laboratory QC effort for this project and the quantitation limits will be in accordance with the laboratory's SOPs, to be supplied by the contracted laboratory selected to perform the work.

2.4.2 Internal Quality Control

The purpose of internal quality control measures is to document the validity of analytical data generated by the laboratory. Laboratory internal quality control may include, but is not limited to, the analysis of blanks, reference standards, analytical spikes, and surrogate spikes. Every analytical series will include some of these controls depending on the analytical methods used. The internal quality controls used by the laboratory will be combined so they are completely representative of every aspect of the analytical task from sample preparation to sample analysis.

The following sections present a summary of, and suggested frequencies for, various quality control measures that may be used dependent upon the analytical method(s) selected.

2.4.2.1 Blank Samples

Blanks are used to assess contamination introduced in transit, storage, or in the laboratory. The types and frequencies of laboratory blank samples are specified by the United States Environmental Protection Agency (USEPA) methods used for analysis.

<u>Method Blanks</u>
Method blanks identify sources of contamination throughout the analytical process, whether a contribution of specific analytes or a source of interference, which will need to be identified, isolated, and corrected. To accomplish this, the method blank must be initiated at the beginning of the analytical process and include all aspects of the analytical work. This includes glassware, reagents, and instrumentation, as well as any other possible source of contamination. Method blanks will meet the criteria specified in the subcontracted laboratory's SOPs or the Analytical Method.

<u>Instrument Blanks</u>
Instrument blanks are analyzed after a sample or dilution has run which contains a target compound at a concentration greater than 25 µg/l, a non-target compound at a concentration greater than 100 µg/l or saturated ions from a compound (excluding compound peaks in the solvent front). The results of the instrument blank analysis indicate whether there is residual contamination in the instrument from a previous sample.

2.4.2.2 Analytical Spikes

The purpose of an analytical spike is to assess the efficiency and proficiency of an analytical series. This includes quantitation standards, sample preparation, instrument set-up, and the premises inherent in quantitation. This control reflects the competency of sample analysis within an analytical series. Matrix and surrogate spikes may also indicate influence of sample matrix interferences that are not within the control of the analyst. The types and frequencies of analytical spikes are specified by the USEPA methods used for analysis.

Laboratory Control Spikes

The LCS is a matrix interference-free blank sample that is spiked with known and verified concentrations of the analytes being measured. The LCS is processed through the same preparation and analytical steps, and the recoveries of the spiked analytes obtained are used to assess the accuracy of the analytical system.

Matrix Spike

Within an analytical series, a representative sample portion is designated as a separate sample and spiked with known concentrations of the analytes under consideration. Advantages of spikes are that the spiked portion is handled and prepared in exactly the same way as the samples. Sample related interference affecting analysis would be reflected in the results from the spiked sample. Results of spikes exceeding tolerances specified by the methods need to be evaluated thoroughly in conjunction with other measures of control.

Surrogate Spike

Surrogates, which have properties similar to the analytes of interest, are compounds unlikely to be found in nature. The intent of a surrogate spike is to provide broader insight to the proficiency and efficiency of an analytical method on a sample specific basis. This control reflects analytical conditions, which may not be attributable to the sample matrix. If results of a surrogate spike analysis exceed method-specified tolerances, then the analytical results need to be evaluated thoroughly in conjunction with other control measures. Re-analysis of the sample with additional controls, or different analytical methodologies, will be necessary.

2.4.2.3 Replicate Analysis

Replicate analysis is a measure of analytical precision and can be limited in its scope. If used in conjunction with reference standards or analytical spikes, it can measure the reliability of the analytical systems. Replicate analyses can be significant in the interpretation of analytical results for samples with complex matrices.

2.4.2.4 Calibration Check Standards

The purpose of a calibration check standard is to assess an instrument's stability. A calibration check standard will be analyzed at the beginning and end of an analytical series or periodically throughout large series of samples. Calibration check standards will be run after every twelve hours. In analyses where internal standards are used, a calibration check standard need only be run at the beginning of an analytical series. If results of the calibration check standard exceed method specified tolerances, then samples analyzed since the last acceptable calibration check standard will be re-analyzed.

2.4.2.5 Internal Standards

Internal standards will be monitored when required by the analytical method. The internal standard is present in all samples to be analyzed with the exception of performance standards. The standard responses must meet the criteria stipulated in the analytical method. If internal standard areas in one or more samples exceed the specified tolerances, then the instrument will be re-calibrated, and all affected samples re-analyzed.

2.4.3 Sampling Quality Control

Several sampling quality control measures will be necessary to assess the integrity of samples collected and determine if the QA objectives discussed in this SAP-QAPP are being met. These measures include the use of field duplicate samples, field blanks (if applicable), and trip blanks to locate possible sources of sample contamination. Table 2 provides a summary of field quality control frequencies.

If using non-dedicated equipment for sampling, field blanks will be collected by running distilled water through or over the parts of the decontaminated sampling devices that contact the samples. The rinsate will be transferred directly to the appropriate laboratory supplied analytical containers. Field blanks will be analyzed for the same parameters as the field samples. It is the sampler's responsibility to collect the appropriate number of field blanks for each sampling activity.

Field duplicate samples will be collected at a minimum frequency of one duplicate sample per every twenty (20) investigative samples.

2.5 Instrument Calibration and Maintenance Requirements

2.5.1 Field Instrument Calibration and Preventative Maintenance

The field equipment for this project may include such items as thermometers, pH meters, conductivity meters, Flame Ionization Detector (FID), or Photoionization Detector (PID), multi-parameter water quality meters and other monitoring equipment as needed. Specific preventative maintenance procedures to be followed for field equipment are those recommended by the manufacturer. Field instruments will be calibrated daily before use, following manufacturer's procedures, and checked as field conditions necessitate through the day. Initial calibration and calibration checks will be documented in the field notebook. The recommended maintenance schedule for field instruments is indicated in Table 4. Critical spare parts such as tape and batteries will be stored on-site to reduce downtime. Backup instruments and equipment will be available on-site or within one-day shipment to avoid delays in the field schedule.

The data quality objectives for field measurements are summarized in Table 5.

2.5.2 Laboratory Instrument Preventative Maintenance

As part of the QA Program Plan, a routine preventative maintenance program is conducted by the analytical subcontractor to minimize the occurrence of instrument failure and other system malfunctions. Designated laboratory employees regularly perform routine scheduled maintenance and repair of (or coordinate with the vendor for the repair of) all instruments. All maintenance that is performed is documented in the laboratory's operating record. All laboratory instruments are maintained in accordance with manufacturer's specifications and the requirements of the specific method employed. This maintenance is carried out on a regular, scheduled basis, and is documented in the laboratory instrument service logbook for each instrument. Emergency repair or scheduled manufacturer's maintenance is provided under a repair and maintenance contract with factory representatives. The laboratory will maintain an adequate supply of all necessary spare parts.

2.5.3 Laboratory Instrumentation Calibration Procedures

Calibration procedures for a specific laboratory instrument will consist of initial five-point calibration, initial calibration verification and continuing calibration verification. The selected analytical subcontractor will provide SOPs describing the calibration procedures for each specific laboratory instrument, including their frequency, acceptance criteria, and the conditions that will require recalibration. Laboratory instrumentation calibration procedures will meet the requirements of the appropriate Method.

2.5.4 Field and Laboratory Consumables

An adequate supply of all supplies and consumables will be available for field and laboratory work. All supplies used in the field and laboratory will be inspected prior to use to ensure that they are free from visible defects. Sampling equipment and analytical supplies will be subject to the various QC measures (i.e., equipment blanks and method blanks) previously discussed. Any unacceptable supplies or consumables will be discarded and replaced with an acceptable item.

2.6 Data Management

2.6.1 Sample Documentation

All sample documents will always be legibly written in ink. Any corrections or revisions to sample documentation shall be made by drawing a single line through the error, writing in the correct information, and initialing any changes. The following sections are provided to outline sample documentation procedures that will be employed when conducting the semi-annual groundwater sampling activities.

2.6.2 Field Data Notes

General field notes will be recorded in the field notebook using permanent ink.

Additionally, a Daily Field Report or equivalent document may be completed at the end of the day summarizing the day's activities and observations. Copies of the documentation will be provided to the Consultant PM as necessary. If copies of previous work are required, arrangements will be made with the Consultant PM.

Field notebooks, or daily field reports will not be obscured, destroyed, or discarded, even if it contains errors or is illegible. Corrections will be made by drawing a single line through the error, writing in the correct information, and initialing any changes. Corrections will be dated and initialed by the person making the correction.

2.6.3 Laboratory Data Reduction, Review and Reporting

2.6.3.1 Data Reduction

Analytical results will be reduced to the concentration units using the equations specified in the analytical procedure. Senior laboratory staff will check the calculations.

2.6.3.2 Data Review

Each laboratory section will provide extensive data review prior to reporting results. In general, there are three levels of data review.

The analyst will be responsible for primary review of data generated from sample analysis. If recoveries of the quality control samples are within the method-specified tolerances, then the data will be presented to data review groups for secondary review. If recoveries of any quality control samples exceed specified tolerances, affected samples will be re-analyzed as required by the method.

Data review groups will conduct secondary review to determine if the analytical results are acceptable. If recoveries of the quality control samples are within the method specified tolerances, then the data will be presented to the Laboratory PM for final review. If recoveries of quality control samples exceed the specified tolerances, affected samples will be submitted for re-analysis as required by the method.

Final review of analytical results will consist of the Laboratory Director's determination that the analytical results of a sample(s) are consistent. If so, the data will be presented in a final report. If discrepancies or deficiencies exist in the analytical results, corrective action will be taken. Audits of final reports by the Laboratory QAO may be conducted to determine the precision, accuracy, completeness, and representativeness of sample analyses.

2.6.3.3 Data Reporting

Data reporting will be in accordance with the appropriate USEPA analysis method and will be prepared in a standard deliverable. Laboratory reports shall, at a minimum, include the following:

1. Narrative including statement of samples received, sample condition upon receipt, description and rationale for any deviations from approved methods/SOPs, summary of data quality, and documentation of any significant problems encountered during analysis;
2. Documentation of laboratory events including date/times of sample receipt, sample preparation or extraction, and sample analysis;
3. Analytical data including method reference, results, reporting limits, dilutions, etc.;
4. A summary of QA/QC results, control limits, and supporting documentation as requested; and
5. A copy of the signed Chain-of-Custody for samples submitted for analysis.

The Laboratory QAO and/or the Laboratory Director should sign the laboratory reports prior to issue. Reports will be issued to the Consultant PM and Consultant QAO. Any draft reports should be clearly identified as such.

2.6.4 Corrective Action

Corrective actions may be required for either analytical and equipment problems or non-compliance problems. Analytical and equipment problems may occur during sampling and sample handling, sample preparation, laboratory analysis, and data review. Non-compliance problems are often associated with non-conformance to this plan or the USEPA methods being used.

2.6.4.1 Laboratory Corrective Action

When deficiencies or "out-of-control" situations exist, the laboratory will provide a means of detecting and correcting these situations. An "out-of-control" situation is defined as data exceeding control limits. Samples analyzed during "out-of-control" situations will be re-analyzed prior to reporting results. The laboratory's corrective action procedures are documented in their QAM and method specific SOPs. In general, there are several levels of "out-of-control" situations that may occur in the laboratory during analysis.

2.6.4.2 Bench Level

Corrective action procedures will often be handled at the bench level. If an analyst finds a non-linear response during calibration of an instrument, then the instrument will be recalibrated before sample analysis. The problem may be corrected by a careful examination of the preparation or extraction procedure, spike and calibration mixes, or instrument sensitivity. If the problem persists, it will be brought to the management level.

2.6.4.3 Management Level

If resolution at the bench level was not achieved, or a deficiency is detected after the data has left the bench level, then corrective action becomes the responsibility of the Laboratory PM or Laboratory Director. Unacceptable laboratory control, matrix, or surrogate spike recoveries detected by data review will be reported to the Laboratory QAO. A decision to re-analyze the sample or report results will be made depending on the circumstance.

2.6.4.4 Receiving Level

If discrepancies exist in either the documentation of a sample or its container, a decision will be made after consulting with the appropriate management personnel. Decisions will be fully documented. Some examples of container discrepancies are broken samples, inappropriate containers, or improper preservation. In these cases, corrective action will involve the Laboratory PM contacting the Consultant PM and/or Consultant QAO.

2.6.4.5 Field Corrective Action

Corrective actions for field equipment problems will consist of reporting the problem to the Consultant PM and/or the Consultant QAO so that maintenance can be performed, or new equipment can be acquired. Non-compliance problems will be reported immediately to the Consultant QAO. The Consultant QAO will consult with the Consultant PM and corrective actions will be initiated. Corrective actions may include resampling when necessary to meet the data objectives. The nature, extent, and corrective action for all non-compliances will be documented.

2.6.5 Quality Assurance Reports to Management

2.6.5.1 Laboratory Internal Reporting

The Laboratory QAO will report the status of the laboratory QA/QC program to the laboratory management. Each report should include:

1. Periodic assessment of measurement data accuracy, precision, and completeness;
2. Results of audits;
3. Significant QA/QC problems and recommended solutions; and
4. Resolutions of previously stated problems.

The laboratory will determine the content and frequency of these reports in accordance with its QAM or SOPs. The laboratory will report to the Consultant QAO or Consultant PM if the laboratory's internal quality control issues have affected the results of the samples.

2.6.5.2 Additional Reporting

Laboratory analytical reports will include a summary of the quality assurance activities and quality control data for the project as related to sample analysis. The Laboratory PM will report suspected field QA/QC problems to the Consultant QAO. The Consultant QAO will report to the Consultant PM when appropriate. These reports may be either oral or written depending upon the nature and complexity of the issues in the report.

The Consultant QAO will report any known issues potentially affecting the quality of the analytical or field data to the Consultant PM. The Consultant PM is responsible for further dissemination of these reports.

2.6.6 Data Management

The raw data obtained during field activities will be recorded on the appropriate field forms or in dedicated field notebooks. This data will become part of the project files to be maintained as previously described in this SAP-QAPP. The analytical subcontractor will maintain all raw data for a minimum of ten (10) years. The analytical subcontractor will not destroy any data or records without the consent of the Environmental Consultant or HFTR. The procedures to be employed for data verification, reduction, validation, and reporting are provided in Section 4 of the SAP-QAPP.

3.0 ASSESSMENT AND OVERSIGHT

3.1 Performance and System Audits

Performance and system audits of both field and laboratory activities may be conducted to verify that sampling and analysis are performed within the constraints of this plan. These audits can either be conducted internally by field or laboratory staff or externally by HFTR or state or federal agencies. The laboratory will participate in any performance or system audit conducted or requested by HFTR or the DEQ.

3.1.1 Performance Audits

Performance audits may be conducted periodically to determine the accuracy of the total measurement system(s) or components. In this program, blind performance evaluation samples, submitted by state agencies, are analyzed and evaluated throughout the year as part of an on-going participation in their certification programs. Any deficiencies in the results of these analyses are reported to the laboratory and corrective action is initiated.

In addition to blind sample analyses, the laboratory will also participate in any audits from state and federal agencies. These agencies submit a report noting any deficiencies and necessary corrective action. The laboratory will respond with evidence of compliance within a limited time.

The laboratory also maintains a schedule of internal audits whereby the Laboratory QAO audits each section of the laboratory. When the audit is completed, a formal report will be issued to the Laboratory Director. This report shall note any deficiencies and a follow-up date to confirm corrective action.

3.1.2 System Audits

A system audit is an evaluation of the various components of the measurement system to assess their proper selection and use. This includes a careful evaluation of all laboratory quality control measures. System audits will be conducted internally by the laboratory.

3.1.3 Field Audits

HFTR or the Environmental Consultant may conduct internal audits of field activities involving sampling and measurements. These audits will include a thorough examination of field sampling records, field instrument operating records, sample collection, shipping and handling, Chain-of-Custody, etc. These audits may occur at the discretion of HFTR or the Consultant PM, the beginning of the project, or when new or modified sampling procedures are introduced to verify that the established procedures are followed. Follow-up audits will be conducted to correct deficiencies, and to verify the QA/QC procedures are being maintained throughout the project. Additionally, audits will occur periodically throughout the monitoring period, especially when changes to sampling teams or subcontractors are implemented. When an audit is completed a written report will be submitted to the Consultant PM and HFTR.

Consultant personnel will participate in any external audit requested by regulatory agencies. The results and recommendations or any external audit should be reported to the Consultant QAO and/or Consultant PM in a timely manner so that corrective actions may be initiated.

3.2 Reports

3.2.1 Internal Reporting

Written reports of field audits will be issued to the Consultant PM. The Consultant PM is responsible for further dissemination of these reports.

The Laboratory QAO (or designees) will report the status of the laboratory QA/QC program to the laboratory management. Each report should include:

1. Periodic assessment of measurement data accuracy, precision, and completeness;
2. Results of audits;
3. Significant QA/QC problems and recommended solutions; and
4. Resolutions of previously stated problems.

The laboratory will determine the content and frequency of these reports in accordance with its QAM and its SOPs. The laboratory will report to the Consultant QAO or Consultant PM if the laboratory's internal quality control issues have affected the results of the Consultant's samples.

3.2.2 Additional Reporting

Laboratory analytical reports will include a summary of the quality assurance activities and quality control data for the project as related to sample analysis. The Laboratory PM will report suspected field QA/QC problems to the Consultant QAO or Consultant PM.

4.0 DATA REDUCTION, VERIFICATION, VALIDATION, AND REPORTING

The quality of field and analytical data must be assessed to ensure that these data are being properly used. To support the conclusions of the assessment, all data must meet the DQOs identified in Section 1.4. All data generated through field activities or by the laboratory operation shall be reduced, verified, and validated prior to reporting. Data shall not be disseminated until it has been subjected to these procedures, which are summarized in subsections below.

4.1 Review of Field Data

Field data reduction procedures will be minimal in scope compared to those implemented in the laboratory setting. Only direct-read instrumentation will be employed in the field. All field data will be written into the field notebook(s) immediately after measurements are taken. If corrections are required, the error will be legibly crossed out with a single line and the correction will be made in a space adjacent to the original. All corrections will be initialed and dated by the individual making the correction. Later, when the results calculation forms required for the Semi-Annual sampling events are being filled out (i.e., corrected LNAPL thicknesses, groundwater elevations, etc.), the FOC will review the forms to determine whether any errors have been made by the field crew.

4.2 Data Validation

Data verification is the process of checking the completeness, correctness, and compliance of data with the field and analytical methods, SOPs, and this SAP-QAPP. Data validation is the process of assessing overall data quality with respect to the PARCC parameters. Data verification and validation procedures shall be performed for both field and laboratory operations as described below.

4.2.1 Procedures Used to Verify and Validate Field Data

The Consultant PM or designee will verify all data generated during field activities. Data verification will consist of reviewing all field data and documentation for transcription errors. Any data that is entered into project databases, spreadsheets, drawings, etc. will be checked against the original field measurements. Field custody records will be checked against the work plan to determine that the appropriate samples were collected. Similarly, the custody records will be checked against the analytical data generated by the laboratory to determine that all requested analyses were complete.

Field measurements will be validated under the direction of the Consultant QAO according to the PARCC parameters. Additionally, the analytical results of field QC samples will be evaluated to determine that the field investigation and sampling methods employed meet the PARCC requirements. Any identified non-compliant data will be evaluated to determine the potential effect on overall validity and usability of the data generated. If the data is determined not suitable for its intended purpose it will not be used and new data may be collected.

4.2.2 Procedures Used to Verify and Validate Laboratory Data

The analytical subcontractor generating the data will perform initial data verification and validation in accordance with individual methods and the laboratory's QA/QC program prior to reporting any analytical results. Data validation on the final analytical data reported by the analytical subcontractor will be performed in accordance with individual methods and national guidelines. Data validation on the final analytical data will be performed by either the Consultant QAO or designee (project- or senior-level scientist).

Data verification and validation is the process through which proper quantification, recording, transcription, and calculations are confirmed. It also confirms that the data is reasonable and complete. The process should be such that errors are minimized and that corrective action steps are taken when errors are detected. The laboratory's data verification and validation processes include three steps: primary, secondary, and final review. The independent data validation is conducted by the Consultant QAO or designee after the laboratory data review process is completed.

4.2.2.1 Primary Review

The analyst performs the initial review of the data. The analyst is responsible for verifying the correctness of the data entered into the Laboratory Information Management System (LIMS). This review includes, but is not limited to, verifying that the quality control indicators (QCI) meet protocol criteria, calibration criteria are met, appropriate detection limits were used, and data was reduced correctly and that any corrective action was documented properly. The primary reviewer is responsible for verifying any documentation associated with the data, completing review records associated with the process, and compiling QC Reports. The analyst must perform primary review on 100% of the data generated.

4.2.2.2 Secondary Review

The Laboratory QAO or designee can be responsible for a secondary review of the data. This step is intended as a validation of the primary review. Secondary review focuses on the calibration criteria, QCIs, compound identification, results expression, reporting limits, and level of documentation. Approximately 10% of the data are validated. If problems exist during this review, the data is returned, a 100% review is done, and corrective action is performed as appropriate.

4.2.2.3 Final Review

The Laboratory PM must perform final review of the completed project prior to releasing the final report. This review ensures that the client requirements have been met and that the final report has been properly completed. The process includes, but is not limited to, verifying that chemical relationships are evaluated, Chain-of-Custody is completed, cover letters/ narratives are present, flags are appropriate, and project specific requirements are met.

4.2.2.4 Data Validation

The Consultant QAO or designee will review the analytical data package and will provide independent validation of the laboratory data according to method and/or regulatory protocols. The basis for validation will be the USEPA Contract Laboratory Program (CLP) National Functional Guidelines for Data Review (most current versions for both organic and inorganic data), modified to accommodate the criteria in the analytical methods reported. Final data qualifiers may be assigned to the original laboratory data reported as a result of the independent validation effort.

4.2.3 Laboratory Data Reporting

After the laboratory has verified and validated the analytical data it will be reported to the Consultant's QAO. The laboratory reports will consist of:

1. A summary page referencing the laboratories sample number, client sample number, date/time collected, and date/time received for each sample submitted.
2. Analytical results for each sample documenting the results, QC flags, units, chronology of analytical events, reporting limits, analyst, dilutions, and method references. Surrogate recoveries and other QC data (as appropriate) are also reported along with the appropriate control limits.
3. Definitions of quality control flags used in report.
4. Notes and comments of any identified QC problems or concerns that potentially affect the quality of the data generated.
5. Copy of the completed Chain-of-Custody record and sample receipt temperature and condition.

Data will also be received electronically from the laboratory in the approved format and uploaded to the project database. These data will be double checked against the hardcopy reports for accuracy and completeness. Final qualifiers assigned during the independent data validation process will also be checked. After being double checked, the data will be tabulated for subsequent presentation for reporting purposes. All finalized tables will be logged and entered into the Consultant's database, which only Consultant employees will have access to.

The original laboratory data received by the Consultant QAO will be maintained in the QA files after the review process is completed. The Consultant QAO will give a copy of all laboratory data to the Consultant PM after review. No one shall, at any time, remove information from job files, QA files, or the project notebook for field use or other use. If additional copies of laboratory data are required, then arrangements will be made with the Consultant's QAO to copy a portion of the file. Job files, QA files, and project notebooks will be kept at the Consultant's office for a period of ten (10) years, after that they will be moved to a secure, fireproof storage facility.

4.3 Reconciliation with User Requirements

Data collected during the semi-annual sampling events will be used to evaluate the current conditions of the dissolved phase and LNAPL plumes beneath the Refinery. These data will be reconciled with the DQOs and PARCC parameters presented in Sections 1.4 and 1.5 of the SAP-QAPP. Specifically, these data will be qualitatively and quantitatively assessed to determine that appropriate sample collection and analytical procedures were used. These assessments will include:

1. Determination of adherence to applicable SOPs;
2. Determination that samples were collected from the proposed sample locations;
3. Evaluation of detection limits, matrix interferences, and other factors potentially biasing data;
4. Evaluation of the data verification results;
5. Evaluation of qualified data for environmental assessment purposes;
6. Determination that the DQO procedures followed and/or refined during the investigation; and
7. Determination if there are any data gaps identified that need further evaluation.

5.0 DISTRIBUTION LIST

5.1 Distribution List

The Distribution List documents who will receive copies of the approved SAP-QAPP and any subsequent revisions or amendments to the SAP-QAPP. The HFTR PM/QAM will assure final copies of the SAP-QAPP are distributed appropriately.

Title	Organization	Distribution Method
RCRA Permit and PM	DEQ	Electronically via permit application
Environmental Specialist - Remediation	HFC	Electronic transmittal
Environmental Consultant PM	Equus	Electronic transmittal
Environmental Consultant PM	HULL	Electronic transmittal
Environmental Consultant PM	TRC	Electronic transmittal
Laboratory PM	ALS	Electronic transmittal
Laboratory PM	Pace	Electronic transmittal

6.0 REFERENCES

A variety of technical manuals, administrative documents, and publications were referred to in preparing this document. Some of the references consulted are presented below. Referenced documents and publications may or may not have been reviewed in their entirety.

HollyFrontier Tulsa Refining LLC. RCRA Permit Application, *Groundwater Monitoring and LNAPL Management Plan*. July 2019.

USEPA. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods. SW-846, 3rd Edition. Updates II and III, 1998.

USEPA. Chapter 21 of Statistical Analysis of Groundwater Data at RCRA Facilities-Unified Guidance, March 2009.

USEPA. Contract Laboratory Program, National Guidelines for Data Review. January 2017.

Tables

Table 1

Summary of Analytes, Method Detection Limits and Practical Quantitation Limits for Groundwater Samples[b,c]

Inorganics U.S. EPA Method 6010		**Water**		
Analyte	**CAS**	**MDL**	**PQL**	**Units**
Antimony	7440-36-0	0.0065	0.015	mg/L
Arsenic	7440-38-2	0.0049	0.010	mg/L
Barium	7440-39-3	0.0015	0.005	mg/L
Beryllium	7440-41-7	0.00016	0.001	mg/L
Cadmium	7440-43-9	0.00045	0.005	mg/L
Chromium	7440-47-3	0.0011	0.005	mg/L
Cobalt	7440-48-4	0.00087	0.005	mg/L
Lead	7439-92-1	0.0030	0.010	mg/L
Nickel	7440-02-0	0.0014	0.005	mg/L
Selenium	7782-49-2	0.0061	0.015	mg/L
Silver	7440-22-4	0.0020	0.007	mg/L
Vanadium	7440-62-2	0.0015	0.010	mg/L
Zinc	7440-66-6	0.0035	0.050	mg/L

Inorganics U.S. EPA Method 7470		**Water**		
Analyte	**CAS**	**MDL**	**PQL**	**Units**
Mercury	7439-97-6	0.00009	0.0002	mg/L

Inorganics Method SM 4500-CN-E		**Water**		
Analyte	**CAS**	**MDL**	**PQL**	**Units**
Cyanide	12408-02-5	0.0019	0.0050	mg/L

VOCs U.S. EPA Method 8260		**Water**		
Analyte	**CAS**	**MDL**	**PQL**	**Units**
1,1,1-Trichloroethane	71-55-6	0.00011	0.0010	mg/L
1,1-Dichloroethane	75-34-3	0.00005	0.0050	mg/L
1,2-Dichloroethane	107-06-2	0.00012	0.0010	mg/L
1,1-Dichloroethene	75-35-4	0.00012	0.0002	mg/L
cis-1,2-Dichloroethene	156-59-2	0.00006	0.00008	mg/L
trans-1,2-Dichloroethene	156-60-5	0.00006	0.00008	mg/L
Carbon Disulfide	75-15-0	0.00012	0.0050	mg/L
Chloroform	67-66-3	0.00014	0.0010	mg/L
Benzene	71-43-2	0.00006	0.0010	mg/L
Ethylbenzene	100-41-4	0.00018	0.0010	mg/L
Methyl Ethyl Ketone (MEK)	78-93-3	0.00059	0.0100	mg/L
Methyl tert-butyl ether (MTBE)	1634-04-4	0.00006	0.0010	mg/L
Tetrachloroethene	127-18-4	0.00010	0.0010	mg/L
Toluene	108-88-3	0.00017	0.0010	mg/L
Trichloroethene	79-01-6	0.00017	0.0010	mg/L
Vinyl Chloride	75-01-4	0.00017	0.0020	mg/L
Xylene (Total)	1330-20-7	0.00042	0.0030	mg/L

Table 1

Summary of Analytes, Method Detection Limits and Practical Quantitation Limits for Groundwater Samples[b,c]

SVOCs U.S. EPA Method 8270[a.]		Water		
Analyte	**CAS**	**MDL**	**PQL**	**Units**
1-Methylnaphthalene	90-12-0	0.0095	0.0095	mg/L
2-Methylnaphthalene	91-57-6	0.00025	0.0095	mg/L
2,4-Dimethylphenol	105-67-9	0.00057	0.0095	mg/L
2-Methylphenol (o-Cresol)	95-48-7	0.00027	0.0095	mg/L
3,4-Methlyphenol (m&p-Cresol)	multiple	0.00070	0.0095	mg/L
Acenaphthene	83-32-9	0.00034	0.0095	mg/L
Anthracene	120-12-7	0.00029	0.0095	mg/L
Benzo(a)anthracene	56-55-3	0.00028	0.0095	mg/L
Benzo(a)pyrene	50-32-8	0.00034	0.0095	mg/L
Benzo(b)fluoranthene	205-99-2	0.00033	0.0095	mg/L
Benzo(k)fluoranthene	207-08-9	0.00040	0.0095	mg/L
bis(2-Ethylhexyl)phthalate	117-81-7	0.00059	0.0095	mg/L
Chrysene	218-01-9	0.00034	0.0095	mg/L
Dibenz(a,h)anthracene	53-70-3	0.00043	0.0095	mg/L
Diethylphthalate	84-66-2	0.00043	0.0095	mg/L
Di-n-butylphthalate	84-74-2	0.00037	0.0095	mg/L
Fluoranthene	206-44-0	0.00035	0.0095	mg/L
Fluorene	86-73-7	0.00032	0.0095	mg/L
Indeno(1,2,3-cd)pyrene	193-39-5	0.00030	0.0095	mg/L
Naphthalene	91-20-3	0.00034	0.0095	mg/L
Phenanthrene	85-01-8	0.00032	0.0095	mg/L
Phenol	108-95-2	0.00010	0.0095	mg/L
Pyrene	129-00-0	0.00027	0.0095	mg/L

a. Polycyclic aromatic hydrocarbons by analytical method SW 8270 SIM.
b. Laboratories will use the most current method version for which they are accredited.
c. Method detection limits (MDLs) and practical quantitation limits (PQLs) will vary based upon laboratory-derived limits.
d. Please refer to laboratory SOPs for additional information.
e. Groundwater samples collected from wells with high concentrations of COCs will have elevated reporting limits due to sample dilution. The reporting limits for samples requiring dilutions will be dependent upon analyte concentrations within the samples.

