Bristol
ENVIRONMENTAL
REMEDIATION SERVICES, LLC

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TECHNICAL MEMORANDUM

DATE: April 18, 2016
TO: Bob Egan, SME, EPA Region 5
FROM: Matt Faust, Project Manager
Bristol Environmental Remediation Services, LLC
RE: EPA Contract No. EP-W-12-009, Task Order (TO) 2012
Tower Standard Site, Lac du Flambeau Reservation, Wisconsin
March and April 2016 Site Investigation, Rev 0

The U.S. Environmental Protection Agency (EPA) retained Bristol Environmental Remediation Services, LLC (Bristol) to prepare this technical memorandum (tech memo) under EPA Contract EP-W-12-009, Task Order (TO) 2012. This tech memo briefly summarizes site activities conducted in March and April 2016, at a leaking underground storage tank (LUST) site in Lac du Flambeau, Wisconsin, on the Lac du Flambeau (LDF) Reservation. The site is referred to as the Tower Standard Site.

Unless otherwise noted, all work was performed in compliance with the Quality Assurance Project Plan (Bristol, 2015), Site Investigation Work Plan (Bristol, 2016a), and Site Safety and Health Plan (Bristol, 2016b).

SITE ACTIVITIES

On March 30 and March 31, 2016, Bristol subcontractor Coleman Engineering Company, advanced six soil borings, 16BH01 – 16BH06, using direct push drilling technology. Borings were advanced at locations selected in the field following consultation with the EPA subject matter expert (SME) and the LDF Tribal representative (Figure 1). Latitude and longitude for each soil boring is presented on Table 1.

Table 1 Soil Boring Locations

Soil Boring ID	Date Drilled	Latitude (degrees north)	Longitude (degrees west)	Total Depth (feet bgs)
16BH-01	3/30/16	45.913713467	89.913093495	30
16BH-02	3/30/16	45.913730490	89.913159829	30
16BH-03	3/30/16	45.913683436	89.913124832	20
16BH-04	3/31/16	45.913698811	89.912972296	20
16BH-05	3/31/16	45.913662247	89.913051165	30
16BH-06	3/31/16	45.913606619	89.913215927	20

Notes:
Datum is WGS84
bgs = below the ground surface ID = identification

Bristol personnel logged the soil borings for lithology, collected in-situ photoionization detector readings, and collected soil analytical samples at depth intervals selected by the EPA SME and LDF Tribal representative. Ten primary soil samples and one duplicate soil sample were collected from the six boring locations. Soil samples were hand delivered to Pace Analytical Services, Inc. (Pace) in Minneapolis, Minnesota, for analysis of volatile organic compounds (VOCs) (including methyl tertiary-butyl ether), polynuclear aromatic hydrocarbons (PAHs), diesel range organics (DRO), gasoline range organics (GRO), and the eight Resource Conservation and Recovery Act (RCRA) metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver). Full analytical results were not received in time for inclusion in this tech memo. Once the analytical report is complete, Pace will email an electronic copy to the EPA SME. Table 2 presents collection date and time, associated soil borings, and depth intervals for all soil samples.

Table 2 Laboratory Analytical Soil Sample Information

Date Collected	Time Collected	Soil Boring ID	Depth Interval (feet bgs)	Sample ID
3/30/16	1300	16BH-01	11-13	16TSSL01
3/30/16	1430	16BH-02	10-12	16TSSL02
3/30/16	1500	16BH-02	22-24	16TSSL03
3/30/16	1640	16BH-03	7-10	16TSSL04
3/30/16	1710	16BH-03	13-15	16TSSL05
3/31/16	0930	16BH-04	8-10	16TSSL06
3/31/16	0945	16BH-04	0.5-2.5	16TSSL07
3/31/16	1000	16BH-05	1.5-5	16TSSL08
3/31/16	1020	16BH-05	10-15	16TSSL09
				16TSSL10†
3/31/16	1130	16BH-06	15-20	16TSSL11

Notes:
† = indicates duplicate sample
bgs = below the ground surface
ID = identification

Bristol also collected groundwater samples from four existing monitoring wells: two wells at the MW-16 location (one shallow and one deep) and two wells at the MW-20 location (one shallow and one deep) (Figure 1). MW-16 locations were sampled on March 29, 2016, and MW-20 locations were sampled on April 3, 2016. Wells were sampled with a bladder pump using a low-flow groundwater sampling technique. Four primary groundwater samples and one duplicate were hand delivered to Pace to be analyzed for VOCs, sulfate, nitrate, manganese, and iron. Full analytical results were not received in time for inclusion in this tech memo. Once the analytical report is complete, Pace will email an electronic copy to the EPA SME. Groundwater sample information is presented in Table 3.

Table 3 Laboratory Analytical Groundwater Sample Information

Date Collected	Time Collected	Monitoring Well ID	Pump Depth (feet BTOC)	Sample ID
3/29/16	1030	MW-16	4	16TSGW01
3/29/16	1245	MW-16D	39.5	16TSGW02
				16TSGW03†
4/3/16	1010	MW-20	9	16TSGW04
4/3/16	1135	MW-20D	22.5	16TSGW05

Notes:
† = indicates duplicate sample
BTOC = below the top of casing
ID = identification

Bristol also collected one sub-slab vapor sample and one indoor and one outdoor ambient air sample. The sub-slab sample was collected at the bait shop located at the former service station. Bristol installed a reusable port through the floor to allow for future sampling events. Following successful shut-in and helium tracer gas leak detection tests, the sub-slab vapor sample (16TSSV01) was collected into a one-liter SUMMA canister fitted with a 200-milliliter per minute flow controller. Bristol collected one indoor ambient air sample (16TSAA01) inside the bait shop and one outdoor ambient air sample (16TSAA02) on the southwest wall of the garage structure. Ambient air sample locations were selected in the field following consultation with the EPA SME and the LDF Tribal representative. Outdoor and indoor ambient air samples were collected over a 24-hour period into 6-liter SUMMA canisters fitted with flow controllers provided by the laboratory. All air samples were submitted to Pace Analytical for VOC analysis by method TO-15. Full analytical results were not received in time for inclusion in this tech memo. Once the analytical report is complete, Pace will email an electronic copy to the EPA SME. Air sample information is presented in Table 4.

Table 4 Laboratory Analytical Air Sample Information

Start Date	Start Time	Sample ID	Location	Sample Type
3/31/16	1759	16TSAA01	Bait shop interior	24-hour ambient air
3/31/16	1810	16TSAA02	Bait shop exterior, SW wall	24-hour ambient air
4/1/16	1719	16TSSV01	Bait shop interior sub-slab probe	5 minute soil vapor

One 55-gallon drum of investigation-derived waste (purge water from groundwater sampling and decontamination fluids) was generated during site activities. The drum is labeled and staged at site for future transport and disposal.

Figures are included as Attachment 1 to this tech memo. Figure 1 is a site map depicting soil boring locations, monitoring well locations, and cross section lines. Figures 2 and 3 are cross sections highlighting groundwater analytical data. Figures 4 and 5 are cross sections highlighting soil analytical data. The cross sections were generated previously but have been updated to include the locations of soil borings and soil samples from this field effort.

The field book and field forms are included as Attachment 2. Soil boring logs are included as Attachment 3.

SUMMARY AND CONCLUSIONS

Petroleum hydrocarbons are present at concentrations that are influencing groundwater at the site. The petroleum hydrocarbons are present in soils in three zones: unsaturated vadose zone soils, smear zone soils, and saturated soils below the smear zone. Groundwater in the area of the release is approximately 8.5 feet below the ground surface (bgs). The smear zone is assumed to be from 8.5 feet to 10 feet bgs.

The extent of contamination in the unsaturated zone is fairly well defined. The extent of contamination in the smear zone is not as well defined as the contamination in the unsaturated zone but is assumed to extend beyond the footprint of the contaminated

unsaturated soils. The horizontal and vertical extents of contaminated saturated soils are unknown. There has been limited soil sample collection in the saturated soils. Soil sample collection in the saturated soils is also hampered by heaving sands. The presence of fine-grained soil, especially clay, interspersed within the sand and gravel are zones where petroleum hydrocarbons can readily adsorb onto the soil particles and become long term sources to the dissolved phase groundwater plume. See the boring log for boring 16BH02 at a depth of 19 to 20 feet for an example of a clay inclusion (Attachment 3).

The horizontal extent of dissolved phase groundwater contamination is not fully characterized, primarily on the east side of the site. The vertical extent of groundwater contamination is also not fully characterized. The movement of groundwater across the site is not fully understood especially the variations in vertical movement of contaminants as well as the interaction of the groundwater plume with Haskell Lake. The fate and transport of contaminants is not understood, especially the geochemistry of the aquifer and the contaminants effects on the geochemistry. Impacts from groundwater to the sediment and surface water are unknown at this time.

RECOMMENDATIONS

This section contains recommendations for further soil, groundwater, sediment, and surface water investigation activities as well as near term remedial actions and discusses possible future remedial approaches.

Near-term groundwater investigation activities include installing two monitoring wells and further soil and groundwater characterization. One well would be a deep monitoring well near MW-16 and MW-16D. The new, deep well would be screened just above the bedrock and provide information on the concentrations at the bottom of the unconsolidated aquifer where the groundwater flows beneath Haskell Lake.

Based on previous investigations the maximum groundwater concentration of benzene was found in MW-20D (Figures 2 and 3). This well is screened at a depth of 20 to 25 feet, or an elevation of 1,550 feet above mean sea level. The wells MW-21 and MW-21D are located near the presumed source area but are screened above and below this depth. A monitoring well located near MW-21 but screened at the similar elevation to MW-20D (approximately 25 feet bgs) would provide information on concentrations in the suspected center of the plume.

Further characterization of the extents of saturated soil contamination and groundwater contamination is recommended. The objectives of this characterization would be to define the horizontal and vertical extent of groundwater contamination as well as to collect additional information on saturated soil contamination and possibly identify clay inclusions that are acting as long-term source areas in saturated soils.

The subsurface investigation can be conducted using direct push drilling equipment and a membrane interface probe (MIP). MIP provides a rapid, in the field, semi-quantitative estimate of contamination. The MIP works by heating the soil and groundwater and the volatiles enter the probe through a semipermeable membrane where the volatiles are transferred via a carrier gas to the surface where the gas can be analyzed by a variety of analytical instruments. MIP probes typically also have a soil conductivity measurement tip which can be used to differentiate between different soil types. Another option is to include a hydraulic profiling tool that can provide estimates of hydraulic conductivity. The MIP collects data continuously as the probe is being pushed. A MIP profile log is then generated in the field and can be used to guide the investigation.

Following the installation of the two deep wells and the MIP investigation the second phase of the characterization can be planned. Activities in this phase would include installation of additional wells to confirm the MIP findings and installation of upgradient wells, as needed.

Potential impacts to Haskell Lake can be investigated by collected pore water samples in the lake sediment. It is recommended that this work be performed in the winter when ice thickness is sufficient to support drilling equipment.

