

Phase I Hydrogeologic Evaluation Hampton Creek Wetland Area

REVIEW DRAFT

Project No. 181663
March 6, 2019



Fishbeck, Thompson, Carr & Huber, Inc.
engineers | scientists | architects | constructors

ftc&h



Phase I Hydrogeologic Evaluation Hampton Creek Wetland Area

**Prepared for:
City of Portage
Portage, Michigan**

**March 6, 2019
Project No. 181663**

Review Draft

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List of Abbreviations/Acronyms

amsl	above mean sea level
City	City of Portage
CFU/100 mL	colony forming units per 100 milliliters
<i>E. Coli</i>	<i>Escherichia coli</i>
ft/ft	foot/feet per foot/feet
FTCH	Fishbeck, Thompson, Carr & Huber, Inc.
HCWA	Hampton Creek Wetland Area
MDEQ	Michigan Department of Environmental Quality
mg/L	milligrams per liter
USGS	U.S. Geological Survey

1.0 Introduction

The Hampton Creek Wetland Area (HCWA) is located north of West Centre Avenue and east of Angling Road in the City of Portage (City), Michigan. It consists of an approximately 85-acre wetland surrounded by commercial, medical, and residential developments and the Moors Golf Club. A location map is included as Figure 1. The HCWA receives stormwater runoff from approximately 2.55 square miles of primarily residential developments. Currently, the HCWA does not have a dedicated stormwater surface outlet and as a result, the wetlands have experienced extended periods of high water levels that are impacting the surrounding properties and making portions of the golf course unusable.

This report investigates the hydrogeological impacts to the wetlands and identifies potential outlet alternatives to Portage Creek.

2.0 Water Quality Impacts

Fishbeck, Thompson, Carr & Huber, Inc. (FTCH) understands that use of Portage Creek as an outlet must consider potential water quality impacts from the HCWA. Therefore, surface water sampling was completed within the HCWA.

2.1 2018 Surface Water Sampling

FTCH visited the HCWA property on December 19, 2018, to collect surface water samples. A total of three surface water samples were collected (SW-01 through SW-03). SW-01 was located along the eastern shore of the northern portion of the HCWA (i.e., open water area). SW-02 was collected along the southern portion of the HCWA immediately north of Harding's Friendly Market. SW-03 was collected in an open water area of the HCWA, located in the southwestern portion, adjacent to Angling Road, north of West Centre Avenue. The approximate surface water sample locations are shown on Figure 2. The samples were collected for laboratory analysis of *Escherichia coli* (*E. Coli*); nitrate, nitrogen; nitrite, nitrogen; ammonia, nitrogen; and total phosphorous. The samples were placed on ice in an ice-chilled cooler and transported under chain-of-custody protocol to Pace Analytical Services, LLC in Grand Rapids, Michigan.

2.2 Surface Water Sampling Results

A summary of the analytical laboratory data is provided in Table 1. Ammonia nitrogen was detected in one of the three sampling locations (SW-02), where it was identified at a concentration of 0.10 milligrams per liter (mg/L) exceeding the Part 31, Rule 57 Final Chronic Value of 0.029 mg/L. Nitrate and nitrite, nitrogen were less than the laboratory reporting limits in all three samples. Total phosphorous was detected in all three samples at concentrations ranging from 0.10 mg/L and 0.50 mg/L. *E. coli* was detected at concentrations ranging from 36.9 to 122.4 colony forming units per 100 milliliters (CFU/100 mL). Total coliforms were detected in all three samples at concentrations ranging from 143 to 260.3 CFU/100 mL. The laboratory report is provided in Appendix 1.

3.0 Hydrogeological Desktop Analysis

3.1 Introduction

3.1.1 Purpose

This hydrogeological desktop analysis was developed to evaluate the physical characteristics of the study area to determine if subsurface conditions may be contributing to observed flooding on adjacent residential, commercial, medical, and recreational properties.

3.1.2 Method and Approach

An abundance of relevant hydrogeological data is available for the City and broader Kalamazoo County. The following information was reviewed as part of this desktop analysis:

- *Simulation of the Ground-Water-Flow System in the Kalamazoo County Area, Michigan: U.S. Geological Survey (USGS) Scientific Investigations Report 2004-5054*
- *Geohydrology and Water Quality of Kalamazoo County, Michigan, 1986-88: USGS Water Resources Investigations Report 90-4028*
- *Wellhead Protection Plan, City of Portage, MI (Earth Tech, Inc. 2000)*
- *Wellhead Protection Area Delineation for the City of Portage (WW Engineering & Science, Inc., 1992)*
- *Updated Wellhead Protection Plan, City of Portage (FTCH, April 2015)*
- *State of Michigan Groundwater Interactive Map (Michigan Department of Environmental Quality (MDEQ)/USGS/Michigan State University, 2005)*
- *MDEQ Water Record Retrieval System*

This information was reviewed in the context of the HCWA to better understand the groundwater/surface water interactions within the study area and develop a conceptual site model.

3.2 Physical Characteristics

3.2.1 Site Location and Physical Description

The subject property encompasses approximately 85 acres and is comprised of approximately 79 acres of freshwater wetland with small areas of open water located on the southern and southwestern portions. A thick vegetative cover of cattails and other shrubs is present throughout the wetland. The remaining approximately 6 acres consists of open water located on the northern portion of the property. Stormwater from nearby commercial, medical, residential, and recreational developments is discharged into the HCWA. There are no surface water outlets present in the HCWA. Refer to Figure 2 for a recent aerial photograph depicting the HCWA area and associated surface water features.

The ground surface elevations of the HCWA range from approximately 872 to 878 feet above mean sea level (amsl). Surface elevations of the immediately adjoining properties range from approximately 880 feet amsl to more than 900 feet amsl. A topographic map has been included for reference as Figure 3.

3.2.2 Surficial Soil

According to the U.S. Department of Agriculture Natural Resources Conservation Service Web Soil Survey (<http://websoilsurvey.nrcs.usda.gov/app/>), the soils on the subject property consist of Houghton Soils and Sebewa Muck. The Houghton Soils transition are comprised of strata of loam, clay loam, and sandy loam. The Sebewa Muck is comprised of a single stratum of muck. Directly adjacent to the HCMA, the soils are comprised of loamy sands and sandy loams. The clay loam and muck strata exhibit low permeability characteristics while the surrounding sandy loam exhibits higher permeabilities. A copy of the soil survey is provided in Appendix 2.

3.2.3 Regional Geology

The surficial geology in this portion of Kalamazoo County is comprised of glacial and post-glacial deposits including outwash, lake deposits, and a few dune-type deposits. Outwash was deposited on the preexisting ground surface by proglacial meltwater streams during retreat of the most recent continental glacier. Outwash deposits consist primarily of fine to coarse sand, gravelly sand, and sandy gravel. The outwash deposits form what is now known as the Galesburg-Vicksburg outwash plain. The Galesburg-Vicksburg outwash plain extends over one half of Kalamazoo County and all but a relatively small portion in the northeast corner of the City. Thickness of outwash deposits range from approximately 150 feet in the southeast corner of the City to more than 350 feet along a narrow, northwest-southeast trending belt in the northeast part of the City. Refer to Appendix 3 for a map depicting the thickness of glacially-derived sediments in the area.

Lake deposits consisting primarily of silt, clay, and organic rich materials were laid down above outwash deposits in the northeast corner of the City and in low lying areas throughout the City. Windblown deposits (i.e., dune deposits) derived from the transport of outwash materials are located in a thin belt along the southern end of the City. The dune deposits consist of well-sorted, fine- to medium-grained sand.

Underlying the unconsolidated deposits is bedrock of the Mississippian Michigan Formation (Coldwater Shale).

3.2.4 Local Geology

The available water well records located within the area of the HCWA were obtained from the MDEQ Water Record Retrieval System. Figure 3 shows the locations of wells closest to the subject property. Logs for these wells are included as Appendix 4.

Select residential water well records were used to generate geological cross-sections within the HCWA study area (refer to Figure 3 for locations). Cross sections A – A', B – B', and C – C' were developed to visualize the underlying geological characteristics within the context of the surface water features and near surface soils. Cross-Section A – A' is shown on Figure 4. Cross-Section B – B' and C – C' are depicted on Figure 5. Review of the cross-sections suggest that a minimum of 90 feet of sand and gravel are present beneath the ground surface around the HCWA. These deposits are part of the of the Galesburg-Vicksburg outwash plain.

The water table appears to be in direct communication with the HCWA based on the observed static water measurements recorded on the nearby well logs. Localized lenses of clay are present; however, they are discontinuous and limited in areal extent. Based on a review of available data, bedrock in the vicinity of the HCWA is encountered between 201 and 400 feet below ground surface.

3.2.5 Hydrology

Figure 6 shows the watershed boundaries in the vicinity of the HCWA, as mapped by the U.S. Environmental Protection Agency. The HCWA is located in the Portage Creek Watershed Sub-Basin of the Kalamazoo River Watershed Basin. In addition to the HCWA's wetland and open water area previously described, other surface water features are located within the study area. Most notable is Portage Creek, located approximately 1,300 feet to the south. This stream discharges into Hampton Lake which is located approximately 2,500 feet south of the HCWA, before continuing to flow out of the lake toward the southeast. Several man-made ponds are also located approximately 500 to 1,000 feet to the east of the open water area of the HCWA. The surface water locations are depicted on Figure 2.

3.2.6 Hydrogeology

Two distinct sand and gravel aquifers are present throughout much of the City and consist of an upper, unconfined aquifer, and a lower, semi-confined aquifer. The aquifers are separated by variable thickness sandy, silty, clay strata. In certain locations, the silty clay layer(s) is not observed, and the aquifer consists of a single water bearing zone.

The upper unconfined aquifer occurs in shallow sand and gravel deposits and is in hydraulic connection with streams and lakes. The aquifer is under atmospheric pressure (water table conditions), and water levels rise and lower in the aquifer depending on recharge and discharge events. Recharge to the aquifer is primarily from infiltration of precipitation.

The lower semi-confined aquifer is hydraulically connected to the unconfined aquifer, and groundwater moves between the two aquifers; however, its hydraulic connectivity is inhibited by the presence of the silty clay layers. The lower semi-confined aquifer is recharged from infiltration from the overlying aquifer and from horizontal underflow from other areas.

An estimate of the water table elevation contours has been provided as Figure 7 and have been overlaid on the geological cross-sections (Figures 4 and 5). These data were obtained from the State of Michigan Groundwater Interactive Map (MDEQ/USGS/Michigan State University, 2005). In general, groundwater flows from topographically high to lower areas. Within the study area of this project, this coincides with a local gradient generally toward the southeast.

West of the HCWA, the horizontal hydraulic gradient is approximately 0.009 foot per foot (ft/ft). As evidenced by the groundwater contours, a flattening out of the hydraulic gradient is apparent beneath the HCWA with an approximate hydraulic gradient of 0.002 ft/ft. This suggests the presence of an area of increased groundwater recharge likely due to the downward infiltration of surface water into the underlying aquifer. The horizontal hydraulic gradient increases east of the HCWA suggesting the increased recharge zone is no longer present. Converging groundwater contours are evident near Portage Creek, suggesting that groundwater is venting or discharging to the stream.