Table 2

Field and Laboratory Quality Control Frequencies

QUALITY CONTROL SAMPLES	FREQUENCY OF SAMPLES
Field Samples	
Field Sample Duplicate	Typically one groundwater duplicate sample for every 20 or fewer samples.
Matrix Spike/Matrix Spike Duplicate	Typically sample volume for one MS/MSD is collected in the field for every 20 or fewer groundwater samples.
Field (Equipment Rinsate) Blank	Typically one field blank for every 20 or fewer groundwater samples with a minimum of one per each day of sampling. Field blanks will only be collected when non-dedicated equipment is used.
Trip Blanks	One blank per sample shipment of VOC sample vials (i.e., one blank per cooler containing VOC sample vials).
Laboratory Samples	
Initial Calibration	Sample analysis cannot proceed without a valid initial calibration.
Continued Calibration Checks	Every 12 hours or 20 samples, which ever is sooner. Recalibrate as required by the method.
Laboratory Control Samples including Method Blanks and Blank Spikes	Every 12 hours or 20 samples, which ever is sooner. Recalibrate as required by the method.
Tune Standard	One per batch.
Laboratory Control Spikes/Spike Duplicates	Every 20 samples.
Surrogates	A minimum of three surrogates at retention times across the GC run.
Internal Standards	A minimum of three standards at retention times across the GC run.

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Table 3

Summary of Sample Containers, Preservation Methods and Holding Times[1]

Parameter	Analytical Method[2]	Bottle Type	Preservation	Holding Time[3]
WATER				
Region 5 Modified Skinner List Volatile Organics (VOCs)	U.S. EPA Method 8260	(3) 40 ml glass vials	HCL to pH<2 Cool to 4°C	14 days
Region 5 Modified Skinner List Semivolatile Organics (SVOCs)	U.S. EPA Method 8270	(2) 1000 ml glass bottle (amber)	Cool to 4°C	7 days to extraction 40 days from extraction to analysis
Region 5 Modified Skinner List Semivolatile Organics (PAHs)	U.S. EPA Method 8270 SIM			
Region 5 Modified Skinner List Inorganics (Metals[4])	U.S. EPA Method 6010	(1) 500 ml plastic bottle (one bottle for both analyses 6010 and 7470)	HNO_3 to pH<2 Cool to 4°C	180 days
Mercury	U.S. EPA Method 7470			28 days
Cyanide	U.S. EPA Method SM 4500-CN-E	(1) 500 ml plastic bottle	NaOH to pH>12 Cool to 4◦C	14 days
Total Dissolved Soilds	U.S. EPA Method 160.1	(1) 250 ml plastic bottle	Cool to 4°C	7 days

Notes:

1. These are typical containers; containers may vary, and containers may be combined during the sampling process.
2. Laboratories will use the most current method version for which they are accredited.
3. All holding times are measured from date of collection.
4. Metals for POC wells include: antimony, arsenic, barium, beryllium,cadmuim, chromium, cobalt, lead, mercury, nickel, selenium, silver, vanadium, and zinc.

Table 4

Preventative Maintenance for Field Instruments

INSTRUMENTS	MAINTENANCE PROCEDURES/SCHEDULE	SPARE PARTS IN STOCK
Multi-parameter water quality sonde with flow through cell	1. Calibrate beginning and end of each day, and as necessary during use. 2. Check probes/membranes daily for wear or damage. 3. Replace probes/membranes as needed. 4. Replace batteries as needed.	1. Battery charger 2. Calibration Solutions 3. Clean flow through cell as needed.
Water Level Indicators and Oil-Water Interface Probes	1. Check probe function before use. 2. Service as needed. 3. Replace batteries as needed.	1. Spare Batteries.

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Table 5

QA Objectives for Field Measurements

PARAMETER	INSTRUMENTS	PRECISION [a.]	ACCURACY [b.]
Immiscible Layer Detection and Measurement	Oil-Water Interface Probe (or similar)	+/- 0.01 ft.	+/- 0.01 ft.
Static Groundwater Levels	Water Level Indicator or Oil-Water Interface Probe (or similar)	+/- 0.01 ft.	+/- 0.01 ft.
Temperature	Multi-parameter water quality sonde	+/- 0.1^{o} C.	+/- 0.35^{o} C.
Specific Conductivity	Multi-parameter water quality sonde	+ 0.001 to 0.1 mS/cm (range dependent)	+ 0.5% of reading +0.0001 mS/cm
pH	Multi-parameter water quality sonde	+/- 0.01 pH units	+/- 0.2 pH units
Dissolved Oxygen	Multi-parameter water quality sonde	+/- 0.01 mg/L	+/- 2% of readings for 0.2 mg/L which ever is greater for 0-20 mg/L range +/- 6% of readings for 20-50 mg/L range.
Oxidation - Reduction Potential	Multi-parameter water quality sonde	+/- 0.1 mV	+/- 0.5 mV

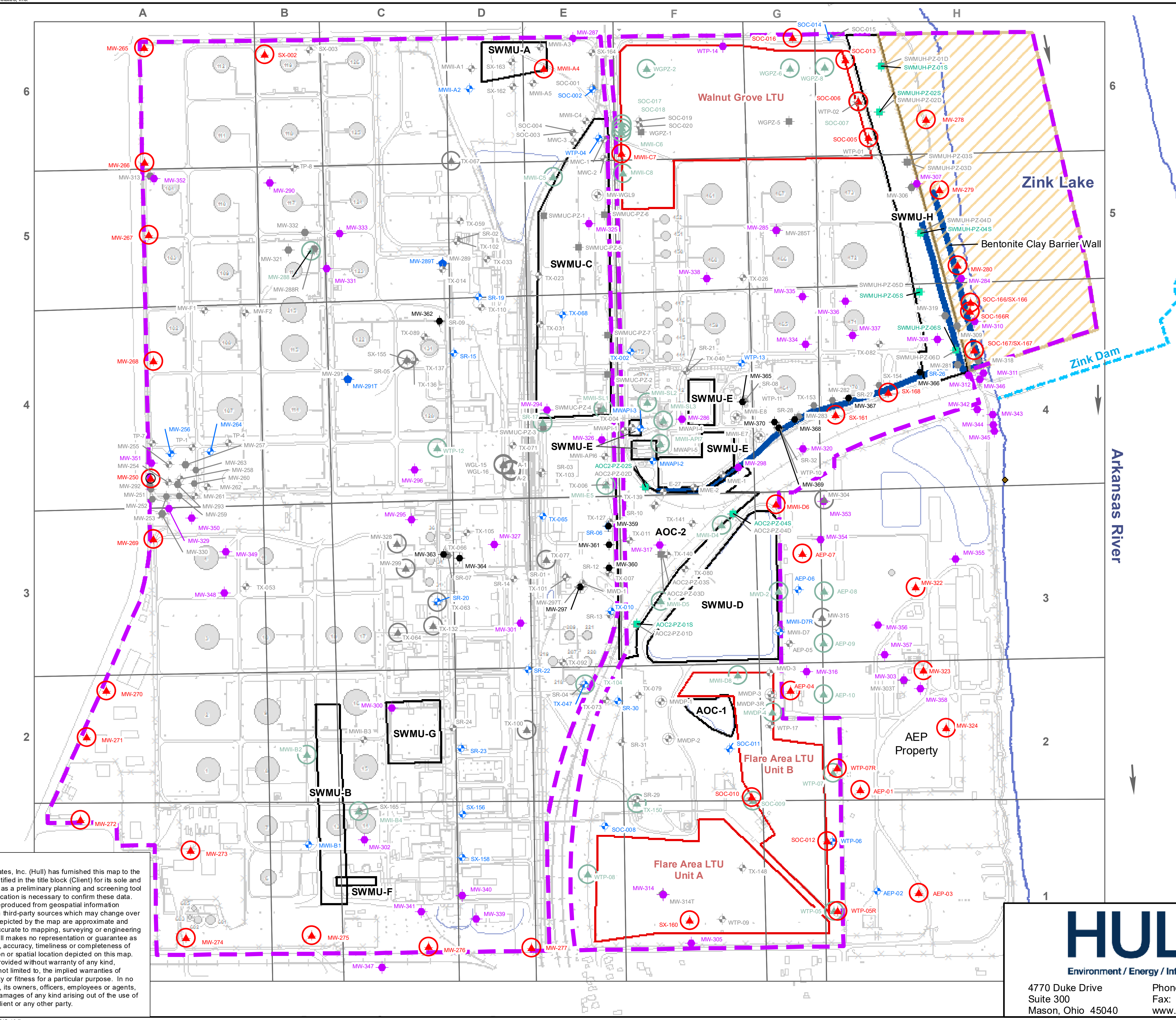
NOTES:
a. Expressed as the acceptable deviation from the Scale.
b. Expected based on equipment manufacturer specifications.

Table 6

Preventative Maintenance for Analytical Instruments

INSTRUMENT	ACTIVITY	FREQUENCY
Gas Chromatograph/ Mass Spectrometer	Replace pump oil	Monthly/as needed
	Change septa	As needed
	Change gas line dryers	When pressure reaches 100 psi
	Clean source	Semi-annually/as needed
	Replace electron multiplier	As needed/poor sensitivity
	Injector port cleaning	As needed/poor sensitivity
	Leak check septum	As needed/when leak suspected
	Check gas flow	As needed
	Clean VOA purge glassware	As needed
	Cut capillary column	As needed
	Replace liner	As needed/contamination suspected
Gas Chromatograph	Change septa	As needed
	Clean gas line dryers	As needed
	Change syringes on autosamp	As needed
	Leak check	When installing columns
	Injection port cleaning	As needed
	Check inlet system for buildup	Periodically
Purge and Trap Sample Concentrator	Replace trap	As needed
	Decontaminate system	As required by blank analysis
	Check system for leaks	As needed
Graphite Furnace Atomic Adsorption Spectrometer	Change graphite contact rings	As needed
	Clean quartz windows	As needed
	Change tubes	As needed
Inductively Coupled Plasma Spectrometer	Change sample rinse lines	As needed
	Clean nebulizer components	As needed
	Clean torch assembly	As needed
	Clean filters	As needed
	Clean Mirrors	As needed
Inductively Coupled Mass Spectrometer	Change pump tubing	As needed
	Clean nebulizer components	As needed
	Clean torch assembly	As needed
	Clean sampler and skimmer co	As needed
	Change roughing pump oil	As needed
pH/Conductivity Meter	Clean electrodes	As needed
	Fill electrodes	As needed

Figures



- Refinery Property Boundary
- Property Leased to River Parks Authority
- LTUs
- SWMUs & AOCs
- Tanks
- Low Water Dam
- Bentonite Clay Barrier Wall
- Railroad
- Fence
- Stream/Pond
- Riverbank
- Outfall

Monitoring Locations

- Point of Compliance Well
- Point of Compliance Well operating as LNAPL Recovery Well
- Program Gauging Wells and Piezometers:
  - Program Monitoring Well
  - Program LNAPL Recovery Well
  - Program LNAPL Transmissivity Monitoring Well
  - Program LNAPL Investigation Monitoring Well
  - Program Piezometer
- Non-Program Double Cased Well With Screen Below Top Groundwater Level
- Non-Program Monitoring Wells
- Abandoned Well
- Destroyed Well
- Non-Program LNAPL Recovery Well
- Non-Program LNAPL Transmissivity Monitoring Well
- Non-Program LNAPL Investigation Monitoring Well
- Non-Program Piezometer

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May 2020

HollyFrontier Tulsa Refining LLC
(Tulsa East Refinery)
Permit No. 990750960-PC
Appendix 3.1 – Sampling and Analysis Plan
and Quality Assurance Project Plan

Facility
Base Map

902 West 25th Street
Tulsa, Tulsa County, Oklahoma

Figure
3.A-1

Produced using ArcGIS 10.7

File Name: HRM319_12_Fig03A1_FacilityMap.mxd

Edited: 9/14/2020 By: rkalp

ATTACHMENT A
STANDARD OPERATING PROCEDURES

SOP INDEX

STANDARD OPERATING PROCEDURE
GROUNDWATER SAMPLING
EQUIPMENT DECONTAMINATION
(SOP-001)

Reviewed By:_______________________________Date:______________

Approved By:_______________________________Date:______________

Approved By:_______________________________Date:______________

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LIST OF ATTACHMENTS

STANDARD OPERATING PROCEDURE
GROUNDWATER SAMPLING EQUIPMENT DECONTAMINATION
(SOP-001)

1.0 SCOPE AND APPLICABILITY

It is estimated that over 50 percent of all errors in environmental analysis result from incorrect sampling. There are five (5) objectives to any groundwater sampling event. These objectives are:

- The safety of the person performing the sampling
- Obtaining a representative sampling of the material being tested
- Preventing contamination of the sample
- Providing legal documentation of the sampling event
- Protecting the sample from chemical, physical or biological change prior to analysis

During sampling activities that involve potentially hazardous substances, personnel may have their personal protective gear contaminated by those substances through the course of the work effort; and, in addition, sampling equipment may become contaminated. Since contamination of this sort is not always easily discernible, it is necessary to assume that all personnel and equipment have been contaminated.

Effective decontamination procedures minimize the potential for cross contamination, offsite contaminant migration (the transfer of contaminants to areas outside the exclusion zone, usually by improperly decontaminated equipment), or personnel exposure from improperly decontaminated protective gear.

1.1 PURPOSE OF PROCEDURE

The purpose of this Standard Operating Procedure (SOP) is to describe decontamination procedures for groundwater sampling equipment. Groundwater sampling equipment can be defined as any equipment that is placed "downhole" in order to obtain measurements or collect groundwater samples.

1.2 SCOPE COVERED BY SOP-001

This procedure describes general decontamination requirements for groundwater sampling equipment, required site facilities and supplies, disposal procedures, and typical decontamination solutions.

1.3 APPLICABILITY

Groundwater equipment decontamination procedures as described herein are applicable for groundwater sampling events and shall be conducted as specified in the Work Plan, Field Sampling Plan (FSP), or other parent document referencing this SOP. In the event there is a conflict in specifications presented herein with those presented in the parent document referencing this SOP, then the specifications in the parent document will be followed to the extent that they are different.

1.4 DEFINITIONS

1.4.1 Contamination

Contamination during groundwater sampling is defined as the introduction of substances not found at the sampling location or the increase of known constituents at the sampling location due to the failure to remove such substances or constituents. These substances or constituents are commonly called contaminants. Uncleaned or improperly cleaned equipment is often called "dirty" or contaminated.

1.4.2 Decontamination

Decontamination is the process of neutralization through washing, rinsing, and removing of contaminants from exposed surfaces of groundwater sampling equipment so that the potential for contamination migration is minimized. Properly decontaminated sampling equipment is often called "clean".

1.4.3 Cross Contamination

When applied to groundwater sampling activities, cross contamination is the transfer of contaminants, usually from one sample to another, by improperly decontaminated sampling equipment, containers, or measurement devices.

1.4.4 Health and Safety Considerations

The decontamination process may involve exposure to impacted groundwater via routes of dermal contact and inhalation. Accordingly, field personnel should follow the precautions and procedures and use the appropriate personal protective equipment as described in the approved Health and Safety Plan (HASP).

Decontamination solutions may also present an exposure hazard. Detergents such as Liquinox® can cause skin irritation with prolonged contact. Organic solvents can cause central nervous system effects as well as eye and skin irritation. Acid solutions may be corrosive to skin, eyes, and the upper respiratory tract.

At a minimum, water-resistant gloves and safety glasses shall be worn when performing equipment decontamination using a detergent solution. Solvex® gloves and safety glasses must be worn when performing equipment decontamination using organic solvents. Equipment decontamination using organic solvents shall be performed in a well-ventilated area. The decontamination basin and exhaust fan shall be utilized when this operation is performed in the warehouse or other enclosed space. Organic solvent shall not be allowed to enter the basin drain. The Field Services Technician shall be notified within 24 hours after use of any solvent other than acetone. This notification is necessary because quantities must be monitored, and a permit may be required if the type of solvent and quantity meet or exceed federal and/or state criteria.

Neoprene gloves, rubber apron, safety glasses, face shield, and a half-face respirator equipped with acid gas cartridges shall be worn by personnel preparing acid solutions. This operation shall be performed in a well-ventilated area.

Personnel performing equipment decontamination using a 10% acid solution shall wear Solvex® gloves and safety glasses. A face shield and a rubber apron shall be worn where there is a high potential for splashing.

2.0 PERSONNEL QUALIFICATIONS

Personnel performing decontamination procedures shall be properly trained in field sampling and decontamination techniques. Such training will be done by placing any new employee with an experienced employee until the new employee has become proficient in the decontamination techniques. All personnel performing groundwater sampling activities shall be proficient in each of the decontamination methods described in this SOP. Occasional on-site field audits conducted by the Environmental Department will ensure that field personnel continue to perform decontamination procedures correctly.

3.0 EQUIPMENT AND MATERIALS

Since the expected types and levels of contaminants at a site and the methods used to investigate them will vary from site to site, a decontamination plan should be customized and of sufficient detail to address the conditions and contaminants at the site.

3.1 GENERAL CONSIDERATIONS

The level of effort needed for decontamination should be determined prior to beginning the field work and shall be commensurate with the level of contamination anticipated . Procedures for personal decontamination of field personnel shall be specifically addressed in the site-specific HASP. These HASP procedures shall be followed and will be incorporated with the groundwater sampling equipment decontamination procedures contained in this SOP to limit personnel exposure and cross-contamination potential. Decontamination activities shall be documented to verify that proper procedures are followed. Quality assurance samples, such as rinsate samples and equipment blanks, should be collected as required by the Quality Assurance Project Plan (QAPP).

Decontamination procedures may be subject to federal, state, or local regulations along with any client requirements. All such requirements must be satisfied, but the procedures adopted should be no less stringent than those presented in this SOP.

Climatic conditions anticipated during the decontamination activities may play a significant factor in the procedures selected. Special facilities may be necessary to compensate for weather conditions such as high heat, extreme cold or wind-blown dust.

3.2 SITE FACILITIES AND SUPPLIES

3.2.1 Site Selection

The equipment decontamination site should be in an area where contaminants can be controlled and at the boundary of a "clean" zone. The location should also be selected to prevent equipment from being exposed to additional or other types of contamination including airborne contaminants. For large projects, a formal "Contamination Reduction Zone" may be established in which all decontamination activities will be conducted. Personnel not involved with the decontamination process should not enter this area.

The decontamination area should have sufficient storage facilities for unused drums, used drums containing spent decontamination fluids and waste, and trash containers.

3.2.2 Water Supply

Large volumes of water (potable, distilled, and/or deionized) may be required for decontamination procedures. Municipal water supplies are generally considered adequate for use as potable water for initial sampling equipment decontamination. Distilled water is purified potable water that typically has a specific conductance of 60 µmhos/centimeter or less. Deionized water is ultra-purified water that has a specific conductance of less than 10 µmhos/centimeter. The lower the specific conductance, the more pure or "clean" the water is. Distilled or deionized water is often used as a final rinse during small equipment decontamination. To ensure that the water supplies are clean, analysis of the water at its source and after it has been stored in a tank may be performed prior to use of the water at the site.

3.2.3 Special Organic or Metals Rinse Solutions

Solvents, such as acetone, hexane, or methanol, may be utilized to decontaminate sampling equipment in cases where a detergent wash solution will not remove all organic residues from sampling equipment. When solvents must be utilized, only pesticide grade or purer solvent is acceptable.

When the analytes of interest include metals, a dilute nitric acid or a dilute hydrochloric acid rinse may be used to assure that sampling equipment is free from metal contaminants. Whenever it is necessary to utilize an acid rinse, only trace- metals-free concentrated acid should be used to prepare the rinse solution. Do not use a nitric acid rinse to clean stainless steel sampling equipment. Nitric acid can remove metals from the stainless steel. At extremely critical work sites, both a dilute nitric acid and a dilute hydrochloric acid rinse may be desired; otherwise, for most work sites only one (1) acid rinse solution is necessary and either nitric acid or hydrochloric acid is acceptable.

3.3 CLEANING EQUIPMENT AND SUPPLIES

Decontamination of groundwater sampling equipment may require tubs or buckets to contain the wash and rinse solutions. Garden sprayers may also be utilized for final rinsing or as part of the initial cleaning. Typically, these sprayers are for use with small hand tools or sampling equipment. Sprayers tend to break down and malfunction and, therefore, should not be relied upon as the sole method of decontamination.

Decontamination solutions, other than potable, distilled, or deionized water, may be required to adequately clean the equipment or neutralize some contaminants. These solutions can vary from low sudsing detergent and water, to various organic solvents, to dilute solutions of acids. Occasionally, even more specialized decontamination solutions will be necessary. As these specialized solutions would be very site-specific and would be defined in a specific FSP, no further discussion of these solutions is included in this SOP. Any necessary concentrated materials or liquids must be stored in a protected environment. Storage areas must be secure, and flammable chemicals should be located away from buildings and high traffic areas. Federal, state, or local laws may dictate the storage methods of these solutions. A list of general purpose compounds/solutions used for decontamination, their mixing ratios and typical uses is provided in **Table 001-T01**.

Miscellaneous items required for decontamination procedures may include some of the following:

- Brushes - to remove mud, dust, etc. or to scrub sampling equipment
- Plastic sheeting or bags - to wrap decontaminated equipment after cleaning or to contain spent fluids
- Paper towels - to dry equipment
- Plastic or stainless steel tubs or buckets - to contain decontamination solutions and rinse water
- Plastic squeeze bottles, garden sprayers, stainless steel trays to contain additional decontamination solutions (such as solvents or dilute acid solutions)

Attachment 001-A01 to this SOP presents a checklist of decontamination equipment typically utilized for hazardous waste investigations. Supplies other than those shown on this checklist may also be needed.

3.4 GENERAL SAMPLING EQUIPMENT DECONTAMINATION PROCEDURES

All sampling equipment that may contribute to the potential contamination of a sample must be thoroughly decontaminated prior to each use. All sampling equipment shall be assumed to be contaminated unless specific documentation exists that the sampling equipment has been properly decontaminated. Examples of specific documentation include vendor certified pre-cleaned sample containers, or sampling equipment that is sealed in plastic (bailers, etc.). Vendor certification paperwork shall be retained in corporate files to verify that equipment was certified to meet the cleaning standard(s) specified. Any equipment that does not appear to meet specified standards shall be decontaminated prior to use.

Most sampling equipment can be cleaned by hand. The following procedure is given as a typical sequence. This sequence should be modified to be consistent with on-site conditions:

- Using a brush, scrub with potable water to remove mud and residue
- Using a brush, scrub with a detergent-potable water solution or other decontamination solution
- Rinse with clean potable water using tubs or sprayer
- Triple rinse with distilled and/or deionized water
- Dry equipment with paper towels
- Pack and seal equipment in plastic bags or other appropriate containers to prevent recontamination unless equipment is to be used immediately

The wash solution and the rinse solutions must be changed whenever they are visibly dirty (i.e., visible dirt, oily residue, etc.).

Retention of used decontamination fluids will vary from site to site. Unless otherwise specified in the project Work Plan, FSP, or QAPP, all decontamination fluids will be contained in properly labeled containers and held for appropriate disposal.

3.5 SPECIFIC SAMPLING EQUIPMENT DECONTAMINATION

Standard decontamination procedures for various pieces of groundwater sampling equipment are discussed below.

3.5.1 Water Level Indicator

Unwind cable from the water level indicator (WLI) reel and place in the wash bucket or tray filled with a solution of potable water and Liquinox®. Use a soft-bristle brush to remove gross contamination from the probe end taking care not to damage the sensor. Using a soft-bristle brush, clean substantially more cable than will be placed down hole. Transfer the cleaned cable and sensor to a rinse bucket/tray (or series of rinse buckets/trays) and rinse with potable water. Transfer the clean, rinsed cable and sensor to a final distilled/deionized water rinse bucket/tray and rinse at least two times with distilled/deionized water. The WLI reel should be placed on a clean sheet of heavy plastic so that any loose cable does not come in contact with the ground surface. Rewind the cable onto the WLI reel. Clean paper towels can be used to dry the cable as it is replaced onto the reel. Clean the sensor holder prior to replacing the WLI sensor in the holder. A decontaminated WLI can be placed in a large, clean plastic bag to help keep it clean between sampling locations.

3.5.2 Interface Probes

Cleaning interface probes is similar to cleaning WLIs. The sensor storage compartment should be cleaned in addition to the sensor and cable. Solvent rinses may be necessary if the Liquinox® wash does not remove all traces of organic contaminants. Follow the same basic protocol presented in Section 3.5.1. for cleaning the interface probe. Field personnel should not place a contaminated sensor in the storage compartment prior to decontaminating the sensor. As with WLIs, the interface probe can be placed in a large, clean plastic bag immediately following decontamination to keep it clean between sampling locations. Do not use acetone to clean the interface probe.

3.5.3 Total Depth Tapes

Regardless of the nature of any real or suspected well impact, special care should always be taken to ensure that all parts of a total depth (TD) tape including the actual stainless steel tape, weight and reel are clean prior to use. In addition, TD tapes present an additional decontamination challenge when they are used to measure total depth in wells with free-phase hydrocarbon present. Special brushes, tubs or trays, and/or solvents may be necessary to properly clean the TD tape between wells. It is also necessary to unreel more tape than was placed downhole into a tub and scrub with a brush in order to remove any traces of free-phase hydrocarbon that might have migrated from the outer portions of the stainless-steel tape to the inner portion of the tape. A decontaminated TD tape can also be placed in a large, clean plastic bag to help keep it clean between sampling locations.

3.5.4 Bailers

Disposable bailers are frequently used to obtain groundwater samples. These bailers are purchased pre-cleaned from the manufacturer and are individually wrapped in plastic. As long as these bailers are not allowed to come in contact with potentially contaminated surfaces (i.e., the ground surface), no additional cleaning is necessary.

Re-useable bailers are cleaned at a stationary location and are also wrapped in plastic. Cleaning bailers at the job site is not normally recommended. Special brushes and stainless steel trays must be transported to the job site to use for bailer decontamination. Unless otherwise specified, the general cleaning protocol is followed and special solvent rinses may or may not be used depending upon the analytes of interest for the site. Bailers should be taken apart for cleaning. Scrub the check valves and the male and female threads of each connection well. Re-assemble the bailer after the final rinse has been performed. Clean bailers should be placed in plastic sleeves to keep them clean until use.

3.5.5 Flexible Plastic Tubing

Flexible plastic tubing, often called poly pipe, is used in conjunction with submersible pumps to purge wells of stagnant groundwater. The standard cleaning protocol for poly pipe is to decontaminate the outside of the pipe and rely on the stagnant groundwater that moves through the pipe to flush out any contaminants from the inside of the poly pipe. The poly pipe comes in large, bulky coils, and it is very difficult for one (1) individual to adequately clean the pipe. Whenever large tubs are not available for decontaminating pipe, clean, heavy plastic sheeting must be placed underneath the coil of pipe to aid in keeping the pipe from coming in contact with the ground. Scrub brushes and Liquinox® wash solution are used to remove contaminants from the outside of the pipe. The various rinse solutions needed can be poured directly over the pipe or can be sprayed onto the pipe. The pipe should be rinsed well with a final distilled/deionized rinse. Cleaned poly pipe can be placed on another clean sheet of heavy plastic or in a clean, large plastic tub. To help assure that the poly pipe is thoroughly decontaminated, use clean paper towels to dry the poly pipe as the pipe is threaded down into the well.

Another type of flexible plastic tubing is used with low flow peristaltic and bladder pumps for purging and sampling monitor wells. This tubing is purchased on reels that should be placed in plastic bags upon receipt from the vendor. Normal decontamination of this tubing is to wipe any tubing that will be placed downhole with paper towels moistened with distilled/deionized water. If the tubing reel is not stored in a plastic bag, then a detergent solution wash followed by the appropriate series of rinse solutions shall be used. As with the larger poly pipe, the purging activities are usually relied upon to flush any contaminants from the inside of the tubing.

All plastic tubing or pipe shall be discarded in an appropriate manner immediately following initial use unless otherwise specified in the FSP. Used plastic tubing or pipe will not be decontaminated and reused at another project site.

3.5.6 Submersible Grundfos Pumps

Submersible pumps are cleaned by placing the pump into a bucket or deep tub of potable water and Liquinox® solution (The electrical cable and the safety cable can be cleaned using the protocol for the WLI, which is described in Section 3.5.1.). The pump controller is turned on and the solution is circulated through the pump. It may be necessary to remove the intake screen on the pump in order to clean it properly. The manufacturer's instructions should be consulted to see if components need to be removed in order to adequately clean the pump. After the wash solution has been circulated through the pump, the pump should be placed into the different water rinse solutions. Neither organic solvents, such as acetone or hexane, nor dilute acid solutions shall be circulated through the pump. The controller should be turned on and each rinse solution circulated through the pump. The final rinse consists of circulating distilled/deionized water through the pump. Following the final rinse, any components that were removed for cleaning should be re-assembled. A clean pair of gloves shall be used to perform any necessary re-assembly. A decontaminated pump can be wrapped in plastic until it is ready for use.

3.5.7 Low-Flow Bladder Pumps

These pumps are decontaminated by disassembling the pump body, disposing of the pump bladder, and scrubbing the internal ports using the supplied brushes. As always, follow the Liquinox® and water wash with three separate rinses of deionized/distilled water.

Reassemble pump, installing new bladder. A clean pair of gloves shall be worn during reassembly of the pump. The flexible tubing used with these pumps is single use only and should be disposed of as described in Section 3.5.5.

3.5.8 Downhole Sensing Instruments

Downhole sensing instruments include dissolved oxygen probes, conductivity probes, Hermit transducers, and any other sensing probe or instrumentation that is placed into a well. The typical cleaning protocol is the same as the protocol presented in Section 3.5.1. Take extreme care not to damage the sensors. The manufacturer's instructions should be consulted for all pieces of specialized equipment in order to determine whether solvents can or cannot be used on the equipment and whether brushing or rubbing the sensors can damage them. The cleaning protocol should be modified accordingly so that equipment is not damaged but is decontaminated to the greatest extent possible.

