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Date: April 17, 2019

To: Operating Record

From: Harold D. Register, Jr., P.E.

RE: Groundwater Monitoring System Certification, §257.91(f)
JR Whiting Power Plant, Pond 6

Introduction

According to Title 40 Code of Federal Regulations (40 CFR) Part 257, Subpart D, §257.91(f); the owner or operator of a Coal Combustion Residual (CCR) management unit must obtain a certification from a qualified professional engineer stating that the groundwater monitoring system at the CCR management unit has been designed and constructed to meet the requirements of §257.91. Additionally, §257.91(a) details a performance standard requiring the system monitor the uppermost aquifer and include a minimum of at least one upgradient and three downgradient monitoring wells, and that if the uppermost aquifer monitoring system includes the minimum number of wells, the basis supporting use of only the minimum.

Groundwater Monitoring System

A groundwater monitoring system has been established for the JR Whiting Pond 6, which established the following locations for determining background groundwater quality and detection monitoring. In the case of JR Whiting Pond 6, an intrawell statistical procedure has been selected; therefore, the groundwater monitoring system consists of only the downgradient monitoring wells. The background monitoring wells used to establish background groundwater quality will be maintained and reused to reestablish background conditions as necessary.

Downgradient:

JRW MW-16001	JRW MW-16002	JRW MW-16003
JRW MW-16004	JRW MW-16005	JRW MW-16006

Provided herein, as required by §257.91(f), is certification from a qualified professional engineer that the groundwater monitoring system at Consumers Energy JR Whiting Pond 6 meets the requirements of §257.91.

CERTIFICATION

Professional Engineer Certification Statement [40 CFR 257.91]

I hereby certify that, having reviewed the attached documentation and being familiar with the provisions of Title 40 of the Code of Federal Regulations §257.91 (40 CFR Part 257.91), I attest that this Groundwater Monitoring System has been designed and constructed to meet the requirements of 40 CFR 257.91. The report is accurate and has been prepared in accordance with good engineering practices, including the consideration of applicable industry standards, and with the requirements of 40 CFR Part 257.91.

Harold D. Register Jr.

Signature

April 17, 2019

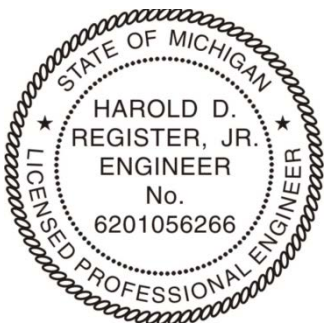
Date of Certification

Harold D. Register, Jr., P.E.

Name

6201056266

Professional Engineer Certification Number



04/17/2019

ENCLOSURES

TRC (2016). "*2016 Monitoring Well Design, Installation, Development, and Decommissioning*"

2016 Monitoring Well Design, Installation Development, and Decommissioning

JR Whiting Electric Generation Facility
Erie, Michigan

December 2016

2016 Monitoring Well Design, Installation Development, and Decommissioning

JR Whiting Electric Generation Facility
Erie, Michigan

December 2016

Prepared For
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TRC Engineers Michigan | Consumers Energy
Final
X:\WPAAM\PJT2\262636\0000\R262636-002 FINAL.DOCX

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Section 1
Introduction

TRC Engineers Michigan, Inc. (TRC) has prepared this Monitoring Well Design, Installation, Development, and Decommissioning Report to summarize monitoring well installation and well decommissioning (also often referred to as well abandonment) activities conducted from October 18, 2016 to December 2, 2016 at the J.R. Whiting electric generation facility (JRW), located at 4525 East Erie Road, Erie, Michigan (Site). This effort specifically documents six monitoring well installations overseen by FK Engineering Associates (FKE) around Pond 6 that has been identified as an inactive CCR surface impoundment as defined in 40 CFR Part 257, Subpart D – Standards for the Disposal of Coal Combustion Residuals (CCR) from Electric Utilities and three monitoring well installations to measure background conditions to the disposal areas. Additionally, the abandonment of six existing monitoring wells around Pond 6 was also overseen by FKE. These monitoring wells had been constructed in 1979, 1982, and 1993 with galvanized steel casing and stainless steel well screens and were found to have compromised integrity. The six new wells replace the six abandoned wells in kind.

This Report summarizes the groundwater monitoring well installation and well abandonment activities by FKE, including drilling procedures, well decommissioning procedures, well locations, well construction details, well decommissioning details, well development activities, boring logs, and hydraulic testing results. The methodologies used in the field activities conform to state guidance, and recognized and generally accepted good engineering practices.

Section 2
Objectives

The objectives of this report are to document the work completed by FKE at the Site, including:

- Advancement of soil borings—Section 3.1
- Monitoring well installation—Section 3.2
- Monitoring well development—Section 3.3
- Hydraulic testing—Section 3.4
- Monitoring well abandonment—Section 3.5

Section 3
Field Activities

Well installation and abandonment activities were performed from October 18 to December 2, 2016 by Cascade Drilling, LLC (Cascade) under continuous oversight performed by FK Engineering Associates (FKE) with technical assistance provided by TRC. Field activities were preceded by an on-site project kick-off meeting on October 14, 2016 to discuss the project approach and health & safety protocols.

The well drilling consisted of the installation of nine groundwater monitoring wells designated as JRW MW-16001 through JRW MW-16009 and the proper decommissioning of six existing wells previously designated as JRW MW-15007 through JRW MW-15012. The locations of the new and abandoned wells are shown on **Drawing SG-22374, Sheet 1, Rev. C**.

3.1 Soil/Bedrock Borings

Prior to the start of drilling at each proposed well location, a 5-foot deep hand-augered boring was advanced to verify underground utility clearance by FKE. Then Cascade completed nine (9) soil/bedrock borings using rotosonic-drilling methods to sufficient depth to install monitoring wells in the upper portion of the bedrock aquifer as directed by FKE with technical input from TRC. Rotosonic drilling uses powered equipment to collect subsurface-soil and bedrock samples. The rotosonic drill rig advances a length of pipe into the ground through a combination of hydraulic force and high-frequency vibration. The high-frequency vibrations allow the pipe to advance through various types of soil and bedrock producing a high-quality, continuous soil core within the pipe. Each length of pipe was extracted from the ground and emptied into a clear plastic liner for logging. This process was repeated until the total depth of the boring was reached.

Continuous soil cores were collected during drilling to provide detailed lithological and stratigraphic data. FKE's on-site engineer inspected each core, classified the contents, and recorded the observations on a boring log field sheet (**Appendix A**). A photographic log showing the typical soil and bedrock types observed at the Site during soil boring advancement is included as **Appendix B**. All soil borings were completed as monitoring wells, and details of the monitoring wells installation are provided in the following section.

3.2 Monitoring Well Installation

Once the total depth of each soil/bedrock boring was reached, Cascade installed a permanent monitoring well as directed by FKE with technical input from TRC in the uppermost usable limestone bedrock aquifer unit for completion of monitoring wells. Monitoring wells were

installed through the rotosonic drill rig piping allowing the driller to construct the monitoring well, while simultaneously removing the drill piping. Monitoring wells were constructed with 2-inch inside diameter Schedule 40, polyvinyl chloride (PVC) screens and PVC risers. At each location, the screen tip was positioned at the bottom of the borehole and within the limestone bedrock. Each well screen is 10 feet long except for at monitoring well JRW-MW-16008 which is 5 feet long, and all screens have a slot size of 0.010-inch (10 slot). A medium-grained sand pack was placed around each well screen to a height of at least 4 feet above the top of the well screen, and at least a 3-foot thick bentonite pellet seal was placed on top of the sand pack. The remaining annular space was tremie-grouted with a cement-bentonite grout.

An above-ground, lockable, steel protective cover and a concrete well pad were installed at each monitoring well. In addition, three bollards were installed around the protective covers at each well except at JRW MW-16008, where only two bollards were installed due to limited space. The total well depth and screened interval below the ground surface (bgs) for each monitoring well is shown in Table 1. Well construction logs are included in **Appendix A**; well locations are shown on **Drawing SG-22374, Sheet 1, Rev. C.** Wells were labeled according to Consumers Energy's site-specific nomenclature provided to FKE and TRC. The CE construction manager supplied keyed-alike locks for each well that match the existing well keys.

3.3 Monitoring Well Development

Newly installed monitoring wells were allowed to set for a minimum of 48 hours, after which the wells were developed. Well development was conducted by FKE using air lifting techniques using a tremie pipe to surge and evacuate until the water flowed relatively clear. Following development with the air lifting technique, FKE used a submersible pump and/or air driven pump that was surged across the well screen while groundwater was pumped from the well. During pumping, the evacuated groundwater was monitored for turbidity and pH. Well development continued until the turbidity stabilized under 10 Nephelometric Turbidity Units (NTUs) and pH was stable and below 8.2 pH units at each monitoring well. FKE collected NTU and pH measurements using hand-held monitoring devices. Initially, all the monitoring wells were developed by FKE with a submersible pump that discharged water at a rate of approximately 2 to 2.5 gallons per minute. Wells that had groundwater with a pH reading higher than 8.2 were subsequently further developed by FKE with an air driven pump that was capable of discharging water at 5 to 6 gallons per minute until their pH values stabilized below 8.2 pH units and the turbidly was stabilized to below 10 NTUs.

The volume of groundwater removed during well development, along with the stabilized water level prior to development, and the stabilized turbidity during well development are summarized in Table 1.

3.4 Hydraulic Testing

For single well recovery testing (herein after referred to as "slug testing") activities, FKE performed four to five slug tests at each of the new monitoring wells. FKE performed each slug test generally by releasing a volume displacement apparatus that induced an immediate water table shift within the well. This resulting water table recovery within the well was monitored using a pressure transducer set to record at 0.25-second intervals, or logarithmic intervals to measure static head, displacement and recovery data. This information was used by FKE to provide an estimate of aquifer hydraulic conductivity (K) in the uppermost portion of the limestone bedrock unit.

The data collected was analyzed by FKE using analytical solutions found in the hydraulic software program AQTESOLV (Version 4.5) using the specific well construction parameters and depth into the limestone unit. The slug test data were evaluated using the confined Hvorslev (1951) and the confined Bouwer and Rice (1976) solutions. The results indicated an estimated hydraulic conductivity range from 3.6 to 11.9 feet per day with an average of 6.9 feet per day. A summary of the results of the hydraulic conductivity tests are presented in Table 2, and full results are included in **Appendix C**.

3.5 Monitoring Well Decommissioning

Existing wells JRW MW-15007 through JRW MW-15012 located around the perimeter of Pond 6 were decommissioned by Cascade under FKE oversight by first removing the steel vaults and concrete barriers around each well, and then over-drilling using a 6-inch diameter roto-sonic casing. Over-drilling to the full depth of the well was accomplished at all wells except JRW MW-15007 and JRW MW-15008. Following over-drilling and well casing extraction, each borehole was tremie grouted with cement-bentonite to grade. Table 3 summarizes the measured well depth and bentonite plug placement (where applicable) prior to over-drilling, the over-drilling depth, and the amount of well casing recovered during the decommissioning of each well.

Tables

Table 1
Monitoring Well Construction and Development Summary
Consumers Energy Co.
J.R. Whiting Generating Facility
Erie, Michigan

MW ID	Former MW ID	Site Coordinates				Date Installed	Geologic Unit of Screen Interval	Well Construction	Well Screen Length (ft)	Screen Interval (ft bgs)	Development Details			
		Northing	Easting	Ground Surface Elevation (ft above msl)	TOC Elevation (ft above msl)						Static DTW (ft below TOC)	Total Depth	Gallons Removed	Final Turbity (NTU)
Ponds 1 & 2 MW														
JRW MW-15001	---	108330.83	13374236.18	589.60	590.71	10/26/2015	Limestone	2" PVC, 10 slot	10	78 - 88	21.34	91.25	1,450	3.92
JRW MW-15002	---	108651.05	13374586.78	590.60	592.31	10/28/2015	Limestone	2" PVC, 10 slot	10	81 - 91	21.89	94.39	750	2.35
JRW MW-15003	---	108321.86	13374980.23	589.60	591.36	10/29/2015	Limestone	2" PVC, 10 slot	10	81 - 91	19.87	94.28	412.5	3.54
JRW MW-15004	---	107881.56	13375045.59	590.80	592.52	10/30/2015	Limestone	2" PVC, 10 slot	10	86 - 96	23.27	99.60	70	2.80
JRW MW-15005	---	107545.15	13374686.90	592.70	594.25	11/2/2015	Limestone	2" PVC, 10 slot	10	86 - 96	25.28	99.48	114	5.04
JRW MW-15006	---	107843.22	13374281.80	590.30	592.01	11/4/2015	Limestone	2" PVC, 10 slot	10	81 - 91	25.30	94.36	650	1.69
Pond 6 MW														
JRW MW-16001	---	111255.91	13374012.08	589.19	592.32	10/25/2016	Limestone	2" PVC, 10 slot	10	71 - 81	17.41	83.92	780	8.40
JRW MW-16002	---	110463.28	13374460.66	585.78	588.68	10/24/2016	Limestone	2" PVC, 10 slot	10	81 - 91	13.80	94.44	480	9.00
JRW MW-16003	---	109687.92	13374452.98	586.19	589.02	10/23/2016	Limestone	2" PVC, 10 slot	10	73 - 83	14.10	85.95	700	8.90
JRW MW-16004	---	108834.64	13374076.00	586.48	589.35	10/23/2016	Limestone	2" PVC, 10 slot	10	75 - 85	14.45	88.76	1,700	9.20
JRW MW-16005	---	110509.27	13373630.27	589.29	592.13	10/25/2016	Limestone	2" PVC, 10 slot	10	78 - 88	17.22	91.32	970	5.60
JRW MW-16006	---	109719.88	13373640.49	588.26	591.03	10/19/2016	Limestone	2" PVC, 10 slot	10	79 - 89	16.11	91.60	1,260	7.70
Background MW														
JRW MW-16007	---	108397.13	13372561.93	579.47	582.32	10/19/2016	Limestone	2" PVC, 10 slot	10	68 - 78	7.58	81.00	650	9.30
JRW MW-16008	---	108021.97	13372562.48	579.95	582.84	10/27/2016	Limestone	2" PVC, 10 slot	5	68 - 73	7.93	76.23	1,900	8.80
JRW MW-16009	---	107653.55	13372573.73	579.90	582.59	10/18/2016	Limestone	2" PVC, 10 slot	10	69 - 79	7.70	81.95	160	8.00
Decommissioned MW														
JRW MW-15007	82-MW-1	109293.21	13373656.23	587.10	588.38	5/4/1982	Dolomite/Limestone	2" SS with galvanized riser	3	84 - 87	Not developed			
JRW MW-15008	82-MW-2	110906.21	13373613.03	588.40	587.88	5/4/1982	Dolomite/Limestone	2" SS with galvanized riser	3	94 - 97	Not developed			
JRW MW-15009	79-MW-3	109884.39	13374455.32	585.30	586.11	NA	NA	NA	NA	NA	Not developed			
JRW MW-15010	93-MW-4	110458.57	13373631.59	587.10	588.09	6/28/1993	Dolomite/Limestone	2" SS with galvanized riser	3	60 - 63	Not developed			
JRW MW-15011	93-MW-5	109790.80	13373648.04	587.50	588.71	6/30/1993	Dolomite/Limestone	2" SS with galvanized riser	3	62 - 65	Not developed			
JRW MW-15012	93-MW-6	110169.45	13374463.62	585.80	587.19	7/1/1993	Dolomite/Limestone	2" SS with galvanized riser	3	66 - 69	Not developed			

Notes:
ft = feet
bgs = below ground surface
TOC = top of casing NR = Not recorded NA = Not applicable msl = mean sea level

Table 2
Estimated Monitoring Well Hydraulic Conductivities

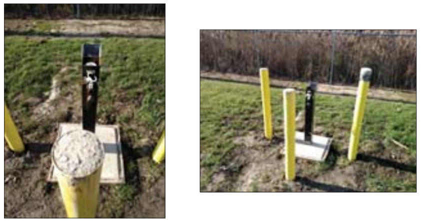
MONITORING WELL NO.	AVERAGE HYDRAULIC CONDUCTIVITY FROM ANALYTICAL SOLUTIONS (FT/D)
JRW MW-16001	4.74
JRW MW-16002	3.56
JRW MW-16003	6.09
JRW MW-16004	4.50
JRW MW-16005	9.95
JRW MW-16006	9.41
JRW MW-16007	3.51
JRW MW-16008	11.85
JRW MW-16009	8.63
Average Pond 6 Wells	6.375
Average Background Wells	8.00
Average All Wells	6.92

FT/D = Feet per day.

Table 3
Monitoring Well Abandonment Information

MONITORING WELL NO.	MEASURED WELL DEPTH (FT)	BENTONITE PLUG DEPTH WITHIN WELL (FT) (BEFORE OVER-DRILLING)	OVER-DRILLED DEPTH (FT)	WELL CASING REMOVED (FT)
JRW MW-15007	99.5	99.5 to 93.7	73	11
JRW MW-15008	110.3	110.3 to 55	53	9
JRW MW-15009	71.5	71.5 to 66	72	49
JRW MW-15010	44.0	44 to 37	46	28
JRW MW-15011	73.3	73.3 to 63	74	44
JRW MW-15012	73.5	None	74	52

Figures



2016 Update Typical Mon. Well

Pictures

2015 Typical Surface Impoundment Monitoring Well

Pictures

Surface Impoundment Monitoring Wells

Pt #	Northing	Easting	Ground	Top Casing	Name	Latitude	Longitude
5902	107843.22	13374281.80	590.3	592.01	JRW MW-15006	41.792150	-83.446597
5904	107545.15	13374686.90	592.7	594.25	JRW MW-15005	41.791322	-83.445125
5906	107881.56	13375045.59	590.8	592.52	JRW MW-15004	41.792233	-83.443797
5908	108321.86	13374980.23	589.6	591.36	JRW MW-15003	41.793444	-83.444017
5910	108651.05	13374586.78	590.6	592.31	JRW MW-15002	41.794358	-83.445447
5912	108330.83	13374236.18	589.6	590.71	JRW MW-15001	41.793492	-83.446744

Background Monitoring Wells

Pt #	Northing	Easting	Ground	Top Casing	Name	Latitude	Longitude
5915	109293.21	13373656.23	587.1	588.38	JRW MW-15007/82MW-1	41.796147	-83.448833
5917	109790.80	13373648.04	587.5	588.71	JRW MW-15011/93MW-5	41.797514	-83.448844
5919	110458.57	13373631.59	587.1	588.09	JRW MW-15010/93MW4	41.799347	-83.448878
5921	110906.21	13373613.03	588.4	587.88	JRW MW-15008/82MW-2	41.800575	-83.448928
5923	110169.45	13374463.62	585.8	587.19	JRW MW-15012/93-MW6	41.798528	-83.445839
5925	109884.39	13374455.32	585.3	586.11	JRW MW-15009/79MW-3	41.797747	-83.445881

Survey Control Points

Pt #	Northing	Easting	Plant Elev	NAVD88	Name	Latitude	Longitude
1	107278.26	13374902.72	590.9	589.99	TP	41.790583	-83.444344
2	108903.66	13374018.38	600.0	599.20	TP	41.795069	-83.447522
4	111273.97	13373688.48	600.1	599.18	TP	41.801583	-83.448636
7	108765.66	13374471.45	577.9	577.09	TP	41.794678	-83.445867
9	108697.62	13372712.75	577.2	576.31	NE Sec. 15	41.794542	-83.452317
10	108610.28	13367111.76	580.4	579.56	BM Q178	41.794467	-83.472856
1918	108101.94	13374607.57	590.4	589.51	TP	41.792850	-83.445394
2168	109013.11	13374349.04	600.8	600.00	TP	41.795358	-83.446306
3081	108683.22	13373439.66	578.0	577.05	CP	41.794481	-83.449653

2016 Update

Pt #	Northing	Easting	Ground	Top Casing	Name	Latitude	Longitude
9001	108397.13	13372561.93	579.5	582.32	JRW MW-16007	41.793722	-83.452881
9002	108021.97	13372562.48	580.0	582.84	JRW MW-16008	41.792694	-83.452894
9003	107653.55	13372573.73	579.9	582.59	JRW MW-16009	41.791681	-83.452869
9004	108834.64	13374076.00	586.5	589.35	JRW MW-16004	41.794878	-83.447314
9005	109687.92	13374452.98	586.2	589.02	JRW MW-16003	41.797208	-83.445897
9006	110463.28	13374460.66	585.8	588.68	JRW MW-16002	41.799336	-83.445836
9007	111255.91	13374012.08	589.2	5992.32	JRW MW-16001	41.801522	-83.447450
9008	110509.27	13373630.27	589.3	592.13	JRW MW-16005	41.799486	-83.448881
9009	109719.88	13373640.49	588.3	591.03	JRW MW-16006	41.797319	-83.448875

Elevation Basis

BM Q 187
Elevation = 579.56' NAVD88

Coordinate Basis

State Plane Coordinates Michigan South Zone 2113
MDOT CORS VRS (G12AUS) NAD83 2011

Legend

- -- CCR UNIT Monitoring Well
- -- Background Monitoring Well
- -- Abandoned Monitoring Well
- -- Traverse Point
- -- Section Corner

GRAPHIC SCALE

100 0 50 100 200 4

(IN FEET)
1 inch = 100 ft.

Elevations are NAVD88 from Benchmark (BM) Q 178 per NGS Data Sheet (Not Shown, Approximately 1.1 miles West of Northeast Corner Section 15. On 11-19-2015, a level loop was performed between BM and Control Point (CP) #3081. A second loop was done from CP to Traverse Point (TP) #1918 and to TP #2168. On 11-20-15, a loop was performed utilizing TP #1918 to determine elevations on Monitoring Wells at Top of Pipe on Pond 1 & 2 and TP #1 (not shown). Another loop was performed from TP #2168, determining elevations for MWs and TP #4 & #2 on Pond 6. Ground elevations at base of MW pipe were obtained on 11-10-15 by GPS observation.

2016 Update

On 11-30-16, a level loop was performed from Control Point (CP) #3081 and Monitoring Wells #16007, #16008, and #16009. Another loop was performed from CP #3081 and Monitoring Wells #16004, #16003, #16002, #16001, #16005, and #16006. Both Top of Casing and Ground (Top of Concrete at Base) were included in level loop.

NOTE: Previous Wells #15007 thru #15012 now abandoned/removed or to be abandoned/removed.

DRAWING NO.	REFERENCE DRAWINGS
SF-19884	Sheet 34, Pond 1 & 2
SF-19884	Sheet 35, Pond 6
	FIELD BOOK NO. 1997A

REV.	DATE	DESCRIPTION	BY
C	12/9 '16	Abandoned Wells, Historic Well ID, Pictures	RST
B	12/1 '16	New Mon. Wells JRW MW #16001 thru #16009	RST
A	12/7 '15	Changes per email request	RST

		DATE
DN.	RST	11-24-15
FLD.	DEE	11-10-15
CHKD.		
APP.		
APP.	DEPARTMENT HEAD	

Consumers Energy

SSC SHERIDAN SURVEYING CO.
910 Fifth Street Michigan Center, MI 49254

Whiting Plant Monitoring Wells
CCR Monitoring

Sec. 11 & 14
City of Luna Pier

SAP WO #25477976

T8S, R8E
Monroe County

SCALE: 1" = 100'
CE FILENAME: 22374base.dwg
SSC FILENAME: 3708_SPCadj.dwg

Drawing No. SG-22374 | Sheet 1 | Rev. C

Appendix A
Soil Boring and Monitoring Well Construction Logs

FK ENGINEERING

SOIL AND ROCK CLASSIFICATION SYSTEM

SUMMARY OF SOIL NOMENCLATURE

Soils are to be classified by the fraction which has the greatest impact on the engineering behavior. Soils will be described according to a strength or density followed by color then by primary and secondary/tertiary components (i.e. soft gray silty clay or loose brown silty sand). United Soil Classification System (USCS) descriptors (ASTM D2487) may also be used. Soils which exhibit unconfined shear strength will in most cases be described as cohesive soils regardless of their clay content whereas soils without unconfined strength will be described as cohesionless soils.

COHESIVE SOIL

Strength	Unconfined Compressive Strength (psf) (Primary)	Pocket Penetrometer Test (tsf) (Primary)	SPT Value (N) (Secondary)
Very Soft	0-500	0-0.25	0-2
Soft	500-1000	0.25-0.5	3-4
Medium	1000-2000	0. 5-1.0	5-8
Stiff	2000-4000	1.0-2.0	9-15
Very Stiff	4000-8000	2.0-4.0	16-30
Hard	8000-16000	4.0-8.0	31-50
Very Hard	>16000	>8.0	>50

COHESIONLESS SOIL

Density	SPT Value (N)
Very Loose	<4
Loose	4-10
Medium Compact	11-30
Compact	31-50
Very Compact	>50

MATERIAL SIZES AND IDENTIFIER GUIDE

Gravel	3/16 inches (No. 4 Sieve) to 3 inches	Generally rounded rock particles
Coarse Sand	3/16 inches to 2 mm (No. 10 Sieve)	Grains easily seen
Medium Sand	2 mm to 0.425 mm (No. 40 Sieve)	Grains can be seen and felt
Fine Sand	0.425 mm to 0.075 mm (No. 200 Sieve)	Grains can be felt
Silt	0.075 mm to 0.005 mm	Easily cracks when rolled. Gritty feel. Dilatant.
Clay	<0.005 mm	Can be rolled. No particle size visible.

SECONDARY/TERTIARY SOIL COMPONENTS

Use secondary components when other than the primary soil appears in significant percentages. Generally the secondary component will compromise between 12 and 30 percent of the total soil weight. Tertiary components would be described as “little” and “trace” when the tertiary components are between 5 and 12 percent and less than 5 percent, respectively. The tertiary components would be inserted after the secondary and primary description (i.e. soft gray silty clay with little gravel and trace sand).

SAMPLE CODES

S	Split Spoon Sample	AU	Auger Sample
LS	Split Spoon Sample with Liner	ST	Shelby Tube Sample
BS	Bag Sample	P	Piston Tube Sample

This system is based on the USCS and MDOT’s Uniform Field Soil Classification System

FK ENGINEERING

SUMMARY OF ROCK NOMENCLATURE

The rock classification system is generally based on FHWA-NHI-01-031 and noted references therein.

ROCK TYPE

Should be classified according to origin into one of the three major groups: igneous, sedimentary, and metamorphic (i.e. Limestone, Shale, etc.)

COLOR

Use basic colors (i.e. brown, gray, etc.) and combinations of colors if applicable (i.e. brown-gray) and the color's intensity (light, medium, dark).

GRAIN SIZE/SHAPE

Grain size terminology should be based on the following:

Very Coarse (VCO)	Grain sizes greater than popcorn kernels, >1/4 in.
Coarse (CO)	Individual grains can be easily seen by naked eye, 1/4 - 1/8 in.
Medium (MD)	Individual grains can be seen by naked eye, up to 1/8 in.
Fine (FN)	Individual grains can be barely seen by naked eye
Amorphous (AM)	Individual grains cannot be seen by naked eye

In addition, the shape of the grains should be used when applicable (i.e. rounded, sharp, etc.).

STRATIFICATION/BEDDING

Stratification features should be described according to the following:

Very Thick (VTH)	>3 feet or not visible
Thick (TH)	1-3 feet
Medium (M)	2 - 12 in.
Thin (TN)	1/2 - 2 in.
Very Thin (VTN)	1/4 - 1/2 in.
Laminated (LAM)	>1/4 in.

In addition if layers are angled make note with respect to the horizontal.

WEATHERING/ALTERATION

Weathering is physical disintegration due to atmospheric processes; while alteration is due to geothermal processes. Terms and abbreviations should be used according to the following:

Fresh (FR)	No discoloration or any other effect of weathering/alteration.
Slight (SL)	Slightly discolored with little to no effect on strength.
Moderate (MOD)	Discolored and is in a weakened state but less than half is decomposed. Large sample cannot be broken by hand.
High (HI)	More than half is decomposed. Large sample can be broken by hand.
Complete (CPL)	Almost completely decomposed with some original fabric intact.
Residual Soil (RS)	Completely decomposed with no original rock fabric left. Can be easily broken by hand.

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DISCONTINUITIES

Rock discontinuities are breaks or fractures separating the rock and should be classified according to the following:

Type

Crack (C)	An incomplete fracture
Joint (J)	A fracture with little to no visible displacement
Shear (S)	A fracture with visible displacement that may have slickness or is polished
Fault (F)	A major fracture with major displacement with possible clayey gouge

Spacing

Very Wide (VW)	3 - 1 feet
Wide (W)	1 - 0.5 feet
Open (O)	6-4 in.
Tight (TG)	4-2 in.
Very Tight (VTG)	< 2 in.

Orientation

Horizontal (H)	0 - 5 degrees
Low Angle (LA)	5 - 30 degrees
Moderate Angle (MA)	30 - 60 degrees
Steep Angle (SA)	60 - 85 degrees
Vertical (V)	85 - 90 degrees

Surface Texture

Slickened (SLK)	Surface has smooth, glassy finish with visual evidence of striations
Smooth (SM)	Surface appears smooth and feels so to the touch
Slightly Rough (SR)	Asperities on the discontinuity surface are distinguishable and can be felt
Rough (R)	Some ridges and side-angle steps are evident: asperities are clearly visible and discontinuity surface feels very abrasive
Very Rough (VR)	Near vertical steps and ridges occur on the discontinuity surface

Infilling	**Type of Infilling**
Surface Stain (Su)	Clay (Cl)
Spotty (Sp)	Calcite (Ca)
Partially Filled (Pa)	Chlorite (Ch)
Filled (Fi)	Iron Oxide (Fe)
None (No)	Gypsum/Talc (Gy)
	Healed (H)
	None (No)
	Pyrite (Py)
	Quartz (Qz)
	Sand (Sd)

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HARDNESS

Should be assessed by a scratch test with terms and abbreviations according to the following:

Soft (SO)	Reserved for plastic material only
Friable (FRI)	Easily crumbled by hand and is too soft to be cut with a pocket knife.
Low Hardness (LH)	Can be gouged deeply or carved with a pocket knife.
Moderately Hard (MH)	Can be readily scratched by a knife blade. Scratch leaves a heavy trace of dust and scratch is readily visible after powder is blown away.
Hard (HD)	Can be scratched with difficulty. Scratch produces little powder and is often faintly visible. Traces of the knife steel may be visible.
Very Hard (VHD)	Cannot be scratched with a pocket knife.

DEFECTS

The following descriptions can be described as few, occasional, or frequent:

Fossil (FOS)	Preserved remain or trace of animals, plants, and other organisms from the distant past
Pit	<3/16 inch
Vug	>3/16 inch and <2 inches
Cavity (Cav)	>2 inches
Carbonaceous Band (CB)	Black carbon styolitic deposit than can be straight or wavy
Solution Feature (SF)	Features formed by water and acids dissolving calcium carbonate sedimentary rock

The following descriptions can be described as light, moderate, or dense:

Hydrocarbon Staining (HCS)	Staining due to petroleum products being released from the rock

ROCK RECOVERY

Rock recovery is defined as:

$$Recovery\ (\%) = 100 \times \frac{Length\ of\ Core\ Recovered}{Length\ of\ Core\ Run}$$

ROCK QUALITY DESIGINATION (RQD)

RQD is defined as:

$$RQD\ (\%) = 100 \times \frac{Length\ of\ Core\ Recovered > 4\ inches}{Length\ of\ Core\ Run}$$

Monitoring Well JRW MW-16001

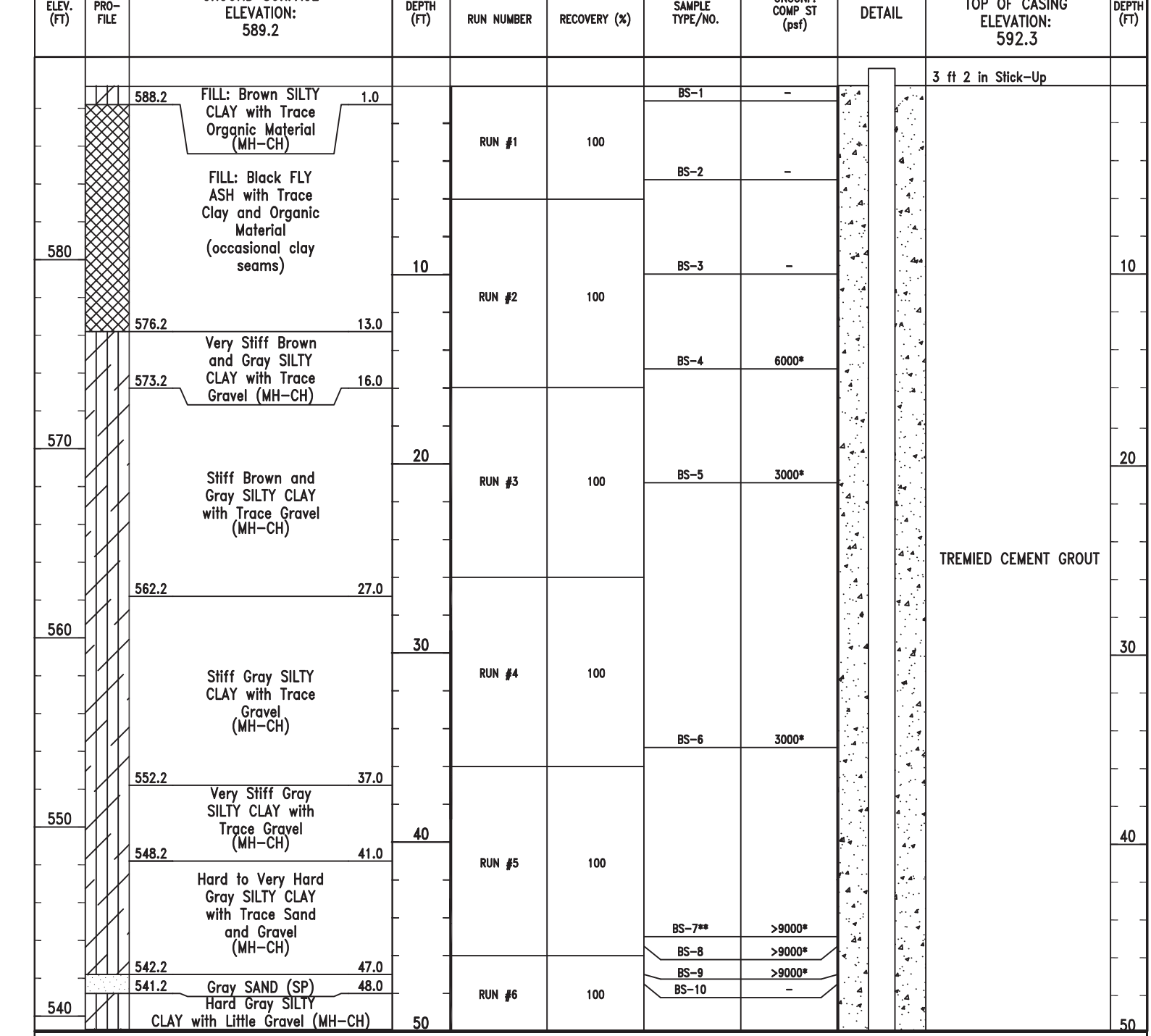
Project Name: J.R. Whiting Observation Wells

Project Location: J.R. Whiting Generating Facility, Erie, MI

FK Engineering Associates

Project No: 16-085

Checked By: Z. Carr, P.E.



Total Depth: *81.0 ft*
Drilling Date: *10/25/2016*
Inspector: *N. Bassett, P.E.*
Contractor: *Cascade Drilling*
Driller: *I. Young*
Equipment: *600T Truck-Mount*

Casing Diameter: *2 in*
Casing Length: *71 ft*
Casing Type: *PVC (SCH 40)*

Screen Diameter: *2 in*
Screen Length: *10 ft*
Screen Mesh: *2 in*
Screen Type: *0.01 in Slotted PVC*

Protective Casing: 3 ft 2 in Stick-Up

Notes:
1) * -Denotes Pocket Penetrometer Value
2) ** -Indicates Clay rich sample packaged for hydraulic permeability testing.
3) No groundwater observations made during or upon completion of drilling due to water added during drilling.

Coordinates: Northing-111255.91 Easting-13374012.08

FIGURE NO. 3

NO: JRW MW-16001

Project Name: J.R. Whiting Observation Wells

Project Location: J.R. Whiting Generating Facility, Erie, MI

FK Engineering Associates

Project No: 16-085

Checked By: Z. Carr, P.E.

SUBSURFACE PROFILE				SOIL SAMPLE DATA				INSTALLATION SCHEMATIC		
ELEV. (FT)	PRO-FILE	GROUND SURFACE ELEVATION: 589.2	DEPTH (FT)	RUN NUMBER	RECOVERY (%)	SAMPLE TYPE/NO.	UNCONF. COMP ST (psf)	DETAIL	TOP OF CASING ELEVATION: 592.3	DEPTH (FT)
		538.2 51.0 SILTY SAND Seam (SM) 537.7 51.5		RUN #6	100	BS-11	>9000*		TREMIED CEMENT GROUT	
						BS-12	>9000*			
530		Hard to Very Hard Gray SILTY CLAY with Trace Sand and Gravel (brittle, breaks into small fragments) (MH-CH)	60	RUN #7	100	BS-13	>9000*			60
		523.2 66.0 GRAVEL/BOULDERS (not all reactive with HCL) 522.7 66.5				BS-14	-		64.0 BENTONITE PELLETS 67.0	
520		521.2 68.0 Very Hard SANDY CLAY/ CLAYEY SAND (CH-SC)	70	RUN #8	50				FILTER SAND 71.0	70
		516.2 73.0 Possible Highly Weathered LIMESTONE (washwater turned white, no recovery in this area)				BS-15	-			
510		LIMESTONE with Occasional Dark Gray Clay Infilling 508.2 (Reacted to HCL) 81.0	80	RUN #9	67	BS-16	-		81.0 END OF BORING	80
500										
490										
480										

Monitoring Well JRW MW-16002

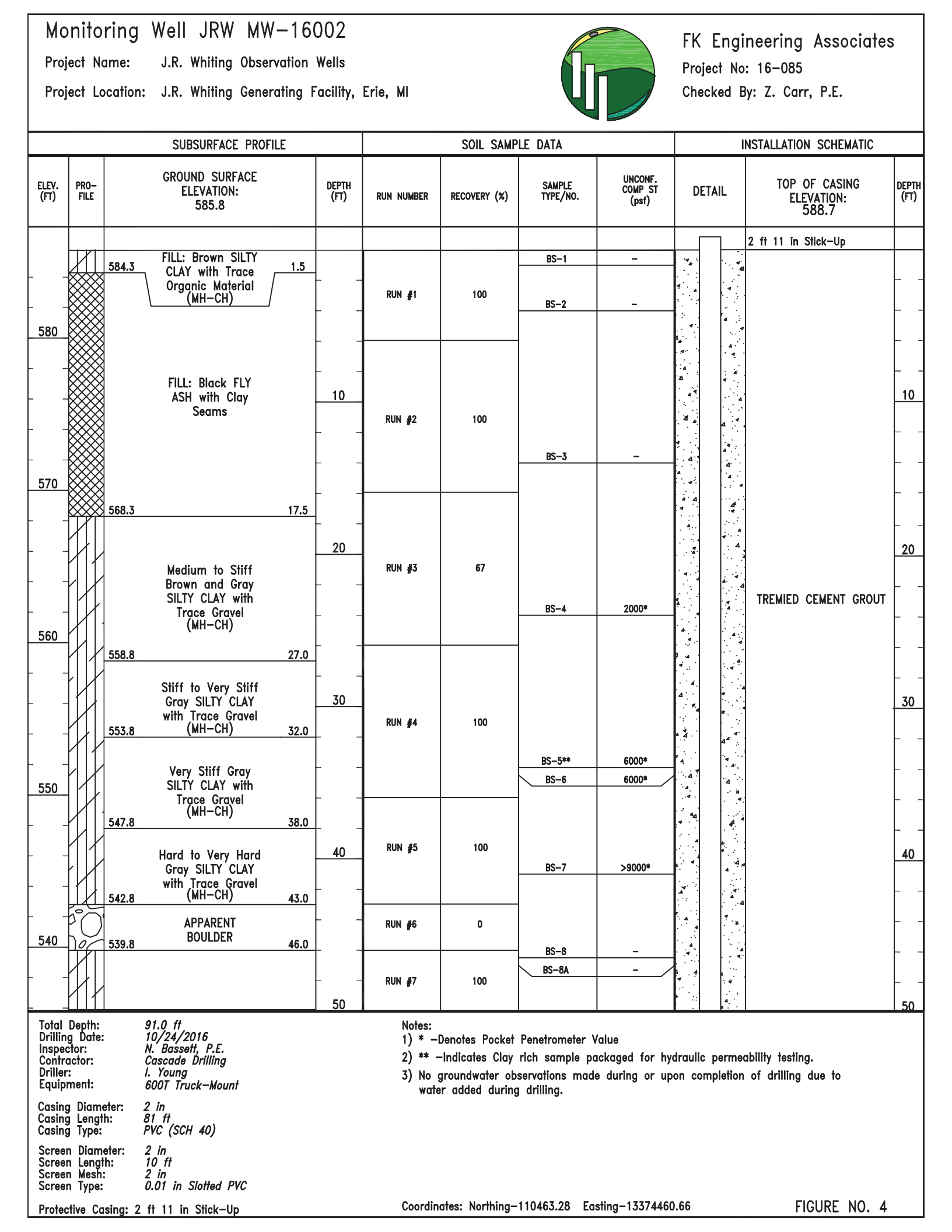
Project Name: J.R. Whiting Observation Wells

Project Location: J.R. Whiting Generating Facility, Erie, MI

FK Engineering Associates

Project No: 16-085

Checked By: Z. Carr, P.E.



Total Depth: *91.0 ft*
Drilling Date: *10/24/2016*
Inspector: *N. Bassett, P.E.*
Contractor: *Cascade Drilling*
Driller: *I. Young*
Equipment: *600T Truck-Mount*

Casing Diameter: *2 in*
Casing Length: *81 ft*
Casing Type: *PVC (SCH 40)*

Screen Diameter: *2 in*
Screen Length: *10 ft*
Screen Mesh: *2 in*
Screen Type: *0.01 in Slotted PVC*

Protective Casing: 2 ft 11 in Stick-Up

Notes:
1) * -Denotes Pocket Penetrometer Value
2) ** -Indicates Clay rich sample packaged for hydraulic permeability testing.
3) No groundwater observations made during or upon completion of drilling due to water added during drilling.

Coordinates: Northing-110463.28 Easting-13374460.66

FIGURE NO. 4

NO: JRW MW-16002

Project Name: J.R. Whiting Observation Wells

Project Location: J.R. Whiting Generating Facility, Erie, MI

FK Engineering Associates

Project No: 16-085

Checked By: Z. Carr, P.E.

SUBSURFACE PROFILE				SOIL SAMPLE DATA				INSTALLATION SCHEMATIC		
ELEV. (FT)	PRO-FILE	GROUND SURFACE ELEVATION: 585.8	DEPTH (FT)	RUN NUMBER	RECOVERY (%)	SAMPLE TYPE/NO.	UNCONF. COMP ST (psf)	DETAIL	TOP OF CASING ELEVATION: 588.7	DEPTH (FT)
530		Hard to Very Hard Gray SILTY CLAY with Little Gravel and Trace Sand (gravel content decreases with depth) (MH-CH)	60	RUN #7	100	BS-9	>9000*		TREMIED CEMENT GROUT	60
				RUN #8	100	BS-10	>9000*			
520		519.8 66.0				BS-11	-		65.1	
		ROCK FRAGMENTS 517.8 68.0							BENTONITE PELLETS	
		Hard Light Gray SILTY CLAY with Trace Gravel (MH-CH)	70	RUN #9	67	BS-12	-			70
		511.8 74.0							73.3	
510		CLAY With LIMESTONE FRAGMENTS 509.8 76.0				BS-13	-		FILTER SAND	
						BS-14	-			
		LIMESTONE (reacted to HCL)	80	RUN #10	100	BS-15	-		81.0	80
		504.8 81.0								
		503.8 CLAY Seam (MH-CH) 82.0				BS-16	-			
500		LIMESTONE (reacted to HCL)				BS-17	-			
			90	RUN #11	100					90
		494.8 91.0							91.0 END OF BORING	
490										
480										

Monitoring Well JRW MW-16003

Project Name: J.R. Whiting Observation Wells

Project Location: J.R. Whiting Generating Facility, Erie, MI

FK Engineering Associates

Project No: 16-085

Checked By: Z. Carr, P.E.