3.2.7 Recharge

The average annual precipitation rate in the City area is 36 inches per year (National Oceanic and Atmospheric Association climate records). Allen et al. (1972) and Rheume (1990) estimated that approximately 9 inches per year of water recharges the aquifer in the City.

3.2.8 Hydraulic Conductivity and Transmissivity

According to the USGS groundwater modeling work, the hydraulic conductivity in the upper aquifer underlying the HCWA is approximately 100 feet per day. This is within the range of hydraulic conductivity values found in unconsolidated glacial outwash aquifers as reported in Fetter (2001).

3.2.9 Hydrograph from Nearby Relevant Site

Groundwater elevation data collected from a site located approximately 2 miles from the HCWA indicates groundwater elevations in the area of the HCWA have been on an overall increasing trend since 2014 with an approximate 0.5- to 1.0-foot annual increase. Although, detailed groundwater elevation data are not available within the HCWA, a similar increasing trend is expected within the underlying unconfined aquifer. A hydrograph of the groundwater elevation data from January 2008 to December 2018 at the nearby site is provided in Appendix 5.

3.3 Hydrogeological Conceptual Site Model

Based on the findings of this hydrogeological desktop analysis, FTCH has developed a Conceptual Site Model to summarize the physical characteristics of the HCWA and convey our understanding of the groundwater flow system. The site is underlain by two moderately permeable regional sand and gravel aquifers, the upper of which is in direct communication with surface water features. Groundwater flow is toward the southeast with a higher rate of movement west of the site and slower rate of movement beneath the site. Groundwater is in direct hydraulic communication with the HCWA wetland and open water area; however, the interaction between the groundwater and surface water features is somewhat inhibited by clay-rich mucky soils. Since the wetland and open water areas receive surface water drainage from the surrounding area and have no physical outlet they act as a source of groundwater recharge to the underlying aquifer. This is evidenced by the flattening of the hydraulic gradient underneath these surface water features.

There is regional evidence to suggest the water table has been increasing over the past several years throughout the area. At an adjacent study area, the water table elevation increased approximately 2 to 3 feet relative to 2014 levels. Since the wetland and open water area of the HCWA are in direct hydraulic communication with the regional aquifer, these increasing groundwater levels will also result in increasing surface water elevations.

These high groundwater conditions appear to be responsible for the observed flooding on the adjacent golf course and residential properties which gently rise from the open water portion. It is presumed that by creating a physical surface water outlet from the wetland and open water and connecting it to Portage Creek one could artificially lower the water table underneath the HCWA. The surface water features would no longer be serving as a source for additional groundwater recharge, but instead act as a hydraulic sink. By lowering the surface water elevations, groundwater would vent to these features and depress the water table within the study area. The extent of the water table depression would primarily be a function of the new surface water elevation as controlled by the drain and the permeability of the aquifer.

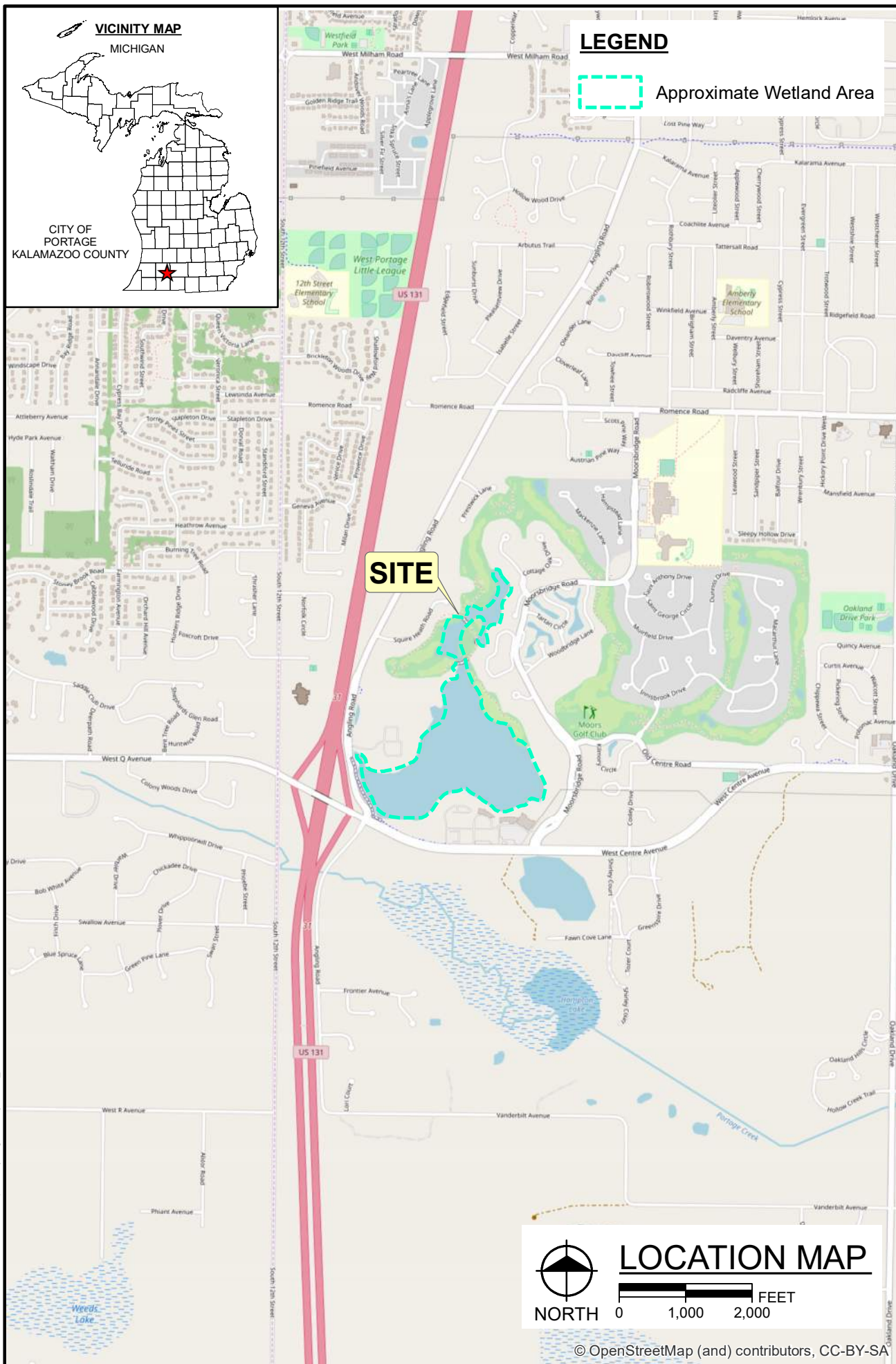
4.0 Alternatives

Review of the surface topography shows the stormwater runoff to the HCWA drainage area flows predominately from the northwest to the southeast. It is suspected that prior to settlement of the area the HCWA could continue to flow southeast through an overland flow route to a second wetland area directly south and adjacent to West Centre Avenue and then continue toward Portage Creek. We believe construction of West Centre Avenue and the surrounding developments has eliminated this hydraulic connection and propagated increased water levels within the HCWA.

FTCH visited the HCWA and reviewed topographic data to investigate potential stormwater outlets for the HCWA. We believe a gravity sewer with a restricted outlet would alleviate flooding impacts to adjacent properties and mitigate some of the localized increase in groundwater depths. We anticipate a storm sewer that would extend from the HCWA from behind the Harding's Friendly Market, through the parking lot to Moosebridge Road, and then into the wetlands on the south side of West Centre Avenue. We believe a second restricted outlet from the wetlands south of West Centre Avenue to the wetlands adjacent to Portage Creek would be warranted to alleviate excessive high water levels and protect riparian properties. See Figure 8 for the approximate route of the stormwater outlets.

By utilizing restricted outlets within both wetlands, downstream flooding impacts to Portage Creek may be mitigated through attenuation of storm events. Additionally, any potential water quality concerns may be further mitigated by the routing the stormwater through the wetlands prior to discharging to Portage Creek. Hydrologic and hydraulic modeling would be necessary to quantify these impacts and appropriately size the restricted outlets. Coordination with the MDEQ through a pre-application meeting would also be necessary to verify the ability to get a permit for this alternative and identify measures to protect the wetlands and mitigate downstream impacts.

Figures



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scientists

architects

constructors

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carr & huber, inc.

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any other size.

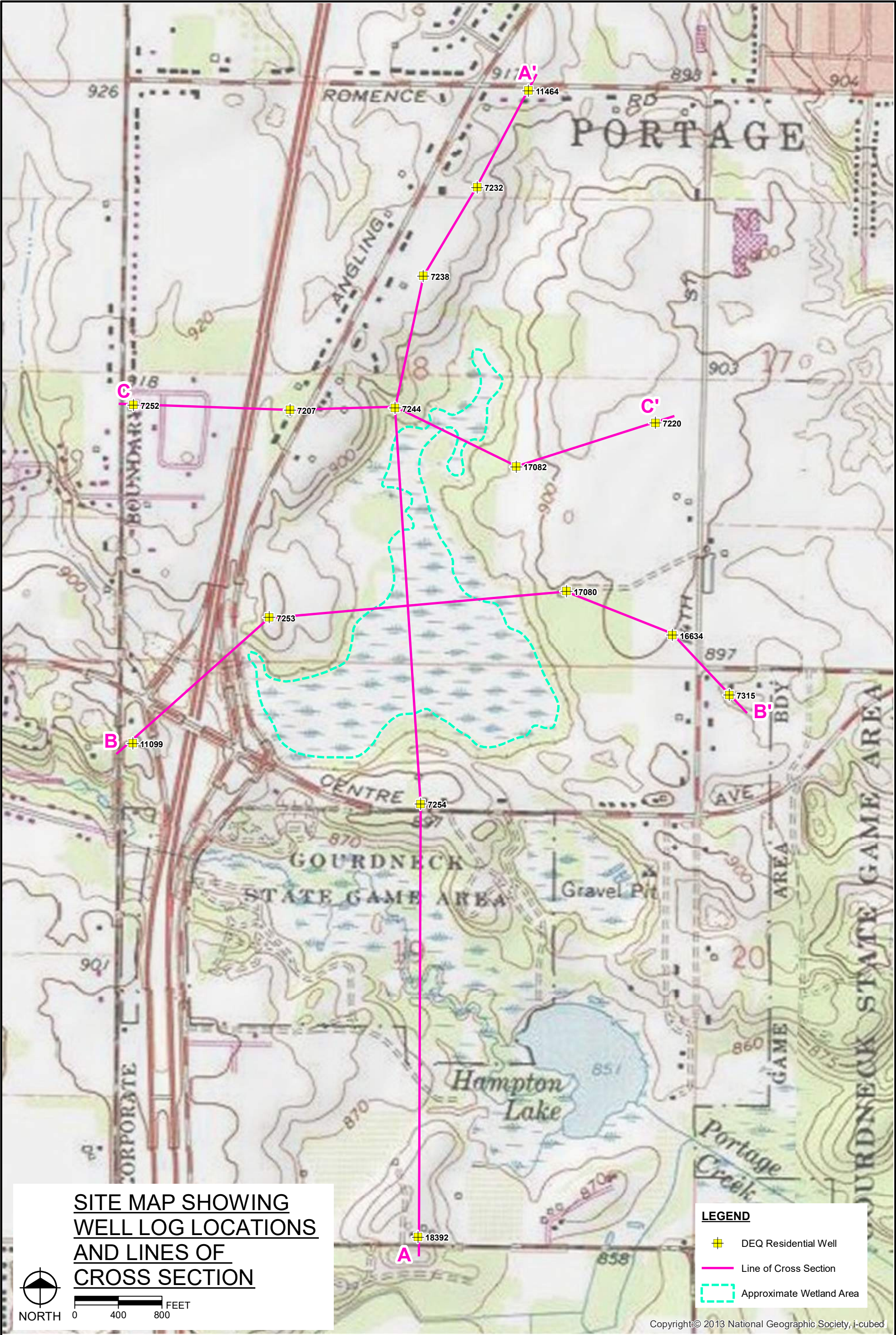
City of Portage
Kalamazoo County, Michigan
Hampton Creek Wetland Area
Phase I - Hydrogeologic Evaluation

