

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 Unit 3 Bottom Ash Pond

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 use of only the minimum.

Groundwater Monitoring System

A groundwater monitoring system has been established for the JHC Unit 3 Bottom Ash Pond, which established the following locations for determining background groundwater quality and detection monitoring. Downgradient monitoring well JHC MW-15014 was reported damaged and inaccessible on June 24, 2016. This well has not been replaced since the remaining wells are still able to adequately detect a release from the CCR unit.

Background:

Dow

JHC MW-15023	JHC MW-15024	JHC MW-15025
JHC MW-15026	JHC MW-15027	JHC MW-15028
vngradient:		

JHC MW-15012

JHC MW-15013

JHC MW-15015

JHC MW-15016

"Groundwater Monitoring System Certification JH Campbell Bottom Unit 3 Bottom Ash Pond" October 17, 2017 Page 2

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 Unit 3 Bottom Ash Pond 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.

). Legu

Signature

October 17, 2017

Date of Certification

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

6201056266 Professional Engineer Certification Number

HAROLD D. HAROLD J. HAROLD J.

ENCLOSURES

ARCADIS (2016). "*Summary of Monitoring Well Design, Installation, and Development – Bottom Ash Pond 3N/3S*"



Consumers Energy Company

SUMMARY OF MONITORING WELL DESIGN, INSTALLATION, AND DEVELOPMENT – BOTTOM ASH POND UNIT 3N/3S

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

May 13, 2016

Gregory E. Zellmer, P.G. Certified Project Manager/Senior Geologist

Summary of Monitoring Well Design, Installation, and Development – Bottom Ash Pond Unit 3N/3S

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

Prepared for: Consumers Energy Company Jackson, Michigan

Prepared by: Arcadis of Michigan, LLC 28550 Cabot Drive Suite 500 Novi Michigan 48377 Tel 248 994 2240 Fax 248 994 2241

Our Ref.: DE000722.0003.00006

Date: May 13, 2016

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Mark Robert Klemmer, PE

Printed Name of Registered Professional Engineer

Signature of Registered Professional Engineer Registration Number: <u>62010-49167</u> State: <u>MI</u>

5/13/16 Date:

Mullan

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\larcadis-us.com\officedata\novi-mi\common\consumers energy\ccr\campbell\6.reports\mw installation reports\linal reports\unit 3n3s\ccr final jhc mw program installation report (unit 3n_3s) 4-28-16.docx

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- Table 3 Estimated Hydraulic Conductivity (K) Values

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Drawing SG-22345 - Campbell Plant Monitoring Wells, CCR Monitoring

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- Appendix A Soil Boring and Monitoring Well Construction Logs
- Appendix B Photographic Log
- Appendix C Hydraulic Test Results

1 INTRODUCTION

ARCADIS has prepared this Summary of Monitoring Well Design, Installation, and Development (Report) to summarize monitoring well installation activities for Unit 3N/3S 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 five downgradient wells (JHC MW-15012 through JHC MW-15016) 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

Thirteen (13) soil borings (JHC MW-15012 through JHC MW-15016 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.

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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 1 to 7 foot thick bentonite 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 24-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**.

Groundwater Parameter	Stabilization Criteria
pH	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

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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 details are 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-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 bail-down 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-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 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

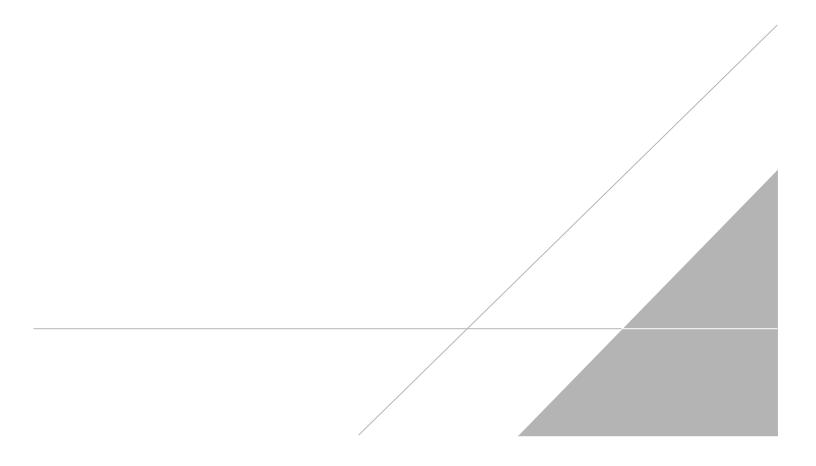


Table 1 Monitoring Well Construction and Development Summary Consumers Energy Co. J.H. Campbell Generating Facility West Olive, Michigan

ARCADIS	Design & Consultancy for natural and built assets
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			Site Coord	linates					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-15012		519214.84	12633675.28	632.59	635.66	9/28/2015	Sand	2" PVC, 10 slot	10	28 - 38	28.70	40.96	31.40	120	8.01
JHC MW-15013		519207.19	12634025.15	632.40	635.25	9/25/2015	Sand	2" PVC, 10 slot	10	28 - 38	25.94	41.15	28.06	120	5.55
JHC MW-15014		519419.85	12634254.12	635.13	638.18	9/25/2015	Sand	2" PVC, 10 slot	10	39 - 49	29.81	52.00	31.89	150	3.90
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-15016		519956.79	12634198.52	631.81	634.64	9/28/2015	Sand	2" PVC, 10 slot	10	28 - 38	30.33	41.06	NR	155	0.63
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															L
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

Notes: ft = feet

bgs = below ground surface TOC = top of casing

NR = Not recorded

NA = Not applicable



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	age		73	2.56E-02	
	Over all Geomet			62	2.19E-02	
	Minimum			21	7.41E-03	
	Maximun	<u>ו</u>		139	4.90E-02	

Note:

H⁰ = initial displacement

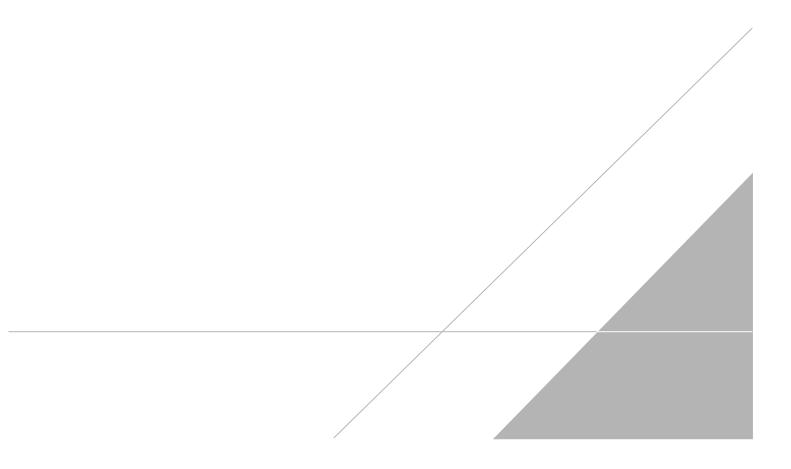
H^{*} = expected (calculated) displacement

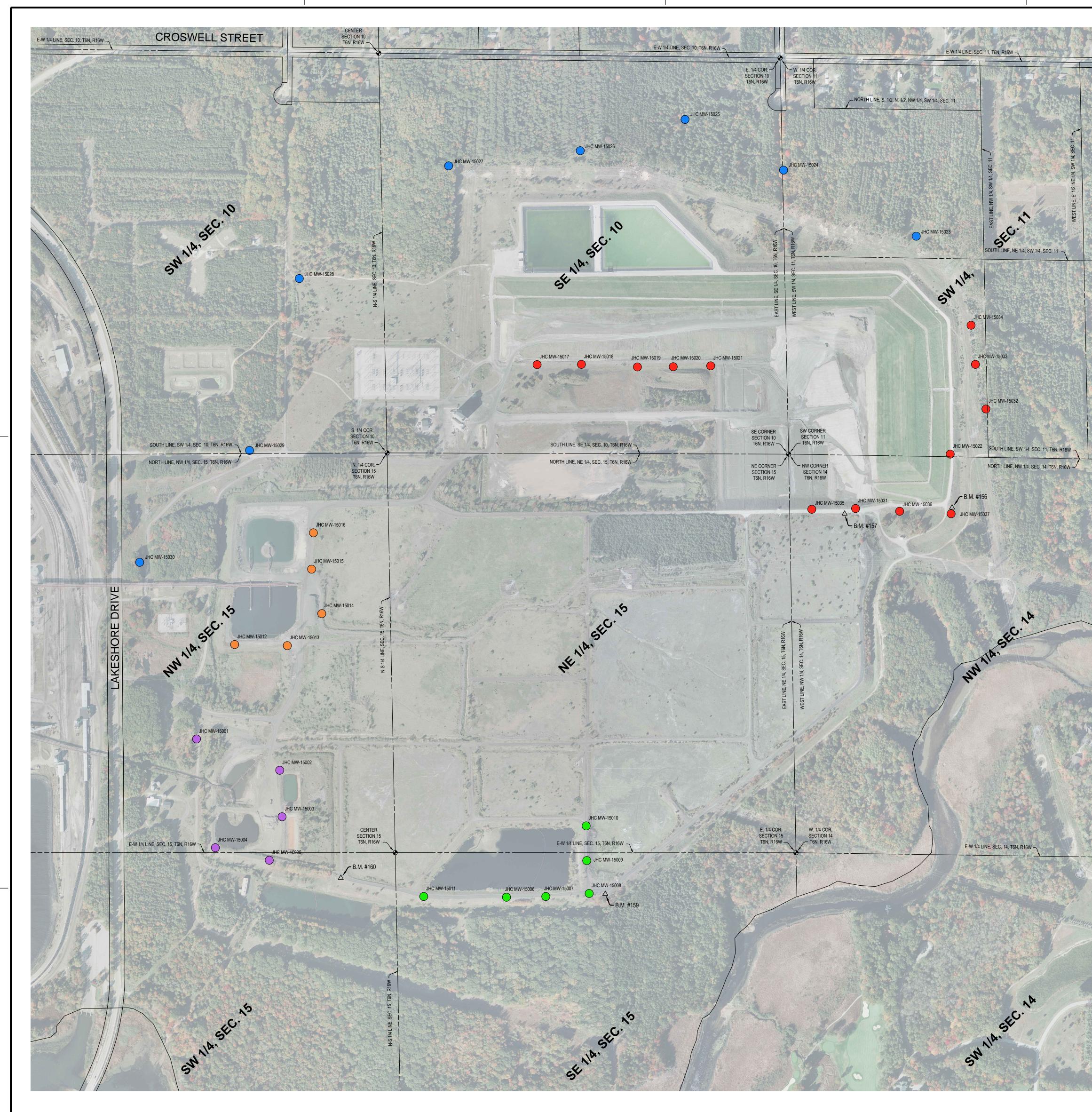
cm/sec = centimeters per second

ft = feet

ft/d = feet per day

FIGURES





SURVEY REPORT

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 2010.00).

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 benchmarks.

SURVEYOR'S NOTES

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

LEGEND

= POND A MONITORING WELL

DRAWING NO.	REFERENCE DRAWINGS	REV	DATE	DESCRIPTION

= EXISTING MONITORING WELL

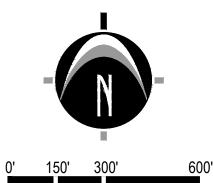
- = DOWNGRADIENT LANDFILL MONITORING WELL
- = DOWNGRADIENT BOTTOM ASH POND 1/2 N/S MONITORING WELL
- = DOWNGRADIENT BOTTOM ASH POND 3 N/S MONITORING WELL

= BACKGROUND MONITORING WELL

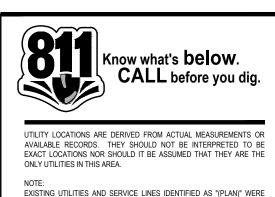
BASIS OF BEARING STATE PLANE COORDINATES

BASIS OF ELEVATION NEDI BM (NAVD88)

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



SCALE: 1" = 300'



NOTE: EXISTING UTILITIES AND SERVICE LINES IDENTIFIED AS "(PLAN)" WERE OBTAINED FROM AVAILABLE CITY AS-BUILT RECORD DRAWINGS. THE CONTRACTOR SHALL VERIFY THE LOCATION, DEPTH AND STATUS OF ALL UTILITIES AND SERVICE LINES PRIOR TO NEW CONNECTIONS.

_____ A 11.25.15 REVISIONS PER CONSUMERS ENERGY REVIEW REV DATE DESCRIPTION REV DATE DESCRIPTION BY APP

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 Street.

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 #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.

