



March 23, 2018

Mr. Matthew Gordon  
Sunoco Logistics, L.P.  
535 Fritztown Road  
Sinking Spring, PA 19608

Re: Hydrogeological Re-Evaluation Report  
Valley Road Crossing, Horizontal Directional Drill (HDD) Location (S3-0591)  
PA DEP Permit No. E23-524  
Middletown Township  
Delaware County

Dear Mr. Gordon:

The Department of Environmental Protection (DEP) has reviewed the HDD reevaluation analysis (Report) submitted on January 23, 2018, for the Valley Road Crossing Horizontal Directional Drill Location (S3-0591), DEP Permit No. E23-524, along with supplemental information provided by Sunoco's hydrogeologist, GES, on February 12, 2018. The Report is composed of the report titled "Horizontal Directional Drill Analysis Valley Road Crossing," (First Report or Sunoco Report) and the other was produced by GES, Inc. (GES), in January 2018 (GES Report). Collectively the First Report and GES Report are referred to as the Re-Evaluation Report, for the purposes of this letter. The initial submission was posted on the DEP Mariner East II pipeline portal webpage on January 23, 2018, and public comments were received.

This analysis of the horizontal directional drill (HDD) pertains to the installation of a 16-inch and 20-inch diameter pipeline crossing of streams S-C42, S-C41, S-C40, S-C39; wetlands C21, C19, C18; Valley Road and Darlington Road in Delaware County. This review of the redesign of HDD No. S3-0591, has been completed in accordance with paragraphs 4 and 5 of the Corrected Stipulated Order (Order) issued under Environmental Hearing Board Docket No. 2017-009-L on August 10, 2017. This HDD is No. 21 on the list of HDD's on Exhibit 2 of the Corrected Stipulated Order. This HDD was not initiated before the issuance of the Corrected Stipulated Order.

Pursuant to paragraph 2 of the Corrected Stipulated Order, Sunoco Pipeline, L.P., proposed to reevaluate the original design profiles for the 16 and 20-inch HDDs to determine if the design could be improved to lower the risk of IRs to the land surface or waters of the Commonwealth. Additional geologic investigations were completed and utilized to redesign the profile of the planned HDD. The redesign adjusts the HDD profile deeper to place the HDD pathway through bedrock, which will result in the HDD having better structural

integrity than the originally designed shallower profile. Due to the approximate 102 feet of elevation difference between the HDD entry (east) side, and HDD exit (west) side, the potential for producing groundwater during the HDD exists. Excess produced groundwater, or groundwater produced during nondrilling periods is to be captured, filtered, and discharged to the land surface at the edge of the temporary workspace, or if the means of filtration is insufficient to prevent the discharge of turbid water to a waterway of the Commonwealth, then the produced waters will be pumped to storage tanks staged at the temporary workspace adjacent to Valley Road, and then hauled away for treatment and disposal. If groundwater discharges through the annulus of the HDD persists after the pipeline is pulled into place, then SPLP proposes to grout the annulus surrounding the pipeline.

DEP has the following comments and questions that need to be addressed.

1. Surface geophysics should be employed to provide evidence of the top of bedrock along the whole run of the pipeline. The five geotechnical borings installed, while very useful in determining fracture density and lithology, are insufficient to determine the top of bedrock outside of their sample locations.
2. A borehole geophysical suite should be performed in geotechnical borings to determine any local fracture sets that exist which may help determine preferential pathways of groundwater and potential drilling fluids.
3. Please provide a comparison of original pipeline construction statistics compared to the reevaluated construction statistics.
4. The GES Report was signed and sealed by a P.G. It made several recommendations that were not incorporated into the First Report, which was not sealed by a professional of any kind. This includes:
  - a. The construction of a dedicated drainage way to the nearest surface water conveyance should drilling fluid overflow the dedicated containment area. This would require additional DEP permitting.
  - b. The First Report states that landowners should make advanced arrangements for the supply of alternate water sources. However, the GES Report and the Inadvertent Return PPC Plan incorporated into the February 6, 2018, Consent Order and Agreement entered into between Sunoco and DEP provides that Sunoco will offer to supply water to these residents prior to drilling. DEP considers the latter two documents to be controlling. Sunoco shall proceed as set forth in the GES Report and the February 6, 2018, Inadvertent Return PPC Plan.

