

**ATLANTIC COAST PIPELINE, LLC  
ATLANTIC COAST PIPELINE**

**and**

**DOMINION TRANSMISSION, INC.  
SUPPLY HEADER PROJECT**

**Supplemental Filing  
January 27, 2017**

**APPENDIX A**

**Cochran's Cave Conservation Area Investigation Update**

Dominion Resources Services, Inc.  
5000 Dominion Boulevard,  
Glen Allen, VA 23060



January 24, 2017

**BY ELECTRONIC MAIL**

Mr. Jason Bulluck  
Natural Heritage Director  
Department of Conservation and Recreation  
Division of Natural Heritage  
600 East Main Street, 24<sup>th</sup> Floor  
Richmond, VA 23219

Ms. S. Rene' Hypes  
Project Review Coordinator  
Department of Conservation and Recreation  
Division of Natural Heritage  
600 East Main Street, 24<sup>th</sup> Floor  
Richmond, VA 23219

**Re: Atlantic Coast Pipeline - Cochran's Cave Conservation Area Report**

Dear Mr. Bulluck and Ms. Hypes:

On behalf of Atlantic Coast Pipeline, LLC (Atlantic) and Dominion Transmission, Inc. (DTI), attached for your review please see the *Cochran's Cave Conservation Area (CCCA) and Moffett Lake Investigation Update* prepared by GeoConcepts Engineering, Inc. for the proposed Atlantic Coast Pipeline (ACP) project.

The report provides a discussion and the results of the subsurface investigation conducted by GeoConcepts to assess the potential for impacts resulting from construction of the ACP. The investigation was conducted in consultation with DCR and included Electrical Resistivity Imaging, Air Track Drilling, and hydrological and dye trace investigations.

Atlantic requests your review and comment on the attached report, including DCR's comments on the viability of the proposed route alignment. Please note that Atlantic is also submitting to DCR under separate cover letter a revised *Karst Terrain Assessment, Construction, Monitoring and Mitigation Plan (Plan)* prepared for the proposed Atlantic Coast Pipeline (ACP) project. This Plan thoroughly addresses the assessment, monitoring and mitigation activities being implemented through areas of karst terrain, including Cochran's Cave Conservation Area.

Thank you for your careful review and evaluation of this report. Atlantic and DTI would appreciate a response within 30 days of receipt of this letter. We are also available to meet with you concerning this matter at your convenience.

Please feel free to contact me at (804) 273-3010 or [robert.m.bisha@dom.com](mailto:robert.m.bisha@dom.com), if you have questions or to arrange a meeting. Please direct written responses to [richard.b.gangle@dom.com](mailto:richard.b.gangle@dom.com) or:

Richard B. Gangle  
Dominion Resources Services, Inc.  
5000 Dominion Boulevard  
Glen Allen, Virginia 23060

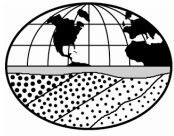
Sincerely,

A handwritten signature in blue ink that reads "Robert M. Bisha".

Robert M. Bisha  
Technical Advisor, Atlantic Coast Pipeline

Attachment: Cochran's Cave Conservation Area (CCCA) and Moffett Lake Investigation Update

cc: Wil Orndorff – DCR  
Richard Gangle



## Memorandum

*Date:* January 20, 2017

*To:* Mr. Colin Olness, PE  
Atlantic Coast Pipeline - Construction

*From:* Mr. Robert K. Denton Jr., CPG, LPSS

*Subject:* CCCA and Moffett Lake Investigation Update  
(Our 11002.04)



GeoConcepts Engineering, Inc. (GeoConcepts) has prepared this memorandum to summarize ongoing investigations to assess possible impacts of the construction of the Dominion Atlantic Coast Pipeline (ACP) to the Cochran's Cave Conservation Area (CCCA) and the karst groundwater recharge to Moffett Lake. The memorandum briefly summarizes the preliminary results of the subsurface investigation (Electrical Resistivity Imaging and Air Track Drilling), hydrological investigation, and dye trace results.

## Project Description

The CCCA is a conservation area which has been delineated by the Virginia Department of Conservation and Recreation – Natural Heritage Program (DCR-NHP) in an effort to protect Cochran's Cave No. 2, considered a "Significant Cave" due to its hydrology (a perennial stream), and geological and aesthetic features (well-developed speleothems). Cochran's Cave No. 2 (CC2) is also a potential habitat locality for the Madison Cave Isopod (MCI), designated as a rare, threatened and endangered species (RTES) by the US Fish and Wildlife Service (USFWS). The CCCA encompasses a broad, shallow swale, approximately 1.4 miles in length and 0.75 mile in width at its widest point. The extent of the CCCA and current proposed route of the ACP are shown on Figure 1, Attachment A.

The Dominion ACP alignment was previously planned to cross over the underground course of CC2, but was subsequently rerouted to the south to avoid the cave. However, the currently proposed alignment passes across a broad, shallow "closed depression"<sup>1</sup> containing four sinkholes, one of which contains the vertical entrance to Cochran's Cave No. 3 (CC3). The depression is internally drained by these sinkholes. A map of this area is included as Figure 2, Attachment A. A LIDAR hillshade raster image showing the locations of the various sinkholes is included as Figure 3, Attachment A.

## Subsurface Investigation

### Electrical Resistivity Imaging (ERI)

An ERI survey was conducted at the site on October 4 – 5, 2016. The survey consisted of five arrays or "lines", consisting of 84 electrodes at a 5 foot spacing with each array being 415 feet long. The five arrays were positioned parallel to one another, spaced 10 feet apart, and extended from the fence at the Route 11 (western) end of the closed depression and extending towards the southeast (see Figure 4, Attachment A). The arrays were numbered 1 through 5, with the central array (ERI 3) running directly over the centerline for 185 feet, at which point the proposed centerline turned towards the east-northeast. The ERI survey soundings were performed using the "dipole-dipole" method, the practice standard for ERI surveys in karst.

<sup>1</sup>This so-called "closed depression" is actually a spur to the principal swale encompassed by the CCCA, and was only "closed" by the construction of modern Route 11, based on the examination of historic topographic maps. Nevertheless, the closed depression as it is currently configured is internally drained, and must be accounted for in the overall assessment of the CCCA hydrogeology.

The parallel arrangement of the arrays allowed GeoConcepts to analyze both 2D ERI scans for the individual arrays, and also to combine them to create a 3D Pseudo-section image of any subsurface “anomalies” (i.e. air, water, or soil-filled voids in the bedrock). Figure 5, Attachment A shows the location of the most significant anomaly detected during this survey as seen from above. Based on the analyses of the 2D and 3D scans (Figures 1 – 7, Attachment B) the anomaly was located at a depth (>20 feet below existing grade) which would not be expected to impact the pipeline excavation.

## Air Track Borings

In order to calibrate the data from the ERI scans, and investigate the possible anomaly, a series of air track borings were advanced along the proposed centerline (concurrent with ERI 3). The boring locations are included as Figure 6, Attachment A. No significant air-filled voids between the surface and 25 feet below grade were intercepted by the borings. The area of the closed depression along Route 11 crossed by the proposed centerline was underlain entirely by soil to a depth greater than 25 feet below grade. The only significant air-filled voids were intercepted by boring B-21, at 20 to 23 feet, and 28 to 36 feet below grade. Both voids were overlain by 13 feet of solid carbonate bedrock to within 7 feet of the surface. Boring B-21 is located north of the proposed centerline, and the depth of the voids would not be expected to impact the pipeline or be intercepted by the trench excavation. Boring logs are included as Attachment C. The air track boreholes were backfilled with cuttings, but any boring that intercepted an open void was grouted shut above the void.

## Hydrological Investigation

Moffett Lake is supplied with water from a perennial spring emerging from a small cavern (Figure 1). It has been inferred that the Cave Spring is hydrologically connected to a subterranean stream in Cochran’s Cave No. 2 (located 168 feet west of the spring); however, an actual connection has not been established by dye trace (the practice standard for groundwater monitoring in karst). The cave entrance is 38 vertical feet above the spring; however, the elevation of the cave stream has not been determined at this time.



**Figure 1. Photograph of the spring cavern**

In order to characterize the hydrology of the lake’s water supply and its source, measurements were performed of the flow rate of the spring and the lake. The measurements were obtained on October 18, 2016.

Figure 7, Attachment A shows the selected monitoring points, one downstream from the Cave Spring ("Spring Run"), and a second downstream from the outfall of the lake ("Lake Outfall").

The flow rate was calculated by determining the cross-sectional area of the channels at the monitoring points, and then measuring the flow velocity in feet/second using a Global Water™ FP-101 automated flow probe.

Flow rate was then calculated using the following equation:

$$\text{FLOW RATE (cubic ft/sec)} = \text{cross section area (sq. feet)} \times \text{velocity (ft/sec)}$$

The rate in cubic ft/sec was then converted to gallons per minute (gpm). The data collected during the monitoring event is shown on Table 1.

**Table 1. Stream Flow Monitoring Results – October 18, 2016 Monitoring Event**

Monitoring Point ID	Channel x-section (sq. feet)	Avg. Current Velocity (ft/sec.)	Flow Rate (cu ft./sec)	Flow Rate (gpm)
Spring Run	0.256	0.5	0.128	57
Lake Outfall	0.506	0.4	0.202	91

Based on these data, it would appear that Moffett Lake is being supplied with water from both the Cave Spring and an additional source as well (most likely subsurface springs). During the site reconnaissance a swale cutting into the hillside was observed extending perpendicular to the west end of Moffett Lake. LIDAR bare earth imagery indicated the presence of at least three sinkholes along this swale, suggesting that it may have developed along a solution-enlarged fracture lineament (Figure 8, Attachment A). These types of structures frequently channel groundwater to springs, and this could be one possible source for the extra recharge being supplied to Moffett Lake.

It should also be noted that during the construction of I-81 in the 1960s, a quarry was excavated southeast of Moffett Lake, and 600 feet due east from the Cave Spring. A second spring (now dry) formerly supplied water to Moffett Lake as well, and its outfall channel can clearly be observed on Figure 8. This spring reportedly ceased to flow during the quarrying operations, and has been dry ever since. The Old Spring rise is located 80 feet east of the Cave Spring, and is located in what now appears to be a sinkhole. The water reportedly rose up from the center of the depression. The fact that the Cave Spring was not affected by the quarrying activities, and the "Old Spring" was, suggests that the karst aquifer in this area is compartmentalized into discreet sub-aquifers, a common occurrence in karst terrains.

