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111 SW Columbia
Portland Oregon, 97201
aecom.com

October 11, 2019

Mr. Christer Loftenius - Hydrogeologist
Toxics Cleanup Program
State of Washington, Department of Ecology
Eastern Regional Office
4601 North Monroe Street
Spokane, WA 99205-1296
Via Email: clof461@ECY.WA.GOV

RE: Data Gap Assessment Work Plan
Tesoro Logistics (Former Chevron) Bulk Fuel Terminal: Cleanup Site No. 4867
2900 Sacajawea Park Road, Pasco, Washington 99301

Dear Mr. Loftenius:

AECOM, on behalf of Tesoro Logistics Operations, LLC. (Tesoro), has prepared this Data Gap Assessment Work Plan letter (work plan) to present proposed monitoring well installation and biodegradation study activities, a revised groundwater monitoring program, and a proposed soil gas screening event for the Tesoro Logistics (former Chevron) Bulk Fuel Terminal, located at 2900 Sacajawea Park Road, Pasco, Washington (Site).

CEECON Testing, Inc. (CEECON) submitted a letter report to the Washington State Department of Ecology (Ecology), dated June 11, 2019, summarizing results of a vapor screening event conducted at the Site. AECOM submitted a letter to Ecology, dated June 18, 2019, presenting proposed wells and a revised groundwater monitoring program in response to Ecology's request during a meeting and site visit on May 21, 2019. Ecology commented on the June 2019 CEECON and AECOM letters via email on June 18 and July 17, 2019, respectively. This work plan was prepared in response to Ecology's email comments and supersedes the June 18, 2019 letter prepared by AECOM.

Remedial Investigation Requirement

Ecology and Tesoro entered into Agreed Order No. DE 12989 (Order) on March 23, 2016. The Order requires Tesoro to conduct a supplemental remedial investigation at the Site. Multiple documents have been submitted, and field investigation events have been conducted, in support of Order requirements since execution in March 2016. A compendium of site-related plan and report documents submitted subsequent to the Order is attached as Appendix A.

This work plan will address data gaps discussed during the May 21, 2019 meeting and subsequent communications. The objectives for this work are:

- Collect additional data to better define the extent of groundwater contamination near MW-19 and MW-3
- Collect data to better understand the geochemical conditions of the aquifer
- Collect data to better understand the microbial population in soil and groundwater
- Collect additional data to support development and evaluation of remedial alternatives

After completion of this field investigation, it is anticipated a comprehensive Remedial Investigation/Feasibility Study Report will be submitted to Ecology in accordance with the Order.

Well Installation Activities

The installation of additional groundwater monitoring wells on Site will be in accordance with the requirements of Agreed Order No. DE 12989 issued by Ecology. Well installation activities will follow the protocols outlined in the *Supplemental Remedial Investigation Feasibility Study*, dated March 31, 2016. Tasks will include pre-field investigation activities and reporting necessary to comply with Ecology requirements. Field activities will include the completion of soil borings and installation of monitoring wells. Drilling and groundwater monitoring well installation activities will be completed by a driller licensed by the State of Washington, with oversight by an AECOM geologist.

Pre-Drilling Activities

Prior to any field activities, the current Site-Specific Health and Safety Plan (HASP) will be updated for use by AECOM and its subcontractors. In accordance with federal, state, or local requirements, AECOM will mark the locations of the proposed borings on-site and contact local public utilities using the Washington Utility Notification Service to field-mark known public underground utility lines. A limited geophysical survey will be completed to identify and locate subsurface utilities in the vicinity of proposed boring locations. Final boring locations will be adjusted in the field base on the results of public and private utility locates and information provided by Tesoro staff. Each boring will be cleared to a depth of 6 feet below ground surface using either a hand auger or vacuum extraction.

Soil Borings

Up to five borings will be completed using 4 x 6 sonic drilling methods and converted to monitoring wells to further delineate concentrations of dissolved gasoline- and diesel-range hydrocarbons in groundwater in the vicinity of wells MW-19 and MW-3, respectively (Figure 1). As discussed during the site walk with Ecology on May 21, 2019, two borings will be completed in the vicinity of MW-19: one up-gradient (MW-20) and one down- to cross-gradient (MW-21). If field observations indicate total petroleum hydrocarbons (TPH) are present at MW-21, a step-out boring (MW-24) will be completed east of MW-21. Two borings will be completed in the vicinity of MW-3: one up-gradient (MW-23) and one down-gradient (MW-22).

An additional two borings will be completed, one adjacent to existing well MW-19 and one adjacent to existing well MW-3 (Figure 1), to collect samples to support a natural attenuation assessment. These are not planned for conversion to monitoring wells.

Subsurface soil cores will be collected continuously using a sonic core to the final depth of each boring. Lithology of recovered soil cores will be recorded and noted for any soil staining or discoloration, odor, and sheen which may be indicative of the presence of TPH. A photoionization detector (PID) will be used to screen soil cores for volatile compounds. In addition, OilScreenSoil Scarlet Red test kits (red-dye based field kits) will be used to screen for the presence of light non-aqueous phase liquid (LNAPL) in soil cores.

Up to three soil samples will be collected from each boring location for MW-20 through MW-24. Samples will be collected only from depths where TPH indicators (petroleum odor, staining/discoloration, or sheen) are observed, elevated PID screening results are reported, or the presence of LNAPL is indicated. Soil samples will not be collected if TPH indicators are absent, PID screening results are below 20 parts per million, and LNAPL presence is not indicated.

Soil samples will be stored in a cooler with ice and submitted to Eurofins TestAmerica in Tacoma, Washington, under chain-of-custody procedures. All samples will be analyzed for the following:

- Total petroleum hydrocarbons, gasoline range (TPH-g) using Washington Method NWTPH-Gx
- Total petroleum hydrocarbons, diesel range (TPH-d) and total petroleum hydrocarbons, oil range (TPH-o) using Washington Method NWTPH-Dx, with and without silica gel cleanup (split-sample)
- Benzene, toluene, ethylbenzene, and total xylenes (BTEX), naphthalene, lead scavengers (and 1,2-dichloroethane [EDC]), and fuel oxygenates (di-isopropyl ether [DIPE], ethyl tertiary-butyl ether [ETBE], methyl tertiary-butyl ether [MTBE], tertiary-butyl alcohol [TBA], and tertiary-amyl methyl ether [TAME]) using Environmental Protection Agency (EPA) Method 8260C
- Lead scavengers (1,2-dibromeoethane [EDB]) using EPA Method 8011

