LIMITED SUBSURFACE INVESTIGATION

of

Wiley H. Bates Middle School
701 Chase Street
Annapolis, MD 21401
MDE Facility ID# 3200
MDE Case# 18-0559 AA

Prepared for:

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Section I
PROJECT BACKROUND

Following the discovery and report of heating oil within the stormwater outfall pipe exiting the school property and entering adjacent Spa Creek in April 2018 and reports of heating oil releases from the school's boiler room, MDE's Oil Control Program (OCP) opened current Case# 2018-0559-AA on May 2, 2018. It is reported that at least two significant heating oil releases have occurred in the boiler room, one on April 27, 2018 and another on December 21, 2018. The amount of heating oil released during each of the two recent events is unknown. The initial response to the April 2018 release at the stormwater outfall pipe included recovery of free product (liquid phase hydrocarbons, LPH) using absorbent booms and vacuum trucks. Placement and recovery of absorbent booms at the stormwater outfall continues as investigation and mitigation of the source of LPH continues.

As a result of these releases, OCP has reviewed the database regarding this site and has noted several other releases of heating oil from this site. MDE Case# 17-0331-AA (closed) documents a similar heating oil release from the school's boiler room that impacted the stormwater drainage system and Spa Creek in December 2016. MDE Case# 15-0497-AA documents consecutive UST tightness test failures that resulted in UST system closure and replacement in July 2015.

In response to the persisting presence of heating oil in the stormwater outfall to Spa Creek, the County's contractor flushed out the stormwater drainage system using 2,500 gallons of water on May 2, 2018. Water was introduced into an upgradient storm drain inlet and recovered at the outfall using vacuum trucks. On June 26, 2018, the interior of the stormwater piping system was inspected using a video camera and no entry point for heating oil intrusion was identified. Following the flushing and video inspection of the stormwater piping, several MDE follow-up inspections of the stormwater outfall to Spa Creek have been completed with heating oil impacts consistently observed during each visit.

Based upon the unknown quantities of heating oil released at this site over time and the continued impacts noted at the stormwater outfall to Spa Creek, the OCP has required that a subsurface investigation of the target areas be completed to identify the source of the ongoing heating oil impacts. Petroleum Management, Inc. (PMI) submitted the requested Work Plan for a *Limited Subsurface Investigation* of the subject area on December 26, 2018 and received approval of the proposed Work Plan on January 28, 2019.

Section II
SCOPE OF WORK

PURPOSE:

The purpose of this Limited Subsurface Investigation was to assess the subsurface conditions in the area of the stormwater outfall to Spa Creek and the upgradient migration path following the stormwater drainage system back towards the school's boiler room and UST (former & current) locations. Following location of all adjacent underground utilities in the area, direct-push technology, *GeoProbe*, was utilized to advance a minimum of twenty (20) soil borings along the stormwater drainage system from adjacent the boiler room, the UST locations, and migrating down-gradient to the stormwater outfall to Spa Creek. As evidence of petroleum contamination was identified during the soil boring and field screening activities, attempts were made to advance each boring until evidence of contamination no longer persisted, to equipment refusal, or to the shallow groundwater table, whichever occurred first. Beginning at the ground surface, soil samples were collected from *Geoprobe* macro-core samplers at 5-foot intervals. Each soil sample interval was identified and screened on-site utilizing a photoionization detector (PID) with results recorded in a soil boring log. All sampling equipment was decontaminated prior to and after each boring advancement using industry standard methods.

Based on boring depth and the PID screening results, one to two soil samples from each boring was retained using *En-Core* sampling equipment (EPA method 5035) and sent to an accredited laboratory facility for analysis of TPH-GRO, TPH-DRO (EPA method 8015b) and Total VOC (EPA method 8260b) accordingly. If groundwater accumulation was encountered in any of the proposed borings, a groundwater sample, in addition to a soil sample from the interface depth, would be sampled via temporary screened casing and submitted for analysis of TPH-GRO, TPH-DRO (EPA method 8015b) and Total VOCs (EPA method 8260) accordingly.

PID readings and laboratory analysis of soil and/or groundwater samples were used to determine representative concentrations of residual and dissolved phase contamination surrounding the source UST area. These concentrations and site conditions were then reviewed in comparison to the Maryland Environmental Assessment Technology guidelines (*MEAT* document, Feb.'03) and presented in the comprehensive assessment report detailing the results of the investigation, risk analysis, and conclusions presented to the Administration as directed.

SCOPE OF WORK:

Based on the site conditions previously reported and in accordance with the MDE directive and approved work plan, PMI was contracted to proceed with a limited subsurface investigation based on the following scope of work:

1) Provide contractor management and on-site PID screening;

2) Provide MD Licensed well driller and *Geoprobe* direct push sampling unit capable of advancing soil borings to the proposed depth of investigation;
3) Advancement of a minimum of twenty (20) soil borings in the target areas;
4) Completion of soil borings as 1" temporary groundwater wells in the event that groundwater or LPH was encountered to serve as monitoring and measurement points for further assessment;
5) Collection and laboratory analysis of soil and or groundwater samples for TPH-DRO/GRO (EPA method 8015b), and Total VOC (EPA method 8260);
6) Review of results and preparation of a *Limited Subsurface Investigation Report* for submittal and review by MDE.

LIMITATIONS:

This Assessment has been conducted and prepared in accordance with generally accepted practices exercised by reputable professionals under similar circumstances. Petroleum Management, Inc. makes no other warranties or guarantees, either expressed or implied, as to the findings, opinions, or conclusions contained in this report, or as to the furthest extent of contamination involved at this site.

Section III
FIELD ACTIVITIES

On March 12-14, 2019, Petroleum Management, Inc. utilized Benner GeoServices Inc. to supply and operate a *Geoprobe* direct-push sampling unit to advance soil borings in the targeted areas extending from the stormwater outfall to Spa Creek, to the foot of the slope below the school's boiler room and around the former and current UST locations adjacent the exterior wall of the boiler room. In consideration of all marked underground utilities, soil borings were located adjacent each side of the stormwater piping, around the perimeter of both current and former UST systems and along the exterior wall of the boiler room in order to best identify any residual petroleum impact originating from reported heating oil released from the USTs and/or boiler room piping. Returning again on April 4, 2019, Benner GeoServices was again utilized to advance an additional 5 soil borings in the extended perimeter of the boiler room and UST area to further delineate impacted soil and groundwater conditions previously identified in Borings B-14 to B-23. Final soil boring locations are depicted on the attached Site Plan (Appendix B). All soil borings were advanced using *Geoprobe* macro-core samplers with soil samples collected continuously every five feet. All sampling equipment was decontaminated prior to and after each boring advancement using industry standard techniques. Portions of each soil sample were containerized and allowed to volatize in order to be field screened utilizing a RKI Instruments GX-6000 photo-ionization detector (PID). The PID was calibrated to 100 ppm of Isobutylene prior to use. All soil samples retained for laboratory analysis were preserved using EPA method 5035 and submitted for analysis of TPH-DRO/GRO (EPA method 8015b), and Total VOC (EPA method 8260) analysis. In borings where shallow groundwater was encountered, a temporary 1" PVC well screen was installed to allow for gauging and groundwater sampling at conclusion of the investigation. Temporary well points were gauged for the presence of liquid phase hydrocarbons (LPH). If LPH was present, thickness of LPH was recorded on attached *Monitoring Well Sampling Forms*. If

no LPH was detected, groundwater from each temporary well screen was sampled and preserved for analysis of TPH-DRO/GRO (EPA method 8015b), and Total VOC (EPA method 8260) analysis. Details of each completed boring, including soil characteristics and PID readings, are included in attached Soil Boring Logs.

Soil Borings B-1 to B-6

Advanced in the area nearest the storm drain outfall to Spa Creek, borings B-1 to B-6 were completed to identify any contaminated soil or LPH which may have originated from within or around the 30" concrete storm drain piping running across the playing field from the UST and boiler room area of the school. Flanking both sides of the storm drain piping, soil borings were advanced to depths of 15-20 feet with groundwater measured at 5-8 feet below the surface. No contaminated soil was encountered and PID readings ranged from 0.0 to 0.7 meter units. With the bottom of storm drain piping in the area estimated at 7-8 feet below the surface, soil samples from each boring at this representative depth were retained for lab analysis. Temporary well points were installed for groundwater sampling. No LPH was observed in temporary wells.

Soil Borings B-7 to B-11

Advanced at the base of the slope below the lateral route of the 30" concrete storm drain piping leading to Spa Creek and below the current and former UST locations adjacent the school building, borings B-7 to B-11 were completed to identify any contaminated soil or LPH which may have originated from within or around the 30" concrete storm drain piping, associated manhole structure (No. 1) or from heating oil releases at the UST and boiler room locations. Soil borings were advanced to refusal depths of 12-15 feet with groundwater measured at 5-7.5 feet below the surface. No contaminated soil was encountered and PID readings ranged from 0.0 to 0.7 meter units. Soil samples were retained for analysis at depths nearest the storm drain piping invert and groundwater interface depth. Temporary well points were installed at B-8, B-9, B-10 and B-11 for groundwater sampling. No LPH was observed in temporary wells.

Soil Borings B-12 to B-23

Advanced in the perimeter of the current and former UST locations and adjacent the exterior wall of the school's boiler room, borings B-12 to B-23 were completed to identify any contaminated soil or LPH which may have originated from heating oil releases at the UST and boiler room locations. Based on historic site drawings provided, Borings B-12 and B-13 were located in the area of former remote fill piping. In borings B-16 and B-21 the concrete pad of former UST #1 and UST #2 was encountered at a refusal depth of 14 feet deep. Elevated PID readings were observed in soils adjacent the exterior wall of the boiler room in borings B-15, B-16, B-17, B-18 and B-19 at depths at or below the boiler room floor and sump elevations at approximately 10-12 feet below the surface. PID readings in these were observed as high as 447 meter units. Elevated PID readings were also observed in boring B-20, adjacent storm drain piping and inlet/manhole No.4. PID readings at B-20 were highest at 448 meter units at the depth of the storm drain piping invert measured at 14.5 feet deep. Residual contaminated soil was also identified at the perimeter of the former UST excavation (Tanks #1 & #2) with elevated PID readings as high as 179.8 meter units recorded at depths below the former tanks at 14.5 to 19 feet deep.

Soil samples were retained for analysis from each boring at depths corresponding to highest PID readings and or terminal depth. Temporary well points were installed for groundwater sampling at B-12, B-14, B-15, B-17, B-18, B-19, B-20 and B-22 with groundwater depth in this area measured at approximately 13-18 feet below the surface. LPH was observed and measured in Borings B-15, B-17 and B-18. LPH thickness is recorded on attached *Monitoring Well Sampling Forms*

Soil Borings B-24 to B-28

After review of initial soil analysis and data collected on March 12-14, 2019, several data gaps were noted regarding the extent of contaminated soil and LPH presence at the North/Northwest perimeter of the investigation area. On April 4, 2019, five additional soil borings, B-24 to B-28 were advanced to fully delineate the extent of LPH and residual soil contaminated at this N/NW perimeter. Moving outward from areas of previously identified contamination, Borings B-24, B-25, B-26, B-27 and B-28 were completed to confirm a perimeter with no residual, dissolved or liquid phase impact. With regards to several identified underground utilities in this location (sewer, storm drain, water & electric), soil borings B-24 to B-27 were advanced to depths of 20 feet with groundwater measured at 12-13 feet below the surface. No contaminated soil was encountered and PID readings ranged from 0.0 to 0.8 meter units. Boring B-28 was completed at the base of the slope, below the UST area and previous borings B-22 and B-23. Boring B-28 was completed to a refusal depth of 13.5 feet with no contaminated soil observed and PID readings ranging from 0.0 to 0.6 meter units. Soil samples were retained for analysis from each boring at depths corresponding groundwater interface and or terminal depth. Temporary well points were installed for groundwater sampling. No LPH was observed in temporary wells.

Section IV
SAMPLING TECHNIQUES & ANALYTICAL PARAMETERS

Numerous soil samples were collected from each boring. A portion of each sample was immediately placed in a cooler with ice for preservation. Remaining portion of each sample was placed in a zip-lock bag to provide headspace VOC measurements with a PID meter. As mentioned, prior, based on PID screening levels, groundwater and refusal depths, soil samples from each boring were retained and preserved using *Terra-Core* sampling equipment (EPA method 5035) and submitted to Maryland Spectral Services, Baltimore, MD for laboratory analysis of TPH-DRO/GRO (EPA method 8015b) and Total VOC (EPA method 8260). Groundwater samples from each temporary well screen were retained and preserved for submittal to Maryland Spectral Services for analysis of TPH-DRO/GRO (EPA method 8015b), and Total VOC (EPA method 8260) analysis. All sample equipment and containers were supplied by the laboratory service provider. Chain-of-custody was maintained utilizing laboratory chain-of-custody tracking forms. Copies of this chain-of-custody as well as actual laboratory analysis results are included in Appendix D.

Section V
Site Contaminants

Liquid-Phase Hydrocarbons

In addition to the observation of persisting free product emerging from the storm drain outlet to Spa Creek, liquid-phase hydrocarbons (LPH) were encountered in the three borings immediately adjacent the exterior basement wall of the boiler room at Borings B-15, B-17 and B-18. Depth to LPH at each boring ranged from 14.11 to 14.48 feet below the surface with the boiler room floor identified at 10-feet below the surface. The location of these LPH impacted soil borings are also in close proximity to the sump pump area at the corner of the boiler room, floor drain effluent locations and product piping trenches leading out to the UST area. LPH measurements were recorded on Monitoring Well Sampling Forms included in Attachment C. LPH measurements from each identified boring are summarized as follows:

Boring B-15: **11.88** inches LPH (3/19/19)
12.00 inches LPH (4/4/19)

Boring B-17: **19.08** inches LPH (3/19/19)
18.72 inches LPH (4/4/19)

Boring B-18: **4.44** inches LPH (3/19/19)
6.60 inches LPH (4/4/19)

Vapor-Phase Contamination

Volatile organic compounds (VOCs) vapor measurements of collected soil samples from each of the 28 completed soil borings were obtained using a RKI Instruments GX-6000 photoionization detector (PID) for field screening purposes. A portion of each soil sample recovered was split and containerized, allowed to volatilize, and was screened for headspace VOC vapor readings. These vapor readings were recorded on the attached soil boring logs. The remaining portions of the soil samples were retained for possible laboratory analysis. Sample depth intervals and VOC vapor concentrations are documented on the soil boring logs in Appendix C.

The only noticeable vapor-phase contamination, identified by elevated PID readings $\geq$ 20 meter units, was identified in Borings B-15, B-17, B-18, B-19, B-20, B-22 and B-23. Highest PID readings were observed in the borings where LPH was present adjacent the boiler room area, B-15 (401 meter units) and B-17 (447 meter units), at depths of 12 ft. and 16 ft. respectively. Boring B-20, adjacent the storm drain piping exiting the boiler room, had an elevated PID reading of 448 meter units as 14 ft. deep, corresponding closely to the storm drain piping invert measured at 14.5 ft. deep. Additionally, elevated PID readings were observed in the area of former UST locations at B-22 (36 meter units) and B-23 (179.8 meter units) at depths of 14.5 ft. and 19 ft. deep.

Residual-Phase Contamination

As expected, based on PID readings observed during this investigation and the accumulation of LPH observed in Borings B-15, B-17 and B-18, the highest concentration of residual-phase contamination was identified along the exterior basement wall of the boiler room (B-15, B-16, B-17 and B-18) with residual TPH-DRO concentrations observed to range from 116 mg/kg to 18,900 mg/kg at depths of 10-16 ft. below the surface, below the depth of the boiler room floor and sump area. Borings B-19 and B-20, at depths at or below the storm drain piping exiting the boiler room, resulted in residual TPH-DRO concentrations of 1,240 mg/kg and 189 mg/kg. Near the extent of the former UST excavations (Tanks #1 and #2), elevated residual TPH-DRO concentrations were observed at Borings B-21, B-22 and B-23 with residual TPH-DRO concentrations of 189 mg/kg, 224 mg/kg and 1,340 mg/kg at depths of 10-19 ft. deep.