GeoConcepts returned on January 5, 2017 to measure the flow rate of the cave stream compared to the spring run. Results are shown on Table 2.

**Table 2. Flow Monitoring Results – January 5, 2017 Monitoring Event**

Monitoring Point ID	Channel x-section (sq. feet)	Avg. Current Velocity (ft/sec.)	Flow Rate (cu ft./sec)	Flow Rate (gpm)
Cave Stream	0.146	1.02	0.148	66
Spring Run	0.256	0.70	0.180	81

Based on these data the cave stream is gaining 15 gpm of flow between the terminal sump in the cave and where the spring run emerges from the cave shown in Figure 1.

## Dye Trace Investigation

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A dye trace was conducted at the Moffett Property in an effort to verify the inferred hydrological connection of the stream in Cochran's Cave No. 2 and the stream emerging from the spring cavern. Background sampling of the water was conducted on November 12 – 13, 2016 to check for any possible dye contamination in the water. Charcoal packets were placed in the stream just outside the cave and allowed to sit in the water flow overnight. Twenty-four hours later the charcoal packets were collected along with grab samples of water, placed into a chilled cooler and shipped to Ozark Underground Laboratory for testing. No Eosine dye was detected in the background samples.

On December 1, 2016 one pound of Eosine dye was placed in the cave stream just upstream from the terminal sump. Dye packets and grab samples were collected from just inside the opening of the cave spring. Dye was detected in the spring run approximately two hours after placement, with the highest concentration detected approximately 4 hours after the dye was introduced into the cave stream. Based on the straight line distance from the introduction point to the sampling point (214 feet), the first arrival of dye traveled at a velocity of 2,568 ft/day, and the principle "slug" of dye traveled at a velocity of 1,284 ft/day, suggesting direct conduit flow and a relatively steep hydraulic gradient. The dye trace verified there is a hydrologic connection between the cave stream and the spring.

## Hydrological Recording Instrument Placement

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Hydrological data loggers were installed in the cave stream in Cochran's Cave No. 2 in a pool approximately 20 feet upstream from the terminal sump on December 20, 2016. The loggers are monitoring water depth, conductivity, and turbidity. The water level and conductivity loggers were placed in slotted PVC pipes mounted to the cavern wall, and the turbidity logger was suspended from a cable mounted on the passage roof (see Figure 2). Instruments were installed and mounted based on guidance received from Wil Orndorff of the Virginia Division of Conservation and Recreation – Natural Heritage Program. Data will be collected on a monthly basis until the completion of construction.



**Figure 2. Installed Data Loggers**

## General Limitations

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The investigations summarized in this memorandum were performed in accordance with generally accepted geologic and geotechnical engineering practices. No warranties, expressed or implied, are made as to the professional services summarized in this memorandum.

Attachment A, Figures 1 – 8 (8 pages)

Attachment B, Figures 1 – 7 (7 pages)

Attachment C, Boring Logs (23 pages)

Attachment D, Laboratory Certificate of Analysis and Chain of Custody Documentation (8 pages)

RKD/TWL/shm

N:\PROJECTS\Active 11 Projects\11002.04, Dominion Resources Pipeline - Randolph and Pocahontas Co\Billing Group 6, Moffett Lake Area Studies\Final\Update Memos\Update Memo 01-20-2017\Update Memo 01-20-2017.docx



# Attachment A






Figures 1 – 8 (8 pages)

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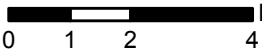
*This information is for environmental review purposes only.*



-  CCCA Boundary
-  milepost
-  acp\_rev11\_centerline
-  acp\_rev11\_KRA
-  acp\_rev11\_survey\_corridor

**FIGURE 1. Site Vicinity Map**  
 Cochran's Cave Conservation Area  
 Project No. 11002.04  
 Folly Mills Area  
 Augusta County, VA









Miles



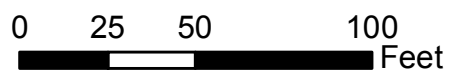
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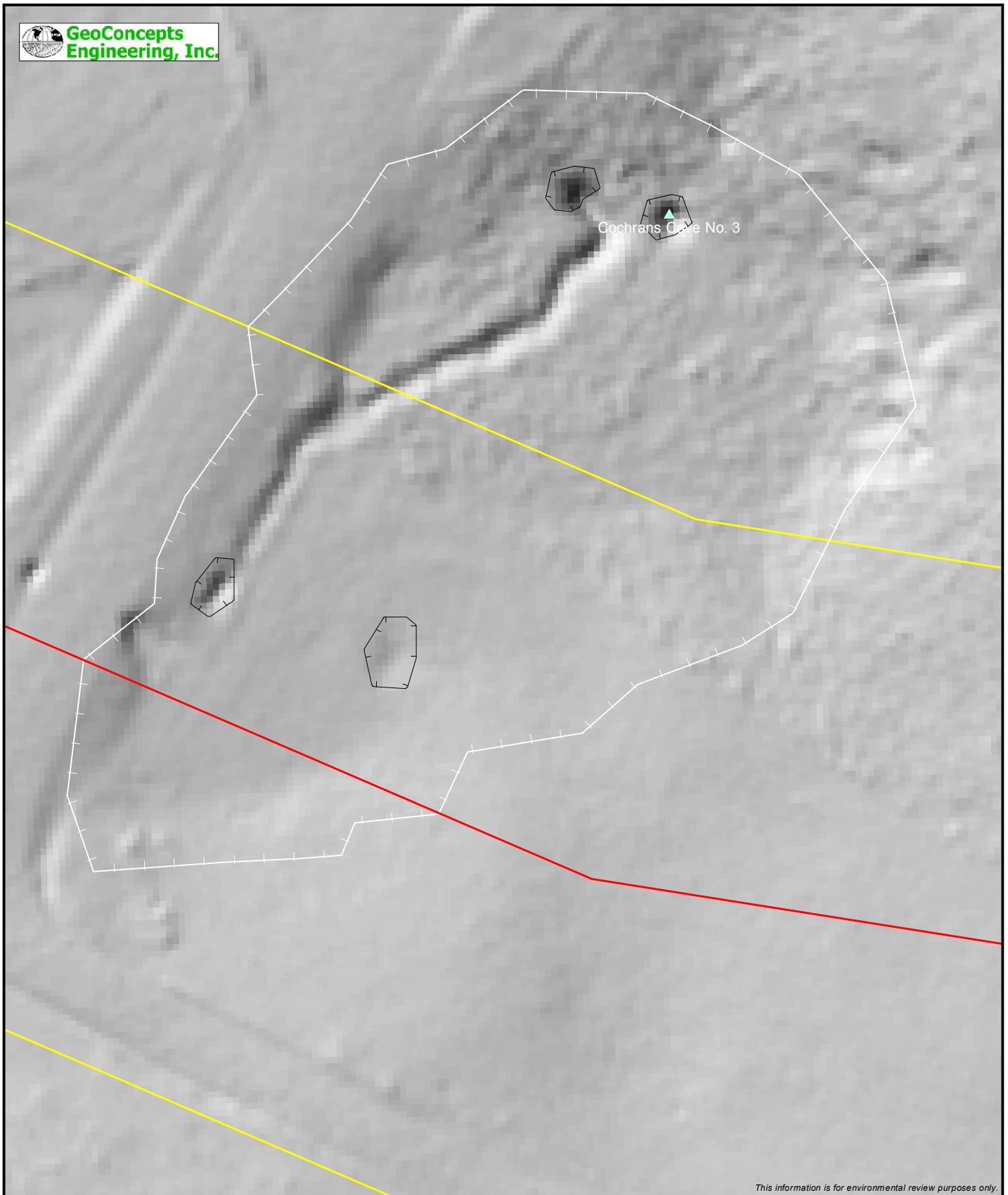


-  VSS Caves
-  closed depression
-  acp\_rev11\_centerline
-  acp\_rev11\_survey\_corridor

**FIGURE 2. Closed Depression Map**






Cochran's Cave Conservation Area  
 Project No. 11002.04  
 Folly Mills Area  
 Augusta County, VA



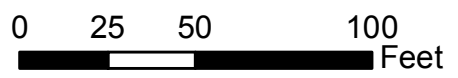


*This information is for environmental review purposes only.*



-  VSS Caves
-  CCCA\_sinkholes
-  closed depression
-  acp\_rev11\_centerline
-  acp\_rev11\_survey\_corridor

**FIGURE 3. LIDAR Sinkhole Map**  
 Cochran's Cave Conservation Area  
 Project No. 11002.04  
 Folly Mills Area  
 Augusta County, VA



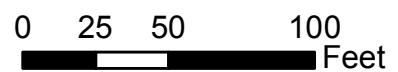


*This information is for environmental review purposes only.*



- ▲ VSS Caves
- CCCA\_sinkholes
- closed depression
- acp\_rev11\_centerline
- acp\_rev11\_survey\_corridor
- ERI Lines






**FIGURE 4. ERI Array Layout**  
 Cochran's Cave Conservation Area  
 Project No. 11002.04  
 Folly Mills Area  
 Augusta County, VA



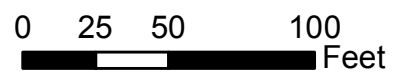


*This information is for environmental review purposes only.*



-  closed depression
-  acp\_rev11\_centerline
-  acp\_rev11\_survey\_corridor
-  ERI Lines
-  anomalies

**FIGURE 5. Subsurface Anomaly Locations**  
 Cochran's Cave Conservation Area  
 Project No. 11002.04  
 Folly Mills Area  
 Augusta County, VA





*This information is for environmental review purposes only.*



- closed depression
- acp\_rev11\_centerline
- acp\_rev11\_survey\_corridor
- ERI Lines
- anomalies
- Air Track Boring