- Fuel oxygenates ethanol and methanol using EPA Method 8015C

Up to four soil samples will be collected from each of the borings located adjacent to existing monitoring wells MW-19 and MW-3 for geotechnical and nutrient analyses to support the natural attenuation assessment. The samples will be stored in a cooler with ice, submitted to Eurofins TestAmerica in Tacoma, Washington under chain-of-custody procedures, and analyzed for the following:

- Fraction Organic Carbon (Foc) using the Walkley-Black method (dichromate oxidation method)
- Grain Size Distribution using ASTM Method D422 (sieve and hydrometer)
- Nitrogen, Phosphorous, and Potassium (NPK) nutrients consisting of the following analyses for each sample:
  - Total Kjeldahl Nitrogen (TKN) using EPA Method 351 and Nitrate/Nitrite Nitrogen (NPN) using EPA Method 353
  - Total Phosphorous and Potassium using EPA Methods 365 and 6020, respectively

Up to eight soil samples will be collected from each of the borings located adjacent to existing monitoring wells MW-19 and MW-3 for bacterial analysis to support the natural attenuation assessment. The samples will be stored in a cooler with ice, submitted to Zymo Research Corporation in Irvine, California under chain-of-custody procedures, and analyzed for the following:

- 16S ribosomal RNA (16S rRNA) and microbiotics analysis for bacterial identification

Groundwater Monitoring Well Installation

Soil borings will be advanced to a depth of about 10 feet below the measured depth-to-groundwater to a total depth of approximately 90 feet below ground surface (bgs). Upon completion, each of boring locations MW-20 through MW-24 will be converted into a monitoring well. Each boring advanced for soil sample collection only (borings adjacent to MW-19 and MW-3) will be backfilled. General well construction and boring backfill will be as follows:

- 0.01-slot polyvinyl chloride (PVC) screen: 10 feet below the water table to 5 feet above the water table
- 10/20 Colorado silica sand: from 1 foot below PVC screen to 2 feet above PVC screen
- 2-inch 40 PVC well casing: from top of PVC screen to 30 inches ags (above ground surface)
- Bentonite chips: from top of 10/20 Colorado silica sand to 2 feet above sand
- Bentonite grout:
  - From top of bentonite chips to 2 feet bgs for wells
  - From bottom of borehole to 2 feet bgs for backfilled borings (no well)
- Concrete: 0 to 2 feet bgs for wells and backfilled borings
- Aboveground monument: 30 inches bgs for wells only

Depths will be adjusted as necessary based on measured depth-to-groundwater and final boring depths. Each monitoring well will be developed at a minimum of 24 hours after the completion. Groundwater samples will be collected during the second semiannual sampling event of 2019 tentatively scheduled in December as summarized in the Revised Groundwater Monitoring Program section below.

Groundwater Monitoring Well Survey

Upon completion of installation, a professional surveyor licensed by the State of Washington will measure the horizonal and vertical position of each monitoring well. The well top-of-casing will be measured to a notch or permanent mark in the PVC casing. Ground surface elevation will be measured at each well monument at an “X” etched in the monument concrete pad.

Biodegradation Studies

In-situ and ex-situ studies will be conducted to quantitatively assess naturally occurring contaminant biodegradation with and without electron acceptor amendment. Study results will be used to support the site monitoring program and the need to introduce site amendments to enhance biodegradation. Each study requires an incubation period; incubation for the in-situ study will take place on-site in groundwater monitoring well MW-19 and incubation for the ex-situ study will take place in a laboratory with a controlled environment.

In-Situ Biodegradation Study

An in-situ biodegradation study will be conducted at monitoring MW-19. Microbial Insights of Knoxville, Tennessee will supply four passive sampling Bio-Trap® units strung as a stacked array. The array will be deployed into the well after three well volumes of groundwater have been purged (macropurge). The four units will consist of one monitored natural attenuation (MNA) unit and three bio stimulation (BioStim) units. The MNA unit will contain no additional electron acceptors and will therefore serve as the control unit. The remaining three BioStim units will contain an oxygen amendment, a nitrate amendment, or a sulfate amendment; the three amendments are initially planned for evaluation. Each of the four units will be baited with ^{13}C-enriched benzene for Stable Isotope Probing (SIP).

The stacked array will remain submerged in well MW-19 for an approximate 60-day incubation period. A minimum of seven feet of water column must be maintained in the well for the array to be completely submerged during the incubation period. If it is determined that seven feet of water column will not be maintained, the sulfate unit will be removed (not tested), reducing the length of the stacked array by one unit, in which case only a minimum of five and one-half feet of water column is required. The minimum water column length in MW-19 is not expected to drop below five and one-half feet. At the end of the incubation period the array will be retrieved and stored in a cooler with blue ice and submitted to Microbial Insights in Knoxville, Tennessee under chain-of-custody procedures for laboratory analysis. Results will allow for comparison of chemical, geochemical, and microbiological data between the units to quantitatively evaluate in-situ contaminant concentration reduction.

Ex-Situ Biodegradation Study

An ex-situ biodegradation study will be conducted using groundwater collected from MW-19 and soil collected from the boring adjacent to MW-19. A minimum 1-liter groundwater sample and a minimum 300-gram soil sample will be collected, stored in a cooler with blue ice, and submitted to AECOM’s treatability laboratory in Austin, Texas under chain-of-custody procedures.

For each of the groundwater and soil samples, a total of five treatments will be evaluated; one sterile control, one unamended control, one oxygen amendment, one nitrate amendment, and one sulfate amendment. Each of the five treatments will incubate simultaneously for an approximate 6-week period and each treatment will undergo at least three sampling and analysis events; a baseline event, at least one event within the incubation period, and one event at the end of the incubation period. Treatment sampling and analysis will be performed at the AECOM Austin laboratory and will include the following:

- Benzene and methane
- pH, oxidation-reduction potential (ORP), and dissolved oxygen (DO)
- Sulfate, and nitrate

In addition, treatment groundwater samples for CENSUS quantitative polymerase chain reaction (qPCR) analysis will be stored in a cooler with blue ice and submitted to Microbial Insights in Knoxville, Tennessee under chain-of-custody procedures. The CENSUS qPCR analysis will be used to detect and quantify specific microbes. Study results will allow for comparison of chemical, geochemical, and microbiological data between treatments to quantitatively evaluate contaminant concentration reduction in both soil and groundwater.

Waste Management

Investigation-derived waste will be collected for proper disposal. Drill cuttings will be placed in labeled 55-gallon drums and securely stored on site. A characterization sample compositing the contents of each drum will be submitted Eurofins TestAmerica Seattle for the following analysis.