Vertical extent of residual phase contamination (TPH-DRO) can be limited to depth approaching 20 ft. below the surface. In all sample locations where elevated TPH-DRO concentrations were confirmed (B-14 to B-23), sample analysis at 20 ft. below the surface resulted in concentrations either below laboratory reporting limits or below the current clean-up standard of 620 mg/kg.

Horizontal extent of residual phase contamination (TPH-DRO) can be limited to within perimeter extent of completed borings B-7, B-13, B-24, B-25, B-26, B-27 and B-28 where elevated TPH-DRO concentrations were confirmed to be either below laboratory reporting limits or below the current clean-up standard of 620 mg/kg.

All soil samples retained were preserved using *Terra-Core* sampling equipment (EPA method 5035) and submitted to Maryland Spectral Services for analysis of TPH-DRO/GRO (EPA method 8015b) and Total VOC (EPA method 8260). The laboratory analytical results for these soil samples are presented in Table 1. Copies of laboratory analytical data sheets are presented in Appendix D.

Table 1 – Geoprobe Soil Sample Results
(Samples collected 3/12/19, 3/13/19, 3/14/19, 4/4/19)

Sample ID	Depth (feet)	TPH-DRO (mg/kg)	TPH-GRO (mg/kg)	Benzene (mg/kg)	Toluene (mg/kg)	Ethyl. (mg/kg)	Xylenes (mg/kg)	MTBE (mg/kg)	Naphthalene (mg/kg)
B-1	6-7'	< 10.5	0.17	0.004	0.016	<0.005	<0.009	<0.005	<0.005
B-1	20'	< 10.1	0.29	0.003	0.010	<0.005	<0.007	<0.005	<0.005
B-2	7'	19.0	< 0.09	0.004	0.016	<0.005	<0.009	<0.005	<0.005
B-2	18'	< 10.3	0.16	0.004	0.016	<0.005	<0.009	<0.005	<0.005
B-3	8'	< 9.9	0.16	0.004	0.017	<0.004	<0.009	<0.004	<0.004
B-4	8-9'	< 10.1	0.19	0.003	0.009	<0.005	<0.008	<0.005	<0.005
B-5	8'	13.9	0.17	0.006	0.004	<0.006	<0.006	<0.006	<0.006
B-6	8'	10.7	0.15	0.003	0.009	<0.005	<0.007	<0.005	<0.005
B-7	8-10'	< 10.7	< 0.12	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
B-8	5'	< 10.4	< 0.11	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
B-8	10'	< 10.5	< 0.10	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
B-9	12'	< 10.8	< 0.11	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
B-10	10'	< 10.8	< 0.11	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
B-11	10'	< 10.5	< 0.11	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

B-12	12'	10.6	< 0.12	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
B-12	17'	< 9.9	< 0.11	<0.005	<0.005	<0.005	<0.005	<0.005	0.002
B-13	12'	< 9.8	< 0.10	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
B-13	20'	< 10.4	< 0.11	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
B-14	17'	45.6	< 0.09	<0.005	0.002	<0.005	<0.007	<0.005	<0.005
B-14	20'	< 10.1	< 0.10	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
B-15	12'	**18900**	581	0.713	<0.924	19.7	107.1	<0.924	34.6
B-15	20'	↓ 194	2.53	<0.006	0.003	0.016	<0.005	0.09	0.041
B-16	9-10'	95.1	0.16	<0.005	<0.005	<0.005	<0.007	<0.005	0.003
B-17	16'	**12500**	311	<0.461	0.980	3.97	23.96	<0.461	8.39
B-17	20'	↓ 17.4	0.18	<0.005	0.002	0.003	0.02	<0.005	0.009
B-18	16'	116	2.08	<0.005	<0.005	0.0052	0.017	<0.005	0.012
B-18	20'	↓ < 9.9	< 0.10	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
B-19	19'	**1240**	68.7	<0.501	<0.501	<0.501	<0.501	<0.501	0.260
B-19	20'	↓ < 9.9	< 0.09	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
B-20	14'	189	< 0.10	<0.005	<0.005	0.003	0.017	<0.005	0.018
B-20	20'	↓< 10.1	< 0.10	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
B-21	10'	224	3.86	<0.005	<0.005	0.020	0.087	<0.005	0.041
B-22	14.5'	85.9	1.55	<0.005	<0.005	0.015	0.04	<0.005	0.016
B-22	20'	↓< 10.4	< 0.11	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
B-23	19'	**1340**	35.1	<0.504	<0.504	<0.504	<0.504	<0.504	0.488
B-23	20'	↓< 10.0	0.17	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
B-24	12'	< 9.1	0.12	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
B-24	20'	< 9.9	< 0.10	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
B-25	12'	< 9.6	< 0.10	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
B-25	20'	< 10.0	< 0.09	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
B-26	20'	< 9.6	< 0.09	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
B-27	12'	< 9.4	< 0.10	<0.005	0.0029	<0.005	<0.005	<0.005	<0.005
B-27	20'	< 9.9	< 0.09	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
B-28	10'	< 11.0	< 0.11	<0.006	<0.006	<0.006	<0.006	<0.0056	<0.006
B-28	13.5'	< 10.5	< 0.10	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
MDE Clean-up Standards (Soils-Non Residential)		*620*	*620*	*5.1*	*4700*	*25*	*250*	*210*	*17*

* Complete analysis results attached in Lab Reports.

Dissolved-Phase Contamination

Attempts were made to collect groundwater from each soil boring completed via temporary 1" well screens placed following Geoprobe withdraw. In the case of Borings B-7, B-13 and B-23, the borings collapsed before a well screen could be placed. In the case of Borings B-16 and B-21, refusal was encountered prior to groundwater depth at the concrete pad of the former UST at 14-feet below the surface. Groundwater encountered at borings B-15, B-17 and B-18 was impacted by measurable liquid phase hydrocarbons (LPH) and no groundwater sample was retained.

Horizontal extent of dissolved phase contamination can be identified in the immediate perimeter of completed borings B-14, B-18, B-19, B-20 and B-22 where elevated dissolved-phase TPH-DRO, TPH-GRO and VOC concentrations were confirmed in excess of current clean-up standards. Based on the confirmation of significant soil contamination at or below the groundwater depth at B-23, this location should be included in the perimeter of dissolved phase contamination as well. Review of groundwater analysis from borings completed outside this perimeter resulted in TPH-DRO, TPH-GRO and VOC concentrations either below laboratory reporting limits or current groundwater clean-up standards.

Groundwater accumulations from each available temporary well location were sampled and submitted to Maryland Spectral Services for analysis of TPH-DRO/GRO (EPA method 8015b) and Total VOC (EPA method 8260). The laboratory analytical results for these groundwater samples are presented in Table 2. Copies of laboratory analytical data sheets are presented in Appendix D.

Table 2 – Geoprobe Groundwater Sample Results
(Samples collected 3/12/19, 3/13/19, 3/19/19, 4/4/19)

Sample ID	Sample Date	TPH-DRO (ug/L)	TPH-GRO (ug/L)	Benzene (ug/L)	Toluene (ug/L)	Ethyl. (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Naphthalene (ug/L)
B-1	3/12/19	ND < 220	ND < 100	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
B-2	3/12/19	ND < 270	ND < 100	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
B-3	3/12/19	ND < 200	ND < 100	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
B-4	3/12/19	ND < 300	ND < 100	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
B-5	3/12/19	ND < 400	ND < 100	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
B-6	3/12/19	ND < 370	ND < 100	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
B-7	*No well screen placed-No sample*								
B-8	3/13/19	ND < 330	ND < 100	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
B-9	3/13/19	ND < 310	ND < 100	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
B-10	3/13/19	ND < 240	ND < 100	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
B-11	3/13/19	ND < 260	ND < 100	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
B-12	3/19/19	ND < 250	ND < 100	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
B-13	*No well screen placed-No sample*								
B-14	3/19/19	**1090**	ND < 100	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
B-15	***LPH** on Groundwater-No sample*								
B-16	*No well screen placed-No sample*								
B-17	***LPH** on Groundwater-No sample*								
B-18	***LPH** on Groundwater-No sample*								
B-19	3/19/19	**4050**	**174**	< 5.0	< 5.0	2.6	11.9	< 5.0	**10.8**
B-20	3/19/19	**1530**	**219**	< 5.0	< 5.0	10.1	43	< 5.0	**18.6**
B-21	*No well screen placed-No sample*								
B-22	3/19/19	**2370**	**390**	**11.5**	< 5.0	72.7	59.1	< 5.0	**78.9**
B-23	*No well screen placed-No sample*								
B-24	4/4/19	ND < 260	ND < 100	< 5.0	< 5.0	< 5.0	8.5	< 5.0	< 5.0
B-25	4/4/19	ND < 220	ND < 100	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
B-26	4/4/19	ND < 220	ND < 100	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
B-27	4/4/19	ND < 290	ND < 100	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
B-28	4/4/19	ND < 310	ND < 100	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
MDE Clean-up Standards (Groundwater-Type I/II aquifers)		*47*	*47*	*5.0*	*1000*	*700*	*10000*	*20*	*0.17*

ND- Not Detected at or above laboratory reporting limits. Reporting limits for TPH-DRO & TPH-GRO, EPA method 8015, are not low enough for comparison to clean-up standard concentrations.
* Complete analysis results attached in Lab Reports.

Section VI
RISK DETERMINATION

In accordance with the Maryland Environmental Assessment Technology guidelines (*MEAT* document, Feb.'03), the following "Seven Risk Factors" have been considered regarding the identified residual site conditions:

1) Liquid Phase Hydrocarbons (LPH)
Persisting LPH has been identified at storm drain outfall to Spa Creek. Soil borings completed along sides of the storm drain piping from Manhole No. 1 to the storm drain outfall did not reveal any LPH or petroleum impacted soils adjacent the piping indicating that LPH is originating closer to the source area of the boiler room. LPH was confirmed in saturated soils immediately adjacent the boiler room at depth below the basement floor nearest completed borings B-15, B-17 & B-18. LPH has likely entered storm drain piping from the boiler room sump pump location or from saturated soil at or below the boiler room floor level between the building discharge and Manhole/Inlet No. 4.

2) Current and Future Use of Impacted Groundwater
No current or future use of impacted groundwater for domestic use has been identified. Wiley H. Bates Middle School, adjacent Maryland Hall for Creative Art and the surrounding neighborhood is served by public water supply as provided by the City of Annapolis Public Works.

3) Migration of Contamination
The highest concentrations of residual soil contamination was identified along the exterior wall at the NW corner of the boiler room extending from the basement floor depth of 10-feet to depth approaching 19-feet below the surface. With the depth of storm drain piping exiting the boiler room identified at approximately 11-feet below the surface, it is likely that the history of LPH release in the boiler room has migrated into exterior soils through cracks in the basement floor, interior piping trenches, or by direct discharge from the sump pump area. It is also possible that LPH in the exterior soils has migrated into the storm drain piping in the exterior area through cracks or joints in the piping as it travels toward Manhole/Inlet No. 4. Whether directly discharged from the sump pump area or entry into the storm drain piping from cracks or joints, LPH has migrated from within the storm drain piping to discharge at the outfall at Spa Creek. Based on PID readings and soil analysis from borings surrounding the LPH identified areas, horizontal migration of impacted soil has been limited to the immediate perimeter extent of borings B-14 to B-23. Vertical migration of impacted soil identified in Boring B-14 to B-23 has been limited to above 20-feet below the surface. Horizontal extent of dissolved phase groundwater impact has been limited to within the perimeter of borings B-14 to B-23. Horizontal and vertical migration of isolated contamination is not widespread.

4) Human Exposure
There is direct human exposure to LPH at the storm drain outfall to Spa Creek. There is also the potential for human exposure to petroleum odor and vapors emanating from the storm drain Inlets No. 4 and No. 22 at the rear of the property. Human exposure to residual contaminated soil is not a factor due to the depths identified at 10-19 feet below the surface. With no domestic use of groundwater in this area, human exposure to dissolved phase groundwater contamination is not a factor.

5) Environmental Ecological Exposure
LPH accumulation at the storm drain outfall to Spa Creek presents environmental and ecological exposure. Direct LPH contact and dissolved phase impact to water entering Spa Creek will continue to have adverse effects on aquatic vegetation and organisms in this tidal marsh area of Spa Creek.

6) Impact to Utilities and Other Buried Services
Direct LPH discharge or migration of LPH from saturated soils surrounding the storm drain piping exiting the boiler room area has impacted the downgradient piping run of concrete storm drain piping leading to discharge at Spa Creek.

7) Other Sensitive Receptors
Tidal waters of Spa Creek, tributary to the Severn River and Chesapeake Bay, are located approximately 500-feet from the source of LPH adjacent the boiler room location.

Section VII
CONCLUSIONS & RECOMMENDATIONS

Upon review of the information and data gathered during this subsurface investigation, it is confirmed that the source of LPH observed in the storm drain discharge to Spa Creek has originated from historic and recent releases of heating oil from the basement boiler room of Wiley H. Bates Middle School. With the highest concentrations of residual phase contaminated soil and presence of LPH in soils identified in a confined area at the exterior NW corner of the boiler room, it is likely that LPH accumulations can be targeted and recovered successfully by installation of permanent recovery wells. It has been directed by MDE that the temporary well points identified to have accumulated LPH, Borings B-15, B-17 and B-18, be completed as permanent 4" PVC recovery wells as a means of LPH recovery.

In consideration of the Maryland Environmental Assessment Technology (MEAT document Feb. 2003) Seven Risk Factors, risk determination at this site, under existing conditions, has been determined as significant due to presence of LPH, its migration into the storm drain piping and subsequent discharge to Spa Creek. Additional exposure exists due to fuel odor and vapor accumulation within the storm drain piping and its persisting draft from the inlets at the rear of the property. Possibility of human exposure to any identified contaminated soil by dermal contact or ingestion is unlikely due to the depth identified. With the site and surrounding developments served by the public water supply, there is no potable use of groundwater in the immediate area.

Currently, Anne Arundel County Public Schools (AACPS) has contracted Miller Environmental to deploy, monitor, maintain and replace as needed absorbent boom and sweep materials at the storm drain outfall to Spa Creek to eliminated any LPH migration into the tidal flow of the creek. Based on the information gathered and site conditions presented in this report, PMI would recommend that further corrective action at this site include installation of 4" recovery wells at locations of LPH accumulation followed by periodic Enhanced Fluid Recovery (EFR) using a vacuum truck to recover and eliminate LPH in the subsurface. Additionally, the corrective action plan would also include installation of additional 4" monitoring wells at the perimeter of identified dissolved phase groundwater contamination to serve as sampling locations to monitor a declining trend of dissolved phase contamination and identify migration of LPH should it occur. A formal Corrective Action Plan proposal will be presented to MDE for review and approval. Please review the information and recommendations presented for this site and respond accordingly.

Thank you for your attention to this case.

W. Scott Alexander
Environmental Projects Manager
Petroleum Management, Inc.

cc: *Mr. Christopher Williams*
Environmental Issues Program Manager
Anne Arundel County Public Schools
9034 Fort Smallwood Rd.
Pasadena, MD 21122

Section VII
APPENDICES

Appendix A
MDE Work Plan Approval
MDE Report of Observations

Maryland
Department of
the Environment

Larry Hogan, Governor
Boyd Rutherford, Lt. Governor

Ben Grumbles, Secretary
Horacio Tablada, Deputy Secretary

January 28, 2019

Mr. Christopher E. Williams
Environmental Issues Program Manager
Anne Arundel County Public Schools
9034 Ft. Smallwood Road
Pasadena MD 21122

RE: DIRECT PUSH WORK PLAN APPROVAL
Case No. 2018-0559-AA
Wiley H. Bates Middle School
701 Chase Street, Annapolis
Anne Arundel County, Maryland
Facility I.D. No. 3200

Dear Mr. Williams:

The Maryland Department of the Environment's (the Department) Oil Control Program (OCP) recently completed a review of the case file for the above-referenced property, including the *Subsurface Investigation Work Plan*, dated December 26, 2018. This case was opened on May 2, 2018 following the report of liquid phase hydrocarbons (LPHs) impacting Spa Creek. Heating oil was discovered within a storm water outfall pipe on school property and a heating oil release was discovered in the school's boiler room. In addition to the two heating oil releases that had occurred in the boiler room between December 21, 2017 and April 27, 2018, research of OCP records revealed that multiple other releases had occurred at this location. Based upon the unknown quantities of fuel released at this site over time, the continued impacts noted at the storm water outfall and the fresh appearance of the oil at both the storm water outfall and upstream within Spa Creak, the OCP required completion of a subsurface investigation to identify the source of the on-going heating oil impacts.