**FIGURE 6. Air Track Boring Locations**

Cochran's Cave Conservation Area

Project No. 11002.04

Folly Mills Area

Augusta County, VA



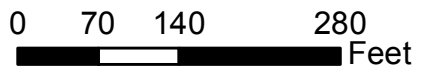


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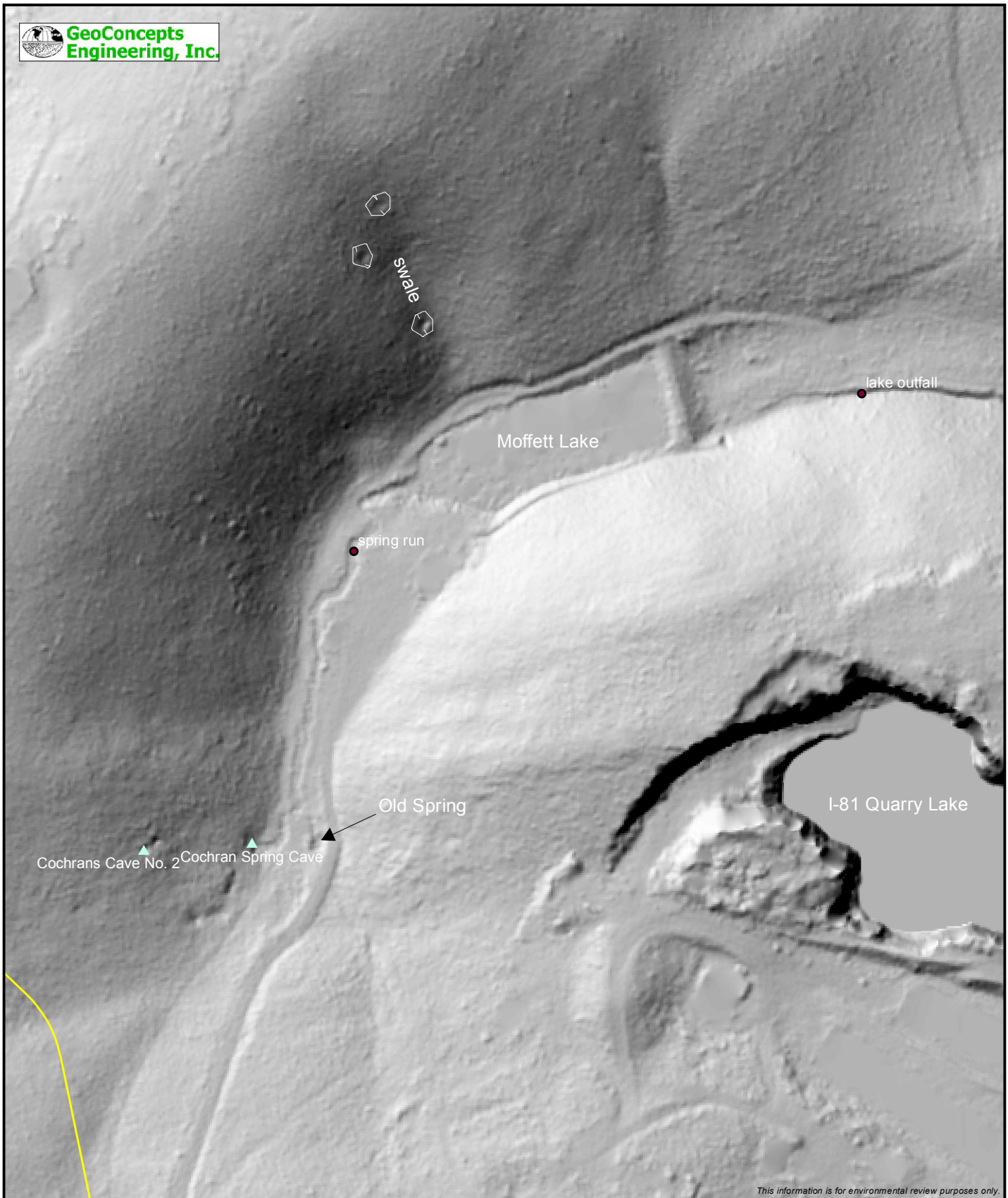


- hydro monitoring point
- ▲ VSS Caves

**FIGURE 7. Hydrological Monitoring Points**  
 Cochran's Cave Conservation Area  
 Project No. 11002.04  
 Folly Mills Area  
 Augusta County, VA





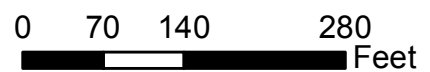


*This information is for environmental review purposes only.*



- hydro monitoring point
- ▲ VSS Caves
- CCCA\_sinkholes

**FIGURE 8. LIDAR Imagery**  
 Cochran's Cave Conservation Area  
 Project No. 11002.04  
 Folly Mills Area  
 Augusta County, VA



# Attachment B

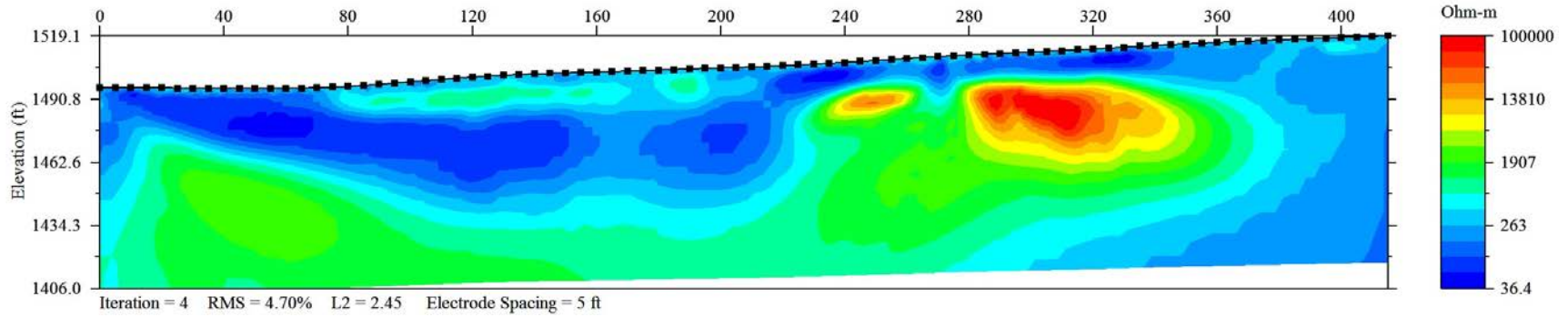
Figures 1 – 7 (7 pages)

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West

East

### Inverted Resistivity Section Line 1



### Inverted Resistivity Section Line 2

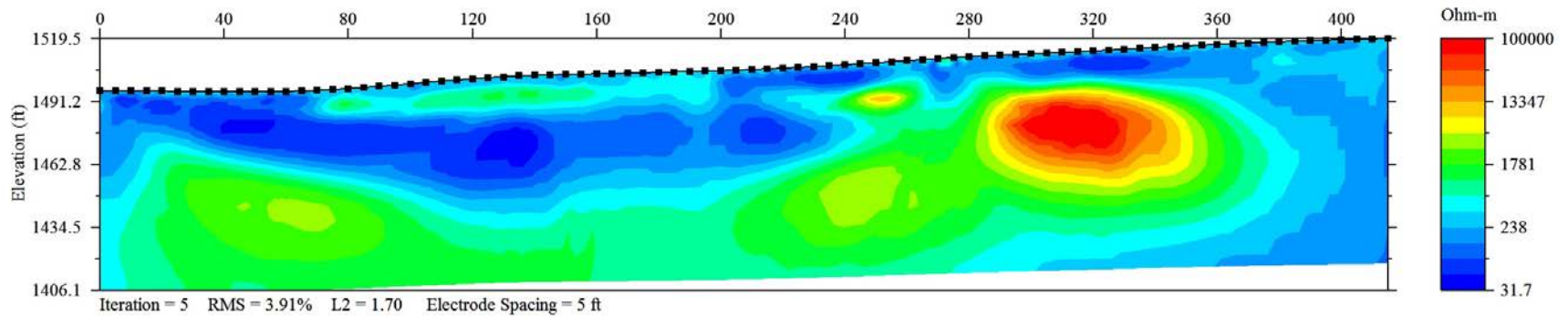
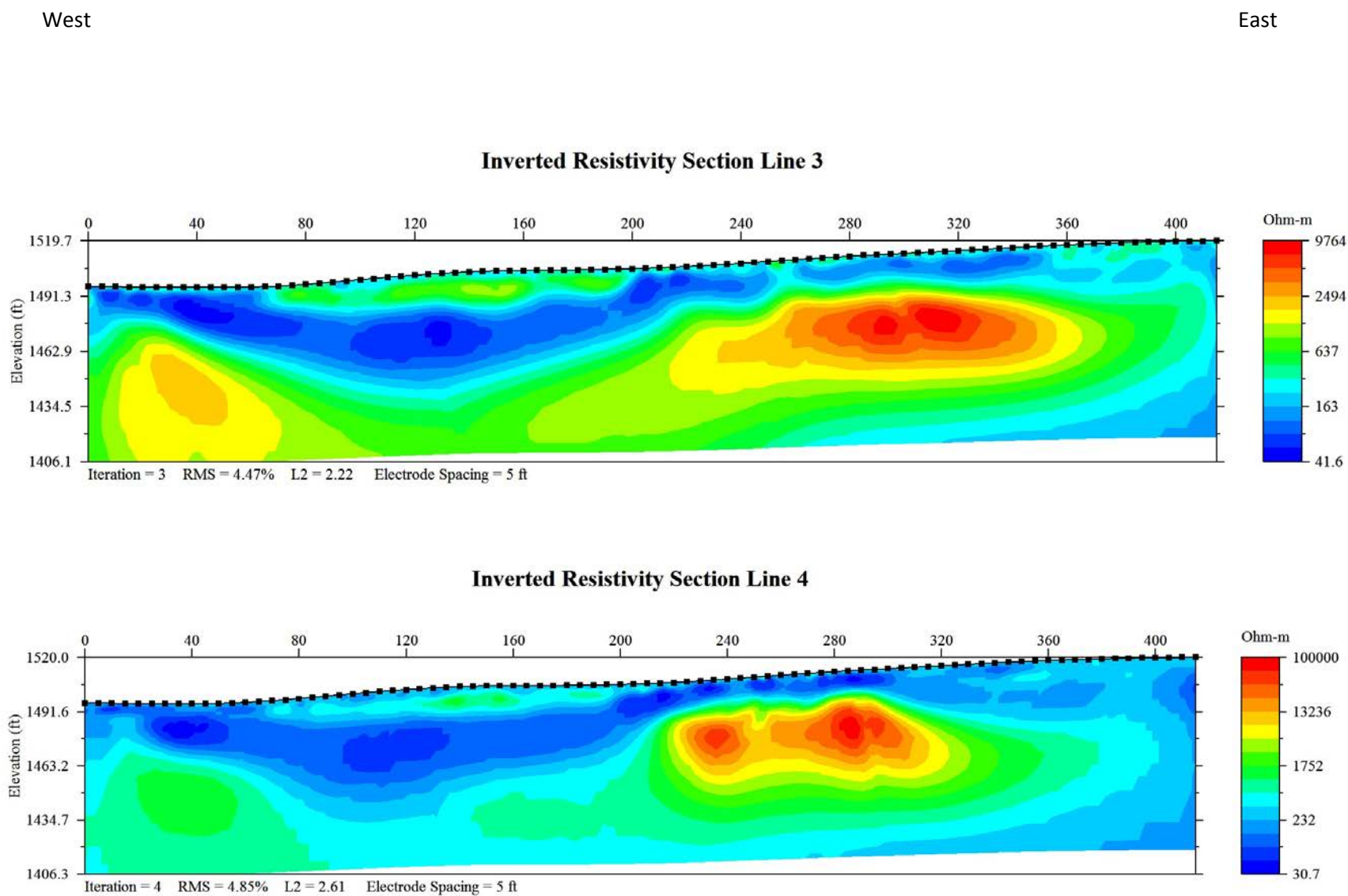