PROJECT NO.
181663

FIGURE NO.
1

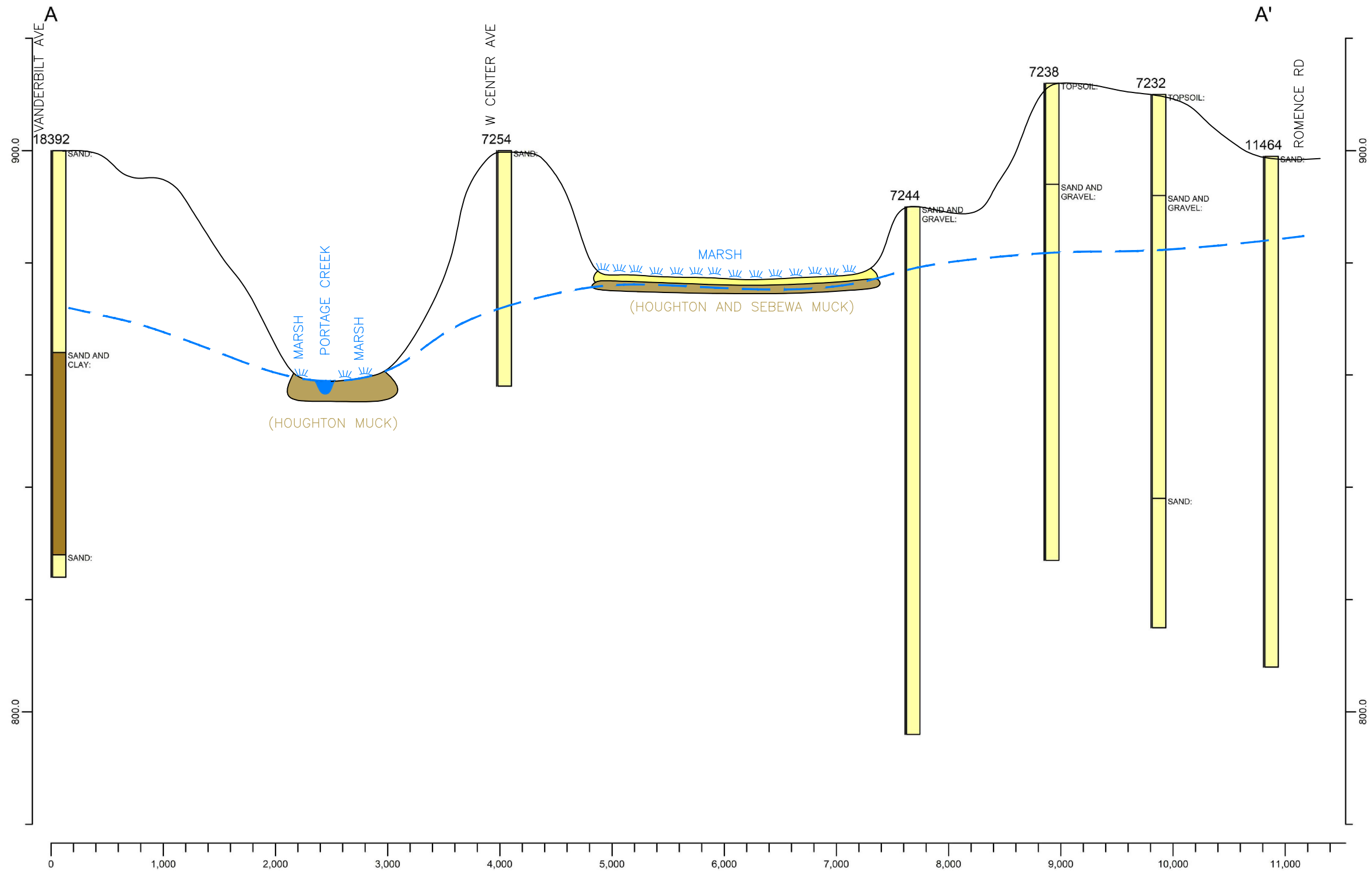
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PLOT INFO: Z:\2018\181663\CAD\CD\Z001-181663.DWG LAYOUT: FIG04_XSEC A DATE: 2/13/2019 TIME: 8:11:47 AM USER: ACS



LEGEND

- (YELLOW) SAND AND GRAVEL OR COARSE GRAINED DEPOSITS
- (BROWN) CLAY/SILT OR FINE GRAINED DEPOSITS
- MDEQ WATER TABLE ELEVATION

GEOLOGIC CROSS SECTION A-A'



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City of Portage
Kalamazoo County, Michigan
Hampton Creek Wetland Area
Phase I - Hydrogeologic Evaluation

PROJECT NO.

181663

FIGURE NO.

4

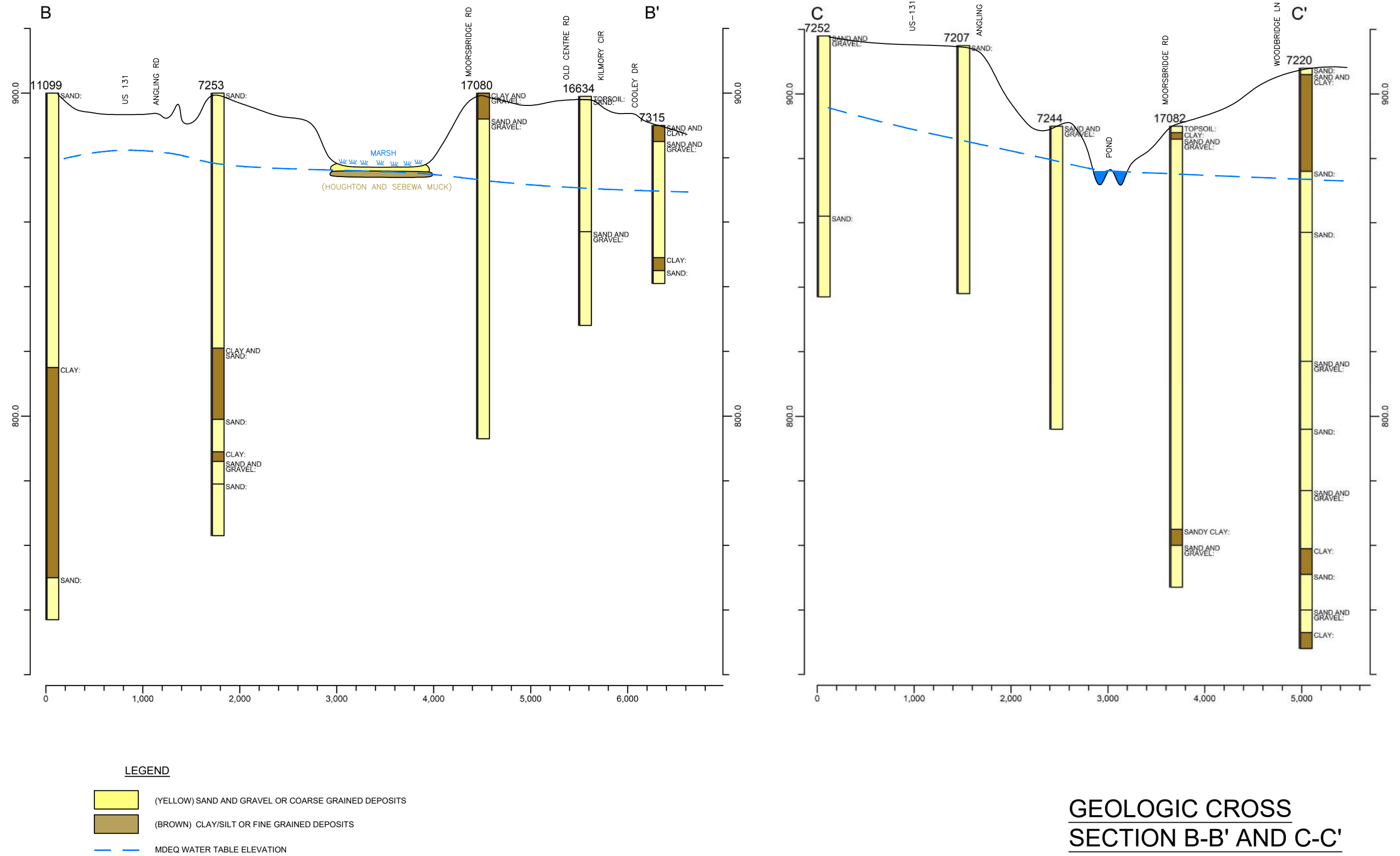
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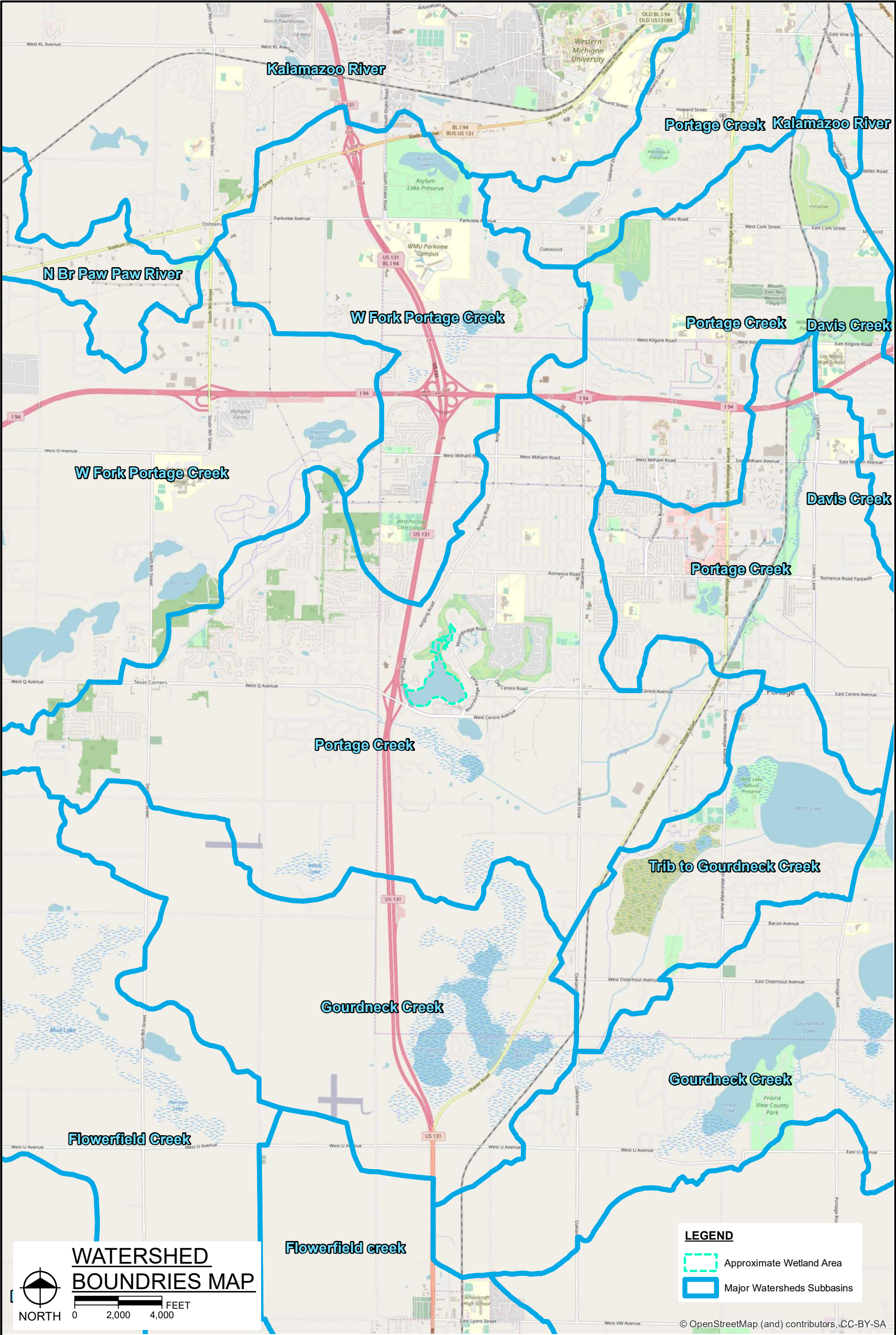
City of Portage
Kalamazoo County, Michigan