4.0 QUALITY CONTROL AND QUALITY ASSURANCE

In order to verify that the equipment cleaning protocol is acceptable, many sampling events will include the submittal of at least one (1) equipment or rinsate blank sample for laboratory analysis for the analytes of interest for a particular project. While results for this type of sample will also include any bias inherent to the procedure and to the laboratory, the results are used to determine that the equipment decontamination protocol has been effective in removing any target analytes that might be present on the sampling equipment and whether the source water is truly "clean".

An equipment blank is prepared by pouring laboratory-supplied reagent-grade water over a piece of sampling equipment that has been cleaned using the specified decontamination protocol. The equipment should be cleaned using the exact same protocol used for all other equipment. An equipment blank that is prepared from inadequately cleaned equipment (cleaned using a different protocol than the protocol used during the actual sampling event being conducted) or that is not prepared from true downhole equipment has no value because it does not assess the true cleaning protocol or conditions that the groundwater samples are subject to .

5.0 REFERENCES

EPA SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, U.S. Environmental Protection Agency, Office of Solid Waste, Washington, DC (May 1996).

OSWER-9950.1, RCRA Ground-Water Monitoring Technical Enforcement Guidance Document, U.S. Environmental Protection Agency, Washington, DC (September 1986).

PBS-181557, A Compendium of Superfund Field Operations Methods, U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC (December 1987)

Smith, Dr. R.K., Handbook of Environmental Analysis, Genium Publishing Corporation, Schenectady, NY (1993).

TABLES

Table 001-T01: General Purpose Decontamination Solutions

Chemical	Solution	Uses/Remarks
Clean, Potable Water	None	Used to remove mud, dirt, or other residues as an initial rinse or to prepare designated solutions.
Distilled/Deionized Water	None	Use as intermediary rinses and as the final rinse for general purpose decontamination. Deionized water is more highly purified than distilled water and may be necessary for some sites.
Low-Sudsing Detergent	Liquinox – Use approximately 1 teaspoon per gallon of potable water; for other detergents-follow manufacturer's directions.	Generally used as a wash solution on most sites; best choice on sites where contaminant is unknown or a wide range of contaminants exists.

Attachment 001-A01
Checklist of Decontamination Equipment

- ☐ Potable Water Supply
- ☐ Distilled/Deionized Water Supply
- ☐ Decontamination Solution(s)
- ☐ Detergent ☐ Liquinox ☐ Other
- ☐ Solvent:______________________________
- ☐ Other:______________________________
- ☐ Cleaning Accessories
  - ☐ Soft-bristle Brushes
  - ☐ Buckets
  - ☐ Trays
  - ☐ Garden Sprayers
  - ☐ Squeeze Bottles
  - ☐ Long handle Brushes (for cleaning bailers)
  - ☐ Plastic Sheeting/Bags
  - ☐ Paper Towels

Notes: ______________________________

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STANDARD OPERATING PROCEDURE
FIELD ACTIVITY DOCUMENTATION - FIELD BOOKS
(SOP-002)

Reviewed By:________________________________Date:______________

Approved By:________________________________Date:______________

Approved By:________________________________Date:______________

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STANDARD OPERATING PROCEDURE
FOR FIELD ACTIVITY DOCUMENTATION - FIELD BOOKS
(SOP-002)

1.0 SCOPE AND APPLICABILITY

The purpose of Standard Operating Procedure 002 (SOP-002) is to describe the procedures for acquiring and using a Field Book (FB) for recording data and observations during field activities as required by Work Plans or other project-specific documents such as Sampling and Analysis Plan (SAP), or Quality Assurance Project Plan (QAPP).

1.1 SCOPE OF SOP-002

This Standard Operating Procedure (SOP) describes the procedures for obtaining a project FB, listing the essential elements that shall be recorded in the FB, and describes document control system for FBs.

1.2 APPLICABILITY

All field activities at a site should be recorded in original form at the time they are conducted in a bound FB. Documentation to be recorded shall include:

- Notation that a site briefing on the task to complete and health and safety took place before field work was conducted
- Weather conditions
- Names of all personnel at the Site
- All sampling activities (planned and revised)
- Field testing and analysis results
- Labeling and chain-of-custody information
- Information regarding decontamination of personnel and equipment
- Sample packaging and shipping information
- Instrumentation calibration and maintenance information, as required per the field instrument

The types of field activities which require the above record keeping include, but are not limited to:

- Drilling, well installation, grouting, and well development activities
- Hydrogeologic testing and sampling
- Air monitoring
- Field audits
- Phase I Site Assessments
- Environmental investigation (general)
- Remediation/construction oversight
- Other field activities as required

Field documentation as described herein shall be conducted for all activities as specified in the Work Plan (WP) or other project-specific documents. In the event there is a conflict in specifications presented herein with those presented in the WP referencing this SOP, then the specifications in the WP will supersede the SOP specifications. FB documentation is not required for site visits where field activities as described above are not conducted.

1.3 STANDARD TERMS

Attachment 002-A01 to SOP-002 contains definitions for standard terms that are acceptable for use as entries into FBs. Use of standardized terms ensures that all personnel have the same understanding when using these defined terms.

2.0 PERSONNEL QUALIFICATIONS

All personnel that perform field activities shall be familiar with the requirements of SOP-002 prior to beginning the field activities requiring documentation. Additionally, training on the use of equipment and materials is required.

3.0 EQUIPMENT AND MATERIALS

3.1 FIELD BOOK

Each FB shall consist of a bound book, preferably with waterproof paper and pre-numbered pages. The individual recording observations or field data in any FB that is not pre-numbered shall number the pages of the book with sequential numbers located in the upper right-hand corner of each page.

Personnel shall utilize an assigned project FB for documenting field activities for a specific project. All field personnel should have at least one (1) spare FB with them at any time they are required to go to a project site.

3.2 WRITING UTENSILS

All entries recorded in a project FB will be made using either blue or black indelible ink or waterproof marker. Use of a pencil is not acceptable. Field personnel should carry an ample supply of spare writing utensils.

4.0 DOCUMENT CONTROL SYSTEM FOR FIELD BOOKS

4.1 FIELD BOOK INITIATION

Each FB shall be initiated when it is determined that field activities will commence. The following information, at a minimum, shall be recorded on the front of each FB:

- Client and/or project name and/or location,
- Project number, and
- FB number.

A FB number, which consists of a three-digit number that will be sequential, will also be assigned in the event that multiple FBs are needed for a project. The sequence number will begin with the number 001, then 002, 003, etc.

Whenever practical (determined by the size of the FB), the client and/or project name and project number shall also be recorded on the spine of the FB. Upon initiation of a FB the initiation information will be entered into the FB Tracking Form. This will document the start, status, and end of FB use.

4.1.1 Initiation of a Spare Field Book

Under some circumstances, personnel may find it necessary to initiate a FB while at a project field site. For example, this could occur because the assigned project FB has become full. The steps below shall be followed whenever a FB is initiated at a field site.

- Contact the QA/QC team as soon as possible with the pertinent information regarding the initiation of the new FB (project name, project number, sequence number, date initiated, and name of the individual retaining custody of the FB). The QA/QC team will record the information in the FB Tracking Log (**Attachment A002-A02**).
- Use a black waterproof marker to record the information discussed in Section 4.1 on the front and, if appropriate, the spine of the FB.
- The first entry in the new FB shall be a notation that the book has been initiated and is checked out by the individual initiating the book. Record the date the entry

is made. Make a notation in the FB that the QA/QC team has been notified of the new FB, unless the QA/QC team initiated the field book.

4.2 FIELD BOOK ORGANIZATION

The first two (2) pages in each field book are reserved for specific information described in Section 4.2.1 and Section 4.2.2 below. The remaining pages in the FB are for field activity documentation.

4.2.1 Field Book Initiation Documentation

A notation of the date the FB is initiated will be made on the first page. The individual initiating the FB shall include their name in the initiation notation. For example:

- Book initiated on April 8, 2013 by Jane Smith

4.2.2 Signatures

Following the FB initiation documentation, the printed name, written name, and initials of each person that makes entries into the FB will be recorded. An example is show in **Attachment 002-A04** This will help to determine which entries were made by various personnel using the FB.

4.2.3 Ownership

All FBs are the property of the client for which the project is being performed and the consultant. Only pertinent project information shall be recorded in the project FB.

4.3 RETURNING A FIELD BOOK TO CENTRAL FILES

All FBs shall be retained by the field team member(s) and provided to the QA/QC team upon completion of the field activities to determine all pertinent information has been recorded. Original field books, after closure of a project, will be maintained in the central files by the QA/QC team.

4.4 OBTAINING AN ESTABLISHED FIELD BOOK

Once a FB has been initiated it will be available for use. Each FB shall be retained in the QA/QC team files until the FB is checked out for use. The QA/QC team shall obtain the appropriate FB from their files to provide it to a member of the field team for upcoming project field work.

5.0 DOCUMENTATION GUIDELINES

The purpose of the FB is to fully document a field activity. Individuals making entries into the FB should ask themselves whether the field activity that is being documented can be re-created by another individual who is unfamiliar with the site by using only a site map and the FB notes. If not, then the level of detail of the field notes is insufficient and more details are necessary. In the case of a legal proceeding, notes, if referred to, can be subjected to cross-examination and are admissible as evidence. Both FBs and personnel (including other personnel in addition to the original note taker) are subject to subpoena. All FB entries should be factual, detailed, objective, and unbiased. At no time should a personal opinion be recorded in a FB.

The type of information that shall be recorded in the field notes is listed in Section 5.1 below. In addition, an example of typical FB entries is included in **Attachment 002-A04**. Even though specific information is required for FB entries, the format of information entry is left to the discretion of the individual making the entry. Individuals may use a tabular format where possible for conciseness and ease of use. This type of information may be duplicated on a form or may be transcribed to a form; however, the bound logbook record will take official precedence over transcribed or duplicated form records when the same data (whether conflicting or agreeing) is contained in both.

In some cases it may become necessary to augment existing FB entries. Any such entry shall be noted as such making it clear that the new information was not made at the time the original work was performed. Reference the “Error Codes” presented in **Table 002-T01**.

5.1 REQUIRED INFORMATION

The following list includes information that shall be included in FB documentation:

- Date and signature of person who checked out the FB
- Date and time of arrival at the field site
- Purpose of the site visit
- Documentation of site safety briefing per the site-specific HASP and review of field activities to be performed
- Signatures of all persons making current entries into the FB

- Weather conditions (daily, or as weather conditions change)
- Names of all personnel present at the site (daily)
- Field equipment unit numbers or other identification number (i.e., serial number)
- Calibration readings of all daily-required field instruments including initial calibration, continuing calibration, and any appropriate notes
- Record lot number and expiration dates for all calibration standards.
- Method of sample collection and any factors that may affect sample quality.
- Equipment and/or personnel decontamination procedures utilized
- Actual field measurements, including, at a minimum, actual measurement results and units of measurement.
- Any health and safety monitoring measurements as indicated by the Health and Safety Plan.
- Documentation of any relevant conversations (such as discussion with a client representative)
- Documentation of any problems encountered (i.e., well lock broken, well pad cracked, etc.) (daily).
- Photograph details
    - Approval to take photographs
    - Time, date, description of photograph
    - Name of photographer
- Initials of each person making entries at the bottom of each page.
- A diagonal line on blank space of any incompletely filled page (see **Attachment 002-A04** for examples) with the signature or initials of the last one to use the field book.

- Date, signature, and notation by person who returns the FB to the QA/QC team when either the FB is completed or the project is completed.

5.2 CORRECTION OF ERRORS

All errors in the FB shall be corrected by drawing only one (1) line through the entry. The initials of the person making the correction, along with the date of the correction shall be entered near the error. Additionally, appropriate error correction can also be found in the example of typical FB entries in **Attachment 002-A04**.

Wherever possible, error codes shall be utilized to explain why it was necessary to change a FB entry. The error code should be written near the correction and should be circled to make it clear that the entry is an error code. Proper error codes are listed in **Table 002-T01**.

6.0 REFERENCES

EPA SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, U.S. Environmental Protection Agency, Office of Solid Waste, Washington, DC (June 1997).

EPA 330/9-78-001-R, NEIC Policies and Procedures, U.S. Environmental Protection Agency, Office of Enforcement, Denver, Colorado (August 1991).

OSWER-9950.1, RCRA Ground-Water Monitoring Technical Enforcement Guidance Document, U.S. Environmental Protection Agency, Washington, DC (September 1986).

PBS-181557, A Compendium of Superfund Field Operations Methods, U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC (December 1987).

TABLE 002-T01
ERROR CODES

Error Code	Description
CE	Calculation error correction
CL	Changed for better clarity
DC	Original sample description changed after further evaluation
NI	Not initialed and dated at the time of entry
OB	Not recorded at the time of initial observation
RE	Recording error
TE	Transcription error
SE	Spelling error
WO	Write over

ATTACHMENT 002-A01
STANDARD TERMS AND ABBREVIATIONS

Soil

SB	Soil Boring (SB-1)
BH	Bore Hole (BH-2)
HA	Hand Auger Boring (HA-1)
BGL	Below Ground Level
SS	Surface Soil Sample, usually for 0.0 – 0.5 feet
GS	Ground Surface
S	Sediment Sample (S-3)
SP	Soil Probe (SP-6)

When collecting soil samples, always record the depth interval that was sampled. BH-1 (2.0 – 3.0 feet BGL)

Water

WL	Water Level
SW	Surface Water sample (SW-3)
TD	Total Well Depth
TOC	Top of Casing
DTW	Depth to water
MW	Monitoring Well (MW-4)
DTP	Depth to Product

General

VOA/VOC	Volatile Organic Analysis/Volatile Organic Compounds
SVOA/SVOC	Semi-Volatile Organic Analysis/Semi-Volatile Organic Compounds

ATTACHMENT 002-A02
FIELD BOOK TRACKING LOG

FIELD BOOK TRACKING LOG

Date Initiated	Client	Project Name	Project Number	Book Number	Book Status	Book Location	Date Closed
7/9/2013	Acme Brick & Anvil, Inc.	Remedial Investiation - Soil	ABAHFRG001	1	Active	Field Book Cabinet	

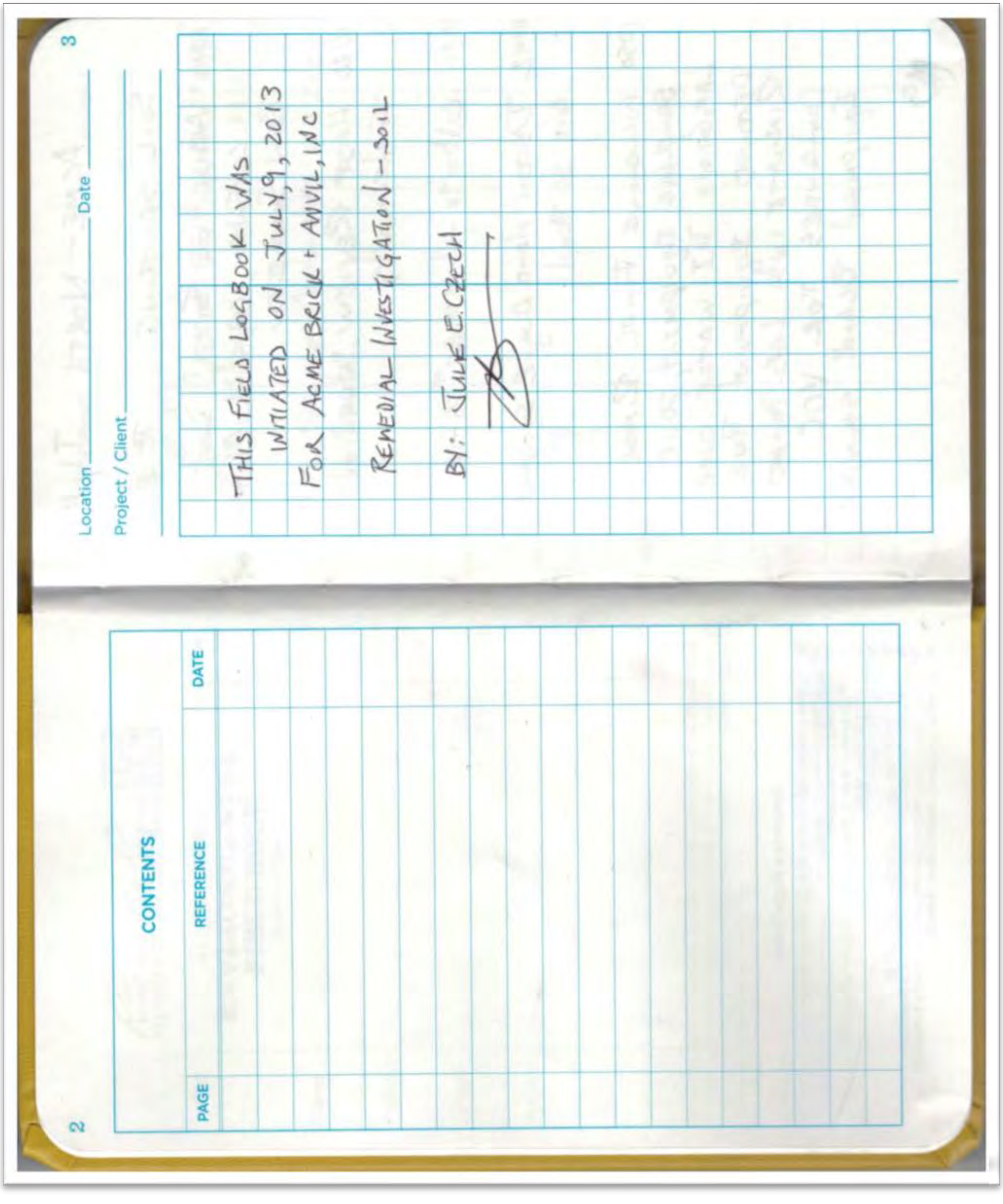
ATTACHMENT 002-A03
FIELD BOOK LOG

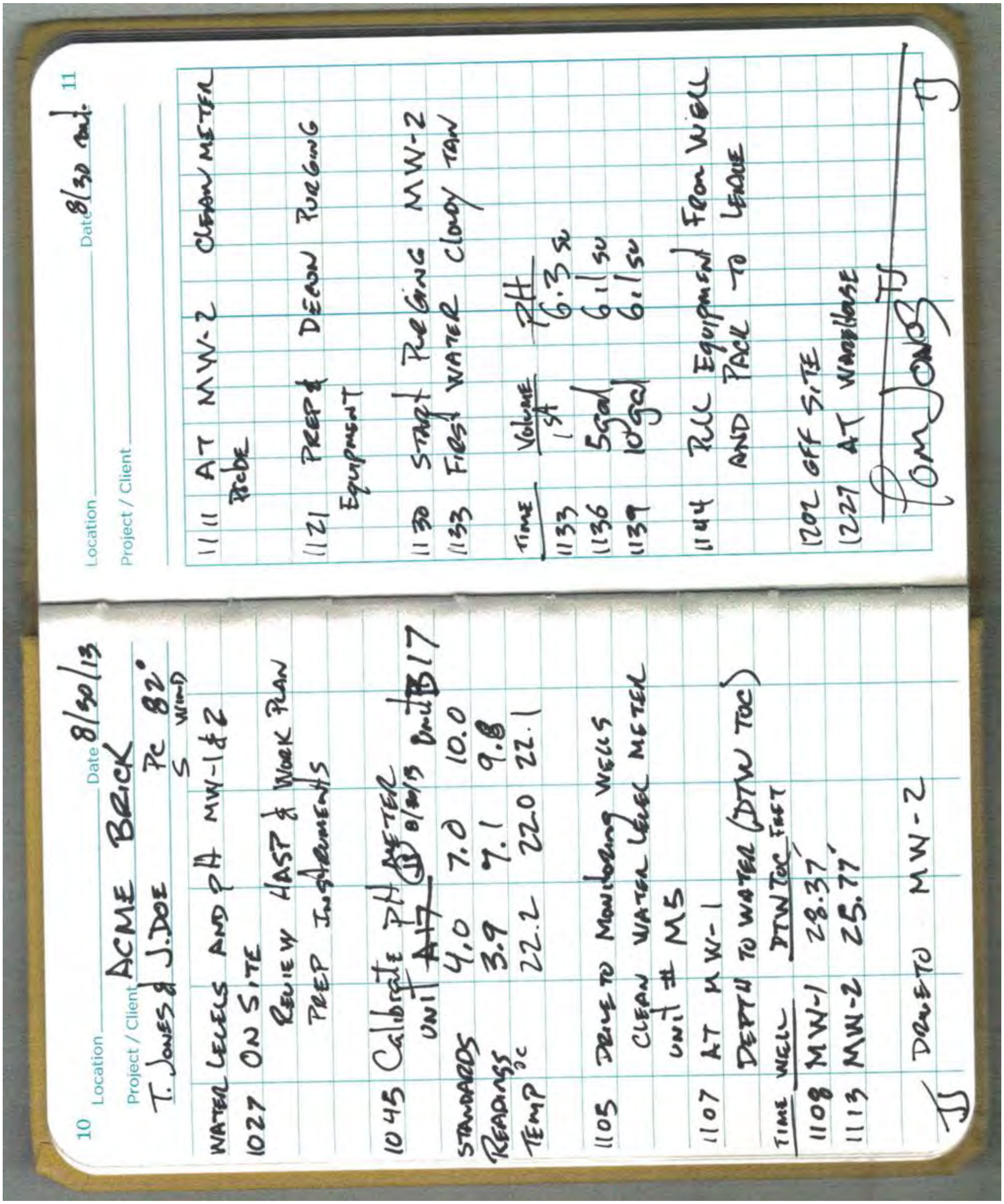
FIELD BOOK LOG

Name	Date Out	Project Name	Project Number	Book #	Returned By	Date In	Copies To	Date Routed	Date Filed
Tom Jones	8/29/13	Acme Brick	ABAHFRG001	1	JJ	8/30/13	JC	9/1	9/1/13
C Clearwater	8/29/13	Alpha Bravo	ABCGHUT013	3	CC	9/30/13			

C:\Users\CherieA\Dropbox\General\Field Book Log.xlsx

ATTACHMENT 002-A04
FIELD BOOK ENTRIES





10 Location ______ Date 8/30/13

Project / Client ACME BRICK

T. JONES & J. DOE   PC 82°
S WIND

WATER LEVELS AND pH MW-1 & 2

1027 ON SITE
REVIEW HASP & WORK PLAN
PREP INSTRUMENTS

1045 Calibrate pH METER
UNIT ~~A17~~ JJ 8/30/13 Unit B17

STANDARDS	4.0	7.0	10.0
READINGS	3.9	7.1	9.8
TEMP °C	22.2	22.0	22.1

1105 DRIVE TO MONITORING WELLS
CLEAN WATER LEVEL METER
UNIT # M5

1107 AT MW-1
DEPTH TO WATER (DTW TOC)

TIME	WELL	DTW TOC FEET
1108	MW-1	28.37'
1113	MW-2	25.77'

DROVE TO MW-2
JJ

Location ______ Date 8/30 cont. 11

Project / Client ______

1111 AT MW-2 CLEAN METER PROBE

1121 PREP & DECON PURGING EQUIPMENT

1130 START PURGING MW-2
1133 FIRST WATER CLOUDY TAN

TIME	Volume	pH
1133	1st	6.3 su
1136	5 gal	6.1 su
1139	10 gal	6.1 su

1144 PULL EQUIPMENT FROM WELL AND PACK TO LEAVE

1202 OFF SITE
1227 AT WAREHOUSE

Tom Jones TJ
TJ

STANDARD OPERATING PROCEDURE
MONITORING WELL DEVELOPMENT
(SOP-008)

Reviewed By:____________________________________Date:________________

Approved By:____________________________________Date:________________

Approved By:____________________________________Date:________________

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STANDARD OPERATING PROCEDURE-
MONITORING WELL DEVELOPMENT
(SOP-008)

1.0 SCOPE AND APPLICABILITY

1.1 PURPOSE OF PROCEDURE

Standard Operating Procedure-008 (SOP-008) describes the minimum acceptable requirements for developing monitoring wells or piezometers as described in the Work Plan, Sampling and Analysis Plan, or as otherwise specified for the purpose of characterizing subsurface groundwater conditions at the site.

In the event there is a conflict in specifications presented herein with those presented in the parent document which may reference this SOP, then the specifications in the parent document will be followed to the extent which they are different.

1.2 SCOPE COVERED BY SOP-008

This procedure describes general requirements and considerations for groundwater monitoring well or piezometer development, well purging and evacuation equipment, and general procedures for well development.

1.3 APPLICABILITY

Monitoring well development as described herein shall be conducted for all wells or piezometers as specified in the Work Plan or other parent document referencing this SOP. In the event there is a conflict in specifications presented herein with those presented in the parent document referencing this SOP, then the specifications in the parent document will be followed to the extent which they are different. The procedures presented herein are required for all environmental personnel.

1.4 DEFINITIONS

None.

2.0 PERSONNEL QUALIFICATIONS

Personnel performing well development shall be properly trained in Health and Safety, field sampling and well development techniques. Such training will be done by placing any new employee with an experienced employee until the new employee has become proficient in the well development techniques. All personnel performing groundwater sampling activities shall be proficient in the well development methods described in this SOP or be under direct supervision of a qualified person.

3.0 HEALTH AND SAFETY

This procedure may involve exposure to impacted groundwater via routes of dermal contact and inhalation. Well development is the first exposure to a monitoring well, and related groundwater impacts, following the installation activities. Accordingly, field personnel should follow the precautions, procedures, and use the appropriate personal protective equipment (PPE) described in the approved Health and Safety Plan (HASP).

At a minimum, appropriate chemical-resistant gloves, safety glasses and steel toed boots shall be worn when performing well development activities. Review the Site specific HASP prior to preparation for well development activities to be aware of the specific PPE requirements.

4.0 EQUIPMENT AND MATERIALS

Equipment required is dependent on the method used for development of the well and partially on the potential groundwater impacts. All equipment to be placed into the well will be clean, either new, unused, or previously decontaminated.

- Gather together monitoring well installation information, Work Plan, or equivalent, Site map, and HASP

- Assemble well development equipment and supplies from approved vendors, including but not limited to

  - PPE
  - Liquid level meter
  - Organic vapor meter (OVM), if volatile organic compounds (VOCs) are potential impact
  - Pump, bailer or air compressor to purge well
  - Surge block
  - Drums for purge water containment
  - Labels
  - Water quality parameter meter(s)
  - Field book
  - Decontamination equipment and supplies
  - Tools

5.0 PROCEDURE

5.1 GENERAL REQUIREMENTS AND CONSIDERATIONS

Well development shall be conducted for all monitoring wells and piezometers and is required for the following reasons:

- To restore the natural permeability of the formation adjacent to the borehole.
- To remove clay, silt and other fines from the filter pack and well screen so that subsequent water samples will not be abnormally turbid or contain undue suspended matter.
- To remove foreign materials such as remnant drilling fluids from the well, filter pack, and aquifer that were introduced during the time of drilling and well installation.
- To remove pH changed/affected groundwater that may have occurred during the well grouting operation.

All well development and groundwater sampling equipment (including pumps, hoses, containers, and bailers) will be decontaminated prior to introduction into wells or piezometers to be developed. Decontamination procedures in SOP-001 should be followed.

5.2 DEVELOPMENT METHODS AND PROCEDURES

Following completion of the monitoring well installations, all wells should be thoroughly developed. The purpose of monitoring well development is to remove any fluids lost to the formation during drilling (if fluids were used in the drilling process) and ensure proper development of the sand pack and formation surrounding the screen. To ensure proper curing of the cement-bentonite grout seals, no development will occur for at least 24 hours following well completion. Monitoring wells should not be sampled within 48 hours of well development.

Prior to development, the water levels within the well and the total well depth will be measured and recorded in accordance with SOP-009. These measurements will be used to calculate the fluid volume in the wells and sand pack prior to development. Water levels should be taken and recorded before, during and after well development. In the event volatile organics are a potential groundwater impact an OVM should be used to monitor the air quality at the top of casing (TOC) of the well and in the operator breathing zone (OBZ).

Development will consist of the removal of sufficient volumes of groundwater until the discharged water is relatively free from suspended sediment and the pH, specific conductance, and temperature of the groundwater has stabilized. In addition, any fluids lost during drilling will be recovered and, if practicable, this quantity plus at least three times the casing and sand pack volume (assume 30% porosity) will be removed. Field conditions, such as well yield and quality of filter pack may have bearing on expected development quality. All development water will be captured and managed in accordance with SOP-024. Measurements of the discharge volume, pH, temperature, and specific conductivity.

The basic procedure for well development is to remove any drilling fluids, silt, clay fines and sands from the well, well screen and surrounding gravel pack. Provided that the formation recharge rate is high enough, groundwater will flow from the formation, through the gravel pack and screen, and into the well. The groundwater flowing from the formation and sand pack will carry loose particles into the well to be removed.

The typical well development methods used are surging, over-pumping, and bailing. Obtaining the highest possible yield is not usually an objective in well development and vigorous development is not always necessary. The choice of an appropriate method to develop a well is based on site conditions and project objectives as outlined in a Work Plan, Sampling and Analysis Plan (SAP), Field Sampling Plan (FSP), or Quality Assurance Project Plan (QAPP). To ensure proper curing of the cement-bentonite grout seals, no development will occur for at least 24 hours following well completion.

- Surging involves raising and lowering a surge block or surge plunger inside the well. This forces water through the well screen and into the sand pack and formation and loosens sediment pulled from the formation into the well. Sediments accumulated in the well will need to be removed with a bailer or pump.
- Surging may also be accomplished through the use of compressed air. The air is used as an air lift to evacuate the well and to agitate the water column and well screen. The agitation and evacuation process are repeated until the well is sufficiently free of sediment.
- Over-pumping involves pumping at a rate rapid enough to draw the water level in the well as low as possible and then allowing the well to recharge to the original level. The process is repeated until sufficiently sediment free water is produced.
- Bailing involves the use of a bailer to remove water from the well. The process is repeated until sufficiently sediment-free water is produced. In some cases, potable water may be added to assist in developing a poor-yielding well. In this instance, the volume of water used must be added to the standard quantity removed from a well for development.

