


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)  
JC Weadock Power Plant, JC Weadock Landfill

### **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 JC Weadock Landfill, which established the following locations for determining background groundwater quality and detection monitoring. The downgradient monitoring network accurately represents the quality of groundwater passing the waste boundary and ensures detection of groundwater contamination in the uppermost aquifer based on the preferred flow path as a result of the construction of a soil-bentonite slurry wall completed in 2008 (drawings attached). The certified construction quality assurance report verifies that the wall achieves a minimum 1E-07 cm/sec hydraulic conductivity with a mean value of 3E-08 cm/sec. The downgradient groundwater monitoring system has been established within the 1,600 linear foot portion of the perimeter embankment dike that lacks the slurry wall construction.

Background:

MW-15002

MW-15008

MW-15016

MW-15019

Downgradient:

JCW-MW-15011

JCW-MW-15012

JCW-MW-15023

**“Groundwater Monitoring System Certification  
JC Weadock Landfill”  
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 JC Weadock Landfill meets the requirements of §257.91.

**CERTIFICATION**

Professional Engineer Certification Statement [40 CFR 257.91]

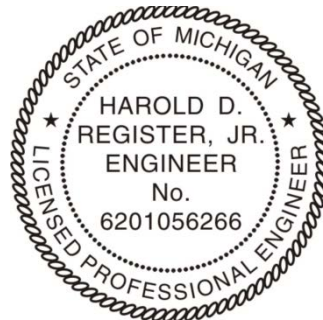
I hereby certify that, having reviewed the attached documentation and being familiar with the provisions of Title 40 of the Code of Federal Regulations §257.91 (40 CFR Part 257.91), I attest that this Groundwater Monitoring System has been designed and constructed to meet the requirements of 40 CFR 257.91.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

Harold D. Register, Jr.  
Signature

October 17, 2017  
Date of Certification

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

6201056266  
Professional Engineer Certification Number



10/17/2017

**ENCLOSURES**

ARCADIS (2016). “Summary of Monitoring Well Design, Installation, and Development – Landfill Unit”

NTH Consultants, Ltd (April 24, 2009). “Construction Certification, Soil-Bentonite Cutoff Wall, J.C. Weadock Ash Storage Area,” Drawing No. 195-6909, Sheets SH24 – SH33.

Consumers Energy Company

# **SUMMARY OF MONITORING WELL DESIGN, INSTALLATION, AND DEVELOPMENT – LANDFILL UNIT**

J.C. Weadock Electric Generation Facility –  
Essexville, Michigan

May 13, 2016






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

Mark Robert Klemmer, PE  
Printed Name of Registered Professional Engineer



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Signature of Registered Professional Engineer  
Registration Number: 62010-49167 State: MI

Date: 5/13/16

## Summary of Monitoring Well Design, Installation, and Development – Landfill Unit

J.C. Weadock Electric Generation Facility  
– Essexville, MI

Prepared for:  
Consumers Energy Company  
Jackson, Michigan

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May 13, 2016

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Drawing SG-22354 – JC Weadock Monitoring Wells, CCR Monitoring

## APPENDICES

Appendix A – Soil Boring and Monitoring Well Construction Logs

Appendix B – Photographic Logs

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 the landfill unit at the J.C. Weadock electric generation facility (JCW), located in Essexville, Michigan (Site). 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.

Arcadis also evaluated the existing monitoring well network to determine if any existing well could be utilized as part of the CCR monitoring program. The following well was determined to be appropriately constructed and will be included in the landfill unit monitoring program and designated as follows for the CCR monitoring program:

Historical Well Name	RCRA Well Name
MW-116A	MW-15027

## 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 were completed using rotosonic-drilling methods operated by Stock Drilling, Inc. of Ida, 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**. Four soil borings were not completed as monitoring wells because they did not meet the minimum requirements of the CCR regulation for first usable aquifer due to the soils encountered at the boring locations. Details of monitoring well installation are provided in the following section.

### 3.2 Monitoring Well Installation

Of the fourteen (14) soil borings that were completed, ten (10) of the soil boring locations were converted into permanent monitoring wells. The four (4) soil borings not converted to monitoring wells (Soil Borings SB-15004, SB-15005, SB-15013 and SB-15017) were backfilled with soil cuttings. Once the total depth of the soil boring was reached, permanent monitoring wells were 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. The length of the monitoring well screens at the Site varied from 3.5 to 10 feet, and the length of the screen intervals was determined based on observations of each location during the soil boring activities. A medium-grained sand pack was placed around each well screen to a height 0.5 to 3 feet above the top of the well screen. Approximately 1 to 11.7 feet of bentonite pellets were placed on top of the sand pack. The remainder of the annular space was finished to ground surface with soil cuttings or concrete.

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-22354**. 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 was completed by surging and evacuated water from the monitoring wells 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
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

### 3.4 Hydraulic Testing

On November 11 and 12, 2015, Arcadis conducted hydraulic tests (slug tests) at seven (7) monitoring wells (MW-15008, JCW MW-15009, JCW MW-15010, JCW MW-15011, MW-15020, JCW MW-15023 and MW-15024) 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 the seven 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. The tests at all monitoring wells were completed using a disposable bailer to remove a known volume of water. The bailer used was 1.5-inches in diameter and 36-inches long. All wells have casing and screen diameters of 2-inches and filter pack diameter of 6-inches. Monitoring wells JCW MW-15010 and JCW MW-15023 are screened in a sand layer that is confined by 9 and 4.5 feet thick clay. Monitoring well JCW MW-15009 was screened in unconfined sand across the water table at the time of hydraulic testing. The remaining wells were screened in unconfined sand approximately 1 to 2.8 feet below the water table at the time of hydraulic testing. At all the monitoring wells, a pressure transducer was set to record at 0.5 second intervals to measure pre-test static head, displacement and recovery data.

All tests at the seven monitoring wells reached full recovery within approximately 30 to 900 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 the recovery data from four of the wells (MW-15008, JCW MW-15009, JCW MW-15010, and MW-15020) was the confined or the unconfined KGS model (1994) that accounts for partial penetration effects. The recovery data of JCW MW-15010 was fit to the confined KGS model (1994) and the recovery data from monitoring wells MW-15008, JCW MW-15009, and MW-15020 were fit to the unconfined KGS model (1994). The confined Cooper et al.

## J.C. WEADOCK MONITORING WELL DESIGN, INSTALLATION, AND DEVELOPMENT

(1967) solution was utilized for recovery data at monitoring wells JCW MW-15011, JCW MW-15023 and MW-15024. The results indicated an estimated hydraulic conductivity range from 7.7 to 30 feet per day (ft/d) with an average of 17 ft/d and a geometric mean of 16 ft/d. The results of this test seem to be a reasonable fit for the very fine to coarse sand formation. The monitoring well locations where slug tests were conducted are shown on **Drawing SG-22354** 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 - Landfill Unit  
Consumers Energy Co.  
J.C. Weadock Generating Facility  
Essexville, Michigan

MW ID	Former MW ID	Site Coordinates				Date Installed	Geologic Unit of Screen Interval	Well Construction	Well Screen Length (ft)	Screen Interval (ft bgs)	Development Details				
		Northing	Easting	Ground Surface Elevation (ft above msl)	TOC Elevation (ft above msl)						Static DTW (ft below TOC)	Total Depth	Pumping DTW (ft below TOC)	Gallons Removed	Final Turbidity (NTU)
<b>Background Monitoring Well</b>															
MW-15002	--	777616.5	13263683.7	584.9	587.71	9/17/2015	Sand	2" PVC, 10 slot	10	4 - 14	7.8	16.9	NR	150	15.7
MW-15008	--	778850.3	13262994.1	582.7	585.36	9/24/2015	Sand	2" PVC, 10 slot	10	4 - 14	4.78	17.46	5.76	110	2.94
MW-15016	--	777566.2	13263941.7	583.7	586.49	9/30/2015	Sand	2" PVC, 10 slot	3.5	5.5 - 9	4.33	8.03	8.00	51	5.1
MW-15018	--	777822.4	13263663.8	583.6	586.42	10/1/2015	Sand	2" PVC, 10 slot	4	3 - 7	6.26	10.03	10.00	68	2.07
MW-15019	--	778024.1	13263504.9	583.5	586.17	10/1/2015	Sand	2" PVC, 10 slot	10	4 - 14	6.02	16.00	10.17	280	0.84
MW-15020	--	778708.4	13263077.4	582.5	585.95	10/1/2015	Sand	2" PVC, 10 slot	10	4 - 14	5.41	17.03	5.95	135	6.1
MW-15024	--	778249.1	13263347.9	583.7	586.56	10/8/2015	Sand	2" PVC, 10 slot	10	4 - 14	6.40	17.11	11.37	200	2.6
MW-15027	MW-116A	778601.3	13263139.3	583.2	586.25	4/26/2005	Sand	NR	10	5 - 15	5.73	18.29	6.45	110	1.51
<b>Landfill Monitoring Well</b>															
JCW MW-15011	--	780807.4	13265133.1	594.9	597.07	9/29/2015	Sand	2" PVC, 10 slot	3.5	12.5 - 16	12.58	18.25	17.3	160	5.32
JCW MW-15012	--	780995.6	13265672.5	592.2	595.07	9/29/2015	Sand (10.8-15) / Clay (15-15.8)	2" PVC, 10 slot	5	10.8 - 15.8	14.29	18.75	NR	330	1.3
JCW MW-15023	--	780840.7	13265275.9	592.7	595.32	10/8/2015	Sand	2" PVC, 10 slot	5	13 - 18	11.05	20.85	15.85	100	0.81
<b>Hydraulic Testing Wells</b>															
MW-15008	--	778850.3	13262994.1	582.7	585.36	9/24/2015	Sand	2" PVC, 10 slot	10	4 - 14	4.78	17.46	5.76	110	2.94
JCW MW-15009	--	780481.4	13262254.9	586.9	589.64	9/24/2015	Sand	2" PVC, 10 slot	5	5 - 10	8.78	13	12.7	65	1.46
JCW MW-15010	--	780809.2	13263418.0	595.2	597.76	9/24/2015	Sand	2" PVC, 10 slot	1.5	15.5 - 17	15.55	19.45	NA	23	2.55
JCW MW-15011	--	780807.4	13265133.1	594.9	597.07	9/29/2015	Sand	2" PVC, 10 slot	3.5	12.5 - 16	12.58	18.25	17.3	160	5.32
MW-15020	--	778708.4	13263077.4	582.5	585.95	10/1/2015	Sand	2" PVC, 10 slot	10	4 - 14	5.41	17.03	5.95	135	6.1
JCW MW-15023	--	780840.7	13265275.9	592.7	595.32	10/8/2015	Sand	2" PVC, 10 slot	5	13 - 18	11.05	20.85	15.85	100	0.81
MW-15024	--	778249.1	13263347.9	583.7	586.56	10/8/2015	Sand	2" PVC, 10 slot	10	4 - 14	6.40	17.11	11.37	200	2.6

**Notes:**  
DTW: depth to water  
ft = feet  
bgs = below ground surface  
TOC = top of casing elevation  
TBD: Pending survey data  
NR = Not recorded

**Table 3**  
**Estimated Hydraulic Conductivity (K) Values**  
**Consumers Energy Co.**  
**J.C. Weadock Generating Facility**  
**Essexville, Michigan**

Well ID	Test	Initial Displacement (ft)	Expected (Calculated) Displacement (ft)	K (ft/d)	K (cm/sec)	Slug Test Solution
MW-15008	2	0.847	0.844	30	1.06E-02	KGS Model (Hyder et. al, 1994)
	3	1.433	1.69	26	9.17E-03	KGS Model (Hyder et. al, 1994)
	Average			28	9.88E-03	
JCW MW-15009	1	0.838	0.844	8.0	2.82E-03	KGS Model (Hyder et. al, 1994)
	3	1.613	1.69	7.7	2.72E-03	KGS Model (Hyder et. al, 1994)
	Average			7.9	2.77E-03	
JCW MW-15010	3	1.678	1.69	13	4.59E-03	KGS Model (Hyder et. al, 1994)
JCW MW-15011	2	0.793	0.844	14	4.93E-03	Cooper et al. (1967)
	3	1.487	1.69	16	5.78E-03	Cooper et al. (1967)
	Average			15	5.35E-03	
MW-15020	1	0.82	0.844	21	7.41E-03	KGS Model (Hyder et. al, 1994)
	2	0.768	0.844	21	7.41E-03	KGS Model (Hyder et. al, 1994)
	Average			21	7.41E-03	
JCW MW-15023	2	0.805	0.844	21	7.35E-03	Cooper et al. (1967)
MW-15024	3	1.438	1.69	11	3.78E-03	Cooper et al. (1967)
<b>Over all Average</b>				<b>17</b>	<b>6.05E-03</b>	
<b>Over all Geometric mean</b>				<b>16</b>	<b>5.53E-03</b>	
<b>Minimum</b>				<b>7.7</b>	<b>2.72E-03</b>	
<b>Maximum</b>				<b>30</b>	<b>1.06E-02</b>	

Note:

cm/sec = centimeters per second

ft = feet

ft/d = feet per day

References

Butler, J.J., Jr., 1998. The Design, Performance, and Analysis of Slug Tests, Lewis Publishers, Boca Raton, 252p.

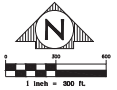
Cooper, H.H., J.D. Bredehoeft and S.S. Papadopulos, 1967. Response of a finite-diameter well to an instantaneous charge of water, Water Resources Research, vol. 3, no. 1, pp. 263-269

Hyder, Z, J.J. Butler, Jr., C.D. McElwee and W. Liu, 1994. Slug tests in partially penetrating wells, Water Resources Research, vol. 30, no. 11, pp. 2945-2957



# FIGURES

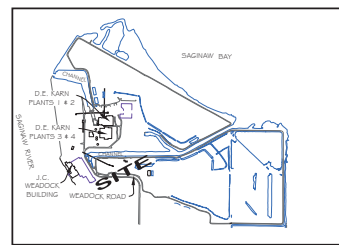




**KARN / WEADOCK CCR MONITORING BENCHMARKS AFTER ADJUSTMENTS**

BY #	DATE	DESCRIPTION
150	5/04/10	NAIL WEST FACE POWER POLE, 80'± NORTH OF RAILROAD TRACKS, 140'± EAST WEADOCK ROAD
151	5/04/10	NAIL SOUTHEAST FACE LIGHT POLE, 170'± NORTHWEST CENTERLINE WEADOCK ROAD, 9'± SOUTHWEST RAILROAD TRACKS
152	5/06/10	SOUTH SOUTHEASTERS FLANGE BODY HYDRANT MARK SOUTHEAST FC OF RAILROAD TRACKS
5035H	5/05/12	NBS BENCHMARK DISK OVER STEEL ROD IN NOAA CASING 4 COVER
153	5/06/10	NAIL NORTH SIDE LIGHT POLE, SOUTH SIDE WEADOCK ROAD, 100'± EAST "DEER HINGDOO HOT TUBS" SIGN
154	5/07/11	NAIL WEST SIDE LIGHT POLE, SOUTHWEST CORNER WEADOCK ASH POND
155	5/06/11	MARKER SQUARE, TOP OF EAST END CONCRETE CURB NORTH OF DIESEL PLUM @ TLY ASH SLO
156	5/06/11	FOUND RAILROAD SPIKE, SOUTH FACE LIGHT POLE, SOUTH SIDE BARBER ACROSS DISCHARGE CHANNEL
157	5/02/09	FOUND NAIL, SOUTH FACE WESTERS MOST POWER POLE @ NORTH SIDE DIKE
158	5/01/11	FOUND NAIL, SOUTH FACE 4TH POWER POLE FROM THE WEST'S POWER POLES @ NORTH SIDE DIKE
159	5/02/11	FOUND NAIL, SOUTH FACE POWER POLE @ NORTHEAST CORNER DIKE
160	5/01/10	SET CHISELED SQUARE IN CONCRETE BASE MONITORING WELL 536 @ EAST SIDE DIKE EAST-WEST HALL ROAD INTERSECTION
161	5/06/11	FOUND NAIL, NORTH FACE 2'± COTTONWOOD @ INTERSECTION OF SLURRY WALL 4 NORTH-SOUTH ROAD
162	5/04/10	NAIL WEST FACE POWER POLE, 45'± EAST OF CENTERLINE BOUTELL ROAD, 45'± SOUTH MW 5025

**SURVEYOR'S NOTES:**  
 1) THE HORIZONTAL COORDINATE VALUES AND GROUND ELEVATIONS WERE OBTAINED WITH GPS RTK EQUIPMENT UTILIZING THE EXISTING SITE SURVEY MONUMENT PERMANENT CONTROL AS FOR THE LOCATION AND ELEVATION CONTROL OF THE BASE STATION. CHECKS WERE MADE BY LOCATING OTHER BASELINE OR PERMANENT CONTROL POINTS OF KNOWN REPORTED VALUES FOR ACCURACY VERIFICATION. THE TOP OF CASING ELEVATION VALUES WERE ESTABLISHED BY UTILIZING A DIGITAL LEVEL AND RUNNING A CLOSED LEVEL LOOP FROM POINTS OF KNOWN ELEVATION (BASELINE/PERMANENT CONTROL, MONUMENTATION AND PREVIOUSLY UTILIZED SITE BENCHMARKS). EACH TOP OF CASING WAS INCLUDED AS A TURN POINT FOR THE LEVEL LOOP. NO SIDE SHOTS WERE USED AS PART OF THE LEVEL LOOP.  
 2) AERIAL IMAGERY IS SHOWN FROM JUNE 2007 FLIGHT FOR THE PORTION SOUTH OF THE STORAGE TANKS AT THE SOUTH END OF THE SITE AND APRIL 2013 FLIGHT FOR THE IMAGERY NORTH OF THE STORAGE TANKS. IMAGERY PROVIDED BY AIR-LAID SURVEYS.



**LOCATION MAP**  
NOT TO SCALE

SECTION 1, 2, 11 & 12  
TRAMPTON TOWNSHIP  
T14N-R5E, BAY COUNTY

**BASIS OF BEARING**

MICHIGAN STATE PLANE COORDINATE SYSTEM  
SOUTH ZONE NAD83 (FIRM), COMBINED SCALE FACTOR = 0.9998043

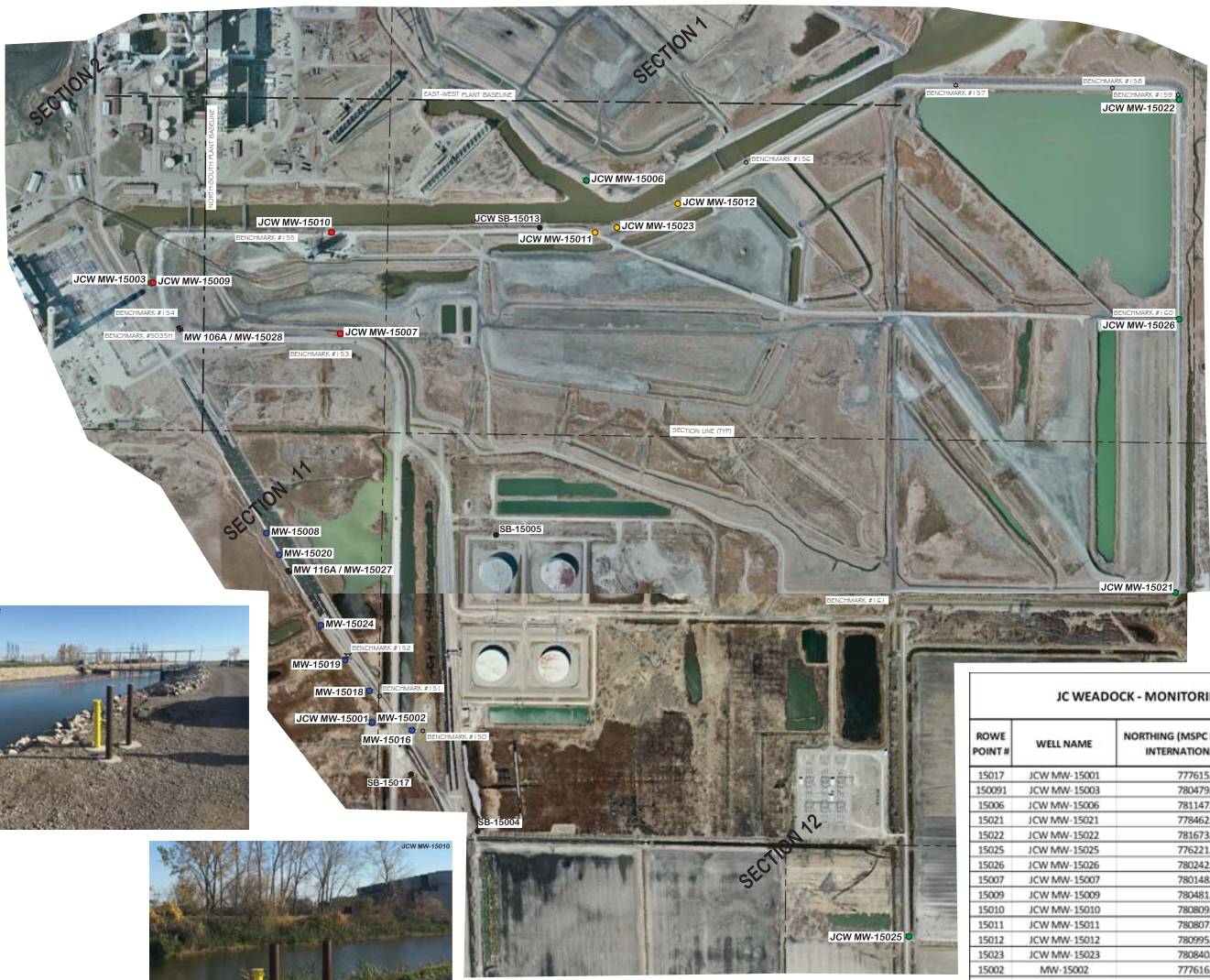
**BASIS OF ELEVATION**

NORTH AMERICAN VERTICAL DATUM 1985 (NAVD85)  
 \*NAVD85 = NORTH AMERICAN VERTICAL DATUM OF 1985  
 \*NGVD29 = NATIONAL GEODETIC VERTICAL DATUM OF 1929  
 \*USLS = UNITED STATES STATE SURVEY 1983  
 \*IGLD85 = INTERNATIONAL GREAT LAKES DATUM 1985 ADJUSTMENT  
 \*IGLD83 = INTERNATIONAL GREAT LAKES DATUM 1983 ADJUSTMENT  
 \* REPORTED IN UNITS OF FEET.

**CONVERSIONS**

NAVD85 TO USLS = +0.82'  
 NAVD85 TO IGLD85 = -0.11'  
 USLS TO IGLD85 = -1.754'  
 USLS TO NGVD29 = -0.297'  
 IGLD85 TO IGLD83 = +0.72'

NOTE: THE CONVERSIONS TO USLS AND TO IGLD DATUMS ONLY APPLY TO THE IMMEDIATE AREA AT THE KARN PLANT AND SHOULD NOT BE USED ELSEWHERE.



