

A CMS Energy Company

Date: October 17, 2017

To: Operating Record

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

RE: Groundwater Monitoring System Certification, §257.91(f)

J.H. Campbell Generating Complex, JH Campbell Pond A

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 JH Campbell Pond A, which established the following locations for determining background groundwater quality and detection monitoring.

Background:

JHC MW-15023 JHC MW-15024 JHC MW-15025

JHC MW-15026 JHC MW-15027 JHC MW-15028

Downgradient:

JHC MW-15006 JHC MW-15007 JHC MW-15008

JHC MW-15010 JHC MW-15011

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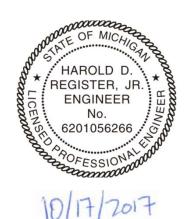
Provided herein, as required by §257.91(f), is certification from a qualified professional engineer that the groundwater monitoring system at Consumers Energy JH Campbell Pond A meets the requirements of §257.91.

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. Registe	,
Signature	
October 17, 2017	
Date of Certification	
Harold D. Register, Jr., P.E.	
Name	
6201056266	
Professional Engineer Certification Number	3 Γ



ENCLOSURES

ARCADIS (2016). "Summary of Monitoring Well Design, Installation, and Development - Pond A"



Consumers Energy Company

SUMMARY OF MONITORING WELL DESIGN, INSTALLATION, AND DEVELOPMENT – POND A

J.H. Campbell Electric Generation Facility – West Olive, Michigan

May 13, 2016

Gregory E. Zellmer, P.G.

Certified Project Manager/Senior Geologist

Mark Robert Klemmer, PE

Printed Name of Registered Professional Engineer

Signature of Registered Professional Engineer

Registration Number: 62010-49167 State: MI

Date: //3/6

Malla

Summary of Monitoring Well Design, Installation, and Development – Pond A

J.H. Campbell Electric Generation Facility

– West Olive, MI

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Appendix B - Photographic Log

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1 INTRODUCTION

ARCADIS has prepared this Summary of Monitoring Well Design, Installation, and Development (Report) to summarize monitoring well installation activities for Pond A at the J.H. Campbell electric generation facility (JHC), located in West Olive, Michigan (Site). The groundwater monitoring system for unit consists of eight background wells (JHC MW-15023 through JHC MW-15030) and six downgradient wells (JHC MW-15006 through JHC MW-15011) as depicted on Figure 1. Monitoring wells were installed to achieve compliance under the recently published 40 CFR Part 257, Subpart D – Standards for the Disposal of Coal Combustion Residuals (CCR) from Electric Utilities (specifically Section 257.91(e)(1)). This Report summarizes the groundwater monitoring well installation activities, including drilling procedures, well locations, well construction details, development activities, and hydraulic testing results. The methodology used in the field activities conforms to federal and state guidance and industry standards.

2 OBJECTIVES

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

- Advancement of soil borings
- Monitoring well installation
- Monitoring well development
- Hydraulic testing

The following section describes each of these elements in more detail.

3 FIELD ACTIVITIES

3.1 Soil Borings

Fourteen (14) soil borings (JHC MW-15006 through JHC MW-15011 and JHC MW-15023 through JHC MW-15030) were completed using rotosonic-drilling methods operated by Mateco Drilling Company of Grand Rapids, Michigan with oversight provided by an ARCADIS geologist. Rotosonic drilling uses powered equipment to collect subsurface-soil 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. An on-site geologist inspected each core, classified the contents, and recorded the observations on an ARCADIS boring log field sheet (**Appendix A**). A photographic log showing the general soil types observed at the Site is included as **Appendix B**. All soil borings were completed as monitoring wells, and details of monitoring well installation are provided in the following section.

3.2 Monitoring Well Installation

Once the total depth of the soil boring was reached, a permanent monitoring well was installed in the uppermost 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. The well screens have a slot size of 0.010 inch and are 10 feet in length. A medium-grained sand pack was placed around each well screen to a height 1 to 2 feet above the top of the well screen. A 2 to 7-foot thick bentonite grout seal was placed on top of the sand pack. Where possible, the remainder of the annular space was sealed with a cement-bentonite grout to a depth approximately 1 to 10-foot below ground surface.

The wells were finished at the surface using a 3-foot long, locking, stickup well cover set in a 24 inch by 24 inch concrete pad. Well construction logs are included in **Appendix A**; well construction is summarized in **Table 1**; well locations are shown on **Drawing SG-22345**. Wells were labeled according to Consumers Energy's site-specific nomenclature provided to ARCADIS. 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 consisted of the gentle swabbing of the entire screened interval with a surge block. After surging the well screen, water was evacuated using a submersible pump. A "flow-thru cell" and a turbidity meter were utilized to monitor indicator parameters (turbidity, pH, temperature, oxidation-reduction potential (ORP), and conductivity) to determine if groundwater parameters had appropriately stabilized during the development activities at each monitoring well. The stabilization parameters are provided below in **Table 2**. Indicator parameters were recorded in field notes and the development process continued until development water was free of visible sediment, stabilization of the field parameters, and below 10 Nephelometric Turbidity Units (NTUs). The volume of groundwater removed during development and its appearance was recorded in the field logbook. If drilling fluids were utilized during well installation, the volume of fluids used was recorded in the field logbook. This volume was removed in addition to the volume required for standard development. Monitoring well development details are included in **Table 1**.

Table 2. Groundwater Parameter Stabilization Criteria

Groundwater Parameter	Stabilization Criteria
рН	3 readings within +/- 0.1 Standard Units
Specific Conductance (SpC)	3 readings within +/- 3% mS/cms
Temperature	3 readings within +/- 3%
Oxidation-Reduction Potential (ORP)	3 readings within +/- 10 mV
Turbidity	3 readings within +/- 10% or <1 when < 10 NTU
Dissolved Oxygen (DO)	3 readings within +/- 0.3 mg/L

3.4 Hydraulic Testing

On November 10, 2015, Arcadis conducted hydraulic tests (slug tests) at nine monitoring wells (JHC MW-15005, JHC MW-15007, JHC MW-15015, JHC MW-15018, JHC MW-15024, JHC MW-15028, JHC MW-15030, JHC MW-15033, and JHC MW-15036) at the Site. Well construction logs are included in **Appendix A**; well construction is summarized in **Table 1**.

During the slug testing activities, three tests were completed at each of the monitoring wells. The slug tests at these wells were completed to estimate hydraulic conductivity (K) by introducing a water table displacement by removing a known volume of water or depressing the water level by compressed air and measuring the rate of recovery. With the exception of the tests competed at JHC MW-15005 and JHC MW-15015, the tests at all wells were completed using a disposable bailer to remove a known volume of water. The bailer used at all wells was 1.5-inches in diameter and 36-inches long. At all the wells where the baildown slug was used, the first two tests were competed using half the bailer size and the last test was completed using the full size bailer. The tests at JHC MW-15005 and JHC MW-15015 were completed using the pneumatic slug test method where a manifold and pump was used to depress the water level. All wells have casing and screen diameters of 2-inches and filter pack diameter of 8-inches. All wells, with the exception of JHC MW-15015 were screened across the water table at the time of well development and hydraulic testing. JHC MW-15015 was screened 2.57 feet below the water table at the time of hydraulic testing. At all wells, a pressure transducer was set to record at 0.5 second intervals to measure static head, displacement and recovery data.

The slug tests at the nine monitoring wells reached full recovery within approximately 7 to 35 seconds. Recovery data collected from the wells were analyzed using the applicable analytical solution with AQTESOLV® for Windows®. Based on diagnostic analyses, the solution utilized at most of the recovery data was the unconfined KGS model (1994) that accounts for partial penetration effects. The unconfined Bouwer and Rice (1976 and 1989) solution was utilized for recovery data at JHC MW-15030. The results indicated an estimated hydraulic conductivity range from 21 to 139 feet per day (ft/d) with an average of 73 ft/d and a geometric mean of 62 ft/d. The results of this test seem to be a reasonable fit with the sandy formation of the unconfined aquifer where the wells are screened. The monitoring well locations where slug tests were conducted are shown on **Drawing SG-22345** and the results of the hydraulic conductivity tests are presented in **Table 3** and **Appendix C**.

TABLES

Table 1
Monitoring Well Construction and Development Summary
Consumers Energy Co.
J.H. Campbell Generating Facility
West Olive, Michigan



			Site Coo	dinates					Well	Screen		D	evelopment Detai	ls	
MW ID	Former MW ID	Northing	Easting	тос	Ground Elevation	Date Installed	Geologic Unit of Screen Interval	Well Construction	Screen Length (ft)	Interval (ft bgs)	Static DTW (ft below TOC)	Total Depth	Pumping DTW (ft below TOC)	Gallons Removed	Final Turbity (NTU)
Downgradient MW															
JHC MW-15006		517535.73	12635481.66	624.74	627.58	9/18/2015	Silty Sand / Sand	2" PVC, 10 slot	10	25 - 35	28.90	38.02	29.05	60	6.69
JHC MW-15007		517540.50	12635742.72	624.82	627.70	9/21/2015	Sand	2" PVC, 10 slot	10	22 - 32	29.28	34.75	29.36	55	2.64
JHC MW-15008		517560.39	12636031.25	632.43	635.30	9/21/2015	Sand	2" PVC, 10 slot	10	28 - 38	38.25	40.76	NR	30	2.29
JHC MW-15009		517779.13	12636014.80	632.33	635.32	9/22/2015	Sand	2" PVC, 10 slot	10	30 - 40	37.14	42.88	37.21	30	1.19
JHC MW-15010		518009.36	12636011.46	632.55	635.57	9/23/2015	Sand	2" PVC, 10 slot	10	30 - 40	36.57	42.88	36.64	50	2.90
JHC MW-15011		517540.50	12634931.59	627.71	630.83	9/23/2015	Sand	2" PVC, 10 slot	10	27 - 37	34.45	40.12	34.61	90	4.42
Background MW															
JHC MW-15023		521927.21	12638205.16	617.01	619.98	10/1/2015	Sand	2" PVC, 10 slot	10	14 - 24	18.91	27.68	NR	130	7.94
JHC MW-15024		522366.01	12637322.68	613.79	616.62	10/1/2015	Sand	2" PVC, 10 slot	10	7 - 17	14.12	19.93	14.49	135	3.31
JHC MW-15025		522702.98	12636668.15	614.14	617.17	10/1/2015	Sand	2" PVC, 10 slot	10	7 - 17	13.50	19.94	14.42	90	2.32
JHC MW-15026		522495.09	12635971.82	615.09	618.04	10/2/2015	Sand	2" PVC, 10 slot	10	8 - 18	15.34	21.02	15.97	180	8.88
JHC MW-15027		522394.86	12635097.51	614.77	617.30	10/2/2015	Sand	2" PVC, 10 slot	10	10 - 20	15.85	22.99	16.36	90	4.31
JHC MW-15028		521646.20	12634105.34	611.02	613.80	10/2/2015	Sand	2" PVC, 10 slot	10	8 - 18	14.38	20.82	14.62	220	9.80
JHC MW-15029		520503.52	12633774.30	608.08	610.95	10/5/2015	Sand	2" PVC, 10 slot	10	8 - 18	10.03	20.96	10.26	105	4.21
JHC MW-15030		519760.83	12633044.37	604.05	607.17	10/5/2015	Sand	2" PVC, 10 slot	10	4 - 14	7.99	16.93	8.30	NR	8.81
Hydraulic Testing MW															
JHC MW-15005		517781.42	12633905.01	624.37	627.30	9/18/2015	Sand	2" PVC, 10 slot	10	27 - 37	33.26	40.10	33.51	45	2.11
JHC MW-15007		517540.50	12635742.72	624.82	627.70	9/21/2015	Sand	2" PVC, 10 slot	10	22 - 32	29.28	34.75	29.36	55	2.64
JHC MW-15015		519715.11	12634186.63	632.46	635.20	9/28/2015	Sand	2" PVC, 10 slot	10	28 - 38	28.57	41.28	29.48	90	5.09
JHC MW-15018		521075.54	12635979.61	614.26	617.02	9/28/2015	Sand	2" PVC, 10 slot	10	10 - 20	16.23	22.95	NR	80	3.99
JHC MW-15024		522366.01	12637322.68	613.79	616.62	10/1/2015	Sand	2" PVC, 10 slot	10	7 - 17	14.12	19.93	14.49	135	3.31
JHC MW-15028		521646.20	12634105.34	611.02	613.80	10/2/2015	Sand	2" PVC, 10 slot	10	8 - 18	14.38	20.82	14.62	220	9.80
JHC MW-15030		519760.83	12633044.37	604.05	607.17	10/5/2015	Sand	2" PVC, 10 slot	10	4 - 14	7.99	16.93	8.30	NR	8.81
JHC MW-15033		521075.81	12638598.12	618.08	620.99	10/6/2015	Sand	2" PVC, 10 slot	10	16 - 26	22.93	28.78	23.2	120	5.47
JHC MW-15036	MW-B6	520099.80	12638094.34	617.94	618.34	3/13/2001	Sand	2" PVC, 10 slot	10	20 - 30	NA	NA	NA	NA	NA
															<u> </u>

Notes: ft = feet

bgs = below ground surface
TOC = top of casing

NR = Not recorded

Table 3
Estimated Hydraulic Conductivity (K) Values
Consumers Energy Co.
J.H. Campbell Generating Facility
West Olive, Michigan



Well ID	Test	H ⁰ (ft)	H ^ˆ (ft)	K (ft/d)	K (cm/sec)	Slug Test Solution
	2	0.738	0.844	61	2.15E-02	KGS Model (Hyder et. al, 1994)
JHC MW-15005	3	1.422	1.69	58	2.05E-02	KGS Model (Hyder et. al, 1994)
		Average		60	2.10E-02	
	2	0.777	0.844	118	4.16E-02	KGS Model (Hyder et. al, 1994)
JHC MW-15036	3	1.219	1.69	139	4.90E-02	KGS Model (Hyder et. al, 1994)
		Average		129	4.53E-02	
JHC MW-15007	1	0.629	0.844	130	4.59E-02	KGS Model (Hyder et. al, 1994)
	2	0.879	1.15	22	7.76E-03	KGS Model (Hyder et. al, 1994)
JHC MW-15015	3	1.98	2.31	21	7.41E-03	KGS Model (Hyder et. al, 1994)
		Average		22	7.59E-03	
	2	0.801	0.844	49	1.73E-02	KGS Model (Hyder et. al, 1994)
JHC MW-15024	3	1.534	1.69	45	1.59E-02	KGS Model (Hyder et. al, 1994)
		Average		47	1.66E-02	
	1	0.704	0.844	104	3.67E-02	KGS Model (Hyder et. al, 1994)
JHC MW-15028	3	1.515	1.69	86	3.03E-02	KGS Model (Hyder et. al, 1994)
		Average		95	3.35E-02	
JHC MW-15033	2	0.669	0.844	74	2.61E-02	KGS Model (Hyder et. al, 1994)
	2	0.701	0.844	100	3.53E-02	Bouwer-Rice (1976)
JHC MW-15030	3	1.194	1.69	87	3.07E-02	Bouwer-Rice (1976)
		Average		94	3.30E-02	
	1	0.732	0.844	34	1.20E-02	KGS Model (Hyder et. al, 1994)
JHC MW-15018	3	1.486	1.69	33	1.16E-02	KGS Model (Hyder et. al, 1994)
		Average		34	1.18E-02	
	Over all Ave	rage		73	2.56E-02	
	Over all Geometr			62	2.19E-02	
	Minimum	า		21	7.41E-03	
	Maximun	n		139	4.90E-02	

Note:

