



## MEMORANDUM

**TO:** Larry Gremminger, Christopher Embry – Sunoco Pipe Line Project/Energy Transfer  
**FROM:** David Demko PG – Groundwater and Environmental Services, Inc. (GES)  
**CC:** Lieschen Fish PG, Rick Wardrop, Stephanie Grillo – GES  
**DATE:** November 7, 2019  
**PROJECT NAME:** ME2 – Spread 6 – HDD S3-0360-16 (Devon Rd/ Shoen Road 16-inch pipeline, PA-CH-0199.0000-RD)  
**SUBJECT:** Restart Report for Groundwater Flowback Discharge at HDD S3-0360-16

This Revised Restart Report has been amended to respond to verbal and email comments/requests for information from the Pennsylvania Department of Environmental Protection (PADEP) to the initial report dated October 21, 2019. The initial report was prepared in accordance with the terms and conditions of Paragraph 3.h. of the Consent Order Agreement between Sunoco Pipe Line Project (SPLP) and the PADEP dated July 24, 2017, concerning drilling operations at HDD S3-0360-16 (Devon Rd/ Shoen Road). This Revised Restart Report proposes changes in HDD operations to mitigate groundwater flowback that occurred at varying rates as the drill was advanced.

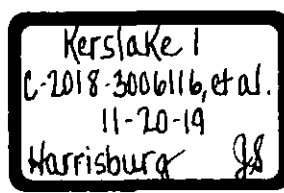
### Background

HDD S3-0360-16 was started on October 9, 2019, following the former (2017 design) 20-inch profile path. This drill advanced from the southeast entry/exit point at Shoen Road toward the northwest entry/exit point at Devon Drive, and traversed approximately 1500 feet and to a depth of 196 feet below ground surface (bgs) until drilling was stopped. Beginning on October 17, 2019, at the drill's advancement beyond approximately 1200 feet northward from the entry at Shoen Road, groundwater was observed flowing back into the drill entry pit at varying flow rates ranging from 1 to 60 gallons per minute (GPM). Lower flow rates were observed during advancement of the drilling tools, and increased groundwater flowback was observed as drill tooling was removed (tripping out) and during drilling shutdown.

On October 18, 2019, all tooling had been removed to add a new steering assembly, when the groundwater discharge was measured at approximately 50-60 GPM. The new assembly and tooling were tripped back in to the bottom of the borehole (rock face) to inject in the borehole a "heavy mud plug," i.e. a plug of drilling mud thickened with a higher bentonite-to-water ratio. Following injection of the heavy mud plug, the discharge of groundwater ceased. Before drilling operations were shut down, the pilot had been advanced to 1,533 feet measured borehole distance (or 1,514 feet horizontal distance) from the southeast entry/exit point. See **Attachment A – Drillers' Daily Logs** for specifics of drilling activities.

### Geology

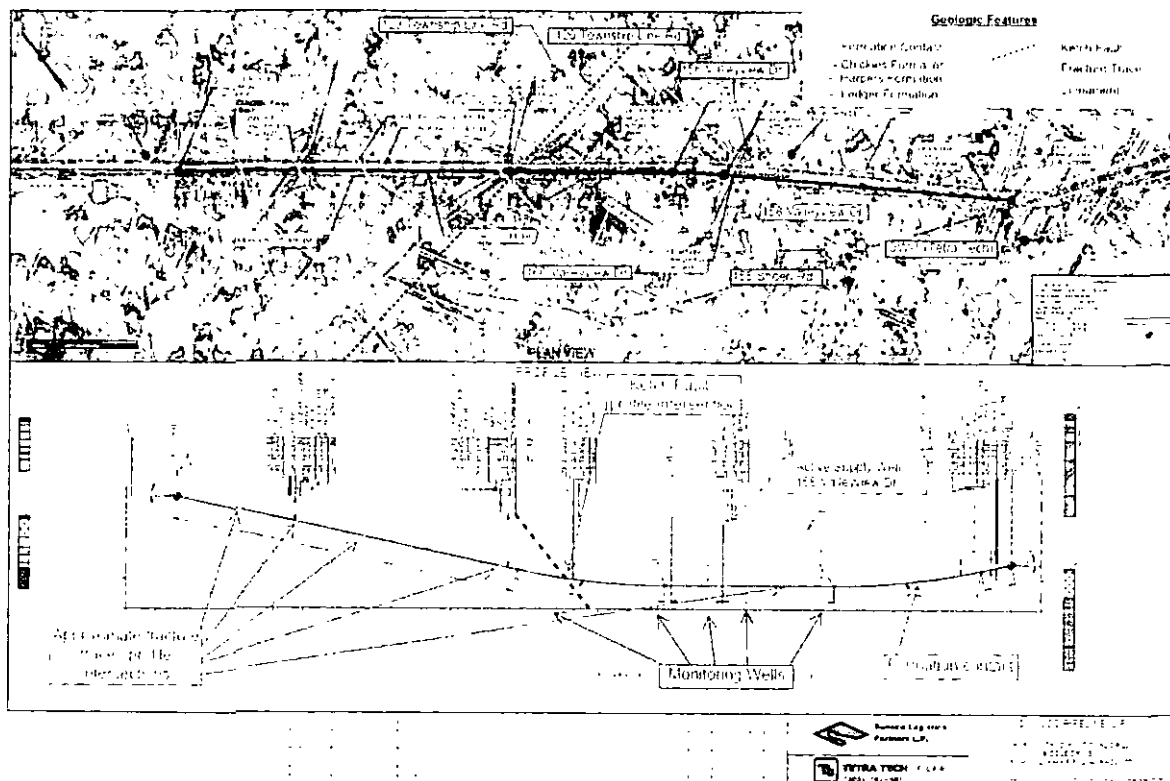
From southeast to northwest, the HDD transects the Harpers Formation [phyllite and micaceous to argillaceous quartzite (Kochanov, 2016)] and extends partially into the Chickies Formation [predominantly quartzite with a basal conglomerate and interbeds of slate and phyllite (Low et al., 2002)]. The contact between the Harpers and Chickies Formations occurs at approximately 325 feet northwest of the southeast entry/exit point. The Chickies Formation is bisected by a major fault (the "Ketch Fault") crossing





the HDD pathway at approximately 1,500 feet from the southeast entry/exit point. A contact between the Chickies Formation and an undifferentiated granodioritic gneiss occurs approximately 800 feet north of the northwest entry/exit point (beyond the HDD S3-0360 profile to the northwest). The valley floor, southeast of the southeast entry/exit point (beyond the HDD S3-0360 profile to the southeast), is composed of carbonates, including the Ledger Dolomite. Fracture traces with north-northwest orientation have been identified to cross the HDD path at approximately 770, 1,735, 2,190, 2,420, and 2,615 feet from the southeast entry/exit point (see annotated **Plan and Profile** below).

HDD S3-0360 - 26-inch line P & P with Geology  
positions of all features should be considered approximate



### Hydrology

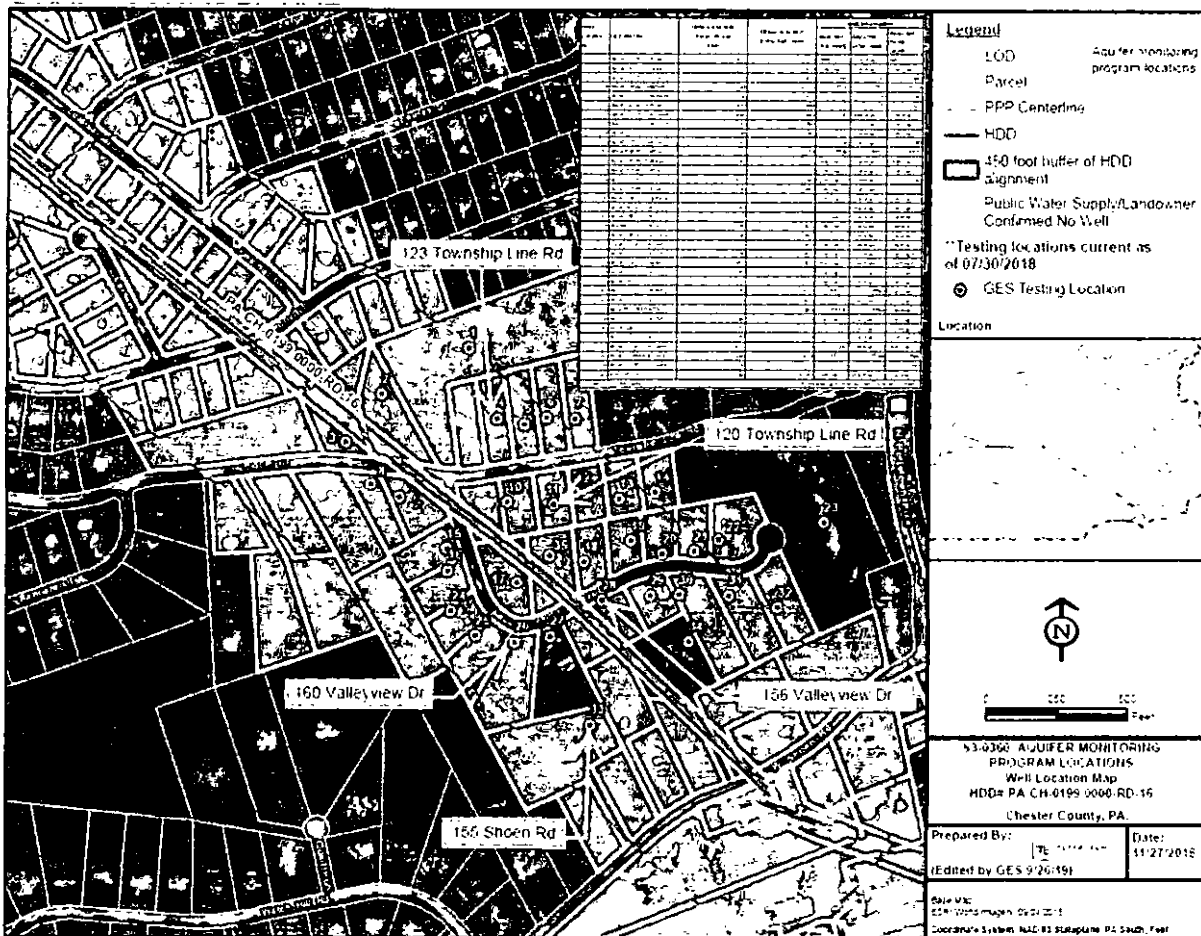
Groundwater in the area is sourced via direct recharge from precipitation and regional flow from the west (Low et al., 2002). In the vicinity of HDD S3-0360, groundwater is expected to flow east along the fabric of the bedrock and south toward tributaries of West Valley Creek. Typical depth to groundwater in the Chickies Quartzite uplands is approximately 40 feet, and depths to groundwater in monitoring wells in the area of HDD S3-0360 (see below) have ranged from 25 to 93 feet bgs.

### Groundwater Monitoring Prior To/During Drilling

Prior to the commencement of drilling on October 9, 2019, data logging transducers were permitted by the associated landowners to be placed in five (5) former domestic wells (essentially converting them to monitoring wells) since most homes in the area were connected to public water supply in July 2017. The locations of these monitoring wells are: 120 Township Line Road, 123 Township Line Road, 155 Shoen



Road, 156 Valleyview Drive, and 160 Valleyview Drive (see annotated **Plan and Profile** above and **Aquifer Monitoring Well Locations Map** below).



Monitoring of the groundwater levels began in December 2017 and the data were downloaded weekly until the start of current drilling activities at HDD S3-0360. A real-time data logger was installed in the 160 Valleyview Drive monitoring well on October 18, 2019, and the remaining four transducers are monitored twice daily (data downloaded and reviewed), during active drilling. The increased monitoring frequency is intended to provide on-going and updated information about the aquifer in the vicinity of HDD S3-0360, particularly regarding the water table conditions at the remaining domestic well being used within the 450-foot buffer zone at 158 Valleyview Drive. The landowner of this domestic well has refused connection to the offered public water supply (see **Attachment B** for a timeline of recent communications with Mr. Mano). The monitoring wells at 156 Valleyview Drive and 160 Valleyview Drive (on either side of 158 Valleyview Drive), and at 120 Township Line Road (slightly upgradient from 158 Valleyview Drive), are well-positioned to indicate immediate influences of drilling activities on the aquifer conditions at 158 Valleyview Drive. The monitoring wells at 123 Township Line Road (upgradient on the water table) and at 155 Shoen Road (downgradient on the water table) are suitable locations to monitor for background conditions possibly influenced by drilling activities, but not affected by pumping and well use at 158 Valleyview Drive.



Review of the historic water levels in the five monitoring wells (see **Table** below) indicates a normal daily range of groundwater level fluctuation ranging from 0.1 to 0.5 feet and maximum daily ranges from 0.3 to 2.6 feet before construction, depending on well location and depths. These ranges have been factored into the ongoing monitoring conducted during drilling operations.

**Table – Daily fluctuations (in feet) of the five converted domestic wells:**

Monitored Wells	2018		2019 Pre-Construction		2019 During Construction	
	average	max	average	max	average	max
120 Township Line Rd	0.080	0.312	0.064	<b>0.031</b>	1.38	3.54
123 Township Line Rd	0.102	1.790	0.041	<b>0.242</b>	--	--
155 Shoen Rd	0.089	1.629	0.103	<b>2.434</b>	0.055	0.08
156 Valleyview Dr	0.223	1.226	0.215	<b>2.683</b>	1.05	2.52
160 Valleyview Dr	0.562	2.069	0.609	<b>2.639</b>	1.10	1.80

Note: Transducer in the 123 Township Line Rd well was down for service October 11 through October 21, 2019.

In response to a request from the PADEP (Richard Staron, PG), additional information and a graphs was provided depicting the water levels in 160 Township Line Road since monitoring began in December 2017. A comparison with the water level measurements collected during routine sampling at 158 Valleyview Drive on October 14, 2019, indicates that the hydraulic head of the well at 160 Valleyview Drive is generally within 0.5 feet of the well at 158 Valleyview Drive, and is hydraulically connected (responsive to the well use activities at 158 Valleyview Drive). It can also be seen that overall water table conditions have been declining since approximately May 2019 (prior to the start of drilling in October 2019), and the hydraulic head in 160 Valleyview Drive is currently approximately 15 feet above the bottom of the well at 158 Valleyview Drive. The email communication/response with Mr. Staron is included as **Attachment C**.

#### **Changes in HDD Operations to Mitigate Groundwater Flow**

Modification to the existing drilling program to mitigate groundwater flowback from drilling operations will include the following:

- Grout the water-bearing horizon(s) encountered from the southeast (Shoen Road) drill entry location. Grouting methods will target water-bearing horizons encountered where groundwater flowback was first observed during drilling (at approximately 1200 ft. from the southeast entry/exit point) and will include the following options/methods:
  - Install a "heavy mud plug" (an injection of thickened drilling mud consisting of a higher bentonite-to-water ratio) until grouting can be performed.
  - From the southeast (Shoen Road) entry location, isolate the water-producing section of the pilot hole using a drillable grout retainer (packer) installed around the drill stem. Once the packer is in place, it uses the mud pump pressure to inject a cement grout plug into the annulus and surrounding formation. This packer will be placed before the water-bearing zone, so that grout can be injected between the packer and the rock face, to seal the annulus across the groundwater production zone.



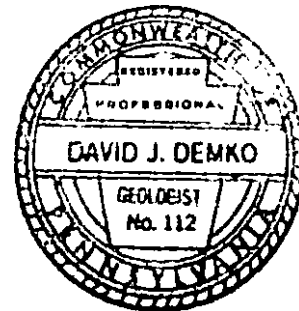
- Repeat either of the above procedures at other locations within the HDD S3-0360 pathway which have been determined to produce 'significant' rates of groundwater flow for both pilot-hole and reaming activities, prior to final pipe-pull operations.
- Drilling from the Devon Drive entry/exit location will utilize topography to reduce/eliminate uncontrolled groundwater flowback from water-bearing horizons encountered by the HDD.
- Continue to monitor the groundwater levels in the area using the groundwater monitoring well network.
- Once the pipe-pull has been completed, the annulus will be grouted in the following manner:
  - The intention is to grout as much of the open annular space as possible.
  - Fiberglass pipe (nominal 3.5" or 4.5") will be inserted from the southeast/Shoen Road entry location (which is the low side), using either a small drill rig or assistance with an excavator. The insertion will progress until refusal or until the lowest elevation of the profile is attained at approximately 800 feet (horizontally) from the southeast end. Grout will then be injected into the hole until refusal or until grout appears at the entry or exit side.
  - After the grout has time to set up/cure and creates a "plug" on the low side, the same process will be completed from the northwest/exit (Devon Drive) location. The pipe will be inserted either with a small drill rig or with assistance from an excavator. The insertion will progress until refusal, and then grout will then be injected into the hole until refusal or until grout appears at the exit side.
  - The intention is to grout as much of the open annular space as possible.