**LEGEND**

- JCW MW-406 ● JCW WEADOCK BOTTOM ASH POND WELL
- MW-408 ● BACKGROUND MONITORING WELL
- JCW MW-407 ● LANDFILL MONITORING WELL
- JCW MW-410 ● BEDROCK MONITORING WELL

**JC WEADOCK - MONITORING WELLS; WO#25477893; ROWE #15L0109; OCTOBER 2015**

ROWE POINT #	WELL NAME	NORTHING (MSPC NAD83(1994) INTERNATIONAL FEET)	EASTING (MSPC NAD83(1994) INTERNATIONAL FEET)	GROUND ELEV. (NAVD88)	T/CASING ELEV. (NAVD88)	LATITUDE (DECIMAL DEGREES)	LONGITUDE (DECIMAL DEGREES)
15017	JCW MW-15001	777615.4	13263677.1	585.3	587.99	43.6325013	-83.8366837
150091	JCW MW-15003	780479.7	13262242.2	586.4	589.10	43.6403837	-83.8420358
15006	JCW MW-15006	781147.2	13265077.1	587.9	590.50	43.6421658	-83.8313111
15021	JCW MW-15021	778462.7	13268914.4	592.1	595.05	43.6347336	-83.8168819
15022	JCW MW-15022	781673.5	13268937.1	591.9	594.72	43.6435414	-83.8167172
15025	JCW MW-15025	776221.6	13267177.6	585.7	588.51	43.6286164	-83.8234966
15026	JCW MW-15026	780242.6	13268936.2	591.3	594.03	43.6396161	-83.8167560
15007	JCW MW-15007	780148.9	13263474.2	585.2	587.40	43.6394549	-83.8373899
15009	JCW MW-15009	780481.4	13262254.9	586.9	589.64	43.6403880	-83.8419878
15010	JCW MW-15010	780809.2	13263418.0	595.2	597.76	43.6412674	-83.8375867
15011	JCW MW-15011	780807.4	13265133.1	594.9	597.07	43.6412327	-83.8311080
15012	JCW MW-15012	780995.6	13265672.5	592.2	595.07	43.6417396	-83.8290659
15023	JCW MW-15023	780840.7	13265275.9	592.7	595.32	43.6413214	-83.8305676
15002	MW-15002	777616.5	13263683.7	584.9	587.71	43.6325042	-83.8366589
15008	MW-15008	778850.3	13262994.1	582.7	585.36	43.6359007	-83.8392343
15016	MW-15016	777566.2	13263941.7	583.7	586.49	43.6323619	-83.8356858
15018	MW-15018	777822.4	13263663.8	583.6	586.42	43.6330693	-83.8367291
15019	MW-15019	778024.1	13263504.9	583.5	586.17	43.6336254	-83.8373244
15020	MW-15020	778708.4	13263077.4	582.5	585.95	43.6355101	-83.8389231
15024	MW-15024	778249.1	13263347.9	583.7	586.56	43.6342456	-83.8379121
15027	MW 116A/MW-15027	778601.3	13263139.3	583.2	586.25	43.6352151	-83.8386919
15028	MW-106A/MW-15028	780181.7	13262428.8	586.7	589.37	43.6395629	-83.8413382

FIG 1, REV 4	ARCADIS NORA CCR GROUNDWATER MONITORING PROGRAM	A	1/10/01/15	EDIT TABLE AND LEGEND			
FIG 1, REV 2	ARCADIS NORA CCR DEEP GROUNDWATER MONITORING PROGRAM						

DRAWING NO.	REFERENCE DRAWINGS	REV.	DATE	DESCRIPTION	BY	APP.	REV.	DATE	DESCRIPTION	BY	APP.



**JC WEADOCK MONITORING WELLS CCR MONITORING**

SECTION 1, 2, 11 & 12  
TRAMPTON TOWNSHIP  
SCALE: 1"=200'  
FILE NAME: 2334948E.DWG  
DATE: 1/10/15

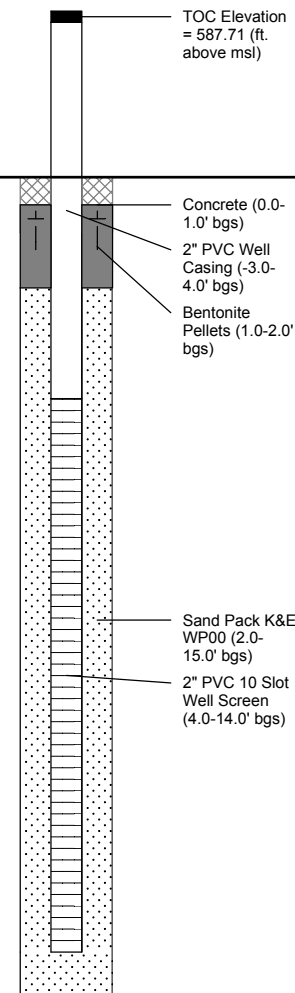
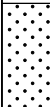
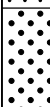


SUP: 25477893  
SHEET: 1  
REV: A


# APPENDIX A

## Soil Boring and Monitoring Well Construction Logs



<b>Date Start:</b> 09/17/15 <b>Date Finish:</b> 09/17/15 <b>Drilling Company:</b> Stock Drilling <b>Driller's Name:</b> Austin Goldsmith <b>Drilling Method:</b> Hydrovac/Sonic <b>Sampling Method:</b> Continuous <b>Rig Type:</b> Sonic <b>Water Level Start (ft. bgs.):</b> NA <b>Water Level Finish (ft. btoc.):</b> 7.8	<b>Northing:</b> 777616.5 <b>Easting:</b> 13263683.7 <b>Casing Elevation:</b> 587.71  <b>Borehole Depth (ft. bgs.):</b> 15.0 <b>Surface Elevation:</b> 584.9  <b>Descriptions By:</b> L. Rogers	<b>Well/Boring ID:</b> MW-15002  <b>Client:</b> Consumers Energy  <b>Location:</b> JC Weadock Facility 2742 Weadock Highway Essexville, MI 48732  <b>Weather Conditions:</b> 72 F Sunny
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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	585									
0.0 - 6.0		1	0.0-6.0'	6.0	NA			(0.0 - 6.0') Hydrovac no lithology recorded.		
6.0 - 8.0								(6.0 - 8.0') SAND, very fine to medium; little organics; trace silt; trace clay; trace granule, subrounded to subangular; moist to wet; very dark brown (10YR 2/2).		
8.0 - 10.0		2	6.0-10.0'	2.5	NA			(8.0 - 14.0') SAND, fine to coarse; little very coarse; trace granule to medium pebbles, subrounded to subangular; poorly sorted; moist; very dark grayish brown (10YR 3/2).		
10.0 - 15.0		3	10.0-15.0'	4.7	NA			NOTE: trace small pebbles to small cobbles, subrounded to subangular from 12.0 to 14.0' bgs.		
14.0 - 15.0								(14.0 - 15.0') CLAY, low to medium plasticity; little silt; little granule to small cobbles, subrounded to subangular; dry; stiff; dark grayish brown (10YR 4/2).		
15.0								End of boring 15.0' bgs.		

	<b>Remarks:</b> bgs = below ground surface      btoc = below top of casing  Hydrovac to 6.0' bgs. Groundwater not encountered during drilling. Water level at development was 7.8' btoc. No odor or staining observed. Groundwater elevation measured on December 8, 2015 was 580.49 feet above mean sea level.
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**Date Start:** 09/23/15  
**Date Finish:** 09/24/15  
**Drilling Company:** Stock Drilling  
**Driller's Name:** Austin Goldsmith  
**Drilling Method:** Hydrovac/Sonic  
**Sampling Method:** Continuous  
**Rig Type:** Sonic  
**Water Level Start (ft. bgs.):** 2.0  
**Water Level Finish (ft. btoc.):** 4.78

**Northing:** 778850.3  
**Easting:** 13262994.1  
**Casing Elevation:** 585.36  
**Borehole Depth (ft. bgs.):** 39.0  
**Surface Elevation:** 582.7  
**Descriptions By:** L. Rogers

**Well/Boring ID:** MW-15008  
**Client:** Consumers Energy  
**Location:** JC Weadock Facility  
 2742 Weadock Highway  
 Essexville, MI 48732  
**Weather Conditions:** 71 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
585										TOC Elevation = 585.36 (ft. above msl)
0								(0.0 - 6.0') Hydrovac no lithology recorded.	2.0	2" PVC Well Casing (-3.0-4.0' bgs) Concrete (0.0-1.5' bgs) Bentonite Pellets (1.5-3.0' bgs)
580		1	0.0-6.0'	0.0	NA					
575		2	6.0-9.0'	3.2	NA		(6.0 - 8.0') SAND, very fine to fine; trace medium to coarse sand; well sorted; wet; trace organics; very dark gray (10YR 3/1). NOTE: Sluff.			
							(8.0 - 8.5') CLAY, low plasticity; trace granule to small pebbles, subrounded to subangular; dry; stiff; dark yellowish brown (10YR 4/4).			
							(8.5 - 19.0') SAND, very fine to medium; trace coarse to very coarse sand; trace granule, subrounded to subangular; well sorted; wet; very dark gray (10YR 3/1).			Sand Pack K&E WP00 (3.0-39.0' bgs) 2" PVC 10 Slot Well Screen (4.0-14.0' bgs)
570		3	9.0-19.0'	9.4	NA			NOTE: little medium to very coarse sand; trace granule, subrounded to subangular; color change to dark grayish brown (10YR 4/2) at 16.5' bgs.		
565										
560		4	19.0-29.0'	10.0	NA			(19.0 - 33.0') SAND, very fine to fine; trace medium to coarse sand; trace clay; well sorted; moist; dark grayish brown (10YR 4/2).		
555										
550		5	29.0-39.0'	8.7	NA			(33.0 - 39.0') SILT and CLAY, medium to high plasticity, slow dilatancy; trace organics; moist; soft; olive brown (2.5Y 4/3).		
545										
40								End of boring 39.0' bgs.		

**Remarks:** bgs = below ground surface      btoc = below top of casing  
 Hydrovac to 6.0' bgs.  
 Groundwater encountered at 2.0' bgs during drilling.  
 Water level at development was 4.78' btoc.  
 No odor or staining observed.  
 Groundwater elevation measured on December 8, 2015 was 580.68 feet above mean sea level.





**Date Start:** 09/24/15  
**Date Finish:** 09/24/15  
**Drilling Company:** Stock Drilling  
**Driller's Name:** Austin Goldsmith  
**Drilling Method:** Hydrovac/Sonic  
**Sampling Method:** Continuous  
**Rig Type:** Sonic  
**Water Level Start (ft. bgs.):** 5.0  
**Water Level Finish (ft. btoc.):** 8.80

**Northing:** 780481.4  
**Easting:** 13262254.9  
**Casing Elevation:** 589.64  
  
**Borehole Depth (ft. bgs.):** 10.0  
**Surface Elevation:** 586.9  
  
**Descriptions By:** L. Rogers

**Well/Boring ID:** JCW MW-15009  
**Client:** Consumers Energy  
  
**Location:** JC Weadock Facility  
 2742 Weadock Highway  
 Essexville, MI 48732  
  
**Weather Conditions:** 70 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
590										<p>TOC Elevation = 589.64 (ft. above msl)</p>
0								(0.0 - 6.0') Hydrovac; no lithology recorded.		<p>Concrete (0.0-2.0' bgs) 2" PVC Well Casing (-3.0-5.0' bgs)</p>
585		1	0.0-6.0'	0.0	NA					<p>Bentonite Pellets (2.0-4.0' bgs)</p>
5										<p>Sand Pack K&amp;E WP00 (4.0-10.0' bgs) 2" PVC 10 Slot Well Screen (5.0-10.0' bgs)</p>
580		2	6.0-10.0'	5.0	NA		<p>(6.0 - 7.0') SAND, very fine to fine; little organics, roots; little silt and clay; poorly sorted; moist; dark gray (10YR 4/1).            (7.0 - 10.0') SAND, very fine to fine; little medium sand; trace coarse sand to granule, subrounded to subangular; trace organics; well sorted; dry to moist; dark gray (10YR 4/1).</p>			
10								NOTE: Lose trace organics at 9.0' bgs.		
								End of boring 10.0' bgs.		
575										

**Remarks:** bgs = below ground surface      btoc = below top of casing  
  
 Hydrovac to 6.0' bgs.  
 Groundwater encountered at 5.0' bgs during drilling.  
 Water level at development was 8.80' btoc.  
 No odor or staining observed.  
 Groundwater elevation measured on December 8, 2015 was 580.84 feet above mean sea level.



**Date Start:** 09/24/15  
**Date Finish:** 09/24/15  
**Drilling Company:** Stock Drilling  
**Driller's Name:** Austin Goldsmith  
**Drilling Method:** Hydrovac/Sonic  
**Sampling Method:** Continuous  
**Rig Type:** Sonic  
**Water Level Start (ft. bgs.):** 10.5  
**Water Level Finish (ft. btoc.):** 15.75

**Northing:** 780809.2  
**Easting:** 13263418  
**Casing Elevation:** 597.76  
  
**Borehole Depth (ft. bgs.):** 19.0  
**Surface Elevation:** 595.2  
  
**Descriptions By:** L. Rogers

**Well/Boring ID:** JCW MW-15010  
**Client:** Consumers Energy  
  
**Location:** JC Weadock Facility  
 2742 Weadock Highway  
 Essexville, MI 48732  
  
**Weather Conditions:** 70 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
0	595	1	0.0-6.0'	0.0	NA			(0.0 - 6.0') Hydrovac no lithology recorded.		
5	590	2	6.0-9.0'	4.6	NA		(6.0 - 9.0') CLAY, little fine sand to small pebbles; trace medium pebbles; subrounded to subangular; dry; stiff; dark yellowish brown (10YR 4/4). NOTE: Fill.			
10	585	3	9.0-19.0'	10.0	NA		(9.0 - 10.5') SAND, very fine to fine; well sorted; dry; grayish brown (10YR 5/2).			
						(10.5 - 14.0') ASH, fly ash, very fine; wet. NOTE: Fill material.				
						(14.0 - 15.0') FILL, roots and organics; trace ash.				
						(15.0 - 17.0') SAND, very fine to medium; trace coarse to very coarse, subrounded to subangular; trace organics, roots and shells; moist to wet; poorly sorted; dark grayish brown (10YR 4/2).				
15	580						(17.0 - 19.0') CLAY, medium to high plasticity; little sand, very fine to medium; little organics, roots; trace silt; dry; medium stiff; light brownish gray (2.5Y 6/2).			
20	575						End of boring 19.0' bgs.			

**Remarks:** bgs = below ground surface      btoc = below top of casing  
  
 Hydrovac to 6.0' bgs.  
 Groundwater encountered at 10.5' bgs during drilling.  
 Water level at development was 15.75' btoc.  
 No odor or staining observed.  
 Groundwater elevation measured on December 8, 2015 was 582.01 feet above mean sea level.



**Date Start:** 09/29/15  
**Date Finish:** 09/29/15  
**Drilling Company:** Stock Drilling  
**Driller's Name:** Austin Goldsmith  
**Drilling Method:** Hydrovac/Sonic  
**Sampling Method:** Continuous  
**Rig Type:** Sonic  
**Water Level Start (ft. bgs.):** 10.0  
**Water Level Finish (ft. btoc.):** 12.67

**Northing:** 780807.4  
**Easting:** 13265133.1  
**Casing Elevation:** 597.07  
  
**Borehole Depth (ft. bgs.):** 18.0  
**Surface Elevation:** 594.9  
  
**Descriptions By:** L. Rogers

**Well/Boring ID:** JCW MW-15011  
**Client:** Consumers Energy  
  
**Location:** JC Weadock Facility  
 2742 Weadock Highway  
 Essexville, MI 48732  
  
**Weather Conditions:** 65 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
0	595							(0.0 - 6.0') Hydrovac no lithology recorded.		
5	590	1	0.0-6.0'	0.0	NA					
6		2	6.0-9.0'	2.3	NA			(6.0 - 8.0') SAND, very fine to fine; trace medium to very coarse, subrounded to subangular; trace clay; well sorted; dry; dark gray (10YR 4/1). NOTE: Fill material.		
8								(8.0 - 9.0') SAND, very fine to coarse; trace granule, subrounded to subangular; little clay; dry; brownish yellow (10YR 6/8).		
9								(9.0 - 10.0') CLAY, medium plasticity; trace very fine to medium sand; trace granule, subrounded to subangular; dry; medium stiff; dark grayish brown (10YR 4/2).	10	
10	585							(10.0 - 11.5') ASH; wet; black (10YR 2/1). NOTE: Fill material.		
11								(11.5 - 16.0') SAND, fine to coarse; trace very coarse sand to granule, subrounded to subangular; trace organics, shells, roots; well sorted; moist to wet; very dark grayish brown (10YR 3/2).		
12		3	9.0-18.0'	8.5	NA			NOTE: color change to black (10YR 2/1) from 15.0-16.0' bgs.		
13								(16.0 - 18.0') CLAY, low plasticity; trace fine sand to large pebbles, subrounded to subangular; trace roots; moist; medium stiff; dark grayish brown (10YR 4/2).		
18								End of boring 18.0' bgs.		

**Remarks:** bgs = below ground surface      btoc = below top of casing  
  
 Hydrovac to 6.0' bgs.  
 Groundwater encountered at 10.0' bgs during drilling.  
 Water level at development was 12.67' btoc.  
 No odor or staining observed.  
 Groundwater elevation measured on December 8, 2015 was 584.4 feet above mean sea level.





**Date Start:** 09/29/15  
**Date Finish:** 09/29/15  
**Drilling Company:** Stock Drilling  
**Driller's Name:** Austin Goldsmith  
**Drilling Method:** Hydrovac/Sonic  
**Sampling Method:** Continuous  
**Rig Type:** Sonic  
**Water Level Start (ft. bgs.):** 13.0  
**Water Level Finish (ft. btoc.):** 14.53

**Northing:** 780995.6  
**Easting:** 13265672.5  
**Casing Elevation:** 595.07  
**Borehole Depth (ft. bgs.):** 19.0  
**Surface Elevation:** 592.2  
**Descriptions By:** L. Rogers

**Well/Boring ID:** JCW MW-15012  
**Client:** Consumers Energy  
**Location:** JC Weadock Facility  
 2742 Weadock Highway  
 Essexville, MI 48732  
**Weather Conditions:** 65 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
595										TOC Elevation = 595.07 (ft. above msl)
0								(0.0 - 6.0') Hydrovac; no lithology recorded.		Concrete (0.0-1.5' bgs)
590		1	0.0-6.0'	0.0	NA					2" PVC Well Casing (-2.8-10.8' bgs)
5										Cement/Bentonite Grout (1.5-6.8' bgs)
585		2	6.0-9.0'	3.1	NA			(6.0 - 6.5') SAND, very fine to medium; little clay; trace coarse sand to granule, subrounded to subangular; poorly sorted; dry; dark yellowish brown (10YR 4/4).		Bentonite Pellets (6.8-7.8' bgs)
								(6.5 - 8.1') CLAY, medium plasticity; some sand, very fine to coarse; trace granule large pebbles, subrounded to subangular; dry; medium stiff; brown (10YR 4/3).		
								(8.1 - 8.5') SAND, very fine to medium; trace coarse sand; well sorted; dry; yellowish brown (10YR 5/6).		
								(8.5 - 9.0') CLAY, medium plasticity; some sand, very fine to coarse; trace granule large pebbles, subrounded to subangular; dry; medium stiff; brown (10YR 4/3).		
10								(9.0 - 10.0') SAND, fine to coarse; some granule to large pebbles, subrounded to subangular; trace clay; poorly sorted; dry; brown (10YR 4/3).		
								(10.0 - 15.0') SAND, very fine to medium; trace coarse sand; well sorted; dry; yellowish brown (10YR 5/6).	13.0	Sand Pack K&E WP00 (7.8-19.0' bgs)
580		3	9.0-19.0'	9.0	NA			NOTE: color change to very dark gray (10YR 3/1) at 12.5' bgs. NOTE: wet at 13.0' bgs.		2" PVC 10 Slot Well Screen (10.8-15.8' bgs)
15								(15.0 - 19.0') CLAY, medium to high plasticity; little granule to large pebble, subrounded to subangular; trace silt; dry; soft to medium stiff; dark grayish brown (10YR 4/2).		
575										
20								End of boring 19.0' bgs.		

**Remarks:** bgs = below ground surface      btoc = below top of casing  
 Hydrovac to 6.0' bgs.  
 Groundwater encountered at 13.0' bgs during drilling.  
 Water level at development was 14.53' btoc.  
 No odor or staining observed.  
 Groundwater elevation measured on December 8, 2015 was 592.2 feet above mean sea level.



**Date Start:** 09/28/15  
**Date Finish:** 09/30/15  
**Drilling Company:** Stock Drilling  
**Driller's Name:** Austin Goldsmith  
**Drilling Method:** Hand Auger/Sonic  
**Sampling Method:** Continuous  
**Rig Type:** Sonic  
**Water Level Start (ft. bgs.):** 2.5  
**Water Level Finish (ft. btoc.):** 4.33

**Northing:** 777566.2  
**Eastings:** 13263941.7  
**Casing Elevation:** 586.49  
**Borehole Depth (ft. bgs.):** 9.0  
**Surface Elevation:** 583.7  
**Descriptions By:** L. Rogers

**Well/Boring ID:** MW-15016  
**Client:** Consumers Energy  
**Location:** JC Weadock Facility  
 2742 Weadock Highway  
 Essexville, MI 48732  
**Weather Conditions:** 55 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
585										
0		1	0.0-6.0'	6.0	NA			(0.0 - 0.1') GRASS and TOPSOIL.  (0.1 - 4.0') SAND, very fine to coarse; little granule; trace small pebbles, subrounded to subangular; poorly sorted; dry; gray (10YR 4/1).  NOTE: Trace clay at 2.0' bgs. NOTE: Wet at 2.5' bgs. NOTE: Trace organics, roots from 3.0 to 4.0' bgs.	2.5	
580								(4.0 - 5.5') SAND, very fine to fine; trace medium sand; trace organics, shell fragments; well sorted; wet; very dark gray (10YR 3/1).		
575		2	6.0-9.0'	6.0	NA			(5.5 - 9.0') CLAY, trace silt, medium plasticity; trace very fine to medium sand; trace organics, roots; moist to dry; medium stiff to stiff; gray (10YR 5/1).  NOTE: Loose trace organics at 6.0' bgs; little granule to small cobbles, subrounded to subangular from 6.0' to 9.0' bgs.		
10								End of boring 9.0' bgs.		

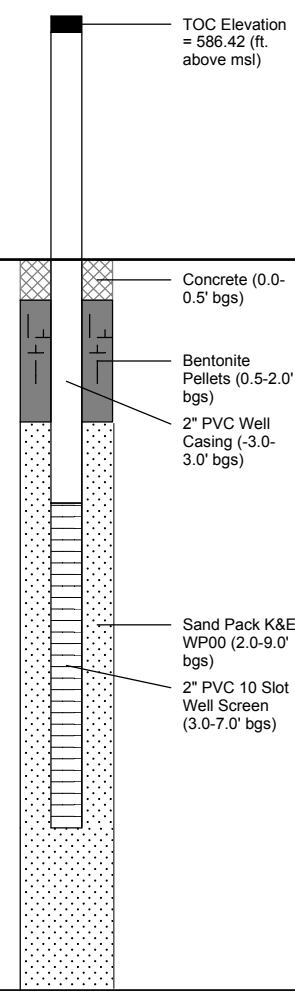


**Remarks:** bgs = below ground surface      btoc = below top of casing  
  
 Hand Auger to 6.0' bgs.  
 Groundwater encountered at 2.5' bgs during drilling.  
 Water level at development was 4.33' btoc.  
 No odor or staining observed.  
 Groundwater elevation measured on December 8, 2015 was 582.73 feet above mean sea level.

**Date Start:** 09/28/15  
**Date Finish:** 10/01/15  
**Drilling Company:** Stock Drilling  
**Driller's Name:** Austin Goldsmith  
**Drilling Method:** Hand Auger/Sonic  
**Sampling Method:** Continuous  
**Rig Type:** Sonic  
**Water Level Start (ft. bgs.):** 3.0  
**Water Level Finish (ft. btoc.):** 6.26

**Northing:** 777822.4  
**Easting:** 13263663.8  
**Casing Elevation:** 586.42  
  
**Borehole Depth (ft. bgs.):** 9.0  
**Surface Elevation:** 583.6  
  
**Descriptions By:** L. Rogers

**Well/Boring ID:** MW-15018  
**Client:** Consumers Energy  
  
**Location:** JC Weadock Facility  
 2742 Weadock Highway  
 Essexville, MI 48732  
  
**Weather Conditions:** 54 F

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
585										
0							(0.0 - 0.2') GRASS and TOPSOIL.			
580		1	0.0-6.0'	6.0	NA		(0.2 - 7.0') SAND, very fine to medium; trace coarse sand to granule, subrounded to subangular; dry; well sorted; dark yellowish brown (10YR 3/4).	NOTE: Moist at 2.0' bgs. NOTE: Wet at 3.0' bgs.	580.5	
575		2	6.0-9.0'	3.2	NA		(7.0 - 9.0') CLAY, medium plasticity; little granule to small pebbles, subrounded to subangular; trace silt; dry stiff; dark gray (10YR 4/1).	NOTE: Little peat and organics at 5.5' to 6.0' bgs. NOTE: Loose peat at 6.0' bgs.		
10							End of boring 9.0' bgs.			