BENCHMARK #157 ELEV. = 630.91 (NAVD88) 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









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

SURVEY POINT	INSTRUMENTATION	NORTHING	EASTING	GROUND ELEVATION (TOP OF CONCRETE)	TOP OF CASING ELEVATION	LATITUDE	LONGITUDE	
NUMBER	STRUCTURE		TERNATIONAL FT.	(NAVD88)	(NAVD88)		DEGREES)	
				(INAV Doo)	(INAV Doo)			
70035	JHC MW-15001	518586.883	12633422.010	607.02	609.53	42.908415	-86.195653	
70034	JHC MW-15001	518378.917	12633974.821	625.97	628.87	42.907878	-86.193573	
70033	JHC MW-15002	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	
70028	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	
70025	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-15012	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 DATU
NED 1	SET 3-1/4" DOMED ALUMINUM CAP ON 3/4" ALUMINUM TOP SECURITY ROD MONUMENT		16259.8663	12360.7163			607.357
	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
	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
	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'					

	DR.		
	FLD.	PV	10.27.15
	ск.	MN	11.25.15
MN	APP.		
APP			



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

Holland, Indianapolis, St. Louis

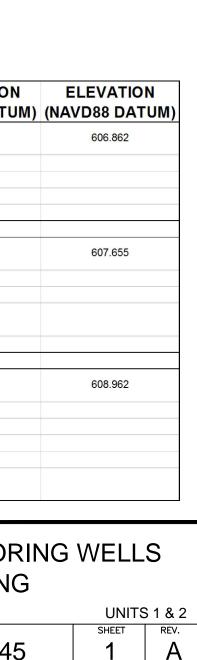
CAMPBELL PLANT MONITORING WELLS CCR MONITORING

22345base.DWG DRAWING NO. 1" = 300' SCALE SG-22345

583-009-441

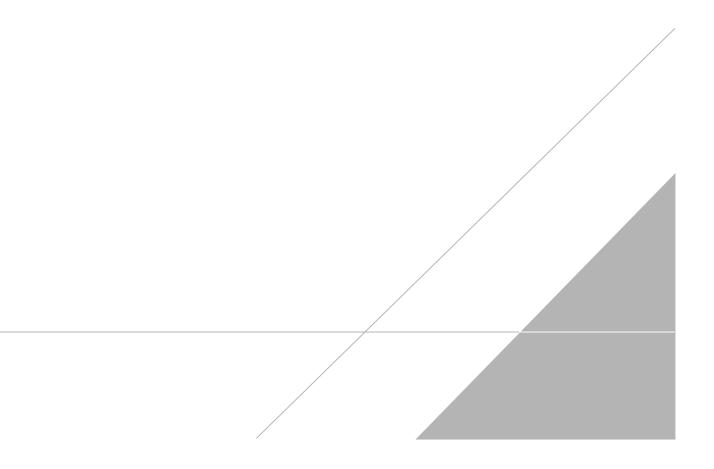


JHC MW-15029



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	Easting: 12633905.01 Client: Consumers Energy Casing Elevation: 627.297 Client: Consumers Energy Borehole Depth (ft. bgs.): 40.0 Location: JH Campbell Facility Surface Elevation: 624.367 1700 Crosswell Street Site A West Olive, MI 49460 West Olive, MI 49460		
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)	
	- - - - - - - - - - - - - - - - 	1	0.0- 10.0'	10	NA		7 × × × × × × × × × × × × × × × × × × ×	(0.0 - 0.3') Grass, Topsoil. (0.3 - 10.0') ASH and SAND, fine to medium; trace granules, subrou to stiff; poorly sorted; brown (10YR 5/3) to dark grayish brown (10YF Fill material.	nded; moist; soft 4/2). NOTE:	Concrete (0.0- 1.0' bgs)	
- 10 - - - - 15 -	- - - - - - - - - - - - - - -	2	10.0-20.0'	6	NA		× × ×	(10.0 - 11.0') ASH; well sorted; medium stiff to stiff; moist; dark gray NOTE: Fill material. (11.0 - 13.0') SAND, medium, little to some fine sand, subrounded; tr sorted; dry; brown (10YR 5/3) to yellowish brown (10YR 5/4). (13.0 - 16.0') SAND, medium; little fine sand, subrounded; trace silt; very pale brown (10YR 7/4). (16.0 - 19.5') SAND, medium; trace fine, subrounded; trace silt; dry; brown (10YR 6/4).	ace silt; well well sorted; dry;	Bentonite/Cement Grout (1.0- 23.0' bgs) 2" PVC Well Casing (-3.0- 27.0' bgs)	
	Remarks: bgs = below ground surface btoc = below top of casing Air knife to 10.0' bgs. Air knife to 10.0' bgs. Groundwater encountered at 29.0' bgs during drilling. Water level at development encountered at 33.26' btoc. No odor or staining observed. Groundwater elevation measured on December 2, 2015 was 595.77 feet roject: DE000722.0003.00006 Template: ARCADIS_Analytical Boring-Well 2013_New Logo										

Dat Dril Dril Dril Sar Rig Wa	e Fini ling C ler's l ling M npling Type ter Le	Compa Name Metho g Meth e: Soni evel St	/18/15 any: M : Johr d: Air nod: (n Pitsc Knife/S Contine	h Sonic uous : 29.0)		Northing: 517781.423 Easting: 12633905.01 Casing Elevation: 627.297 Borehole Depth (ft. bgs.): 40.0 Surface Elevation: 624.367 Descriptions By: A. Westhuis	oring ID: JHC MW-15005 Consumers Energy on: JH Campbell Facility 1700 Crosswell Street Site A West Olive, MI 49460 or 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 	605 - - - - - - - - - - - - - - - - - - -	3	20.0- 30.0'	6	NA			(19.5 - 19.8') SAND, medium; trace fine, subrounded; little to some s (10YR 4/3). (19.8 - 29.0') SAND, medium, trace fine, subrounded; trace silt; well pale brown (10YR 7/4). (29.0 - 31.0') SAND, medium, little fine, trace coarse, subrounded; trace sorted; wet; pale brown (10YR 6/3).	sorted; dry; very		AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
- 35	- - 590 - - - - 585 -	4	30.0- 40.0'	9	NA			(31.0 - 33.0') SAND, medium to coarse, little fine, subrounded; trace wet; pale brown (10YR 6/3). (33.0 - 40.0') SAND, fine, some medium, subrounded; well sorted; w (10YR 6/3).			Sand Pack K&E WP1 (25.0- 40.0' bgs) """"""""""""""""""""""""""""""""""""
End of boring at 40.0' bgs. End of boring at 40.0' bgs. Remarks: bgs = below ground surface btoc = below top of casing											
Proje	ect: DI	E0007	22.000 5005.d	03.000				Air knife to 10.0' bgs. Groundwater encountered at 29.0' I Water level at development encoun No odor or staining observed. Groundwater elevation measured o RCADIS_Analytical Boring-Well 2013_New Logo Date: 2/4/2016 Created/Edited by: S.E	n December 2	6' bto 2, 20	DC.

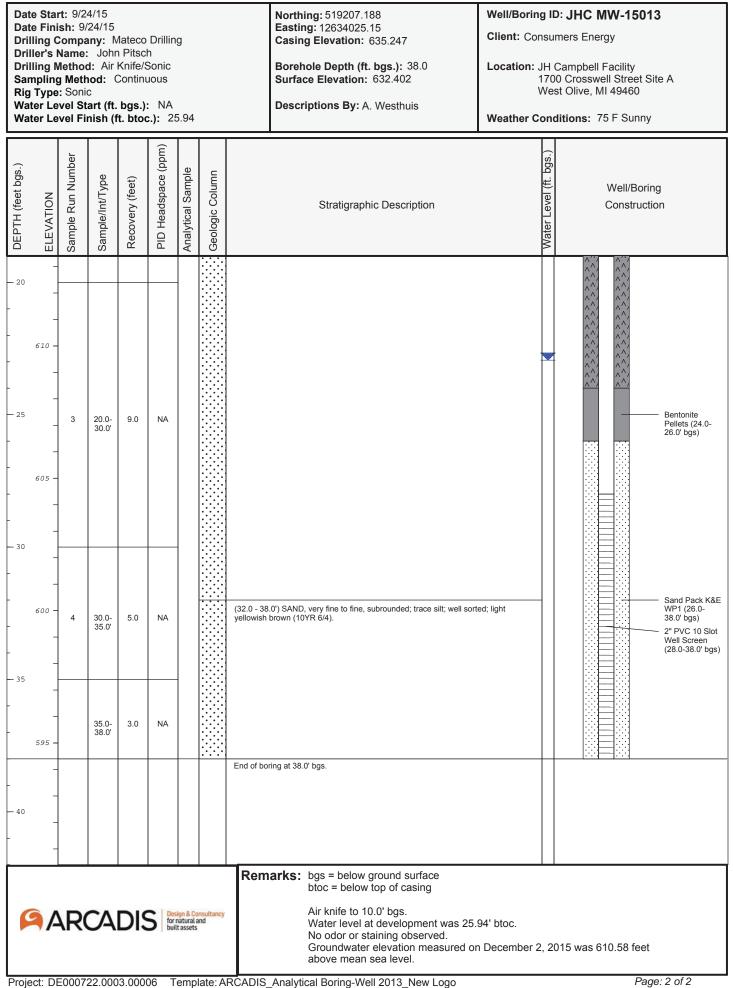
Date Dril Dril Dril San Rig Wat	e Fini ling C ler's I ling M npling Type er Le	Compa Name Metho g Meth : Soni vel St	/21/15 any: M : Johr d: Air nod: (n Pitsc Knife/S Contine	h Sonic uous : 21.()		Northing: 517540.502 Easting: 12635742.72 Casing Elevation: 627.697Well/Boring ID: JHC MW-15007 Client: Consumers EnergyBorehole Depth (ft. bgs.): 40.0 Surface Elevation: 624.817 Descriptions By: A. WesthuisLocation: JH Campbell Facility 1700 Crosswell Street Site West Olive, MI 49460Weather Conditions: 75 F Sunny			rgy Facility ell Street Site A /Ι 49460	
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	
-	_ _ 						↓ * ↓ * 、	(0.0 - 0.3') Grass, Topsoil.			TOC = 627.697 (ft. above msl)	
5	-5	1	0.0- 10.0'	10	NA			(0.3 - 10.0') SAND, fine to medium, subrounded; trace silt; well sorte light brownish gray (10YR 6/2).	ed; dry to moist;		Concrete (0.0- 1.0' bgs)	
-	-10 - - - - - 15 - - - - 15 - - -	2	10.0- 20.0'	8	NA			(10.0 - 17.0') SAND, fine, trace to little medium, subrounded; little sid dry; light yellowish brown (10YR 6/4). (17.0 - 17.5') SAND, very fine to fine, subrounded; little to some silt; very pale brown (10YR 7/3). (17.5 - 40.0') SAND, fine to medium, subrounded; trace silt; well som brownish yellow (10YR 6/6).	well sorted; dry;		A 18.0' bgs) A 2" PVC Well Casing (-3-25.0' A B B B B B B B B B B B B B B B	
	Remarks: bgs = below ground surface btoc = below top of casing Air knife to 10.0' bgs. Groundwater encountered at 21.0' bgs during drilling. Water level at development was 29.28' btoc. No odor or staining observed. Groundwater elevation measured on December 2, 2015 was 599.22 feet roject: DE000722.0003.00006 Template: ARCADIS_Analytical Boring-Well 2013_New Logo Page: 1 of 2											

Date Dril Dril Dril San Rig Wat	e Fini ling C ler's l ling N npling Type ter Le	Compa Name Metho g Metho s: Soni evel St	/21/15 any: M : Johr d: Air nod: (n Pitsc Knife/S Contini bgs.)	h Sonic uous : 21.0)		Northing: 517540.502 Easting: 12635742.72 Casing Elevation: 627.697 Borehole Depth (ft. bgs.): 40.0 Surface Elevation: 624.817 Descriptions By: A. Westhuis	D: JHC MW-15007 Imers Energy Campbell Facility 00 Crosswell Street Site A Ist Olive, MI 49460 ditions: 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 - - - 25 - - -	3	20.0- 30.0'	5	NA			NOTE: Wet at 21.0' bgs.		Bentonite Pellets (18.0- 20.0' bgs)
- 30 - 35 - 35	- 30 - - - - - - - - - - - - - - - - - - -	4	30.0- 40.0'	5	NA					
								End of boring at 40.0' bgs. Remarks: bgs = below ground surface btoc = below top of casing Air knife to 10.0' bgs. Groundwater encountered at 21.0' I Water level at development was 29 No odor or staining observed. Groundwater elevation measured o RCADIS Analytical Boring-Well 2013	.28' btoc.	

Dat Dril Dril Dril Sar Rig Wa	e Fini ling C ler's I ling M npling Type ter Le	Compa Name Metho g Meth s: Soni evel St	/28/15 any: M : Johr d: Air nod: (/lateco n Pitsc Knife/S Continu	h Sonic uous : 33.()		Northing: 519214.841 Easting: 12633675.28 Casing Elevation: 635.662 Borehole Depth (ft. bgs.): 38.0 Surface Elevation: 632.592 Descriptions By: A. Westhuis	D: JHC MW-15012 Imers Energy Campbell Facility, 1700 Crosswell eet Site A, West Olive, MI 49460 ditions: 60 F Cloudy, Windy		
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 = 635.662 (ft. above msl)
		1	0.0- 10.0'	10.0	NA			(0.0 - 10.0') SAND, fine, subrounded; trace to little silt; well sorted; grayish brown (10YR 4/2). NOTE: Little ash.	dry to moist; dark		Concrete (0.0- 1.0' bgs)
- 10 - - - - - -	- 620 - - - - - - - - -	2	10.0- 20.0'	NA	NA			(10.0 - 28.0') Blind drilled; no soils logged. Refer to soil boring log	SB-Z.		A A A Bentonite/Cement Grout (1.0- 24.0' bgs) A 2" PVC Well Casing (-3-28.0' bgs) A A A A
			22.000					Remarks: bgs = below ground surface btoc = below top of casing Air knife to 10.0' bgs. Groundwater encountered at 33.0' Water level at development was 2i No odor or staining observed. Groundwater elevation measured RCADIS_Analytical Boring-Well 2013_New Logo	3.70' btoc.	2, 2	015 was 608.50 feet Page: 1 of 2

Dat Dril Dril Dril San Rig Wat	e Fini ling C ler's I ling M npling Type ter Le	Compa Name: Methoo g Meth : Soni evel St	(28/15 any: M : Johr d: Air nod: (n Pitsc Knife/S Continu bgs.)	h Sonic Jous : 33.0)		Northing: 519214.841 Easting: 12633675.28 Casing Elevation: 635.662Well/Boring ID: JHC MW-15012 Client: Consumers EnergyBorehole Depth (ft. bgs.): 38.0 Surface Elevation: 632.592Location: JH Campbell Facility, 1700 Cro Street Site A, West Olive, MI 48Descriptions By: A. WesthuisWeather Conditions: 60 F Cloudy, Wind			
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 -		3	20.0-28.0'	NA	NA			(28.0 - 33.0') SAND, fine to medium, subrounded; well sorted; mo pale brown (10YR 7/4).	st to wet; very	-	Bentonite Pellets (24.0- 26.0' bgs)
- 30 	- - - - - - - - - - - - - - - - - - -	4	28.0- 38.0'	7.0	NA			(33.0 - 38.0') SAND, fine, subrounded; trace silt; well sorted; wet; (10YR 7/4).	very pale brown	-	Sand Pack K&E WP1 (26.0- 38.0' bgs) 2" PVC 10 Slot Well Screen (28.0-38.0' bgs)
- 40	-							End of boring at 38.0' bgs.			
								Remarks: bgs = below ground surface btoc = below top of casing Air knife to 10.0' bgs. Groundwater encountered at 33.0 Water level at development was 2 No odor or staining observed. Groundwater elevation measured	8.70' btoc.	2, 20	115 was 608.50 feet Page: 2 of 2