H⁰ = initial displacement

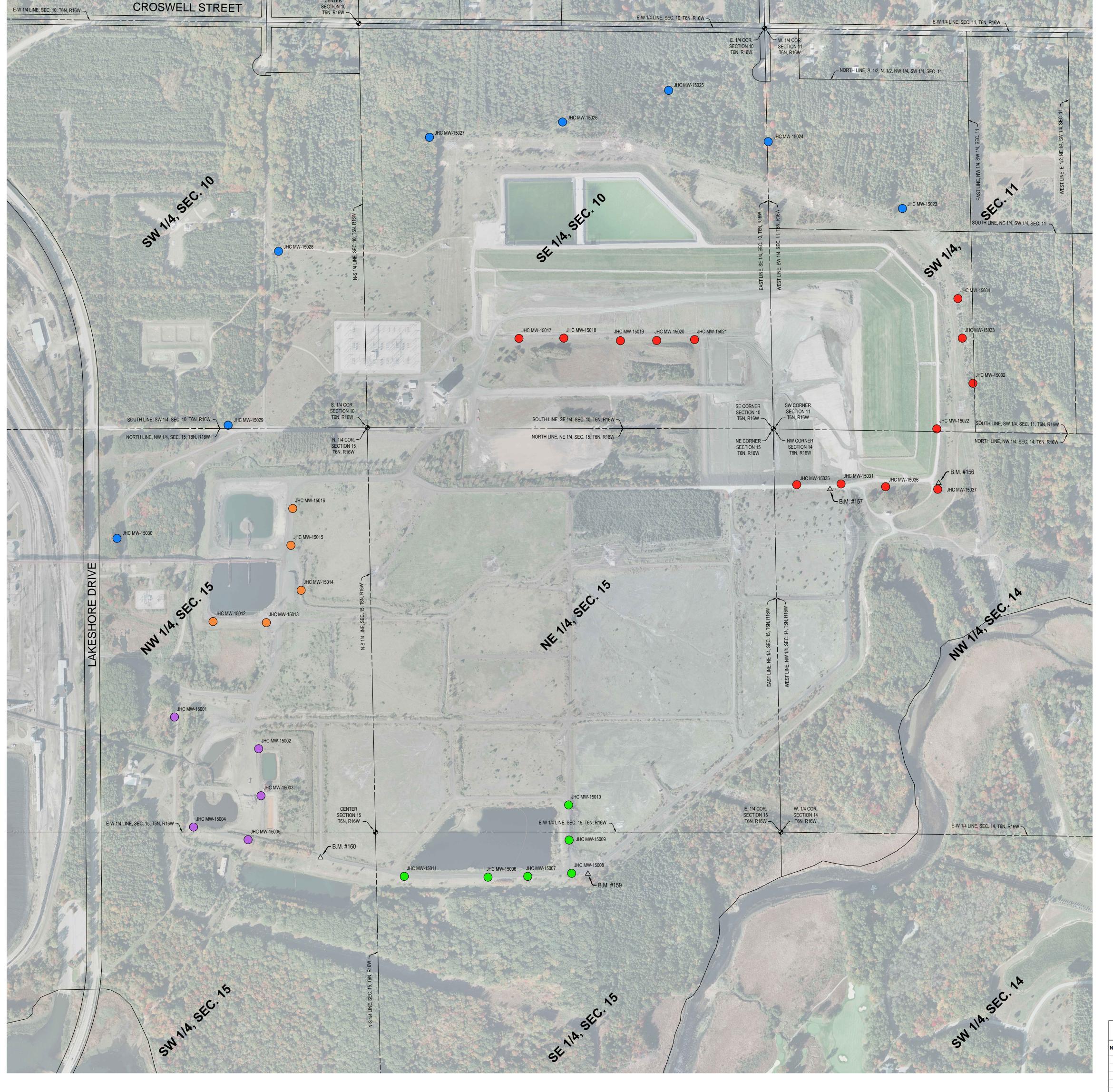
H = expected (calculated) displacement

cm/sec = centimeters per second

ft = feet

ft/d = feet per day

FIGURES



BENCHMARKS

BENCHMARK #150 ELEV. = 611.72 (NAVD88) Set railroad spike in West side of power pole 32'± East of centerline of old Hiawatha Drive, 1000'± North of Polk

BENCHMARK #151 ELEV. = 612.77 (NAVD88)

Set on top of top bolt on West side of Northwest tower leg of middle tower of three running North-South.

BENCHMARK #152 ELEV. = 620.75 (NAVD88)

Set on top of top bolt on Southwest side of South tower leg of North-most tower.

BENCHMARK #153 ELEV. = 618.84 (NAVD88) Set on top of top bolt on North side of Northwest tower leg.

BENCHMARK #157 ELEV. = 630.91 (NAVD88)

BENCHMARK #154 ELEV. = 614.44 (NAVD88)

Set on top of top bolt on North side of Northwest tower leg, 50'± East of two-track to North extended. BENCHMARK #155 ELEV. = 619.32 (NAVD88)

JHC Control Point #33 monument, 100'± South and 100'± West of woods line in Northeast corner of site. BENCHMARK #156 ELEV. = 617.12 (NAVD88)

JHC Control Point #34 monument, approximately at top of bank, Southeast part of site, 60'± Southeast of gravel drive, approximately at Southeast corner of grassy mound.

JHC Control Point #35 monument, 7'± South of South edge of gravel drive, 120'± West of centerline of gravel to South, approximately at Southwest corner of grassy mound.

BENCHMARK #158 ELEV. = 631.45 (NAVD88) JHC Control Point monument, no #, on top of bank approximately at point of intersection of gravel road to North and Southwest, 22'± South of centerline of gravel road at Southeast corner of site.

BENCHMARK #159 ELEV. = 632.77 (NAVD88)

JHC Control Point monument, no #, 0.5' above ground level, approximately at point of intersection of centerline of gravel road to Northeast and West 30'± South of centerline of gravel road on top of bank.

BENCHMARK #160 ELEV. = 631.70 (NAVD88) JHC Control Point monument, 0.25'± above ground level, at top of bank 22'± South of centerline "T" intersection of gravel drive roads going East, West and North, approximately at centerline point of intersection of centerline to North and East.

BENCHMARK #161 ELEV. = 628.67 (NAVD88)

Set railroad spike in Northwest side of light pole, 5' West of fence, 100'± South of Northwest corner of fence surrounding a pond and a metal building, approximate Southwest part of site.

BENCHMARK #162 ELEV. = 633.81 (NAVD88)

Set on top of bolt on East side on East side of Southeast tower leg, North-most tower of three, North and East of Monitor Well 15013 (Tower #6810).

BENCHMARK #163 ELEV. = 635.03 (NAVD88)

Set on top of steel post holding bird house #150, across gravel road from Northeast corner of ash pond.

TYPICAL INSTRUMENTATION STRUCTURE

JHC MW-15012



JHC MW-15014



JHC MW-15018

JHC MW-15029





Randal J. Vugteveen Professional Surveyor No. 28429 Nederveld, Inc. rvugteveen@nederveld.com

SURVEY POINT	INSTRUMENTATION			GROUND ELEVATION	TOP OF CASING		
		NORTHING	EASTING	(TOP OF CONCRETE)	ELEVATION	LATITUDE	LONGITUDE
NUMBER	STRUCTURE	NAD83 ADJ.2011 IN	TERNATIONAL FT.	(NAVD88)	(NAVD88)	(DECIMAL	DEGREES)
70035	JHC MW-15001	518586.883	12633422.010	607.02	609.53	42.908415	-86.195653
70034	JHC MW-15002	518378.917	12633974.821	625.97	628.87	42.907878	-86.193573
70033	JHC MW-15003	518069.863	12633990.368	628.31	630.63	42.907031	-86.193490
70032	JHC MW-15004	517864.558	12633547.120	624.92	628.44	42.906441	-86.195127
70031	JHC MW-15005	517781.423	12633905.007	624.37	627.30	42.906234	-86.193785
70028	JHC MW-15006	517535.735	12635481.661	624.74	627.58	42.905654	-86.187881
70027	JHC MW-15007	517540.502	12635742.724	624.82	627.70	42.905683	-86.186908
70025	JHC MW-15008	517560.390	12636031.246	632.43	635.30	42.905754	-86.185833
70024	JHC MW-15009	517779.126	12636014.800	632.33	635.32	42.906353	-86.185912
70023	JHC MW-15010	518009.361	12636011.459	632.55	635.57	42.906985	-86.185943
70029	JHC MW-15011	517540.496	12634931.588	627.71	630.83	42.905635	-86.189935
70045	JHC MW-15012	519214.841	12633675.278	632.59	635.66	42.910153	-86.194759
70046	JHC MW-15013	519207.188	12634025.153	632.40	635.25	42.910153	-86.193452
70044	JHC MW-15014	519419.850	12634254.118	635.13	638.18	42.910750	-86.192615
70043	JHC MW-15015	519715.111	12634186.634	632.46	635.20	42.911556	-86.192891
70042	JHC MW-15016	519956.792	12634198.522	631.81	634.64	42.912220	-86.192866
70037	JHC MW-15017	521074.309	12635685.320	613.69	616.61	42.915374	-86.187407
70038	JHC MW-15018	521075.536	12635979.612	614.26	617.02	42.915394	-86.186309
70039	JHC MW-15019	521058.673	12636351.996	609.81	612.86	42.915370	-86.184918
70040	JHC MW-15020	521059.974	12636589.953	609.04	611.90	42.915388	-86.184030
70041	JHC MW-15021	521065.933	12636839.055	610.70	613.65	42.915419	-86.183100
70014	JHC MW-15022	520479.719	12638430.236	620.92	623.79	42.913905	-86.177114
70010	JHC MW-15023	521927.205	12638205.162	617.01	619.98	42.917863	-86.178071
70056	JHC MW-15024	522366.013	12637322.677	613.79	616.62	42.919014	-86.181400
70007	JHC MW-15025	522702.978	12636668.146	614.14	617.17	42.919900	-86.183870
70006	JHC MW-15026	522495.091	12635971.882	615.09	618.04	42.919288	-86.186452
70057	JHC MW-15027	522394.860	12635097.509	614.77	617.30	42.918961	-86.189708
70002	JHC MW-15028	521646.198	12634105.336	611.03	613.80	42.916849	-86.193350
70000	JHC MW-15029	520503.524	12633774.295	608.08	610.95	42.913694	-86.194493
70036	JHC MW-15030	519760.827	12633044.373	604.05	607.17	42.911613	-86.197157
70020	JHC MW-15031	520118.003	12637801.509	632.94	635.87	42.912876	-86.179432
70013	JHC MW-15032	520779.281	12638667.931	611.32	614.29	42.914741	-86.176251
70012	JHC MW-15033	521075.809	12638598.117	618.08	620.99	42.915550	-86.176536
70011	JHC MW-15034	521335.834	12638568.896	612.90	615.97	42.916262	-86.176666
70022	JHC MW-15035	520112.933	12637510.259	632.53	634.28	42.912844	-86.180518
70019	JHC MW-15036	520099.800	12638094.344	617.94	618.34	42.912843	-86.178337
70017	JHC MW-15037	520083.044	12638436.693	614.28	616.06	42.912817	-86.177058

STATION	DESCRIPTION	WITNESSES	NORTHING (PLANT DATUM)	EASTING (PLANT DATUM)	NORTHING (UNIT 1 & 2)	EASTING (UNIT 1 & 2)	ELEVATION (PLANT DATUM)	ELEVATION (NAVD88 DATU
NED 1	SET 3-1/4" DOMED ALUMINUM CAP ON 3/4" ALUMINUM TOP SECURITY ROD MONUMENT		16259.8663	12360.7163			607.357	606.862
	DEPTH = 43' TO REFUSAL							
	SET MAG IN EAST SIDE OF POWER POLE	N26°W 90.83'						
	SET MAG IN NORTH SIDE OF POWER POLE	S63°W 185.96'						
	SOUTHWEST FACE OF S.B.C. RISER	N54°E 39.19'						
NED 2	SET 3-1/4" DOMED ALUMINUM CAP ON 3/4" ALUMINUM TOP SECURITY ROD MONUMENT		16584.3789	12791.7633			608.150	607.655
	DEPTH = 43' TO REFUSAL							
	SET "X" ON SOUTH LEG OF TRANSMISSION LINE TOWER	N25°E 82.25'						
	WEST FACE OF FENCE POST AT SOUTWEST CORNER OF FENCE AROUND SUBSTATION	N90°E 89.54'						
	SET MAG NAIL IN NORTH SIDE OF 10" PINE	S52°E 59.82'						
NED 3	SET 3-1/4" DOMED ALUMINUM CAP ON 3/4" ALUMINUM TOP SECURITY ROD MONUMENT		16566.3834	13451.8335			609.457	608.962
	DEPTH = 47' TO REFUSAL							
	SOUTHEAST CORNER OF METAL GARAGE BUILDING	S28°W 93.60'						
	NORTHEAST CORNER OF METAL GARAGE BUILDING	S41°W 69.22'						
	MAG NAIL IN SOUTHEAST SIDE OF POWER POLE	N33°E 33.86'						
	FACE OF FENCE POST AT SOUTHEAST CORNER OF FENCE AROUND SUBSTATION	N49°W 11.34'						

SURVEY REPORT

DRAWING NO.

- Horizontal: State Plane Coordinates were obtained on the monitor wells using RTK GPS using the CORS network. The horizontal datum is Michigan State Plane Coordinates, Michigan South Zone, NAD83 (2011 Adjustment, Epoch
- Vertical: Elevations are on NAVD 88 datum. All elevations were established on the monitor wells using closed and adjusted level loops from known JHC plant

REFERENCE DRAWINGS

SURVEYOR'S NOTES

REV DATE

- 1) Utility locations are derived from actual measurements or available records. They should not be interpreted to be exact locations nor should it be assumed
- that they are the only utilities in this area. 2) NOTE TO CONTRACTORS: 3 (THREE) WORKING DAYS BEFORE YOU DIG, CALL MISS DIG AT TOLL FREE 1-800-482-7171 FOR UTILITY = DOWNGRADIENT BOTTOM ASH POND 1/2 N/S MONITORING WELL

DESCRIPTION

LOCATIONS ON THE GROUND. 3) 2012 aerial imagery provided by Consuemers Energy.