**Remarks:** bgs = below ground surface      btoc = below top of casing  
  
 Hand Auger to 6.0' bgs.  
 Groundwater encountered at 3.0' bgs during drilling.  
 Water level at development was 6.26' btoc.  
 No odor or staining observed.  
 Groundwater elevation measured on December 8, 2015 was 580.5 feet above mean sea level.



**Date Start:** 10/01/15  
**Date Finish:** 10/01/15  
**Drilling Company:** Stock Drilling  
**Driller's Name:** Austin Goldsmith  
**Drilling Method:** Hand Auger/Sonic  
**Sampling Method:** Continuous  
**Rig Type:** Sonic  
**Water Level Start (ft. bgs.):** 3.0  
**Water Level Finish (ft. btoc.):** 6.02

**Northing:** 778024.1  
**Easting:** 13263504.9  
**Casing Elevation:** 586.17  
**Borehole Depth (ft. bgs.):** 19.0  
**Surface Elevation:** 583.5  
**Descriptions By:** L. Rogers

**Well/Boring ID:** MW-15019  
**Client:** Consumers Energy  
**Location:** JC Weadock Facility  
 2742 Weadock Highway  
 Essexville, MI 48732  
**Weather Conditions:** 55 F Windy

DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headpace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
585										TOC Elevation = 586.17 (ft. above msl)
0							(0.0 - 0.2') GRASS and TOPSOIL.			Concrete (0.0-1.5' bgs)
580		1	0.0-6.0'	6.0	NA		(0.2 - 2.0') SAND, fine to medium; little coarse to very coarse sand; trace granule to small pebbles, subrounded to subangular; dry; well sorted; dark brown (10YR 3/3).		6.02	2" PVC Well Casing (-3.0-4.0' bgs)
5							(2.0 - 7.5') SAND, very fine to medium; trace coarse sand; moist; well sorted; very dark brown (10YR 2/2).			Bentonite Pellets (1.5-3.0' bgs)
		2	6.0-9.0'	NA	NA		NOTE: Wet at 3.0' bgs. NOTE: Little coarse sand to granule, subrounded to subangular starting at 4.0' bgs.			
575							(7.5 - 14.5') SAND and CLAY, very fine to fine, high plasticity; trace medium sand; trace silt; moist to wet; well sorted; dark gray (10YR 4/1).			Sand Pack K&E WP00 (3.0-19.0' bgs)
10										2" PVC 10 Slot Well Screen (4.0-14.0' bgs)
570		3	9.0-19.0'	9.5	NA		(14.5 - 16.5') SAND, fine to coarse; little very coarse sand to granule; trace small pebbles, subrounded to subangular; well sorted; wet; dark gray (10YR 4/1).			
15							(16.5 - 19.0') SAND, very fine to fine; some clay; trace medium sand; well sorted; wet; dark gray (10YR 4/1).			
565										
20								End of boring 19.0' bgs.		

**Remarks:** bgs = below ground surface      btoc = below top of casing  
 Hand Auger to 6.0' bgs.  
 Groundwater encountered at 3.0' bgs during drilling.  
 Water level at development was 6.02' btoc.  
 No odor or staining observed.  
 Groundwater elevation measured on December 8, 2015 was 580.39 feet above mean sea level.



<b>Date Start:</b> 09/28/15 <b>Date Finish:</b> 10/01/15 <b>Drilling Company:</b> Stock Drilling <b>Driller's Name:</b> Austin Goldsmith <b>Drilling Method:</b> Hand Auger/Sonic <b>Sampling Method:</b> Continuous <b>Rig Type:</b> Sonic <b>Water Level Start (ft. bgs.):</b> 5.0 <b>Water Level Finish (ft. btoc.):</b> 5.41	<b>Northing:</b> 778708.4 <b>Easting:</b> 13263077.4 <b>Casing Elevation:</b> 585.95  <b>Borehole Depth (ft. bgs.):</b> 19.0 <b>Surface Elevation:</b> 582.5  <b>Descriptions By:</b> L. Rogers	<b>Well/Boring ID:</b> MW-15020  <b>Client:</b> Consumers Energy  <b>Location:</b> JC Weadock Facility 2742 Weadock Highway Essexville, MI 48732  <b>Weather Conditions:</b> 54 F Windy
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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
585										
0								(0.0 - 0.2') GRASS, TOPSOIL. and FRAGMENTES.		
580		1	0.0-6.0'	6.0	NA			(0.2 - 1.0') SAND, very fine to medium; trace coarse sand to granule, subrounded to subangular; trace roots; poorly sorted; moist; dark grayish brown (10YR 4/2).		
5								(1.0 - 19.0') SAND, very fine to fine; trace medium sand; well sorted; moist; dark yellowish brown (10YR 4/4).		
								NOTE: Color change to gray (10YR 5/1) at 2.0' bgs.		
								NOTE: Trace coarse sand; color change to very dark brown (10YR 2/2) at 4.0' bgs.		
								NOTE: Trace organics, shells; wet at 5.0' bgs.		
575		2	6.0-9.0'	3.5	NA			NOTE: Loose trace shells; color change to dark gray (10YR 4/1) at 6.0' bgs.		
10										
570										
15		3	9.0-19.0'	9.6	NA					
565										
20								End of boring 19.0' bgs.		





**Remarks:** bgs = below ground surface      btoc = below top of casing

Hand Auger to 6.0' bgs.  
 Groundwater encountered at 5.0' bgs during drilling.  
 Water level at development was 5.41' btoc.  
 No odor or staining observed.  
 Groundwater elevation measured on December 8, 2015 was 580.61 feet above mean sea level.

**Date Start:** 10/08/15  
**Date Finish:** 10/08/15  
**Drilling Company:** Stock Drilling  
**Driller's Name:** Austin Goldsmith  
**Drilling Method:** Hand Auger/Sonic  
**Sampling Method:** Continuous  
**Rig Type:** Sonic  
**Water Level Start (ft. bgs.):** 6.0  
**Water Level Finish (ft. btoc.):** 11.05

**Northing:** 780840.7  
**Easting:** 13265275.9  
**Casing Elevation:** 595.32  
**Borehole Depth (ft. bgs.):** 19.0  
**Surface Elevation:** 592.7  
**Descriptions By:** L. Rogers

**Well/Boring ID:** JCW MW-15023  
**Client:** Consumers Energy  
**Location:** JC Weadock Facility  
 2742 Weadock Highway  
 Essexville, MI 48732  
**Weather Conditions:** 43 F Partly 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
595										TOC Elevation = 595.32 (ft. above msl)
0								(0.0 - 6.0') Hydrovac; no lithology recorded.		Concrete (0.0-1.5' bgs)
590		1	0.0-6.0'	0.0	NA					2" PVC Well Casing (-3.0-13.0' bgs)
585		2	6.0-9.0'	3.2	NA		 (6.0 - 7.0') SAND, very fine to fine; trace medium sand; trace ash; trace organics, shells; wet; dark gray (10YR 4/1).  (7.0 - 11.5') CLAY, medium plasticity; little very fine to fine sand; trace medium sand to granule, subrounded to subangular; trace silt; dry; dark grayish brown (10YR 4/2).			Bentonite Pellets (0.3-12.0' bgs)
580		3	9.0-19.0'	NA	NA		 (11.5 - 18.0') SAND, very fine to medium; little coarse sand; trace very coarse sand; trace organics, shells; wet; well sorted; dark gray (10YR 4/1). NOTE: Color change to very dark gray (10YR 3/1) at 16.0' bgs.			Sand Pack K&E WP00 (12.0-19.0' bgs)
575							 (18.0 - 19.0') CLAY, low plasticity; trace fine sand to small pebbles, subrounded to subangular; dry; stiff; dark gray (10YR 4/1).			2" PVC 10 Slot Well Screen (13.0-18.0' bgs)
20								End of boring 19.0' bgs.		

**Remarks:** bgs = below ground surface      btoc = below top of casing  
 Hydrovac to 6.0' bgs.  
 Groundwater encountered at 6.0' bgs during drilling.  
 Water level at development was 11.05' btoc.  
 No odor or staining observed.  
 Groundwater elevation measured on December 8, 2015 was 584.17 feet above mean sea level.



**Date Start:** 10/08/15  
**Date Finish:** 10/08/15  
**Drilling Company:** Stock Drilling  
**Driller's Name:** Austin Goldsmith  
**Drilling Method:** Hand Auger/Sonic  
**Sampling Method:** Continuous  
**Rig Type:** Sonic  
**Water Level Start (ft. bgs.):** 5.0  
**Water Level Finish (ft. btoc.):** 6.4

**Northing:** 778249.1  
**Easting:** 13263347.9  
**Casing Elevation:** 586.56  
**Borehole Depth (ft. bgs.):** 19.5  
**Surface Elevation:** 583.7  
**Descriptions By:** L. Rogers

**Well/Boring ID:** MW-15024  
**Client:** Consumers Energy  
**Location:** JC Weadock Facility  
 2742 Weadock Highway  
 Essexville, MI 48732  
**Weather Conditions:** 61 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
585										TOC Elevation = 586.56 (ft. above msl)
0								(0.0 - 0.2') GRASS and TOPSOIL.		Concrete (0.0-1.5' bgs)
580		1	0.0-6.0'	6.0	NA			(0.2 - 1.0') CLAY, medium plasticity; trace fine to medium sand; trace granule to small cobbles, subrounded to subangular; dry; stiff; dark yellowish brown (10YR 4/6).		2" PVC Well Casing (-3.0-4.0' bgs)
5								(1.0 - 13.0') SAND, very fine to medium; trace coarse sand to small pebbles, subrounded to subangular; well sorted; moist; very dark gray brown (10YR 3/2).	5.0	Bentonite Pellets (1.5-3.0' bgs)
								NOTE: Loose trace small pebbles; change to trace coarse sand to granule; color change to black (10YR 2/1) at 3.0' bgs.		
								NOTE: Change to little coarse to very coarse sand with trace organics, shells; color change to very dark gray (10YR 3/1) at 4.0' bgs.		
								NOTE: Little shell fragments; wet at 5.0' bgs.		
575		2	6.0-9.5'	3.0	NA					Sand Pack K&E WP00 (3.0-19.5' bgs)
5										2" PVC 10 Slot Well Screen (4.0-14.0' bgs)
10								NOTE: Little coarse sand to small cobbles, subrounded from 10.0-13.0' bgs.		
570		3	9.5-19.5'	10.0	NA			(13.0 - 19.5') SAND, medium to very coarse; some granule to large cobbles, subrounded to subangular; poorly sorted; wet; dark gray (10YR 4/1).		
15										
565										
20								End of boring 19.5' bgs.		



**Remarks:** bgs = below ground surface      btoc = below top of casing  
 Hand Auger to 6.0' bgs.  
 Groundwater encountered at 5.0' bgs during drilling.  
 Water level at development was 6.4' btoc.  
 No odor or staining observed.  
 Groundwater elevation measured on December 8, 2015 was 580.27 feet above mean sea level.

**Date Start:** 04/26/2005  
**Date Finish:** 04/26/2005  
**Drilling Company:** Rau Drilling  
**Driller's Name:** Greg Compeau  
**Drilling Method:** Hollow Stem Auger  
**Sampling Method:** Continuous  
**Rig Type:** Auger  
**Water Level Start (ft. bgs.):** 2.0  
**Water Level Finish (ft. btoc.):** NA

**Northing:** 778601  
**Eastings:** 13263139  
**Casing Elevation:**  
**Borehole Depth (ft. bgs.):** 15.5  
**Surface Elevation:** 584.1  
**Descriptions By:** B Hennings (NRT, Inc.)

**Well/Boring ID:** MW-15027  
**Client:** Consumers Energy  
**Location:** JC Weadock Facility  
 2742 Weadock Highway  
 Essexville, MI 48732  
**Weather Conditions:** 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
585										
0		1	0.0-2.0'	1	NA	X		(0.0 - 1.0') CLAY, tan low plasticity lean clay, trace gravel and organics.		Concrete (0.0-1.0' bgs)
								(1.0 - 2.0') SAND, brown medium grained sand, trace fine gravel.		Bentonite (1.0-2.0' bgs)
580		2	2.0-4.0'	2	NA	X		(2.0 - 15.5') SAND, well graded, tan, wet, fine to coarse grained, sub-rounded sand composed of 90% quartz and 10% other lithic grains, trace shell fragments, mottled red-orange. NOTE: Sand becomes gray, no mottling.		
5		3	4.0-6.0'	1.6	NA	X		NOTE: Sand becomes medium grained, well graded with trace coarse sand.		
		4	6.0-8.0'	1.5	NA	X		NOTE: Sand becomes brown (10YR 5/3), 5% shell fragments, trace roots.		
575		5	8.0-10.0'	1.5	NA	X				Sand Pack (2.0-15.5' bgs)
10		6	10.0-12.0'	1.7	NA	X				2" Well Screen (5.0-15.0' bgs)
		7	12.0-14.0'	1.7	NA	X		NOTE: Sand becomes well-graded medium to coarse grained, 5% shell fragments, no roots.		
570		8	14.0-15.5'	1.7	NA	X				
15								End of boring 15.5' bgs.		




**Remarks:** bgs = below ground surface      btoc = below top of casing  
 Groundwater encountered at 2.0' bgs during drilling.  
 No odor or staining observed.




<b>Date Start:</b> 09/21/15 <b>Date Finish:</b> 09/21/15 <b>Drilling Company:</b> Stock Drilling <b>Driller's Name:</b> Austin Goldsmith <b>Drilling Method:</b> Hydrovac/Sonic <b>Sampling Method:</b> Continuous <b>Rig Type:</b> Sonic <b>Water Level Start (ft. bgs.):</b> NA <b>Water Level Finish (ft. btoc.):</b> NA	<b>Northing:</b> NA <b>Easting:</b> NA <b>Casing Elevation:</b> NA  <b>Borehole Depth (ft. bgs.):</b> 20.0 <b>Surface Elevation:</b> NA  <b>Descriptions By:</b> L. Rogers	<b>Well/Boring ID:</b> SB-15004  <b>Client:</b> Consumers Energy  <b>Location:</b> JC Weadock Facility 2742 Weadock Highway Essexville, MI 48732  <b>Weather Conditions:</b> 74 F Sunny
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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							(0.0 - 0.6') Hydrovac; no lithology recorded.		
5	-5	1	0.0-6.0'	0.0	NA					
10	-10	2	6.0-10.0'	7.5	NA	X		(6.0 - 6.5') Bottom ASH. NOTE: Fill material.  (6.5 - 20.0') CLAY, medium plasticity, no dilatancy; trace very fine to fine sand; trace granule to small cobble, subrounded to subangular; dry; stiff to very stiff; dark yellowish brown (10YR 4/6).		Borehole backfilled with soil cuttings.
15	-15	3	10.0-15.0'	7.5	NA			NOTE: color change to dark gray (10YR 4/1) at 13.5' bgs.		
20	-20	4	15.0-20.0'	9.0	NA					
20	-20							End of boring 20.0' bgs.		


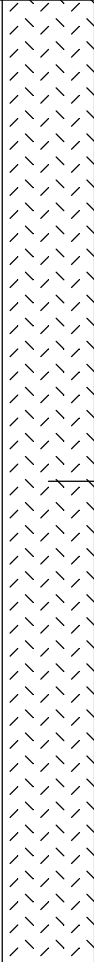


	<b>Remarks:</b> bgs = below ground surface      btoc = below top of casing
	Hydrovac to 6.0' bgs. Groundwater not encountered during drilling. No odor or staining observed.


<b>Date Start:</b> 09/21/15 <b>Date Finish:</b> 09/21/15 <b>Drilling Company:</b> Stock Drilling <b>Driller's Name:</b> Austin Goldsmith <b>Drilling Method:</b> Hydrovac/Sonic <b>Sampling Method:</b> Continuous <b>Rig Type:</b> Sonic <b>Water Level Start (ft. bgs.):</b> NA <b>Water Level Finish (ft. btoc.):</b> NA	<b>Northing:</b> NA <b>Easting:</b> NA <b>Casing Elevation:</b> NA  <b>Borehole Depth (ft. bgs.):</b> 20.0 <b>Surface Elevation:</b> NA  <b>Descriptions By:</b> L. Rogers	<b>Well/Boring ID:</b> SB-15005  <b>Client:</b> Consumers Energy  <b>Location:</b> JC Weadock Facility 2742 Weadock Highway Essexville, MI 48732  <b>Weather Conditions:</b> 70 F Sunny
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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							(0.0 - 6.0') Hydrovac; no lithology recorded.		
5	-5	1	0.0-6.0'	0.0	NA					
10	-10	2	6.0-10.0'	5.0	NA			(6.0 - 20.0') CLAY, medium plasticity, no dilatancy; trace very fine to fine sand; trace granule to small cobble, subrounded to subangular; dry; stiff to very stiff; dark yellowish brown (10YR 4/6).		Borehole backfilled with soil cuttings.
15	-15	3	10.0-15.0'	7.0	NA			NOTE: color change to dark gray (10YR 4/1) at 13.0' bgs.		
20	-20	4	15.0-20.0'	7.0	NA					
20	-20							End of boring 20.0' bgs.		



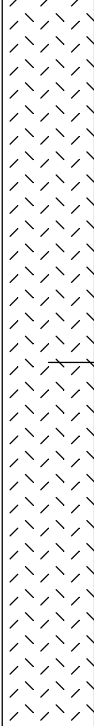


	<b>Remarks:</b> bgs = below ground surface      btoc = below top of casing
	Hydrovac to 6.0' bgs. Groundwater not encountered during drilling. No odor or staining observed.


<b>Date Start:</b> 09/30/15 <b>Date Finish:</b> 09/30/15 <b>Drilling Company:</b> Stock Drilling <b>Driller's Name:</b> Austin G. <b>Drilling Method:</b> Hydrovac/Sonic <b>Sampling Method:</b> Continuous <b>Rig Type:</b> Sonic <b>Water Level Start (ft. bgs.):</b> NA <b>Water Level Finish (ft. btoc.):</b> NA	<b>Northing:</b> NA <b>Easting:</b> NA <b>Casing Elevation:</b> NA  <b>Borehole Depth (ft. bgs.):</b> 19.0 <b>Surface Elevation:</b> NA  <b>Descriptions By:</b> L. Rogers	<b>Well/Boring ID:</b> JCW SB-15013  <b>Client:</b> Consumers Energy  <b>Location:</b> JC Weadock Facility 2742 Weadock Highway Essexville, MI 48732  <b>Weather Conditions:</b> 55 F Cloudy
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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							(0.0 - 6.0') Hydrovac; no lithology recorded.		
5	-5	1	0.0-6.0'	0.0	NA					
10	-10	2	6.0-9.0'	2.4	NA			(6.0 - 11.0') CLAY, medium to low plasticity; little fine to coarse sand; trace silt; trace granule to large pebbles, subrounded to subangular; dry; stiff; dark gray (10YR 4/1).  NOTE: Sand seam ~1", very coarse; poorly sorted; dry from 8.0-8.1' bgs.  NOTE: Clay; medium stiff to soft from 9.5 to 11.0' bgs.		 Borehole backfilled with soil cuttings.
15	-15	3	9.0-19.0'	9.5	NA		(11.0 - 16.5') Fly ASH and Clay mixture; moist; very soft; balck (10YR 2/1).			
20	-20						(16.5 - 19.0') CLAY, trace very fine to medium sand; trace granule to very large pebbles, subrounded to subangular; dry; very stiff to hard; dark gray (10YR 4/1).			
20	-20						End of boring 19.0' bgs.			

	<b>Remarks:</b> bgs = below ground surface  Hydrovac to 6.0' bgs. Groundwater not encountered. No odor or staining observed.
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<b>Date Start:</b> 10/01/15 <b>Date Finish:</b> 10/01/15 <b>Drilling Company:</b> Stock Drilling <b>Driller's Name:</b> Austin Goldsmith <b>Drilling Method:</b> Hand Auger/Sonic <b>Sampling Method:</b> Continuous <b>Rig Type:</b> Sonic <b>Water Level Start (ft. bgs.):</b> 3.0 <b>Water Level Finish (ft. btoc.):</b> NA	<b>Northing:</b> NA <b>Eastings:</b> NA <b>Casing Elevation:</b> NA  <b>Borehole Depth (ft. bgs.):</b> 9.0 <b>Surface Elevation:</b> NA  <b>Descriptions By:</b> L. Rogers	<b>Well/Boring ID:</b> SB-15017  <b>Client:</b> Consumers Energy  <b>Location:</b> JC Weadock Facility 2742 Weadock Highway Essexville, MI 48732  <b>Weather Conditions:</b> 51 F Cloudy, windy
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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							(0.0 - 0.1') TOPSOIL, GRASS and road GRAVEL.		
		1	0.0-6.0'	6.0	NA		 (0.1 - 1.0') SAND and ASH, very fine to medium pebbles, subrounded to subangular; poorly sorted; dry; dark brown (10YR 3/3). NOTE: Fill.  (1.0 - 5.0') CLAY, medium plasticity; little very fine to medium sand; trace coarse sand to small pebbles, subrounded to subangular; trace silt; trace ash; dry; medium stiff; brown (10YR 4/3). NOTE: Lose trace ash, clay becomes stiff; wet; dark grayish brown (10YR 4/2) at 3.0' bgs.		 Borehole backfilled with soil cuttings.	
-5	-5					 (5.0 - 6.0') PEAT; black (10YR 2/1).				
		2	6.0-9.0'	3.0	NA	 (6.0 - 9.0') CLAY, medium to low plasticity; little granule to small pebbles, subrounded to subangular; dry; stiff; dark grayish brown (10YR 4/2).				
-10	-10						End of boring 9.0' bgs.			

	<b>Remarks:</b> bgs = below ground surface      btoc = below top of casing
	Hydrovac to 6.0' bgs. Groundwater encountered at 3.0' bgs during drilling. No odor or staining observed.

# SOIL DESCRIPTION

Udden-Wenworth Scale Modified ARCADIS, 2008			
Size Class	Millimeters	Inches	Standard Sieve #
Boulder	256 – 4096	10.09+	
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	½ - 1	0.02 – 0.04	No.18 - No.35
Medium sand	¼ - ½	0.01 – 0.02	No.35 - No.60
Fine sand	1/8 -¼	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.
Medium	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.
High	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 ¼ 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	Particles have nearly plane sides but have well-rounded corners and edges.
Rounded	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 Logs







**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.  
JC Weadock Generating Facility  
Essexville, Michigan

**Photograph Taken By:**  
Lance Rogers

**Date of Photograph:**  
September 21, 2015



**Photograph #2**

**Description of Photograph:**  
View of the various soil types encountered during the monitoring well installation activities at the Site.

Consumers Energy Co.  
JC Weadock Generating Facility  
Essexville, Michigan

**Photograph Taken By:**  
Lance Rogers

**Date of Photograph:**  
October 8, 2015





**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.  
JC Weadock Generating Facility  
Essexville, Michigan

**Photograph Taken By:**  
Lance Rogers

**Date of Photograph:**  
September 21, 2015



**Photograph #2**

**Description of Photograph:**  
View of the various soil types encountered during the monitoring well installation activities at the Site.