In summary, groundwater conditions will be monitored very closely while implementing a series of controls aimed at prevention of groundwater discharge along the borehole annulus and lowering of the local groundwater table. Upon completion of the drilling of the borehole and pulling of the pipe, the borehole annulus will be grouted to the extent possible.

Respectfully,

A handwritten signature in black ink, appearing to read 'David J. Demko'.

**David J. Demko, P.G.**  
PG-000112-G, expires 9/30/2021



*By affixing my seal to this document, I am certifying that the information is true and correct. I further certify I am licensed to practice geology in the Commonwealth of Pennsylvania and that it is within my professional expertise to verify the correctness of the information.*



**References**

Kochanov, W. E., 2016, Geology of part of the Chester Valley area, Chester, Delaware, Montgomery, and Philadelphia Counties, Pennsylvania: Pennsylvania Geological Survey, 4th ser., Open-File Report OFGA 16-01.0, 40 p., 1 map, scale 1:36,000.

Low, D.J., Hippe, D.J., Yannacci, D., 2002. Geohydrology of Southeastern Pennsylvania: Water Resources Investigation Report 00-4166, U.S. Department of the Interior, U.S. Geological Survey, in cooperation with the Pennsylvania Department of Conservation and Natural Resources, Bureau of Topographic and Geologic Survey, New Cumberland, Pennsylvania.

**Attachments:**

**Attachment A – Drillers Daily Logs**

**Attachment B – Mano Communications Timeline**

**Attachment C – Email Response to PADEP RE: Groundwater Monitoring**

MICHELS DIRECTIONAL CROSSINGS DAILY PROGRESS REPORT			LOCATION:	Exton, PA	
			DATE:	Wednesday, October 9, 2019	
OWNER: Sunoco			WEATHER:	60° - Rainy	
MICHELS JOB # 193440 - MPL #360 Shoen Road / Devon Drive			PREPARED BY:	Tucker Toelke	
EMPLOYEE	CLASS	HOURS	OPERATIONAL INFORMATION		
<u>Entry Site</u>			OPERATION PERFORMED:		
Karl Kornkven	OP1 Driller	10	HOLE SIZE:	Pilot Hole	Setup
Dan Kriesel	OP1 Driller	10	TOOL IN USE:	N/A	N/A
Aaron Schwenn	OP1	10	FOOTAGE TODAY:	34.55	0
Hunter Hintz	LAB	10	FOOTAGE TO DATE:	34.55	0
Connor Weber	LAB	10	Pilot Hole Length / % Complete:	2,852.00	1.2%
Ronald Wolfe	LAB	10	<b>DRILLING FLUIDS INFORMATION</b>		
				Entry	Exit
			BENTONITE USED TODAY:	55	0
			BENTONITE JOB TO DATE:	55	0
			WATER USED TODAY:	4,300	0
			WATER USED TOTAL:	4,300	0
			DID YOU LOSE CIRCULATION TODAY:		NO
			VAC TRUCKS TODAY:	0	0
			LIQUIDS DISPOSED TODAY:	0	0
			LIQUIDS DISPOSED TOTAL:	0	0
			DUMP TRUCKS TODAY:	0	0
			SOLIDS DISPOSED TODAY:	0	0
			SOLIDS DISPOSED TOTAL:	0	0
			SOLIDIFIER TODAY:	0	0
			SOLIDIFIER TOTAL:	0	0
<b>SUMMARY OF DAILY ACTIVITIES AND PROGRESS:</b>					
<u>Entry Site</u>					
Personnel conducted the daily jobsite safety analysis on site.					
Pilot hole operations commenced.					
End of shift.					
~ Gyro steering tool is on site.					
<u>Exit Site</u>					
Personnel conducted the daily jobsite safety analysis on site.					
Setup operations commenced.					
End of shift.					

MICHELS DIRECTIONAL CROSSINGS DAILY PROGRESS REPORT						LOCATION: Exton, PA	
						DATE: Thursday, October 10, 2019	
OWNER: Sunoco						WEATHER: 70° - Fair	
MICHELS JOB # 193440 - MPL #360 Shoen Road / Devon Drive						PREPARED BY: Tucker Toelke	
EMPLOYEE			CLASS	HOURS	OPERATIONAL INFORMATION		
<u>Entry Side</u>					OPERATION PERFORMED:		
Karl Kornkven	OP1 Driller	10			Pilot Hole	Setup	
Dan Kriesel	OP1 Driller	10			N/A	N/A	
Aaron Schwenn	OP1	10			HOLE SIZE:		
Hunter Hintz	LAB	10			TOOL IN USE:		
Connor Weber	LAB	10			FOOTAGE TODAY:		
Ronald Wolfe	LAB	10			FOOTAGE TO DATE:		
					Pilot Hole Length / % Complete:		
					DRILLING FLUIDS INFORMATION		
					Entry	Exit	
					BENTONITE USED TODAY:	BAGS	
					BENTONITE JOB TO DATE:	BAGS	
					WATER USED TODAY:	GALLONS	
					WATER USED TOTAL:	GALLONS	
					DID YOU LOSE CIRCULATION TODAY:		
					NO		
<u>Exit Side</u>					VAC TRUCKS TODAY:		
Marcus Carratt	OP1 Driller	12				TRUCKS	
Brandon Schwenn	OP1	12			LIQUIDS DISPOSED TODAY:	GALLONS	
Joel Williams	OP3	12			LIQUIDS DISPOSED TOTAL:	GALLONS	
Cody Nichols	LAB	12			DUMP TRUCKS TODAY:	TRUCKS	
William Gates	LAB	12			SOLIDS DISPOSED TODAY:	CUBIC YARDS	
Kenneth Doward	LAB	12			SOLIDS DISPOSED TOTAL:	CUBIC YARDS	
					SOLIDIFIER TODAY:	SUPER SACKS	
					SOLIDIFIER TOTAL:	SUPER SACKS	
SUMMARY OF DAILY ACTIVITIES AND PROGRESS:							
<u>Entry Site</u>							
Personnel conducted the daily jobsite safety analysis on site.							
Pilot hole operations continued.							
End of shift.							
~ Gyro steering tool is on site.							
<u>Exit Site</u>							
Personnel conducted the daily jobsite safety analysis on site.							
Setup operations continued.							
End of shift.							



<b>MICHEL'S DIRECTIONAL CROSSINGS DAILY PROGRESS REPORT</b>				<b>LOCATION:</b> Exton, PA		
				<b>DATE:</b> Friday, October 11, 2019		
<b>OWNER:</b> <b>Sunoco</b>				<b>WEATHER:</b> 60° - Fair		
<b>MICHEL'S JOB #</b> 193440 - MPL #360 Shoen Road / Devon Drive				<b>PREPARED BY:</b> Tucker Toelke		
<b>EMPLOYEE</b>		<b>CLASS</b>	<b>HOURS</b>	<b>OPERATIONAL INFORMATION</b>		
<u>Entry Side</u>				<b>OPERATION PERFORMED:</b>		
Karl Kornkven	OP1 Driller	12		Pilot Hole	Setup	
Dan Kriesel	OP1 Driller	12		N/A	N/A	
Aaron Schwenn	OP1	12		N/A	N/A	
Hunter Hintz	LAB	12		FOOTAGE TODAY:	63.7      0	
Connor Weber	LAB	12		FOOTAGE TO DATE:	226.09      0	
Ronald Wolfe	LAB	12		Pilot Hole Length / % Complete:	2,852.00      7.9%	
				<b>DRILLING FLUIDS INFORMATION</b>		
				<b>BENTONITE USED TODAY:</b>	25	0
				<b>BENTONITE JOB TO DATE:</b>	111	0
				<b>WATER USED TODAY:</b>	3.600	0
				<b>WATER USED TOTAL:</b>	7.900	0
				<b>DID YOU LOSE CIRCULATION TODAY:</b>	NO	
<u>Exit Site</u>				VAC TRUCKS TODAY:	2	0
Marcus Carratt	OP1 Driller	12		LIQUIDS DISPOSED TODAY:	5.000	0
Brandon Schwenn	OP1	12		LIQUIDS DISPOSED TOTAL:	5.000	0
Joel Williams	OP3	12		DUMP TRUCKS TODAY:	0	0
Cody Nichols	LAB	12		SOLIDS DISPOSED TODAY:	0	0
William Gates	LAB	12		SOLIDS DISPOSED TOTAL:	0	0
Kenneth Doward	LAB	12		SOLIDIFIER TODAY:	0	0
				SOLIDIFIER TOTAL:	0	0
<b>SUMMARY OF DAILY ACTIVITIES AND PROGRESS:</b>						
<u>Entry Site</u>						
Personnel conducted the daily jobsite safety analysis on site.						
Pilot hole operations continued.						
End of shift.						
- Gyro steering tool is on site.						
<u>Exit Site</u>						
Personnel conducted the daily jobsite safety analysis on site.						
Setup operations continued.						
End of shift.						

MICHELS DIRECTIONAL CROSSINGS DAILY PROGRESS REPORT				LOCATION:		Exton, PA	
OWNER: Sunoco				DATE:		Saturday, October 12, 2019	
MICHELS JOB # 193440 - MPL #360 Shoen Road / Devon Drive				WEATHER:		65° - Fair	
				PREPARED BY:		Tucker Toelke	
EMPLOYEE		CLASS	HOURS	OPERATIONAL INFORMATION			
<u>Entry Site</u>				OPERATION PERFORMED: Pilot Hole Setup			
Karl Kornkven	OP1 Driller	10	HOLE SIZE: N/A N/A				
Dan Kriesel	OP1 Driller	10	TOOL IN USE: N/A N/A				
Aaron Schwenn	OP1	10	FOOTAGE TODAY: 255.36 0				
Hunter Hintz	LAB	10	FOOTAGE TO DATE: 481.45 0				
Connor Weber	LAB	10	Pilot Hole Length / % Complete: 2,852.00 16.9%				
Ronald Wolfe	LAB	10	DRILLING FLUIDS INFORMATION				
				Entry	Exit		
			BENTONITE USED TODAY:		51	0	BAGS
			BENTONITE JOB TO DATE:		162	0	BAGS
			WATER USED TODAY:		1,700	0	GALLONS
			WATER USED TOTAL:		9,600	0	GALLONS
			DID YOU LOSE CIRCULATION TODAY:				NO
<u>Exit Site</u>			VAC TRUCKS TODAY:		0	0	TRUCKS
Marcus Carratt	OP1 Driller	10	LIQUIDS DISPOSED TODAY:		0	0	GALLONS
Brandon Schwenn	OP1	10	LIQUIDS DISPOSED TOTAL:		5,000	0	GALLONS
Joel Williams	OP3	10	DUMP TRUCKS TODAY:		0	0	TRUCKS
Cody Nichols	LAB	10	SOLIDS DISPOSED TODAY:		0	0	CUBIC YARDS
William Gates	LAB	10	SOLIDS DISPOSED TOTAL:		0	0	CUBIC YARDS
Kenneth Doward	LAB	10	SOLIDIFIER TODAY:		0	0	SUPER SACKS
			SOLIDIFIER TOTAL:		0	0	SUPER SACKS
SUMMARY OF DAILY ACTIVITIES AND PROGRESS:							
<u>Entry Site</u>							
Personnel attended the weekly all hands safety meeting.							
Personnel conducted the daily jobsite safety analysis on site.							
Pilot hole operations continued.							
End of shift.							
~ Gyro steering tool is on site.							
<u>Exit Site</u>							
Personnel attended the weekly all hands safety meeting.							
Personnel conducted the daily jobsite safety analysis on site.							
Setup operations continued.							
End of shift.							
~Gyro steering tool is on site.							

MICHELS DIRECTIONAL CROSSINGS DAILY PROGRESS REPORT			LOCATION:	Exton, PA	
			DATE:	Monday, October 14, 2019	
OWNER: Sunoco			WEATHER:	70° - Fair	
MICHELS JOB # 193440 - MPL #360 Shoen Road / Devon Drive			PREPARED BY:	Tucker Toelke	
EMPLOYEE	CLASS	HOURS	OPERATIONAL INFORMATION		
<u>Entry Side</u>			OPERATION PERFORMED: Pilot Hole Standby		
Karl Kornkven	OP1 Driller	12	HOLE SIZE: N/A N/A		
Dan Kriesel	OP1 Driller	12	TOOL IN USE: N/A N/A		
Aaron Schwenn	OP1	12	FOOTAGE TODAY: 383.07 0		
Hunter Hintz	LAB	12	FOOTAGE TO DATE: 864.52 0		
Connor Weber	LAB	12	Pilot Hole Length / % Complete: 2,852.00 30.3%		
Ronald Wolfe	LAB	12	DRILLING FLUIDS INFORMATION		
				Entry	Exit
			BENTONITE USED TODAY:	77	0 BAGS
			BENTONITE JOB TO DATE:	239	0 BAGS
			WATER USED TODAY:	2,566	0 GALLONS
			WATER USED TOTAL:	12,166	0 GALLONS
			DID YOU LOSE CIRCULATION TODAY:		NO
<u>Exit Side</u>			VAC TRUCKS TODAY: 1 0 TRUCKS		
Marcus Carratt	OP1 Driller	10	LIQUIDS DISPOSED TODAY: 2,000 0 GALLONS		
Brandon Schwenn	OP1	10	LIQUIDS DISPOSED TOTAL: 7,000 0 GALLONS		
Joel Williams	OP3	10	DUMP TRUCKS TODAY: 2 0 TRUCKS		
Cody Nichols	LAB	10	SOLIDS DISPOSED TODAY: 28 0 CUBIC YARDS		
William Gates	LAB	10	SOLIDS DISPOSED TOTAL: 28 0 CUBIC YARDS		
Kenneth Doward	LAB	10	SOLIDIFIER TODAY: 2 0 SUPER SACKS		
			SOLIDIFIER TOTAL: 12 0 SUPER SACKS		
SUMMARY OF DAILY ACTIVITIES AND PROGRESS:					
<u>Entry Site</u>					
Personnel conducted the daily jobsite safety analysis on site.					
Pilot hole operations continued.					
End of shift.					
~ Gyro steering tool is on site.					
<u>Exit Site</u>					
Personnel on standby.					
~Gyro steering tool is on site.					

<b>MICHELS DIRECTIONAL CROSSINGS DAILY PROGRESS REPORT</b>				<b>LOCATION:</b> Exton, PA		
				<b>DATE:</b> Tuesday, October 15, 2019		
<b>OWNER:</b> <b>Sunoco</b>				<b>WEATHER:</b> 65° - Fair		
<b>MICHELS JOB #</b> 193440 - MPL #360 Shoen Road / Devon Drive				<b>PREPARED BY:</b> Tucker Toelke		
<b>EMPLOYEE</b>		<b>CLASS</b>	<b>HOURS</b>	<b>OPERATIONAL INFORMATION</b>		
<u>Entry Site</u>				<b>OPERATION PERFORMED:</b>		
Karl Kornkven	OP1 Driller	12		Pilot Hole	Setup	
Dan Kriesel	OP1 Driller	12		N/A	N/A	
Aaron Schwenn	OP1	12		N/A	N/A	
Hunter Hintz	LAB	12		255.54	0	
Connor Weber	LAB	12		1120.06	0	
Ronald Wolfe	LAB	12		Pilot Hole Length / % Complete:	2,852.00	39.3%
				<b>DRILLING FLUIDS INFORMATION</b>		
				<b>Entry</b>	<b>Exit</b>	
				BENTONITE USED TODAY:	41	0 BAGS
				BENTONITE JOB TO DATE:	280	0 BAGS
				WATER USED TODAY:	300	6,000 GALLONS
				WATER USED TOTAL:	12,466	6,000 GALLONS
				<b>DID YOU LOSE CIRCULATION TODAY:</b>		NO
<u>Exit Site</u>				VAC TRUCKS TODAY:	1	0 TRUCKS
Marcus Carratt	OP1 Driller	12		LIQUIDS DISPOSED TODAY:	2,300	0 GALLONS
Brandon Schwenn	OP1	12		LIQUIDS DISPOSED TOTAL:	9,300	0 GALLONS
Joel Williams	OP3	12		DUMP TRUCKS TODAY:	0	0 TRUCKS
Cody Nichols	LAB	12		SOLIDS DISPOSED TODAY:	0	0 CUBIC YARDS
William Gates	LAB	12		SOLIDS DISPOSED TOTAL:	28	0 CUBIC YARDS
Kenneth Doward	LAB	12		SOLIDIFIER TODAY:	2	0 SUPER SACKS
				SOLIDIFIER TOTAL:	14	0 SUPER SACKS
<b>SUMMARY OF DAILY ACTIVITIES AND PROGRESS:</b>						
<u>Entry Site</u>						
Personnel conducted the daily jobsite safety analysis on site.						
Pilot hole operations continued.						
End of shift.						
~ Gyro steering tool is on site.						
<u>Exit Site</u>						
Personnel conducted the daily jobsite safety analysis on site.						
Setup operations continued.						
End of shift.						
~Gyro steering tool is on site.						