The *Subsurface Investigation Work Plan*, dated December 26, 2018, proposes to install a minimum of 20 direct-push borings to assess and delineate petroleum-impacted soils in the vicinity of the current UST system, the historic UST field, and along the stormwater piping run to the outfall at Spa Creek. The borings will be advanced until evidence of contamination no longer exists, groundwater is reached, or to equipment refusal. Beginning 4 feet below the ground surface (bgs), soil intervals will be logged and screened using a photo-ionization detector (PID). Soil samples are proposed to be collected using EPA Method 5035. Up to two soil samples will be collected from each boring. If groundwater is encountered, temporary wells will be installed and groundwater samples will be collected. A *Limited Subsurface Investigation Report* will be provided when the work is completed. The Department hereby approves the proposed *Work Plan* contingent upon the following modifications:

1) Boring locations may be field modified based on the locations of underground utilities. If field conditions in any advanced boring reveal petroleum impact, the Department will require stepping out a minimum of10 feet and advancing additional borings to complete assessment of the petroleum impacts.

2) In order to account for petroleum impacts in shallow utilities and piping runs, continuous cores must be logged and screened for contaminants beginning at the surface instead of beginning at 4 feet bgs as proposed. Include PID readings in the boring logs.

If you have any questions, please contact the case manager, Mr. Michael Edillon, at 410-537-4151 (email: *michael.edillon@maryland.gov*) or me at 410-537-3499 (email: *susan.bull@maryland.gov*).

Sincerely,

Susan R. Bull, Eastern Region Supervisor
Remediation and State-Lead Division
Oil Control Program

ME/nln

cc: Mr. Scott Alexander (Petroleum Management Services)
Mr. William Dehn (Anne Arundel County Health Dept.)
Mr. Matthew D. Waters (City of Annapolis)
Mr. Andrew B. Miller (Chief, Remediation and State-Lead Division, OCP)
Mr. Christopher H. Ralston (Program Manager, Oil Control Program)
Ms. Kaley Laleker (Director, Land and Materials Administration)

MARYLAND DEPARTMENT OF THE ENVIRONMENT

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(410) 537-3442 • 1-800-633-6101 • http://www.mde.maryland.gov
LAND MANAGEMENT ADMINISTRATION
Oil Control Program

Report of Observations

Type of Inspection/Observations: Direct Push Subsurface Investigation	**Date:** 3/13/19
Site/Facility Name: Wiley H. Bates Middle School	**Facility ID #:** 3200
Address: 701 Chase Street, Annapolis, MD 21401	**Case #:** 18-0559AA
County: Anne Arundel	**Permit #:**

Remarks:
On 3/12/19, MDE-OCP representatives Susan Bull, Mike Edillon, and this writer met with representatives from Anne Arundel Public Schools, City of Annapolis, Petroleum Management Inc., and Benner Geoservices on site for the approved direct push event. The approved direct push work plan includes the installation of a minimum of 20 direct-push borings to assess and delineate petroleum-impacted soils in the vicinity of the current underground storage tank (UST) system, the historic UST field, and along the storm water piping run to the outfall at Spa Creek. This writer in company with Susan Bull and Mike Edillon observed the boiler room this date. A pan and bucket containing heating oil were observed beneath pipe joints and filters on the boiler system. An absorbent pad with evidence of heating oil saturation was observed beneath the bucket. Absorbent pads were present in the boiler room trench drains. No heating oil was observed in the trench drains or the boiler room sump pump this date.

This writer in company with MDE-OCP representatives observed petroleum odors at the storm drain grate between the dumpsters and the boiler room. This writer and representatives of the above mentioned parties observed the storm drain outfall on Spa Creek this date. Red emulsified petroleum, sheen, and petroleum odors were observed at the outfall this date. Multiple absorbent booms were in place on the water surface from the storm drain outfall to Spa Creek.

A total of six direct push borings were advanced on 3/12/19. All direct push borings were logged and field screened by Petroleum Management with a photo-ionization detector (PID). Temporary wells were installed in borings where groundwater was encountered to collect groundwater samples. Two direct push borings (B-1 and B-2) were advanced between the outfall at Spa Creek and the walking path, one on either side of the storm water piping run. Two direct push borings (B-3 and B-4) were advanced just on the other side of the walking path in the sports field, one on either side of the storm water piping run. The final two direct push borings (B-5 and B-6) were advanced on the sports field, approximately 20 feet away from B-3 and B-4, toward the school building, along the storm water piping run. In general, soil compositions were brown sandy clay approximately 2 to 5 feet below ground surface (bgs) to a red/brown silty/clayey sand with increased depth. In general, increasing moisture was observed approximately 7 to 10 feet bgs. No evidence of petroleum impact was observed. End 3/12/19.

On 3/13/19, a total of seven direct push borings were advanced to refusal depths. All direct push borings were logged and field screened with a PID. Five direct push borings (B-7 through B-11) were advanced on the hillside between the tank field and the sports fields. Two direct push borings (B-12 and B-13) were advanced on the upgradient concrete area between the dumpsters and the boiler room. Temporary wells were installed in borings where groundwater was encountered to collect groundwater samples. Boring B-13 was dry, no petroleum impacts were detected, and no temporary well was installed.

On 3/13/19, the storm drain manhole cover on the hillside down gradient from the tank field area was removed and petroleum sheen and odors were observed within the storm drain. In addition, Intermittent petroleum odors were observed coming from the storm drain grate between the dumpsters and the boiler room, and the storm drain grate northwest of the boiler room between the former UST tank field and the track. End 3/13/19.

On 3/14/19, This writer (Mike Edillon) and MDE-OCP representative Lindley Campbell met with representatives from Anne Arundel Public Schools and Petroleum Management Inc. Petroleum Management began by opening all UST system

manways to observe piping run depths and directions. No petroleum impacts were observed in the tank top sumps or the product piping and vent piping transition sumps. The tank field monitoring pipe (TFMP) was also opened and gauged—no liquid phase hydrocarbons were identified. A total of ten direct push borings (B-14 through B-23) were advanced to refusal depths in the vicinity of the boiler room, the current tank field, and the historical tank field. The historical concrete tank pad was discovered at approximately 14 feet below grade in borings B-16 and B-21 located in the historical tank field area. All direct push borings were logged and field screened with a PID. Based on soil contamination identified in borings B-15 through B-23 at depths from approx. 6-20 feet below grade, it appears that there was a subsurface heating oil release in the vicinity of the northwest corner of the boiler room. The boiler sump outfall is located in this area and petroleum impacts appear to track along the subsurface stormwater piping run toward the storm drain grate located to the northwest of the boiler room toward the track. Strong petroleum odors were observed in this storm drain this day. Based on soil screening petroleum impacts were also detected on the west side of both the historical and the current tank field. Petroleum Management gauged the temporary wells this day and measurable liquid phase hydrocarbons (LPHs) were detected in B-15, B-17, and B-18. The temporary wells will remain in place over the weekend to allow the sediment to settle out and Petroleum Management will gauge the wells again on Monday 3/18 when they sample. Benner Geoservices place bentonite around the temporary monitoring pipes because they will remain in place.

A total of 35 soil samples were collected from the soil borings and up to 15 groundwater samples will be collected. The OCP understands that the number of water samples may vary dependant upon whether or not LPH is detected in additional wells on 3/18. The soil and groundwater samples will be taken to Maryland Spectral Labs for analysis. See the attached site map for boring locations and the attached table for soil screening, soil sampling, and water sampling info.

REQUIREMENTS:

1) See item #4(d) and #5 from the OCP Direct Push Work Plan Approval letter dated January 28, 2019 for soil and groundwater analytical requirements.

2) The Subsurface Investigation Report of Results is due 45-days from the completion of work. See item #8 from the OCP Direct Push Work Plan Approval letter dated January 28, 2019 for reporting requirements.

3) **No later than April 30, 2018**, provide a *Work Plan* to install permanent 4-inch diameter groundwater monitoring and recovery wells in the vicinity of the boiler room and the tank fields due to the LPH detected. The 4-inch wells must be installed using air rotary methods so as not to meet refusal in more dense soils. It is recommended that AACPS assess the direct push results for data gaps or areas that were not delineated for further assessment to complete the horizontal and vertical delineation. Include proposals for additional delineation points in the *Work Plan* as well.

MDE/LMA/OCP
Report of Observation

NOTES

- Report the following conditions to the Department immediately, but not later than 2 hours after the detection, at **410-537-3442** during normal business hours, or to the Emergency Response Division hotline at **1-866-633-4686**:
  - An oil spill or discharge
  - If a storage system fails a test for tightness,
  - A storage system is determined to be leaking,
  - There exists evidence of a discharge
  - Two consecutive inconclusive tests
  - Presence of liquid phase hydrocarbons
- Reports should **not** be made via voice messages to OCP case managers.
- Operating without a permit or in violation of a permit, regulation, or law may result in the assessment of civil or administrative penalties and or other legal sanctions.

MDE Representative: Lindley Campbell	**Person Interviewed:** Scott Alexander
Signature:	**Signature:**
Date:	**Date:**
MDE Representative: Mike Edillon	**Person Interviewed:**
Signature: Michael Edillon	**Signature:**
Date: 3/15/19	**Date:**

MARYLAND DEPARTMENT OF THE ENVIRONMENT

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LAND MANAGEMENT ADMINISTRATION
Oil Control Program

Report of Observations

Type of Inspection/Observations: Direct Push Subsurface Investigation	**Date:** 4/4/19
Site/Facility Name: Wiley H. Bates Middle School	**Facility ID #:** 3200
Address: 701 Chase Street, Annapolis, MD 21401	**Case #:** 18-0559AA
County: Anne Arundel	**Permit #:**

Remarks:
On 4/4/19, this writer met with representatives from Anne Arundel Public Schools, Petroleum Management Inc., and Benner Geoservices on site for the follow up direct push event. The approved direct push work plan includes the installation of a minimum of 5 direct push borings to assess and further delineate petroleum-impacted soils in the vicinity of the building's boiler room and underground storage tank (UST) field.

This writer observed intermittent petroleum odors at the storm drain grate between the dumpsters and the boiler room, and at the storm drain grate between the school building and the track on the City of Annapolis property. This writer observed the storm drain outfall on Spa Creek this date. Red emulsified petroleum, sheen, and petroleum odors were observed at the outfall this date. An absorbent sweep was in place at the outfall and multiple absorbent booms were in place on the water surface from the storm drain outfall to Spa Creek.

A total of 5 direct push borings were advanced on 4/4/19. All direct push borings were logged and field screened by Petroleum Management with a photo-ionization detector (PID). The maximum PID reading was 0.8 units. Four direct push borings (B-24, B-25, B-26, and B-27) were advanced along the side of the building between the boiler room and the track, to a depth of 20 feet. One direct push boring (B-28) was advanced at the bottom of the hill, behind the baseball backstop, until the GeoProbe hit refusal at 13.5 feet below ground surface (bgs). In general, soil compositions were brown sandy clay approximately 2 to 5 feet bgs to a red/brown clayey sand with increased depth. In general, increasing moisture was observed approximately 15 to 18 feet bgs in borings B-24, B-25, B-26, and B-27, with a darker clay layer at approximately 19 to 20 feet bgs. A total of 5 groundwater samples were collected this date. A total of 9 soil samples were collected this date.

Eight of the 1-inch temporary wells installed during the 3/12/19-3/14/19 mobilization were left in place until the mobilization on this date. Petroleum Management gauged the temporary wells in B-14, B-15, B-17, B-18, and B-19 with an Interface Probe this date and measureable liquid phase hydrocarbons (LPHs) were detected in B-15, B-17, and B-18. The same three temporary wells had LPHs present on this date as on 3/14/19.

Petroleum Management gauged the 1-inch temporary wells that were installed this date. Depth to water was 13.04 feet in B-24, 12.90 feet in B-25,12.15 feet in B-26, 12.53 feet in B-27, and 2.41 feet in B-28. No LPHs were encountered in B-24, B-25, B-26, B-27, or B-28 this date. Bentonite clay was put in place around the temporary monitoring wells this date.

This writer will update the attached site map of boring locations and the attached table of soil screening, soil sampling, and water sampling information and send via email.

REQUIREMENTS:

1) See item #4(d) and #5 from the OCP Direct Push Work Plan Approval letter dated January 28, 2019 for soil and groundwater analytical requirements.

2) The Subsurface Investigation Report of Results is due within 45-days, no later than May 20th, 2019. See item #8 from the OCP Direct Push Work Plan Approval letter dated January 28, 2019 for reporting requirements.

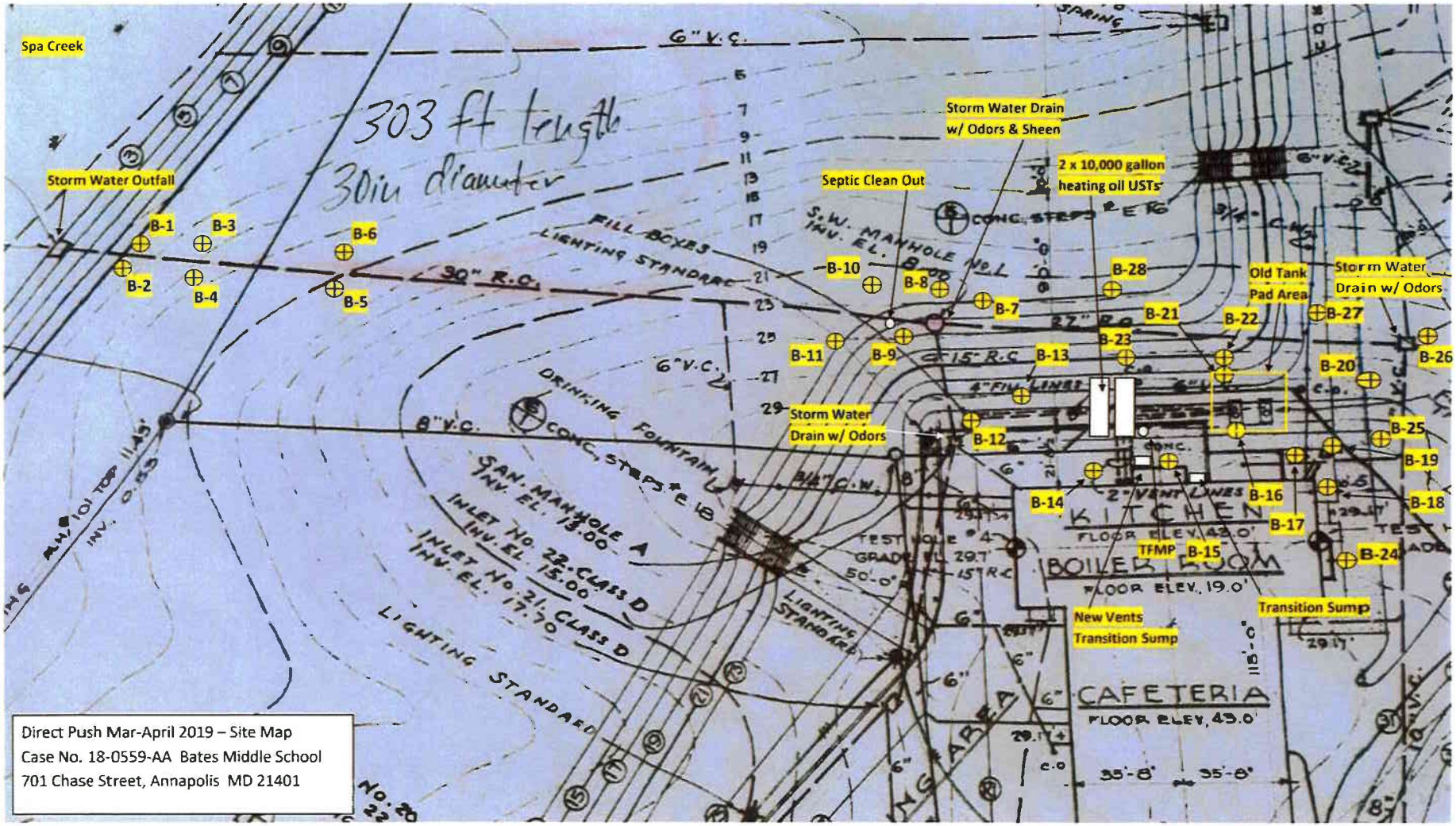
Revised: 04/15/2015

3) **No later than April 30, 2018**, provide a *Work Plan* to install permanent 4-inch diameter groundwater monitoring and recovery wells in the vicinity of the boiler room and the tank fields due to the LPH detected. The 4-inch wells must be installed using air rotary methods so as not to meet refusal in more dense soils. It is recommended that AACPS assess the direct push results for data gaps or areas that were not delineated for further assessment to complete the horizontal and vertical delineation. Include proposals for additional delineation points in the *Work Plan* as well.