Dat Dril Dril Dril Sar Rig Wa	e Fini lling C ller's I lling M npling Type ter Le	Compa Name: Metho g Meth : Soni vel St	/24/15 any: M : Johr d: Air nod: (n Pitsc Knife/S Contine	h Sonic uous : NA			Northing: 519207.188 Easting: 12634025.15 Casing Elevation: 635.247Well/Boring ID: JHC MW-15013 Client: Consumers EnergyBorehole Depth (ft. bgs.): 38.0 Surface Elevation: 632.402Location: JH Campbell Facility 1700 Crosswell Street Site A West Olive, MI 49460Descriptions By: A. WesthuisWeather 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	Watar aval (# hrs.)	Well/Boring	
-	- 635 - -										TOC = 635.247 (ft. above msl)	
	- 	1	0.0- 10.0'	5.0	NA			(0.3 - 10.0	I GRASS, TOPSOIL.) SAND, fine to medium, subrounded; trace to little silt; w e brown (10YR 6/3) to brownish yellow (10YR 6/6).	ell sorted; dry to	Concrete (0.0- 1.0' bgs)	
- 10 - - - 15 -	- 620 - - - 615 -	2	10.0- 20.0'	8.0	NA		×	(16.0 - 16. grayish br (16.5 - 17. (10YR 6/2	 0') SAND, fine, subrounded; trace to little silt; well sorted; wish brown (10YR 6/4). 5') ASH and SAND, fine, subrounded; well sorted; moist; own (10YR 3/2). NOTE: Fill material. 0') SAND, fine, subrounded; little silt; well sorted; dry; ligh). NOTE: Trace ash. Soils hot; cooked by Sonic rig. 0') SAND, fine, subrounded; trace silt; well sorted; yellowi 	very dark t brownish gray	Bentonite/Cement Grout (1.0- 24.0' bgs) 2" PVC Well Casing (-3-28.0' bgs)	
	Remarks: bgs = below ground surface btoc = below top of casing Air knife to 10.0' bgs. Water level at development was 25.94' btoc. No odor or staining observed. Groundwater elevation measured on December 2, 2015 was 610.58 feet above mean sea level. roject: DE000722.0003.00006 Template: ARCADIS_Analytical Boring-Well 2013_New Logo											



Dat Dril Dril Dril Sar Rig Wa	e Fini lling C ller's I lling N npling Type ter Le	Compa Name Metho g Meth c: Soni evel St	/25/15 any: M : Johr d: Air hod: (n Pitsc Knife/S Continu bgs.)	h Sonic Jous : 24.3	35		Northing: 519419.85 Easting: 12634254.12 Casing Elevation: 638.132 Borehole Depth (ft. bgs.): 50.0 Surface Elevation: 635.132 Descriptions By: A. Westhuis	Client: Const Location: JH 171 We	ID: JHC MW-15014 sumers Energy H Campbell Facility 700 Crosswell Street Site A /est Olive, MI 49460 enditions: 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 = 638.132 (ft. above msl)		
- - - - - -	635 = - - - - - - - - - - - - - -	1	0.0- 10.0'	5.0	NA		× × × × × × × × × × × × × × × × × × ×	(0.0 - 0.3') GRASS, TOPSOIL. (0.3 - 10.0') ASH; trace fine sand, subrounded; well sorted; moist to gray (10YR 4/1). NOTE: Fill material.	wet; soft; dark	Concrete (0.0- 1.0' bgs)		
- 10 - - - - - - - - - - - - - - - - - - -	625 - - - - - - - - - - - - - - - - - - -	2	10.0-20.0'	8.0	NA		× × × × × × × × × × × × × × × × × × ×	(10.0 - 35.0') ASH; well sorted; very soft; wet; gray (10YR 5/1). NOT	E: Fill material.	Bentonite/Cemeni Grout (1.0- 35.0' bgs) 2" PVC Well Casing (-3-39.0' bgs)		
-												
	Remarks: bgs = below ground surface btoc = below top of casing Air knifed to 10.0' bgs. Air knifed to 10.0' bgs. Groundwater encountered at 24.35' bgs. Water level at development was 29.81' btoc. No odor or staining observed. Groundwater elevation measured on December 3, 2015 was 609.49 feet oject: DE000722.0003.00006 Template: ARCADIS_Analytical Boring-Well 2013_New Logo											

Dat Dril Dril Dril Sar Rig Wat	e Fini lling C ller's I lling N npling Type ter Le	Compa Name Metho g Meth e: Soni evel St	/25/15 any: M : Johr d: Air nod: (n Pitsc Knife/S Continu bgs.)	h Sonic Jous : 24.3	35		Easting: 12634254.12 Casing Elevation: 638.132Client: ConBorehole Depth (ft. bgs.): 50.0 Surface Elevation: 635.132Location: JDescriptions By: A. WesthuisV			ID: JHC MW-15014 sumers Energy H Campbell Facility 700 Crosswell Street Site A Vest Olive, MI 49460 onditions: 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		
- 25 - - - - 30	610 - - - - - - -	3	20.0- 30.0'	8.0	NA	-		NOTE: Wet at 24.35' bgs.					
- - - - - - - - - - -	- - - - - - - - - - - - -	4	30.0- 40.0'	9.0	NA		× × × × × × × × · · · · · · · · · · · ·	(35.0 - 35.5') SAND, fine, little very fine, subrounded; well sorted; we 6/2). (35.5 - 41.0') SAND, fine, little very fine, subrounded; trace silt; well brown (10YR 6/3).			AAA AAA AAA AAA AAA AAA AAA AAA AAA AA		
- - - 45 - - -	595 - - - - - - - - - - - - - - - - - - -	5	40.0- 50.0'	10.0	NA			(41.0 - 42.0') SAND, fine, little very fine, subrounded; little silt; well s grayish brown (10YR 5/2). (42.0 - 50.0') SAND, fine, trace medium, subrounded; trace to little s wet; light yellowish brown (10YR 6/4) to brownish yellow (10YR 6/6)	ilt; well sorted;		Sand Pack K&E WP1 (37.0- 50.0' bgs) 2" PVC 10 Slot Well Screen (39.0-49.0 bgs)		
			CA					Remarks: bgs = below ground surface btoc = below top of casing Air knifed to 10.0' bgs. Groundwater encountered at 24.35 Water level at development was 29 No odor or staining observed. Groundwater elevation measured c Groundwater elevation measured c	.81' btoc.	3, 20)15 was 609.49 feet Page: 2 of 2		

Dat Dri Dri Dri Sar Rig Wa	e Fini Iling C Iler's I Iling M npling Type ter Le	Compa Name: Metho g Meth e: Soni evel St	/28/15 any: M : Johr d: Air nod: (n Pitsc Knife/S Continu . bgs.)	h Sonic Jous : 23.9	92		Northing: 519715.111 Well/Boring ID: JHC MW-15015 Easting: 12634186.63 Client: Consumers Energy Casing Elevation: 635.202 Location: JH Campbell Facility Borehole Depth (ft. bgs.): 40.0 Location: JH Campbell Facility Surface Elevation: 632.462 1700 Crosswell Street Site A Descriptions By: A. Westhuis 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 - -										TOC = 635.202 (ft. above msl)	
	- 630 - - - - - - - - - - - 	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, subroi sorted; moist; medium stiff; gray (10YR 5/1). NOTE: Fill material.	unded; well		Concrete (0.0- 1.0' bgs)	
- 10	- 620 - - - - 615 -	2	10.0-20.0'	7.0	NA		×	(10.0 - 15.0') SAND, fine, little medium; subrounded; trace to little sil moist to wet; light brownish gray (10YR 6/2). (15.0 - 35.0') SAND, fine, little medium, subrounded; trace silt; well s wet; very pale brown (10YR 7/4).			Bentonite/Cemen Grout (1.0- 24.0' bgs) 2" PVC Well Casing (-3-28.0' bgs)	
Proje	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, 2015 was 607.68 feet oject: DE000722.0003.00006 Template: ARCADIS_Analytical Boring-Well 2013_New Logo Page: 1 of 2 Date: 4/27/2016 Created/Edited by: S.Das/C. Jeffers											

Dat Dril Dril Dril San Rig Wat	e Fini ling C ler's I ling M npling Type ter Le	Compa Name Metho g Metho Soni Soni Svel St	/28/15 any: M : Johr d: Air nod: (n Pitsc Knife/S Continu bgs.)	h Sonic uous : 23.9	92		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	Mater Level (ft. bgs.) Construction
- 20 - - - - 25 - - - - - - - 30		3	20.0- 30.0'	8.0	NA			NOTE: Wet at 23.92' bgs.	Bentonite Pellets (24.0- 26.0' bgs)
- - - 35 - - -	- 600 - - - 595 - - -	4	30.0- 40.0'	8.0	NA			(35.0 - 40.0') SAND, very fine to fine, subrounded; trace silt; well sor brown (10YR 6/3).	ted; wet; pale
			CA					Remarks: bgs = below ground surface btoc = below top of casing Air knife to 10.0' bgs. Groundwater encountered at 23.92' Water level at development was 28 No odor or staining observed.	' bgs. .57' btoc. n December 3, 2015 was 607.68 feet Page: 2 of 2

Dat Dril Dril Dril San Rig Wat	e Fini ling C ler's I ling M npling Type ter Le	Compa Name: Metho g Meth : Soni evel St	/28/15 any: M : Johr d: Air nod: (n Pitsc Knife/S Continu bgs.)	h Sonic Jous : 33.()		Northing: 519956.792 Easting: 12634198.52 Casing Elevation: 634.637Well/Boring ID: JHC MW-15016 Client: Consumers EnergyBorehole Depth (ft. bgs.): 40.0 Surface Elevation: 631.807Location: JH Campbell Facility 1700 Crosswell Street Site A West Olive, MI 49460Descriptions By: A. WesthuisWeather Conditions: 75 F Cloudy					
DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Mater Level (ft. bgs.) Construction				
-	635 -									TOC = 634.6 (ft. above ms			
		1	0.0- 10.0'	3.0	NA			(0.0 - 0.3') Grass, Topsoil. (0.3 - 10.0') ASH and SAND, fine to medium; subrounded; trcae grar pebbles, subrounded; trace to little silt; poorly sorted; moist; dark gra (10YR 4/2). NOTE: Fill material.	nules to small lyish brown	Concrete (0. 1.0' bgs)	(0.0-		
- 10 - - - - 15 -	- 620 - - - 615 - - -	2	10.0-20.0'	8.0	NA			 (10.0 - 12.5') SAND, fine, trace medium, subrounded; trace granules pebbles, subrounded; trace silt; well sorted; dry to moist; brownish yelds) (12.5 - 12.8') SAND, fine, trace medium, subrounded; trace silt; well moist; dark yellowish brown (10YR 4/4). (12.8 - 15.5') SAND, fine, trace medium, subrounded; trace silt; well moist; pale brown (10YR 6/3). (15.5 - 17.0') SAND, very fine to fine, subrounded; trace granules to subrounded; trace silt; dry; well sorted; very pale brown (10YR 8/3). (17.0 - 24.0') SAND, fine, subrounded; little silt; well sorted; dry to me (10YR 6/3). 	sorted; dry to sorted; dry to sorted; dry to small pebbles;	Bentonite/CG Grout (1.0- 24.0' bgs) 2" PVC Well Casing (-3-2 bgs)	0-) Vell		
	Remarks: bgs = below ground surface btoc = below top of casing Air knife to 10.0' bgs. Groundwater encountered at 33.0' bgs. Water level at development was 30.34' btoc. No odor or staining observed. Groundwater elevation measured on December 3, 2015 was 604.92 feet roject: DE000722.0003.00006 Template: ARCADIS_Analytical Boring-Well 2013_New Logo												

Date Dril Dril Dril San Rig Wat	e Fini ling C ler's I ling N npling Type er Le	Compa Name: Methoo g Meth g Soni Soni Svel St	/28/15 any: M : Johr d: Air nod: (n Pitsc Knife/S Continu bgs.)	h Sonic Jous : 33.0)		Northing: 519956.792 Easting: 12634198.52 Casing Elevation: 634.637Well/Boring ID: JHC MW-15016 Client: Consumers EnergyBorehole Depth (ft. bgs.): 40.0 Surface Elevation: 631.807 Descriptions By: A. WesthuisLocation: JH Campbell Facility 1700 Crosswell Street Site A West Olive, MI 49460Weather Conditions: 75 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 		3	20.0- 30.0'	9.0	NA			(24.0 - 26.0') SAND, fine, subrounded; trace silt; well sorted; moist; v (10YR 7/3). (26.0 - 27.0') SAND, fine, subrounded, trace silt; well sorted; moist; b 5/3) to dark brown (10YR 3/3). NOTE: Trace large wood fragments. (27.0 - 33.0') SAND, very fine to fine, subrounded; well sorted; moist brownish gray (10YR 6/2).	prown (10YR		AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA				
- 35	- 600 - - - 595 - - - -	4	30.0- 40.0'	9.0	NA			(33.0 - 40.0') SAND, medium, trace to little fine, subrounded; trace si wet; very pale brown (10YR 8/4).	ilt; well sorted;	ell sorted;					
-	- 590 -							End of boiling at 40.0 bgs.							
								Remarks: bgs = below ground surface btoc = below top of casing Air knife to 10.0' bgs. Groundwater encountered at 33.0' b Water level at development was 30. No odor or staining observed. Groundwater elevation measured o RCADIS_Analytical Boring-Well 2013_New Logo	.34' btoc.	3, 20	015 was 604.92 feet Page: 2 of 2				