Consumers Energy Co.  
JC Weadock Generating Facility  
Essexville, Michigan

**Photograph Taken By:**  
Lance Rogers

**Date of Photograph:**  
October 8, 2015



# APPENDIX C

## Hydraulic Test Logs



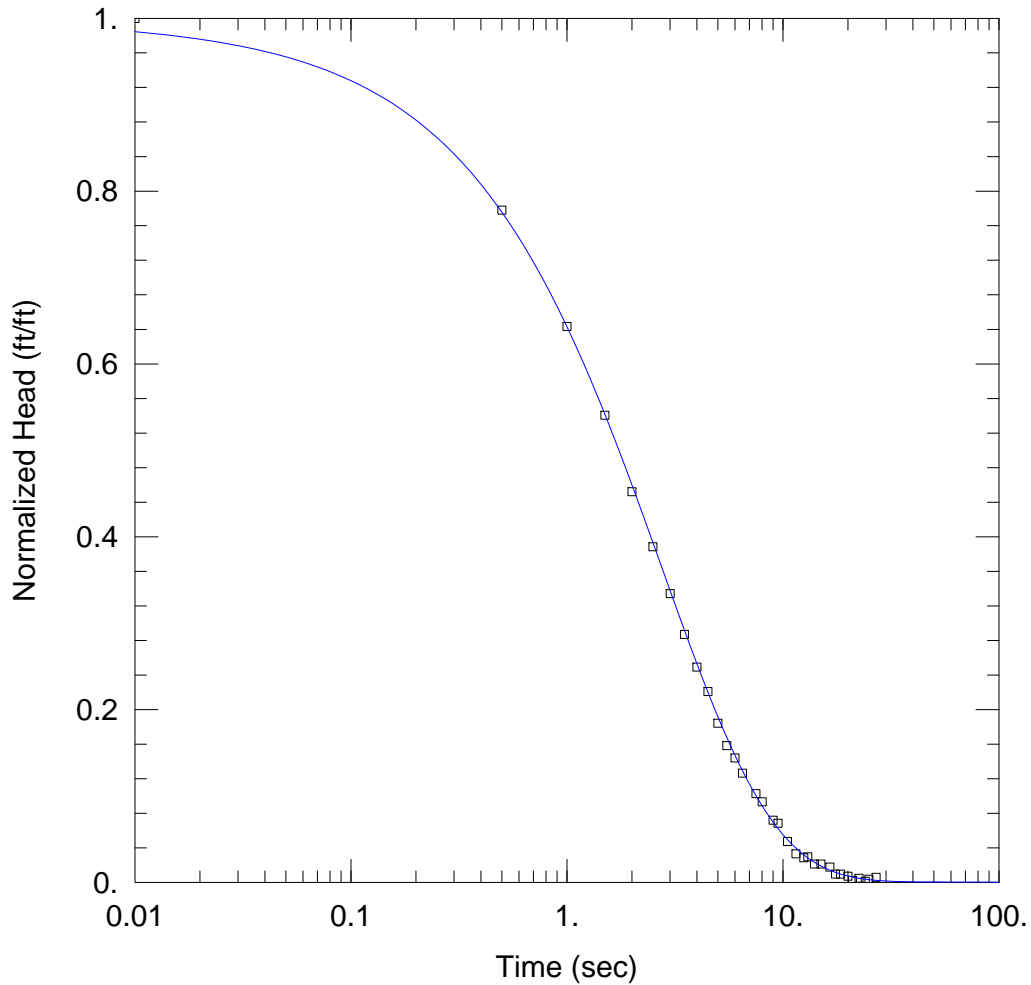
# Slug Test Analysis Results for JCW MW-15008 -Test 2

Prepared By:  
**Arcadis**

Prepared For:  
**Consumer Energy**

Project:

Location:  
**Essexville, MI**



## SOLUTION

Aquifer Model: Unconfined  
Solution Method: KGS Model

Kr = 30. ft/day      Ss = 5.2E-5 ft<sup>-1</sup>  
Kz/Kr = 1.

## AQUIFER DATA

Saturated Thickness: 27. ft

## WELL DATA (JCW MW-15008)

Initial Displacement: 0.847 ft  
Static Water Column Height: 12.81 ft  
Total Well Penetration Depth: 12.81 ft  
Screen Length: 10. ft  
Casing Radius: 0.083 ft  
Well Radius: 0.25 ft



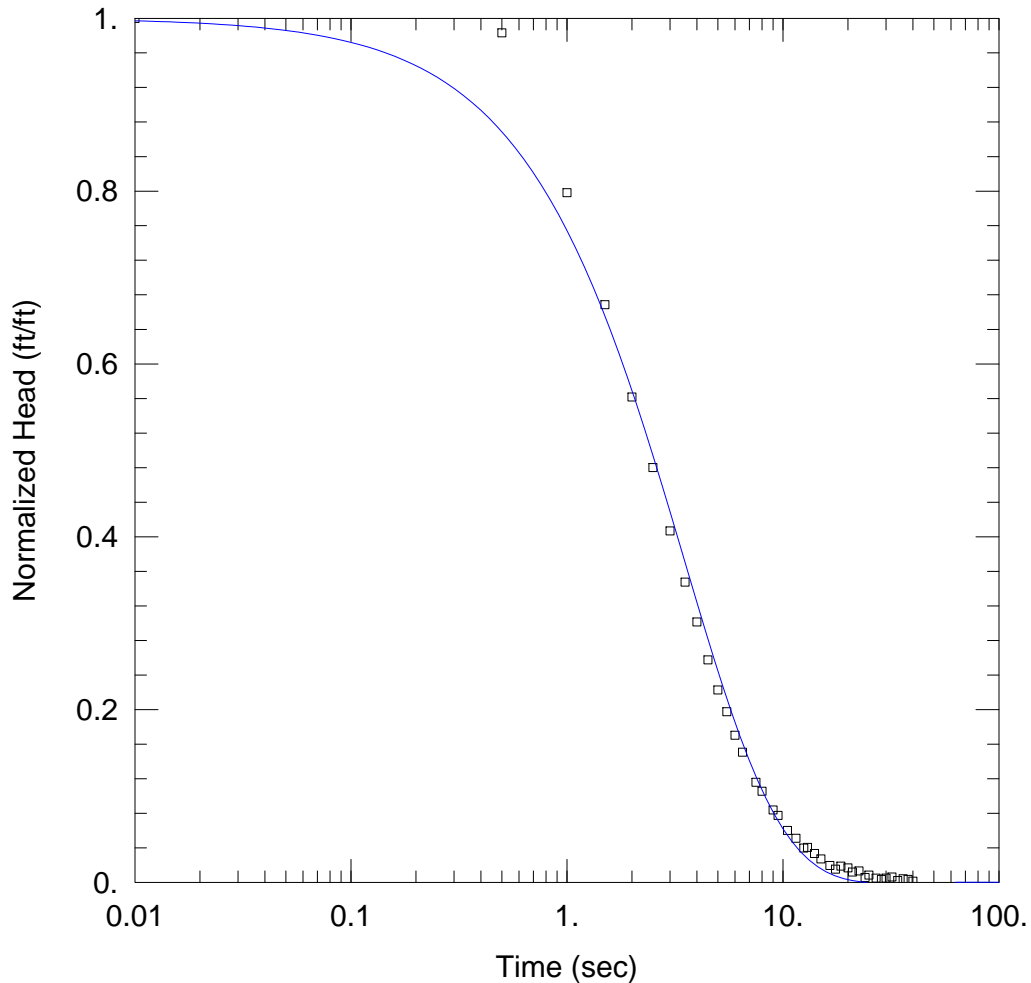
# Slug Test Analysis Results for JCW MW-15008 -Test 3

Prepared By:  
**Arcadis**

Prepared For:  
**Consumer Energy**

Project:

Location:  
**Essexville, MI**



## SOLUTION

Aquifer Model: Unconfined  
Solution Method: KGS Model

Kr = 26. ft/day      Ss = 2.2E-13 ft<sup>-1</sup>  
Kz/Kr = 1.

## AQUIFER DATA

Saturated Thickness: 27. ft

## WELL DATA (JCW MW-15008)

Initial Displacement: 1.433 ft  
Static Water Column Height: 12.81 ft  
Total Well Penetration Depth: 12.81 ft  
Screen Length: 10. ft  
Casing Radius: 0.083 ft  
Well Radius: 0.25 ft

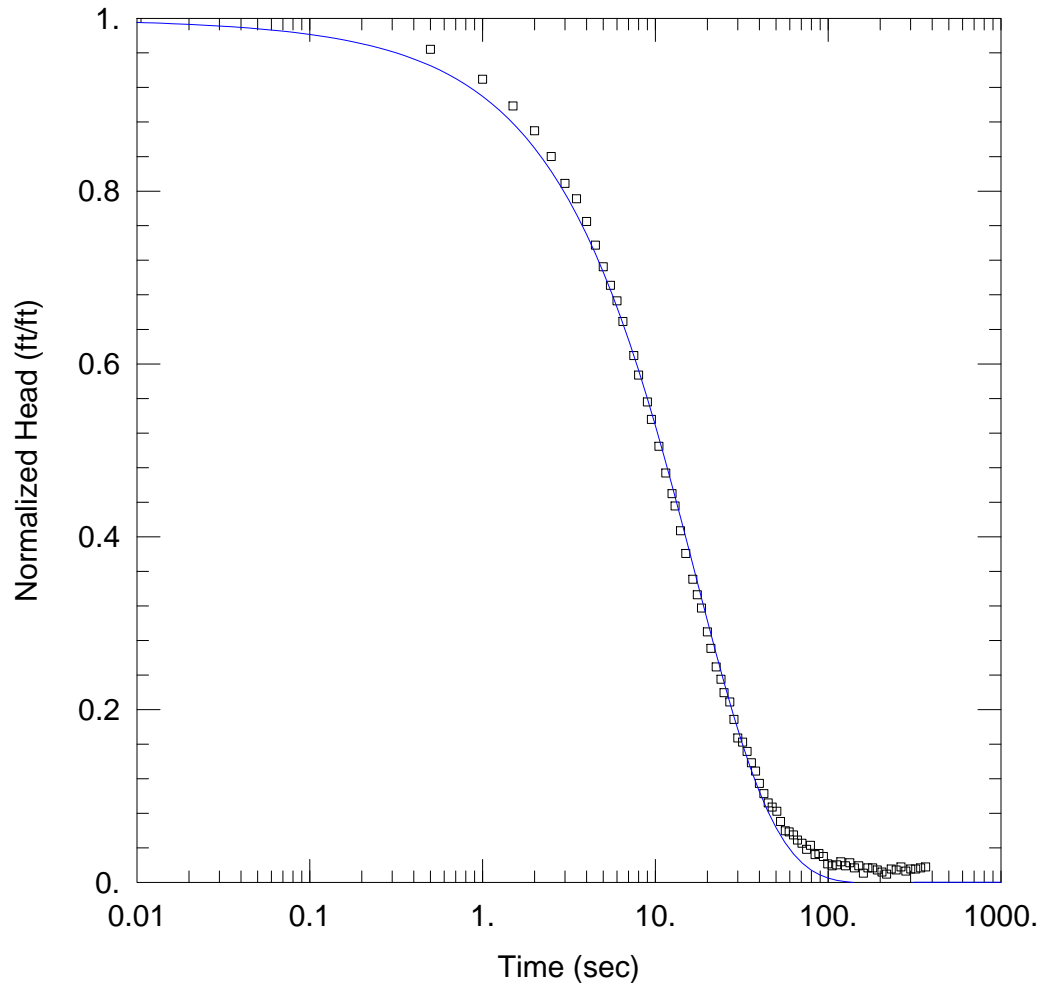
# Slug Test Analysis Results for JCW MW-15009 -Test 1

Prepared By:  
**Arcadis**

Prepared For:  
**Consumer Energy**

Project:

Location:  
**Essexville, MI**



## SOLUTION

Aquifer Model: Unconfined  
Solution Method: KGS Model

Kr = 8. ft/day      Ss = 0.00013 ft<sup>-1</sup>  
Kz/Kr = 1.

## AQUIFER DATA

Saturated Thickness: 22.46 ft

## WELL DATA (JCW MW-15009)

Initial Displacement: 0.838 ft  
Static Water Column Height: 4.46 ft  
Total Well Penetration Depth: 4.46 ft  
Screen Length: 4.46 ft  
Casing Radius: 0.083 ft  
Well Radius: 0.25 ft

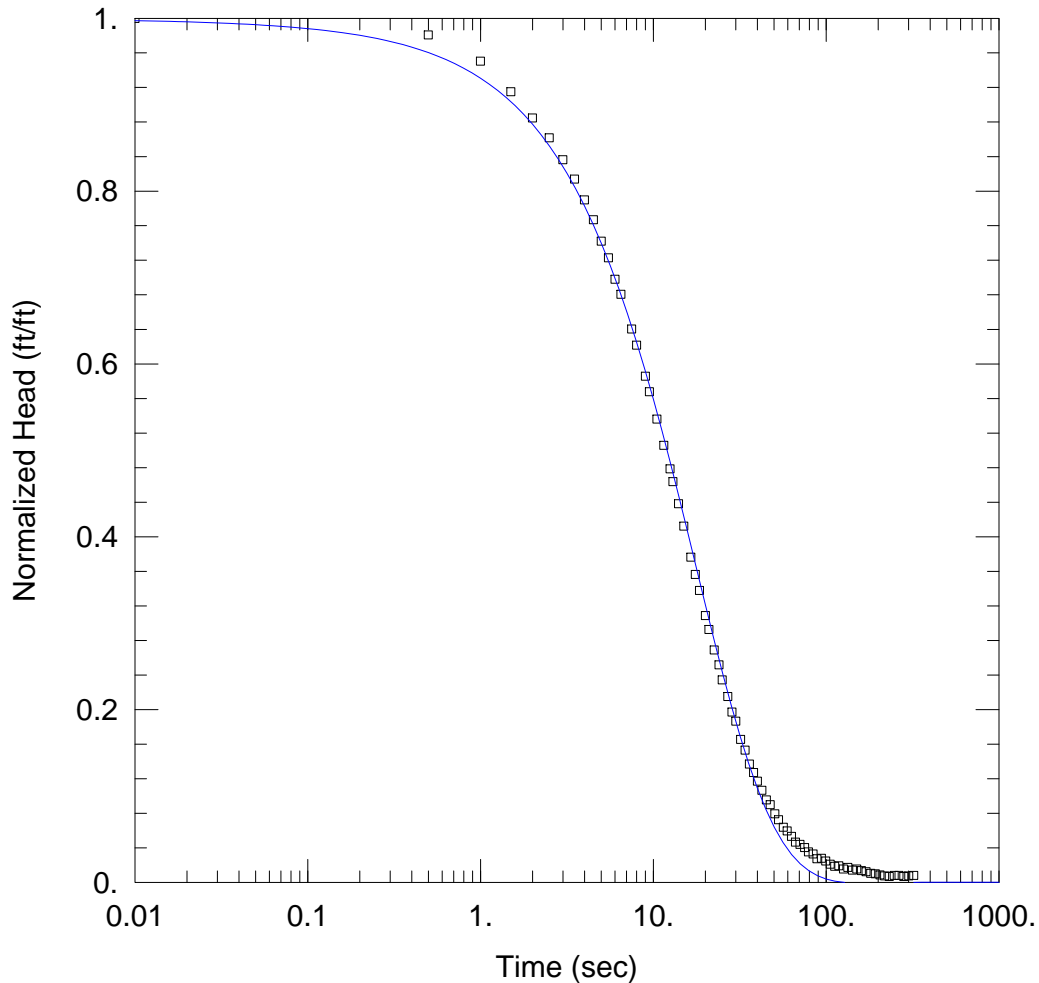
# Slug Test Analysis Results for JCW MW-15009 -Test 3

Prepared By:  
**Arcadis**

Prepared For:  
**Consumer Energy**

Project:

Location:  
**Essexville, MI**



## SOLUTION

Aquifer Model: Unconfined  
Solution Method: KGS Model

Kr = 7.7 ft/day      Ss = 3.4E-5 ft<sup>-1</sup>  
Kz/Kr = 1.

## AQUIFER DATA

Saturated Thickness: 22.46 ft

## WELL DATA (JCW MW-15009)

Initial Displacement: 1.613 ft  
Static Water Column Height: 4.46 ft  
Total Well Penetration Depth: 4.46 ft  
Screen Length: 4.46 ft  
Casing Radius: 0.083 ft  
Well Radius: 0.25 ft

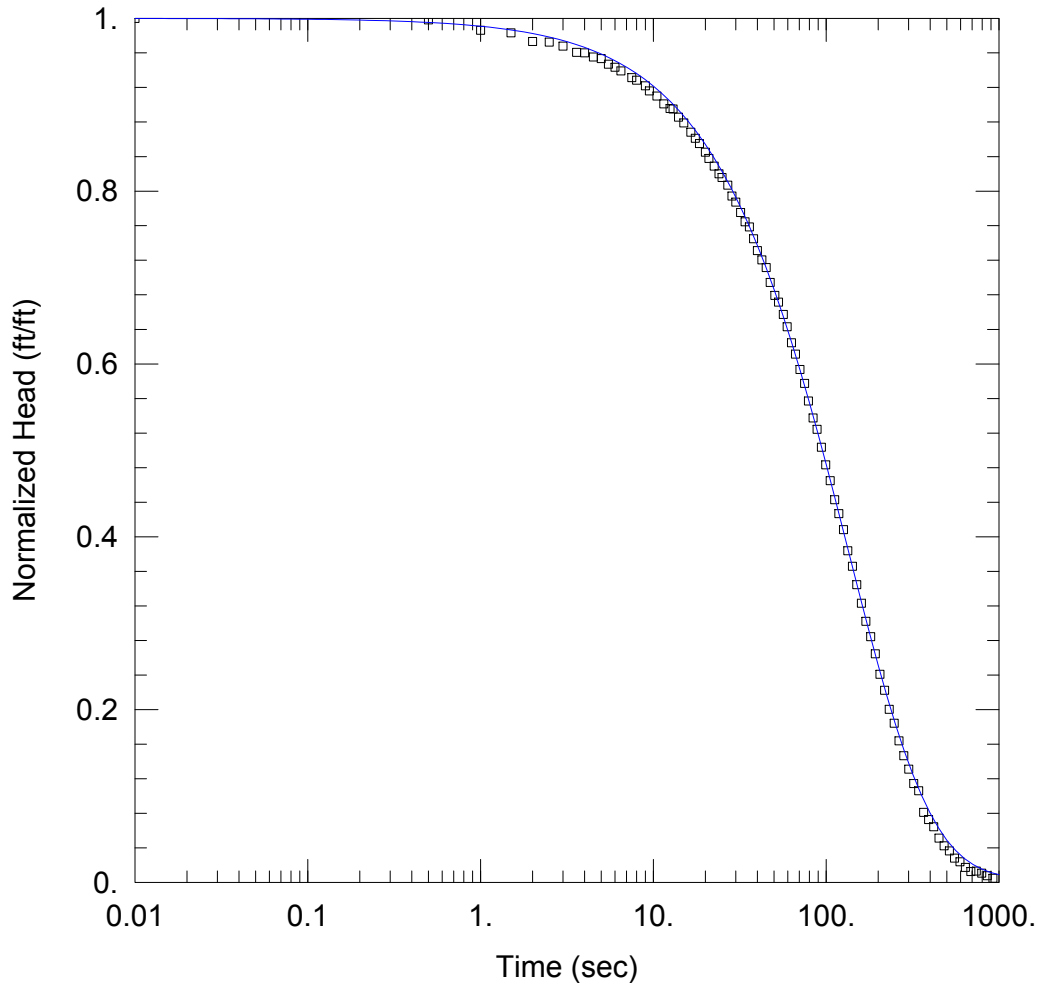
# Slug Test Analysis Results for JCW MW-15010 -Test 3

Prepared By:  
**Arcadis**

Prepared For:  
**Consumer Energy**

Project:

Location:  
**Essexville, MI**



## SOLUTION

Aquifer Model: Confined

Solution Method: KGS Model

Kr = 13. ft/day      Ss = 2.1E-11 ft<sup>-1</sup>

Kz/Kr = 1.

## AQUIFER DATA

Saturated Thickness: 2. ft

## WELL DATA (JCW MW-15010)

Initial Displacement: 1.678 ft

Static Water Column Height: 4.02 ft

Total Well Penetration Depth: 2. ft

Screen Length: 1.5 ft

Casing Radius: 0.083 ft

Well Radius: 0.25 ft

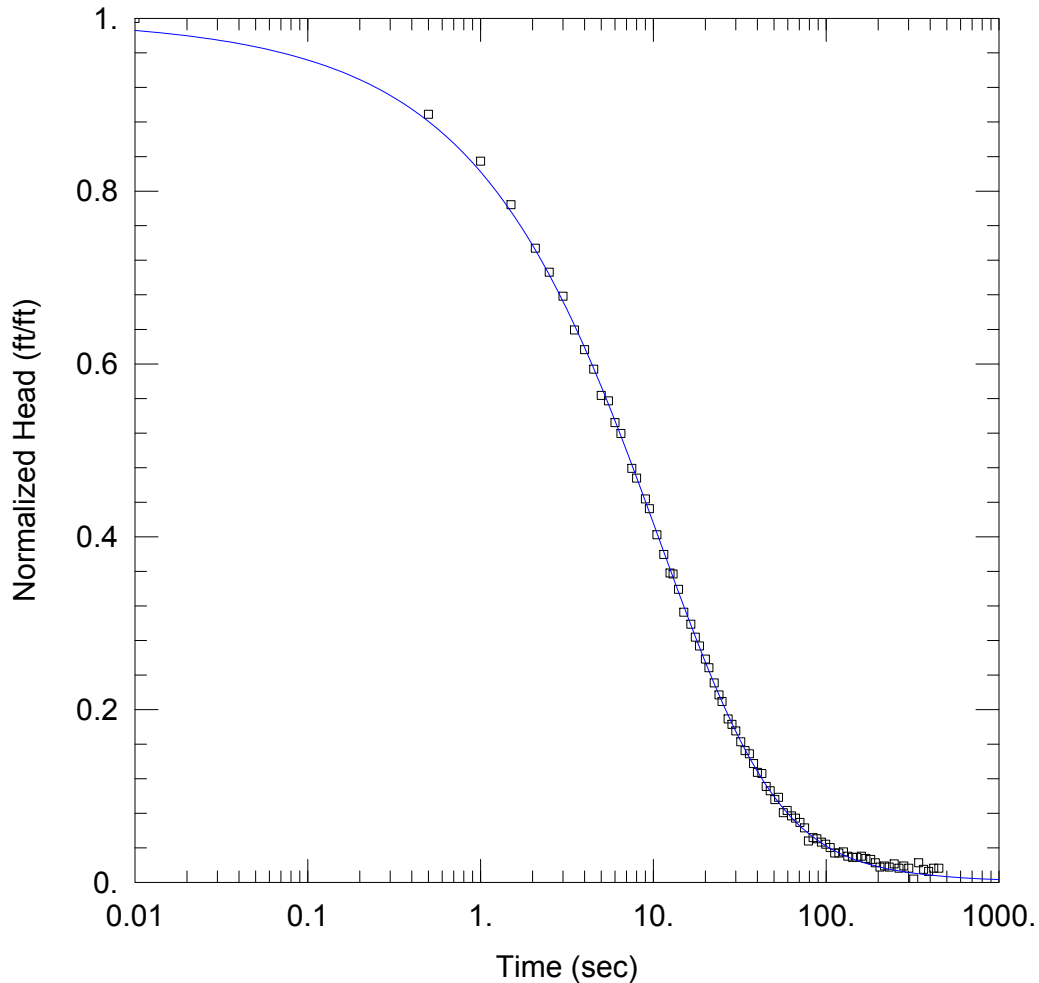
# Slug Test Analysis Results for JCW MW-15011 -Test 2

Prepared By:  
**Arcadis**

Prepared For:  
**Consumer Energy**

Project:

Location:  
**Essexville, MI**



## SOLUTION

Aquifer Model: Confined  
 Solution Method: Cooper-Bredehoeft-Papadopulos  
 $T = 49. \text{ ft}^2/\text{day}$        $S = 0.0047$

## AQUIFER DATA

Saturated Thickness: 5.83 ft

## WELL DATA (JCW MW-15011)

Initial Displacement: 0.793 ft  
 Static Water Column Height: 5.83 ft  
 Total Well Penetration Depth: 5.83 ft  
 Screen Length: 3.5 ft  
 Casing Radius: 0.083 ft  
 Well Radius: 0.25 ft