- TPH-g using Washington Method NWTPH-Gx
- BTEX only using EPA Method 8260C
- TCLP metals using EPA Methods 1311/6010/7473

Upon review of the analytical results, drummed soil will be transported and disposed of at an approved waste facility. Wastewater generated during drilling activities, decontamination, and well development will be treated on-site wastewater treatment system. Soiled disposable equipment free of liquid hydrocarbons will be disposed of in the local waste stream.

Revised Groundwater Monitoring Program

Since May 2019, the monitoring well program (Table 1) has been revised as discussed in the May 21, 2019 meeting, per email form Ecology dated July 17, 2019, and to support the natural attenuation assessment. The revisions include the following:

- EPA Method 8011 for EDB analysis, which has lower reporting and detection limits.
- Natural attenuation parameter testing on groundwater samples collected from both the proposed monitoring wells and those installed in 2018.
- TPH-d and TPH-o analysis using Washington Method NWTPH-Dx with silica gel cleanup (SGC), in addition to the original monitoring program analysis with no SGC (split-sample), from four pre-existing monitoring wells, MW-2, MW-3, MW-17, and MW-19.
- TPH-d and TPH-o analysis using Washington Method NWTPH-Dx with SGC, in addition to the original monitoring program analysis with no SGC (split-sample), from proposed monitoring wells where at least one soil sample is collecting during boring advancement based on observed TPH indicators.
- The following natural attenuation assessment analyses from samples collected during the second semi-annual event in 2019:
  - Total Organic Carbon (TOC) analysis using Standard Method 5310D (Wet Oxidation) from MW-3 and MW-19
  - Total Iron and Total Manganese analysis using EPA Method 6020A from up to twelve pre-existing and proposed monitoring wells.

Soil Gas Screening

An on-site soil gas screening event will be conducted at pre-existing vapor extraction wells and pre-existing and new groundwater monitoring wells, up to twenty-five (25) wells total. The purpose of the event is to support the natural attenuation assessment by providing quantifiable data about aerobic/anaerobic conditions in soil gas. The event will be conducted in accordance with the Standard Operating Procedure for Down-Well Soil Gas Screening attached as Appendix B. Each well will be temporarily equipped with a gas tight wellhead cap and a length of tubing extending from the cap down into the well. For wells not screened in groundwater, i.e., vapor extraction wells, the tubing will extend to the middle of the screen. For wells screened in groundwater, i.e., groundwater monitoring wells, the tubing will extend to within one

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foot of the measured water level. Hand-held monitoring equipment will be connected to the down-well tubing via a port on the wellhead cap, and the internal hand-held equipment pump will be used to purge gas from the well at low-flow. The monitoring equipment will include a photo-ionization detector (PID) to measure soil gas volatile organic compound (VOC) concentrations and a Landfill Gas (LFG) detector to measure oxygen, carbon dioxide, and methane concentrations. Low-flow purging will continue, and readings will be recorded on a field sheet every 30 seconds, until stable readings are achieved (3 consecutive readings within 10% of each other with no consistent increasing/decreasing trend).

Schedule

Well installation activities including sample collection to support biodegradation studies is tentatively scheduled to be completed in December 2019, with a proposed start date of November 18, 2019. These activities are anticipated to take eight to ten days to complete. The vapor monitoring event will proceed concurrently with the second 2019 semi-annual groundwater monitoring event in December 2019. A data submittal letter for well installation and vapor monitoring, which will summarize the field work and sample results with accompanying boring logs, figures, tables, and laboratory reports, will be submitted within three weeks following the receipt of the final laboratory analytical results and receiving disposal receipts. An additional data submittal letter with results of the biodegradation studies will be provided within five months of deploying BioTrap® units in well MW-19.

After submittal of the data from this investigation, it is anticipated a comprehensive RI/FS Report can be prepared incorporating data collected under each of the previous investigations. The report will be prepared in accordance with the Order and present the nature and extent of contamination, an applicable relevant and appropriate requirements analysis, risk assessment analysis, identification and screening of remedial options, and a recommended remedial alternative.

Sustainable Remediation

AECOM will implement Green and Sustainable Remediation (GSR) practices while conducting the activities described in this letter. Environmental, social, and economic impacts of the project will be considered and best management practices (BMPs) will be used to minimize such impacts. Such BMPs may include sourcing materials and personnel locally, minimizing waste production, and using lower-impact materials when appropriate.

The ultimate goal of implementing GSR is to allow for the balance of environmental, social, and economic impacts of the remediation processes themselves while ensuring remediation goals are met. This goal applies to all phases of the remediation process, from investigation to remedy selection, design, and implementation, including passive approaches (e.g. MNA), and ongoing maintenance and/or monitoring.

If you have any questions about the discussion presented above, please feel free to call Nicky Moody or Jacob Barnes at (503) 948-7296.