LEGEND

- = EXISTING MONITORING WELL
- = DOWNGRADIENT LANDFILL MONITORING WELL
- = DOWNGRADIENT BOTTOM ASH POND 3 N/S MONITORING WELL

BY APP REV DATE

- = POND A MONITORING WELL
- = BACKGROUND MONITORING WELL

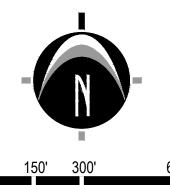
BASIS OF BEARING STATE PLANE COORDINATES

BASIS OF ELEVATION

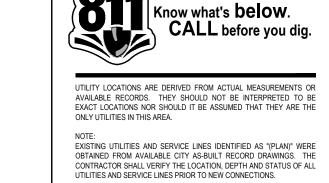
NEDI BM (NAVD88)

DESCRIPTION

DATUM CONVERSION Plant Datum (NGVD29) to NAVD88 = -0.495'



SCALE: 1" = 300'



						DR.			DATE	
						FLD.	PV	10.27.15		
						CK.	MN	11.25.15		NГ
	Α	11.25.15	REVISIONS PER CONSUMERS ENERGY REVIEW	MJL	MN	APP.				www.r
)	REV	DATE	DESCRIPTION	BY	APP	APP.				WWW.1



Grand Rapids 217 Grandville Ave., Suite 302 Grand Rapids, MI 49503 Ann Arbor, Chicago, Columbus,

Holland, Indianapolis, St. Louis

CAMPBELL PLANT MONITORING WELLS CCR MONITORING

UNITS 1 & 2 22345base.DWG 1" = 300' SG-22345 583-009-441

APPENDIX A

Soil Boring and Monitoring Well Construction Logs

Date Start: 9/18/15 **Date Finish:** 9/18/15

Drilling Company: Mateco Drilling Driller's Name: John Pitsch Drilling Method: Air Knife/Sonic Sampling Method: Continuous

Rig Type: Sonic

Water Level Start (ft. bgs.): 29.0 Water Level Finish (ft. btoc.): 33.26 Northing: 517781.423 Easting: 12633905.01 Casing Elevation: 627.297

Borehole Depth (ft. bgs.): 40.0 Surface Elevation: 624.367

Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15005

Client: Consumers Energy

Location: JH Campbell Facility

1700 Crosswell Street Site A West Olive, MI 49460

Weather Conditions: 70 F Cloudy

DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
-	625									TOC = 627.297 (ft. above msl)
- 5	625 615	1	0.0-10.0'	10	NA		***** ** ** ** ** ** ** ** **	(0.0 - 0.3') Grass, Topsoil. (0.3 - 10.0') ASH and SAND, fine to medium; trace granules, subrounded; moist; soft to stiff; poorly sorted; brown (10YR 5/3) to dark grayish brown (10YR 4/2). NOTE: Fill material.		Concrete (0.0- 1.0' bgs)
- 10 - - - 15 -	610 -	2	10.0-20.0'	6	NA		*	(10.0 - 11.0') ASH; well sorted; medium stiff to stiff; moist; dark gray (10YR 4/1). NOTE: Fill material. (11.0 - 13.0') SAND, medium, little to some fine sand, subrounded; trace silt; well sorted; dry; brown (10YR 5/3) to yellowish brown (10YR 5/4). (13.0 - 16.0') SAND, medium; little fine sand, subrounded; trace silt; well sorted; dry; very pale brown (10YR 7/4). (16.0 - 19.5') SAND, medium; trace fine, subrounded; trace silt; dry; light yellowish brown (10YR 6/4).	-	Bentonite/Cement Grout (1.0-23.0' bgs) 2" PVC Well Casing (-3.0-27.0' bgs)
	PARCADIS Design & Consultancy for natural and built assets							Remarks: bgs = below ground surface btoc = below top of casing Air knife to 10.0' bgs. Groundwater encountered at 29.0' bgs during dri Water level at development encountered at 33.26 No odor or staining observed. Groundwater elevation measured on December 2	6' bto	

Date: 2/4/2016 Created/Edited by: S.Das/C. Jeffers

Page: 1 of 2

Date Start: 9/18/15 **Date Finish:** 9/18/15

Drilling Company: Mateco Drilling Driller's Name: John Pitsch Drilling Method: Air Knife/Sonic Sampling Method: Continuous

Rig Type: Sonic

Water Level Start (ft. bgs.): 29.0 Water Level Finish (ft. btoc.): 33.26 Northing: 517781.423 Easting: 12633905.01 Casing Elevation: 627.297

Borehole Depth (ft. bgs.): 40.0 Surface Elevation: 624.367

Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15005

Client: Consumers Energy

Location: JH Campbell Facility

1700 Crosswell Street Site A West Olive, MI 49460

Weather Conditions: 70 F Cloudy

\vdash										
DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
	605 -						/	(19.5 - 19.8') SAND, medium; trace fine, subrounded; little to some silt; moist, brown (10YR 4/3).	П	\^\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
- 20 - - - 25	600 —	3	20.0-30.0'	6	NA			(19.8 - 29.0') SAND, medium, trace fine, subrounded; trace silt; well sorted; dry; very pale brown (10YR 7/4).		Bentonite Pellets (23.0- 25.0' bgs)
-	595 -							(29.0 - 31.0') SAND, medium, little fine, trace coarse, subrounded; trace silt; well		
- 30 - - - 35 - - -	- - 590 - - - - - -	4	30.0-40.0'	9	NA			sorted; wet; pale brown (10YR 6/3). (31.0 - 33.0') SAND, medium to coarse, little fine, subrounded; trace silt; well sorted; wet; pale brown (10YR 6/3). (33.0 - 40.0') SAND, fine, some medium, subrounded; well sorted; wet; pale brown (10YR 6/3). End of boring at 40.0' bgs.		Sand Pack K&E WP1 (25.0- 40.0' bgs) 2" PVC 10 Slot Well Screen (27.0-37.0 bgs)
C	ARCADIS Design & Consultancy for natural and built assets							Remarks: bgs = below ground surface btoc = below top of casing Air knife to 10.0' bgs. Groundwater encountered at 29.0' bgs during dril Water level at development encountered at 33.26 No odor or staining observed. Groundwater elevation measured on December 2	b' bt	OC.

Project: DE000722.0003.00006 Template: ARCADIS_Analytical Boring-Well 2013_New Logo

Data File: MW-15005.dat Date: 2/4/2016 Created/Edited by: S.Das/C. Jeffers

Date Start: 9/18/15 **Date Finish:** 9/18/15

Drilling Company: Mateco Drilling Driller's Name: John Pitsch Drilling Method: Air Knife/Sonic Sampling Method: Continuous

Rig Type: Sonic

Water Level Start (ft. bgs.): NA Water Level Finish (ft. btoc.): 28.90 Northing: 517535.735 Easting: 12635481.66 Casing Elevation: 627.577

Borehole Depth (ft. bgs.): 40.0 Surface Elevation: 624.737

Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15006

Client: Consumers Energy

Location: JH Campbell Facility

1700 Crosswell Street Site A West Olive, MI 49460

Weather Conditions: 70 F Cloudy

DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
-	-									TOC = 627.577 (ft. above msl)
-5-10	625 -	1	0.0-10.0'	10	NA			(0.0 - 0.3') Grass, Topsoil. (0.3 - 10.0') SAND, fine to medium, subrounded; trace silt; poorly sorted; dry to moist; light brownish gray (10YR 6/2) to light yellowish brown (10YR 6/4). NOTE: Trace slag fragments from 0.0 to 1.0' bgs.		Concrete (0.0- 1.0' bgs)
- 15	610 -	2	10.0-20.0'	8	NA			(10.0 - 12.0') SAND, fine, subrounded; trace silt; well sorted; dry; pale brown (10YR 6/3). (12.0 - 15.0') SAND, fine to medium, subrounded; trace silt; well sorted; brownish yellow (10YR 6/6). (15.0 - 17.0') SAND, fine to medium, subrounded; trace silt; well sorted; dry; very pale brown (10YR 7/3). (17.0 - 18.0') SAND, fine to very fine, subrounded; little silt; well sorted; dry; light brownish gray (10YR 6/2). (18.0 - 25.0') SAND, very fine to fine, trace medium, subrounded; little to some silt; well sorted; dry; brown (10YR 4/3).	-	Bentonite/Cement Grout (1.0- 21.0' bgs) 2" PVC Well Casing (-3.0- 25.0' bgs)
<u></u>								Remarks: bgs = below ground surface btoc = below top of casing Air knife to 10.0' bgs. Groundwater not encountered during drilling. Water level at development was 28.90' btoc. No odor or staining observed. Groundwater elevation measured on December 2	2, 20	015 was 599.08 feet

Date: 2/4/2016 Created/Edited by: S.Das/C. Jeffers

Page: 1 of 2

Date Start: 9/18/15 Date Finish: 9/18/15

Drilling Company: Mateco Drilling Driller's Name: John Pitsch Drilling Method: Air Knife/Sonic Sampling Method: Continuous

Rig Type: Sonic

Water Level Start (ft. bgs.): NA Water Level Finish (ft. btoc.): 28.90 Northing: 517535.735 Easting: 12635481.66 Casing Elevation: 627.577

Borehole Depth (ft. bgs.): 40.0 Surface Elevation: 624.737

Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15006

Client: Consumers Energy

Location: JH Campbell Facility 1700 Crosswell Street Site A West Olive, MI 49460

Weather Conditions: 70 F Cloudy

DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
- 20 	600	3	20.0- 30.0'	5	NA NA			(25.0 - 29.5') SAND, very fine, subrounded; some silt; well sorted; dry; light brownish gray (10YR 6/2). (29.5 - 40.0') SAND, fine to medium, subrounded; trace silt; well sorted; light yellowish brown (10YR 6/4).		Bentonite Pellets (21.0- 23.0' bgs) Sand Pack K&E WP1 (23.0- 40.0' bgs) 2" PVC 10 Slot Well Screen (25.0-35.0 bgs)
- 40	-							End of boring at 40.0' bgs.		
	PARCADIS Design & Consultancy for natural and built assets							Remarks: bgs = below ground surface btoc = below top of casing Air knife to 10.0' bgs. Groundwater not encountered during drilling. Water level at development was 28.90' btoc. No odor or staining observed. Groundwater elevation measured on December 2	2, 20	015 was 599.08 feet

Date: 2/4/2016 Created/Edited by: S.Das/C. Jeffers

Page: 2 of 2

Date Start: 9/21/15 Date Finish: 9/21/15

Drilling Company: Mateco Drilling Driller's Name: John Pitsch Drilling Method: Air Knife/Sonic Sampling Method: Continuous

Rig Type: Sonic

Water Level Start (ft. bgs.): 21.0 Water Level Finish (ft. btoc.): 29.28 Northing: 517540.502 Easting: 12635742.72 Casing Elevation: 627.697

Borehole Depth (ft. bgs.): 40.0 Surface Elevation: 624.817

Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15007

Client: Consumers Energy

Location: JH Campbell Facility 1700 Crosswell Street Site A West Olive, MI 49460

Weather Conditions: 75 F Sunny

DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
-	- - -									TOC = 627.697 (ft. above msl)
	-5	1	0.0-10.0'	10	NA		→	(0.0 - 0.3') Grass, Topsoil. (0.3 - 10.0') SAND, fine to medium, subrounded; trace silt; well sorted; dry to moist; light brownish gray (10YR 6/2).		Concrete (0.0- 1.0' bgs) AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
- 15	-	2	10.0-20.0'	8	NA			(17.0 - 17.5') SAND, very fine to fine, subrounded; little to some silt; well sorted; dry; very pale brown (10YR 6/4). (17.5 - 40.0') SAND, fine to medium, subrounded; little to some silt; well sorted; dry; very pale brown (10YR 7/3).	_	18.0' bgs) 18.0' bgs) 2" PVC Well Casing (-3-25.0' bgs)
C	<u> </u>	\R(CA	DIS	S Des for a	ign & Co natural a it assets	nsultancy nd	Remarks: bgs = below ground surface btoc = below top of casing Air knife to 10.0' bgs. Groundwater encountered at 21.0' bgs during dril Water level at development was 29.28' btoc. No odor or staining observed. Groundwater elevation measured on December 2		

Project: DE000722.0003.00006 Template: ARCADIS_Analytical Boring-Well 2013_New Logo

Data File: MW-15007.dat Date: 2/4/2016 Created/Edited by: S.Das/C. Jeffers **Date Start:** 9/21/15 **Date Finish:** 9/21/15

Drilling Company: Mateco Drilling Driller's Name: John Pitsch Drilling Method: Air Knife/Sonic Sampling Method: Continuous

Rig Type: Sonic

Water Level Start (ft. bgs.): 21.0 Water Level Finish (ft. btoc.): 29.28 Northing: 517540.502 Easting: 12635742.72 Casing Elevation: 627.697

Borehole Depth (ft. bgs.): 40.0 Surface Elevation: 624.817

Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15007

Client: Consumers Energy

Location: JH Campbell Facility

1700 Crosswell Street Site A West Olive, MI 49460

Weather Conditions: 75 F Sunny

DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
20	20									Bentonite Pellets (18.0-
-	-20 - - - - -25 - - - - - -	3	20.0-30.0'	5	NA			NOTE: Wet at 21.0' bgs.		Pellets (18.0-20.0' bgs) Sand Pack K&E WP1 (20.0- 40.0' bgs) 2" PVC 10 Slot Well Screen (22.0-32.0' bgs)
- 35	-	4	30.0- 40.0'	5	NA					
- 10	-40 -							End of boring at 40.0' bgs.		
	ARCADIS Design & Consultancy for natural and built assets						nsultancy ind	Remarks: bgs = below ground surface btoc = below top of casing Air knife to 10.0' bgs. Groundwater encountered at 21.0' bgs during dri Water level at development was 29.28' btoc. No odor or staining observed. Groundwater elevation measured on December 2		

Date: 2/4/2016 Created/Edited by: S.Das/C. Jeffers

Page: 2 of 2

Date Start: 9/21/15 **Date Finish:** 9/22/15

Drilling Company: Mateco Drilling Driller's Name: John Pitsch Drilling Method: Air Knife/Sonic Sampling Method: Continuous

Rig Type: Sonic

Water Level Start (ft. bgs.): NA Water Level Finish (ft. btoc.): 38.25 Northing: 517560.39 Easting: 12636031.25 Casing Elevation: 635.302

Borehole Depth (ft. bgs.): 38.0 Surface Elevation: 632.432

Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15008

Client: Consumers Energy

Location: JH Campbell Facility

1700 Crosswell Street Site A West Olive, MI 49460

Weather Conditions: 75 F Sunny

			•							<u> </u>
DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
-	635 -									TOC = 635.302 (ft. above msl)
-5-10	630 625	1	0.0-10.0'	10	NA		↓ * ↓ *	(0.0 - 0.3') Grass, Topsoil. (0.3 - 10.0') SAND, fine to medium, subrounded; trace silt; well sorted; dry; light brownish gray (10YR 6/2).		Concrete (0.0- 1.0' bgs)
- 15	620 -	2	10.0-20.0'	9	NA			(10.0 - 15.0') SAND, fine, trace to little medium sand, subrounded; little silt; well sorted; dry; light yellowish brown (10YR 6/4). (15.0 - 19.0') SAND, very fine to fine, subrounded; little to some silt; well sorted; dry; very pale brown (10YR 7/3).		Bentonite/Cement Grout (1.0-24.0' bgs) 2" PVC Well Casing (-3.0-28.0' bgs)
C	1 /2	\R(CA	DIS	S for bui	sign & Co natural a It assets	nsultancy	Remarks: bgs = below ground surface btoc = below top of casing Air knife to10.0' bgs. Water level at development was 38.25' btoc. No odor or staining observed. Groundwater elevation measured on December 2	20	15 was 508 00 feet

above mean sea level.