NOTES

- **Report the following conditions to the Department immediately, but not later than 2 hours after the detection, at 410-537-3442 during normal business hours, or to the Emergency Response Division hotline at 1-866-633-4686:**
  - **An oil spill or discharge**
  - **If a storage system fails a test for tightness,**
  - **A storage system is determined to be leaking,**
  - **There exists evidence of a discharge**
  - **Two consecutive inconclusive tests**
  - **Presence of liquid phase hydrocarbons**
- Reports should **not** be made via voice messages to OCP case managers.
- **Operating without a permit or in violation of a permit, regulation, or law may result in the assessment of civil or administrative penalties and or other legal sanctions.**

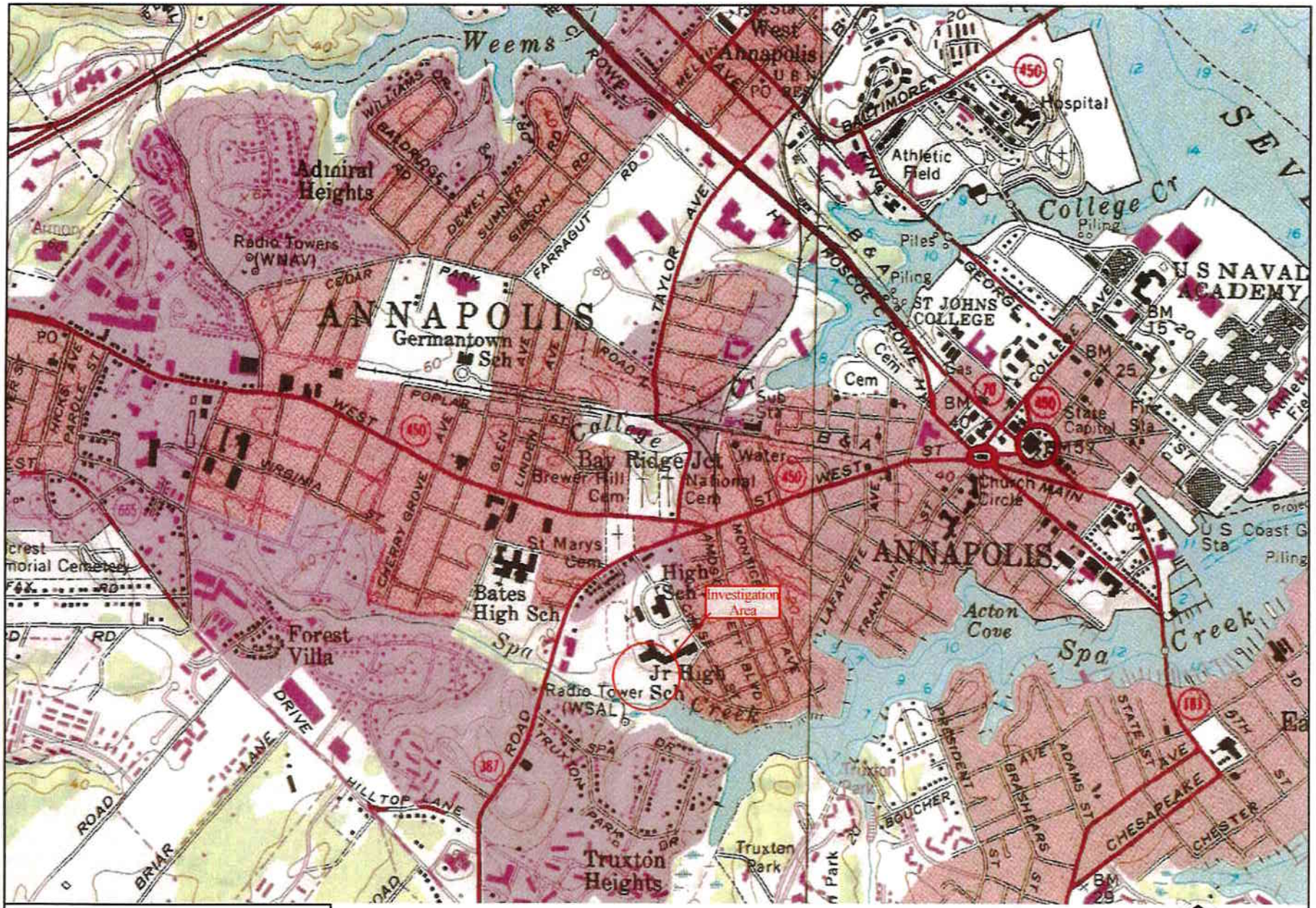
MDE Representative: Lindley Campbell	**Person Interviewed:** Scott Alexander
Signature: Lindley Campbell	**Signature:**
Date: 4/4/19	**Date:**
MDE Representative:	**Person Interviewed:**
Signature:	**Signature:**
Date:	**Date:**



Direct Push Mar-April 2019 – Site Map
Case No. 18-0559-AA Bates Middle School
701 Chase Street, Annapolis MD 21401

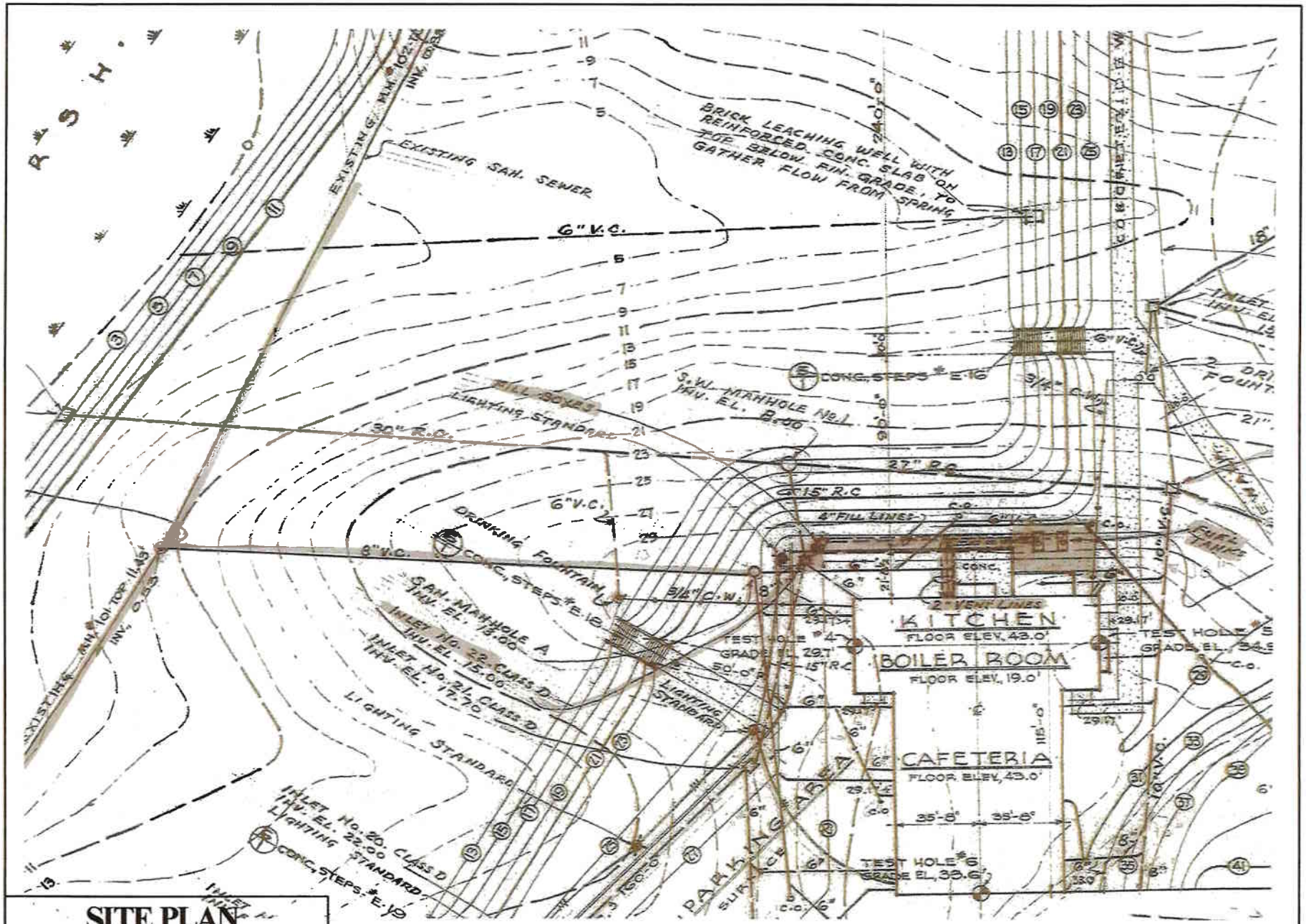
Appendix B

Site Topographic Maps
Site Plan-UST & Soil Boring Locations
Site Plan-*LPH Phase Area*
Site Plan-*Residual Phase Area*
Site Plan-*Dissolved Phase Area*
Site Photos



AREA TOPOGRAPH

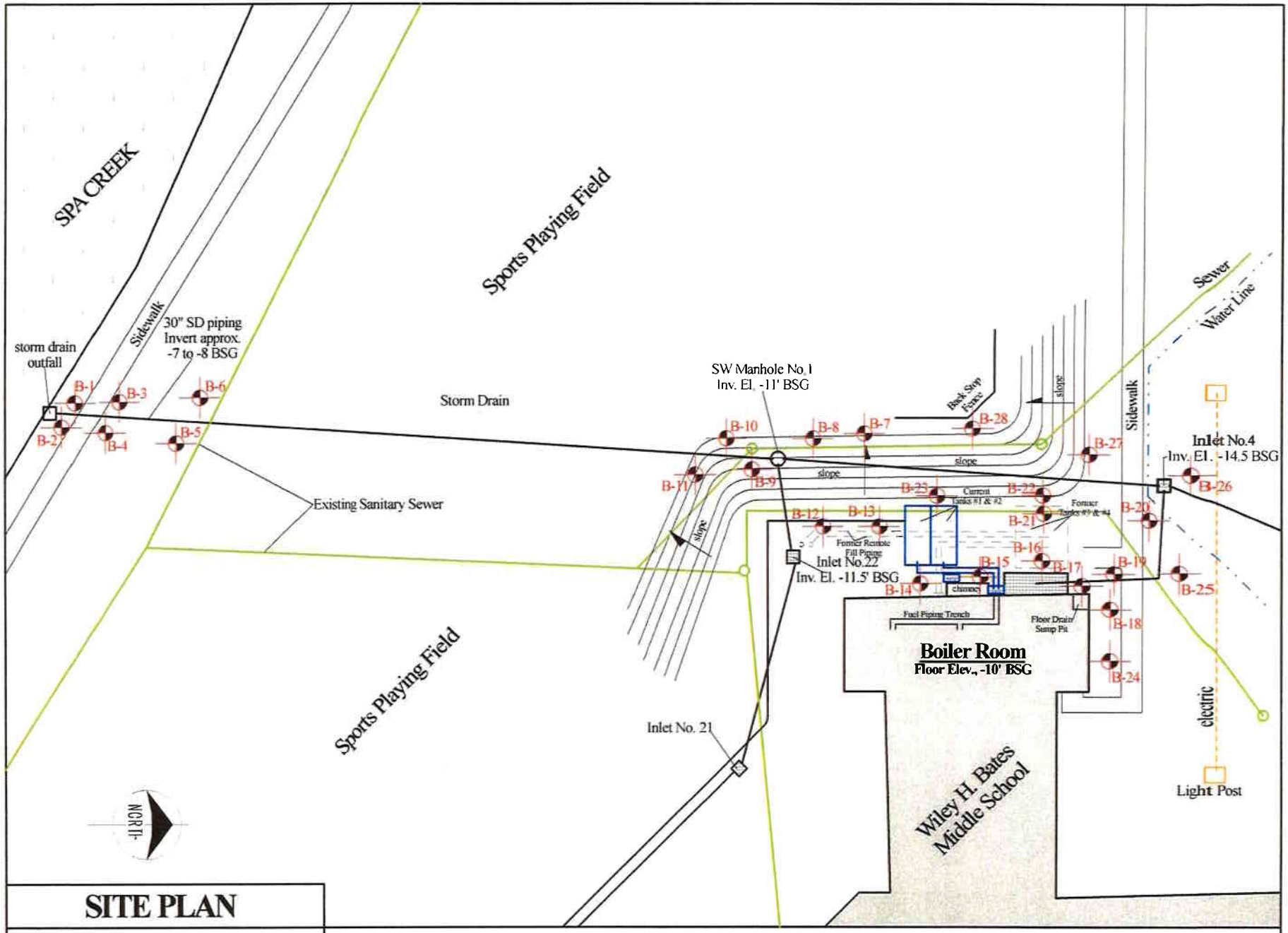
Petroleum Management, Inc. 5218 Curtis Avenue Curtis Bay, MD 21226 410-354-0200	**Job Name:**	Wiley H. Bates Middle School			
	Location:	701 Chase Street, Annapolis, MD 21401			
	Drawn By:	WSA	**Scale:**	1" = 2000'	**Date:** 4/12/19