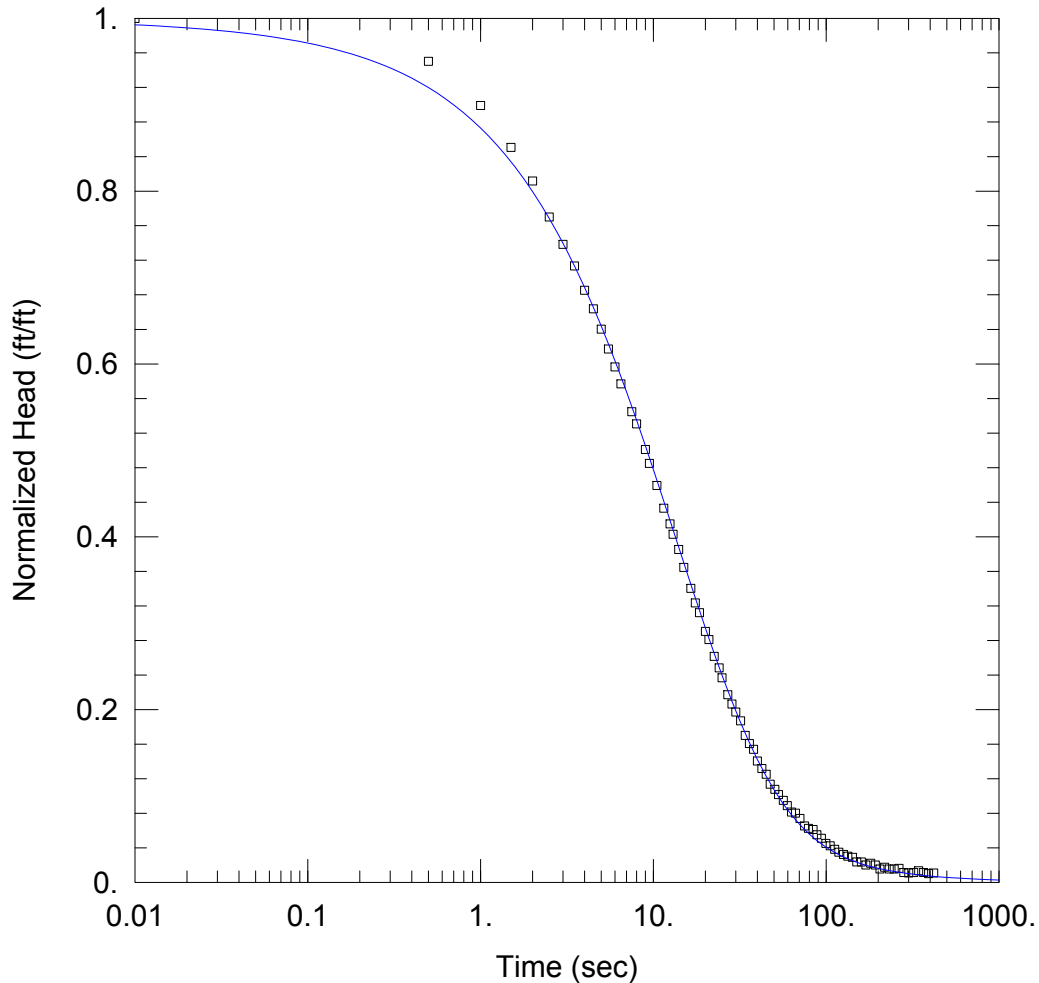
# Slug Test Analysis Results for JCW MW-15011 -Test 3

Prepared By:  
**Arcadis**

Prepared For:  
**Consumer Energy**

Project:

Location:  
**Essexville, MI**



## SOLUTION

Aquifer Model: Confined  
 Solution Method: Cooper-Bredehoeft-Papadopoulos  
 $T = 57. \text{ ft}^2/\text{day}$        $S = 0.00098$

## AQUIFER DATA

Saturated Thickness: 5.83 ft

## WELL DATA (JCW MW-15011)

Initial Displacement: 1.487 ft  
 Static Water Column Height: 5.83 ft  
 Total Well Penetration Depth: 5.83 ft  
 Screen Length: 3.5 ft  
 Casing Radius: 0.083 ft  
 Well Radius: 0.25 ft



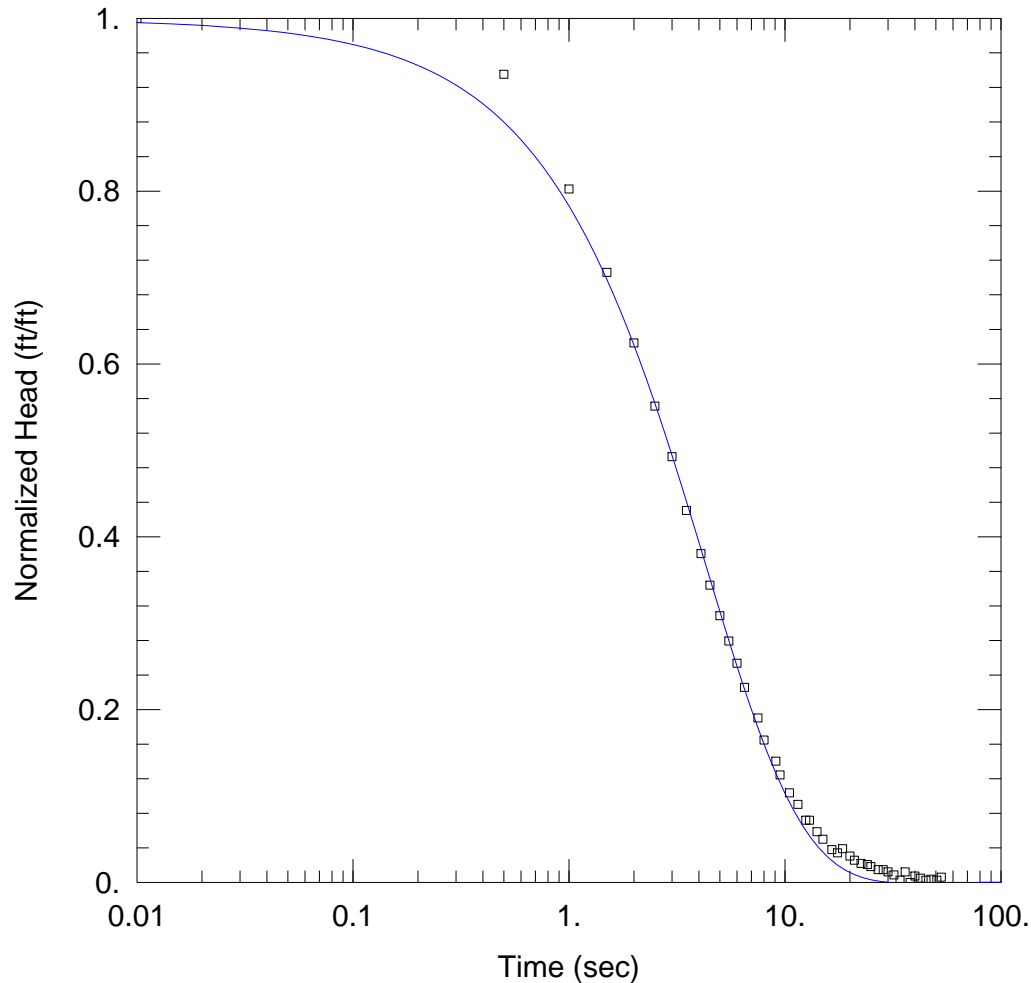
# Slug Test Analysis Results for JCW MW-15020 -Test 1

Prepared By:  
**Arcadis**

Prepared For:  
**Consumer Energy**

Project:

Location:  
**Essexville, MI**



## SOLUTION

Aquifer Model: Unconfined  
Solution Method: KGS Model

Kr = 21. ft/day      Ss = 2.6E-6 ft<sup>-1</sup>  
Kz/Kr = 1.

## AQUIFER DATA

Saturated Thickness: 29.55 ft

## WELL DATA (JCW MW-15020)

Initial Displacement: 0.82 ft  
Static Water Column Height: 12.05 ft  
Total Well Penetration Depth: 12.05 ft  
Screen Length: 10. ft  
Casing Radius: 0.083 ft  
Well Radius: 0.25 ft

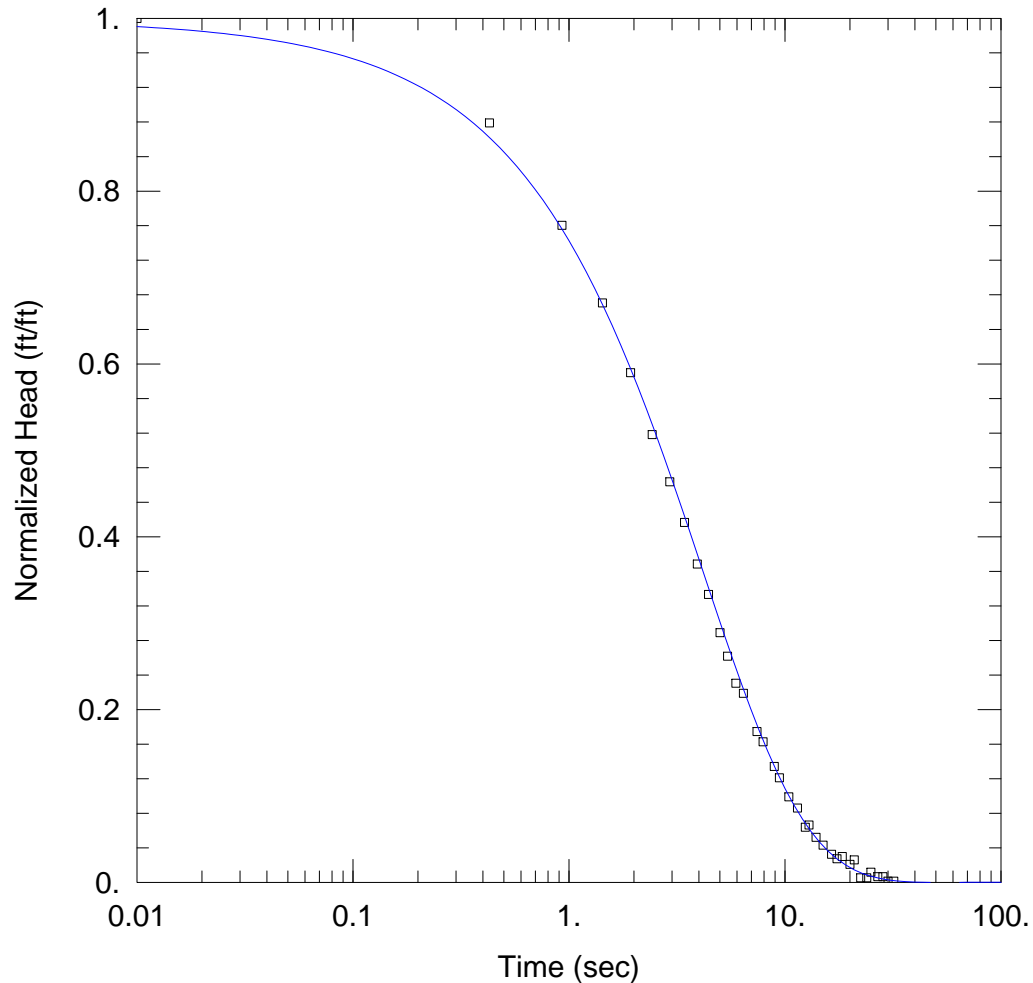
# Slug Test Analysis Results for JCW MW-15020 -Test 2

Prepared By:  
**Arcadis**

Prepared For:  
**Consumer Energy**

Project:

Location:  
**Essexville, MI**



## SOLUTION

Aquifer Model: Unconfined  
Solution Method: KGS Model

Kr = 21. ft/day      Ss = 2.5E-5 ft<sup>-1</sup>  
Kz/Kr = 1.

## AQUIFER DATA

Saturated Thickness: 29.55 ft

## WELL DATA (JCW MW-15020)

Initial Displacement: 0.768 ft  
Static Water Column Height: 12.05 ft  
Total Well Penetration Depth: 12.05 ft  
Screen Length: 10. ft  
Casing Radius: 0.083 ft  
Well Radius: 0.25 ft

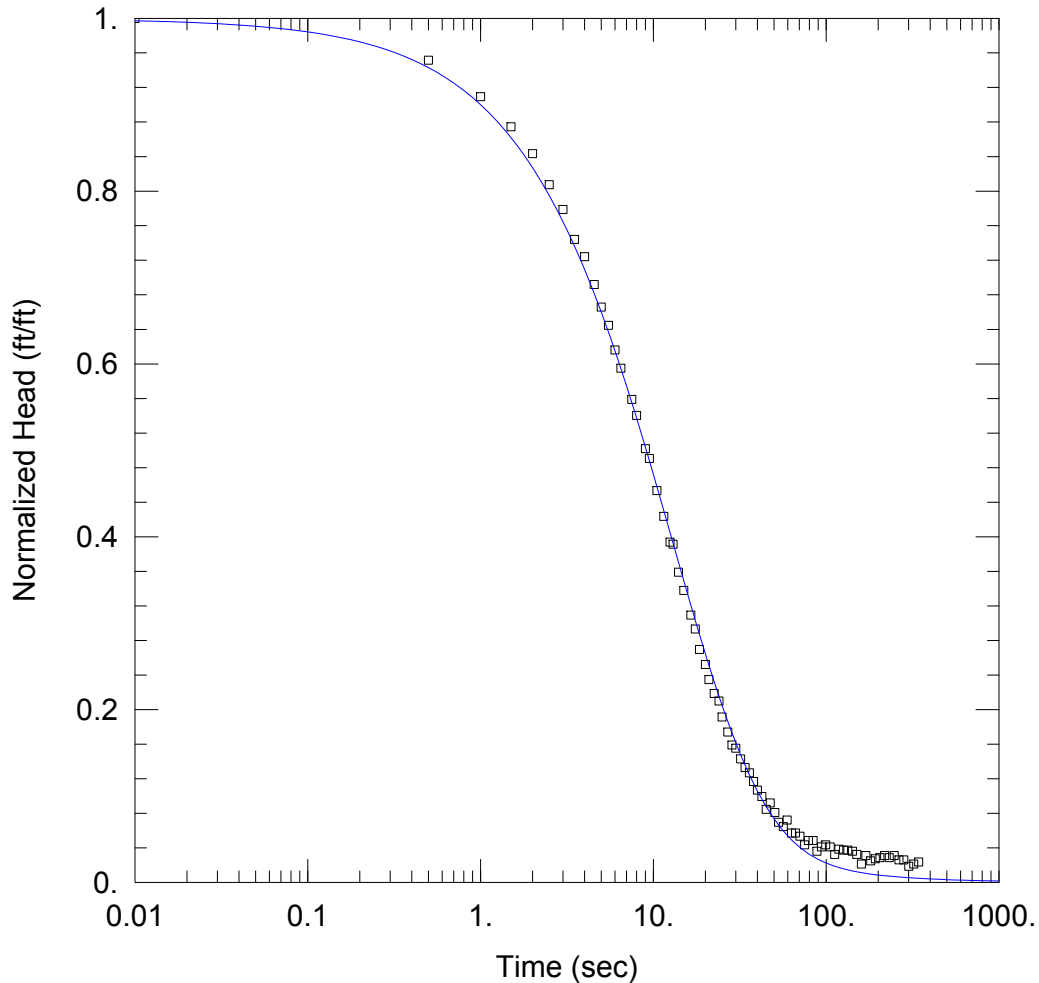
# Slug Test Analysis Results for JCW MW-15023 -Test 2

Prepared By:  
**Arcadis**

Prepared For:  
**Consumer Energy**

Project:

Location:  
**Essexville, MI**



## SOLUTION

Aquifer Model: Confined  
 Solution Method: Cooper-Bredehoeft-Papadopulos  
 $T = 104. \text{ ft}^2/\text{day}$        $S = 2.5\text{E-}5$

## AQUIFER DATA

Saturated Thickness: 6.5 ft

## WELL DATA (JCW MW-15023)

Initial Displacement: 0.805 ft  
 Static Water Column Height: 9.48 ft  
 Total Well Penetration Depth: 6.5 ft  
 Screen Length: 5. ft  
 Casing Radius: 0.083 ft  
 Well Radius: 0.25 ft

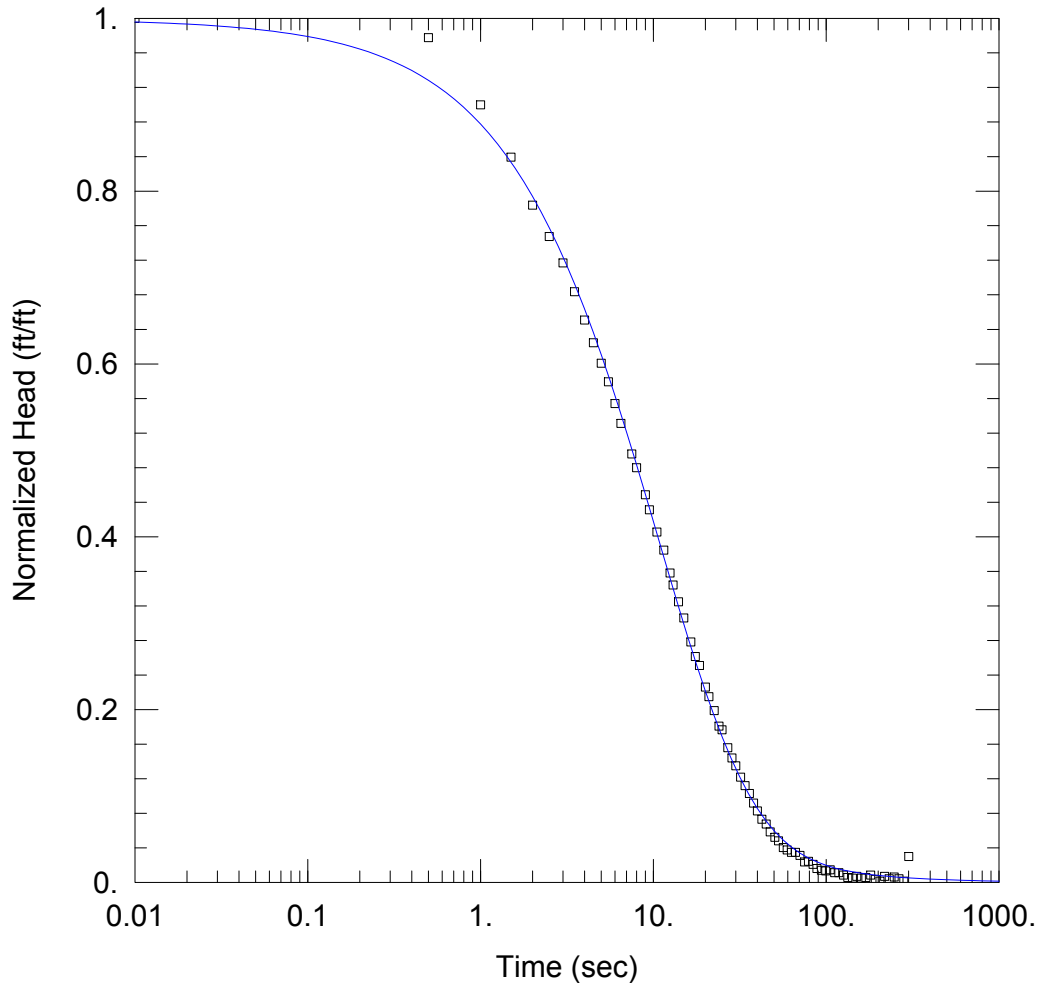
# Slug Test Analysis Results for JCW MW-15024 -Test 3

Prepared By:  
**Arcadis**

Prepared For:  
**Consumer Energy**

Project:

Location:  
**Essexville, MI**



## SOLUTION

Aquifer Model: Confined  
 Solution Method: Cooper-Bredehoeft-Papadopoulos  
 T = 107. ft<sup>2</sup>/day      S = 8.5E-5

## AQUIFER DATA

Saturated Thickness: 28.5 ft

## WELL DATA (JCW MW-15024)

Initial Displacement: 1.438 ft  
 Static Water Column Height: 11. ft  
 Total Well Penetration Depth: 11. ft  
 Screen Length: 10. ft  
 Casing Radius: 0.083 ft  
 Well Radius: 0.25 ft



Arcadis of Michigan, LLC

28550 Cabot Drive

Suite 500

Novi, Michigan 48377

Tel 248 994 2240

Fax 248 994 2241

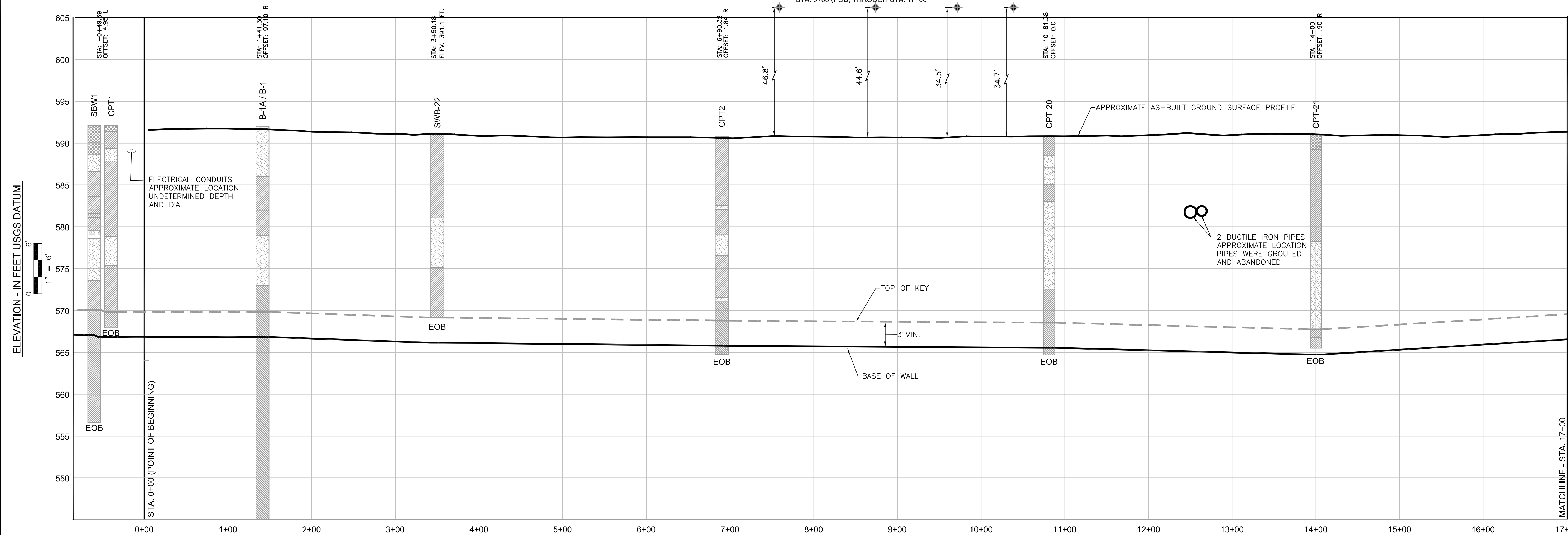
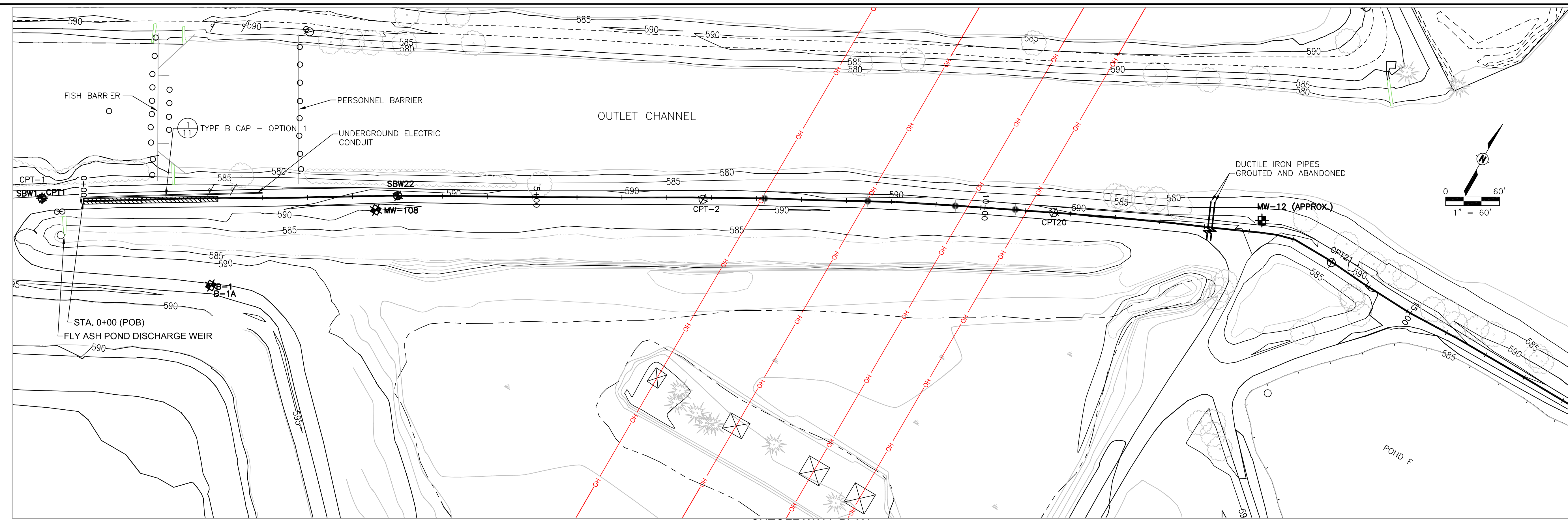
[www.arcadis.com](http://www.arcadis.com)

A decorative graphic consisting of three thin orange lines. One line is horizontal, extending across the width of the page. Two other lines are diagonal, starting from the bottom left and extending towards the top right, crossing the horizontal line.