Data File: MW-15008.dat Date: 2/4/2016 Created/Edited by: S.Das/C. Jeffers

Page: 1 of 2

Groundwater elevation measured on December 2, 2015 was 598.09 feet

Date Start: 9/21/15 **Date Finish:** 9/22/15

Drilling Company: Mateco Drilling Driller's Name: John Pitsch Drilling Method: Air Knife/Sonic Sampling Method: Continuous

Rig Type: Sonic

Water Level Start (ft. bgs.): NA Water Level Finish (ft. btoc.): 38.25 Northing: 517560.39 Easting: 12636031.25 Casing Elevation: 635.302

Borehole Depth (ft. bgs.): 38.0 **Surface Elevation:** 632.432

Descriptions By: A. Westhuis

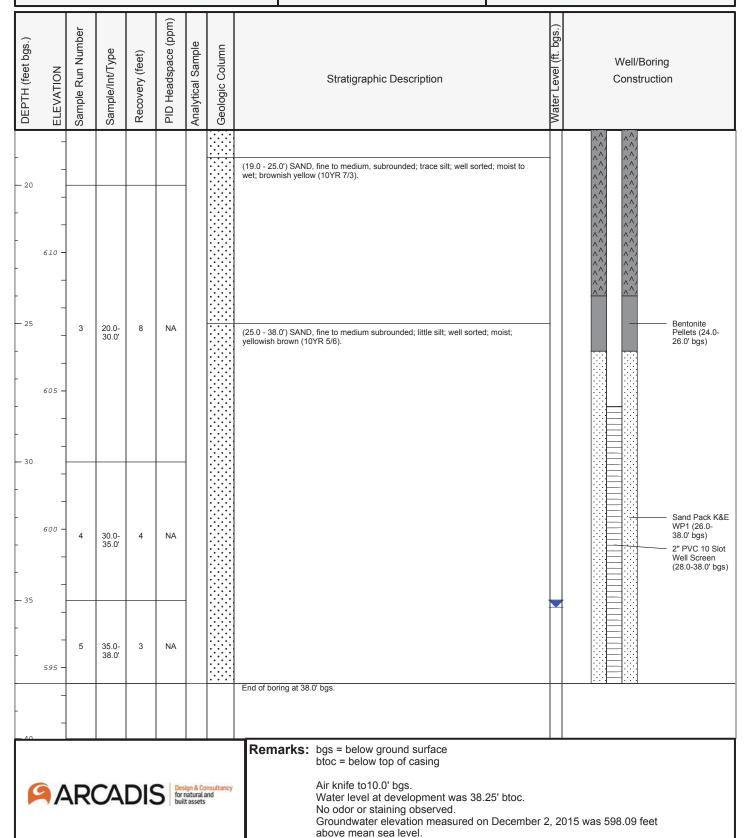
Well/Boring ID: JHC MW-15008

Client: Consumers Energy

Location: JH Campbell Facility

1700 Crosswell Street Site A West Olive, MI 49460

Weather Conditions: 75 F Sunny



Data File: MW-15008.dat Date: 2/4/2016 Created/Edited by: S.Das/C. Jeffers

Date Start: 9/22/15 **Date Finish:** 9/22/15

Drilling Company: Mateco Drilling
Driller's Name: John Pitsch
Drilling Method: Continous
Sampling Method: Air Knife/Sonic
Rig Type: Enter Rig Type Here
Water Level Start (ft. bgs.): NA
Water Level Finish (ft. btoc.): 37.14

Northing: 517779.126 Easting: 12636014.8 Casing Elevation: 635.322

Borehole Depth (ft. bgs.): 40.0 **Surface Elevation:** 632.327

Descriptions By: A. Westhuis

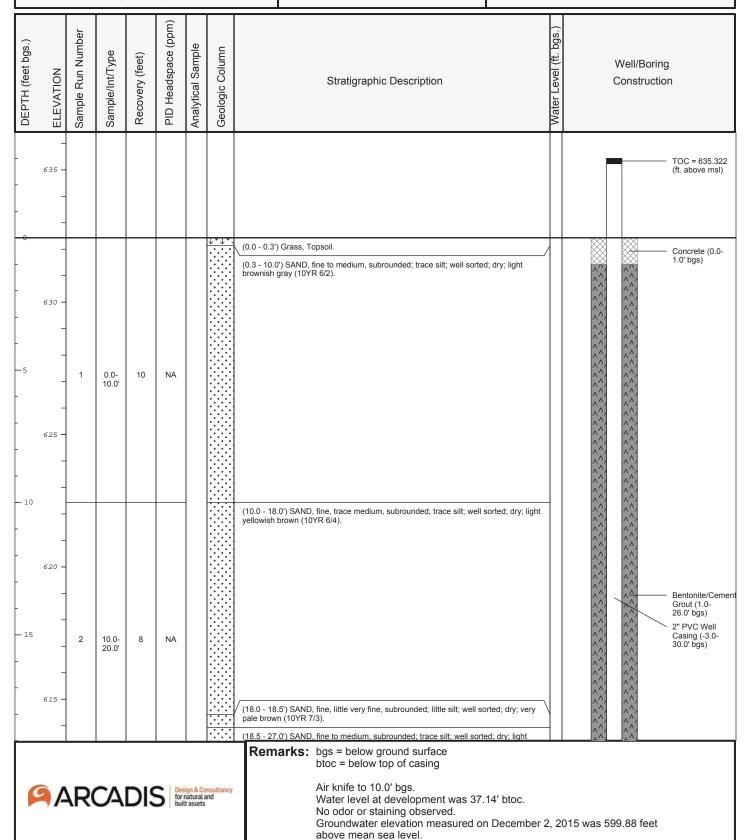
Well/Boring ID: JHC MW-15009

Client: Consumers Energy

Location: JH Campbell Facility

1700 Crosswell Street Site A West Olive, MI 49460

Weather Conditions: 75 F Sunny



Date: 2/4/2016 Created/Edited by: C. Jeffers

Page: 1 of 2

Date Start: 9/22/15 Date Finish: 9/22/15

Drilling Company: Mateco Drilling Driller's Name: John Pitsch **Drilling Method:** Continous Sampling Method: Air Knife/Sonic Rig Type: Enter Rig Type Here Water Level Start (ft. bgs.): NA Water Level Finish (ft. btoc.): 37.14 Northing: 517779.126 Easting: 12636014.8 Casing Elevation: 635.322

Borehole Depth (ft. bgs.): 40.0 Surface Elevation: 632.327

Descriptions By: A. Westhuis

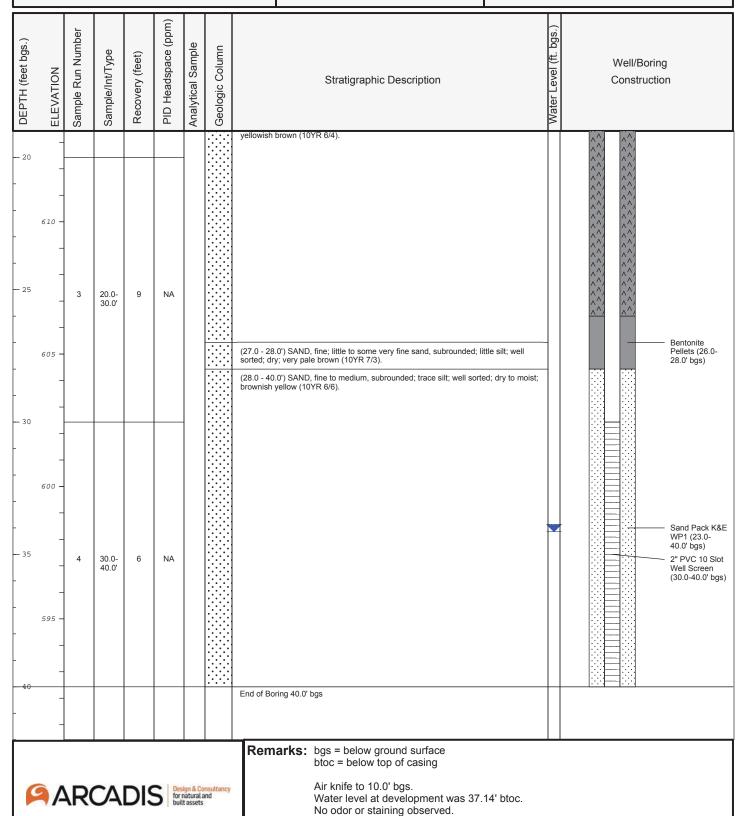
Well/Boring ID: JHC MW-15009

Client: Consumers Energy

Location: JH Campbell Facility

1700 Crosswell Street Site A West Olive, MI 49460

Weather Conditions: 75 F Sunny



Page: 2 of 2

Date: 2/4/2016 Created/Edited by: C. Jeffers

above mean sea level.

Groundwater elevation measured on December 2, 2015 was 599.88 feet

Date Start: 9/22/15 Date Finish: 9/23/15

Drilling Company: Mateco Drilling Driller's Name: John Pitsch Drilling Method: Air Knife/Sonic Sampling Method: Continuous

Rig Type: Sonic

Water Level Start (ft. bgs.): 29.5 Water Level Finish (ft. btoc.): NA Northing: 518009.361 Easting: 12636011.46 Casing Elevation: 635.567

Borehole Depth (ft. bgs.): 40.0 Surface Elevation: 632.547

Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15010

Client: Consumers Energy

Location: JH Campbell Facility 1700 Crosswell Street Site A West Olive, MI 49460

Weather Conditions: 75 F Sunny

DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction	
- 6:	35 -									TOC = 635.567 (ft. above msl)	
- -5 -	30	1	0.0- 10.0'	10.0	NA			(0.0 - 0.3') Grass, Topsoil. (0.3 - 10.0') SAND, fine to medium, subrounded, trace silt; well sorted; dry; light brownish gray (10YR 6/2).		Concrete (0.0- 1.0' bgs)	
- - 15 -		2	10.0- 20.0'	8.0	NA			(10.0 - 17.0') SAND, fine, trace medium, subrounded; trace silt; well sorted; dry; light yellowish brown (10YR 6/4). (17.0 - 17.5') SAND, fine to very fine, subrounded; little silt; well sorted; dry; very pale brown (10YR 7/3). (17.5 - 20.0') SAND, fine to medium, subrounded; trace silt; well sorted; dry; light yellowish brown (10YR 6/4).	-	Bentonite/Cement Grout (1.0-26.0' bgs) 2" PVC Well Casing (-3-30.0' bgs)	
	Remarks: bgs = below ground surface btoc = below top of casing Air knife to 10.0' bgs. Groundwater encountered at 29.5' bgs. Water level at development was 36.57' btoc. No odor or staining observed. Groundwater elevation measured on December 2, 2015 was 600.36 feet										

Data File: JHC-MW-15010.dat

Date: 2/4/2016 Created/Edited by: S.Das/C. Jeffers

Date Start: 9/22/15 Date Finish: 9/23/15

Drilling Company: Mateco Drilling Driller's Name: John Pitsch Drilling Method: Air Knife/Sonic Sampling Method: Continuous

Rig Type: Sonic

Water Level Start (ft. bgs.): 29.5 Water Level Finish (ft. btoc.): NA Northing: 518009.361 Easting: 12636011.46 Casing Elevation: 635.567

Borehole Depth (ft. bgs.): 40.0 Surface Elevation: 632.547

Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15010

Client: Consumers Energy

Location: JH Campbell Facility

1700 Crosswell Street Site A West Olive, MI 49460

Weather Conditions: 75 F Sunny

DEPTH (feet bgs.)	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
— 20 -					_		(20.0 - 25.5') SAND, fine to medium, subrounded; little to some silt; well sorted; dry; brown (10YR 5/4).		
610 - - - 25	3	20.0-	9.0	NA					
- 605	_	30.0'					(25.5 - 28.5') SAND, fine to medium, subrounded; trace silt; well sorted; dry; very pale brown (10YR 7/4). (28.5 - 29.5') SAND, very fine to fine, subrounded; trace to little silt; well sorted; dry;		Bentonite Pellets (26.0- 28.0' bgs)
- - 30 -					_		(29.5 - 49.0') SAND, fine to line, subrounded; little silt; well sorted; moist to wet; yellowish brown (10YR 5/4).		
- 35	4	30.0-	6.0	NA					Sand Pack K&E WP1 (28.0- 40.0' bgs) 2" PVC 10 Slot
- - 595		40.0'							Well Screen (30.0-40.0' bgs)
- 40 -							End of boring at 40.0' bgs.		
9/	ARCADIS Design & Consultancy for natural and built assets					insultancy and	Remarks: bgs = below ground surface btoc = below top of casing Air knife to 10.0' bgs. Groundwater encountered at 29.5' bgs. Water level at development was 36.57' btoc. No odor or staining observed. Groundwater elevation measured on December 2	2, 2	015 was 600.36 feet

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Data File: JHC-MW-15010.dat

Date Start: 9/23/15 **Date Finish:** 9/23/15

Drilling Company: Mateco Drilling Driller's Name: John Pitsch Drilling Method: Air Knife/Sonic Sampling Method: Continuous

Rig Type: Sonic

Water Level Start (ft. bgs.): 30.0 Water Level Finish (ft. btoc.): 34.45 Northing: 517540.496 Easting: 12634931.59 Casing Elevation: 630.832

Borehole Depth (ft. bgs.): 40.0 Surface Elevation: 627.712

Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15011

Client: Consumers Energy

Location: JH Campbell Facility

1700 Crosswell Street Site A West Olive, MI 49460

Weather Conditions: 75 F Sunny

DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
_	630 -									TOC = 630.832 (ft. above msl)
_ 5 _	- 625	1	0.0- 10.0'	10.0	NA		<u>↓</u> ↓ ↓ ·	(0.0 - 0.3') Grass, Topsoil. (0.3 - 10.0') SAND, fine to medium, subrounded; trace silt; well sorted; dry; dark grayish brown (10YR 4/2). NOTE: Color change to yellowish brown (10YR 5/6) from 3.0-4.5' bgs. NOTE: Color change to light yellowish brown (10YR 6/4) from 4.5-10.0' bgs.		Concrete (0.0- 1.0' bgs)
_ _ 15	615 -	2	10.0-20.0	9.0	NA			(17.0 - 20.0') SAND, very fine to fine, subrounded; little to some silt; well sorted; very pale brown (10YR 7/3). NOTE: Soils hot; cooked by Sonic rig.	_	Bentonite/Cement Grout (1.0-23.0' bgs) Bentonite/Cement Grout (1.0-23.0' bgs) 2" PVC Well Casing (-3-27.0' bgs)
G	Δ	AR(CA	DIS	S Des for buil	i <mark>ign & Co</mark> natural a It assets	nsultancy ind	Remarks: bgs = below ground surface btoc = below top of casing Air knife to 10.0' bgs. Groundwater encountered at 30.0' bgs. Water level at development was 34.45' btoc. No odor or staining observed. Groundwater elevation measured on December 2	2, 20	015 was 596.74 feet

Date: 2/4/2016 Created/Edited by: S.Das/C. Jeffers

Page: 1 of 2

Data File: JHC-MW-15011.dat

Date Start: 9/23/15 **Date Finish:** 9/23/15

Drilling Company: Mateco Drilling Driller's Name: John Pitsch Drilling Method: Air Knife/Sonic Sampling Method: Continuous

Rig Type: Sonic

Water Level Start (ft. bgs.): 30.0 Water Level Finish (ft. btoc.): 34.45 Northing: 517540.496 Easting: 12634931.59 Casing Elevation: 630.832

Borehole Depth (ft. bgs.): 40.0 Surface Elevation: 627.712

Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15011

Client: Consumers Energy

Location: JH Campbell Facility

1700 Crosswell Street Site A West Olive, MI 49460

Weather Conditions: 75 F Sunny

DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
20 25	605 -	3	20.0-30.0'	9.0	NA			(20.0 - 24.0') SAND, fine to medium, subrounded; trace silt; well sorted; moist, pale brown (10YR 6/3). (24.0 - 27.0') SAND, fine to medium; little to some silt; trace coarse sand, subrounded; well sorted; moist, brown (10YR 5/3). (27.0 - 29.0') SAND, fine to medium, subrounded; little to some silt; trace coarse sand, subrounded; well sorted; dry; very pale brown (10YR 7/3) to light gray (10YR 7/2). NOTE: Soils hot; cooked by Sonic rig.		Bentonite Pellets (23.0- 25.0' bgs)
- 30 	595 -	4	30.0-40.0	7.0	NA			(29.0 - 31.0') SAND, fine, subrounded; little silt; well sorted; moist, dark yellowish brown (10YR 4/4). NOTE: Wet at 30.0' bgs. (31.0 - 38.0') SAND, medium to coarse, subrounded; trace silt; well sorted; wet; brown (10YR 5/3). NOTE: Color change to dark brown (10YR 3/3) from 37.5-38.0' bgs. (38.0 - 40.0') SAND, fine to medium, subrounded; trace silt; well sorted; wet, brown (10YR 5/3).		Sand Pack K&E WP1 (25.0- 40.0' bgs) 2" PVC 10 Slot Well Screen (27.0-37.0' bgs)
-40	-	\R(CA	DIS	S for buil	ign & Co natural a t assets	onsultancy and	Remarks: bgs = below ground surface btoc = below top of casing Air knife to 10.0' bgs. Groundwater encountered at 30.0' bgs. Water level at development was 34.45' btoc. No odor or staining observed. Groundwater elevation measured on December 3	22, 20	015 was 596.74 feet