5.2.1 Well Casing Evacuation

Using the depth to water, well depth, and filter pack interval (assume a porosity of 30%), calculate the minimum volume of groundwater to remove from each well. The following equations should be used to calculate the volume of groundwater:

(1) Casing water volume is $V_c = \pi r_c^2 h_c \times 7.48$; where:

V_c = The volume of water in casing, gallons

r_c = Radius of casing, feet

h_c = Height of water column in casing, (TD – DTW) feet

7.48 = Conversion factor from cubic feet to gallons

(2) Annular water volume is $V_s = (\pi r_s^2 h_s - \pi r_c^2 h_{cs}) \times 7.48 \times 0.30$; where:

V_s = The volume of water in the saturated sand pack interval, gallons

r_s = Radius of drilled borehole, feet

h_s = Height of saturated sand pack interval, feet

r_c = Radius of casing, feet

h_{cs} =Length of casing/screen in sand pack interval, feet

0.30 = Estimated porosity of sand pack

7.48 = Conversion factor from cubic feet to gallons

The minimum amount of water that should be removed from the well for well development equals three casing volumes (V_c) plus the three sand pore volumes (V_s).

(3) The volume to be removed is $V = 3(V_c + V_s)$

If a well is incapable of yielding three well volumes, then the well will be surged and evacuated to dryness, multiple times if possible) and allowed to recover. If necessary, potable water may be added to the well to assist in developing. All purged groundwater will be collected and stored for proper disposal.

Purged water shall be tested periodically for pH, temperature, and specific conductance. Readings shall be compared to ensure that water quality in the well has stabilized. Stabilization is indicated when the above parameters vary less than 10 percent for at least three consecutive readings. In some instances turbidity of the purge water can be monitored to evaluate the progress of the well development.

6.0 DOCUMENTATION

Prior to development, the water levels within the well and the well depth will be measured and recorded in accordance with SOP-009. These measurements will be used to calculate the fluid volume in the wells and sand pack prior to development. Measurements of the discharge volume, pH, temperature, and specific conductivity along with observations of water clarity will be recorded on field forms or in the field logbook. Water levels may be taken and recorded before, during and after well development.

7.0 REFERENCES

Practical Guide to Ground Water Sampling, United States EPA, EPA/600/2-85/104, September 1985.

RCRA Ground-Water Monitoring: Draft Technical Guidance, United States EPA Office of Solid Waste, November 1992.

RCRA Ground-Water Monitoring Technical Enforcement Guidance Document (TEGD), OSWER- 9950.1, September 1986.

United States EPA Environmental Response Team SOP 2044 rev 0.1, November 23, 2001.

STANDARD OPERATING PROCEDURE
GROUNDWATER LEVEL MEASUREMENTS
(SOP-009)

Reviewed By:____________________________________Date:________________

Approved By:____________________________________Date:________________

Approved By:____________________________________Date:________________

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STANDARD OPERATING PROCEDURE
FOR GROUNDWATER LEVEL MEASUREMENTS
(SOP-009)

1.0 SCOPE AND APPLICIBILITY

1.1 PURPOSE OF PROCEDURE

Standard Operating Procedure-009 (SOP-009) describes the minimum acceptable requirements for obtaining groundwater levels in monitoring wells and piezometers.

1.2 SCOPE COVERED BY SOP-009

This procedure describes the minimum requirements for conducting water level measurements of groundwater, discrete water level measurements, and continuous water level measurements.

1.3 APPLICABILITY

Water level measurements as described herein are applicable for groundwater sampling events and shall be conducted as specified in the Work Plan, Sampling and Analysis Plan (SAP), or other parent document referencing this SOP. In the event there is a conflict in specifications presented herein with those presented in the parent document referencing this SOP, then the specifications in the parent document will be followed to the extent they are different.

1.4 DEFINITIONS

1.4.1 Water Table Elevation

Water table elevation is the elevation of the groundwater surface in an unconfined aquifer or confining bed at which the pore water pressure is atmospheric.

1.4.2 Total Hydraulic Head

Total hydraulic head is the sum of the elevation head, the pressure head, and the velocity head at a given point in an aquifer.

1.5 HEALTH AND SAFETY CONSIDERATIONS

This procedure may involve exposure to impacted groundwater via routes of dermal contact and inhalation. Accordingly, sampling personnel should follow the precautions, procedures, and use the appropriate personal protective equipment described in the approved Health and Safety Plan. Care shall be exercised to avoid direct skin contact with the water or well contaminants on equipment during and after measuring.

2.0 PERSONNEL QUALIFICATIONS

Personnel performing groundwater level measurements shall be properly trained in field sampling and water level measurement techniques. Such training will be done by placing any new employee with an experienced employee until the new employee has become proficient in the water level measurement techniques. All personnel performing groundwater sampling activities shall be proficient in methods described in this SOP. Occasional on-site field audits conducted by the Environmental Department will ensure that field personnel continue to perform water level measurements correctly.

3.0 EQUIPMENT AND MATERIALS

3.1 GENERAL REQUIREMENTS

Water level measurements shall be obtained at wells and piezometers designated in the Work Plan or SAP. Water levels should be referenced to a common elevation datum for the entire site, preferably to a USGS benchmark. Water depths within wells and piezometers shall be referenced to the top of the casing, which is, in turn, referenced to a permanent benchmark. Water level measurement devices shall be decontaminated as per SOP-001.

3.2 DISCRETE WATER LEVEL MEASUREMENTS

3.2.1 Wells/Piezometers with Screens, Fully Open to Water Table

Water levels shall typically be required from a series of wells when data for preparing groundwater contour maps are needed. Water levels may also be required when monitoring the changes in water level during aquifer testing if aquifer response is sufficiently slow.

Water level measurements shall be made by determining the depth to the water surface below the reference point. The fixed reference point is typically established by scribing the point on the northern, outer edge (lip) of the well casing. A line should be scribed or notched so that filings do not fall into the wall.

Attachment 009-A01 describes the method to be used making water level measurements with electronic water level indicators. Electronic water level indicators are conduction probes which activate an alarm and light when they intersect the water. The depth to water level is determined by reading the measured and marked increments on the lowering cord.

3.3 INTERFACE METERS

If light non-aqueous phase liquids (LNAPL) are suspected to be present or if dense non-aqueous phase liquids (DNAPL) are suspected, then a meter equipped with an electronic interface probe that is capable of distinguishing between water and LNAPL/DNAPL should be utilized. If LNAPL or DNAPL are suspected, then the interface meter should be used to check the surface of the fluid column and also the base of the fluid column. Manufacturer's instructions for use shall be reviewed prior to using an interface meter. All readings will be recorded in the field log book.

Attachment 009-A02 describes the method to be used making water level measurements with an interface meter. Interface meters typically use an infrared beam and detector which activate an alarm and light when they intersect the water and non-aqueous liquids. The depth to water level is determined by reading the measured and marked increments on the lowering cord.

3.4 CONTINUOUS WATER LEVEL MEASUREMENTS

Continuous water level measurements are made by determining the height of the water column above a pressure transducer and electronically recording fluctuations in this height with a data logger. The continuous record is used for aquifer testing where rapid changes in water level are anticipated.

4.0 REFERENCES

Driscolt Fletcher, G., Groundwater and Wells, Second Edition, Minnesota, 1986.

Practical Guide for Ground-Water Sampling, U.S. EPA, EPA/600/2-85/104, September 1985.

RCRA Groundwater Monitoring: Draft Technical Guidance, EPA Office of Solid Waste, November 1992.

RCRA Ground-Water Monitoring Technical Enforcement Guidance Document (TEGD), OSWER- 9950.1, September 1986.

ATTACHMENT 009-A01

WATER LEVEL MEASUREMENT WITH ELECTRICAL WATER LEVEL INDICATORS

Description

Electrical water level indicators use the water in the well to close an electrical circuit. Contact with water is indicated by a small lamp or amp meter. Power is supplied by small flashlight batteries. Typical electrical water level indicators use either a single wire or a two-wire configuration. Single wire (electrode) indicators are grounded to the steel well casing. The wire is then lowered to contact the water, and the circuit is closed. Both the positive and negative electrodes are lowered into contact with the water in a two-wire configuration. In both water level indicator types, the wire or cable is marked in 0.01-foot intervals to indicate depth. Depth is referenced to the surveyor's mark. All water level indicators are equipped with weights to maintain line tension for accurate readings.

Application

Electrical water level indicators are useful for all water level measurement needs. Electrical water level indicators can also be used to obtain accurate readings in pumping wells where water turbulence makes steel tape readings difficult. Electrical water level indicators may be left in a well for long periods of time, if required.

Limitations

The most serious drawback to the use of electrical water level indicators in monitoring is the insulating effect of oil contaminants (if present), particularly where there is a significant amount of floating oil. In such cases, an electrical water level indicator made to detect floating oil and water (interface meter) should be used.

Procedure

Check the interval markers with a surveyor's tape to verify length of water level indicator wire or cable. Inspect the surveyor's reference mark inside the casing to be sure of legibility.

Lower the water level indicator probe until it just makes contact with the water in the well. Record the position of the probe relative to the reference point. Record the actual water level reading to the nearest 0.01-foot. Repeat to confirm depth.

Withdraw the water level indicator from the well. Decontaminate the water level indicator wire or cable and probe in accordance with SOP-001.

ATTACHMENT 009-A02

WATER LEVEL MEASUREMENT WITH INTERFACE METERS

Description

Electrical water level indicators use the water in the well to close an electrical circuit. However, if LNAPL or DNAPL is suspected to be present, then a meter equipped with an electronic interface probe should be utilized that is capable of distinguishing between water and LNAPL/DNAPL based on non-completion of the conductivity circuit. All water level indicators are equipped with weights to maintain line tension for accurate readings.

Application

Interface meters measure the thickness of floating or sinking products in monitoring wells or storage tanks. To detect liquids, interface meters typically use an infra-red beam and detector. When the probe enters a liquid, the beam is refracted away from the detector, which activates an audible tone and light. If the liquid is a non-conductive oil/product, the signals are steady. If the liquid is water, the conductivity of the water completes a conductivity circuit. This overrides the infrared circuit, and the tone and light are intermittent.

Procedure

Turn main switch to the “on” position. Also twist probe to the “on” position. A flashing light on the faceplate indicates that the probe is in the “on” position, but the main switch is not “on.” A continuous buzz indicates that the main switch is “on”, but the probe is “off.”

Lower probe slowly until lights and audible tone are on. Raise and lower the probe gently to determine the exact upper level of the nonconductive floating product (LNAPL). Note level from marked tape. If no floating product exists, one single light will come on. Continue to lower the probe until only one light is on. Shake the probe slightly at this point to clear any residual product from the conductivity sensor. Raise the probe slowly until both lights and the audible tone are on to determine the LNAPL/water interface. Read level directly from the tape to the nearest 0.01ft. Repeat to confirm readings. Record depth and thickness and continue logging to determine if DNAPL is present by lowering the probe to the bottom of the well. Allow the probe to each the bottom and lift up on the tape until some tension is felt. Record the total depth of the well. If DNAPL is detected, record the top and bottom elevations of that layer.

Withdraw the water level indicator from the well. Decontaminate the water interface meter and probe in accordance with SOP-001.

STANDARD OPERATING PROCEDURE
SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES
(SOP-018)

Reviewed By:________________________________Date:______________

Approved By:________________________________Date:______________

Approved By:________________________________Date:______________

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STANDARD OPERATING PROCEDURE
SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES
(SOP-018)

1.0 SCOPE AND APPLICABILITY

Standard Operating Procedure-018 (SOP-018) describes the requirements for preparation of sample containers, preservation of samples, and sample holding times to ensure that accurate and valid chemical analyses may be performed.

1.1 SCOPE COVERED BY SOP-018

This procedure describes the general requirements, types of containers, cleaning procedures for sample containers, preservation procedures for samples, and holding times for samples.

1.2 APPLICABILITY

Procedures for sample containers, preservation of samples, and sample holding times as described herein shall be conducted as specified in the Work Plan, Sampling and Analysis Plan, or other parent document referencing this SOP. In the event there is a conflict in specifications presented herein with those presented in the parent document referencing this SOP, then the specifications in the parent document will be followed to the extent they are different. Further, if an analytical method change occurs (e.g., EPA SW 846 or equivalent), the new procedures will supersede the protocols presented herein.

1.3 DEFINITIONS

Holding time – the maximum time that samples may be held before the start of preparation and/or analysis where the resulting analytical data are considered valid. Holding time will be determined by the laboratory based on the date and time provided on the sample containers/chain-of custody forms.

1.4 HEALTH AND SAFETY CONSIDERATIONS

These procedures may involve exposure to impacted sample waters or soils via routes of dermal contact and inhalation. Accordingly, sampling personnel should follow the precautions, procedures, and use the appropriate personal protective equipment described in the approved Health and Safety Plan.

1.5 PERSONNEL QUALIFICATIONS

Personnel collecting samples for chemical analyses shall be properly trained in field sampling techniques. Such training will be done by placing any new employee with an experienced employee until the new employee has become proficient in using the equipment needed to conduct sampling techniques.

2.0 MATERIALS AND METHODS

2.1 GENERAL REQUIREMENTS AND CONSIDERATIONS

Sample containers and preservation methods should be selected and used such that accurate and valid chemical and physical analyses may be performed. Materials or procedures that might cause overt disturbance, contamination, oxidation or other chemical decomposition or reaction of the sample should be avoided. This SOP only addresses containers and preservation of chemical analytical samples. Use of containers and preservation procedures should be consistent with analytical procedures to be used by the analytical laboratory. Preservation is generally limited to pH control, addition of chemicals, and refrigeration. These techniques are intended to retard biological action, retard hydrolysis of chemical compounds, keep metals in solution, and reduce volatility of constituents.

Refrigeration to maintain the sample temperature near 4°C is the minimum amount of preservation that should be performed for most environmental samples. Samples should not be frozen and dry ice should not be used as the cooling agent (due to shipping restrictions). Chemical preservatives may be added to sample bottles in advance, generally by the testing laboratory or by field personnel.

The sample volumes required for analysis vary widely depending on laboratory capabilities. The volumes prescribed herein are conservative numbers; however, the actual analytical laboratory that will be performing the required analyses should be consulted as to the quantity required.

2.2 CONTAINER TYPES

Sample containers are generally be supplied by the laboratory which is contracted to perform the analyses. Laboratories shall provide appropriate, pre-cleaned containers for the types of analyses specified. Each container should be clearly labeled as to the type of test and chemical preservative (if required).

2.2.1 Documentation of Containers and Preservatives Used

A list of containers and preservatives used to collect aqueous or solid samples shall be recorded in the field log book.

2.3 CONTAINER AND PRESERVATION REQUIREMENTS FOR ENVIRONMENTAL SAMPLES

Containers, preservatives, and holding times specific to an individual project should be provided in the site-specific Work Plan or SAP. The selected analytical laboratory can supply specifics on the required preservation and holding times for the specified analytical methods.

2.3.1 Water Samples

2.3.1.1 Organics

Water samples for organics shall be collected in glass bottles equipped with teflon- lined screw caps. Water supply and other samples suspected of also containing residual chlorine shall have 0.008 percent NA2S203 (sodium thiosulfate) added. These water samples should be preserved by cooling with ice to 4°C.

Regulatory or other considerations may require that duplicate samples be collected for purgeable organics (volatile organics). Samples for purgeable organics should be collected in 40-ml glass vials (purge vials) equipped with teflon-backed silicon septum screw caps, filled with minimal aeration to the sample, and vials shall be filled completely with no headspace. The sampler shall take care that any chemical preservative in the vial is not washed out while filling the vial.

Samples for extractable organics should be collected in two one-liter, amber glass bottles with teflon-lined caps.

2.3.1.2 Metals

Water samples for metals analyses should be collected in high-density polyethylene bottles with solid polyethylene or polyethylene-lined caps. Containers should be filled to within ¼ inch of the top of the bottle. The samples should be preserved with nitric acid to below pH 2. Nitric acid concentration should not exceed 0.15 percent if the sample is to be shipped via air cargo.

2.3.1.3 General Chemistry

Water samples collected for general chemistry parameters will include a variety of containers and preservatives depending on the analyses to be performed. Containers should be filled to within ¼ inch of the top of each bottle.

2.3.2 Soil or Sediment Samples

Soil or sediment samples should be collected in wide-mouth glass jars equipped with teflon-lined screw caps. Samples should be preserved by cooling with ice or refrigeration at 4°C.

For samples being collected for volatile analyses by SW-846 Method 5035, samples shall be collected with appropriate coring devices. The cores shall be placed directly into appropriate, tared sample vials. Depending on the analytical method, the vials may or may not contain preservatives or teflon stir bars. The sampler shall write only on the supplied label and shall take extra care to remove any excess sample from the vial threads before replacing the vial lid. A separate wide-mouth glass jar should also be filled with sample and submitted to the analytical laboratory. This jar is used for moisture determination so that sample results can be reported on a dry-weight basis.

3.0 REFERENCES

U.S. EPA, "Methods for Evaluation of Water and Wastes," EPA-600/4-79-020.

U.S. EPA, "RCRA Ground-Water Monitoring Technical Enforcement Guidance Document," September,1986.

U.S. EPA, "Test Methods for Evaluating Solid Waste," publication SW-846, 1986 (Third Edition).

STANDARD OPERATING PROCEDURE
SAMPLE CLASSIFICATION, STORAGE, PACKAGING AND SHIPMENT
(SOP-019)

Reviewed By:____________________________________Date:________________

Approved By:____________________________________Date:________________

Approved By:____________________________________Date:________________

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STANDARD OPERATING PROCEDURE
SAMPLE CLASSIFICATION, STORAGE, PACKING AND SHIPMENT
(SOP-019)

1.0 SCOPE AND APPLICIBILITY

1.1 PURPOSE OF PROCEDURE

Standard Operating Procedure-019 (SOP-019) describes the requirements for sample classification, storage, packaging, and shipment for the purpose of ensuring proper handling of samples.

1.2 SCOPE COVERED BY SOP-019

This procedure describes the general requirements, sample classification categories, sample storage requirements, sample packaging procedures, and sample shipping requirements for environmental samples being transported to analytical laboratories for analyses.

1.3 APPLICABILITY

Procedures for classification, storage, packaging, and shipment of samples as described herein shall be conducted as specified in the Work Plan, Sampling and Analysis Plan (SAP), or other document referencing this SOP. In the event there is a conflict in specifications presented herein with those presented in the parent document referencing this SOP, then the specifications in the parent document will be followed to the extent they are different.

1.4 DEFINITIONS

None.

1.5 HEALTH AND SAFETY CONSIDERATIONS

These procedures may involve exposure to impacted sample waters or soils via routes of dermal contact and inhalation. Accordingly, sampling personnel should follow the precautions, procedures and use the appropriate personal protective equipment described in the approved Site Health and Safety Plan.

2.0 PERSONNEL QUALIFICATIONS

Personnel performing sample packaging and shipment procedures shall be trained in field sampling techniques. Such training will be done by placing any new employee with an experienced employee until the new employee has become proficient in sample packaging and shipment techniques described in this SOP.

3.0 MATERIALS AND METHODS

3.1 GENERAL REQUIREMENTS AND CONSIDERATIONS

Classification of samples shall be made on the basis of the suspected level of contaminant concentration which determines subsequent packaging and labeling requirements, shipping procedures and laboratory handling of samples.

Contamination concentrations must be assessed early in the planning stage of an investigation because of their effect upon field operations. Sample classification must be considered in the development of the Health and Safety Plan and Field Sampling Plan. The procedures and materials used for sample packaging must adequately protect the sample container from accidental breakage and should be sufficient to prevent any leaks or spills. Sample labels for proper sample identification are discussed in SOP-022. Samples classified as hazardous shall be shipped only by means specified in the appropriate Department of Transportation (DOT) regulations.

3.2 SAMPLE CLASSIFICATION

3.2.1 Environmental Samples

On-site samples may be classed as "environmental" by the Project Manager based on knowledge of the site and the nature of the sample. Samples collected off-site are considered "environmental" unless information to the contrary exists.

Initially, concentrations of constituents are estimated based on knowledge of contaminant sources and the contaminant transport mechanisms and their effects on contaminant concentrations. It is necessary to be conservative in the estimate of contaminant concentration. Sample classification can be downgraded for subsequent samples if data exists to support that decision.

3.2.2 Hazardous Samples

"Hazardous Samples" include soil or water samples that may be highly contaminated, sludge or waste pile samples of concentrated wastes, or any sample from an unlabeled drum or container.

3.3 SAMPLE STORAGE

Samples shall be stored in a manner consistent with the requirements for sample preservation so as to maintain the quality of the sample. Samples preserved by cooling shall be stored in such a way as to maintain the acceptable range of temperature for the duration of the holding time. The cooling process must be initiated immediately after sample collection in the field. Samples shall not be stored on-site for extended periods of time and should be protected from environmental extremes. Shipment to the laboratory should be completed as soon as possible and well within any holding time limits specified for particular analyses.

If temporary storage is necessary, samples shall remain in an area that has been designated as the "sample storage area" which must be locked and secured to maintain sample integrity and chain-of-custody requirements. Samples subjected to temporary storage shall be checked periodically to confirm that the appropriate holding temperature is being maintained. If temporary storage is necessary, holding temperature shall be confirmed with an NIST-certified thermometer or other device that has been calibrated to a NIST-certified thermometer. The sampler shall record the holding temperature and any periodic temperature measurements in the field logbook.

Samples shall not be stored in refrigerators or other areas where food or drink may also be stored and vice versa.

3.4 ENVIRONMENTAL SAMPLE PACKAGING

3.4.1 Regulatory Considerations

Current DOT regulations shall be reviewed prior to a sampling event to ensure that samples are shipped appropriate depending upon matrix and expected concentration of constituents of concern.

3.4.2 Shipping Containers

All sample containers should be placed inside a strong shipping container capable of withstanding a 4-foot drop on solid concrete in the position most likely to cause damage. A metal or plastic picnic cooler (ice chest) with a hard plastic liner withstands this test. The drainage hole at the bottom of the cooler must be taped shut so that the contents from broken containers or water from ice cannot escape. The shipping container should be taped shut to form an adequate seal around the lid to prevent any leakage in the event that the cooler is turned over.

Two plastic liners shall be placed inside the shipping container and all samples and ice shall be placed inside these liners.

3.4.3 Ice

Samples shall be packed in loose wet ice. The amount of ice used will depend on the available space in the cooler but 10 pounds per 20 quarts of cooler volume should be the minimum amount to ensure sufficient cooling. Dry ice (CO_2) generally should not be used.

3.4.4 Glass Sample Bottles

The lid of the glass sample bottle shall be tightened to ensure an adequate seal and to prevent loosening during transit. Glass containers should be wrapped and cushioned in an inert packing material such as Styrofoam, closed-cell foam packing material, or bubble wrap.

3.4.5 Plastic Containers

Plastic containers do not require individual cushioning material, but shall be packed to prevent movement during transport. Caps should be adequately tightened to prevent loosening during transit.

3.5 HAZARDOUS SAMPLE PACKAGING

3.5.1 Regulatory Considerations

If a sample is known to contain a material identified in the DOT Hazardous Materials Table, packaging, labeling and shipment must conform to the specific requirements for that substance. Current DOT and shipping firm requirements shall be followed for these types of shipments.

3.6 SHIPPING OF SAMPLES

3.6.1 Environmental Samples

Environmental samples may be shipped by commercial common-carrier, bus, by rental vehicle or air-cargo service to the testing laboratory. Samples should be received by the laboratory within 1 day after sampling or sooner, if necessary, to allow initiation of analyses within prescribed holding times.

3.6.2 Hazardous Samples

Hazardous samples shall comply with current DOT and shipping form requirements and regulations regarding shipment.

4.0 REFERENCES

Code of Federal Regulations, Title 49 {Transportation}, Hazardous Materials Tables and Hazardous Materials Communications Regulations: 49 CFR, Part 172, Office of the Federal Register, Material Archives and Records Service, General Services Administration.

Code of Federal Regulations, Title 49 (Transportation), Shippers - General Requirements for Shipments and Packages: 49 CFR, Part 173, Office of the Federal Register, National Archives and Records Service, General Services Administration.

U.S. EPA, "EPA Technical Methods for Investigating Sites Containing Hazardous Substances," Technical Monograph No. 22, Draft, dated June, 1981.

U.S. EPA, "RCRA Ground-Water Technical Enforcement Guidance Document," September 1986.

STANDARD OPERATING PROCEDURE
SAMPLE CONTROL AND CUSTODY PROCEDURES
(SOP-022)

Reviewed By:________________________________Date:______________

Approved By:________________________________Date:______________

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STANDARD OPERATING PROCEDURE
SAMPLE CONTROL AND CUSTODY PROCEDURES
(SOP-022)

1.0 SCOPE AND APPLICABILITY

To assure the integrity of data and the quality of the data generated from samples collected during environmental investigations, all samples are presumed to be collected as legal evidence and must be handled using strict custody control procedures described herein. Chain of Custody (COC) begins at the time of sample collection and ends at the final disposal of any remaining sample after laboratory analysis/storage.

This procedure is to be used by all personnel collecting samples for any variety of sample matrix.

1.1 PURPOSE OF PROCEDURE

Standard Operating Procedure-022 (SOP-022) describes the procedures for controlling sample custody to maintain the quality and integrity of samples during collection, transportation, and storage for analysis.

1.2 SCOPE OF SOP-022

This procedure describes requirements for sample identification labels, transfer of sample custody and shipment, use of COC forms, and use of custody seals.

1.3 APPLICABILITY

Sample control and custody procedures described in this SOP are applicable for all sampling activities. In the event there is a conflict in the specifications presented herein with those requested by a Client or a Regulatory Agency, then those specifications will supersede the SOP's specifications.

1.4 DEFINITIONS

1.4.1 Chain-of-Custody Forms

Because samples collected during a field investigation could be used as evidence in litigation, possession of the samples must be traceable from the time each sample is collected until disposal procedures are implemented by the analytical laboratory after analysis has been completed and the samples are released for disposal. To document sample possessions, COC forms are used and COC procedures are followed.

1.4.2 Custody Seal

A custody seal is an adhesive-backed strip that is placed on a sample or shipping container in such a manner that a broken seal would provide evidence that the container was opened during transit, thereby potentially affecting the integrity of the sample(s).

1.4.3 Sample Nomenclature

Standard terms for sample nomenclature are discussed in SOP-002 Attachment 002-A01 and will be utilized when identifying samples in field book documentation, on sample labels, and on COC forms.

1.4.4 Custody Control

A sample is under custody control if one or more of the following criteria are met:

- The sample is in the sampler's possession
- The sample is in plain view of the sampler
- The sample was in the sampler's possession and then was locked up to protect the integrity of the sample
- The sample is in a secured area

2.0 PERSONNEL QUALIFICATIONS

All personnel that may perform field activities shall be familiar with the requirements of SOP- 022 prior to beginning a field investigation.

3.0 EQUIPMENT AND MATERIALS

3.1 COC FORM

A 2-part COC form is utilized to document sample custody. **Attachment 022-A01** contains an example of a COC form. Alternatives to this form may be acceptable. Each person accepting or relinquishing custody of samples shall sign and date the COC form. The top copy is shipped with sample containers to the analytical laboratory and the bottom copy is returned to the originating project manager. Additionally, a copy of the COC shall be provided to the QA/QC team as soon as practicable.

3.2 SAMPLE IDENTIFICATION LABEL

An adhesive-backed label is used to record the pertinent sample information and is affixed to the sample container. The label must not be easily removable from the container. **Attachment 022-A02** contains an example of a sample identification label.

3.3 CUSTODY SEAL

The custody seal is an adhesive-backed strip with space for the signature of the shipper and the shipping date. An example of a custody seal is proved as **Attachment 022-A02**. Custody seals are affixed to the shipping container or sample containers to ensure sample integrity and quality. A broken seal would suggest that the shipping containers and/or sample bottles were opened during transit.

3.4 WRITING UTENSILS

All entries recorded on COC forms, sample identification labels, or custody seals will be made using either blue or black indelible ink or waterproof marker. Use of a pencil is not acceptable. Field personnel shall carry an ample supply of spare writing utensils.

4.0 PROCEDURES

Sample control and custody shall be followed, without exception, by all persons involved in sampling and documentation activities during a field investigation.

Documentation of sample identification include, but are not limited to, COC forms, field books, custody seals, and sample labels.

4.1 SAMPLE IDENTIFICATION LABELS

Sample labels shall be provided by the analytical laboratory or the QA/QC team. Labels may be preprinted with spaces for the appropriate sample identification and information requirements. The label shall be of the type of material that indelible ink will write, but not be so overly absorbent that the ink will run. Labels will have an adhesive backing for securing on the sample containers.

The following sample information will be contained on each sample label and will be recorded in the field book:

- Site identification
- Sample identification number
- Date and time of the sample collection
- Preservative(s) used
- Printed name and signature of sampler

4.1.1 Labeling Procedure

After collection of a sample and placing it into the appropriate container, wipe off any excess sample matrix from the container surface. Fill out label information as prescribed above using indelible ink. Remove paper backing and affix adhesive label to the container. If a mistake is made, neatly mark through the mistake with a single line and write in the appropriate correction. All corrections must be initialed, dated, and an appropriate error code assigned to it.

If a label is too smudged or damaged to correct it neatly, affix a new label onto the container, completely covering the damaged label. **Attachment 022-A02** contains an example of a label.

Labels supplied by some analytical laboratories may be attached to the sample containers prior to shipment to the project site. The described procedure will be followed with the necessary modifications.

4.2 CHAIN OF CUSTODY RECORD

Because samples collected during an investigation could be used as evidence in litigation, possession of the samples must be traceable from the time each is collected, until disposal. To document sample possession, COC procedures and documentation are discussed below.

4.2.1 Chain of Custody Documentation and Forms

Chain of Custody documents are initiated by the sampling personnel in the field with the notation of sampling date, sample collection time, and sample identification. These data will also be noted in the field book, generally in a tabular format along with the description of the sample and sampling procedure, and include the following at a minimum:

- Sample identification information
- Date and time sample was taken
- Number and type of containers used
- Whether sample was grab or composite
- Preservation method used
- Notation of any samples that may be ‘hot” or contain light or dense non-aqueous phase liquids
- Analyses requested
- Name of sampling personnel (printed name and signature)
- QA/QC contact names, telephone numbers
- Shipping method and airbill tracking number

Each sample sent off-site will be recorded on a COC form by the sampler or a field sample custodian at the site. Any COC forms that are serialized with a unique COC identification number shall be documented in the field book for traceability. An example of a COC form is presented in **Attachment 022-A01**.