Sincerely,

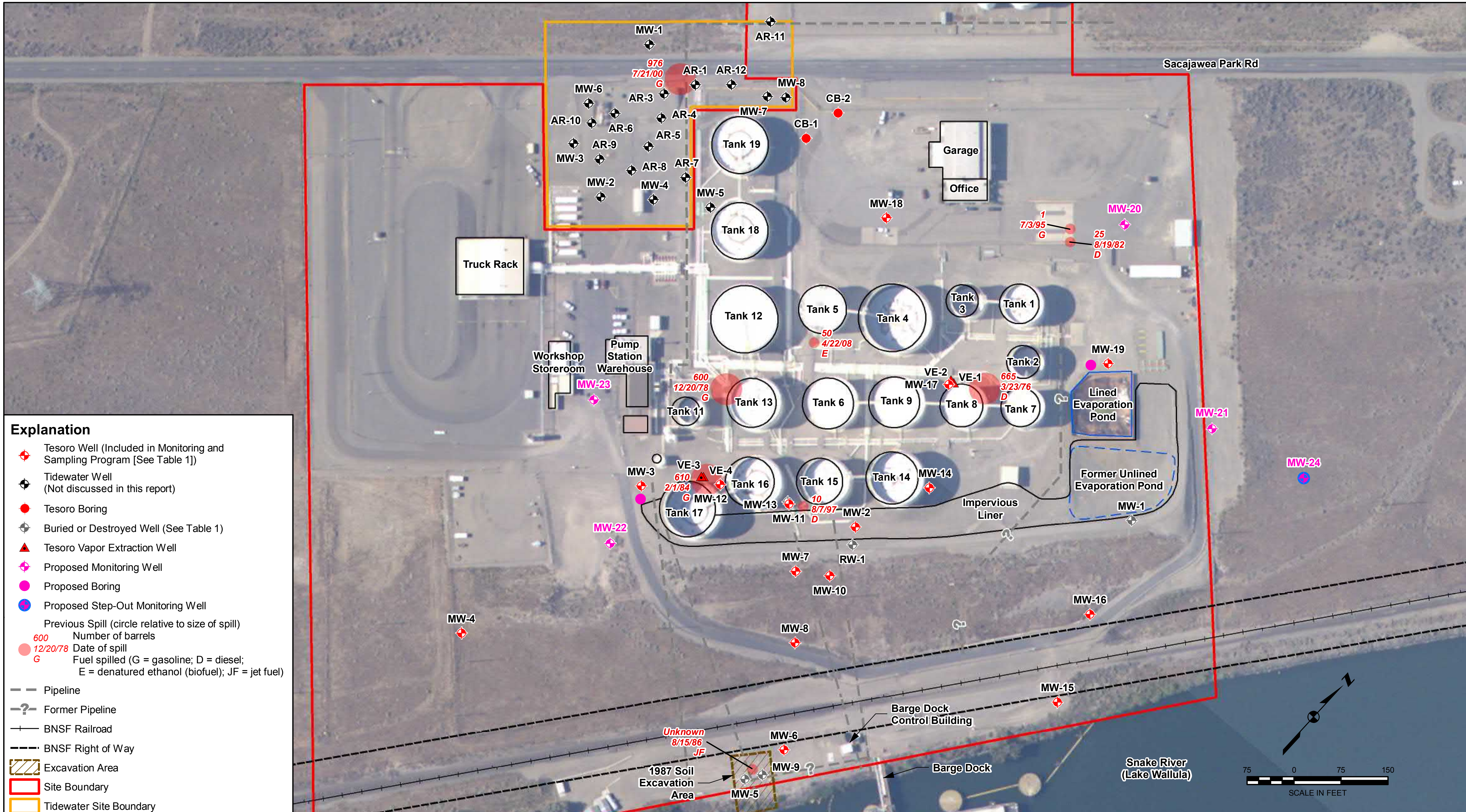
Nicky Moody
Project Manager

Jacob Barnes
Project Engineer

Attachments:

Figure 1.	Proposed Monitoring Well Location Map
Table 1.	Groundwater Monitoring and Sampling Program Summary
Appendix A	Compendium of site-related plan and report documents submitted subsequent to Agreed Order No. DE 12989, March 23, 2016.
Appendix B	Standard Operating Procedure – Down-Well Soil Gas Screening

cc:
Kyle Waldron, Marathon, via email: KAWaldron@Marathonpetroleum.com
Brent Pierce, Marathon, via email: Jack.B.Pierce@andeavor.com
Dan Andersen, Marathon, via email: Dan.J.Anderson@andeavor.com
William Fees, Ecology, via email: WFEE461@ECY.WA.GOV



Imagery Source: USGS, 2012

K:\Tesoro_Pasco\MXD\Site_Visit\Fig 2 Proposed MW Locations.mxd

PROPOSED MONITORING WELL LOCATION MAP

TESORO LOGISTICS OPERATIONS, LLC
TESORO PASCO BULK FUEL TERMINAL
PASCO, WASHINGTON

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FIGURE 1

Table 1. Groundwater Monitoring and Sampling Program Summary
Tesoro Pasco Bulk Fuel Terminal
Pasco, Washington