Project: DE000722.0003.00006 Template: ARCADIS_Analytical Boring-Well 2013_New Logo

Data File: JHC-MW-15011.dat

Date: 2/4/2016

Created/Edited by: S.Das/C. Jeffers

Page: 2 of 2

Date Start: 9/25/15 Date Finish: 9/28/15

Drilling Company: Mateco Drilling Driller's Name: John Pitsch Drilling Method: Air Knife/Sonic Sampling Method: Continuous

Rig Type: Sonic

Water Level Start (ft. bgs.): 23.92 Water Level Finish (ft. btoc.): 28.57 Northing: 519715.111 Easting: 12634186.63 Casing Elevation: 635.202

Borehole Depth (ft. bgs.): 40.0 Surface Elevation: 632.462

Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15015

Client: Consumers Energy

Location: JH Campbell Facility 1700 Crosswell Street Site A West Olive, MI 49460

Weather Conditions: 75 F Sunny

DEPTH (feet bgs.)	ELEVATION Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
- 635	5 -								TOC = 635.202 (ft. above msl)
-5 -625	1	0.0-10.0'	5.0	NA		× × × × × × × × × × × × × × × × × × ×	(0.0 - 0.3') Grass, Topsoil. (0.3 - 10.0') ASH; some sand, very fine to fine, trace medium, subrounded; well sorted; moist; medium stiff; gray (10YR 5/1). NOTE: Fill material.		Concrete (0.0- 1.0' bgs)
- 620 15 - 615	2	10.0- 20.0'	7.0	NA			(15.0 - 35.0') SAND, fine, little medium; subrounded; trace to little silt; well sorted; moist to wet; light brownish gray (10YR 6/2). (15.0 - 35.0') SAND, fine, little medium, subrounded; trace silt; well sorted; moist to wet; very pale brown (10YR 7/4).	-	Bentonite/Cement Grout (1.0-24.0' bgs) 2" PVC Well Casing (-3-28.0' bgs)
	AR						Remarks: bgs = below ground surface btoc = below top of casing Air knife to 10.0' bgs. Groundwater encountered at 23.92' bgs. Water level at development was 28.57' btoc. No odor or staining observed. Groundwater elevation measured on December 3	3, 20	015 was 607.68 feet

Date: 4/27/2016 Created/Edited by: S.Das/C. Jeffers

Page: 1 of 2

Date Start: 9/25/15 **Date Finish:** 9/28/15

Drilling Company: Mateco Drilling Driller's Name: John Pitsch Drilling Method: Air Knife/Sonic Sampling Method: Continuous

Rig Type: Sonic

Water Level Start (ft. bgs.): 23.92 Water Level Finish (ft. btoc.): 28.57 Northing: 519715.111 Easting: 12634186.63 Casing Elevation: 635.202

Borehole Depth (ft. bgs.): 40.0 **Surface Elevation:** 632.462

Descriptions By: A. Westhuis

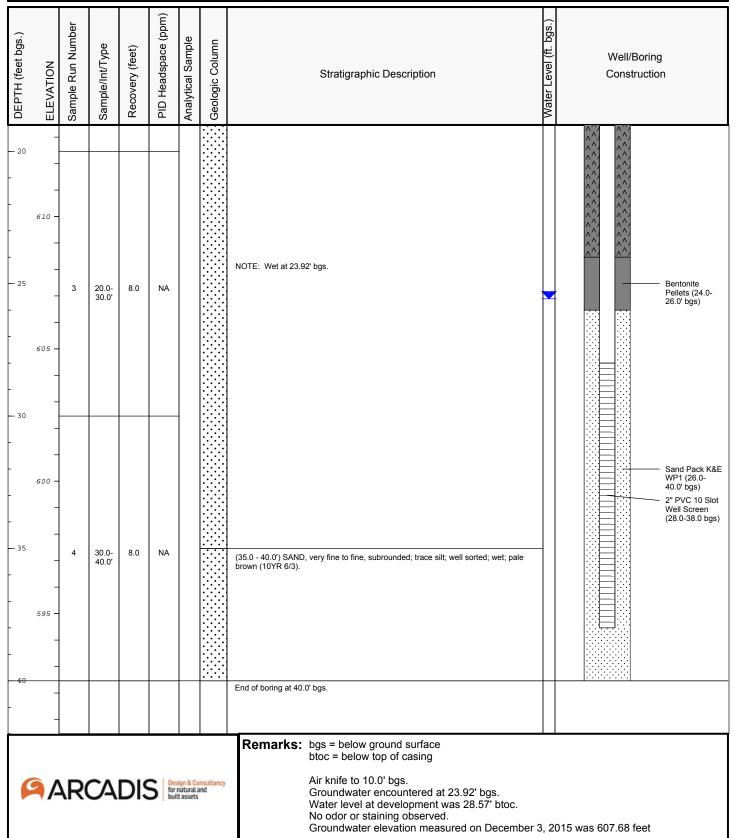
Well/Boring ID: JHC MW-15015

Client: Consumers Energy

Location: JH Campbell Facility

1700 Crosswell Street Site A West Olive, MI 49460

Weather Conditions: 75 F Sunny



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Data File: JHC-MW-15015.dat

Date: 4/27/2016 Created/Edited by: S.Das/C. Jeffers

Date Start: 9/29/15 **Date Finish:** 9/29/15

Drilling Company: Mateco Drilling Driller's Name: John Pitsch Drilling Method: Air Knife/Sonic Sampling Method: Continuous

Rig Type: Sonic

Water Level Start (ft. bgs.): 12.0 Water Level Finish (ft. btoc.): 16.29 Northing: 521075.536 Easting: 12635979.61 Casing Elevation: 617.022

Borehole Depth (ft. bgs.): 20.0 **Surface Elevation:** 614.262

Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15018

Client: Consumers Energy

Location: JH Campbell Facility

1700 Crosswell Street Site A West Olive, MI 49460

Weather Conditions: 60 F Cloudy

DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
-	615 -									TOC Elevation = 617.022 (ft. above msl)
- - - - - - - - - -	610 -	1	0.0- 10.0'	3.0	NA		× × ×	(0.0 - 0.3') Grass, Topsoil. (0.3 - 1.0') ASH and SAND, very fine to fine, well sorted; dry; light gray (10YR 7/2). NOTE: Fill material. (1.0 - 10.0') SAND, fine, subrounded; well sorted; dry; brownish yellow (10YR 6/6). (10.0 - 17.0') SAND, fine, subrounded; trace silt; well sorted; moist to wet; very pale brown (10YR 7/3).		Concrete (0.0- 1.0' bgs) Bentonite/Cement Grout (1.0-6.0' bgs) 2" PVC Well Casing (-3-10.0' bgs) Bentonite Pellets (6.0-8.0' bgs)
- 15 	- 600 - - - - 595 -	2	10.0-20.0'	7.0	NA			(17.0 - 20.0') SAND, medium, little fine, subrounded; trace granules; subrounded; trace silt; well sorted; wet; very pale brown (10YR 7/4). End of boring at 20.0' bgs.		Sand Pack K&E WP1 (8.0-20.0' bgs) 2" PVC 10 Slot Well Screen (10.0-20.0 bgs)
	3 /2	AR(CA	DIS	S Des for buil	ign & Co natural a t assets	nsultancy and	Remarks: bgs = below ground surface btoc = below top of casing Air knife to 10.0' bgs. Groundwater encountered at 12.0' bgs during dri Water level at development was 16.29' btoc. No odor or staining observed. Groundwater elevation measured on December 2		

Date: 4/27/2016 Created/Edited by: S.Das/C. Jeffers

Page: 1 of 1

Date Start: 10/1/15 Date Finish: 10/1/15

Drilling Company: Mateco Drilling Driller's Name: Dan Mourer Drilling Method: Hand Auger/Sonic Sampling Method: Continuous Rig Type: Sonic

Water Level Start (ft. bgs.): 18.0 Water Level Finish (ft. btoc.): 18.91 Northing: 521927.205 Easting: 12638205.16 Casing Elevation: 619.977

Borehole Depth (ft. bgs.): 25.0 Surface Elevation: 617.012

Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15023

Client: Consumers Energy

Location: JH Campbell Facility 1700 Crosswell Street Site A West Olive, MI 49460

Weather Conditions: Sunny, 60F.

DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
	620 -									TOC Elevation = 619.977 (ft. above msl)
-5	615	1	0-10'	10	NA			(0.0 - 0.3') TOPSOIL; grass. (0.3 - 10.0') SAND, very fine to fine, subrounded; trace silt; well sorted; dry; brown (10 YR 4/3). Note: Trace wood fragments from 7.0 to 10.0' bgs.		Concrete (0.0- 1.0' bgs) Bentonite/Cem Grout (1.0- 10.0' bgs) 2" PVC Well Casing (-3.0- 14.0' bgs)
- 10 - - - 15 - - - 20	605 -	2	10-20'	8	NA			(10.0 - 16.0') SAND, very fine to fine, subrounded; trace to little silt; well sorted; dry to moist; brownish yellow (10 YR 6/8). (16.0 - 17.0') SAND, very fine to fine, subrounded; trace silt; well sorted; moist; yellow (10 YR 7/6). (17.0 - 18.0') SAND, fine, subrounded; trace silt; well sorted; moist; brownish yellow (10 YR 6/6). (18.0 - 21.0') SAND, very fine; little fine sand, subrounded; trace silt; well sorted; wet; pale brown (10 YR 6/3).		Bentonite Pellets (10.0- 12.0' bgs) Sand Pack K& WP1 (12.0- 25.0' bgs) 2" PVC 10 Slo
- 20 - - -	595 — —	3	20-25'	4	NA			(21.0 - 25.0') SAND, medium; trace fine sand, subangular; trace granules, subangular; poorly sorted; wet; pale brown (10 YR 6/3).		Well Screen (14.0-24.0' bgs
-	- 590 -							End of boring at 25.0' bgs.		
	ARCADIS Design & Consultancy for natural and built assets							Remarks: bgs= below ground surface btoc = below top of casing Hand auger to 10.0' bgs. Groundwater encountered at 18.0' bgs during dri Water level at development was 18.91' btoc. No odor or staining observed. Groundwater elevation measured on December 2		

Data File: JHC MW-15023.dat

Page: 1 of 1

Date Start: 10/1/15 **Date Finish:** 10/1/15

Drilling Company: Mateco Drilling Driller's Name: Dan Mourer Drilling Method: Air Knife/Sonic Sampling Method: Continuous

Rig Type: Sonic

Water Level Start (ft. bgs.): 10.0 Water Level Finish (ft. btoc.): 14.12 Northing: 522366.013 Easting: 12637322.68 Casing Elevation: 616.617

Borehole Depth (ft. bgs.): 20.0 Surface Elevation: 613.787

Descriptions By: A. Westhuis

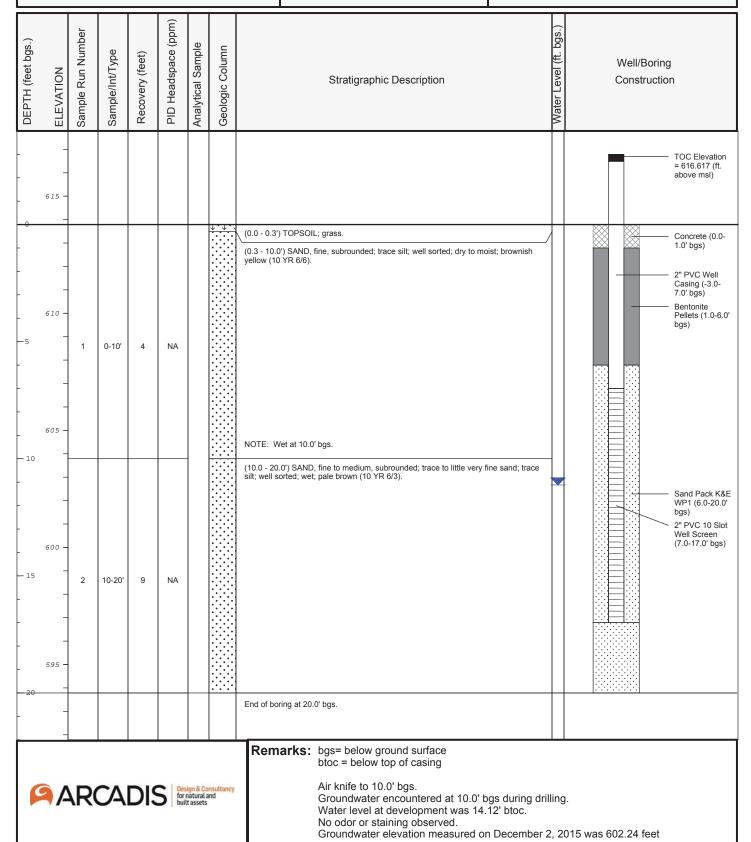
Well/Boring ID: JHC MW-15024

Client: Consumers Energy

Location: JH Campbell Facility

1700 Crosswell Street Site A West Olive, MI 49460

Weather Conditions: Sunny, 60F.



rtical Boring-Well 2013 New Logo

Data File: JHC MW-15024.dat

Date Start: 10/1/15 **Date Finish:** 10/1/15

Drilling Company: Mateco Drilling Driller's Name: Dan Mourer Drilling Method: Hand Auger/Sonic Sampling Method: Continuous Rig Type: Sonic

Water Level Start (ft. bgs.): 12.0 Water Level Finish (ft. btoc.): 13.50 Northing: 522702.978 Easting: 12636668.15 Casing Elevation: 617.167

Borehole Depth (ft. bgs.): 20.0 Surface Elevation: 614.137

Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15025

Client: Consumers Energy

Location: JH Campbell Facility

1700 Crosswell Street Site A West Olive, MI 49460

Weather Conditions: Sunny, 60F.

DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
-	615 —									TOC Elevation = 617.167 (ft. above msl)
-	610 -							(0.0 - 0.3') TOPSOIL; grass. (0.3 - 5.0') SAND, fine, subrounded; trace silt; well sorted; dry; very pale brown (10 YR 7/3).		Concrete (0.0- 1.0' bgs)
-5 - - - -	- 605 -	1	0-10'	10	NA			(5.0 - 12.0') SAND, fine, subrounded; trace silt; well sorted; dry; brownish yellow (10 YR 6/6). Note: Color change to brownish yellow (10YR 6/8) at 6.0' bgs.		
- 15	- 600 -							(12.0 - 15.0') SAND, fine, subrounded; trace silt; well sorted; wet; pale brown (10 YR 6/3).		Sand Pack K&E WP1 (6.0-20.0' bgs) 2" PVC 10 Slot Well Screen (7.0-17.0' bgs)
	- - - 595 -	2	10-20'	8	NA			(15.0 - 16.0') SAND, fine to medium, subrounded; trace coarse sand, subrounded; trace granules, subrounded; trace silt; well sorted; wet; pale brown (10 YR 6/3). (16.0 - 20.0') SAND, very fine to fine, subrounded; little silt; well sorted; wet; pale brown (10 YR 6/3).		
_	-							End of boring at 20.0' bgs.		
	3 /2	\R(CA	DIS	S Des for buil	ign & Co natural a It assets	nsultancy nd	Remarks: bgs= below ground surface btoc = below top of casing Hand auger to 10.0' bgs. Groundwater encountered at 12.0' bgs during dri Water level at development was 13.50' btoc. No odor or staining observed. Groundwater elevation measured on December 2		

I 2013 New Logo Page: 1 of 1

Data File: JHC MW-15025.dat

Date Start: 10/2/15 Date Finish: 10/2/15

Drilling Company: Mateco Drilling Driller's Name: Dan Mourer Drilling Method: Hand Auger/Sonic Sampling Method: Continuous Rig Type: Sonic

Water Level Start (ft. bgs.): 12.0 Water Level Finish (ft. btoc.): 15.34 Northing: 522495.091 Easting: 12635971.82 Casing Elevation: 618.042

Borehole Depth (ft. bgs.): 20.0 Surface Elevation: 615.087

Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15026

Client: Consumers Energy

Location: JH Campbell Facility

1700 Crosswell Street Site A West Olive, MI 49460

Weather Conditions: Sunny, 45F.

DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
_	-									TOC Elevation = 618.042 (ft. above msl)
- - - - - - -	615 =	1	0-10'	10	NA			(0.0 - 0.3') TOPSOIL; grass. (0.3 - 3.0') SAND, fine, subrounded; trace medium sand, subrounded; trace silt; well sorted; dry; very pale brown (10 YR 7/3). (3.0 - 8.0') SAND, fine, subrounded; trace silt; well sorted; dry; brownish yellow (10 YR 6/6).	_	Concrete (0.0- 1.0' bgs)
- 10 - - - - 15 -	605 -	2	10-20'	6	NA			(12.0 - 20.0') SAND, very fine to fine, subrounded; trace silt; well sorted; moist to wet; pale brown (10 YR 6/3).		Sand Pack K&E WP1 (7.0-20.0' bgs) 2" PVC 10 Slot Well Screen (8.0-18.0' bgs)
	595 -							Remarks: bgs= below ground surface btoc = below top of casing		[10000001]
C	Parallancy for natural and built assets						insultancy and	Hand auger to 10.0' bgs. Groundwater encountered at 12.0' bgs during dri Water level at development was 15.34' btoc. No odor or staining observed. Groundwater elevation measured on December 2		

Page: 1 of 1

Data File: JHC MW-15026.dat

Date Start: 10/2/15 Date Finish: 10/2/15

Drilling Company: Mateco Drilling Driller's Name: Dan Mourer Drilling Method: Hand Auger/Sonic Sampling Method: Continuous Rig Type: Sonic

Water Level Start (ft. bgs.): 13.0 Water Level Finish (ft. btoc.): 15.85 Northing: 522394.86 Easting: 1235097.51 Casing Elevation: 617.302

Borehole Depth (ft. bgs.): 20.0 Surface Elevation: 614.767

Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15027

Client: Consumers Energy

Location: JH Campbell Facility 1700 Crosswell Street Site A West Olive, MI 49460

Weather Conditions: Sunny, 50F.

DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
-	- - -									TOC Elevation = 617.302 (ft. above msl)
-5-10	615	1	0-10'	10	NA			(0.0 - 0.3') TOPSOIL; grass. (0.3 - 2.0') SAND, very fine to fine, subrounded; trace silt; well sorted; dry; dark yellowish brown (10 YR 4/6). (2.0 - 6.0') SAND, very fine to fine, subrounded; trace silt; well sorted; dry; very pale brown (10 YR 7/3).	-	Concrete (0.0-1.0' bgs) 2" PVC Well Casing (-3.0-10.0' bgs) Bentonite Pellets (1.0-8.0' bgs)
- - - 15 - -	600 -	2	10-20'	8	NA			Note: Wet at 13.0' bgs. (16.0 - 20.0') SAND, fine; trace medium sand, subrounded; well sorted; wet; pale brown (10 YR 6/3).		Sand Pack K&E WP1 (8.0-20.0' bgs) 2" PVC 10 Slot Well Screen (10.0-20.0' bgs)
		\R(CA	DIS	S Des	ign & Con natural a It assets	nsultancy nd	Remarks: bgs= below ground surface btoc = below top of casing Hand auger to 10.0' bgs. Groundwater encountered at 13.0' bgs during dril Water level at development was 15.85' btoc. No odor or staining observed.	lling	

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Date Start: 10/2/15 Date Finish: 10/2/15

Drilling Company: Mateco Drilling Driller's Name: Dan Mourer Drilling Method: Air knife/Sonic Sampling Method: Continuous

Rig Type: Sonic

Water Level Start (ft. bgs.): 9.0 Water Level Finish (ft. btoc.): 14.38 Northing: 521646.198 Easting: 12634105.34 Casing Elevation: 613.8

Borehole Depth (ft. bgs.): 20.0 Surface Elevation: 611.025

Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15028

Client: Consumers Energy

Location: JH Campbell Facility

1700 Crosswell Street Site A West Olive, MI 49460

Weather Conditions: Sunny, 60F.

DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
-	-									TOC Elevation = 613.80 (ft. above msl)
-5	610 -	1	0-10'	10	NA			(0.0 - 0.3') TOPSOIL; grass. (0.3 - 5.0') SAND, very fine to fine, subrounded; trace silt; well sorted; dry; yellowish (10 YR 7/8). (5.0 - 9.0') SAND, fine, subrounded; trace silt; well sorted; dry to moist; pale brown (10 YR 6/3).		Concrete (0.0- 1.0' bgs) Bentonite/Cement Grout (1.0-4.0' bgs) 2" PVC Well Casing (-3.0- 8.0' bgs) Bentonite Pellets (4.0-6.0' bgs)
- 10 - - - - 15 - -	595 —	2	10-20'	9	NA			silt; poorly sorted; moist to wet; pale brown (10 YR 6/3).		Sand Pack K&E WP1 (6.0-20.0' bgs) 2" PVC 10 Slot Well Screen (8.0-18.0' bgs)
	590 -							End of boring at 20.0' bgs.		
ARCADIS Design & Consultancy for natural and built assets					S Des	sign & Co natural a It assets	nsultancy nd	Remarks: bgs= below ground surface btoc = below top of casing Air knife to 10.0' bgs. Groundwater encountered at 9.0' bgs during drilli Water level at development was 14.38' btoc. No odor or staining observed. Groundwater elevation measured on December 3		015 was 599.00 feet

Page: 1 of 1

Date Start: 10/5/15 **Date Finish:** 10/5/15

Drilling Company: Mateco Drilling
Driller's Name: Dan Mourer
Drilling Method: Air knife/Sonic
Sampling Method: Continuous

Rig Type: Sonic

Water Level Start (ft. bgs.): 12.0 Water Level Finish (ft. btoc.): 10.03 Northing: 520503.524 Easting: 12633774.3 Casing Elevation: 610.952

Borehole Depth (ft. bgs.): 20.0 Surface Elevation: 608.082

Descriptions By: A. Westhuis

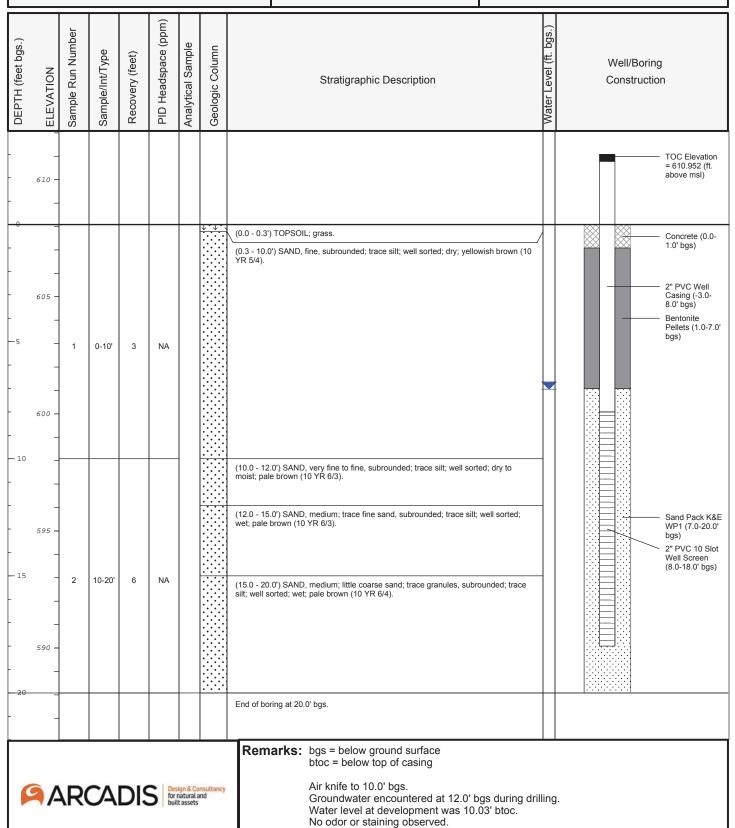
Well/Boring ID: JHC MW-15029

Client: Consumers Energy

Location: JH Campbell Facility

1700 Crosswell Street Site A West Olive, MI 49460

Weather Conditions: Cloudy, Light Rain, 65F.



Project: DE000722.0003.00005 Template: ARCADIS_Analytical Boring-Well 2013_New Logo

Data File: JHC MW-15029.dat Date: 2/4/2016 Created/Edited by: A. DeGrandis/C. Jeffers

Page: 1 of 1

Groundwater elevation measured on December 3, 2015 was 601.18 feet

Date Start: 10/5/15 **Date Finish:** 10/5/15

Drilling Company: Mateco Drilling Driller's Name: Dan Mourer Drilling Method: Air knife/Sonic Sampling Method: Continuous

Rig Type: Sonic

Water Level Start (ft. bgs.): 5.0 Water Level Finish (ft. btoc.): 7.99 Northing: 519760.827 Easting: 12633044.37 Casing Elevation: 607.167

Borehole Depth (ft. bgs.): 20.0 Surface Elevation: 604.047

Descriptions By: A. Westhuis

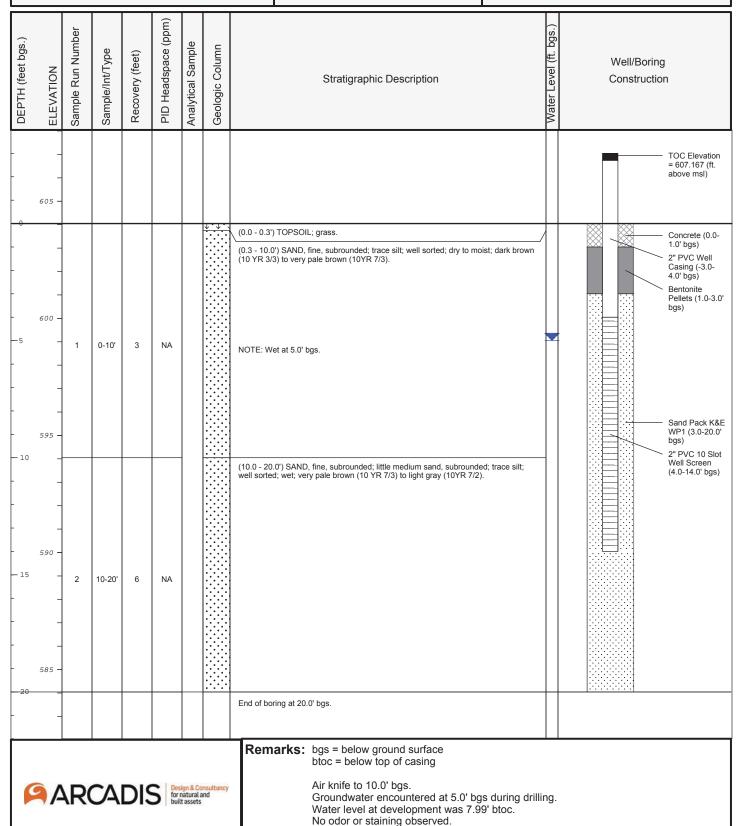
Well/Boring ID: JHC MW-15030

Client: Consumers Energy

Location: JH Campbell Facility

1700 Crosswell Street Site A West Olive, MI 49460

Weather Conditions: Cloudy, Light Rain, 65F.



Project: DE000722.0003.00005 Template: ARCADIS_Analytical Boring-Well 2013_New Logo

Data File: JHC MW-15030.dat Date: 2/4/2016 Created/Edited by: A. DeGrandis/C. Jeffers

Groundwater elevation measured on December 3, 2015 was 599.65 feet

Date Start: 10/6/15 Date Finish: 10/6/15

Drilling Company: Mateco Drilling Driller's Name: John Pitsch Drilling Method: Hand Auger/Sonic Sampling Method: Continuous

Rig Type: Sonic

Water Level Start (ft. bgs.): 19.0 Water Level Finish (ft. btoc.): 22.93 Northing: 521075.809 Easting: 12638598.12 Casing Elevation: 620.987

Borehole Depth (ft. bgs.): 30.0 Surface Elevation: 618.082

Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15033

Client: Consumers Energy

Location: JH Campbell Facility 1700 Crosswell Street Site A West Olive, MI 49460

Weather Conditions: Cloudy, 60F.

DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction	
- 62	20 -									=	OC Elevation 620.987 (ft. pove msl)
- - - - - - - - -	- - - - - - - - -	1	0-10'	10	NA			(0.0 - 0.3') TOPSOIL; grass. (0.3 - 0.8') SAND, fine, subrounded; trace silt; well sorted; dry; brown (10 YR 4/3). (0.8 - 2.0') SAND, fine, subrounded; trace silt; well sorted; dry; yellowish brown (10 YR 5/6). (2.0 - 10.0') SAND, fine, subrounded; trace silt; well sorted; dry; very pale brown (10 YR 7/3).		1.	entonite/Cement rout (1.0- 2.0' bgs) PVC Well assign (-3.0- 5.0' bgs)
- 10 - 60 - 15 - 60	-	2	10-20'	6	NA			(10.0 - 20.0') SAND, very fine to fine, subrounded; trace silt; well sorted; moist; yellowish brown (10 YR 5/4).		^^/	entonite Bllets (12.0- 4.0' bgs)
- 25 -	95 90	3	20-30'	6	NA			(20.0 - 30.0') SAND, fine; little medium sand, subrounded; trace silt; well sorted; moist to wet; very pale brown (10 YR 6/3).		30 30 2" W	and Pack K&E P1 (14.0-).0' bgs) PVC 10 Slot (ell Screen 6.0-26.0' bgs)
- 30	-							End of boring at 30.0' bgs.			
ARCADIS Design & Consultancy for natural and built assets						s <mark>ign & Co</mark> natural a It assets	nsultancy nd	Remarks: bgs = below ground surface btoc = below top of casing Hand auger to 10.0' bgs. Groundwater encountered at 19.0' bgs during dril Water level at development was 22.93' btoc. No odor or staining observed. Groundwater elevation measured on December 2			

Page: 1 of 1

Data File: JHC-MW-15033.dat

Date Start: 3/13/01
Date Finish: 3/13/01
Drilling Company: EDC, Inc.
Driller's Name: Sean Smith
Drilling Method: Hollow Stem Auger
Sampling Method: Split Spoon
Rig Type: Hollow Stem Auger
Water Level Start (ft. bgs.): NA