SITE PLAN

Petroleum Management, Inc.
5218 Curtis Avenue
Curtis Bay, MD 21226
410-354-0200

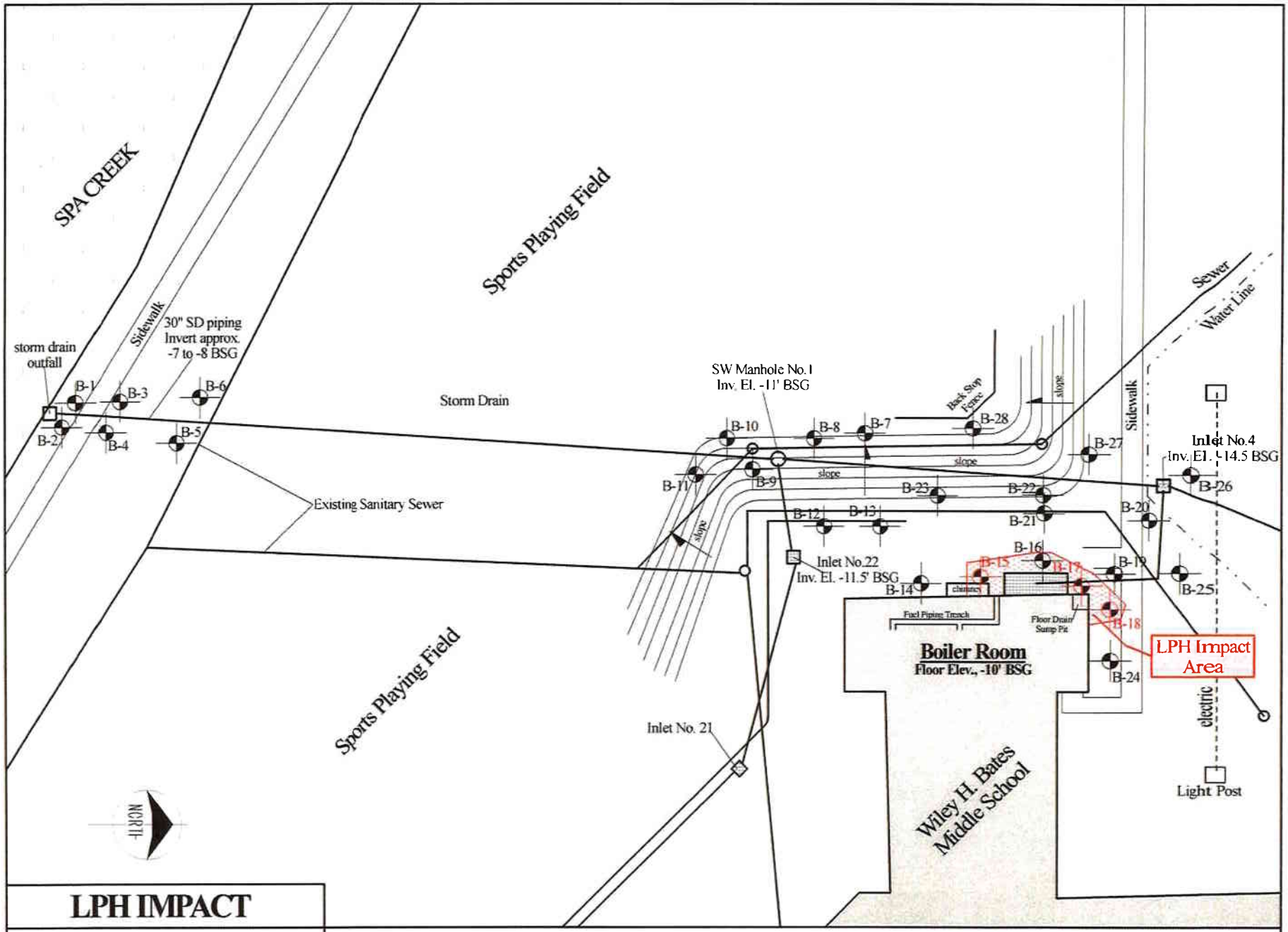
Job Name:	Wiley H. Bates Middle School (Eevation Plan From Original)				
Location:	701 Chase Street, Annapolis, MD 21401				
Drawn By:	WSA	**Scale:**	1" = 50'	**Date:**	12/26/18



SITE PLAN

Petroleum Management, Inc.
5218 Curtis Avenue
Curtis Bay, MD 21226
410-354-0200

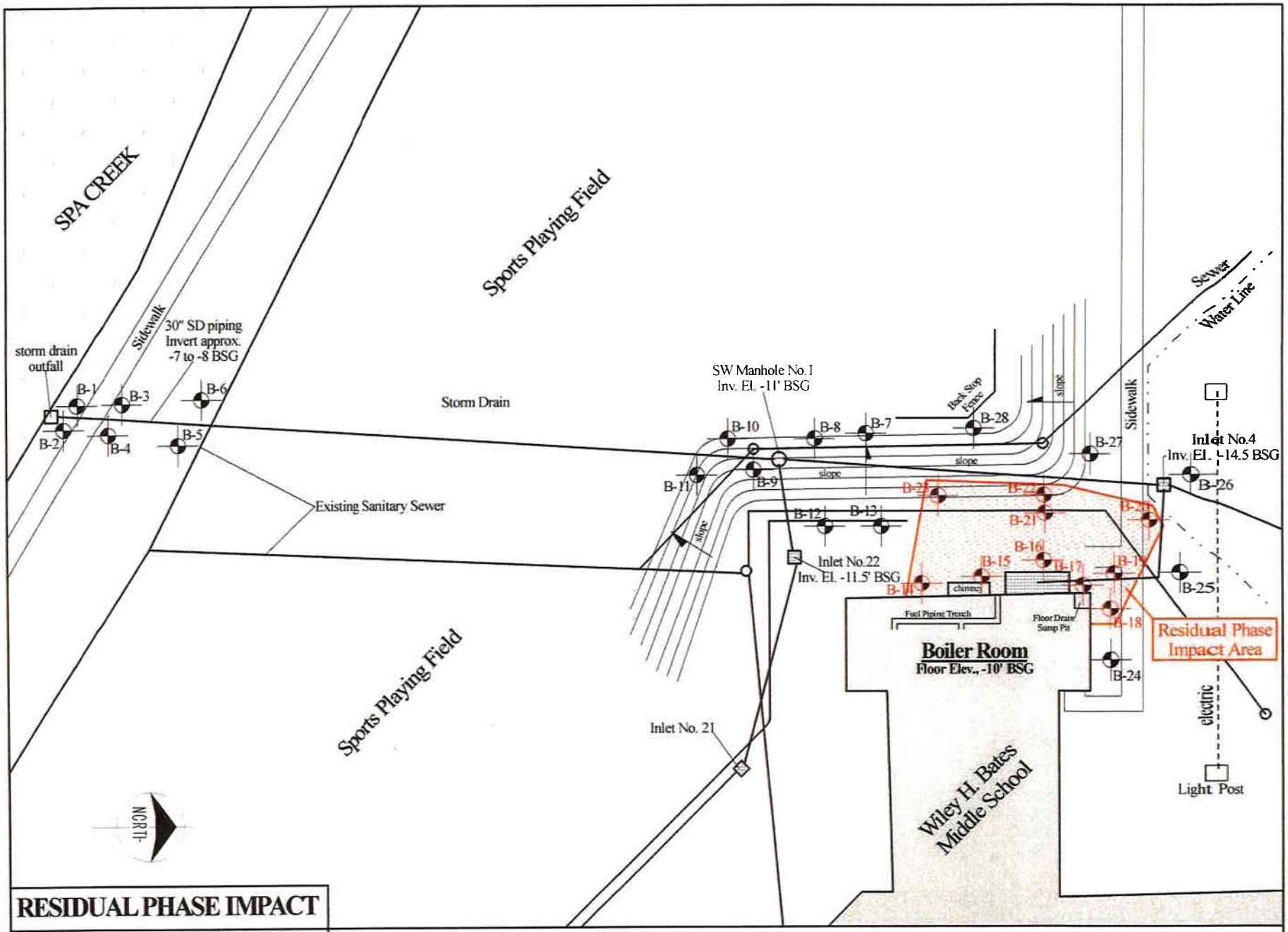
Job Name:	Wiley H. Bates Middle School - Subsurface Investigation (Soil Boring Locations)
Location:	701 Chase Street, Annapolis, MD 21401
Drawn By:	WSA
Scale:	1" = 50'
Date:	04/04/2019



LPH IMPACT

Petroleum Management, Inc.
5218 Curtis Avenue
Curtis Bay, MD 21226
410-354-0200

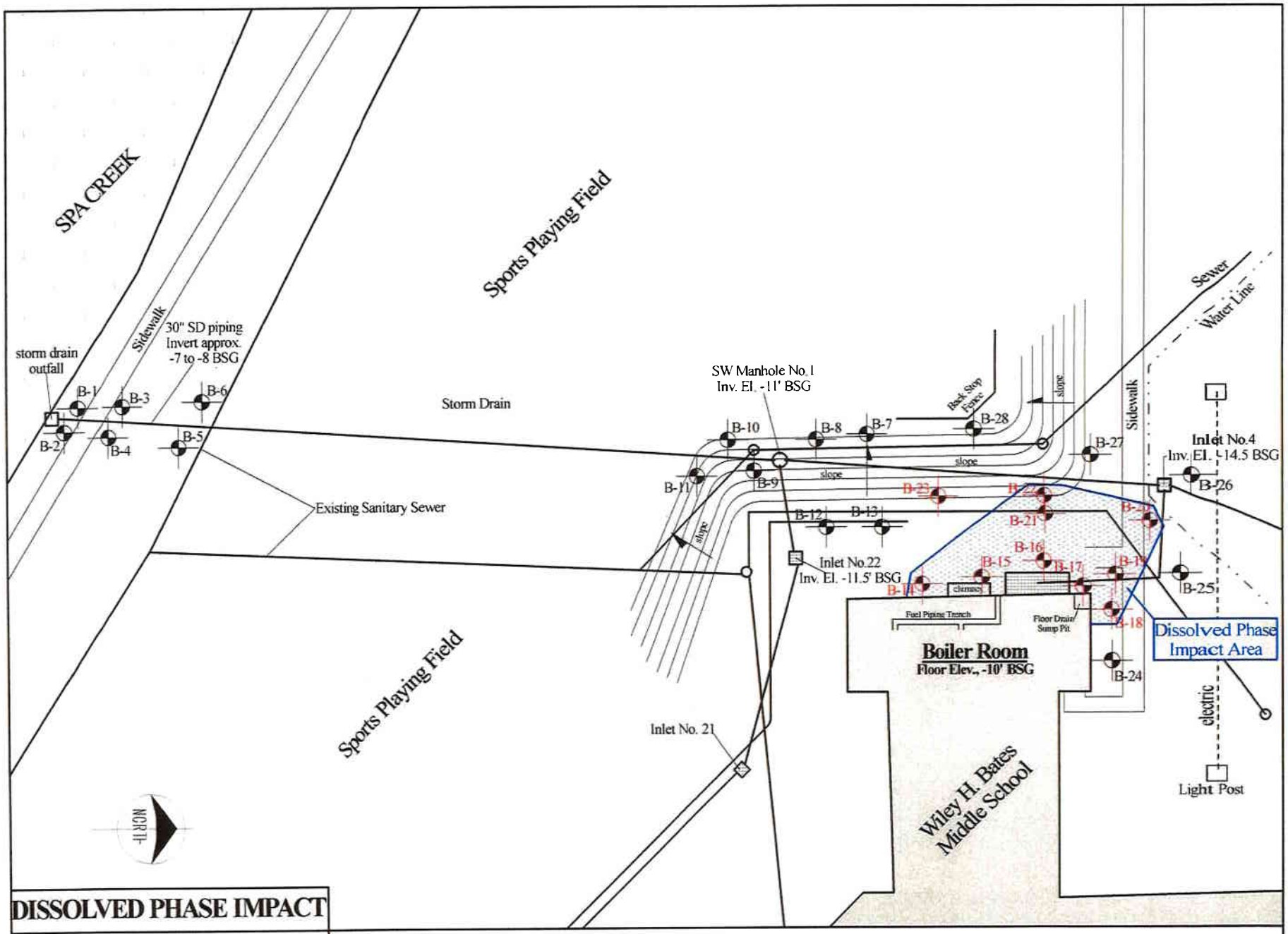
Job Name:	Wiley H. Bates Middle School - Subsurface Investigation (LPH Impact Zone))				
Location:	701 Chase Street, Annapolis, MD 21401				
Drawn By:	WSA	**Scale:**	1" = 50'	**Date:**	04/04/2019



RESIDUAL PHASE IMPACT

Petroleum Management, Inc.
5218 Curtis Avenue
Curtis Bay, MD 21226
410-354-0200

Job Name:	Wiley H. Bates Middle School - Subsurface Investigation (Residual Phase Impact)				
Location:	701 Chase Street, Annapolis, MD 21401				
Drawn By:	WSA	**Scale:**	1" = 50'	**Date:**	04/04/2019

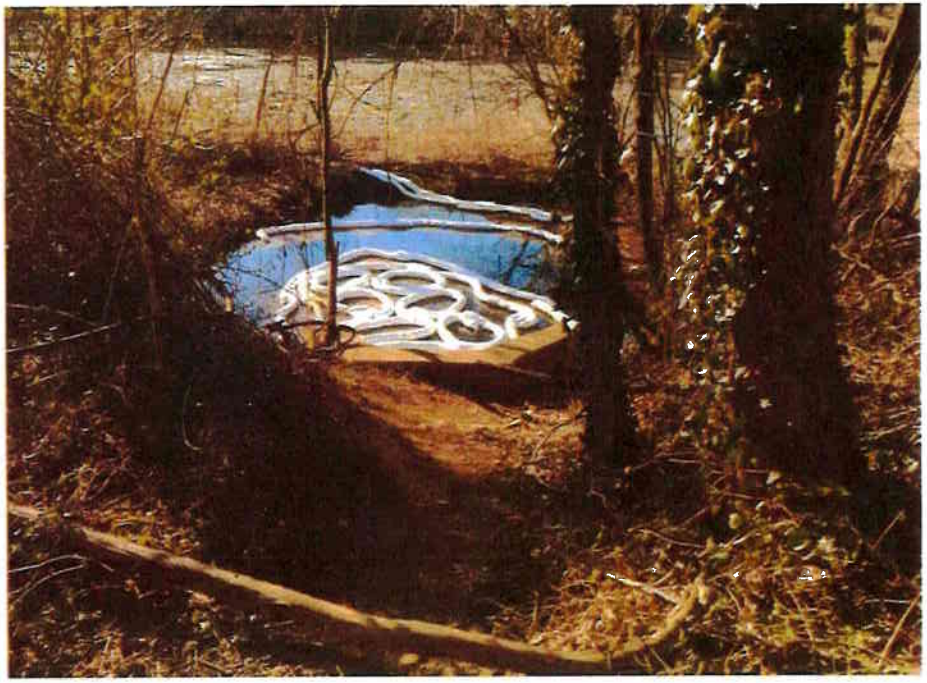


DISSOLVED PHASE IMPACT

Petroleum Management, Inc.
5218 Curtis Avenue
Curtis Bay, MD 21226
410-354-0200

Job Name:	Wiley H. Bates Middle School - Subsurface Investigation (Dissolved Phase Impact)			
Location:	701 Chase Street, Annapolis, MD 21401			
Drawn By:	WSA	**Scale:**	1" = 50'	**Date:** 04/04/2019

Boring B-1 Location



Storm Drain Outfall to Spa Creek

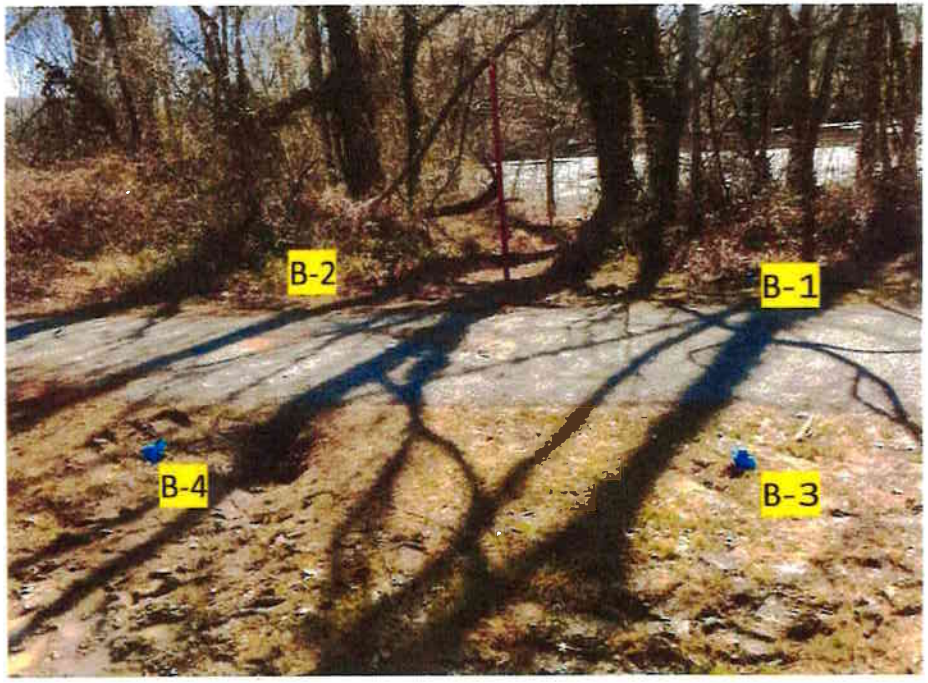
View from Storm Drain Outfall North toward School