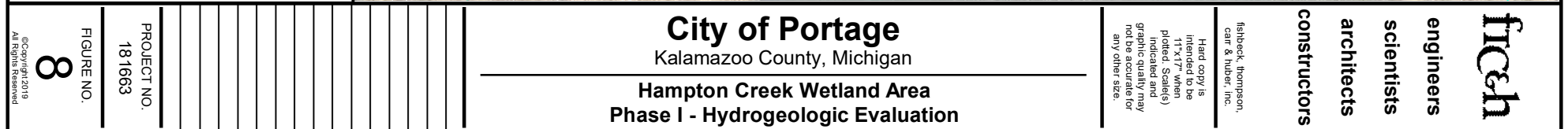
Hampton Creek Wetland Area
Phase I - Hydrogeologic Evaluation

PROJECT NO.	181663
FIGURE NO.	

5







Tables

Table 1 - Surface Water Data Summary

Portage Hampton Creek - Phase 1 Hydrogeologic Evaluation

City of Portage, Kalamazoo County, Michigan

December 2018

Monitoring Location:			SW01	SW02	SW03	Drinking Water	Non-Drinking	Wildlife	Drinking Water	Non-Drinking	Final Chronic	Aquatic	Final Acute
Laboratory ID:			50212878001	50212878002	50212878003	HNV ⁽¹⁾	Water	Value ⁽¹⁾	HCV ⁽¹⁾	Water	Value ⁽¹⁾	Maximum	Value ⁽¹⁾
Collection Date:			12/19/18	12/19/18	12/19/18		HNV ⁽¹⁾			HCV ⁽¹⁾		Value ⁽¹⁾	
General Chemistry	CAS Number	Units											
Nitrogen, Ammonia	7664-41-7	mg/L	0.10 U	0.10	0.10 U	ID*	ID*	NA	NA	NA	0.029	0.16	0.32
Nitrogen, Nitrate	14797-55-8	mg/L	0.050 U	0.050 U	0.050 U	10	NLS	NA	NA	NA	NLS	NLS	NLS
Nitrogen, Nitrite	14797-65-0	mg/L	0.010 U	0.010 U	0.010 U	--	--	--	--	--	--	--	--
Phosphorus, Total	7723-14-0	mg/L	0.18	0.50	0.10	--	--	--	--	--	--	--	--
Microbial	CAS Number												
E. coli	--	CFU/100 mL	122.4	60.5	36.9	--	--	--	--	--	--	--	--
Total Coliforms	--	CFU/100 mL	260.3	143.0	165.8	--	--	--	--	--	--	--	--

Bolded values exceed an applicable criterion.

Data Qualifiers:

U Not detected

Footnotes/Abbreviations:

⁽¹⁾ Act 451, Part 31, Rule 57 Water Quality Values, Surface Water Assessment Section, MDEQ, March 15, 2018.

* the lowest HNV, Wildlife Value, HCV or Final Chronic Value given for this chemical will adequately protect the uses identified with an ID*

HCV human cancer value

HNV human noncancer value

ID insufficient data to derive value

NA not applicable

NLS no literature search has been conducted

Appendix 1

January 03, 2019

Penni Mahler
Fishbeck, Thompson, Carr & Huber
1515 Arboretum Drive SE
Grand Rapids, MI 49546

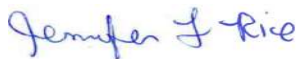
RE: Project: Portage/Hampton Creek Wetland
Pace Project No.: 50212878

Dear Penni Mahler:

Enclosed are the analytical results for sample(s) received by the laboratory on December 19, 2018. The results relate only to the samples included in this report. Results reported herein conform to the most current, applicable TNI/NELAC standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,



Jennifer Rice
jennifer.rice@pacelabs.com
(616)975-4500
Project Manager

Enclosures



REPORT OF LABORATORY ANALYSIS

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CERTIFICATIONS

Project: Portage/Hampton Creek Wetland

Pace Project No.: 50212878

Indiana Certification IDs

7726 Moller Road, Indianapolis, IN 46268

Illinois Certification #: 200074

Indiana Certification #: C-49-06

Kansas/NELAP Certification #: E-10177

Kentucky UST Certification #: 80226

Kentucky WW Certification #: 98019

Ohio VAP Certification #: CL0065

Oklahoma Certification #: 2018-101

Texas Certification #: T104704355-18-12

West Virginia Certification #: 330

Wisconsin Certification #: 999788130

USDA Soil Permit #: P330-16-00257

Grand Rapids Certification ID's

5560 Corporate Exchange Ct SE, Grand Rapids, MI 49512

Minnesota Department of Health, Certificate #1385941

Arkansas Department of Environmental Quality, Certificate
#18-046-0

Georgia Environmental Protection Division, Stipulation

Illinois Environmental Protection Agency, Certificate

#004325

Michigan Department of Environmental Quality, Laboratory
#0034

New York State Department of Health, Serial #57971 and
57972

North Carolina Division of Water Resources, Certificate
#659

Virginia Department of General Services, Certificate #9780

Wisconsin Department of Natural Resources, Laboratory
#999472650

U.S. Department of Agriculture Permit to Receive Soil,
Permit #P330-17-00278

REPORT OF LABORATORY ANALYSIS

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SAMPLE SUMMARY

Project: Portage/Hampton Creek Wetland

Pace Project No.: 50212878

Lab ID	Sample ID	Matrix	Date Collected	Date Received
50212878001	PH-18-12-SW01(I)	Water	12/19/18 08:40	12/19/18 11:07
50212878002	PH-18-12-SW02(I)	Water	12/19/18 09:05	12/19/18 11:07
50212878003	PH-18-12-SW03(I)	Water	12/19/18 09:25	12/19/18 11:07

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SAMPLE ANALYTE COUNT

Project: Portage/Hampton Creek Wetland

Pace Project No.: 50212878

Lab ID	Sample ID	Method	Analysts	Analytes Reported
50212878001	PH-18-12-SW01(I)	SM 4500-NO3 F-11	NRC	3
		SM 9223B-04	JTW	2
		EPA 365.1	ZM	1
		SM 4500-NH3 G	GWA	1
50212878002	PH-18-12-SW02(I)	SM 4500-NO3 F-11	NRC	3
		SM 9223B-04	JTW	2
		EPA 365.1	ZM	1
		SM 4500-NH3 G	GWA	1
50212878003	PH-18-12-SW03(I)	SM 4500-NO3 F-11	NRC	3
		SM 9223B-04	JTW	2
		EPA 365.1	ZM	1
		SM 4500-NH3 G	GWA	1

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: Portage/Hampton Creek Wetland

Pace Project No.: 50212878

Sample: PH-18-12-SW01(I) Lab ID: 50212878001 Collected: 12/19/18 08:40 Received: 12/19/18 11:07 Matrix: Water								
Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
4500-NO3 F NO2/NO3 unpres Analytical Method: SM 4500-NO3 F-11								
Nitrogen, NO2 plus NO3	<0.050	mg/L	0.050	1		12/19/18 14:33		
Nitrogen, Nitrate	<0.050	mg/L	0.050	1		12/19/18 14:33	14797-55-8	
Nitrogen, Nitrite	<0.010	mg/L	0.010	1		12/19/18 14:33	14797-65-0	
MBIO Total Coliform Analytical Method: SM 9223B-04 Preparation Method: SM 9223B-04								
Total Coliforms	260.3	CFU/100 mL	1.0	1	12/19/18 13:45	12/20/18 16:37		N2
E.coli	122.4	CFU/100 mL	1.0	1	12/19/18 13:45	12/20/18 16:37		
365.1 Total Phosphorus Analytical Method: EPA 365.1 Preparation Method: EPA 365.1								
Phosphorus	0.18	mg/L	0.050	1	12/21/18 11:00	12/24/18 09:58	7723-14-0	
4500 Ammonia Water Analytical Method: SM 4500-NH3 G								
Nitrogen, Ammonia	<0.10	mg/L	0.10	1		12/21/18 17:39	7664-41-7	

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: Portage/Hampton Creek Wetland

Pace Project No.: 50212878

Sample: PH-18-12-SW02(I)		Lab ID: 50212878002		Collected: 12/19/18 09:05		Received: 12/19/18 11:07		Matrix: Water	
Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual	
4500-NO3 F NO2/NO3 unpres		Analytical Method: SM 4500-NO3 F-11							
Nitrogen, NO2 plus NO3	<0.050	mg/L	0.050	1		12/19/18 14:34			
Nitrogen, Nitrate	<0.050	mg/L	0.050	1		12/19/18 14:34	14797-55-8		
Nitrogen, Nitrite	<0.010	mg/L	0.010	1		12/19/18 14:34	14797-65-0		
MBIO Total Coliform		Analytical Method: SM 9223B-04 Preparation Method: SM 9223B-04							
Total Coliforms	143.0	CFU/100 mL	1.0	1	12/19/18 13:45	12/20/18 16:37		N2	
E.coli	60.5	CFU/100 mL	1.0	1	12/19/18 13:45	12/20/18 16:37			
365.1 Total Phosphorus		Analytical Method: EPA 365.1 Preparation Method: EPA 365.1							
Phosphorus	0.50	mg/L	0.050	1	12/21/18 11:00	12/24/18 09:58	7723-14-0		
4500 Ammonia Water		Analytical Method: SM 4500-NH3 G							
Nitrogen, Ammonia	0.10	mg/L	0.10	1		12/21/18 17:41	7664-41-7		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: Portage/Hampton Creek Wetland