Dat Dri Dri Dri Sai Rig Wa	te Fini Iling C Iler's I Iling N mpling I Type ter Le	Name Metho g Metho e: Soni evel St	/29/15 any: M : Johr d: Air nod: (n Pitsc Knife/S Continu bgs.)	h Sonic Jous : 12.()		Northing: 521075.536 Easting: 12635979.61 Casing Elevation: 617.022 Borehole Depth (ft. bgs.): 2 Surface Elevation: 614.262 Descriptions By: A. Westhu	1700 Cros West Olive	nergy ell Facility swell Street Site A , MI 49460
DEPTH (feet bgs.)	ELEVATION Sample Run Number Sample/Int/Type Recovery (feet) PID Headspace (ppm) Analytical Sample Geologic Column							Stratigraphic Descri	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 s NOTE: Fill material. (1.0 - 10.0') SAND, fine, subrounded; well sorted;	dry; brownish yellow (10YR 6/6).	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	- - - - - - - - - - - - - - - - - - -	2	10.0-20.0'	7.0	NA			(10.0 - 17.0') SAND, fine, subrounded; trace silt; w brown (10YR 7/3). NOTE: Wet at 12.0' bgs. (17.0 - 20.0') SAND, medium, little fine, subrounde trace silt; well sorted; wet; very pale brown (10YR End of boring at 20.0' bgs.	d; trace granules; subrounded;	Sand Pack K&E WP1 (8.0-20.0' bgs) 2" PVC 10 Slot Well Screen (10.0-20.0 bgs)
Proje	ect: DI	E0007	CA 22.000 1W-150	3.000	06 T			Remarks: bgs = below ground so btoc = below top of ca Air knife to 10.0' bgs. Groundwater encount Water level at develop No odor or staining ob	sing ered at 12.0' bgs during drilling. ment was 16.29' btoc. served. n measured on December 2, 2015 wa lew Logo	s 600.45 feet Page: 1 of 1

Date Dril Dril Dril San Rig Wat	e Fini ling C ler's l ling N npling Type ter Le	Name: Methoo g Meth : Soni evel St	0/1/15 any: M : Dan d: Har nod: (Moure nd Aug Continu bgs.)	er jer/Sor uous : 18.0	nic		Northing: 521927.205 Easting: 12638205.16 Casing Elevation: 619.977 Borehole Depth (ft. bgs.): 25.0 Surface Elevation: 617.012 Descriptions By: A. Westhuis	Client: Con Location: J 1 V	ISUM IH Ca I700 Vest	JHC MW-15023 ers Energy ampbell Facility Crosswell Street Site A Olive, MI 49460 tions: Sunny, 60F.
DEPTH (feet bgs.)	ELEVATION ELEVATION Sample/Int/Type Recovery (feet) PID Headspace (ppm) Analytical Sample Geologic Column						Geologic Column	Stratigraphic Description		Water Level (ft. bgs.)	Well/Boring Construction
-	620 -										TOC Elevation = 619.977 (ft. above msl)
- - - - - - -	615 - - - 610 - - -	1	0-10'	10	NA		+ + + +	(0.0 - 0.3') TOPSOIL; grass. (0.3 - 10.0') SAND, very fine to fine, subrounded; trace silt; well sorter (10 YR 4/3). Note: Trace wood fragments from 7.0 to 10.0' bgs.	d; dry; brown		Concrete (0.0- 1.0' bgs)
- 10 	- 605 - - - - - - - - - - - -	2	10-20'	8	NA			 (10.0 - 16.0') SAND, very fine to fine, subrounded; trace to little silt; w to moist; brownish yellow (10 YR 6/8). (16.0 - 17.0') SAND, very fine to fine, subrounded; trace silt; well sort yellow (10 YR 7/6). (17.0 - 18.0') SAND, fine, subrounded; trace silt; well sorted; moist; b (10 YR 6/6). (18.0 - 21.0') SAND, very fine; little fine sand, subrounded; trace silt; wet; pale brown (10 YR 6/3). 	ed; moist; rownish yellow		Bentonite Pellets (10.0- 12.0' bgs)
-	_ 595 — _	3	20-25'	4	NA			(21.0 - 25.0') SAND, medium; trace fine sand, subangular; trace gran subangular; poorly sorted; wet; pale brown (10 YR 6/3).	ules,		Well Screen (14.0-24.0' bgs)
25 - -	- 590							End of boring at 25.0' bgs.			
			CA					Remarks: bgs= below ground surface btoc = below top of casing Hand auger to 10.0' bgs. Groundwater encountered at 18.0' b Water level at development was 18.1 No odor or staining observed. Groundwater elevation measured or RCADIS_Analytical Boring-Well 2013_New Logo	91' btoc.	-	5 was 592.53 feet Page: 1 of 1

Project: DE000722.0003.00005 Template: ARCADIS_Analytical Boring-Well 2013_New Logo
Data File: JHC MW-15023.dat Date: 2/4/2016 Created/Edited by: A. DeGrandis/C. Jeffers

Date Start: 10/1/15 Date Finish: 10/1/15 Drilling Company: Mateco Drilli Driller's Name: Dan Mourer Drilling Method: Air Knife/Sonic Sampling Method: Continuous Rig Type: Sonic Water Level Start (ft. bgs.): 10. Water Level Finish (ft. btoc.): 1	0	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.
DEPTH (feet bgs.) ELEVATION Sample Run Number Sample/Int/Type Recovery (feet) PID Headspace (ppm)	Analytical Sample Geologic Column	Stratigraphic Description	Mater Level (ft. pgs.) Construction
 615 -			TOC Elevation = 616.617 (ft. above msl)
		(0.0 - 0.3') TOPSOIL; grass. (0.3 - 10.0') SAND, fine, subrounded; trace silt; well sorted; dry to m yellow (10 YR 6/6). NOTE: Wet at 10.0' bgs. (10.0 - 20.0') SAND, fine to medium, subrounded; trace to little very silt; well sorted; wet; pale brown (10 YR 6/3).	2" PVC Well Casing (-3.0- 7.0' bgs) Bentonite Pellets (1.0-6.0' bgs)
	esign & Consultancey rnatural and ilt assets	End of boring at 20.0' bgs. Remarks: bgs= below ground surface btoc = below top of casing Air knife to 10.0' bgs. Groundwater encountered at 10.0' I Water level at development was 14 No odor or staining observed. Groundwater elevation measured o	

Dat Dri Dri Dri Sar Rig Wa	e Fini lling C ller's I lling N npling Type ter Le	Compa Name Aetho g Meth c: Soni evel St	0/1/15 any: M : Dan d: Har nod: (Moure nd Aug Contine bgs.)	er jer/Soi uous : 12.(nic)		Northing: 522702.978 Easting: 12636668.15 Casing Elevation: 617.167 Borehole Depth (ft. bgs.): 20.0 Surface Elevation: 614.137 Descriptions By: A. Westhuis	Client: Con Location: J 1 V	sumers H Cam 700 Cr Vest Ol	HC MW-15025 s Energy pbell Facility osswell Street Site A ive, MI 49460 ns: Sunny, 60F.
DEPTH (feet bgs.)	ELEVATION Sample Run Number Sample/Int/Type Recovery (feet) PID Headspace (ppm) Analytical Sample Geologic Column					Analytical Sample	Geologic Column	Stratigraphic Description		Water Level (ft. bgs.)	Well/Boring Construction
-	- 615										TOC Elevation = 617.167 (ft. above msl)
		1	0-10'	10	NA	-		(0.0 - 0.3') TOPSOIL; grass. (0.3 - 5.0') SAND, fine, subrounded; trace silt; well sorted; dry; very p YR 7/3). (5.0 - 12.0') SAND, fine, subrounded; trace silt; well sorted; dry; brow YR 6/6). Note: Color change to brownish yellow (10YR 6/8) at 6.0' bgs.			Concrete (0.0- 1.0' bgs) 2" PVC Well Casing (-3.0- 7.0' bgs) Bentonite Pellets (1.0-6.0' bgs) Sand Pack K&E
- - - - - -	- 600 - - - 595 -	2	10-20'	8	NA			(12.0 - 15.0') SAND, fine, subrounded; trace silt; well sorted; wet; pa 6/3). (15.0 - 16.0') SAND, fine to medium, subrounded; trace coarse sand trace granules, subrounded; trace silt; well sorted; wet; pale brown (' (16.0 - 20.0') SAND, very fine to fine, subrounded; little silt; well sorted brown (10 YR 6/3). End of boring at 20.0' bgs.	, subrounded; 10 YR 6/3).		WP1 (6.0-20.0' bgs) 2" PVC 10 Slot Well Screen (7.0-17.0' bgs)
								Remarks: bgs= below ground surface btoc = below top of casing Hand auger to 10.0' bgs. Groundwater encountered at 12.0' t Water level at development was 13. No odor or staining observed. Groundwater elevation measured o RCADIS_Analytical Boring-Well 2013_New Logo	50' btoc.	-	was 603.36 feet Page: 1 of 1

Dat Dril Dril Dril Sar Rig Wat	e Fini lling C ller's I lling M npling Type ter Le	Compa Name Metho g Meth Soni Soni Svel St	0/2/15 any: M : Dan d: Har nod: (Moure nd Aug Continu bgs.)	er jer/Sor uous : 12.0	nic)		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						Geologic Column	Stratigraphic Description		Mater Level (ft. bgs.) Construction		
-	-										TOC Elevation = 618.042 (ft. above msl)	
		2	0-10'	6	NA			(0.0 - 0.3') TOPSOIL; grass. (0.3 - 3.0') SAND, fine, subrounded; trace medium sand, subrounder sorted; dry; very pale brown (10 YR 7/3). (3.0 - 8.0') SAND, fine, subrounded; trace silt; well sorted; dry; brown YR 6/6). (8.0 - 12.0') SAND, fine, subrounded; little very fine sand, subrounder sorted; dry; pale brown (10 YR 6/3) to brownish yellow (10YR 6/6). (12.0 - 20.0') SAND, very fine to fine, subrounded; trace silt; well sort wet; pale brown (10 YR 6/3).	hish yellow (10 d; trace silt; well		Concrete (0.0- 1.0' bgs) 2" PVC Well Casing (-3.0- 8.0' bgs) Bentonite Pellets (1.0-7.0' bgs) Sand Pack K&E WP1 (7.0-20.0' bgs) 2" PVC 10 Slot Well Screen (8.0-18.0' bgs)	
								End of boring at 20.0' bgs. Remarks: bgs= below ground surface btoc = below top of casing Hand auger to 10.0' bgs. Groundwater encountered at 12.0' bwater level at development was 15 No odor or staining observed. Groundwater elevation measured owater elevation measured owater elevation measured owater elevation measured owater RCADIS_Analytical Boring-Well 2013_New Logo	.34' btoc.	-		

Dat Drii Drii Drii Sar Rig Wa	e Fini Iling C Iler's I Iling M npling Type ter Le	Compa Name: Methoo g Meth g Soni Soni Svel St	0/2/15 any: M : Dan d: Har nod: (Moure nd Aug Continu bgs.)	er jer/Sor uous : 13.0	nic)		Northing: 522394.86 Easting: 1235097.51 Casing Elevation: 617.302 Borehole Depth (ft. bgs.): 20.0 Surface Elevation: 614.767 Descriptions By: A. Westhuis	Client: Con Location: J 1 V	IH Ca 1700 Vest	: JHC MW-15027 hers Energy ampbell Facility Crosswell Street Site A : Olive, MI 49460 t ions: Sunny, 50F.
DEPTH (feet bgs.)	ELEVATION Sample Run Number Sample/Int/Type Recovery (feet) PID Headspace (ppm) Analytical Sample Geologic Column						Geologic Column	Stratigraphic Description		Water Level (ft. bgs.)	Well/Boring Construction
- - -	- 615 -										TOC Elevation = 617.302 (ft. above msl)
		2	0-10'	8	NA			(0.0 - 0.3) TOPSOIL; grass. (0.3 - 2.0') SAND, very fine to fine, subrounded; trace silt; well sorted yellowish brown (10 YR 4/6). (2.0 - 6.0') SAND, very fine to fine, subrounded; trace silt; well sorted brown (10 YR 7/3). (6.0 - 16.0') SAND, fine, subrounded; trace silt; well sorted; dry; yellow (6.0 - 16.0') SAND, fine, subrounded; trace silt; well sorted; dry; yellow Note: Wet at 13.0' bgs. (16.0 - 20.0') SAND, fine; trace medium sand, subrounded; well sort brown (10 YR 6/3).	t; dry; very pale		Concrete (0.0- 1.0' bgs) 2" PVC Well Casing (-3.0- 10.0' bgs) Bentonite Pellets (1.0-8.0' bgs) Sand Pack K&E WP1 (8.0-20.0' bgs) 2" PVC 10 Slot Well Screen (10.0-20.0' bgs)
								End of boring at 20.0' bgs. Remarks: bgs= below ground surface btoc = below top of casing Hand auger to 10.0' bgs. Groundwater encountered at 13.0' H Water level at development was 15 No odor or staining observed. Groundwater elevation measured o RCADIS_Analytical Boring-Well 2013_New Logo	.85' btoc.		15 was 601.04 feet Page: 1 of 1