As an interim removal action, the area of unsaturated zone soils and possibly some of the smear zone soils can be excavated and disposed of in a landfill or some other ex situ treatment may be possible that would not require disposal in a landfill (for example, land farming).

After further characterization has occurred and the extent of soil and groundwater contamination is better understood, appropriate remedial technologies can be considered. This includes targeting source zone areas with enhanced biodegradation or chemical oxidation. The dissolved phase plume can also be treated with enhanced biodegradation. This enhanced biodegradation can include addition of an oxygen release compound or the injection of a liquid activated carbon material such as PlumeStop. Petroleum hydrocarbons will sorb onto the liquid activated carbon and then carbon provides surface area for microbes to grow and destroy mass.

REFERENCES

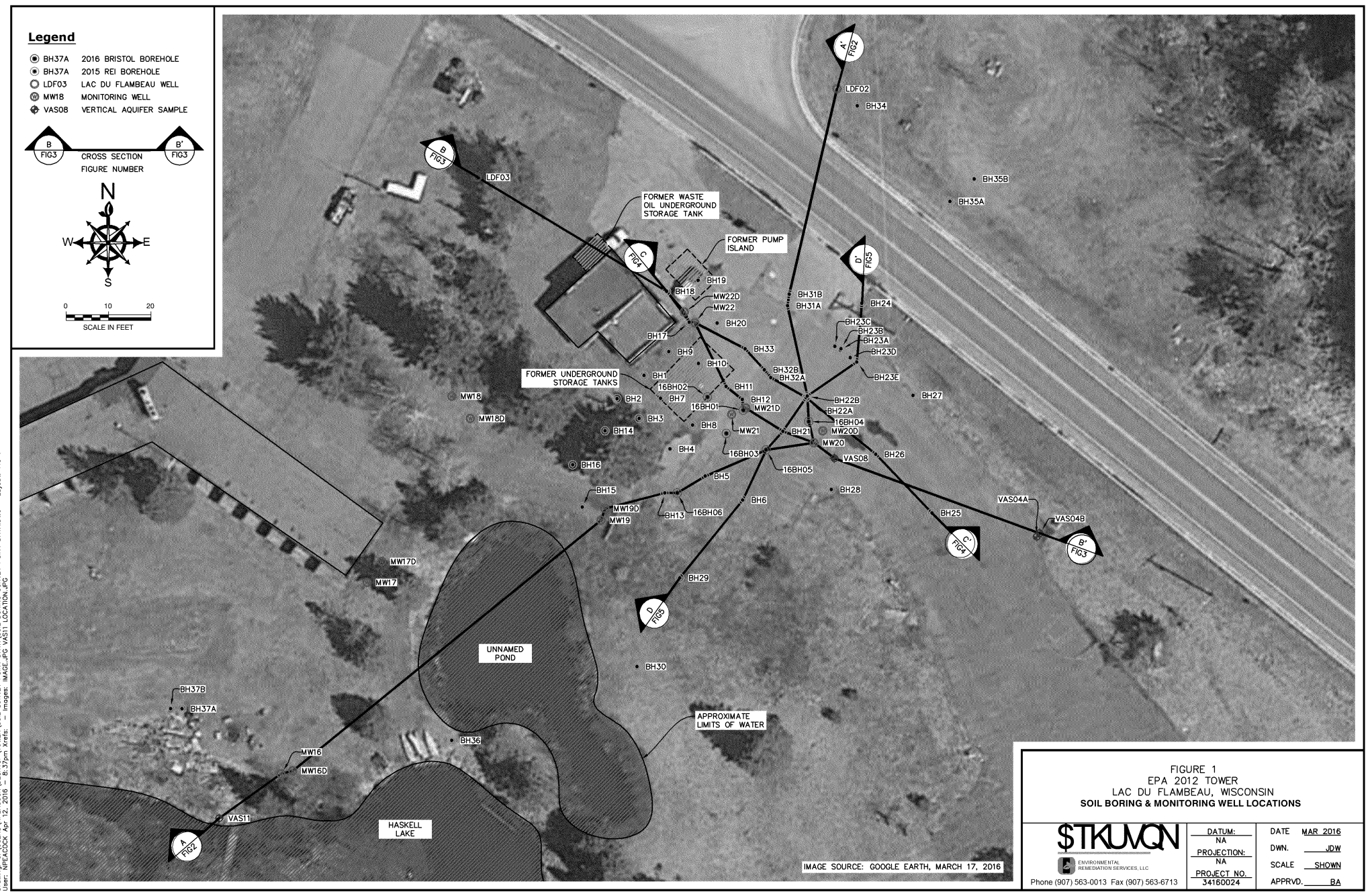
Bristol Environmental Remediation Services, LLC (Bristol). (2015). Final Quality Assurance Project Plan. Revision 1. LUST Sites in Indian Country, EPA Region 5: EPA.

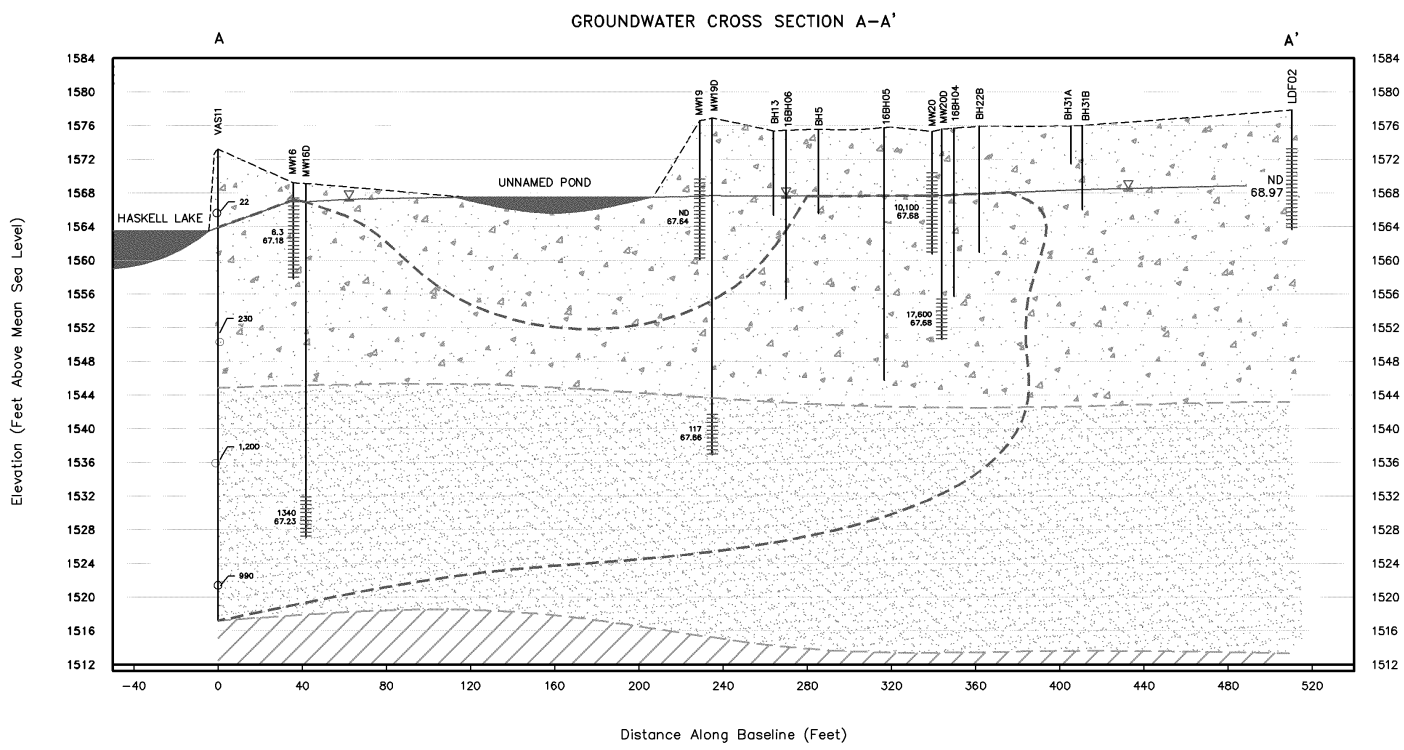
Bristol. (2016a). Site Investigation Work Plan, Tower Standard LUST Site. Revision 1. Task Order 2012. Lac du Flambeau Reservation: EPA.

Bristol. (2016b) Site Safety and Health Plan, Tower Standard LUST Site. Revision 2. Task Order 2012. Lac du Flambeau Reservation: EPA.

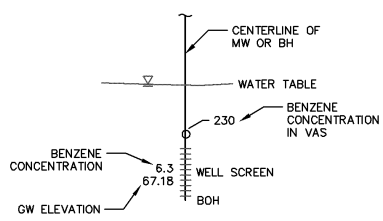
ATTACHMENT 1

Figures


Legend
BH37A 2016 BRISTOL BOREHOLE
BH37A 2015 REI BOREHOLE
LDF03 LAC DU FLAMBEAU WELL
MW18 MONITORING WELL
VAS08 VERTICAL AQUIFER SAMPLE
B FIG3
B' FIG3
CROSS SECTION FIGURE NUMBER
N
W
E
S
0 10 20
SCALE IN FEET
A FIG2
A' FIG2
B FIG3
B' FIG3
C FIG4
C' FIG4
D FIG5
D' FIG5
LDF02
BH34
BH35B
BH35A
LDF03
FORMER WASTE OIL UNDERGROUND STORAGE TANK
FORMER PUMP ISLAND
BH19
BH18
MW22D
MW22
BH20
BH17
BH9
BH10
BH33
BH31B
BH31A
BH24
BH23C
BH23B
BH23A
BH23D
BH23E
BH32B
BH32A
FORMER UNDERGROUND STORAGE TANKS
BH1
16BH02
BH11
BH12
MW21D
16BH01
BH7
BH2
BH3
BH8
MW21
BH14
BH4
16BH03
BH21
MW20D
MW20
VAS08
BH26
16BH05
BH22B
BH22A
16BH04
BH27
MW18
MW18D
BH16
BH5
BH15
MW19D
MW19
BH13
16BH06
BH6
BH28
BH25
VAS04A
VAS04B
MW17D
MW17
BH29
UNNAMED POND
BH30
BH37B
BH37A
APPROXIMATE LIMITS OF WATER
BH36
MW16
MW16D
VAS11
HASKELL LAKE
IMAGE SOURCE: GOOGLE EARTH, MARCH 17, 2016
FIGURE 1
EPA 2012 TOWER
LAC DU FLAMBEAU, WISCONSIN
SOIL BORING & MONITORING WELL LOCATIONS
$TKUVQN
ENVIRONMENTAL REMEDIATION SERVICES, LLC
Phone (907) 563-0013 Fax (907) 563-6713
DATUM: NA
PROJECTION: NA
PROJECT NO. 34160024
DATE MAR 2016
DWN. JDW
SCALE SHOWN
APPRVD. BA
Drawing: C:\USERS\NPEACOCK\DESKTOP\TOWER\SOIL SURVEY POINT DATA\SOIL BORING SURVEY POINT DATA.DWG – Layout: FIG 1
User: NPEACOCK Apr 12, 2016 – 8:37pm Xrefs: – Images: IMAGE_JPG VAS11 LOCATION.JPG



Boring or Well Diagram



0 30 60
SCALE IN FEET HORIZONTAL

0 7.5 15
SCALE IN FEET VERTICAL (4X)

Abbreviations

BH	BOREHOLE
BOH	BOTTOM OF HOLE
LDF	LAC DU FLAMBEAU WELL
GW	GROUNDWATER
MW	MONITORING WELL
ND	NOT DETECTED
PID	PHOTOIONIZATION DETECTOR
PPM	PARTS PER MILLION
VAS	VERTICAL AQUIFER SAMPLE

Legend

- SAND AND GRAVEL
- SAND
- BEDROCK
- APPROXIMATE SHALLOW WATER TABLE
- EXISTING GROUND
- APPROXIMATE LIMITS OF CONTAMINATION

Notes

1. BENZENE RESULTS ARE IN $\mu g/L$.
2. PID READINGS ARE IN PPM.
3. VAS11 BENZENE RESULTS ARE FROM DECEMBER 2013.
4. MONITORING WELL DATA FROM NOVEMBER 2015.
5. WATER TABLE ELEVATION SHOWN IS BASED ON SHALLOW WELLS.
6. MAXIMUM CONTAMINANT LEVEL FOR BENZENE IS 5 $\mu g/L$.