**LEGEND**

	CLAY TILL		CPT BORING (BY STS)		OVERHEAD ELECTRICAL LINE (MAY NOT REPRESENT ALL LINES)
	ALLUVIAL CLAYEY SOILS		CONVENTIONAL ROTARY BORINGS (BY STS)		WOODEN UTILITY POLE LOCATION
	SANDY SOILS		MONITORING WELL (BY STS)		TRANSMISSION TOWER LOCATION
	ORGANIC		BORING (BY OTHERS)		SOIL- BENTONITE CUTOFF WALL
	FILL SOIL / BOTTOM ASH		OVERHEAD ELECTRICAL LINE (CROSSING WORK AREA) LOCATION		

**NOTES:**

- BORINGS PROJECTED IN PROFILE AND NOT NECESSARILY ON WALL ALIGNMENT.
- ELEVATIONS ARE REPORTED IN NAVD 88 DATUM IN FEET.
- TOPOGRAPHY BY ROWE INC. FROM AERIAL PHOTOGRAPHY FLOWN 04/16/2007.
- IN CASE OF MULTIPLE OVERHEAD LINES, SURVEY LINE IS LOWEST OF GROUP.

04/27/2009 ISSUED FOR RECORD

Rev	Date	Description
ISSUED	04/27/2009	
RECORD		

PROJECT NUMBER  
**200703855**  
SHEET REFERENCE NUMBER  
**C-03**

Reference 195-6909-24  
Reference 195-6909-33

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A	04/27/2009	GWO 1547 Weadock Slurry Wall Project - Submitted for Record	DAS	EHW	04/27/2009

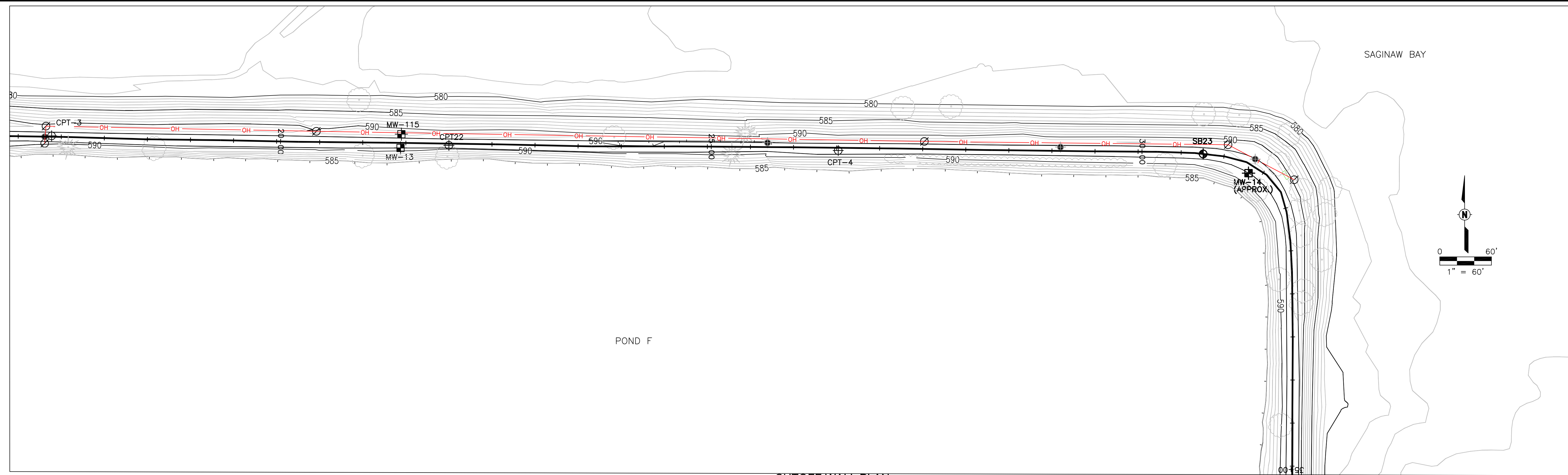


JC WEADOCK PLANT

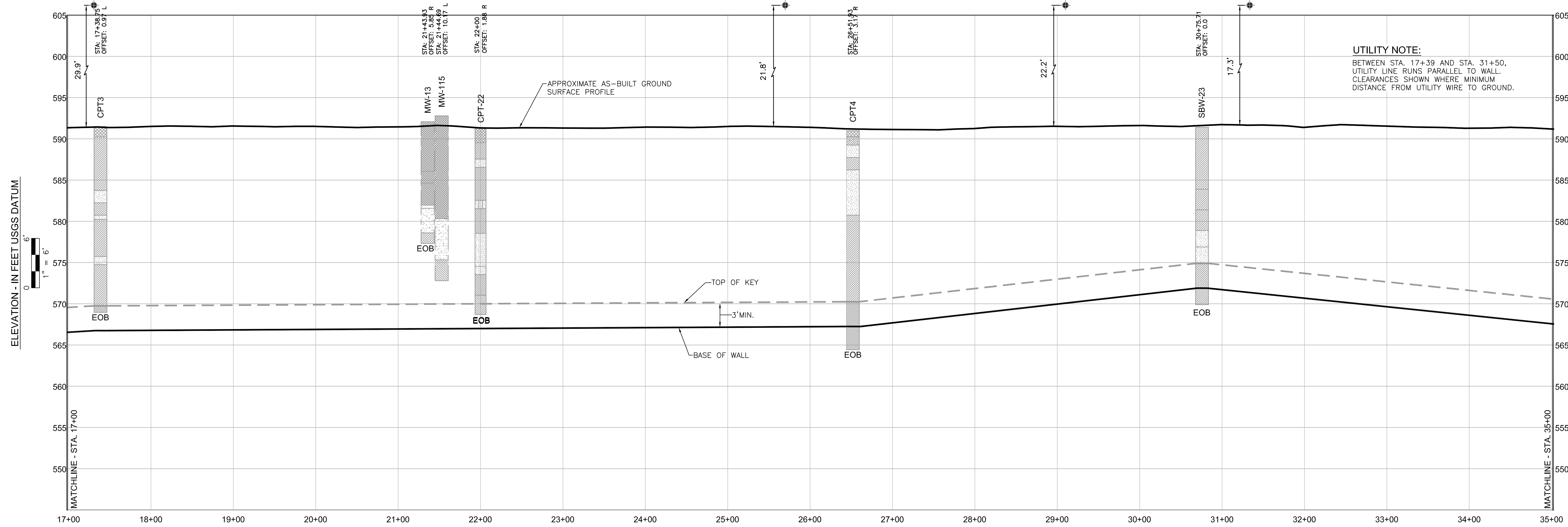
FLY ASH SLURRY WALL  
STA 0+00 TO STA 17+00  
WITH BORING DATA

SCALE	DRAWING NO.	SHEET	REV.
JOB	195-6909	SH25	A





CUTOFF WALL PLAN  
STA. 17+00 THROUGH STA. 35+00



CUTOFF WALL PROFILE  
STA. 17+00 THROUGH STA. 35+00

- LEGEND**
- CLAY TILL
  - ALLUVIAL CLAYEY SOILS
  - SANDY SOILS
  - ORGANIC
  - FILL SOIL / BOTTOM ASH
  - CPT (BY STS)
  - CONVENTIONAL ROTARY BORINGS (BY STS)
  - MONITORING WELL (BY STS)
  - BORING (BY OTHERS)
  - OVERHEAD ELECTRICAL LINE (CROSSING WORK AREA) LOCATION
  - OH OVERHEAD ELECTRIC LINE (MAY NOT REPRESENT ALL LINES)
  - WOODEN UTILITY POLE LOCATION
  - TRANSMISSION TOWER LOCATION
  - SOIL - BENTONITE CUTOFF WALL

- NOTES:**
- BORINGS PROJECTED IN PROFILE AND NOT NECESSARILY ON WALL ALIGNMENT.
  - ELEVATIONS ARE REPORTED IN NAVD 88 DATUM IN FEET.
  - TOPOGRAPHY BY ROWE INC. FROM AERIAL PHOTOGRAPHY FLOWN 04/16/2007.
  - IN CASE OF MULTIPLE OVERHEAD LINES, SURVEY LINE IS LOWEST OF GROUP.
- 04/27/2009 ISSUED FOR RECORD

STS | AECOM

3839 East Paris Ave, Suite 301  
Grand Rapids, MI 49512  
616-940-3077

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SOIL - BENTONITE CUTOFF WALL - RECORD DRAWINGS  
WEADOCK FLY ASH DISPOSAL AREA - STA. 17+00 THROUGH STA. 35+00  
CONSUMERS ENERGY COMPANY  
D.E. KARN AND J.C. WEADOCK GENERATING FACILITIES  
ESSEXVILLE, MICHIGAN

Issued

Rev	Date	Description
ISSUED	04/27/2009	FOR RECORD

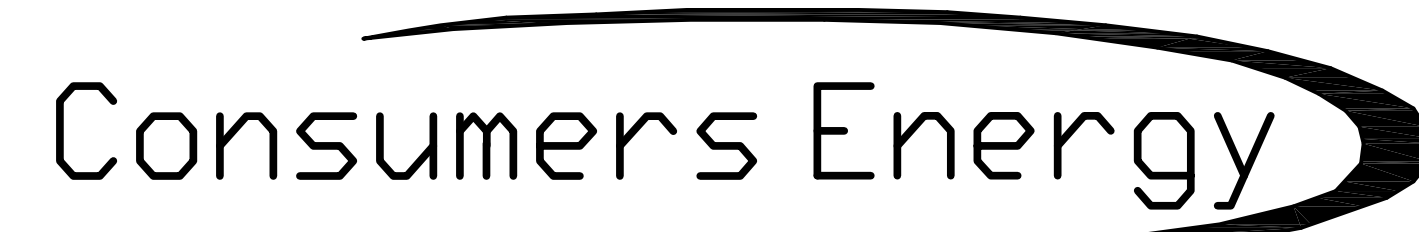
Designed: CF 10/03/2007  
Drawn: DAS 01/22/2009  
Checked: CF 01/22/2009  
Approved: JAT 01/26/2009

PROJECT NUMBER  
200703855  
SHEET REFERENCE NUMBER

C-04

Reference 195-6909-24  
Reference 195-6909-33

REV.	DATE	DESCRIPTION	BY	APP.	DATE
A	04/27/2009	GWO 1547 Weadock Slurry Wall Project - Submitted for Record	DAS	EHW	04/27/2009



JC WEADOCK PLANT

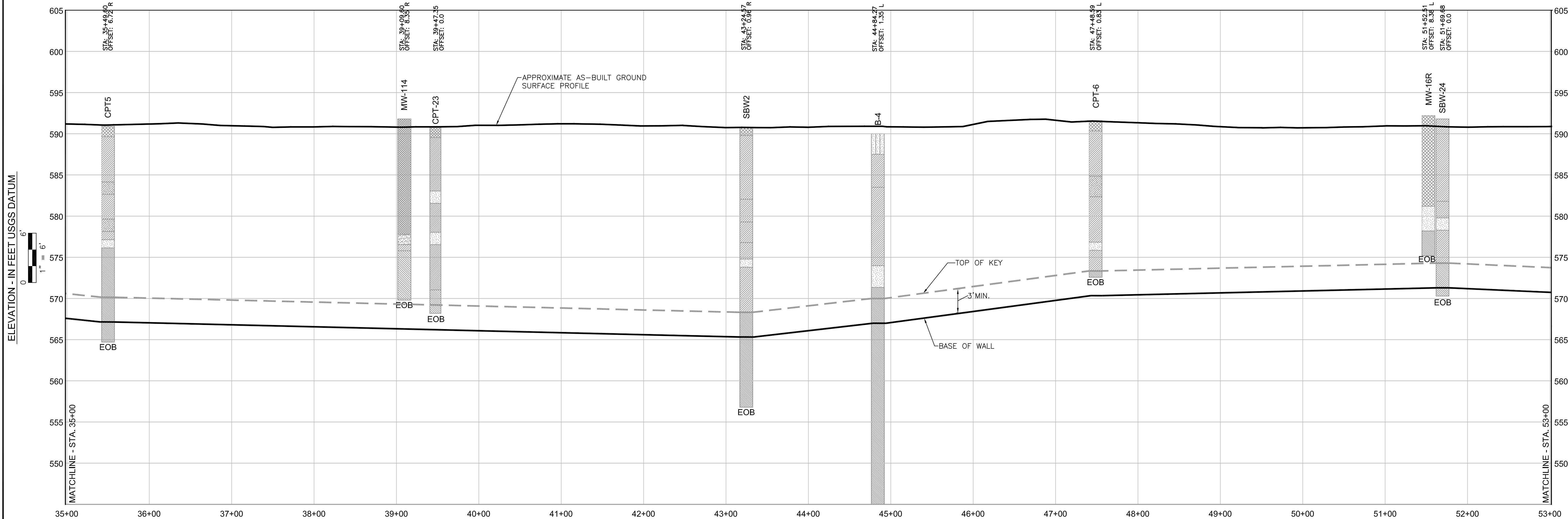
FLY ASH SLURRY WALL  
STA 17+00 TO STA 35+00  
WITH BORING DATA

SCALE	DRAWING NO.	SHEET	REV.
JDB	195-6909	SH26	A





CUTOFF WALL PLAN  
STA. 35+00 THROUGH STA. 53+00



CUTOFF WALL PROFILE  
STA. 35+00 THROUGH STA. 53+00

- LEGEND**
- CLAY TILL
  - ALLUVIAL CLAYEY SOILS
  - SANDY SOILS
  - ORGANIC
  - FILL SOIL / BOTTOM ASH
  - CPT BORING (BY STS)
  - CONVENTIONAL ROTARY BORINGS (BY STS)
  - MONITORING WELL (BY STS)
  - BORING (BY OTHERS)
  - OVERHEAD ELECTRICAL LINE (CROSSING WORK AREA) LOCATION
  - OVERHEAD ELECTRIC LINE (MAY NOT REPRESENT ALL LINES)
  - WOODEN UTILITY POLE LOCATION
  - TRANSMISSION TOWER LOCATION
  - SOIL - BENTONITE CUTOFF WALL

- NOTES:**
- BORINGS PROJECTED IN PROFILE AND NOT NECESSARILY ON WALL ALIGNMENT.
  - ELEVATIONS ARE REPORTED IN NAVD 88 DATUM IN FEET.
  - TOPOGRAPHY BY ROWE INC. FROM AERIAL PHOTOGRAPHY FLOWN 04/16/2007.
  - IN CASE OF MULTIPLE OVERHEAD LINES, SURVEY LINE IS LOWEST OF GROUP.
- 04/27/2009 ISSUED FOR RECORD

**STS | AECOM**

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Grand Rapids, MI, 49512

616-940-3077

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SOIL - BENTONITE CUTOFF WALL - RECORD DRAWINGS  
WEADOCK FLY ASH DISPOSAL AREA - STA. 35+00 THROUGH -STA. 53+00  
CONSUMERS ENERGY COMPANY  
D.E. KARN AND J.C. WEADOCK GENERATING FACILITIES  
ESSEXVILLE, MICHIGAN

Issued	
Rev	Date
ISSUED	04/27/2009
FOR RECORD	

PROJECT NUMBER  
**200703855**

SHEET REFERENCE NUMBER  
**C-05**

Reference 195-6909-24  
Reference 195-6909-33

REV.	DATE	DESCRIPTION	BY	APP.	DATE
A	04/27/2009	GWO 1547 Weadock Slurry Wall Project - Submitted for Record	DAS	EHW	04/27/2009



JC WEADOCK PLANT

FLY ASH SLURRY WALL  
STA 35+00 TO STA 53+00  
WITH BORING DATA

SCALE	DRAWING NO.	SHEET	REV.
JOB	195-6909	SH27	A



SOIL - BENTONITE CUTOFF WALL - RECORD DRAWINGS  
WEADOCK FLY ASH DISPOSAL AREA - STA. 53+00 THROUGH STA. 69+00  
CONSUMERS ENERGY COMPANY  
D.E. KARN AND J.C. WEADOCK GENERATING FACILITIES  
ESSEXVILLE, MICHIGAN

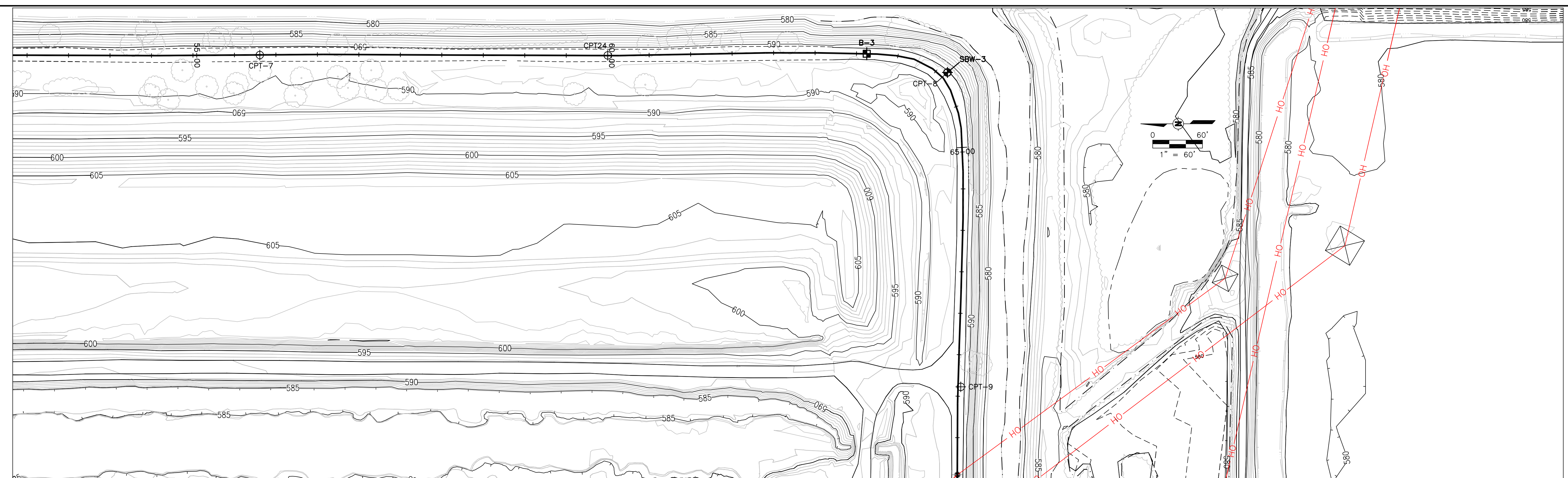
Issued

Rev	Date	Description
ISSUED	04/27/2009	FOR RECORD

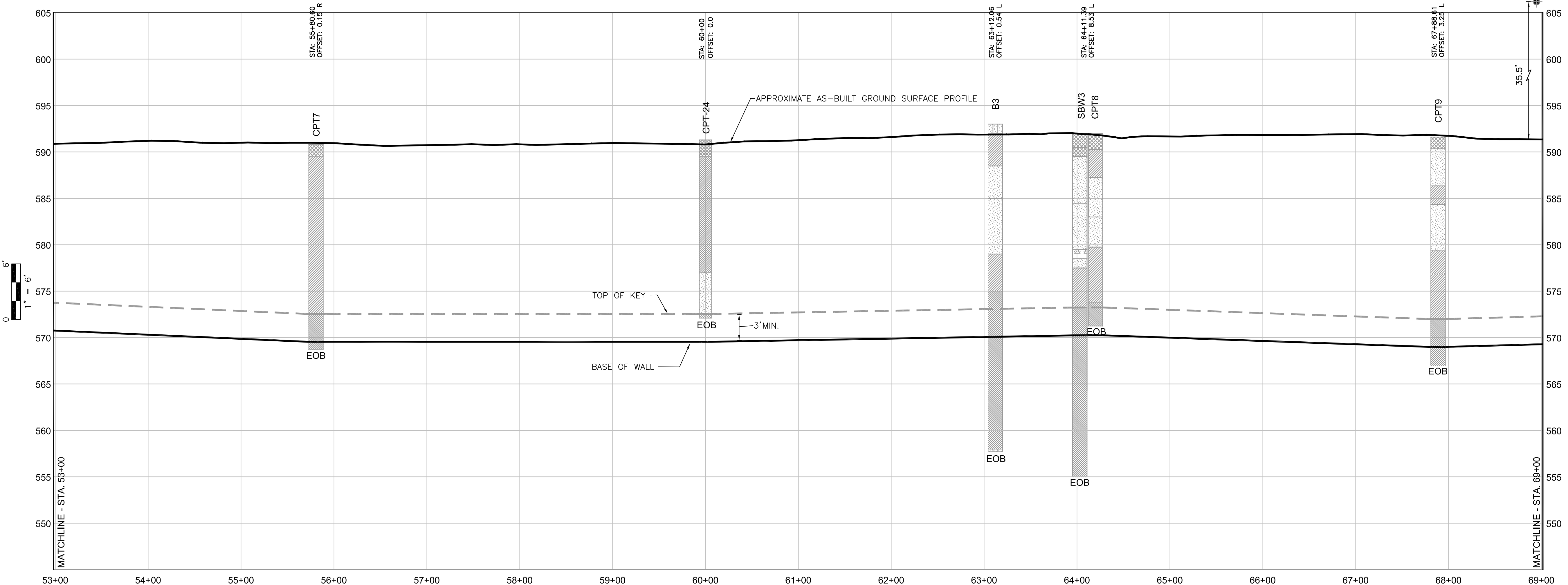
Designed: CF 10/03/2007  
Drawn: DAS 01/22/2009  
Checked: CF 01/22/2009  
Approved: JAT 01/26/2009

PROJECT NUMBER  
**200703855**  
SHEET REFERENCE NUMBER

**C-06**



CUTOFF WALL PLAN  
STA. 53+00 THROUGH STA. 69+00



CUTOFF WALL PROFILE  
STA. 53+00 THROUGH STA. 69+00

**LEGEND**

CLAY TILL	CPT ⊕ CPT BORING (BY STS)	OH ——— OVERHEAD ELECTRIC LINE (MAY NOT REPRESENT ALL LINES)
ALLUVIAL CLAYEY SOILS	SBW ⊕ CONVENTIONAL ROTARY BORINGS (BY STS)	□ WOODEN UTILITY POLE LOCATION
SANDY SOILS	MW ⊕ MONITORING WELL (BY STS)	⊠ TRANSMISSION TOWER LOCATION
ORGANIC	B ⊕ BORING (BY OTHERS)	——— SOIL - BENTONITE CUTOFF WALL
FILL SOIL / BOTTOM ASH	⊕ OVERHEAD ELECTRICAL LINE (CROSSING WORK AREA) LOCATION	