MICHELS DIRECTIONAL CROSSINGS DAILY PROGRESS REPORT				LOCATION: DATE:		Exton, PA Wednesday, October 16, 2019	
OWNER: MICHOLS JOB #				Sunoco 193440 - MPL #360 Shoen Road / Davon Drive		WEATHER: 60° - Rainy	
				PREPARED BY:		Tucker Toelke	
EMPLOYEE		CLASS	HOURS	OPERATIONAL INFORMATION			
<u>Entry Side</u>				OPERATION PERFORMED:			
Karl Kornkven	OP1 Driller	10	HOLE SIZE:		Pilot Hole	Setup	
Dan Kriesel	OP1 Driller	10	TOOL IN USE:		12.25	N/A	
Aaron Schwenn	OP1	10	FOOTAGE TODAY:		Gyro / Drill Motor	N/A	
Hunter Hintz	LAB	10	FOOTAGE TO DATE:		126.78	0	
Connor Weber	LAB	10	Pilot Hole Length / % Complete:		1746.84	0	
Ronald Wolfe	LAB	10			2,852.00	43.7%	
				DRILLING FLUIDS INFORMATION			
					Entry	Exit	
				BENTONITE USED TODAY:	31	0	BAGS
				BENTONITE JOB TO DATE:	311	0	BAGS
				WATER USED TODAY:	800	6,000	GALLONS
				WATER USED TOTAL:	13,266	6,000	GALLONS
				DID YOU LOSE CIRCULATION TODAY:			NO
<u>Exit Side</u>				VAC TRUCKS TODAY:		1	0
Marcus Carratt	OP1 Driller	10	LIQUIDS DISPOSED TODAY:		2,300	0	TRUCKS
Brandon Schwenn	OP1	10	LIQUIDS DISPOSED TOTAL:		11,600	0	GALLONS
Joel Williams	OP3	10	DUMP TRUCKS TODAY:		1	0	GALLONS
Cody Nichols	LAB	10	SOLIDS DISPOSED TODAY:		15	0	TRUCKS
William Gates	LAB	10	SOLIDS DISPOSED TOTAL:		43	0	CUBIC YARDS
Kenneth Doward	LAB	10	SOLIDIFIER TODAY:		0	0	CUBIC YARDS
				SOLIDIFIER TOTAL:		14	0
				SUPER SACKS			
				SUPER SACKS			
SUMMARY OF DAILY ACTIVITIES AND PROGRESS:							
<u>Entry Site</u>							
Personnel conducted the daily jobsite safety analysis on site.							
Pilot hole operations continued.							
End of shift.							
~ Gyro steering tool is on site.							
<u>Exit Site</u>							
Personnel conducted the daily jobsite safety analysis on site.							
Setup operations continued.							
End of shift.							
~Gyro steering tool is on site.							

MICHELS DIRECTIONAL CROSSINGS DAILY PROGRESS REPORT			LOCATION:	Exton, PA	
			DATE:	Thursday, October 17, 2019	
OWNER: Sunoco			WEATHER:	60° - Fair	
MICHELS JOB # 193440 - MPL #360 Shoen Road / Devon Drive			PREPARED BY:	Tucker Toelke	
EMPLOYEE	CLASS	HOURS	OPERATIONAL INFORMATION		
<u>Entry Side</u>			OPERATION PERFORMED: Pilot Hole Setup		
Karl Kornkven	OP1 Driller	10	HOLE SIZE: 12.25 N/A		
Dan Kriesel	OP1 Driller	10	TOOL IN USE: Gyro / Drill Motor N/A		
Aaron Schwenn	OP1	10	FOOTAGE TODAY: 255.03 0		
Hunter Hintz	LAB	10	FOOTAGE TO DATE: 1501.87 0		
Connor Weber	LAB	10	Pilot Hole Length / % Complete: 2,852.00 52.7%		
Ronald Wolfe	LAB	10	<b>DRILLING FLUIDS INFORMATION</b>		
				Entry	Exit
			BENTONITE USED TODAY:	66	0 BAGS
			BENTONITE JOB TO DATE:	377	0 BAGS
			WATER USED TODAY:	1,600	6,000 GALLONS
			WATER USED TOTAL:	14,866	6,000 GALLONS
			DID YOU LOSE CIRCULATION TODAY:		NO
<u>Exit Side</u>			VAC TRUCKS TODAY: 0 0 TRUCKS		
Marcus Carratt	OP1 Driller	12	LIQUIDS DISPOSED TODAY: 0 0 GALLONS		
Brandon Schwenn	OP1	12	LIQUIDS DISPOSED TOTAL: 11,600 0 GALLONS		
Joel Williams	OP3	12	DUMP TRUCKS TODAY: 1 0 TRUCKS		
Cody Nichols	LAB	12	SOLIDS DISPOSED TODAY: 15 0 CUBIC YARDS		
William Gates	LAB	12	SOLIDS DISPOSED TOTAL: 45 0 CUBIC YARDS		
Kenneth Doward	LAB	12	SOLIDIFIER TODAY: 2 0 SUPER SACKS		
			SOLIDIFIER TOTAL: 7 0 SUPER SACKS		
<b>SUMMARY OF DAILY ACTIVITIES AND PROGRESS:</b>					
<u>Entry Site</u>					
Personnel conducted the daily jobsite safety analysis on site.					
Pilot hole operations continued.					
End of shift.					
~ Gyro steering tool is on site.					
<u>Exit Site</u>					
Personnel conducted the daily jobsite safety analysis on site.					
Setup operations continued. Casing installation.					
End of shift.					
~Gyro steering tool is on site.					

<b>MICHEL'S DIRECTIONAL CROSSINGS DAILY PROGRESS REPORT</b>				<b>LOCATION:</b>	Exton, PA
				<b>DATE:</b>	Friday, October 18, 2019
<b>OWNER:</b>				<b>WEATHER:</b>	60° - Fair
<b>Sunoco</b>				<b>PREPARED BY:</b>	Tucker Toelke
<b>MICHEL'S JOB #      193440 - MPL #360 Shoen Road / Devon Drive</b>					
<b>EMPLOYEE</b>		<b>CLASS</b>	<b>HOURS</b>	<b>OPERATIONAL INFORMATION</b>	
<b>Entry Side</b>				<b>OPERATION PERFORMED:</b>	
Karl Kornkven	OP1 Driller	12		Pilot Hole	Setup
Dan Kriesel	OP1 Driller	12		HOLE SIZE:	12 25 N/A
Aaron Schwenn	OP1	12		TOOL IN USE:	Gyro / Drill Motor N/A
Hunter Hintz	LAB	12		FOOTAGE TODAY:	255.03 0
Connor Weber	LAB	12		FOOTAGE TO DATE:	1501.8/ 0
Ronald Wolfe	LAB	12		Pilot Hole Length / % Complete:	2,852.00 52.7%
				<b>DRILLING FLUIDS INFORMATION</b>	
				<b>BENTONITE USED TODAY:</b>	153 0 BAGS
				<b>BENTONITE JOB TO DATE:</b>	530 0 BAGS
				<b>WATER USED TODAY:</b>	700 6,000 GALLONS
				<b>WATER USED TOTAL:</b>	15,566 6,000 GALLONS
				<b>DID YOU LOSE CIRCULATION TODAY:</b>	NO
<b>Exit Site</b>				<b>VAC TRUCKS TODAY:</b>	2 0 TRUCKS
Marcus Carratt	OP1 Driller	10		<b>LIQUIDS DISPOSED TODAY:</b>	5,000 0 GALLONS
Brandon Schwenn	OP1	10		<b>LIQUIDS DISPOSED TOTAL:</b>	16,600 0 GALLONS
Joel Williams	OP3	10		<b>DUMP TRUCKS TODAY:</b>	0 0 TRUCKS
Cody Nichols	LAB	10		<b>SOLIDS DISPOSED TODAY:</b>	0 0 CUBIC YARDS
William Gates	LAB	10		<b>SOLIDS DISPOSED TOTAL:</b>	45 0 CUBIC YARDS
Kenneth Doward	LAB	10		<b>SOLIDIFIER TODAY:</b>	0 0 SUPER SACKS
				<b>SOLIDIFIER TOTAL:</b>	7 0 SUPER SACKS
<b>SUMMARY OF DAILY ACTIVITIES AND PROGRESS:</b>					
<b>Entry Site</b>					
Personnel conducted the daily jobsite safety analysis on site.					
Pilot hole operations continued. Tripping out, tripping in.					
End of shift.					
~ Gyro steering tool is on site.					
<b>Exit Site</b>					
Personnel conducted the daily jobsite safety analysis on site.					
Setup operations continued. Casing installation.					
End of shift.					
~Gyro steering tool is on site.					

MICHELS DIRECTIONAL CROSSINGS DAILY PROGRESS REPORT				LOCATION:		Exton, PA	
OWNER: Sunoco				DATE:		Saturday, October 19, 2019	
MICHELS JOB # 193440 - MPL #360 Shoen Road / Devon Drive				WEATHER:		60° - Fair	
				PREPARED BY:		Tucker Toeke	
EMPLOYEE		CLASS	HOURS	OPERATIONAL INFORMATION			
<b>Entry Side</b>				<b>OPERATION PERFORMED:</b>			
Karl Kornkven	OP1 Driller	10		Pilot Hole		Setup	
Dan Kriesel	OP1 Driller	10		HOLE SIZE:		12.25 N/A	
Aaron Schwenn	OP1	10		TOOL IN USE:		Gyro / Drill Motor N/A	
Hunter Hintz	LAB	10		FOOTAGE TODAY:		0 0	
Connor Weber	LAB	10		FOOTAGE TO DATE:		1533.87 0	
Ronald Wolfe	LAB	10		Pilot Hole Length / % Complete:		2,852.00 53.8%	
				<b>DRILLING FLUIDS INFORMATION</b>			
					Entry	Exit	
				BENTONITE USED TODAY:		0	0 BAGS
				BENTONITE JOB TO DATE:		530	0 BAGS
				WATER USED TODAY:		0	0 GALLONS
				WATER USED TOTAL:		15,566	6,000 GALLONS
				DID YOU LOSE CIRCULATION TODAY:			NO
<b>Exit Side</b>				VAC TRUCKS TODAY:		0	0 TRUCKS
Marcus Carratt	OP1 Driller	10		LIQUIDS DISPOSED TODAY:		0	0 GALLONS
Brandon Schwenn	OP1	10		LIQUIDS DISPOSED TOTAL:		16,600	0 GALLONS
Joel Williams	OP3	10		DUMP TRUCKS TODAY:		0	0 TRUCKS
Cody Nichols	LAB	10		SOLIDS DISPOSED TODAY:		0	0 CUBIC YARDS
William Gates	LAB	10		SOLIDS DISPOSED TOTAL:		45	0 CUBIC YARDS
Kenneth Doward	LAB	10		SOLIDIFIER TODAY:		0	0 SUPER SACKS
				SOLIDIFIER TOTAL:		7	0 SUPER SACKS
<b>SUMMARY OF DAILY ACTIVITIES AND PROGRESS:</b>							
<b>Entry Site</b>							
Personnel attended the weekly all hands safety meeting.							
Personnel conducted the daily jobsite safety analysis on site.							
Personnel on standby.							
End of shift.							
- Gyro steering tool is on site.							
<b>Exit Site</b>							
Personnel attended the weekly all hands safety meeting.							
Personnel conducted the daily jobsite safety analysis on site.							
Personnel on standby.							
End of shift.							
-Gyro steering tool is on site.							



## **ATTACHMENT B**

### **Timeline of Recent Communications with Mr. Mano at 158 Valleyview Drive, Exton, PA**

#### **2019**

September 26, 2019 - 72-hour notice of restart mailed to Mano

September 27, 2019 - 30-day notice of restart sent to all landowners on HDD 360

October 2, 2019 - Offer of temporary water sent to Mano (NO ACCEPTANCE/DENIAL)

October 10, 2019 - Lancaster Office contacted Mano to offer water well test on 10/14/19. Mano was to check with wife and confirm.

October 11, 2019 - Mano contacted Lancaster Office to confirm appointment. Lancaster Office, upon directive from management/legal, informed Mano that all communications should be through legal counsel moving forward.

- Mano attorney confirmed appointment with Lancaster Office.

October 14, 2019 - Water well test by GES with no issues.

October 15, 2019 - Water well complaint by Mano.

October 16, 2019 - Sunoco/ETP Legal attempted to schedule another water well test due to complaint.

October 17, 2019 - Mano attorney denied call of complaint. DEP collected well sample. Mano claimed well cap damage during GES water well test.

October 18, 2019 - GES reported no problem with well cap during test and provided before and after photos.

October 18, 2019 - Notice of Making Water letter sent to landowners.

October 21, 2019 - Received letter from Mano attorney claiming SPLP "violated existing DEP permits by breaching and draining aquifer."

## ATTACHMENT C - Email Response to PADEP Re: Groundwater Monitoring

David J. Demko VP, P.G.  
Program Manager  
Senior Hydrogeologist

Office: 610.458.1077 ext. 3452  
Mobile: 484-645-2328  
ddemko@GESonline.com

Groundwater & Environmental Services, Inc.  
440 Creamery Way, Suite 500  
Exton, PA 19341

Follow Us: \_\_\_\_\_



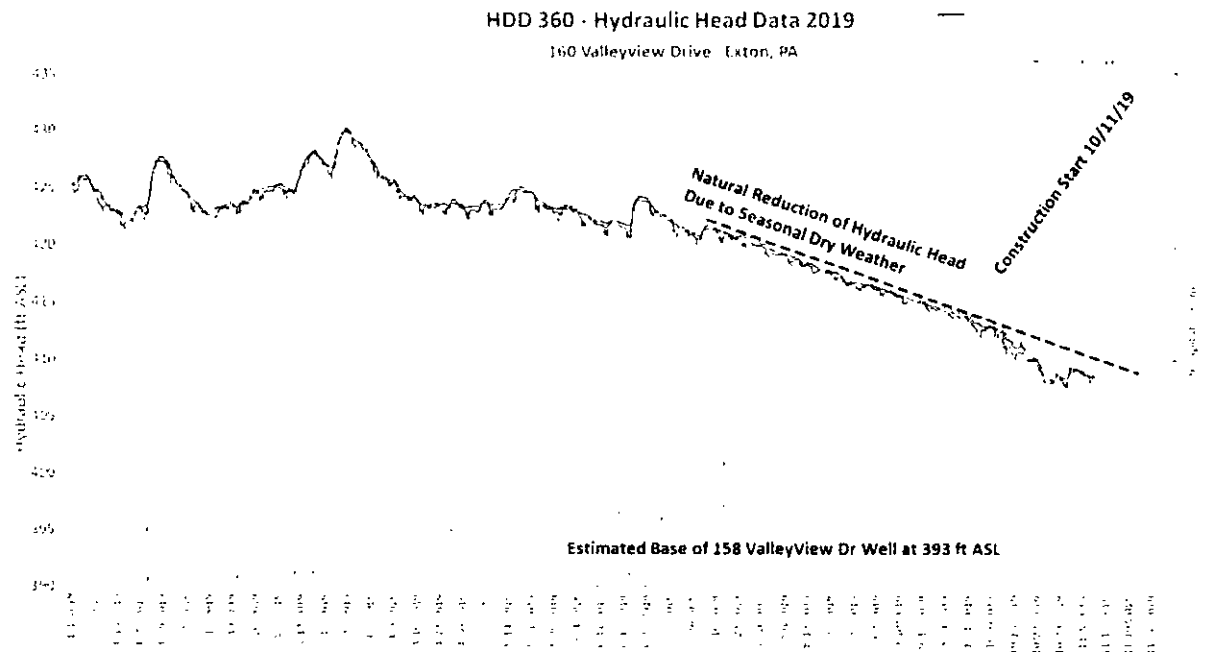
Safety. Health. Environment.

**From:** David Demko  
**Sent:** Friday, November 8, 2019 3:31 PM  
**To:** 'Staron, Richard' <rstaron@pa.gov>  
**Cc:** Greiminger, Larry <larry.greiminger@energytransfer.com>; Hohenstein, John <john.hohenstein@pa.gov>; Manning Duckey, Desree <desree@pa.gov>  
**Subject:** RE: HDD 360 restart report

Reply originates from the Internet and is not a registered email until today.

The existing monitoring well network can detect a reduction in hydraulic head during construction by comparing water levels to pre-construction values. GES has a database of approximately 22 months' worth of water level data on the well in Valley View Drive and the HDD 360 drill prior to the start of the current drilling activity. This long-term data provides information on the natural fluctuations in water level due to the large, natural discharge through the well and variations in water levels due to changes in the annual hydrological cycle. This information is used in combination with data from monthly water level data during drilling to access the true water level response observed during HDD activity.