FIGURE 2
EPA 2012 TOWER
LAC DU FLAMBEAU, WISCONSIN
GROUNDWATER CROSS SECTION A-A'

$TKUVQN
ENVIRONMENTAL REMEDIATION SERVICES, LLC
Phone (907) 563-0013 Fax (907) 563-6713

DATUM: NA	DATE	MAR 2016
PROJECTION: NA	DWN.	JDW
PROJECT NO. 34160024	SCALE	SHOWN
	APPRVD.	BA

Drawing: C:\USERS\NPEACOCK\DESKTOP\TOWER\SOIL SURVEY POINT DATA\SOIL BORING SURVEY POINT DATA.DWG – Layout: FIG 2
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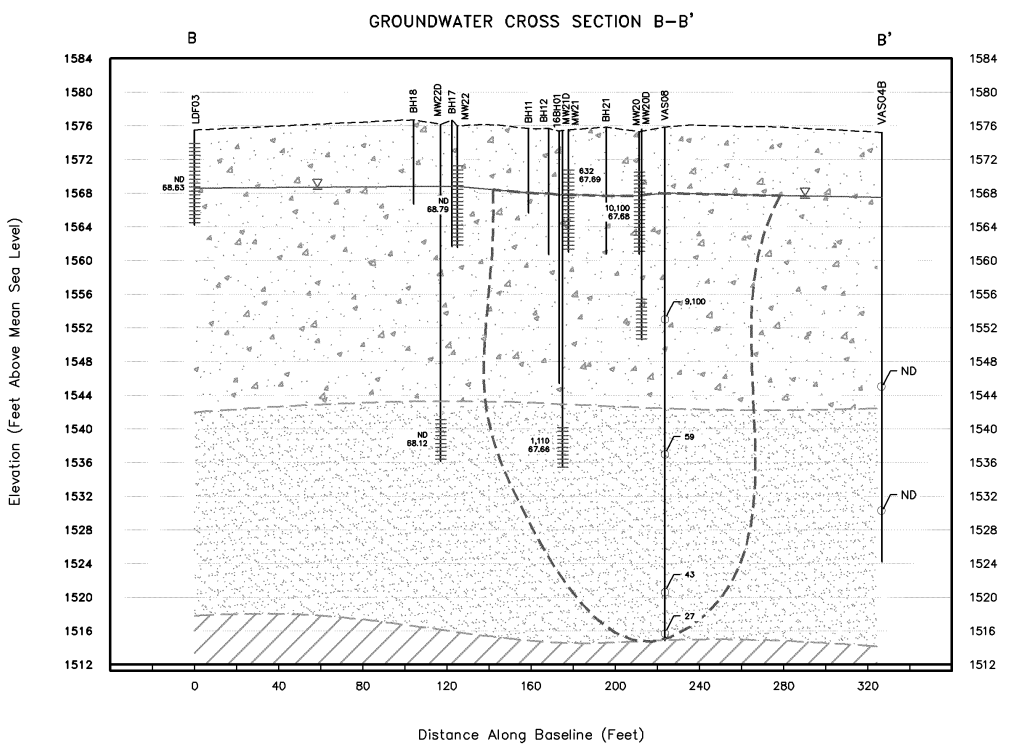
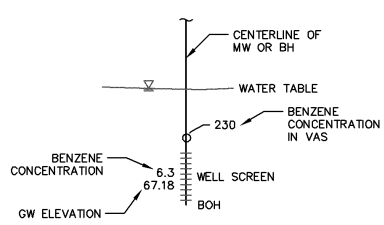


Boring or Well Diagram



0 30 60
SCALE IN FEET HORIZONTAL

0 7.5 15
SCALE IN FEET VERTICAL (4X)

Abbreviations

BH	BOREHOLE
BOH	BOTTOM OF HOLE
LDF	LAC DU FLAMBEAU WELL
GW	GROUNDWATER
MW	MONITORING WELL
ND	NOT DETECTED
PID	PHOTOIONIZATION DETECTOR
PPM	PARTS PER MILLION
VAS	VERTICAL AQUIFER SAMPLE

Legend

- SAND AND GRAVEL
- SAND
- BEDROCK
- APPROXIMATE SHALLOW WATER TABLE
- EXISTING GROUND
- APPROXIMATE LIMITS OF CONTAMINATION

Notes

1. BENZENE RESULTS ARE IN $\mu g/L$.
2. PID READINGS ARE IN PPM.
3. VAS08 & VAS04B BENZENE RESULTS ARE FROM DECEMBER 2013.
4. MONITORING WELL DATA FROM NOVEMBER 2015.
5. WATER TABLE ELEVATION SHOWN IS BASED ON SHALLOW WELLS.
6. MAXIMUM CONTAMINANT LEVEL FOR BENZENE IS 5 $\mu g/L$.

FIGURE 3
EPA 2012 TOWER
LAC DU FLAMBEAU, WISCONSIN
GROUNDWATER CROSS SECTION B-B'

$TKUVQN
ENVIRONMENTAL REMEDIATION SERVICES, LLC
Phone (907) 563-0013 Fax (907) 563-6713

DATUM:	NA
PROJECTION:	NA
PROJECT NO.	34160024
DATE	MAR 2016
DWN.	JDW
SCALE	SHOWN
APPRVD.	BA

Drawing: C:\USERS\NPEACOCK\DESKTOP\TOWER\SOIL SURVEY POINT DATA\SOIL BORING SURVEY POINT DATA.DWG – Layout: FIG 3
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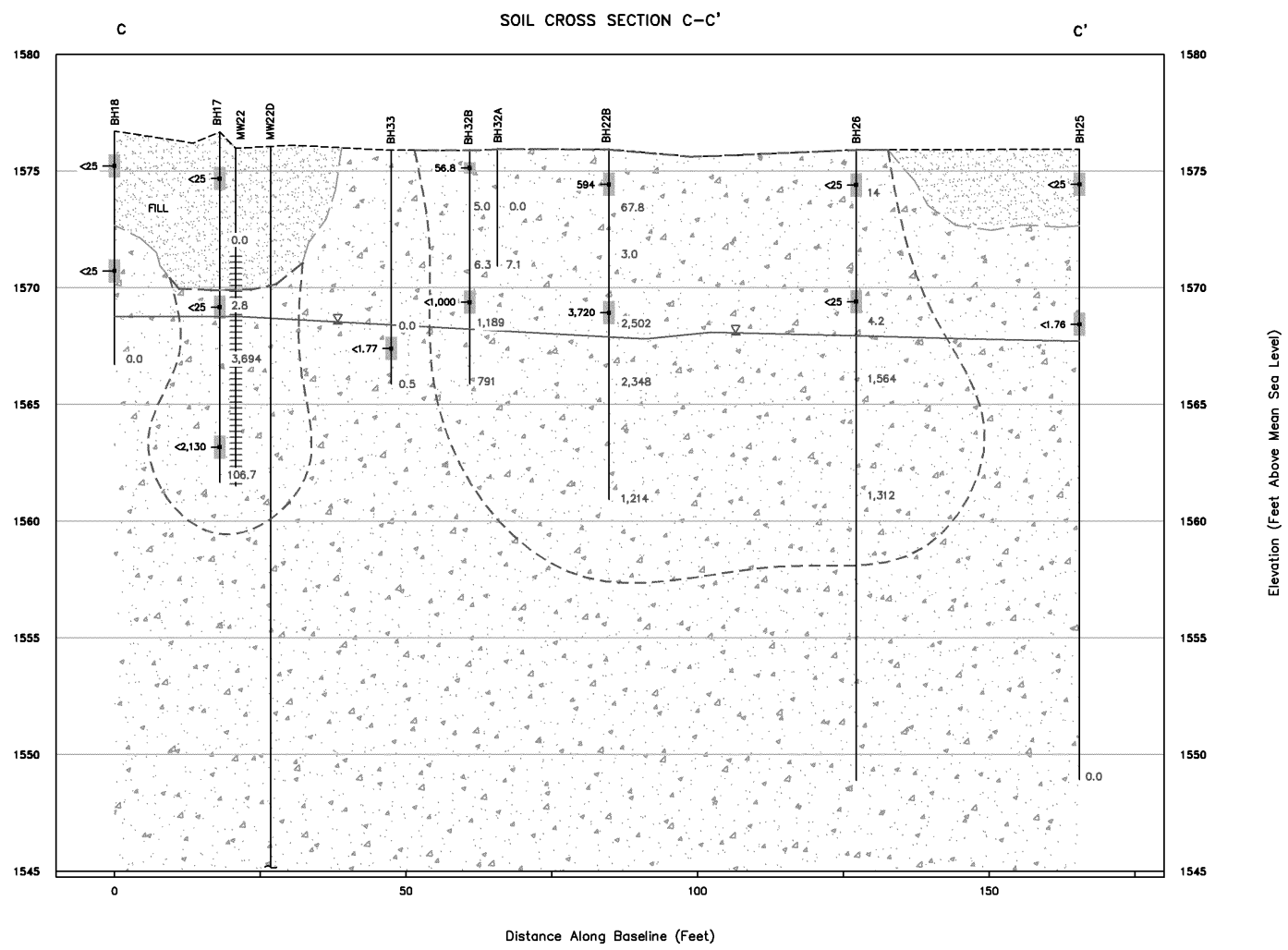
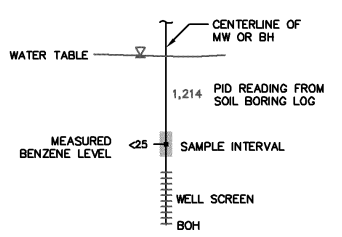


Boring or Well Diagram



SCALE IN FEET HORIZONTAL (0, 10, 20)

SCALE IN FEET VERTICAL (4X) (0, 2.5, 5)

Abbreviations

BH	BOREHOLE
BOH	BOTTOM OF HOLE
LDF	LAC DU FLAMBEAU WELL
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MW	MONITORING WELL
ND	NOT DETECTED
PID	PHOTOIONIZATION DETECTOR
PPM	PARTS PER MILLION
VAS	VERTICAL AQUIFER SAMPLE

Legend

- SAND AND GRAVEL
- SAND
- BEDROCK
- APPROXIMATE SHALLOW WATER TABLE
- EXISTING GROUND
- APPROXIMATE LIMITS OF CONTAMINATION

Notes

1. BENZENE RESULTS ARE IN µg/L.
2. PID READINGS ARE IN PPM.
3. SOIL DATA FROM NOVEMBER 2015.
4. SOIL SCREENING LEVEL IS 5.1 FROM WISCONSIN NR 140 GROUNDWATER PATHWAY PROTECTION.