- c. The implementation of the early detection groundwater monitoring program using domestic wells described in the GES Report was not incorporated into the First Report. For additional clarification, please provide a map of the domestic wells, along with a time frame of drilling activities, within the monitoring plan.
  - d. No mention was made in the First Report to suggest that areas of concern would be monitored with any greater frequency during drilling activities. The Report needs to describe the prescriptive measures to be employed for each area of concern, including, but not limited to, the number of observers, and the distance of the drill bit from the areas of concern.
  - e. Specific points of potential weak bedrock and soils were not individually identified. This should be done. Predetermined areas of weakness should be addressed by a description of the prescriptive approach Sunoco will use when drilling. For example, when a certain waypoint is reached in the boring, drilling fluid pressures should be automatically adjusted.
5. The six (6) recommendations outlined in the geologic report should be fully integrated into the redesign plan. Presently only a portion of these appear to have been included.
6. Please provide further communication with the drilling company that may clarify what happened on the core run from 185.5 to 195.5 (Elev.169.5 to 159.5) on hole B6-2W. The log shows the RQD as not recorded. They did recover 118 inches of a 120-inch run, and described and photographed the core that was recovered. The geologic report discusses the RQD as zero which implies that there may be some anomaly or problem with the rock at that depth when that may not be the case.
7. The 150-foot "impact area" relied upon in the Report does not appear to be supported by site specific Geologic or Hydrologic data or other competent data. Provide the basis for this determination.
8. If the prescribed minimum 15-foot tremie grouting is inadequate to prevent groundwater discharges from the HDD annulus, explain what additional measures will be employed.
9. The following best management practices (BMPs) should be incorporated into the Report. If Sunoco feels it is inappropriate to include any of these BMPs, Sunoco should provide an explanation as to why it is inappropriate to do so.
  - a. SPLP will provide the drilling crew and company inspectors the location(s) data on potential zones of higher risk for fluid loss and IRs, including the area

- related to previous IRs, and potential zones of fracture concentration identified by the fracture trace analysis along the drill path, so that monitoring can be enhanced when drilling through these locations.
- b. SPLP will require and enforce the use of annular pressure monitoring during the drilling of the pilot hole, which assists in immediate identification of pressure changes indicative of loss of return flows or over pressurization of the annulus, managing development pressures that can induce an IR.
  - c. SPLP inspectors will ensure that an appropriate diameter pilot tool, relative to the diameter of the drilling pipe, is used to ensure adequate "annulus spacing" around the drilling pipe exits to allow good return flows during the pilot drilling.
  - d. SPLP will mandate short-tripping of the drilling tools to ensure an open annulus is maintained to manage the potential inducement of IRs.
  - e. Sunoco will require monitoring of the drilling fluid viscosity, such that fissures and fractures in the subsurface are sealed during the drilling process.
  - f. Based upon the behavior of the soil overburden and near subsurface geology during the entry and exit of the pilot phase, casing of the pilot hole can be implemented to control IR where the profile depth is shallow and oversight of the pilot indicates a long-term risk of IR that should be controlled.
  - g. During the reaming phase, the use of Loss Control Materials can be implemented if indications of a potential IR are noted or an IR is observed.
  - h. If LCMs prove ineffective to mitigate loss of returns or IRs, then grouting of the pilot hole may be implemented.
  - i. SPLP will prepare and stage the materials required to manage groundwater flow back to the southeastern entry/exit point to control potential groundwater discharge during HDD installations.
10. It is also recommended that given the geologic conditions present at this site, and in particular given the prediction that both Sunoco and DEP reviewing geologists have reached, that this HDD has the potential to produce significant quantities of groundwater that would flow back to the entry point, Sunoco should incorporate into the Report a provision that provides that during critical drilling phases Sunoco management/technical representatives will be present on site and that DEP regional staff will be provided with adequate advance notice to allow DEP staff to be present.

11. The Re-Evaluation Report should include additional details such as pilot bore and reaming diameters, annular pressures, mud viscosities, action levels, and specific IR response actions should be included.
12. The Re-Evaluation Report states that loss control materials (LCM) can be used to manage the loss of fluids during the pilot hole phase. The discussion also states that loss of fluids may be managed by grouting. A discussion of the timing of the potential grouting program is not provided. Grouting of highly fractured zones of rock or fracture traces as a preventative measure may be prudent, whereas, grouting after an inadvertent return (IR) already occurs may not be desirable. If grouting is necessary, it may be better to identify and remediate the zones along the alignment that should be grouted prior to drilling the pilot holes. A conceptual description of the proposed grouting program, if any, would be helpful.
13. IR prevention typically includes linking the respective proposed HDD geometry with site-specific geotechnical data. This approach will allow the HDD designer and driller to understand what specific HDD station ranges will be most vulnerable to IRs. Questions regarding the linking of the proposed HDD geometry and the site-specific geotechnical data for this specific bore include the following:
  - a. Has the possibility of IRs via weak subsurface soil/weathered rock/fill zones at existing utility trenches (if present) been considered?
  - b. The Re-Evaluation Report states that "Based upon the behavior of the soil overburden and near subsurface geology during the entry and exit of the pilot phase, casing of the pilot hole can be implemented to control IR where the profile depth is shallow and oversight of the pilot indicates a long-term risk of IR that should be controlled." Based on the occurrence of at least four (4) recent IRs in nearby HDDs, the use of casing in the pilot hole at the entry and exit points should be mandated by Sunoco.
14. Page 2 of the Terracon Report (Attachment 2 of GES Report) states: "When laboratory soil testing results are available, we will submit a complete data report for the subject crossing." This report appears to be preliminary, and an update may be available by now. Any final report from Terracon should be offered as part of the Re-Evaluation Report.
15. Soil laboratory testing results for B6-2E and B6-2W, if any, are missing. Supporting lab testing reports that could be used to support designs near entry and exit stations are not provided. Are lab test results now available?

