



SITE CHARACTERIZATION WORK PLAN

Sunoco Pipeline LP Twin Oaks-Newark 14" Diameter Pipeline Release
Upper Makefield Township, Bucks County, Pennsylvania

Prepared for:

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April 18, 2025



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1. Introduction and Purpose

This work plan was prepared by Verdantas LLC (“Verdantas”) on behalf of Sunoco Pipeline LP (“Sunoco Pipeline”) in relation to the release of petroleum products from the 14-inch diameter Twin Oaks – Newark Pipeline (“pipeline”). The location of the release is in the Mt. Eyre neighborhood of Upper Makefield Township (“Township”), Bucks County, Pennsylvania (the “Project Area”). A USGS Topographic Map is provided as Figure 1 and Figure 2 is a Project Area Layout Map.

The purpose of the work plan is to detail the initial tasks planned to characterize the nature, extent, direction, rate of movement, volume, and composition of the petroleum products released from the pipeline. This work plan is intended to satisfy obligations established by the Administrative Order issued to Sunoco Pipeline by the Pennsylvania Department of Environmental Protection (“PADEP”) on March 6, 2025. Specifically, this work plan addresses Paragraph 2(b)(i) of the Administrative Order and includes details of the planned report to address Paragraph 2(b)(ii) of the Administrative Order. These two obligations were also discussed as Items (i) and (ii) of the March 14, 2025, Proposed Implementation Schedule prepared by Sunoco Pipeline and submitted to the PADEP.

This work plan includes discussions of information previously provided to the PADEP in meetings, daily and weekly reports, the Interim Remedial Action Plan, and other submitted documents. This information is included in the work plan only to support the preliminary conceptual site model (“CSM”) and selection of the planned characterization activities. This work plan is not intended to be a comprehensive report documenting the results of interim remedial actions.

2. Preliminary Source Characterization and Conceptual Site Model

The following information presents the CSM. The purpose of including the preliminary CSM in this work plan is to provide the current understanding of the site environmental system and the processes that appear to control the transport and movement of regulated substances through environmental media. This preliminary CSM has been prepared to organize the data collected during implementation of the interim remedial activities and will be refined as additional data are collected. A revised CSM will be presented in the interim site characterization report to be submitted to the PADEP by Sunoco Pipeline and the Act 2 Final Report will include the final CSM. As stated previously, this work plan is not intended to be a comprehensive report documenting the results of the interim remedial activities.

2.1 Release mechanism

A release of petroleum products from the pipeline was discovered on January 31, 2025. The pipeline predominantly transports jet fuel but occasionally transports unleaded gasoline and diesel fuel

The release occurred from the pipeline in a location within the pipeline right-of-way at a property along Glenwood Drive near the intersection with Walker Road ("Release Location") is identified on Figures 2 and 3.

Impacted soils around the pipeline at the Release Location were excavated and properly disposed of at an off-site facility as documented in prior submissions to PADEP. Excavation of the impacted soils extended to or beneath the top of the weathered bedrock surface.

The pipeline was repaired, tested, and returned to service on February 2, 2025.

2.2 Estimated Volume of Release

Based on the observed leak rate, Sunoco Pipeline estimates that the volume of the released petroleum product to be 156 barrels (6,552 gallons). Petroleum products were recovered by the excavation of soil and are being recovered by ongoing well bailing activities.

2.3 Soil impacts

Post-excavation soil samples collected on February 2 and February 10, 2025 were analyzed for the substances on the PADEP Short Lists of Petroleum Products ("Short Lists"). Analytical results indicate that low concentrations of certain regulated substances may remain in soil at the base of the excavation, which is within the weathered/rippable bedrock. See Figure 3 for post-excavation sample locations. Penetrometer measurements of the excavation sidewalls and floor prior to backfilling support that the floor of the excavation was in weathered bedrock.