FIGURE 1. ERI Lines 1 and 2



**FIGURE 2. ERI Lines 3 and 4**

West

East

### Inverted Resistivity Section Line 5

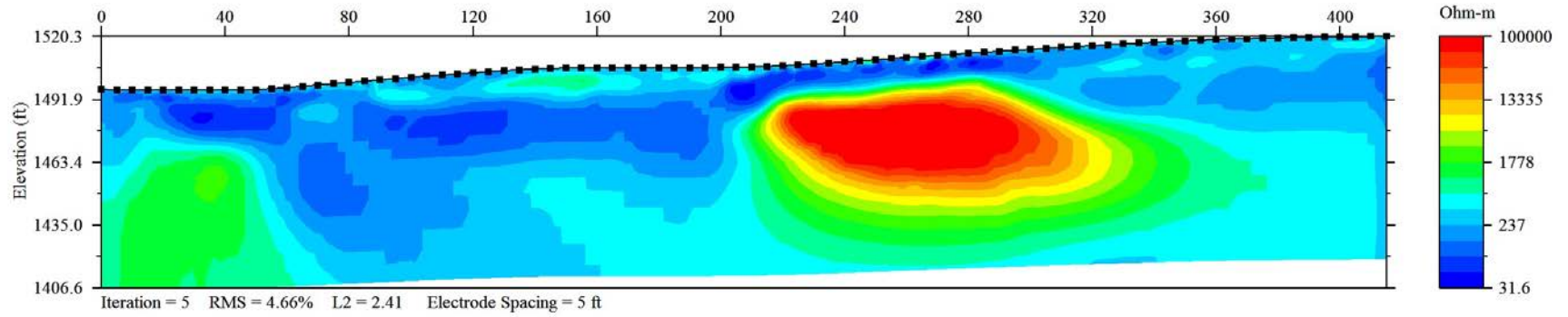


FIGURE 3. ERI Line 5

West

East

# 3D Resistivity Contour Plot

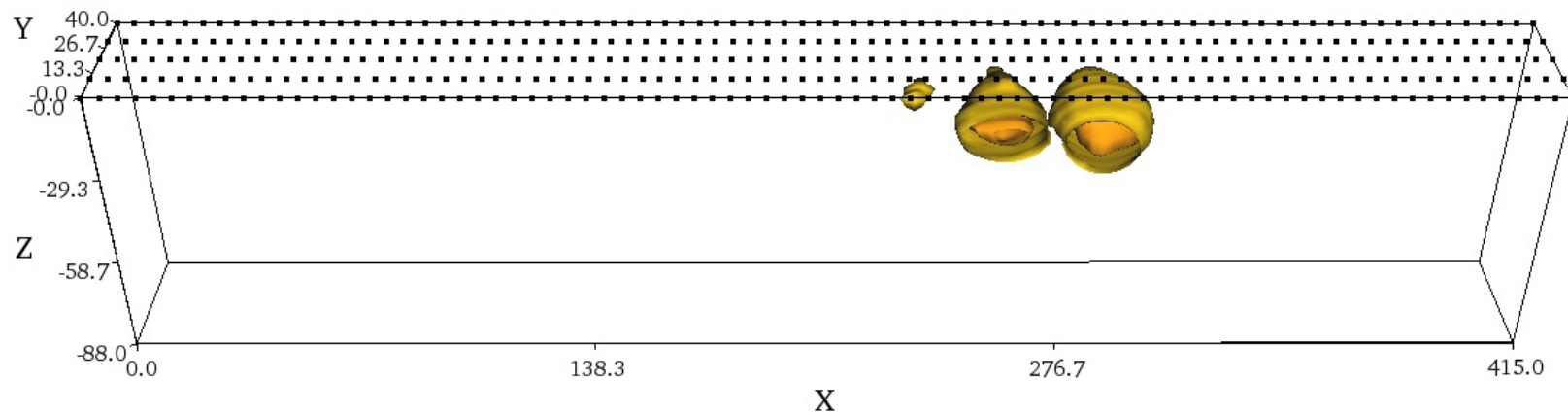


FIGURE 4. 3D Pseudosection, Oblique View

West

East

# 3D Resistivity Contour Plot

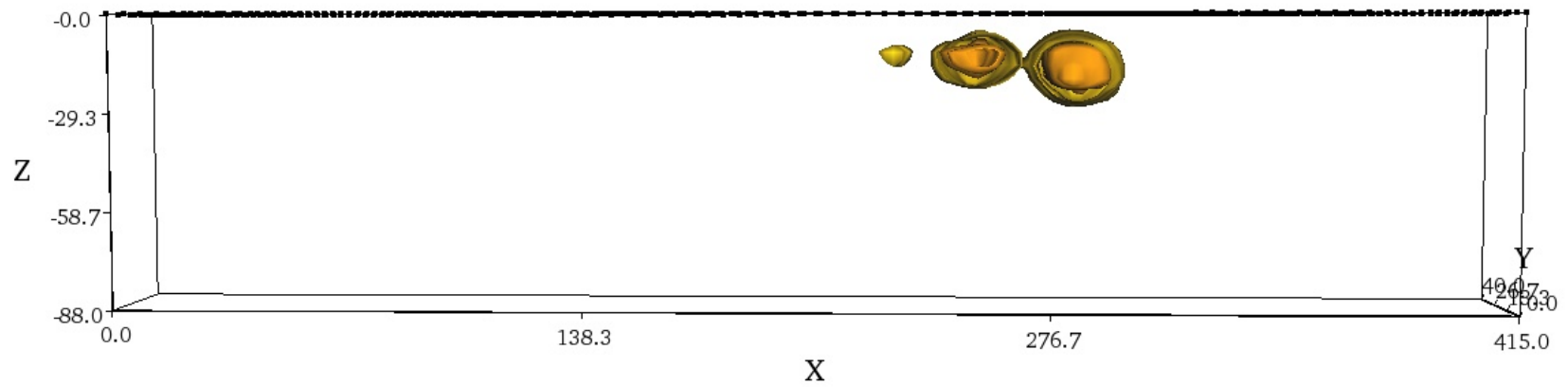


FIGURE 5. 3D Pseudosection, x-section view looking north

West

East

# 3D Resistivity Contour Plot

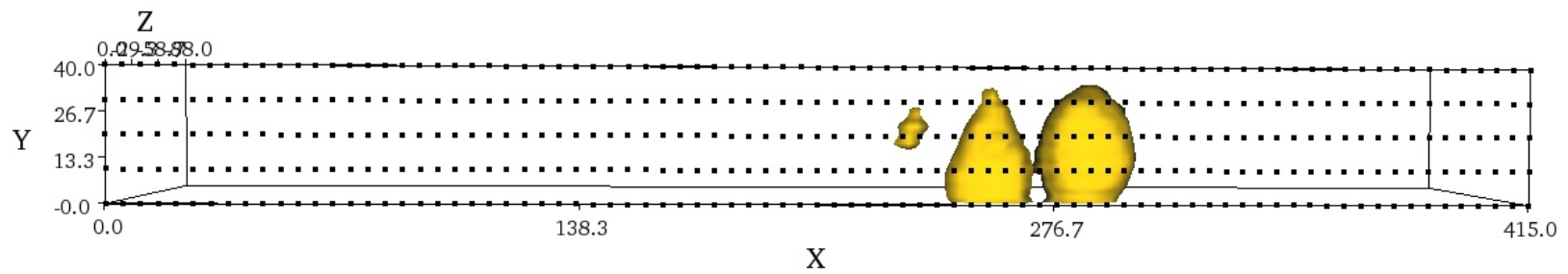


FIGURE 6. 3D Pseudosection, plan view



West

East

# Inverted Resistivity Image

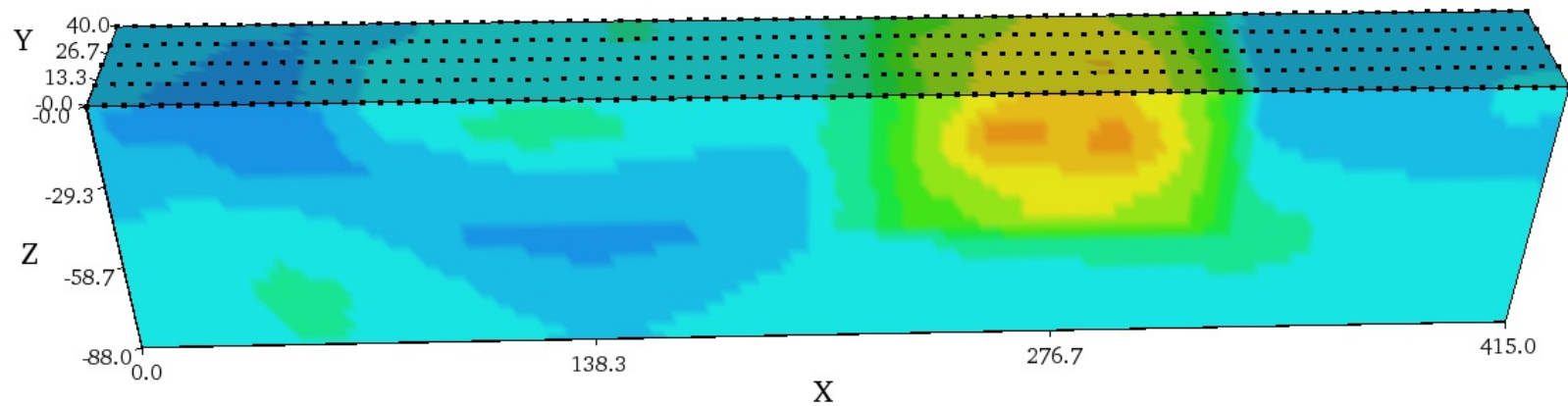


FIGURE 7. 3D Pseudosection, inverted resistivity image – oblique view

# Attachment C

Boring Logs (23 pages)