Well Type	Well ID	Well Location	Install Date	Total Boring Depth (feet bgs)	TOC Elevation (feet MSL) (1)	Well Diameter (inches)	Well Screen Interval (feet below bgs)	Screen Length (feet)	Depth to Pump Inlet (feet below bgs)	Monitoring and Sampling Program															
															Fuel Oxygenates		Natural Attenuation								
										Measure Depth to Groundwater	Collect Samples (During 1st SA)	Collect Samples (During 2nd SA)	TPH-g, TPH-d, & TPH-o (NWTPH-Gx and NWTPH-Dx)	VOCs: BTEX+N, EDB, & EDC (EPA 8260C / EPA 8011)	DIPE, ETBE, MTBE, TBA, & TAME (EPA 8260C)	Ethanol & Methanol (EPA 8015C)	Total Organic Carbon (SM 5310D)	Field Parameters (pH, Cond., DO, Temp, & ORP)	Total Iron (EPA 6020A)	Ferrous Iron & Nitrate (Field Test Kits)	Total Manganese (EPA 6020A)	Dissolved Manganese (field filtered) (200.7 Rev 4.4 - Metals)	Sulfate (EPA Method 300)	Alkalinity (SM 2320B)	Methane (RSK 175)
Monitoring Wells	MW-1	Downgradient	11/1983	93.9	419.40	4	73.9 - 93.9	20	--	Well Abandoned in October 2018															
	MW-2	Cross-gradient	11/1983	83.3	417.23	4	63.3 - 83.3	20	77.0	1st/2nd SA	X	X	1st/2nd SA[2]	1st/2nd SA	1st/2nd SA	1st/2nd SA	--	1st/2nd SA	2nd SA 2019	1st/2nd SA	2nd SA 2019	1st/2nd SA	1st/2nd SA	1st/2nd SA	1st/2nd SA
	MW-3	Source	11/1983	94.95	423.40	4	74.95 - 94.95	20	85.0	1st/2nd SA	X	X	1st/2nd SA[2]	1st/2nd SA	1st/2nd SA	1st/2nd SA	2nd SA 2019	1st/2nd SA	2nd SA 2019	1st/2nd SA	2nd SA 2019	1st/2nd SA	1st/2nd SA	1st/2nd SA	1st/2nd SA
	MW-4	Downgradient	11/1983	76.75	412.05	4	56.75 - 76.75	20	72.0	1st/2nd SA	X	--	1st SA	1st SA	1st SA	1st SA	--	1st SA	--	--	--	--	--	--	--
	MW-5	Downgradient	1986	--	--	--	--	--	--	Well Destroyed in May 1989															
	MW-6	Downgradient	11/17/1986	23.5	358.52	2	8.5 - 23.5	15	21.0	1st/2nd SA	X	X	1st/2nd SA	1st/2nd SA	1st/2nd SA	1st/2nd SA	--	1st/2nd SA	2nd SA 2019	1st/2nd SA	2nd SA 2019	1st/2nd SA	1st/2nd SA	1st/2nd SA	1st/2nd SA
	MW-7	Downgradient	11/18/1986	79	411.32	2	57 - 77	20	72.0	1st/2nd SA	X	X	1st/2nd SA	1st/2nd SA	1st/2nd SA	1st/2nd SA	--	1st/2nd SA	--	--	--	--	--	--	--
	MW-8	Downgradient	11/25/1986	56	383.76	2	29 - 54	25	44.0	1st/2nd SA	X	--	1st SA	1st SA	1st SA	1st SA	--	1st SA	--	1st SA	--	1st SA	1st SA	1st SA	1st SA
	MW-9	Downgradient	11/20/1986	26	--	2	10 - 25	15	--	Well Destroyed in May 1987															
	MW-10	Downgradient	1/6/1989	78.25	407.83	4	55 - 78	23	68.0	1st/2nd SA	X	--	1st SA	1st SA	1st SA	1st SA	--	1st SA	--	--	--	--	--	--	--
	MW-11	Downgradient	1/16/1989	84.5	423.44	2	75 - 85	10	83.0	1st/2nd SA	X	X	1st/2nd SA	1st/2nd SA	1st/2nd SA	1st/2nd SA	--	1st/2nd SA	--	--	--	--	--	--	--
	MW-12	Cross-gradient	1/17/1989	85	423.62	2	33 - 60 / 75 - 85	37	83.5	1st/2nd SA	X	X	1st/2nd SA	1st/2nd SA	1st/2nd SA	1st/2nd SA	--	1st/2nd SA	2nd SA 2019	1st/2nd SA	2nd SA 2019	1st/2nd SA	1st/2nd SA	1st/2nd SA	1st/2nd SA
	MW-13	Downgradient	1/17/1989	48	424.05	2	18.5 - 47.5	29	--	Well Screened Above the Water Table															
	MW-14	Cross-gradient	1/17/1989	82.5	421.84	2	82.5	36	82.0	1st/2nd SA	X	X	1st/2nd SA	1st/2nd SA	1st/2nd SA	1st/2nd SA	--	1st/2nd SA	--	--	--	--	--	--	--
	MW-15	Downgradient	9/5/2018	23.5	358.50	2	8.5 - 23.5	15	20.5	1st/2nd SA	X	X	1st/2nd SA	1st/2nd SA	1st/2nd SA	1st/2nd SA	--	1st/2nd SA	--	--	--	--	--	--	--
	MW-16	Downgradient	9/6/2018	30	370.92	2	20 - 30	10	31.0	1st/2nd SA	X	X	1st/2nd SA	1st/2nd SA	1st/2nd SA	1st/2nd SA	--	1st/2nd SA	2nd SA 2019	1st/2nd SA	2nd SA 2019	1st/2nd SA	1st/2nd SA	1st/2nd SA	1st/2nd SA
	MW-17	Cross-gradient	9/8/2018	83	424.28	2	73 - 83	10	84.0	1st/2nd SA	X	X	1st/2nd SA[2]	1st/2nd SA	1st/2nd SA	1st/2nd SA	--	1st/2nd SA	--	--	--	--	--	--	--
	MW-18	Upgradient	10/11/2018	87	423.69	2	72 - 87	15	86.5	1st/2nd SA	X	X	1st/2nd SA	1st/2nd SA	1st/2nd SA	1st/2nd SA	--	1st/2nd SA	2nd SA 2019	1st/2nd SA	2nd SA 2019	1st/2nd SA	1st/2nd SA	1st/2nd SA	1st/2nd SA
	MW-19	Source	10/12/2018	87	424.20	2	72 - 87	15	85.0	1st/2nd SA	X	X	1st/2nd SA[2]	1st/2nd SA	1st/2nd SA	1st/2nd SA	2nd SA 2019	1st/2nd SA	2nd SA 2019	1st/2nd SA	2nd SA 2019	1st/2nd SA	1st/2nd SA	1st/2nd SA	1st/2nd SA
	MW-20	To Be Installed in November 2019						10-15	--	1st/2nd SA	X	X	1st/2nd SA[3]	1st/2nd SA	1st/2nd SA	1st/2nd SA	--	1st/2nd SA	2nd SA 2019	1st/2nd SA	2nd SA 2019	1st/2nd SA	1st/2nd SA	1st/2nd SA	1st/2nd SA
	MW-21	To Be Installed in November 2019						10-15	--	1st/2nd SA	X	X	1st/2nd SA[3]	1st/2nd SA	1st/2nd SA	1st/2nd SA	--	1st/2nd SA	2nd SA 2019	1st/2nd SA	2nd SA 2019	1st/2nd SA	1st/2nd SA	1st/2nd SA	1st/2nd SA
	MW-22	To Be Installed in November 2019						10-15	--	1st/2nd SA	X	X	1st/2nd SA[3]	1st/2nd SA	1st/2nd SA	1st/2nd SA	--	1st/2nd SA	2nd SA 2019	1st/2nd SA	2nd SA 2019	1st/2nd SA	1st/2nd SA	1st/2nd SA	1st/2nd SA
	MW-23	To Be Installed in November 2019						10-15	--	1st/2nd SA	X	X	1st/2nd SA[3]	1st/2nd SA	1st/2nd SA	1st/2nd SA	--	1st/2nd SA	2nd SA 2019	1st/2nd SA	2nd SA 2019	1st/2nd SA	1st/2nd SA	1st/2nd SA	1st/2nd SA
	MW-24	Step-Out Well, if necessary, to be installed in November 2019								1st/2nd SA	X	X	1st/2nd SA[3]	1st/2nd SA	1st/2nd SA	1st/2nd SA	--	1st/2nd SA	2nd SA 2019	1st/2nd SA	2nd SA 2019	1st/2nd SA	1st/2nd SA	1st/2nd SA	1st/2nd SA
Recovery Wells	RW-1	Downgradient	1/4/1989	105	417.29	8	64 - 98	34	--	Well Abandoned in October 2018															
Vapor Extraction Wells	VE-1	Cross-gradient	9/6/2018	25	424.15	2	15 - 25	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	VE-2	Cross-gradient	9/6/2018	40	423.25	2	30 - 40	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	VE-3	Source	9/8/2018	40	423.64	2	30 - 40	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	VE-4	Source	9/9/2018	25	423.70	2	15 - 25	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tidewater Monitoring Wells	AR-11	Upgradient	--	88	422.62	2	73 - 88	15	--	1st/2nd SA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	MW-5	Upgradient	--	90	425.02	2	74.5 - 89.5	15	--	1st/2nd SA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:
Green text indicates updates to the monitoring program for at least the second semi-annual event of 2019 to support a natural attenuation assessment (October 2019 Data Gap Assessment Work Plan).
Red text indicates updates to the monitoring program since the last version provided to Ecology (7/24/2019).
(1) On February 7, 2019, the wells (except the Tidewater monitoring wells) were resurveyed by Stratton Surveying and Mapping, P.C. The horizontal datum = Washington State Plane South Zone North American Datum 1983(1991). The vertical datum = North American Vertical Datum 29.
(2) TPH-d and TPH-o will be determined by NWTPH-Dx both with and without silica gel cleanup (split-samples) for the second semi-annual event of 2019.
(3) During the second semi-annual event of 2019, TPH-d and TPH-o will be determined by NWTPH-Dx with silca gel cleanup (SGC) in additon to no SGC (split-sample) if at least one soil sample was collected during boring advancement based on observed TPH indicators.