16. This plan is to address a specific HDD bore at a specific location. Previous history with IRs in this area suggests that soil cover alone may not provide sufficient resistance to prevent future IRs and that a profile that penetrates sound rock may be more appropriate. As a result, discussion regarding sufficient depth of soil cover versus maximum allowable mud pressure should be included for portions of the HDD where the HDD path does not penetrate rock. The discussion of sufficient depth of soil cover versus maximum allowable mud pressure is especially important in the area where the HDD bores will cross stream S-C40, given the stream, a mapped fracture, and variable depth of weathered bedrock coincide.
17. The Re-Evaluation Report states "No geophysical studies were recommended or performed due to lack of karstic terrain." Geophysical surveys should not be limited to karst environments, as they may be useful and provide valuable data in this instance. Specifically, a geophysical survey could be helpful to interpolate between geotechnical boring points, identifying areas of soft soils, better defining the top of competent rock, and in delineating/characterizing the fractures identified by GES.
18. Evaluation of water levels should be performed prior to initiating the HDD bore to provide information regarding potential diminution of flow issues and the ability to determine if any future potential impact is related to head differentials or plugging of a potential water-bearing zone. Given the developed nature of this area and proximity of residential groundwater supply wells, further discussion is warranted regarding this topic. Potential actions could include the following:
  - a. Project water well depths, casing depths and water-level depths (based on a water-level survey) on cross sections/profile views.
  - b. The GES Report identifies fracture traces on a plan view. The Re-Analysis Report should also identify potential zones of fractures or fracture trace intercepts, and the residential water supply wells on the plan view and profile view figures.
  - c. The Re-Analysis Report should include a specific plan for temporary supply replacements, as the bedrock is highly fractured, even at depth, and residential water supply wells are located as close as 42 feet from the planned bore path. To limit potential impact on residential water well users, there should be a well-conceived response plan in place and ready to execute.
19. Figure 4 of the GES Report appears to be an earlier version and conflicts with what appears to be a later version of the same figure located in Attachment 2 of the GES Report. Figure 4 includes a table listing 20 wells, while the later version in Attachment 2 lists 28 wells. In addition, the text of the GES Report (Section 2.3.4) includes reference to 18 homes identified by the PAGWIS search, and then describes

- 28 properties & 20 domestic wells within the 450-ft search area. Based on the figure in Attachment 2 of the GES Report, DEP believes 83 properties are located within 450 feet of the proposed HDD, 28 of which have private water supply wells. These discrepancies should be clarified and SPLP should confirm that all private water supply owners have been contacted.
20. The Re-Evaluation Report indicates Sunoco will monitor downhole pressures, viscosities, mud loss, and nearby water wells. However, there are no specific values or action levels such as how often mud loss is calculated or what viscosity would be maintained during the bore or at what point an IR contingency plan would be implemented (i.e., if there is X pressure increase or X mud loss, an IR contingency plan would be started). The specific viscosities and action values and pressures should be defined and documented to facilitate prompt actions during the HDD bore.
  21. Although the drilling practices are intended to minimize the risk of an IR occurring, there is a possibility that an IR could reach the ground surface. Given the highly developed nature of this area and the close proximity to residential water supply wells, the Report should reference the current *HDD Inadvertent Return Assessment, Preparedness, Prevention and Contingency Plan*.
  22. The terms pressure, fluid pressure, drilling pressure, mud pressure, etc., may refer to either the injection pressure of the drilling fluid (mud) inside the drill string or to the pressure outside the drill string but within the borehole. Most HDD drillers measure the injection pressure of the mud/drilling fluid within the drill string and do not measure the pressure of the bore outside the drill string but within the borehole. The Re-Evaluation Report should clarify which pressure values are being monitored as part of this proposed HDD bore.
  23. When applying the cavity expansion model, maximum allowable mud pressures in soil will likely be exceeded near the exit point (and possibly at other locations) due to the length of the bore through which cuttings must be transported. The Re-Evaluation Report should consider options for lowering mud pressures to help minimize the risk of IRs. For example, perhaps the pilot holes could be initiated from both ends.
  24. As noted in the Re-Evaluation Report, the bore has a reasonable chance of discharging groundwater from the lower elevation bore entry/exit. Groundwater handling has been addressed in a general manner. Also, the grouting plan is very basic. A more detailed plan is required. For instance, Sunoco indicates it will inject a bentonite plug, and then grout. Setting a bentonite plug in a horizontal bore is not as simple as just dropping in some bentonite chips. More importantly, if groundwater is flowing in the bore, it is likely to wash out the grout before it sets, leaving groundwater discharging the bore exit.