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PROJECT: <b>Moffett Lake and Cochran's Cave</b>		LOGGED BY: <b>B. Weinmann</b>	BORING NUMBER: <b>B-1</b>
LOCATION:		DRILLING CONTRACTOR: <b>GeoConcepts Engineering</b>	
OWNER/CLIENT: <b>Dominion Transmission</b>		DRILLER:	DATES DRILLED: <b>10/12/16 - 10/12/16</b>
PROJECT NUMBER: <b>11002.04, task 6</b>	GROUND SURFACE ELEVATION (ft): <b>NOT SURVEYED</b>	DRILLING METHOD:	OFFSET NOTES:

DEPTH (ft)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL					
					SPT BLOW COUNTS	REC (ft)	STANDARD PENETRATION TEST RESISTANCE (BPF)			
							20	40	60	80
0 - 5				SOIL						
5 - 10				ROCK						
10 - 13				VOID/SEAM WITH DIRT AND DEBRIS						
13 - 23				ROCK						
23 - 25				VOID/SEAM/SOIL						
25 - 33				ROCK						
33 - 33.0				Bottom of Boring at 33.0 ft						

GROUND WATER LEVELS:	SAMPLE TYPES:
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REMARKS:

BOREHOLE/TEST PIT DOMINION RESOURCES PIPELINE AIR TRACK LOGS.GPJ GEOCONCEPTS TEMPLATE 02-12-2015.GDT 10/31/16

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.



PROJECT: <b>Moffett Lake and Cochran's Cave</b>		LOGGED BY: <b>B. Weinmann</b>	BORING NUMBER: <b>B-2</b>
LOCATION:		DRILLING CONTRACTOR: <b>GeoConcepts Engineering</b>	
OWNER/CLIENT: <b>Dominion Transmission</b>		DRILLER:	DATES DRILLED: <b>10/12/16 - 10/12/16</b>
PROJECT NUMBER: <b>11002.04, task 6</b>	GROUND SURFACE ELEVATION (ft): <b>NOT SURVEYED</b>	DRILLING METHOD:	OFFSET NOTES:

DEPTH (ft)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL														
					SPT BLOW COUNTS	REC (ft)	STANDARD PENETRATION TEST RESISTANCE (BPF) 20 40 60 80												
				SOIL															
5				VOID															
10				ROCK															
20				VOID WITH VERY LITTLE SOIL															
20				ROCK															
30				Bottom of Boring at 28.0 ft															

GROUND WATER LEVELS:	SAMPLE TYPES:
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REMARKS:

BOREHOLE/TEST PIT DOMINION RESOURCES PIPELINE AIR TRACK LOGS.GPJ GEOCONCEPTS TEMPLATE 02-12-2015.GDT 10/31/16

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.



PROJECT: <b>Moffett Lake and Cochran's Cave</b>		LOGGED BY: <b>B. Weinmann</b>		BORING NUMBER: <b>B-3</b>
LOCATION:		DRILLING CONTRACTOR: <b>GeoConcepts Engineering</b>		
OWNER/CLIENT: <b>Dominion Transmission</b>		DRILLER:	DATES DRILLED: <b>10/12/16 - 10/12/16</b>	
PROJECT NUMBER: <b>11002.04, task 6</b>	GROUND SURFACE ELEVATION (ft): <b>NOT SURVEYED</b>	DRILLING METHOD:	OFFSET NOTES:	

DEPTH (ft)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL			
					SPT BLOW COUNTS	REC (ft)	STANDARD PENETRATION TEST RESISTANCE (BPF) 20 40 60 80	
				SOIL				
5				ROCK				
10								
15								
20								
				Bottom of Boring at 20.0 ft				
25								
30								
35								
40								
45								

GROUND WATER LEVELS:	SAMPLE TYPES:
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REMARKS:

BOREHOLE/TEST PIT DOMINION RESOURCES PIPELINE AIR TRACK LOGS.GPJ GEOCONCEPTS TEMPLATE 02-12-2015.GDT 10/31/16

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.



PROJECT: <b>Moffett Lake and Cochran's Cave</b>		LOGGED BY: <b>B. Weinmann</b>	BORING NUMBER: <b>B-4</b>
LOCATION:		DRILLING CONTRACTOR: <b>GeoConcepts Engineering</b>	
OWNER/CLIENT: <b>Dominion Transmission</b>		DRILLER:	DATES DRILLED: <b>10/12/16 - 10/12/16</b>
PROJECT NUMBER: <b>11002.04, task 6</b>	GROUND SURFACE ELEVATION (ft): <b>NOT SURVEYED</b>	DRILLING METHOD:	OFFSET NOTES:

DEPTH (ft)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL					
					SPT BLOW COUNTS	REC (ft)	STANDARD PENETRATION TEST RESISTANCE (BPF)			
							20	40	60	80
				SOIL						
				ROCK						
5				SEAM WITH DIRT						
				SOLID ROCK						
10										
15										
20				Bottom of Boring at 20.0 ft						
25										
30										
35										
40										
45										

GROUND WATER LEVELS:	SAMPLE TYPES:
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REMARKS:

BOREHOLE/TEST PIT DOMINION RESOURCES PIPELINE AIR TRACK LOGS.GPJ GEOCONCEPTS TEMPLATE 02-12-2015.GDT 10/31/16

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.



PROJECT: <b>Moffett Lake and Cochran's Cave</b>		LOGGED BY: <b>B. Weinmann</b>	BORING NUMBER: <b>B-5</b>
LOCATION:		DRILLING CONTRACTOR: <b>GeoConcepts Engineering</b>	
OWNER/CLIENT: <b>Dominion Transmission</b>		DRILLER:	DATES DRILLED: <b>10/12/16 - 10/12/16</b>
PROJECT NUMBER: <b>11002.04, task 6</b>	GROUND SURFACE ELEVATION (ft): <b>NOT SURVEYED</b>	DRILLING METHOD:	OFFSET NOTES:

DEPTH (ft)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL														
					SPT BLOW COUNTS	REC (ft)	STANDARD PENETRATION TEST RESISTANCE (BPF) 20 40 60 80												
				SOIL															
5				ROCK															
10				DIRT SEAM															
15				ROCK															
20																			
25				Bottom of Boring at 23.0 ft															
30																			
35																			
40																			
45																			

GROUND WATER LEVELS:	SAMPLE TYPES:
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REMARKS:

BOREHOLE/TEST PIT DOMINION RESOURCES PIPELINE AIR TRACK LOGS.GPJ GEOCONCEPTS TEMPLATE 02-12-2015.GDT 10/31/16

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.



PROJECT: <b>Moffett Lake and Cochran's Cave</b>		LOGGED BY: <b>B. Weinmann</b>	BORING NUMBER: <b>B-6</b>
LOCATION:		DRILLING CONTRACTOR: <b>GeoConcepts Engineering</b>	
OWNER/CLIENT: <b>Dominion Transmission</b>		DRILLER:	DATES DRILLED: <b>10/12/16 - 10/12/16</b>
PROJECT NUMBER: <b>11002.04, task 6</b>	GROUND SURFACE ELEVATION (ft): <b>NOT SURVEYED</b>	DRILLING METHOD:	OFFSET NOTES:

DEPTH (ft)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL					
					SPT BLOW COUNTS	REC (ft)	STANDARD PENETRATION TEST RESISTANCE (BPF)			
							20	40	60	80
			[Diagonal Hatching]	SOIL						
			[Horizontal Hatching]	ROCK						
5			[Horizontal Hatching]							
			[Diagonal Hatching]	DIRT FILLED SEAM						
10			[Diagonal Hatching]							
			[Horizontal Hatching]	ROCK						
15			[Horizontal Hatching]							
20			[Horizontal Hatching]							
				Bottom of Boring at 22.0 ft						
25										
30										
35										
40										
45										

GROUND WATER LEVELS:	SAMPLE TYPES:
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REMARKS:

BOREHOLE/TEST PIT DOMINION RESOURCES PIPELINE AIR TRACK LOGS.GPJ GEOCONCEPTS TEMPLATE 02-12-2015.GDT 10/31/16

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.





PROJECT: <b>Moffett Lake and Cochran's Cave</b>		LOGGED BY: <b>B. Weinmann</b>		BORING NUMBER: <b>B-7</b>
LOCATION:		DRILLING CONTRACTOR: <b>GeoConcepts Engineering</b>		
OWNER/CLIENT: <b>Dominion Transmission</b>		DRILLER:	DATES DRILLED: <b>10/12/16 - 10/12/16</b>	
PROJECT NUMBER: <b>11002.04, task 6</b>	GROUND SURFACE ELEVATION (ft): <b>NOT SURVEYED</b>	DRILLING METHOD:	OFFSET NOTES:	

DEPTH (ft)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL					
					SPT BLOW COUNTS	REC (ft)	STANDARD PENETRATION TEST RESISTANCE (BPF)			
							20	40	60	80
0 - 7.5				SOIL						
7.5 - 19.5				ROCK						
19.5 - 20.5				6-inch seam ROCK						
20.5 - 25.0				ROCK						
25.0 - 25.0				Bottom of Boring at 25.0 ft						
25.0 - 30.0										
30.0 - 35.0										
35.0 - 40.0										
40.0 - 45.0										
45.0 - 50.0										

GROUND WATER LEVELS:	SAMPLE TYPES:
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REMARKS:

BOREHOLE/TEST PIT DOMINION RESOURCES PIPELINE AIR TRACK LOGS.GPJ GEOCONCEPTS TEMPLATE 02-12-2015.GDT 10/31/16

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.