Acronyms:
-- = Not applicable, not available, or not sampled
BTEX = benzene, toluene, ethylbenzene, and total xylenes
Cond = conductivity
DG = down-gradient
DIPE = di-isopropyl ether
DO = dissolved oxygen
EDB = ethylene dibromide (1,2 dibromoethane)
EDC = ethylene dichloride (1,2 dichloroethane)
EPA = US Environmental Protection Agency
ETBE = ethyl tertiary-butyl ether
MSL = mean sea level
MTBE = methyl tertiary-butyl ether
ORP = oxidation reduction potential
QA = quality assurance
QC = quality control
SA = semiannual
SM = Standard Methods
SVE = soil vapor extraction
TAME = tertiary-amyl methyl ether
TBA = tertiary-butanol
Temp = temperature
TOC = top of casing
TPH = total petroleum hydrocarbons
TPH-g = gasoline range hydrocarbons (as analyzed by Northwest Method NWPTH-Gx)
TPH-d = diesel range hydrocarbons (as analyzed by Northwest Method NWTPH-Dx with no silica gel cleanup unless otherwise specified)
TPH-o = motor oil range hydrocarbons (as analyzed by Northwest Northwest Method TPH-Dx with nor silica gel cleanup unless otherwise specified)
UG = up-gradient
VOC = volatile organic compounds

Appendix A

Compendium of Site-Related Plan and Report Documents Submitted Subsequent to
Agreed Order No. DE 12989, March 23, 2016

Compendium of Site-Related Plan and Report Documents Submitted Subsequent to Agreed Order No. DE 12989, March 23, 2016
Tesoro Logistics (Former Chevron) Bukj Fuel Terminal: Cleanup Site No. 4867
2900 Sacajawea Park Road, Pasco, Washington 99301

AECOM, 2019. *First Semiannual 2019 Groundwater Monitoring Report.* Tesoro Pasco Bulk Fuel Terminal, 2900 Sacajawea Park Road, Pasco, Washington. September 25.

AECOM, 2019. *Proposed Additional Monitoring Well Installation for the Supplemental Remedial Investigation Feasibility Study and Revised Groundwater Monitoring Program.* Tesoro Logistics (Former Chevron) Bulk Fuel Terminal: Cleanup Site No. 4867, 2900 Sacajawea Park Road, Pasco, Washington 99301. June 18.

CEECON, 2019. *Letter Report on the December 2018 Vapor Screening at the Tesoro Logistics (Former Chevron) Pasco Bulk Fuel Terminal.* 2900 Sacajawea Park Road, Pasco, Washington 99301. June 11.

AECOM, 2019. *Revised Second Semiannual 2018 Groundwater Monitoring Report.* Tesoro Pasco Bulk Fuel Terminal, 2900 Sacajawea Park Road, Pasco, Washington. March 19.

AECOM, 2019. *Second Semiannual 2018 Groundwater Monitoring Report.* Tesoro Pasco Bulk Fuel Terminal, 2900 Sacajawea Park Road, Pasco, Washington. March 15.

AECOM, 2019. *Final 2018 Soil and Grab Groundwater Data Submittal - Supplemental Remedial Investigation and Feasibility Study.* Tesoro Pasco Bulk Fuel Terminal, 2900 Sacajawea Park Road, Pasco, Washington. March 6.

AECOM, 2018. *2018 Soil and Grab Groundwater Data Submittal - Supplemental Remedial Investigation and Feasibility Study.* Tesoro Pasco Bulk Fuel Terminal, 2900 Sacajawea Park Road, Pasco, Washington. November 16.

CEECON, 2018. *Proposed Additional Monitoring Wells to be included with those in the Addendum to Supplemental Remedial Investigation Feasibility Study.* Andeavor - Tesoro Logistics (Former Chevron) Pasco Bulk Fuel Terminal, 2900 Sacajawea Park Road, Pasco, Washington 99301. November 14.

AECOM, 2018. *First Semiannual 2018 Groundwater Monitoring Report.* Tesoro Pasco Bulk Fuel Terminal, 2900 Sacajawea Park Road, Pasco, Washington. October 11.

CEECON, 2018. *Proposed Additional Vapor-Extraction Wells to be included with those in the Addendum to Supplemental Remedial Investigation Feasibility Study.* Andeavor - Tesoro Logistics (Former Chevron) Pasco Bulk Fuel Terminal, 2900 Sacajawea Park Road, Pasco, Washington 99301. September 6.

CEECON, 2018. *Proposed New Groundwater Monitoring Well/Soil Boring Locations for the Addendum to Supplemental Remedial Investigation Feasibility Study.* Andeavor - Tesoro Logistics (Former Chevron) Pasco Bulk Fuel Terminal, 2900 Sacajawea Park Road, Pasco, Washington 99301. April 11.

CEECON, 2017. *2nd Semi-Annual 2017 Ground-Water Monitoring Data Transmittal.* Andeavor - Tesoro Logistics (Former Chevron) Pasco Bulk Fuel Terminal, 2900 Sacajawea Park Road, Pasco, Washington 99301. December 26.

CEECON, 2017. *Addendum to Supplemental Remedial Investigation Feasibility Study.* Andeavor - Tesoro Logistics (Former Chevron) Pasco Bulk Fuel Terminal, 2900 Sacajawea Park Road, Pasco, Washington 99301. December 10.

CEECON, 2017. *1st Semi-Annual 2017 Ground-Water Monitoring Data Transmittal.* Andeavor/Tesoro Logistics (Former Chevron) Pasco Bulk Fuel Terminal, 2900 Sacajawea Park Road, Pasco, Washington 99301. July 27.