- NOTES:**
- BORINGS PROJECTED IN PROFILE AND NOT NECESSARILY ON WALL ALIGNMENT.
  - ELEVATIONS ARE REPORTED IN NAVD 88 DATUM IN FEET.
  - TOPOGRAPHY BY ROWE INC. FROM AERIAL PHOTOGRAPHY FLOWN 04/16/2007.
  - IN CASE OF MULTIPLE OVERHEAD LINES, SURVEY LINE IS LOWEST OF GROUP.
- 04/27/2009 ISSUED FOR RECORD

Reference 195-6909-24  
Reference 195-6909-33

REV.	DATE	DESCRIPTION	BY	APP.	DATE
A	04/27/2009	GWO 1547 Weadock Slurry Wall Project - Submitted for Record	DAS	EHW	04/27/2009

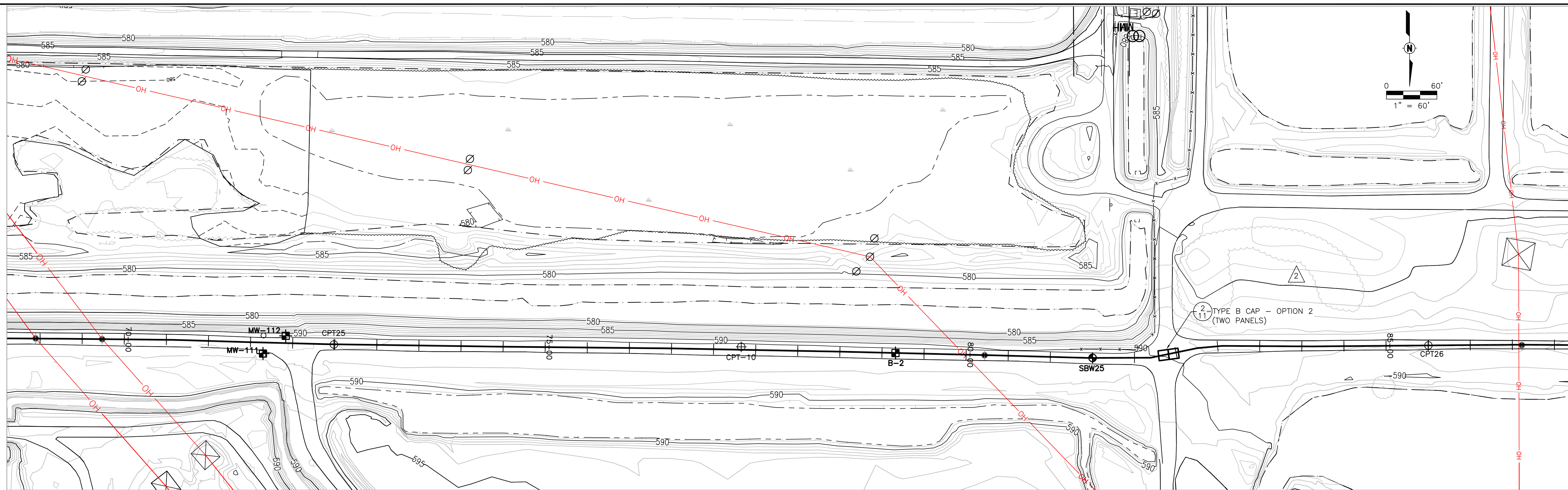


JC WEADOCK PLANT

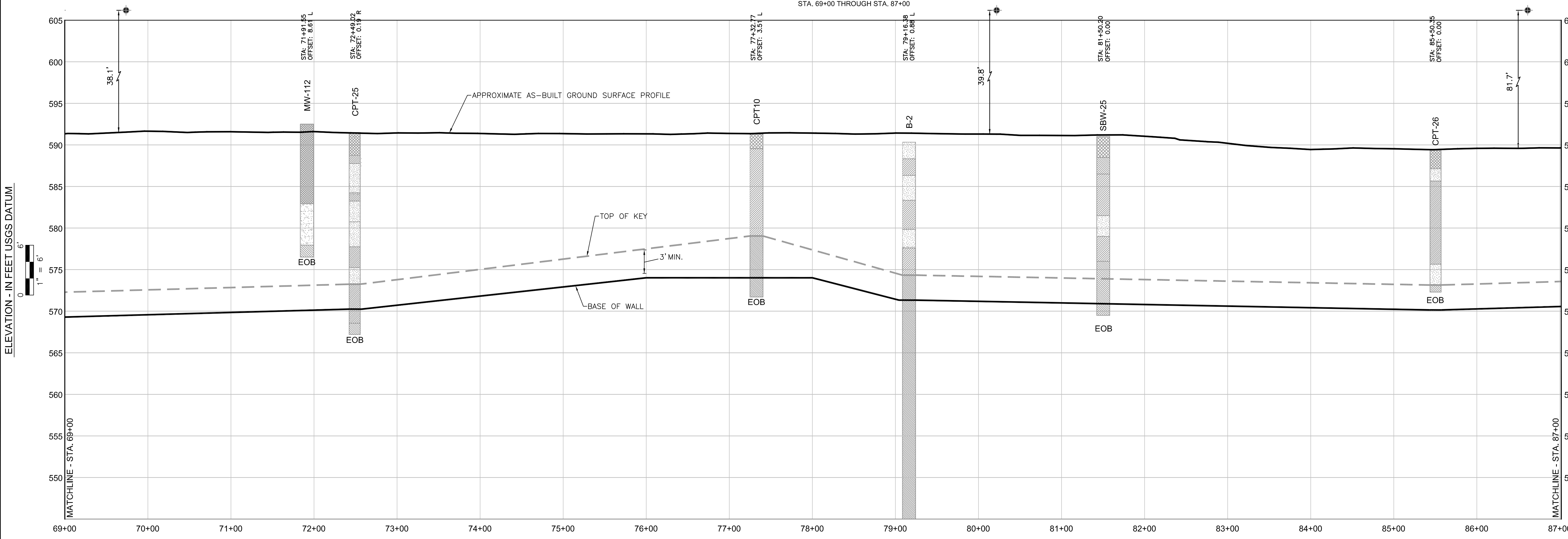
FLY ASH SLURRY WALL  
STA 53+00 TO STA 69+00  
WITH BORING DATA

SCALE	DRAWING NO.	SHEET	REV.
JDB	195-6909	SH28	A





CUTOFF WALL PLAN  
STA. 69+00 THROUGH STA. 87+00



CUTOFF WALL PROFILE  
STA. 69+00 THROUGH STA. 87+00

- LEGEND**
- CLAY TILL
  - ALLUVIAL CLAYEY SOILS
  - SANDY SOILS
  - ORGANIC
  - FILL SOIL / BOTTOM ASH
  - CPT BORING (BY STS)
  - CONVENTIONAL ROTARY BORINGS (BY STS)
  - MONITORING WELL (BY STS)
  - BORING (BY OTHERS)
  - OVERHEAD ELECTRICAL LINE (CROSSING WORK AREA) LOCATION
  - OVERHEAD ELECTRIC LINE (MAY NOT REPRESENT ALL LINES)
  - WOODEN UTILITY POLE LOCATION
  - TRANSMISSION TOWER LOCATION
  - SOIL-BENTONITE CUTOFF WALL

- NOTES:**
- BORINGS PROJECTED IN PROFILE AND NOT NECESSARILY ON WALL ALIGNMENT.
  - ELEVATIONS ARE REPORTED IN NAVD 88 DATUM IN FEET.
  - TOPOGRAPHY BY ROWE INC. FROM AERIAL PHOTOGRAPHY FLOWN 04/16/2007.
  - IN CASE OF MULTIPLE OVERHEAD LINES, SURVEY LINE IS LOWEST OF GROUP.
- 04/27/2009 ISSUED FOR RECORD

**Issued**

Rev	Date	Description
ISSUED FOR RECORD	04/27/2009	

Designed: CF 10/03/2007  
Drawn: DAS 01/22/2009  
Checked: CF 01/22/2009  
Approved: JAT 01/26/2009

PROJECT NUMBER  
**200703855**  
SHEET REFERENCE NUMBER  
**C-07**

Reference 195-6909-24  
Reference 195-6909-33



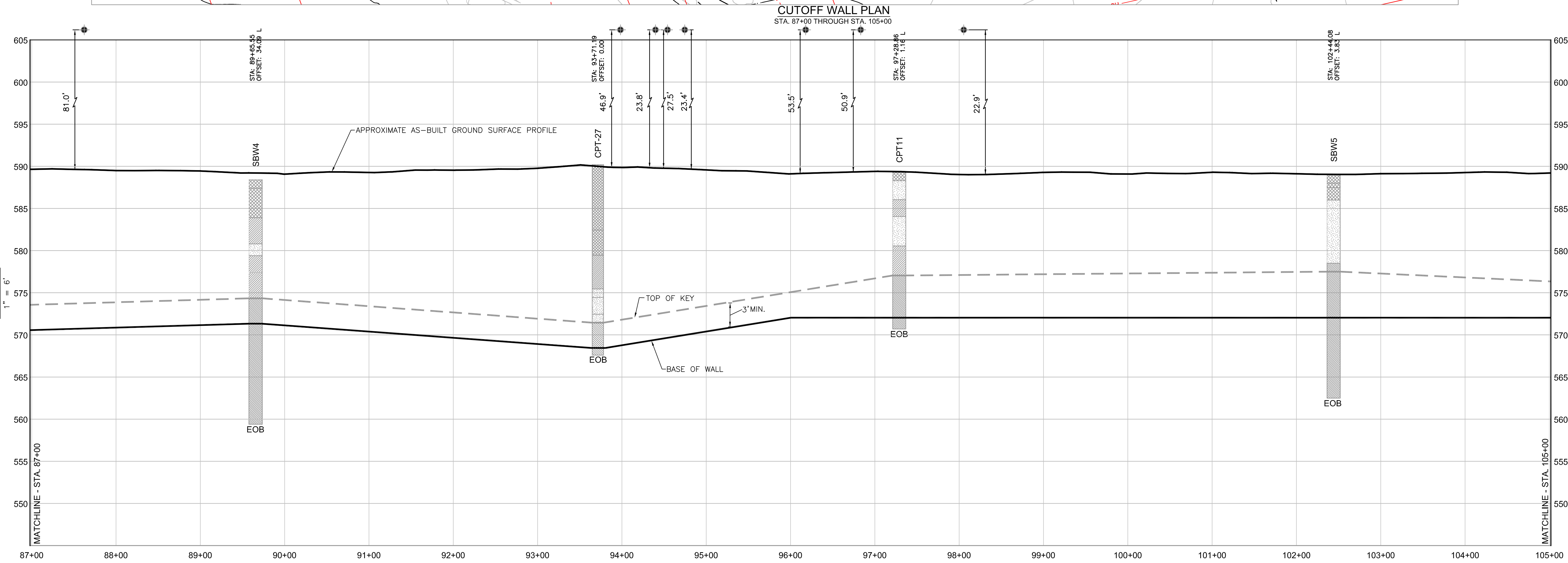
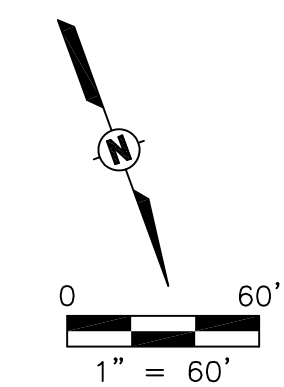
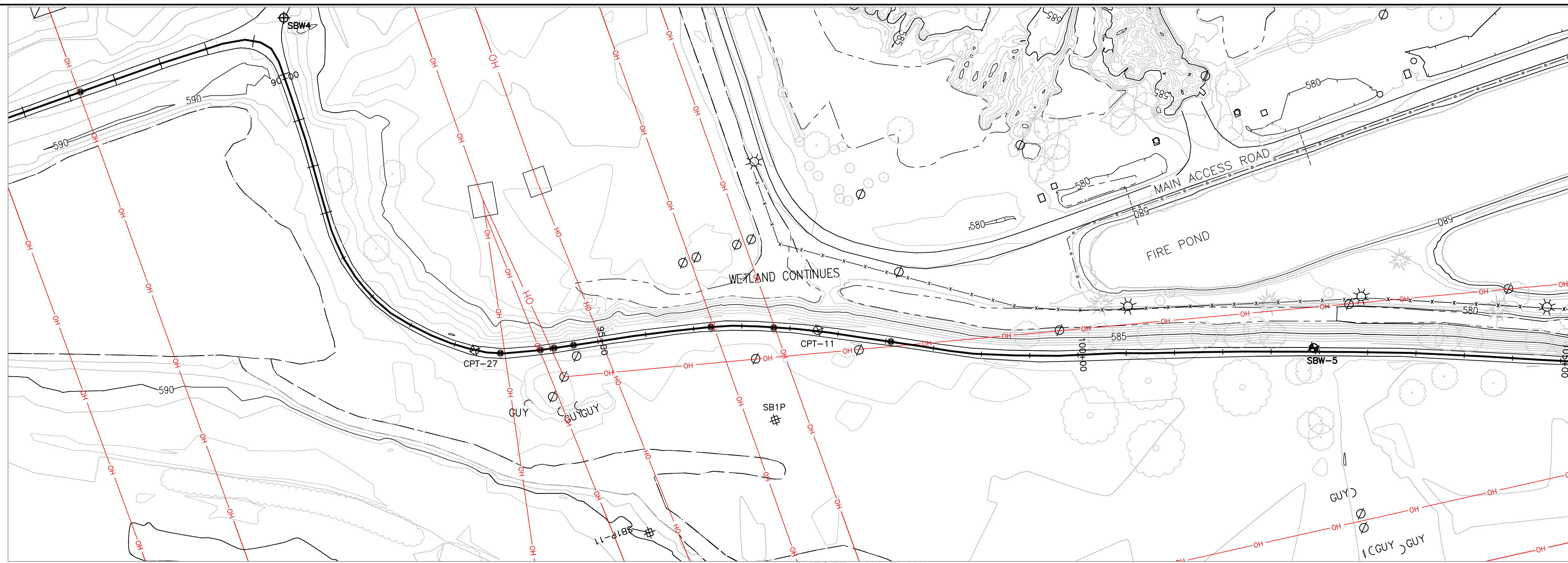
FLY ASH SLURRY WALL  
STA 69+00 TO STA 87+00  
WITH BORING DATA

REV.	DATE	DESCRIPTION	BY	APP.	DATE
A	04/27/2009	GWO 1547 Weadock Slurry Wall Project - Submitted for Record	DAS	EHW	04/27/2009

JC WEADOCK PLANT

SCALE	DRAWING NO.	SHEET	REV.
JOB	195-6909	SH29	A





- LEGEND**
- |                        |  |  |
|------------------------|--|--|
| CLAY TILL              | CPT BORING (BY STS)                                    | OVERHEAD ELECTRIC LINE (MAY NOT REPRESENT ALL LINES) |
| ALLUVIAL CLAYEY SOILS  | CONVENTIONAL ROTARY BORINGS (BY STS)                   | WOODEN UTILITY POLE LOCATION                         |
| SANDY SOILS            | MONITORING WELL (BY STS)                               | TRANSMISSION TOWER LOCATION                          |
| ORGANIC                | BORING (BY OTHERS)                                     | SOIL- BENTONITE CUTOFF WALL                          |
| FILL SOIL / BOTTOM ASH | OVERHEAD ELECTRICAL LINE (CROSSING WORK AREA) LOCATION |  |

- NOTES:**
- BORINGS PROJECTED IN PROFILE AND NOT NECESSARILY ON WALL ALIGNMENT.
  - ELEVATIONS ARE REPORTED IN NAVD 88 DATUM IN FEET.
  - TOPOGRAPHY BY ROWE INC. FROM AERIAL PHOTOGRAPHY FLOWN 04/16/2007.
  - IN CASE OF MULTIPLE OVERHEAD LINES, SURVEY LINE IS LOWEST OF GROUP.
- 04/27/2009 ISSUED FOR RECORD

Issued	
Rev	Date
ISSUED	04/27/2009
FOR RECORD	

PROJECT NUMBER  
**200703855**  
SHEET REFERENCE NUMBER

**C-08**

Reference 195-6909-24  
Reference 195-6909-33

REV.	DATE	DESCRIPTION	BY	APP.	DATE
A	04/27/2009	GWO 1547 Weadock Slurry Wall Project - Submitted for Record	DAS	EHW	04/27/2009

Consumers Energy

JC WEADOCK PLANT

FLY ASH SLURRY WALL  
STA 87+00 TO STA 105+00  
WITH BORING DATA

SCALE	DRAWING NO.	SHEET	REV.
JDB	195-6909	SH30	A



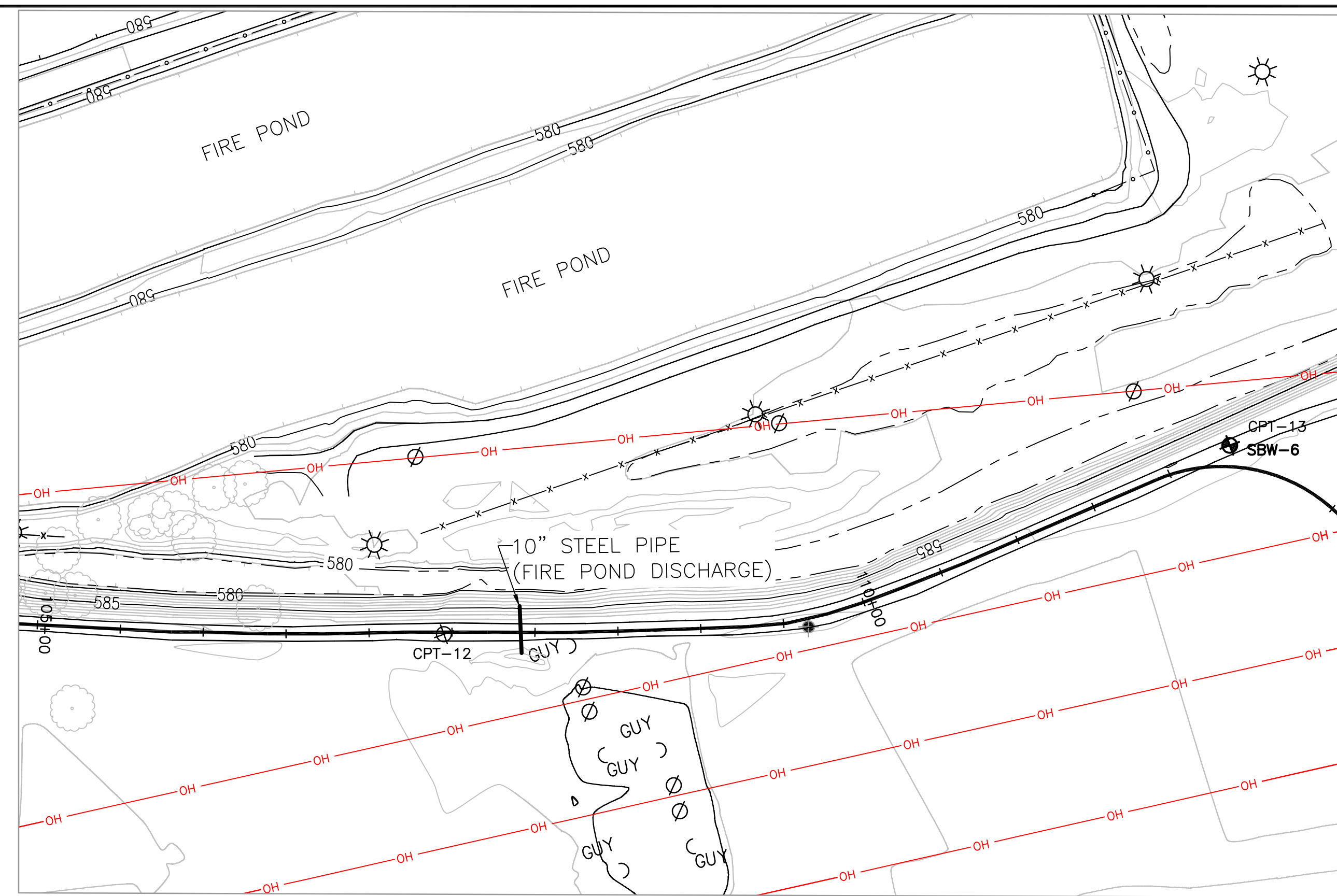
SOIL - BENTONITE CUTOFF WALL - RECORD DRAWINGS  
WEADOCK FLY ASH DISPOSAL AREA - STA. 105+00 THROUGH STA. 113+00  
CONSUMERS ENERGY COMPANY  
D.E. KARN AND J.C. WEADOCK GENERATING FACILITIES  
ESSEXVILLE, MICHIGAN

Issued	
Rev	Date
ISSUED	
FOR RECORD	04/27/2009

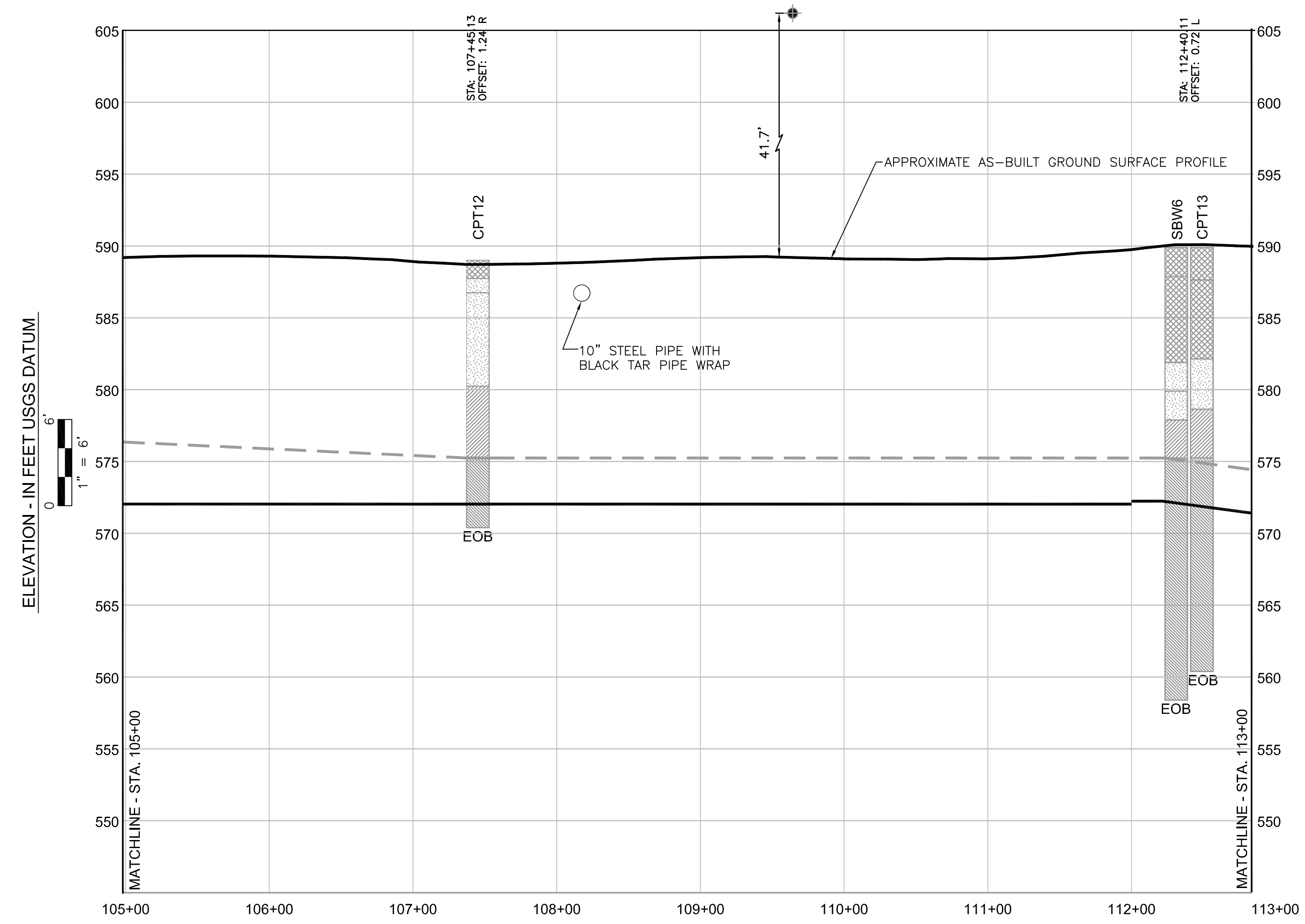
PROJECT NUMBER  
**200703855**  
SHEET REFERENCE NUMBER

**C-09**

- NOTES:**
- BORINGS PROJECTED IN PROFILE AND NOT NECESSARILY ON WALL ALIGNMENT.
  - ELEVATIONS ARE REPORTED IN NAVD 88 DATUM IN FEET.
  - TOPOGRAPHY BY ROWE INC. FROM AERIAL PHOTOGRAPHY FLOWN 04/16/2007.
  - IN CASE OF MULTIPLE OVERHEAD LINES, SURVEY LINE IS LOWEST OF GROUP.
- 04/27/2009 ISSUED FOR RECORD