Pace Project No.: 50212878

Sample: PH-18-12-SW03(I)		Lab ID: 50212878003		Collected: 12/19/18 09:25		Received: 12/19/18 11:07		Matrix: Water	
Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual	
4500-NO3 F NO2/NO3 unpres		Analytical Method: SM 4500-NO3 F-11							
Nitrogen, NO2 plus NO3	<0.050	mg/L	0.050	1		12/19/18 14:35			
Nitrogen, Nitrate	<0.050	mg/L	0.050	1		12/19/18 14:35	14797-55-8		
Nitrogen, Nitrite	<0.010	mg/L	0.010	1		12/19/18 14:35	14797-65-0		
MBIO Total Coliform		Analytical Method: SM 9223B-04 Preparation Method: SM 9223B-04							
Total Coliforms	165.8	CFU/100 mL	1.0	1	12/19/18 13:45	12/20/18 16:37		N2	
E.coli	36.9	CFU/100 mL	1.0	1	12/19/18 13:45	12/20/18 16:37			
365.1 Total Phosphorus		Analytical Method: EPA 365.1 Preparation Method: EPA 365.1							
Phosphorus	0.10	mg/L	0.050	1	12/21/18 11:00	12/24/18 09:59	7723-14-0		
4500 Ammonia Water		Analytical Method: SM 4500-NH3 G							
Nitrogen, Ammonia	<0.10	mg/L	0.10	1		12/21/18 17:43	7664-41-7		

REPORT OF LABORATORY ANALYSIS

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QUALITY CONTROL DATA

Project: Portage/Hampton Creek Wetland

Pace Project No.: 50212878

QC Batch: 477135 Analysis Method: SM 4500-NO3 F-11
QC Batch Method: SM 4500-NO3 F-11 Analysis Description: 4500NO3F Nitrate + Nitrite, Unpres.
Associated Lab Samples: 50212878001, 50212878002, 50212878003

METHOD BLANK: 2201982 Matrix: Water

Associated Lab Samples: 50212878001, 50212878002, 50212878003

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Nitrogen, Nitrate	mg/L	<0.050	0.050	12/19/18 14:31	
Nitrogen, Nitrite	mg/L	<0.010	0.010	12/19/18 14:31	
Nitrogen, NO2 plus NO3	mg/L	<0.050	0.050	12/19/18 14:31	

LABORATORY CONTROL SAMPLE: 2201983

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nitrogen, Nitrate	mg/L	0.25	0.25	99	90-110	
Nitrogen, Nitrite	mg/L	0.25	0.26	102	90-110	
Nitrogen, NO2 plus NO3	mg/L	0.5	0.50	100	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2201984 2201985

Parameter	Units	50212688001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Nitrogen, Nitrate	mg/L	1.9	0.5	0.5	2.6	2.6	151	151	90-110	0	20	
Nitrogen, Nitrite	mg/L	0.034	0.25	0.25	0.29	0.29	103	102	68-138	0	20	
Nitrogen, NO2 plus NO3	mg/L	1.9	1	1	2.9	2.9	101	101	90-110	0	20	E

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

REPORT OF LABORATORY ANALYSIS

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QUALITY CONTROL DATA

Project: Portage/Hampton Creek Wetland

Pace Project No.: 50212878

QC Batch:	477172	Analysis Method:	SM 9223B-04
QC Batch Method:	SM 9223B-04	Analysis Description:	9223B MBIO Total Coliform
Associated Lab Samples: 50212878001, 50212878002, 50212878003			

SAMPLE DUPLICATE: 2202147

Parameter	Units	50212878002 Result	Dup Result	RPD	Max RPD	Qualifiers
E.coli	CFU/100 mL	60.5	133.1			
Total Coliforms	CFU/100 mL	143.0	238.2			N2

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

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QUALITY CONTROL DATA

Project: Portage/Hampton Creek Wetland

Pace Project No.: 50212878

QC Batch:	477690	Analysis Method:	EPA 365.1
QC Batch Method:	EPA 365.1	Analysis Description:	365.1 Total Phosphorus
Associated Lab Samples: 50212878001, 50212878002, 50212878003			

METHOD BLANK: 2204795 Matrix: Water

Associated Lab Samples: 50212878001, 50212878002, 50212878003

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Phosphorus	mg/L	<0.050	0.050	12/24/18 09:43	

LABORATORY CONTROL SAMPLE: 2204796

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Phosphorus	mg/L	0.5	0.49	98	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2204797 2204798

Parameter	Units	50212884001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Phosphorus	mg/L	<0.032	0.5	0.5	0.53	0.53	101	101	90-110	0	20	

MATRIX SPIKE SAMPLE: 2204799

Parameter	Units	50213066001 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Phosphorus	mg/L	0.66	0.5	1.2	112	90-110	M0

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

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QUALITY CONTROL DATA

Project: Portage/Hampton Creek Wetland

Pace Project No.: 50212878

QC Batch: 477814 Analysis Method: SM 4500-NH3 G
QC Batch Method: SM 4500-NH3 G Analysis Description: 4500 Ammonia
Associated Lab Samples: 50212878001, 50212878002, 50212878003

METHOD BLANK: 2205772 Matrix: Water

Associated Lab Samples: 50212878001, 50212878002, 50212878003

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Nitrogen, Ammonia	mg/L	<0.10	0.10	12/21/18 17:04	

LABORATORY CONTROL SAMPLE: 2205773

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nitrogen, Ammonia	mg/L	5	5.2	104	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2205774 2205775

Parameter	Units	50212532003 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Nitrogen, Ammonia	mg/L	2.5	5	5	7.4	7.4	99	99	90-110	0	20	

MATRIX SPIKE SAMPLE: 2205776

Parameter	Units	50212674001 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Nitrogen, Ammonia	mg/L	<0.10	5	5.2	104	90-110	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

REPORT OF LABORATORY ANALYSIS

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QUALIFIERS

Project: Portage/Hampton Creek Wetland

Pace Project No.: 50212878

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above adjusted reporting limit.

TNTC - Too Numerous To Count

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PQL - Practical Quantitation Limit.

RL - Reporting Limit - The lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

ANALYTE QUALIFIERS

E Analyte concentration exceeded the calibration range. The reported result is estimated.

M0 Matrix spike recovery and/or matrix spike duplicate recovery was outside laboratory control limits.

N2 The lab does not hold NELAC/TNI accreditation for this parameter.

REPORT OF LABORATORY ANALYSIS

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QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: Portage/Hampton Creek Wetland

Pace Project No.: 50212878

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
50212878001	PH-18-12-SW01(I)	SM 4500-NO3 F-11	477135		
50212878002	PH-18-12-SW02(I)	SM 4500-NO3 F-11	477135		
50212878003	PH-18-12-SW03(I)	SM 4500-NO3 F-11	477135		
50212878001	PH-18-12-SW01(I)	SM 9223B-04	477172	SM 9223B-04	477555
50212878002	PH-18-12-SW02(I)	SM 9223B-04	477172	SM 9223B-04	477555
50212878003	PH-18-12-SW03(I)	SM 9223B-04	477172	SM 9223B-04	477555
50212878001	PH-18-12-SW01(I)	EPA 365.1	477690	EPA 365.1	477958
50212878002	PH-18-12-SW02(I)	EPA 365.1	477690	EPA 365.1	477958
50212878003	PH-18-12-SW03(I)	EPA 365.1	477690	EPA 365.1	477958
50212878001	PH-18-12-SW01(I)	SM 4500-NH3 G	477814		
50212878002	PH-18-12-SW02(I)	SM 4500-NH3 G	477814		
50212878003	PH-18-12-SW03(I)	SM 4500-NH3 G	477814		

REPORT OF LABORATORY ANALYSIS

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Reference:

181663-2018-1219



Sample Conditions Upon Receipt F

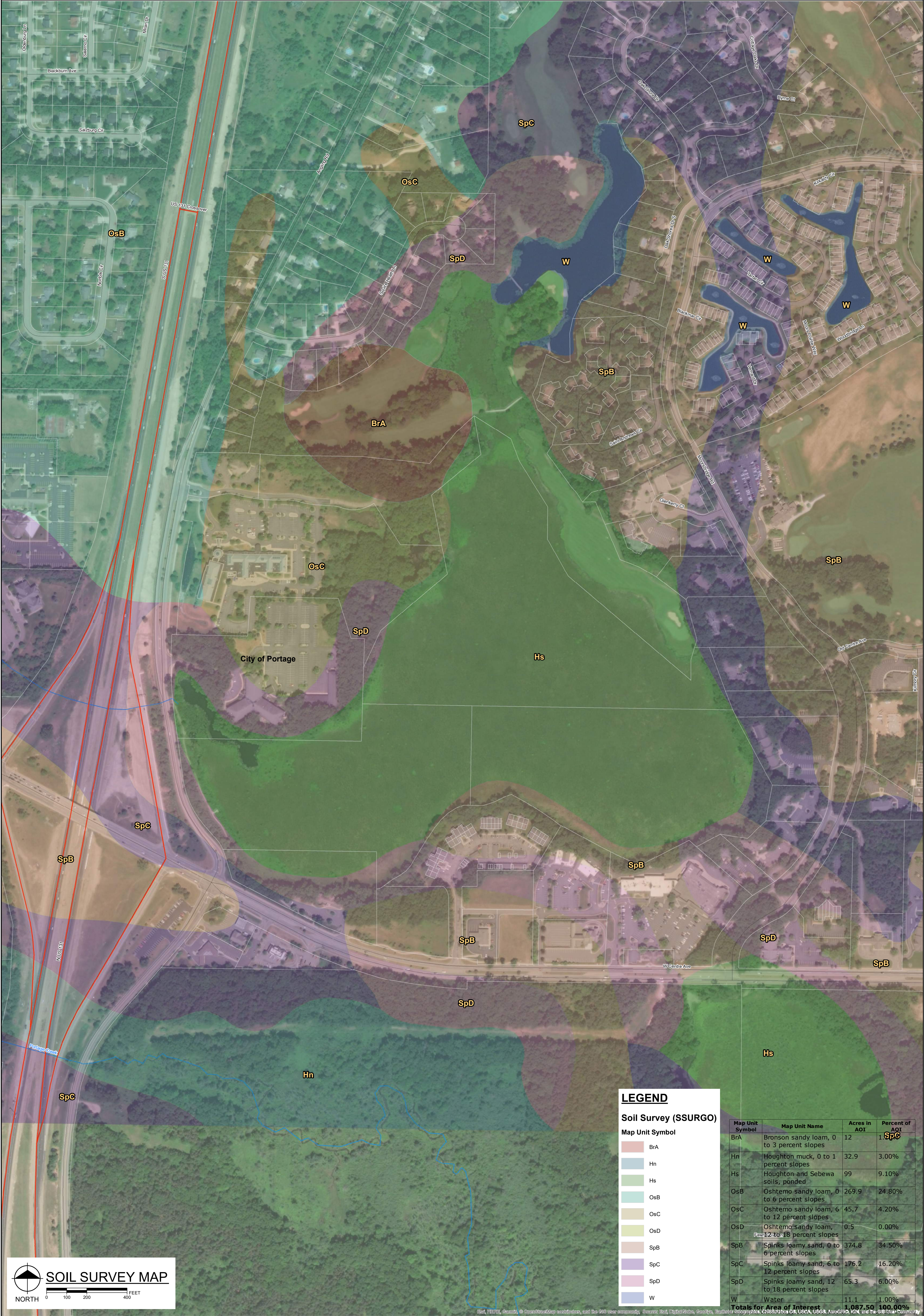
WO# : 50212878

Date: <u>12/19/18</u>	Evaluated by: <u>aw</u>	Affix 1	PM: JLR1	Due Date: 01/03/19
Client: <u>FTCH - Portage</u>		Worl	CLIENT: GR-FTCH	
Profile ID:	Project Manager:			
Sample Receiving Non Conformance Form Required: YES ☒ NO ☐	Rush Turn Around Time Requested: YES ☐ NO ☒			Due Date:
Page <u>1</u> Of <u>1</u>	Lab Notified of Rush or Short Holds: YES ☐ NO ☒			