PROJECT: <b>Moffett Lake and Cochran's Cave</b>		LOGGED BY: <b>B. Weinmann</b>	BORING NUMBER: <b>B-8</b>
LOCATION:		DRILLING CONTRACTOR: <b>GeoConcepts Engineering</b>	
OWNER/CLIENT: <b>Dominion Transmission</b>		DRILLER:	DATES DRILLED: <b>10/12/16 - 10/12/16</b>
PROJECT NUMBER: <b>11002.04, task 6</b>	GROUND SURFACE ELEVATION (ft): <b>NOT SURVEYED</b>	DRILLING METHOD:	OFFSET NOTES:

DEPTH (ft)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL					
					SPT BLOW COUNTS	REC (ft)	STANDARD PENETRATION TEST RESISTANCE (BPF)			
							20	40	60	80
				SOIL						
5				RUBBLE/BROKEN ROCK						
				SOIL						
10				ROCK						
15										
20										
25										
30										
				Bottom of Boring at 30.0 ft						
35										
40										
45										

GROUND WATER LEVELS:	SAMPLE TYPES:
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REMARKS:

BOREHOLE/TEST PIT DOMINION RESOURCES PIPELINE AIR TRACK LOGS.GPJ GEOCONCEPTS TEMPLATE 02-12-2015.GDT 10/31/16

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.



PROJECT: <b>Moffett Lake and Cochran's Cave</b>		LOGGED BY: <b>B. Weinmann</b>	BORING NUMBER: <b>B-9</b>
LOCATION:		DRILLING CONTRACTOR: <b>GeoConcepts Engineering</b>	
OWNER/CLIENT: <b>Dominion Transmission</b>		DRILLER:	DATES DRILLED: <b>10/12/16 - 10/12/16</b>
PROJECT NUMBER: <b>11002.04, task 6</b>	GROUND SURFACE ELEVATION (ft): <b>NOT SURVEYED</b>	DRILLING METHOD:	OFFSET NOTES:

DEPTH (ft)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL														
					SPT BLOW COUNTS	REC (ft)	STANDARD PENETRATION TEST RESISTANCE (BPF) 20 40 60 80												
5				SOIL															
10																			
15																			
20				ROCK															
25																			
30				Bottom of Boring at 28.0 ft															
35																			
40																			
45																			

GROUND WATER LEVELS:	SAMPLE TYPES:
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REMARKS:

BOREHOLE/TEST PIT DOMINION RESOURCES PIPELINE AIR TRACK LOGS.GPJ GEOCONCEPTS TEMPLATE 02-12-2015.GDT 10/31/16

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.



PROJECT: <b>Moffett Lake and Cochran's Cave</b>		LOGGED BY: <b>B. Weinmann</b>	BORING NUMBER: <b>B-10</b>
LOCATION:		DRILLING CONTRACTOR: <b>GeoConcepts Engineering</b>	
OWNER/CLIENT: <b>Dominion Transmission</b>		DRILLER:	DATES DRILLED: <b>10/12/16 - 10/12/16</b>
PROJECT NUMBER: <b>11002.04, task 6</b>	GROUND SURFACE ELEVATION (ft): <b>NOT SURVEYED</b>	DRILLING METHOD:	OFFSET NOTES:

DEPTH (ft)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL					
					SPT BLOW COUNTS	REC (ft)	STANDARD PENETRATION TEST RESISTANCE (BPF)			
							20	40	60	80
5				SOIL						
10										
15										
20										
25				ROCK						
30										
35				Bottom of Boring at 35.0 ft						
40										
45										

GROUND WATER LEVELS:	SAMPLE TYPES:
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REMARKS:

BOREHOLE/TEST PIT DOMINION RESOURCES PIPELINE AIR TRACK LOGS.GPJ GEOCONCEPTS TEMPLATE 02-12-2015.GDT 10/31/16

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.



PROJECT: <b>Moffett Lake and Cochran's Cave</b>		LOGGED BY: <b>B. Weinmann</b>	BORING NUMBER: <b>B-11</b>
LOCATION:		DRILLING CONTRACTOR: <b>GeoConcepts Engineering</b>	
OWNER/CLIENT: <b>Dominion Transmission</b>		DRILLER:	DATES DRILLED: <b>10/12/16 - 10/12/16</b>
PROJECT NUMBER: <b>11002.04, task 6</b>	GROUND SURFACE ELEVATION (ft): <b>NOT SURVEYED</b>	DRILLING METHOD:	OFFSET NOTES:

DEPTH (ft)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL			
					SPT BLOW COUNTS	REC (ft)	STANDARD PENETRATION TEST RESISTANCE (BPF) 20 40 60 80	
0 - 20				SOIL				
20 - 30				ROCK				
30 - 30.0				Bottom of Boring at 30.0 ft				

GROUND WATER LEVELS:	SAMPLE TYPES:
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REMARKS:

BOREHOLE/TEST PIT DOMINION RESOURCES PIPELINE AIR TRACK LOGS.GPJ GEOCONCEPTS TEMPLATE 02-12-2015.GDT 10/31/16

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.



PROJECT: <b>Moffett Lake and Cochran's Cave</b>		LOGGED BY: <b>B. Weinmann</b>	BORING NUMBER: <b>B-12</b>
LOCATION:		DRILLING CONTRACTOR: <b>GeoConcepts Engineering</b>	
OWNER/CLIENT: <b>Dominion Transmission</b>		DRILLER:	DATES DRILLED: <b>10/12/16 - 10/12/16</b>
PROJECT NUMBER: <b>11002.04, task 6</b>	GROUND SURFACE ELEVATION (ft): <b>NOT SURVEYED</b>	DRILLING METHOD:	OFFSET NOTES:

DEPTH (ft)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL														
					SPT BLOW COUNTS	REC (ft)	STANDARD PENETRATION TEST RESISTANCE (BPF) 20 40 60 80												
0 - 23				SOIL															
23 - 34				ROCK															
34 - 34.0				Bottom of Boring at 34.0 ft															

GROUND WATER LEVELS:	SAMPLE TYPES:
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REMARKS:

BOREHOLE/TEST PIT DOMINION RESOURCES PIPELINE AIR TRACK LOGS.GPJ GEOCONCEPTS TEMPLATE 02-12-2015.GDT 10/31/16

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.



PROJECT: <b>Moffett Lake and Cochran's Cave</b>		LOGGED BY: <b>B. Weinmann</b>		BORING NUMBER: <b>B-13</b>
LOCATION:		DRILLING CONTRACTOR: <b>GeoConcepts Engineering</b>		
OWNER/CLIENT: <b>Dominion Transmission</b>		DRILLER:		DATES DRILLED: <b>10/12/16 - 10/12/16</b>
PROJECT NUMBER: <b>11002.04, task 6</b>	GROUND SURFACE ELEVATION (ft): <b>NOT SURVEYED</b>	DRILLING METHOD:		OFFSET NOTES:

DEPTH (ft)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL					
					SPT BLOW COUNTS	REC (ft)	STANDARD PENETRATION TEST RESISTANCE (BPF)			
							20	40	60	80
5				SOIL						
10										
15										
20										
25										
30										
35										
40										
45										
50										
55										
60										
65										
				Bottom of Boring at 68.0 ft						

GROUND WATER LEVELS:	SAMPLE TYPES:
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REMARKS:

BOREHOLE/TEST PIT DOMINION RESOURCES PIPELINE AIR TRACK LOGS.GPJ GEOCONCEPTS TEMPLATE 02-12-2015.GDT 10/31/16

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.



PROJECT: <b>Moffett Lake and Cochran's Cave</b>		LOGGED BY: <b>B. Weinmann</b>	BORING NUMBER: <b>B-14</b>
LOCATION:		DRILLING CONTRACTOR: <b>GeoConcepts Engineering</b>	
OWNER/CLIENT: <b>Dominion Transmission</b>		DRILLER:	DATES DRILLED: <b>10/12/16 - 10/12/16</b>
PROJECT NUMBER: <b>11002.04, task 6</b>	GROUND SURFACE ELEVATION (ft): <b>NOT SURVEYED</b>	DRILLING METHOD:	OFFSET NOTES:

DEPTH (ft)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL					
					SPT BLOW COUNTS	REC (ft)	STANDARD PENETRATION TEST RESISTANCE (BPF)			
							20	40	60	80
5				SOIL						
10										
15										
20										
25										
30				Bottom of Boring at 30.0 ft						
35										
40										
45										

GROUND WATER LEVELS:	SAMPLE TYPES:
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REMARKS:

BOREHOLE/TEST PIT DOMINION RESOURCES PIPELINE AIR TRACK LOGS.GPJ GEOCONCEPTS TEMPLATE 02-12-2015.GDT 10/31/16

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.





PROJECT: <b>Moffett Lake and Cochran's Cave</b>		LOGGED BY: <b>B. Weinmann</b>		BORING NUMBER: <b>B-15</b>
LOCATION:		DRILLING CONTRACTOR: <b>GeoConcepts Engineering</b>		
OWNER/CLIENT: <b>Dominion Transmission</b>		DRILLER:	DATES DRILLED: <b>10/12/16 - 10/12/16</b>	
PROJECT NUMBER: <b>11002.04, task 6</b>	GROUND SURFACE ELEVATION (ft): <b>NOT SURVEYED</b>	DRILLING METHOD:	OFFSET NOTES:	

DEPTH (ft)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL					
					SPT BLOW COUNTS	REC (ft)	STANDARD PENETRATION TEST RESISTANCE (BPF)			
							20	40	60	80
5				SOIL						
10										
15										
20										
25										
30				Bottom of Boring at 30.0 ft						
35										
40										
45										

GROUND WATER LEVELS:	SAMPLE TYPES:
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REMARKS:

BOREHOLE/TEST PIT DOMINION RESOURCES PIPELINE AIR TRACK LOGS.GPJ GEOCONCEPTS TEMPLATE 02-12-2015.GDT 10/31/16

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.



PROJECT: <b>Moffett Lake and Cochran's Cave</b>		LOGGED BY: <b>B. Weinmann</b>	BORING NUMBER: <b>B-16</b>  SHEET 1 OF 1
LOCATION:		DRILLING CONTRACTOR: <b>GeoConcepts Engineering</b>	
OWNER/CLIENT: <b>Dominion Transmission</b>		DRILLER:	DATES DRILLED: <b>10/12/16 - 10/12/16</b>
PROJECT NUMBER: <b>11002.04, task 6</b>	GROUND SURFACE ELEVATION (ft): <b>NOT SURVEYED</b>	DRILLING METHOD:	OFFSET NOTES:

DEPTH (ft)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL														
					SPT BLOW COUNTS	REC (ft)	STANDARD PENETRATION TEST RESISTANCE (BPF) 20 40 60 80												
5				SOIL															
10																			
15																			
20																			
25																			
30				Bottom of Boring at 30.0 ft															
35																			
40																			
45																			

GROUND WATER LEVELS:	SAMPLE TYPES:
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REMARKS:

BOREHOLE/TEST PIT DOMINION RESOURCES PIPELINE AIR TRACK LOGS.GPJ GEOCONCEPTS TEMPLATE 02-12-2015.GDT 10/31/16

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.