Other interim investigation activities conducted to date provide additional lines of evidence to support preliminary CSM related to soil impacts. These additional lines of evidence are:

- The pipeline inspection conducted between January 20, 2025 and January 27, 2025 including over 1,000 photo-ionization detector ("PID") measurements along the pipeline did not identify widespread petroleum impact along the pipeline.
- The advancement of eight direct-push borings along Glenwood Drive (understood to be downgradient from the release location) did not identify widespread petroleum impacts in soil.
- The preliminary results of the passive soil gas survey conducted between March 13 and March 20, 2025, do not support the existence of widespread petroleum impacts to soils in the area of the survey.

2.4 Bedrock Geology and Hydrogeology

According to Pennsylvania Geologic Survey mapping of the area, the bedrock formation beneath the Project Area is the Triassic-aged Lockatong Formation. The Lockatong Formation is described in literature as dark gray to black argillite (weakly metamorphosed mudstone or shale) having some zones of black shale and locally, thin layers of impure calcareous shale. The primary porosity and permeability of the weathered and un-weathered rock in the Lockatong Formation are described as low with joint openings providing secondary porosity.

The depth to bedrock based on observations and direct-push refusal is between four and seven feet below the ground surface. The boring log from the first recovery well installed at a property on Spencer Drive described the bedrock as argillite. Bedrock was encountered at approximately 11 feet below ground surface during the recovery well boring advancement.

Fracture/joint porosity appears to be the major source of groundwater yield in water supply wells and appears to be the predominant factor for shallow groundwater flow. Borehole geophysical logging and imaging confirmed this general interpretation.

Water supply wells are used as the potable water supply in vicinity of the release. Reported water supply well depths are generally between 100 and 700 feet below ground surface. The depth of the water supply wells appears to provide borehole storage for the water supply due to the relatively low formation yields in the area.

Regional groundwater flow is expected to be generally eastward.

2.5 Depth to Groundwater

Ongoing gauging of domestic water supply wells and the recovery well indicates that the depth to water in the water supply wells is variable based on water usage (e.g., pumping of the well). Recently measured depths to water in the water supply wells generally range from approximately

25 feet to 70 feet below ground surface. Observed variations in the depth to water may be attributed to topography, construction, seasonality, and operation of the well. Groundwater was not encountered during the interim remedial excavation of impacted soils or direct-push activities described above.

Bedrock depths are estimated to be between four and eleven feet below ground surface. Therefore, groundwater beneath the site is located within the bedrock unit and there does not appear to be a hydraulically saturated unconsolidated (soil) interval.

2.6 Extent of Separate-Phase Liquid

Sampling of private water supply wells conducted to date has indicated the presence of floating separate phase liquid (light non-aqueous phase liquid ("LNAPL")) at five locations. These are:

- Two properties on Glenwood Drive, including the Release Location and a property northeast of the Release Location;
- One property on Walker Road, adjoining and to the east of the Release Location;
- Two properties on Spencer Road, approximately 1,000 feet east-northeast of the Release Location.

LNAPL was also observed at an additional property on Spencer Road, but the LNAPL did not appear to be jet fuel. Rather the LNAPL appears to be a different petroleum product. Also, LNAPL at that location has not been observed since January 29, 2025. Figure 4 depicts the locations of water supply wells and LNAPL observations.

2.7 Extent of Groundwater Impacts

The analytical results for the most recent samples collected from water supply wells on April 2, 2025 are depicted on Figure 5. Water supply well sample results where low-level dissolved phase volatile organic compounds were detected at concentrations greater than the Statewide health standard ("SHS") medium-specific concentrations ("MSCs") for Organic Regulated Substances in Groundwater, Residential, Used Aquifers (TDS \leq 2500) are also depicted on Figure 5.

A fracture trace analysis along with an electrical resistivity imaging ("ERI") survey in the Mt. Eyre neighborhood were completed between February 20 and March 7, 2025 and results were provided to the PADEP. The ERI survey was conducted to detect and delineate underground electrically conductive semi-planar features that could represent water-bearing fractures or bedding plane partings. These assessments along with literature reviews and LNAPL gauging and analytical results led to the development of Figure 6, which depicts inferred water-bearing fractures along with LNAPL observations. Fracture sets are interpreted to strike approximately North 50° and south dipping, greater than 60°. As shown on this figure, an inferred fracture passes very close to two wells on Spencer Road where LNAPL has been observed. Extrapolation of this

feature captures the property on Walker Road where LNAPL was also observed, and the property on Glenwood Drive (Release Location).