Dat Dri Dri Dri Sar Rig Wa	lling C ller's I lling M npling Type ter Le	ish: 1 Compa Name Jetho g Meti s: Soni evel St	0/2/15 any: M : Dan d: Air I nod: (Moure knife/S Contine bgs.)	er Sonic uous : 9.0	-		Northing: 521646.198 Easting: 12634105.34 Casing Elevation: 613.8 Borehole Depth (ft. bgs.): 20.0 Surface Elevation: 611.025 Descriptions By: A. Westhuis	Client: Co Location:	JH (170 Wes	D: JHC MW-15028 mers Energy Campbell Facility 0 Crosswell Street Site A st Olive, MI 49460 ditions: Sunny, 60F.
DEPTH (feet bgs.)	ELEVATION Sample Run Number Sample/Int/Type Recovery (feet) PID Headspace (ppm) Analytical Sample Geologic Column						Geologic Column	Stratigraphic Description		Water Level (ft. bgs.)	Well/Boring Construction
- - - -							+ + + + + + + + + + + + + + + + + + +	(0.0 - 0.3') TOPSOIL; grass. (0.3 - 5.0') SAND, very fine to fine, subrounded; trace silt; well sorted	; dry; yellowish		TOC Elevation = 613.80 (ft. above msl) Concrete (0.0- 1.0' bgs)
- - - - -	- - 605 - -	1	0-10'	10	NA			(10 YR 7/8). (5.0 - 9.0') SAND, fine, subrounded; trace silt; well sorted; dry to mois (10 YR 6/3).		_	AAA Bentonite/Cement Grout (1.0-4.0' bgs) AAA 2" PVC Well Casing (-3.0- 8.0' bgs) Bentonite Pellets (4.0-6.0' bgs)
- 10		2	10-20'	9	NA	-		(9.0 - 20.0') SAND, medium; trace to little very fine to fine sand, subre silt; poorly sorted; moist to wet; pale brown (10 YR 6/3).	ounded; trace		Sand Pack K&E WP1 (6.0-20.0' bgs) 2" PVC 10 Slot Well Screen (8.0-18.0' bgs)
- 20	590 -							End of boring at 20.0' bgs.			
Proje	ect: DI	E0007	22.000 1W-150	3.000	05 T			Remarks: bgs= below ground surface btoc = below top of casing Air knife to 10.0' bgs. Groundwater encountered at 9.0' bg Water level at development was 14. No odor or staining observed. Groundwater elevation measured or RCADIS_Analytical Boring-Well 2013_New Logo Date: 2/4/2016 Created/Edited by: A. D	38' btoc. n December (3, 20	Page: 1 of 1

Dat Dri Dri Dri Sai Rig Wa	lling C ller's I lling M npling Type ter Le	sh: 1 Compa Name Metho g Metho : Soni vel St	0/5/15 any: № : Dan d: Air∣ nod: (Moure knife/S Continu bgs.)	er Sonic uous : 12.0)		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
DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Mater Level (ft. bgs.) Construction
-	- 610 - -								TOC Elevati = 610.952 (ft above msl)
- - - - - - - - - - - - - - - - - - -	- 605 - - - - - - - - - - - - - - - - - - -	1	0-10'	3	NA	-		(0.0 - 0.3') TOPSOIL; grass. (0.3 - 10.0') SAND, fine, subrounded; trace silt; well sorted; dry; yellor YR 5/4). (10.0 - 12.0') SAND, very fine to fine, subrounded; trace silt; well sort moist; pale brown (10 YR 6/3).	- 2" PVC Well Casing (-3.0 8.0' bgs) Bentonite Pellets (1.0-7 bgs)
- - - - - - - -	- 595 - - - 590 - - -	2	10-20'	6	NA			(12.0 - 15.0') SAND, medium; trace fine sand, subrounded; trace silt; wet; pale brown (10 YR 6/3). (15.0 - 20.0') SAND, medium; little coarse sand; trace granules, subro silt; well sorted; wet; pale brown (10 YR 6/4). End of boring at 20.0' bgs.	WP1 (7.0-20 bgs) 2" PVC 10 S Well Screen (8.0-18.0' bg
							nsultancy nd	Remarks: bgs = below ground surface btoc = below top of casing Air knife to 10.0' bgs. Groundwater encountered at 12.0' b Water level at development was 10.1 No odor or staining observed. Groundwater elevation measured or RCADIS_Analytical Boring-Well 2013_New Logo	

Dat Dri Dri Dri Sar Rig Wa	e Fini lling C ller's I lling M npling Type ter Le	Compa Name Metho g Meth e: Soni evel St	0/5/15 any: M : Dan d: Air nod: (Moure knife/S Contine bgs.)	er Sonic uous : 5.0			Northing: 519760.827 Easting: 12633044.37 Casing Elevation: 607. Borehole Depth (ft. bgs Surface Elevation: 604 Descriptions By: A. We	.167 Client: C s.): 20.0 Location 4.047 esthuis	Unsu : JH 17(We	D: JHC MW-15030 Imers Energy Campbell Facility 00 Crosswell Street Site A Ist Olive, MI 49460 ditions: Cloudy, Light Rain, 65F.
DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic D	escription	Water Level (ft. bgs.)	Well/Boring Construction
-	- 605 -										TOC Elevation = 607.167 (ft. above msl)
							$\overline{\mathbf{v}}$	(0.0 - 0.3') TOPSOIL; grass.			Concrete (0.0-
- 5		1	0-10'	3	NA	-		(0.3 - 10.0') SAND, fine, subrounded; trace s (10 YR 3/3) to very pale brown (10YR 7/3). NOTE: Wet at 5.0' bgs.			1.0' bgs) 2" PVC Well Casing (-3.0- 4.0' bgs) Bentonite Pellets (1.0-3.0' bgs) Sand Pack K&E WP1 (3.0-20.0' bgs) 2" PVC 10 Slot Well Screen
	- - 590 - - - - - - - -	2	10-20'	6	NA			(10.0 - 20.0') SAND, fine, subrounded; little well sorted; wet; very pale brown (10 YR 7/3			(4.0-14.0' bgs)
	-							End of boring at 20.0' bgs.			
	Project: DE000722.0003.00005 Template: AR							Water level at de No odor or stainir Groundwater elev CADIS_Analytical Boring-Well 20	of casing bgs. countered at 5.0' bgs during dr velopment was 7.99' btoc. ng observed. vation measured on Decembe	r 3, 2	015 was 599.65 feet Page: 1 of 1

Dat Dril Dril Dril Sar Rig Wa	e Fini lling C ller's I lling M npling Type ter Le	Compa Name Aetho g Meth c: Soni evel St	0/6/15 any: M : Johr d: Har nod: (n Pitsc nd Aug Contini bgs.)	h ger/Sor uous : 19.0	nic)		Northing: 521075.809 Easting: 12638598.12 Casing Elevation: 620.987 Borehole Depth (ft. bgs.): 30.0 Surface Elevation: 618.082 Descriptions By: A. Westhuis	Client: Cons Location: JF 17 W	ID: JHC MW-15033 sumers Energy H Campbell Facility 700 Crosswell Street Site A /est Olive, MI 49460 nditions: Cloudy, 60F.
DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description		Well/Boring Construction
- - -	- 620 - -						* * *			TOC Elevation = 620.987 (ft. above msl)
	- 615 - - - 610 -	1	0-10'	10	NA			(0.0 - 0.3') TOPSOIL; grass. (0.3 - 0.8') SAND, fine, subrounded; trace silt; well sorted; dry; brown (0.8 - 2.0') SAND, fine, subrounded; trace silt; well sorted; dry; yellow YR 5/6). (2.0 - 10.0') SAND, fine, subrounded; trace silt; well sorted; dry; very YR 7/3).	vish brown (10	Concrete (0.0- 1.0' bgs) Bentonite/Cement Grout (1.0- 12.0' bgs) 2" PVC Well Casing (-3.0- 16.0' bgs)
- - - - - - - -	- 605 - - - - - - - - - - - -	2	10-20'	6	NA			(10.0 - 20.0') SAND, very fine to fine, subrounded; trace silt; well sor yellowish brown (10 YR 5/4). NOTE: Wet at 19.0' bqs.	ted; moist;	Bentonite Pellets (12.0- 14.0' bgs)
- 20 - - - 25 - - -	- - 595 - - - - 590 -	3	20-30'	6	NA			(20.0 - 30.0') SAND, fine; little medium sand, subrounded; trace silt; moist to wet; very pale brown (10 YR 6/3).	well sorted;	Sand Pack K&E WP1 (14.0- 30.0' bgs) 2" PVC 10 Slot Well Screen (16.0-26.0' bgs)
- 30-								End of boring at 30.0' bgs.		
			CA					Remarks: bgs = below ground surface btoc = below top of casing Hand auger to 10.0' bgs. Groundwater encountered at 19.0' H Water level at development was 22 No odor or staining observed. Groundwater elevation measured o Groundwater elevation measured o RCADIS_Analytical Boring-Well 2013_New Logo	.93' btoc.	-

Dat Dril Dril Dril San Rig Wat	e Fini lling C ller's I lling N npling Type ter Le	Name Metho g Meth e: Hollo evel St		n Smit Iow St Split Sj m Aug bgs.)	h em Au boon er : NA	-		Northing: NA Easting: NA Casing Elevation: 615.90 Borehole Depth (ft. bgs.): 30.5 Surface Elevation: NA Descriptions By: Rebecca J. Koepke	Client: Cor Location: . 1 V	JH (170 Wes	D: JHC MW-15036 mers Energy Campbell Facility 0 Crosswell Street Site A st Olive, MI 49460 itions: NA
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 = 615.90 (ft. above msl)
	_	-					<u></u>	(0.0 - 0.5') SANDY ORGANIC SOII, very dark brown, very fine to fine	, loose, moist.		Concrete (0.0-
- - - -5 -	- - 620 - -	· · ·	5.0-	0.9	NA	_		(0.5 - 30.5') SAND, very pale brown (10YR 7/4), poorly graded, fine, loose, slightly moist.	trace silt, round,		XXX 1.0' bgs)
- - - 10	- - 615 -		7.0'			-					2" PVC Well Casing (-3.0- 20.0' bgs)
-	-	2	10.0- 12.0'	1.6	NA	-		NOTE: Very fine.			Bentonite Chips (1.0-18.0' bgs)
- 15 -	610 - -	3	15.0- 17.0'	1.6	NA	-		NOTE: Very pale brown (10YR 8/3), fine.			
- 20	- 605 -					_					
- -	-	4	20.0- 22.0'	1.8	NA	-		NOTE: Fine to medium, moist.			
- 25 -	600 -	5	25.0-	1.8	NA	_					Sand Pack Flat Rock #30 (18.0- 30.5' bgs)
-	-		27.0'	1.0		_					Well Screen (20.0-30.0 bgs)
- 30	595 -										
[_							End of boring at 30.5' bgs.			
Proje	Remarks: bgs = below ground surface btoc = below top of casing No odor or staining observed.										

 Data File:
 MW-15036.dat

 Data File:
 MW-15036.dat

SOIL DESCRIPTION

Udden-Wenworth Scale Modified ARCADIS, 2008				
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	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 orumbles when drier than the plastic limit.
-	It takes considerable time rolling and inneading to reach the plastic limit. The thread can be rolled several times after reaching the plastic limit. The lump can be formed without orumbling 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

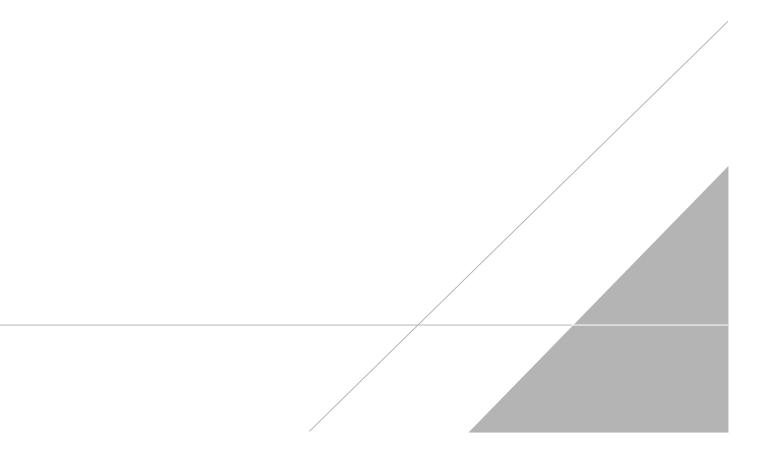
Coarse-grained soil - Density

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

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.

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 Facility West Olive, Michigan

Photograph Taken By: Austin Westhuis

Date of Photograph: 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

Date of Photograph: 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 Facility West Olive, Michigan

Photograph Taken By: Austin Westhuis

Date of Photograph: September 25, 2015



Photograph #4

Description of Photograph:

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

<u>Site Location</u>: Consumers Energy Co.