SUBSURFACE PROFILE				SOIL SAMPLE DATA				INSTALLATION SCHEMATIC		
ELEV. (FT)	PRO-FILE	GROUND SURFACE ELEVATION: 586.2	DEPTH (FT)	RUN NUMBER	RECOVERY (%)	SAMPLE TYPE/NO.	UNCONF. COMP ST (psf)	DETAIL	TOP OF CASING ELEVATION: 589.0	DEPTH (FT)
									2 ft 10 in Stick-Up	
580		584.2 2.0 FILL: Brown SILTY CLAY with Organic Material (MH-CH)		RUN #1	100	BS-1	–			
570		FILL: BOTTOM ASH and FLY ASH (clay drain tile fragment at 4 ft)	10	RUN #2	100	BS-2	–			10
		566.2 20.0	20	RUN #3	100	BS-3	4000*			20
560		564.2 22.0 Stiff to Very Stiff Brown SILTY CLAY with Trace Sand and Gravel (MH-CH) Medium Brown SILTY CLAY with Trace Sand and Gravel (MH-CH) 558.9 27.3							TREMIED CEMENT GROUT	
550		Medium Gray SILTY CLAY with Trace Sand and Gravel (MH-CH) 550.2 36.0	30	RUN #4	100	BS-4A	1000*			30
		Stiff to Very Stiff Gray SILTY CLAY with Trace Sand and Gravel (MH-CH)	40	RUN #5	100	BS-4B	4000*			40
		543.7 42.5				BS-4C**	>9000*			
540		Hard to Very Hard Gray SILTY CLAY with Trace Sand and Gravel (MH-CH)	50	RUN #6	100					50

Total Depth: *85.0 ft*
Drilling Date: *10/23/2016*
Inspector: *J. Elsey*
Contractor: *Cascade Drilling*
Driller: *I. Young*
Equipment: *600T Truck-Mount*

Casing Diameter: *2 in*
Casing Length: *73 ft*
Casing Type: *PVC (SCH 40)*

Screen Diameter: *2 in*
Screen Length: *10 ft*
Screen Mesh: *2 in*
Screen Type: *0.01 in Slotted PVC*

Protective Casing: 2 ft 10 in Stick-Up

Notes:
1) * –Denotes Pocket Penetrometer Value
2) ** –Indicates Clay rich sample packaged for hydraulic permeability testing.
3) No groundwater observations made during or upon completion of drilling due to water added during drilling.

Coordinates: Northing-109687.92 Easting-13374452.98

FIGURE NO. 5

NO: JRW MW-16003

Project Name: J.R. Whiting Observation Wells

Project Location: J.R. Whiting Generating Facility, Erie, MI

FK Engineering Associates

Project No: 16-085

Checked By: Z. Carr, P.E.

SUBSURFACE PROFILE				SOIL SAMPLE DATA				INSTALLATION SCHEMATIC		
ELEV. (FT)	PRO-FILE	GROUND SURFACE ELEVATION: 586.2	DEPTH (FT)	RUN NUMBER	RECOVERY (%)	SAMPLE TYPE/NO.	UNCONF. COMP ST (psf)	DETAIL	TOP OF CASING ELEVATION: 589.0	DEPTH (FT)
530		533.7 Very Stiff Gray SILTY CLAY with Trace Sand and Gravel (MH-CH) 52.5 532.9 53.3 Hard to Very Hard Gray SILTY CLAY with Trace Sand, Gravel (possible cobbles/boulders) (MH-CH)	60	RUN #6	100	BS-5	7000*		TREMIED CEMENT GROUT	60
				RUN #7	100	BS-6A	>9000*			
		522.2 64.0				BS-6B	>9000*		65.9	
520		520.2 Hard to Very Hard SANDY CLAY with Little Gravel (CH-SC) 66.0 Hard to Very Hard Gray SILTY CLAY with Little Gravel and (possible cobbles /boulders) (MH-CH)	70			BS-7	>9000*		BENTONITE PELLETS 69.0	70
		516.2 70.0		RUN #8	100	BS-8	-		73.0	
						BS-9	-			
510						BS-10	-		FILTER SAND	
		LIMESTONE (sand seam at 82 ft) (odoriferous & reacted with HCL)	80	RUN #9	40	BS-11	-			80
		503.2 83.0							83.0	
									END OF BORING	
500										
490										
480										

Monitoring Well JRW MW-16004

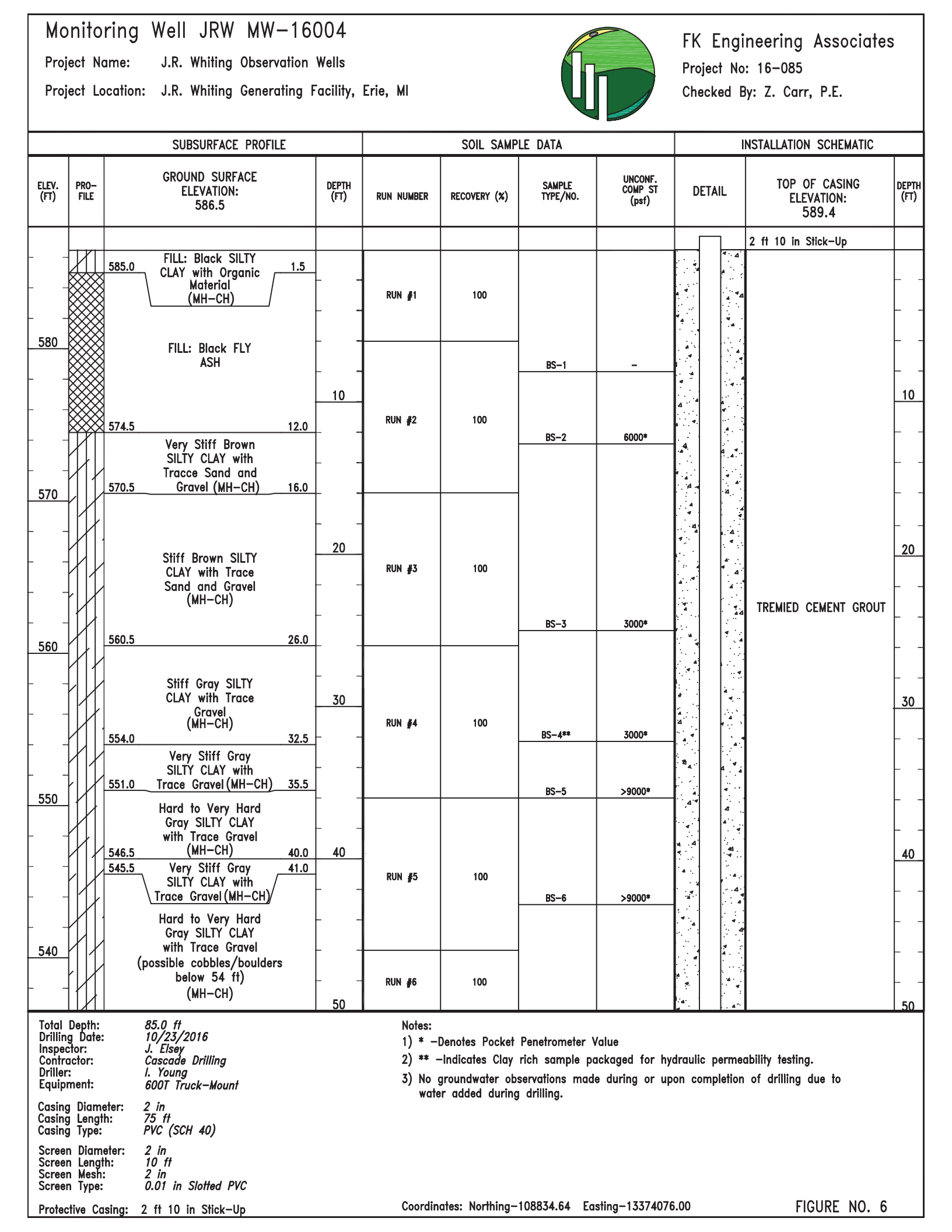
Project Name: J.R. Whiting Observation Wells

Project Location: J.R. Whiting Generating Facility, Erie, MI

FK Engineering Associates

Project No: 16-085

Checked By: Z. Carr, P.E.



Total Depth: *85.0 ft*
Drilling Date: *10/23/2016*
Inspector: *J. Elsey*
Contractor: *Cascade Drilling*
Driller: *I. Young*
Equipment: *600T Truck-Mount*

Casing Diameter: *2 in*
Casing Length: *75 ft*
Casing Type: *PVC (SCH 40)*

Screen Diameter: *2 in*
Screen Length: *10 ft*
Screen Mesh: *2 in*
Screen Type: *0.01 in Slotted PVC*

Protective Casing: 2 ft 10 in Stick-Up

Notes:

1) * -Denotes Pocket Penetrometer Value
2) ** -Indicates Clay rich sample packaged for hydraulic permeability testing.
3) No groundwater observations made during or upon completion of drilling due to water added during drilling.

Coordinates: Northing-108834.64 Easting-13374076.00

FIGURE NO. 6

NO: JRW MW-16004

Project Name: J.R. Whiting Observation Wells

Project Location: J.R. Whiting Generating Facility, Erie, MI

FK Engineering Associates

Project No: 16-085

Checked By: Z. Carr, P.E.

SUBSURFACE PROFILE				SOIL SAMPLE DATA				INSTALLATION SCHEMATIC		
ELEV. (FT)	PRO-FILE	GROUND SURFACE ELEVATION: 586.5	DEPTH (FT)	RUN NUMBER	RECOVERY (%)	SAMPLE TYPE/NO.	UNCONF. COMP ST (psf)	DETAIL	TOP OF CASING ELEVATION: 589.4	DEPTH (FT)
530		Hard to Very Hard Gray SILTY CLAY with Trace Gravel (possible cobbles/boulders below 54 ft) (MH-CH)	60	RUN #6	100	BS-7	8000*		TREMIED CEMENT GROUT	60
						BS-8	>9000*			
				RUN #7	100					
		523.5 63.0				BS-9	6000*		63.2	
520		Very Stiff SILTY CLAY with Trace Gravel (possible cobbles/ boulders) (MH-CH)							BENTONITE PELLETS	
		517.5 69.0	70			BS-10	-		67.0	70
						BS-11	-			
				RUN #8	100	BS-12	-			
						BS-13	-		75.0	
510		LIMESTONE (reacted to HCL)							FILTER SAND	
			80			BS-14	-			80
				RUN #9	40					
						BS-15	-			
		501.5 85.0							85.0	
500									END OF BORING	
490										
480										

Monitoring Well JRW MW-16005

Project Name: J.R. Whiting Observation Wells

Project Location: J.R. Whiting Generating Facility, Erie, MI

FK Engineering Associates

Project No: 16-085

Checked By: Z. Carr, P.E.

Total Depth: *88.0 ft*
Drilling Date: *10/25/2016*
Inspector: *N. Bassett, P.E.*
Contractor: *Cascade Drilling*
Driller: *I. Young*
Equipment: *600T Truck-Mount*

Casing Diameter: *2 in*
Casing Length: *78 ft*
Casing Type: *PVC (SCH 40)*

Screen Diameter: *2 in*
Screen Length: *10 ft*
Screen Mesh: *2 in*
Screen Type: *0.01 in Slotted PVC*

Protective Casing: 2 ft 10 in Stick-Up

Notes:

1) * -Denotes Pocket Penetrometer Value
2) ** -Indicates Clay rich sample packaged for hydraulic permeability testing.
3) No groundwater observations made during or upon completion of drilling due to water added during drilling.

Coordinates: Northing-110509.27 Easting-13373630.27

FIGURE NO. 7

NO: JRW MW-16005

Project Name: J.R. Whiting Observation Wells

Project Location: J.R. Whiting Generating Facility, Erie, MI

FK Engineering Associates

Project No: 16-085

Checked By: Z. Carr, P.E.

SUBSURFACE PROFILE				SOIL SAMPLE DATA				INSTALLATION SCHEMATIC		
ELEV. (FT)	PRO-FILE	GROUND SURFACE ELEVATION: 589.3	DEPTH (FT)	RUN NUMBER	RECOVERY (%)	SAMPLE TYPE/NO.	UNCONF. COMP ST (psf)	DETAIL	TOP OF CASING ELEVATION: 592.1	DEPTH (FT)
530		Hard to Very Hard Gray SILTY CLAY with Trace Sand and Gravel (gravel content increases with depth) (MH-CH) (At 56 ft 3-inch diameter cobble, did not react to HCL)	60	RUN #6	100	BS-9	>9000*		TREMIED CEMENT GROUT	60
				RUN #7	100	BS-10	-			
		522.3 67.0							66.0	
520		520.8 Very Hard SANDY CLAY/ CLAYEY SAND with Trace Gravel (CH-SC) 68.5	70	RUN #8	50	BS-11	-		BENTONITE PELLETS	70
		516.3 INTERFACE ZONE: FRAGMENTED ROCK with Clay (no recovery in this interval) 73.0				BS-12	-		72.0 FILTER SAND	
510		LIMESTONE (odoriferous & reacted with HCL)	80	RUN #9	50	BS-13	-		78.0	80
						BS-14	-			
		501.3 88.0							88.0 END OF BORING	
500										
490										
480										

Monitoring Well JRW MW-16006

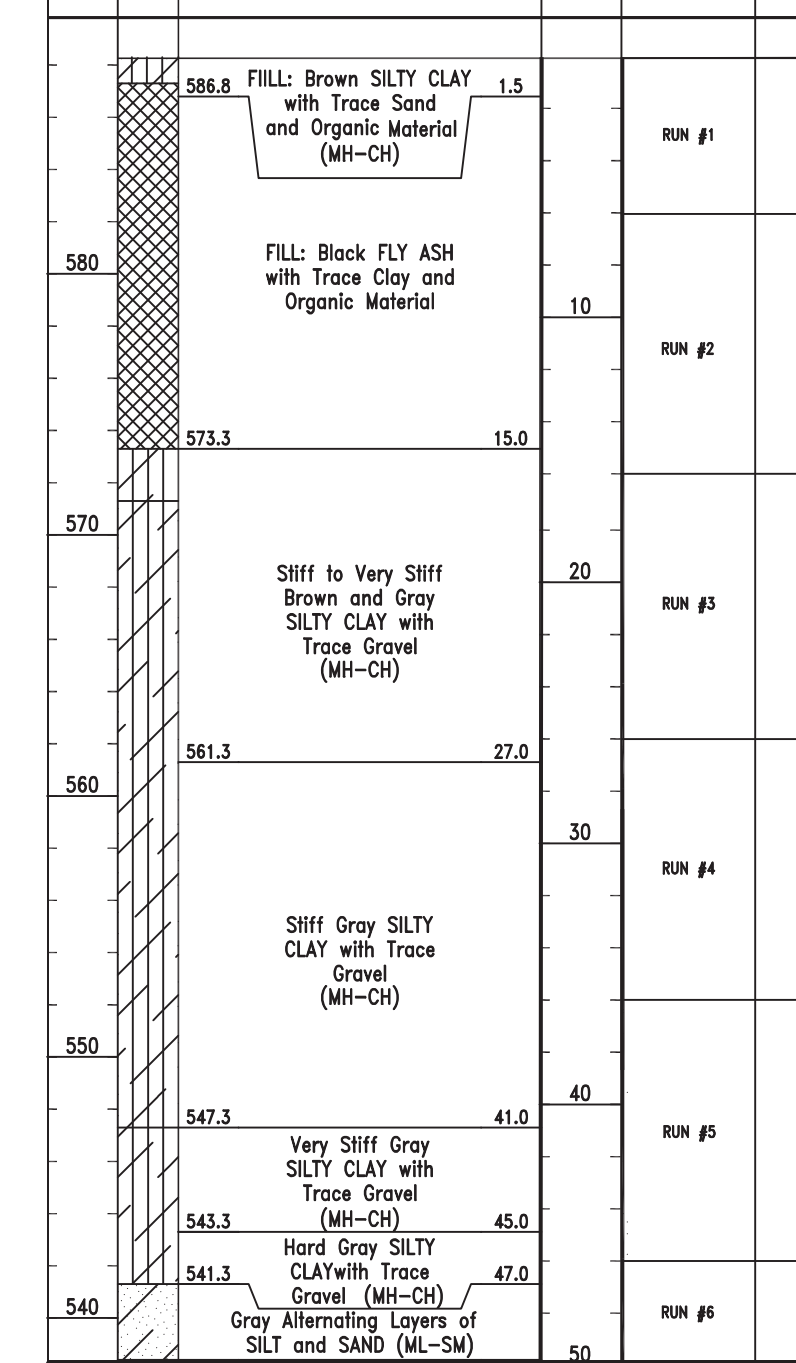
Project Name: J.R. Whiting Observation Wells

Project Location: J.R. Whiting Generating Facility, Erie, MI

FK Engineering Associates

Project No: 16-085

Checked By: Z. Carr, P.E.



Total Depth: *89.0 ft*
Drilling Date: *10/19/2016*
Inspector: *N. Bassett, P.E.*
Contractor: *Cascade Drilling*
Driller: *I. Young*
Equipment: *600T Truck-Mount*

Casing Diameter: *2 in*
Casing Length: *79 ft*
Casing Type: *PVC (SCH 40)*

Screen Diameter: *2 in*
Screen Length: *10 ft*
Screen Mesh: *2 in*
Screen Type: *0.01 in Slotted PVC*

Protective Casing: 2 ft 9 in Stick-Up

Notes:

1) * -Denotes Pocket Penetrometer Value
2) ** -Indicates Clay rich sample packaged for hydraulic permeability testing.
3) No groundwater observations made during or upon completion of drilling due to water added during drilling.

Coordinates: Northing-109719.88 Easting-13373640.49

FIGURE NO. 8

NO: JRW MW-16006

Project Name: J.R. Whiting Observation Wells

Project Location: J.R. Whiting Generating Facility, Erie, MI

FK Engineering Associates

Project No: 16-085

Checked By: Z. Carr, P.E.

SUBSURFACE PROFILE				SOIL SAMPLE DATA				INSTALLATION SCHEMATIC		
ELEV. (FT)	PRO-FILE	GROUND SURFACE ELEVATION: 588.3	DEPTH (FT)	RUN NUMBER	RECOVERY (%)	SAMPLE TYPE/NO.	UNCONF. COMP ST (psf)	DETAIL	TOP OF CASING ELEVATION: 591.0	DEPTH (FT)
		Gray Alternating Layers of SILT and SAND (ML-SM)				BS-10	–			
		535.3				BS-10A	–			
				RUN #6	100	BS-11	>9000*			
530						BS-12	>9000*		TREMIED CEMENT GROUT	
		Hard Gray SILTY CLAY with Trace Gravel (MH-CH)	60	RUN #7	100					60
						BS-13	>9000*			
520		519.3 69.0								
		Very Hard Gray SANDY CLAY/ CLAYEY SAND (CH-SC)	70	RUN #8	100	BS-14	–			70
		514.3 74.0							71.0	
		513.3 INTERFACE ZONE:							BENTONITE PELLETS	
		512.3 FRAGMENTED ROCK with Clay 76.0				BS-15	–		74.0	
						BS-16	–			
510									79.0	
			80							80
				RUN #9	40	BS-17	–		FILTER SAND	
						BS-18	–			
		LIMESTONE (reacted to HCL)								
						BS-19	–			
500				RUN #10	67					
		499.3 89.0							89.0	
									END OF BORING	
490										
480										

Monitoring Well JRW MW-16007

Project Name: J.R. Whiting Observation Wells

Project Location: J.R. Whiting Generating Facility, Erie, MI

FK Engineering Associates

Project No: 16-085

Checked By: Z. Carr, P.E.

SUBSURFACE PROFILE				SOIL SAMPLE DATA				INSTALLATION SCHEMATIC		
ELEV. (FT)	PRO-FILE	GROUND SURFACE ELEVATION: 579.5	DEPTH (FT)	RUN NUMBER	RECOVERY (%)	SAMPLE TYPE/NO.	UNCONF. COMP ST (psf)	DETAIL	TOP OF CASING ELEVATION: 582.3	DEPTH (FT)
									2 ft 10 in Stick-Up	
		579.0 TOPSOIL 0.5								
		Stiff Brown SILTY CLAY with Trace Organic Material (MH-CH)		RUN #1	100	BS-1	-			
		574.5 5.0				BS-2	-			
		572.5 Brown SILTY SAND (SM) 7.0								
570		Medium to Stiff Brown and Gray SILTY CLAY with Trace Gravel (MH-CH)	10	RUN #2	100					10
		563.5 16.0				BS-3	3000*			
560		Stiff Gray SILTY CLAY with Trace Gravel (MH-CH)	20	RUN #3	100	BS-4	3000*		TREMIED CEMENT GROUT	20
		553.5 26.0								
550		Stiff to Very Stiff Gray SILTY CLAY with Trace Gravel (MH-CH)	30	RUN #4	100					30
		546.5 33.0								
		Hard Gray SILTY CLAY with Trace Gravel (MH-CH)				BS-5**	>9000*			
		543.5 36.0				BS-6	-			
		543.0 Gray SAND (SP) 36.5								
540		Hard Gray SILTY CLAY with Trace Gravel (2 inch sand seam at 39.5') (MH-CH)	40	RUN #5	100					40
		535.0 44.5				BS-7	-			
		534.5 Gray SAND (SP) 45.0				BS-8	-			
		Hard Gray SILTY CLAY with Trace Gravel (sand and silt seams present) (MH-CH)		RUN #6	100	BS-9	-			
530			50							50

Total Depth: *78.3 ft*
Drilling Date: *10/19/2016*
Inspector: *N. Bassett, P.E.*
Contractor: *Cascade Drilling*
Driller: *I. Young*
Equipment: *600T Truck-Mount*

Casing Diameter: *2 in*
Casing Length: *68 ft*
Casing Type: *PVC (SCH 40)*

Screen Diameter: *2 in*
Screen Length: *10 ft*
Screen Mesh: *2 in*
Screen Type: *0.01 in Slotted PVC*

Protective Casing: 2 ft 10 in Stick-Up

Notes:

1) * -Denotes Pocket Penetrometer Value
2) ** -Indicates Clay rich sample packaged for hydraulic permeability testing.
3) No groundwater observations made during or upon completion of drilling due to water added during drilling.
4) Driller noted continuous loss of drilling wash water during Run #8.

Coordinates: Northing-108397.13 Easting-13372561.93

FIGURE NO. 9

NO: JRW MW-16007

Project Name: J.R. Whiting Observation Wells

Project Location: J.R. Whiting Generating Facility, Erie, MI

FK Engineering Associates

Project No: 16-085

Checked By: Z. Carr, P.E.

SUBSURFACE PROFILE				SOIL SAMPLE DATA				INSTALLATION SCHEMATIC		
ELEV. (FT)	PRO-FILE	GROUND SURFACE ELEVATION: 579.5	DEPTH (FT)	RUN NUMBER	RECOVERY (%)	SAMPLE TYPE/NO.	UNCONF. COMP ST (psf)	DETAIL	TOP OF CASING ELEVATION: 582.3	DEPTH (FT)
		Hard Gray SILTY CLAY with Trace (sand and silt seams present) (MH-CH)		RUN #6	100	BS-10	>9000*		TREMIED CEMENT GROUT	
525.0			54.5							
520		Very Hard Gray SILTY CLAY with Little Sand and Trace Gravel (color lightens with depth) (cobble/boulder at 63')	60			BS-11	-		59.9	60
515.5			64.0	RUN #7	100				BENTONITE PELLETS 63.2	
						BS-12	-			
510		LIMESTONE (reacted to HCL)	70	RUN #8	50				68.0 FILTER SAND	70
						BS-13	-			
						BS-14	-			
501.2			78.3						78.0	
500									78.3 END OF BORING	
490										
480										
470										

Monitoring Well JRW MW-16008

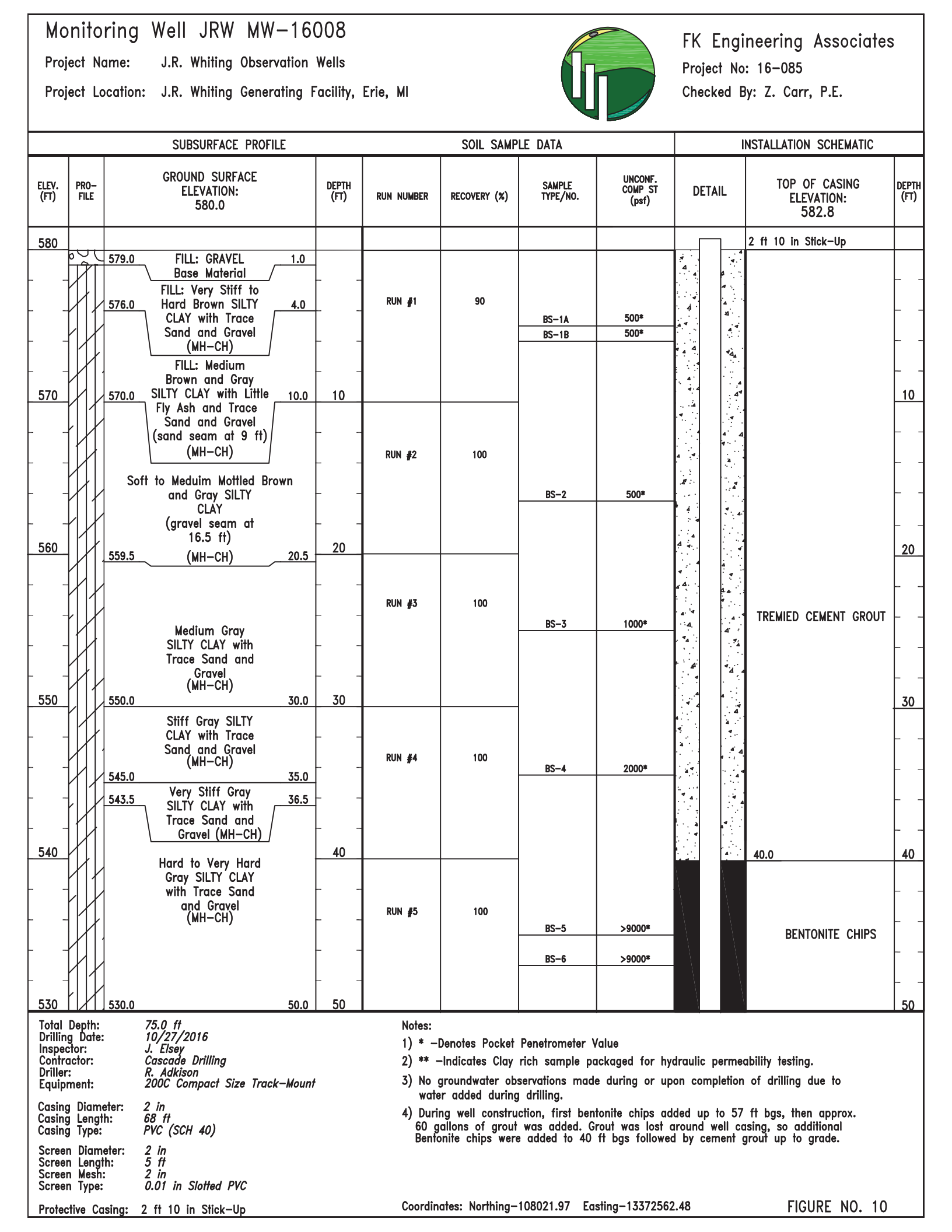
Project Name: J.R. Whiting Observation Wells

Project Location: J.R. Whiting Generating Facility, Erie, MI

FK Engineering Associates

Project No: 16-085

Checked By: Z. Carr, P.E.



Total Depth: *75.0 ft*
Drilling Date: *10/27/2016*
Inspector: *J. Elsey*
Contractor: *Cascade Drilling*
Driller: *R. Adkison*
Equipment: *200C Compact Size Track-Mount*

Casing Diameter: *2 in*
Casing Length: *68 ft*
Casing Type: *PVC (SCH 40)*

Screen Diameter: *2 in*
Screen Length: *5 ft*
Screen Mesh: *2 in*
Screen Type: *0.01 in Slotted PVC*

Protective Casing: 2 ft 10 in Stick-Up

Notes:

1) * -Denotes Pocket Penetrometer Value
2) ** -Indicates Clay rich sample packaged for hydraulic permeability testing.
3) No groundwater observations made during or upon completion of drilling due to water added during drilling.
4) During well construction, first bentonite chips added up to 57 ft bgs, then approx. 60 gallons of grout was added. Grout was lost around well casing, so additional Bentonite chips were added to 40 ft bgs followed by cement grout up to grade.

Coordinates: Northing-108021.97 Easting-13372562.48

FIGURE NO. 10

NO: JRW MW-16008

Project Name: J.R. Whiting Observation Wells

Project Location: J.R. Whiting Generating Facility, Erie, MI

FK Engineering Associates

Project No: 16-085

Checked By: Z. Carr, P.E.

SUBSURFACE PROFILE				SOIL SAMPLE DATA				INSTALLATION SCHEMATIC		
ELEV. (FT)	PRO-FILE	GROUND SURFACE ELEVATION: 580.0	DEPTH (FT)	RUN NUMBER	RECOVERY (%)	SAMPLE TYPE/NO.	UNCONF. COMP ST (psf)	DETAIL	TOP OF CASING ELEVATION: 582.8	DEPTH (FT)
530										
		Hard to Very Hard Gray SILTY CLAY with Trace Sand and Gravel (MH-CH)							BENTONITE CHIPS	
		525.0 — 55.0		RUN #6	100					
		Very Hard Gray SANDY CLAY/CLAYEY SAND (CH-SC)				BS-7	-			
		521.5 — 58.5								
520			60						61.0	60
		INTERFACE ZONE: FRAGMENTED ROCK with Silty Clay and Sand (odoriferous)							FILTER SAND	
		517.5 — 62.5		RUN #7	80	BS-8	-			
									68.0	
510		LIMESTONE (reacted to HCL)	70							70
				RUN #8	30	BS-9	-		73.0	
		505.0 — 75.0							Caved-In Material 75.0	
									END OF BORING	
500										
490										
480										
470										

Monitoring Well JRW MW-16009

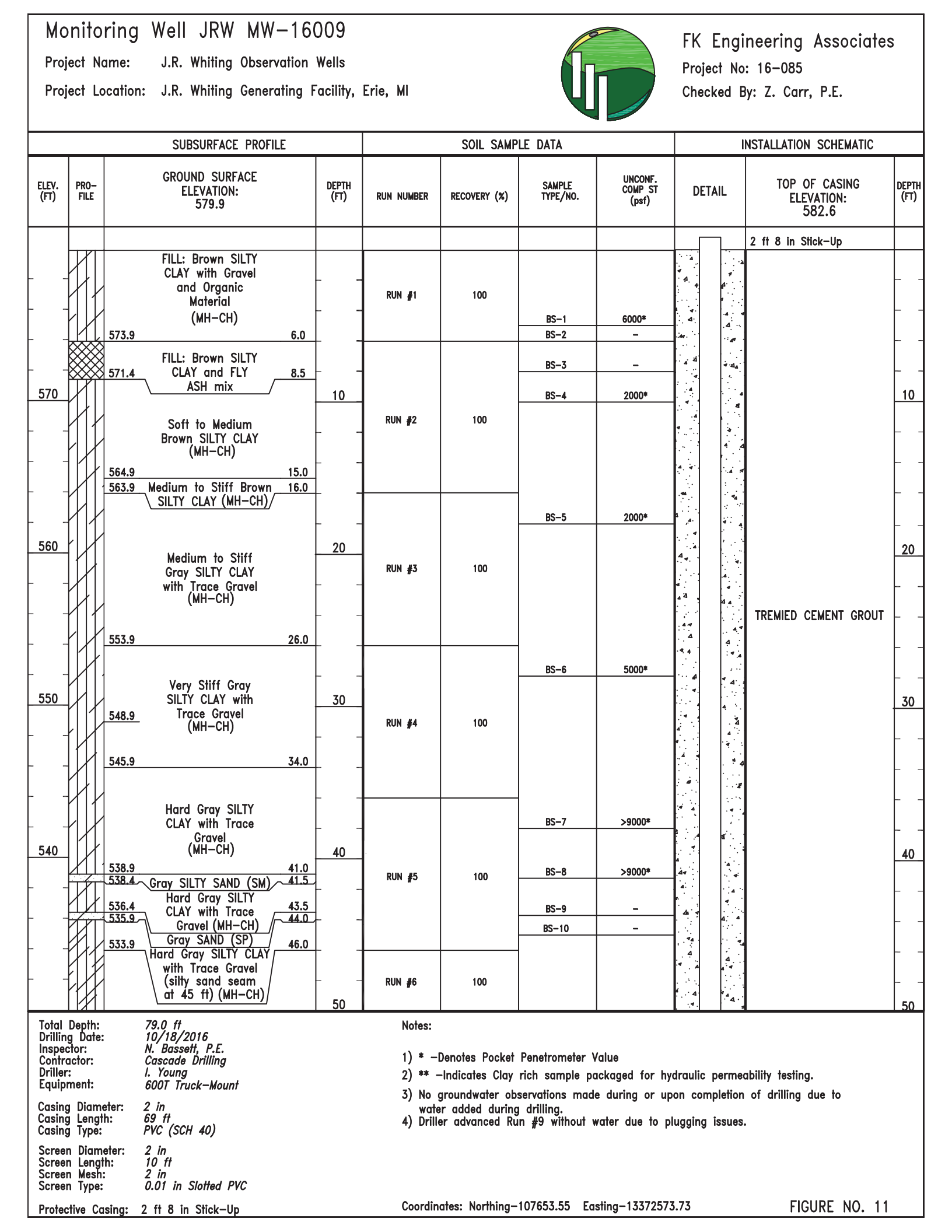
Project Name: J.R. Whiting Observation Wells

Project Location: J.R. Whiting Generating Facility, Erie, MI

FK Engineering Associates

Project No: 16-085

Checked By: Z. Carr, P.E.



Total Depth: *79.0 ft*
Drilling Date: *10/18/2016*
Inspector: *N. Bassett, P.E.*
Contractor: *Cascade Drilling*
Driller: *I. Young*
Equipment: *600T Truck-Mount*

Casing Diameter: *2 in*
Casing Length: *69 ft*
Casing Type: *PVC (SCH 40)*

Screen Diameter: *2 in*
Screen Length: *10 ft*
Screen Mesh: *2 in*
Screen Type: *0.01 in Slotted PVC*

Protective Casing: 2 ft 8 in Stick-Up

Notes:

1) * -Denotes Pocket Penetrometer Value
2) ** -Indicates Clay rich sample packaged for hydraulic permeability testing.
3) No groundwater observations made during or upon completion of drilling due to water added during drilling.
4) Driller advanced Run #9 without water due to plugging issues.

Coordinates: Northing-107653.55 Easting-13372573.73

FIGURE NO. 11

NO: JRW MW-16009

Project Name: J.R. Whiting Observation Wells

Project Location: J.R. Whiting Generating Facility, Erie, MI

FK Engineering Associates

Project No: 16-085

Checked By: Z. Carr, P.E.

SUBSURFACE PROFILE				SOIL SAMPLE DATA				INSTALLATION SCHEMATIC		
ELEV. (FT)	PRO-FILE	GROUND SURFACE ELEVATION: 579.9	DEPTH (FT)	RUN NUMBER	RECOVERY (%)	SAMPLE TYPE/NO.	UNCONF. COMP ST (psf)	DETAIL	TOP OF CASING ELEVATION: 582.6	DEPTH (FT)
		Hard Gray SILTY CLAY with Trace Gravel with Sand and Silt Seams (MH-CH)		RUN #6	100	BS-11	>9000*			
		523.9	56.0	RUN #7	75	BS-12	6000*		TREMIED CEMENT GROUT	
520		INTERFACE ZONE: FRAGMENTED ROCK with Silty Clay	60	RUN #8	100	BS-13	-		60.4	60
		514.4	65.5			BS-14	-		BENTONITE PELLETS 64.0	
						BS-15	-			
						BS-16	-		69.0	
510		LIMESTONE (clay infilling at 73 ft and 76 ft) (reacted to HCL)	70	RUN #9	100	BS-17	-		FILTER SAND	70
						BS-18	-			
				RUN #10	100	BS-19	-			
		500.9	79.0						79.0	
500									END OF BORING	
490										
480										
470										

LOG OF HAND AUGER BORING NO: HAB-1

Project Name: *J.R. Whiting Well Installation*

Project Location: *J. R. Whiting Generating Facility, Erie, Michigan*

FK Engineering Associates
Project No: 16-085
Checked By: Z. Carr, P.E

SUBSURFACE PROFILE | SOIL SAMPLE DATA

ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 589.2	DEPTH (ft)	SAMPLE NO.	HOUSEL TESTS (Blows/6 Inches)	MOIST. CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP ST (PSF)
589		FILL: Brown SILTY CLAY with Trace Organic Material	1	BS-1	-	-	-	-
588				BS-2	-	-	-	-
		587.8	1.4					
		FILL: Gray FLY ASH	2	BS-3	-	-	-	-
587			3					
586			4					
585			5	BS-4	-	-	-	-
		584.2	5.0					
		END OF BORING						
584			6					

Total Depth: *5 FT*
Drilling Date: *10/19/16*
Inspector: *J. Elsey*

Water Level Observation:
No groundwater encountered during or upon completion of drilling.

Drilling Method:
4-inch diameter bucket-type hand auger.

Notes:
1) Drilled to clear boring location for the sonic drilling of JRW MW-16001.

Plugging Procedure:
Borehole backfilled with soil cuttings to prevailing grade.

GPS Coordinates:

Figure No. 12

LOG OF HAND AUGER BORING HAND AUGERS.GPJ 12/8/16

LOG OF HAND AUGER BORING NO: HAB-2

Project Name: *J.R. Whiting Well Installation*

Project Location: *J. R. Whiting Generating Facility, Erie, Michigan*

FK Engineering Associates
Project No: 16-085
Checked By: Z. Carr, P.E

SUBSURFACE PROFILE | SOIL SAMPLE DATA

ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 585.8	DEPTH (ft)	SAMPLE NO.	HOUSEL TESTS (Blows/6 Inches)	MOIST. CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP ST (PSF)
585		FILL: Brown SILTY CLAY with Trace Organic Material	1					
		584.8 — 1.0						
584			2					
583		FILL: Gray BOTTOM/ FLY ASH with Ocasional Clay Seams	3					
582			4					
581			5					
		580.8 — 5.0						
		END OF BORING						
580			6					

Total Depth: *5 FT*
Drilling Date: *10/21/16*
Inspector: *N. Bassett, P.E.*

Water Level Observation:
No groundwater encountered during or upon completion of drilling.

Drilling Method:
4-inch diameter bucket-type hand auger.

Notes:
1) Drilled to clear boring location for the sonic drilling of JRW MW-16002.

Plugging Procedure:
Borehole backfilled with soil cuttings to prevailing grade.

GPS Coordinates:

Figure No. 13

LOG OF HAND AUGER BORING HAND AUGERS.GPJ 12/8/16

LOG OF HAND AUGER BORING NO: HAB-3

Project Name: *J.R. Whiting Well Installation*

Project Location: *J. R. Whiting Generating Facility, Erie, Michigan*

FK Engineering Associates

Project No: 16-085

Checked By: Z. Carr, P.E

SUBSURFACE PROFILE | SOIL SAMPLE DATA

ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 586.2		DEPTH (ft)	SAMPLE NO.	HOUSEL TESTS (Blows/6 Inches)	MOIST. CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP ST (PSF)
586		FILL: Brown SILTY CLAY with Trace Organic Material							
			585.2 1.0	1	BS-1	-	-	-	-
585		FILL: Brown SILTY CLAY with Little Fly Ash							
			584.4 1.8		BS-2	-	-	-	-
				2	BS-3	-	-	-	-
584									
				3					
583		FILL: Gray FLY ASH and BOTTOM ASH (bottom ash increases with depth)							
				4	BS-4	-	-	-	-
582									
			581.2 5.0	5	BS-5	-	-	-	-
		END OF BORING							
581									
				6					

Total Depth: *5 FT*
Drilling Date: *10/19/16*
Inspector: *J. Elsey*

Water Level Observation:
No groundwater encountered during or upon completion of drilling.

Drilling Method:
4-inch diameter bucket-type hand auger.

Notes:
1) Drilled to clear boring location for the sonic drilling of JRW MW-16003.

Plugging Procedure:
Borehole backfilled with soil cuttings to prevailing grade.

GPS Coordinates:

Figure No. 14

LOG OF HAND AUGER BORING HAND AUGERS.GPJ 12/8/16

LOG OF HAND AUGER BORING NO: HAB-4

Project Name: *J.R. Whiting Well Installation*

Project Location: *J. R. Whiting Generating Facility, Erie, Michigan*

FK Engineering Associates
Project No: 16-085
Checked By: Z. Carr, P.E

SUBSURFACE PROFILE | SOIL SAMPLE DATA

ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 586.5	DEPTH (ft)	SAMPLE NO.	HOUSEL TESTS (Blows/6 Inches)	MOIST. CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP ST (PSF)
586		FILL: Dark Brown to Black SILTY CLAY with Trace Organic Material	1	BS-1	-	-	-	-
		585.3 / 1.3						
585				BS-2	-	-	-	-
		FILL: Gray FLY ASH	2					
584								
		583.5 / 3.0	3					
583				BS-3	-	-	-	-
		FILL: Gray FLY ASH and BOTTOM ASH (bottom ash increases with depth)	4					
				BS-4	-	-	-	-
582								
		581.5 / 5.0	5	BS-5	-	-	-	-
		END OF BORING						
581								
			6					

Total Depth: *5 FT*
Drilling Date: *10/19/16*
Inspector: *J. Elsey*

Water Level Observation:
No groundwater encountered during or upon completion of drilling.

Drilling Method:
4-inch diameter bucket-type hand auger.

Notes:
1) Drilled to clear boring location for the sonic drilling of JRW MW-16004.

Plugging Procedure:
Borehole backfilled with soil cuttings to prevailing grade.

GPS Coordinates:

Figure No. 15

LOG OF HAND AUGER BORING HAND AUGERS.GPJ 12/8/16

LOG OF HAND AUGER BORING NO: HAB-5

Project Name: *J.R. Whiting Well Installation*

Project Location: *J. R. Whiting Generating Facility, Erie, Michigan*

FK Engineering Associates
Project No: 16-085
Checked By: Z. Carr, P.E

SUBSURFACE PROFILE | SOIL SAMPLE DATA

ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 589.3	DEPTH (ft)	SAMPLE NO.	HOUSEL TESTS (Blows/6 Inches)	MOIST. CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP ST (PSF)
589				BS-1	-	-	-	-
			1					
588		FILL: Brown SILTY CLAY with Trace Gravel and Organic Material		BS-2	-	-	-	-
			2					
587								
		586.6 / 2.7						
			3	BS-3	-	-	-	-
586		FILL: Brown SILTY CLAY with Trace Fly Ash						
		585.4 / 3.9						
			4	BS-4	-	-	-	-
585		FILL: Gray FLY ASH						
		584.3 / 5.0	5	BS-5	-	-	-	-
		END OF BORING						
584								
			6					

Total Depth: *5 FT*
Drilling Date: *10/19/16*
Inspector: *J. Elsey*

Water Level Observation:
No groundwater encountered during or upon completion of drilling.

Drilling Method:
4-inch diameter bucket-type hand auger.

Notes:
1) Drilled to clear boring location for the sonic drilling of JRW MW-16005.

Plugging Procedure:
Borehole backfilled with soil cuttings to prevailing grade.

GPS Coordinates:

Figure No. 16

LOG OF HAND AUGER BORING HAND AUGERS.GPJ 12/8/16

LOG OF HAND AUGER BORING NO: HAB-6

Project Name: *J.R. Whiting Well Installation*

Project Location: *J. R. Whiting Generating Facility, Erie, Michigan*

FK Engineering Associates
Project No: 16-085
Checked By: Z. Carr, P.E

SUBSURFACE PROFILE | SOIL SAMPLE DATA

ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 588.3	DEPTH (ft)	SAMPLE NO.	HOUSEL TESTS (Blows/6 Inches)	MOIST. CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP ST (PSF)
588		FILL: Brown SILTY CLAY with Trace Organic Material		BS-1	-	-	-	-
		587.3	1.0					
			1	BS-2	-	-	-	-
587								
			2					
586								
		FILL: Gray/Black FLY ASH (clay seams from 2ft to 3ft)	3	BS-3	-	-	-	-
585								
			4					
584								
		583.3	5.0	BS-4	-	-	-	-
		END OF BORING	5					
583								
			6					

Total Depth: *5 FT*
Drilling Date: *10/19/16*
Inspector: *J. Elsey*

Water Level Observation:
No groundwater encountered during or upon completion of drilling.

Drilling Method:
4-inch diameter bucket-type hand auger.

Notes:
1) Drilled to clear boring location for the sonic drilling of JRW MW-16006.

Plugging Procedure:
Borehole backfilled with soil cuttings to prevailing grade.

GPS Coordinates:

Figure No. 17

LOG OF HAND AUGER BORING HAND AUGERS.GPJ 12/8/16

LOG OF HAND AUGER BORING NO: HAB-7

Project Name: *J.R. Whiting Well Installation*

Project Location: *J. R. Whiting Generating Facility, Erie, Michigan*

FK Engineering Associates
Project No: 16-085
Checked By: Z. Carr, P.E

SUBSURFACE PROFILE | SOIL SAMPLE DATA

ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 579.5	DEPTH (ft)	SAMPLE NO.	HOUSEL TESTS (Blows/6 Inches)	MOIST. CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP ST (PSF)
579		FILL: Brown SAND with Little Gravel and Asphalt Debris		BS-1	-	-	-	-
		578.5 1.0	1	BS-2	-	-	-	-
		ASPHALT 578.3 1.2						
578			2	BS-3	-	-	-	-
		FILL: Dark Brown SAND with Trace Clay and Organic Material						
577				BS-4	-	-	-	-
		576.5 3.0	3					
576				BS-5	-	-	-	-
		Dark Brown SILTY CLAY	4					
575								
		574.8 4.7						
		Brown SAND with Trace Silt						
		574.5 5.0	5	BS-6	-	-	-	-
		END OF BORING						
574								
			6					

Total Depth: *5 FT*
Drilling Date: *10/18/16*
Inspector: *J. Elsey*

Water Level Observation:
No groundwater encountered during or upon completion of drilling.