Water Level Finish (ft. btoc.): NA

Northing: NA Easting: NA

Casing Elevation: 615.90

Borehole Depth (ft. bgs.): 30.5 Surface Elevation: NA

Descriptions By: Rebecca J. Koepke

Well/Boring ID: JHC MW-15036

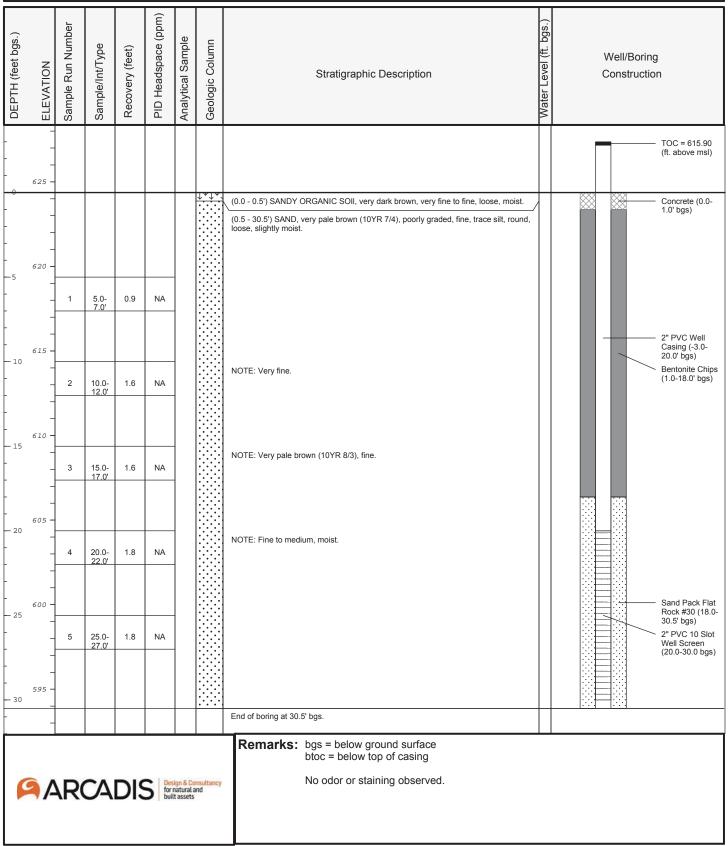
Client: Consumers Energy

Location: JH Campbell Facility

1700 Crosswell Street Site A

West Olive, MI 49460

Weather Conditions: NA



Page: 1 of 1

Data File: MW-15036.dat Date: 2/4/2016 Created/Edited by: Natural Resource Technology, Inc./A. Westhuis

SOIL DESCRIPTION

Udden-Wenworth Scale Modified ARCADIS, 2008						
	Wodiled Art	CADIS, 2000				
Size Class	Millimeters	Inches	Standard Sieve #			
Boulder	256 – 4096	10.08+				
Large cobble	128 - 256	5.04 -10.08				
Small cobble	64 - 128	2.52 - 5.04				
Very large pebble	32 – 64	0.16 - 2.52				
Large pebble	16 – 32	0.63 - 1.26				
Medium pebble	8 – 16	0.31 - 0.63				
Small pebble	4-8	0.16 - 0.31	No. 5+			
Granule	2-4	0.08 - 0.16	No.5 – No.10			
Very coarse sand	1-2	0.04 - 0.08	No.10 - No.18			
Coarse sand	1/2 - 1	0.02 - 0.04	No.18 - No.35			
Medium sand	1/4 - 1/2	0.01 - 0.02	No.35 - No.60			
Fine sand	1/8 -1/4	0.005 - 0.1	No.60 - No.120			
Very fine sand	1/16 – 1/8	0.002 - 0.005	No. 120 – No. 230			
Silt (subgroups not included)	1/256 – 1/16	0.0002 - 0.002	Not applicable (analyze by pipette or hydrometer)			
Clay (subgroups not included	1/2048 - 1/256	.00002 - 0.0002				

Modifier	Percent of Total Sample (by volume)
and	36 - 50
some	21 - 35
little	10 - 20
trace	<10

Description	Criteria
Nonplastic	A ¹ / ₈ inch (3 mm) thread cannot be rolled at any water content.
Low	
Medium	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
High	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit

Description	Criteria
Dry	Absence of moisture, dry to touch, dusty.
Moist	Damp but no visible water.
Wet (Saturated)	Visible free water, soil is usually below the water table.

Fine-grained soil – Consistency

Description	Criteria
Very soft	N-value < 2 or easily penetrated several inches by thumb.
Soft	N-value 2-4 or easily penetrated one inch by thumb.
Medium stiff	N-value 9-15 or indented about 1/4 inch by thumb with great effort.
Very stiff	N-value 16-30 or readily indented by thumb nail.
Hard	
	N-value > than 30 or indented by thumbnail with difficulty

Description	Criteria
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces.
Subangular	Particles are similar to angular description but have rounded edges.
Subrounded	
Rounded	Particles have nearly plane sides but have well-rounded corners and edges.
	Particles have smoothly curved sides and no edges.

Coarse-grained soil - Density

Description	Criteria
Very loose	N-value 1- 4
Loose	N-value 5-10
Medium dense	N-value 11-30
Dense	N-value 31- 50
Very dense	N-value >50

APPENDIX B

Photographic log



Photograph #1

Description of Photograph:

View of the various soil types encountered during the monitoring well installation activities at the Site.

Site Location:

Consumers Energy Co. J.H. Campbell Generating West Olive, Michigan

Photograph Taken By:

Austin Westhuis

<u>Date of Photograph:</u> September 17, 2015



Photograph #2

Description of Photograph:

View of the various soil types encountered during the monitoring well installation activities at the Site.

Site Location:

Consumers Energy Co. J.H. Campbell Generating Facility West Olive, Michigan

Photograph Taken By:

Austin Westhuis

<u>Date of Photograph:</u> September 23, 2015



Photograph #3

Description of Photograph:

View of the various soil types encountered during the monitoring well installation activities at the Site.

Site Location:

Consumers Energy Co. J.H. Campbell Generating West Olive, Michigan

Photograph Taken By:

Austin Westhuis

<u>Date of Photograph:</u> September 25, 2015



Photograph #4

Description of Photograph:

View of the typical sand layer encountered at the Site where monitoring well screens were installed.

Site Location:

Consumers Energy Co. J.H. Campbell Generating Facility West Olive, Michigan

Photograph Taken By:

Austin Westhuis

<u>Date of Photograph</u>: September 18, 2015

APPENDIX C

Hydraulic Test Logs

Slug Test Analysis Result for JHC MW-15005 - Test 2

Prepared By: Prepared For:

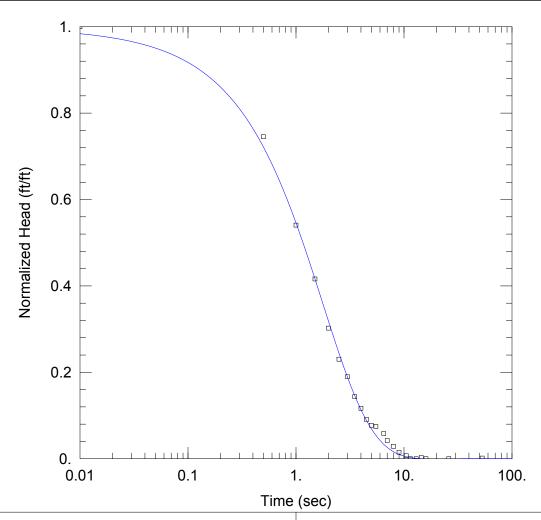
Arcadis

Project:

Consumer Energy

Location:

West Olive, MI



SOLUTION

Aquifer Model: <u>Unconfined</u> Solution Method: KGS Model

Kr = 61. ft/day $Ss = 3.7E-5 \text{ ft}^{-1}$

 $Kz/Kr = \overline{1}$.

AQUIFER DATA

Saturated Thickness: 19.82 ft

WELL DATA (JHC MW-15005)

Initial Displacement: 0.738 ft

Static Water Column Height: 6.82 ft Total Well Penetration Depth: 6.82 ft

Screen Length: 6.82 ft
Casing Radius: 0.083 ft
Well Radius: 0.33 ft



Slug Test Analysis Result for JHC MW-15005 - Test 3

Prepared By: Prepared For:

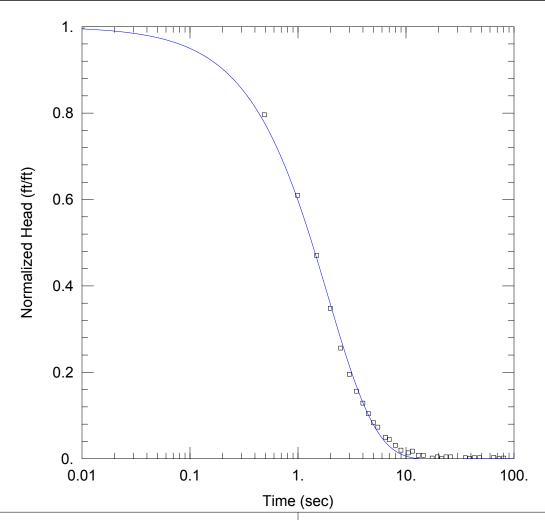
Arcadis

Project:

Consumer Energy

Location:

West Olive, MI



SOLUTION

Aquifer Model: <u>Unconfined</u> Solution Method: KGS Model

Kr = <u>58.</u> ft/day Ss = <u>5.05E-12</u> ft⁻¹

 $Kz/Kr = \overline{1}$.

AQUIFER DATA

Saturated Thickness: 19.82 ft

WELL DATA (JHC MW-15005)

Initial Displacement: 1.422 ft

Static Water Column Height: 6.82 ft Total Well Penetration Depth: 6.82 ft

Screen Length: $\underline{6.82}$ ft Casing Radius: $\underline{0.083}$ ft Well Radius: $\underline{0.33}$ ft



Slug Test Analysis Result for JHC MW-B6 - Test 2

Prepared By: Prepared For:

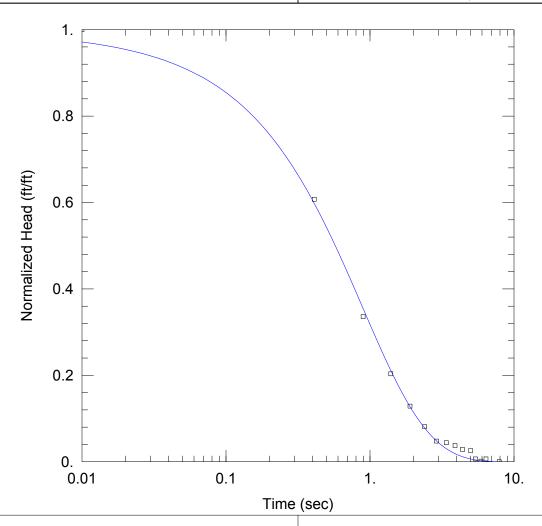
Arcadis

Project:

Consumer Energy

Location:

West Olive, MI



SOLUTION

Aquifer Model: <u>Unconfined</u> Solution Method: KGS Model

Kr = 118. ft/day Ss = 6.03E-5 ft⁻¹

 $Kz/Kr = \overline{1}$.

AQUIFER DATA

Saturated Thickness: 25.71 ft

WELL DATA (JHC MW-B6)

Initial Displacement: <u>0.777</u> ft

Static Water Column Height: 5.71 ft
Total Well Penetration Depth: 5.71 ft

Screen Length: $\underline{5.71}$ ft Casing Radius: $\underline{0.083}$ ft Well Radius: $\underline{0.33}$ ft



Slug Test Analysis Result for JHC MW-B6 - Test 3

Prepared By: Prepared For:

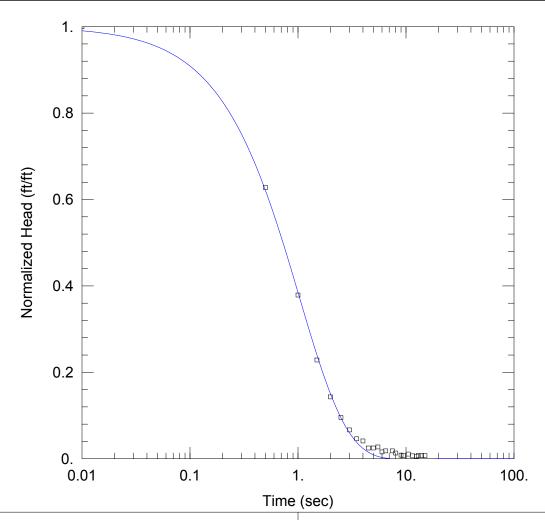
Arcadis

Project:

Consumer Energy

Location:

West Olive, MI



SOLUTION

Aquifer Model: <u>Unconfined</u> Solution Method: KGS Model

 $Kz/Kr = \overline{1}$.

AQUIFER DATA

Saturated Thickness: 25.71 ft

WELL DATA (JHC MW-B6)

Initial Displacement: 1.217 ft

Static Water Column Height: 5.71 ft
Total Well Penetration Depth: 5.71 ft

Screen Length: $\underline{5.71}$ ft Casing Radius: $\underline{0.083}$ ft Well Radius: $\underline{0.33}$ ft



Slug Test Analysis Result for JHC MW-15007 - Test 1

Prepared By: Prepared For:

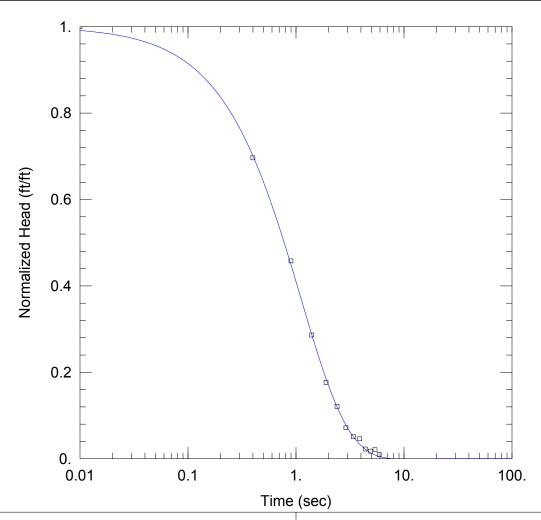
Arcadis

Project:

Consumer Energy

Location:

West Olive, MI



SOLUTION

Aquifer Model: <u>Unconfined</u> Solution Method: KGS Model

Kr = 130. ft/day

Ss = $5.05E-12 \text{ ft}^{-1}$

Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 23.37 ft

WELL DATA (JHC MW-15007)

Initial Displacement: 0.629 ft

Static Water Column Height: 5.37 ft Total Well Penetration Depth: 5.37 ft

Screen Length: 5.37 ft
Casing Radius: 0.083 ft
Well Radius: 0.33 ft



Slug Test Analysis Result for JHC MW-15015 - Test 2

Prepared By: Prepared For:

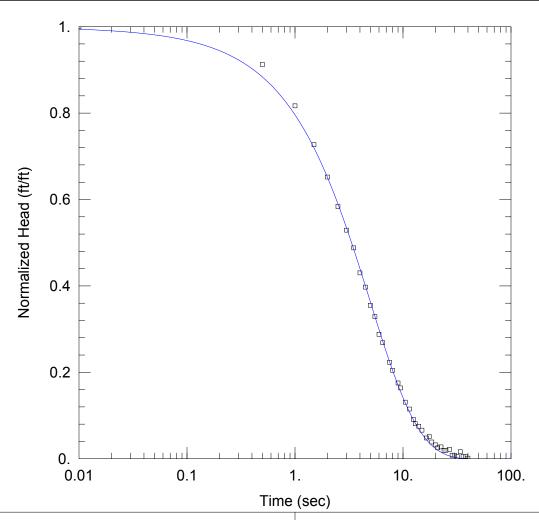
Arcadis

Consumer Energy

Location:

Project:

West Olive, MI



SOLUTION

Aquifer Model: <u>Unconfined</u> Solution Method: KGS Model

Kr = <u>22.</u> ft/day

Ss = $7.0E-6 \text{ ft}^{-1}$

Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 24.57 ft

WELL DATA (JHC MW-15015)

Initial Displacement: 0.879 ft

Static Water Column Height: 12.57 ft
Total Well Penetration Depth: 12.57 ft

Screen Length: 10. ft
Casing Radius: 0.083 ft
Well Radius: 0.33 ft



Slug Test Analysis Result for JHC MW-15015 - Test 3

Prepared By: Prepared For:

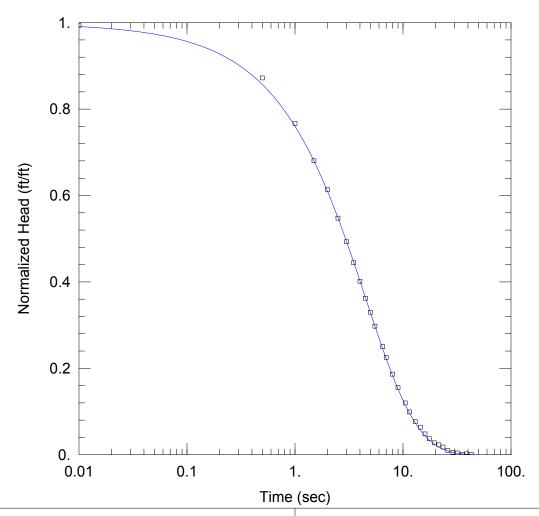
Arcadis

Project:

Consumer Energy

Location:

West Olive, MI



SOLUTION

Aquifer Model: <u>Unconfined</u> Solution Method: KGS Model

Kr = <u>21.</u> ft/day Ss = <u>1.9E-5</u> ft⁻¹

 $Kz/Kr = \overline{1}$.