Lab Sample Receipt Checklist:

Samples Received Via:	FEDEX	UPS	CLIENT	PACE COURIER
Custody Seals Present and Intact:	YES	NO	NA	
USDA Regulated Soils:	YES	NO	NA	
Short Holds Present (< 72 Hours):	YES	NO	NA	
Samples Received in Hold:	YES	NO	NA	
Custody Signatures Present:	YES	NO	NA	
Collector Signature Present:	YES	NO	NA	
Samples Received On Ice:	YES	NO	NA	<u>Bagged</u>
Type of Ice: <u>WET</u> BLUE DRY NONE	YES	NO	NA	
Packing Material Used:	YES	NO	NA	
IR Gun #: <u>202</u> 402 Temp should be 0-6°C				Cooler Temp Upon Receipt: <u>2.7</u> °C
Temp Blank Received:	YES	NO	NA	
Trip Blank Received: Type: HCL MeOH TSP OTHER	YES	NO	NA	
Bottles Intact:	YES	NO	NA	
Correct Bottles:	YES	NO	NA	
Sufficient Volume:	YES	NO	NA	
Sample pH Acceptable: All containers needing preservation are found to be in compliance with EPA recommendation Exceptions are VOA, coliform, TOC, O & G, HEM, DRO	YES	NO	NA	pH Strip Lot Number: <u>H0849164</u>
VOA Headspace Acceptable (<6mm):	YES	NO	NA	
Comments:				

Appendix 2



Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BrA	Bronson sandy loam, 0 to 3 percent slopes	12	1.00%
Hn	Houghton muck, 0 to 1 percent slopes	32.9	3.00%
Hs	Houghton and Sebewa soils, ponded	99	9.10%
OsB	Oshstemo sandy loam, 0 to 6 percent slopes	269.9	24.80%
OsC	Oshstemo sandy loam, 6 to 12 percent slopes	45.7	4.20%
OsD	Oshstemo sandy loam, 12 to 18 percent slopes	0.5	0.00%
SpB	Spinks loamy sand, 0 to 6 percent slopes	374.8	34.50%
SpC	Spinks loamy sand, 6 to 12 percent slopes	176.2	16.20%
SpD	Spinks loamy sand, 12 to 18 percent slopes	65.3	6.00%
W	Water	11.1	1.00%

Totals for Area of Interest 1,087.50 100.00%

Kalamazoo County, Michigan

Hs—Houghton and Sebewa soils, ponded

Map Unit Setting

National map unit symbol: 68nf

Elevation: 360 to 1,000 feet

Mean annual precipitation: 30 to 36 inches

Mean annual air temperature: 45 to 48 degrees F

Frost-free period: 140 to 150 days

Farmland classification: Not prime farmland

Map Unit Composition

Houghton and similar soils: 45 percent

Sebewa and similar soils: 40 percent

Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Houghton

Setting

Landform: Outwash plains, depressions

Landform position (three-dimensional): Dip

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Herbaceous organic material

Typical profile

Oa1 - 0 to 10 inches: muck

Oa2 - 10 to 60 inches: muck

Properties and qualities

Slope: 0 to 1 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Very poorly drained

Runoff class: Very low

Capacity of the most limiting layer to transmit water (Ksat):

Moderately high to high (0.20 to 5.95 in/hr)

Depth to water table: About 0 inches

Frequency of flooding: None

Frequency of ponding: Frequent

Available water storage in profile: Very high (about 23.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 8w

Hydrologic Soil Group: A/D

Hydric soil rating: Yes

Description of Sebewa

Setting

Landform: Outwash plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy over sandy and gravelly outwash

Typical profile

Ap - 0 to 11 inches: loam
Btg - 11 to 23 inches: clay loam
2Cg - 23 to 60 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat):
Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 25 percent
Available water storage in profile: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Adrian

Percent of map unit: 3 percent
Landform: Depressions on lake plains
Hydric soil rating: Yes

Granby

Percent of map unit: 3 percent
Landform: Depressions on lake plains
Hydric soil rating: Yes

Edwards

Percent of map unit: 3 percent
Landform: Depressions on lakebeds
Hydric soil rating: Yes

Glendora

Percent of map unit: 3 percent
Landform: Flood plains
Hydric soil rating: Yes

Gilford

Percent of map unit: 3 percent

Landform: Depressions on outwash plains

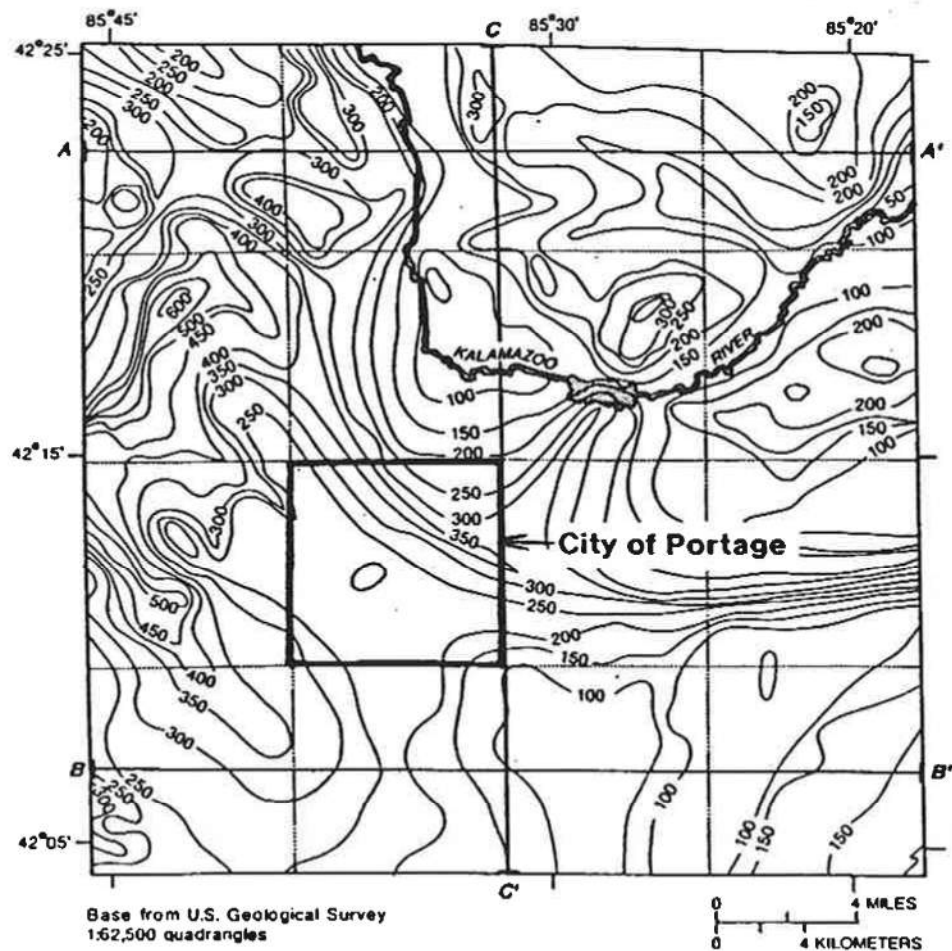
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Kalamazoo County, Michigan

Survey Area Data: Version 13, Sep 6, 2018

Appendix 3



EXPLANATION

—200— LINE OF EQUAL THICKNESS OF GLACIAL DEPOSITS--
Interval 50 feet

A A' LINE OF GEOLOGIC SECTION

FIGURE 2. THICKNESS of GLACIAL DRIFT
after RHEAUME (1990)

Appendix 4

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.



Import ID:

Failure to comply is a misdemeanor.

Tax No:		Permit No:		County: Kalamazoo			Township: Portage	
Well ID: 39000017082 Elevation: Latitude: 42.2061069 Longitude: -85.6348005 Method of Collection: Address Matching-House Number				Town/Range: 03S 11W	Section: 18	Well Status: Active	WSSN:	Source ID/Well No: 12"-05 IRR WELL
				Distance and Direction from Road Intersection: 1/2 MILE SOUTH OF MOORS BRIDGE RD.				
				Well Owner: MOORS GOLF CLUB				
				Well Address: 7877 Moorsbridge Rd PORTAGE, MI 49024			Owner Address: 7877 MOORSBRIDGE RD. PORTAGE, MI 49002-4076	

Drilling Method: Rotary Well Depth: 143.00 ft. Well Type: New	Well Use: Irrigation Date Completed: 2/25/2005	Pump Installed: Yes Pump Installation Date: 3/15/2005 Manufacturer: Other Model Number: 8JLE-6 Drop Pipe Length: 84.00 ft. Drop Pipe Diameter: 6.00 in. Draw Down Seal Used: No	Pump Installation Only: No HP: 60.00 Pump Type: Submersible Pump Capacity: 500 GPM Pump Voltage: Drilling Record ID:
Casing Type: Steel - black Casing Joint: Welded Casing Fitting: Centralizer		Height: 2.00 ft. above grade	
Diameter: 12.00 in. to 123.00 ft. depth		Pressure Tank Installed: No Pressure Relief Valve Installed: No	
Borehole: 20.00 in. to 143.00 ft. depth			

Static Water Level: 35.00 ft. Below Grade Well Yield Test: Pumping level 88.00 ft. after 4.00 hrs. at 1000 GPM Yield Test Method: Test pump	Formation Description	Thickness	Depth to Bottom
	Topsoil	2.00	2.00
	Red Clay	2.00	4.00
	Sand W/Gravel	121.00	125.00
Screen Installed: Yes Screen Diameter: 12.00 in. Screen Material Type: Stainless steel-wire wrapped Slot 80.00 Length 20.00 ft. Set Between 123.00 ft. and 143.00 ft. Filter Packed: Yes Blank: 0.00 ft. Fittings: Other	Clay Sandy	5.00	130.00
	Sand & Gravel	13.00	143.00
Well Grouted: Yes Grouting Material	Grouting Method: Grout pipe outside casing		
	Bags Additives Depth		

Neat cement	125.00	None	0.00 ft. to 115.00 ft.	Geology Remarks:
Wellhead Completion: 12 inches above grade				

Nearest Source of Possible Contamination:	Drilling Machine Operator Name:
Type	JOSEPH KNAUF
Distance	Employment: Employee
Direction	
None	Contractor Type: Water Well Drilling Contractor Reg No: 70-2055
None	Business Name: Raymer Company
	Business Address: 1357 Comstock Street, Marne, MI, 49435
	Water Well Contractor's Certification
	This well was drilled under my supervision and this report is true to the best of my knowledge and belief.
	Signature of Registered Contractor
	Date

General Remarks: Q/s= 18.86 @ 1000 G.P.M.
Other Remarks: Pump Manufacturer:ROBBOCO, Screen Fittings:WELD RING X PLATE, Coordinate Source:Google well address geocoding



Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.