Boring B-2 Location

Boring B-3 Location

Boring B-3 Location

Boring B-4 Location

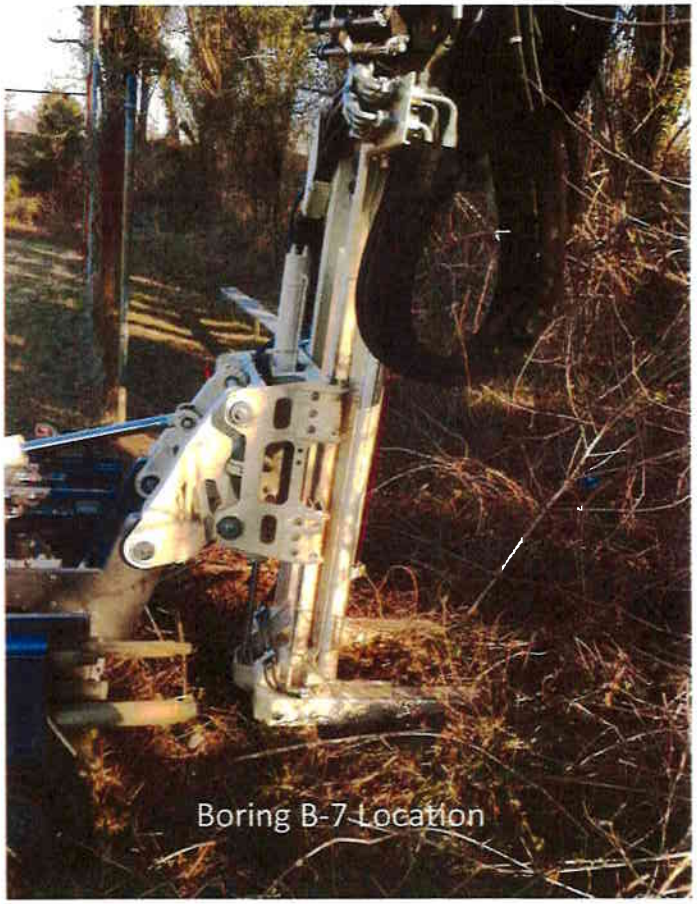


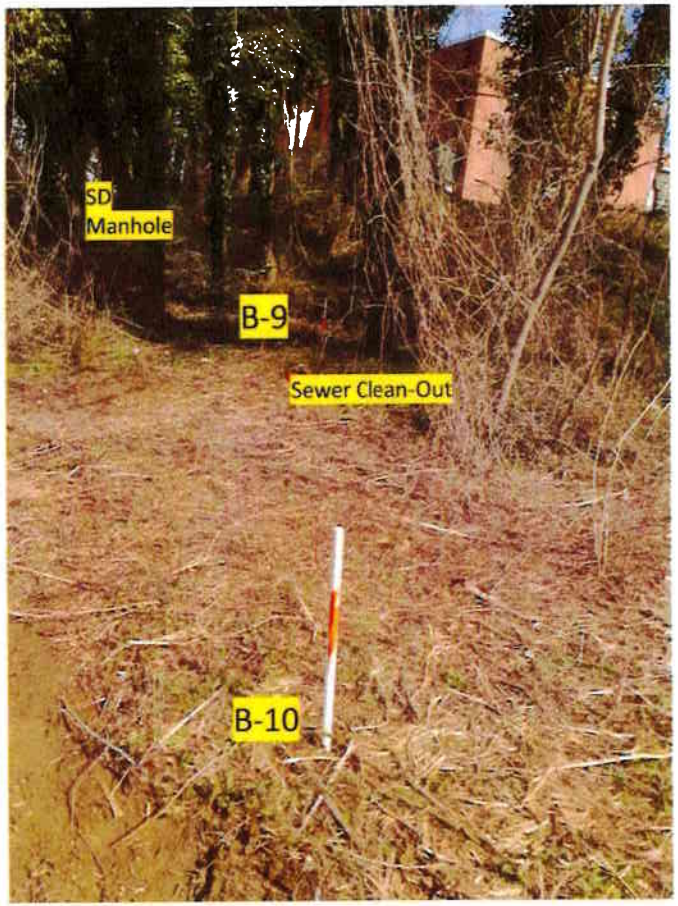
Boring Locations B-1, B-2, B-3, B-4

Borings B-5 & B-6

Borings B-5 & B-6

Boring B-7 Location



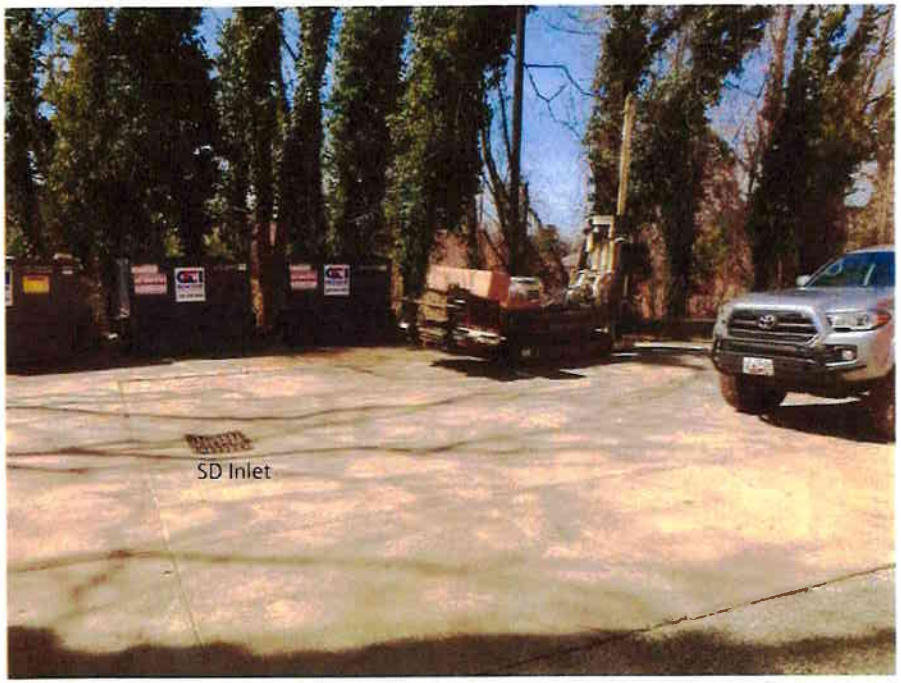


Borings B-9 & B-10 Locations

Boring B-8 Location

Boring B-11 Location

Boring B-12 Location



Boring B-13 Location

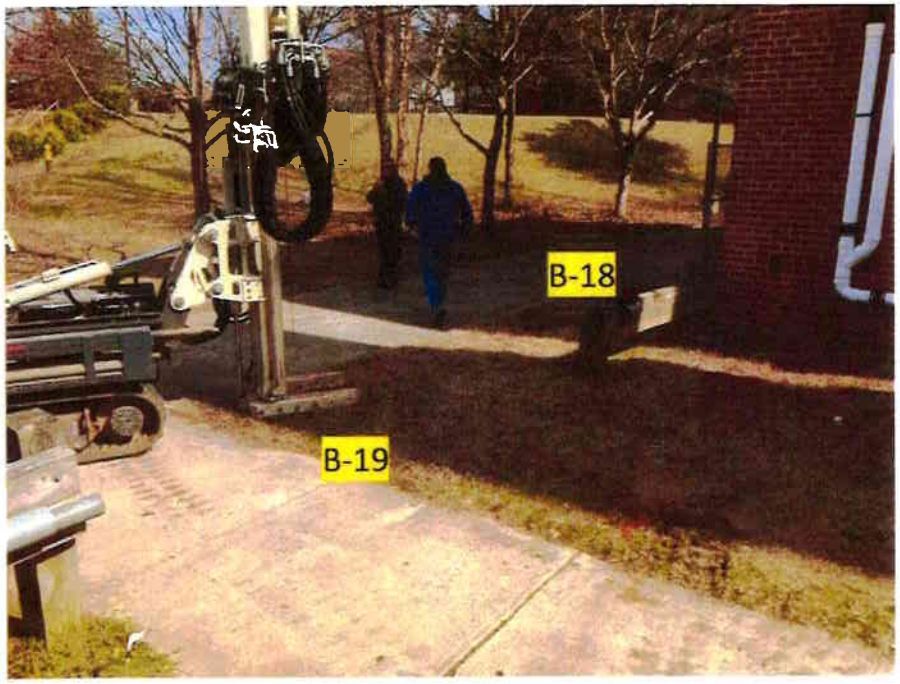
Boring B-13 Location

Boring B-14 Location

Boring B-15 Location

Boring B-16 Location

Boring B-17 Location



Boring Locations B-18 & B-19

Boring B-20 Location

Boring B-21 & B-22 Locations

Boring B-21 & B-22 Locations

Boring B-23 Location

Boring B-25 Location

Boring B-18 & B-24 Location

Boring B-26 Location

Boring B-26 Location

Boring B-27 Location

Boring B-28 Location

Appendix C
Soil Boring Logs
Monitoring Well Sampling Forms

Wiley H. Bates Elementary School
701 Chase Street
Annapolis, MD

MDE Case# 2018-0559-AA
MDE Facility ID# 3200

SOIL BORING LOG

Geoprobe Investigation-Benner Environmental
Completion Date: March 12-14, 2019 (B-1 to B-23)
April 4, 2019 (B-24 to B-28)

Boring ID	Depth	Soil Description	PID units
B-1	*-Adjacent asphalt path, flanking SD piping, nearest edge of woods line to SD outfall*		
	0 – 5'	Topsoil with transition to brown sandy clay to -4 ft.	0.1 @ 2'
		Brown/tan sandy clay w/ increasing moisture content to 5 ft.	0.0 @ 3-4' 0.0 @ 5'
	5 – 10'	Brown/tan sandy clay, damp with depth to 10 ft. Storm Drain pipe invert est. at approx. -7' BSG	**0.0 @ 6-7'** 0.0 @ 8-10'
	10 – 15'	Brown/tan sandy clay, damp to 14 ft. Brown/dark brown sandy clay w/ mixed Black organics to 15 ft.	
	15 – 20'	Grey/dark brown sandy clay w/ streaks of decayed organic materials to 16 ft.	0.1 @ 16'
		Brown/Tan fine sandy clay from 16-18 ft.	0.1 @ 18'
		Brown/Tan course sandy clay w/ traces of larger sandstone fragments to 20 ft.	**0.1 @ 20'**
	20 – 21'	Refusal at 20.8'. Tight, dense gray clay	No recovery

***Temp 1" well point set to -20', standing water measured at -8'; water sample taken for analysis.**
***Soil sample retained from 6-7 feet for analysis.**
***Soil sample retained from 20 feet for analysis**

Boring ID	Depth	Soil Description	PID units
B-2	*-Adjacent asphalt path, flanking SD piping, nearest edge of woods line to SD outfall*		
	0 – 5'	~6" topsoil w/ transition to brown, fine sandy clay to 5 ft. Mostly fine sand, less clay, from 4.5-5 ft.	0.0 @ 2' 0.3 @ 3' 0.1 @ 5'
	5 – 10'	Brown, clayey sand to 8 ft.	**0.1 @ 7'**
		8-10 ft. sandy clay w/ organic staining	0.1 @ 8-10'
		Storm Drain pipe invert est. at approx. -7' BSG	
	10 – 15'	Dk. Brown w/ black organic staining from 10-15 ft. w/ increasing moisture to 14 ft. Saturated w/ water to 15 ft. in dk. Brown sandy clay.	0.0 @ 12' 0.0 @ 14' 0.1 @ 15'
	15 – 20'	Brown sandy clay w/ declining organic Staining from 15-16 ft. Brown/tan sandy Clay from 16-20 ft. w/ increasing course Sand content to 20 ft.	0.1 @ 16' **0.1 @ 18'** 0.0 @ 20'

***Temp 1" well point set to -20', standing water measured at -8'; water sample taken for analysis.**
***Soil sample retained from 7 feet for analysis.**
***Soil sample retained from 18 feet for analysis.**

Boring ID	Depth	Soil Description	PID units
B-3	*-Adjacent asphalt path, nearest edge of sports field, flanking SD piping*		
	0 – 5'	~6" topsoil over tan/brown sandy clay.	0.0 @ 3'
		Transition to more clayey sand to 5 ft.	0.1 @ 5'
	5 – 10'	Brown/tank, wet sandy clay to -6 ft.	0.1 @ 6'
		Layer of dk. stained organics at ~6-8 ft.	**0.3 @ 8'**
		Brown clayey wet sand from 8-10 ft.	0.1 @ 10'
		Storm Drain pipe invert est. at approx. 7-8 ft. BSG	
	10 – 15'	No recovery 10-12 ft; lrg. stone in liner	
		Brown/gray sandy clay w/ bands of dk.	1.0 @ 12'
		Organic staining from 12-15 ft.	0.0 @ 15'
		Saturated w/ water from 12-15 ft.	
	15 – 20'	Dk. brown sandy clay to 16 ft. w/ transition	0.0 @ 16'
		To brown/tan course sandy clay to 20 ft.	0.0 @ 18'
		Sand increasingly course from 19-20 ft.	0.0 @ 20'

***Temp 1" well point set to -20', standing water measured at -8'; water sample taken for analysis.**
***Soil sample retained from 8 feet for analysis.**

Boring ID	Depth	Soil Description	PID units
B-4	*-Adjacent asphalt path, nearest edge of sports field, flanking SD piping*		
	0 – 5'	~6" of wet/muddy topsoil over brown	0.0 @ 3'
		sandy clay, trace gravels to 5 ft.	0.0 @ 5'
	5 – 10'	Void in liner from 5-7 ft. w/ limited	
		recovery due to lrg. gravels at 7-10 ft.	0.2 @ 7'
		Brown sandy clay w/ increasing moisture	**0.7 @ 8-9'**
		to 10 ft. Storm Drain pipe invert est. at approx.7-8 ft. BSG	
	10 – 15'	Dk. brown/gray, wet sandy clay to 11 ft.	0.0 @ 12'
		with a dk. black organic staining to 14 ft.	0.0 @ 14'
		14-15 ft. transition to a drier, brown	0.0 @ 15'
		course sandy clay.	
	15 – 20'	Brown/orange clayey, course sand	0.0 @ 18'
		Decreasing clay content from above.	0.0 @ 20'

***Temp 1" well point set to -20', standing water measured at -5'; water sample taken for analysis.**
***Soil sample retained from 8-9 feet for analysis.**

Boring ID	Depth	Soil Description	PID units
B-5	*-In sports field, flanking side of SD piping nearest intersection with sanitary piping*		
	0 – 5'	~8" topsoil over transition to brown sandy clay to 5 ft.	0.0 @ 3' 0.0 @ 5'
	5 – 10'	Brown sandy clay w/ increasing moisture to ~8 ft. in a band of dk. stained organics. Dk. brown clayey sand from 8-10 ft. Storm Drain pipe invert est. at approx. 7-8 ft. BSG	**0.0 @ 8'** 0.0 @ 10'
	10 – 15'	Wet/saturated dk. brown clayey course sand to 12 ft. Brown silty/sandy clay from 12-15 ft. Refusal at 15 ft.	0.0 @ 12' 0.1 @ 15'

***Temp 1" well point set to -15', standing water measured at -9'; water sample taken for analysis.**
***Soil sample retained from 8 feet for analysis.**

Boring ID	Depth	Soil Description	PID units
B-6	*-In sports field, flanking side of SD piping nearest intersection with sanitary piping*		
	0 – 5'	~8" topsoil w/ transition to brown sandy clay to 5 ft.	0.0 @ 2' 0.0 @ 5'
	5 – 10'	Dk. brown/gray sandy clay to 8 ft. Increasing moisture & sand content, Brown clayey sand to 10 ft. Storm Drain pipe invert est. at approx.7-8 ft. BSG	**0.0 @ 8'** 0.3 @ 10'
	10 – 15'	Wet, brown/gray sandy clay w/ saturation at 12-14 ft. Transition to a wet orange/brown course sandy clay to 15 ft.	0.1 @ 12' 0.0 @ 15'
	15 – 18'	wet/damp, brown course sandy clay to refusal at 18 ft.	0.0 @ 18'

***Temp 1" well point set to -18', standing water measured at -9'; water sample taken for analysis.**
***Soil sample retained from 8 feet for analysis.**

Boring ID	Depth	Soil Description	PID units
B-7	*-Foot of slope below UST area; nearest backstop fence.*		
	0 – 5'	~8" topsoil & organics w/ transition	
		to brown/tan clayey med. sand to 5 ft.	0.0 @ 2'
		Increasing moisture from 4-5 ft.	0.0 @ 5'
	5 – 10'	Wet, brown/tan clayey med sand to ~ 9 ft.	0.0 @ 6'
		Brown clayey sand, increasing sand	**0.0 @ 8'**
		content & grain size from 9-10 ft.	**0.0 @ 10'**
		Storm Drain pipe invert at Manhole #1 measured at -11 ft. (8-10 ft. at B-7)	
	10 – 15'	Brown/tan clayey med sand, wet to 12 ft.	0.0 @ 12'
		Drying clayey, course sand to refusal	0.1 @ 15'
		At 15 ft. Boring collapse, no well point.	
		***Soil sample retained from 8-10 feet for analysis.**	

Boring ID	Depth	Soil Description	PID units
B-8	*-Foot of slope below UST area; North of MH #1*		
	0 – 5'	~8" topsoil w/ transition to brown	0.4 @ 2'
		clayey med sand to 5 ft.	**0.3 @ 5'**
	5 – 10'	Brown med sandy, silty clay	0.6 @ 7'
		w/ increasing moisture from 8-10 ft.	**0.5 @ 10'**
		Storm Drain pipe invert at Manhole #1 Measured at -11 ft. (8-10 ft. at B-8)	
	10 – 14'	Brown, course silty sand to Refusal	
		At 14 ft. Liner torn/collapsed in	0.1 @ 10-14'
		Macro-core, limited recovery.	