The COC form will be filled out by the sampler or the field sample custodian on behalf of the sampler. The COC form will be signed by the sampler upon relinquishing custody.

4.3 CUSTODY SEALS

When samples are shipped to the laboratory, they must be placed in containers sealed with custody seals. When samples are shipped, two or more seals are to be placed on each shipping container (such as a cooler), with at least one at the back, located in such a manner that a seal or seals would be broken if the container were opened during transit. Wide, clear tape will be placed over the seals to ensure that seals are not accidentally broken during shipment.

If samples are subject to interim storage before shipment, custody seals may be placed over the lid of the jar or across the opening of the storage box. Custody during storage will be the same as described above.

Attachment 022-A02 contains an example of a custody seal. **Attachment 022-A03** shows custody seal placement on a shipping container.

4.4 FIELD CUSTODY PROCEDURES

Only enough of the sample will be collected to provide representation of the matrix being sampled. To the extent possible, the quantity, types of samples, and the sample locations will be determined before the actual field work. As few people as possible will handle the samples.

Sample containers will be provided by the laboratory. In the event that emergency sampling is required, bottles (provided they are not expired or may have been compromised) that an office may have on-hand can be used. This is not preferable, but may sometimes be necessary and shall be noted in the field book and communicated to the QA/QC team.

Trained field samplers are personally responsible for the care and custody of the samples collected until the samples are transferred or properly dispatched. The criteria listed in Section 1.4.4 will be followed. A person may be designated to receive the samples from the field samplers after container decontamination; this person maintains custody until the samples are dispatched. The project manager or QA/QC team will determine whether proper custody procedures were followed during the field work and will decide if additional samples are required to make up for any deficiencies.

Samples shall be accompanied by a COC. When transferring samples, the individuals relinquishing and receiving them will sign, date and note the time of relinquishment or receipt on the form.

Samples shall be packaged properly for shipment and will be dispatched to the appropriate laboratory for analysis, with a separate COC record accompanying each shipping container. Shipping containers are sealed with custody seals for shipment to the laboratory. All shipments are accompanied by a COC record identifying their contents. The original form accompanies the shipment; the remaining copy is retained by the sampler and returned to the QA/QC team. The sampler must provide shipment tracking information to the QA/QC team as soon as practicable after shipment and must submit a copy of the COC to the QA/QC team upon completion of the field sampling activities.

All samples must be shipped in a manner that can be tracked. Samples that are classified as dangerous goods shall be handled and shipped in compliance with federal, state, and local regulations. Personnel must have successfully completed all mandated federal, state, and local training requirements prior to handling and shipping dangerous goods. Freight shipping labels will be retained as part of the permanent documentation of the COC records.

4.5 CORRECTIONS TO DOCUMENTATION

Unless restricted by weather conditions, all original data on sample identification labels, COC forms, and custody seals are written using indelible ink.

If an error is made on an accountable document assigned to one person, that individual may make corrections simply by crossing out the error with a single line striking the erroneous information and entering the correct information. Any error discovered on an accountable document will be corrected by the person who made the entry. All corrections must be initialed and dated, and if applicable, using generally used error codes.

5.0 REFERENCES

U.S. EPA, A Compendium of Superfund Field Operations Methods, publication EPA/540/P-87/001, December, 1987.

U.S. EPA, RCRA Ground-Water Technical Enforcement Guidance Document, September 1986.

Wisconsin Department of Natural Resources, Bureau of Drinking Water and Groundwater, "Groundwater Sampling Desk Reference", publication PUBL-DG-037 96, September 1996.

ATTACHMENT 022-A01
CHAIN OF CUSTODY RECORD

ALS Environmental

Chain of Custody Form

Page ____ of ______

COC ID: 123456

☐ Cincinnati, OH +1 513 733 5336	☐ Holland, MI +1 616 399 6070	☐ Salt Lake City, UT +1 801 266 7700
☐ Everett, WA +1 425 356 2600	☐ Houston, TX +1 281 530 5656	☐ Spring City, PA +1 610 948 4903
☐ Fort Collins, CO +1 970 490 1511	☐ Middletown, PA +1 717 944 5541	☐ York, PA +1 717 505 5280

ALS Project Manager: | Work Order #:

Customer Information		Project Information		Parameter/Method Request for Analysis	
Purchase Order		Project Name		A	
Work Order		Project Number		B	
Company Name		Bill To Company		C	
Send Report To		Invoice Attn.		D	
Address		Address		E	
				F	
City/State/Zip		City/State/Zip		G	
Phone		Phone		H	
Fax		Fax		I	
e-Mail Address		e-Mail Address		J	

No.	Sample Description	Date	Time	Matrix	Pres.	# Bottles	A	B	C	D	E	F	G	H	I	J	Hold
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

Sampler(s): Please Print & Sign	Shipment Method:	Required Turnaround Time: ☐ STD 10 Wk Days ☐ 5 Wk Days ☐ 2 Wk Days ☐ 24 Hour ☐ Other ____	Results Due Date:

Relinquished by:	Date:	Time:	Received by:	Notes:
Relinquished by:	Date:	Time:	Received by (Laboratory):	Cooler Temp. / QC Package: (Check Box Below)
Logged by (Laboratory):	Date:	Time:	Checked by (Laboratory):	

QC Package: (Check Box Below)
- ☐ Level II: Standard QC
- ☐ Level III: Std QC + Raw Data
- ☐ Level IV: SW846 CLP-Like
- Other: ______________

Preservative Key: 1-HCL 2-HNO3 3-H2SO4 4-NaOH 5-Na2S2O3 6-NaHSO4 7-Other 8-4 degrees C 9-5035

Note: Any changes must be made in writing once samples and COC Form have been submitted to ALS Environmental.

ATTACHMENT 022-A02
SAMPLE IDENTIFICATION LABEL AND CUSTODY SEAL

Company Name

Sample Description

Parameter **Preservative**

Date **Time**

Sampler's Signature

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
195215

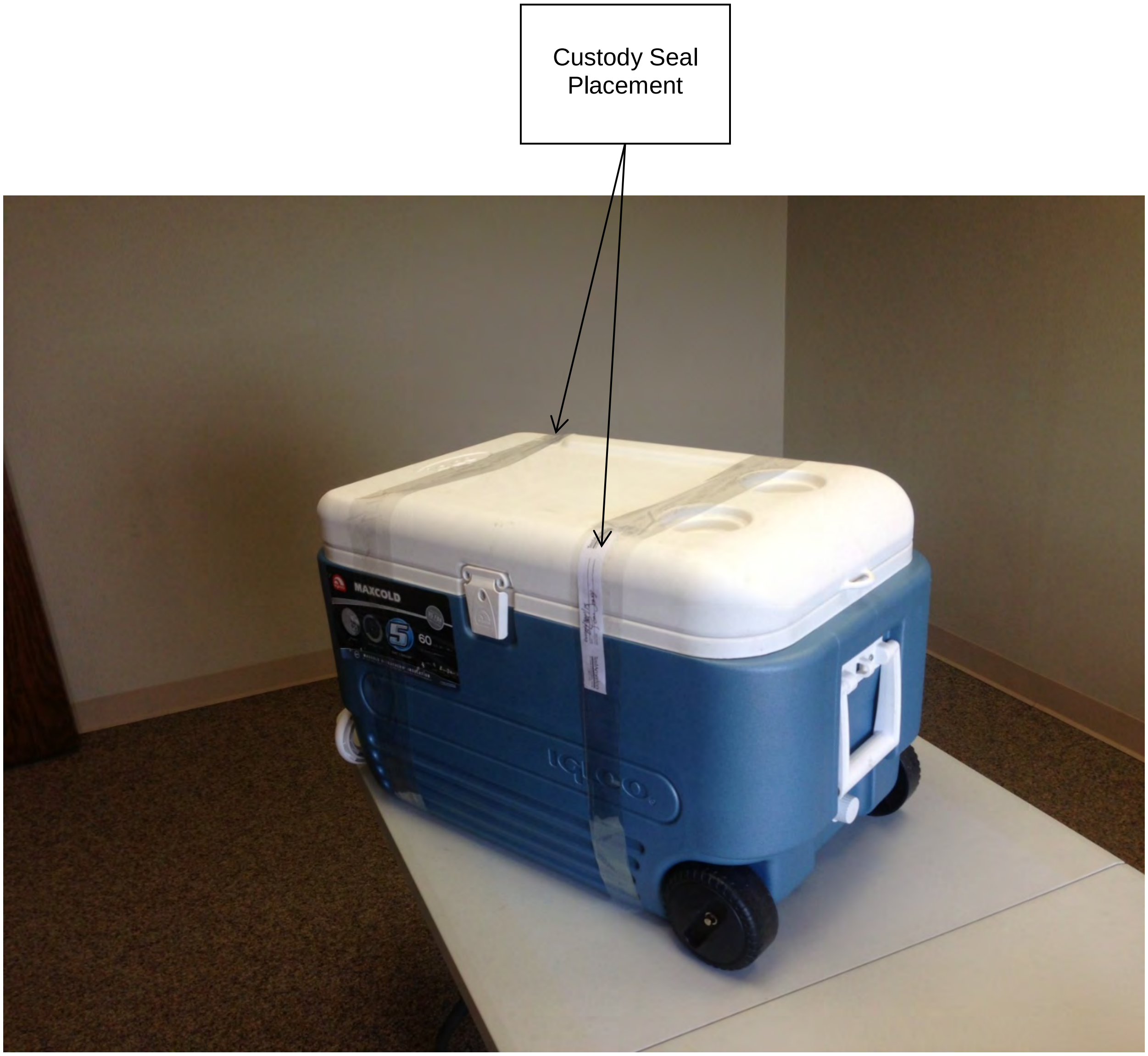
Custody Seal

DATE

SIGNATURE

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
195215

ATTACHMENT 022-A03
CUSTODY SEAL PLACEMENT



STANDARD OPERATING PROCEDURE
HANDLING OF INVESTIGATION DERIVED WASTE
(SOP-024)

Reviewed By:____________________________________Date:________________

Approved By:____________________________________Date:________________

Approved By:____________________________________Date:________________

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STANDARD OPERATING PROCEDURE
HANDLING OF INVESTIGATION DERIVED WASTE
(SOP-024)

1.0 SCOPE AND APPLICABILITY

A by-product of most field investigations includes materials of various types that can become waste, which are generated during the course of the investigation. These materials can include, but are not limited to, soil cuttings, equipment decontamination fluids, excess field-testing fluids or solids, well purging fluids, and used personal protection equipment (PPE). The procedures presented herein are required for all environmental personnel.

1.1 PURPOSE OF PROCEDURE

Standard Operating Procedure-024 (SOP-024) describes the procedures for handling investigation-derived waste (IDW). SOP-024 has been structured so that it can be used to manage different wastes that will be generated during the performance of various field investigations at a site. These procedures were developed to preserve flexibility in the choice of waste handling options as well as being acceptable to the State or Federal agencies involved.

1.2 SCOPE COVERED BY SOP-024

- Identifies a Waste Coordinator
- Identifies activities that will result in the generation of waste and provides a means to estimate the types and quantities of waste to be generated
- Identifies the waste management activities to be conducted, including containerization, handling, waste accumulation areas, and ultimate disposition
- Describes the measures to be taken to ensure the proper management of wastes
- Provides a Spill Control Plan for appropriate response actions to spills
- Describes the measures to be taken to minimize the generation of wastes

1.3 WORK SPECIFICATIONS

All handling of investigation-generated materials as described herein shall be conducted at the locations specified in the Work Plan, Sampling and Analysis Plan (SAP), or other parent document referencing this SOP. In the event there is a conflict in specifications presented herein with those presented in the parent document referencing this SOP, then the specifications in the parent document will be followed to the extent they are different.

1.4 HEALTH AND SAFETY CONSIDERATIONS

This procedure may involve exposure to various impacted media and materials via routes of dermal contact and inhalation. Accordingly, sampling personnel should follow the procedures and use the appropriate personal protective equipment described in the approved health and safety plan.

2.0 PERSONNEL QUALIFICATIONS

Personnel shall be properly trained in field sampling, decontamination, and waste handling procedures. Such training will be done by study of appropriate SOPs and by placing any new employee with an experienced employee until the new employee has become proficient in field procedures. Personnel shall also maintain current certification of OSHA HAZWOPER training. The Project Coordinator will be the designated Waste Coordinator unless otherwise specified by the Project Coordinator.

3.0 PROCEDURE

3.1 ASSUMPTIONS

SOP-024 is based on the field sampling and analysis requirements set forth in the SAP, the health and safety requirements set forth in the Health and Safety Plan (HSP), and the following assumptions:

- Disposable protective gear will be treated as potentially contaminated waste. Non- disposable protective clothing will be sent to a commercial laundry facility that has been approved by the Health and Safety Department for cleaning.
- All subsurface soil extracted during soil sampling activities and all soil and water brought to the surface during the installation of boreholes and monitoring wells will be treated as potentially contaminated waste until analyses prove otherwise.
- Drums, bags and other containers of generated waste (excluding non-contaminated trash) may be stored on-site.
- Uncontaminated ("clean") trash will be segregated from presumed contaminated waste. Clean trash will be disposed of in an appropriate manner.
- Aqueous wastes can be containerized and transferred for management and disposal at the onsite wastewater treatment plant (WWTP). Aqueous waste may also be containerized, sampled, tested and disposed of at the appropriate disposal facility.
- Containers of RCRA hazardous waste (if any) will be manifested and disposed of off- site by the Site Owner or client.
- The Site owner or operator is assumed to be the "generator" of IDW.
- Multiple containers of the same or nearly the same waste will be accumulated and sampled as the same lot, in order to reduce the frequency of the waste characterization effort. Known hazardous waste material will not be mixed with non-hazardous waste materials.

3.2 WASTE MINIMIZATION

A primary goal of the Waste Minimization Program (WMP) is to minimize, to the extent practical: the volume of waste that must be generated and stored; and the amount of material that must be removed from the site for disposal. In order to minimize the volume of wastes, the following general procedures are recommended:

- Plan work ahead, based upon the work procedure to be utilized.
- Take only the material (i.e., chemicals) needed to perform the work activity

- Additional material can be brought to the work location if it is found to be necessary. Materials can be stored in large containers, but the smallest container reasonable should be used to transport the material to the location where it is needed.
- Maintain cleaning supplies outside of any potentially contaminated area to keep them clean and to minimize additional waste generation.
- Maintain or construct prefabricated materials, barriers, support equipment, etc., outside potentially contaminated areas.
- Perform mixing of detergents or decontamination solutions outside potentially contaminated areas.
- Avoid placing media considered contaminated for different reasons together.
- Use drop cloths or other absorbent material to contain small spills or leaks.
- Avoid a bellows effect when bagging contaminated materials.
- Use containers to minimize the spread of contamination.
- Do not place contaminated materials with clean materials.
- Verify waste containers are solidly packed to minimize the number of containers.
- Utilize only the size of container to meet your needs e.g., do not use a garbage can when a small polyethylene bag will do.
- Less hazardous substances should be used whenever possible, e.g. substitution of one type of solvent rinse for another more hazardous solvent for decontamination procedures.

3.3 PROJECT MATERIALS HANDLING

This section describes the anticipated inventory of project specific materials to be used during the course of the investigation. Potentially hazardous materials are typically materials brought on site in order to perform the investigation. The materials are used for decontamination, to seal boreholes, and provide lubrication and fuel for machinery. These materials should also be reported to the Industrial Hygiene/Health & Safety Group so that Safety Data Sheets (SDSs) can be included in the Health and Safety Plan. Spills of project specific materials may result in an evaluation of a reportable quantity for spill reporting purposes or the preparation of SDS forms. The anticipated inventory of materials includes:

- Alconox® detergent for equipment decontamination
- Type I Portland Cement for well grout material

- Silica sand filter pack material
- Powdered Bentonite® for well grout material
- Bentonite® pellets for well annular sealant
- Gasoline for use in portable equipment
- Hydraulic fluid for use by drilling equipment
- Motor oil for use of drilling equipment
- Diesel fuel for use by drilling equipment
- Solvent for equipment decontamination of metals (may be an acid rinse solution)
- Solvent for equipment decontamination of organics (may be an organic rinse solution)
- Chemical preservatives for environmental samples

3.4 EXPECTED WASTE STREAMS

Expected waste streams associated with soil and water investigation sampling activities and the related decontamination and clean-up. The expected waste streams can be categorized as follows:

- Drilling Waste
- Well Development Water and Purged Groundwater Waste
- Soil and Rock Sampling Waste
- Equipment Waste
- Field Laboratory Waste
- Decontamination Wastes

The various sources of waste are described in the following sections. All sampling activities will have associated disposable PPE and sampling equipment.

3.4.1 Drilling Waste

Drilling wastes expected to be generated include the soil cuttings extracted during the installation of soil borings and groundwater monitoring wells and the fluid water used for well drilling, well development, and well purging. All solid wastes generated during the drilling process will be containerized, sampled, tested and properly disposed. Aqueous wastes generated during well drilling, development and purging of groundwater can be containerized, and transferred for management and disposal at the onsite WWTP. Aqueous waste may also be containerized, sampled, tested and disposed of at the appropriate disposal facility.

3.4.2 Well Development Water and Purged Groundwater Waste

Aqueous wastes generated during well development and purging of groundwater can be containerized, and transferred for management and disposal at the onsite WWTP. Aqueous waste may also be containerized, sampled, tested and disposed of at the appropriate disposal facility.

3.4.3 Soil and Rock Sampling Waste

Soil and rock samples may be collected for physical and chemical testing during field investigations. All soil and rock samples sent to the contract laboratory and any wastes generated during analytical activities will become the laboratory's responsibility for disposal.

Soil and rock samples not sent to contract laboratories will be handled as follows:

- Samples retained for visual reference or laboratory analysis at a later date will be stored on site in a designated area. After storage, all samples will be containerized with the material from the identical sample location.

- Media not retained for initial laboratory samples will be containerized with the material from the identical sample location.

3.4.4 Equipment Waste

During the performance of investigative activities, it is expected that some drilling tools and equipment may break during the performance of investigative activities, wear-out, or become unserviceable. It will be the drilling contractor's responsibility to decontaminate unserviceable tools or equipment and to remove these items from the site.

Air rotary drilling requires the use of several types of air filters. The number of filters required during the course of an investigation will vary according to the number and depth of boreholes and depend directly on the amount of drilling performed. Knowledge of contaminants in the filters will be gained from the sample results generated and the size and weight of the filter. If there is a question as to possible presence of contaminants, a representative sample will be collected of the filter material and tested as per 40 CFR Part 261, Subpart C. If filters are used in background locations or areas that have previously been demonstrated to be nonhazardous, the filters will be managed as non-hazardous industrial waste (NHIW). Cutting and/or manual compaction of these filters should be employed to minimize the waste volume.

3.4.5 Field Laboratory Waste

Ancillary field sampling activities are performed in the field laboratory. The field laboratory activities that can be expected can include the preparation of reagents, sample filtering, sample preservation, and conductance of actual on-site test procedures. These activities are accomplished in accordance with procedures as outlined in the Field Sampling Plan (FSP). The field laboratory activities are expected to generate limited amounts of waste, which will consist of:

- Empty laboratory chemical containers
- Sample handling gloves
- Sample containers
- Absorbent towels for general cleaning and small spills

3.4.6 Decontamination Wastes

Tools required for drilling, well installation and development, and collecting samples must be cleaned and decontaminated. To minimize the amount of waste generated and to facilitate the management and disposal of decontamination wastes, equipment should be cleaned and decontaminated in batches. This practice will allow for the containerization of smaller amounts of fluids in fewer containers until a characterization of the chemical quality is determined and the appropriate method of disposal is determined. The wastes that could be generated are:

- Waste decontamination wash water
- Organic solvents
- Metal solvents
- Used gloves
- Drop cloths, paper towels, plastic bags, etc.
- Disposable bailers and monofilament line

Most decontamination activities will be performed at designated areas dedicated to decontamination identified by the Project Coordinator. This does not preclude the performance of "spot" decontamination in the field, i.e., boring locations.

Each decontamination area will be designed and equipped to ensure minimization of hazards to the environment. Some decontamination areas may be plastic-lined and bermed to provide total containment for decontamination wastes. A "spill kit" may be placed at each central decontamination facility consisting of:

- Personal protective clothing (disposable polyethylene-coated Tyvek ®, rubber boot-covers)
- Solvex® latex gloves
- Black/yellow barricade tape
- Barricade posts
- Solvent
- 10 mil thick plastic
- Shovels
- Absorbent booms
- Absorbent material
- Over-pack drums
- Organic/acid gas respirator cartridges (or other appropriate material-specific cartridges)

The emergency spill procedure will be to contact the Health and Safety Representative (as identified in the Health and Safety Plan); identify the source of the spill along with potential hazards; and contain the spill by either stopping it at the source and/or by use of absorbent booms. The Health and Safety Representative will give guidance on appropriate clean-up methods to be used as well as personal protective equipment employed. It is expected that any spills occurring at a decontamination facility will either consist of used decontamination fluids or unused decontamination fluids. The characterization of the spilled material will be the same as for the decontamination fluids in general.

3.5 SPECIFIC WASTE STREAMS

This section describes the various waste management control measures planned for each waste stream. The waste management measures include the containment of contamination, packaging of waste, handling of waste containers, labeling of waste containers, logging of waste containers on a waste container inventory list, storage, characterization and ultimate disposition of waste.

The Project Coordinator or person assigned will be responsible for ensuring waste is properly characterized and managed in accordance with the applicable solid waste rules. IDW is expected to fall into the one of the following categories: Hazardous Waste, Radioactive Waste, or NHIW. Waste management procedures are discussed in the following sections.

3.5.1 Containment, Packaging and Handling

All containers will be labeled. The container sizes listed in the following sections are suggested, not to preclude the use of larger or smaller waste containers where appropriate.

3.5.1.1 Personal Protective Equipment (PPE)

All disposable PPE, laboratory equipment, and general rubbish (paper towels, etc.) will be doffed in accordance with the Health and Safety Plan (HSP) and placed in large polyethylene trash bags. A separate bag(s) will be used for each investigation borehole area and closed tightly at the end of the workday.

3.5.1.2 Drill Cuttings

All drill cuttings will immediately be containerized. Separate containers will be used for each sampling location. At the end of each workday, the containers will either remain adjacent to the sampling location or be placed at a designated container storage area (CSA). The containers will be transported to the CSA by use of drum caddy, dolly, hand truck, or forklift.

3.5.1.3 Well Development/Purge Water and Drilling Fluids

Drilling fluids and all water generated during developing and purging monitoring wells will be containerized in closed-head containers. It may become feasible to use a larger container if several wells are being installed in a short time frame. Appropriate engineering judgment shall be used to group the waste. The containers will be securely closed after each use. Aqueous wastes can be transferred for management and disposal at the onsite WWTP. Aqueous waste may also be containerized, sampled, tested and disposed of at the appropriate disposal facility.

3.5.1.4 Decontamination Fluids

All fluids generated during decontamination activities will be containerized in closed head containers. Alconox® (detergent) based fluids and fluids containing solvents will be segregated in different drums when containerized. The containers will be securely closed when full or at the end of each day. Aqueous wastes can be transferred for management and disposal at the onsite WWTP. Aqueous waste may also be containerized, sampled, tested and disposed of at the appropriate disposal facility.

3.5.2 Labeling and Logging

Environmental media collected during site activities that must be placed into drums or other containers for storage should be labeled with the contents of the containers, type of waste (borehole cuttings, decontamination water, etc.) and the location of waste source (e.g., MW-6, drill rig decontamination area, etc.). If the media is a known listed waste then the container must be labeled with the words "Hazardous Waste", and the accumulation start date must also be placed on the container. If the waste is being sampled to determine if it is a RCRA hazardous waste then the container shall be labeled with the words “Non-Hazardous Waste, pending analysis”, and the accumulation start date must also be placed on the container.

When the sample characterization results (see Section 3.6) are returned from the laboratory, the waste classification will be confirmed. The containers will then be labeled according to the following procedure.

Containers that have been characterized as containing hazardous waste as defined in 40 CFR Part 261 will retain the Hazardous Waste label. If the waste is nonhazardous, the “Non-hazardous waste, pending analysis” label should be removed and a Non-Hazardous label applied. Other labels may be necessary according to shipping procedures and constituents present in the waste.

3.5.3 Storage

Containers can be stored either on site adjacent to the waste generation location or at the appropriate CSA (Hazardous vs. Non-hazardous CSA). No container shall remain on site for more than 90 days. All wastes will be grouped based on characterization data (Hazardous vs. Non-hazardous) and stored in separate CSAs.

3.6 CHARACTERIZATION AND DISPOSITION

Environmental media are the property of the Client or Landowner. All wastes generated during investigation activities will be characterized according to the requirements of the SAP or a Site-Specific Disposal Plan. The waste will be sampled and tested for hazardous characteristics, and the results of the testing will be provided to the Project Coordinator.

Procedures for solid waste management in Oklahoma are well documented in the Chapter 520 rules. In many instances, for example, when wastes qualify as de minimus, waste characterization should be done to meet the requirements of the disposal facility. Refer to OAC 252:520 Generator Requirements for Oklahoma wastes. Refer to the appropriate state rules for wastes generated in other locations.

Unless modified by input from the applicable state agency, the following is the anticipated characterization and disposal process. Aqueous waste must be tested prior to disposition with EPA Methods 1311 (TCLP), 1110 (Corrosivity-field pH may be used in place of this test), ignitability (1010, 1020A) and EPA Chapter 7 methods for reactive cyanide and sulfide. Solids will be tested according to these methods with the exception of corrosivity, which is not applicable to solids. Soil samples may also be tested for EPA Region 5 Skinner list volatiles, semi-volatiles and metals in order to document concentrations for approval to reuse on site. In the event the soil cannot be reused on site, additional soil samples will be tested for TCLP volatiles, TCLP semi-volatiles and TCLP metals to determine the appropriate characterization for disposal.

All above referenced sample results will be available from the analytical laboratory at least 60 days from first date of storage and will be maintained at the site for at least three years. The data will also be forwarded to the Project Coordinator. The 60 day time period allows an additional 30 days to manifest and dispose, if hazardous, and still not exceed the 90-day storage time limit for hazardous waste.

After a container has been characterized, the Project Coordinator or designee will coordinate the disposal of the waste with the Client or Landowner. Preparation for transport of containers shall include, but is not limited to, closure of container, sealing of closures (i.e., tightening of bungs or bolting of lock rings), palletizing of drums, and removing any contamination on the outside of the container. All manifests must be signed by the waste generator, and transportation must be done by a licensed hazardous waste transporter. Waste shipment and disposal will be tracked by the client representative.

All wastes will be disposed of in accordance with state and federal regulations.

4.0 DATA AND RECORDS MANAGEMENT

Documentation of the day-to-day handling of investigation-generated materials will be the responsibility of the Project Coordinator or designee.

STANDARD OPERATING PROCEDURE
LOW-FLOW PURGING AND SAMPLING
(SOP-028)

Reviewed By:____________________________________Date:________________

Approved By:____________________________________Date:________________

Approved By:____________________________________Date:________________

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STANDARD OPERATING PROCEDURE
FOR LOW FLOW PURGING AND SAMPLING
(SOP-028)

1.0 SCOPE AND APPLICABILITY

1.1 PURPOSE OF PROCEDURE

Standard Operating Procedure-028 (SOP-028) describes purging wells and collection of groundwater samples using EPA approved low-flow techniques.

1.2 SCOPE COVERED BY SOP-028

This procedure describes requirements for low-flow purging, water quality field parameters, sampling, and documentation. This SOP applies only to sampling at the wellhead and does not address sampling light or dense non-aqueous-phase liquids (LNAPL or DNAPL). The method does not require the removal of large volumes of water from the well.

1.3 APPLICABILITY

Low-flow purging and sampling as described herein shall be conducted at the locations specified in the Work Plan, Sampling and Analysis Plan, or other parent document referencing this SOP. In the event there is a conflict in specifications presented herein with those presented in the parent document referencing this SOP, then the specifications in the parent document will be followed to the extent they are different.

1.4 DEFINITIONS

1.4.1 Drawdown (low-flow purging and sampling)

The water level in a well is lowered by pumping the well.

1.4.2 Low-Flow

Low-flow refers to the velocity of formation pore water adjacent to the well screen that is imparted during the well pumping. It does not necessarily refer to the flow rate of water discharged by a pump at the surface.

1.5 HEALTH & SAFETY CONSIDERATIONS

This procedure may involve exposure to impacted groundwater via routes of dermal contact and inhalation. Accordingly, sampling personnel should follow the precautions, procedures, and use the appropriate personal protective equipment described in the approved Health and Safety Plan.

2.0 PERSONNEL QUALIFICATIONS

Personnel performing low-flow purging and sampling procedures shall be trained in field sampling techniques. Such training will be done by placing any new employee with an experienced employee until the new employee has become proficient in groundwater sampling techniques described in this SOP. Occasional on-site field audits conducted by the Environmental Department will ensure that field personnel continue to perform low-flow purging and sampling procedures correctly.

3.0 EQUIPMENT AND MATERIALS

3.1 GENERAL REQUIREMENTS

Low-flow purging involves pumping a well at rates less than the natural recovery rate at a continuous drawdown from a specific zone of the formation in the well screened interval. Field parameters rather than specific water volumes are used to determine groundwater stability prior to sample collection.

The objective of using low-flow purging is to pump the well in a manner that minimizes the stress and disturbance to the groundwater flow system. The low pump rate purges water at a rate that does not exceed the well yield and isolates the column of stagnant water above the pump intake; therefore it does not have to be removed prior to collection. Using low-flow techniques can eliminate or greatly reduce the need for sample filtration. Low-flow purging and sampling is generally not suitable for very low yield wells.

Special care will be exercised to prevent contamination of the groundwater and samples collected during sampling activities. Two primary ways in which such contamination can occur are:

- improperly cleaned equipment
- insufficient cleaning of equipment between wells

Therefore, all portions of non-dedicated sampling and test equipment that will potentially contact the interior well casing shall be thoroughly cleaned before use and between uses at different sampling locations. This includes water-level tapes or probes, pumps, tubing, lifting line, test equipment for on-site use, and other equipment or portions thereof. Specific procedures for equipment cleaning are found in SOP-001. Disposable equipment that has been cleaned and certified by the vendor should be utilized whenever possible to avoid the cleaning process and to minimize potential cross-contamination issues.