**CUTOFF WALL PLAN**  
STA. 105+00 THROUGH STA. 113+00



**CUTOFF WALL PROFILE**  
STA. 105+00 THROUGH STA. 113+00

LEGEND			
	CLAY TILL		OVERHEAD ELECTRICAL LINE (MAY NOT REPRESENT ALL LINES)
	ALLUVIAL CLAYEY SOILS		WOODEN UTILITY POLE LOCATION
	SANDY SOILS		TRANSMISSION TOWER LOCATION
	ORGANIC		SOIL- BENTONITE CUTOFF WALL
	FILL SOIL / BOTTOM ASH		CPT BORING (BY STS)
	MONITORING WELL (BY STS)		CONVENTIONAL ROTARY BORINGS (BY STS)
	BORING (BY OTHERS)		OVERHEAD ELECTRICAL LINE (CROSSING WORK AREA) LOCATION

X:\Projects\200703855\DWG\_OUTBOX\ISSUED FOR RECORD WEADOCK AS-BUILT\ISSUED RECORD DRAWINGS\195-6909-31-REV-A.dwg, 4/29/2009 9:32:35 AM, FITZGERALD, CARLIN

Reference 195-6909-24  
Reference 195-6909-33



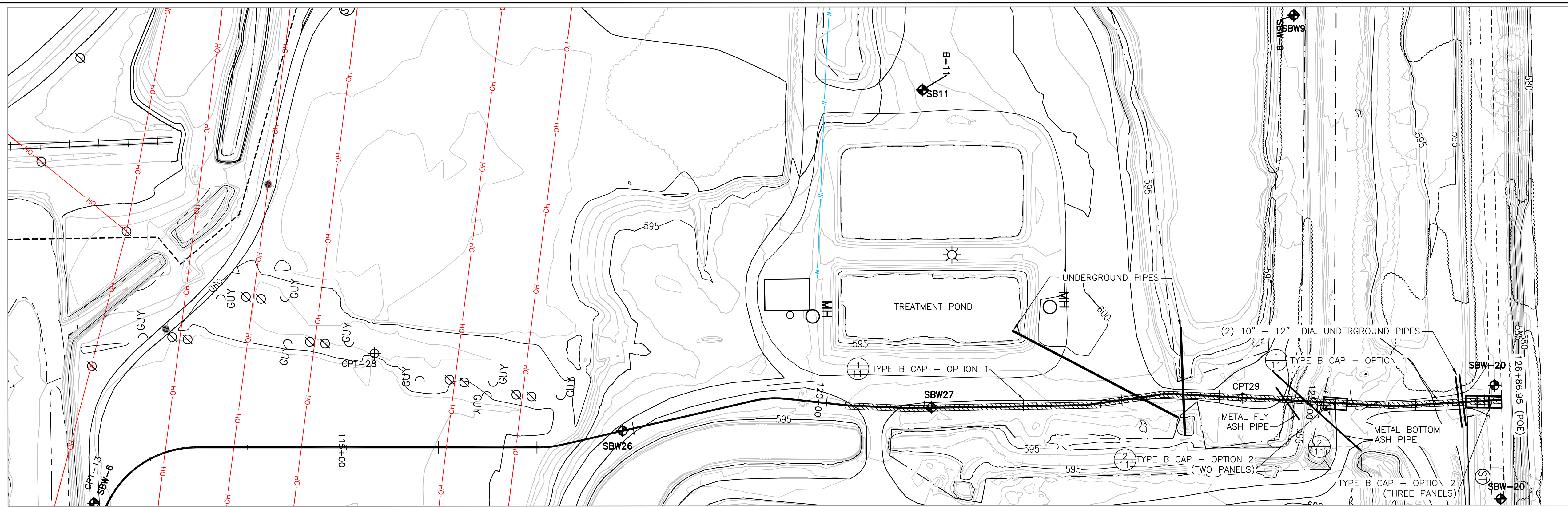
JC WEADOCK PLANT

FLY ASH SLURRY WALL  
STA 105+00 TO STA 113+00  
WITH BORING DATA

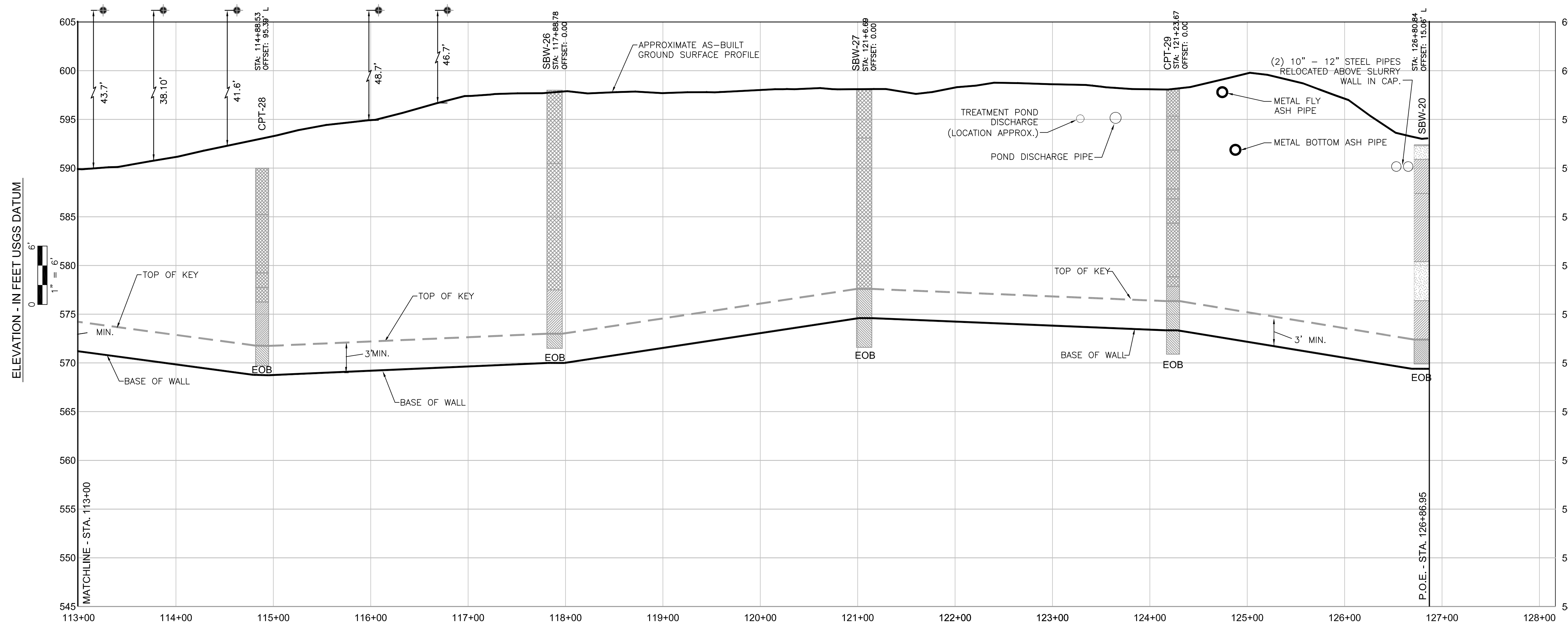
REV.	DATE	DESCRIPTION	BY	APP.	DATE
A	04/27/2009	GWO 1547 Weadock Slurry Wall Project - Submitted for Record	DAS	EHW	04/27/2009

SCALE	DRAWING NO.	SHEET	REV.
JDB	195-6909	SH31	A





**CUTOFF WALL PLAN**  
STA. 113+00 THROUGH STA. 126+86.95 (POE)



**CUTOFF WALL PROFILE**  
STA. 113+00 THROUGH STA. 126+86.95 (POE)

LEGEND	
	CLAY TILL
	ALLUVIAL CLAYEY SOILS
	SANDY SOILS
	ORGANIC
	FILL SOIL / BOTTOM ASH
	CPT $\oplus$ CPT BORING (BY STS)
	SBW $\oplus$ CONVENTIONAL ROTARY BORINGS (BY STS)
	MW $\oplus$ MONITORING WELL (BY STS)
	B $\oplus$ BORING (BY OTHERS)
	OH $\oplus$ OVERHEAD ELECTRICAL LINE (CROSSING WORK AREA) LOCATION
	OH $\oplus$ OVERHEAD ELECTRIC LINE (MAY NOT REPRESENT ALL LINES)
	$\square$ WOODEN UTILITY POLE LOCATION
	$\square$ TRANSMISSION TOWER LOCATION
	$\square$ SOIL- BENTONITE CUTOFF WALL

- NOTES:**
- BORINGS PROJECTED IN PROFILE AND NOT NECESSARILY ON WALL ALIGNMENT.
  - ELEVATIONS ARE REPORTED IN NAVD 88 DATUM IN FEET.
  - TOPOGRAPHY BY ROWE INC. FROM AERIAL PHOTOGRAPHY FLOWN 04/16/2007.
  - IN CASE OF MULTIPLE OVERHEAD LINES, SURVEY LINE IS LOWEST OF GROUP.
- 04/27/2009 ISSUED FOR RECORD

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SOIL - BENTONITE CUTOFF WALL - RECORD DRAWINGS  
WEADOCK FLY ASH DISPOSAL AREA - STA. 113+00 THROUGH STA. 126+86.95 (POE)  
CONSUMERS ENERGY COMPANY  
D.E. KARN AND J.C. WEADOCK GENERATING FACILITIES  
ESSEXVILLE, MICHIGAN

Issued

Rev	Date	Description
ISSUED		
FOR RECORD	04/27/2009	

Designed: CF 10/03/2007  
Drawn: DAS 01/22/2009  
Checked: CF 01/22/2009  
Approved: JAT 01/26/2009

PROJECT NUMBER  
**200703855**  
SHEET REFERENCE NUMBER

**C-10**

Reference 195-6909-24  
Reference 195-6909-33

Consumers Energy

FLY ASH SLURRY WALL  
STA 113+00 TO STA 126+86.95  
WITH BORING DATA

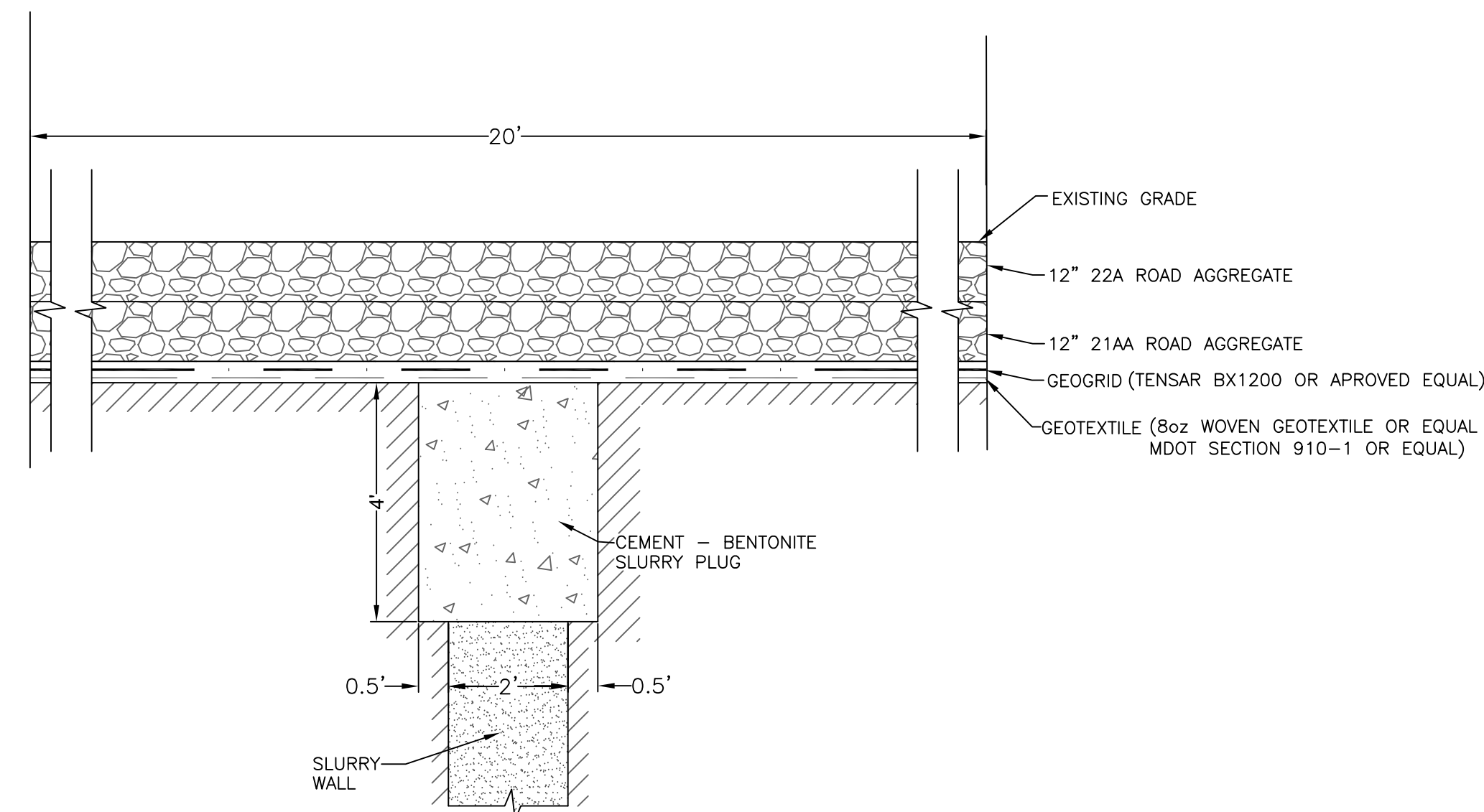
JC WEADOCK PLANT

SCALE	DRAWING NO.	SHEET	REV.
JDB	195-6909	SH32	A

REV.	DATE	DESCRIPTION	BY	APP.	DATE
A	04/27/2009	GWO 1547 Weadock Slurry Wall Project - Submitted for Record	DAS	EHW	04/27/2009

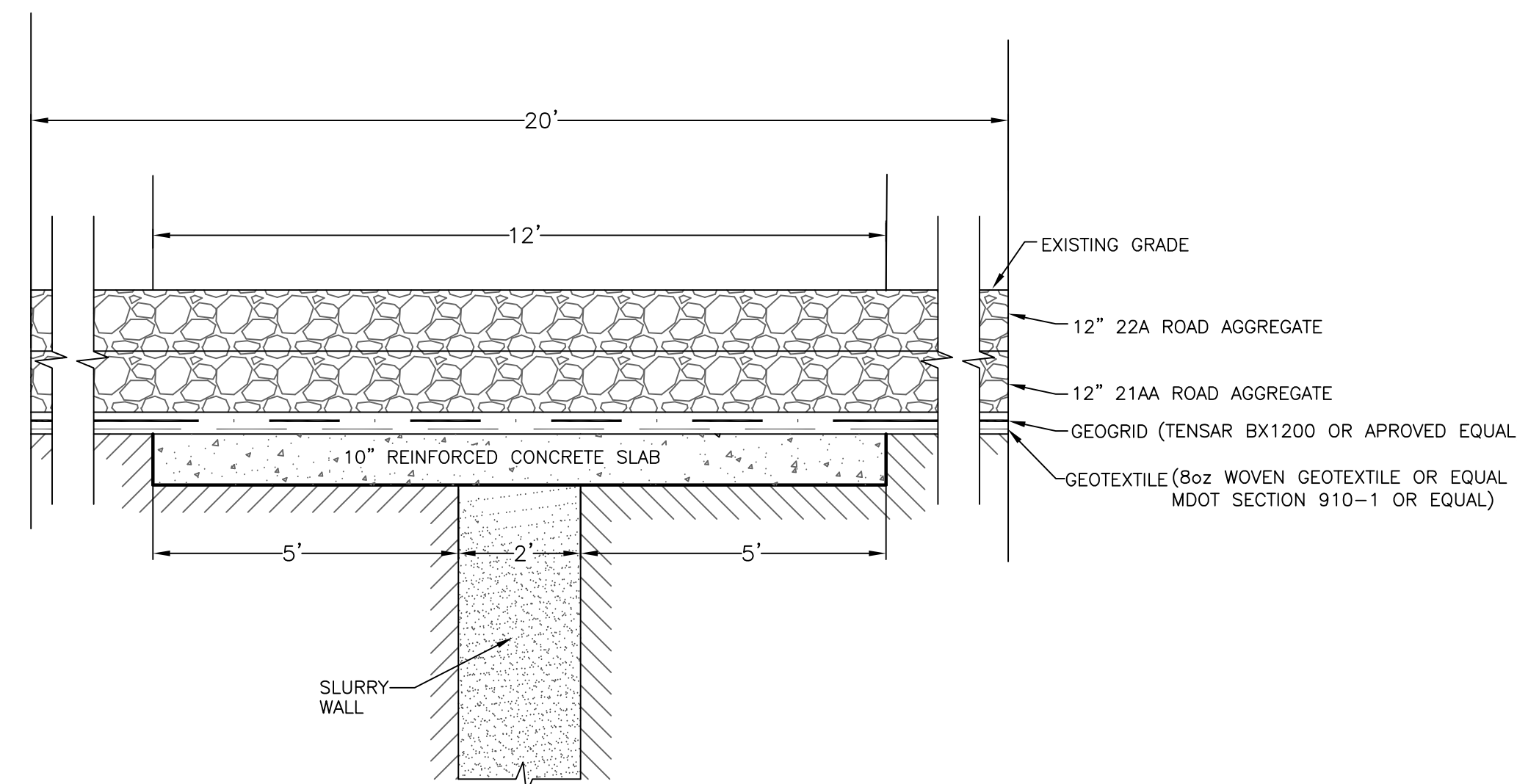


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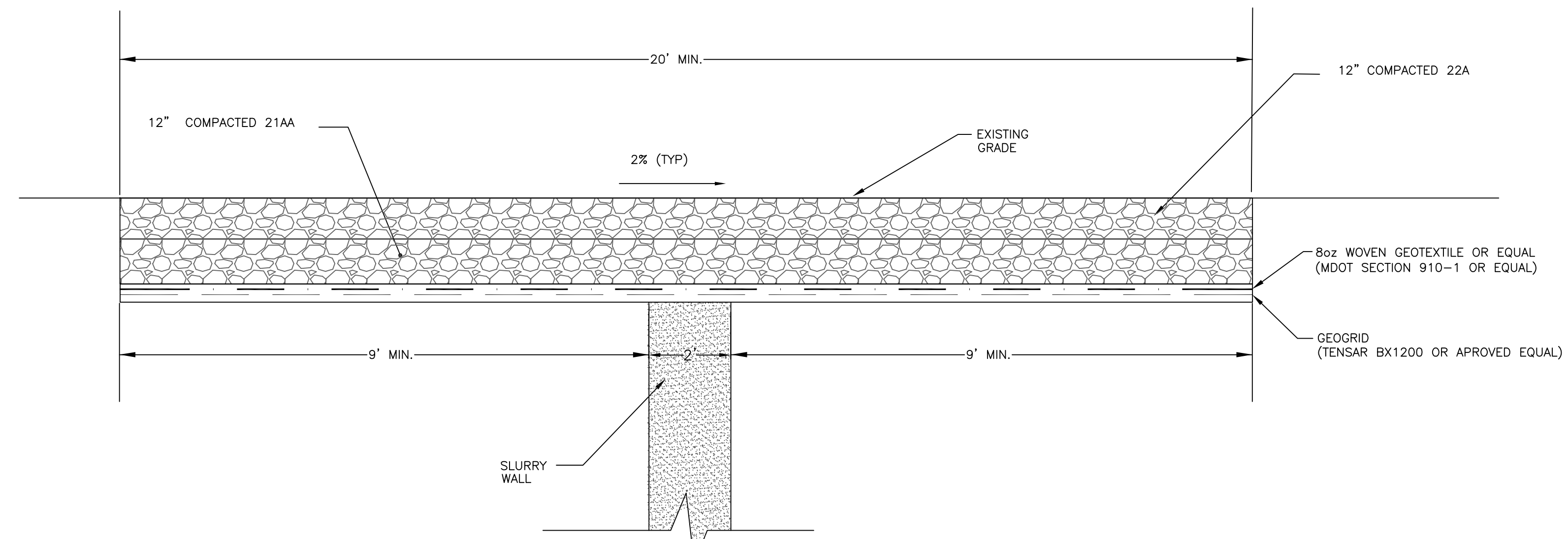
**1**  
**11** TYPE B CAP - OPTION 1  
NOT TO SCALE  
APPLIES: STATION 0+00 TO 1+50  
STATION 120+25 TO 126+56.95

NOTES: DRY PORTLAND CEMENT WAS MIXED AT 20% ADDITION BY DRY WEIGHT OF SLURRY AND WAS TESTED TO HAVE A MINIMUM 28-DAY STRENGTH OF AT LEAST 200 PSI.



**2**  
**11** TYPE B CAP - OPTION 2  
NOT TO SCALE  
APPLIES: STATION 82.38 TO 82+60  
STATION 125+06 TO 125+30  
STATION 126+51 TO 126+87

NOTES: CONCRETE SLABS WERE PRECAST TO A DIMENSION OF 12'x12'x 0.83'



**3**  
**11** TYPE A CAP FOR CONSTRUCTION ALONG GRAVEL ACCESS ROAD  
NOT TO SCALE  
APPLIES: STATION 1+50 TO 82+38  
STATION 82+60 TO 120+25

NOTES: CAPACITY OF TYPE A CAP SHALL NOT EXCEED 10 TONS.

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SOIL - BENTONITE CUTOFF WALL - CONSTRUCTION PLAN  
CUTOFF WALL CAP DETAILS  
CONSUMERS ENERGY CO.  
D.E.KARN AND J.C. WEADOCK GENERATING FACILITIES  
ESSEXVILLE, MICHIGAN

Issued

Rev	Date	Description
ISSUED FOR RECORD	04/27/2009	

Designed:	CF	10/03/2007
Drawn:	DAS	01/22/2009
Checked:	CF	01/22/2009
Approved:	JAT	01/28/2009

PROJECT NUMBER  
**200703855**  
SHEET REFERENCE NUMBER

**C-11**

04/27/2009 ISSUED FOR RECORD

Reference 195-6909-24

REV.	DATE	DESCRIPTION	BY	APP.	DATE
				DR.	DAS 04/27/2009
				CK.	
				APP.	SECTION HEAD
A	04/27/2009	GWO 1547 Weadock Slurry Wall Project - Submitted for Record	DAS	EHW	APP. DIVISION HEAD
				APP.	DEPARTMENT HEAD

Consumers Energy

JC WEADOCK PLANT

FLY ASH SLURRY WALL  
CUTOFF CAP DETAILS

SCALE	DRAWING NO.	SHEET	REV.
JOB	195-6909	SH33	A