J.H. Campbell Generating Facility West Olive, Michigan

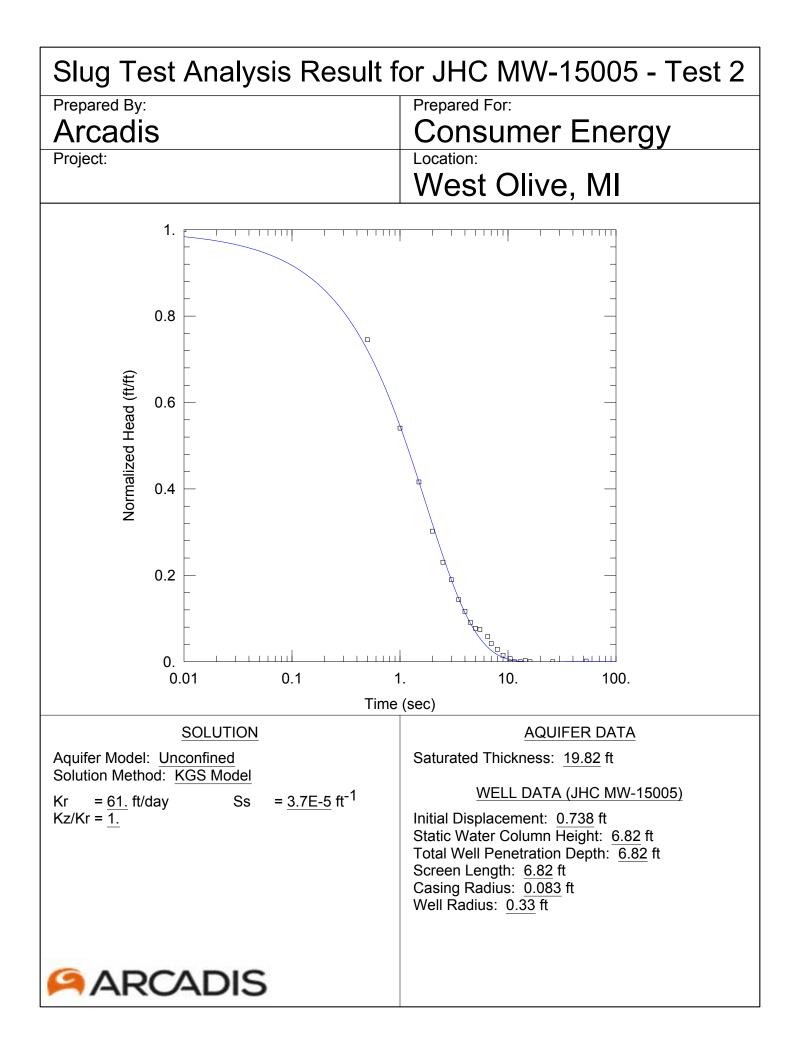
<u>Photograph Taken By:</u> Austin Westhuis