In addition to the use of properly cleaned equipment, further precautions shall be followed:

- A clean pair of new, disposable nitrile (or similar) gloves shall be worn each time a different well is sampled; and
- Sample collection activities, in general, should proceed progressively from wells which are least affected by constituents of concern progressively to wells most affected by constituents of concern.
- Groundwater sampling should not commence within 48 of monitoring well development.

3.2 PURGING AND GROUNDWATER SAMPLING PROCEDURES

3.2.1 Groundwater Level and Well Depth Measurements

Prior to the water level and well depth measurements, each well shall be inspected thoroughly for signs of damage. Any damage or repairs needed on the well must be noted in the field logbook.

Prior to installing a portable pump or prior to pumping wells with permanent pumps, an initial water level measurement shall be obtained.

Low-flow purging requires periodic water level measurements. Any water level equipment that does not disturb the water column may be used, as long as it meets the accuracy required by the SAP.

Using a pre-cleaned water level meter, the groundwater surface will be measured in accordance with SOP-009. These measurements shall be recorded in the field logbook. The date and time of water level measurements must also be recorded.

During well pumping, water level measurements should be taken every one to two flow cell volumes until sample collection. Drawdown should not exceed ten percent of the static water column height or extend below the top of the well screen.

3.2.2 Pumps

The pump that is used must be capable of pumping at low flow rates. Because the purging and sampling processes are one continuous operation, the pump selected should be appropriate for both.

Lower turbidity and lower purge volumes can achieve stabilized field parameters quicker if dedicated pumps are utilized. If portable pumps are used, care must be taken to minimize disturbance of the well and time (typically 30 to 60 minutes) is allowed prior to pump operations to allow any sediment to settle out before the purging process is started.

Examples of pumps include:

- Continuous Discharge Pumps
- Cyclic Discharge Pumps
- Peristaltic Pumps

Effort should be made to closely match the length of the tubing with the depth that the pump will be set. The pump intake should be positioned at or near the mid-point of the well screen or the middle of the water column if the height of the water column is less than the screened interval. The depth of the pump intake should be recorded in field book. If constituents of interest are known to concentrate at the top or bottom of the screened zone it may be desirable to position the pump intake to target the zone.

Portable pumps shall be carefully installed and lowered slowly into the screened interval to minimize water column disturbance. Some mixing of the water column above the well screen and the release of suspended material will require longer periods of time to achieve the required field parameter stabilization. The pump intake should be at least two feet from the top and bottom of the well screen.

The pumping rate shall be determined on a well-specific basis. The initial pumping rate should be approximately 100 milliliters per minute (mL/min) or less. If this is not possible with the pump being used, start with the lowest flow rate possible. Typical flow rates average from 0.1 L/min to 0.5 L/min.

Acceptable drawdown shall be no more than 10 percent of the water column. The maximum pump rate shall be equal or less than the well recharge rate. For low-flow purging and sampling the maximum pump rate is approximately 100 mL/min for most wells.

3.2.3 Grab sampling devices

No grab sampling devices are allowed when using the low-flow purging technique. These devices cause disturbance to the well column. Grab sampling devices include:

- Bailers
- Kemmerer samplers
- Inertial-lift devices

3.2.4 Volume Measuring Device

A volume measuring device (for example, graduated cylinder) and a time piece capable of measuring in seconds are necessary for calculating the flow rate from the pump discharge tube.

Once the correct pumping rate has been established for a well, use a large graduated cylinder and a stop watch or a watch with a second hand to determine how much groundwater is being removed over a one-minute time interval. It may be necessary to repeat this procedure every 1-2 flow cell volumes to verify the pumping rate has not changed. Record the pumping rate in the field notes in units of milliliters per minute (mL/min).

3.2.5 Field Parameters

Low-flow purging requires measurement of field parameters to determine when purging is complete and sampling can commence. At a minimum, pH, specific conductance, temperature, dissolved oxygen, and oxygen-reduction potential (ORP) are monitored until at least three sets of readings vary less than 10%. Field parameters should be collected every 1-2 flow cell volumes. Continuous monitoring using a properly sized, closed flow-through cell is most consistent and reliable.

Record all readings including periodic depth to groundwater measurements and the time of readings in the field book.

4.0 SAMPLE EXTRACTION

When project specific stability criteria have been met, actual sample collection will begin. When samples are collected using bladder or peristaltic pumps, the end of the pump discharge tubing shall be removed so that the water stream is discharging from a clean section of tubing. If a flow cell has been utilized for measuring field parameters, the tubing shall be cut off before the flow cell. If volatile organic compound vials are to be filled, the sample stream shall be slowed, if necessary, to minimize aeration of the sample stream while filling the vials. The discharge tubing shall not be allowed to come in contact with the sample containers.

Any excess water taken during well purging and sampling shall be placed in a container for proper disposal as described in SOP-024.

5.0 REFERENCES

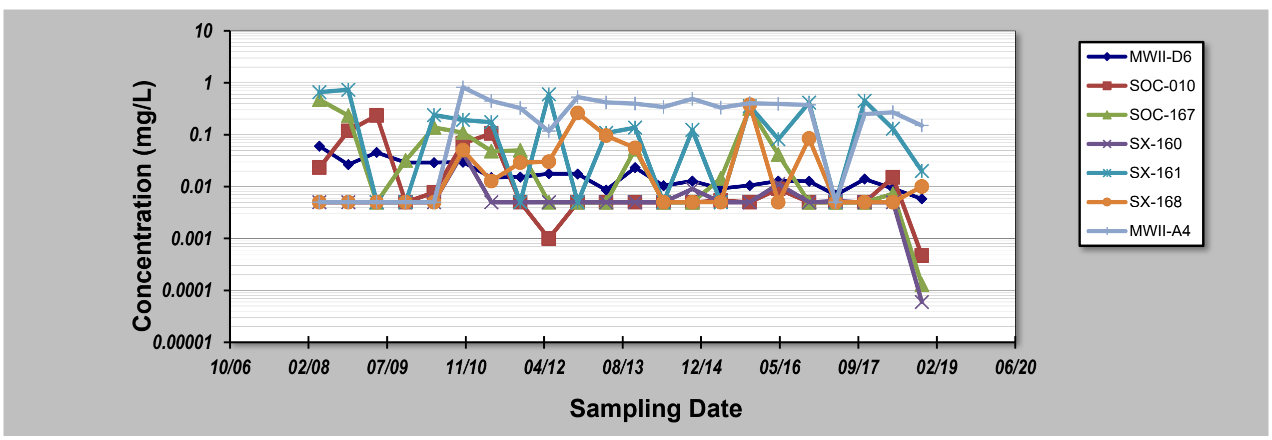
ASTM, "Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Groundwater Quality Investigations," Designation D 6771- 02, 2002

APPENDIX 3.2
OUTPUT OF MANN-KENDALL STATISTICAL ANALYSIS

GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date: Jan-19
Facility Name: HollyFrontier Tulsa East
Conducted By: Scott Sojda
Job ID: HRM313
Constituent: Benzene
Concentration Units: mg/L

Sampling Event	Sampling Date	MWII-D6	SOC-010	SOC-167	SX-160	SX-161	SX-168	MWII-A4
		BENZENE CONCENTRATION (mg/L)						
1	May-08	0.0602	0.0232	0.472	0.005	0.66	0.005	0.005
2	Nov-08	0.0265	0.118	0.233	0.005	0.735	0.005	0.005
3	May-09	0.0455	0.233	0.005	0.005	0.005	0.005	0.005
4	Nov-09	0.0291	0.005	0.032	0.005	0.005	0.005	0.005
5	May-10	0.029	0.0077	0.138	0.005	0.239	0.005	0.005
6	Nov-10	0.0296	0.0681	0.11	0.0452	0.192	0.0503	0.817
7	May-11	0.0149	0.105	0.0483	0.005	0.174	0.0128	0.443
8	Nov-11	0.0153	0.005	0.0498	0.005	0.005	0.029	0.326
9	May-12	0.0177	0.001	0.005	0.005	0.599	0.0302	0.117
10	Nov-12	0.0175	0.005	0.005	0.005	0.005	0.261	0.53
11	May-13	0.0086	0.005	0.005	0.005	0.108	0.096	0.419
12	Nov-13	0.0232	0.005	0.0524	0.005	0.137	0.0557	0.397
13	May-14	0.0104	0.005	0.005	0.005	0.005	0.005	0.341
14	Nov-14	0.0128	0.005	0.005	0.009	0.124	0.005	0.487
15	May-15	0.0092	0.0054	0.0144	0.005	0.005	0.005	0.331
16	Nov-15	0.0105	0.005	0.319	0.005	0.356	0.379	0.406
17	May-16	0.0128	0.009	0.0415	0.0112	0.0822	0.005	0.392
18	Nov-16	0.0127	0.005	0.005	0.005	0.414	0.0845	0.376
19	May-17	0.0069	0.005	0.005	0.0053	0.005	0.005	0.005
20	Nov-17	0.014	0.005	0.005	0.005	0.45	0.005	0.25
21	May-18	0.0092	0.015	0.0073	0.005	0.13	0.005	0.27
22	Nov-18	0.0058	0.00047	0.00013	0.00006	0.02	0.01	0.15
23								
24								
25								
Coefficient of Variation:		0.70	1.93	1.71	1.23	1.14	1.93	0.79
Mann-Kendall Statistic (S):		-147	-68	-87	-1	-24	17	18
Confidence Factor:		>99.9%	97.1%	99.3%	50.0%	73.9%	67.2%	68.2%
Concentration Trend:		Decreasing	Decreasing	Decreasing	No Trend	No Trend	No Trend	No Trend



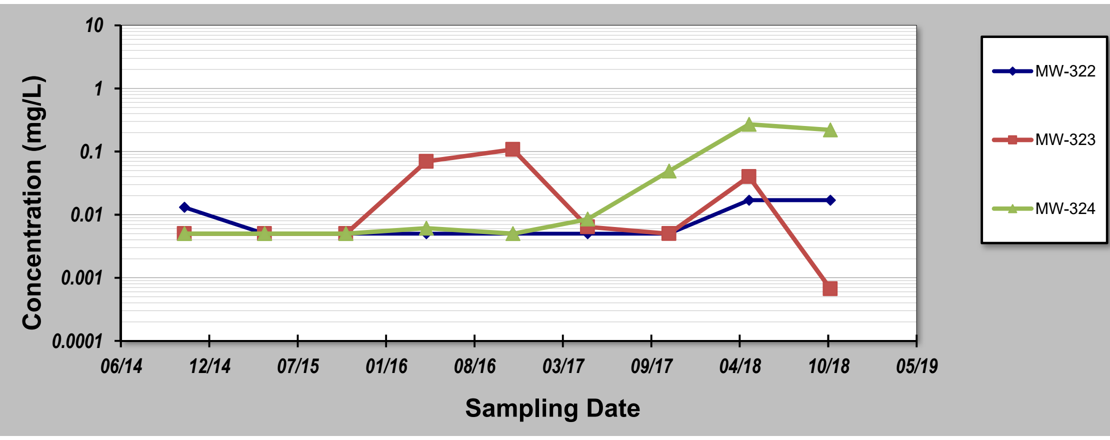
Notes:

1. At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
2. Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
3. Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date:	Jan-19	Job ID:	HRM313
Facility Name:	HollyFrontier Tulsa East	Constituent:	Benzene
Conducted By:	Scott Sojda	Concentration Units:	mg/L

Sampling Event	Sampling Date	MW-322	MW-323	MW-324				
		BENZENE CONCENTRATION (mg/L)						
1	Nov-14	0.0131	0.005	0.005				
2	May-15	0.005	0.005	0.005				
3	Nov-15	0.005	0.005	0.005				
4	May-16	0.005	0.0698	0.0061				
5	Nov-16	0.005	0.108	0.005				
6	May-17	0.005	0.0064	0.0085				
7	Nov-17	0.005	0.005	0.049				
8	May-18	0.017	0.04	0.27				
9	Nov-18	0.017	0.00067	0.22				
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
Coefficient of Variation:		0.64	1.40	1.64				
Mann-Kendall Statistic (S):		8	0	26				
Confidence Factor:		76.2%	46.0%	99.7%				
Concentration Trend:		No Trend	No Trend	Increasing				



Notes:

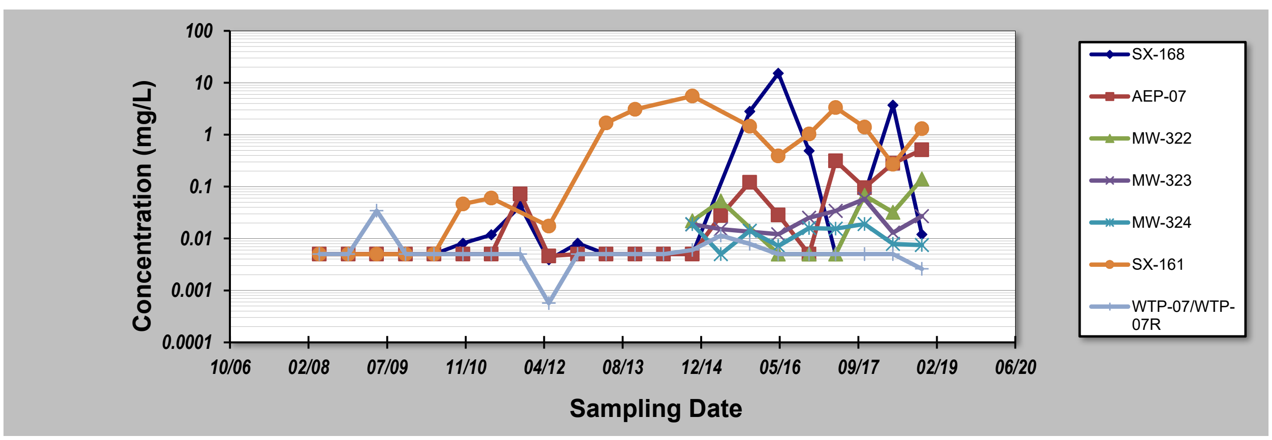
1. At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
2. Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
3. Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date: Jan-19
Facility Name: HollyFrontier Tulsa East
Conducted By: Scott Sojda

Job ID: HRM313
Constituent: MTBE
Concentration Units: mg/L

Sampling Event	Sampling Date	SX-168	AEP-07	MW-322	MW-323	MW-324	SX-161	WTP-07/WTP-07R
		MTBE CONCENTRATION (mg/L)						
1	May-08	0.005	0.005				0.005	0.005
2	Nov-08	0.005	0.005				0.005	0.005
3	May-09	0.005	0.005				0.005	0.0343
4	Nov-09	0.005	0.005				0.005	0.005
5	May-10	0.005	0.005				0.005	0.005
6	Nov-10	0.0081	0.005				0.0462	0.005
7	May-11	0.0118	0.005				0.06	0.005
8	Nov-11	0.0427	0.072					0.005
9	May-12	0.0039	0.0046				0.0173	0.00057
10	Nov-12	0.0081	0.005					0.005
11	May-13	0.005	0.005				1.68	0.005
12	Nov-13	0.005	0.005				3.08	0.005
13	May-14		0.005					0.005
14	Nov-14	0.005	0.005	0.0219	0.0187	0.0189	5.56	0.006
15	May-15		0.0277	0.053	0.0152	0.005		0.0114
16	Nov-15	2.8	0.121			0.0141	1.45	0.0079
17	May-16	15.2	0.0284	0.005	0.0121	0.0072	0.39	0.005
18	Nov-16	0.488	0.005	0.005	0.0251	0.0159	1.03	0.005
19	May-17	0.005	0.313	0.005	0.034	0.0155	3.33	0.005
20	Nov-17	0.07	0.095	0.068	0.058	0.019	1.4	0.005
21	May-18	3.7	0.28	0.032	0.013	0.0079	0.27	0.005
22	Nov-18	0.012	0.51	0.14	0.027	0.0075	1.3	0.0026
23								
24								
25								
Coefficient of Variation:		2.93	1.81	1.12	0.60	0.44	1.28	1.03
Mann-Kendall Statistic (S):		53	93	9	8	0	51	-15
Confidence Factor:		97.6%	99.9%	83.2%	80.1%	46.0%	98.9%	67.3%
Concentration Trend:		Increasing	Increasing	No Trend	No Trend	Stable	Increasing	No Trend



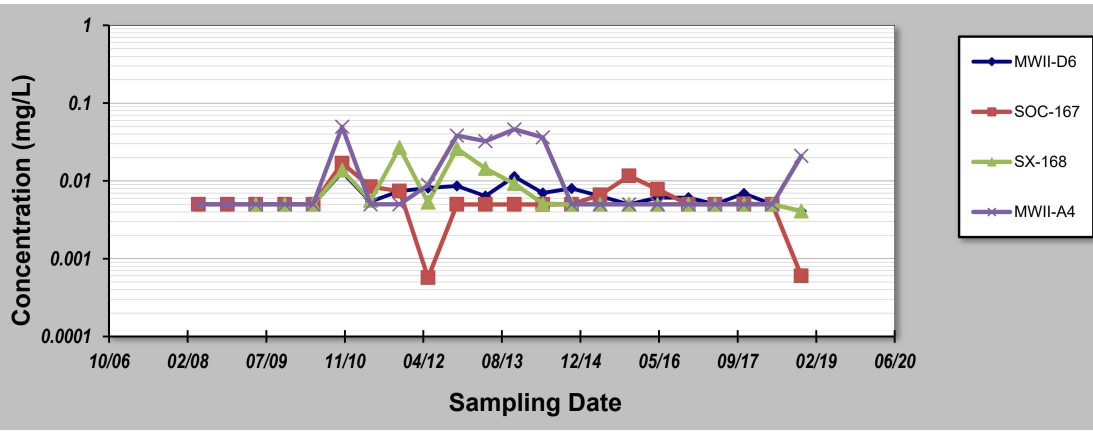
Notes:

1. At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
2. Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
3. Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date:	Jan-19	Job ID:	HRM313
Facility Name:	HollyFrontier Tulsa East	Constituent:	Toluene
Conducted By:	Scott Sojda	Concentration Units:	mg/L

	Sampling Point ID:	MWII-D6	SOC-167	SX-168	MWII-A4			
Sampling Event	Sampling Date	TOLUENE CONCENTRATION (mg/L)						
1	May-08	0.005	0.005		0.005			
2	Nov-08	0.005	0.005		0.005			
3	May-09	0.005	0.005	0.005	0.005			
4	Nov-09	0.005	0.005	0.005	0.005			
5	May-10	0.005	0.005	0.005	0.005			
6	Nov-10	0.013	0.0169	0.0137	0.0496			
7	May-11	0.0054	0.0084	0.0056	0.005			
8	Nov-11	0.0074	0.0074	0.0268	0.005			
9	May-12	0.0081	0.00057	0.0053	0.0088			
10	Nov-12	0.0086	0.005	0.0259	0.0383			
11	May-13	0.0064	0.005	0.0144	0.0324			
12	Nov-13	0.0114	0.005	0.0092	0.0459			
13	May-14	0.007	0.005	0.0051	0.0363			
14	Nov-14	0.008	0.005	0.005	0.005			
15	May-15	0.0064	0.0066	0.005	0.005			
16	Nov-15	0.005	0.0116	0.005	0.005			
17	May-16	0.0061	0.0078	0.005	0.005			
18	Nov-16	0.0061	0.005	0.005	0.005			
19	May-17	0.005	0.005	0.005	0.005			
20	Nov-17	0.0069	0.0051	0.005	0.005			
21	May-18	0.005	0.005	0.005	0.005			
22	Nov-18	0.0041	0.0006	0.0041	0.021			
23								
24								
25								
Coefficient of Variation:		0.33	0.56	0.83	1.10			
Mann-Kendall Statistic (S):		-11	-3	-67	0			
Confidence Factor:		61.0%	52.2%	98.5%	48.9%			
Concentration Trend:		Stable	Stable	Decreasing	No Trend			



Notes:

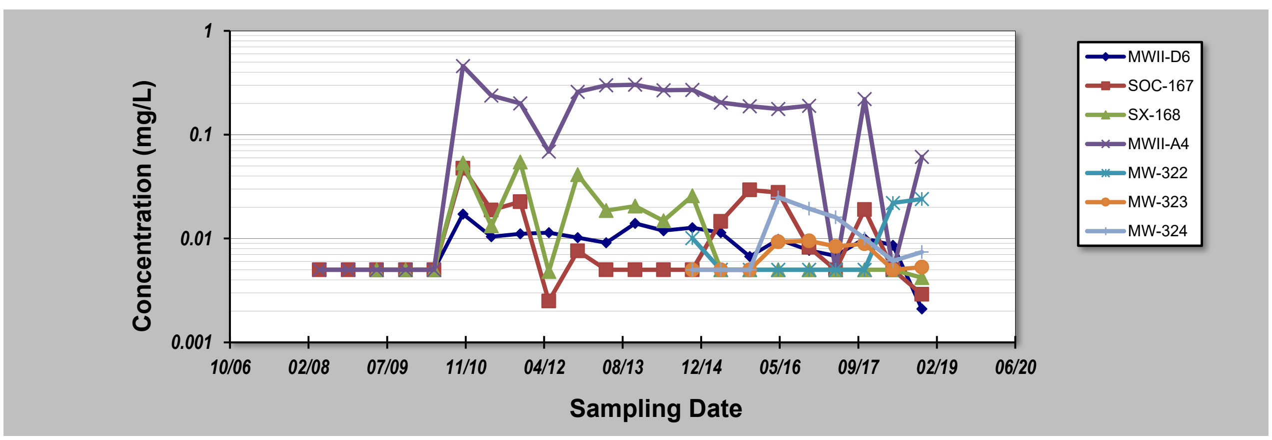
1. At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
2. Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
3. Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date: Jan-19
Facility Name: HollyFrontier Tulsa East
Conducted By: Scott Sojda

Job ID: HRM313
Constituent: Xylene
Concentration Units: mg/L

Sampling Event	Sampling Date	MWII-D6	SOC-167	SX-168	MWII-A4	MW-322	MW-323	MW-324
		XYLENE CONCENTRATION (mg/L)						
1	May-08	0.005	0.005		0.005			
2	Nov-08	0.005	0.005		0.005			
3	May-09	0.005	0.005	0.005	0.005			
4	Nov-09	0.005	0.005	0.005	0.005			
5	May-10	0.005	0.005	0.005	0.005			
6	Nov-10	0.0172	0.0475	0.0534	0.458			
7	May-11	0.0104	0.0188	0.0132	0.238			
8	Nov-11	0.0111	0.0226	0.0546	0.2			
9	May-12	0.0114	0.0025	0.0048	0.0686			
10	Nov-12	0.0102	0.0076	0.0412	0.258			
11	May-13	0.0091	0.005	0.0186	0.299			
12	Nov-13	0.014	0.005	0.0205	0.303			
13	May-14	0.0119	0.005	0.0148	0.268			
14	Nov-14	0.0127	0.005	0.0258	0.27	0.0101	0.005	0.005
15	May-15	0.0114	0.0146	0.005	0.204	0.005	0.005	0.005
16	Nov-15	0.0067	0.0294	0.005	0.188	0.005	0.005	0.005
17	May-16	0.0098	0.0278	0.005	0.177	0.005	0.0093	0.0249
18	Nov-16	0.0077	0.0082	0.005	0.19	0.005	0.0095	0.0194
19	May-17	0.0068	0.005	0.005	0.005	0.005	0.0084	0.016
20	Nov-17	0.01	0.019	0.005	0.22	0.005	0.0089	0.01
21	May-18	0.0086	0.005	0.005	0.005	0.022	0.005	0.0061
22	Nov-18	0.0021	0.0029	0.0042	0.061	0.024	0.0053	0.0074
23								
24								
25								
Coefficient of Variation:		0.41	0.99	1.09	0.84	0.82	0.31	0.67
Mann-Kendall Statistic (S):		10	12	-51	14	9	6	5
Confidence Factor:		59.9%	62.1%	94.8%	64.2%	79.2%	69.4%	65.7%
Concentration Trend:		No Trend	No Trend	Prob. Decreasing	No Trend	No Trend	No Trend	No Trend



Notes:

1. At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
2. Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
3. Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

HOLLYFRONTIER TULSA REFINING LLC
TULSA EAST REFINERY
TULSA, OKLAHOMA

PERMIT ATTACHMENT 4

INSPECTION AND MAINTENANCE PLAN

INSPECTION AND MAINTENANCE PLAN
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Tables

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HollyFrontier Tulsa Refining LLC, East Refinery
Attachment #4
Inspection and Maintenance Plan
July 2019, Updated May 2020

1.0 INTRODUCTION

HollyFrontier Tulsa Refining LLC (HFTR), the "Permittee", owns and operates the Tulsa East Refinery (the Refinery), including two (2) land treatment units (LTUs) where wastes remain in place after closure of the hazardous waste management units. The two (2) closed LTUs are known as the Flare Area LTU (FALTU) and the Walnut Grove LTU (WGLTU). The FALTU covers approximately twenty-nine (29) acres; the WGLTU is approximately twenty (20) acres in size.

The Refinery has developed a comprehensive Inspection and Maintenance Plan (IMP) for the Resource Conservation and Recovery Act (RCRA) regulated LTUs located at the Refinery. The IMP also applies to the Arkansas Riverbank Areas 1-6 located at the Refinery (note - Arkansas Riverbank Areas 1, 2, 3 and part of 4 are located on property owned by The Public Service Company of Oklahoma [PSO]). This IMP (Permit Attachment 4) has been prepared to meet the submittal requirements of the RCRA Part B Permit. A Facility Base Map showing the LTUs, SWMUs, AOCs and the Arkansas Riverbank Areas 1-6 is attached as Figure 1.

1.1 Objectives and Scope

The objective of the IMP is to detail the inspection and maintenance activities and the frequency of those activities that will be carried out during the post-closure period for each LTU and the Arkansas Riverbank Areas 1-6. Several solid waste management units (SWMUs) and areas of concern (AOCs) have been identified at the Refinery, many of which are closed with no further action and therefore do not require additional inspection and maintenance. SWMUs and AOCs that are not currently closed (SWMU-C, SWMU-H and AOC-2) are being further evaluated through the risk assessment process (as described below) and any inspection and maintenance actions that may be needed going forward will be identified during that process. SWMUs-E, -F and -G are located in areas with on-going Refinery operations and are proposed for evaluation when the Refinery ceases operations or the unit is taken out of permanent service, and thus are not included in the IMP. The IMP meets the inspection requirements of Title 40 of the Code of Federal Regulations (40 CFR) Part 264.15 and the post-closure care requirements found in 40 CFR § 264.117, 264.118 and 264.273(g).

2.0 GENERAL INSPECTION AND MAINTENANCE PLAN INSPECTION SCHEDULES

Inspections at the Refinery will generally consist of the following activities for the LTUs and the Arkansas Riverbank Areas 1-6.

2.1 Inspection Summary

The inspections cover the major features of the LTUs and the Arkansas Riverbank Areas 1-6 including:

- Deterioration, malfunctions, or improper operation of LTU run-on and run-off control systems (where present and applicable) including any potentially detrimental changes in the existing system of dikes and levees surrounding the LTUs;
- Integrity of the monitoring well network at the LTUs (this routinely occurs in conjunction with the facility-wide semi-annual sampling events);
- Security features of the LTUs including integrity of fences, gates, locks and appropriate signage where present and applicable;
- Conditions of paved, gravel and concrete surfaces where present at the LTUs;
- Condition of vegetative cover where present, including soil erosion, subsidence, stressed vegetation and animal burrows at the LTUs;
- Potential for wind dispersion of waste or waste residues at the LTUs; and
- Arkansas Riverbank Areas 1-6 inspection.

Conditions that require attention during the LTU inspections (such as fence integrity, signs, vegetative cover condition, well condition, etc.) are outlined on the inspection logs. Example LTU inspection logs for the IMP are provided as Table 1. The format of the inspection logs may change over time but the essential items to maintain compliance will remain.

2.2 Frequency of Inspections

Area	Frequency
FALTU	**Semi-annual, or as needed**
WGLTU	**Semi-annual, or as needed**
Monitoring Well Network	**Semi-annual**
Arkansas Riverbank Areas 1-6	**Weekly (three times per week if certain conditions are triggered)**

Note: LTU inspections may be performed more frequently than semi-annually if significant weather events occur (e.g., after a major storm event yielding seven or more inches of precipitation within 24 hours or less).

2.3 Corrective Actions

Any problems, deficiencies or issues detected by inspections or at any other time will immediately be brought to the attention of the appropriate supervisor, Refinery Security and/or the Refinery Environmental Department and noted in the inspection log. Repairs and/or corrective actions will be conducted as soon as possible to remedy the issue. A description of any repairs or remedial actions will be recorded in the inspection log. Corrective actions made in response to noted deficiencies or issues identified during any inspection will also be included in the semi-annual monitoring report (SMR) prepared for the Oklahoma Department of Environmental Quality (DEQ).

2.4 Record Keeping

The inspection logs will be kept for a minimum of three (3) years from the date of inspection and will be kept in electronic or hard copy in the Refinery Environmental Department files.

3.0 AREAS OF THE INSPECTION AND MAINTENANCE PLAN

The closed LTUs listed below and the Arkansas Riverbank Areas 1-6 will be inspected as part of this IMP. Descriptions and brief histories of the SWMUs/AOCs are also provided in the following subsections of this IMP for informational purposes. More detail regarding the LTUs can be found in Permit Attachment 2, Post-Closure Plan.

1. Flare Area LTU (FALTU)
2. Walnut Grove LTU (WGLTU)
3. Arkansas Riverbank Areas 1-6

The following SWMUs and AOCs are undergoing evaluation (and ultimately closure) via the risk assessment process and if they require long-term inspection and maintenance upon closure, the permit will be modified as needed at that time:

- SWMU-C – Former Land Farm (Tetraethyl Lead Area)
- SWMU-H – Former Waste Disposal Site
- AOC-2 – Former Union Pacific Railroad Property

The following closed SWMUs/AOCs are proposed for removal from the IMP based on their regulatory status and approval:

- SWMU-A – Former Land Farm – Closed with No Further Action (NFA) December 10, 1998
- SWMU-B –Former Land Farm – Closed with NFA December 10, 1998
- SWMU-D – Former Landfill (Off Unit Storm Pond) – Closed with NFA December 10, 1998
- AOC-1 – Former Landfill (Dredge Pond) – Closed with NFA December 10, 1998; DEQ confirmed in correspondence dated November 27, 2018 that a surface water investigation would not be required.