The 158 Valley View Dr well is not to be used as a close analog to the HDD 360 well. Water level measurements of the 158 Valley View Dr well during routine sampling on October 11 revealed that the hydraulic heads of these two wells are generally within 0.5 ft of each other. Moreover, the 158 Valley View Dr well records drawdown and recovery each time the pump is used in the 158 Valley View Dr well, providing additional evidence that these wells are similar in hydraulic response. The following equipment pressure transducer installed in the 158 Valley View Dr well is being monitored routinely and is now programmed to trigger an alarm if the hydraulic head drops below a threshold value in future days.



Subsequently, if water level monitoring detects a significant decrease in water level compared to the natural fluctuations of the two wells, please inform all PADEP and all interested groundwater system (exchange) stakeholders immediately. Feel free to contact me to discuss any questions. Thank you.

David J. Demko VP, P.G.  
Program Manager  
Senior Hydrogeologist

Office: 610.458.1077 ext. 3452  
Mobile: 484-645-2328  
ddemko@GESonline.com

Groundwater & Environmental Services, Inc.  
440 Creamery Way, Suite 500  
Exton, PA 19341

Follow Us: \_\_\_\_\_



Safety. From start to finish.

**From:** Staron, Richard <[richard.staron@pa.gov](mailto:richard.staron@pa.gov)>  
**Sent:** Thursday, October 31, 2019 9:35 AM  
**To:** David Demko <[ddemko@gesonline.com](mailto:ddemko@gesonline.com)>  
**Cc:** Gremminger, Larry <[larry.gremminger@delawarehydro.com](mailto:larry.gremminger@delawarehydro.com)>; Hohenstein, John <[johnd@delawarehydro.com](mailto:johnd@delawarehydro.com)>; Henning-Dudley, Denise <[denise.henningdudley@pa.gov](mailto:denise.henningdudley@pa.gov)>  
**Subject:** HDD 360 restart report

David,

On page 4 of the restart memo, the average daily fluctuations are reported. While this is good information, it doesn't tell us anything about the cumulative effects. It's understood the groundwater elevation in the wells will naturally rise and fall. However, the drilling does have the ability to punctuate a net loss of water.

The main question I have, is the daily change normalized from an average depth? Or could the net change be a cumulative negative impact as a result of the drilling? If we take 120 Township Line Road as an example. The average daily flux is 1.38 feet. If we have a negative daily affect of -1.38 feet per day as a result of the drilling, then that has the potential to dewater the well still in use at 158 Valley View Road.

I know this seems like an unlikely worst case scenario. However, we have to cover all of our bases and should consider if the remaining well could be dewatered. Would you be able to provide a line graph for a well proximal to 158 Valley View Road exhibiting groundwater elevations over the three time periods presented in the table?

**Richard Staron** | Professional Geologist Manager  
Department of Environmental Protection | Southeast Regional Office  
2 East Main Street | Norristown, PA 19401  
Phone: 484.250.5717 | Fax: 484.250.5961  
[www.dep.pa.gov](http://www.dep.pa.gov)

**PRIVILEGED AND CONFIDENTIAL COMMUNICATION**

This document is confidential to the Pennsylvania Department of Environmental Protection and is intended for the use of the recipient only. It may contain information that is exempt from public release under the provisions of the Pennsylvania Freedom of Information Act. If you are not the intended recipient, you should not disseminate this information to others. If you have received this document in error, please notify the sender immediately and delete this document from your system.

**TAKE NOTE: This E-Mail came from outside of GES. Please consider the sender and nature of email before responding back to, clicking on any links or opening any attachments. If it appears suspicious delete it immediately.**



Groundwater & Environmental Services, Inc.

EASTERN PENNSYLVANIA OFFICE

September 1, 2017

Mr. Matthew Gordon  
Sunoco Pipeline, L. P.  
535 Fritztown Road  
Sinking Spring, Pennsylvania 19608

**Re: Hydrogeological Investigation  
Shoen Road Drill Area  
West Whiteland and Uwchlan Townships, Chester County, PA**

Dear Mr. Gordon,

This report has been prepared to satisfy the requirements for a hydrogeological investigation of the Shoen Road Drill Area as specified in the Consent Order and Agreement (Order) between Sunoco Pipeline, L. P. and the Pennsylvania Department of Environmental Protection dated July 24, 2017. These requirements are stipulated in Item 3. Corrective Action, subpart f. of the Order, which states, "Sunoco shall conduct a hydrogeological investigation of the impacted aquifer(s) in the Schoen Road Drill Area to determine the cause(s) of why the private water supplies that draw from the aquifer(s) were impacted by Sunoco's activities. On or before September 1, 2017, Sunoco shall submit a report to the Department detailing the results of its investigation and its recommendations of pipeline installation. Sunoco's recommendations shall include all steps it will undertake to prevent impacts to the groundwater, or mitigate any such impacts, to the satisfaction of the Department."

#### **Background and Conceptual Site Model**

The S3-360-20 horizontal directional drill (HDD) (hereinafter referred to as the "360 Drill" or the Shoen Road Drill") (PA-CH-0199) is located on the 100-block of Shoen Rd., Exton, West Whiteland Township, Chester County, Pennsylvania. The 360 Drill centerline extends 2,834 ft toward the northwest from this location (project station 15082+58 to 15054+24), starting at an elevation of 350 feet above sea level (ft ASL) and ending at 575 ft ASL. The following is a list of notable events that occurred at the site between June 14 and July 20, 2017:

- 6/14/17, Start of the HDD and advancement of the 10 5/8-inch pilot bit began.
- 6/22/17, The pilot hole began producing water at a distance of 747 ft.
- 6/28/17, The flow rate of water increased to 70 gpm at a distance of 1,287 ft. Groundwater was produced during the evening hours but stopped or was greatly reduced during rig operations. A crew remained on site each night to manage produced groundwater. The groundwater was either removed by vacuum truck or allowed to infiltrate through a water management structure constructed on site.
- 6/29/17, The flow rate of groundwater diminished to 40 gpm.
- 7/3/17, Residents at 118 and 120 Township Line Rd reported experiencing "cloudy" well water.
- Between 7/5/17 and 7/31/17, water samples were collected from 36 residential wells in the area of the HDD. Of these wells, 15 residents either complained of well issues or requested sampling.
- 7/6/2017, The HDD crew partially sealed the pilot hole using 27 cubic yards of cement grout. Grout was pumped from a cement truck into an adapter to the drill rods and pumped through the drill stem. During the pumping, the drill rods were gradually withdrawn from the pilot hole in an attempt to

Kerslake 2  
C-2018-3006116, et al.  
11-20-19  
Harrisburg JH



grout the entire length. During the process, some grout and water was observed flowing out of the entry point.

- 7/10/17, Crew resumed drilling from entry point through the grout plug. The grout had not hardened before drilling began so forward progress was rapid.
- 7/11/17, Groundwater flow rate increased to 37.5 gpm at a 1,479 ft. drill distance.
- 7/12/17, Water flow rate increased to 50 gpm at 1,575 ft. in drill distance.
- 7/13/17, Water flow rate decreased to 35-40 gpm in response to a pause in the drilling. An additional 30 cubic yards of cement grout was pumped into the pilot hole. The drill stem was extended with no bit to the bottom of the pilot hole and the driller began to inject grout and withdraw pipe (i.e. used the drill stem as a tremie pipe). When they reached the top of the hole, they noticed the grout was settling and water was beginning to flow out the entry. So the driller inserted an old reamer bit to plug the hole and the reamer was left in place within 20 feet of the entry.
- 7/14/17, Crew demobilized rig.
- 7/20/17, Water was observed discharging from seeps along the slope north of Shoen Rd., upslope from the 360 HDD drill rig at a rate of approximately 10 gpm.

Notably, there was no inadvertent return ensuing from the 360 Drill.

#### Geology/Hydrogeology

Based on geologic maps, the site is located in the uplands along the northern edge of Chester Valley. As shown on Figure 1, the completed HDD will advance northeast through the Harpers Phyllite and partially into the Chickies Quartzite. A contact between the Chickies and gneiss occurs north of the northwest exit/entry point. The valley floor, southeast of the low end entry point is composed of carbonates, including the Ledger Dolomite. A major fault, named the "Ketch Fault," bisects the Chickies. The geologic structure in this area is complex and the location of the contacts, as shown on geologic mapping, may lack accuracy. For example, a monitoring well was installed at the location shown on Figure 1. The log for that well shows limestone where one would expect Harpers Phyllite. Also, a recent geotechnical boring drilled near the south entry/exit was most likely in karst as the boring went 130 feet before encountering bedrock.

Typical depth to groundwater in the Chickies Quartzite uplands is approximately 40 ft, as indicated by a residential well monitored by the USGS and reported by Low et al. (2002). The source of groundwater is direct recharge from precipitation and regional flow from the west. Groundwater in the vicinity of the 360 HDD path is expected to flow east along the fabric of the bedrock and south toward tributaries of West Valley Creek.

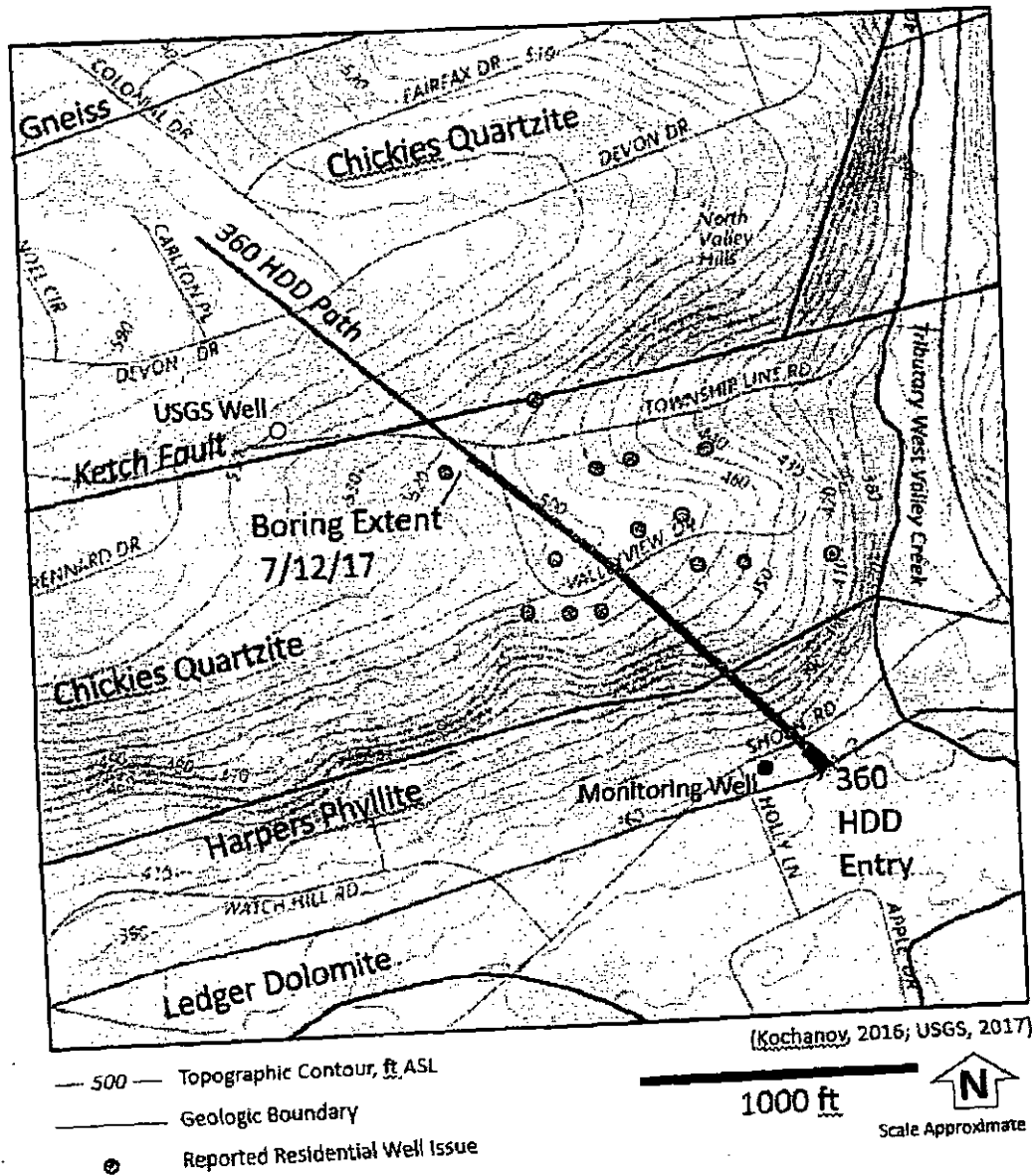


Figure 1. Site geology and hydrology of the S3-360 HDD boring.



#### **Method for assessing cause of impact to residential wells.**

Either directly or indirectly, the impacts on local residential water supply wells were caused by a lowering of the local water table. Owners of residential wells surrounding the 360 Drill's path reported loss of pressure and increased turbidity. The loss in pressure was attributed to a lowering of the water table and the turbidity was, most likely, due to sediment suspended in the water as the well produced water from the bottom of the well.

In the absence of other information, the most likely cause of the impact on water levels in the area of the 360 Drill was the advancement of the pilot hole and, in essence, the creation of a drain that collected groundwater from the fractured bedrock aquifer. The original drill length was 2,833 feet and the 10-inch pilot hole was advanced to 1,575 feet before attempts were made to seal the pilot hole. The pilot hole was advanced through a network of interconnected secondary openings (open joints, bedding planes, fractures, and perhaps a fault zone) filled with groundwater, which acted as a source of water for local residential wells. At some point during drilling of the pilot hole, the aquifer began to drain as manifested in the groundwater discharge at the entry point.

There was a degree of uncertainty and question as to whether the groundwater discharge from the uncompleted pilot hole could lower water levels and adversely affect water wells located up to 1,000 feet away from the path of the 360 Drill. In order to answer the question, a numerical model was constructed to quantify 3-dimensional groundwater flow at the site. The model was created using industry-standard software MODFLOW-USG (Panday et. al., 2015), PEST (Doherty, 2015), and Groundwater Vistas (Rumbaugh and Rumbaugh, 2016). The model was used to estimate natural (pre-construction) conditions and to simulate known, during-construction conditions. Details of the model include:

- Five layers from ground surface to sea level, 24,500 cells with a 50-ft spacing.
- Assumption of steady-state conditions.
- Five hydraulic property zones (Table 1), including Chickies Quartzite ( $K = 0.03$  to  $0.51$  ft/day, model calibrated), Harpers Phyllite ( $0.52$  ft/day), gneiss ( $1.1$  ft/day), Ledger Dolomite ( $5.8$  ft/day), and Alluvium ( $33$  ft/day). Median hydraulic conductivity ( $K$ ) values from the literature (Low et al., 2002) were used for each formation, with the exception of the Chickies Quartzite, which was determined through model calibration.
- A vertical anisotropy of  $1/10$  was assumed common to general practice. Hydraulic properties were considered to be homogeneous within each geologic unit. General head boundaries were set to the west and north to simulate regional groundwater flow from these positions to the northern terminus of the tributary of West Valley Creek.
- River boundaries were set in the model to the east and south, representing tributaries of West Valley Creek.
- A drain boundary was incorporated to simulate groundwater discharge through the 360 Drill pilot hole.
- A recharge rate ( $R$ ) ranging from  $0.0009$  to  $0.0096$  ft./day was derived from the literature (Senior et al., 1997) and model calibration.
- The model was calibrated to a single well reported to have a hydraulic head of  $509$  ft ASL, labeled "USGS Well" in Figure 1 (Aichele and Wood, 1996).



Table 1. Model input parameters for simulation of natural, pre-construction conditions. Only Recharge (R) and the hydraulic conductivity ( $K_h$ ,  $K_z$ ) of the Chickies formation were modified for the various model simulations. Although the 360 Drill exists principally in the Chickies Formation, properties of the surrounding formations influence groundwater flow and boundary conditions.