***Temp 1" well point set to -14', standing water measured at -5.5'; water sample taken for analysis.**
***Soil sample retained from 5 feet for analysis.**
***Soil sample retained from 10 feet for analysis.**

Boring ID	Depth	Soil Description	PID units
B-9	*-Mid-slope, just South of MH #1 and lateral SD pipe from inlet #22*		
	0 – 5'	~4" topsoil & organics w/ transition to brown silty, clayey sand to 5 ft.	0.2 @ 2' 0.2 @ 5'
	5 – 10'	Brown silty, clayey sand to 7 ft. then increasing moisture from 7-10 ft. in brown/tan silty med sand. Storm Drain pipe invert at Manhole #1 measured at -11 ft. (~11 ft. at B-9)	0.2 @ 6' 0.2 @ 8' 0.7 @ 10'
	10 – 15'	Wet/saturated, brown silty sand to 13 ft. Brown/tan silty course sand to Refusal at 14.5 feet.	**0.3 @ 12'** 0.3 @ 14.5'

***Temp 1" well point set to -14.5', standing water measured at -7.1'; water sample taken for analysis.**
***Soil sample retained from 12 feet for analysis.**

Boring ID	Depth	Soil Description	PID units
B-10	*-Foot of slope South of MH #1, flanking SD piping at turn in slope*		
	0 – 5'	~4" topsoil & organics w/ transition to brown clayey sand w/ increasing moisture to 5 ft.	0.0 @ 2' 0.1 @ 5'
	5 – 10'	Brown silty, clayey sand to ~7 ft., Increasing moisture from 7-10 ft. in brown/tan silty medium sand. Storm Drain pipe invert at Manhole #1 Measured at -11 ft. (9-10 ft. at B-10)	0.1 @ 6' 0.2 @ 8' **0.2 @ 10'**
	10 – 12.5'	Brown/tan wet silty clayey sand above a denser layer of drier course brown/tan course clayey sand to Refusal at 12.5 ft	0.1 @ 11' 0.1 @ 12.5

***Temp 1" well point set to -12.5', standing water measured at -4'; water sample taken for analysis.**
***Soil sample retained from 10 feet for analysis.**

Boring ID	Depth	Soil Description	PID units
B-11	*- Foot of slope South of MH #1, flanking SD piping at turn in slope*		
	0 – 5'	~8" topsoil w/ transition to brown/tan clayey sand, increasing moisture to 5 ft.	0.1 @ 2' 0.1 @ 5'
	5 – 10'	Brown/tan clayey sand damp to ~6 ft. Moisture increasing to 8 ft. Increasingly Course sand content to 10 ft. Storm Drain pipe invert at Manhole #1 measured at -11 ft. (8-10 ft. at B-11)	0.1 @ 6' 0.2 @ 8' **0.2 @ 10'**
	10 – 12'	Wet/saturated layer of brown sandy mud above a denser layer of brown/tan/grey clayey course sand to Refusal at 12 ft.	0.1 @ 11' 0.1 @ 12'

***Temp 1" well point set to -12', standing water measured at -5.1'; water sample taken for analysis.**
***Soil sample retained from 10 feet for analysis.**

Boring ID	Depth	Soil Description	PID units
B-12	*-In front of dumpsters, area of former remote fill piping.*		
	0 – 5'	~4-6" of concrete pad over dk. brown sandy clay mixed with shattered concrete fragments from above to 3 ft. Dk. brown course sandy clay 3-5 ft.	0.0 @ 4-5'
	5 – 10'	Crushed concrete fragments fall-in from above at 5-6 ft. Remainder of boring to 10 ft. in brown/dk. brown Clayey medium sand Storm Drain pipe invert at Inlet #22 measured at -11.5 ft.	0.0 @ 6' 0.1 @ 8' 0.5 @ 10'
	10 – 15'	Brown/tan clayey medium sand in entire boring from 10-15 ft.	**0.3 @ 12'** 0.5 @ 15'
	15 – 19.5'	Brown/tan silty sand to 17 ft., Increasing moisture to 18 ft., Saturated silty sand to Refusal at 19.5 ft.	**0.3 @ 17'** 0.3 @ 19.5'

***Temp 1" well point set to -19.5', water measured at -18'; water sample taken for analysis.**
***Soil sample retained from 12 feet for analysis.**
***Soil sample retained from 17 feet for analysis.**

Boring ID	Depth	Soil Description	PID units
B-13	*- Rt. side of dumpsters, off concrete at corner nearest light post, area of former remote fill piping.*		
	0 – 5'	~6" of topsoil over 12" of brown/tan mixed sandy fill & gravel to 2 ft.	0.0 @ 2'
		Dk. brown/brown clayey sand to 5 ft.	0.0 @ 5'
	5 – 10'	Brown clayey sand to 7 ft.	0.0 @ 6'
		Increasing moisture from 7 ft. with	0.1 @ 8'
		more clay content in sand to 10 ft.	0.2 @ 10'
		Storm Drain pipe invert at Inlet #22 measured at -11.5 ft.	
	10 – 15'	Brown/tan silty, clayey sand to 7 ft.	**0.0 @ 12'**
		Moisture increasing with clay content from 7-10 feet.	0.1 @ 15'
	15 – 20'	Brown/tan silty, clayey sand w/ increased Moisture to ~18 ft. Transition at 18-20 ft.	0.0 @ 18'
		to brown/red silty course sand, saturated w/ water to 20 ft.	**0.0 @ 20'**

*Boring collapsed at ~10 ft., no temp well point set in location.
***Soil sample retained from 12 feet for analysis.**
***Soil sample retained from 20 feet for analysis.**

Boring ID	Depth	Soil Description	PID units
B-14	*-Chimney corner, next to AC unit. Adjacent active vent & product piping (-28")*		
	0 – 5'	~6" topsoil over brown/tan sandy clay to 3 ft. Brown clayey sand w/ increased	0.0 @ 2'
		moisture to 5 ft.	0.0 @ 5'
	5 – 10'	Brown clayey medium sand to 8 ft.	0.1 @ 6'
		Brown/gray clayey medium sand to 10 ft.	0.1 @ 8'
		Boiler Room Floor measured at -10' BSG	0.1 @ 10'
	10 – 15'	Brown clayey medium sand to 12 ft. Thin zone of wet/saturated material	0.6 @ 12'
		just above 12 ft. Dense wet sandy clay to 15 ft.	0.5 @ 15'
	15 – 20'	Brown clayey sand from 15-17 ft. w/	**0.9 @ 17'**
		zone of wet/saturated brown/tan silty sand from 17-18 ft. Brown/tan dense	0.7 @ 18'
		silty/sandy clay to terminal depth at 20 ft.	**0.8 @ 20'**
		~1/2" thin seam of fractured rock at ~19.8'	

***Temp 1" well point set to -20', water measured at -17'; water sample taken for analysis.**
***Soil sample retained from 17 feet for analysis.**
***Soil sample retained from 20 feet for analysis.**

Boring ID	Depth	Soil Description	PID units
B-15	*-In front of chimney, between active fuel piping (-28") and wall.*		
	0 – 5'	Hand-auger to -3' to clear fuel piping.	
		Brown/tan clayey sand from 3-5 ft.	0.8 @ 5'
	5 – 10'	Brown/tan clayey sand from 5-6.5 ft.	13.6 @ 6'
		w/ a course cobble/gravel zone at 6.5-7 ft.	
		Brown/grey clayey medium sand to 9 ft.	53.1 @ 7-8'
		w/ slight fuel odor present at 9-10 ft.	374 @ 9-10'
		Boiler room floor at -10' BSG.	
	10 – 15'	Gravel fill from above in top 8" of liner	
		Dark stained & wet medium silty sand	**401.1 @ 12'**
		from 11-12 ft. Drying & less staining in	
		band of silty course sand/ w/ crushed	128.7 @ 13'
		sandstone fragments to 14 ft.	
		Dk. gray fine sandy clay from 14-15 ft.	23.1 @ 15'
	15 – 20'	Gravel fill sluff from above to 15-18 ft.	11.2 @ 18'
		Gray/brown silty clay from 18-19 ft.	
		Brown/red silty clay w/ fragments of	**10.5 @ 20'**
		crushed sandstone to 20 ft.	

***Temp 1" well point set to -20', LPH identified at -14.5'; no sample taken. Gauging form completed.**
***Soil sample retained from 12 feet for analysis.**
***Soil sample retained from 20 feet for analysis.**

Boring ID	Depth	Soil Description	PID units
B-16	*-Former UST excavation, in front of air shaft to boiler room*		
	0 – 5'	~6" topsoil w/ transition to brown	0.8 @ 2'
		clayey sand to 5 ft.	0.7 @ 5'
	5 – 10'	No recovery in liner from 5-9' due	
		to large gravel in fill material of old	
		tank field. Brown/gray mixed clayey	
		fill from 9-10 ft.	**17.4 @ 9-10**
		Boiler room floor at -10' BSG.	
	10 – 14'	Brown clayey sand w/ trace crushed	
		gravel to 14 ft. Refusal on concrete	0.0 @ 14'
		pad at 14 ft.	
		Former UST concrete pad at 14' BSG	

***Soil sample retained from 9-10 feet for analysis.**

Boring ID	Depth	Soil Description	PID units
B-17	*-At corner of building, next to air shaft to boiler room. Exterior, adjacent sump pit in Boiler Room.*		
	0 – 5'	~6-8" topsoil w/ transition to brown/silty clay to 5 ft.	3.3 @ 5'
	5 – 10'	Brown silty clay to 9 ft.	1.5 @ 6'
		Brown med. Sandy clay from 9-10 ft. w/ increase in moisture content to 10 ft.	1.6 @ 10'
		Boiler room floor at -10' BSG.	
	10 – 15'	Brown clayey med. sand to 13 ft.	21.0 @ 13'
		Followed by increase in clay content & moisture content to 15 ft.	308 @ 15'
		Fuel odor present at terminal depth at 15 ft.	
		Boiler room sump pit at approx. 10-12 ft. BSG.	
	15 – 20'	Brown clayey med. sand with fuel odor Present from 15-16 ft. Increased clay	**447 @ 16'**
		Content to brown/tan sandy clay to 19 ft. w/ slight fuel odor to 19 ft.	75.1 @ 19'
		Red/brown wet med. sandy clay, Odor diminished from 19-20 ft.	**22.4 @ 20 ft.**

***Temp 1" well point set to -20', LPH identified at -14.1'; no sample taken. Gauging form completed.**
***Soil sample retained from 16 feet for analysis.**
***Soil sample retained from 20 feet for analysis.**

Boring ID	Depth	Soil Description	PID units
B-18	*-Around corner of building from air shaft. Exterior, adjacent sump pit in Boiler Room.*		
	0 – 5'	~6" topsoil w/ transition to brown sandy clay to 5 ft.	3.8 @ 5'
	5 – 10'	No recovery in liner to 8 ft. due to large gravel in fill material.	2.8 @ 8'
		Brown/tan silty sandy clay to 10 ft.	12.6 @ 10'
		Boiler room floor at -10' BSG.	
	10 – 15'	Brown/tan silty sandy clay to 12 ft.	
		Brown tan med/course sand w/ increased moisture from 12-15 ft.	12.9 @ 13' 24.4 @ 15'
		Boiler room sump pit at approx. 10-12 ft. BSG.	
	15 – 20'	Brown/tan silty clay to 16 ft.	**37.1 @ 16'**
		Wet/saturated brown/tan silty sand to 18 ft. Dk brown/Dk gray	14.4 @ 18'
		silty dense clay to 20ft.	**9.9 @ 20'**

***Temp 1" well point set to -20', LPH identified at -14.3'; no sample taken. Gauging form completed.**
***Soil sample retained from 16 feet for analysis.**
***Soil sample retained from 20 feet for analysis.**

Boring ID	Depth	Soil Description	PID units
B-19	*-Off corner of building, adjacent boiler room. In corner of sidewalk intersection.*		
	0 – 5'	~6" topsoil w/ transition to	0.7 @ 2'
		brown/tan sandy clay to 5 ft.	0.5 @ 5'
	5 – 10'	Brown/tan silty sand w/ increasing	0.4 @ 6'
		Grain size to med. sand at 8-10 ft.	0.3 @ 8'
		Boiler room floor at -10' BSG.	0.4 @ 10'
	10 – 15'	Brown silty med. sand to 12 ft.	11.5 @ 12'
		Brown/gray fine silty sand w/ increased	16.8 @ 14'
		moisture at 14 ft. Brown/red/orange	70.1 @ 15'
		fine sandy clay from 14-15 ft.	
		Boiler room sump pit at approx. 10-12 ft. BSG.	
	15 – 20'	Brown/orange sandy clay to 16 ft.	68.7 @ 16'
		Brown/orange wet/saturated clayey sand	71.7 @ 18'
		from 16-18 ft. Brown/gray med. sandy	**82.5 @ 19'**
		clay to a gray dense silty clay at 18-20 ft.	**4.1 @ 20'**

***Temp 1" well point set to -20', water measured at -14'; water sample taken for analysis.**
***Soil sample retained from 19 feet for analysis.**
***Soil sample retained from 20 feet for analysis.**