2.8 Summary of Preliminary CSM

The preliminary CSM is that petroleum products released from the pipeline migrated primarily downward through a thin layer of soil beneath the pipeline to the bedrock surface at approximately eight to eleven feet below ground surface. Impacted soil material beneath the pipeline at the Release Location was removed during the interim remedial excavation. There is no evidence of residual petroleum products in soils at the Release Location except for potential low-level concentrations at the base of the interim remedial excavation in weathered bedrock.

The released petroleum products migrated downward through the weathered bedrock and into bedrock fractures. Downward migration continued to the (unconfined) water table at a depth of approximately 25 to 35 feet. The variable pumping of domestic water supply wells in the Project Area creates dynamic hydraulic gradients in the water bearing bedrock fractures which are the predominant pathways for groundwater movement. Separate- and dissolved-phase petroleum has migrated along the bedrock fractures in response to these gradients and the eastwardly regional groundwater gradient.

A schematic cross-section illustrating the preliminary CSM is included as Figure 7.

3. Proposed Site Characterization Tasks

Site characterization is an iterative process with the results of each characterization activity being used to refine and shape the scope of future activities. As such, the scope of characterization work presented in this work plan represents the most-likely initial site characterization activities based on the preliminary CSM. Changes to the planned activities and the performance of additional activities are expected. These changes will be communicated to the PADEP in the required 90-day updates or other written communications.

Planned activities are located in public rights-of-way to the greatest extent possible to minimize disruption to local residents and simplify the logistics of property access. Activities planned on public and private property not owned by Sunoco Pipeline will require permission for access from the property owners. Sunoco Pipeline may request assistance from the PADEP during access discussions with property owners.

Standard operating procedures ("SOPs") are not included in this work plan. Existing SOPs will be used if applicable and new SOPs will be prepared as necessary. SOPs will account for conditions associated with negotiated access to properties. These SOPs will be identified or prepared and provided to the PADEP prior to the performance of characterization activities.

3.1 Compile Available Property Information

Publicly available and observable information regarding the location and construction of the water supply wells, septic systems and sand mounds, and sub-grade structures (basements and crawl spaces, sumps, and radon systems) in the Project Area will be reviewed and compiled. The review will include the Pennsylvania Groundwater Well Information System, County and Township land development and property records, and information obtained by visual observation from public rights-of-way. Sunoco Pipeline's consultants will also obtain additional property-specific data and information during field activities at private properties in the Project Area as permitted by property owners. This information will be used to refine the CSM specifically related to potential shallow groundwater flow and vapor intrusion preferential pathways.

3.2 Additional Surficial Geophysical Investigations

As stated above, ERI has been used in the project area during interim remedial and initial investigation activities. A supplemental ERI survey and a seismic refraction survey are planned to provide additional information regarding the inferred bedrock fractures and the nature of the soil/bedrock interface.

3.2.1 Supplemental ERI Survey

A supplemental ERI survey is planned in the area to the west and east of the previous ERI survey area to facilitate mapping of inferred fracture traces across the segment of the pipeline where the

release occurred. The planned survey will be to the west of the pipeline in the Township-owned property that extends northward from Walker Road along the western edge of the Mt. Eyre neighborhood and between the eastern-most ERI line and Bruce Road. The proposed location of the supplemental ERI survey is depicted on Figure 8. The performance of the supplemental survey requires the granting of access by the owners of the properties where the supplemental survey is planned.

3.2.2 Perform Seismic Refraction Survey

A seismic refraction survey is planned in the area of the original and planned supplemental ERI survey. The purpose of the seismic refraction survey is to refine the understanding of the depth to, and nature of, the soil/bedrock interface within the survey area. Performance of this survey will require access to the locations used for the previous and planned supplemental ERI survey discussed above. The proposed location of the seismic refraction survey is depicted on Figure 8. The performance of the survey requires the granting of access by the owners of the properties where the survey is planned.