25. Regarding the grouting plan, Sunoco mentions a minimum of a 15 feet bentonite plug to stop the flow of groundwater. DEP recommends a minimum bentonite plug of 20 feet.
26. The Re-Evaluation Report indicates the viscosity of the drilling fluids will be monitored. More specificity should be provided regarding the viscosity values at which actions will be taken, in order to make it clear to the inspectors to know when conditions are no longer optimal or normal. The Re-Evaluation Report should clearly state that Sunoco will actively monitor the volumes of drilling fluid returns. For example, if the inflows do not match the outflows, there is likely an issue with either a plugged annulus or an IR.
27. There was a public comment received regarding the location of a private well at 226 Valley Road, in Media PA. The Well Location Map incorrectly locates GES Well ID WL-08102017-604-01 at an offset of 490 feet. The correct offset is 150 feet. Please revise the location and all appropriate action for this well to reflect this revised offset.
28. With regard to water supplies that might be impacted by these HDD activities, Sunoco must address those impacts in an acceptable manner. Sunoco has the option to enter into written agreements with all private water supply owners whose water supplies may be impacted by this Drill, regardless of their location from the Drill, as part of this reevaluation, and in advance of commencing the HDD. Under the agreements, Sunoco must provide short and long-term replacement potable water supplies adequate in quantity and quality for the purposes served, to the satisfaction of all potentially affected water supply owners. The agreements should provide for Sunoco to conduct water quality and quantity testing of each potentially affected water supply prior to, during, and after the HDD activities. Sunoco needs to provide proof of these agreements to DEP with a response to this letter.
29. In the alternative, if Sunoco chooses not to pursue these agreements with the private water supply owners, it must provide a discussion of actions to be taken by Sunoco to prevent water supply impacts from occurring. Sunoco needs to demonstrate how, in the absence of the agreements described above, Sunoco will avoid impacts to all water supplies. Sunoco's approach should include the utilization of technical and nontechnical measures to avoid such impacts, including, but not limited to, the conversion of the HDD to a trench installation, use of other trenchless construction methods, the use of NSF-60 approved gels or other approved additives that could prevent such impacts from the Drill, or some combination of all of the above. To the extent Sunoco proposes to use any ANSI/NSF 60 certified HDD additives, consistent with Special Condition NN contained in DEP Permit Nos. E23-524 and E15-862, Sunoco will only be able to use the additives in the manner indicated in the certification of the proposed additive. The manner in which the proposed additive is to be used, as indicated in its ANSI/NSF 60 certification, should be submitted with



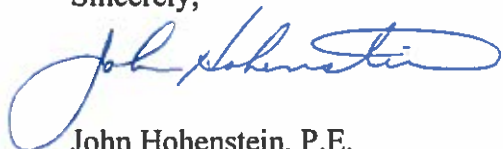
your response. In addition, Sunoco should indicate whether it will be following all conditions included as part of the additive's certification or, if not, provide an explanation as to why it is not and why that deviation is acceptable.

30. The Report discusses potential changes in water quality, but also needs to discuss potential changes to water quantity, as the potential exists for the HDD bore to adversely impact the yield of private water supply wells. Please describe how this will be done consistent with applicable provisions of the latest versions (February 6, 2018) of the Inadvertent Return Assessment, Preparedness, Prevention and Contingency Plan, and the Operations Plan (January 2018).

Based on the technical review of the information submitted in the subject Horizontal Directional Drilling Analysis and the related comments listed above, it has been determined, that to the best of our information, knowledge and belief, the requirements regarding geologic information and geologic analysis detailed in the Corrected Stipulated Order, EHB Docket 2017-009-L ("Agreement"), have not been met. Overall, DEP concurs that deepening the boreholes in the competent bedrock will reduce the risk of IRs. This proposal to deepen the boreholes appears to be approvable once the above listed concerns are adequately addressed. DEP looks forward to the receipt of information requested above.

If you have additional questions, please contact me at 454.250.5160.

Sincerely,



John Hohenstein, P.E.  
Chief, Dams and Waterways Section  
Waterways and Wetlands

cc: Mr. Mulray, P.G., GES  
Mr. Waldrop, P.G., GES  
Ms. Wheeler, Delaware County Conservation District  
Re 30 (GJS18WAW)82-40