The following SWMUs/AOCs that are located within active Refinery areas will be addressed when the Refinery closes.

- SWMU-E – Former Landfill – Active Wastewater Treatment Plant (WWTP)
- SWMU-F – Former Land Farm – Active Naphtha Hydrotreater
- SWMU-G – Former Land Farm – Active Alky Unit

3.1 Regulated Land Treatment Units (LTUs)

Two RCRA regulated LTUs have historically operated at the Refinery. Solid (and hazardous) wastes were reportedly placed in the LTUs starting in the early 1900s. The last hazardous waste application was in

February 1988 for the FALTU and June 2001 for the WGLTU. Only nonhazardous wastes were applied to the WGLTU since 2001. The Refinery also applied biosolids wastewater to the LTUs for irrigation; however, this practice ceased in December 2015. The FALTU was certified closed on April 1, 1993. The WGLTU was certified closed on April 24, 2009. In total, the two (2) LTUs occupy approximately forty-nine (49) acres. As part of the LTU closures, all areas were either seeded or had previously established vegetative cover with small areas having gravel cover. Both LTUs are currently under post-closure care.

The Permittee proposes to inspect, maintain and monitor the LTUs during the post-closure period by performing the following activities:

1. Inspect and maintain a vegetative, pavement and gravel cover, including fertilization, watering, mowing and reseeding as needed/appropriate;
2. Inspect to preserve adequate security requirements by checking Refinery fencing, locks and proper warning signs, as well as warning signs located at the perimeter of both LTUs;
3. Inspect run-on/off controls to maintain minimal run-on to LTUs;
4. Inspect erosion controls to prevent erosion of cover and minimize ponding on LTUs;
5. Inspect integrity of the monitoring well network; and
6. Perform required post-closure semi-annual fluid level gauging of Refinery network gauging wells and semi-annual groundwater monitoring of Refinery point of compliance (POC) wells. The groundwater monitoring protocol for the Refinery is detailed in the Sampling and Analysis Plan and Quality Assurance Project Plan (SAP-QAPP) provided as Permit Attachment 3.1.

3.2 Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs)

3.2.1 SWMU-A: Former Land Farm

SWMU-A was originally identified as a SWMU by the United States Environmental Protection Agency (U.S. EPA) in 1984 as a result of a Refinery Site Inspection as part of Sinclair Oil Company's (SOC's) hazardous waste management permit. SWMU-A reportedly was used for the disposal of rust scale from unleaded tank bottoms from 1947 to 1970. Lead and chromium were reportedly historically identified in the subsurface soils at the SWMU. In Section VI, page 1 of the December 10, 1998 Walnut Grove Operations Permit, DEQ stated that it "received Sinclair's completed RFI Phase 2 report which presented the results of field sampling and analysis around the identified SWMUs and AOC". DEQ further stated that "with respect to SWMUs A, B, C, D, and the Dredge Pond Area of Concern (AOC-1), the DEQ determined that no further remediation or corrective action is required". SWMU-A's status is "closed with NFA" as a result of this determination.

3.2.2 SWMU-B: Former Land Farm

SWMU-B was originally identified as a SWMU by the U.S. EPA in 1984 as a result of a Refinery Site Inspection as part of SOC's hazardous waste management permit. It was reported that SWMU-B historically received oily tank bottom sludges up to 1966 and was the reported location of a onetime crude oil spill. Lead and chromium have historically been identified in the subsurface soils at the SWMU. In Section VI, page 1 of the December 10, 1998 Walnut Grove Operations Permit, DEQ stated that it "received Sinclair's completed RFI Phase 2 report which presented the results of field sampling and analysis around the identified SWMUs and AOC". DEQ further stated that "with respect to SWMUs A, B, C, D, and the Dredge Pond Area of Concern (AOC-1), the DEQ determined that no further remediation or corrective action is required". The SWMU-B status is "closed with NFA" as a result of this determination.

3.2.3 SWMU-C: Former Land Farm (Tetraethyl Lead Area)

SWMU-C was originally identified as a SWMU by the U.S. EPA in 1984 as a result of a Refinery Site Inspection as part of SOC's hazardous waste management permit. Originally described as a one (1) acre site, SWMU-C historically received leaded tank bottom sludges in 1973. Lead was historically identified in the subsurface soils at the SWMU. Elemental mercury, lead and petroleum hydrocarbons were discovered during soil pre-characterization activities as part of a geotechnical investigation performed by SOC during construction of a new sulfur unit on July 1, 2008. The boundaries of SWMU-C were expanded in August 2008 to incorporate these additional impacted areas.

The DEQ requested an investigative work plan to address the elemental mercury. The work plan was submitted by SOC in June 2009 and approved by DEQ in October 2009. Holly Refining & Marketing Tulsa Inc. (HRMT – former entity name prior to HFTR) conducted investigation activities and impacted soil removal actions in December 2009 and February 2010. A summary report was submitted to DEQ in June 2010. The report concluded that no visible elemental mercury remained in the investigation target area, and the elemental mercury impact was localized and appeared to be of limited extent. However, soil sampling in the area after soil removal indicated that mercury-impacted soils were still present above U.S. EPA risk-based industrial soil screening levels. The DEQ response letter dated August 15, 2011 (received by HRMT on September 9, 2011) noted additional measures that HFTR must take if follow-up investigation and corrective actions were not performed. HRMT submitted an additional investigation work plan *SWMU-C Screening Investigation Work Plan* on March 8, 2013, that was approved by DEQ on May 28, 2013. On November 13, 2015, DEQ received the *Soil Investigation Summary Report SWMU-C*. DEQ noted that inorganics, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and light non-aqueous phase liquid (LNAPL) impacts to the soil and groundwater at SWMU-C are likely attributed to cumulative effects of historic operations and singular releases from facility equipment, tanks and process lines over time. No specific SWMU-C point sources were identified during the investigation (with the exception of historically identified mercury in the Linde Pump House area).

HFTR intends to conduct a risk assessment at SWMU-C to evaluate whether the site presents risk and whether additional work is warranted. The risk assessment will be conducted in accordance with the *Revised Work Plan for the Development of Soil and Groundwater Risk-based Cleanup Levels for AOC-2, SWMU-H, and SWMU-C Areas* submitted to DEQ in April 2019 and approved by DEQ in correspondence dated June 19, 2019.

3.2.4 SWMU-D: Former Landfill (Current Off Unit Storm Water Pond)

SWMU-D was originally identified as a SWMU by the U.S. EPA in 1984 as a result of a Refinery Site Inspection as part of SOC's hazardous waste management permit. Originally described as a five (5) acre site, SWMU-D reportedly historically received oily tank bottoms and heater bundle cleaning sludges sometime prior to 1947 and ending in 1976. These wastes were reportedly excavated and land farmed at the FALTU. SWMU-D is currently occupied by an active storm water holding pond lined with a four-inch thick clay layer. Lead and chromium have historically been identified in the groundwater adjacent to SWMU-D. In Section VI, page 1 of the December 10, 1998 Walnut Grove Operations Permit, DEQ stated that it "received Sinclair's completed RFI Phase 2 report which presented the results of field sampling and analysis around the identified SWMUs and AOC". DEQ further stated that "with respect to SWMUs A, B, C, D, and the Dredge Pond Area of Concern (AOC-1), the DEQ determined that no further remediation or corrective action is required". The SWMU-D status is "closed with NFA" as a result of this determination.

3.2.5 SWMU-E: Former Landfill (Current WWTP)

SWMU-E was originally identified as a SWMU by the U.S. EPA in 1984 as a result of a Refinery Site Inspection as part of SOC's hazardous waste management permit. Originally described as a five (5) acre site, SWMU-E reportedly was an active landfill where API separator sludge was disposed of sometime prior to 1947 and ending in 1976. These wastes were reported to have been excavated and land farmed at the FALTU. Currently, SWMU-E is the location of the Refinery WWTP including the On-Unit Storm Water Pond, the north storm water pond, the two API separators and Tanks 400 and 401 (slop oil tanks).

In July 2008, additional waste materials were encountered during the cleaning of the north storm water pond located at the WWTP. The boundaries of SWMU-E were subsequently expanded to include the newly identified impacted areas. The dimensions of the bottom of the north storm water pond are approximately one hundred eighteen (118) feet by two hundred twenty-four (224) feet. The dimensions of the top of the north storm pond are approximately one hundred seventy-five (175) feet by two hundred eighty-two (282) feet. The depth of the pond is approximately eleven and one half (11.5) feet. The overall holding capacity of the pond is estimated at 2.8 million gallons. It is not feasible to perform current investigations at SWMU-E due to ongoing Refinery operations. Further investigation of SWMU-E will be proposed when the Refinery ceases operations or the WWTP is taken out of permanent service.

3.2.6 SWMU-F: Former Land Farm (Active Naphtha Hydrotreater Unit)

SWMU-F was identified as a SWMU in October 2004 as a result of Refinery construction activities. Refinery personnel were installing new naphtha hydrotreater equipment when solid waste material identified as coke was found approximately three (3) feet below ground surface inside an old concrete foundation. The dimensions of the foundation were approximately one hundred sixty (160) feet long by fifty (50) feet wide by twelve (12) feet deep. SWMU-F was estimated to have a capacity of around 3,600 cubic yards based on the aforementioned dimensions. A total of approximately 3,875 cubic yards of waste material was reportedly excavated from SWMU-F and disposed of off-site. It is not feasible to perform current investigations at SWMU-F due to ongoing Refinery operations. Further investigation of SWMU-F will be performed when the Refinery ceases operations or the naphtha hydrotreater and associated units are taken out of permanent service.

3.2.7 SWMU-G: Former Land Farm (Active Alky Unit)

SWMU-G was identified as a SWMU in August 2007 as a result of Refinery personnel evaluating the integrity of buried sections of the process wastewater sewer system located at the Alkylation (Alky) Unit. It was determined that a release through cracks or other openings in one of the drain lines that discharges oily water to the sewer system had occurred, impacting soils adjacent to the line. The main sewer system is comprised of approximately 1,266 linear feet of pipe. The excavated drain line was approximately one hundred (100) feet in length and the associated feed lines totaled approximately one hundred twenty (120) linear feet. Based upon the dimensions of the Alky Unit and assuming an area of impact to a maximum depth of five (5) feet, the SMWU is estimated to have a 19,450-cubic yard capacity. The Alky Unit is located near the center of the process area of the Refinery. It is not feasible to perform current investigations at SWMU-G due to ongoing Refinery operations. Further investigation of SWMU-G will be proposed when the Refinery ceases operations or the Alky Unit is taken out of permanent service.

3.2.8 SWMU-H: Former Waste Disposal Site

SWMU-H was identified as a SWMU in May 2008 when buried drums were discovered during Refinery landscaping and grading. An approximate nine and one half (9.5) acre tract of land adjacent to the Arkansas River located between the east tank farm fence and the east property fence was slated for public access under the management of the River Parks Authority (RPA). Prior to opening the area to the public, a patch of tar-like material and debris was reportedly encountered during landscaping activities. The waste materials were excavated to a depth of approximately three (3) feet below ground surface. Deteriorated drums, petroleum impacted soils and potential asbestos containing materials (ACM) were reportedly identified during excavation activities. Employees from former Refinery operations indicated a portion of SWMU-H was apparently used as a waste disposal site. Pits approximately eighteen (18) to twenty (20) feet wide by approximately twenty (20) to twenty-five (25) feet long and eight (8) to twelve (12) feet deep were dug and then filled with a variety of waste material (e.g., asbestos, wood scraps, glass, scrap metal, dirt, bricks, coke, gunite, spent catalyst, residue materials, tank bottoms). The disposal area was operational prior to 1951 and closed prior to 1982. SWMU-H has been investigated per the approved *AOC-2 and SWMU-H Investigation Work Plan* submitted on May 16, 2011 and approved by DEQ on June 28, 2011.

On December 31, 2015, HFTR submitted an *Areas of Interest Screening Investigation Summary Report for AOC-2 and SWMU-H*. The report summarized the findings of the Areas of Interest (AOI) Investigation screening activities, examined the nature and extent of subsurface impact, provided an updated conceptual site model (CSM), and identified potential data gaps that may require additional investigation and delineation.

HFTR submitted the following additional work plans for SWMU-H and the RPA as follows:

- *SWMU-H Supplemental Investigation Work Plan* dated January 19, 2017 and approved by the DEQ on March 20, 2017; and
- *SWMU-H Supplemental Investigation Work Plan – River Parks Authority Leased Area Investigation Addendum* dated April 17, 2017 and approved by the DEQ on July 17, 2017.

On February 28, 2018, HFTR submitted the *Solid Waste Management Unit-H / River Parks Authority Perimeter Investigation Report* to DEQ. The report summarized the findings of the investigation including the nature and extent of Refinery waste, nature and extent of LNAPL, and soil and groundwater quality in the RPA area. DEQ responded to the report in correspondence dated February 12, 2019.

HFTR intends to conduct a risk assessment at SWMU-H to evaluate whether the site presents risk and whether additional work is warranted. The risk assessment will be conducted in accordance with the *Revised Work Plan for the Development of Soil and Groundwater Risk-based Cleanup Levels for AOC-2, SWMU-H, and SWMU-C Areas* submitted to DEQ in April 2019 and approved by DEQ in correspondence dated June 19, 2019.

3.2.9 AOC-1: Former Landfill (Dredge Pond)

AOC-1 was reportedly a naturally occurring pond that was used for disposal of spent catalyst from the Fluid Catalytic Cracking Unit (FCCU). AOC-1 was reportedly designated as an AOC resulting from the disposal of spent catalyst and tank bottom wastes, with reported impacts from lead and hydrocarbons. In Section VI, page 1 of the December 10, 1998 Walnut Grove Operations Permit, DEQ stated that they "received Sinclair's completed RFI Phase 2 report which presented the results of field sampling and analysis around the identified SWMUs and AOC". DEQ further stated that "with respect to SWMUs A, B, C, D, and the Dredge Pond Area of Concern (AOC-1), the DEQ determined that no further remediation or corrective action is required". The AOC-1 status is "closed with NFA" as a result of this determination.

In the October 21, 2016 SMR approval letter, DEQ requested that HFTR "determine if the water in AOC-1 is storm water runoff or if the water contains any waste" and include the result in the next SMR. The source of the water at AOC-1 was confirmed to be seepage from the adjacent active storm water pond (SMWU-D) and surface water runoff; therefore, the ponded water in AOC-1 would not contain waste. In the SMR (July-December 2017), HFTR requested this matter be closed and had no recommendations for additional activities for AOC-1. DEQ confirmed in correspondence dated November 27, 2018 that a surface water investigation would not be required.

3.2.10 AOC-2: Former Union Pacific Railroad Property

AOC-2 was identified July 22, 2008 as a result of Refinery construction activities. Solid waste was encountered in two (2) excavations during the rerouting of an off-unit storm water line. The buried solid waste was located in a triangular portion of property located south of the Refinery's WWTP and northeast of the Refinery's off unit storm water pond. SOC purchased the triangle piece of property from Union Pacific Railroad in 2008. The buried waste was encountered near the surface to depths ranging from approximately four (4) to six (6) feet below ground surface. The waste was comprised primarily of fire brick, scrap metal, construction debris, glassware, insulation and ACM. Asbestos was reportedly then removed from an excavation in AOC-2 that was approximately six hundred (600) feet long by thirty (30) feet wide by five (5) to six (6) feet deep. The ACM were reportedly disposed of off-site at an appropriate disposal facility.

HFTR intends to conduct a risk assessment at AOC-2 to evaluate whether the site presents risk and whether additional work is warranted. The risk assessment will be conducted in accordance with the *Revised Work Plan for the Development of Soil and Groundwater Risk-based Cleanup Levels for AOC-2,* *SWMU-H, and SWMU-C Areas* submitted to DEQ in April 2019 and approved by DEQ in correspondence dated June 19, 2019.

The majority of AOC-2 is heavily wooded and would be a safety concern for Refinery personnel to enter and perform inspections. In addition, AOC-2 is fenced and access must be requested.

3.3 Arkansas Riverbank Areas 1-6

The Refinery includes approximately one half (½) mile of shoreline along the Arkansas River. Areas 1-6 are based on the intersection of base map grid lines A-1 through A-6 along the riverbank (Figure 1). Arkansas Riverbank Areas 5, 6 and the northern part of 4 are located on property owned by HFTR while Arkansas Riverbank Areas 1, 2, 3 and the southern part of 4 are located on property owned by PSO. Groundwater generally moves from the interior of the Refinery east toward the bank of the Arkansas River. The presence of LNAPL on the groundwater table is a possible source for intermittent hydrocarbon sheen on the Arkansas River. Therefore, routine inspections are performed along the bank of the Arkansas River in Areas 1-6. Table 2 provides an example Inspection Log for the Arkansas Riverbank Areas. The format of the inspection log may change over time but the essential items to maintain compliance will remain.

Permittee proposes to:

- Inspect the Arkansas Riverbank Areas 1-6 weekly. The inspection will include an observance of the presence, extent and intensity of hydrocarbon sheen, whether booms are in place or needed, and whether sorbent booms were replaced. Any other unusual observations will be noted, and river levels and flow will be recorded. Follow-up action regarding any observed hydrocarbon sheen will be as described below.

If hydrocarbon sheen is identified during an inspection, HFTR will undertake the following actions:

- File an initial report via email with the DEQ's Land Protection Division (LPD) and Water Quality Division (WQD) within 24 hours of discovery of a hydrocarbon sheen; and
- Determine whether the source of the hydrocarbon sheen is from the Refinery and if confirmed, then perform the following actions:
  - Modify the inspection frequency at the location of the observed hydrocarbon sheen to three times per week (generally Monday, Wednesday and Friday);
  - Commence remedial actions, as appropriate (including placement of sorbent booms);
  - File monthly reports via email with the DEQ's LPD and WQD until the hydrocarbon sheen is no longer observed during inspections; and
  - File a summary report with the DEQ's LPD and WQD and return to once a week inspections once the hydrocarbon sheen is no longer observed for four (4) consecutive weeks of three (3) times a week inspections.

Note that the terms of these inspections are currently under discussion with DEQ. HFTR will continue to implement the inspection schedule and protocol proposed above, which reflects the information provided to HFTR on October 31, 2018 in a letter from DEQ and will modify the schedule based on any further communications with DEQ.

4.0 ROUTINE MAINTENANCE AND USE PLAN

The routine intrusive maintenance and surface use of the LTUs will be limited to routine intrusive maintenance which may include temporary subsurface work. When these activities occur, they will be managed as described in the follow subsections.

4.1 Routine Intrusive Maintenance at Closed LTUs

Routine intrusive maintenance at the closed LTUs will be limited to surface and/or subsurface disturbances that may include disturbance of the cover (vegetative, gravel, pavement) and materials beneath the ground surface. Examples of routine intrusive maintenance activities covered under this use includes removal/installation of bollards and signage; repair, inspection and maintenance of surface and subsurface utilities and/or hydrocarbon lines; and the placement of additional gravel or paving for decontamination pad construction, construction laydown areas, trailer placement, vehicle parking, etc. The Refinery Environmental Department will be contacted for any intrusive maintenance. For any planned intrusive maintenance that is considered non-routine, such as potential well installation, the Refinery Environmental Department will determine if a permit modification is needed and will prepare and submit the permit modification to DEQ for approval.

The Permittee proposes to manage routine intrusive maintenance activities on the closed LTUs as follows:

- DEQ will be notified prior to any intrusive maintenance; a permit modification will not be needed.
- An environmental consultant will be involved in the management and oversight of each routine intrusive maintenance activity.
- Work will be stopped if waste material is encountered.
- Work will be performed by Hazardous Waste Operations and Emergency Response (HAZWOPER) trained personnel.
- Equipment and any removed debris (e.g., personal protective equipment (PPE), bollards, signage, utilities, etc.) will be decontaminated to standards as specified in the Land Disposal Restrictions (LDR 40 CFR §268.45) and as incorporated by reference in Oklahoma Administrative Code (OAC) 252:205-3-2(j) and manage by recycling or disposal as non-hazardous waste at a permitted off-site facility. Decontamination would take place on a decontamination pad or, if a decontamination pad is not accessible, on the LTU(s). Decontamination will consist of using water pressure to remove contaminated debris surface layers resulting in a “clean debris surface” based on visual inspection. A “clean debris surface” means the surface, when viewed without magnification, shall be free of all visible contaminated soil and hazardous waste except that residual staining from soil and waste consisting of light shadows, slight streaks, or minor discolorations, and soil and waste in cracks, crevices, and pits may be present provided that such staining and waste and soil in cracks, crevices, and pits shall be limited to no more than 5% of each square inch of surface area. If disposed, decontaminated debris will be classified as

nonhazardous waste. The wastewater generated during decontamination will remain on and infiltrate into the LTU.

- Excavated soil/materials will be replaced in the excavation, to the extent feasible. If needed, clean material will be used for additional backfill. If excavated soil/materials cannot be replaced in the excavation, it will be contained, characterized and disposed accordingly.
- Surface cover will be reestablished as soon as practicable upon project completion.
- A summary of new activities/post-construction activities conducted within the LTUs in a given six-month period will be provided to DEQ in the SMRs.

Inspection and Maintenance Plan Example Tables

1. EXAMPLE Land Treatment Unit Inspection and Repair Log

2. EXAMPLE Arkansas Riverbank Areas 1-6 Inspection Log

Table 1.
EXAMPLE Land Treatment Unit Inspection and Repair Log

At least semi-annually and after major storm events* – the following should be inspected, observations recorded, and repairs made if necessary.

Inspection performed by: ___________________________Date: _______________Time: _________________

Inspection Item	Yes	No [1]	Comments (if "No", must include comment)	Date and Nature of Repairs
Flare Area Land Treatment Unit				
1. Is gravel/paving/vegetative cover in good condition?				
2. Is the integrity of the Refinery property fence to the west, south and east of FALTU intact?				
3. Are warning signs in place and legible from a distance (i.e. > 25 feet)?				
4. Is there evidence of spilled/leaked material?				
5. Is there evidence of standing water or erosion?				
6. Are run-on/run-off features in good condition?				
7. Are the LTU monitoring wells in good condition and undamaged?				
Walnut Grove Land Treatment Unit				
1. Is gravel/paving/vegetative cover in good condition?				
2. Is the integrity of the Refinery property fence to the west, north and east of WGLTU intact?				
3. Are warning signs in place and legible from a distance (i.e. > 25 feet)?				
4. Is there evidence of spilled/leaked material?				
5. Is there evidence of standing water or erosion?				
6. Are run-on/run-off features in good condition?				

Inspection Item	Yes	No [1]	Comments (if "No", must include comment)	Date and Nature of Repairs
7. Are the LTU monitoring wells in good condition and undamaged?				
Other Observations:				

1. Record N/A in "No" column if inspection line item does not apply for the specific area being inspected.

NOTE: This inspection log and any related work orders must be maintained for at least three (3) years from the date of inspection. The format of the inspection log may change over time but the essential items to maintain compliance will remain.

*A major storm event is defined as yielding seven (7) or more inches of precipitation within twenty-four (24) hours or less.

Table 2.
EXAMPLE Arkansas Riverbank Areas 1-6 Inspection Log

RIVERBANK INSPECTION REPORT

HOLLYFRONTIER TULSA REFINING LLC - TULSA EAST REFINERY

Inspectors: ______________________

Date: ______________________

Time (Start & End) ______________________

River Flow: ______________________

Water Level: ______________________

Change in Water Level: ______________________

Wind Direction and Strength: ______________________

	Location of Hydrocarbon Sheen(s) within Area	GPS Coordinates	Horizontal Size of Sheen (feet)	Vertical Location of Sheen (feet on bank, at river surface)	Is Sheen Out in River (how many feet)	Intensity (droplets, light, medium, heavy)	Unusual Characteristics	Were Photos Taken of Area	Are Sorbent Booms in Place	Was Sorbent Boom Maintenance Performed	Comments
Area A											
Area B											
Area C											
Area D											
Area E											
Area F											
Area G											
Area H											

1. If a hydrocarbon sheen is observed in any area, please contact Equus Environmental (Cherie Almeida 918-808-8256)**before** leaving the Refinery.
2. If Cherie Almeida is not available, please contact Bruce McKenzie (Equus) 918-906-6780
3. If hydocarbon sheen is observed, Equus to contact HFTR within 3 hours. HFTR Contacts (in priority order)
   Arsin Sahba: (972) 689-8540; Brian Moore: (918) 935-6695; Jennifer Sanchez: (918) 519-1920; and Mike Holder: (575) 308-1115

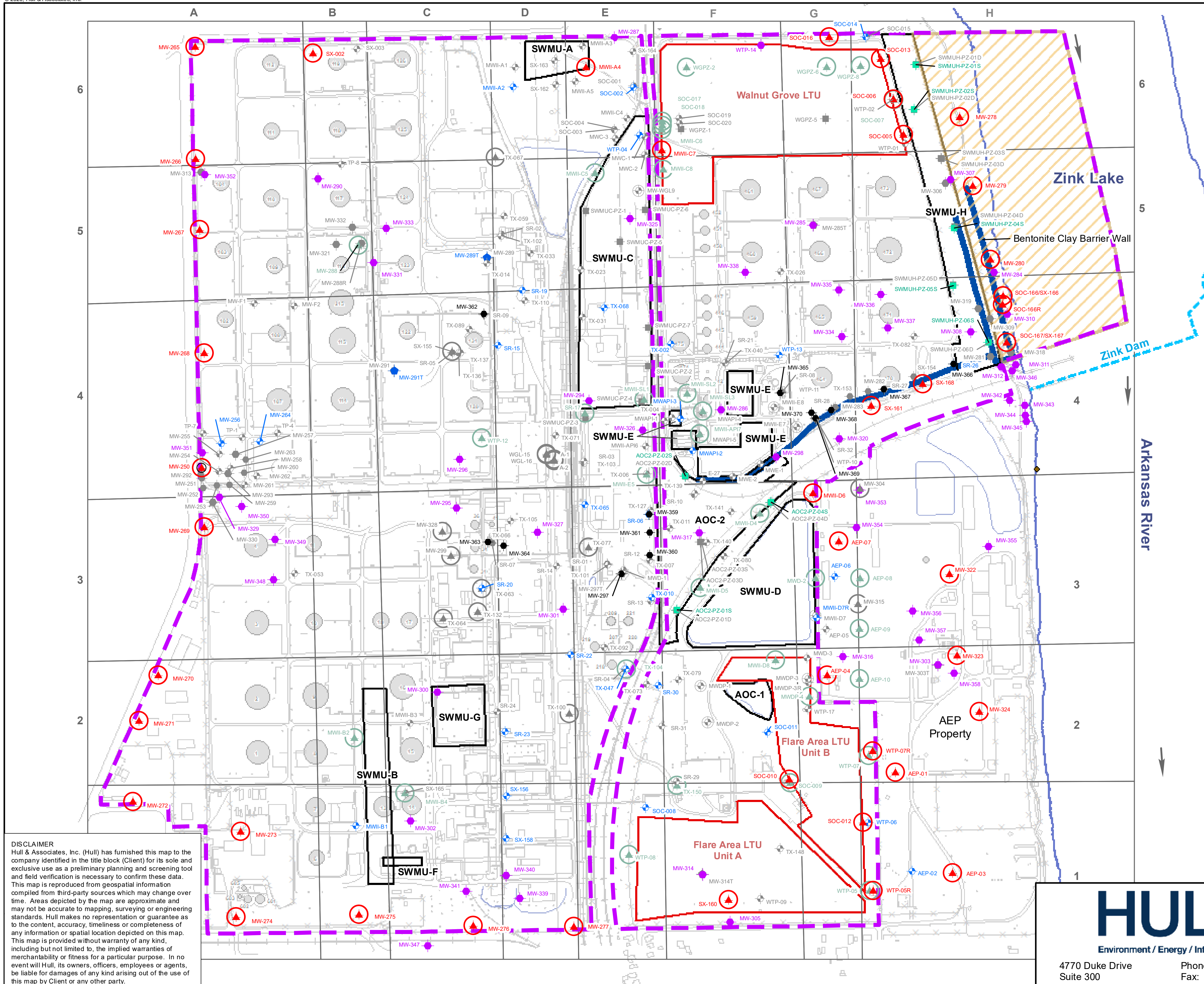
NOTE: This inspection log and any related work orders must be maintained for at least three (3) years from the date of inspection. The format of the inspection log may change over time but the essential items to maintain compliance will remain.

River flow and river gauge height: Obtain from United States Geological Survey (USGS) website for location 07164500 Arkansas River at Tulsa, Oklahoma approximate location 11th Street and the Arkansas River. Flow is in cubic feet per second (cfs). River gauge height is in feet above floor of river = 615.29 feet above mean sea level (famsl).