CEECON, 2017. *Passive Soil Gas Sampling Results.* Tesoro Logistics (Former Chevron) Pasco Bulk Fuel Terminal, 2900 Sacajawea Park Road, Pasco, Washington 99301. March 23.

CEECON, 2017. *Riverbank Sampling Results.* Tesoro Logistics (Former Chevron) Pasco Bulk Fuel Terminal, 2900 Sacajawea Park Road, Pasco, Washington 99301. February 21.

CEECON, 2017. *Status Update.* Tesoro Logistics (Former Chevron) Pasco Bulk Fuel Terminal, 2900 Sacajawea Park Road, Pasco, Washington 99301. January 10.

CEECON, 2017. *2nd Semi-Annual 2016 Ground-Water Monitoring Data Transmittal.* Tesoro Logistics (Former Chevron) Pasco Bulk Fuel Terminal, 2900 Sacajawea Park Road, Pasco, Washington 99301. January 6.

CEECON, 2016. *1st Semi-Annual 2016 Ground-Water Monitoring Data Transmittal.* Tesoro Logistics (Former Chevron) Pasco Bulk Fuel Terminal, 2900 Sacajawea Park Road, Pasco, Washington 99301. December 27.

CEECON, 2016. *Addendum to the Supplemental Remedial Investigation/Feasibility Study Workplan for the Former Chevron Pipeline Company Pasco Bulk Terminal Site Sacajawea Road, Pasco, Washington*. May 25.

CEECON, 2016. *Supplemental RI/FS Workplan.* Former Chevron Pipe Line Company Pasco Bulk Terminal, 2900 Sacajawea Park Road, Pasco, WA. March 31.

Appendix B

Standard Operating Procedure – Down-Well Soil Gas Screening

Standard Operating Procedure
Down-Well Soil Gas Screening

Date: August 2018

1.0 Purpose and Applicability

This Standard Operation Procedure (SOP) describes how to conduct low purge volume soil gas sampling from groundwater monitoring wells screened across the vadose zone. Low-flow soil gas screening is performed to assess the composition of soil gas near the base of the vadose zone, which can be used as inputs for petroleum vapor intrusion (PVI) screening calculations or to estimate rates of hydrocarbon biodegradation are occurring over an LNAPL source. The test is conducted by lowering sample tubing to the base of the vadose zone (just above the LNAPL source) in a standard screen/riser monitoring well, connecting the tubing to gas-tight fittings at the top-of-casing, and purging the tubing at a low flow rate to collect real-time gas measurements with a field gas analyzer.

1.1 Limitations

Low purge volume gas sampling is suitable for wells screened across the vadose zone. An adequate monitoring well network within the LNAPL footprint must be accessible for comparing the real-time analytical results across space. Additionally, it may be desirable to collect soil gas samples from one or more monitoring wells installed in similar geologic conditions located outside of the LNAPL source zone (i.e., upgradient) to assess background soil gas conditions. This data can be used to account for potential oxygen utilization and/or methane production that is not directly related to LNAPL biodegradation. The accuracy of and confidence in soil gas sample results are dependent upon the instrument calibration, seal around the top-of-casing, the condition of the well, and environmental factors (i.e., soil temperature). This small purge method utilizes the internal pump from the field gas analyzer to extract soil gas from base of the vadose zone at low flow rates (typically 1 L/min or less). The small purge rate limits potential for dilution from soil gas in shallower, more permeable layers in the soil that may intersect the screened interval of the monitoring well (Sweeney and Ririe, 2017). Leak testing using helium or other tracer gases may also be considered to ensure gas samples are not compromised by leaks in the sampling train or at the seal at the top of the well casing, as necessary.

Low purge volume gas sampling may not be suitable for evaluation of contaminants other than petroleum hydrocarbons (PHC). This method is intended for a rapid assessment of PVI risk and the state of biodegradation at petroleum release sites. A more in-depth characterization of vapor intrusion (VI) may be warranted if volatile contaminants other than petroleum in origin are present and/or results of the low purge sampling (with O_2 correction) indicate a potential receptor to VI. Refer to state-specific guidance for additional sampling methodologies and parameters for VI risk assessment.

2.0 Soil Gas Sampling Background

Conventional methods for soil gas (vapor) sampling typically involve intrusive installation of permanent soil gas sampling probes or temporary probes driven into the desired interval of the vadose zone at petroleum contaminated sites. Recent developments in vapor sampling indicate that representative soil gas composition data can be collected directly from existing groundwater monitoring wells screened across the water table. Field and numerical modeling studies suggest that data collected using the low purge volume method can be representative of subsurface soil gas conditions, and are suitable for assessing petroleum vapor risk and evaluating natural source zone depletion (NSZD) processes (Sweeney and Ririe, 2017; Sookhak Lari et al., 2017).

Total petroleum hydrocarbon (TPH) concentrations from within the anaerobic region near the LNAPL source can be estimated using an O_2 correction factor made for data collected from monitoring wells (Wilson et al., 2014). O_2 concentrations (low near the LNAPL source; higher away from the source) are collected in-situ with the field gas analyzer. This method has been adapted from an agency accepted model to demonstrate effective aerobic biodegradation (Sweeney and Ririe, 2017; USEPA, 2012). A rate of degradation can be estimated from these data to predict point of compliance.

3.0 Responsibilities

The AECOM personnel performing the tests are responsible for contacting the AECOM project manager and/or project technical team if there are any uncertainties about the test procedure or unusual observations in the field. The project manager, technical lead, or their designee is responsible to oversee and ensure that the tests are performed in accordance with the project specific sampling program and this SOP.

4.0 Health and Safety

Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, Job Hazard Analysis (JHA) or Site-Specific Health & Safety Plan (HASP) will take precedence over the procedures described in this document. The hazards associated with soil gas sampling from monitoring wells include, but are not limited to, the following:

Slip, trips, and falls

Review terrain hazards prior to conducting these operations.

Ensure there is a safe means of access/egress to the wellhead.

Dermal exposure to LNAPL

Ensure that proper personal protective equipment (PPE) is used to mitigate the impact of potential splashes of LNAPL to skin and/or eyes.

Exposure to site contaminants

Take all precautions necessary to prevent fire/explosion and/or exposure to airborne vapors from product in the well; high volatility LNAPLS such as gasoline and condensate are of greater concern than low volatility LNAPL such as rail fuel or lubricating oils.

Ergonomics

Use appropriate ergonomic techniques when inserting or retrieving equipment for the wells to preclude injury to the body.