FIGURE 4
EPA 2012 TOWER
LAC DU FLAMBEAU, WISCONSIN
SOIL CROSS SECTION C-C'

Bristol
ENVIRONMENTAL REMEDIATION SERVICES, LLC
Phone (907) 563-0013 Fax (907) 563-6713

DATUM:	NA
PROJECTION:	NA
PROJECT NO.	34160024
DATE	MAR 2016
DWN.	JDW
SCALE	SHOWN
APPRVD.	BA

Drawing: G:\JOBS\34160024 EPA 2012 TOWER\CAD-ENVIRO\SOIL SURVEY POINT DATA\SOIL BORING SURVEY POINT DATA.DWG – Layout: FIG 4
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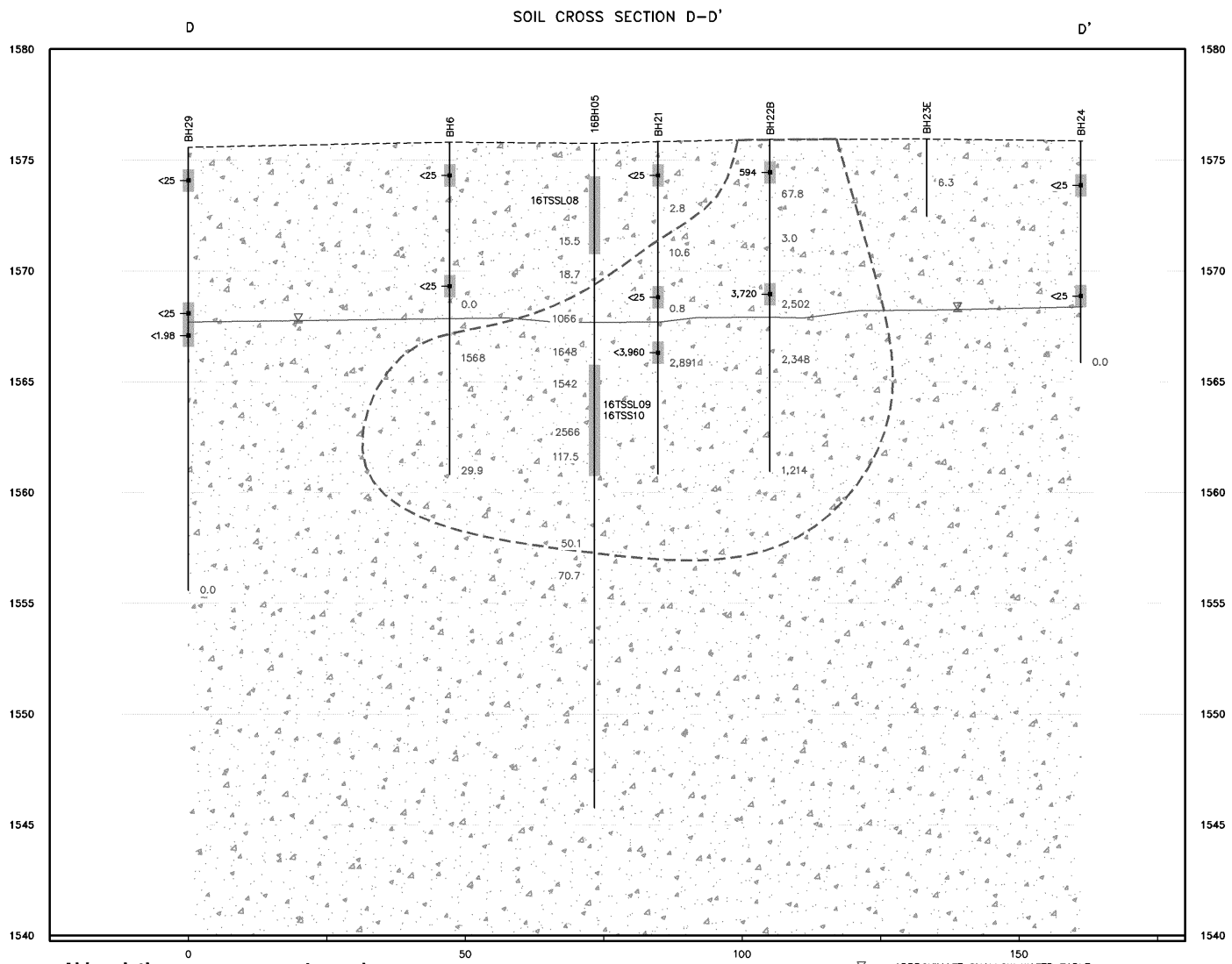
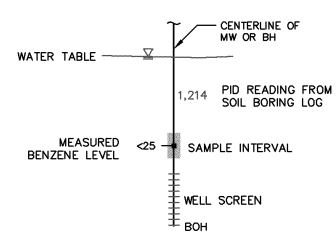


Boring or Well Diagram



0 10 20
SCALE IN FEET HORIZONTAL

0 2.5 5
SCALE IN FEET VERTICAL (4X)

Abbreviations

BH	BOREHOLE
BOH	BOTTOM OF HOLE
LDF	LAC DU FLAMBEAU WELL
GW	GROUNDWATER
MW	MONITORING WELL
ND	NOT DETECTED
PID	PHOTOIONIZATION DETECTOR
PPM	PARTS PER MILLION
VAS	VERTICAL AQUIFER SAMPLE

Legend

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- SAND
- BEDROCK
- APPROXIMATE SHALLOW WATER TABLE
- EXISTING GROUND
- APPROXIMATE LIMITS OF CONTAMINATION

Notes

1. BENZENE RESULTS ARE IN $\mu g/L$.
2. PID READINGS ARE IN PPM.
3. SOIL DATA FROM NOVEMBER 2015.
4. SOIL SCREENING LEVEL IS 5.1 FROM WISCONSIN NR 140 GROUNDWATER PATHWAY PROTECTION.

FIGURE 5
EPA 2012 TOWER
LAC DU FLAMBEAU, WISCONSIN
SOIL CROSS SECTION D-D'

$TKUVQN
ENVIRONMENTAL REMEDIATION SERVICES, LLC
Phone (907) 563-0013 Fax (907) 563-6713

DATUM:	NA
PROJECTION:	NA
PROJECT NO.	34160024
DATE	MAR 2016
DWN.	JDW
SCALE	SHOWN
APPRVD.	BA

Drawing: C:\USERS\NPEACOCK\DESKTOP\TOWER\SOIL SURVEY POINT DATA\SOIL BORING SURVEY POINT DATA.DWG – Layout: FIG 5
User: NPEACOCK Apr 12, 2016 – 8:18pm Xrefs: – Images: IMAGE.JPG VAS11 LOCATION.JPG

ATTACHMENT 2

Field Book and Field Forms

3/27/16 — 31 01 — Tube Stand CA

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J OD \ kPIIA N - f r f

c18 6 - rise 1 1 1 1

Drive to Minoqua - 4.5 hours

Check into Quality Inn, cooler inventory
Bladder pump + tubing from GeoTech,
2 boxes of summa canisters from Pace

FI

34160024

1/a (/V (,

0700 Get bucket & ACE hardware, fill down buckets + spray bottles w/ distilled water

0800 Bristol, Tribal representative and EPA SME on site, review SSHP and toolbox meeting
Decon water level meter and bladder pump with Alconox and distilled water rinse

0922 Begin purge @ MW16 (shallow)
good recovery @ 2.31' BTOC
turbidity dropping steadily from 50 NTU w/ new poly bladder
Discussion w/ Bob Egan (EPA SME) + Matt Faust (Bristol) will do PID measurements for soil boring in situ, rather than in ziplocs to conserve soil volume for sampling

1030 collect 16TSGW01 (MS/MSD)
nitrate, sulfate, VOC, metals (Mn + Fe)
Decon WL meter, pump, install new bladder

1115 Begin purge @ MW16D
Pump set @ 39.5 BTOC (middle of screen)
strong petroleum odor, no sheen, clear
cloudy after ~1 gallon of purge, strong fuel odor
turbidity @ 258 NTU @ sampling

1245 16TSGW02

1300 16TSGW03 duplicate
decon WL meter, YSI, flow through cell, pump

3/29/16

8 gallons of purge water between the 2 wells
cover w/ lids + stage on site for containerization
into 55 gal drum when CEC arrives.
Matt Faust completes Page COC, will hand
deliver tomorrow morning to lab.