Property	Value (ft/day)	Source
Recharge, R	0.0042	Senior et al., 1997
Chickies $K_h$ , $K_z$	0.16, 0.016	Calibrated
Harpers $K_h$ , $K_z$	0.52, 0.052	Low et al., 2002
Gneiss $K_h$ , $K_z$	1.1, 0.11	Low et al., 2002
Ledger $K_h$ , $K_z$	5.8, 0.58	Low et al., 2002
Alluvium $K_h$ , $K_z$	33 ft/day, 3.3 ft/day	Low et al., 2002

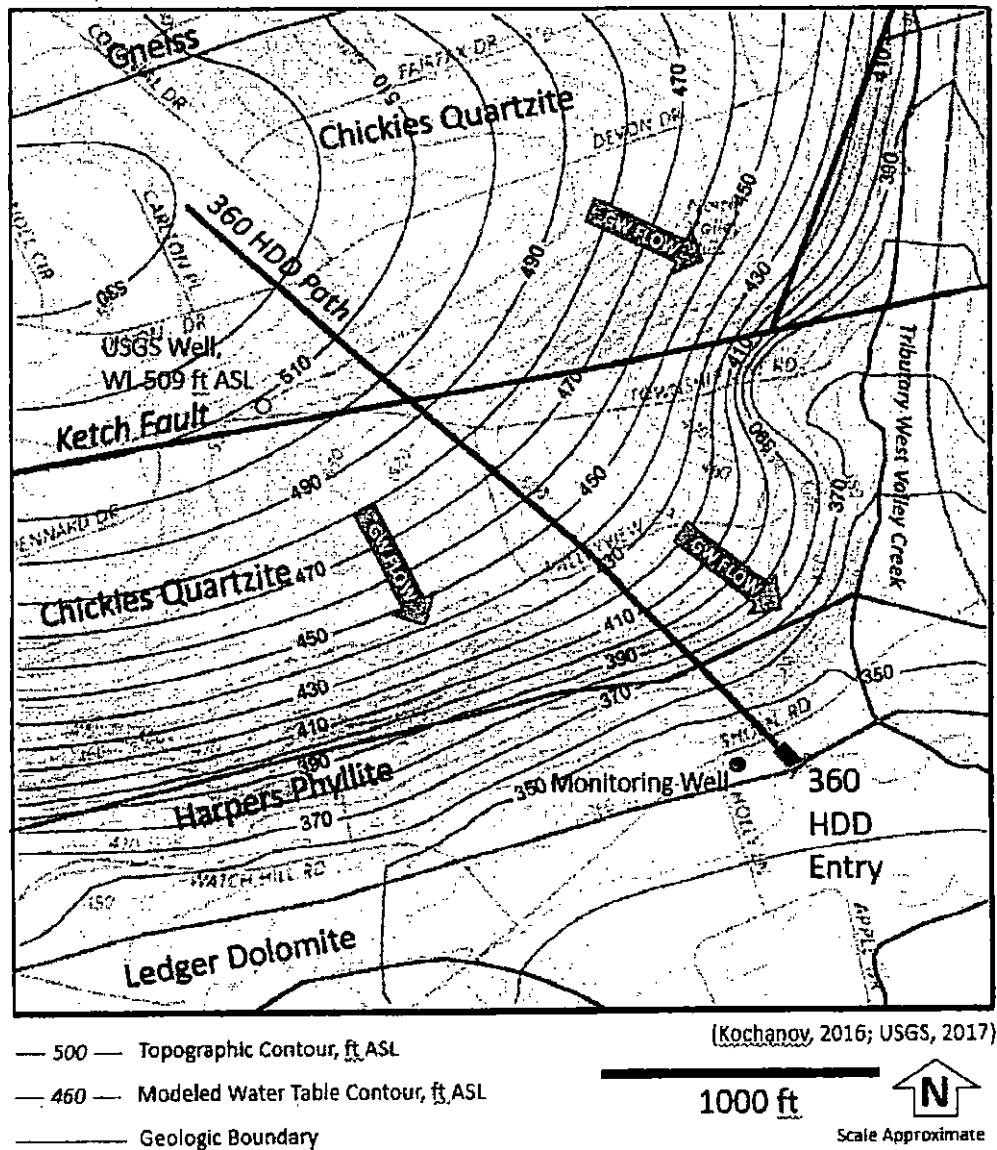
The following scenarios were evaluated:

1. Natural, pre-construction conditions.
2. Lowering of the water table that might have occurred during 10" pilot boring advancement for the 360 Drill in July, 2017.
3. Effect on water table if the annulus of the 20" pipe along southernmost 200 feet of the HDD were completely sealed with cement grout.
4. Effect on water table if the annulus of the 20" pipe along southernmost 200 feet of the HDD were completely sealed with cement grout and the remainder of the annulus was completely filled with a competent high viscosity bentonite-cuttings mix.
5. Effect on water table if the annulus of the 20" pipe along southernmost 200 feet of the HDD were completely sealed with cement grout and the remainder of the annulus was filled with a less competent high viscosity bentonite-cuttings mix due to a continuous open conduit remaining on top of the pipe after installation.

#### Scenario 1: Natural, Pre-Construction Conditions

The model-generated water table corroborates the conceptual site model, showing groundwater flowing toward the southeast in the vicinity of the 360 Drill path (Figure 2). The water table is approximately 40 ft below ground surface along Valleyview Drive. For this simulation, recharge was specified at the rate of 0.0042 ft/day reported by Senior et al. (1997). Model calibration predicted a Chickies hydraulic conductivity ( $K_h$ ) of 0.16 ft/day. This is similar in magnitude to the median K value of 0.32 ft/day reported by Low et al. (2002).





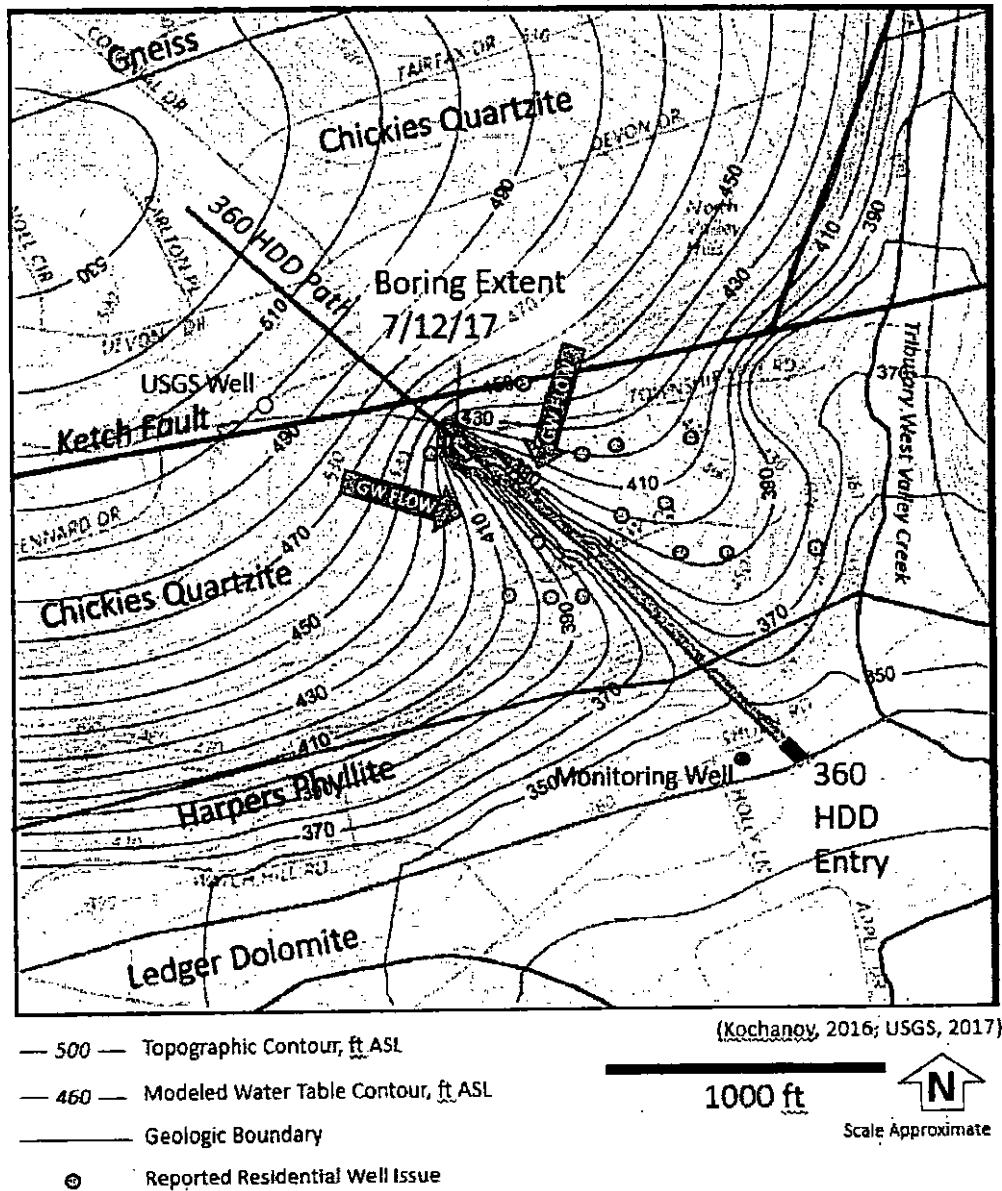
**Figure 2.** Computer-simulated water table under natural, pre-construction conditions.



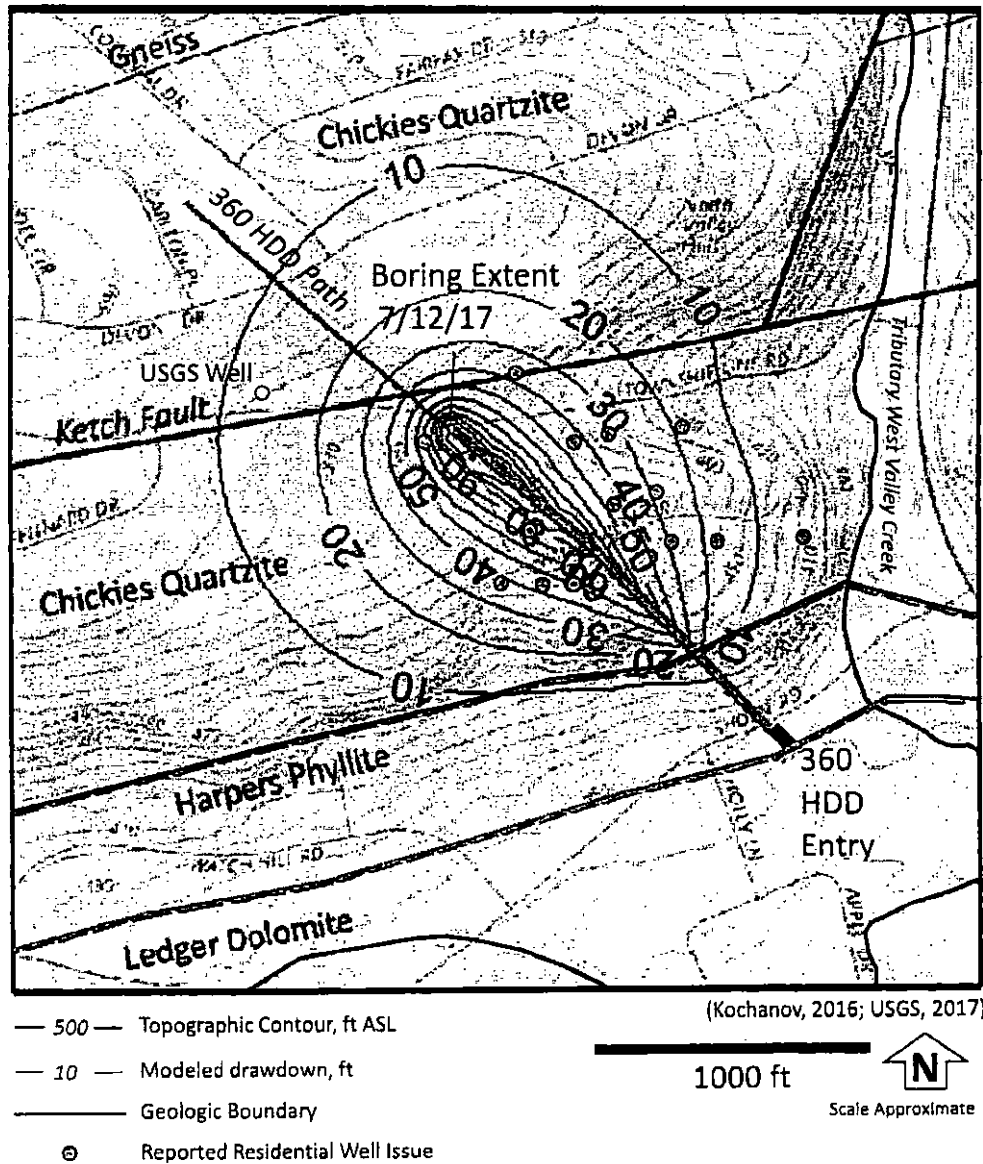
#### **Scenario 2: Effect on the Water Table during 360 Drill 10" Pilot Hole**

A drain (groundwater zone of depression) was placed within the model to simulate the effect of groundwater discharge produced by the pilot hole at a distance of 1,575 ft. from entry (Figure 3). Discharge from the pilot hole lowers the water table, forming a "depression" in the groundwater associated with the Valleyview Dr./Township Line Rd. neighborhood. In this simulation, groundwater migrates toward the pilot hole (indicated by the groundwater flow arrows) and discharges from the pilot hole at a rate (Q) of 43 gpm, which is very similar to the groundwater flow reported by field personnel at the drill entry point. Figure 4 represents the simulated change in water level from the pre-construction condition shown in Scenario 1 to conditions present on 7/12/17 when the pilot hole was advanced to 1,575 ft.

To evaluate the extent of potential impact of the HDD 360 Drill during construction, a map of *drawdown* (vertical distance the water table might have been lowered) was produced by plotting the difference in water levels between Scenario 1 and Scenario 2 (Figure 4). The maximum predicted drawdown is 130 ft near the northwest end of the pilot hole. This simulation reveals that the zone of influence in water table drawdown (here assumed to be 10 ft of drawdown or greater) may have extended up to 1,000 ft. from the path of the 360 Drill. Most, but not all, of the residential wells reported to have had issues are located within this zone.



**Figure 3.** Simulated effect to water table after pilot hole was advanced to 1,575 ft, from entry, showing a trench-shaped depression above the pilot hole. Input parameters  $R = 0.0042$  ft/day, Chickies  $K_h = 0.16$  ft/day.



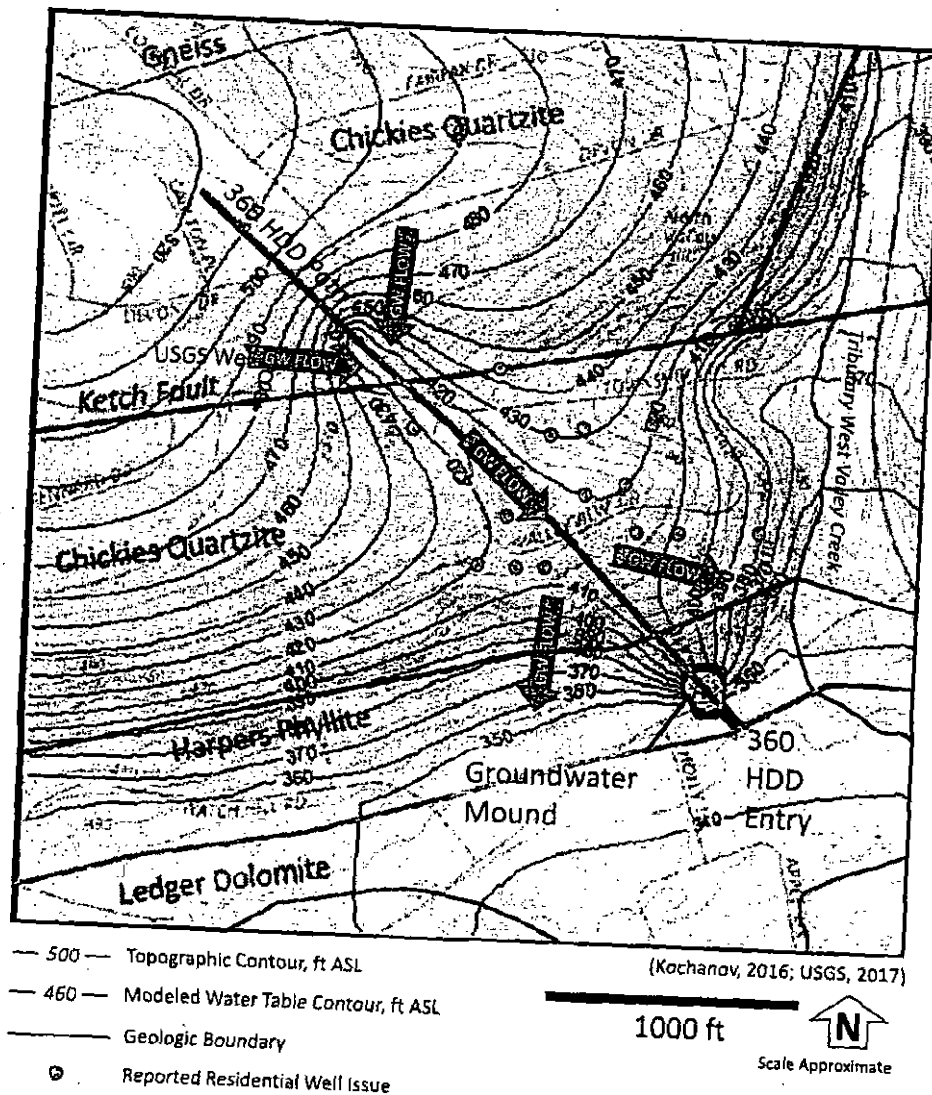
**Figure 4.** Simulated drawdown (lowering of the water table) during pilot hole advancement, indicating that the pilot hole may have lowered the water table 130 ft. Aquifer drawdown potentially extended 1,000 feet away from the path of the 360 Drill. Input parameters  $R = 0.0042$  ft/day and Chickies  $K_h = 0.16$  ft/day. Simulated flow rate of produce groundwater is 43 gpm.