Drilling Method:
4-inch diameter bucket-type hand auger.

Notes:
1) Drilled to clear boring location for the sonic drilling of JRW MW-16007.
2) Used chisel to penetrate asphalt encouneterd at 1ft.

Plugging Procedure:
Borehole backfilled with soil cuttings to prevailing grade.

GPS Coordinates:

Figure No. 18

LOG OF HAND AUGER BORING HAND AUGERS.GPJ 12/8/16

LOG OF HAND AUGER BORING NO: HAB-8

Project Name: *J.R. Whiting Well Installation*

Project Location: *J. R. Whiting Generating Facility, Erie, Michigan*

FK Engineering Associates
Project No: 16-085
Checked By: Z. Carr, P.E

SUBSURFACE PROFILE				SOIL SAMPLE DATA				
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 580.0	DEPTH (ft)	SAMPLE NO.	HOUSEL TESTS (Blows/6 Inches)	MOIST. CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP ST (PSF)
580								
		FILL: GRAVEL BASE MATERIAL						
		579.5	0.5					
		ASPHALT						
		579.3	0.7					
579			1					
		FILL: GRAVEL BASE MATERIAL						
		578.5	1.5					
578			2					
		FILL: Brown SILTY CLAY with Trace Sand and Gravel						
577			3					
576		576.0	4.0					
		FILL: Brown and Gray SILTY CLAY with Little Black Fly Ash and Trace Sand and Gravel	4					
		575.2	4.8					
575		Brown SAND						
		575.0	5.0					
		END OF BORING	5					
574			6					

Total Depth: *5 FT*
Drilling Date: *10/27/16*
Inspector: *J. Elsey*

Drilling Method:
4-inch diameter bucket-type hand auger.

Plugging Procedure:
Borehole backfilled with soil cuttings to prevailing grade.

Water Level Observation:
Groundwater observed at 4.8 ft during drilling and 4.2 ft upon completion of drilling.

Notes:
1) Drilled to clear boring location for the sonic drilling of JRW MW-16008.
2) Used chisel to penetrate asphalt encouneterd at 0.5ft.

GPS Coordinates:

Figure No. 19

LOG OF HAND AUGER BORING HAND AUGERS.GPJ 12/8/16

LOG OF HAND AUGER BORING NO: HAB-9

Project Name: *J.R. Whiting Well Installation*

Project Location: *J. R. Whiting Generating Facility, Erie, Michigan*

FK Engineering Associates
Project No: 16-085
Checked By: Z. Carr, P.E

SUBSURFACE PROFILE | SOIL SAMPLE DATA

ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 579.9	DEPTH (ft)	SAMPLE NO.	HOUSEL TESTS (Blows/6 Inches)	MOIST. CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP ST (PSF)
579		FILL: Gray SAND with Little Gravel and Trace Fly Ash	1	BS-1	-	-	-	-
				BS-2	-	-	-	-
578		577.9 2.0	2	BS-3	-	-	-	-
577		FILL: Brown SILTY CLAY	3					
576			4	BS-4	-	-	-	-
575		574.9 5.0	5	BS-5	-	-	-	-
		END OF BORING						
574			6					

Total Depth: *5 FT*
Drilling Date: *10/18/16*
Inspector: *J. Elsey*

Water Level Observation:
No groundwater encountered during or upon completion of drilling.

Drilling Method:
4-inch diameter bucket-type hand auger.

Notes:
1) Drilled to clear boring location for the sonic drilling of JRW MW-16009.

Plugging Procedure:
Borehole backfilled with soil cuttings to prevailing grade.

GPS Coordinates:

Figure No. 20

LOG OF HAND AUGER BORING HAND AUGERS.GPJ 12/8/16

Appendix B
Photographic Log

Photographs of Clay to Bedrock Transition (individual well locations)

Photograph of clay to bedrock transitions at JRW MW-16001:

JRW MW-16001 66-76 feet bgs

Photograph of clay to bedrock transitions at JRW MW-16002:

JRW MW-16002 66-76 feet bgs

Photograph of clay to bedrock transitions at JRW MW-16003:

JRW MW-16003 66-76 feet bgs

Photograph of clay to bedrock transitions at JRW MW-16004:

JRW MW-16004 66-76 feet bgs

Photograph of clay to bedrock transitions at JRW MW-16005:

JRW MW-16005 66-76 feet bgs

Photograph of clay to bedrock transitions at JRW MW-16006:

JRW MW-16006 66-76 feet bgs

Photograph of clay to bedrock transitions at JRW MW-16007:

JRW MW-16007 56-66 feet bgs

Photograph of clay to bedrock transitions at JRW MW-16008:

JRW MW-16008 50-60 feet bgs – Run 6

Photograph of clay to bedrock transitions at JRW MW-16008:

JRW MW-16008 60-70 feet bgs – Run 7

Photograph of clay to bedrock transitions at JRW MW-16009:

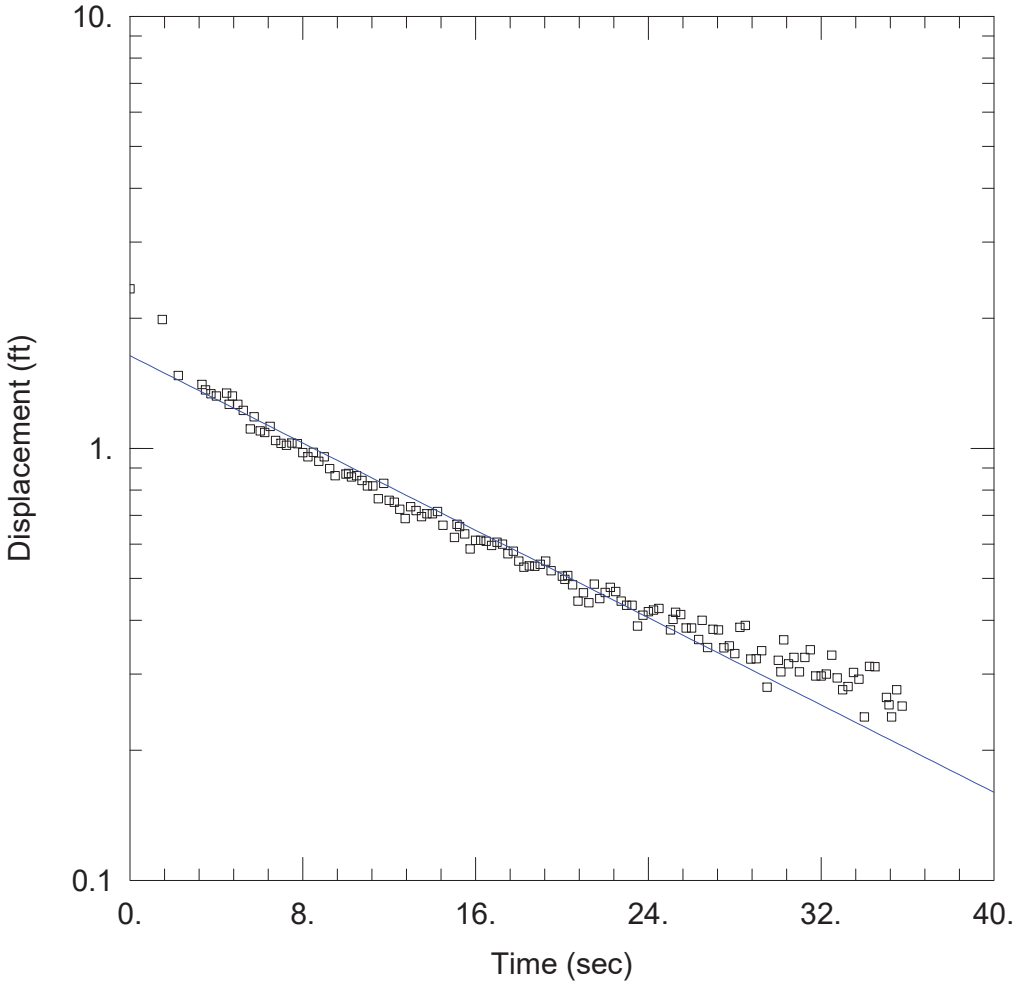
JRW MW-16009 66-70 feet bgs

Photograph of clay to bedrock transitions at JRW MW-16009:

JRW MW-16009 66-76 feet bgs

Appendix C
Hydraulic Test Results

Individual Well Locations



JR MW-16001 SLUG IN 1

Data Set: S:\...\MW-16001 Slug in 1.aqt
Date: 11/08/16 Time: 08:38:58

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16001
Test Date: 11/1/16

AQUIFER DATA

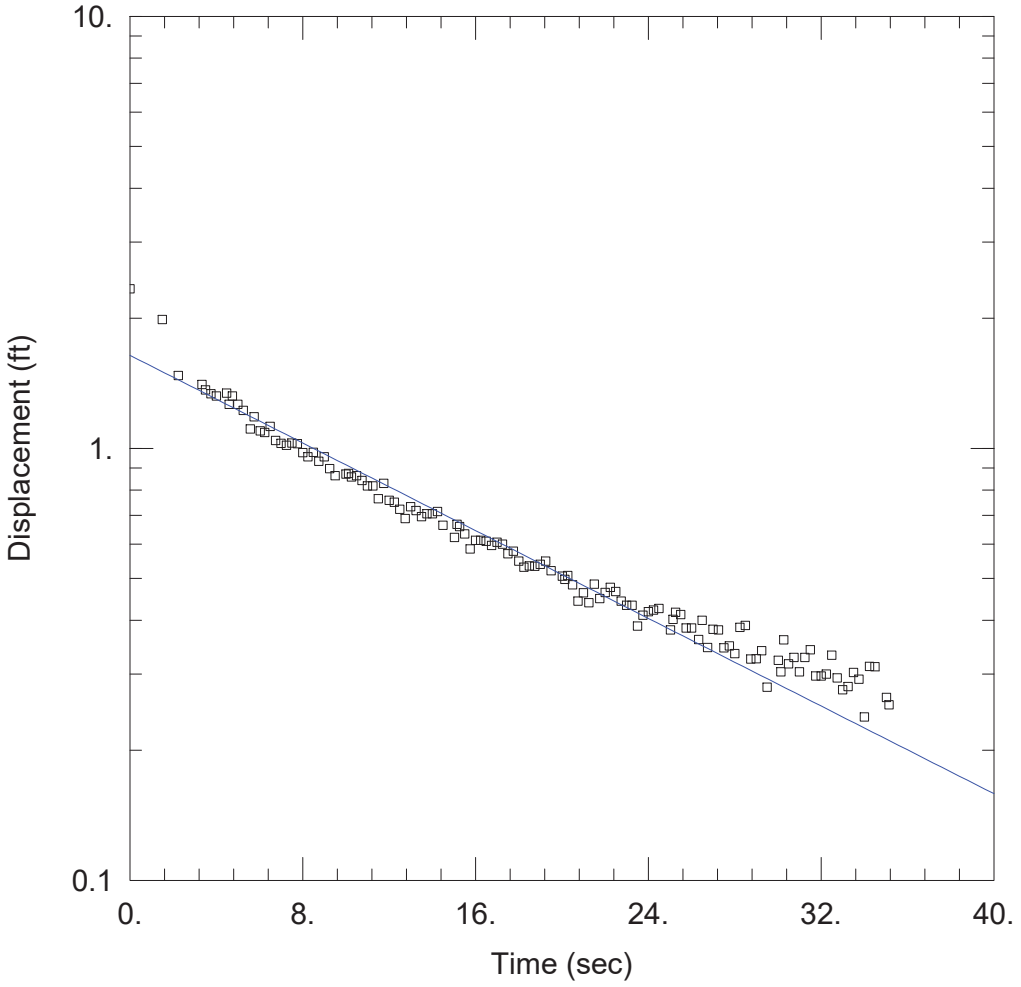
Saturated Thickness: 13. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16001)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 66.3 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 3.161 ft/day
y0 = 1.638 ft



JR MW-16001 SLUG IN 1

Data Set: S:\...\MW-16001 Slug in 1.aqt
Date: 11/08/16 Time: 08:46:48

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16001
Test Date: 11/1/16

AQUIFER DATA

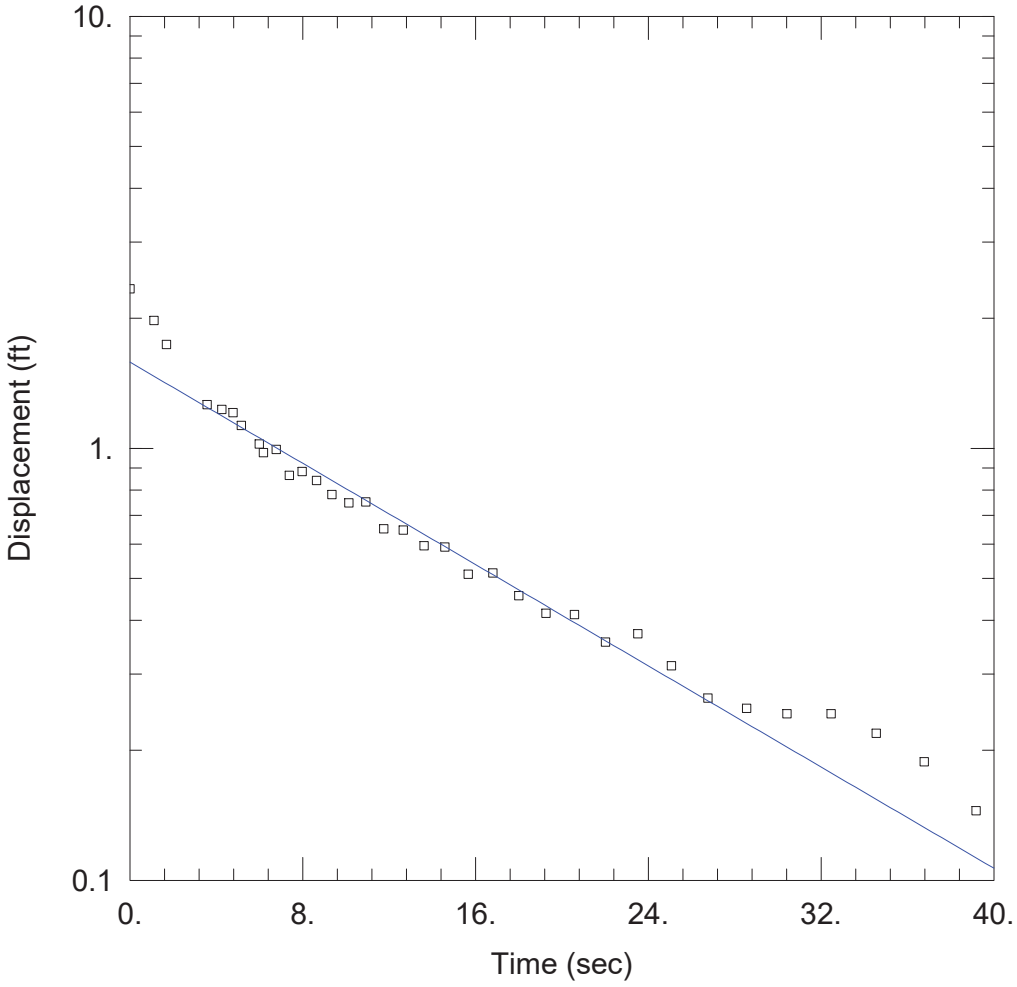
Saturated Thickness: 13. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16001)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 66.3 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 4.672 ft/day
y0 = 1.642 ft



JR MW-16001 SLUG IN 2

Data Set: S:\...\MW-16001 Slug in 1.aqt
Date: 11/08/16 Time: 08:42:55

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16001
Test Date: 11/1/16

AQUIFER DATA

Saturated Thickness: 13. ft Anisotropy Ratio (Kz/Kr): 1.

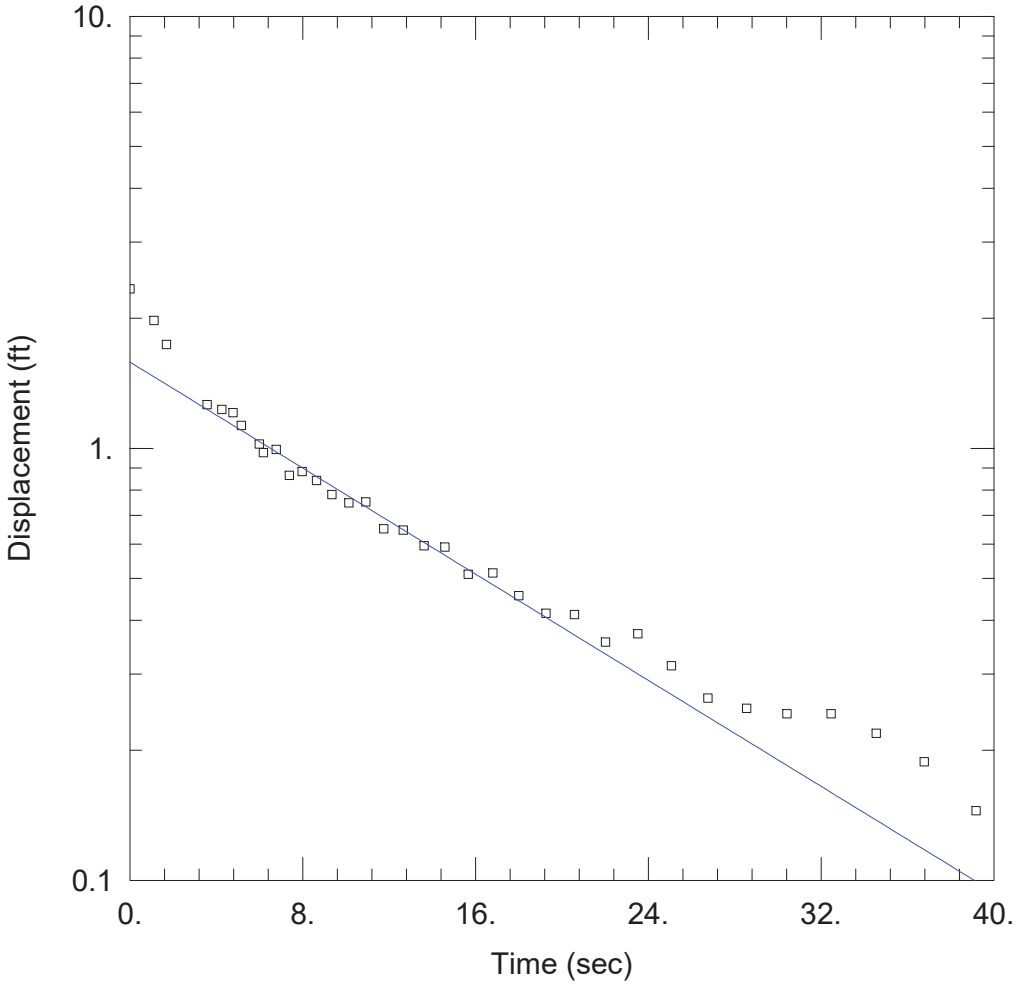
WELL DATA (JR MW-16001)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 66.3 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 3.666 ft/day y0 = 1.583 ft



JR MW-16001 SLUG IN 2

Data Set: S:\...\MW-16001 Slug in 1.aqt
Date: 11/08/16 Time: 08:44:25

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16001
Test Date: 11/1/16

AQUIFER DATA

Saturated Thickness: 13. ft Anisotropy Ratio (Kz/Kr): 1.

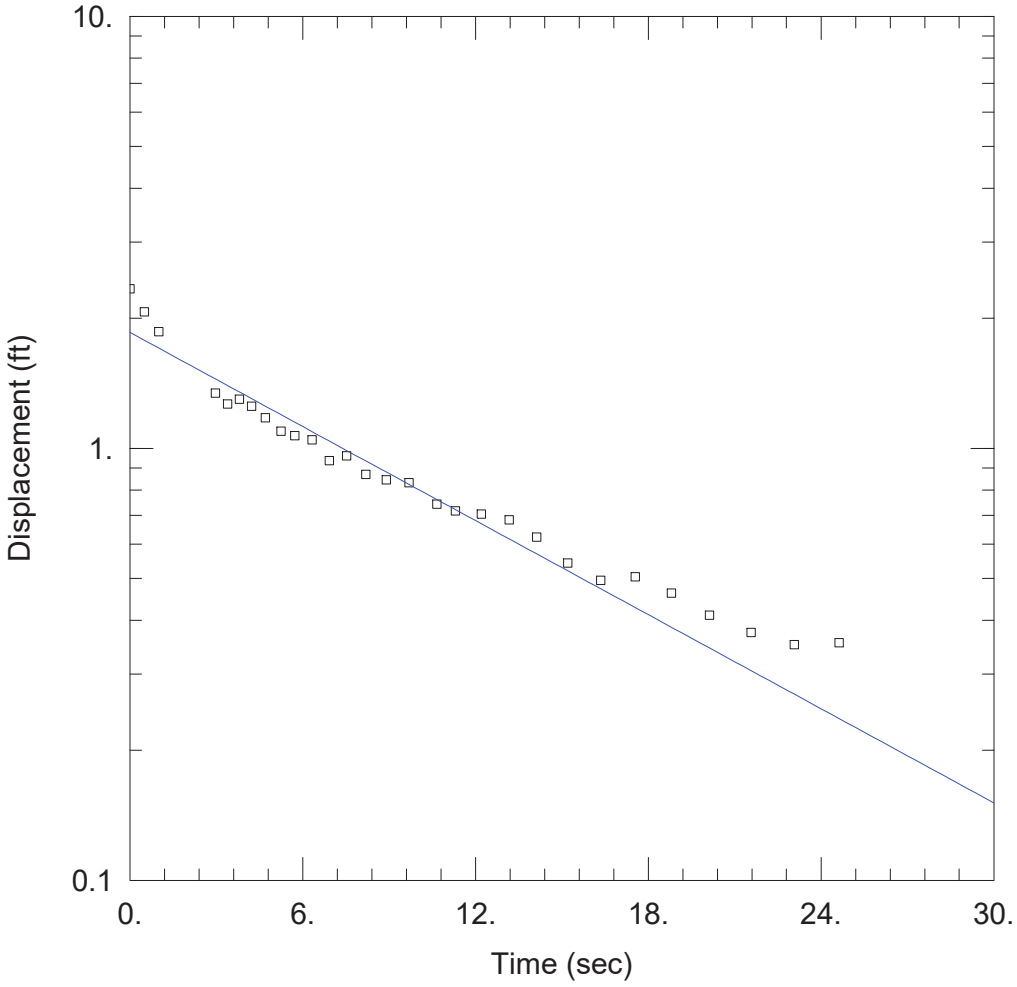
WELL DATA (JR MW-16001)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 66.3 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 5.652 ft/day y0 = 1.583 ft



JR MW-16001 SLUG IN 3

Data Set: S:\...\MW-16001 Slug in 1.aqt
Date: 11/08/16 Time: 08:50:31

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16001
Test Date: 11/1/16

AQUIFER DATA

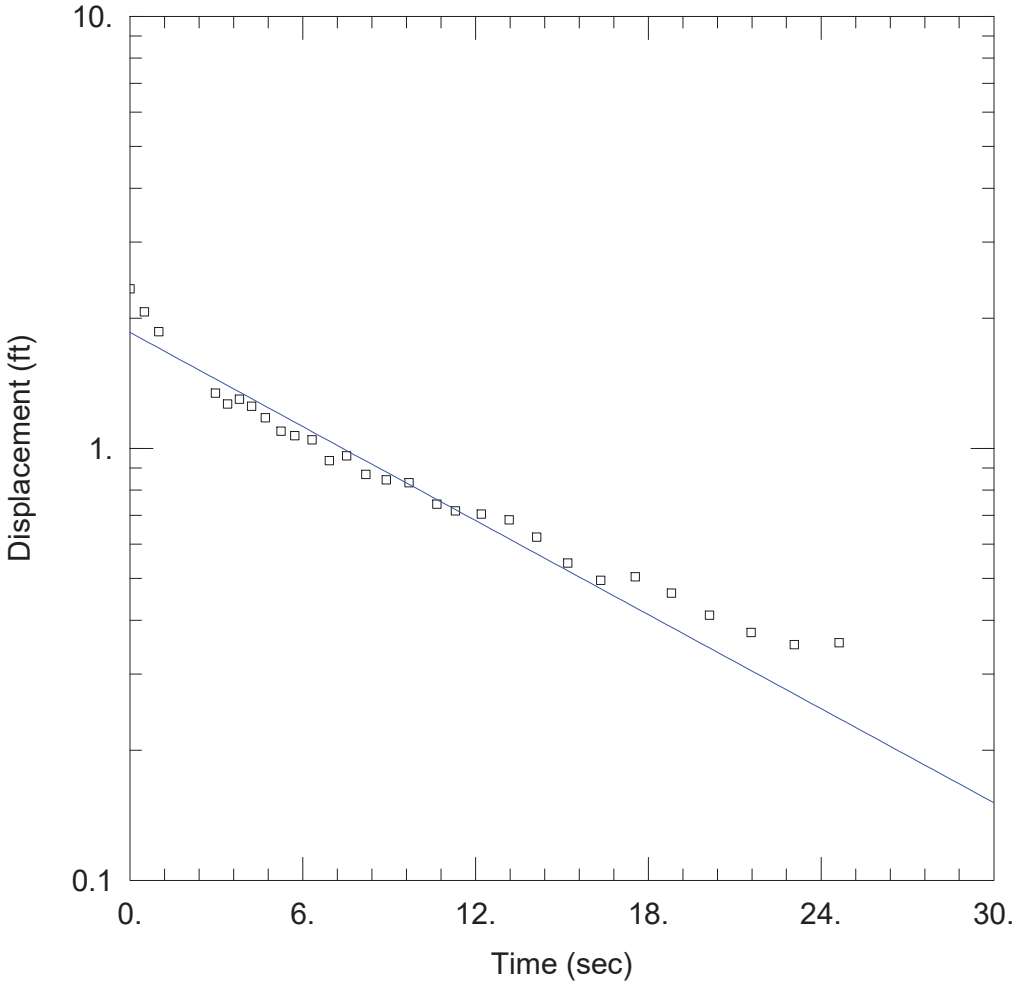
Saturated Thickness: 13. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16001)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 66.3 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 4.545 ft/day
y0 = 1.855 ft



JR MW-16001 SLUG IN 3

Data Set: S:\...\MW-16001 Slug in 1.aqt
Date: 11/08/16 Time: 08:49:31

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16001
Test Date: 11/1/16

AQUIFER DATA

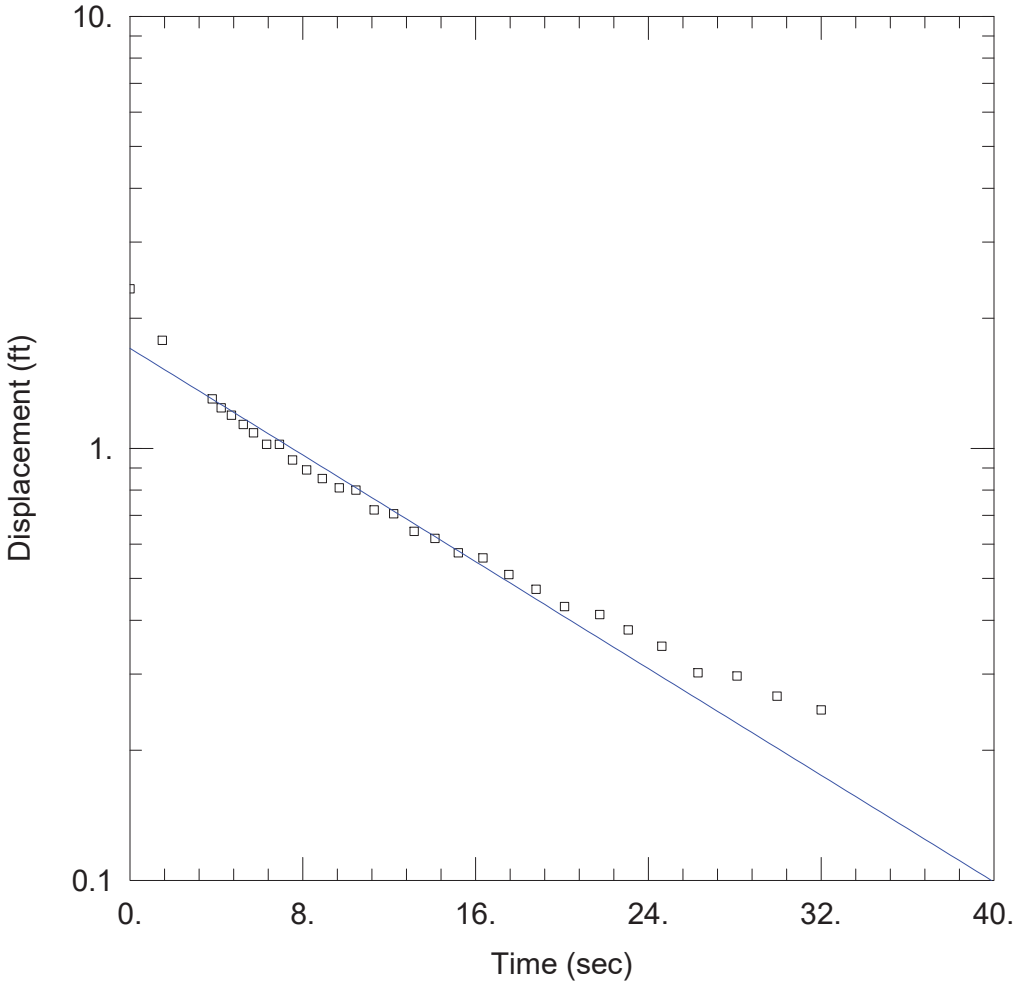
Saturated Thickness: 13. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16001)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 66.3 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 6.686 ft/day
y0 = 1.854 ft



JR MW-16001 SLUG IN 4

Data Set: S:\...\MW-16001 Slug in 1.aqt
Date: 11/08/16 Time: 08:53:50

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16001
Test Date: 11/1/16

AQUIFER DATA

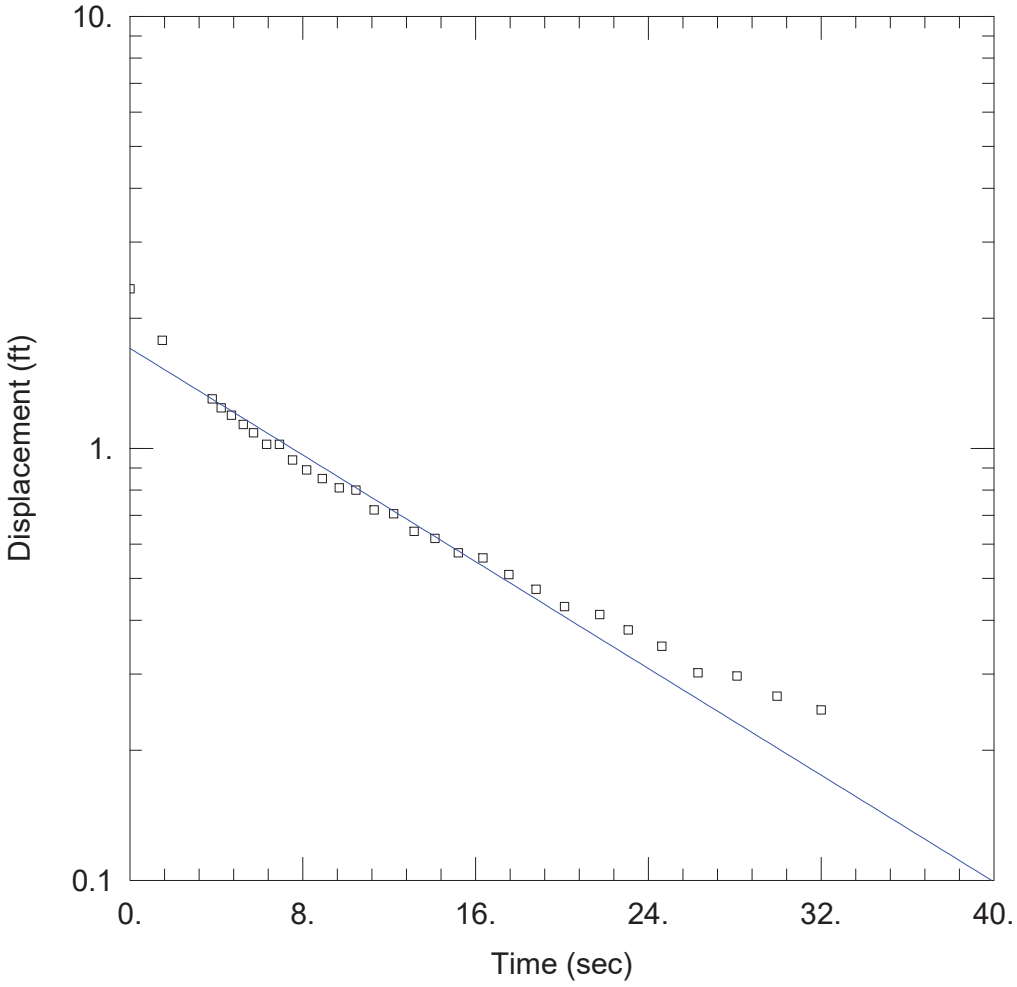
Saturated Thickness: 13. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16001)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 66.3 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 3.865 ft/day
y0 = 1.704 ft



JR MW-16001 SLUG IN 4

Data Set: S:\...\MW-16001 Slug in 1.aqt
Date: 11/08/16 Time: 08:54:39

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16001
Test Date: 11/1/16

AQUIFER DATA

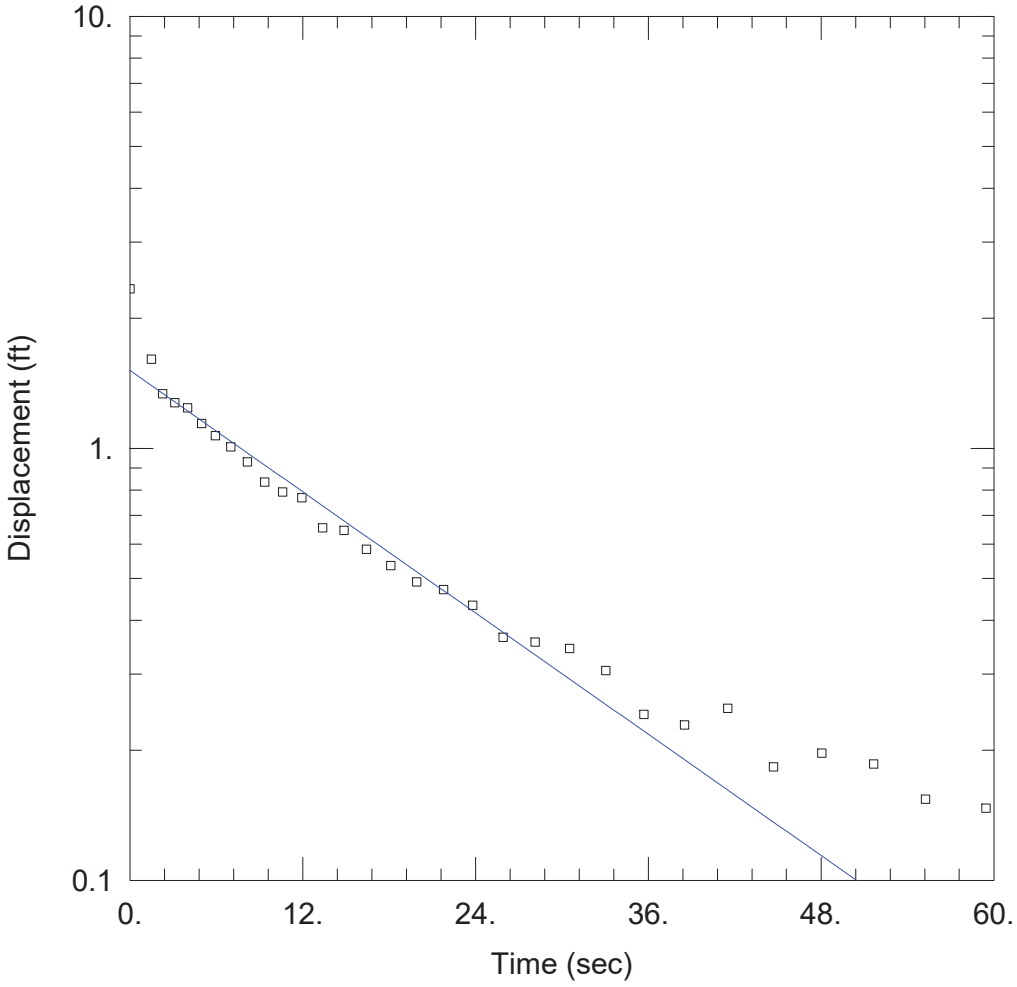
Saturated Thickness: 13. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16001)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 66.3 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 5.686 ft/day
y0 = 1.704 ft



JR MW-16002 SLUG IN 1

Data Set: S:\...\MW-16002.aqt
Date: 11/08/16 Time: 08:57:00

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16002
Test Date: 10/31/16

AQUIFER DATA

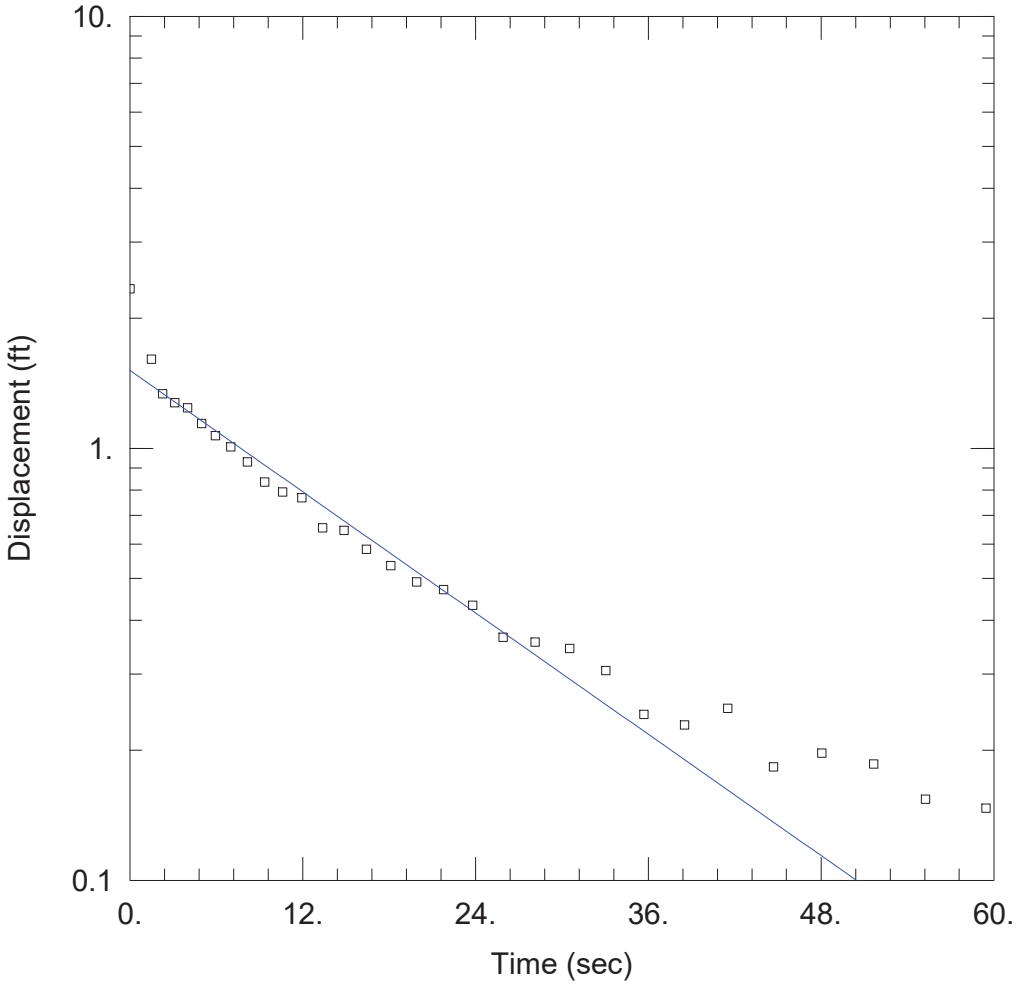
Saturated Thickness: 15. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16002)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 15. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 79.5 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 3.016 ft/day
y0 = 1.514 ft



JR MW-16002 SLUG IN 1

Data Set: S:\...\MW-16002.aqt
Date: 11/08/16 Time: 08:58:55

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16002
Test Date: 10/31/16

AQUIFER DATA

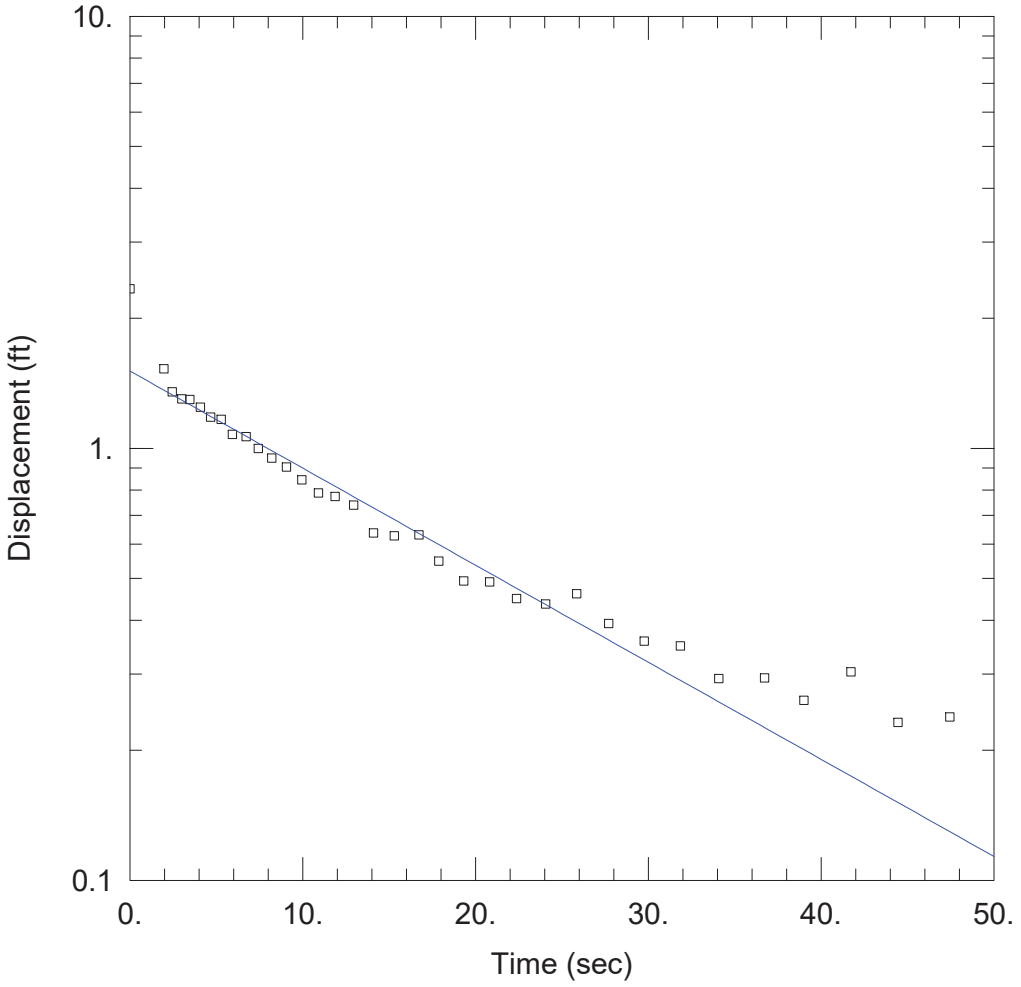
Saturated Thickness: 15. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16002)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 15. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 79.5 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 4.31 ft/day
y0 = 1.514 ft



JR MW-16002 SLUG IN 2

Data Set: S:\...\MW-16002.aqt
Date: 11/08/16 Time: 09:04:11

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16002
Test Date: 10/31/16

AQUIFER DATA

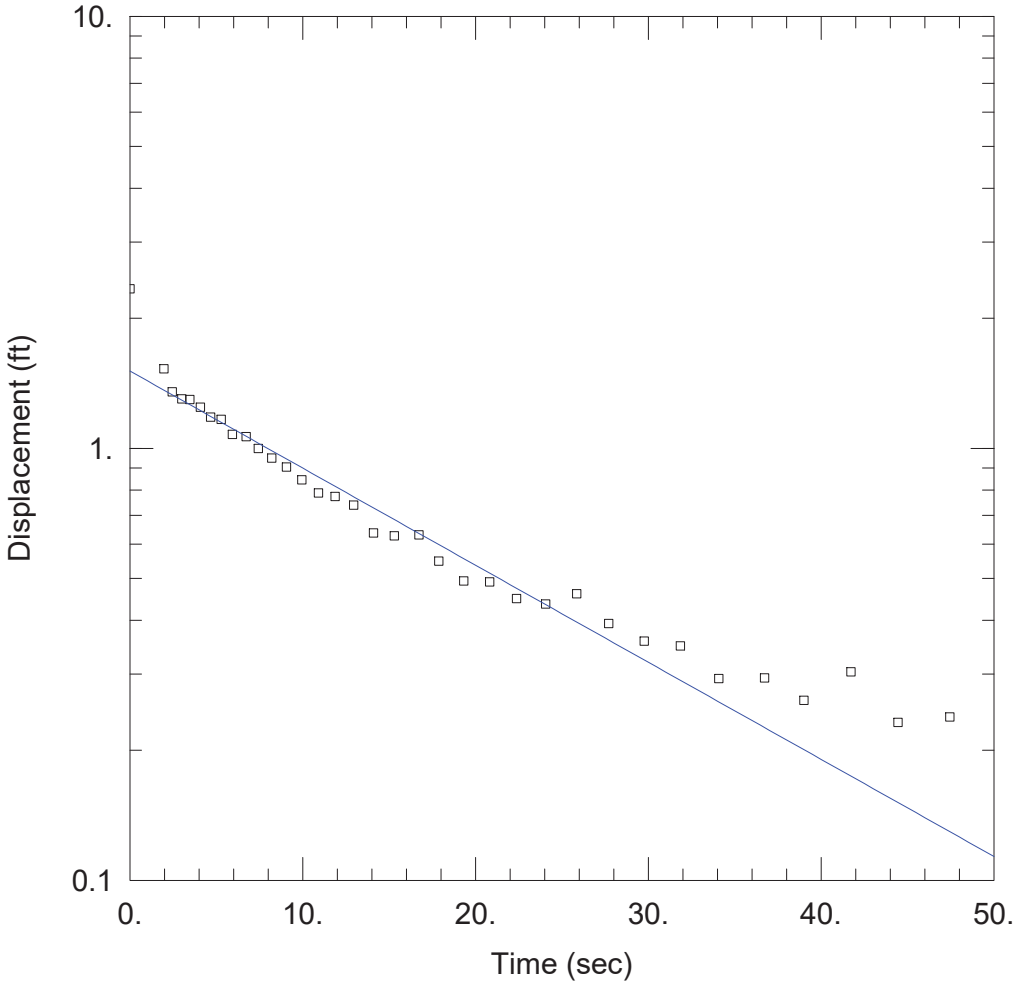
Saturated Thickness: 15. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16002)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 15. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 79.5 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
K = 2.897 ft/day
Solution Method: Bouwer-Rice
y0 = 1.509 ft



JR MW-16002 SLUG IN 2

Data Set: S:\...\MW-16002.aqt
Date: 11/08/16 Time: 09:00:47

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16002
Test Date: 10/31/16

AQUIFER DATA

Saturated Thickness: 15. ft Anisotropy Ratio (Kz/Kr): 1.