1300 – Meeting at Natural Resource Bldg in progress –

1330 Drive to Nat. Resource bldg
Bob Egan, Matt Faust, Bob Aiken (phone)
Kristen Hanten, Larry Wawrzonowicz
Rollover # to be used to install 2 wells,
audit DEC site work, reporting for
current work
Future Task Orders: 5 new wells – screening
prior to determine well placement using MIP
(membrane

1500 Drive to Minoa
Sort coolers
Agree to take PID readings
in-situ to conserve sample
volume, Kristen
and Bob agree

3/30/16

0730 Mob coolers, calibrate PID
0840 Meet with Kristen at Trial office w/ Bob Egan *
0930 Arrive at site with CEC, safety meeting
1000 BH01 SE of MW21D ~3 feet ~30'
1300 Collect 16TSSL01 from 11-13' bgs
PID readings collected in situ – sheen observed
at ~12' bgs w/ highest PID (1740)
Begin BH02 between historic BH8 and BH11 along tank basin
1430 BH02 16TSSL02 10-12' bgs
1500 16TSSL03 22-24' bgs
(sample intervals ok'd with Bob and Kristen)
* reevaluate data gaps – delineation
Bob Egan suggests MIP membrane interface probe
would be better for characterization/delineation of
contamination below the water table. Kristi
agrees. Will focus on volatile/smear contamination
data gaps for future soil removal activities
At ≈ 20' bgs sand is stuck between sample rod
and carry barrel. Low recovery +
drilling is difficult – specifically recovery of sample
barrel without also removing outer carry +
caving the hole in.
Loose, wet, unconsolidated sand

3/30/16

Christopher Smart with WDEC on site.
Coordinating future work with Bob Egan
BH-3 location selected by Bob + Kristen
Move to BH 3 south of BH-1

1640 BH-3 16TSSL04 7-10' bgs
(highest unsaturated PID hit in BH-3)
Interval selected by Bob and Kristen
Heaving sand - boring terminated at 20' bgs
Bob and Kristen declined CEC offer to retrieve pump to remove collapsed sand in core in order to retrieve sample.
Additional BH-3 interval selected by Bob and Kristen:
1710 16TSSL05 @ BH03 (13'-15')
Kristen says 6 borings should be sufficient for characterization
1815 Depart site
Purchase disposable spoons at Thys for soil
Refuel rental vehicle, charge PID
Sample management
1930 End

12 hours

3/31/16

0730 Mob to site
0800 Arrive at site - daily safety tailgate
Bob Egan, Kristin Hansen, Elizabeth Stempihn (CE)
Randy Ochs (CE)
Select BH-4 site with Bob and Kristen
Begin BH04 NE of BH01
0930 16TSSL06 8-10' bgs @ water table
interval selected by Bob and Kristen
0945 16TSSL07 0.5-2.5' bgs
interval selected by Bob Egan
Terminate boring @ 20' due to heaving sand
Move to BH05
1000 16TSSL08 1-5' bgs
1020 16TSSL09 10-15' bgs
1030 16TSSL10 (duplicate)

Move to BH06 south of MW21
@ MW-20 well appears to have "sunk" approx 4 inches - top of PVC is below sand, in bentonite. Asphalt surrounding well is heaved up slightly (but this may have occurred during well install)

1130 16TSSL11 (15-20') MS/MSD interval selected due to good recovery in macrocore

3/31/16

1700 Meet with Bill Kozak for access to built shop

16TSAA01 can ID 971 serial # 5726

initial vacuum: -30 inHg

regulator ID: 136

start time 1759

located in center of built shop on floor

16TSAA02 outdoor ambient air behind garage

start time: 1810 (location selected by Bob Egan)

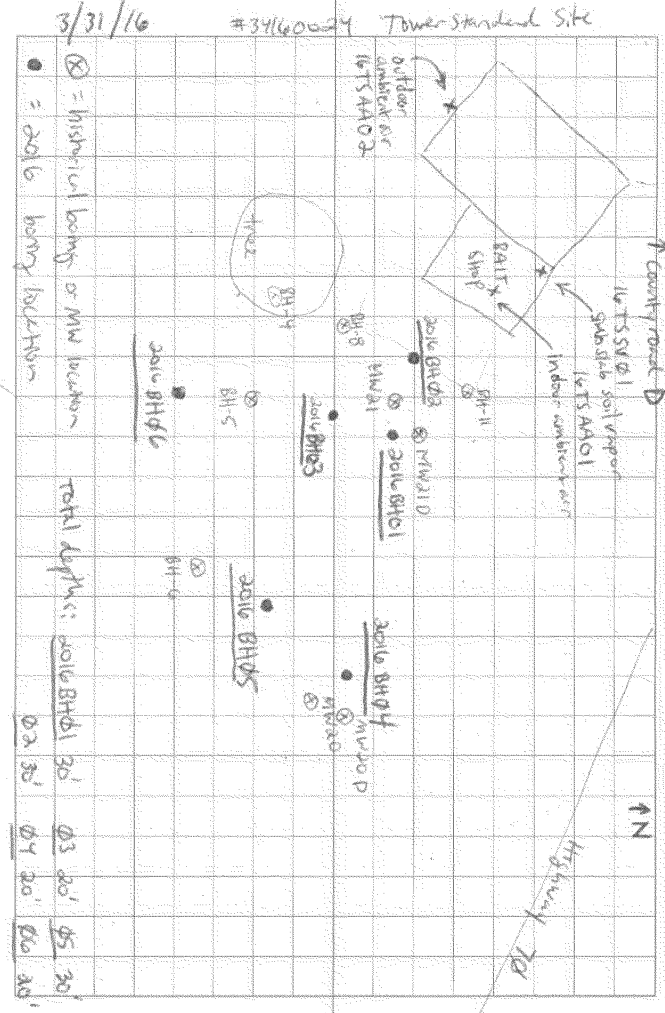
initial vacuum: -30 inHg

located behind garage building on the ground per Bob Egan.

1830 Depart site, leave for Muskogee

Haskell Lodge property owner contacted by Bob Egan is in Arkansas and has no one to open property for us. Ambient air samples will not be collected from lodge crawlspace during this site visit.

3/31/16 #34160024 Tower Standard Site



⊗ = historical borings or MW location

● = 2016 boring location

	Total depths:				
2016 BH01	30'	03	20'	05	30'
02	30'	04	20'	06	20'

3/31/16

soil sample summary

date	time	boring ID	depth	sample ID	
3/30/16	1300	BH-01	11-13	16TSSLØ1	x
↓	1430	BH-02	10-12	16TSSLØ2	x
	1500	BH-Ø2	22-24	16TSSLØ3	x
	1640	BH-Ø3	7-10	16TSSLØ4	x
3/30/16	1710	BH-Ø3	~~8-10~~ 13-15	16TSSLØ5	x
3/31/16	0930	BH-Ø4	8-10	16TSSLØ6	x
↓	0945	BH-Ø4	0.5-2.5	16TSSLØ7	
	1000	BHØ5	1.5-5	16TSSLØ8	x
	1020	BHØ5	10-15	16TSSLØ9	x
	1030	BHØ5	10-15	16TSSL10	DUPØØ9
	1130	BHØ6	15-20	16TSSL11	MS/MSD x

Note: all PID readings in boring logs were collected in-situ

4/1/16 34160024

1000 sample management

Ace hardware for compression fittings & tubing, constructed manifold

initial vacuum, -26 mmHg (can ID# 2195)

Arsenic manifold with iron ferrules provided by Pace.

vacuum leak check on custody:

canister to manifold: -8 mmHg stable

probe to manifold: -8 mmHg stable

purged 2L with syringe

Maximum helium shroud concentration 86.9%

Maximum helium ~~shro~~ sample train concentration 50ppm - helium leak test passed

start 1719 16TSSVØ1

end 1726 can ID 2195 final -3 mmHg

1748 terminate collection of 16TSAAØ1 (-5 mmHg)

1805 terminate collection of 16TSAAØ2 (-5 mmHg)

CEL/Tribe/EPA offsite @ 1810

Arrive Minocqua 1830

4/2/16

1100 Ship summa canisters to Pace @ Postal Express
2 Fedex boxes:
16TSAA01 interior ambient air
16TSAA02 exterior ambient air
16TSSV01 soil vapor probe point

decon pump, sort gear, find rental vehicle for water sampling tomorrow
soil sample management - QC labels, bubble wrap VOAs

4/3/16 # 34160024

0730 Mob gear, check out
calibrate turbidimeter, YSI
YSI DO @ 94% after calibration
in air. DO estimates will run high.
0810 setup on MW-20 (shallow)
good recharge, strong fuel odor
1010 16TSGW04 @ MW-20 (shallow)

1135 16TSGW05 @ MW-20 (deep) pump @ 22.5'

Drive to Minneapolis
Ship bladder pump to GeoTech @ FedEx Minneapolis location
End 1700

4/4/16

0900 Hand deliver soil and groundwater samples to Pace - 2 coolers with ice, 2 COCs
one cooler with groundwater samples + trip blank
one cooler with soil samples + trip blank

Pack equipment in totes, clean rental vehicle

1530 Arrive at airport, return rental car
2 checked overweight bags @ Delta
MSP → ANC

GROUNDWATER LOW-FLOW PURGING FORM

Date: 4/03/16 Well ID: MW-20D (deep)

Job Name: Tower Standard

Job Number: 3416 0024 Well Type: ☒ Monitor ☐ Extraction ☐ Other

Company: BERS Well Material: ☒ PVC ☐ St. Steel ☐ Other

Purged by: L Klappin (print name) (signature)

Sample ID: ~~16TSGW06~~ 16TSGW05 Time: 1135

QC Sample ID: Time:

WELL PURGING

PURGE VOLUME (3 casing volumes OR 3 consecutive stable parameter measurements)

Casing Diameter (D in inches)

☒ 2-inch ☐ 4-inch ☐ 6-inch ☐ Other

PURGE METHOD

☐ Pump – Type: geotech

☐ Submersible ☐ Centrifugal ☒ Bladder ☐ Peristaltic

A. Historical total Depth of Casing (TD in feet BTOC):

B. Water Level Depth (WL in feet BTOC): 7.22

C. Water Column Length (A-B):

D. Water Column Volume (Cx 0.15 for 2-inch diameter 0.65 for 4-inch diameter):

PUMP INTAKE SETTING

Pump Depth in feet (BTOC) ~ 22.5

Screen Interval in feet (BTOC) 20-25

PURGE TIME **PURGE RATE** **ACTUAL PURGE VOLUME**

1039 Start 1133 Stop 54 Elapsed Initial 0.06 gpm Final 0.06 gpm 3 gallons

FIELD PARAMETER MEASUREMENT (collect parameters every 5 minutes)

Time	Water Depth below MP	Discharge/Fill Pump Dial	100-400 Purge Rate (ml/min)	Temperature (°C)	Specific Cond. (mS/cm)[c] (± 3%)	pH (± 0.1)	ORP (mV) (± 10)	DO (mg/L) (± 10%)	Turbidity (NTU) (± 10% or <5 NTU)	Cumulative Volume Purged (<3 casing volumes)
1039	7.24	5/10	210	7.32	0.948	6.20	-20.3	5.01	151	
1043	7.24	5/10		7.96	0.957	6.20	-18.2	4.12	152	0.4
1052	7.24	5/10		8.28	0.961	6.20	-16.0	2.52	134	1
1104	7.24	5/10		8.32	0.969	6.16	-10.7	2.00	62.3	1.5
1109	7.24	5/10		8.15	0.968	6.19	-9.4	0.89	56.2	2
1113	7.24	5/10		8.19	0.968	6.19	-8.8	0.72	52.6	2
1117	7.24	5/10		8.25	0.970	6.19	-8.1	0.71	50.9	2.3
1121	7.24	5/10		8.46	0.970	6.21	-7.2	0.63	44.5	2.5
1124	7.24	5/10		8.43	0.972	6.21	-7.0	0.53	41.3	2.8
1130	7.24	5/10		8.36	0.972	6.20	-7.1	0.52	39.3	2.9
1133	7.24	5/10		8.35	0.972	6.19	-6.6	0.60	37.0	3

If well is purged dry, allow water column to recharge to 80% (Cx0.8 +A) and collect sample.