Boring ID	Depth	Soil Description	PID units
B-20	*-Across sidewalk, between sidewalk and SD Inlet #4*		
	0 – 5'	~6" topsoil w/ transition to brown	
		sandy clay to 4 ft. Brown/orange	0.8 @ 3'
		clayey med. sand to 5 ft.	2.2 @ 5'
	5 – 10'	Brown/tan clayey medium sand	1.2 @ 8'
		thru-out boring to 10 ft.	1.0 @ 10'
	10 – 15'	Lt. brown/tan clayey med. sand to 13 ft.	14.0 @ 12'
		Brown/tan clayey med. sand w/ increased	
		moisture from 13-14 ft.	**448 @ 14'**
		Brown/red course-med. sandy clay,	
		drier from 14-15 ft.	2.8 @ 15'
		SD piping invert at Inlet #4 at -14.5 ft.	
	15 – 20'	Brown course-med. sandy clay to 16 ft.	6.2 @ 16'
		Wet/Saturated zone of brown fine	
		sandy silt from 16-18 ft.	4.8 @ 18'
		Layered gray/brown clayey sand 18-20 ft.	**5.1 @ 20'**

***Temp 1" well point set to -20', water measured at -13.5'; water sample taken for analysis.**
***Soil sample retained from 14 feet for analysis.**
***Soil sample retained from 20 feet for analysis.**

Boring ID	Depth	Soil Description	PID units
B-21	*-Edge of former UST field, along tree line opposite building.*		
	0 – 5'	~6" topsoil w/ transition to brown silty clay to 5 ft. Layer of crushed red clay brick in boring at ~4.5 ft.	0.1 @ 2' 0.1 @ 5'
	5 – 10'	Brown silty sandy clay thru-out boring to 10 ft.	0.2 @ 6' 0.2 @ 8'
	10 – 14'	Brown silty sandy clay to Refusal on old concrete tank pad at 14 ft. Former UST concrete pad at 14' BSG	**0.9 @ 10'** 0.0 @ 14'
		***Soil sample retained from 10 feet for analysis.**	

Boring ID	Depth	Soil Description	PID units
B-22	*-6 ft. offset from B-21 into tree line to miss concrete tank pad.*		
	0 – 5'	~6" topsoil w/ brown silty clay thru-out to 5 ft.	0.0 @ 3' 0.0 @ 5'
	5 – 10'	Brown silt clay thru-out boring to 10 ft.	0.0 @ 8' 0.0 @ 10'
	10 – 15'	Brown silty clay as above to 12 ft. ~4" seam of dense gray clay at 12.5' Red/brown seam of silty course sand & crushed sandstone from 12.5-14.5 ft. Dense brown/gray silty clay, increase Moisture from 14.5-15 ft.	4.3 @ 12' **36.0 @ 14.5'** 18.6 @ 15'
	15 – 20'	Brown wet sandy clay to 16 ft. Brown, dense silty clay from 16-18.5 ft. Brown/red silty clay to 20 ft.	19.6 @ 16' 6.8 @ 18' **6.3 @ 20'**

***Temp 1" well point set to -20', water measured at -14'; water sample taken for analysis.**
***Soil sample retained from 14.5 feet for analysis.**
***Soil sample retained from 20 feet for analysis.**

Boring ID	Depth	Soil Description	PID units
B-23	*-Edge of current UST field at edge of tree line*		
	0 – 5'	~18" topsoil w/ transition to brown silty clay to 5 ft.	0.0 @ 5'
	5 – 10'	No Recovery, pea-gravel from edge of tank fill backfill did not remain in liner	--- @ 5-10'
	10 – 15'	Pea-gravel fall in from above to 13 ft. Brown/tan fine sandy clay from 13-15 ft. Existing UST tank bottoms at 10.5' BSG	1.6 @ 13' 0.9 @ 15'
	15 – 20'	Brown/tan silty sandy clay to 18 ft. Brown/red med. sandy clay w/ Increased moisture approaching 20 ft. Refusal at 20 ft. in dense red clay.	19.4 @ 18' **179.8 @ 19'** **22.9 @ 20'**

***Pea-gravel fill collapsed boring to -10'; no well point installed.**
***Soil sample retained from 19 feet for analysis.**
***Soil sample retained from 20 feet for analysis.**

Boring ID	Depth	Soil Description	PID units
B-24	*-Adjacent North side of Bldg. boiler room, between side walk & air shaft*		
	0 – 5'	~6" topsoil w/ brown/lt. brown course silty sand thru-out to 5 ft.	0.0 @ 3' 0.5 @ 5'
	5 – 10'	Brown course silty sand to 10 ft.	0.3 @ 8' 0.1 @ 10'
	10 – 15'	Brown/Tan silty sand to 12 ft. Clay content & moisture increasing to brown/gray course sandy clay from 12-15 ft.	**0.1 @ 12'** 0.0 @ 15'
	15 – 20'	Brown/gray sandy clay w/ increased to 16 ft., then transition to black/gray organic silty clay to refusal at 20 ft.	0.1 @ 16' **0.2 @ 20'**

***Temp 1" well point set to -20', water measured at -13'; water sample taken for analysis.**
***Soil sample retained from 12 feet for analysis.**
***Soil sample retained from 20 feet for analysis.**

Boring ID	Depth	Soil Description	PID units
B-25	*-Across sidewalk, off North bldg. corner, between sewer & water lines, next to small tree*		
	0 – 5'	~6" topsoil over brown silty sand w/ transition to brown/tan clayey course sand to 5 ft.	0.2 @ 5'
	5 – 10'	Brown/tan clayey course sand thru-out to 10 ft.	0.1 @ 8' 0.1 @ 10'
	10 – 15'	Brown/tan clayey course sand w/ increasing moisture and transition to gray sandy clay to 15 ft.	**0.2 @ 12'** 0.0 @ 15'
	15 – 20'	Brown/gray course sandy clay w/ saturation in silty/sandy layer at 18 ft. Dense gray sandy silty from 18-20 ft.	0.6 @ 18' **0.3 @ 20'**

***Temp 1" well point set to -20', water measured at -12.9'; water sample taken for analysis.**
***Soil sample retained from 12 feet for analysis.**
***Soil sample retained from 20 feet for analysis.**

Boring ID	Depth	Soil Description	PID units
B-26	*-Across sidewalk, next to Storm Drain Inlet No. 4*		
	0 – 5'	~6" topsoil over brown/tan course clayey sand to 5 ft.	0.1 @ 5'
	5 – 10'	No Recovery from 5-15 ft. Material too wet & sandy to recover in liner.	
	10 – 15'	No Recovery from 5-15 ft. Material too wet & sandy to recover in liner.	
	15 – 20'	Wet, saturated clayey med. sand to 20 ft. Standing water in liner At 18-19 ft.	**0.8 @ 16'** **0.5 @ 20'**

***Temp 1" well point set to -20', water measured at -12.15'; water sample taken for analysis.**
***Soil sample retained from 20 feet for analysis.**

Boring ID	Depth	Soil Description	PID units
B-27	*-Top of slope, between sidewalk and tree line*		
	0 – 5'	~6" topsoil over brown course/med sandy clay to 5 ft.	0.1 @ 5'
	5 – 10'	Brown course/med sandy clay to 9 ft.	0.2 @ 8'
		Mixed sandy/ gravel fill layer 9-10 ft.	0.2 @ 9'
		Brown/tan/gray silty clay with bands of course sand/decayed sandstone, small angular stone to 10 ft.	0.3 @ 10'
	10 – 15'	Brown/tan mixed sandy clay w/ trans to clayey course sand to 12 ft.	**0.2 @ 12'**
		Increased moisture & clay content from 12-15 ft.	0.3 @ 15'
	15 – 20'	Brown/red wet clayey med. sand to 18 ft.	0.2 @ 16'
		Trans to layer of fine brown/gray sandy silt. Saturated w/ standing water in liner from 18-19 ft. Brown/gray clayey med sand to 20 ft.	0.4 @ 18'
			0.4 @ 20'

***Temp 1" well point set to -20', water measured at -12.5'; water sample taken for analysis.**
***Soil sample retained from 12 feet for analysis.**
***Soil sample retained from 20 feet for analysis.**

Boring ID	Depth	Soil Description	PID units
B-28	*-Base of slope, below UST area, behind backstop.*		
	0 – 5'	Mixed topsoil & course organics From surface to 12". Brown/Red wet clayey med. sand from 1-5 ft.	0.0 @ 5'
	5 – 10'	Brown/red/gray clayey med sand	0.5 @ 6'
		w/ increasing moisture w/ depth	0.5 @ 8'
		and standing water in liner @ 10 ft.	**0.6 @ 10'**
	10 – 13.5'	Brown/red clayey med sand w/ increasing clay content to	
		refusal at 13.5 ft. (liner collapse)	**0.4 @ 13.5'**

***Temp 1" well point set to -13', water measured at -2.5'; water sample taken for analysis.**
***Soil sample retained from 10 feet for analysis.**
***Soil sample retained from 13.5' for analysis**

MONITORING WELL SAMPLING FORM

Project Name: Bates Middle School
Project #: Case # 18-0559 AA
Well Condition: Geoprobe Temp well

Well #: Boring B-15
Gauging Method: Interface probe
Measure Reference: 0.01'

GAUGING: Date: 3/19/19 Time: 10:35 Well Dia: 1"

Depth to Liquid: 14.48'
Depth to Water: 15.47'
Free Product: 0.99'
Liquid Volume: 0.22 gallons (x3)

Well Depth: 20'
Liquid Depth: 5.52'
Gallons/Foot: 0.04

(11.88" LPH)

1" dia. = 0.04 gpf 2" dia. = 0.16 gpf 3" dia. = 0.37 gpf 4" dia. = 0.67 gpf 6" dia. = 1.47 gpf

PURGING: Date: _____ Start Time: _____ End Time: _____

Liquid Volume: _____
Purge Volume (3x liquid volume): _____
Purge Method: _____
Comments: _____

Purge Rate: _____
Purge Time: _____

SAMPLING: Date: _____ Time: _____

Sample Type: _____
Sample Container Type: _____
Number of Samples Collected: _____
Preservative: _____
Analytical Parameters: _____

COMMENTS: 11.88" LPH

GAUGED BY: S. Alexander

SAMPLED BY: N/A

MONITORING WELL SAMPLING FORM

Project Name: Bates Middle School
Project #: Case # 18-0559 AA
Well Condition: Geoprobe Temp well

Well #: Boring B-15
Gauging Method: Interface Probe
Measure Reference: 0.01'

GAUGING: Date: 4/4/19 Time: 11:55 Well Dia: 1"

Depth to Liquid: 14.48'
Depth to Water: 15.48'
Free Product: 1.00'
Liquid Volume: 0.22 gallons (x3)

Well Depth: 20'
Liquid Depth: 5.52'
Gallons/Foot: 0.04

1" dia. = 0.04 gpf 2" dia. = 0.16 gpf 3" dia. = 0.37 gpf 4" dia. = 0.67 gpf 6" dia. = 1.47 gpf

PURGING: Date:_____ Start Time:_____ End Time:_____

Liquid Volume:_____
Purge Volume (3x liquid volume):_____
Purge Method:_____
Comments:_____

Purge Rate:_____
Purge Time:_____

SAMPLING: Date:_____ Time:_____

Sample Type:_____
Sample Container Type:_____
Number of Samples Collected:_____
Preservative:_____
Analytical Parameters:_____

COMMENTS: 12.00" LPH

GAUGED BY: S. Alexander

SAMPLED BY: N/A

MONITORING WELL SAMPLING FORM

Project Name: Bates Middle School
Project #: Case # 18-0559 AA
Well Condition: Geoprobe temp well

Well #: Boring B-17
Gauging Method: interface probe
Measure Reference: 0.01'

GAUGING: Date: 3/19/19 Time: 10:37 Well Dia: 1"

Depth to Liquid: 14.11'
Depth to Water: 15.70'
Free Product: 1.59'
Liquid Volume: 0.24 gallons (x3)

Well Depth: 20'
Liquid Depth: 5.89'
Gallons/Foot: 0.04

1" dia. = 0.04 gpf 2" dia. = 0.16 gpf 3" dia. = 0.37 gpf 4" dia. = 0.67 gpf 6" dia. = 1.47 gpf

PURGING: Date:_____ Start Time:_____ End Time:_____

Liquid Volume:_____
Purge Volume (3x liquid volume):_____
Purge Method:_____
Purge Rate:_____
Purge Time:_____
Comments:_____

SAMPLING: Date:_____ Time:_____

Sample Type:_____
Sample Container Type:_____
Number of Samples Collected:_____
Preservative:_____
Analytical Parameters:_____

COMMENTS: 19.08" LPH

GAUGED BY: S. Alexander

SAMPLED BY: N/A

MONITORING WELL SAMPLING FORM

Project Name: Bates Middle School
Project #: Case # 18-0559 AA
Well Condition: Geoprobe Temp Well

Well #: Boring B-17
Gauging Method: Interface probe
Measure Reference: Ground

GAUGING: Date: 4/4/19 Time: 11:57 Well Dia: 1"

Depth to Liquid: 14.12'
Depth to Water: 15.68
Free Product: 1.56'
Liquid Volume: 0.24 gallons (x3)

Well Depth: 20'
Liquid Depth: 5.88'
Gallons/Foot: 0.04

1" dia. = 0.04 gpf 2" dia. = 0.16 gpf 3" dia. = 0.37 gpf 4" dia. = 0.67 gpf 6" dia. = 1.47 gpf

PURGING: Date: _____ Start Time: _____ End Time: _____

Liquid Volume: _____
Purge Volume (3x liquid volume): _____
Purge Method: _____
Comments: _____

Purge Rate: _____
Purge Time: _____

SAMPLING: Date: _____ Time: _____

Sample Type: _____
Sample Container Type: _____
Number of Samples Collected: _____
Preservative: _____
Analytical Parameters: _____

COMMENTS: 18.72" LPH

GAUGED BY: S. Alexander

SAMPLED BY: N/A

MONITORING WELL SAMPLING FORM

Project Name: Bates Middle School
Project #: MDE Case# 18-0559 AA
Well Condition: Geoprobe temp well

Well #: Boring B-18
Gauging Method: Interface probe
Measure Reference: 0.01'

GAUGING: Date: 3/19/19 Time: 10:40 Well Dia: 1"

Depth to Liquid: 14.34'
Depth to Water: 14.71'
Free Product: 0.37'
Liquid Volume: 0.23 gallons (x3)

Well Depth: 20'
Liquid Depth: 5.66'
Gallons/Foot: 0.04

1" dia. = 0.04 gpf 2" dia. = 0.16 gpf 3" dia. = 0.37 gpf 4" dia. = 0.67 gpf 6" dia. = 1.47 gpf

PURGING: Date:_____ Start Time:_____ End Time:_____

Liquid Volume:_____
Purge Volume (3x liquid volume):_____
Purge Method:_____
Comments:_____

Purge Rate:_____
Purge Time:_____

SAMPLING: Date:_____ Time:_____

Sample Type:_____
Sample Container Type:_____
Number of Samples Collected:_____
Preservative:_____
Analytical Parameters:_____

COMMENTS: 4.44" LPH

GAUGED BY: S. Alexander

SAMPLED BY: N/A

MONITORING WELL SAMPLING FORM

Project Name: Bates Middle School
Project #: MDE Case # 18-0559 AA
Well Condition: Geoprobe temp well

Well #: Boring B-18
Gauging Method: interface probe
Measure Reference: 0.01'

GAUGING: Date: 4/4/19 Time: 12:00 Well Dia: 1"

Depth to Liquid: 14.30'
Depth to Water: 14.85'
Free Product: 0.55'
Liquid Volume: 0.23 gallons (x3)

Well Depth: 20'
Liquid Depth: 5.70'
Gallons/Foot: 0.04

1" dia. = 0.04 gpf 2" dia. = 0.16 gpf 3" dia. = 0.37 gpf 4" dia. = 0.67 gpf 6" dia. = 1.47 gpf

PURGING: Date:_____ Start Time:_____ End Time:_____

Liquid Volume:_____
Purge Volume (3x liquid volume):_____
Purge Method:_____
Purge Rate:_____
Purge Time:_____
Comments:_____

SAMPLING: Date:_____ Time:_____

Sample Type:_____
Sample Container Type:_____
Number of Samples Collected:_____
Preservative:_____
Analytical Parameters:_____

COMMENTS: 6.6" CPH

GAUGED BY: S. Alexander

SAMPLED BY: N/A

Appendix D
Analytical Reports/Chain of Custody