**Scenario 3: Sealing 200 feet of 20-inch pipe annulus at low end only**

This scenario was developed as part of the evaluation for purposes of comparison and does not simulate any potential actual condition relevant to MEII pipeline construction. The scenario assumes no annular seal between the borehole wall and 20-inch pipe and that this open space would allow groundwater to flow towards Shoen Rd. Assuming laminar flow, this space would have hydraulic properties similar to a 19-inch diameter open pipe (Bradley, 1992). In this scenario, groundwater would flow freely to the final drill hole terminus at the Shoen Road location. The scenario was used to simulate how groundwater flow would respond to completely sealing the annulus over the bottom 200 ft. of the drill hole (from the Shoen road entry point 200 feet northwest). This simulation was run under expected conditions ( $R = 0.0042$  ft./day,  $Kh = 0.16$  ft./day).

The model simulation suggests that groundwater would flow toward the drill hole in the northwest, through the assumed open annular space in the drill hole, then away from the drill hole near the southeast terminus (Figure 5). Subsequently, a groundwater mound would develop which could generate seeps north of Shoen Rd., similar to what was observed on July 20, 2017 in response to attempts to grout the open drill hole, and reportedly continues currently to produce surface seepage at that location.



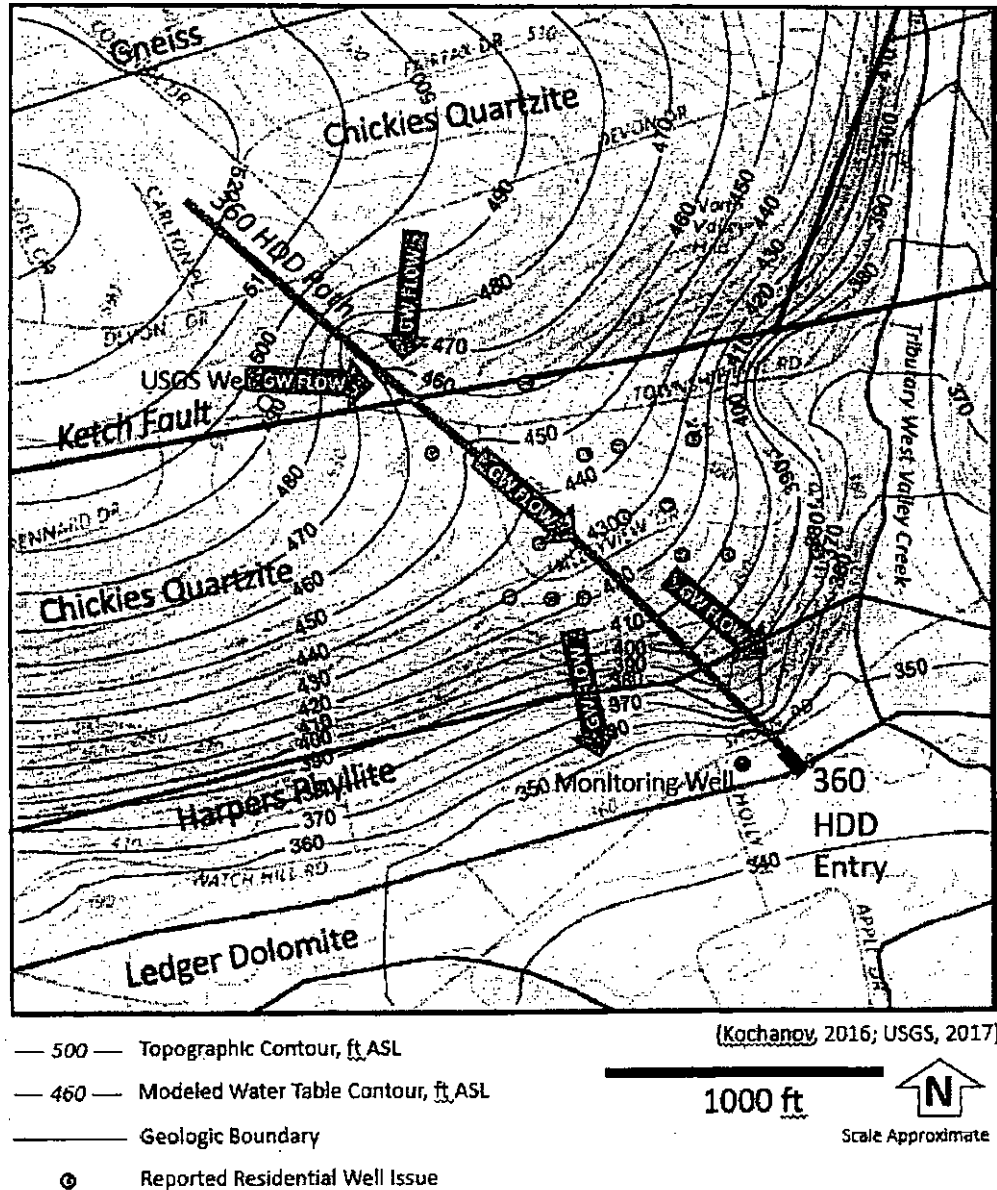
**Figure 5.** Groundwater flow response for Scenario 3. The annular space drains groundwater from uphill and creates a groundwater mound that produces seeps on the hillslope.



**Scenario 4: Complete sealing of 20-inch pipe annulus**

For this scenario the annular space between the 20-inch pipe and 30-inch final drill hole for the first 200 feet from Shoen Road northwest would be filled with cement grout and the remainder of the annulus would be filled with a sealant of varying hydraulic conductivity. This simulation was run under expected conditions ( $R = 0.0042$  ft./day,  $K_h = 0.16$  ft./day). The groundwater discharge from the annulus and hydraulic conductivity of the fill material ( $K_{\text{sealant}}$ ) were adjusted to determine the conditions at which seeps would appear on the hillside. Seeps appeared when  $K_{\text{sealant}}$  was set high at 51,000 ft./day and the resultant discharge was 62 gpm. Seeps did not appear when  $K_{\text{sealant}}$  was set at 25,000 ft./day and the resultant flow was 53 gpm (see Figure 6). Under this scenario groundwater mounding would occur under the hillside but seeps would not occur. In addition, a significant improvement (reduction) in the drawdown shown on Figure 4 would be achieved.

High viscosity bentonite-cutting mixes, such as those used for installing MEII pipe, can achieve a permeability of  $10^{-7}$  cm/sec or  $2.83 \times 10^{-4}$  ft./day (reference Directional Project Support) or 7 orders of magnitude lower than the  $K_{\text{sealant}}$  needed to prevent seepage from occurring in this simulation. This would suggest complete filling of the annulus with high viscosity bentonite-cuttings mix would be adequate to mitigate future seepage. In fact, achieving a complete seal of the annulus with any material with a hydraulic conductivity lower than that of the aquifer would prevent flow down the annulus and allow water levels in the aquifer to return to pre-drill levels, as in Figure 2.



**Figure 6.** Groundwater flow system response to leaving a complete competent seal for moderate K ( $K_{\text{sealant}} = 25,000 \text{ ft/day}$ ) in borehole annulus with a 200-ft sealed end. Simulated annular flow would be 53 gpm. Predicted water table would rise to just below ground surface upgradient of the HDD entry point. No seeps would be expected.





#### **Scenario 5: Partial sealing of 20-inch pipe annulus**

This scenario addresses the predicted effect of an incomplete seal of the annular space. Again, in this scenario the lower 200 feet of annulus is assumed to be completely sealed with a cement grout and sealing of the remainder of the annulus is incomplete, simulated as a 2-inch diameter continuous open conduit on top of the pipe after pipe installation. This scenario can be addressed considering use of the Hazen-Williams equation for full pipe flow. For example, a full 2-inch diameter angled pipe dropping 150 feet over 1,900 feet and having a roughness coefficient (100) similar to concrete will flow at 44 gpm. This is approximately the same rate of flow that was measured discharging from the entry point under field conditions before the grout plug was installed, eventually causing seepage to appear on the hillside. Larger continuous pore spaces would create higher discharge rates from the seep zone above the 200-foot seal with greater potential to create seepage. This scenario emphasizes the importance of creating an effective and competent seal of the annulus upon completion of pipe installation.

#### **Summary of Findings**

This hydrogeologic simulation and evaluation of the 360 Drill installation shows that the partially drilled 10-inch pilot hole into the Chickies Formation from the southeast entry point created a drain within the Chickies Formation and that this drain had the capacity to affect water levels at distances similar to those observed when local residences reported impacts in July 2017. This condition was simulated using published hydrogeologic data, specific to the study area, and reasonable real-world assumptions for model input parameters.

Findings of this study include:

1. The water table under natural, pre-construction conditions is likely to be approximately 40 ft below ground surface in the vicinity of the Valleyview Dr. and Township Line Rd. neighborhood.
2. Advancement of the 360 Drill to its present position of 1,575 ft significantly lowered the water table in the vicinity of the pilot hole and likely affected the water table at residential wells within 1,000 ft. radius of the drill path.
3. If a 200-foot section of the annulus at the southeastern end boring terminus near Shoen Road were completely sealed after installation of the 20" pipe, groundwater flowing through openings in the HDD annulus northwest of the seal would create a mound in the water table that could generate groundwater seeps and associated surface water runoff.
4. If a 200-foot section of the annulus at the low end boring terminus near Shoen Road were completely sealed after installation of the 20" pipe and the remainder of the annulus upslope of the seal were completely filled with a competent high viscosity bentonite-cuttings mix, groundwater drainage from the annulus would end, groundwater levels would return to pre-drill levels, and the groundwater mounding that created the seeps on the hillside would stop.
5. If, under Finding 4, the annulus upslope of the 200-foot seal were not completely filled resulting in a less competent seal, drainage from the annulus would be similar to that of the current condition, where seepage is reportedly occurring.
6. Redesign of the 20-inch drill and associated procedures should include management of the groundwater drainage that will be created during drilling and reaming for the 20-inch pipe, and how to achieve a complete annular seal..

Hydrogeologic Investigation  
Shoen Road Area  
September 1, 2017



These findings were developed from model simulations based both on data collected on site and derived from the literature. The model is a simplification of real world conditions and is subject to the limitations of the aquifer assumptions provided herein.

Sincerely,  
Groundwater & Environmental Services, Inc.

A handwritten signature in black ink, reading "David J. Demko". The signature is written in a cursive style with a large, prominent "D".

David J. Demko  
Vice President – Program Manager. P. G.

A handwritten signature in black ink, reading "Martin Helmke". The signature is written in a cursive style with a large, prominent "M".

Martin Helmke  
Senior Hydrogeologist, Ph.D., P.G.

A handwritten signature in black ink, reading "Richard T. Wardrop". The signature is written in a cursive style with a large, prominent "R".

Richard T. Wardrop, P. G  
Senior Hydrogeologist



### References

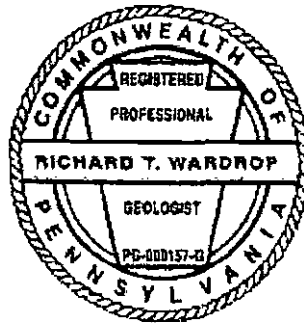
- Aichele, S. S. and C. R. Wood. 1996. Altitude and Configuration of the Potentiometric Surface in the Crystalline and Metasedimentary Rocks in East Brandywine, Upper Uwchlan, and Uwchlan Townships and Parts of Caln, East Caln, and West Whiteland Townships, Chester County, Pennsylvania, April 1993 through June 1994. U.S. Geological Survey Open File Report 96-338. 1 p.
- Bradley, H. B. 1992. Petroleum Engineering Handbook. Society of Petroleum Engineers. Third Printing. 1824 p.
- Doherty, J. 2015. Calibration and Uncertainty Analysis for Complex Environmental Models. Watermark Numerical Computing, Brisbane, Australia. ISBN: 978-0-9943786-0-6.
- Kochanov, W. E. 2016. Bedrock Geologic Map of Part of the Chester Valley Area, Chester, Delaware, Montgomery, and Philadelphia Counties, Pennsylvania. PA DCNR Geologic Survey.
- Low, D., L., D. J. Hippe, and D. Yannacci. 2002. Geohydrology of Southeastern Pennsylvania. U.S. Geological Survey Water Resources Investigations Report 00-4166. 347 p.
- Rumbaugh, J. and D. Rumbaugh. 2016. Groundwater Vistas 6.96 Build 17. Environmental Simulations Incorporated, [www.groundwatermodels.com](http://www.groundwatermodels.com).
- Senior, L. A., Sloto, R. A., and Reif, A. G. 1997. Hydrogeology and Water Quality of the West Valley Creek Basin, Chester County, Pennsylvania. U.S. Geological Survey Water-Resources Investigations Report 94-4137. 160 p.
- Panday, S., Langevin, C.D., Niswonger, R.G., Ibaraki, Motomu, and Hughes, J.D. 2015. MODFLOW-USG version 1.3.00: An unstructured grid version of MODFLOW for simulating groundwater flow and tightly coupled processes using a control volume finite-difference formulation: U.S. Geological Survey Software Release, 01 December 2015, <http://dx.doi.org/10.5066/F7R20ZFJ>
- United States Geological Survey. 2017. National Map Program, <https://viewer.nationalmap.gov/viewer/>.

Hydrogeologic Investigation  
Shoen Road Area  
September 1, 2017



By affixing my seal to this document, I am certifying that the information is true and correct. I further certify I am licensed to practice in the Commonwealth of Pennsylvania and that it is within my professional expertise to verify the correctness of the information.

*Richard T. Wardrop*



Richard T. Wardrop, P. G.  
Lic. No. PG000157G

September 1, 2017  
date



COMMONWEALTH OF PENNSYLVANIA  
DEPARTMENT OF ENVIRONMENTAL RESOURCES

FIELD OPERATIONS - WATER QUALITY MANAGEMENT  
Suite 6010, Lee Park  
555 North Lane  
Conshohocken, PA 19428  
215 832-6130

January 22, 1993

Mr. Kevin Fulmer  
Sun Pipe Line Company  
1275 Drummers Lane  
Wayne, PA 19087-1593

Re: Sun Pipe Line Company — *Sholen Rd oil spill*  
Whiteland West Apartments  
WQ - Correspondence  
West Whiteland Township  
Chester County

NOTICE OF VIOLATION

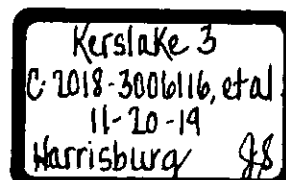
Dear Mr. Fulmer:

This is to confirm the results of our inspection conducted on December 31, 1992 which revealed that an eight inch pipeline ruptured and discharged a substantial quantity of heating oil to the surrounding soils, a parking lot, an unnamed tributary of West Valley Creek flowing through the Whiteland West Apartment Complex and to West Valley Creek. The spill also impacted an apartment pond and a private pond just north of Route 30.

Such discharge of oil to waters of the Commonwealth without a permit is a violation of the Pennsylvania Clean Streams Law, the Act of June 22, 1937, P.L. 1987, as amended, and subject to the penalties provided therein.

The removal and disposal of the contaminated soil must adhere to our October 18, 1991 interim guidance document concerning protective levels for the excavation treatment, cleanup and disposal of virgin fuel contaminated soils. Also, any soil contaminated along the creek during the cleanup process will need to be removed.

All contaminated absorbent material (booms, pads, sweeps, fiberpearl, etc.) and all contaminated debris and vegetation in the streams and along the stream banks will need to be removed. This should be disposed of in accordance with our Bureau of Waste Management regulations. Fresh absorbent material should be maintained in the affected waterways until further notice from this Department.



Mr. Kevin Fulmer  
January 22, 1993  
- 2 -

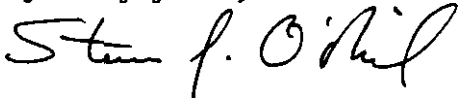
Please provide this office by February 15, 1993 with a written report which summarizes this incident and contains the following:

1. An explanation for the cause of the pipeline rupture. This should include a copy of the DOT Form 7000-1 Accident Report, or a facsimile.
2. A detailed account of how Sun Pipe Line Company reacted to the spill. Include descriptions of manpower and equipment numbers and deployment.
3. All soil analysis data and final disposal sites for all contaminated material generated by this spill.
4. Final figures on volume of product lost and a breakdown of where it went (i.e. how much was removed by vac truck, how much was tied up in soil and absorbent materials, etc.).
5. A proposal to conduct a limited subsurface soil investigation beneath the apartment parking lot which was impacted by the spill.