Remarks (well recovery, odor, sheen, unusual conditions/observations):

strong fuel odor, orange clearing to yellow

Well Integrity (condition of casing, end cap, monument, bollards, etc.):

good condition

Revised 10/09/2015

GROUNDWATER LOW-FLOW PURGING FORM

Date: 04/03/16 Well ID: MW-20 shallow

Job Name: Tower Standard

Job Number: 34160074 Well Type: ☒ Monitor ☐ Extraction ☐ Other

Company: BERS Well Material: ☒ PVC ☐ St. Steel ☐ Other

Purged by: L. Klepper (print name) (signature)

Sample ID: 16TSGW04 Time: 1010

QC Sample ID: Time:

WELL PURGING

PURGE VOLUME (3 casing volumes OR 3 consecutive stable parameter measurements)

Casing Diameter (D in inches)

☒ 2-inch ☐ 4-inch ☐ 6-inch ☐ Other

PURGE METHOD

☐ Pump – Type: geotech

☐ Submersible ☐ Centrifugal ☒ Bladder ☐ Peristaltic

A. Historical total Depth of Casing (TD in feet BTOC):

B. Water Level Depth (WL in feet BTOC): 7.00

C. Water Column Length (A-B):

D. Water Column Volume (Cx 0.15 for 2-inch diameter 0.65 for 4-inch diameter):

PUMP INTAKE SETTING

Pump Depth in feet (BTOC) 9'

Screen Interval in feet (BTOC)

PURGE TIME 0858 Start 1006 Stop 68 Elapsed

PURGE RATE Initial 0.12 gpm Final 0.12 gpm

ACTUAL PURGE VOLUME 8 gallons

FIELD PARAMETER MEASUREMENT (collect parameters every 5 minutes)

Time	Water Depth below MP	Discharge/Fill Pump Dial	100-400 Purge Rate (ml/min)	Temperature (°C)	Specific Cond. (mS/cm)[c] (± 3%)	pH (± 0.1)	ORP (mV) (± 10)	DO (mg/L) (± 10%)	Turbidity (NTU) (± 10% or <5 NTU)	Cumulative Volume Purged (<3 casing volumes)
0858	7.06	5/10	440	6.34	0.910	6.12	37.3	4.90	85.3	
0907	↓	5/10								
0909		5/10		6.89	0.996	6.29	11.9	3.66	72.6	1.8
0919	7.06	5/7		6.87	0.999	6.36	-4.1	2.15	43.6	3
0930	7.06	5/7		6.90	1.008	6.35	-14.0	1.27	28.1	4
0940	7.06	5/7		6.94	1.014	6.38	-22.0	0.78	20.7	5
0945	7.06	5/7		6.93	1.012	6.38	-24.2	0.74	14.4	
0954	7.06	5/7		6.98	1.010	6.37	-29.4	0.50	10.7	7
0957	7.06	5/7		6.99	1.013	6.45	-29.3	0.55	10.0	
1000	7.06	5/7		7.01	1.010	6.37	-30.7	0.62	8.52	7.5
1003	7.06	5/7		6.99	1.009	6.38	-32.1	0.50	7.61	
1006	7.06	5/7		6.97	1.011	6.38	-32.9	0.50	7.72	8

If well is purged dry, allow water column to recharge to 80% (Cx0.8 +A) and collect sample.

Remarks (well recovery, odor, sheen, unusual conditions/observations):

strong fuel odor, orange

Well Integrity (condition of casing, end cap, monument, bollards, etc.):

good condition. Well may have "sunk" up to 4" – top of PVC in sand + bentonite. Scraped bentonite out around PVC.

Revised 10/09/2015

GROUNDWATER LOW-FLOW PURGING FORM

Date: 3/29/16 Well ID: MW-16D (deep)

Job Name: Tower Standard

Job Number: 34160024 Well Type: ☒ Monitor ☐ Extraction ☐ Other

Company: BERS Well Material: ☒ PVC ☐ St. Steel ☐ Other

Purged by: Lyndsey Kleppin (print name) (signature)

Sample ID: ~~16GW~~ 16TSGW02 Time: 1245

QC Sample ID: 16TSGW03 Time: 1300

VOCs, sulfate, nitrate, manganese, iron

WELL PURGING

PURGE VOLUME (3 casing volumes OR 3 consecutive stable parameter measurements)

Casing Diameter (D in inches)

☒ 2-inch ☐ 4-inch ☐ 6-inch ☐ Other

PURGE METHOD

☐ Pump – Type: geotech

☐ Submersible ☐ Centrifugal ☒ Bladder ☐ Peristaltic

A. Historical total Depth of Casing (TD in feet BTOC): ~42.00

B. Water Level Depth (WL in feet BTOC): 1.92

C. Water Column Length (A-B): 40.8

D. Water Column Volume (Cx 0.15 for 2-inch diameter 0.65 for 4-inch diameter): 6.12

PUMP INTAKE SETTING

Pump Depth in feet (BTOC) ~39.5

Screen Interval in feet (BTOC) 37-42

PURGE TIME

1115 Start 1245 Stop 90 Elapsed

PURGE RATE

Initial 0.03 gpm Final 0.03 gpm

ACTUAL PURGE VOLUME

3 gallons

FIELD PARAMETER MEASUREMENT (collect parameters every 5 minutes)

Time	Water Depth below MP	Discharge/ Fill Pump Dial	100-400 Purge Rate (ml/min)	Temperature (°C)	Specific Cond. (mS/cm)[c] (± 3%)	pH (± 0.1)	ORP (mV) (± 10)	DO (mg/L) (± 10%)	Turbidity (NTU) (± 10% or <5 NTU)	Cumulative Volume Purged (<3 casing volumes)
1118	2.06	8/10	130	8.02	0.856	6.96	-24.5	4.53	26.4	~~0.5~~ M
1126	2.04	↓	↓	7.91	0.890	7.04	-61.7	2.60	446	0.25
1136	2.04			7.90	0.922	7.08	-80.5	2.14	583	0.75
1140	2.03			7.96	0.928	7.09	-84.4	1.99	589	
1152	2.02			8.00	0.945	7.13	-100.0	1.58	536	1.25
1202	2.04			8.25	0.948	7.15	-110.5	1.28	466	1.5
1212	2.00			8.23	0.943	7.14	-108.8	1.74	379	1.75
1218	2.02			8.23	0.952	7.17	-115.8	0.62	355	2.0
1226	2.02			8.39	0.956	7.20	-122.8	0.44	315	
1236	2.02			8.36	0.958	7.21	-125.0	0.39	290	
1240	2.01			8.43	0.958	7.21	-126.9	0.35	262	
1245	2.02		↓	8.54	0.958	7.22	-129.0	0.37	258	3

If well is purged dry, allow water column to recharge to 80% (Cx0.8 +A) and collect sample.

Remarks (well recovery, odor, sheen, unusual conditions/observations): Strong fuel odor, no sheen

Well Integrity (condition of casing, end cap, monument, bollards, etc.): good

Revised 10/09/2015

GROUNDWATER LOW-FLOW PURGING FORM

Date: 3/29/16 Well ID: MW-16 (shallow)

Job Name: Tower Standard

Job Number: 34160024 Well Type: ☒ Monitor ☐ Extraction ☐ Other

Company: BERS Well Material: ☒ PVC ☐ St. Steel ☐ Other

Purged by: Matt Faust (print name) (signature)

Sample ID: 16TSGWQ1 Time: 1030

QC Sample ID: Time:

WELL PURGING

PURGE VOLUME (3 casing volumes OR 3 consecutive stable parameter measurements)

Casing Diameter (D in inches)

☒ 2-inch ☐ 4-inch ☐ 6-inch ☐ Other

PURGE METHOD

☐ Pump – Type: geotech

☐ Submersible ☐ Centrifugal ☒ Bladder ☐ Peristaltic

A. Historical total Depth of Casing (TD in feet BTOC): 11.48

B. Water Level Depth (WL in feet BTOC): 2.08

C. Water Column Length (A-B): 9.40

D. Water Column Volume (Cx 0.15 for 2-inch diameter 0.65 for 4-inch diameter): 1.41

PUMP INTAKE SETTING

Pump Depth in feet (BTOC) ~4.0 ft

Screen Interval in feet (BTOC)

PURGE TIME

0922 Start 1030 Stop 68 Elapsed

PURGE RATE

Initial 0.05 gpm Final 0.05 gpm

ACTUAL PURGE VOLUME

3.75 gallons

FIELD PARAMETER MEASUREMENT (collect parameters every 5 minutes)

Time	Water Depth below MP	Discharge/ Fill Pump Dial	100-400 Purge Rate (ml/min)	Temperature (°C)	Specific Cond. (mS/cm)[c] (± 3%)	pH (± 0.1)	ORP (mV) (± 10)	DO (mg/L) (± 10%)	Turbidity (NTU) (± 10% or <5 NTU)	Cumulative Volume Purged (<3 casing volumes)
0922	2.29	6/15	200	4.48	0.281	5.69	64.6	5.79	222	~0
0932	2.30	6/15		4.79	0.225	6.05	21.4	1.33	68.7	0.6
0938	2.32			4.99	0.231	6.26	6.1	0.96	56.0	0.9
0948	2.32			5.30	0.243	6.34	-2.9	0.64	56.0	1.5
0952	2.32			5.39	0.250	6.36	-5.1	0.63	51.1	1.75
0958	2.32			5.44	0.283	6.38	-8.5	0.57	41.3	2.15
1002	2.32			5.46	0.306	6.39	-11.8	0.52	37.9	2.40
1008	2.32			5.53	0.337	6.42	-16.6	0.53	32.2	2.7
1012	2.32			5.48	0.355	6.46	-20.3	0.50	28.5	2.9
1018	2.32			5.52	0.373	6.50	-24.6	0.48	19.9	3.25
1022	2.30			5.65	0.385	6.51	-26.7	0.52	15.0	3.45
1028	2.28			5.64	0.399	6.52	-29.9	0.71	10.8	3.75
1030									8.67	

If well is purged dry, allow water column to recharge to 80% (Cx0.8 +A) and collect sample.

Remarks (well recovery, odor, sheen, unusual conditions/observations): No odor, murky, yellow initially Slight oil odor?

Well Integrity (condition of casing, end cap, monument, bollards, etc.): Good. Cover rusted on.

Revised 10/09/2015

INDOOR AIR QUALITY QUETIONNAIRE AND BUILDING INVENTORY

Preparer's Name: BOB EGAN Date/Time Prepared: 4/1/16 1615

Preparer's Affiliation: USEPA Phone No. 312 886-6310

Purpose of Investigation: LUST SITE

1. ~~OCCUPANT~~: BUSINESS PROPRIETOR

Interviewed: ☒ Yes ☐ No N/A

Last Name: KOZAK First Name: WILLIAM

Address: 1467 HWY 70 WEST

County: VILAS Home Phone: N/A Office Phone: N/A

Number of Occupants/persons at this location: 2 Age of Occupants: _____

2. OWNER OR LANDLORD: (Check if same as occupant ☐)

Interviewed: ☒ Yes ☐ No

Last Name: KOZAK First Name: WILLIAM

Address: _____

County: ONEIDA Home Phone: 715 588-3934 Office Phone: —

3. BUILDING CHARACTERISTICS

Type of Building: (Circle appropriate response)

Residential	School	Commercial/Multi-use
Industrial	Church	~~Other~~: RETAIL BAITSHOP

If the property is residential, type? (Circle appropriate response)

Ranch	2-Family	3-Family
Raised Ranch	Split Level	Colonial
Cape Cod	Contemporary	Mobile Home
Duplex	Apartment House	Townhouse/Condos
Modular	Log Home	Other: _____

If multiple units, how many: _____

If the property is commercial, type?