Static Electricity

While very rare, a static electricity source explosion hazard can result during the course of field work when potential static electricity charge accumulations and ignition sources (i.e. flammable or combustible vapors/dust in atmosphere) exist.

Standard PPE includes safety glasses or goggles, hard hat, protective toe cap safety boots, and hand protection such as nitrile gloves. Specialized PPE may include reflective vests, fire retardant coveralls, Tyvek and face shield, and hearing protection.

5.0 Equipment

The following is a list of field equipment needed to perform the down-well soil gas screening:

Equipment to be fitted to the top of well casing

Appropriate sized PVC cap (2” or 4” diameter standard)

Alternative fittings include:

Campbell Well Seals: (https://www.envisupply.com/pdf/campbell_catalog.pdf)

Rubber Stoppers: (https://www.coleparmer.com/p/cole-parmer-two-hole-stoppers-rubber/48940)

Fernco Couplers: (https://in-situ.com/products/accessories/well-cap-cable-holder)

Cordless drill and appropriate-sized bit (1/4” or 3/8” standard)
Nylon or Teflon ® tubing (1/4” or 3/8” standard) of appropriate length to reach bottom of vadose zone
Brass barbs to be threaded into the top of the PVC cap (1/2” diameter thread standard) – Optional
Plumber’s putty

Decontamination solutions and equipment

Liquinox
Deionized water
Paper towels
Garbage bags
Oil absorbent pads
Plastic sheeting to place around well before starting test

PPE

Modified Level D PPE unless Site Specific requirements
Safety glasses or goggles
Hard hat
Safety toe boots
Abrasion resistant gloves under nitrile gloves

Measuring devices

Electric Air/LNAPL/Water interface probe

Field Gas Analyzer (e.g., GEM 2000 internal flow meter (capable of 0.5 to 1 LPM))

PID (10.6 eV bulb)

Other tools

- Time piece (e.g., digital watch or other device)
- Tube cutter
- Tool box including socket wrench set for flush mount wells
- Tape or permanent ink pens for marking elevations on tubing
- Calculator
- Well keys
- Project field book for recording field observations
- Site-specific permitting (if required)
- HASP/THA/Daily Tailgate Forms
- Work plan or field memo with site maps

See Photo 1 for an example of the equipment setup at the test well.

6.0 Procedures

Procedures for conducting low purge volume method are presented below. Procedures may vary depending on site specific needs and desired data.

6.1 Pre-Test Monitoring Procedures

Review well construction details along with other relevant data (e.g., historical fluid level gauging data and LNAPL footprint maps) prior to opening well-head. Required parameters for test implementation include:

- Ground surface and top of measuring point elevations
- Depth to water, or in the even that LNAPL is present, depth to air-LNAPL and LNAPL-water interfaces
- Casing diameters
- Depth to top of well screened interval
- Total well depth

6.2 Field Procedures

An outline of low purge volume procedures is included below:

1. Record pre-test monitoring information on the low purge volume data sheet (included in Attachment B) and calibrate field gas analyzer according to manufacturer's specification.
2. Measure fluid levels (water and LNAPL) in each monitoring well where soil gas sampling is planned.
3. Cut length of tubing so that when placed down the well the opening will be within one foot of LNAPL or water interface when connected to PVC cap.

4. Assemble gas-tight fittings (see photo below) with a pass through for sample tubing to be fastened/sealed to the top of the well casing and allow soil gas sampling from the base of the vadose zone using the field gas analyzer.

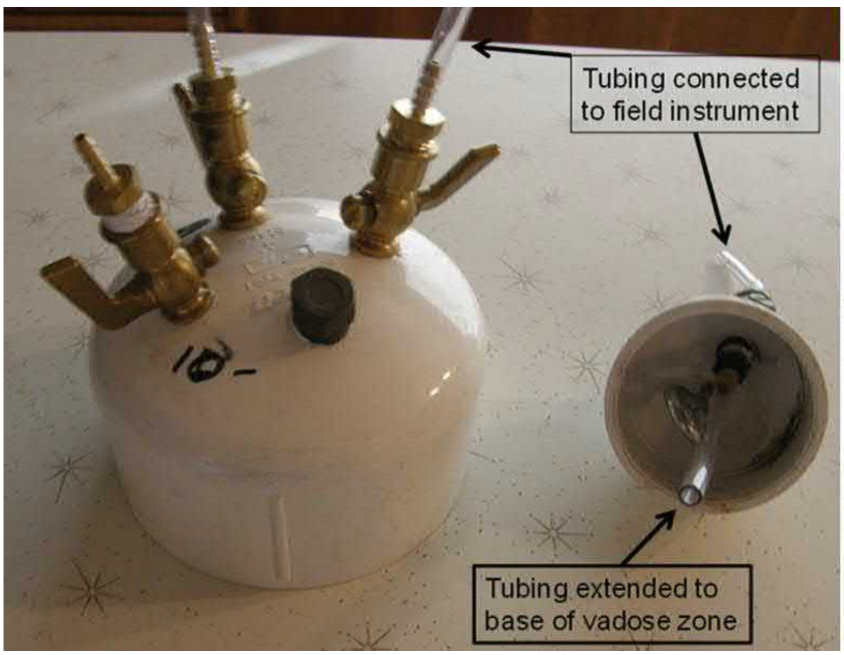
5. Lower tubing into screened interval of well within a foot of the water table/LNAPL interface being careful not to bias opening toward wall of PVC.

6. Connect sealed fittings firmly on top of the well casing and connect field gas analyzer to tubing.

7. Begin purging gas from tubing and record O_2, CO_2, and CH_4 readings every 30 seconds until stable readings are achieved (3 consecutive readings within 10% of each other with no consistent increasing/decreasing trend).

8. Dismantle set up and move to next monitoring point.

Photos of typical down-well gas sampling set-up



7.0 References

R.E. Sweeney and G.T. Ririe, 2017. Small Purge Method to Sample Vapor from Groundwater Monitoring Wells Screened Across the Water Table. Ground Water Monitoring & Remediation, Vol. 37, No. 4: 51-59.

Sookhak Lari, K., Rayner, J.L. and Davis, G.B. 2017. A computational assessment of representative sampling of soil gas using existing monitoring wells screened across the water table. Journal of Hazardous Materials 335: 197-207.

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Wilson, J.T., K. Jewell, C. Adair, C. Paul, C. Ruybal, G. DeVaull, and J.W. Weaver. 2014. An approach that uses the concentrations of hydrocarbon compounds in soil gas at the source of contamination to evaluate the potential for intrusion of petroleum vapors into buildings (PVI). EPA/600/R-14/318.