3.3 Soil Characterization

Soil characterization is planned in the vicinity of the Release Location to delineate the horizontal and vertical extent of petroleum impact including the identification and delineation of soil or LNAPL that may be a potential vapor intrusion source. As stated above, results from sampling at the extent of the interim remedial excavation showed relatively low concentrations of PADEP Short List substances. However, laboratory reporting limits for some PADEP Short List substances were elevated above the PADEP SHS MSCs and/or soil vapor intrusion screening values.

Direct-push borings are planned within the Sunoco Pipeline right-of-way in the area around the interim remedial excavation. Twelve borings will be positioned at a 15-foot spacing along the perimeter of the interim remedial excavation (Figure 9). The borings are planned to be approximately ten feet to the north and south of the pipeline.

Borings will be advanced to direct-push refusal which is expected to be within the weathered bedrock at depths between seven and eleven feet below ground surface. Recovered soil will be screened with a PID using a headspace technique which can minimize variability in PID responses due to differences in grain size and soil moisture. Recovered soil will also be scanned with ultraviolet light to screen for the presence of separate-phase petroleum products.

At least one laboratory analytical sample will be collected from each soil boring. The depth of the sampling interval will be based on the preliminary CSM and observations made during the boring advancement. Samples will generally be collected at the interval with the greatest PID response or the interval identified as containing petroleum products by ultraviolet light scanning. If there are no indications of petroleum impact, the laboratory analytical sample will be collected from the deepest soil interval recovered from the boring.

The laboratory analytical samples will be analyzed for the PADEP Short List substances and Sunoco Pipeline and its contractors will work with the analytical laboratory to attempt to obtain laboratory reporting limits that are below the SHS MSCs and SHS soil vapor intrusion screening values.

Logs for each soil boring will be prepared by, or under the direct supervision of a professional geologist licensed in the Commonwealth of Pennsylvania using a standard classification system (e.g., Unified Soil Classification System or modified Burmister).

3.4 Groundwater Characterization

Installation and sampling of groundwater monitoring wells is planned to delineate the horizontal and vertical extent of petroleum impacts to groundwater including the identification and delineation of groundwater and LNAPL that may be a potential vapor intrusion source. As stated above, the preliminary CSM is that the water table is within the fractured bedrock system beneath the Project Area. Results of water sampling conducted in water supply wells identified wells with LNAPL and dissolved-phase concentrations of PADEP Short List substances greater than the SHS MSCs. The planned location of the monitoring wells is based on the locations of identified LNAPL and dissolved-phase concentrations greater than the SHS MSCs and the distribution of fracture traces identified by the ERI survey.

The locations of the planned monitoring wells may be adjusted based on the results of the currently ongoing and planned interim remedial activities including the reconnaissance groundwater sampling of the water-supply wells (external well water sampling), ongoing recovery well installation and sampling, continued water supply well monitoring, and the location of underground utilities. Results from the planned ERI survey, seismic refraction survey, and soil characterization will also be evaluated and used to modify the locations of the planned monitoring wells. Additional monitoring wells may be required to complete the groundwater characterization. Installation of the planned monitoring wells requires the granting of access by the Township and the other owners of the properties where the well installations are planned.

3.4.1 Monitoring Well Installation

Eight groundwater monitoring well locations are planned at locations primarily along the inferred traces of bedrock fractures shown on Figures 6 and 8 that have indications of impact based on interim remedial activities. Planned recovery wells near the Release Location will be used to characterize groundwater adjacent to the Release Location should access be granted by the landowner.

The completion procedures are being evaluated for the monitoring well installations. These different procedures are being evaluated because of the hydrogeological setting described in the preliminary CSM. The well completion procedure will be selected from these methods based on results of the ongoing interim remedial actions including recovery well installation and sampling and the reconnaissance well water sampling. In this hydrogeologic setting, it can be difficult to

install monitoring wells at different locations that monitor the same aquifer interval and also have sufficient water for monitoring and sampling.