Business Type(s) BAIT SHOP

Does it include residences (i.e., multi-use)? ☐ Yes ☒ No If yes, how many? _____

Other characteristics:

Number of floors 1 Building age 70 +

Is the building insulated? ☐ Yes ☒ No How air tight? Tight / Average / Not Tight

4. BASEMENT AND CONSTRUCTION CHARACTERISTICS (Circle all that apply)

a. Above grade construction:	wood frame	concrete	stone	brick	CONCRETE BLOCK
b. Basement type:	full	crawlspace	slab	other	NONE
c. Basement floor:	concrete	dirt	stone	other	NONE
d. Basement floor:	uncovered	covered	covered with	NONE	
e. Concrete floor:	unsealed	sealed	sealed with	PAINT	
f. Foundation walls:	poured	block	stone	other	UNKNOWN
g. Foundation wals:	unsealed	sealed	sealed with	UNKNOWN	
h. The basement is:	wet	damp	dry	moldy	
i. The basement is:	finished	unfinished	partially finished		
j. Sump present?	☐ Yes	☒ No			
k. Water in sump:	☐ Yes	☐ No	not applicable		

Basement/Lowest level depth below grade: — (feet)

Identify potential soil vapor entry points and approximate size (e.g., cracks, utility ports, drains)

NO UNUSUAL CRACKS OBSERVED IN SHOP AREA

POSSIBLE CROSS CONTAMINATION FROM FORMER AUTO SERVICE BAY AREA

5. HEATING, VENTING, AND AIR CONDITIONING (Circle all that apply)

Type of heating system(s) used in this building: (circle all that apply – note primary)

Hot air circulation	Heat pump	Hot water baseboard	
Space Heaters	Stream radiation	Radiant floor	
Electric baseboard	Wood stove	Outdoor wood boiler	Other: ~~NONE~~

f. Is there a workshop or hobby/craft area?	Y / N	Where & What Type?	
g. Is there smoking in the building?	Y / N	How frequently?	
h. Have cleaning products been used recently?	Y / N	When & What Type?	
i. Have cosmetic products been used recently?	Y / N	When & What Type?	
j. Has painting/staining been done in the last 6 months?	Y / N	Where & When?	
k. Is there new carpet, drapes or other textiles?	Y / N	Where & When?	
l. Have air fresheners been used recently?	Y / N	When & What Type?	
m. Is there a kitchen exhaust fan?	Y / N	If yes, where vented?	
n. Is there a bathroom exhaust fan?	Y / N	If yes, where vented?	
o. Is there a clothes dryer?	Y / N	If yes, is it vented outside?	Y / N
p. Has there been a pesticide application?	Y / N	When & What Type?	

Are there odors in the building? Y / N

If yes, please describe: ONLY THOSE RELATED TO BUILDING BEING CLOSED – MUSTY ODORS

Do any of the building occupants use solvents at work? Y / N

(e.g., chemical manufacturing or laboratory, auto mechanic or auto body shop, painting, fuel oil delivery, boiler mechanic, pesticide application, cosmetologist

If yes, what type of solvents are used? _____

If yes, are their clothes washed at work? Y / N

Do any of the building occupants regularly use or work at a dry-cleaning service? (Circle appropriate response)

- Yes, use dry-cleaning regularly (weekly)
- Yes, use dry-cleaning infrequently (monthly or less)
- Yes, work at a dry-cleaning service

No

Unknown

Is there a radon mitigation system for the building/structure? Y / N Date of installation:

Is the system active or passive? Active/Passive

MATERIALS STORED IN AUTO SERVICE (FORMER) AREA

- FIBERGLASS RESIN
- HOUSEHOLD PAINT CANS
- RUSTOLEUM SPRAY CAN
- MOTOR OIL
- ATF FLUID
- AUTO PAINT IN CANS (2)
- CARB CLEANER
- BATTERY SEALER
- WOOD CLEANER
- OLD WASTE OIL TANKS (UNUSED / EMPTY)

ATTACHMENT 3

Soil Boring Logs

Bristol
ENVIRONMENTAL REMEDIATION SERVICES, LLC

BOREHOLE LOG

PROJECT: Tower Standard LUST Site	BOREHOLE LOCATION: 45.913713467° N, -89.913093495° W	DRILLING COMPANY: Coleman Engineering
CLIENT: EPA Region 5	COORDINATE SYSTEM AND DATUM: Lat/Long, WGS84	DRILL RIG: Geoprobe 6620 DT
JOB NUMBER: 34160024	ELEVATION AT TOP OF HOLE: 479.462239 feet	DRILLING METHOD: Direct Push
SITE: Tower Standard	ELEVATION AT TOP OF CASING: Not Applicable	DRILLER: Randy Ochs
LOCATION: Lac du Flambeau	ELEVATION DATUM: height above ellipsoid	BOREHOLE DIAMETER: 3 inches
	TOTAL DEPTH: 30 feet / DEPTH TO WATER: 8.5 feet	LOGGED BY: Lyndsey Kleppin
	GROUNDWATER ELEVATION: 470.962239 feet	DATE HOLE: STARTED 3/30/2016 / COMPLETED 3/30/2016

DEPTH (FEET)	GRAPHIC LOG	LITHOLOGY DESCRIPTION	PID SAMPLE INTERVAL	RECOVERY	PID (ppm)	ANALYTICAL SAMPLE	DRILLING NOTES
0.0 – 5.0		**(GW)** sandy gravel with clay, reddish brown, moist, slight fuel odor		30%	8.2		
5.0 – 8.5		**(SW)** gravelly sand with silt, brown, moist, loose, moderate fuel odor		40%	14.1 720		
8.5 – 11.0		**(SW)** sand, brown, wet, loose, very fine to coarse grained, strong fuel odor, sheen			1290		
11.0 – 14.0		**(SW)** sand with gravel, brown, wet, loose, trace clay, stong fuel odor, sheen		60%	1790	16TSSL01	

Water table at 8.5 feet.

BOREHOLE LOG (Cont)

ELEVATION TOP OF HOLE
479.462239 feet

Borehole No. 16BH01

PROJECT
Tower Standard LUST Site

SITE
Tower Standard

SHEET 2 OF 2 SHEETS

DEPTH (FEET)	GRAPHIC LOG	LITHOLOGY DESCRIPTION	SAMPLE INTERVAL	RECOVERY	PID (ppm)	ANALYTICAL SAMPLE	DRILLING NOTES
15.0		**(SW)** sand with silt, brown, wet, loose, medium grained, moderate fuel odor			111.5		
16.0		**(SP)** sand, brown, wet, loose, medium grained, slight fuel odor			59.9		
18.0		**(SW)** sand, brown, wet, loose, medium to coarse grained, slight fuel odor		60%	32.7		
19.0		**(SP)** sand, brown, wet, loose, fine grained, slight fuel odor			52		
20.0		**(SP)** sand, brown, wet , loose, medium grained, slight fuel odor			32		
22.0		**(SP)** sand, brown, wet, loose, medium grained, slight fuel odor [possibly slough]		90%	30.8		
24.0					9.5		
26.0		**(SW)** sand with gravel, brown, wet, loose, coarse to medium grained sand, slight fuel odor			18.7		
28.0				20%	18.7		
30.0		Bottom of Borehole					

Bristol
ENVIRONMENTAL REMEDIATION SERVICES, LLC

BOREHOLE LOG

PROJECT: Tower Standard LUST Site	BOREHOLE LOCATION: 45.91373049° N, -89.913159829° W	DRILLING COMPANY: Coleman Engineering
CLIENT: EPA Region 5	COORDINATE SYSTEM AND DATUM: Lat/Long, WGS84	DRILL RIG: Geoprobe 6620 DT
JOB NUMBER: 34160024	ELEVATION AT TOP OF HOLE: 479.494875 feet	DRILLING METHOD: Direct Push
SITE: Tower Standard	ELEVATION AT TOP OF CASING: Not Applicable	DRILLER: Randy Ochs
LOCATION: Lac du Flambeau	ELEVATION DATUM: height above ellipsoid	BOREHOLE DIAMETER: 3 inches
	TOTAL DEPTH: 30 feet / DEPTH TO WATER: 9 feet	LOGGED BY: Lyndsey Kleppin
	GROUNDWATER ELEVATION: 470.494875 feet	DATE HOLE: STARTED 3/30/2016 / COMPLETED 3/30/2016

DEPTH (FEET)	GRAPHIC LOG	LITHOLOGY DESCRIPTION	PID SAMPLE INTERVAL	RECOVERY	PID (ppm)	ANALYTICAL SAMPLE	DRILLING NOTES
0.0		**(SM)** silty sand with clay, brown, moist, dense, trace gravel, no fuel odor					
2.0				30%	2.5		
4.0							
5.0		**(SW)** sand with clay and gravel, brown, moist, loose, no fuel odor					
6.0				20%			
8.0					3.8		
9.5					5.7		
10.0		**(SW)** gravelly sand, brown, wet, loose, no fuel odor					
		(SW) sand, brown, wet, loose, fine to medium grained, trace clay, moderate fuel odor			353	16TSSL02	
12.0					9.2		
				50%	15.9		

BOREHOLE LOG (Cont)

ELEVATION TOP OF HOLE
479.494875 feet

Borehole No. 16BH02

PROJECT
Tower Standard LUST Site

SITE
Tower Standard

SHEET 2 OF 2 SHEETS

DEPTH (FEET)	GRAPHIC LOG	LITHOLOGY DESCRIPTION	SAMPLE INTERVAL	RECOVERY	PID (ppm)	ANALYTICAL SAMPLE	DRILLING NOTES
15.0		**(SW)** sand, brown, wet, loose, fine to medium grained, trace clay, moderate fuel odor *(continued)*					
16.0		**(SP)** sand, brown, wet, loose, medium grained, slight fuel odor			11.7		
				80%	7.4		
18.0							
19.0					23		
20.0		**(SW)** sand with clay and gravel, brown, loose, wet, grey clay inclusion with strong fuel odor, slight fuel odor in sand					
22.0		**(SW)** sand, greyish brown, wet, loose, medium to coarse grained, slight fuel odor		30%	6.2	16TSSL03	
24.0					2.7		
25.0		**(GW)** gravel with sand, greyish brown, wet, loose, slight fuel odor			20		
26.0		No Recovery		0%			
28.0							
30.0		Bottom of Borehole					