Import ID:

Failure to comply is a misdemeanor.

Tax No:	Permit No:	County: Kalamazoo		Township: Portage	
Well ID: 39000007232 Elevation: 910 ft. Latitude: 42.213123397 Longitude: -85.6362698145 Method of Collection: Interpolation-Map		Town/Range: 03S 11W	Section: 18	Well Status: Active	WSSN:
		Source ID/Well No:			
		Distance and Direction from Road Intersection: 1000' S OF ROMENCE & 500' E OF ANGLING			
		Well Owner: WISLON			
		Well Address: 7210 PRESTWICK PORTAGE, MI 49002		Owner Address: 7210 PRESTWICK PORTAGE, MI 49002	

Drilling Method: Hollow Rod Well Depth: 95.00 ft. Well Type: Replacement Casing Type: Steel - black Casing Joint: Threaded & coupled Casing Fitting: Drive shoe Diameter: 4.00 in. to 90.00 ft. depth Borehole:		Well Use: Household Date Completed: 12/9/1983 Height:		Pump Installed: Yes Pump Installation Date: Manufacturer: Other Model Number: Drop Pipe Length: 63.00 ft. Drop Pipe Diameter: Draw Down Seal Used: No Pressure Tank Installed: No Pressure Relief Valve Installed: No		Pump Installation Only: No HP: Pump Type: Submersible Pump Capacity: 0 GPM Pump Voltage: Drilling Record ID:																																																
Static Water Level: 41.00 ft. Below Grade Well Yield Test: Pumping level 41.00 ft. after 0.00 hrs. at 39 GPM Pumping level 40.00 ft. after 1.00 hrs. at 39 GPM		Yield Test Method: Unknown		<table border="1"> <thead> <tr> <th>Formation Description</th> <th>Thickness</th> <th>Depth to Bottom</th> </tr> </thead> <tbody> <tr><td>Topsoil W/Sand W/Gravel</td><td>18.00</td><td>18.00</td></tr> <tr><td>Sand & Gravel Fine</td><td>18.00</td><td>36.00</td></tr> <tr><td>Sand & Gravel Fine To Coarse</td><td>18.00</td><td>54.00</td></tr> <tr><td>Sand & Gravel Coarse Water Bearing</td><td>18.00</td><td>72.00</td></tr> <tr><td>Sand Wet/Moist</td><td>23.00</td><td>95.00</td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </tbody> </table>		Formation Description	Thickness	Depth to Bottom	Topsoil W/Sand W/Gravel	18.00	18.00	Sand & Gravel Fine	18.00	36.00	Sand & Gravel Fine To Coarse	18.00	54.00	Sand & Gravel Coarse Water Bearing	18.00	72.00	Sand Wet/Moist	23.00	95.00																												Screen Installed: Yes Screen Diameter: 3.00 in. Screen Material Type: Unknown Slot Length Set Between 10.00 4.00 ft. 90.00 ft. and 95.00 ft. Fittings: Neoprene packer		Filter Packed: No Blank: 0.00 ft. Above	
Formation Description	Thickness	Depth to Bottom																																																				
Topsoil W/Sand W/Gravel	18.00	18.00																																																				
Sand & Gravel Fine	18.00	36.00																																																				
Sand & Gravel Fine To Coarse	18.00	54.00																																																				
Sand & Gravel Coarse Water Bearing	18.00	72.00																																																				
Sand Wet/Moist	23.00	95.00																																																				
Well Grouted: No		Wellhead Completion: Other, 12 inches above grade		Geology Remarks:																																																		
Nearest Source of Possible Contamination: Type Distance Direction Septic tank 75 ft. Southwest		Drilling Machine Operator Name: Stan Keene Employment: Employee		Contractor Type: Water Well Drilling Contractor Reg No:																																																		
Abandoned Well Plugged: No Reason Not Plugged: Other		Business Name: Business Address: 1803 Lincoln Road, Allegan, MI, 49010		Water Well Contractor's Certification This well was drilled under my supervision and this report is true to the best of my knowledge and belief. Signature of Registered Contractor Date																																																		
General Remarks:																																																						
Other Remarks: Wellhead Completion:12 inch Above Grade, Pump Manufacturer:STANDARD, Not Plugged Reason:New Construction																																																						



Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.



Import ID: 39731118036

Failure to comply is a misdemeanor.

Tax No:	Permit No:	County: Kalamazoo		Township: Portage	
Well ID: 39000007238 Elevation: 912 ft. Latitude: 42.2108704596 Longitude: -85.638048317 Method of Collection: Interpolation-Map		Town/Range: 03S 11W	Section: 18	Well Status:	WSSN:
		Source ID/Well No:			
		Distance and Direction from Road Intersection: 1750' S OF ROMENCE & 400' E OF ANGLING			
		Well Owner: GRIFFIN			
		Well Address: 7340 PRESTWICK PORTAGE, MI 49002		Owner Address: 7340 PRESTWICK PORTAGE, MI 49002	

Drilling Method: Hollow Rod Well Depth: 85.00 ft. Well Type: Replacement Casing Type: Steel - black Casing Joint: Threaded & coupled Casing Fitting: Drive shoe Diameter: 4.00 in. to 80.00 ft. depth Borehole:		Well Use: Household Date Completed: 4/13/1984 Height:		Pump Installed: Yes Pump Installation Date: Manufacturer: Other Model Number: Drop Pipe Length: 65.00 ft. Drop Pipe Diameter: Draw Down Seal Used: No Pressure Tank Installed: No Pressure Relief Valve Installed: No		Pump Installation Only: No HP: Pump Type: Submersible Pump Capacity: 0 GPM Pump Voltage: Drilling Record ID:																																														
Static Water Level: 30.00 ft. Below Grade Well Yield Test: Pumping level 80.00 ft. after 0.00 hrs. at 35 GPM Pumping level 80.00 ft. after 2.00 hrs. at 35 GPM		Yield Test Method: Unknown		<table border="1"> <thead> <tr> <th>Formation Description</th> <th>Thickness</th> <th>Depth to Bottom</th> </tr> </thead> <tbody> <tr><td>Topsoil W/Sand W/Gravel</td><td>18.00</td><td>18.00</td></tr> <tr><td>Sand & Gravel Fine</td><td>18.00</td><td>36.00</td></tr> <tr><td>Sand & Gravel Coarse</td><td>18.00</td><td>54.00</td></tr> <tr><td>Sand & Gravel W/Stones</td><td>18.00</td><td>72.00</td></tr> <tr><td>Sand & Gravel Wet/Moist W/Stones</td><td>13.00</td><td>85.00</td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </tbody> </table>		Formation Description	Thickness	Depth to Bottom	Topsoil W/Sand W/Gravel	18.00	18.00	Sand & Gravel Fine	18.00	36.00	Sand & Gravel Coarse	18.00	54.00	Sand & Gravel W/Stones	18.00	72.00	Sand & Gravel Wet/Moist W/Stones	13.00	85.00																													
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Screen Installed: Yes Screen Diameter: 3.00 in. Screen Material Type: Slot Length Set Between 10.00 4.00 ft. 80.00 ft. and 85.00 ft. Fittings: Neoprene packer		Filter Packed: No Blank: 3.00 ft. Above																																																		
Well Grouted: No																																																				
Wellhead Completion: Other, 12 inches above grade																																																				
Nearest Source of Possible Contamination: <table border="1"> <thead> <tr> <th>Type</th> <th>Distance</th> <th>Direction</th> </tr> </thead> <tbody> <tr> <td>Septic tank</td> <td>65 ft.</td> <td>South</td> </tr> </tbody> </table>		Type	Distance	Direction	Septic tank	65 ft.	South			Drilling Machine Operator Name: Employment: Unknown																																										
Type	Distance	Direction																																																		
Septic tank	65 ft.	South																																																		
Abandoned Well Plugged: No Reason Not Plugged:				Contractor Type: Unknown Business Name: Business Address:		Reg No:																																														
				Water Well Contractor's Certification This well was drilled under my supervision and this report is true to the best of my knowledge and belief.																																																
				Signature of Registered Contractor		Date																																														
General Remarks:																																																				
Other Remarks: Wellhead Completion:12 inch Above Grade, Pump Manufacturer:STANDARD																																																				

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.



Import ID: 39731118042

Failure to comply is a misdemeanor.

Tax No: 03761110042		Permit No:		County: Kalamazoo			Township: Portage		
Well ID: 39000007244 Elevation: 890 ft. Latitude: 42.2075351255 Longitude: -85.6389431223 Method of Collection: Interpolation-Map				Town/Range: 03S 11W	Section: 18	Well Status:	WSSN:	Source ID/Well No:	
				Distance and Direction from Road Intersection:					
				Well Owner:					
				Well Address: 4191 SQUIRE HEATH PORTAGE, MI 49002			Owner Address: 4191 SQUIRE HEATH PORTAGE, MI 49002		

Drilling Method: Cable Tool	Pump Installed: Yes	Pump Installation Only: No
Well Depth: 94.00 ft.	Pump Installation Date:	HP:
Well Type: Replacement	Manufacturer: Sta-Rite	Pump Type: Submersible
Date Completed: 10/24/1984	Model Number:	Pump Capacity: 0 GPM
Casing Type: Steel - black	Drop Pipe Length: 52.00 ft.	Pump Voltage:
Casing Joint: Threaded & coupled	Drop Pipe Diameter:	Drilling Record ID:
Casing Fitting: Drive shoe	Draw Down Seal Used: No	
Diameter: 4.00 in. to 88.00 ft. depth	Pressure Tank Installed: No	
Borehole:	Pressure Relief Valve Installed: No	

Static Water Level: 40.00 ft. Below Grade Well Yield Test: Yield Test Method: Unknown Pumping level 40.00 ft. after 1.00 hrs. at 57 GPM	Formation Description	Thickness	Depth to Bottom
	Sand & Gravel	40.00	40.00
	Sand & Gravel	54.00	94.00

Screen Installed: Yes	Filter Packed: No		
Screen Diameter: 4.00 in.	Blank: 0.00 ft. Above		
Screen Material Type:			
Slot	Length	Set Between	
12.00	6.00 ft.	88.00 ft. and 94.00 ft.	
Fittings: Neoprene packer			

Well Grouted: Yes Grouting Method: Unknown						
Grouting Material	Bags	Additives	Depth			
Bentonite slurry	0.00	None	0.00 ft. to 40.00 ft.	Geology Remarks:		

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:			Drilling Machine Operator Name:
Type	Distance	Direction	Employment: Unknown
Septic tank	90 ft.	South	
			Contractor Type: Unknown Reg No: 80-0112

Abandoned Well Plugged: No	Business Name:
Reason Not Plugged:	Business Address:

	Water Well Contractor's Certification This well was drilled under my supervision and this report is true to the best of my knowledge and belief.
	Signature of Registered Contractor
	Date

General Remarks:
Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.



Import ID:

Failure to comply is a misdemeanor.