- The first completion procedure is to construct a single monitoring well to a depth of approximately 75 feet with the screened interval extending from approximately 20 feet to the bottom of the well.
- The second completion procedure is to install two separate monitoring wells at each location. The first well will be installed to a total depth of approximately 75 feet with the screened interval extending from approximately 50 feet below ground surface to 75 feet below ground surface. Solid casing may be used to isolate the screened interval from the overlying interval in these deep wells. The second well at each location would be installed with a screened interval from approximately 20 to 40 feet below ground surface.
- The third completion technique is to install a boring to approximately 75 feet and perform borehole geophysics on the open borehole. The completion of the well will be determined on the results of the geophysics and may include the use of multi-level monitoring materials (e.g., Solinst® Flute or Waterloo Multilevel system).

The SOP for the advancement of the monitoring well borings and completion of the monitoring wells will be developed after the procedure is selected based on the results of the recovery well installation and sampling and reconnaissance well water sampling. The SOP will be provided to the PADEP for review prior to the initiation of the monitoring well installation activities. Monitoring wells will be installed and developed in general accordance with the current PADEP Land Recycling Program Technical Guidance Manual ("TGM"). Logs for the monitoring well borings will be prepared by, or under the direct supervision of, a professional geologist licensed in the Commonwealth of Pennsylvania. The top of casing for each monitoring well will be professionally surveyed by a surveyor licensed in the Commonwealth of Pennsylvania to allow for the calculation of water level elevations and the preparation of a potentiometric surface or water table contour map.

3.4.2 Groundwater Monitoring and Sampling

Two rounds of groundwater monitoring and sampling will be conducted. This will include the measurement of water levels in the monitoring and recovery wells, purging of the monitoring wells, and the collection of analytical samples from the monitoring wells. The first round of monitoring and sampling will occur at least two weeks after the monitoring wells are developed.

The depth of water will be measured in each monitoring and recovery well using an electronic conductance-type water level indicator capable of discerning LNAPL. If LNAPL is encountered, the depth to the LNAPL and the depth to water in the well will both be measured to allow for the calculation of LNAPL thickness. The monitoring wells will then be purged, and analytical samples will be collected for the PADEP Short List substances. As stated previously, to the extent possible, existing SOPs will be used for groundwater monitoring and sampling activities. If

necessary, alternative SOPs will be developed and provided to the PADEP prior to performance of the characterization activity, including SOPs for purging and sampling of monitoring wells with LNAPL

3.5 Evaluation of Potential Vapor Intrusion Pathways

Following completion of the planned soil and groundwater characterization work described above, potential vapor intrusion pathways from soil and groundwater impact (including LNAPL) will be evaluated in accordance with the current PADEP TGM. The first step in the evaluation will be the identification of potential vapor intrusion sources. There are two components that define a potential vapor intrusion source. The first component is the presence of soil or groundwater at concentrations above the applicable SHS screening value or the presence of LNAPL. The second component is that the location(s) identified in the first component are within a proximity distance of an inhabited space or a potential preferential vapor migration pathway.

Identified potential vapor intrusion sources will be further evaluated using either additional soil and groundwater sampling or vapor intrusion-specific sampling (near-source soil gas, sub-slab soil gas, or indoor air). Alternatively, mitigation of the potential vapor intrusion pathway may be implemented prior to vapor intrusion sampling in accordance with the current PADEP TGM.

Existing SOPs for vapor intrusion sampling will be used or new SOPs will be created and provided to the PADEP prior to sampling. An SOP for mitigation will be prepared and provided to the PADEP prior to implementation of any mitigation measures.

4. Interim Site Characterization Report

An Interim Site Characterization Report ("ISCR") that provides the results of the completed interim remedial and characterization activities will be prepared. In accordance with the obligations of the Administrative Order Paragraph 2(b)(ii), which established a Proposed Implementation Schedule of Act 2 deliverables, the ISCR will be submitted to the PADEP on or before September 2, 2025.

Neither the PADEP TGM or the 25 PA Code Chapter 250 Regulations reference or require a site characterization report or an interim site characterization report. However, in accordance with the Administrative Order, the ICSR will describe the interim characterization of the nature, extent, direction, rate of movement, volume and composition of regulated substances released in the environment from the release in accordance with the SHS. The ISCR will present the data generated during the implementation of this work plan as well as the results of the interim activities undertaken and completed to address the release. The ISCR will include an updated CSM and additional characterization activities will be proposed, if appropriate.