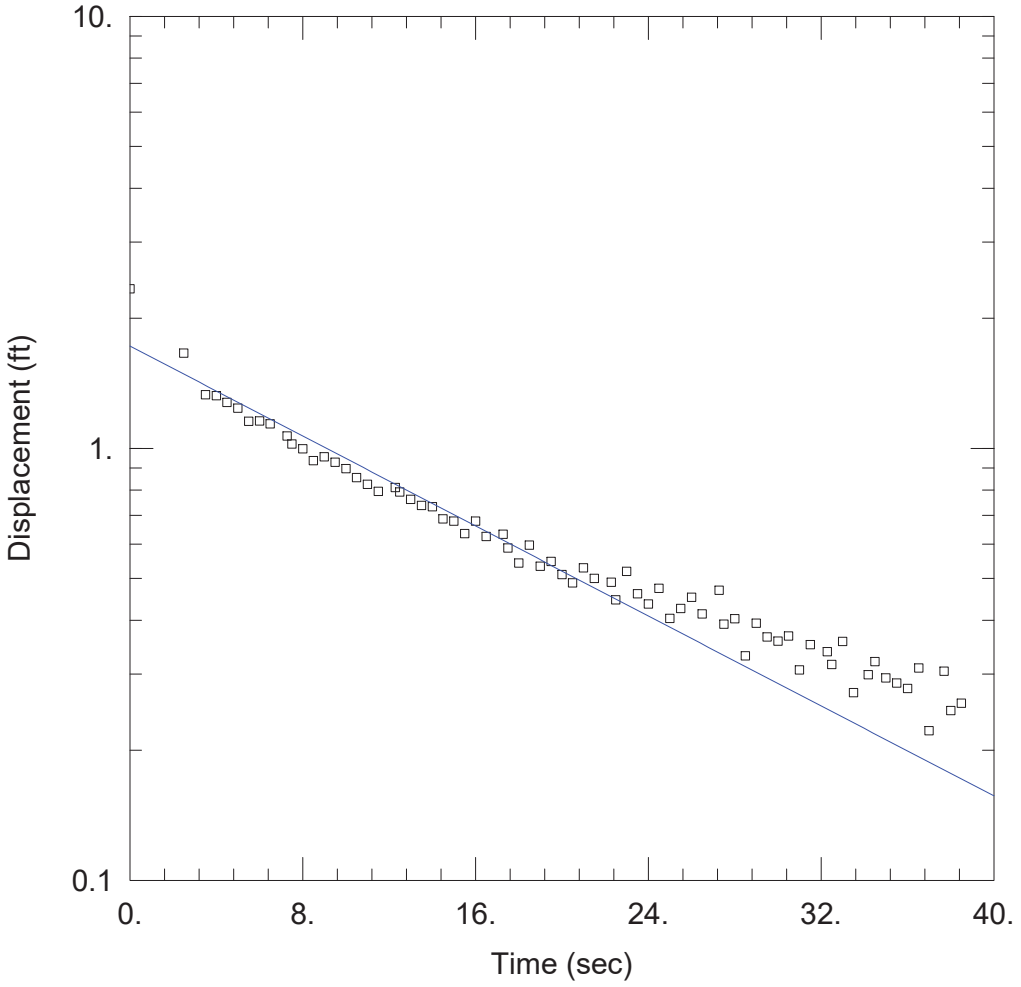
WELL DATA (JR MW-16002)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 15. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 79.5 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 4.14 ft/day y0 = 1.509 ft



JR MW-16002 SLUG IN 3

Data Set: S:\...\MW-16002.aqt
Date: 11/08/16 Time: 09:06:33

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16002
Test Date: 10/31/16

AQUIFER DATA

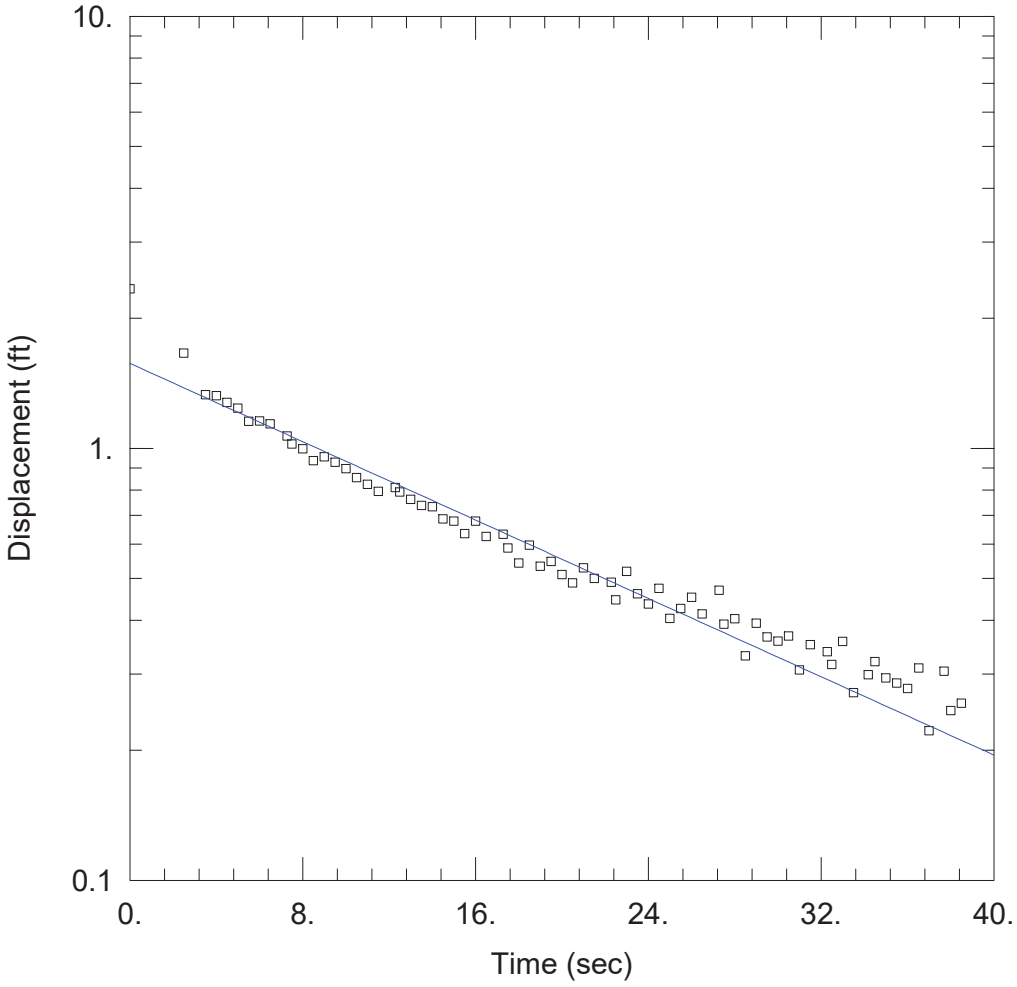
Saturated Thickness: 15. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16002)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 15. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 79.5 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 3.355 ft/day
y0 = 1.724 ft



JR MW-16002 SLUG IN 3

Data Set: S:\...\MW-16002.aqt
Date: 11/08/16 Time: 09:08:20

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16002
Test Date: 10/31/16

AQUIFER DATA

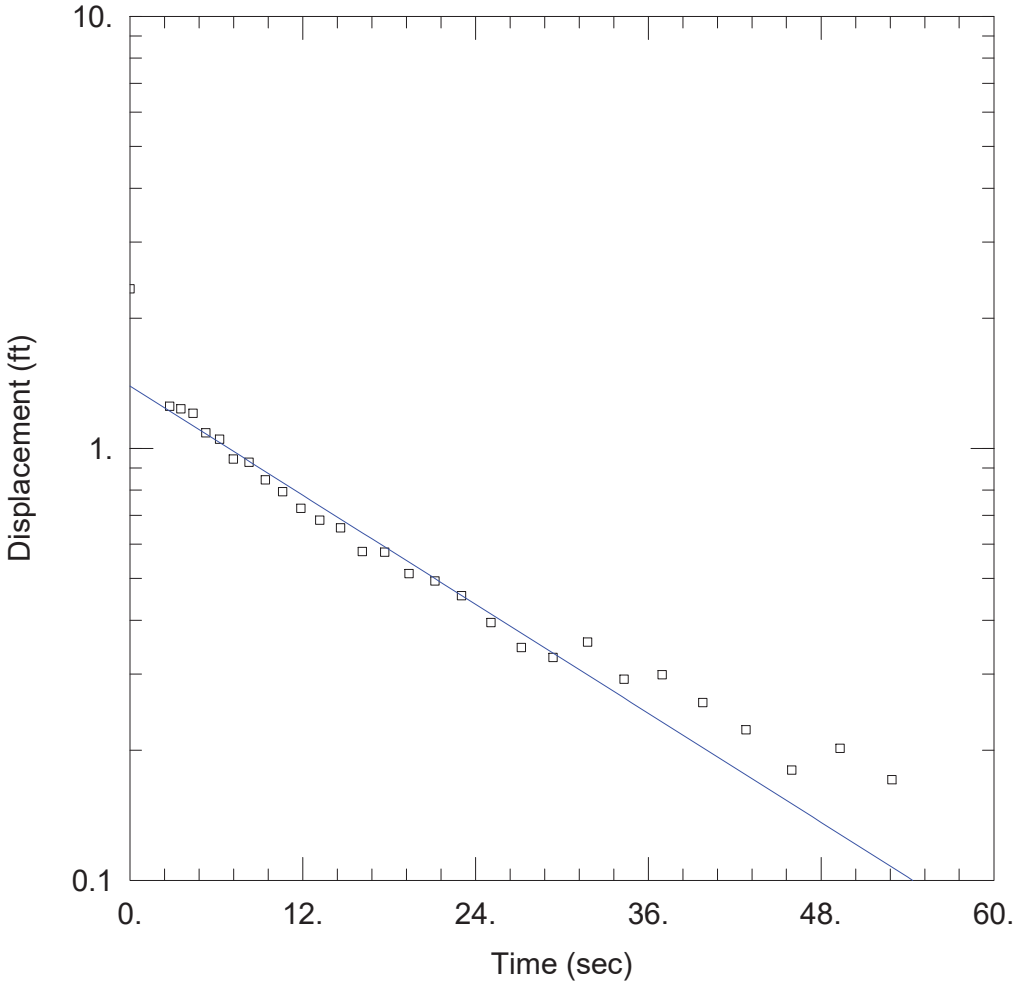
Saturated Thickness: 15. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16002)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 15. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 79.5 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 4.174 ft/day
y0 = 1.572 ft



JR MW-16002 SLUG IN 4

Data Set: S:\...\MW-16002.aqt
Date: 11/08/16 Time: 09:12:31

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16002
Test Date: 10/31/16

AQUIFER DATA

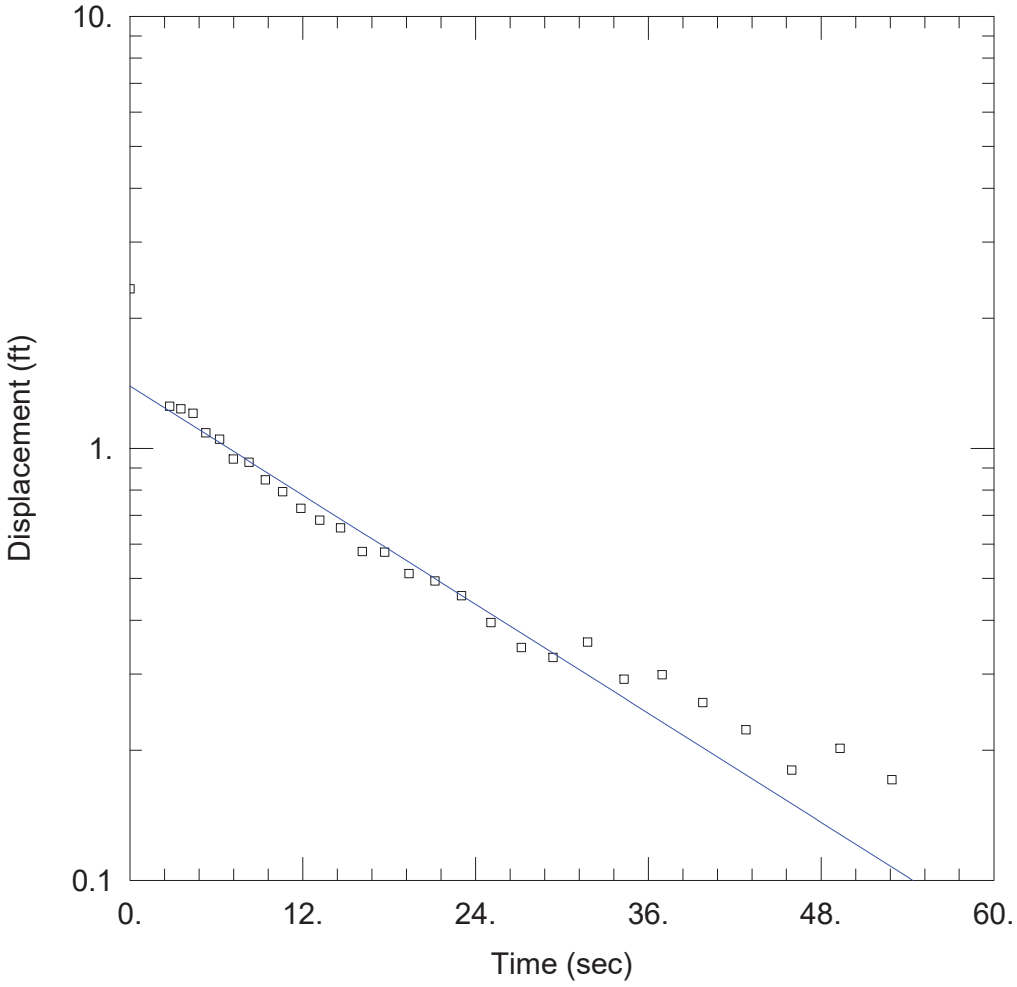
Saturated Thickness: 15. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16002)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 15. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 79.5 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 2.713 ft/day
y0 = 1.394 ft



JR MW-16002 SLUG IN 4

Data Set: S:\...\MW-16002.aqt
Date: 11/08/16 Time: 09:11:17

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16002
Test Date: 10/31/16

AQUIFER DATA

Saturated Thickness: 15. ft Anisotropy Ratio (Kz/Kr): 1.

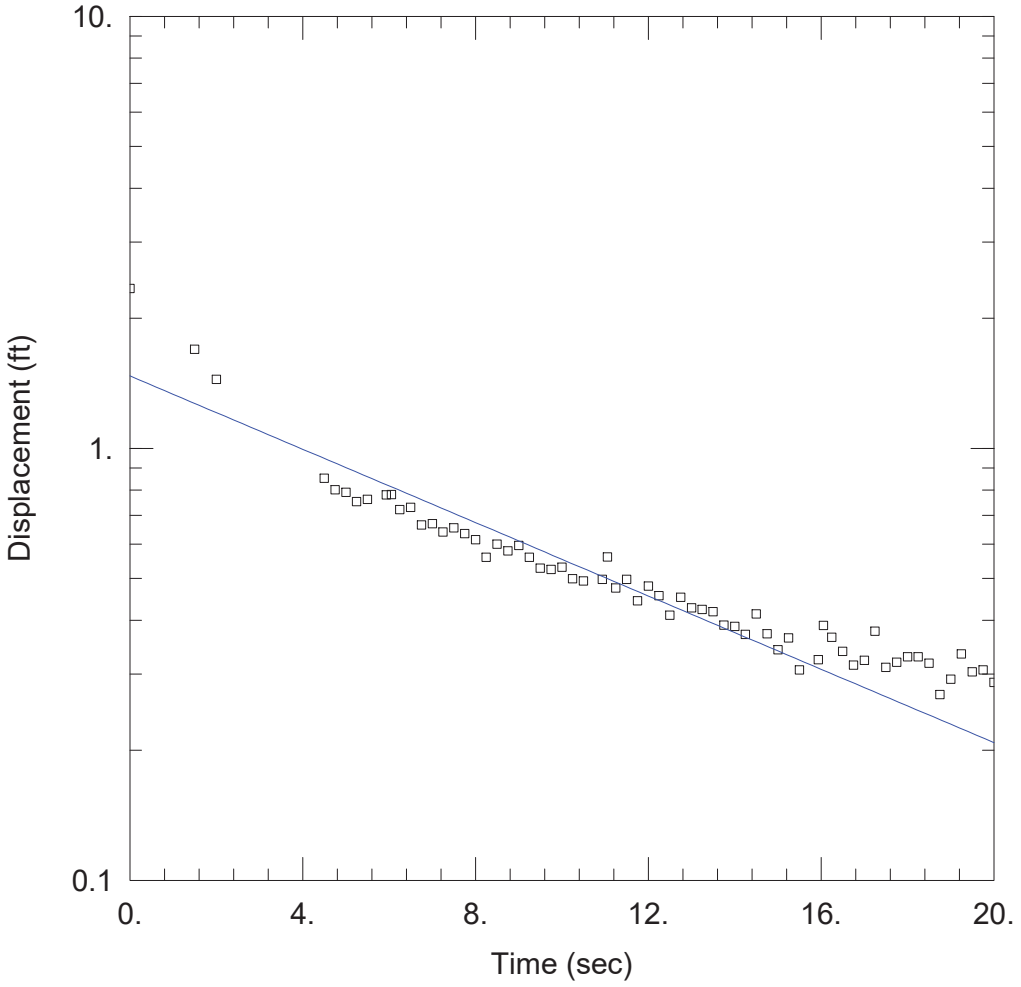
WELL DATA (JR MW-16002)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 15. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 79.5 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 3.877 ft/day
y0 = 1.394 ft



JR MW-16003 SLUG IN 1

Data Set: S:\...\MW-16003.aqt
Date: 11/08/16 Time: 09:18:52

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16003
Test Date: 11/1/16

AQUIFER DATA

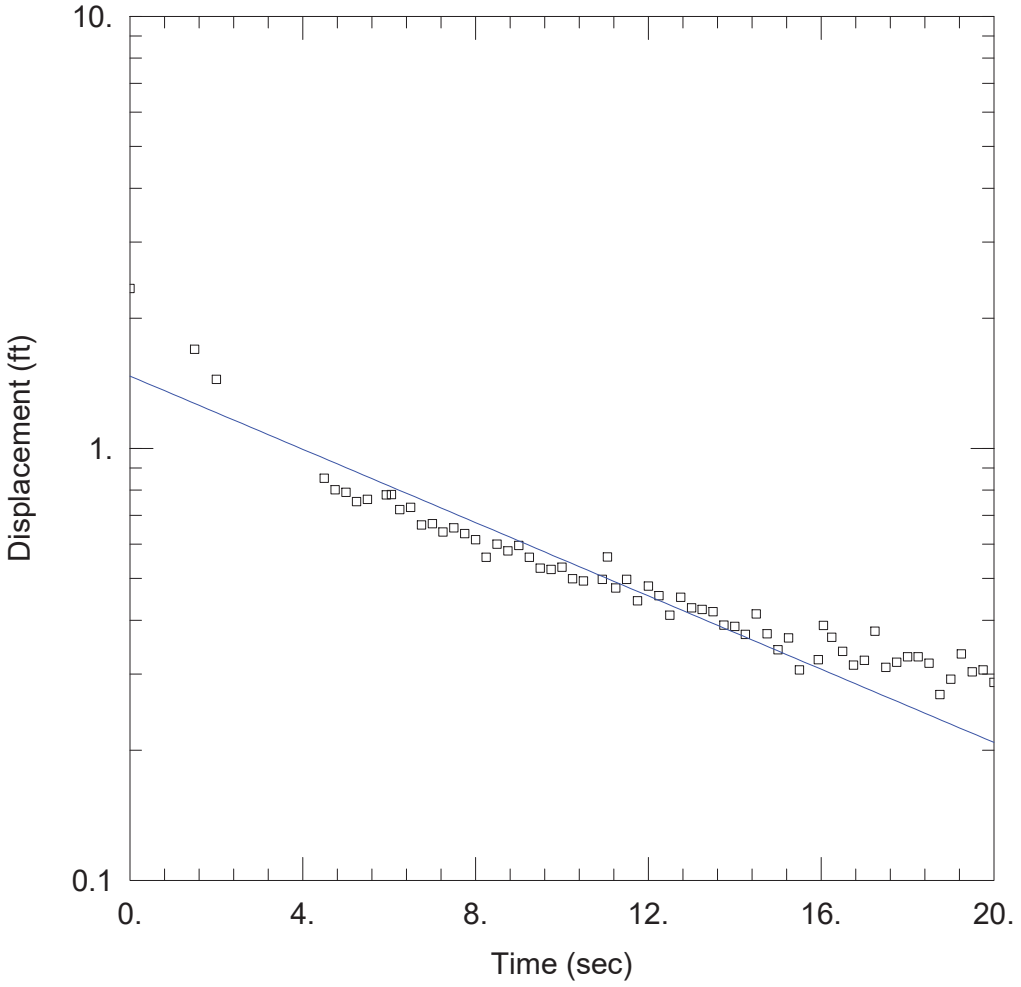
Saturated Thickness: 13. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16003)

Initial Displacement: 2.345 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 71.1 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 5.31 ft/day
y0 = 1.47 ft



JR MW-16003 SLUG IN 1

Data Set: S:\...\MW-16003.aqt
Date: 11/08/16 Time: 09:18:07

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16003
Test Date: 11/1/16

AQUIFER DATA

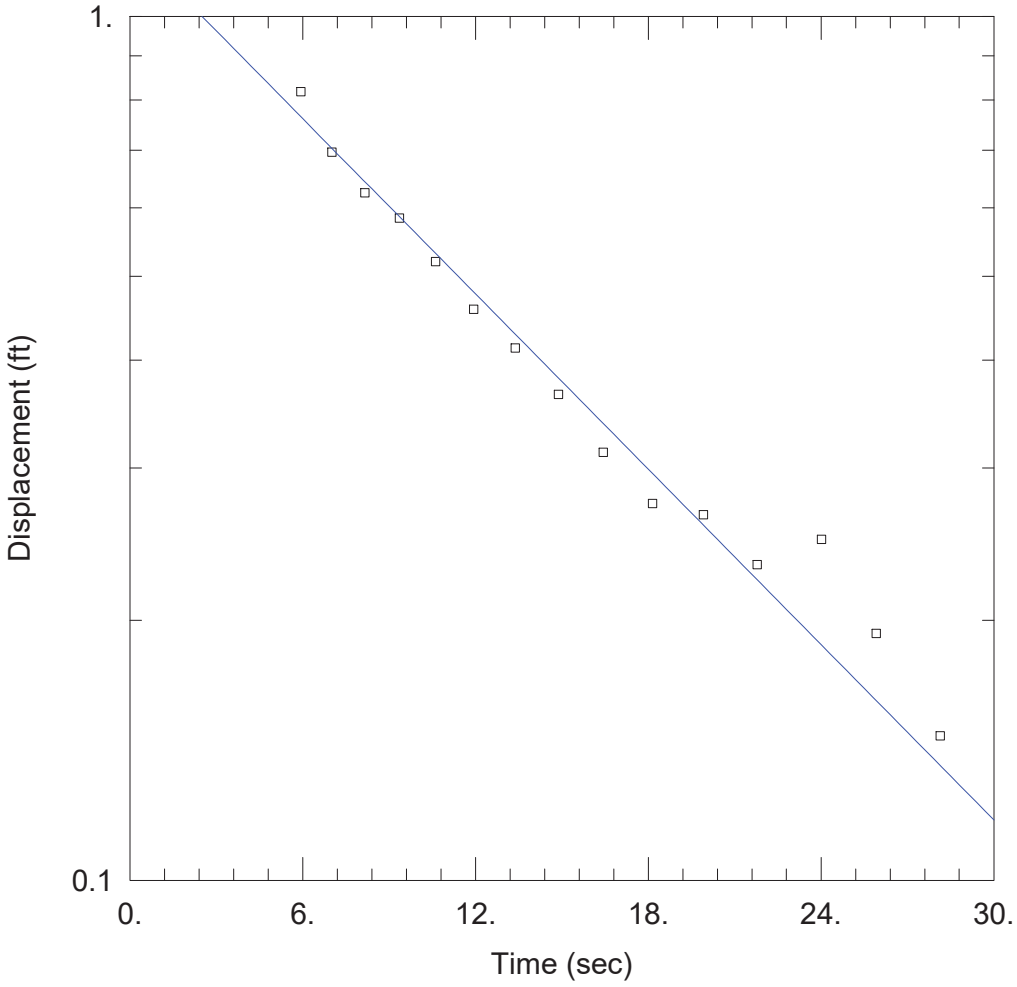
Saturated Thickness: 13. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16003)

Initial Displacement: 2.345 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 71.1 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 7.811 ft/day
y0 = 1.47 ft



JR MW-16003 SLUG IN 2

Data Set: S:\...\MW-16003.aqt
Date: 11/08/16 Time: 09:22:16

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16003
Test Date: 11/1/16

AQUIFER DATA

Saturated Thickness: 13. ft Anisotropy Ratio (Kz/Kr): 1.

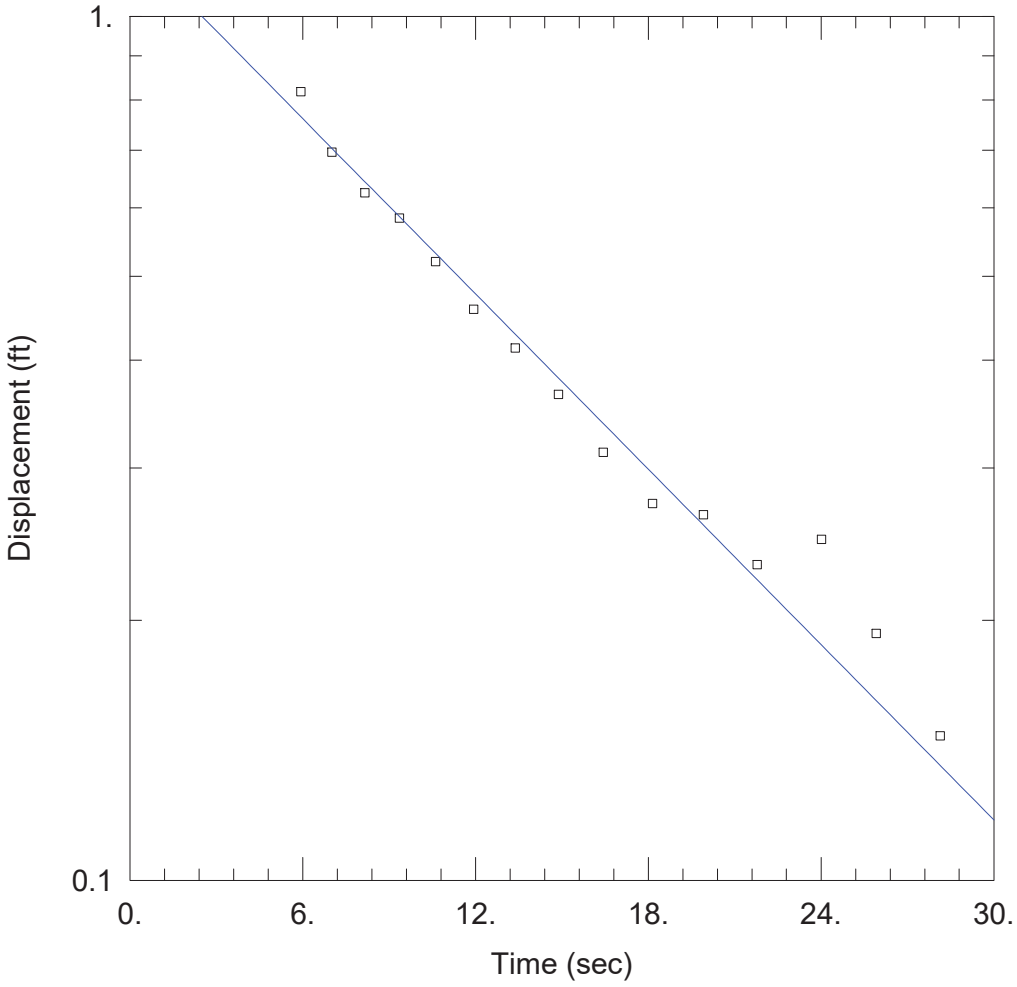
WELL DATA (JR MW-16003)

Initial Displacement: 2.345 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 71.1 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 4.235 ft/day
y0 = 1.215 ft



JR MW-16003 SLUG IN 2

Data Set: S:\...\MW-16003.aqt
Date: 11/08/16 Time: 09:23:11

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16003
Test Date: 11/1/16

AQUIFER DATA

Saturated Thickness: 13. ft Anisotropy Ratio (Kz/Kr): 1.

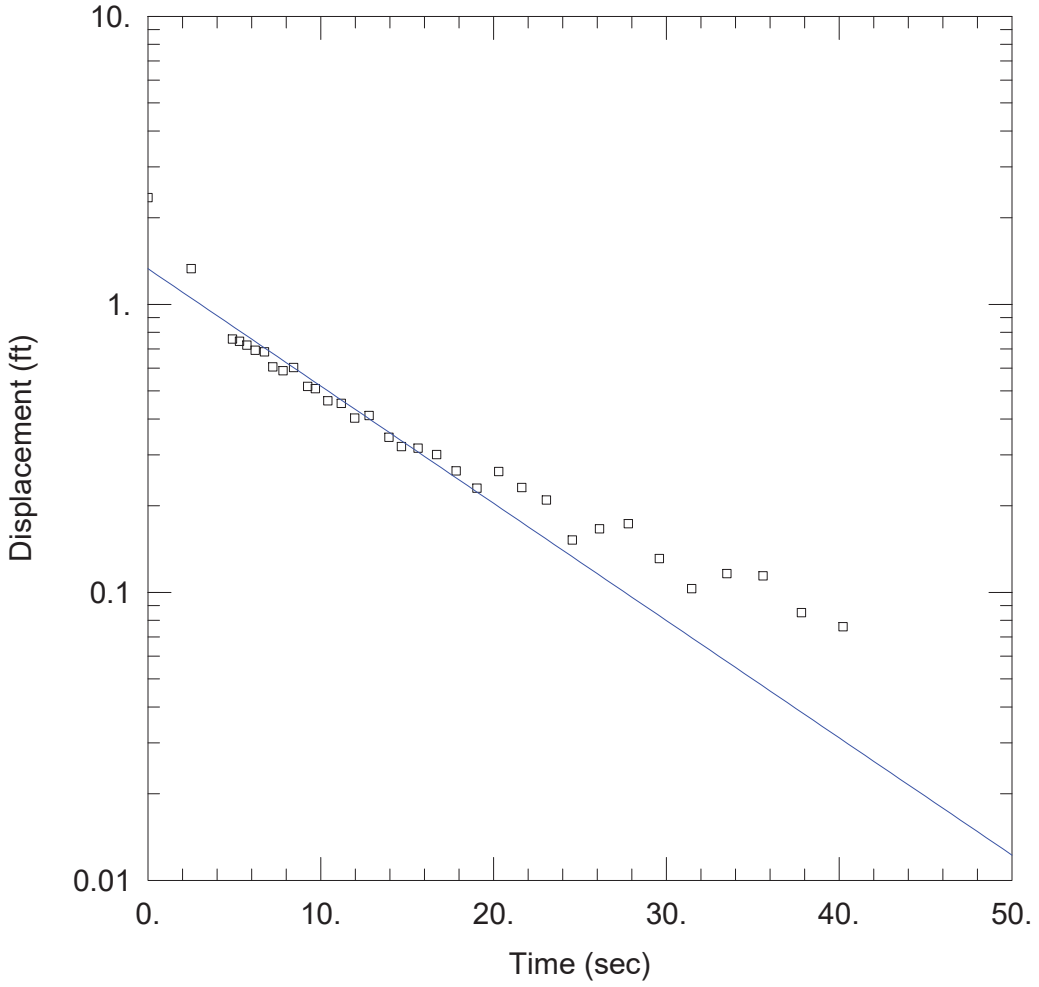
WELL DATA (JR MW-16003)

Initial Displacement: 2.345 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 71.1 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 6.232 ft/day y0 = 1.215 ft



JR MW-16003 SLUG IN 3

Data Set: S:\...\MW-16003.aqt
Date: 11/08/16 Time: 09:26:04

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16003
Test Date: 11/1/16

AQUIFER DATA

Saturated Thickness: 13. ft Anisotropy Ratio (Kz/Kr): 1.

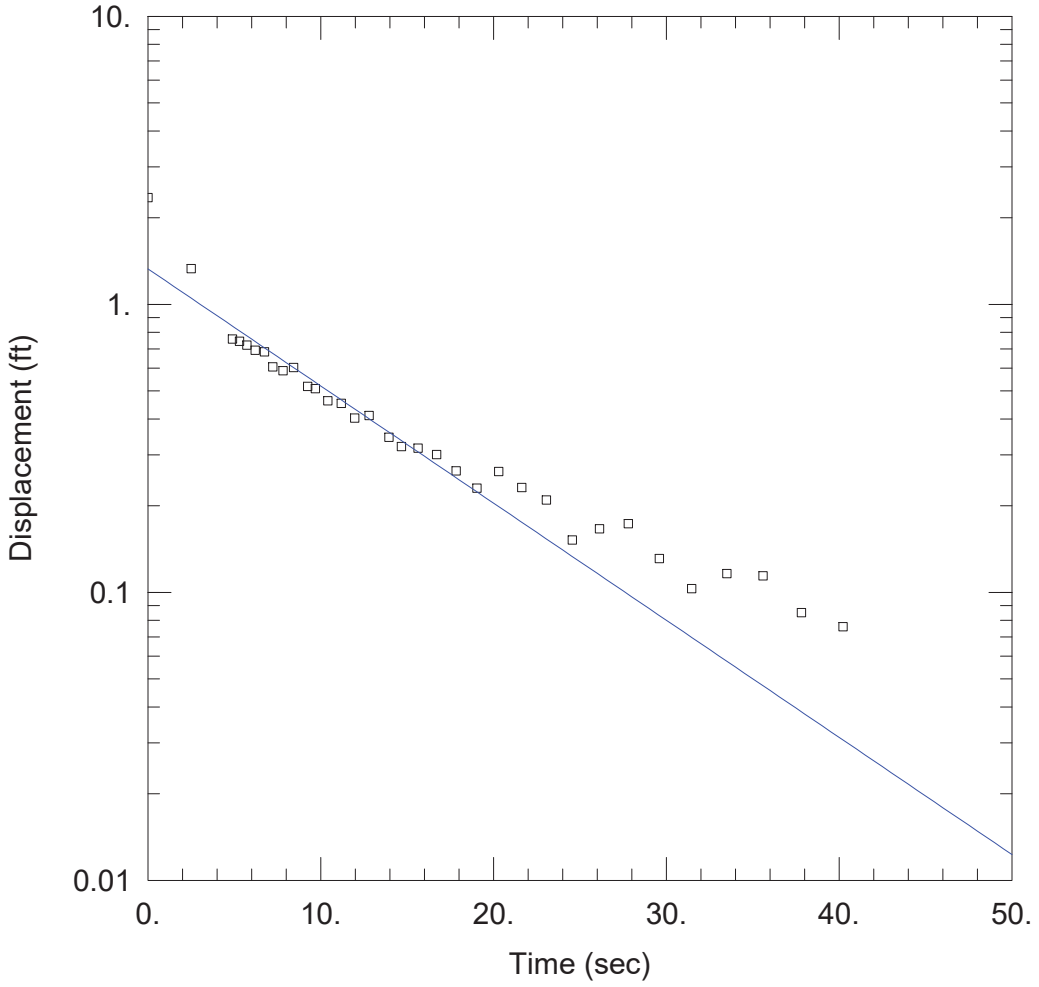
WELL DATA (JR MW-16003)

Initial Displacement: 2.345 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 71.1 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 5.097 ft/day
y0 = 1.329 ft



JR MW-16003 SLUG IN 3

Data Set: S:\...\MW-16003.aqt
Date: 11/08/16 Time: 09:25:24

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16003
Test Date: 11/1/16

AQUIFER DATA

Saturated Thickness: 13. ft Anisotropy Ratio (Kz/Kr): 1.

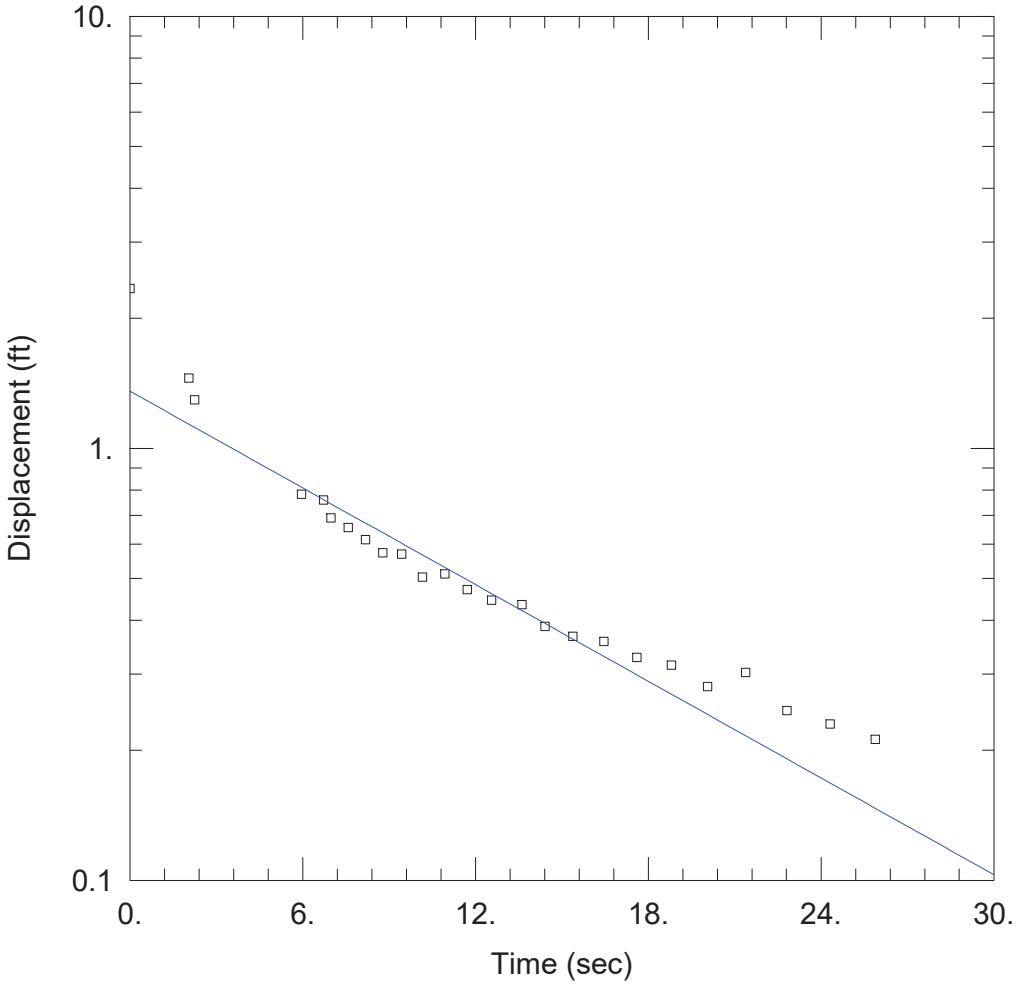
WELL DATA (JR MW-16003)

Initial Displacement: 2.345 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 71.1 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 7.493 ft/day y0 = 1.328 ft



JR MW-16003 SLUG IN 4

Data Set: S:\...\MW-16003.aqt
Date: 11/08/16 Time: 09:28:45

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16003
Test Date: 11/1/16

AQUIFER DATA

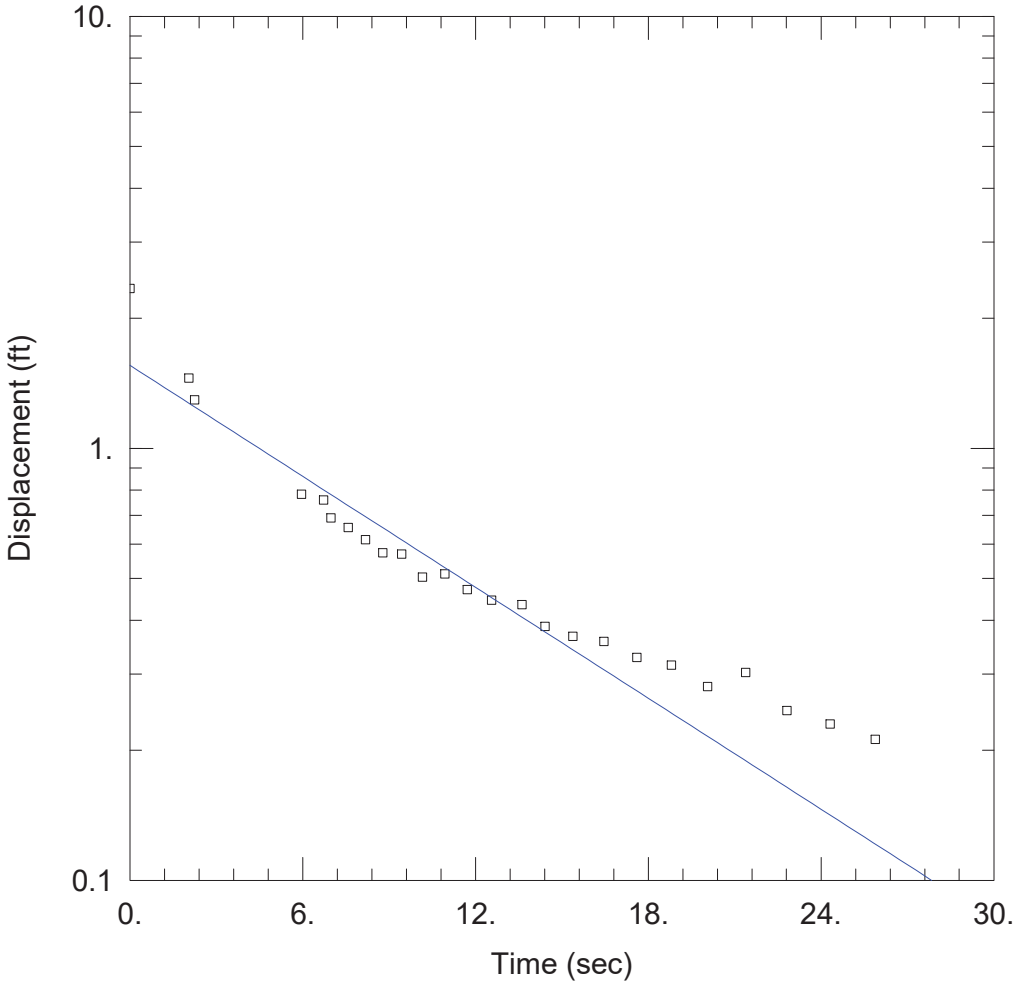
Saturated Thickness: 13. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16003)

Initial Displacement: 2.345 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 71.1 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 4.671 ft/day
y0 = 1.356 ft



JR MW-16003 SLUG IN 4

Data Set: S:\...\MW-16003.aqt
Date: 11/08/16 Time: 09:29:28

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16003
Test Date: 11/1/16

AQUIFER DATA

Saturated Thickness: 13. ft Anisotropy Ratio (Kz/Kr): 1.