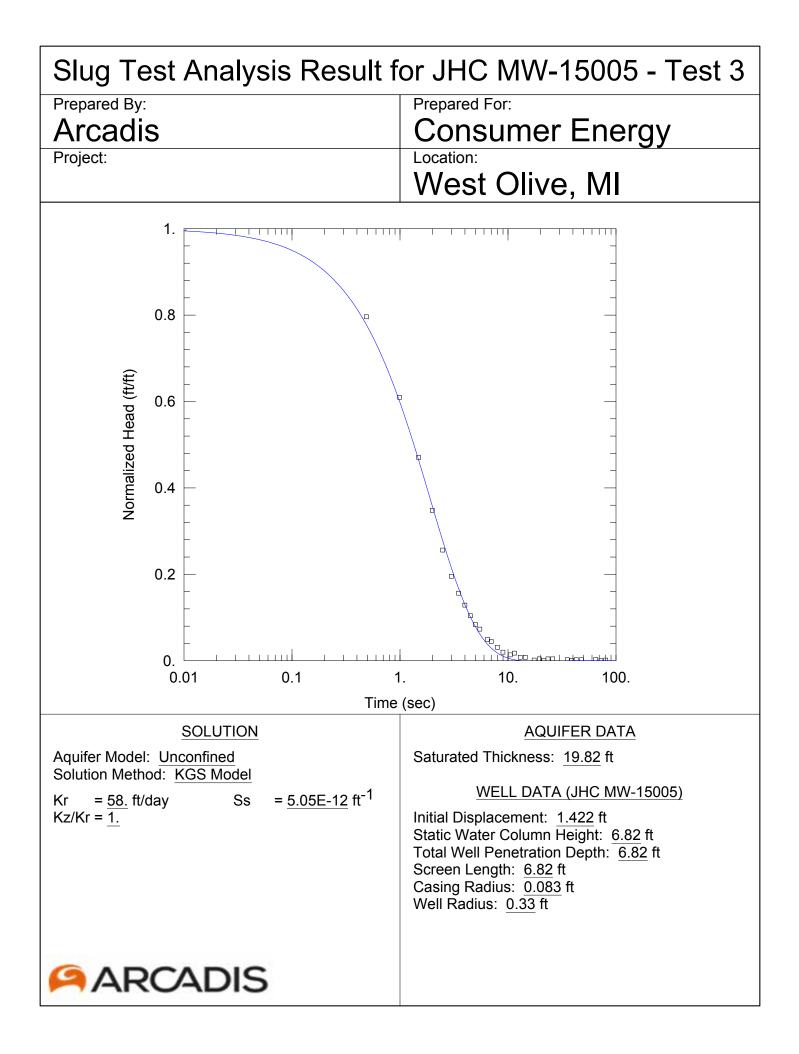
Date of Photograph: September 18, 2015

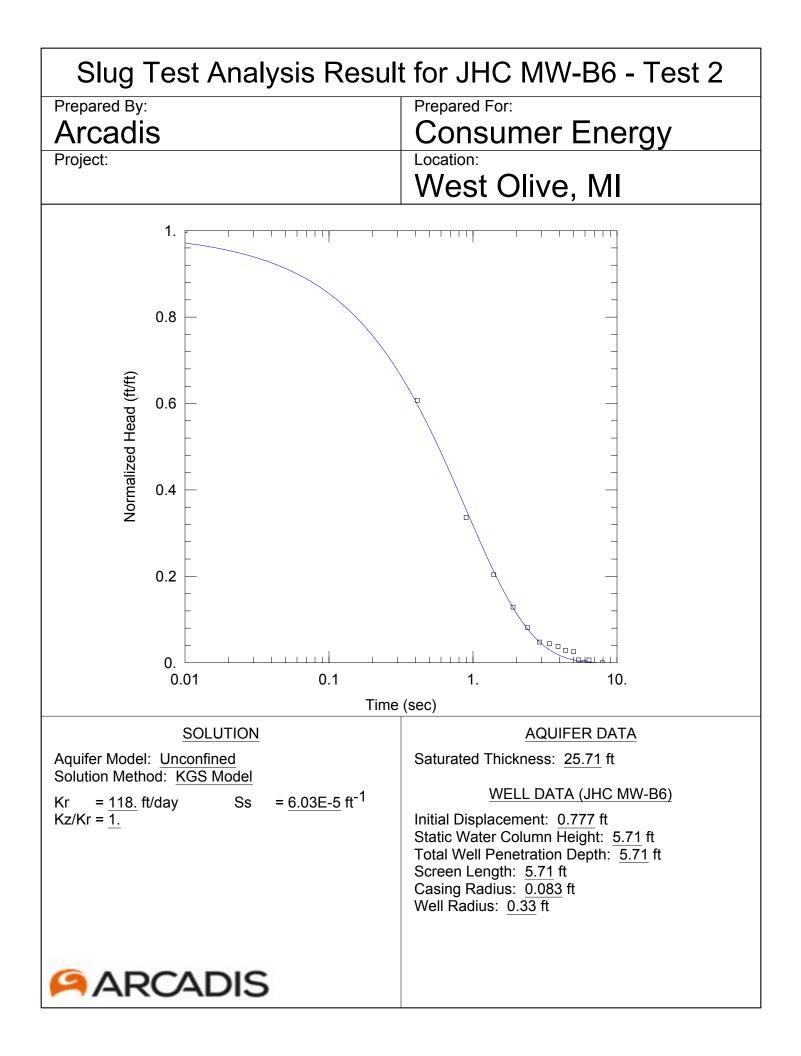
APPENDIX C

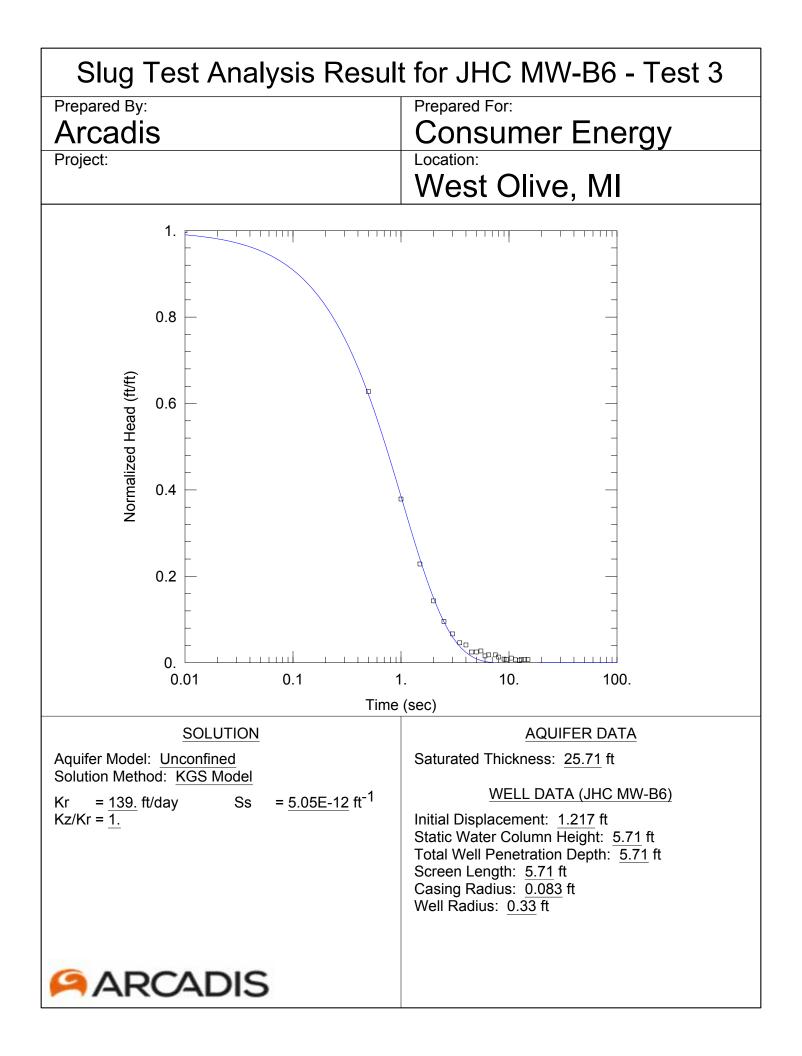
Hydraulic Test Logs

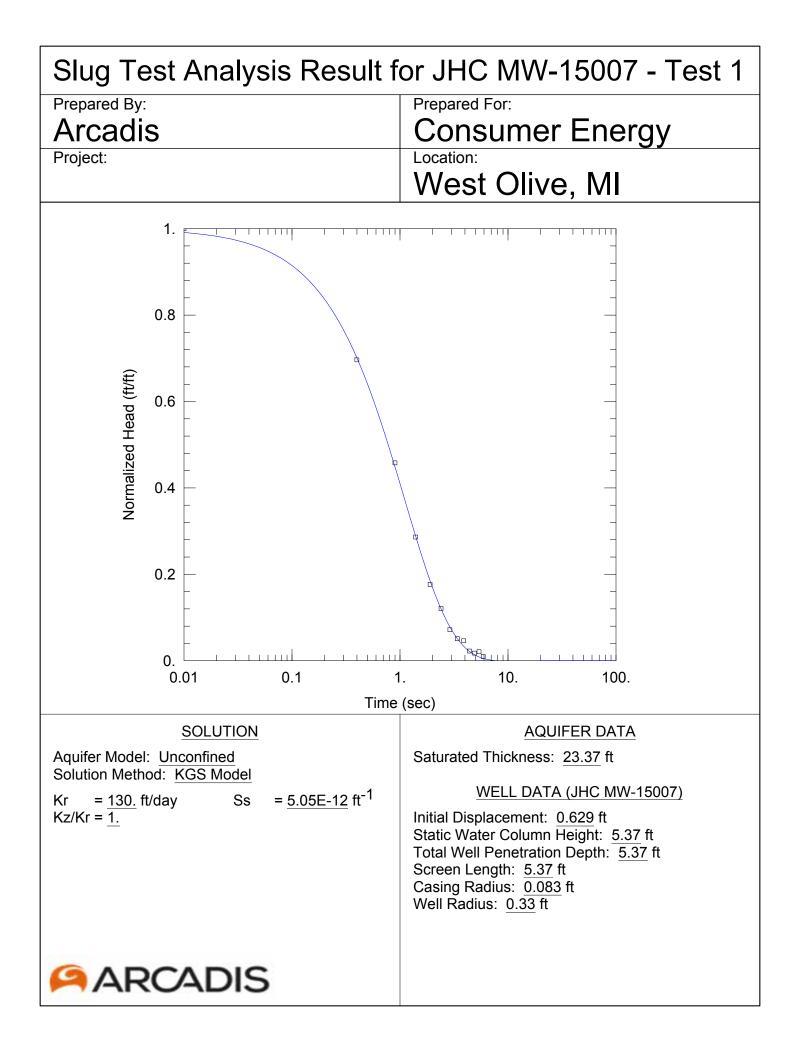


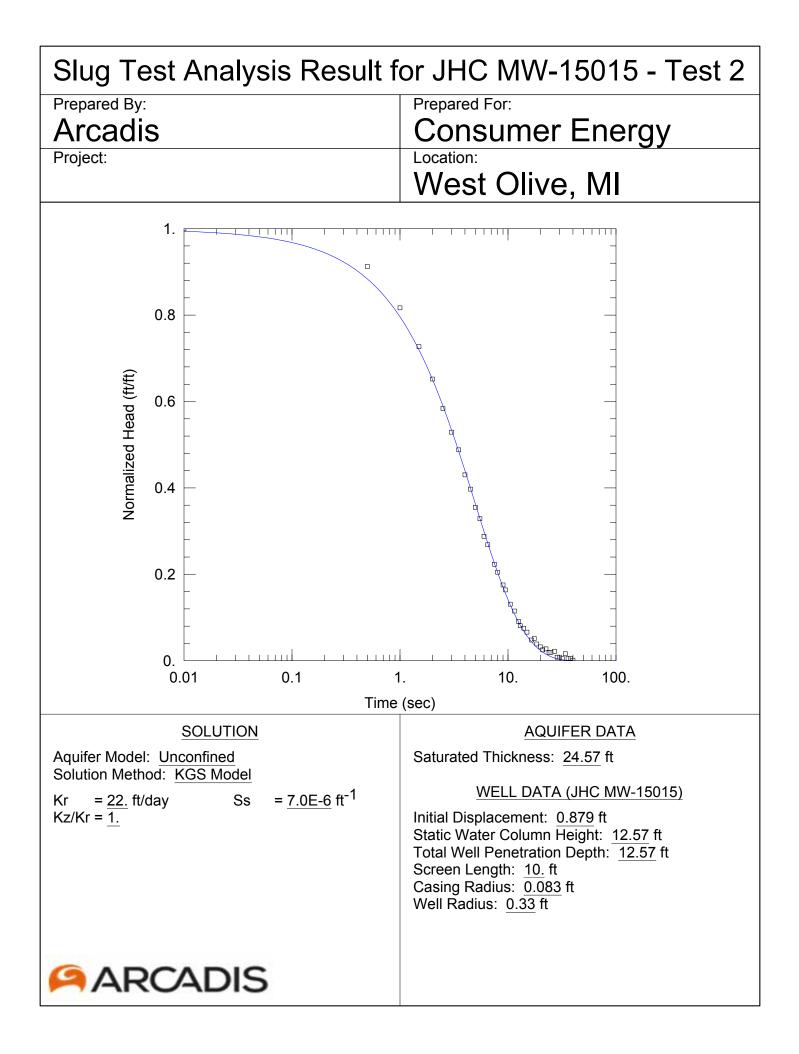


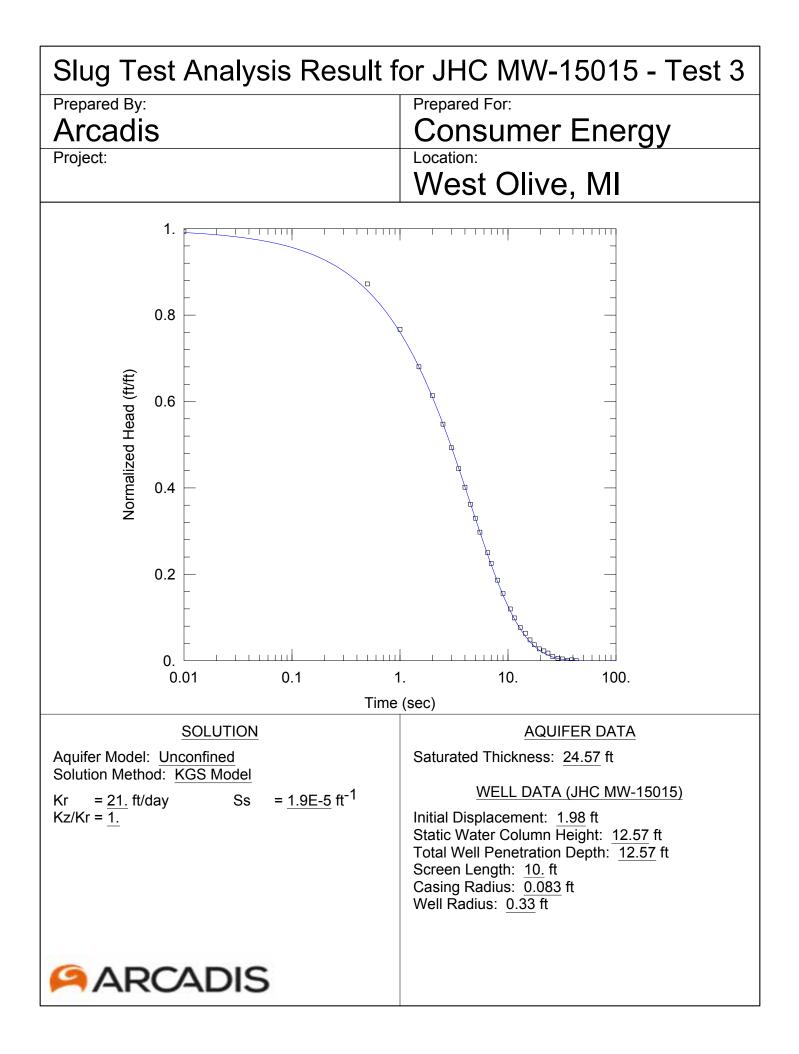


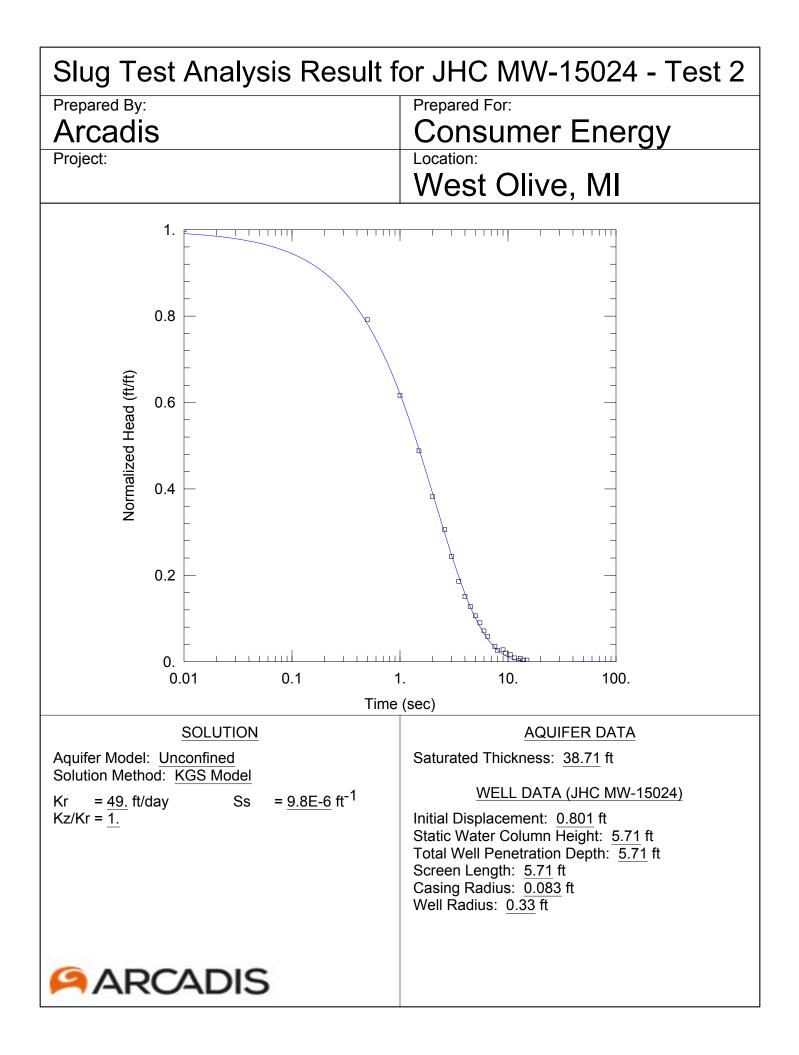


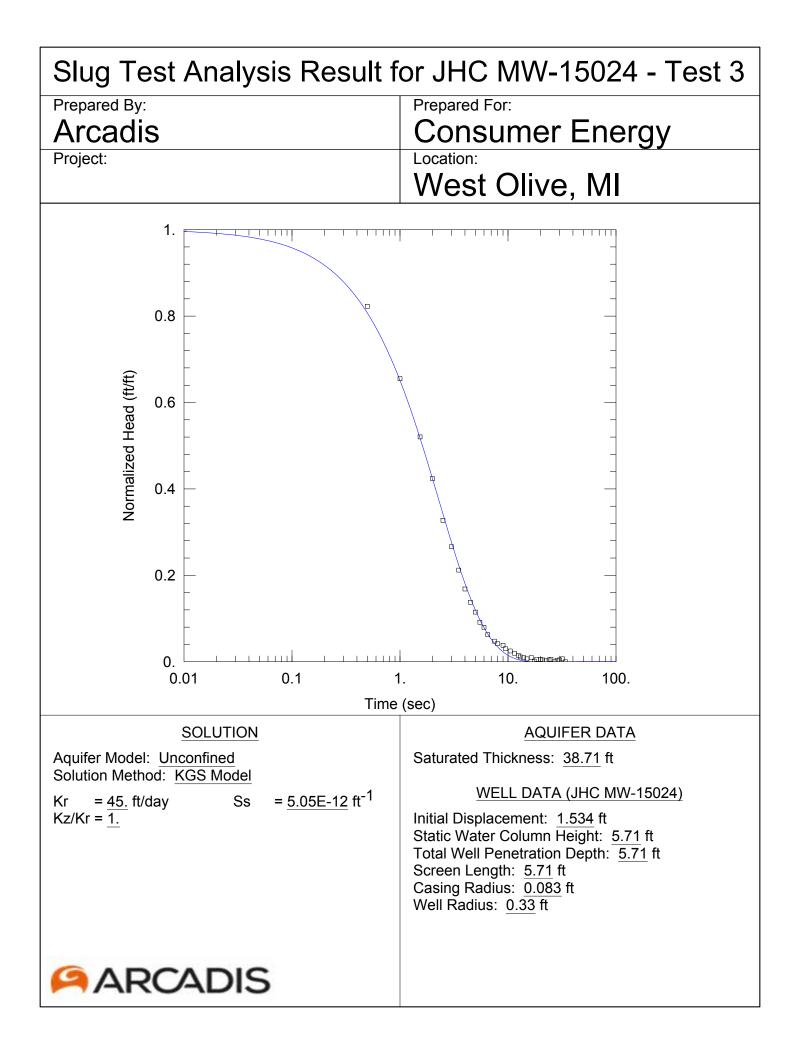