This letter does not waive, either expressly or by implication, the power or authority of the Commonwealth of Pennsylvania to prosecute for any and all violations of law arising prior to or after the issuance of this letter or the conditions upon which the letter is based. This letter shall not be construed so as to waive or impair any rights of the Department of Environmental Resources, heretofore or hereafter existing.

If you have any questions, please feel free to contact me.

Very truly yours,



for JO ANN DOLCHAK  
Water Quality Specialist

cc: West Whiteland Township  
Mr. Lauver  
Whiteland West Apartments  
County Health Department  
Compliance and Monitoring Section  
(Re) 30 (KAL)12.34



*W. J. Ind. Waste / Corres  
Sun Pipe Line Co - Shoen  
Rd. Spill  
W. Whiteland Twp, Chester  
Co.*

**Sun Pipe Line Company**  
RD #3  
PO Box 1051  
Honey Brook PA 19344-1051

February 7, 1994

Mr. Stephen Ross  
Township Manager  
West Whiteland Township  
222 North Pottstown Pike  
Exton, PA 19341

RECEIVED  
FEB  
24 1994  
P.A. DURRANS

Dear Mr Ross:

This letter is in response to your request for information relative to Sun Pipe Line Company's (Sun) leak near Shoen Road. Specifically, you asked for information as to the cause of the leak and an account of actions that Sun has taken to prevent a similar occurrence.

As you know, the failed weld was taken to an independent laboratory for metallurgical analysis. After conducting numerous tests, the laboratory concluded that the weld failed due to pressures exerted by an adjacent section of pipeline, the support of which had eroded over time. Sun examined the support medium that had been employed during the summer of 1992, when the line was last repaired, and determined that it may have compacted due to moisture and settling thus creating the conditions which may have led to the leak.

In order to prevent a potential recurrence of this incident, Sun crews excavated all locations where similar sand bag supports were used in conjunction with pipeline repairs. All welds in these areas were reinforced with steel collars and the line was subsequently supported using concrete bags that are not subject to settling or compaction.

In addition to correcting conditions suspected to be responsible for the Shoen Road leak, Sun also conducted an eight hour hydrostatic test on the entire length of pipeline from its origin in Philadelphia to its terminus near Reading, PA. This test was conducted at 125% of normal operating pressure and the results were provided to the Federal Department of Transportation, Office of Pipeline Safety, Research and Special Programs Administration, for their review. Following the Department's approval, the line was returned to normal, pre-leak operating pressure.

Finally, Sun is engaged in many ongoing programs to ensure the integrity of our facilities. Most of these programs were described

in Ms. Pretz's letter to you dated February 19, 1993, a copy of which is attached for your reference.

We hope that the foregoing adequately addresses your requirements for additional information. If you have further questions, please let me know. Sun sincerely desires to be a good neighbor as we conduct our business in your community.

Sincerely,



David R. Chalson  
Superintendent





**Sun Pipe Line Company**  
1275 Drummers Lane  
Suite 300  
Wayne PA 19087-1593

February 19, 1993

Ms. Jo anne Dolchak, Water  
Quality Specialist  
Pennsylvania Department of  
Environmental Resources  
Field Operations-Water  
Quality Management  
Suite 6010, Lee Park  
555 North Lane  
Conshohocken, PA 19428

**Via: Hand Delivery**

**Re: Response to PA DER Notice of Violation Dated 22 January 1993,  
Shoen Road #2 Fuel Oil Release, Chester County, West  
Whiteland Township on 31 December 1992**

Dear Ms. Dolchack:

Sun Pipe Line Company (SPL) hereby responds to the Pennsylvania Department of Environmental Resources' (PA DER) Notice of Violation (NOV) as referenced above. In the NOV, the PA DER requires response to five specific items which SPL must provide by 15 February 1993. In a 12 February 1993 conversation with Steve O'Neill (PA DER Water Quality Management), SPL was granted a one week extension. The extension was necessary in order to prepare a report which addresses a subsurface investigation below the Whiteland West Apartment parking lot. Each of the five (5) items are repeated below and followed by SPL's response:

**Item #1 - "An explanation for the cause of the pipeline rupture. This should include a copy of the DOT Form 7000-1 Accident Report, or a facsimile."**

Included with this letter, as Attachment A, is a copy of the Department of Transportation's 7000-1 report for the incident. The immediate cause for the pipeline failure was described in the report as a failed weld. SPL intends to conduct a laboratory failure analysis of the pipe to identify the root cause of the weld failure. This failure analysis is being conducted with the

technical assistance and full approval from the Department of Transportation's Office of Pipeline Safety Office in Washington, D.C.

**Item #2 - "A detailed account of how Sun Pipe Line Company reacted to the spill. Include descriptions of manpower and equipment numbers and deployment."**

The West Whiteland Fire Company and the Chester County Hazmat Team were the first responders to this spill. These units began deploying boom at the storm drain outfall and other locations along the unnamed tributary of West Valley creek. They also covered the storm drain opening with plywood and sand and effectively stopped the ingress of product into the creek.

At approximately 0300 the first SPL employees were on scene and contractors were immediately notified. REACT, Guardian, Snow Environmental, Eldridge and Freehold Cartage were all immediately activated and were on-scene within hours. By mid-day (12/31/92) approximately fifty people were on-site with more en route. The following is a list, by day, of contractor personnel on-site from 12/31/92 to 01/06/93:

<u>Day</u>	<u># of Contractor Personnel</u>
December 31, 1992	62
January 01, 1993	95
January 02, 1993	72
January 03, 1993	67
January 04, 1993	43
January 05, 1993	37
January 06, 1993	30

Contractor equipment included two equipment trailers stocked with boom and sorbents, eight vacuum trucks and four tank trailers. Two SPL maintenance crews at the site totaled approximately twenty personnel, three backhoes, two equipment trailers and a communications trailer.

SPL and contractor personnel initially deployed skirted and sorbent boom at several locations on the creek. This effort effectively stopped the spread of fuel oil at Whitford Road which was confirmed by helicopter overflight. In addition, a flume dam was constructed between Route 30 and Commerce Drive. A total of twenty six boom sites existed at the peak of the containment

activity. The following is a list of containment/sorbent boom used to date:

<u>Boom/sorbent Type</u>	<u>Amount</u>
Containment Boom	800 feet
Small Sorbent Boom	12,720 feet
Large Sorbent Boom	9,360 feet
Sorbent Pads	22,700 Pads
Sorbent Pillows	444 Pillows
Sorbent Sweeps	8,600 feet
Fiber-pearl Absorbent	425 Bags
Speedy-dry Absorbent	6 Bags

Clean-up/restoration activities included three tributary/creek walkings to remove oil soaked leaves, twigs and debris. Contaminated soils were excavated around the pipeline and properly stockpiled on-site pending analytical analysis for disposal. In addition, the parking lot was covered with absorbent material and then mechanically swept to remove any residual oil.

Clean-up activities were performed on a 24 hour basis until January 09, 1993, when it was determined that there was no more removable product. To date, maintenance activities at the site have occurred on a daily basis including all weekends.

The above expenditure of significant manpower and equipment enabled the recovery of an estimated 83% of lost product. A recovery rate of this magnitude could not have been achieved without such a dedicated effort.

**Item #3 - "All soil analysis data and final disposal sites for all contaminated material generated by this spill."**

Included as Attachment B is a report prepared by our consultant, Geraghty and Miller Inc., with regard to excavation and sampling of soils in the immediate area of the leak. After three excavation/sampling iterations, SPL is confident that all petroleum-affected soils have been removed. Accordingly, we recommend backfill of the excavation and subsequent restoration of the affected property. This effort should commence as soon as

possible because of the safety concerns related to the close proximity of the excavated area to the public road.

SPL intends to dispose of all soils at a state approved recycling facility where the soils will be thermally oxidized to below PA DER level A guidelines. The resulting material can then be beneficially used (road base aggregate etc.). SPL anticipates removal and disposal of all soils by March 31, 1993.

Upon receipt of PA DER permission to remove existing sorbent materials in the tributary/creek, SPL will initiate disposal activities of the sorbent materials. Currently, all sorbent materials are stored in five, 30 yard rolloff-type containers at our Exton terminal. SPL intends to dispose of this material at a state approved facility using the stabilization/landfill method.

**Item #4 - "Final figures on volume of product lost and a breakdown of where it went (i.e. how much was removed by vac truck, how much was tied up in soil and absorbent materials, etc.)."**

SPL estimates that 645 barrels of product were released, of which 539 barrels were recovered by vacuum trucks. Final figures for amounts tied-up in soil and sorbent material cannot be calculated at this time.

The amount of product tied-up into soil will be estimated using total soil weights obtained after disposal and multiplying this by an estimated concentration (ppm) figure. Historically, estimated amounts recovered via excavated soil have been so low, as compared to amounts recovered via vacuum truck, this figure could be assumed negligible.

Product tied-up in the sorbents will also be estimated after disposal by subtracting the total versus dry weights of the sorbent material to obtain a total weight of product. However, a weight estimate of leaves, twigs, etc. must be subtracted from this figure. The product density of fuel oil is then used to obtain a liquid amount.

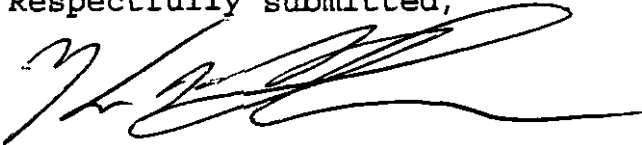
**Item #5 - "A proposal to conduct a limited subsurface soil investigation beneath the apartment parking lot which was impacted by the spill."**

SPL, via Geraghty and Miller Inc., has already conducted an investigation beneath the parking lot surface. The report is included with this letter as Attachment C and all samples, less one, were below PA DER level B cleanup guidelines with no free product encountered. One sample, located immediately adjacent to the storm drain, contained 160 ppm total petroleum hydrocarbons (TPH). SPL, with Geraghty and Miller Inc.'s concurrence, recommend no further activity due to the following:

- o Parking lot drainage most likely includes petroleum products from automobiles (leaks, oil changes, etc.)
- o Presence of other petroleum products used in construction of the asphalt pavement (this was observed as the analytical detection limit was elevated tenfold in one sample)
- o Presence of subsurface clays which will limit further migration of petroleum hydrocarbons

If you have any questions or comments, please call me at (215) 975-5920.

Respectfully submitted,



Kevin D. Fulmer  
Environmental Specialist

cc:	R.A. Arnet	J.R. Nyce
	D.R. Chalson	J.W. Wagner
	P.S. Broker	B.J. Currens

**ATTACHMENT A**

Report Date

## ACCIDENT REPORT-HAZARDOUS LIQUID PIPELINE

No. 7000-1  
(DOT)

## PART A—OPERATOR INFORMATION

- 1.) Name of operator Sun Pipe Line Company
- 2.) Principal business address 1801 Market Street  
Philadelphia PA 19103-1699  
 (city) (state) (zip code)
- 3.) Is pipeline interstate? ☒ yes ☐ no

## PART B—TIME AND LOCATION OF ACCIDENT

- 1.) Date: (month) December (day) 31 (year) 1992
- 2.) Hour (24 hour clock) 0050
- 3.) If onshore give state (including Puerto Rico and Washington, D.C.), and county or city. West Whiteland, Chester County, Pennsylvania
- 4.) If offshore, give offshore coordinates N/A
- 5.) Did accident occur on Federal Land? ☐ yes ☒ no  
 (See instructions for definition of Federal Land.)
- 6.) Specific location (If location is near offshore platforms, buildings, or other landmarks, such as highways, waterways, or railroads, attach a sketch or drawing showing relationship of accident location to these landmarks)  
On left, approx. 0.1 mile west of Rt. 100, on Shoen Rd.

## PART C—ORIGIN OF RELEASE OF LIQUID OR VAPOR.

(Check all applicable items)

- 1.) Part of system involved:  
☒ line pipe ☐ tank farm ☐ pump station
- 2.) Item Involved: ☐ pipe ☐ valve ☐ scraper trap ☐ pump  
☐ welding fitting ☒ girth weld ☐ tank  
☐ bolted fitting ☐ longitudinal weld
- Other (specify) \_\_\_\_\_
- 3.) Year item installed 1931

## PART D—CAUSE OF ACCIDENT

- ☐ corrosion ☒ failed weld ☐ incorrect operation by operator personnel
- ☐ failed pipe ☐ outside force damage
- ☐ malfunction of control or relief equipment.
- ☐ other (specify) \_\_\_\_\_

## PART E—DEATH OR INJURY

- 1.) Number of persons killed. 0  
0 Operator employees 0 Non-employees
- 2.) Number of persons injured. 0  
0 Operator employees 0 Non-employees

## PART F—ESTIMATED TOTAL PROPERTY DAMAGE

\$ 750,000

## PART G—COMMODITY SPILLED

- 1.) Name of commodity spilled: #2 Fuel Oil
- 2.) Classification of commodity spilled:  
☒ Petroleum Petroleum product ☐ HVL or ☐ Non-HVL
- 3.) Estimated amount of commodity involved  
645 Barrels spilled 539 Barrels recovered
- 4.) Was there an explosion?  
☐ yes ☒ no
- 5.) Was there a Fire?  
☐ yes ☒ no

INSTRUCTIONS: Answer sections H, I, or J only if it applies to the particular accident being reported.

**PART H—OCCURRED IN LINE PIPE**

- 1.) Nominal diameter (inches) 8 2.) Wall thickness (inches) .322
- 3.) SMYS (psi) 35000 4.) Type of joint: ☒ welded ☐ flanged ☐ threaded ☐ coupled ☐ other
- 5.) Pipe was ☒ Below ground ☐ Above ground
- 6.) Maximum operating pressure (psig) 1100
- 7.) Pressure at time and location of accident (psig) 940
- 8.) Had there been a pressure test on system?  
☐ yes ☒ no
- 9.) Duration of test (hrs) \_\_\_\_\_
- 10.) Maximum test pressure (psig) \_\_\_\_\_
- 11.) Date of latest test \_\_\_\_\_

**PART I—CAUSED BY CORROSION**

1. Location of corrosion  
☐ internal ☐ external
2. Facility coated?  
☐ yes ☐ no
3. Facility under cathodic protection?  
☐ yes ☐ no
4. Type of corrosion  
☐ galvanic ☐ other (Specify) \_\_\_\_\_

**PART J—CAUSED BY OUTSIDE FORCE**

1. ☐ Damage by operator or its contractor  
☐ Damage by others  
☐ Damage by natural forces  
☐ Landslide  
☐ Subsidence  
☐ Washout  
☐ Frostheave  
☐ Earthquake  
☐ Ship anchor  
☐ Mudslide  
☐ Fishing Operations  
Other \_\_\_\_\_
2. Was a damage prevention program in effect  
☐ yes ☐ no
3. If yes, was the program  
☐ "one-call" ☐ other \_\_\_\_\_
4. Did excavator call?  
☐ yes ☐ no
5. Was pipeline location temporarily marked for the excavator?  
☐ yes ☐ no

**PART K—ACCOUNT OF ACCIDENT**

The 8" Boot to Montello line segment was shut down by Sun Pipe Line Company (SPL) Control Center operators at 0101 on 12/31/92 due to a pressure drop. At approximately 0234 on 12/31/92, the West Whiteland Fire Company reported a leak to the SPL Control Center just southwest of the Rt. 100 Shoen Road Intersection. The leak, consisting of #2 FO, surfaced through the ground onto a nearby parking lot. The product subsequently flowed into a storm sewer which emptied into a tributary of Valley Creek. Clean up consisted of the placement of sorbent and skirted boom stations at strategic locations with vacuum trucks skimming product off the surface. A flume dam was also constructed. Product recovery continued throughout the weekend with only a light sheen visible on the tributary surface by the end of the weekend (1/03/93). Contaminated soil was excavated and properly stockpiled awaiting disposal. Excavation of the pipe at the leak site on 12/31/92 revealed a crack in a girth weld.

NAME AND TITLE OF OPERATOR OFFICIAL FILING THIS REPORT.

Buddy J. Currans

Manager, Risk Management & Engineering

(215) 975-5803

Telephone no. (Including area code)

January 21, 1993

Date



**ATTACHMENT B**

February 17, 1993

Mr. Kevin Fulmer  
Sun Pipe Line Company  
1275 Drummers Lane, Suite 300  
Wayne, Pennsylvania 19087-1593

RE: Soil Excavation at Sun Pipe Line Company Shoen Road Leak Site,  
Exton, Pennsylvania  
Project Number: WP065.01

Dear Mr. Fulmer:

Geraghty & Miller, Inc., on behalf of Sun Pipe Line Company (SPL), has supervised the excavation and sampling of fuel-oil impacted soils at the Shoen Road Leak Site in Exton, Pennsylvania. From January 2 until January 26, 1993 soils were removed from an excavation at the site to attain the Pennsylvania Department of Environmental Resources (PADER) Level A Interim Guidance Protection Levels for the cleanup of virgin fuel contaminated soil (PADER, 1991). As analytical results for soil samples were evaluated, the excavation was extended in three phases.