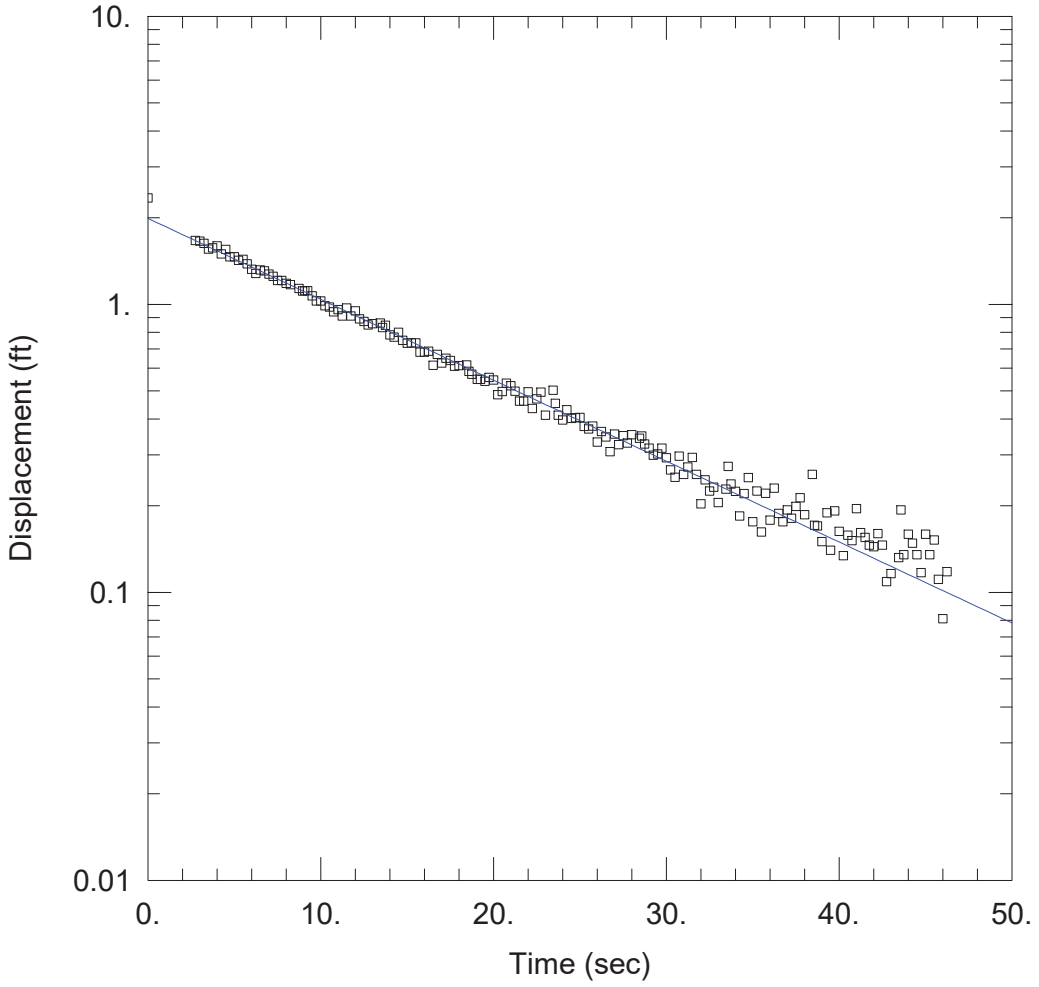
WELL DATA (JR MW-16003)

Initial Displacement: 2.345 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 71.1 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 7.888 ft/day y0 = 1.556 ft



JR MW-16004 SLUG IN 1

Data Set: S:\...\MW-16004.aqt
Date: 11/07/16 Time: 15:52:17

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16004
Test Date: 11/1/16

AQUIFER DATA

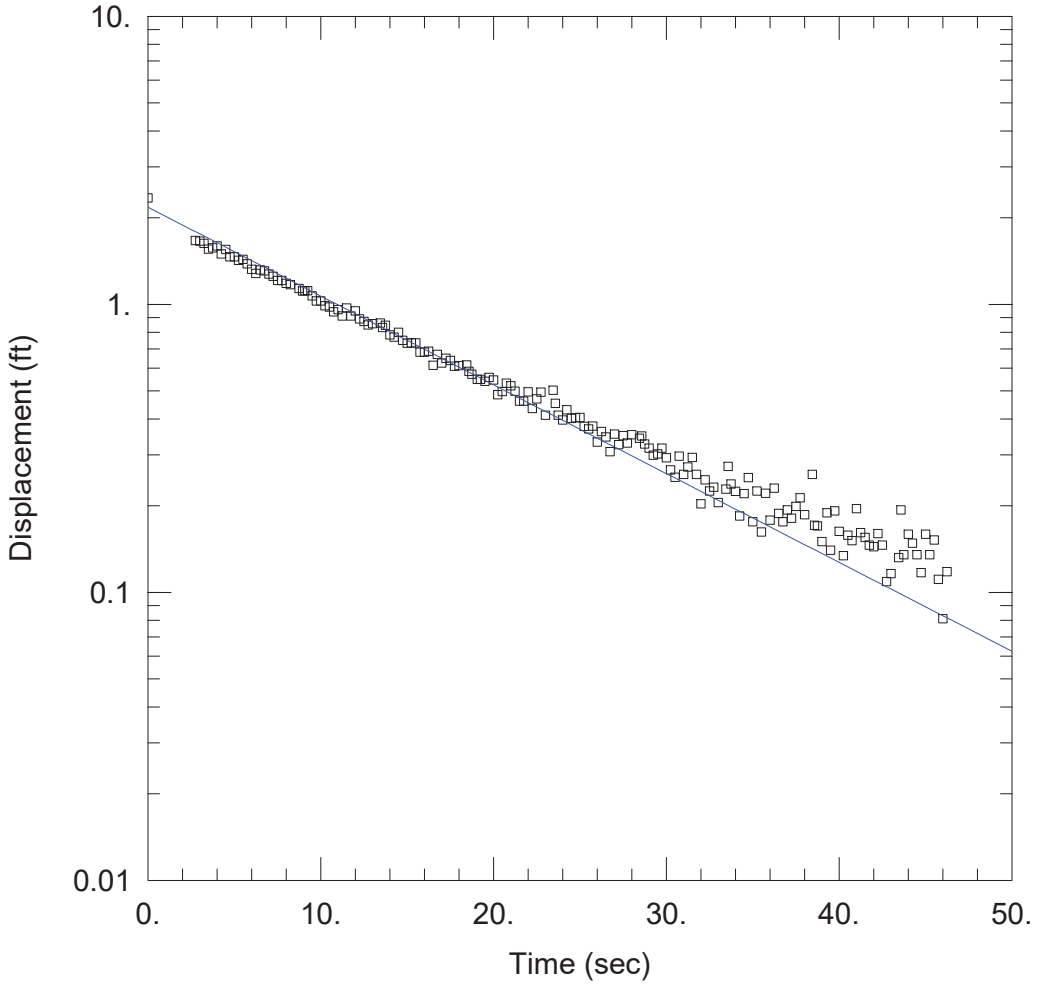
Saturated Thickness: 16. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16004)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 16. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 73. ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 3.669 ft/day
y0 = 1.987 ft



JR MW-16004 SLUG IN 1

Data Set: S:\...\MW-16004.aqt
Date: 11/07/16 Time: 15:51:30

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16004
Test Date: 11/1/16

AQUIFER DATA

Saturated Thickness: 16. ft Anisotropy Ratio (Kz/Kr): 1.

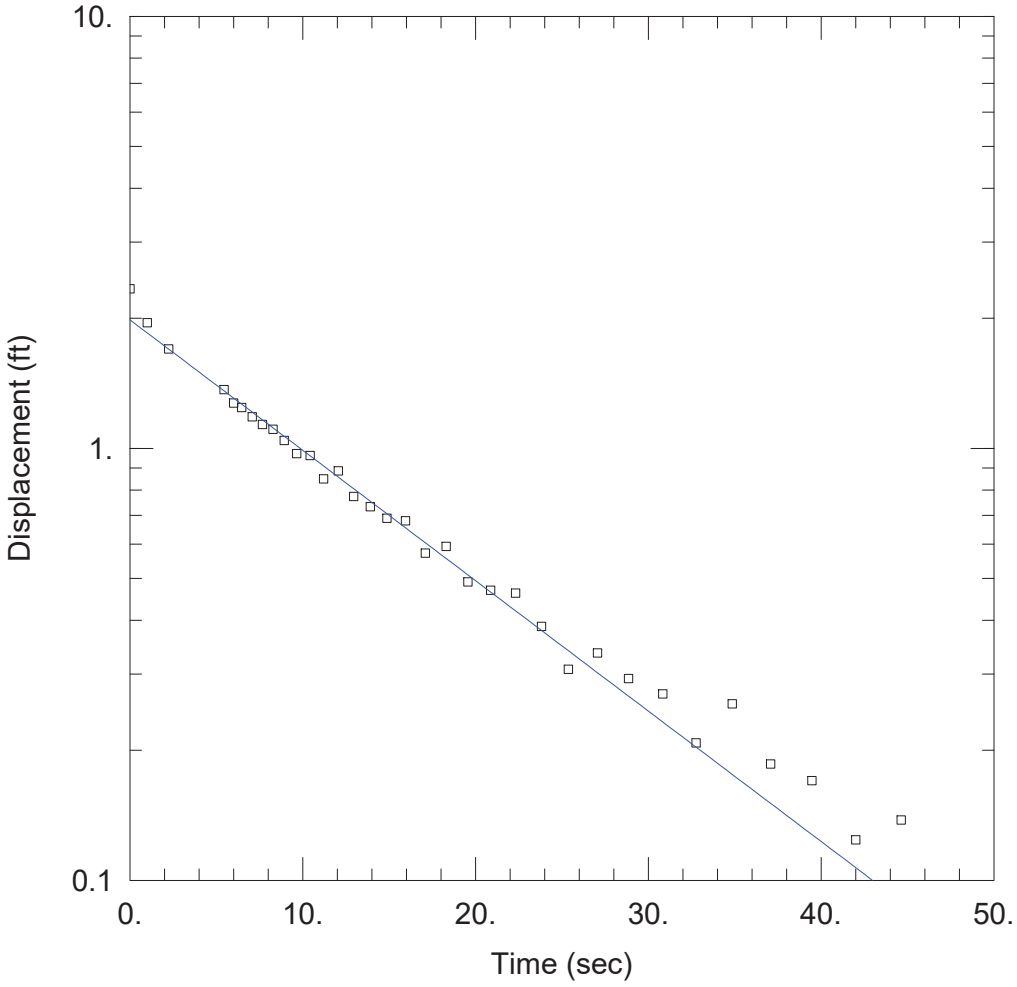
WELL DATA (JR MW-16004)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 16. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 73. ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 5.68 ft/day y0 = 2.173 ft



JR MW-16004 SLUG IN 2

Data Set: S:\...\MW-16004.aqt
Date: 11/07/16 Time: 15:55:38

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16004
Test Date: 11/1/16

AQUIFER DATA

Saturated Thickness: 16. ft Anisotropy Ratio (Kz/Kr): 1.

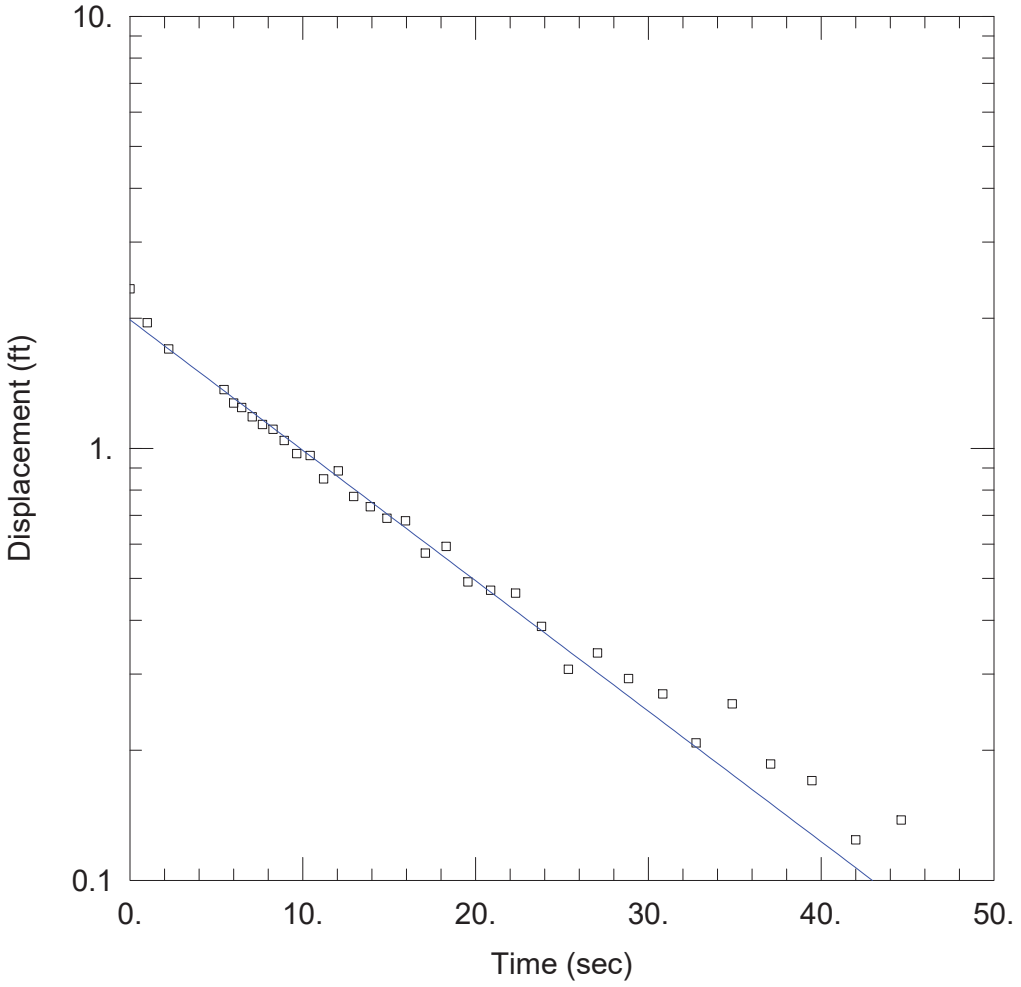
WELL DATA (JR MW-16004)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 16. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 73. ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 3.942 ft/day
y0 = 1.983 ft



JR MW-16004 SLUG IN 2

Data Set: S:\...\MW-16004.aqt
Date: 11/07/16 Time: 15:56:33

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16004
Test Date: 11/1/16

AQUIFER DATA

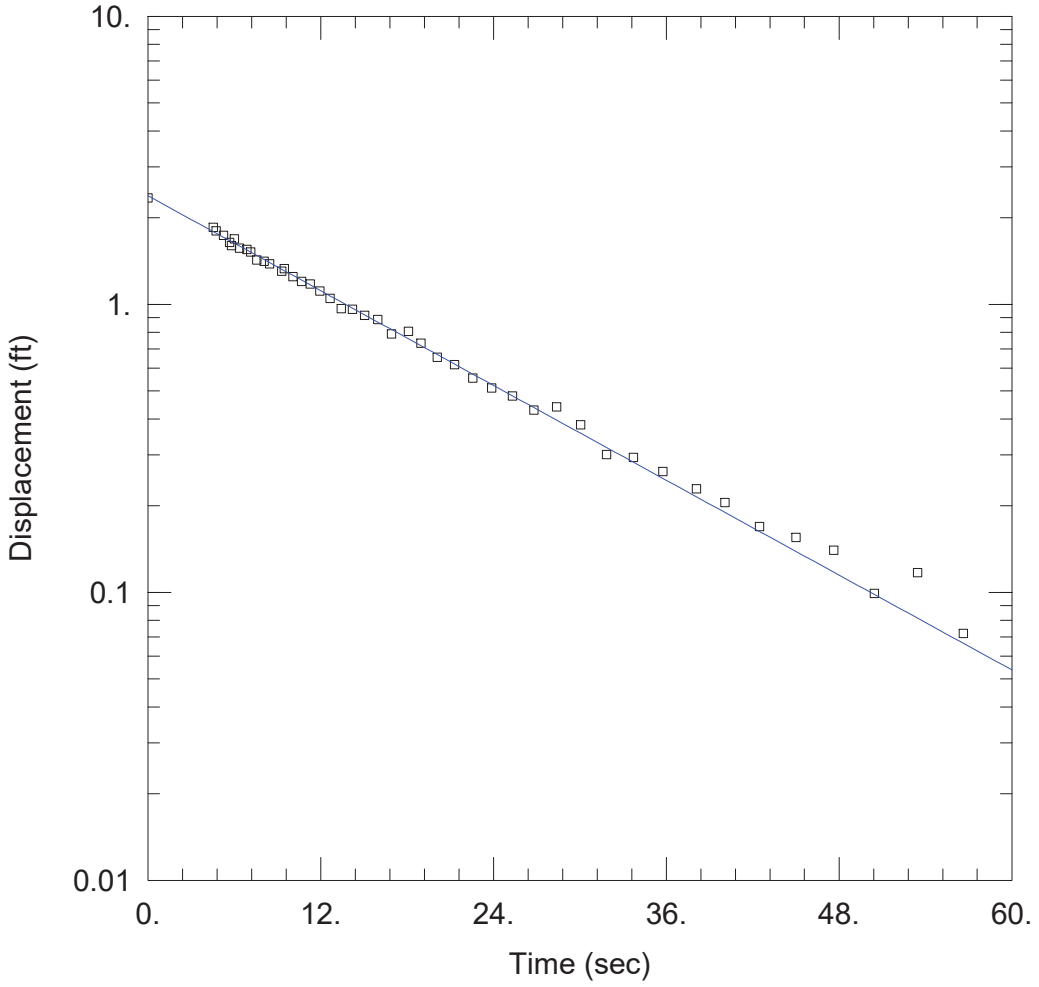
Saturated Thickness: 16. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16004)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 16. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 73. ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 5.563 ft/day
y0 = 1.983 ft



JR MW-16004 SLUG IN 3

Data Set: S:\...\MW-16004.aqt
Date: 11/07/16 Time: 16:00:29

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16004
Test Date: 11/1/16

AQUIFER DATA

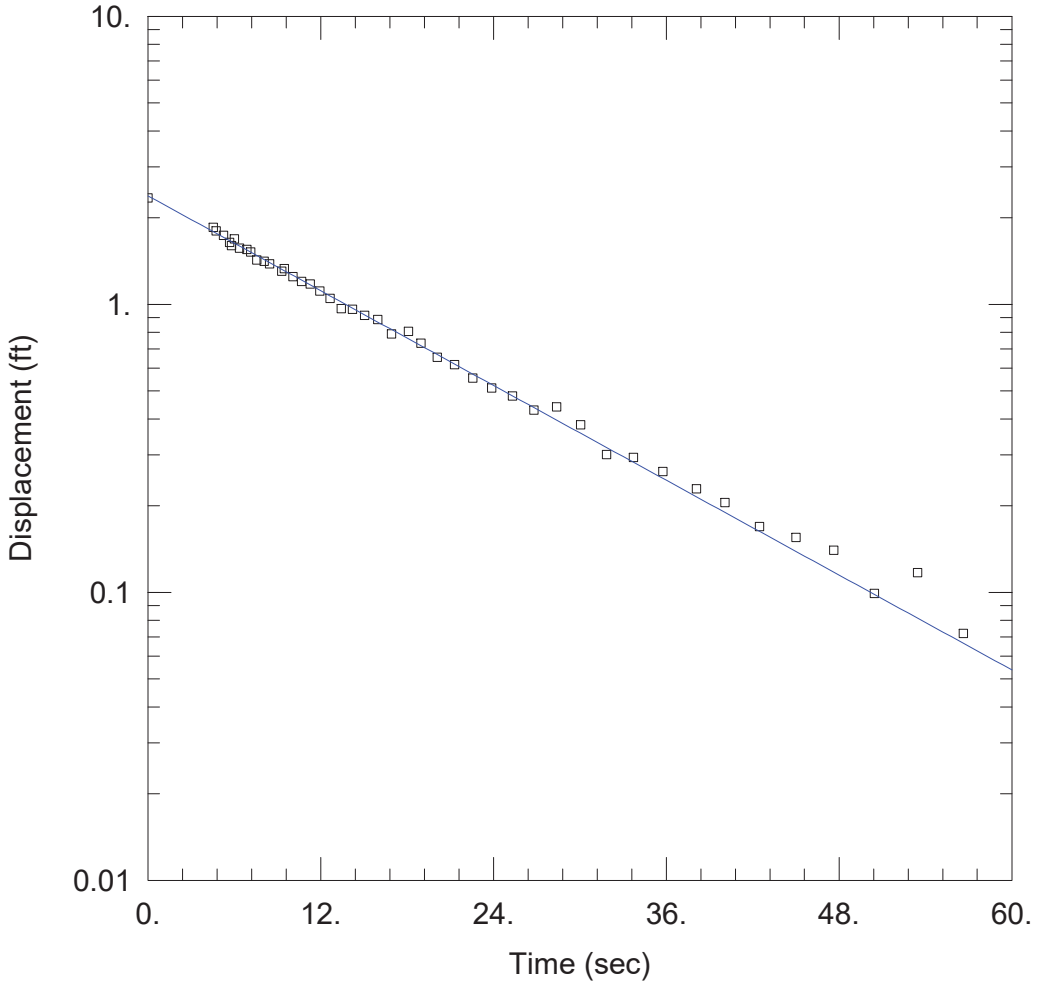
Saturated Thickness: 16. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16004)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 16. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 73. ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 3.583 ft/day
y0 = 2.381 ft



JR MW-16004 SLUG IN 3

Data Set: S:\...\MW-16004.aqt
Date: 11/07/16 Time: 15:59:39

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16004
Test Date: 11/1/16

AQUIFER DATA

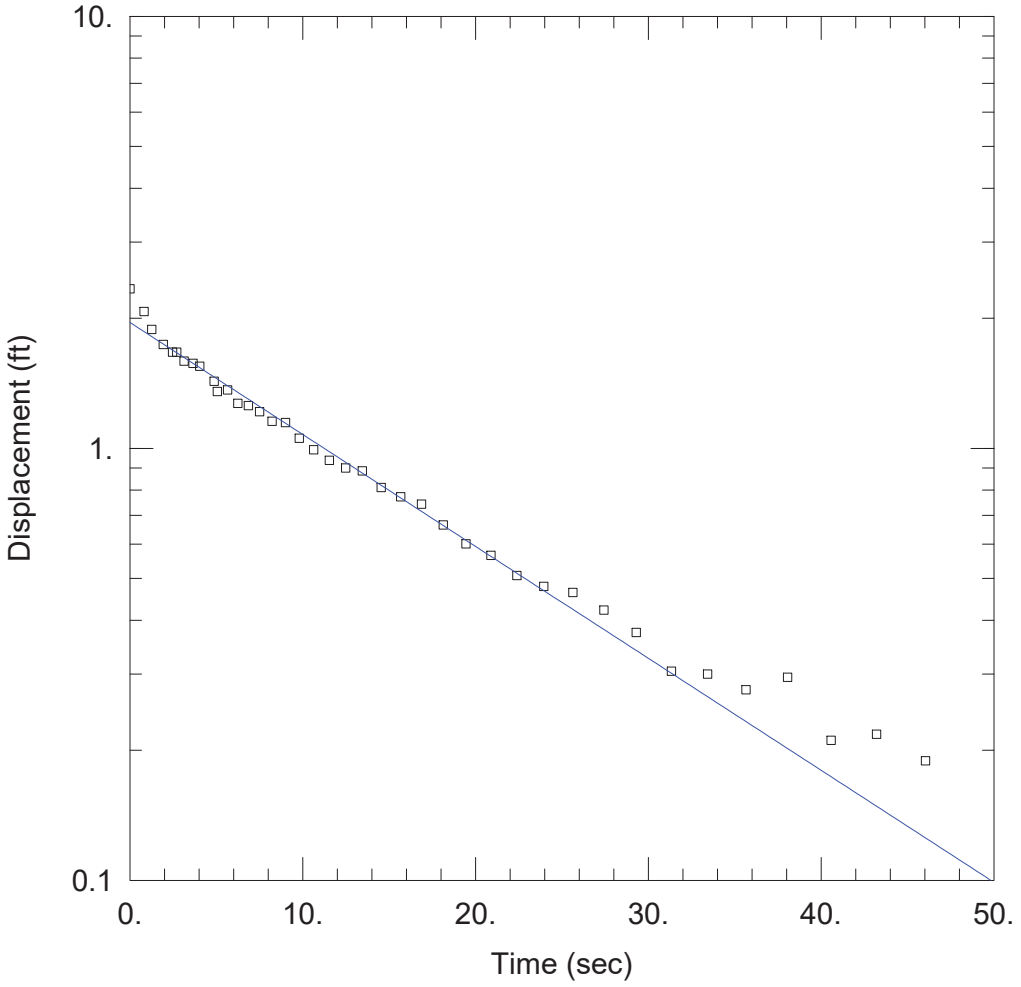
Saturated Thickness: 16. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16004)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 16. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 73. ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 5.055 ft/day
y0 = 2.38 ft



JR MW-16004 SLUG IN 4

Data Set: S:\...\MW-16004.aqt
Date: 11/07/16 Time: 16:04:38

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16004
Test Date: 11/1/16

AQUIFER DATA

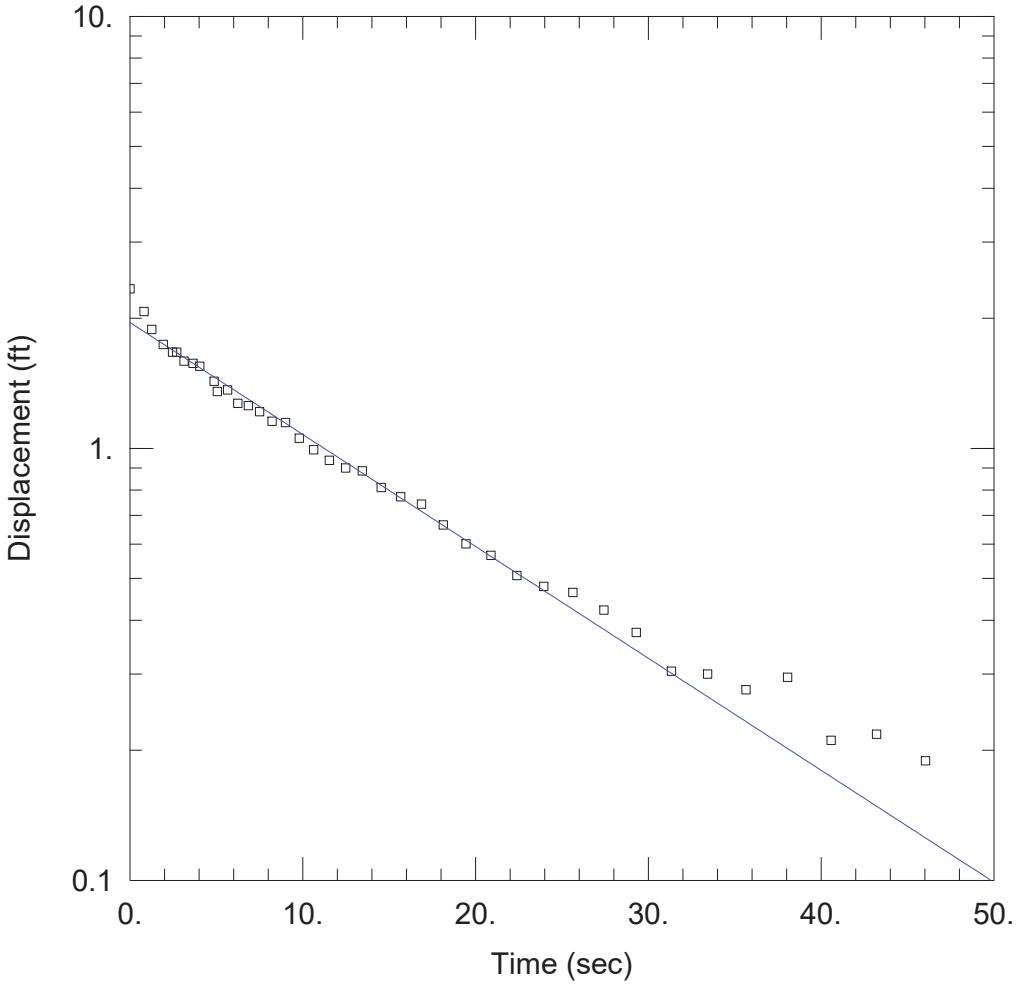
Saturated Thickness: 16. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16004)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 16. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 73. ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 3.384 ft/day
y0 = 1.955 ft



JR MW-16004 SLUG IN 4

Data Set: S:\...\MW-16004.aqt
Date: 11/07/16 Time: 16:05:24

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16004
Test Date: 11/1/16

AQUIFER DATA

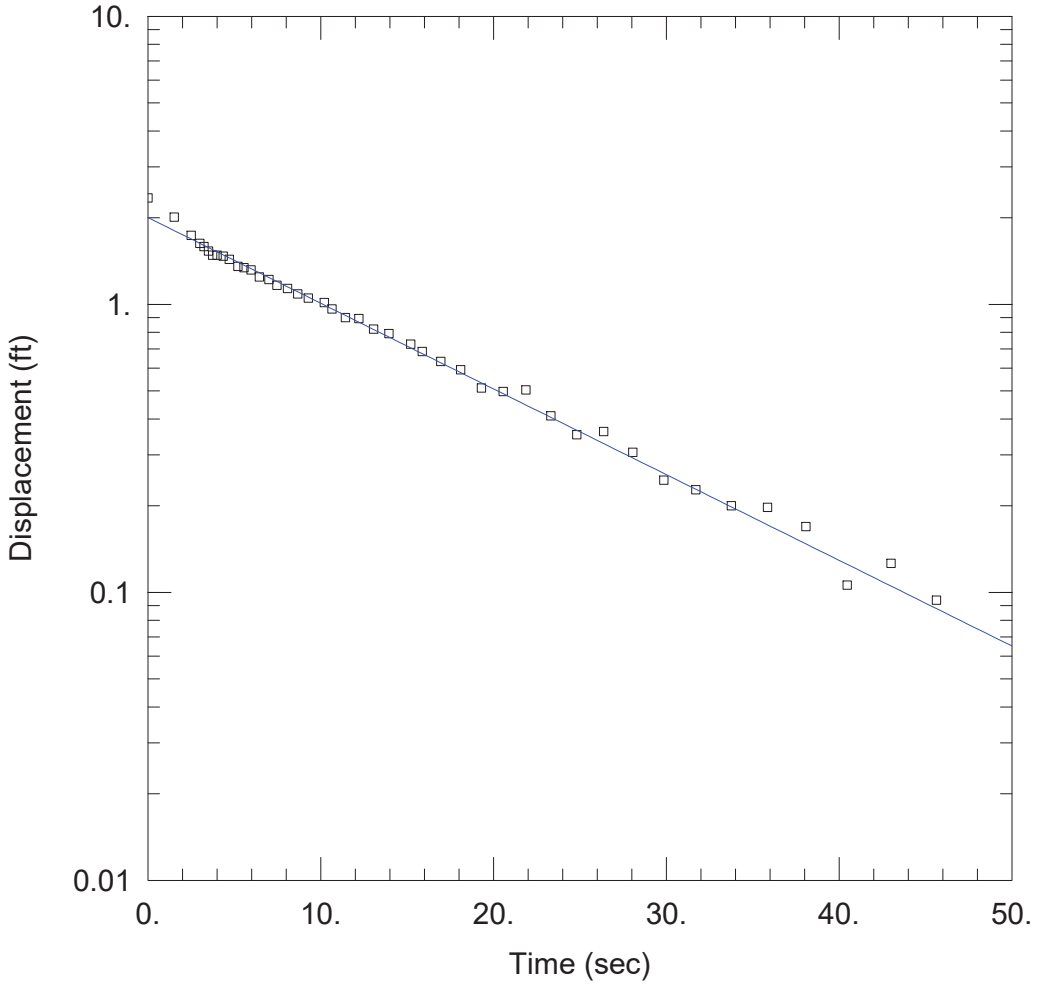
Saturated Thickness: 16. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16004)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 16. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 73. ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 4.774 ft/day
y0 = 1.955 ft



JR MW-16004 SLUG IN 5

Data Set: S:\...\MW-16004.aqt
Date: 11/07/16 Time: 16:08:03

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16004
Test Date: 11/1/16

AQUIFER DATA

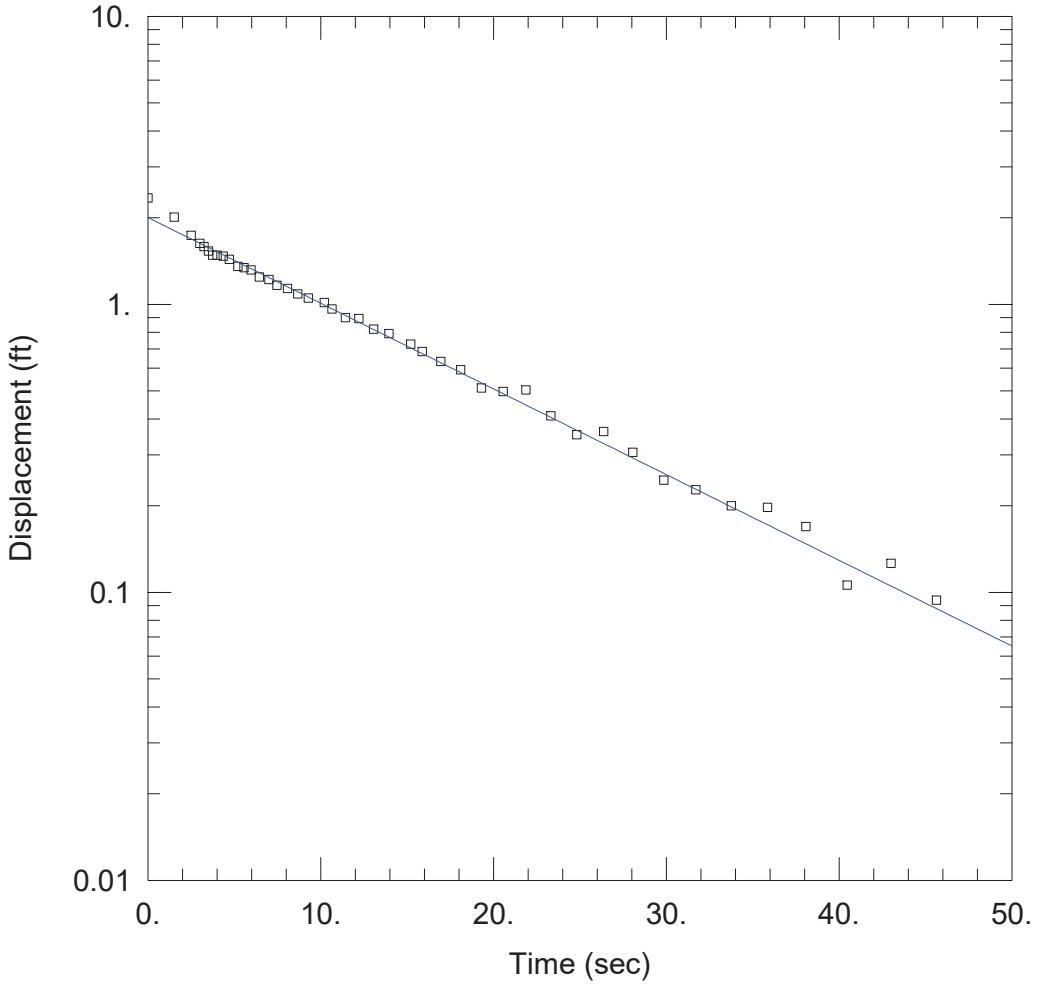
Saturated Thickness: 16. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16004)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 16. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 73. ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 3.886 ft/day
y0 = 2.001 ft



JR MW-16004 SLUG IN 5

Data Set: S:\...\MW-16004.aqt
Date: 11/07/16 Time: 16:07:33

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16004
Test Date: 11/1/16

AQUIFER DATA

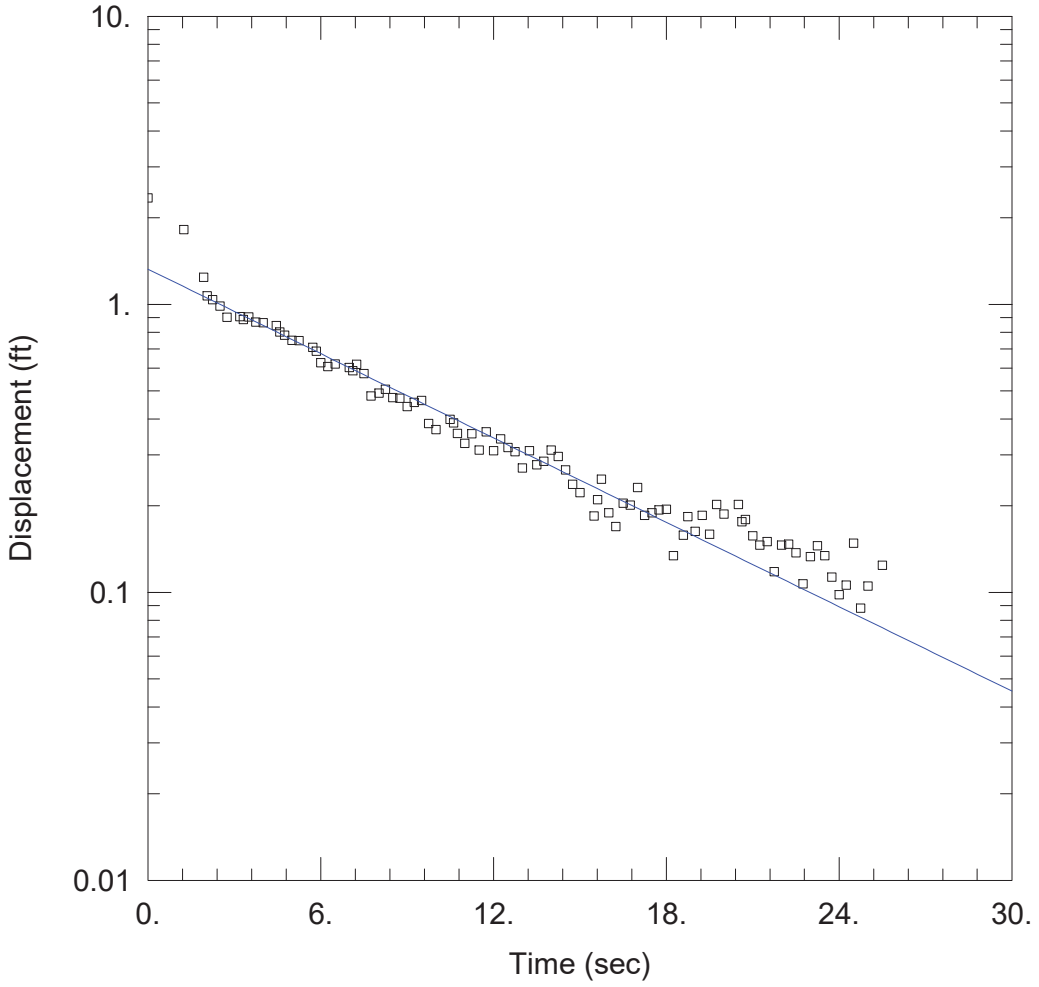
Saturated Thickness: 16. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16004)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 16. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 73. ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 5.482 ft/day
y0 = 2.001 ft



JR MW-16005 SLUG IN 1

Data Set: S:\...\MW-16005.aqt
Date: 11/07/16 Time: 16:15:32

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16005
Test Date: 11/3/16

AQUIFER DATA

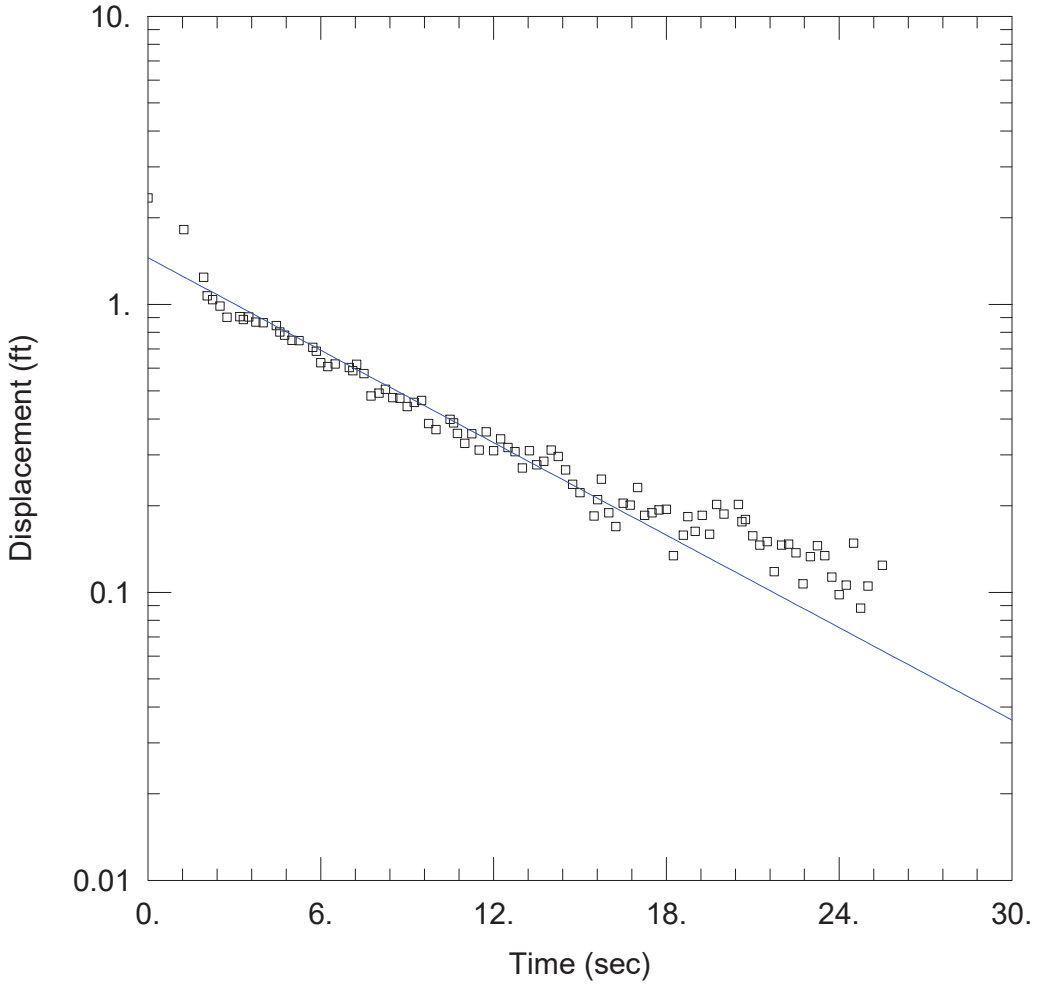
Saturated Thickness: 15. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16005)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 15. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 73.2 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 6.296 ft/day
y0 = 1.324 ft



JR MW-16005 SLUG IN 1

Data Set: S:\...\MW-16005.aqt
Date: 11/07/16 Time: 16:14:24

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16005
Test Date: 11/3/16

AQUIFER DATA

Saturated Thickness: 15. ft Anisotropy Ratio (Kz/Kr): 1.