PROJECT: <b>Moffett Lake and Cochran's Cave</b>		LOGGED BY: <b>B. Weinmann</b>	BORING NUMBER: <b>B-17</b>
LOCATION:		DRILLING CONTRACTOR: <b>GeoConcepts Engineering</b>	
OWNER/CLIENT: <b>Dominion Transmission</b>		DRILLER:	DATES DRILLED: <b>10/12/16 - 10/12/16</b>
PROJECT NUMBER: <b>11002.04, task 6</b>	GROUND SURFACE ELEVATION (ft): <b>NOT SURVEYED</b>	DRILLING METHOD:	OFFSET NOTES:

DEPTH (ft)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL														
					SPT BLOW COUNTS	REC (ft)	STANDARD PENETRATION TEST RESISTANCE (BPF) 20 40 60 80												
5				SOIL															
10																			
15																			
20																			
25				Wet															
30				Bottom of Boring at 30.0 ft															
35																			
40																			
45																			

GROUND WATER LEVELS:	SAMPLE TYPES:
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REMARKS:

BOREHOLE/TEST PIT DOMINION RESOURCES PIPELINE AIR TRACK LOGS.GPJ GEOCONCEPTS TEMPLATE 02-12-2015.GDT 10/31/16

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.



PROJECT: <b>Moffett Lake and Cochran's Cave</b>		LOGGED BY: <b>B. Weinmann</b>		BORING NUMBER: <b>B-18</b>
LOCATION:		DRILLING CONTRACTOR: <b>GeoConcepts Engineering</b>		
OWNER/CLIENT: <b>Dominion Transmission</b>		DRILLER:		DATES DRILLED: <b>10/12/16 - 10/12/16</b>
PROJECT NUMBER: <b>11002.04, task 6</b>	GROUND SURFACE ELEVATION (ft): <b>NOT SURVEYED</b>	DRILLING METHOD:		OFFSET NOTES:

DEPTH (ft)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL					
					SPT BLOW COUNTS	REC (ft)	STANDARD PENETRATION TEST RESISTANCE (BPF)			
							20	40	60	80
5			[Diagonal Hatching]	SOIL						
10			[Diagonal Hatching]							
15			[Diagonal Hatching]							
20			[Diagonal Hatching]							
25			[Horizontal Hatching]	ROCK						
30			[Diagonal Hatching]	VOID/MUD SEAM, very wet						
35			[Diagonal Hatching]							
40			[Horizontal Hatching]	ROCK						
45			[Horizontal Hatching]	Bottom of Boring at 45.0 ft						

GROUND WATER LEVELS:	SAMPLE TYPES:
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REMARKS:

BOREHOLE/TEST PIT DOMINION RESOURCES PIPELINE AIR TRACK LOGS.GPJ GEOCONCEPTS TEMPLATE 02-12-2015.GDT 10/31/16

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.



PROJECT: <b>Moffett Lake and Cochran's Cave</b>		LOGGED BY: <b>B. Weinmann</b>	BORING NUMBER: <b>B-19</b>
LOCATION:		DRILLING CONTRACTOR: <b>GeoConcepts Engineering</b>	
OWNER/CLIENT: <b>Dominion Transmission</b>		DRILLER:	DATES DRILLED: <b>10/12/16 - 10/12/16</b>
PROJECT NUMBER: <b>11002.04, task 6</b>	GROUND SURFACE ELEVATION (ft): <b>NOT SURVEYED</b>	DRILLING METHOD:	OFFSET NOTES:

DEPTH (ft)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL								
					SPT BLOW COUNTS	REC (ft)	STANDARD PENETRATION TEST RESISTANCE (BPF) 20 40 60 80						
0 - 23				SOIL									
23 - 33				ROCK									
33 - 33.0				Bottom of Boring at 33.0 ft									

GROUND WATER LEVELS:	SAMPLE TYPES:
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REMARKS:

BOREHOLE/TEST PIT DOMINION RESOURCES PIPELINE AIR TRACK LOGS.GPJ GEOCONCEPTS TEMPLATE 02-12-2015.GDT 10/31/16

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.



PROJECT: <b>Moffett Lake and Cochran's Cave</b>		LOGGED BY: <b>B. Weinmann</b>	BORING NUMBER: <b>B-20</b>
LOCATION:		DRILLING CONTRACTOR: <b>GeoConcepts Engineering</b>	
OWNER/CLIENT: <b>Dominion Transmission</b>		DRILLER:	DATES DRILLED: <b>10/12/16 - 10/12/16</b>
PROJECT NUMBER: <b>11002.04, task 6</b>	GROUND SURFACE ELEVATION (ft): <b>NOT SURVEYED</b>	DRILLING METHOD:	OFFSET NOTES:

DEPTH (ft)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL					
					SPT BLOW COUNTS	REC (ft)	STANDARD PENETRATION TEST RESISTANCE (BPF)			
							20	40	60	80
0 - 13			[Diagonal Hatching]	SOIL						
13 - 23			[Brick Pattern]	ROCK						
23 - 24			[Diagonal Hatching]	VOID/MUD SEAM, wet						
24 - 38			[Brick Pattern]	ROCK						
38 - 39			[Diagonal Hatching]	VOID/MUD SEAM						
39 - 37.0			[Brick Pattern]	Bottom of Boring at 37.0 ft						

GROUND WATER LEVELS:	SAMPLE TYPES:
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REMARKS:

BOREHOLE/TEST PIT DOMINION RESOURCES PIPELINE AIR TRACK LOGS.GPJ GEOCONCEPTS TEMPLATE 02-12-2015.GDT 10/31/16

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.



PROJECT: <b>Moffett Lake and Cochran's Cave</b>		LOGGED BY: <b>B. Weinmann</b>	BORING NUMBER: <b>B-21</b>
LOCATION:		DRILLING CONTRACTOR: <b>GeoConcepts Engineering</b>	
OWNER/CLIENT: <b>Dominion Transmission</b>		DRILLER:	DATES DRILLED: <b>10/12/16 - 10/12/16</b>
PROJECT NUMBER: <b>11002.04, task 6</b>	GROUND SURFACE ELEVATION (ft): <b>NOT SURVEYED</b>	DRILLING METHOD:	OFFSET NOTES:

DEPTH (ft)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL														
					SPT BLOW COUNTS	REC (ft)	STANDARD PENETRATION TEST RESISTANCE (BPF) 20 40 60 80												
0 - 5				SOIL															
5 - 20				ROCK															
20 - 23				AIR VOID															
23 - 28				ROCK															
28 - 35				AIR VOID															
35 - 41.0				ROCK															
41.0 - 45				Bottom of Boring at 41.0 ft															

GROUND WATER LEVELS:	SAMPLE TYPES:
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REMARKS:

BOREHOLE/TEST PIT DOMINION RESOURCES PIPELINE AIR TRACK LOGS.GPJ GEOCONCEPTS TEMPLATE 02-12-2015.GDT 10/31/16

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.



PROJECT: <b>Moffett Lake and Cochran's Cave</b>		LOGGED BY: <b>B. Weinmann</b>	BORING NUMBER: <b>B-22</b>
LOCATION:		DRILLING CONTRACTOR: <b>GeoConcepts Engineering</b>	
OWNER/CLIENT: <b>Dominion Transmission</b>		DRILLER:	DATES DRILLED: <b>10/12/16 - 10/12/16</b>
PROJECT NUMBER: <b>11002.04, task 6</b>	GROUND SURFACE ELEVATION (ft): <b>NOT SURVEYED</b>	DRILLING METHOD:	OFFSET NOTES:

DEPTH (ft)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL					
					SPT BLOW COUNTS	REC (ft)	STANDARD PENETRATION TEST RESISTANCE (BPF)			
							20	40	60	80
5				SOIL						
10				ROCK						
15										
20										
25										
30				Bottom of Boring at 27.0 ft						
35										
40										
45										

GROUND WATER LEVELS:	SAMPLE TYPES:
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REMARKS:

BOREHOLE/TEST PIT DOMINION RESOURCES PIPELINE AIR TRACK LOGS.GPJ GEOCONCEPTS TEMPLATE 02-12-2015.GDT 10/31/16

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.





PROJECT: <b>Moffett Lake and Cochran's Cave</b>		LOGGED BY: <b>B. Weinmann</b>		BORING NUMBER: <b>B-23</b>
LOCATION:		DRILLING CONTRACTOR: <b>GeoConcepts Engineering</b>		
OWNER/CLIENT: <b>Dominion Transmission</b>		DRILLER:		DATES DRILLED: <b>10/12/16 - 10/12/16</b>
PROJECT NUMBER: <b>11002.04, task 6</b>	GROUND SURFACE ELEVATION (ft): <b>NOT SURVEYED</b>	DRILLING METHOD:		OFFSET NOTES:

DEPTH (ft)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL					
					SPT BLOW COUNTS	REC (ft)	STANDARD PENETRATION TEST RESISTANCE (BPF)			
							20	40	60	80
5				SOIL						
10										
15										
20				ROCK						
25				Bottom of Boring at 25.0 ft						
30										
35										
40										
45										

GROUND WATER LEVELS:	SAMPLE TYPES:
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REMARKS:

BOREHOLE/TEST PIT DOMINION RESOURCES PIPELINE AIR TRACK LOGS.GPJ GEOCONCEPTS TEMPLATE 02-12-2015.GDT 10/31/16

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.

# Attachment D

Chain of Custody & Certificate of Analysis Documentation (8 pages)

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## Certificate of Analysis

**Date of certificate:** November 18, 2016

**Client:** GeoConcepts Engineering, Inc.

19955 Highland Vista Drive, Suite 170  
Ashburn, VA 20147

**Project name / location:** Moffett Lake Recharge Study

**Project number:** 11002.04, billing group 6

**Contact person:** Bob Denton (Rdenton@GeoConcepts-Eng.com)

**Samples collected by:** Joshua Valentino

**Date samples shipped:** November 15, 2016

**Date samples rec'd at OUL:** November 16, 2016

**Date analyzed by OUL:** November 17, 2016

**Included with certificate of analysis:** Table of results and copy of sample collection data sheet

**Results for charcoal samplers analyzed for the presence of eosine dye.**

Peak wavelengths are reported in nanometers (nm); dye concentrations are reported in parts per billion (ppb).