Web address: http://waterdata.usgs.gov/ok/nwis/dv/?site_no=07164500&PARAmeter_cd=00060,00065

Inspection and Maintenance Plan Figures

1. Facility Base Map



Refinery Property Boundary
Property Leased to River Parks Authority
LTUs
SWMUs & AOCs
Tanks
Low Water Dam
Bentonite Clay Barrier Wall
Railroad
Fence
Stream/Pond
Riverbank
Outfall

Monitoring Locations

Point of Compliance Well
Point of Compliance Well operating as LNAPL Recovery Well
Program Monitoring Well
Program LNAPL Recovery Well
Program LNAPL Transmissivity Monitoring Well
Program LNAPL Investigation Monitoring Well
Program Piezometer
(Program Gauging Wells and Piezometers)
Non-Program Double Cased Well With Screen Below Top Groundwater Level
Non-Program Monitoring Wells
Abandoned Well
Destroyed Well
Non-Program LNAPL Recovery Well
Non-Program LNAPL Transmissivity Monitoring Well
Non-Program LNAPL Investigation Monitoring Well
Non-Program Piezometer

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May 2020

HollyFrontier Tulsa Refining LLC
(Tulsa East Refinery)
Permit No. 990750960-PC
Attachment #4 – Inspection and Maintenance Plan

Facility Base Map

902 West 25th Street
Tulsa, Tulsa County, Oklahoma

Figure 1

File Name: HRM319_13_Fig01_FacilityMap.mxd
Edited: 9/14/2020 By: rkaip

HOLLYFRONTIER TULSA REFINING LLC
TULSA EAST REFINERY
TULSA, OKLAHOMA

PERMIT ATTACHMENT 5

CORRECTIVE ACTION AND POST-CLOSURE COST ESTIMATES

HollyFrontier Tulsa Refining, Tulsa East Refinery
RCRA Permit Renewal
Attachment 5 - Corrective Action and Post-Closure Cost Estimates
July 2020

Unit	Unit / Site / Project	Summary of Scope	Closure		Post-Closure	Total Estimated Cost
			Estimated Investigation Cost	Estimated Remediation Cost	Estimated O&M Cost	
SWMU H	SWMU H - RPA Leased Area	Investigation and Remediation	$313,035	$500,680	$0	$813,715
AOC 2	AOC-2	Investigation and Remediation	$56,853	$155,000	$0	$211,853
GW-Dis	Dissolved Phase GW Plumes	Investigation and Remediation, Groundwater Standards Development	$508,700	$2,272,553	$0	$2,781,253
LNAPL	LNAPL Plume	Investigation and Remediation	$438,207	$61,447	$0	$499,654
SWMU C	SWMU C	Investigation and Remediation	$352,072	$1,115,000	$0	$1,467,072
O&M	Facility Wide O&M	General Plant wide O&M	$0	$0	$14,473,544	$14,473,544
RCRA-LTU	RCRA Permit and LTU Compliance	RCRA Permit and LTU Compliance	$508,370	$0	$0	$508,370
POC	Point of Compliance Well Network	Evaluation of Data, POC Network Optimization	$94,008	$0	$0	$94,008
Sheen	Arkansas River Sheen	Investigate sheen along Arkansas River at northeast corner of PSO/AEP Property	$81,957	$2,253,219	$0	$2,335,176
RPA Riverbank	RPA Riverbank	Preliminary design of long term remedy, river inspection and boom maintenance	$182,962	$0	$0	$182,962
			$2,536,164	**$6,357,899**	**$14,473,544**	**$23,367,607**

SWMU H - RPA Leased Area

	Investigation / Remediation	Corrective Action and Post Closure Cost Estimate: Unit Rate	Units	Quantity	Cost
Permit Compliance & Investigation					
HF, ODEQ & Sinclair Meetings	Investigation	$ 29,508	each	1	$ 29,508.00
SWMU-H Data Gap Report, Response to Comments, TRC Rev	Investigation	$ 13,730	each	1	$ 13,730.00
Daily Construction Inspection (2020)	Investigation	$ 71,033	each	1	$ 71,033.00
Daily Construction Inspection (2021)	Investigation	$ 16,480	each	1	$ 16,480.00
Risk Assessment Data Gap Investigation	Investigation	$ 39,688	each	1	$ 39,688.00
Risk Assessment & Soil Disposal					
Risk Assessment Report	Investigation	$ 26,259	each	1	$ 26,259.00
Ecological Risk Evaluation	Investigation	$ 9,750	each	1	$ 9,750.00
Maintenance, Impacted Soil/GW Mgnt.					
Environmental Construction Document Preparation	Investigation	$ 9,926	each	1	$ 9,926.00
Pier Drilling and Installation Support/Oversight	Investigation	$ 49,413	each	1	$ 49,413.00
Bridge Abutment Construction Support/Oversight	Investigation	$ 47,248	each	1	$ 47,248.00
Closure Tasks					
Soil Excavation	Remediation	$ 475,000	each	1	$ 475,000.00
Surface Waste Expression Inspection & Removal	Remediation	$ 17,640	each	1	$ 17,640.00
Survey RPA	Remediation	$ 8,040	each	1	$ 8,040.00

Post-Closure Costs

	Unit Rate	Units	Quantity	Cost	Year (non-routine tasks)	Starting Year (annual tasks)	Ending Year (annual tasks)
Post-Closure Non-routine Tasks							
Add							
				$ -			
				$ -			
Post-Closure Annual Tasks							
Add							
				$ -			
				$ -			
				$ -			

	Closure:	Post-Closure:	Total
2020	$ 797,235	$ -	$ 797,235
2021	16,480	-	16,480
2022	-	-	-
2023	-	-	-
2024	-	-	-
2025	-	-	-
2026	-	-	-
2027	-	-	-
2028	-	-	-
2029	-	-	-
2030	-	-	-
2031	-	-	-
2032	-	-	-
2033	-	-	-
2034	-	-	-
2035	-	-	-
2036	-	-	-
2037	-	-	-
2038	-	-	-
2039	-	-	-
2040	-	-	-
2041	-	-	-
2042	-	-	-
2043	-	-	-
2044	-	-	-
2045	-	-	-
2046	-	-	-
2047	-	-	-
2048	-	-	-
2049	-	-	-
2050	-	-	-
2051	-	-	-
2052	-	-	-
2053	-	-	-
2054	-	-	-
2055	-	-	-
2056	-	-	-
2057	-	-	-
2058	-	-	-
2059	-	-	-
	$ 813,715	$ -	$ 813,715

Tulsa East
Corrective Action and Post Closure Cost Estimate
2020

AOC-2

	Investigation / Remediation	Unit Rate	Units	Quantity	Cost
Permit Required Tasks					
HF, ODEQ & Sinclair Meetings	Investigation	$29,508	each	1	$ 29,508
Risk Assessment Data Gap Investigation	Investigation	$1,086	each	1	$ 1,086
Add			each	-	$ -
Add			each	-	$ -
Risk Assessment & Soil Disposal					
Risk Assessment Report	Investigation	$26,259	each	1	$ 26,259
Closure Tasks					
Soil Excavation	Remediation	$155,000	each	1	$ 155,000
Add			each	-	$ -
Add			each	-	$ -

Post-Closure Costs

	Unit Rate	Units	Quantity	Cost	Year (non-routine tasks)	Starting Year (annual tasks)	Ending Year (annual tasks)
Post-Closure Non-routine Tasks							
Add				$ -			
Add				$ -			
Add				$ -			
Post-Closure Annual Tasks							
Add				$ -			
Add				$ -			

	Closure:	Post-Closure:	Total
2020	$ 211,853	$ -	$ 211,853
2021	-	-	-
2022	-	-	-
2023	-	-	-
2024	-	-	-
2025	-	-	-
2026	-	-	-
2027	-	-	-
2028	-	-	-
2029	-	-	-
2030	-	-	-
2031	-	-	-
2032	-	-	-
2033	-	-	-
2034	-	-	-
2035	-	-	-
2036	-	-	-
2037	-	-	-
2038	-	-	-
2039	-	-	-
2040	-	-	-
2041	-	-	-
2042	-	-	-
2043	-	-	-
2044	-	-	-
2045	-	-	-
2046	-	-	-
2047	-	-	-
2048	-	-	-
2049	-	-	-
2050	-	-	-
2051	-	-	-
2052	-	-	-
2053	-	-	-
2054	-	-	-
2055	-	-	-
2056	-	-	-
2057	-	-	-
2058	-	-	-
2059	-	-	-
	$ 211,853	$ -	$ 211,853

Tulsa East
Corrective Action and Post Closure Cost Estimate
2020

Dissolved Phase GW Plumes	Investigation / Remediation	Unit Rate	Units	Quantity	Cost
		Corrective Action and Post Closure Cost Estimate			
Permit Required Tasks					
LTU GW Figs (2x/yr.) and Misc. Task Support	Investigation	$ 36,740	each	1	$ 36,740
GW Standards Investigation and Reporting and Determine Groundwater Background	Investigation	$ 113,850	each	1	$ 113,850
Dissolved Plumes Pilot Testing/Engineering Study	Investigation	$ 130,000	each	1	$ 130,000
HF, ODEQ and/ or AEP Meetings	Investigation	$ 35,512	each	1	$ 35,512
Community Outreach	Investigation	$ 2,500	month	12	$ 30,000
2019 Perimeter Investigation Tasks					
Western Perimeter Data Gap Report, Response to Comments, TRC Review	Investigation	$ 15,953	each	1	$ 15,953
NW Perimeter Data Gap Report , Response to Comments, TRC Review	Investigation	$ 8,564	each	1	$ 8,564
Northern Perimeter Data Gap Report, Response to Comments, TRC Review	Investigation	$ 13,221	each	1	$ 13,221
Southern Perimeter Data Gap, Response to Comments, Hull Support, Hull Review	Investigation	$ 20,010	each	1	$ 20,010
Eastern/AEP Perimeter Data Gap Report, Response to comments, TRC Review	Investigation	$ 14,896	each	1	$ 14,896
Perimeter Risk Assessment	Investigation	$ 89,954	each	1	$ 89,954
Closure Tasks					
Remediation Project Management (Design)	Remediation	$ 55,000	each	1	$ 55,000
Remediation System Design	Remediation	$ 95,000	each	1	$ 95,000
Remediation Project Management (Install)	Remediation	$ 105,000	each	1	$ 105,000
Remediation System Installation	Remediation	$ 1,815,000	each	1	$ 1,815,000
Remediation Project Management (Startup)	Remediation	$ 55,000	each	1	$ 55,000
Recovery System Startup	Remediation	$ 100,000	each	1	$ 100,000
Well Abandonment (3 wells at soccer complex)	Remediation	$ 19,943	each	1	$ 19,943
North Perimeter GW Sampling (3 wells at north COT property)	Remediation	$ 7,879	each	1	$ 7,879
Southern Perimeter Area GW Sampling (6 wells at southern perimeter area)	Remediation	$ 15,758	each	1	$ 15,758
AEP GW Sampling (1 well at AEP)	Remediation	$ 3,973	each	1	$ 3,973
					$ -
			each	1	$ -
					$ -
Post-Closure Non-routine Tasks					
Add					
Add					
Add					
Post-Closure Annual Tasks					

Post-Closure Costs

Unit Rate	Units	Quantity	Cost	Year (non-routine tasks)	Starting Year (annual tasks)	Ending Year (annual tasks)
			$ -			
			$ -			
			$ -			
			$ -			

	Closure:	Post-Closure:	Total
2020	$ 706,253	$ -	$ 706,253
2021	1,920,000	-	1,920,000
2022	155,000	-	155,000
2023	-	-	-
2024	-	-	-
2025	-	-	-
2026	-	-	-
2027	-	-	-
2028	-	-	-
2029	-	-	-
2030	-	-	-
2031	-	-	-
2032	-	-	-
2033	-	-	-
2034	-	-	-
2035	-	-	-
2036	-	-	-
2037	-	-	-
2038	-	-	-
2039	-	-	-
2040	-	-	-
2041	-	-	-
2042	-	-	-
2043	-	-	-
2044	-	-	-
2045	-	-	-
2046	-	-	-
2047	-	-	-
2048	-	-	-
2049	-	-	-
2050	-	-	-
2051	-	-	-
2052	-	-	-
2053	-	-	-
2054	-	-	-
2055	-	-	-
2056	-	-	-
2057	-	-	-
2058	-	-	-
2059	-	-	-
	$ 2,781,253	$ -	$ 2,781,253

Tulsa East
Corrective Action and Post Closure Cost Estimate
2020

LNAPL Plume

	Investigation / Remediation	Unit Rate	Units	Quantity	Cost
Investigation Tasks					
Facility-wide LNAPL Data Gap Report Addendum, Response to Comments & TRC Rev	Investigation	$ 20,391	each	1	$ 20,391
ODEQ Meetings/LNAPL Management Plan Presentation	Investigation	$ 64,132	each	1	$ 64,132
Vapor Building Survey, Evaluation, and Work Plan and Sampling	Investigation	$ 161,540	each	1	$ 161,540
Direct Contact Worker Protection Plan at Refinery and Perimeter Areas	Investigation	$ 7,631	each	1	$ 7,631
LNAPL Management Plan (NFA, active recovery, NSZD, & LNAPL Tn, TRC CAP supp	Investigation	$ 54,384	each	1	$ 54,384
Closure Tasks					
LNAPL Recovery System Baseline Evaluation (response to comments, edits)	Investigation	$ 130,129	each	1	$ 130,129
Monitoring Well Install (LNAPL Recovery Optimization)	Remediation	$ 61,447	each	1	$ 61,447

Post-Closure Costs

	Unit Rate	Units	Quantity	Cost	Year (non-routine tasks)	Starting Year (annual tasks)	Ending Year (annual tasks)
Post-Closure Non-routine Tasks							
	$ -				$ -		
Post-Closure Annual Tasks							

	Closure:	Post-Closure:	Total
2020	$ 499,654	$ -	$ 499,654
2021	-	-	-
2022	-	-	-
2023	-	-	-
2024	-	-	-
2025	-	-	-
2026	-	-	-
2027	-	-	-
2028	-	-	-
2029	-	-	-
2030	-	-	-
2031	-	-	-
2032	-	-	-
2033	-	-	-
2034	-	-	-
2035	-	-	-
2036	-	-	-
2037	-	-	-
2038	-	-	-
2039	-	-	-
2040	-	-	-
2041	-	-	-
2042	-	-	-
2043	-	-	-
2044	-	-	-
2045	-	-	-
2046	-	-	-
2047	-	-	-
2048	-	-	-
2049	-	-	-
2050	-	-	-
2051	-	-	-
2052	-	-	-
2053	-	-	-
2054	-	-	-
2055	-	-	-
2056	-	-	-
2057	-	-	-
2058	-	-	-
2059	-	-	-
	$ 499,654	$ -	$ 499,654

Tulsa East
Corrective Action and Post Closure Cost Estimate
2020

SWMU C

	Investigation / Remediation	Corrective Action and Post Closure Cost Estimate: Unit Rate	Units	Quantity	Cost
Permit Required Tasks					
ODEQ Data Review & Scope Negotiation Meetings	Investigation	$ 29,508	each	1	$ 29,508
Add			each	-	$ -
Investigations					
Risk Assessment Data Gap Investigation	Investigation	$ 49,371	each	1	$ 49,371
Risk Assessment Report	Investigation	$ 33,804	each	1	$ 33,804
Risk Assessment Additional Data Gap Investigation	Investigation	$ 59,389	each	1	$ 59,389
Remediation & Excavations					
Limited Soil Excavation Confirmation Sampling/Work Plan	Remediation	$ 45,000	each	1	$ 45,000
Limited "Hot Spot" Soil Excavation	Remediation	$ 935,000	each	1	$ 935,000
Confirmation Soil Sampling	Investigation	$ 130,000	each	1	$ 130,000
Limited Excavation IM Report	Investigation	$ 50,000	each	1	$ 50,000
Engineered Controls					
Air Monitoring and Dust Suppression	Remediation	$ 45,000	each	1	$ 45,000
Fencing SWMU-C	Remediation	$ 90,000	each	1	$ 90,000
Add				-	$ -
Misc.					
Add		$ -	each	-	$ -
Add		$ -	each	-	$ -
Add		$ -	each	-	$ -

	Post-Closure Costs: Unit Rate	Units	Quantity	Cost	Year (non-routine tasks)	Starting Year (annual tasks)	Ending Year (annual tasks)
Post-Closure Non-routine Tasks							
				$ -			
Add				$ -			
Add				$ -			
Add				$ -			
Post-Closure Annual Tasks							
Add				$ -			
Add				$ -			
Add				$ -			
Add				$ -			

	Closure:	Post-Closure:	Total
2020	$ 1,467,072	$ -	$ 1,467,072
2021	-	-	-
2022	-	-	-
2023	-	-	-
2024	-	-	-
2025	-	-	-
2026	-	-	-
2027	-	-	-
2028	-	-	-
2029	-	-	-
2030	-	-	-
2031	-	-	-
2032	-	-	-
2033	-	-	-
2034	-	-	-
2035	-	-	-
2036	-	-	-
2037	-	-	-
2038	-	-	-
2039	-	-	-
2040	-	-	-
2041	-	-	-
2042	-	-	-
2043	-	-	-
2044	-	-	-
2045	-	-	-
2046	-	-	-
2047	-	-	-
2048	-	-	-
2049	-	-	-
2050	-	-	-
2051	-	-	-
2052	-	-	-
2053	-	-	-
2054	-	-	-
2055	-	-	-
2056	-	-	-
2057	-	-	-
2058	-	-	-
2059	-	-	-
	$ 1,467,072	$ -	$ 1,467,072

Facility Wide O&M	Investigation / Remediation	Unit Rate	Units	Quantity	Cost
		Corrective Action and Post Closure Cost Estimate			
Permit Required Tasks					
		$ -	each		$ -
		$ -	each		$ -
Closure Tasks					
		$ -	each	-	$ -
		$ -	each	-	$ -
LNAPL Investigation					

	Closure:	Post-Closure:	Total
2020	$ -	$ 564,574	$ 564,574
2021	-	486,214	486,214
2022	-	486,214	486,214
2023	-	443,214	443,214
2024	-	503,148	503,148
2025	-	521,574	521,574
2026	-	443,214	443,214
2027	-	443,214	443,214
2028	-	579,214	579,214
2029	-	503,148	503,148
2030	-	514,678	514,678
2031	-	436,318	436,318
2032	-	436,318	436,318
2033	-	436,318	436,318
2034	-	496,252	496,252
2035	-	511,230	511,230
2036	-	432,870	432,870
2037	-	432,870	432,870
2038	-	568,870	568,870
2039	-	492,804	492,804
2040	-	511,230	511,230
2041	-	432,870	432,870
2042	-	432,870	432,870
2043	-	432,870	432,870
2044	-	492,804	492,804
2045	-	511,230	511,230
2046	-	432,870	432,870
2047	-	432,870	432,870
2048	-	568,870	568,870
2049	-	492,804	492,804
2050	-	-	-
2051	-	-	-
2052	-	-	-
2053	-	-	-
2054	-	-	-
2055	-	-	-
2056	-	-	-
2057	-	-	-
2058	-	-	-
2059	-	-	-
	$ -	$ 14,473,544	$ 14,473,544

Post-Closure Costs

Task	Unit Rate	Units	Quantity	Cost	Year (non-routine tasks)	Starting Year (annual tasks)	Ending Year (annual tasks)
Post-Closure Non-routine Tasks							
2027 Permit Renewal	$ 136,000	each	1	$ 136,000	2028		
2037 Permit Renewal	$ 136,000	each	1	$ 136,000	2038		
2047 Permit Renewal	$ 136,000	each	1	$ 136,000	2048		
NSZD Progress Testing Perimeter (every 5 yrs)	$ 59,934	each	1	$ 59,934	2024		
NSZD Progress Testing Perimeter (every 5 yrs)	$ 59,934	each	1	$ 59,934	2029		
NSZD Progress Testing Perimeter (every 5 yrs)	$ 59,934	each	1	$ 59,934	2034		
NSZD Progress Testing Perimeter (every 5 yrs)	$ 59,934	each	1	$ 59,934	2039		
NSZD Progress Testing Perimeter (every 5 yrs)	$ 59,934	each	1	$ 59,934	2044		
NSZD Progress Testing Perimeter (every 5 yrs)	$ 59,934	each	1	$ 59,934	2049		
NSZD Baseline Establishment - Facility Interior	$ 78,360	each	1	$ 78,360	2020		
NSZD Progress Testing - Facility Interior (every 5 years)	$ 78,360	each	1	$ 78,360	2025		
NSZD Progress Testing - Facility Interior (every 5 years)	$ 78,360	each	1	$ 78,360	2030		
NSZD Progress Testing - Facility Interior (every 5 years)	$ 78,360	each	1	$ 78,360	2035		
NSZD Progress Testing - Facility Interior (every 5 years)	$ 78,360	each	1	$ 78,360	2040		
NSZD Progress Testing - Facility Interior (every 5 years)	$ 78,360	each	1	$ 78,360	2045		
Post-Closure Annual Tasks							
Riversheen O&M and Cap Maintenance - Quarterly	$ 3,448	qtrly	4	$ 13,792		2020	2029
Riversheen O&M and Cap Maintenance - Semi-Annually	$ 3,448	semi-ann	2	$ 6,896		2030	2034
Riversheen O&M and Cap Maintenance - Annual	$ 3,448	per year	1	$ 3,448		2035	2049
LNAPL Cap and Trap Remedy Maintenance - Tree and Brush	$ 6,000	per year	1	$ 6,000		2020	2049
Post-Closure Annual Tasks (permit required)							
LNAPL Recovery System - Operation/Optimization - (bi weekly review calls/data evaluation)	$ 64,614	per year	1	$ 64,614		2020	2049
LNAPL Recovery System - Routine O&M (equipment & materials)	$ 28,731	per year	1	$ 28,731		2020	2049
LNAPL Recovery Well - 1 Replacement Well	$ 18,109	per year	1	$ 18,109		2020	2049
LNAPL Tasks							
HF Technician Support	$ 50,000	per year	1	$ 50,000		2020	2049
LNAPL Transmissivity Testing (30 years)	$ 25,582	per year	1	$ 25,582		2020	2049
Semi-Annual Monitoring Tasks							
Semi-annual Field Event	$ 56,640	per year	1	$ 56,640		2020	2049
Semi-annual Reporting	$ 50,060	per year	1	$ 50,060		2020	2049
Semi-annual Lab Analysis	$ 50,046	per year	1	$ 50,046		2020	2049
POC/Network Well Surface Completion Upgrade (OWRB Standards) - (3 annual events at 43 wells/event)	$ 43,000	per year	1	$ 43,000		2020	2022
LTU Tasks							
LTU Inspection/Maint/Mowing	$ 30,000	per year	1	$ 30,000		2020	2049
Riverbank Tasks							
Riverbank Inspections - Weekly (Acme)	$ 29,640	per year	1	$ 29,640		2020	2049
Misc. Tasks							
LNAPL Recovery AST (Vacuum Truck)	$ 20,000	per year	1	$ 20,000		2020	2049

Tulsa East
Corrective Action and Post Closure Cost Estimate
2020

RCRA Permit and LTU Compliance

	Investigation / Remediation	Corrective Action and Post Closure Cost Estimate: Unit Rate	Units	Quantity	Cost
Permit Required Tasks					
RCRA Permit Negotiation and Revisions	Investigation	$ 71,451	each	1	$ 71,451
Meetings with ODEQ	Investigation	$ 14,762	each	1	$ 14,762
Institutional Controls	Investigation	$ 78,941	each	1	$ 78,941
CAP/ CSM	Investigation	$ 170,326	each	1	$ 170,326
LTU Surface Soil Safety Report	Investigation	$ 7,780	each	1	$ 7,780
LNAPL Investigation					
Well Abandonment	Investigation	$ 165,110	each	1	$ 165,110
Add			each	-	$ -
Add			each	-	$ -
Add			each	-	$ -

Post-Closure Costs

	Unit Rate	Units	Quantity	Cost	Year (non-routine tasks)	Starting Year (annual tasks)	Ending Year (annual tasks)
Post-Closure Non-routine Tasks							
Post-Closure Annual Tasks							
Add				$ -			
Add				$ -			

	Closure:	Post-Closure:	Total
2020	$ 508,370	$ -	$ 508,370
2021	-	-	-
2022	-	-	-
2023	-	-	-
2024	-	-	-
2025	-	-	-
2026	-	-	-
2027	-	-	-
2028	-	-	-
2029	-	-	-
2030	-	-	-
2031	-	-	-
2032	-	-	-
2033	-	-	-
2034	-	-	-
2035	-	-	-
2036	-	-	-
2037	-	-	-
2038	-	-	-
2039	-	-	-
2040	-	-	-
2041	-	-	-
2042	-	-	-
2043	-	-	-
2044	-	-	-
2045	-	-	-
2046	-	-	-
2047	-	-	-
2048	-	-	-
2049	-	-	-
2050	-	-	-
2051	-	-	-
2052	-	-	-
2053	-	-	-
2054	-	-	-
2055	-	-	-
2056	-	-	-
2057	-	-	-
2058	-	-	-
2059	-	-	-
	$ 508,370	$ -	$ 508,370

Tulsa East
Corrective Action and Post Closure Cost Estimate
2020

Point of Compliance Well Network	Investigation / Remediation	Unit Rate	Units	Quantity	Cost
Permit Required Tasks					
POE Well Installation Activities (6 South, 3 North & 1 AEP)	Investigation	$ 94,008	each	1	$ 94,008
Add			each	-	$ -
Add			each	-	$ -
Investigation Tasks					
Add			each	-	$ -
Add			each	-	$ -
Closure Tasks					
Add			each	-	$ -
Add			each	-	$ -

Corrective Action and Post Closure Cost Estimate

Post-Closure Costs

	Unit Rate	Units	Quantity	Cost	Year (non-routine tasks)	Starting Year (annual tasks)	Ending Year (annual tasks)
Post-Closure Non-routine Tasks							
Add				$ -			
Add				$ -			
Add				$ -			
Add				$ -			
Add				$ -			
				$ -			
Post-Closure Annual Tasks							
Add				$ -			
Add				$ -			
Add				$ -			
Add				$ -			
Add				$ -			
				$ -			

	Closure:	Post-Closure:	Total
2020	$ 94,008	$ -	$ 94,008
2021	-	-	-
2022	-	-	-
2023	-	-	-
2024	-	-	-
2025	-	-	-
2026	-	-	-
2027	-	-	-
2028	-	-	-
2029	-	-	-
2030	-	-	-
2031	-	-	-
2032	-	-	-
2033	-	-	-
2034	-	-	-
2035	-	-	-
2036	-	-	-
2037	-	-	-
2038	-	-	-
2039	-	-	-
2040	-	-	-
2041	-	-	-
2042	-	-	-
2043	-	-	-
2044	-	-	-
2045	-	-	-
2046	-	-	-
2047	-	-	-
2048	-	-	-
2049	-	-	-
2050	-	-	-
2051	-	-	-
2052	-	-	-
2053	-	-	-
2054	-	-	-
2055	-	-	-
2056	-	-	-
2057	-	-	-
2058	-	-	-
2059	-	-	-
	$ 94,008	$ -	$ 94,008

Tulsa East
Corrective Action and Post Closure Cost Estimate
2020

Arkansas River Sheen

	Investigation / Remediation	Corrective Action and Post Closure Cost Estimate: Unit Rate	Units	Quantity	Cost
Response					
HF ODEQ meetings	Remediation	$ 22,021	each	1	$ 22,021
Conceptual Remedy Plan Edits (Hull & TRC)	Remediation	$ 40,000	each	1	$ 40,000
Daily Sheening Inspection/Boom Replacement (2020)	Remediation	$ 277,640	per year	1	$ 277,640
Daily Sheening Inspection/Boom Replacement (2021)	Remediation	$ 277,640	per year	1	$ 277,640
Install LNAPL Cap & Trap Remedy	Remediation	$ 1,626,432	LS	1	$ 1,626,432
Plug and Abandon MW-342	Remediation	$ 9,486	per year	1	$ 9,486
Investigation					
Riverbank Sheen Report HF Edits, Response to Comments, TRC Review	Investigation	$ 30,000	each	1	$ 30,000
Gauging Riverbank wells (5)	Investigation	$ 14,160	per year	1	$ 14,160
Gauging Riverbank wells (5)	Investigation	$ 14,160	per year	1	$ 14,160
Sampling Riverbank wells (4)	Investigation	$ 9,832	per year	1	$ 9,832
Sampling Riverbank wells (5)	Investigation	$ 13,805	per year	1	$ 13,805
					$ -

Post-Closure Costs

	Unit Rate	Units	Quantity	Cost	Year (non-routine tasks)	Starting Year (annual tasks)	Ending Year (annual tasks)
Post-Closure Non-routine Tasks							
Add				$ -			
Add				$ -			
Add				$ -			
Post-Closure Annual Tasks							
Add							
Add				$ -			
Add							

	Closure:	Post-Closure:	Total
2020	$ 2,029,571	$ -	$ 2,029,571
2021	305,605	-	305,605
2022	-	-	-
2023	-	-	-
2024	-	-	-
2025	-	-	-
2026	-	-	-
2027	-	-	-
2028	-	-	-
2029	-	-	-
2030	-	-	-
2031	-	-	-
2032	-	-	-
2033	-	-	-
2034	-	-	-
2035	-	-	-
2036	-	-	-
2037	-	-	-
2038	-	-	-
2039	-	-	-
2040	-	-	-
2041	-	-	-
2042	-	-	-
2043	-	-	-
2044	-	-	-
2045	-	-	-
2046	-	-	-
2047	-	-	-
2048	-	-	-
2049	-	-	-
2050	-	-	-
2051	-	-	-
2052	-	-	-
2053	-	-	-
2054	-	-	-
2055	-	-	-
2056	-	-	-
2057	-	-	-
2058	-	-	-
2059	-	-	-
	$ 2,335,176	$ -	$ 2,335,176

Tulsa East
Corrective Action and Post Closure Cost Estimate
2020

RPA Riverbank

	Investigation / Remediation	Unit Rate	Units	Quantity	Cost
		Corrective Action and Post Closure Cost Estimate			
Corrective Measures Study Tasks					
Oversight and Design	Investigatio	$ 43,060	each	1	$ 43,060
RPA Riverbank Construction	Investigatio	$ 139,902	year	1	$ 139,902
				1	$ -
Closure Tasks					
					$ -
					$ -

Post-Closure Costs

	Unit Rate	Units	Quantity	Cost	Year (non-routine tasks)	Starting Year (annual tasks)	Ending Year (annual tasks)
Post-Closure Non-routine Tasks							
				$ -			
				$ -			
				$ -			
Post-Closure Annual Tasks							
				$ -			
				$ -			

	Closure:	Post-Closure:	Total
2020	$ 182,962	$ -	$ 182,962
2021	-	-	-
2022	-	-	-
2023	-	-	-
2024	-	-	-
2025	-	-	-
2026	-	-	-
2027	-	-	-
2028	-	-	-
2029	-	-	-
2030	-	-	-
2031	-	-	-
2032	-	-	-
2033	-	-	-
2034	-	-	-
2035	-	-	-
2036	-	-	-
2037	-	-	-
2038	-	-	-
2039	-	-	-
2040	-	-	-
2041	-	-	-
2042	-	-	-
2043	-	-	-
2044	-	-	-
2045	-	-	-
2046	-	-	-
2047	-	-	-
2048	-	-	-
2049	-	-	-
2050	-	-	-
2051	-	-	-
2052	-	-	-
2053	-	-	-
2054	-	-	-
2055	-	-	-
2056	-	-	-
2057	-	-	-
2058	-	-	-
2059	-	-	-
	$ 182,962	$ -	$ 182,962