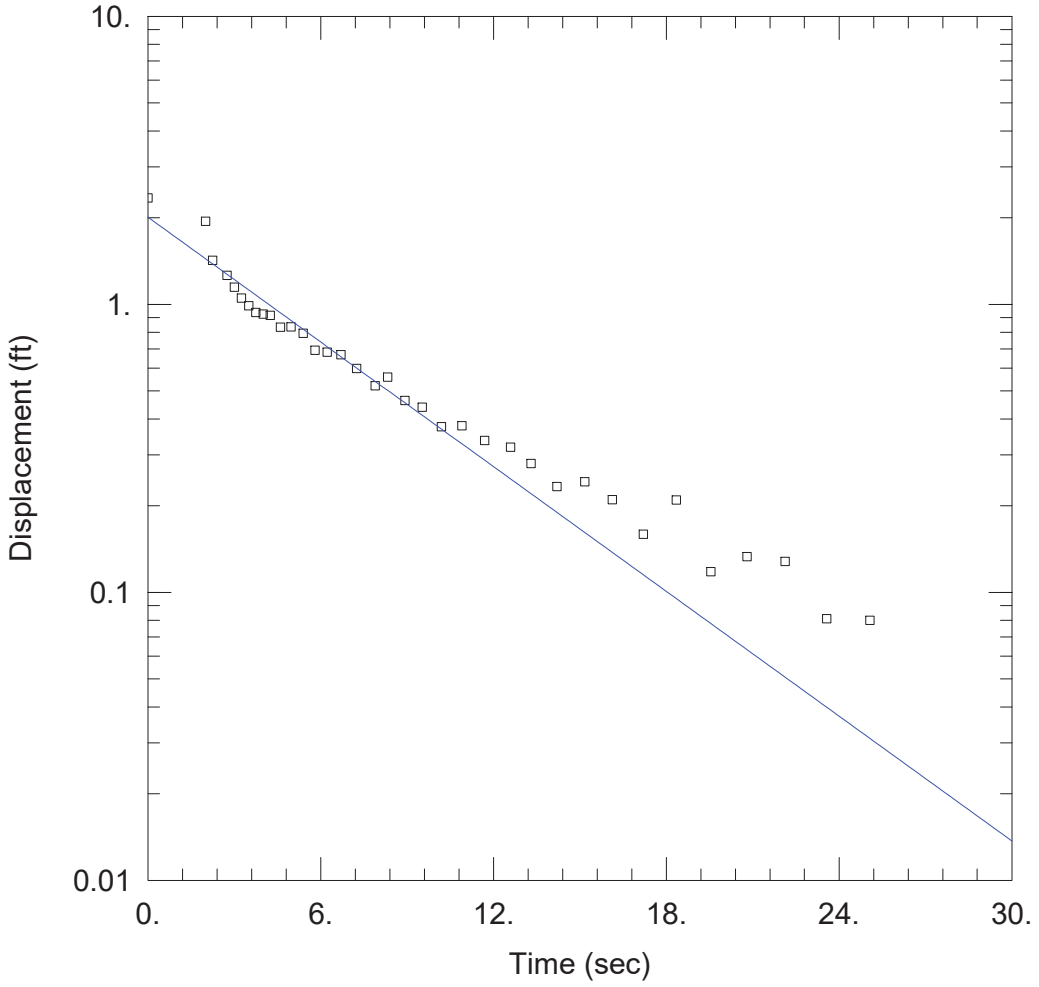
WELL DATA (JR MW-16005)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 15. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 73.2 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 9.859 ft/day
y0 = 1.452 ft



JR MW-16005 SLUG IN 2

Data Set: S:\...\MW-16005.aqt
Date: 11/07/16 Time: 16:17:55

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16005
Test Date: 11/3/16

AQUIFER DATA

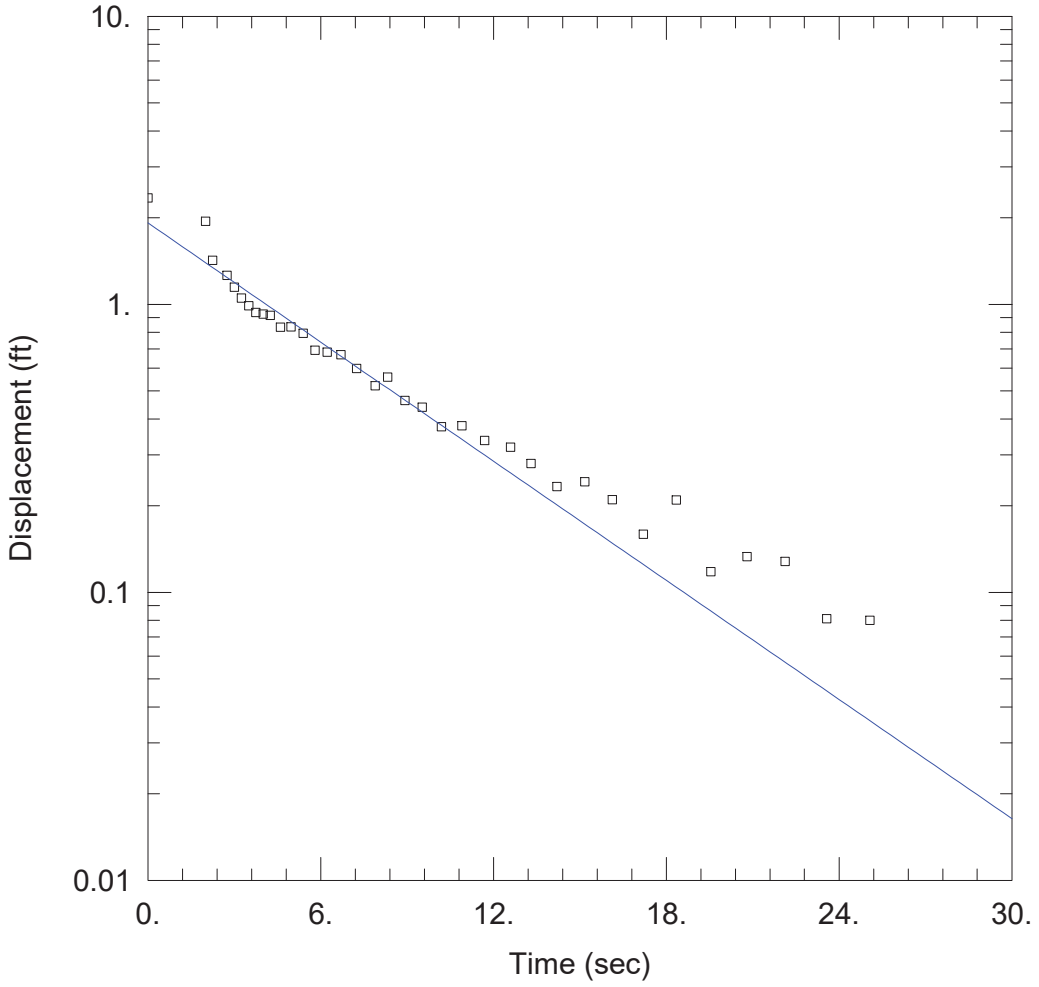
Saturated Thickness: 15. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16005)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 15. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 73.2 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 9.309 ft/day
y0 = 2.007 ft



JR MW-16005 SLUG IN 2

Data Set: S:\...\MW-16005.aqt
Date: 11/07/16 Time: 16:19:41

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16005
Test Date: 11/3/16

AQUIFER DATA

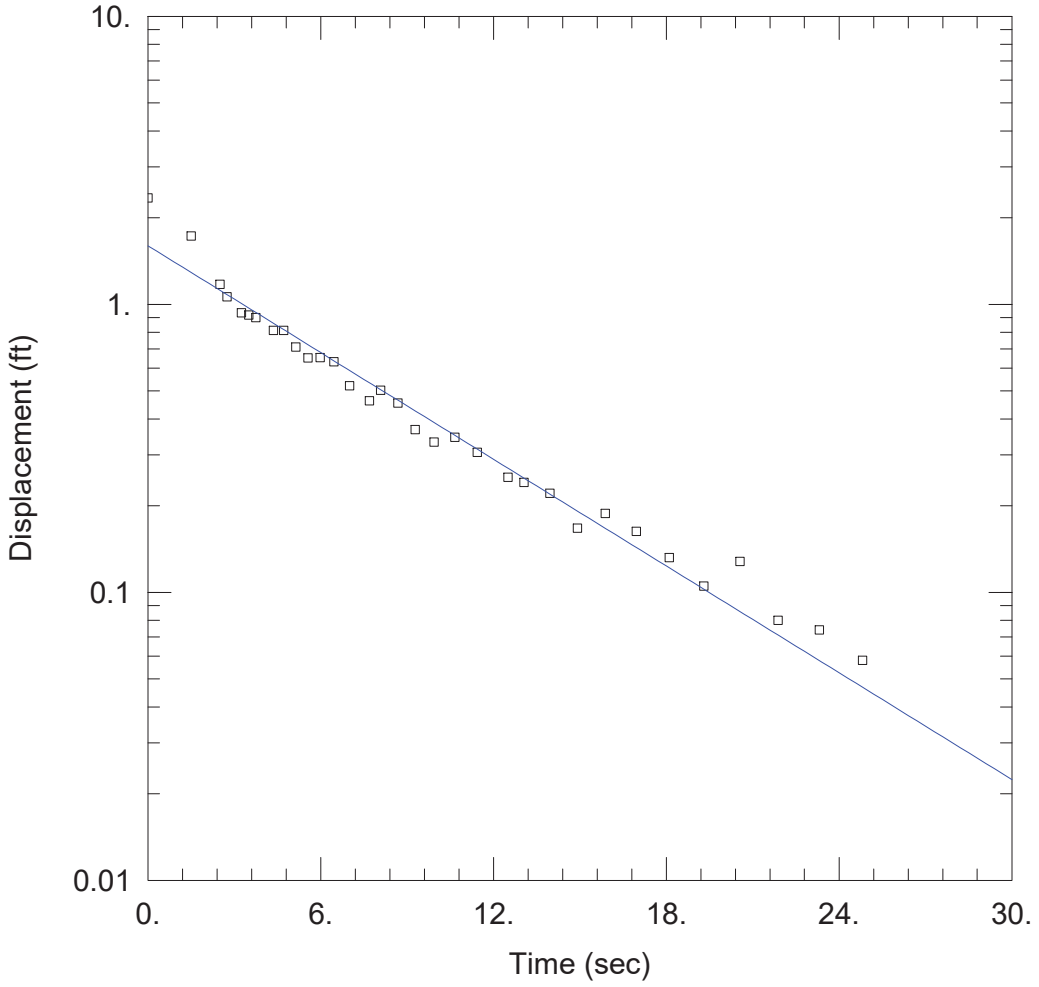
Saturated Thickness: 15. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16005)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 15. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 73.2 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 12.7 ft/day
y0 = 1.917 ft



JR MW-16005 SLUG IN 3

Data Set: S:\...\MW-16005.aqt
Date: 11/07/16 Time: 16:24:41

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16005
Test Date: 11/3/16

AQUIFER DATA

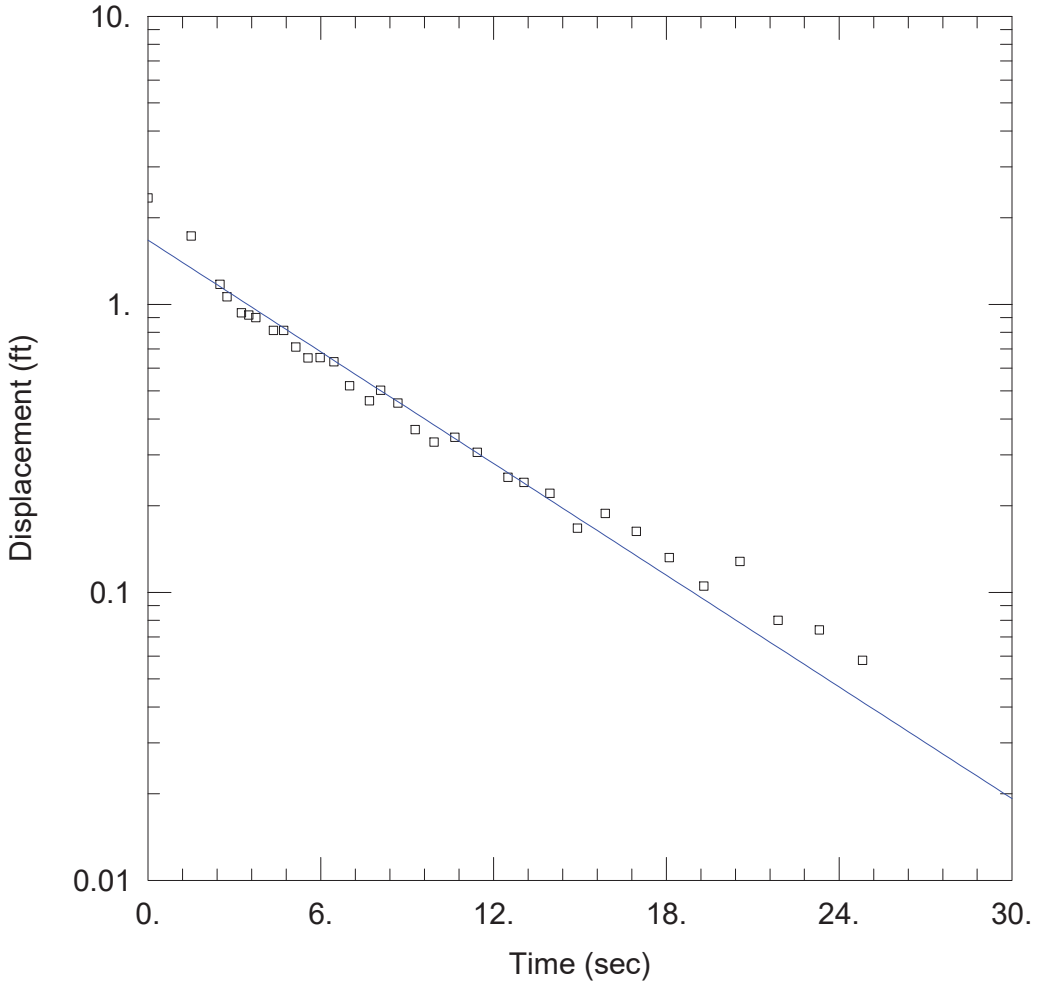
Saturated Thickness: 15. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16005)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 15. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 73.2 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 7.965 ft/day
y0 = 1.597 ft



JR MW-16005 SLUG IN 3

Data Set: S:\...\MW-16005.aqt
Date: 11/07/16 Time: 16:23:23

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16005
Test Date: 11/3/16

AQUIFER DATA

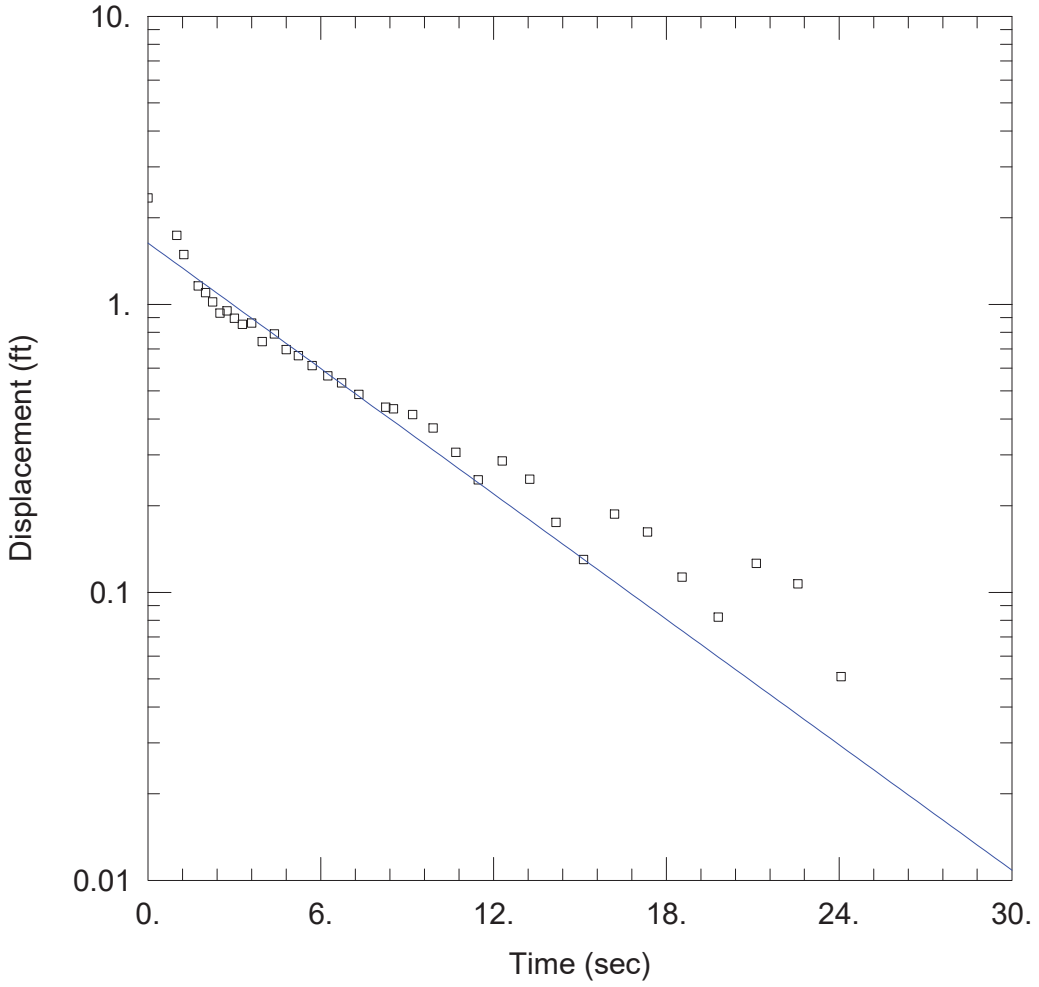
Saturated Thickness: 15. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16005)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 15. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 73.2 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 11.91 ft/day
y0 = 1.671 ft



JR MW-16005 SLUG IN 4

Data Set: S:\...\MW-16005.aqt
Date: 11/07/16 Time: 16:26:45

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16005
Test Date: 11/3/16

AQUIFER DATA

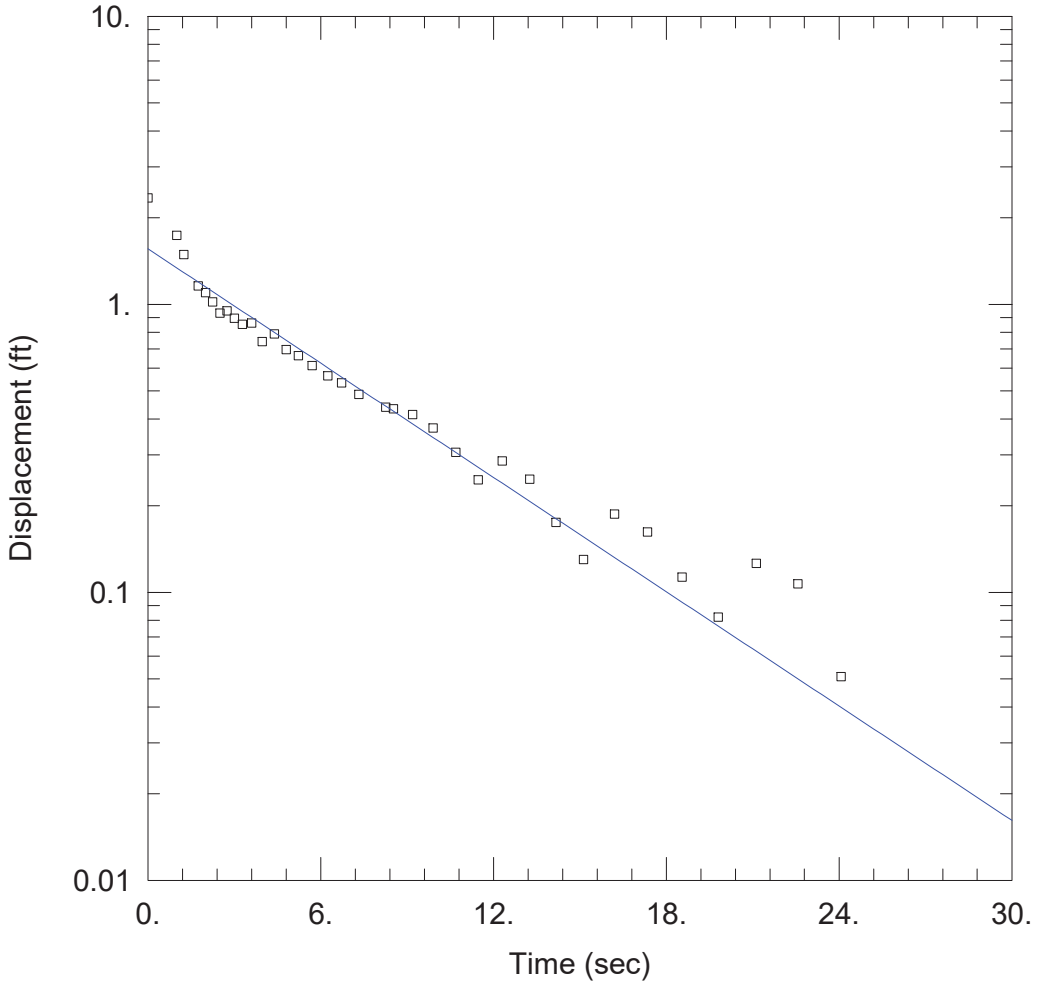
Saturated Thickness: 15. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16005)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 15. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 73.2 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 9.359 ft/day
y0 = 1.633 ft



JR MW-16005 SLUG IN 4

Data Set: S:\...\MW-16005.aqt
Date: 11/07/16 Time: 16:28:15

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16005
Test Date: 11/3/16

AQUIFER DATA

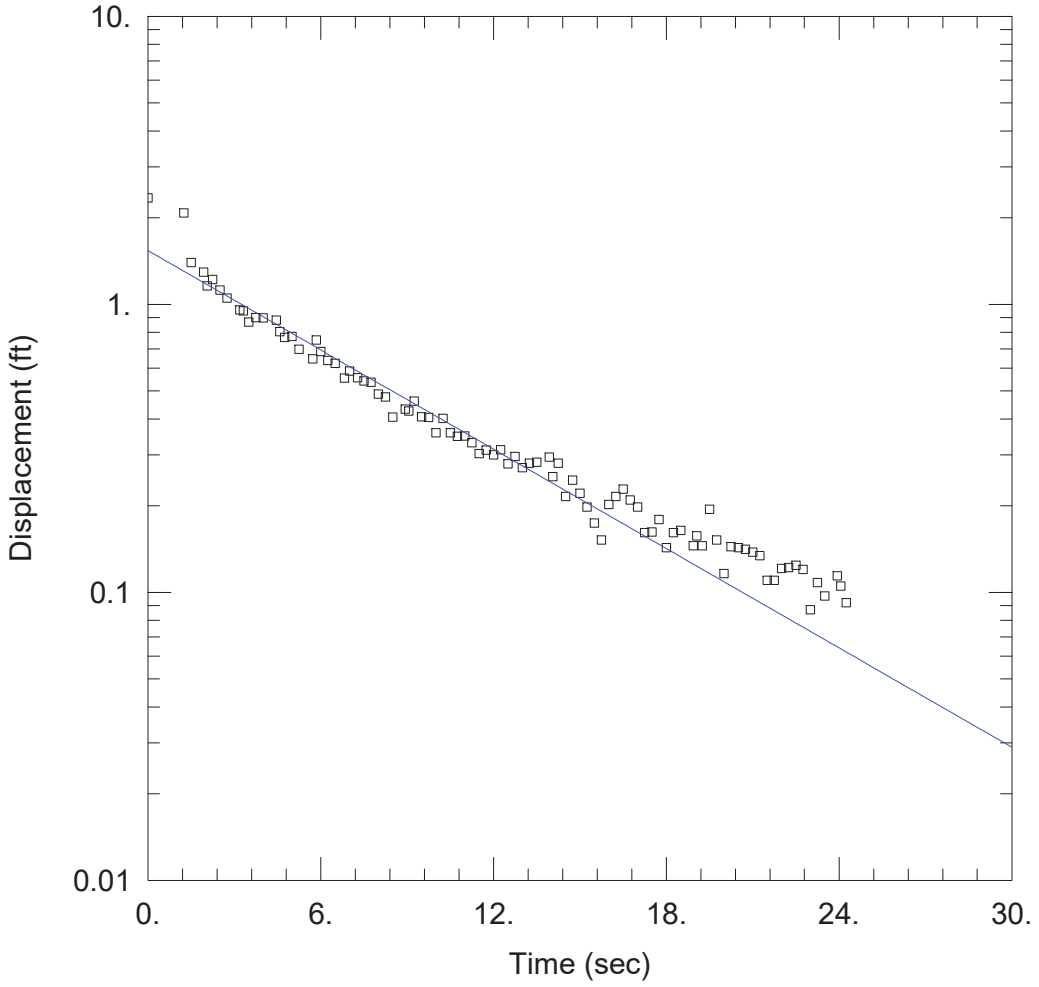
Saturated Thickness: 15. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16005)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 15. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 73.2 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 12.19 ft/day
y0 = 1.559 ft



JR MW-16006 SLUG IN 1

Data Set: S:\...\MW-16006.aqt
Date: 11/07/16 Time: 16:35:42

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16006
Test Date: 11/2/16

AQUIFER DATA

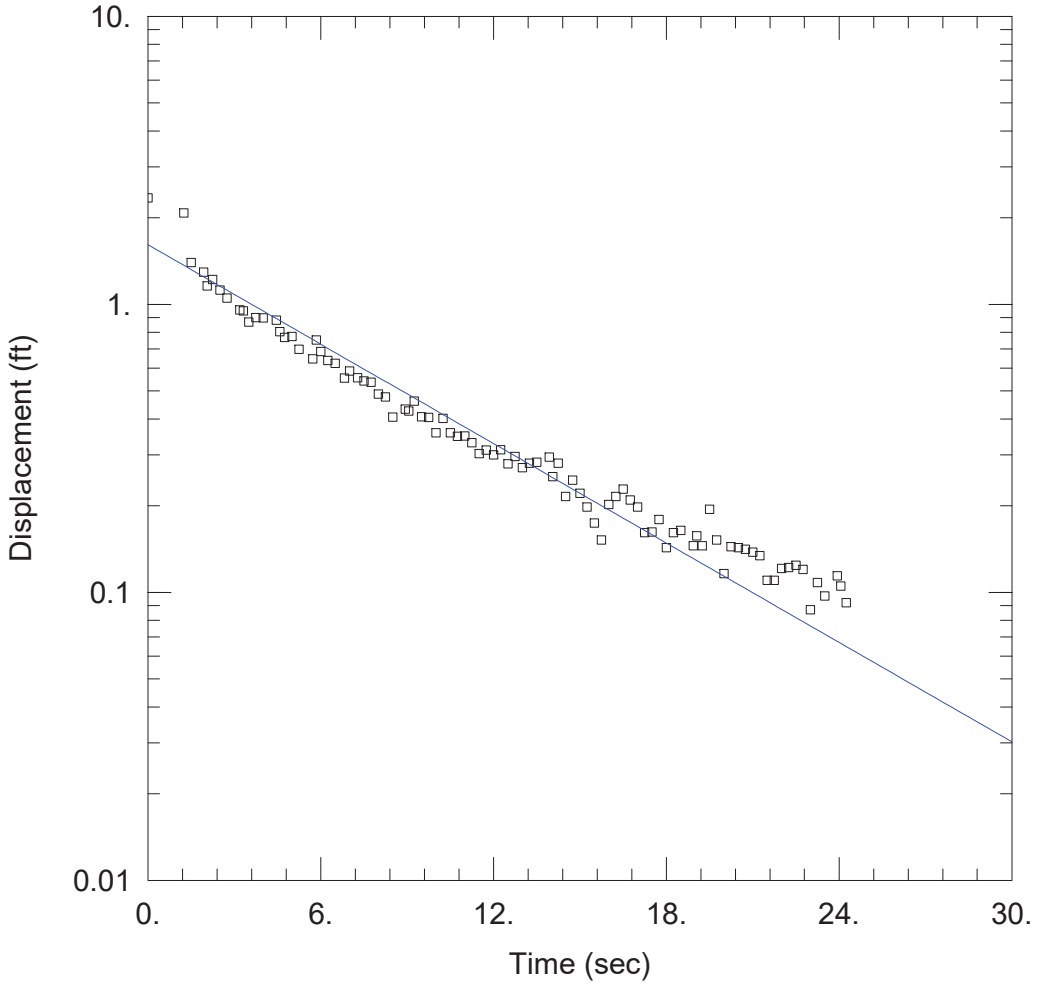
Saturated Thickness: 13. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16006)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 75. ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 7.198 ft/day
y0 = 1.537 ft



JR MW-16006 SLUG IN 1

Data Set: S:\...\MW-16006.aqt
Date: 11/07/16 Time: 16:33:13

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16006
Test Date: 11/2/16

AQUIFER DATA

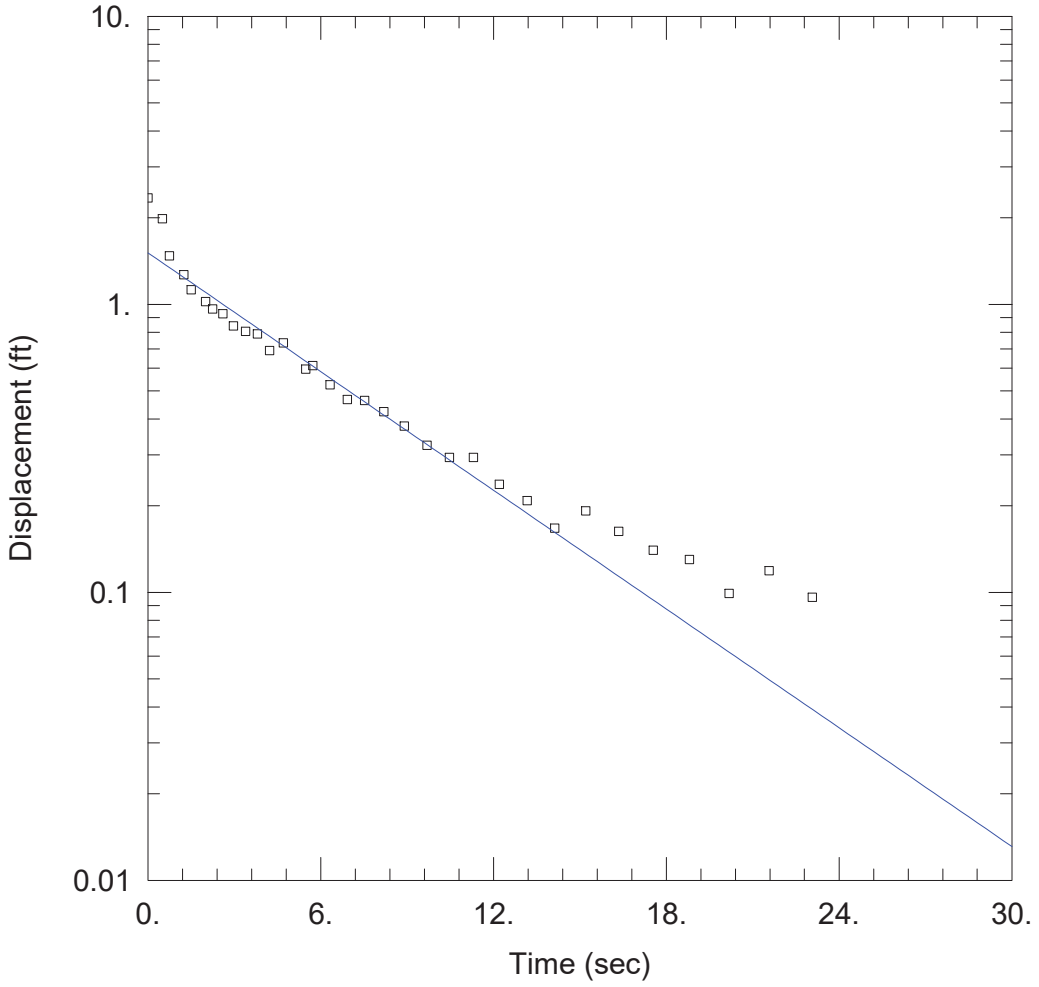
Saturated Thickness: 13. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16006)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 75. ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 10.6 ft/day
y0 = 1.61 ft



JR MW-16006 SLUG IN 2

Data Set: S:\...\MW-16006.aqt
Date: 11/07/16 Time: 16:44:16

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16006
Test Date: 11/2/16

AQUIFER DATA

Saturated Thickness: 13. ft Anisotropy Ratio (Kz/Kr): 1.

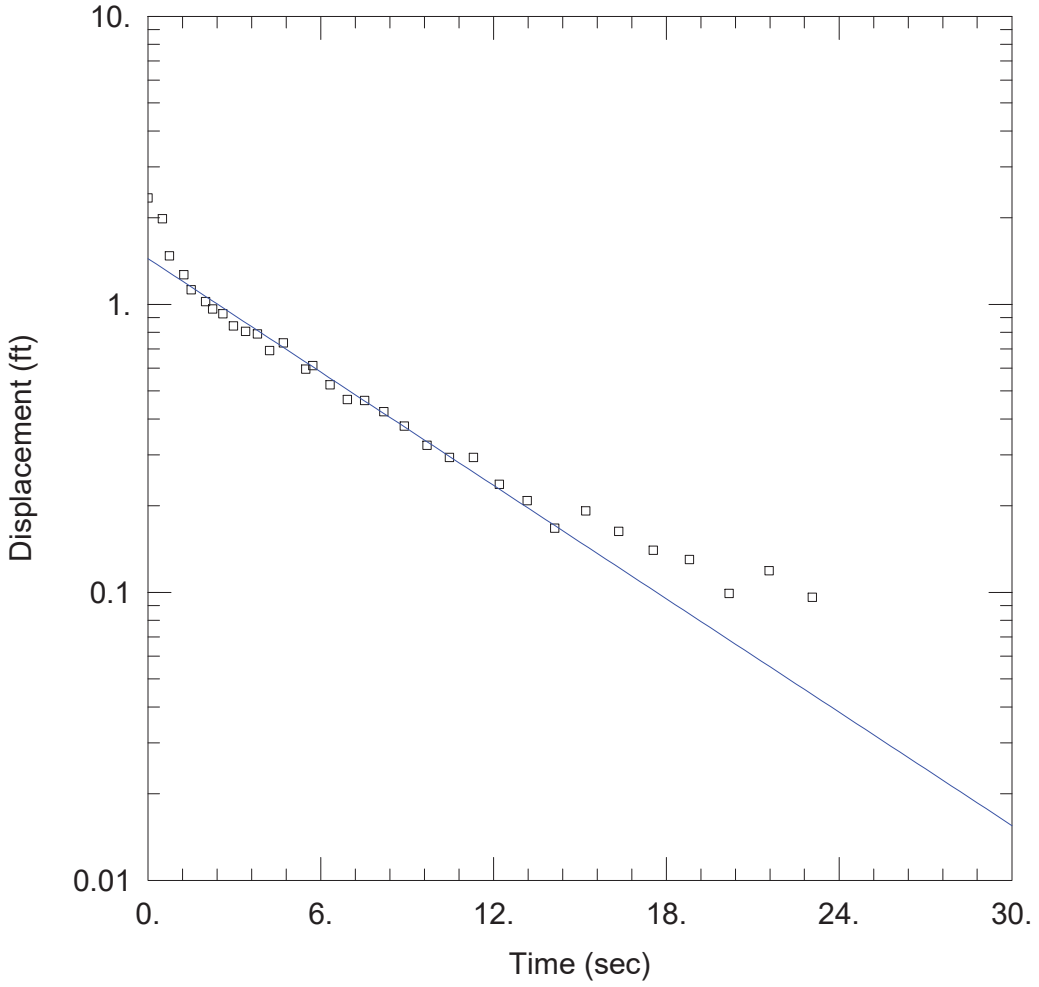
WELL DATA (JR MW-16006)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 75. ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 8.603 ft/day
y0 = 1.509 ft



JR MW-16006 SLUG IN 2

Data Set: S:\...\MW-16006.aqt
Date: 11/07/16 Time: 16:45:46

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16006
Test Date: 11/2/16

AQUIFER DATA

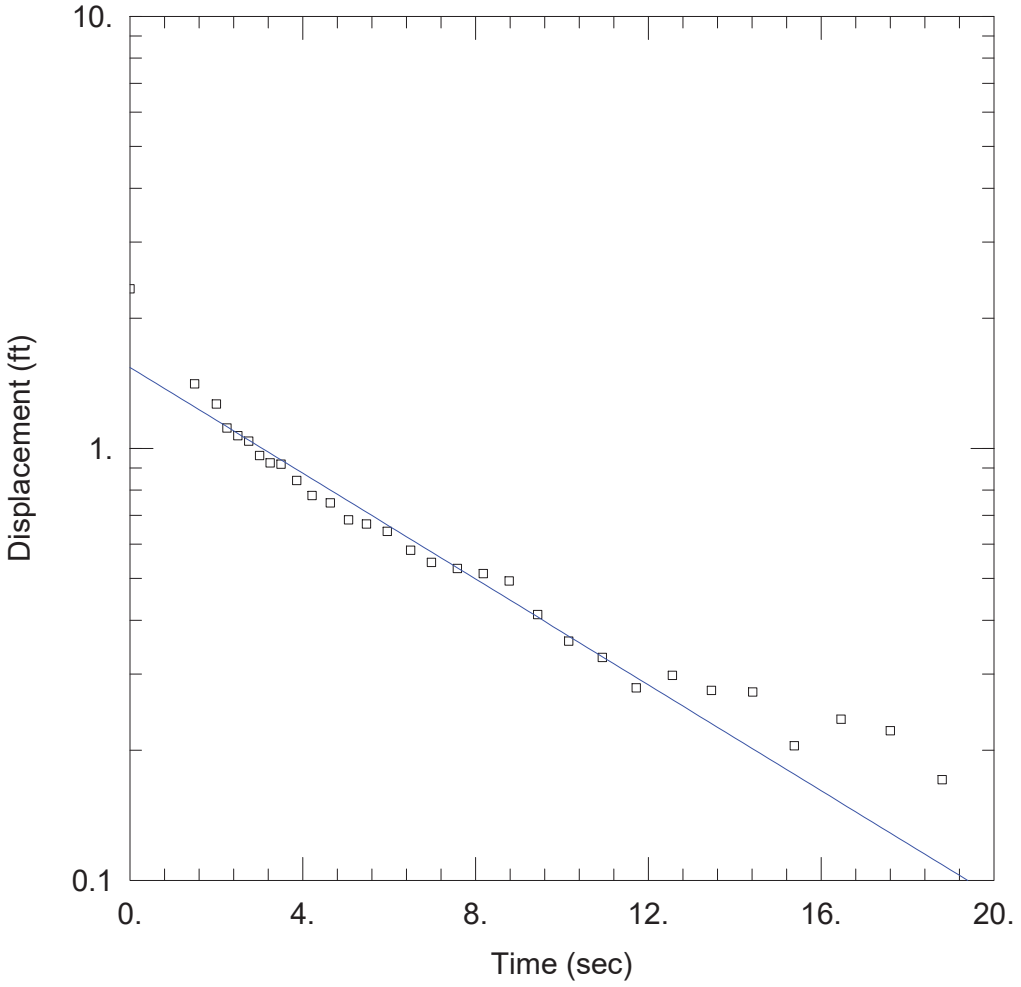
Saturated Thickness: 13. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16006)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 75. ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 12.09 ft/day
y0 = 1.441 ft



JR MW-16006 SLUG IN 3

Data Set: S:\...\MW-16006.aqt
Date: 11/07/16 Time: 16:48:54

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16006
Test Date: 11/2/16

AQUIFER DATA

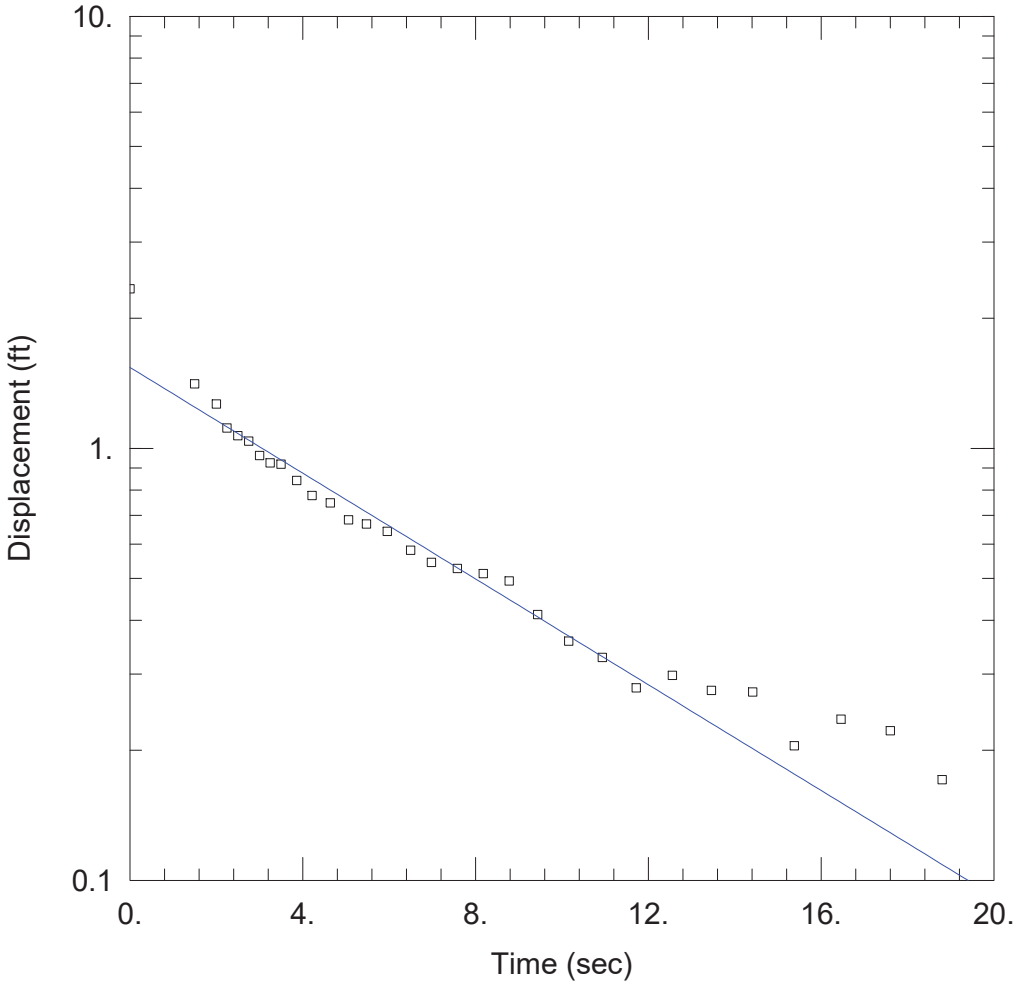
Saturated Thickness: 13. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16006)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 75. ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 7.663 ft/day
y0 = 1.539 ft



JR MW-16006 SLUG IN 3

Data Set: S:\...\MW-16006.aqt
Date: 11/07/16 Time: 16:48:08

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16006
Test Date: 11/2/16

AQUIFER DATA

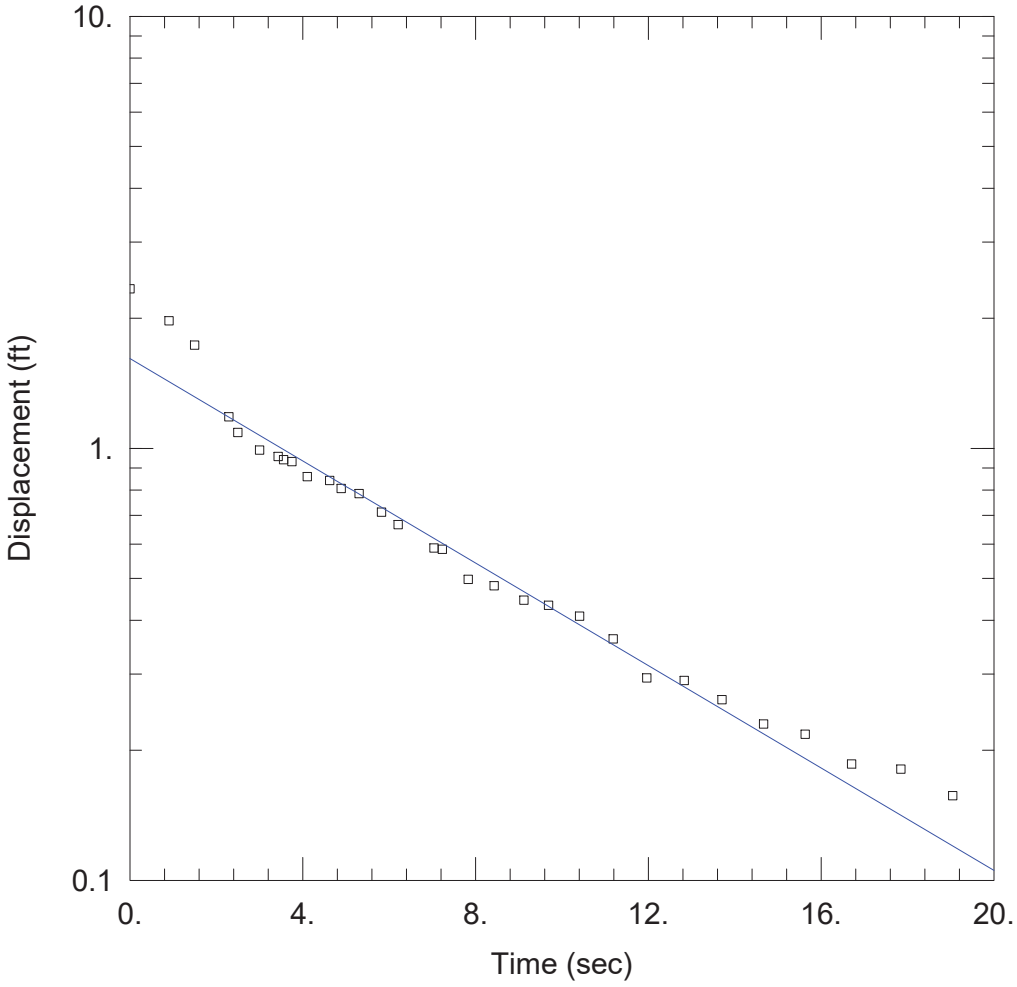
Saturated Thickness: 13. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16006)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 75. ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 11.27 ft/day
y0 = 1.539 ft