OUL Number	Station Number	Station Name	Date/Time Placed	Date/Time Collected	Eosine	
					Peak (nm)	Conc (ppb)
B8784	1	Spring Run	11/14/16 1430	11/15/16 0944	ND	
B8785	2	Lake Outfall	11/14/16 1440	11/15/16 0957	ND	

**Note:** Dye concentrations are based upon standards used at the OUL. The standard concentrations are based upon the as sold weight of the dye that the OUL uses. If the client is not using OUL dyes, the client should provide the OUL with a sample of the dye to compare to the OUL dyes.

**Footnote:** ND = No dye detected

**Thomas J. Aley, PHG and RG**





## Certificate of Analysis

**Date of certificate:** December 9, 2016

**Client:** GeoConcepts Engineering, Inc.

19955 Highland Vista Drive, Suite 170

Ashburn, VA 20147

**Project name / location:** Moffett Lake Recharge Study

**Project number:** 11002.04, billing group 6

**Contact person:** Bob Denton (Rdenton@GeoConcepts-Eng.com)

**Samples collected by:** Joshua Valentino

**Date samples shipped:** December 2, 2016

**Date samples rec'd at OUL:** December 5, 2016

**Date analyzed by OUL:** December 8, 2016

**Included with certificate of analysis:** Table of results, copy of sample collection data sheets and discrepancy sheet

**Results for charcoal and water samples analyzed for the presence of eosine dye.**

Peak wavelengths are reported in nanometers (nm); dye concentrations are reported in parts per billion (ppb).

All results are for charcoal unless otherwise indicated.

OUL Number	Station Number	Station Name	Date/Time Placed	Date/Time Collected	Eosine	
					Peak (nm)	Conc (ppb)
B9042	1	Spring Run	12/1/16 1030	12/1/16 1045	ND	
B9043	1	Spring Run	12/1/16 1045	12/1/16 1115	ND	
B9044	1	Spring Run	12/1/16 1115	12/1/16 1130	ND	
B9045	1	Spring Run	12/1/16 1130	12/1/16 1230	541.4	17.5
B9046	1	Spring Run	12/1/16 1230	12/1/16 1430	541.9	23,600
B9047	1	Spring Run	12/1/16 1430	12/1/16 1830	542.1	25,000
B9048	1	Spring Run	12/1/16 1830	12/1/16 2200	541.6	4,180
B9049	1	Spring Run	12/1/16 2200	12/2/16 1030	541.9	2,020
B9050	2	Lake Outfall	12/1/16 1030	12/1/16 1045	ND	
B9051	2	Lake Outfall	12/1/16 1045	12/1/16 1115	ND	
B9052	2	Lake Outfall	12/1/16 1115	12/1/16 1230	ND	
B9053	2	Lake Outfall	12/1/16 1230	12/1/16 1430	ND	
B9054	2	Lake Outfall	12/1/16 1430	12/1/16 1830	541.6	117
B9055	2	Lake Outfall	12/1/16 1830	12/1/16 2200	541.4	262
B9056	2	Lake Outfall	12/1/16 2200	12/2/16 1030	541.7	655
B9066	1	Spring Run	<b>Water</b>	12/1/16 1230	534.4	859
B9067	1	Spring Run	<b>Water</b>	12/1/16 1430	534.5	11,600
B9068	1	Spring Run	<b>Water</b>	12/1/16 1830	534.3	2,030
B9069	1	Spring Run	<b>Water</b>	12/1/16 2200	534.4	254
B9070	1	Spring Run	<b>Water</b>	12/2/16 1030	534.3	34.7
B9071	2	Lake Outfall	<b>Water</b>	12/1/16 1830	534.3	53.0
B9072	2	Lake Outfall	<b>Water</b>	12/1/16 2200	534.4	43.7
B9073	2	Lake Outfall	<b>Water</b>	12/2/16 1030	534.3	79.5

**Note:** Dye concentrations are based upon standards used at the OUL. The standard concentrations are based upon the as sold weight of the dye that the OUL uses. If the client is not using OUL dyes, the client should provide the OUL with a sample of the dye to compare to the OUL dyes.

**Footnote:** ND = No dye detected

**Thomas J. Aley, PHG and RG**



**OZARK UNDERGROUND LABORATORY, INC.**

1572 Aley Lane Protem, MO 65733 (417) 785-4289 fax (417) 785-4290 email: contact@ozarkundergroundlab.com

**SAMPLE COLLECTION DATA SHEET for FLUORESCENCE ANALYSIS**

Project Moffett Lake Area Studies Week No: N/A Samples Collected By: Joshua Valentino *John Valler*

Samples Shipped By: Joshua Valentino *John Valler* Samples Received By: R. Cochran/OUL

Date Samples Shipped: 12/2/2016 Date Samples Received: 12/5/2016 Time Samples Received: 1300 Return Cooler? Yes  No

Bill to: 11002.04 Billing Group 6 Send Results to: R.Denton@geocconcepts-eng.com

Analyze for:  Fluorescein  Eosine  Rhodamine WT  Other \_\_\_\_\_ Ship cooler to: 19955 Highland Vista Drive, Suite 170

Ashburn, VA 20147

OUL use only		Please indicate stations where dye was visible in the field for field technician use - use black ink only						OUL use only	
# CHAR REC'D	LAB NUMBER	STATION NUMBER	STATION NAME	PLACED		COLLECTED		# WATER REC'D	
				DATE	TIME	DATE	TIME		
	<u>Charcoal</u>								
1	B9042	1	Spring Run	12/1/16	10:30 AM	12/1/16	10:45 AM	1	
1	B9043	1	Spring Run	12/1/16	10:45 AM	12/1/16	11:15 AM	1	
1	B9044	1	Spring Run	12/1/16	11:15 AM	12/1/16	11:30 AM	1	
1	B9045	1	Spring Run	12/1/16	11:30 AM	12/1/16	12:30 PM	1	
1	B9046	1	Spring Run	12/1/16	12:30 PM	12/1/16	2:30 PM	1	
1	B9047	1	Spring Run	12/1/16	2:30 PM	12/1/16	6:30 PM	1	
1	B9048	1	Spring Run	12/1/16	6:30 PM	12/1/16	10:00 PM	1	
1	B9049	1	Spring Run	12/2/16	10:00 PM	12/2/16	10:30 AM	1	
1	B9050	2	Lake Outfall	12/1/16	10:30 AM	12/1/16	10:45 AM	1	
1	B9051	2	Lake Outfall	12/1/16	10:45 AM	12/1/16	11:15 AM	1	
1	B9052	2	Lake Outfall	12/1/16	11:15 AM	12/1/16	12:30 PM	1	
1	B9053	2	Lake Outfall	12/1/16	12:30 PM	12/1/16	2:30 PM	1	
1	B9054	2	Lake Outfall	12/1/16	2:30 PM	12/1/16	6:30 PM	1	
1	B9055	2	Lake Outfall	12/1/16	6:30 PM	12/1/16	10:00 PM	1	

COMMENTS \_\_\_\_\_

This sheet filled out by OUL staff? Yes  No  Charts for samples on this page proofed by OUL: *CA*  
 OUL Project No. 1524 Date Analyzed: 12/8/16 Analyzed By: Lisa Gilcrease/OUL



**OZARK UNDERGROUND LABORATORY, INC.**

1572 Aley Lane Protem, MO 65733 (417) 785-4289 fax (417) 785-4290 email: contact@ozarkundergroundlab.com

**SAMPLE COLLECTION DATA SHEET for FLUORESCENCE ANALYSIS**

Project Moffett Lake Area Studies Week No: N/A Samples Collected By: Joshua Valentine Glenn Vail

Samples Shipped By: Joshua Valentine Glenn Vail Samples Received By: K. Cochran/OUL

Date Samples Shipped: 12/2/2016 Date Samples Received: 12/5/2016 Time Samples Received: 1:00 Return Cooler? Yes  No

Bill to: 11002.04 Billing Group 6 Send Results to: R.Denton@geconcepts-eng.com

Analyze for:  Fluorescein  Eosine  Rhodamine WT  Other \_\_\_\_\_ Ship cooler to: 19955 Highland Vista Drive, Suite 170  
Ashburn, VA 20147

OUL use only		Please indicate stations where dye was visible in the field for field technician use - use black ink only						OUL use only
# CHAS REC'D	LAB NUMBER Water	STATION NUMBER	STATION NAME	PLACED		COLLECTED		# WATER REC'D
				DATE	TIME	DATE	TIME	
1		1	Spring Run	12/1/16	10:30 AM	12/1/16	10:45 PM	1
1		1	Spring Run	12/1/16	10:45 AM	12/1/16	11:15 PM	1
1		1	Spring Run	12/1/16	11:15 AM	12/1/16	11:30 PM	1
1	B9066	1	Spring Run	12/1/16	11:30 AM	12/1/16	12:30 PM	1
1	B9067	1	Spring Run	12/1/16	12:30 PM	12/1/16	2:30 PM	1
1	B9068	1	Spring Run	12/1/16	2:30 PM	12/1/16	6:30 PM	1
1	B9069	1	Spring Run	12/1/16	6:30 PM	12/1/16	10:00 PM	1
1	B9070	1	Spring Run	12/2/16	10:00 PM	12/2/16	10:30 AM	1
1		2	Lake Outfall	12/1/16	10:30 AM	12/1/16	10:45 AM	1
1		2	Lake Outfall	12/1/16	10:45 AM	12/1/16	11:15 AM	1
1		2	Lake Outfall	12/1/16	11:15 AM	12/1/16	12:30 PM	1
1	B9071	2	Lake Outfall	12/1/16	12:30 PM	12/1/16	2:30 PM	1
1	B9072	2	Lake Outfall	12/1/16	2:30 PM	12/1/16	6:30 PM	1
1		2	Lake Outfall	12/1/16	6:30 PM	12/1/16	10:00 PM	1

COMMENTS \_\_\_\_\_

This sheet filled out by OUL staff? Yes (No) Charts for samples on this page proofed by OUL: Ca  
OUL Project No. 1524 Date Analyzed: 12/8/16 Analyzed By: Lisa Gilcrease/OUL