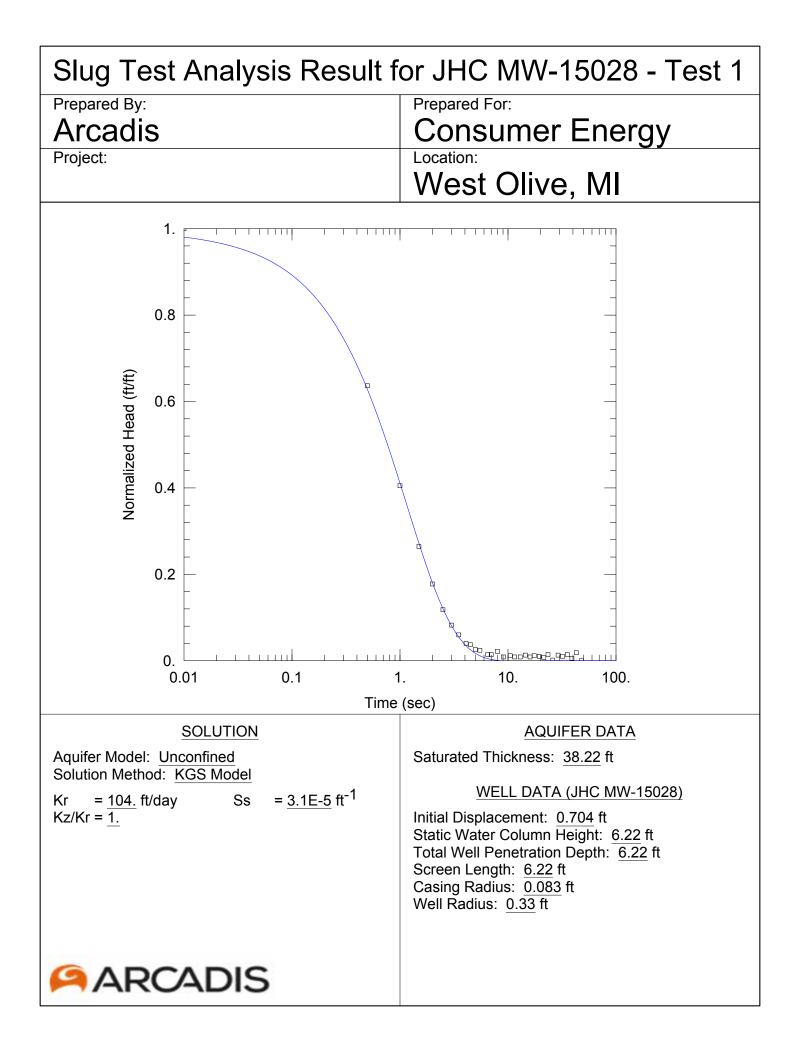


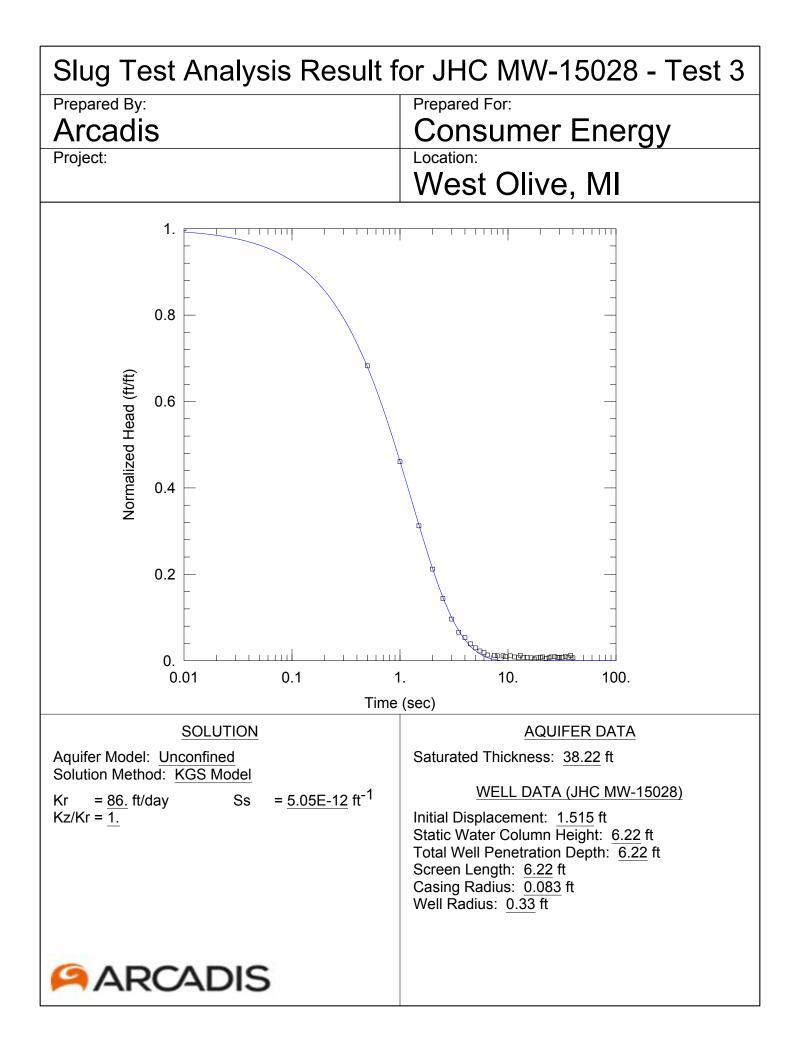


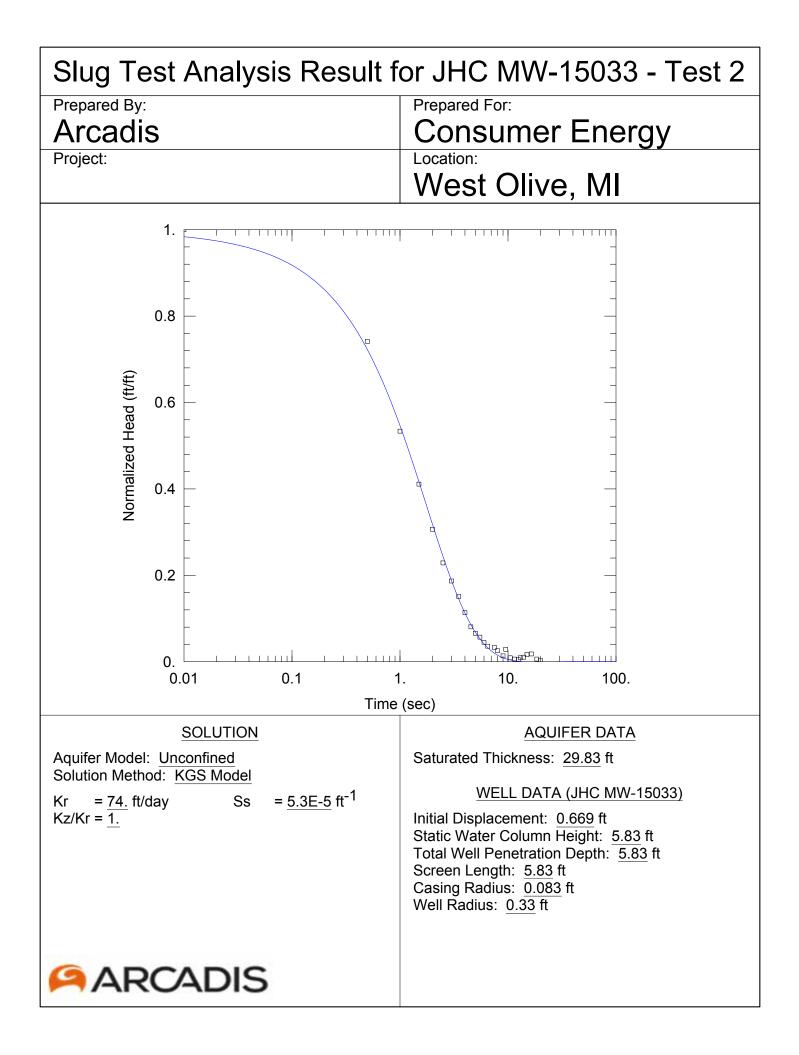


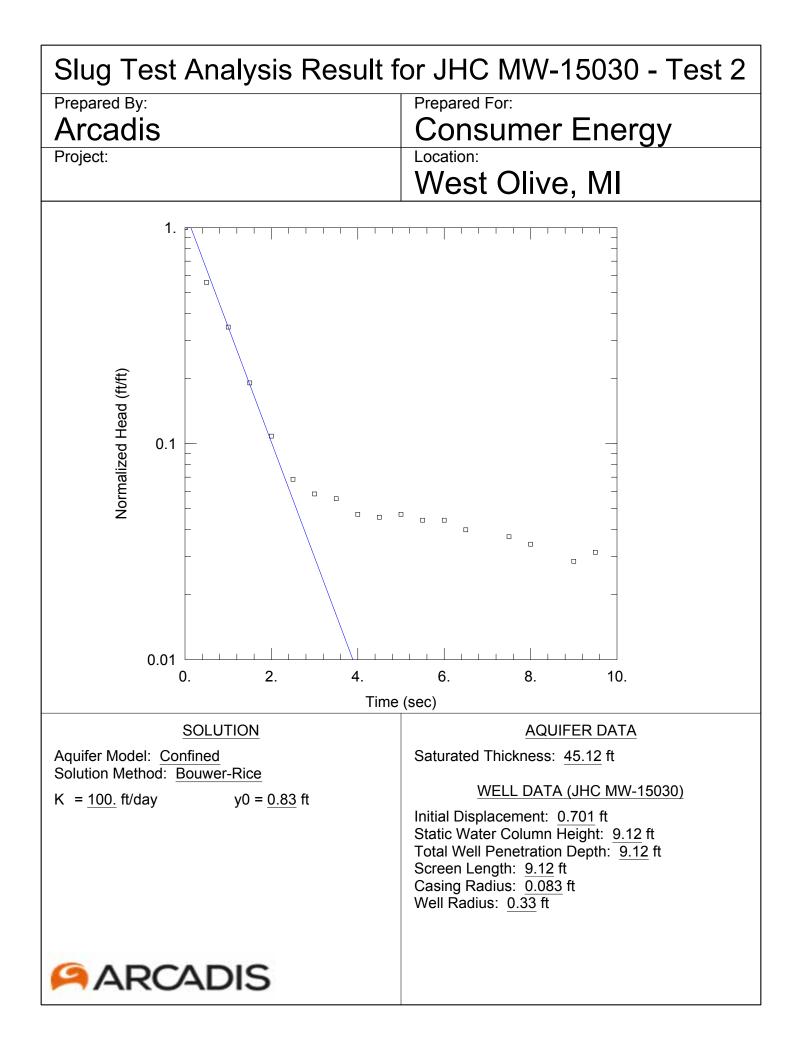


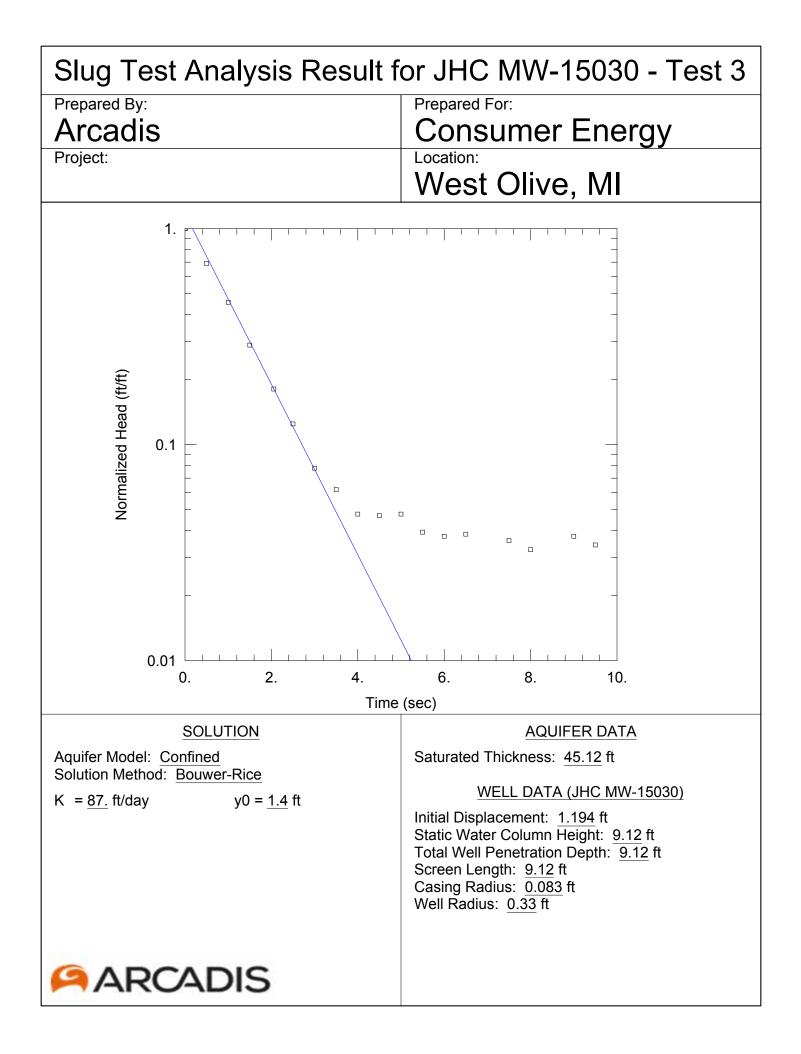


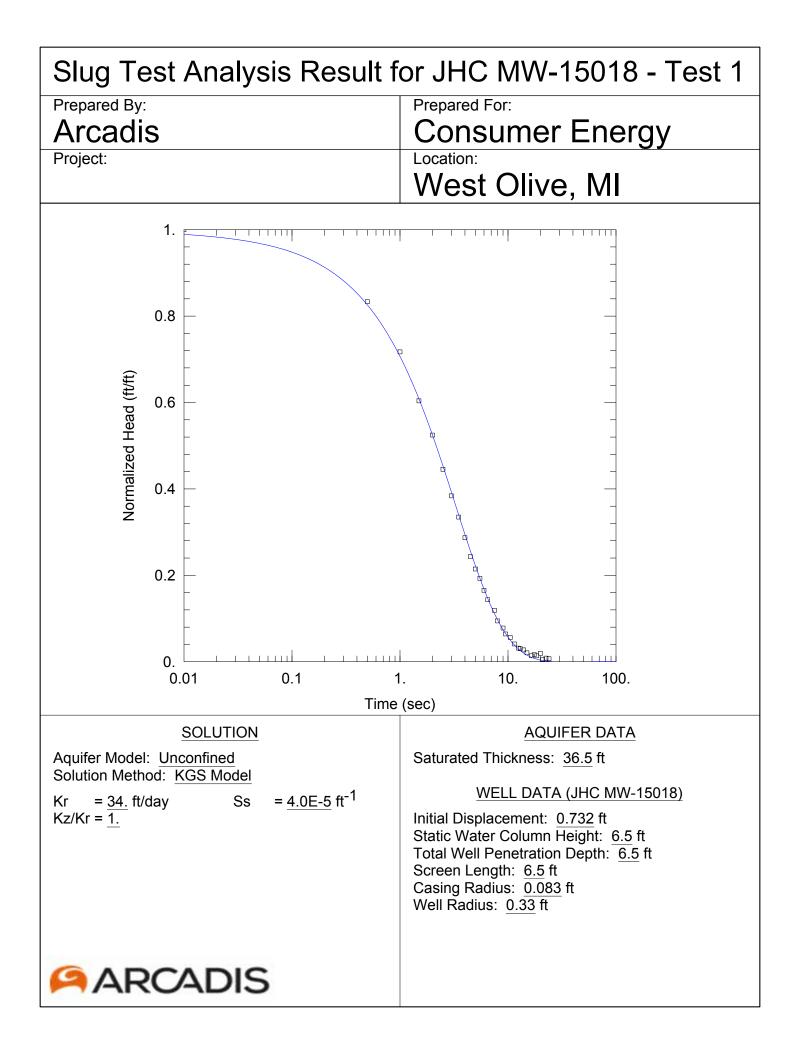


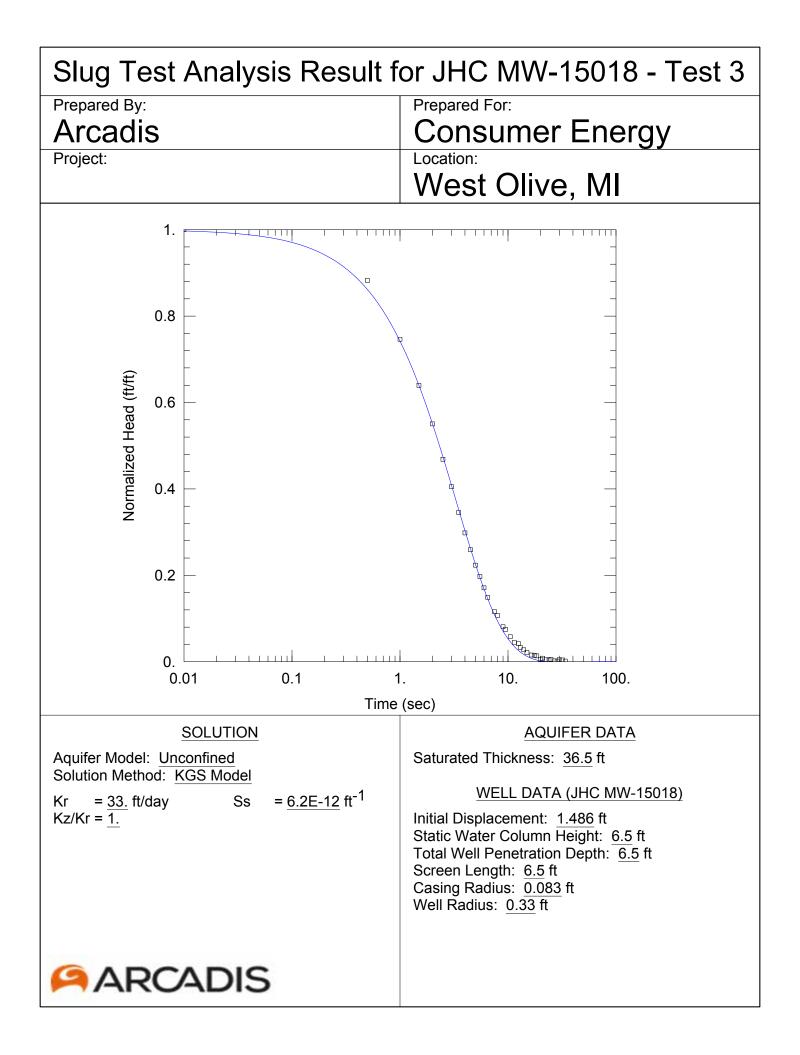














Arcadis of Michigan, LLC

28550 Cabot Drive Suite 500 Novi, Michigan 48377 Tel 248 994 2240 Fax 248 994 2241

www.arcadis.com