JR MW-16006 SLUG IN 4

Data Set: S:\...\MW-16006.aqt
Date: 11/07/16 Time: 16:51:25

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16006
Test Date: 11/2/16

AQUIFER DATA

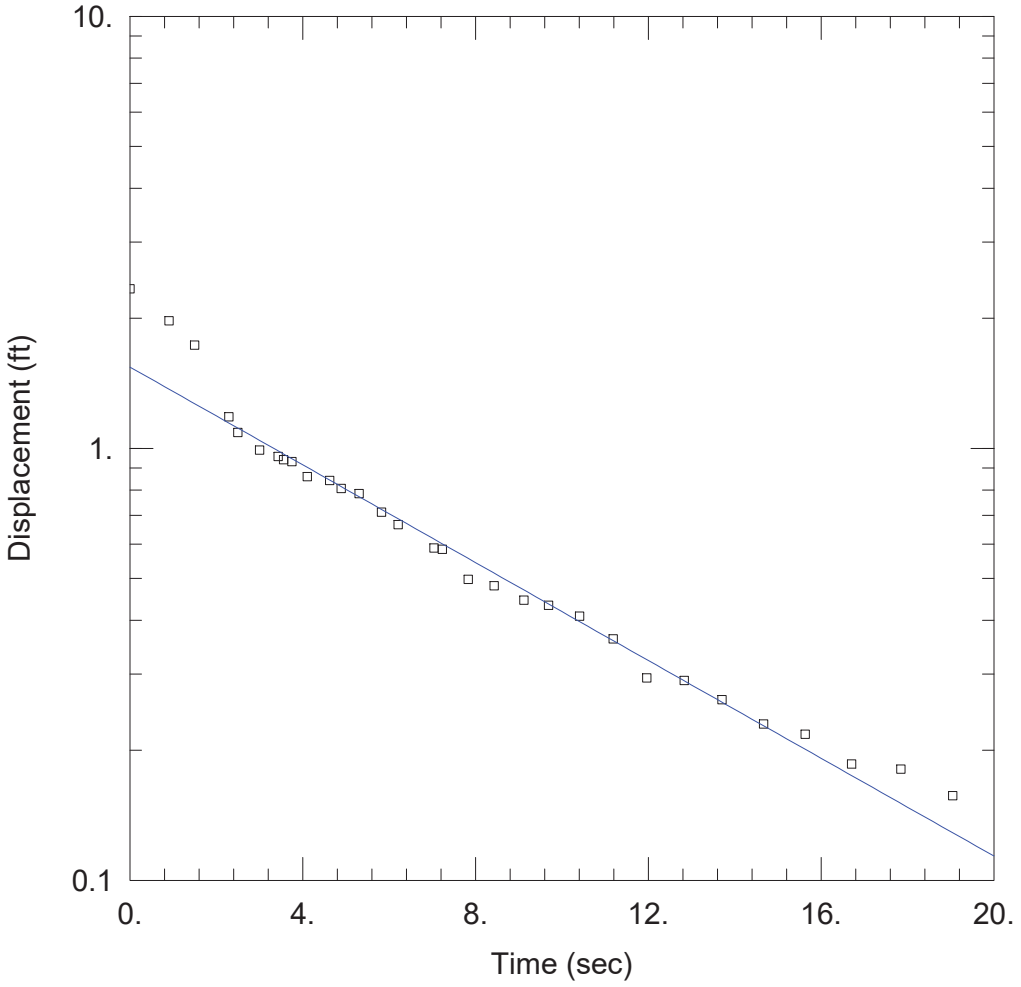
Saturated Thickness: 13. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16006)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 75. ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 7.415 ft/day
y0 = 1.614 ft



JR MW-16006 SLUG IN 4

Data Set: S:\...\MW-16006.aqt
Date: 11/07/16 Time: 16:52:44

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16006
Test Date: 11/2/16

AQUIFER DATA

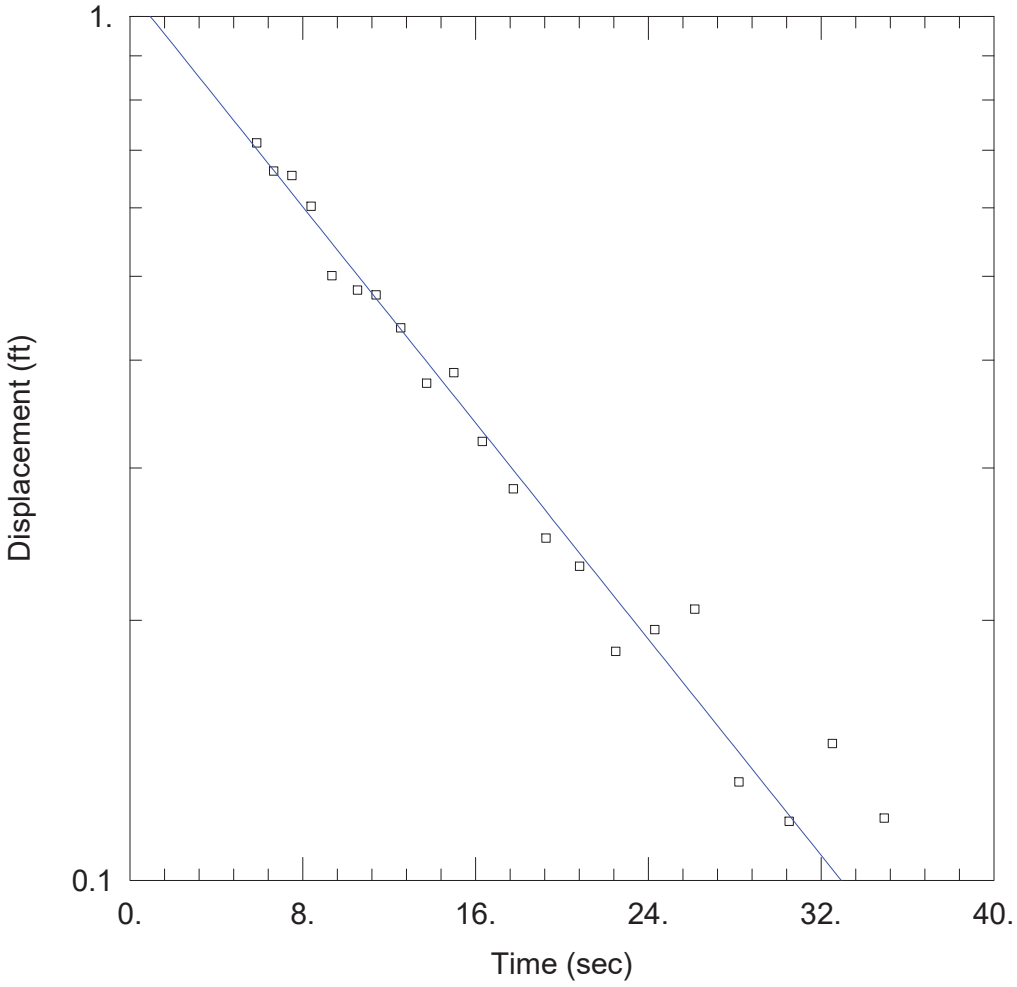
Saturated Thickness: 13. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16006)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 75. ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 10.42 ft/day
y0 = 1.542 ft



JR MW-16007 SLUG IN 1

Data Set: S:\...\MW-16007.aqt
Date: 11/07/16 Time: 16:57:58

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16007
Test Date: 10/31/16

AQUIFER DATA

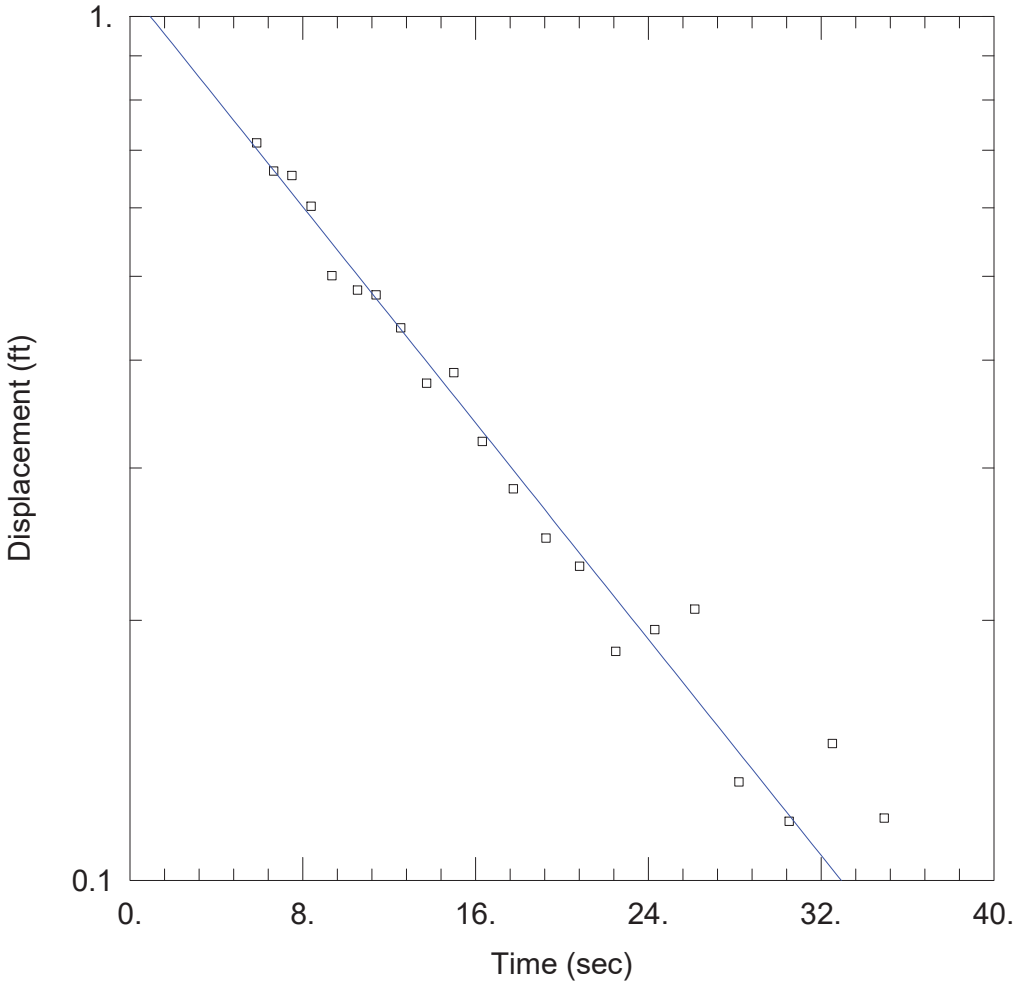
Saturated Thickness: 14.3 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16007)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 14. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 73. ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 3.816 ft/day
y0 = 1.07 ft



JR MW-16007 SLUG IN 1

Data Set: S:\...\MW-16007.aqt
Date: 11/07/16 Time: 16:58:34

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16007
Test Date: 10/31/16

AQUIFER DATA

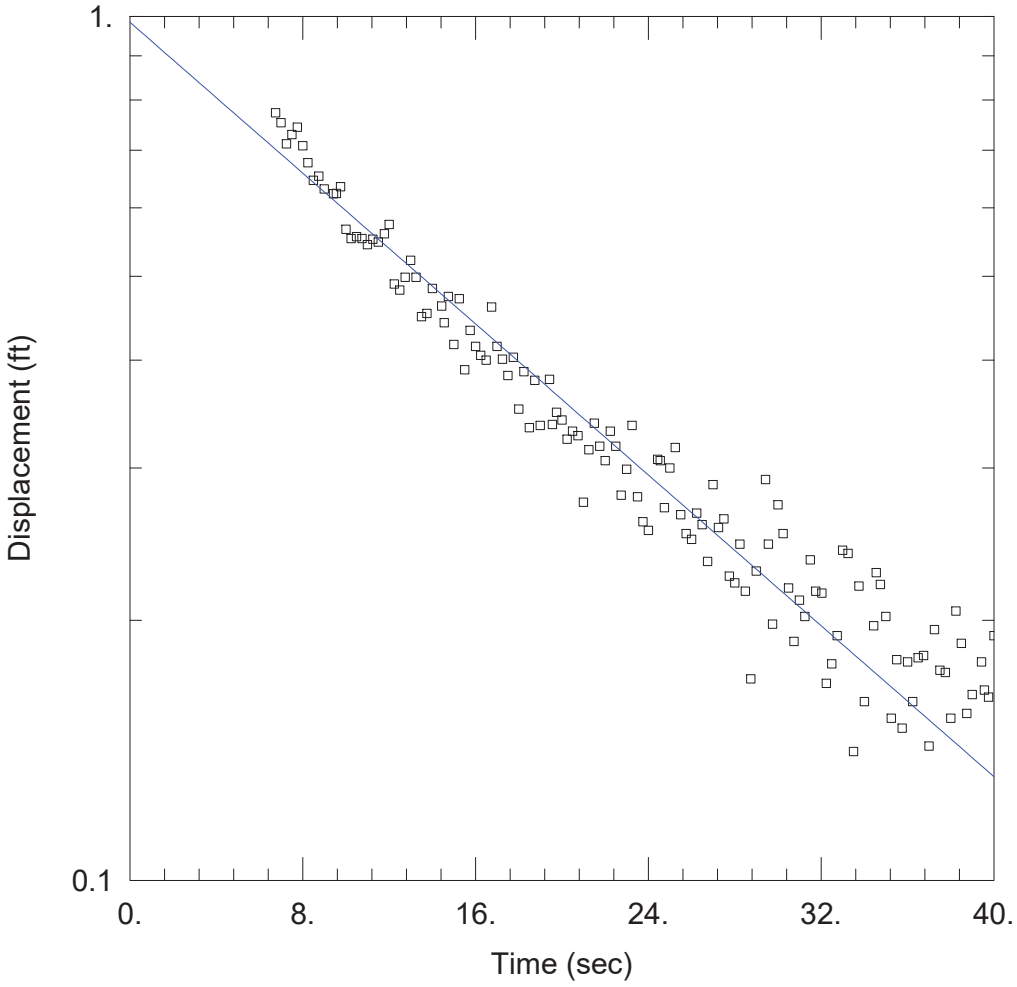
Saturated Thickness: 14.3 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16007)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 14. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 73. ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 4.849 ft/day
y0 = 1.071 ft



JR MW-16007 SLUG IN 2

Data Set: S:\...\MW-16007.aqt
Date: 11/07/16 Time: 17:04:23

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16007
Test Date: 10/31/16

AQUIFER DATA

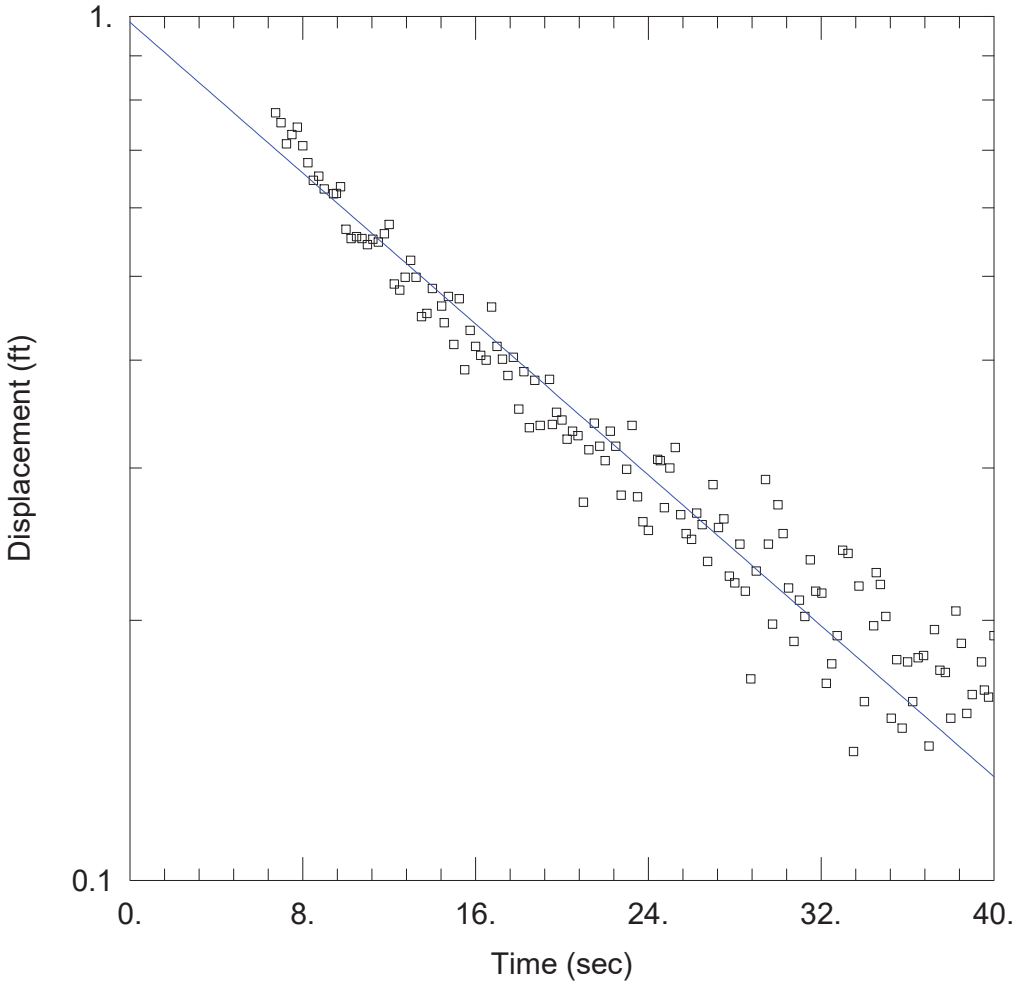
Saturated Thickness: 14.3 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16007)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 14. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 73. ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 2.664 ft/day
y0 = 0.9841 ft



JR MW-16007 SLUG IN 2

Data Set: S:\...\MW-16007.aqt
Date: 11/07/16 Time: 17:03:06

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16007
Test Date: 10/31/16

AQUIFER DATA

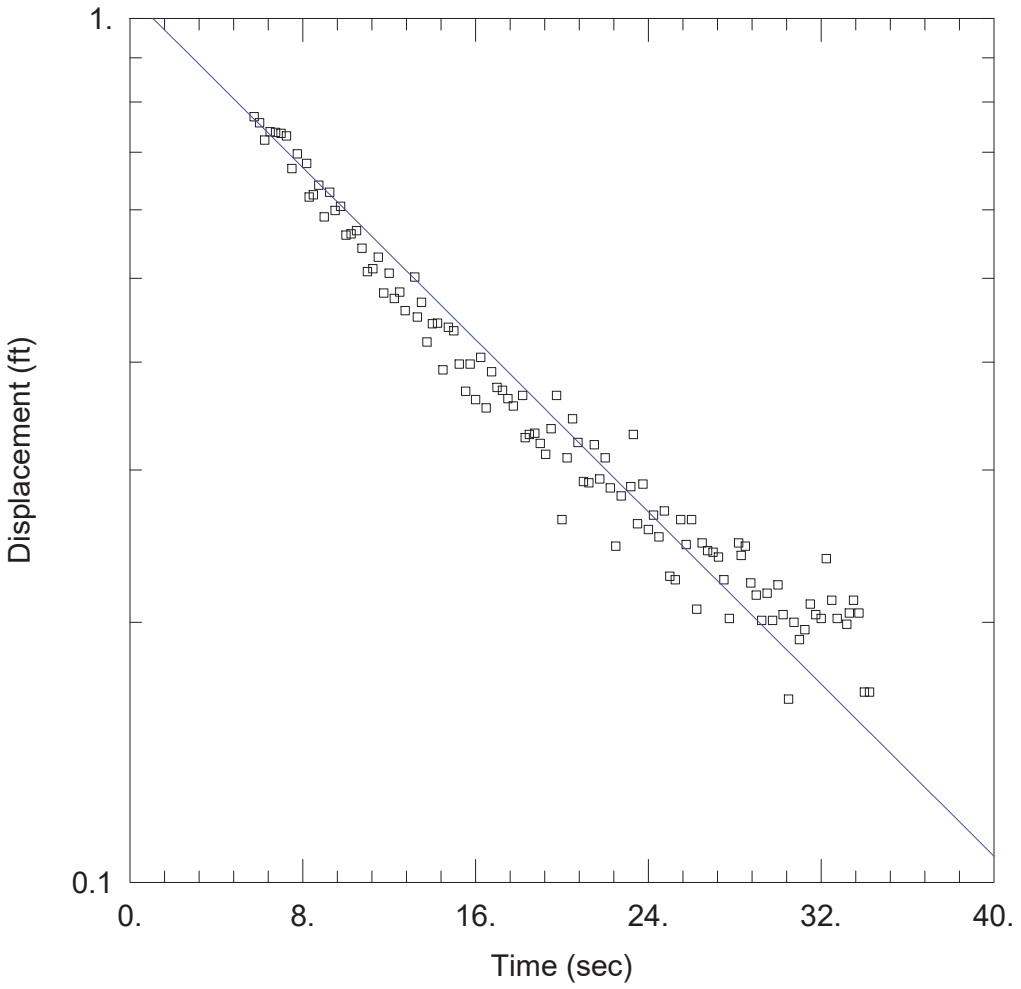
Saturated Thickness: 14.3 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16007)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 14. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 73. ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 3.385 ft/day
y0 = 0.9842 ft



JR MW-16007 SLUG IN 3

Data Set: S:\...\MW-16007.aqt
Date: 11/07/16 Time: 17:09:46

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16007
Test Date: 10/31/16

AQUIFER DATA

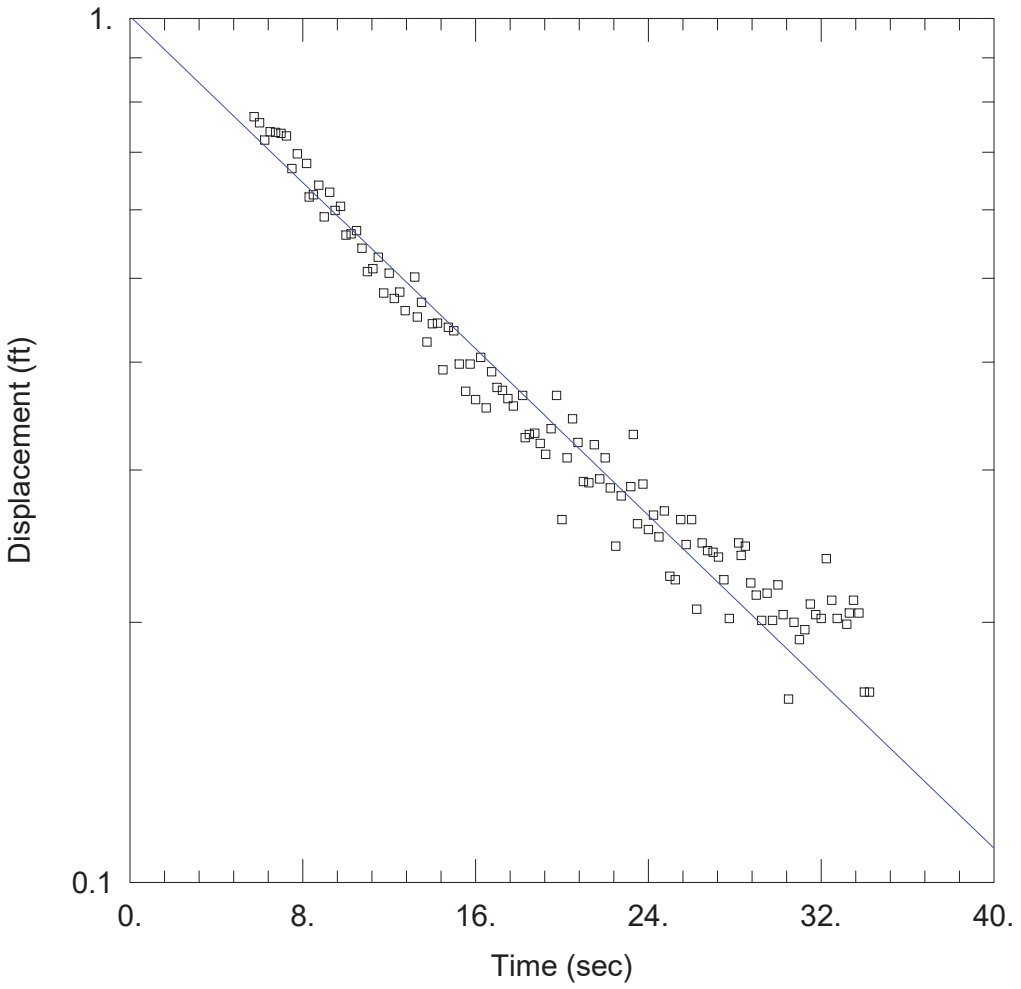
Saturated Thickness: 14.3 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16007)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 14. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 73. ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 3.04 ft/day
y0 = 1.063 ft



JR MW-16007 SLUG IN 3

Data Set: S:\...\MW-16007.aqt
Date: 11/07/16 Time: 17:10:28

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16007
Test Date: 10/31/16

AQUIFER DATA

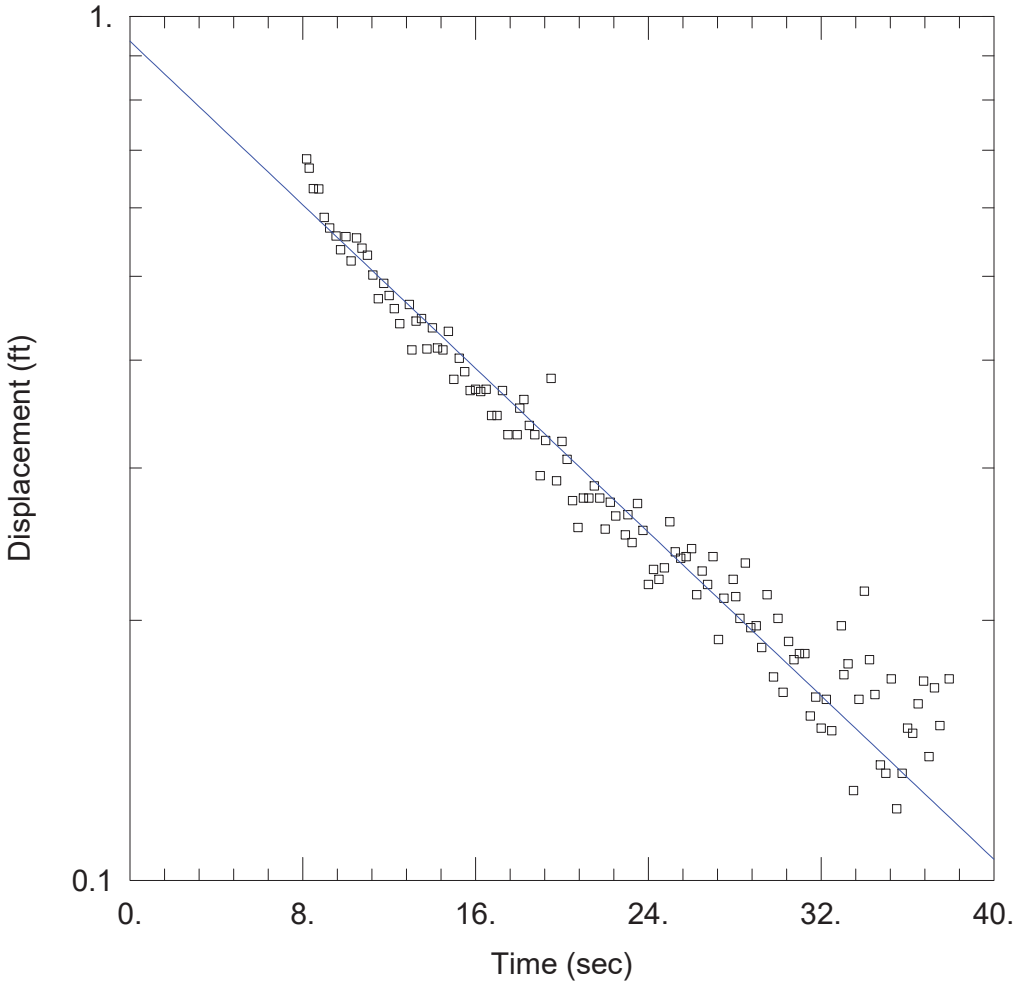
Saturated Thickness: 14.3 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16007)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 14. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 73. ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 3.734 ft/day
y0 = 1.006 ft



JR MW-16007 SLUG IN 4

Data Set: S:\...\MW-16007.aqt
Date: 11/07/16 Time: 17:17:00

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16007
Test Date: 10/31/16

AQUIFER DATA

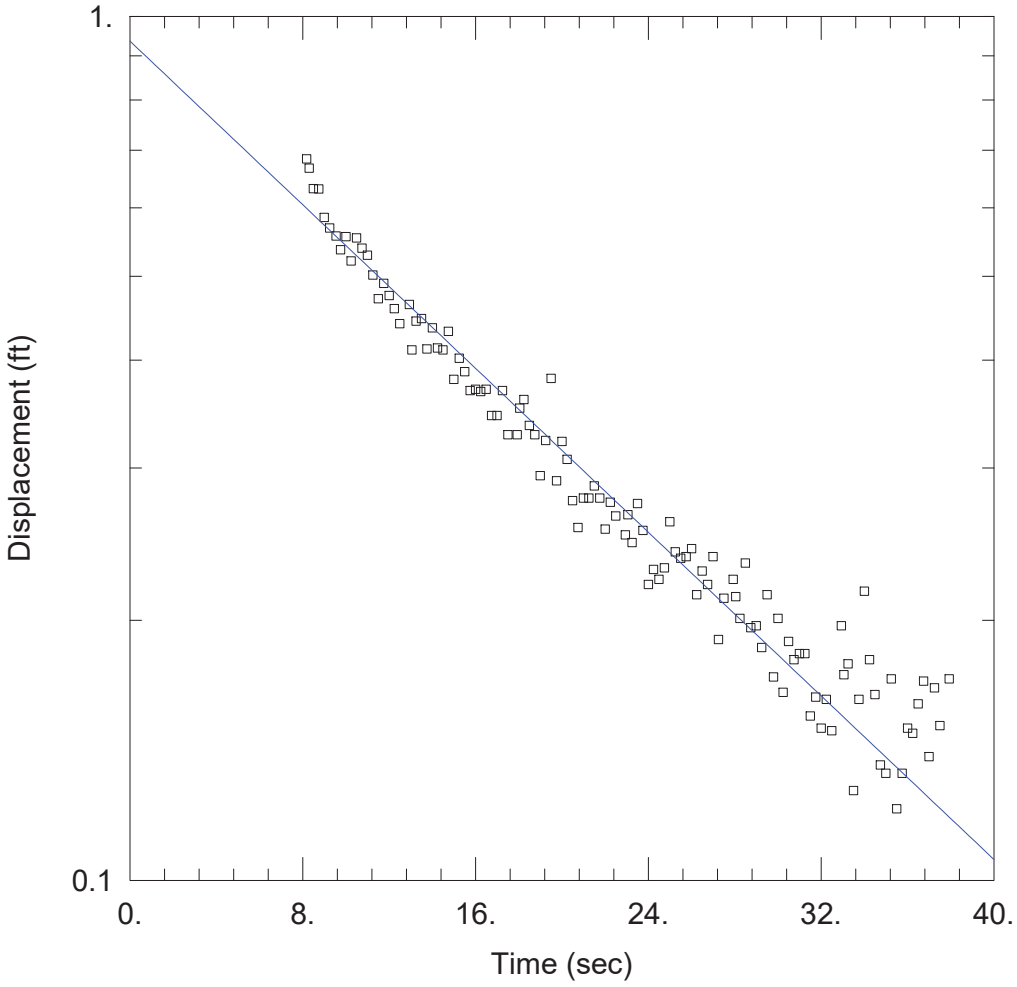
Saturated Thickness: 14.3 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16007)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 14. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 73. ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 2.889 ft/day
y0 = 0.9357 ft



JR MW-16007 SLUG IN 4

Data Set: S:\...\MW-16007.aqt
Date: 11/07/16 Time: 17:16:21

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16007
Test Date: 10/31/16

AQUIFER DATA

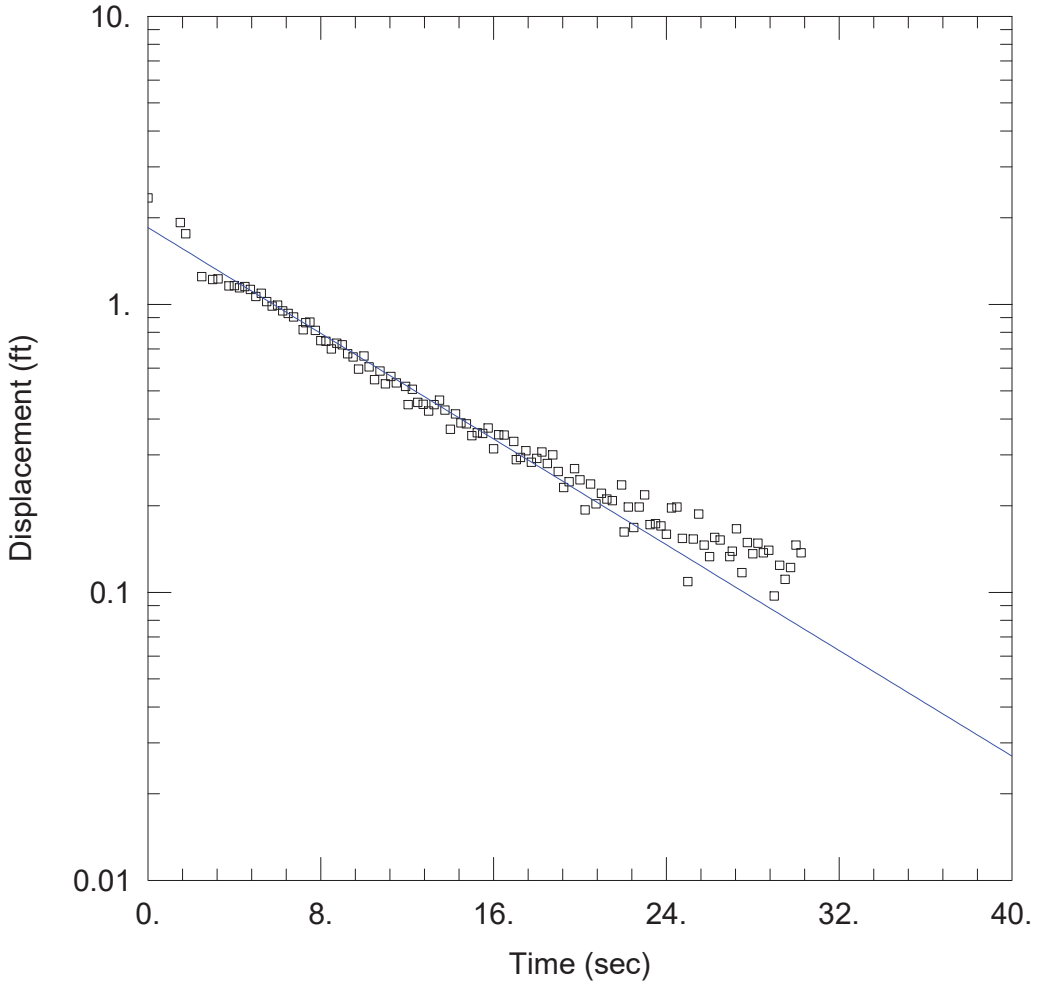
Saturated Thickness: 14.3 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16007)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 14. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 73. ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 3.671 ft/day
y0 = 0.9359 ft



JR MW-16008 SLUG IN 1

Data Set: S:\...\MW-16008.aqt
Date: 11/07/16 Time: 17:26:45

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16008
Test Date: 11/4/16

AQUIFER DATA

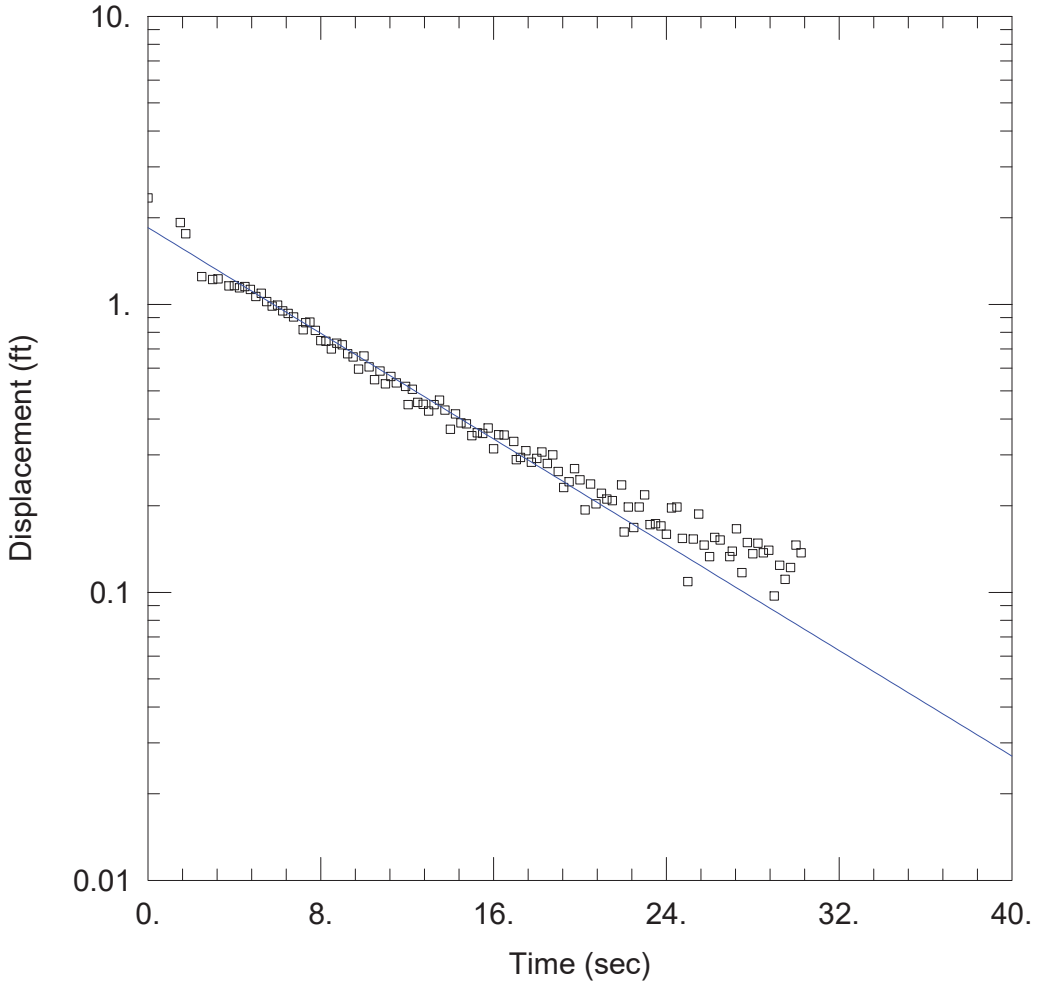
Saturated Thickness: 12.5 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16008)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 10.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 67.2 ft
Screen Length: 5. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 8.826 ft/day
y0 = 1.846 ft



JR MW-16008 SLUG IN 1

Data Set: S:\...\MW-16008.aqt
Date: 11/07/16 Time: 17:26:12

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16008
Test Date: 11/4/16

AQUIFER DATA

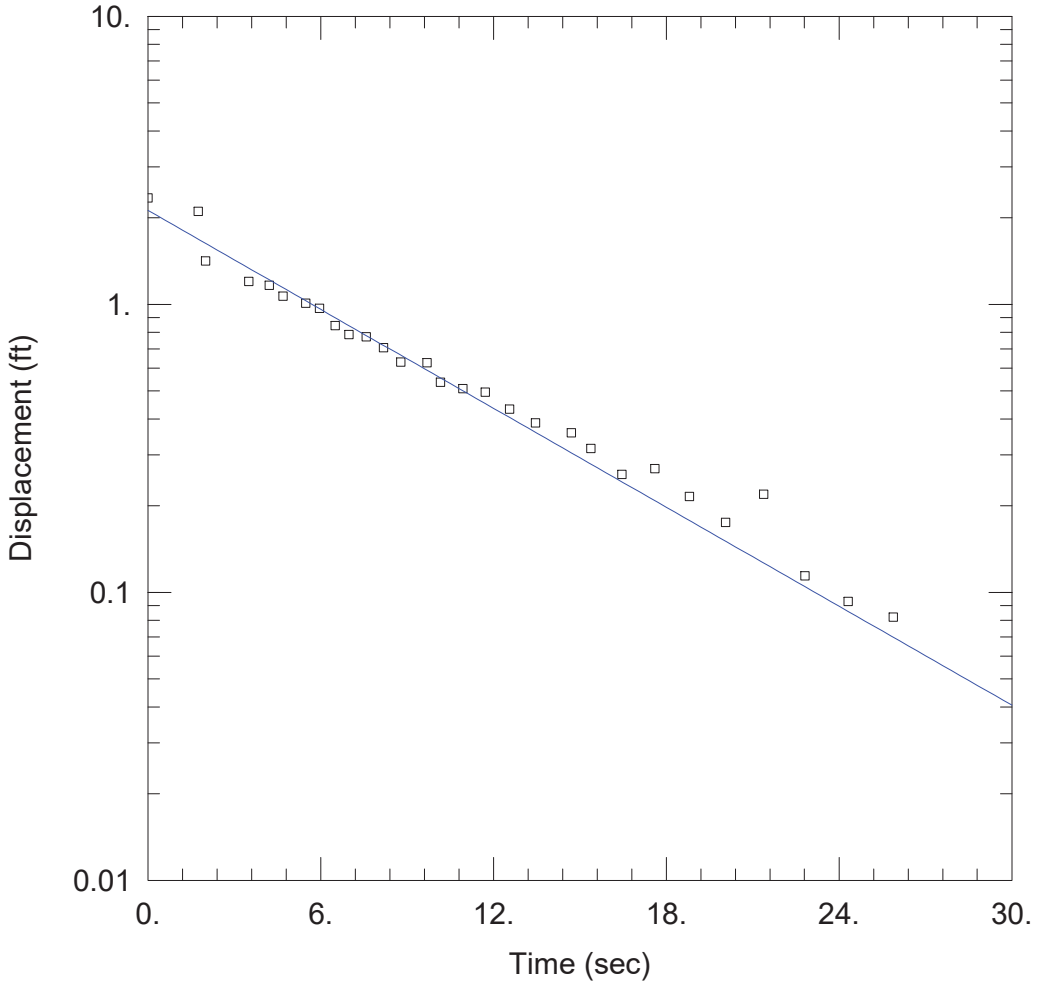
Saturated Thickness: 12.5 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16008)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 10.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 67.2 ft
Screen Length: 5. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 11.56 ft/day
y0 = 1.846 ft



JR MW-16008 SLUG IN 2

Data Set: S:\...\MW-16008.aqt
Date: 11/07/16 Time: 17:29:00

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16008
Test Date: 11/4/16

AQUIFER DATA

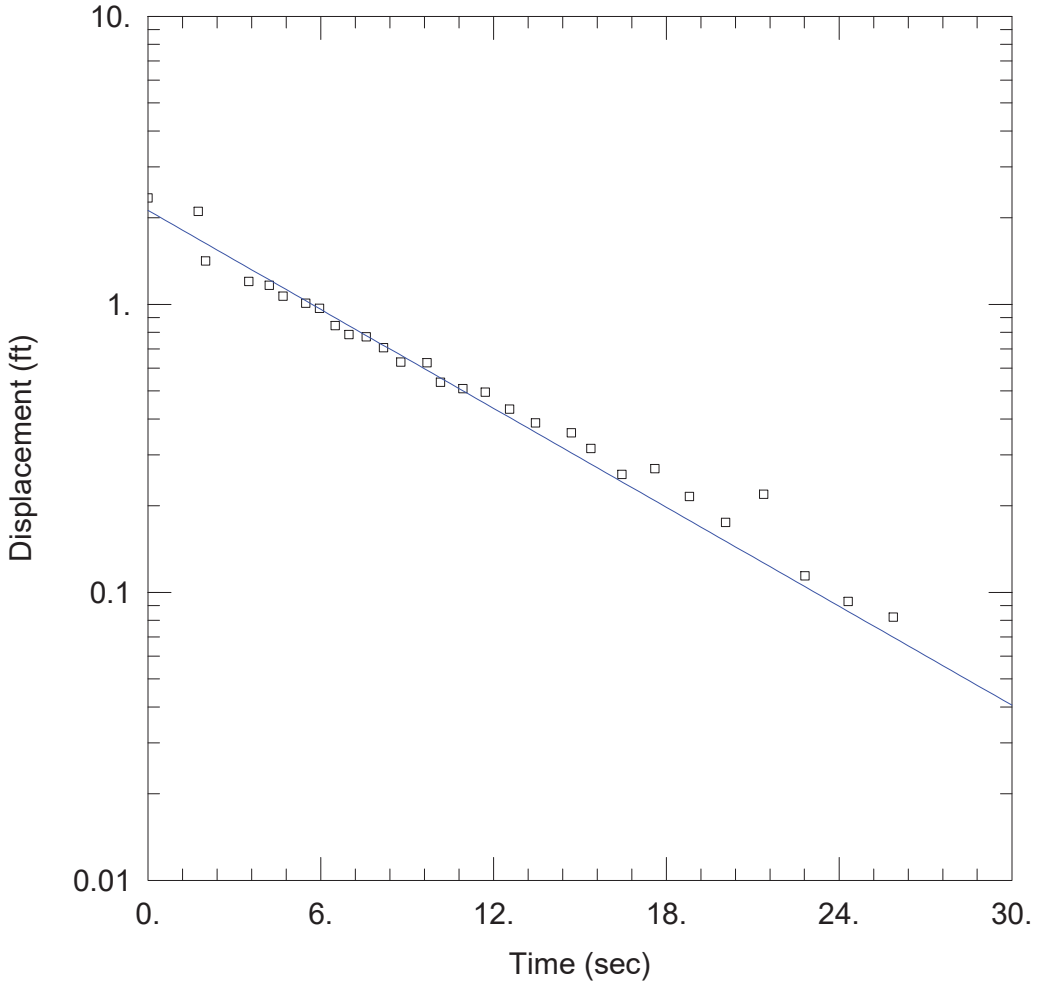
Saturated Thickness: 12.5 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16008)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 10.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 67.2 ft
Screen Length: 5. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 11.02 ft/day
y0 = 2.119 ft