BERS Borehole Log Version: 0413

PROJECT
Tower Standard LUST Site

HOLE NO.
16BH02

Bristol
ENVIRONMENTAL REMEDIATION SERVICES, LLC

BOREHOLE LOG

	BOREHOLE LOCATION 45.913683436° N, -89.913124832° W	DRILLING COMPANY Coleman Engineering
	COORDINATE SYSTEM AND DATUM Lat/Long, WGS84	DRILL RIG Geoprobe 6620 DT
PROJECT Tower Standard LUST Site	ELEVATION AT TOP OF HOLE 479.488087 feet	DRILLING METHOD Direct Push
CLIENT EPA Region 5	ELEVATION AT TOP OF CASING Not Applicable	DRILLER Randy Ochs
JOB NUMBER 34160024	ELEVATION DATUM height above ellipsoid	BOREHOLE DIAMETER 3 inches
SITE Tower Standard	TOTAL DEPTH 20 feet / DEPTH TO WATER 9 feet	LOGGED BY Lyndsey Kleppin
LOCATION Lac du Flambeau	GROUNDWATER ELEVATION 470.488087 feet	DATE HOLE STARTED 3/30/2016 COMPLETED 3/30/2016

DEPTH (FEET)	GRAPHIC LOG	LITHOLOGY DESCRIPTION	PID SAMPLE INTERVAL	RECOVERY	PID (ppm)	ANALYTICAL SAMPLE	DRILLING NOTES
0.0		**(GW)** sandy gravel, brownigh grey, moist, loose					
2.0				10%			
4.0					22.3		
5.0		**(GW)** sandy gravel, olive grey, moist, loose, strong fuel odor					
6.0					465.9		
7.0		**(SW)** sand, brown, moist, loose, fine to coarse garined, moderate fuel odor		50%	730.2		
8.0						16TSSL04	
9.0		**(SW)** sand with gravel, greyish brown, wet, loose, coarse grained sand, moderate fuel odor			640.5		
10.0							
12.0				20%			
13.0		**(SW)** sand, greyish brown, wet, loose, medium to coarse grained, strong fuel odor			1451		

BOREHOLE LOG (Cont)

ELEVATION TOP OF HOLE
479.488087 feet

Borehole No. 16BH03

PROJECT
Tower Standard LUST Site

SITE
Tower Standard

SHEET 2 OF 2 SHEETS

DEPTH (FEET)		GRAPHIC LOG	LITHOLOGY DESCRIPTION	SAMPLE INTERVAL	RECOVERY	PID (ppm)	ANALYTICAL SAMPLE	DRILLING NOTES
			(SW) sand, greyish brown, wet, loose, medium to coarse grained, strong fuel odor *(continued)*			1908	16TSSL05	
16.0	16.0					22.5		
			(SP) sand, brown, wet, loose, medium grained, slight fuel odor					
	17.0					10.7		
			(SW) gravelly sand, brown, wet, loose, fine to coarse grained sand, slight fuel odor heaving sand at 20' bgs, boring terminated at 20' bgs		70%			
18.0						15.5		
						24.6		
20.0	20.0		Bottom of Borehole					

Bristol
ENVIRONMENTAL REMEDIATION SERVICES, LLC

BOREHOLE LOG

	BOREHOLE LOCATION 45.913698811° N, -89.912972296° W	DRILLING COMPANY Coleman Engineering
	COORDINATE SYSTEM AND DATUM Lat/Long, WGS84	DRILL RIG Geoprobe 6620 DT
PROJECT Tower Standard LUST Site	ELEVATION AT TOP OF HOLE 479.432530 feet	DRILLING METHOD Direct Push
CLIENT EPA Region 5	ELEVATION AT TOP OF CASING Not Applicable	DRILLER Randy Ochs
JOB NUMBER 34160024	ELEVATION DATUM height above ellipsoid	BOREHOLE DIAMETER 3 inches
SITE Tower Standard	TOTAL DEPTH 20 feet / DEPTH TO WATER 8.5 feet	LOGGED BY Lyndsey Kleppin
LOCATION Lac du Flambeau	GROUNDWATER ELEVATION 470.93253 feet	DATE HOLE STARTED 3/31/2016 COMPLETED 3/31/2016

DEPTH (FEET)	GRAPHIC LOG	LITHOLOGY DESCRIPTION	PID SAMPLE INTERVAL	RECOVERY	PID (ppm)	ANALYTICAL SAMPLE	DRILLING NOTES
0.0 – 4.0		**(GW)** sandy gravel with silt and clay, brown, moist, loose, slight fuel odor		50%	78.6	16TSSL07	
4.0 – 6.0		**(GW)** sandy gravel, brown, moist, loose, slight fuel odor			52.1		
6.0 – 8.0		**(SW)** gravelly sand with silt, brown, moist, loose, moderate fuel odor		50%	18.6		
8.0 – 10.0		**(SW)** gravelly sand with silt, brown, wet, loose, strong fuel odor, sheen			40 1878	16TSSL06	
10.0 – 14.0		**(GW)** sandy gravel, brown, wet, loose, trace silt and clay, fine to coarse gravel		60%	1210 1314		

BOREHOLE LOG (Cont)

ELEVATION TOP OF HOLE
479.432530 feet

Borehole No. 16BH04

PROJECT
Tower Standard LUST Site

SITE
Tower Standard

SHEET 2 OF 2 SHEETS

DEPTH (FEET)	GRAPHIC LOG	LITHOLOGY DESCRIPTION	SAMPLE INTERVAL	RECOVERY	PID (ppm)	ANALYTICAL SAMPLE	DRILLING NOTES
		(GW) sandy gravel, brown, wet, loose, trace silt and clay, fine gravel heaving sand at 20' bgs, boring terminated at 20' bgs			117.5		
16.0					82.2		
				60%	24.3		
18.0							
					42		
20.0	20.0	Bottom of Borehole					

BERS Borehole Log Version: 0413

PROJECT
Tower Standard LUST Site

HOLE NO.
16BH04

Bristol
ENVIRONMENTAL REMEDIATION SERVICES, LLC

BOREHOLE LOG

	BOREHOLE LOCATION 45.913662247° N, -89.913051165° W	DRILLING COMPANY Coleman Engineering
	COORDINATE SYSTEM AND DATUM Lat/Long, WGS84	DRILL RIG Geoprobe 6620 DT
PROJECT Tower Standard LUST Site	ELEVATION AT TOP OF HOLE 479.464763 feet	DRILLING METHOD Direct Push
CLIENT EPA Region 5	ELEVATION AT TOP OF CASING Not Applicable	DRILLER Randy Ochs
JOB NUMBER 34160024	ELEVATION DATUM height above ellipsoid	BOREHOLE DIAMETER 3 inches
SITE Tower Standard	TOTAL DEPTH 30 feet / DEPTH TO WATER 8.5 feet	LOGGED BY Lyndsey Kleppin
LOCATION Lac du Flambeau	GROUNDWATER ELEVATION 470.964763 feet	DATE HOLE STARTED 3/31/2016 COMPLETED 3/31/2016

DEPTH (FEET)	GRAPHIC LOG	LITHOLOGY DESCRIPTION	PID SAMPLE INTERVAL	RECOVERY	PID (ppm)	ANALYTICAL SAMPLE	DRILLING NOTES
0.0		**(SW)** gravelly sand with clay, brown, moist, loose, grey silty clay inclusions, no fuel odor					
2.0				20%		16TSSL08	
4.0					15.5		
6.0					18.7		
7.0		**(GW)** sandy gravel, greyish brown, moist, loose		30%			
8.0					1066		
▼ 8.5		**(SW)** gravelly sand, brown, wet, loose, strong fuel odor			1648		
10.0		**(SW)** gravelly sand with silt, brown, wet, loose, strong fuel odor, sheen			1542		
12.0				50%	2566	16TSSL09 and 16TSSL10 (Duplicate)	

BOREHOLE LOG (Cont)

ELEVATION TOP OF HOLE
479.464763 feet

Borehole No. 16BH05

PROJECT
Tower Standard LUST Site

SITE
Tower Standard

SHEET 2 OF 2 SHEETS

DEPTH (FEET)	GRAPHIC LOG	LITHOLOGY DESCRIPTION	SAMPLE INTERVAL	RECOVERY	PID (ppm)	ANALYTICAL SAMPLE	DRILLING NOTES
		(SW) gravelly sand with silt, brown, wet, loose, strong fuel odor, sheen *(continued)*			117.5		
16.0	16.0	**(SW)** sand, brown, wet, loose, fine to coarse grained, slight fuel odor		20%	50.1		
18.0							
					70.7		
20.0	20.0	No Recovery- heaving sand					
22.0							
24.0							
26.0							
28.0							
	29.8						
30.0	30.0	**(GW)** sandy gravel, wet, loose, no fuel odor Bottom of Borehole					

Bristol
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BOREHOLE LOG

	BOREHOLE LOCATION 45.913606619° N, -89.913215927° W	DRILLING COMPANY Coleman Engineering
	COORDINATE SYSTEM AND DATUM Lat/Long, WGS84	DRILL RIG Geoprobe 6620 DT
PROJECT Tower Standard LUST Site	ELEVATION AT TOP OF HOLE 479.719090 feet	DRILLING METHOD Direct Push
CLIENT EPA Region 5	ELEVATION AT TOP OF CASING Not Applicable	DRILLER Randy Ochs
JOB NUMBER 34160024	ELEVATION DATUM height above ellipsoid	BOREHOLE DIAMETER 3 inches
SITE Tower Standard	TOTAL DEPTH 20 feet / DEPTH TO WATER 9 feet	LOGGED BY Lyndsey Kleppin
LOCATION Lac du Flambeau	GROUNDWATER ELEVATION 470.71909 feet	DATE HOLE STARTED 3/31/2016 COMPLETED 3/31/2016

DEPTH (FEET)	GRAPHIC LOG	LITHOLOGY DESCRIPTION	PID SAMPLE INTERVAL	RECOVERY	PID (ppm)	ANALYTICAL SAMPLE	DRILLING NOTES
0.0 – 2.5		**(SW)** sand, brown, moist, loose, fine to coarse grained, no fuel odor			7		
2.5 – 5.0		**(SW)** gravelly sand with silt, reddish brown, moist, loose, trace clay, no fuel odor		20%	6.4 3.6		
5.0 – 10.0		No Recovery- rock lodged in sample tube		0%			
10.0 – 20.0		**(SW)** sand, brown, wet, loose, fine to medium grained, no fuel odor		50%	7.4 2.2		

BOREHOLE LOG (Cont)

ELEVATION TOP OF HOLE
479.719090 feet

Borehole No. 16BH06

PROJECT
Tower Standard LUST Site

SITE
Tower Standard

SHEET 2 OF 2 SHEETS

DEPTH (FEET)	GRAPHIC LOG	LITHOLOGY DESCRIPTION	SAMPLE INTERVAL	RECOVERY	PID (ppm)	ANALYTICAL SAMPLE	DRILLING NOTES
		(SW) sand, brown, wet, loose, fine to medium grained, no fuel odor *(continued)*			1.4		
16.0							
16.5		**(SW)** gravelly sand, brown, wet, loose, trace silt, no fuel odor		70%		16TSSL11	
18.0							
20.0		Bottom of Borehole					