AQUIFER DATA

Saturated Thickness: 24.57 ft

WELL DATA (JHC MW-15015)

Initial Displacement: 1.98 ft

Static Water Column Height: 12.57 ft
Total Well Penetration Depth: 12.57 ft

Screen Length: $\underline{10}$. ft Casing Radius: $\underline{0.083}$ ft Well Radius: $\underline{0.33}$ ft



Slug Test Analysis Result for JHC MW-15024 - Test 2

Prepared By: Prepared For:

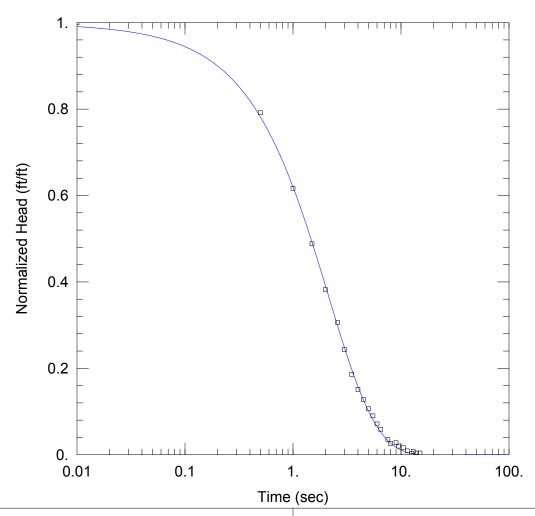
Arcadis

Consumer Energy

Location:

Project:

West Olive, MI



SOLUTION

Aquifer Model: <u>Unconfined</u> Solution Method: KGS Model

Kr = 49. ft/day Ss

 $Kz/Kr = \overline{1}$.

 $68 = 9.8E-6 \text{ ft}^{-1}$

AQUIFER DATA

Saturated Thickness: 38.71 ft

WELL DATA (JHC MW-15024)

Initial Displacement: <u>0.801</u> ft

Static Water Column Height: 5.71 ft
Total Well Penetration Depth: 5.71 ft

Screen Length: $\underline{5.71}$ ft Casing Radius: $\underline{0.083}$ ft Well Radius: 0.33 ft



Slug Test Analysis Result for JHC MW-15024 - Test 3

Prepared By: Prepared For:

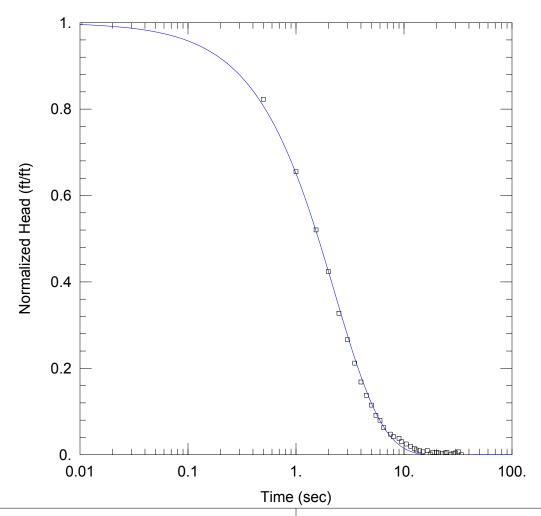
Arcadis

Consumer Energy

Location:

Project:

West Olive, MI



SOLUTION

Aquifer Model: <u>Unconfined</u> Solution Method: KGS Model

Kr = 45. ft/day

Ss = $5.05E-12 \text{ ft}^{-1}$

Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 38.71 ft

WELL DATA (JHC MW-15024)

Initial Displacement: 1.534 ft

Static Water Column Height: 5.71 ft
Total Well Penetration Depth: 5.71 ft

Screen Length: 5.71 ft
Casing Radius: 0.083 ft
Well Radius: 0.33 ft



Slug Test Analysis Result for JHC MW-15028 - Test 1

Prepared By: Prepared For:

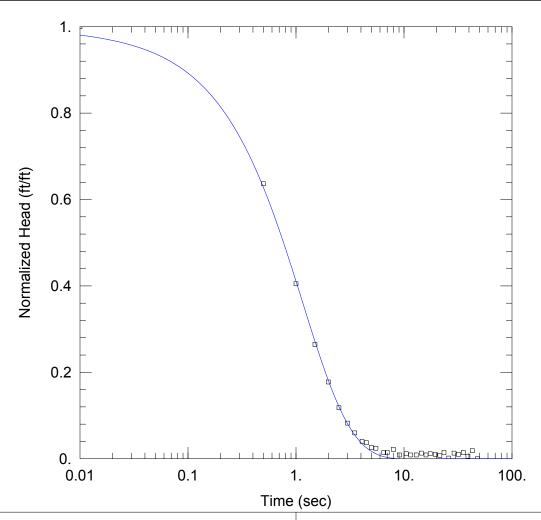
Arcadis

Project:

Consumer Energy

Location:

West Olive, MI



SOLUTION

Aquifer Model: <u>Unconfined</u> Solution Method: KGS Model

Kr = 104. ft/day

Ss = $3.1E-5 \text{ ft}^{-1}$

Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 38.22 ft

WELL DATA (JHC MW-15028)

Initial Displacement: 0.704 ft

Static Water Column Height: 6.22 ft
Total Well Penetration Depth: 6.22 ft

Screen Length: 6.22 ft Casing Radius: 0.083 ft Well Radius: 0.33 ft



Slug Test Analysis Result for JHC MW-15028 - Test 3

Prepared By: Prepared For:

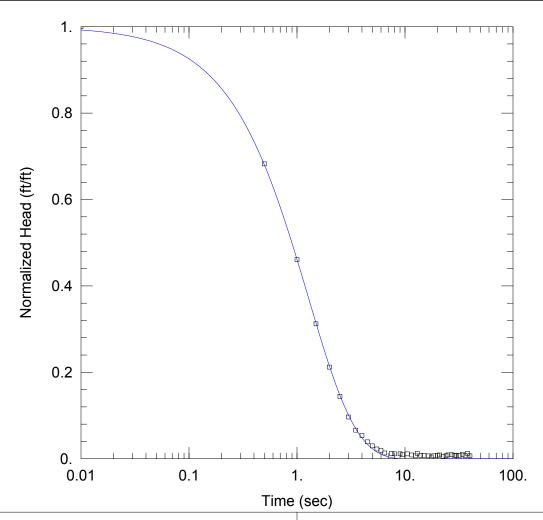
Arcadis

Project:

Consumer Energy

Location:

West Olive, MI



SOLUTION

Aquifer Model: <u>Unconfined</u> Solution Method: KGS Model

 $Kz/Kr = \overline{1}$.

AQUIFER DATA

Saturated Thickness: 38.22 ft

WELL DATA (JHC MW-15028)

Initial Displacement: 1.515 ft

Static Water Column Height: 6.22 ft Total Well Penetration Depth: 6.22 ft

Screen Length: 6.22 ft Casing Radius: 0.083 ft Well Radius: 0.33 ft



Slug Test Analysis Result for JHC MW-15033 - Test 2

Prepared By: Prepared For:

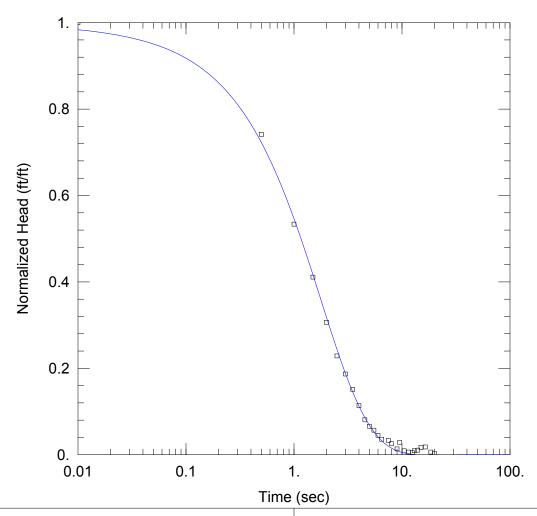
Arcadis

Consumer Energy

Location:

Project:

West Olive, MI



SOLUTION

Aquifer Model: <u>Unconfined</u> Solution Method: KGS Model

Kr = 74. ft/day

Ss = $5.3E-5 \text{ ft}^{-1}$

 $Kz/Kr = \overline{1}$.

AQUIFER DATA

Saturated Thickness: 29.83 ft

WELL DATA (JHC MW-15033)

Initial Displacement: 0.669 ft

Static Water Column Height: 5.83 ft
Total Well Penetration Depth: 5.83 ft

Screen Length: $\underline{5.83}$ ft Casing Radius: $\underline{0.083}$ ft Well Radius: $\underline{0.33}$ ft



Slug Test Analysis Result for JHC MW-15030 - Test 2

Prepared By: Prepared For:

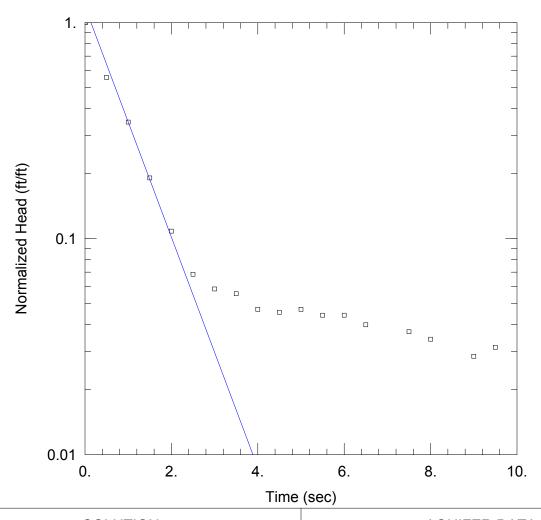
Arcadis

Project:

Consumer Energy

Location:

West Olive, MI



SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

K = 100. ft/day y0 = 0.83 ft

AQUIFER DATA

Saturated Thickness: 45.12 ft

WELL DATA (JHC MW-15030)

Initial Displacement: <u>0.701</u> ft

Static Water Column Height: 9.12 ft
Total Well Penetration Depth: 9.12 ft

Screen Length: 9.12 ft Casing Radius: 0.083 ft Well Radius: 0.33 ft



Slug Test Analysis Result for JHC MW-15030 - Test 3

Prepared By: Prepared For:

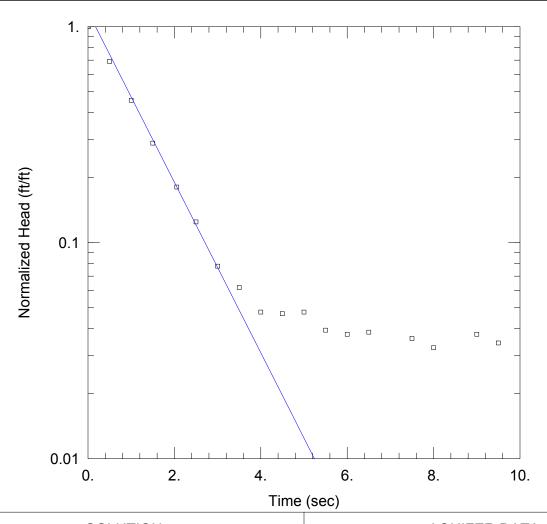
Arcadis

Project:

Consumer Energy

Location:

West Olive, MI



SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

K = 87. ft/day y0 = 1.4 ft

AQUIFER DATA

Saturated Thickness: 45.12 ft

WELL DATA (JHC MW-15030)

Initial Displacement: 1.194 ft

Static Water Column Height: 9.12 ft
Total Well Penetration Depth: 9.12 ft

Screen Length: 9.12 ft
Casing Radius: 0.083 ft
Well Radius: 0.33 ft



Slug Test Analysis Result for JHC MW-15018 - Test 1

Prepared By: Prepared For:

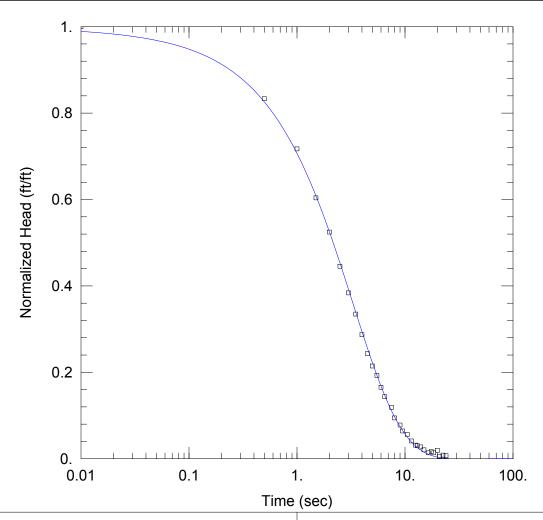
Arcadis

Project:

Consumer Energy

Location:

West Olive, MI



SOLUTION

Aquifer Model: <u>Unconfined</u> Solution Method: KGS Model

Kr = 34. ft/day Ss = $4.0E-5 \text{ ft}^{-1}$

 $Kz/Kr = \overline{1}$.

AQUIFER DATA

Saturated Thickness: 36.5 ft

WELL DATA (JHC MW-15018)

Initial Displacement: 0.732 ft Static Water Column Height: 6.5 ft Total Well Penetration Depth: 6.5 ft

Screen Length: $\underline{6.5}$ ft Casing Radius: $\underline{0.083}$ ft Well Radius: $\underline{0.33}$ ft



Slug Test Analysis Result for JHC MW-15018 - Test 3

Prepared By: Prepared For:

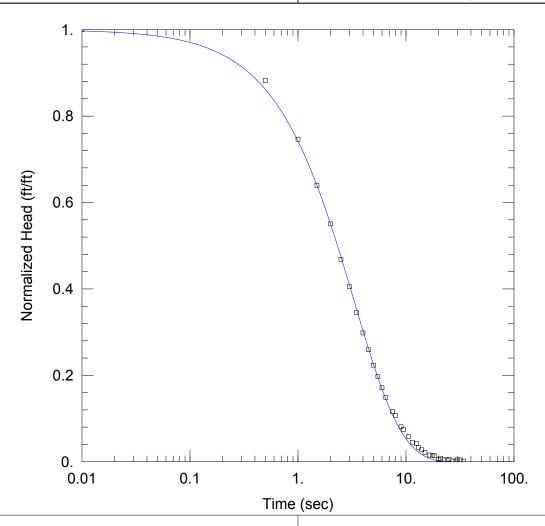
Arcadis

Project:

Consumer Energy

Location:

West Olive, MI



SOLUTION

Aquifer Model: <u>Unconfined</u> Solution Method: KGS Model

 $Kz/Kr = \overline{1}$.

AQUIFER DATA

Saturated Thickness: 36.5 ft

WELL DATA (JHC MW-15018)

Initial Displacement: 1.486 ft Static Water Column Height: 6.5 ft Total Well Penetration Depth: 6.5 ft

Screen Length: 6.5 ft
Casing Radius: 0.083 ft
Well Radius: 0.33 ft





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Novi, Michigan 48377

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Fax 248 994 2241

www.arcadis.com