### **Background**

On December 31, 1992, Geraghty & Miller responded to a leak in an 8-inch diameter pipeline operated by SPL at Shoen Road in Exton, Pennsylvania. At the time of the leak, #2 fuel oil was discharged to soils above the pipe. The oil migrated through these soils to the ground surface near the leak and flowed along an asphalt parking lot surface toward a storm drain which empties into an unnamed tributary of West Valley Creek.

### Geology

Dense kaolinite clay was encountered from ground surface to the bottom of the excavation. Based on drilling logs from a Philadelphia Suburban Water Company well located approximately 500 yards west of the site, this clay extends to approximately 30 feet below land surface (bls) and is underlain by fractured limestone and dolomite. The well logs indicate that the water table is at a depth of 22 feet bls.

### Soil Excavation and Sampling

On January 2, 1993, SPL and Geraghty & Miller began excavating impacted soil at the leak site. Approximately 200 cubic yards of soil were removed from the excavation pit surrounding the repaired pipeline. The soil was excavated to a maximum depth of approximately 8 feet bls. A soil sample was collected from each of the four pit walls at approximately two feet below the level of the pipeline. Three soil samples were taken from the bottom of the elongated pit along the length of the exposed pipeline.

In addition, approximately 400 cubic yards of topsoil were removed from the grassy slope impacted by the leak. The topsoil was excavated to an average depth of 1 foot through the entire affected area. Five soil samples were collected upon removal of the topsoil. The sample locations, shown on Figure 1, were labelled S-1 through S-5.

All soil samples were collected from depth of approximately 4 inches bls using a stainless-steel trowel. The trowel was decontaminated with laboratory-grade Micro™ detergent and rinsed with distilled water prior to each sample collection. The samples were sent to Lancaster Laboratories, Inc. of Lancaster, Pennsylvania to be analyzed for total petroleum hydrocarbons using USEPA Method 8015.

On January 13 and 26, 1993, the excavation was enlarged by approximately 150 and 200 cubic yards, respectively. The additional soil removal was necessary to attain PADER

Level A Interim Guidance Protection levels for cleanup of hydrocarbon-contaminated soils (PADER, 1991). The bottom and the north, south and east walls of the pit were re-excavated. The pit was enlarged to a depth of approximately 10 feet bls; ground water was not encountered. An additional two feet of soil were removed from the central portion of the grassy slope. Locations S-2, S-3 and S-4 were resampled.

### Results

The analytical results for all soil samples collected during the three excavation phases are provided in Table 1. The analytical results for the last sample collected at each location are shown on Figure 1. The Lancaster Laboratory analytical reports for all samples collected are enclosed in Attachment A.

As shown in Figure 1, with the exception of one sample collected on January 13, 1993 in the bottom-south corner of the pit, fuel-oil was not detected in the last sample collected at each location. The detection limit for these samples was below the 10 mg/kg PADER Level A Interim Guidance Protection Levels for hydrocarbon-contaminated soils (PADER, 1991).

Additional soils were removed from the bottom-south corner of the excavation on January 26, 1993. This corner of the excavation could not be resampled due to the presence of ponded rain water.

### **Conclusions**

The analytical data and field observations indicate the following for the Shoen Road Leak Site:

- The soil excavation attained PADER Level A Interim Protection Levels for the cleanup of virgin fuel contaminated soils.
- The fuel oil did not migrate to ground water which was not encountered in the excavation.

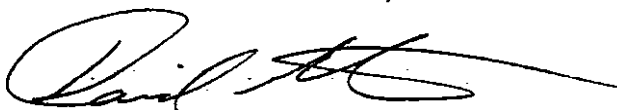
### **Recommendations**

Based on the soil sampling results and the favorable soil conditions, Geraghty & Miller recommends that the soil excavation site be backfilled with clean material and restored as soon as possible.

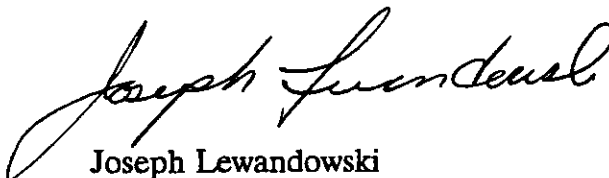
If you have any questions or comments concerning this report, please contact one of the individuals listed below.

Sincerely,

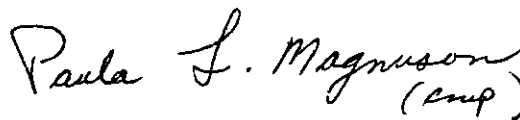
**GERAGHTY & MILLER, INC.**



David Stockar  
Project Manager/Hydrogeologist



Joseph Lewandowski  
Principal Scientist

  
(emp)

Paula L. Magnuson  
Project Director

cc: David Chalson (SPL)

ds/awp06501.3

### **Reference**

Pennsylvania Department of Environmental Resources, 1991. Interim Guidance Protection Levels for the Excavation, Treatment, Cleanup and Disposal of Virgin Fuel Contaminated Soils, October 18, 1991.

Table 1. Soil-Excavation Sampling Results, Shoen Road Leak Site, Sun Pipe Line Company, Exton, Pennsylvania.

Sample Location	Sample Date	Gasoline (mg/kg)	Kerosene (mg/kg)	Diesel/ #2 Fuel Oil (mg/kg)
<b><u>EXCAVATION PIT:</u></b>				
North Wall	1/2/93	<8.0	<8.0	69.0
	1/13/93	<9.0	<9.0	170.0
	1/26/93	<9.0	<9.0	<9.0
South Wall	1/2/93	<9.0	<9.0	110.0
	1/13/93	<500.0	<500.0	4,700.0
	1/26/93	<9.0	<9.0	<9.0
East Wall	1/2/93	<80.0	<80.0	890.0
	1/13/93	<80.0	<80.0	660.0
	1/26/93	<9.0	<9.0	<9.0
West Wall	1/2/93	<9.0	<9.0	<9.0
Bottom - North	1/2/93	<9.0	<9.0	<9.0
Bottom - Center	1/2/93	<8.0	<8.0	170.0
	1/13/93	<9.0	<9.0	<9.0
Bottom - South	1/2/93	<9.0	<9.0	150.0
	1/13/93	<8.0	<8.0	13.0
<b><u>GRASSY SLOPE:</u></b>				
S-1	1/2/93	<8.0	<8.0	<8.0
S-2	1/2/93	<8.0	<8.0	47.0
	1/13/93	<8.0	<8.0	69.0
	1/26/93	<9.0	<9.0	<9.0
S-3	1/2/93	<8.0	<8.0	66.0
	1/13/93	<8.0	<8.0	<8.0
S-4	1/2/93	<8.0	<8.0	18.0
	1/13/93	<50.0	<50.0	530.0
	1/26/93	<9.0	<9.0	<9.0
S-5	1/2/93	<8.0	<8.0	<8.0

mg/kg = Milligrams per kilogram.

Soil results calculated on a dry weight basis.



DRAFTER: GS

APPROVED: PM

CHECKED: DS

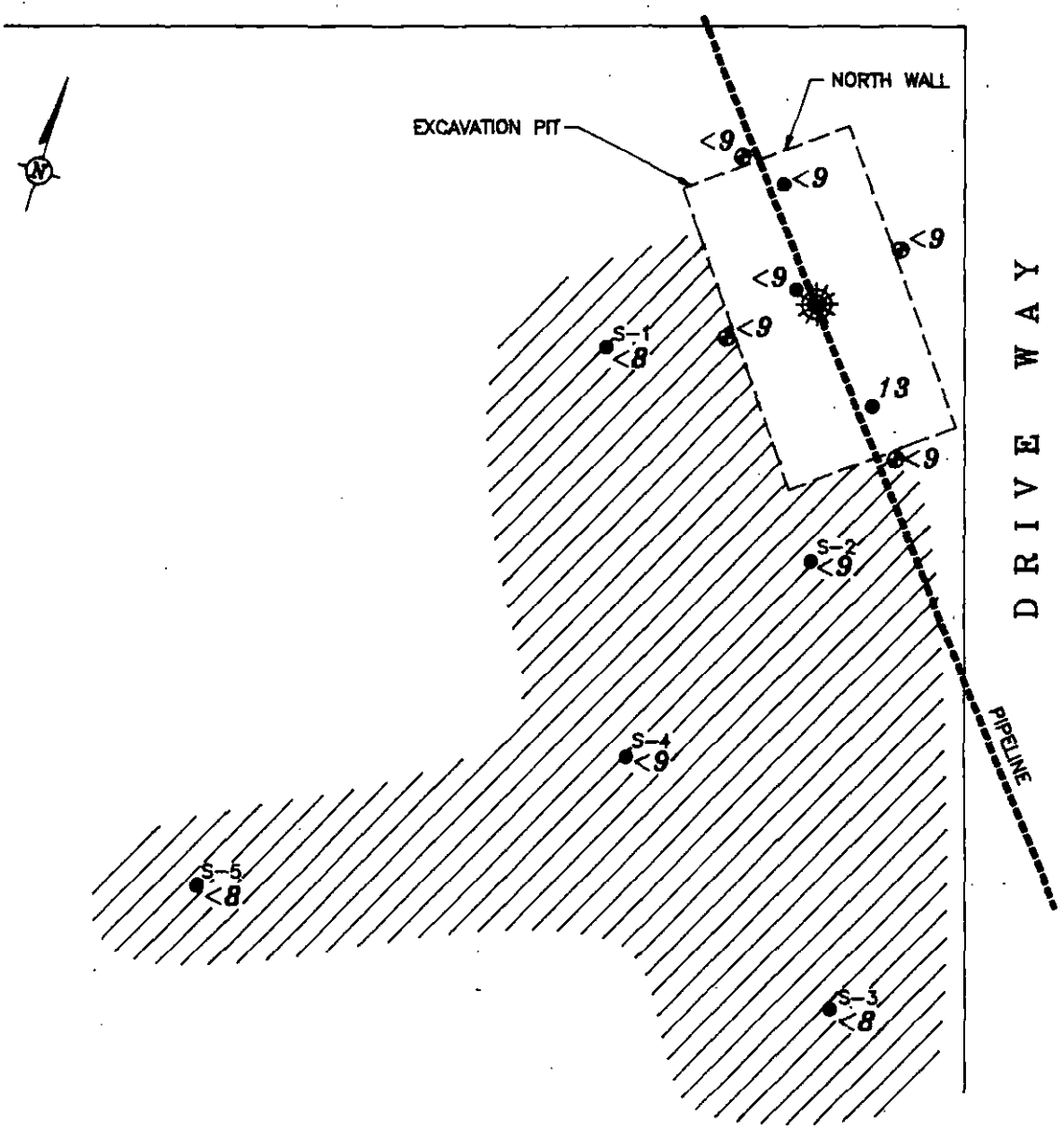
DRAWING: SHUENAMP

FILE NO.: 1817

PROJECT NO.: WPO8501

DWG. DATE: 2-2-93

# SHOEN ROAD



## EXPLANATION

- S-1 ● SAMPLE POINT
- SAMPLE POINT ALONG WALL
- ★ LOCATION OF LEAK
- AREA OF TOP-SOIL EXCAVATION
- <9 DRY WEIGHT FUEL-OIL CONCENTRATIONS IN mg/kg

0 20 FT



## FINAL SOIL-SAMPLING RESULTS

SHOEN ROAD LEAK SITE  
SUN PIPE LINE COMPANY, EXTON, PENNSYLVANIA

FIGURE  
1

February 18, 1993

Mr. Kevin Fulmer  
Sun Pipe Line Company  
1275 Drummers Lane, Suite 300  
Wayne, Pennsylvania 19087-1593

RE: Results of Soil Sampling Beneath Apartment Parking Lot, Shoen Road Leak Site, Sun Pipe Line Company, Exton, Pennsylvania  
Project Number: WP065.01

Dear Mr. Fulmer:

As requested by the Pennsylvania Department of Environmental Resources (PADER) in a January 22, 1993 letter to Sun Pipe Line Company (SPL), Geraghty & Miller, Inc., on behalf of SPL, conducted a soil investigation beneath the Whiteland West Apartment complex parking lot.

#### Background

On December 31, 1992, Geraghty & Miller responded to a leak in an 8-inch diameter pipeline operated by SPL at Shoen Road in Exton, Pennsylvania. At the time of the leak, No. 2 fuel oil was discharged into the soils above the pipe. The oil migrated through these soils to the ground surface near the leak, and flowed along an asphalt parking lot toward a storm drain which empties into an unnamed tributary of West Valley Creek.

#### Geology

Dense kaolinite clay was encountered from the ground surface to the bottom of the excavation, approximately 8 feet below land surface (bls). Based on drilling logs from a Philadelphia Suburban Water Company well located approximately 1500 feet west of the

site, this clay extends to approximately 30 feet bls and is underlain by fractured limestone and dolomite. The well logs indicate that the water table is at a depth of approximately 22 feet bls.

### Soil Sampling

On February 5, 1993, Geraghty & Miller collected eight soil samples immediately below the asphalt road base of the potential impacted parking lot. Sample locations were chosen to best evaluate the soil below the area of past product migration and around the central storm drain. A background sample, PL-9, was collected in a neighboring parking area unaffected by the leak.

Sample collection consisted of drilling a 1.5-inch diameter hole through the pavement and sampling with a hand-held stainless-steel auger. The auger was decontaminated with laboratory-grade Micro™ detergent and rinsed with distilled water prior to each sample collection. Upon sampling, the hole was filled with concrete to prevent frost damage to the pavement. The samples were submitted to Lancaster Laboratories, Inc. of Lancaster, Pennsylvania for total petroleum hydrocarbon (TPH) analyses using USEPA Method 8015.

None of the samples were saturated with No. 2 fuel oil. A petroleum odor was noted during the collection of sample PL-7. The remaining samples were free of petroleum odor.

### Results

The analytical results of the investigation are listed in Table 1 and shown on Figure 1. The analytical reports for all samples collected are enclosed in Attachment A.

As shown in Figure 1, fuel-oil dry-weight concentrations ranged from non-detected, in five of the soil samples, to 160 mg/kg in sample PL-7. This sample, located approximately 10 feet south of the storm drain, was the only one which exceeded the applicable 100 mg/kg

PADER Level B Interim Guidance Protection Level for the cleanup of virgin fuel contaminated soils (PADER, 1991). The remaining three samples had positive results of 9, 15 and 26 mg/kg of fuel oil. All concentrations were reported on a dry weight basis. The detection limit for the analyses was 8 mg/kg. However, the detection limit was raised to 80 mg/kg for sample PL-8 due to the presence of petroleum related material from the asphalt road base.

### **Conclusions**

Geraghty & Miller has developed the following conclusions based on analytical data and field observations.

- Eight of the nine samples collected beneath the parking lot are free of contamination or contain fuel-oil concentrations less than PADER Level B Interim Guidance Protection Levels for the cleanup of virgin fuel contaminated soils. The remaining sample contains No. 2 fuel oil at 160 mg/kg as compared to the 100 mg/kg Protection Level.
- Additional protection to the ground-water and surface-water resources is provided by the clayey nature of the soil under the parking lot and leak site since clay is capable of immobilizing any residual fuel-oil deposits.

### **Recommendations**

Geraghty & Miller recommends that no further soil investigation or cleanup activities be performed below the asphalt parking lot at the Shoen Road Leak Site.

Table 1. Results of Soil Sampling Beneath Apartment Parking Lot, Shoen Road Leak Site, Sun Pipe Line Company, Exton, Pennsylvania.

Sample Location	Sample Date	Soil Type	Odor	Gasoline (mg/kg)	Kerosene (mg/kg)	Diesel/ #2 Fuel Oil (mg/kg)
PL-1	2/5/93	Clay	Not Noted	<8	<8	<8
PL-2	2/5/93	Clay	Not Noted	<8	<8	<8
PL-3	2/5/93	Clay	Not Noted	<8	<8	9
PL-4	2/5/93	Clay	Not Noted	<8	<8	<8
PL-5	2/5/93	Clay	Not Noted	<8	<8	26
PL-6	2/5/93	Clay	Not Noted	<8	<8	15
PL-7	2/5/93	Clay	Yes	<80	<80	160
PL-8 *	2/5/93	Clay	Not Noted	<80	<80	<80
PL-9	2/5/93	Clay	Not Noted	<8	<8	<8

mg/kg = Milligrams per kilogram.

Soil results calculated on a dry weight basis.

\* Limit of quantitation was raised due to the presence of petroleum related material from the asphalt road base.

Rte 100

DWG DATE: 2-11-83 | PRJCT NO.: WP06501 | FILE NO.: 1817 | DRAWING: S-SAMPLE | CHECKED: DS | APPROVED: DVS | DRAFTER: GS