JR MW-16008 SLUG IN 2

Data Set: S:\...\MW-16008.aqt
Date: 11/07/16 Time: 17:30:07

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16008
Test Date: 11/4/16

AQUIFER DATA

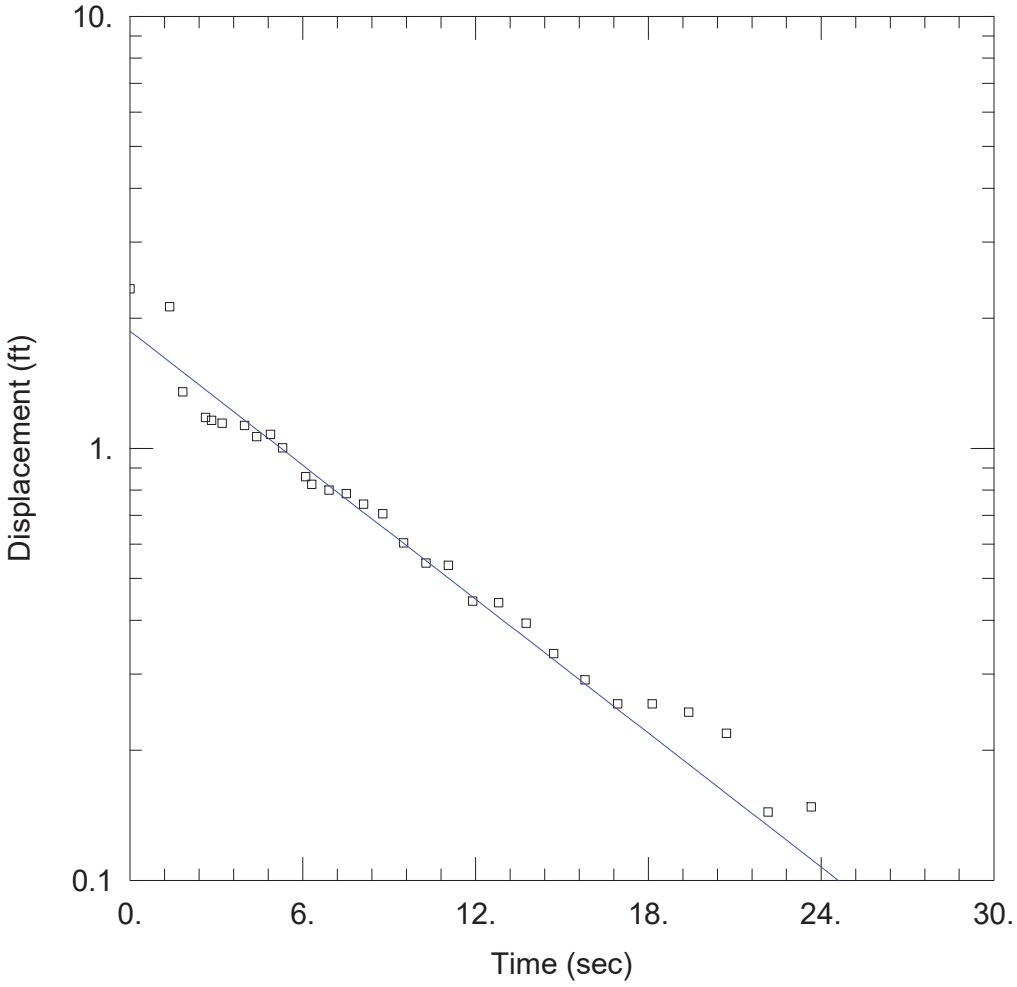
Saturated Thickness: 12.5 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16008)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 10.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 67.2 ft
Screen Length: 5. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 14.44 ft/day
y0 = 2.119 ft



JR MW-16008 SLUG IN 3

Data Set: S:\...\MW-16008.aqt
Date: 11/07/16 Time: 17:33:37

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16008
Test Date: 11/4/16

AQUIFER DATA

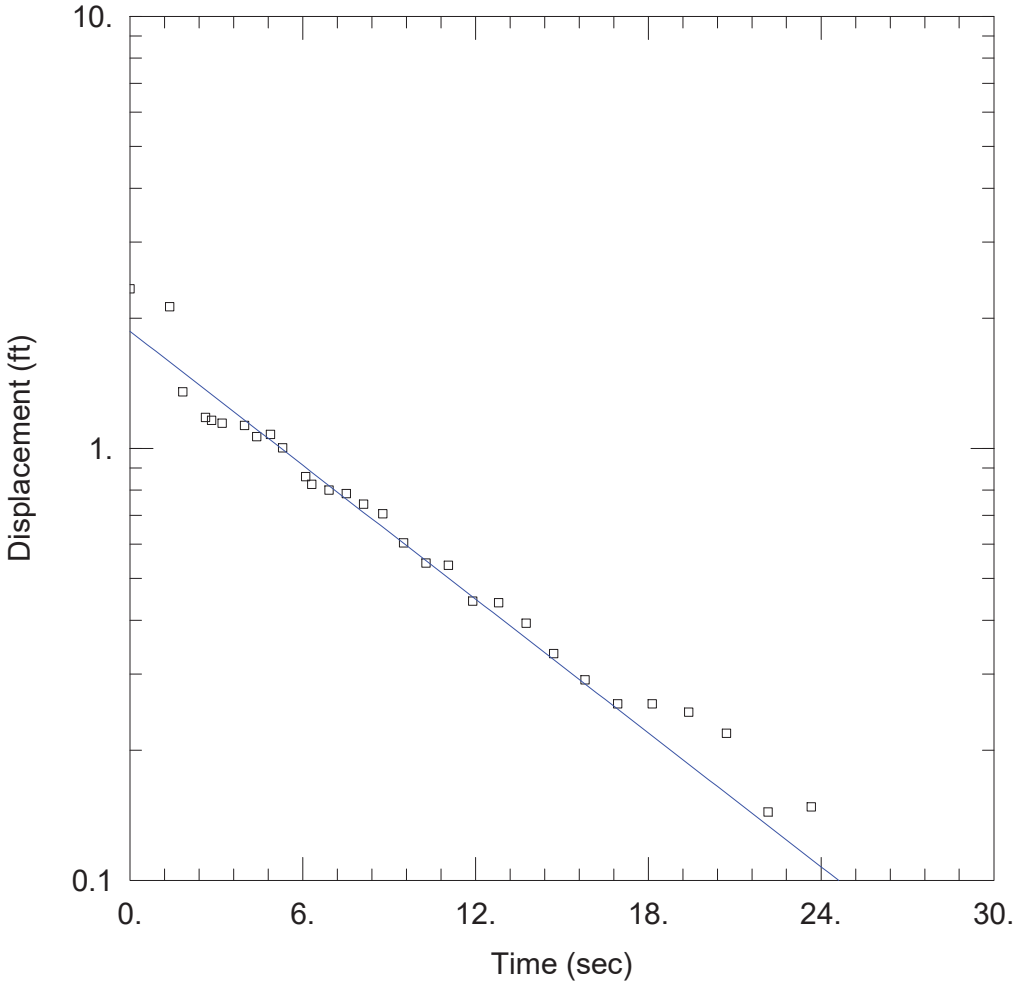
Saturated Thickness: 12.5 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16008)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 10.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 67.2 ft
Screen Length: 5. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 9.947 ft/day
y0 = 1.867 ft



JR MW-16008 SLUG IN 3

Data Set: S:\...\MW-16008.aqt
Date: 11/07/16 Time: 17:32:57

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16008
Test Date: 11/4/16

AQUIFER DATA

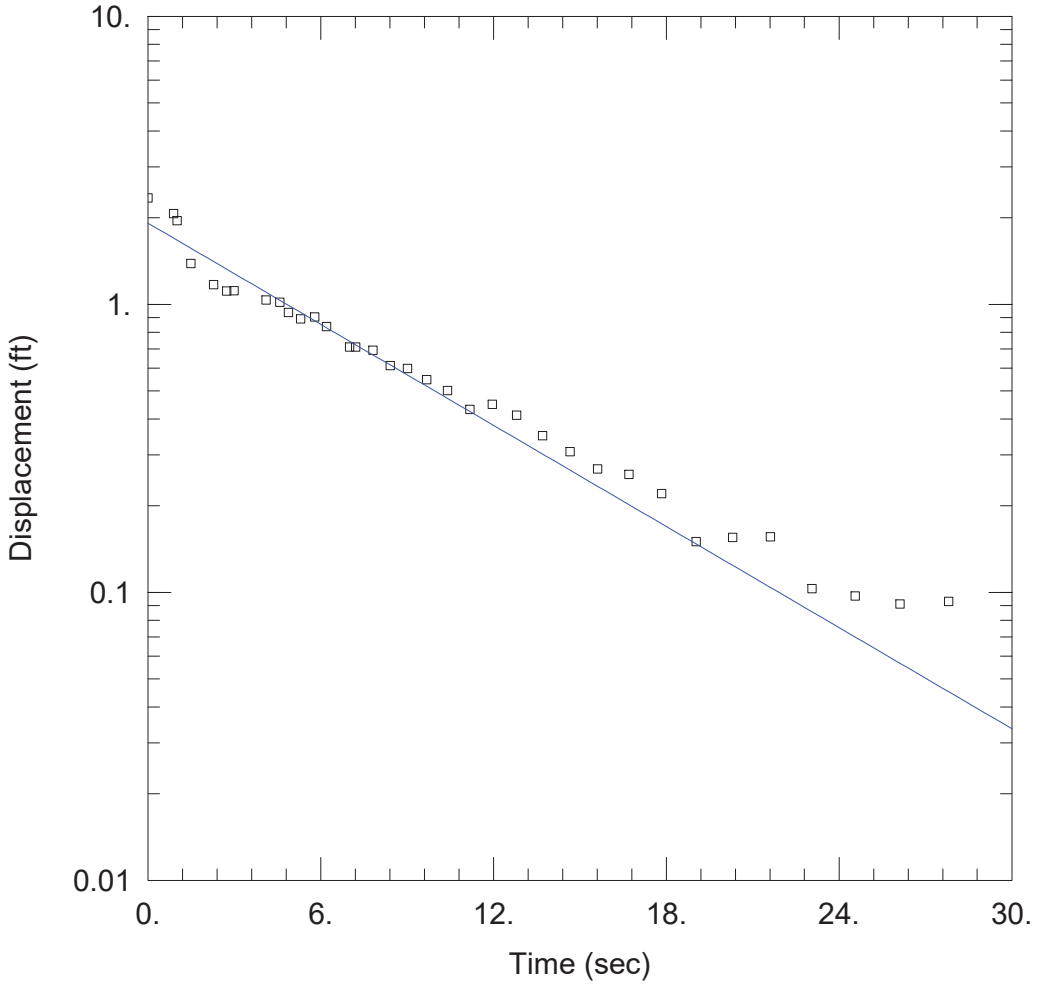
Saturated Thickness: 12.5 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16008)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 10.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 67.2 ft
Screen Length: 5. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
K = 13.02 ft/day
Solution Method: Hvorslev
y0 = 1.866 ft



JR MW-16008 SLUG IN 4

Data Set: S:\...\MW-16008.aqt
Date: 11/07/16 Time: 17:35:15

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16008
Test Date: 11/4/16

AQUIFER DATA

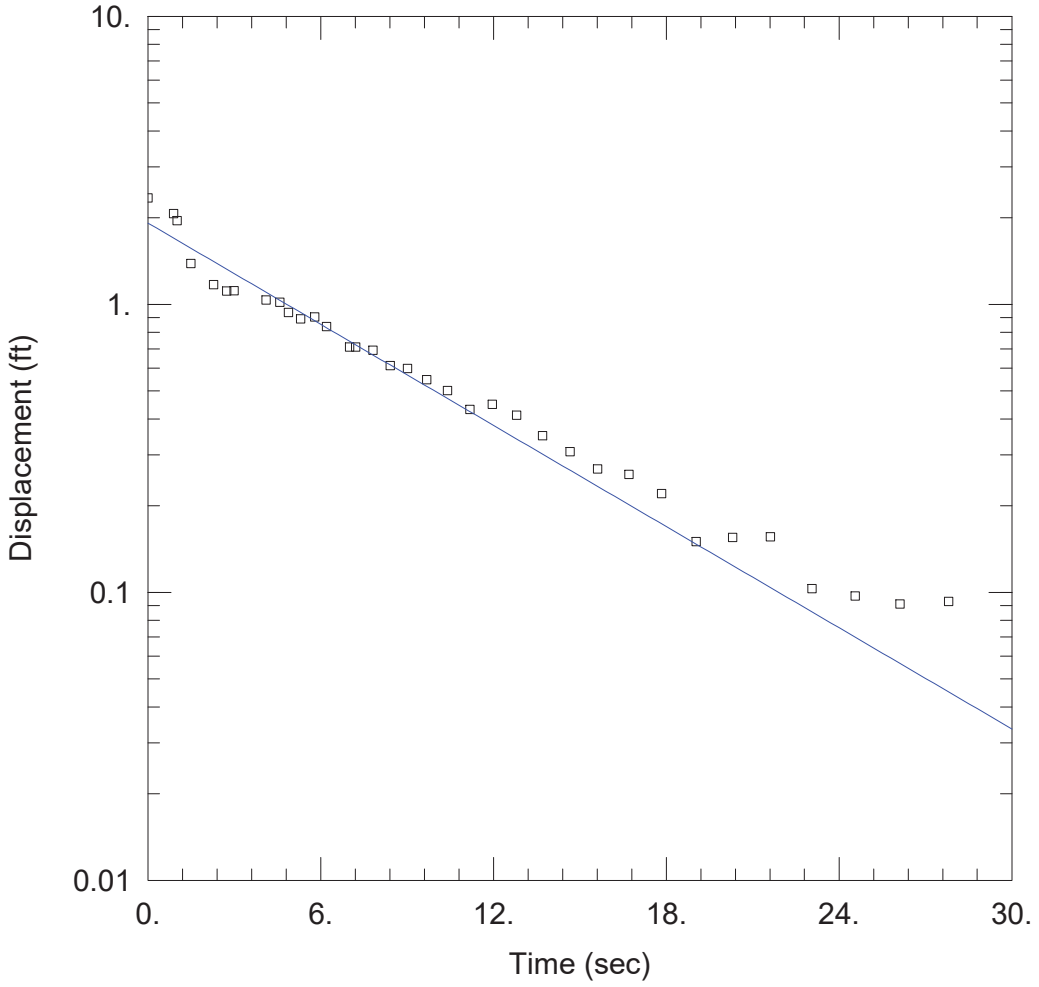
Saturated Thickness: 12.5 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16008)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 10.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 67.2 ft
Screen Length: 5. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 11.26 ft/day
y0 = 1.914 ft



JR MW-16008 SLUG IN 4

Data Set: S:\...\MW-16008.aqt
Date: 11/07/16 Time: 17:35:53

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16008
Test Date: 11/4/16

AQUIFER DATA

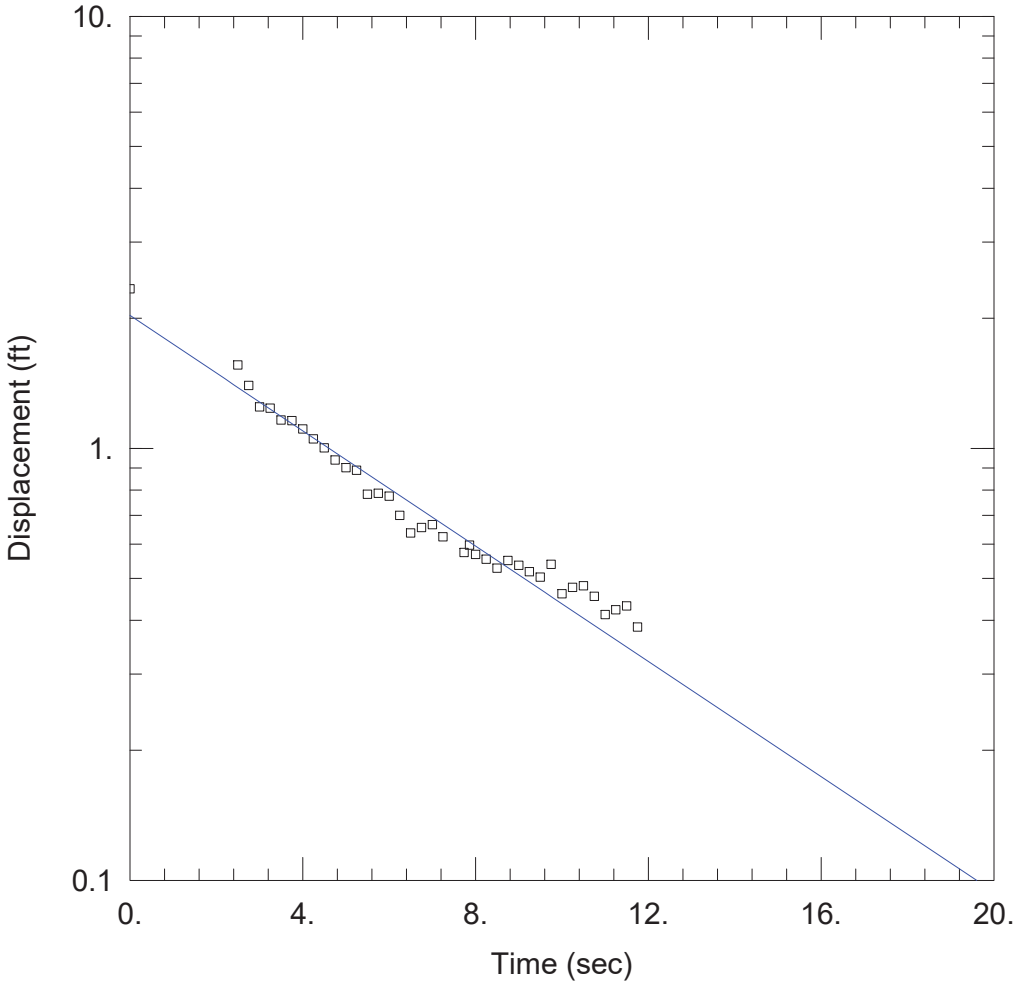
Saturated Thickness: 12.5 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16008)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 10.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 67.2 ft
Screen Length: 5. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 14.76 ft/day
y0 = 1.914 ft



JR MW-16009 SLUG IN 1

Data Set: S:\...\MW-16009.aqt
Date: 11/07/16 Time: 17:40:30

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16009
Test Date: 10/31/16

AQUIFER DATA

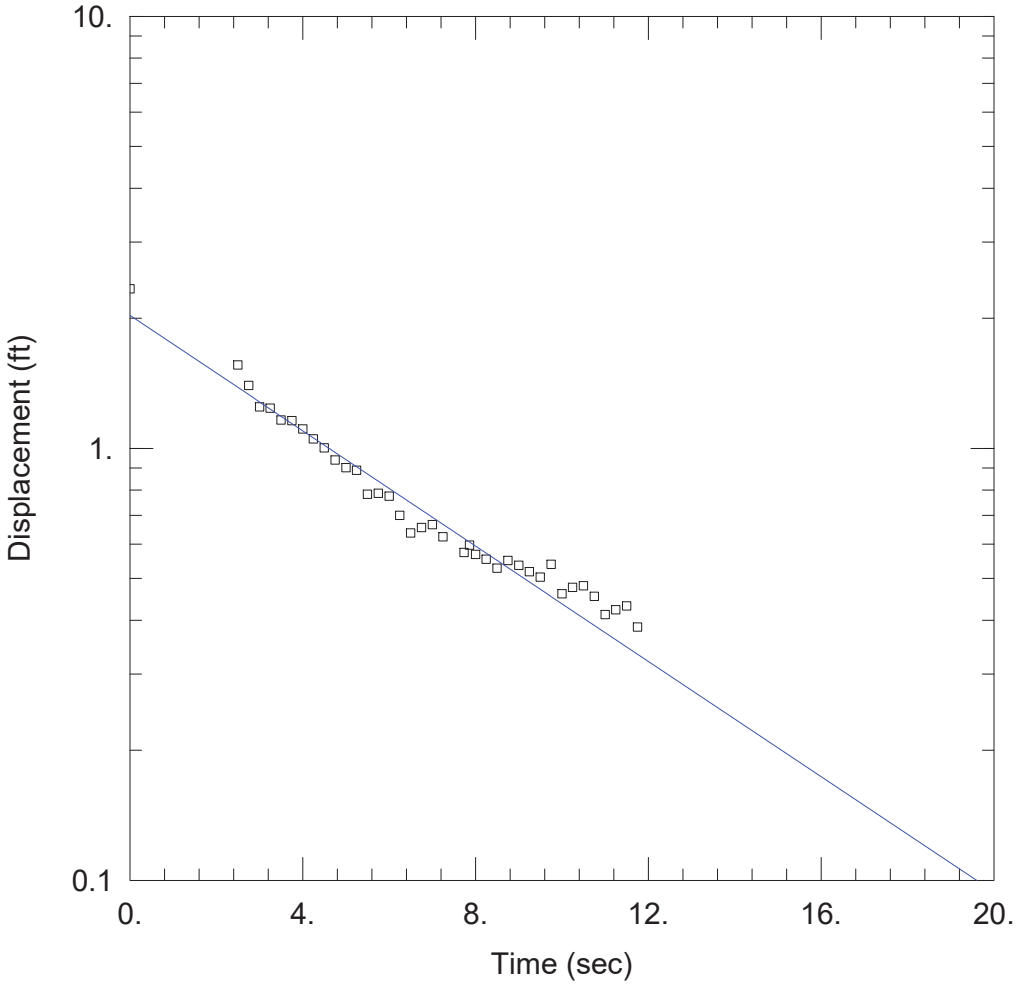
Saturated Thickness: 13.5 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16009)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 13.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 53.3 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 8.415 ft/day
y0 = 2.03 ft



JR MW-16009 SLUG IN 1

Data Set: S:\...\MW-16009.aqt
Date: 11/07/16 Time: 17:39:42

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16009
Test Date: 10/31/16

AQUIFER DATA

Saturated Thickness: 13.5 ft Anisotropy Ratio (Kz/Kr): 1.

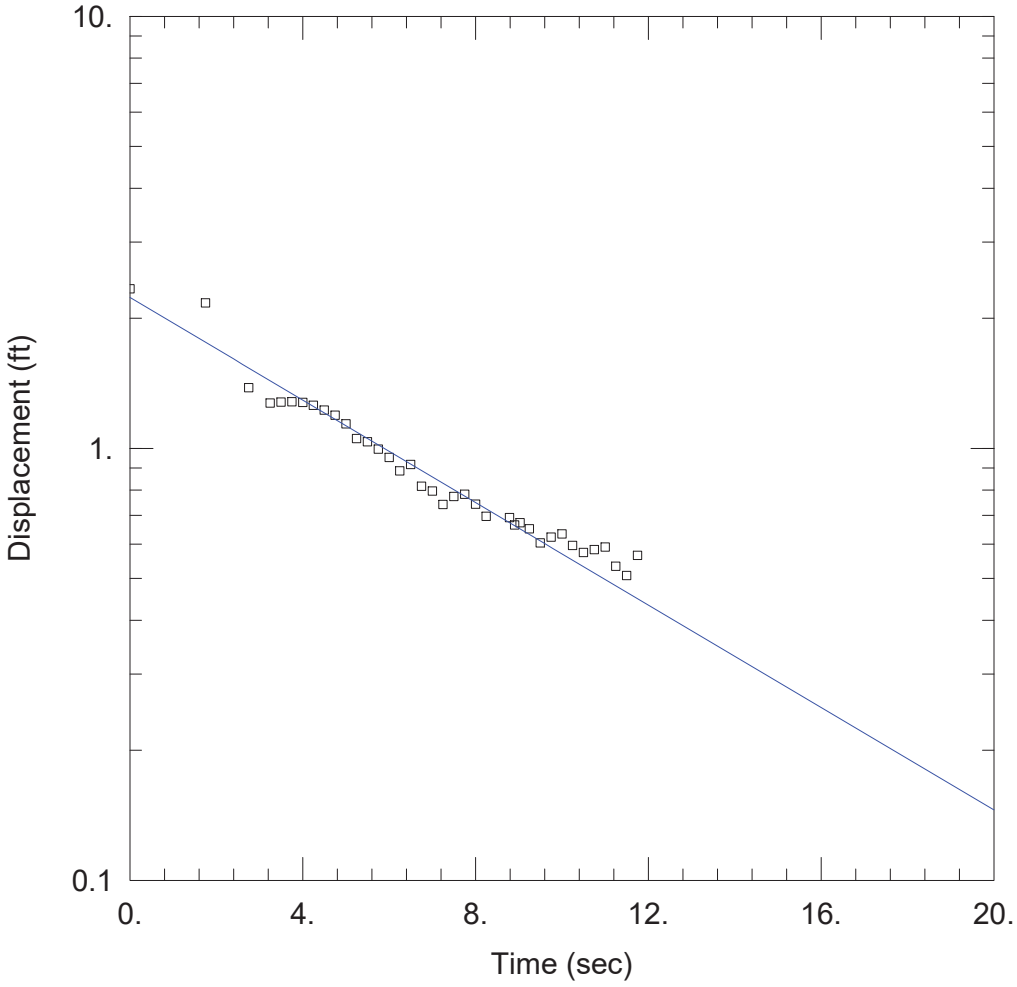
WELL DATA (JR MW-16009)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 13.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 53.3 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 12.29 ft/day y0 = 2.03 ft



JR MW-16009 SLUG IN 2

Data Set: S:\...\MW-16009.aqt
Date: 11/07/16 Time: 17:42:22

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16009
Test Date: 10/31/16

AQUIFER DATA

Saturated Thickness: 13.5 ft Anisotropy Ratio (Kz/Kr): 1.

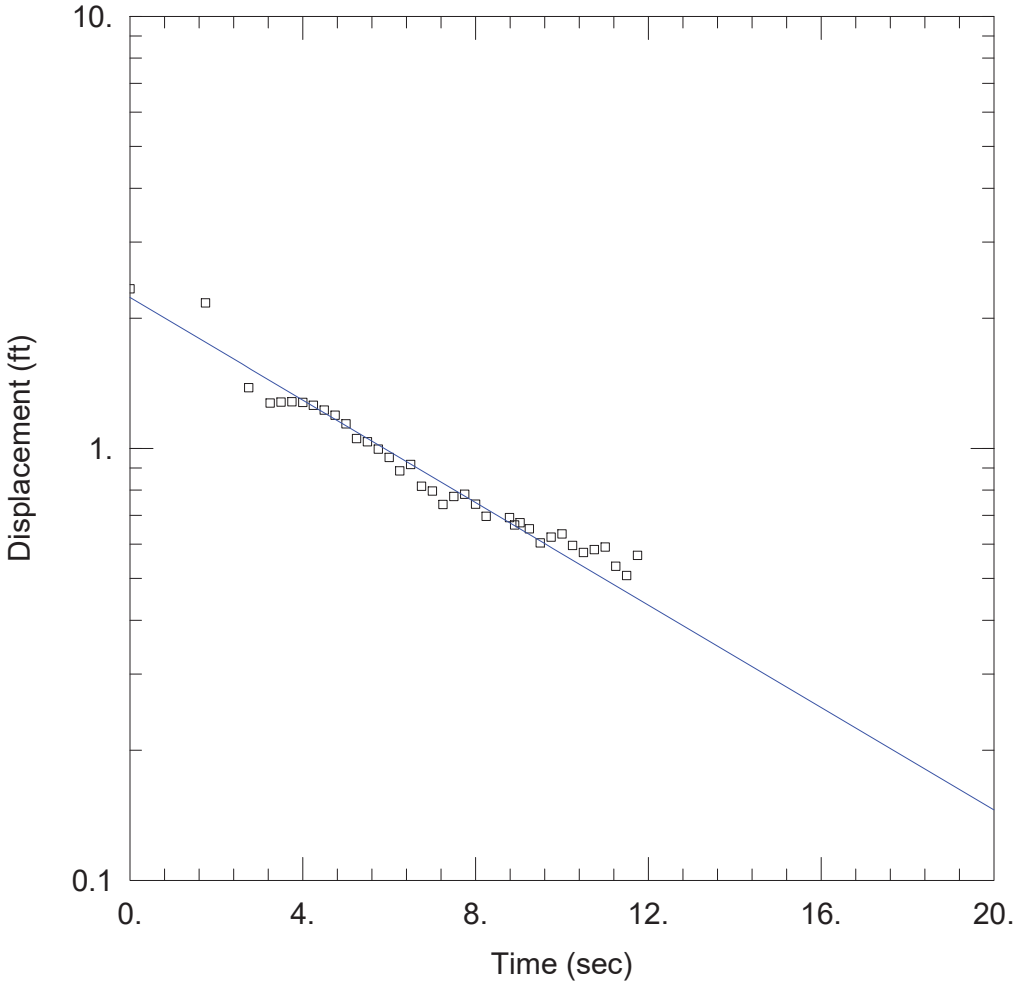
WELL DATA (JR MW-16009)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 13.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 53.3 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 7.481 ft/day
y0 = 2.233 ft



JR MW-16009 SLUG IN 2

Data Set: S:\...\MW-16009.aqt
Date: 11/07/16 Time: 17:43:00

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16009
Test Date: 10/31/16

AQUIFER DATA

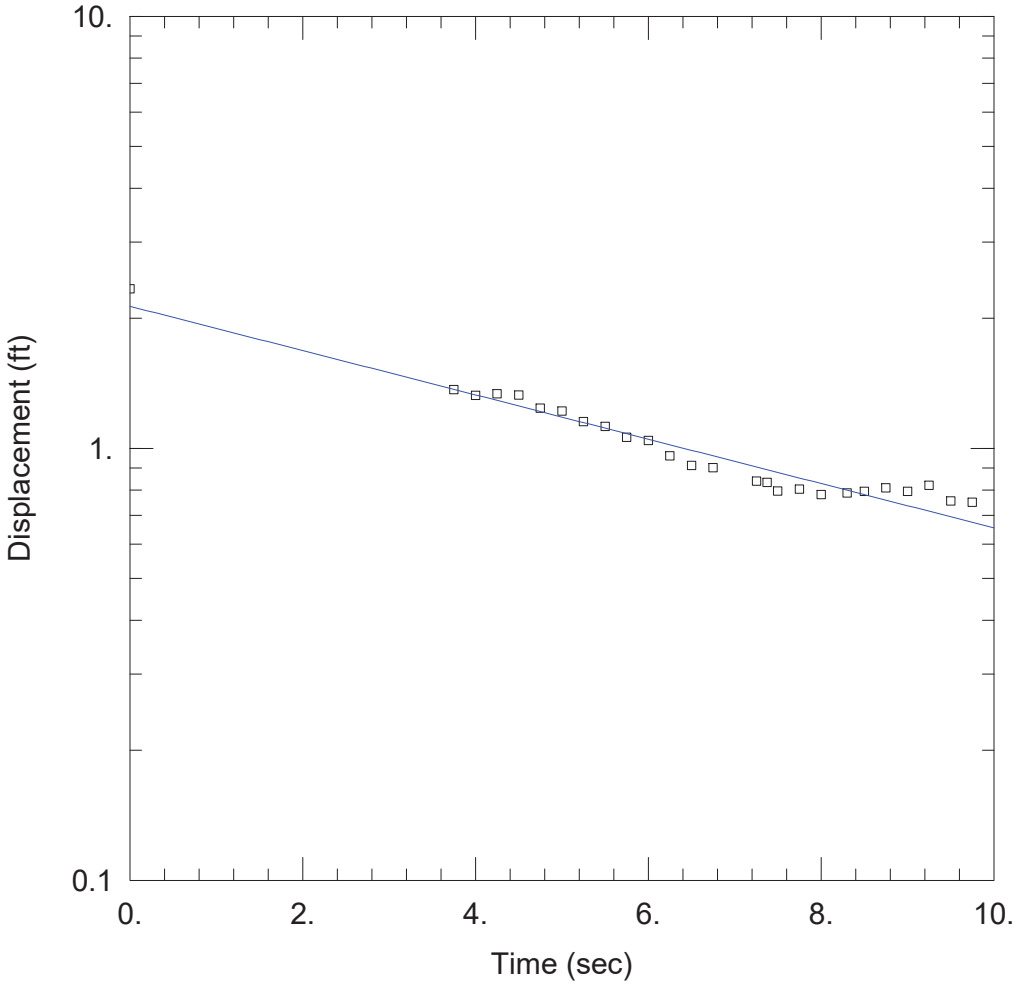
Saturated Thickness: 13.5 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16009)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 13.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 53.3 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 10.92 ft/day
y0 = 2.233 ft



JR MW-16009 SLUG IN 3

Data Set: S:\...\MW-16009.aqt
Date: 11/07/16 Time: 17:45:33

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16009
Test Date: 10/31/16

AQUIFER DATA

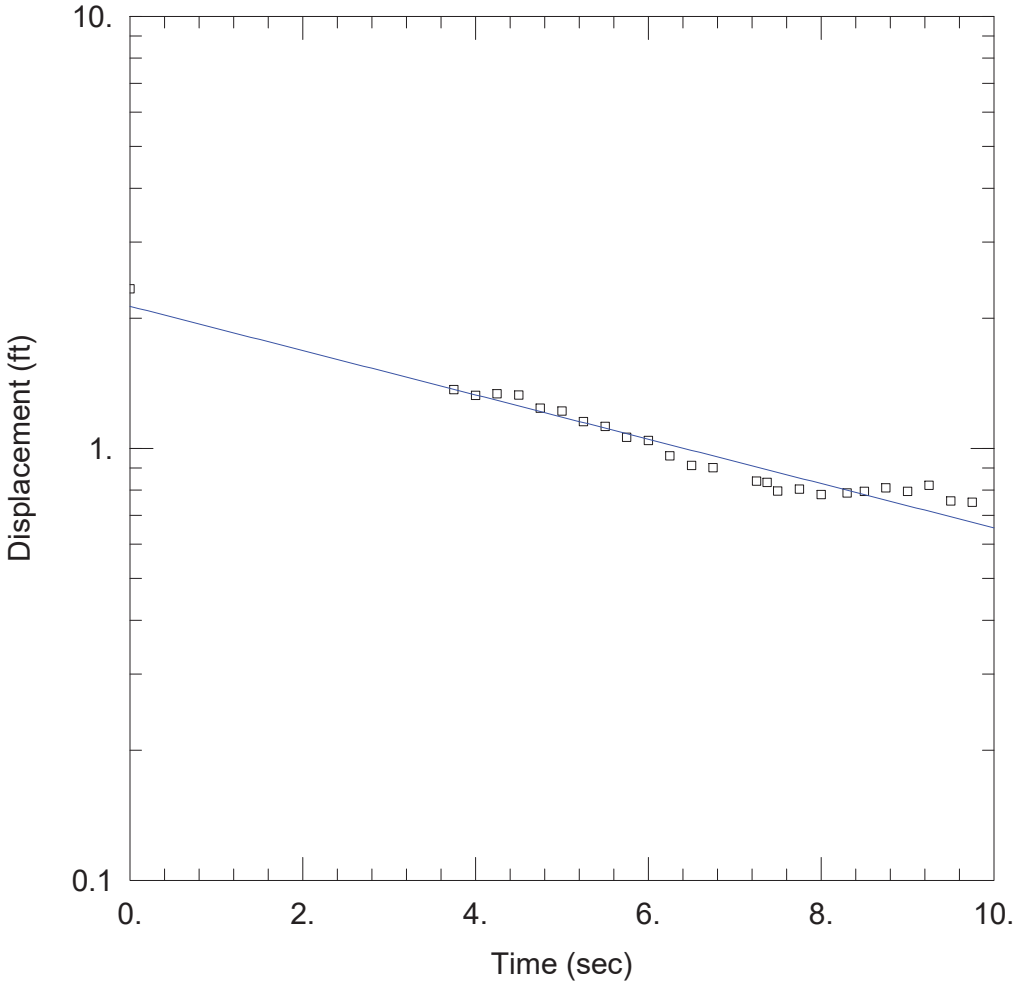
Saturated Thickness: 13.5 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16009)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 13.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 53.3 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 6.468 ft/day
y0 = 2.132 ft



JR MW-16009 SLUG IN 3

Data Set: S:\...\MW-16009.aqt
Date: 11/07/16 Time: 17:45:00

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16009
Test Date: 10/31/16

AQUIFER DATA

Saturated Thickness: 13.5 ft Anisotropy Ratio (Kz/Kr): 1.

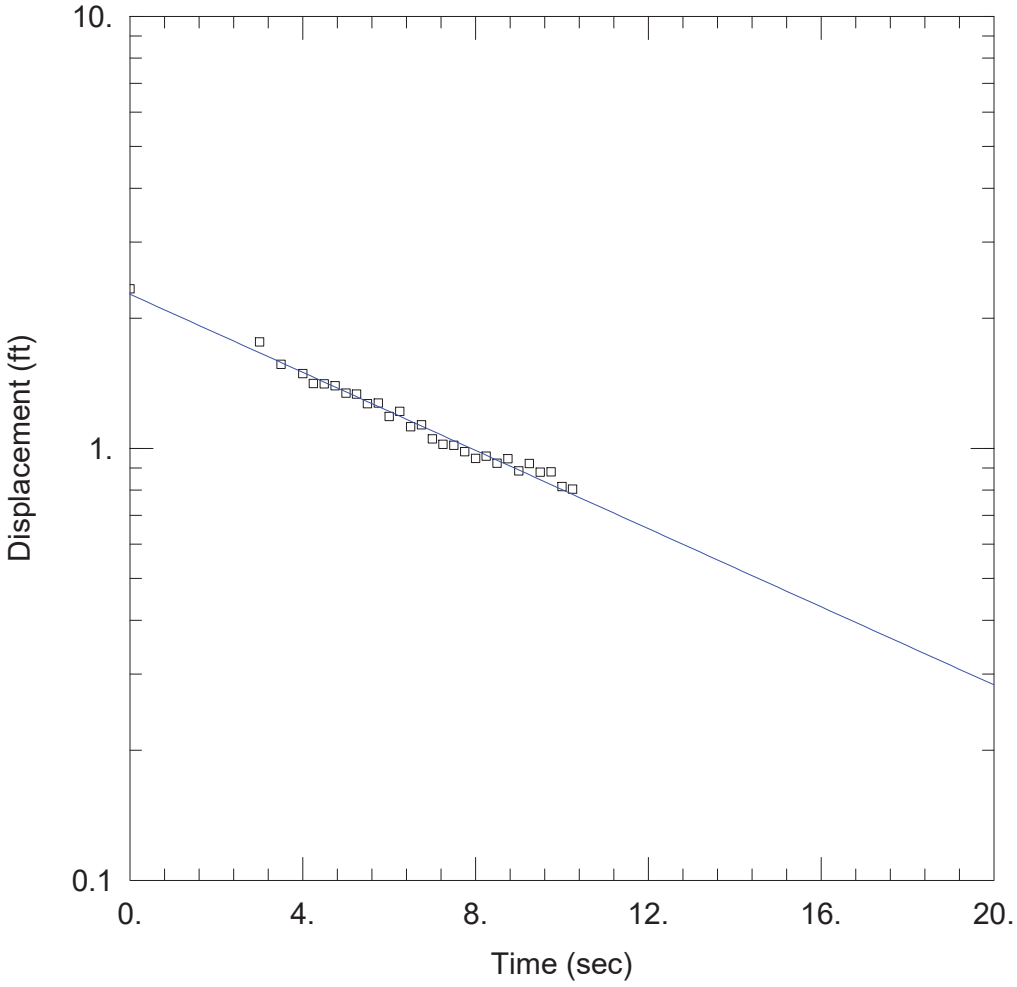
WELL DATA (JR MW-16009)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 13.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 53.3 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 9.446 ft/day y0 = 2.132 ft



JR MW-16009 SLUG IN 4

Data Set: S:\...\MW-16009.aqt
Date: 11/07/16 Time: 17:47:14

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16009
Test Date: 10/31/16

AQUIFER DATA

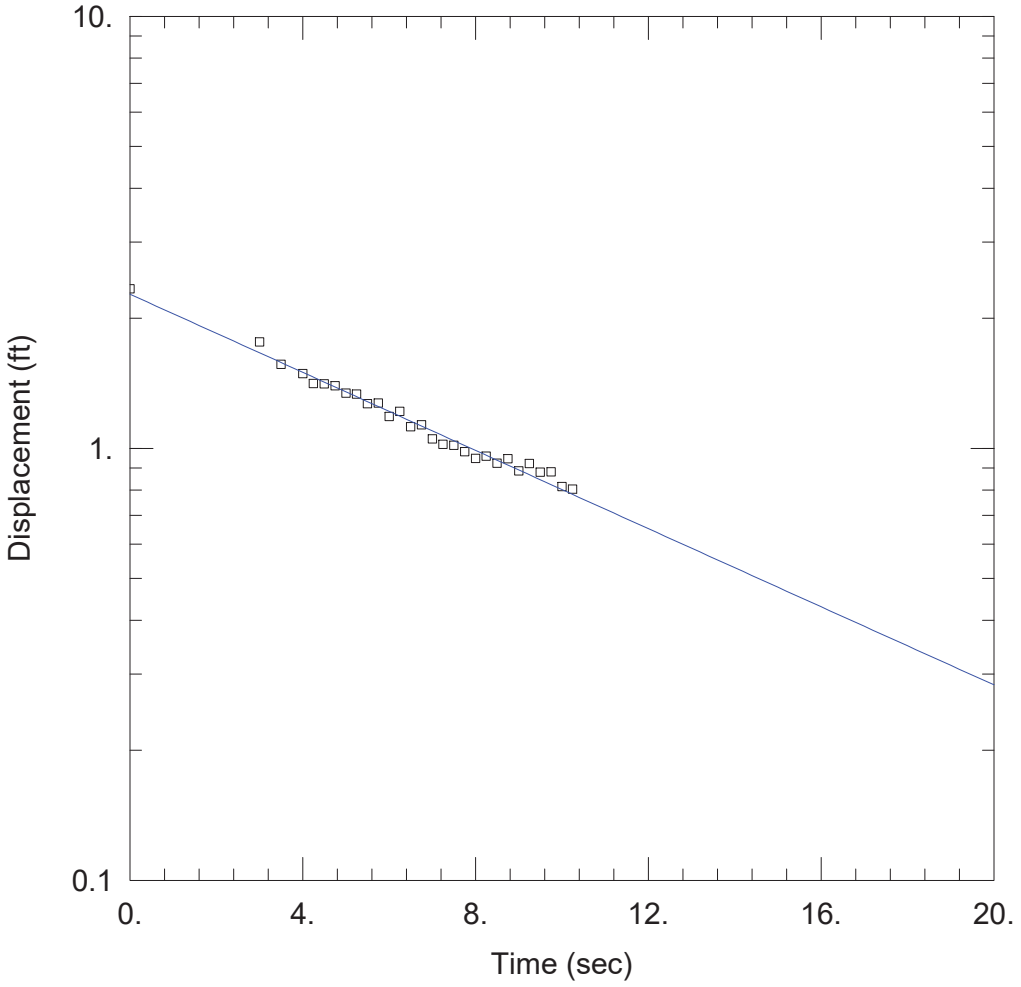
Saturated Thickness: 13.5 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16009)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 13.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 53.3 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 5.703 ft/day
y0 = 2.273 ft



JR MW-16009 SLUG IN 4

Data Set: S:\...\MW-16009.aqt
Date: 11/07/16 Time: 17:48:07

PROJECT INFORMATION

Company: FK Engineering
Client: Consumer's Energy
Project: 16-085
Location: Erie, Michigan
Test Well: JR MW-16009
Test Date: 10/31/16

AQUIFER DATA

Saturated Thickness: 13.5 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (JR MW-16009)

Initial Displacement: 2.34 ft
Total Well Penetration Depth: 13.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 53.3 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 8.327 ft/day y0 = 2.273 ft