Tax No:		Permit No:		County: Kalamazoo			Township: Portage	
Well ID: 39000011464 Elevation: 899 ft. Latitude: 42.215574 Longitude: -85.634586 Method of Collection: Address Matching-House Number				Town/Range: 03S 11W	Section: 18	Well Status:	WSSN:	Source ID/Well No:
				Distance and Direction from Road Intersection:				
				Well Owner: AMERICAN VILLAGE BLDG				
				Well Address: 3805 ROMENCE PORTAGE, MI 49002			Owner Address: 4200 WEST CENTRE PORTAGE, MI 49002	

Drilling Method: Cable Tool Well Depth: 91.00 ft. Well Type: New	Well Use: Household Date Completed: 1/22/1997	Pump Installed: Yes Pump Installation Date: Manufacturer: Sta-Rite Model Number: Drop Pipe Length: 63.00 ft. Drop Pipe Diameter: Draw Down Seal Used: No	Pump Installation Only: No HP: 1.00 Pump Type: Submersible Pump Capacity: 20 GPM Pump Voltage: Drilling Record ID:
Casing Type: Steel - black Casing Joint: Threaded & coupled Casing Fitting: Drive shoe	Height:	Pressure Tank Installed: Yes Pressure Tank Type: Unknown Manufacturer: Well-Mate Model Number: Pressure Relief Valve Installed: No	Tank Capacity: 14.0 Gallons
Diameter: 4.00 in. to 85.00 ft. depth			
Borehole:			

Static Water Level: 33.00 ft. Below Grade Well Yield Test: Yield Test Method: Plunger Pumping level 33.00 ft. after 1.00 hrs. at 50 GPM	Formation Description	Thickness	Depth to Bottom
	Sand Dry	35.00	35.00
	Sand Coarse Wet/Moist	56.00	91.00

Screen Installed: Yes	Filter Packed: No		
Screen Diameter: 4.00 in.	Blank: 1.00 ft. Above		
Screen Material Type:			
Slot	Length	Set Between	
10.00	6.00 ft.	85.00 ft. and 91.00 ft.	
Fittings: Neoprene packer			

Well Grouted: Yes Grouting Method: Unknown						
Grouting Material	Bags	Additives	Depth			
Unknown	4.00	Other	0.00 ft. to 25.00 ft.	Geology Remarks:		

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination: Type Distance Direction Septic tank 80 ft. East			Drilling Machine Operator Name: CHARLIE JR. Employment: Employee	
			Contractor Type: Water Well Drilling Contractor Reg No: 80-0112	

	Business Name: EARL SANDERS Business Address:
	Water Well Contractor's Certification This well was drilled under my supervision and this report is true to the best of my knowledge and belief.
	Signature of Registered Contractor Date

General Remarks:
Other Remarks: Grouting Additive 1:Bentonite, Screen Fittings:Blank Above Screen



Water Well And Pump Record



Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

Import ID: 39731120003

Tax No:	Permit No:	County: Kalamazoo	Township: Portage			
Well ID: 39000007315 Elevation: 890 ft. Latitude: 42.2004373189 Longitude: -85.627478665 Method of Collection: Interpolation-Map		Town/Range: 03S 11W	Section: 20	Well Status:	WSSN:	
		Source ID/Well No:				
		Distance and Direction from Road Intersection: 300' E OF COOLEY & 150' S OF CENTRE				
		Well Owner: CLENNA SIPPLE				
		Well Address: 3205 CENTRE PORTAGE, MI 49002		Owner Address: 3205 CENTRE PORTAGE, MI 49002		

Drilling Method: Jetted Well Depth: 49.00 ft. Well Type: Replacement Casing Type: Steel - black Casing Joint: Threaded & coupled Casing Fitting: Drive shoe Diameter: 2.00 in. to 46.00 ft. depth Borehole:		Well Use: Household Date Completed: 5/18/1976 Height:		Pump Installed: Yes Pump Installation Date: Manufacturer: Tait Model Number: Drop Pipe Length: 36.00 ft. Drop Pipe Diameter: Draw Down Seal Used: No Pressure Tank Installed: No Pressure Relief Valve Installed: No		Pump Installation Only: No HP: Pump Type: Jet Pump Capacity: 0 GPM Pump Voltage: Drilling Record ID:																																														
Static Water Level: 32.00 ft. Below Grade Well Yield Test: Pumping level 34.00 ft. after 1.00 hrs. at 12 GPM Pumping level 34.00 ft. after 1.00 hrs. at 12 GPM		Yield Test Method: Unknown		<table border="1"> <thead> <tr> <th>Formation Description</th> <th>Thickness</th> <th>Depth to Bottom</th> </tr> </thead> <tbody> <tr><td>Brown Sand & Clay</td><td>5.00</td><td>5.00</td></tr> <tr><td>Sand & Gravel</td><td>36.00</td><td>41.00</td></tr> <tr><td>Brown Clay</td><td>4.00</td><td>45.00</td></tr> <tr><td>Sand</td><td>4.00</td><td>49.00</td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </tbody> </table>		Formation Description	Thickness	Depth to Bottom	Brown Sand & Clay	5.00	5.00	Sand & Gravel	36.00	41.00	Brown Clay	4.00	45.00	Sand	4.00	49.00																																
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Screen Installed: Yes Screen Diameter: 1.25 in. Screen Material Type: Slot Length Set Between 10.00 3.50 ft. 45.50 ft. and 49.00 ft. Fittings: Neoprene packer		Filter Packed: No Blank: 0.00 ft. Above																																																		
Well Grouted: No																																																				
Wellhead Completion: Pitless adapter																																																				
Nearest Source of Possible Contamination: <table border="1"> <thead> <tr> <th>Type</th> <th>Distance</th> <th>Direction</th> </tr> </thead> <tbody> <tr> <td>Septic tank</td> <td>65 ft.</td> <td>South</td> </tr> </tbody> </table>		Type	Distance	Direction	Septic tank	65 ft.	South			Drilling Machine Operator Name: Employment: Unknown																																										
Type	Distance	Direction																																																		
Septic tank	65 ft.	South																																																		
Abandoned Well Plugged: No Reason Not Plugged:				Contractor Type: Unknown Business Name: Business Address:		Reg No:																																														
				Water Well Contractor's Certification This well was drilled under my supervision and this report is true to the best of my knowledge and belief.																																																
				Signature of Registered Contractor		Date																																														
General Remarks:																																																				
Other Remarks:																																																				



Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.



Import ID:

Failure to comply is a misdemeanor.

Tax No:	Permit No: NOT NEEDED	County: Kalamazoo		Township: Portage	
Well ID: 39000016634 Elevation: 899 ft. Latitude: 42.20192421 Longitude: -85.62943153 Method of Collection: Interpolation-Map		Town/Range: 03S 11W	Section: 18	Well Status: Active	WSSN:
		Source ID/Well No:			
		Distance and Direction from Road Intersection: GOING NROTH ON 131, GO TO CENTRE AVE EXIT, TURN RIGHT ON CENTRE AVE, GO TO THE MOORS			
		Well Owner: LAKE OF WOODBRIDGE CONDOS			
		Well Address: 7950 MOORS BRIDGE RD PORTAGE, MI 49024		Owner Address: 7950 MOORS BRIDGE RD PORTAGE, MI 49024	

Drilling Method: Rotary	Well Use: Irrigation	Pump Installed: Yes	Pump Installation Only: No
Well Depth: 70.00 ft.	Date Completed: 5/20/2004	Pump Installation Date: 5/20/2004	HP: 2.00
Well Type: New		Manufacturer: F.E. Myers	Pump Type: Submersible
Casing Type: PVC plastic	Height:	Model Number: SS50-20	Pump Capacity: 35 GPM
Casing Joint: Solvent welded/glued		Drop Pipe Length: 55.00 ft.	Pump Voltage:
Casing Fitting: None		Drop Pipe Diameter:	Drilling Record ID:
Diameter: 5.00 in. to 60.00 ft. depth		Draw Down Seal Used: No	
Borehole: 7.80 in. to 70.00 ft. depth		Pressure Tank Installed: No	
		Pressure Relief Valve Installed: No	

Static Water Level: 24.00 ft. Below Grade	Formation Description	Thickness	Depth to Bottom
Well Yield Test:			
Yield Test Method: Air	Topsoil	1.00	1.00
Pumping level 50.00 ft. after 1.00 hrs. at 70 GPM	Sand	41.00	42.00
	Sand & Gravel	29.00	71.00

Screen Installed: Yes	Filter Packed: Yes
Screen Diameter: 4.00 in.	Blank: *u
Screen Material Type: PVC-slotted	
Slot	Length
16.00	10.00 ft.
Set Between	
60.00 ft. and 70.00 ft.	
Fittings: Other	

Well Grouted: Yes	Grouting Method: Unknown
Grouting Material	Bags
Bentonite slurry	4.00
Additives	Depth
None	

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:	Drilling Machine Operator Name: JAMES WHITAKER
Type	Employment: Employee
Sewer line	
Distance	
12 ft.	
Direction	
Northwest	

Contractor Type: Water Well Drilling Contractor	Reg No: 14-1699
Business Name: J.W. BOWLES WELL DRILLING	
Business Address:	
Water Well Contractor's Certification	
This well was drilled under my supervision and this report is true to the best of my knowledge and belief.	
Signature of Registered Contractor	Date

General Remarks:
Other Remarks: Screen Fittings: GLUED TO CASING



Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.



Import ID:

Failure to comply is a misdemeanor.

Tax No:	Permit No:	County: Kalamazoo		Township: Portage	
Well ID: 39000017080 Elevation: Latitude: 42.202991 Longitude: -85.633037 Method of Collection: Address Matching-House Number		Town/Range: 03S 11W	Section: 18	Well Status: Active	WSSN:
		Source ID/Well No: 5			
		Distance and Direction from Road Intersection: 1/2 MILE EAST OF 131 - 1/2 MILE NORTH OF CENTRE AVE. - 1/4 MILE EAST OF MOORS BRIDGE RD.			
		Well Owner: MOORS GOLF CLUB			
		Well Address: 7877 MOORS BRIDGE RD. PORTAGE, MI 49002-4076		Owner Address: 7877 MOORS BRIDGE RD. PORTAGE, MI 49002-4076	

Drilling Method: Rotary	Well Use: Irrigation	Pump Installed: Yes	Pump Installation Only: No
Well Depth: 107.00 ft.	Date Completed: 1/27/2005	Pump Installation Date: 3/15/2005	HP: 3.00
Well Type: New	Height: 1.00 ft. above grade	Manufacturer: Berkeley	Pump Type: Submersible
Casing Type: PVC plastic		Model Number: L30P4	Pump Capacity: 25 GPM
Casing Joint: Solvent welded/glued		Drop Pipe Length: 63.00 ft.	Pump Voltage:
Casing Fitting: Centralizer		Drop Pipe Diameter: 2.00 in.	Drilling Record ID:
		Draw Down Seal Used: No	
Diameter: 5.00 in. to 97.00 ft. depth		Pressure Tank Installed: No	
		Pressure Relief Valve Installed: No	
Borehole: 8.75 in. to 107.00 ft. depth			

Static Water Level: 39.00 ft. Below Grade	Yield Test Method: Test pump	Formation Description	Thickness	Depth to Bottom
Well Yield Test: Pumping level 43.00 ft. after 2.00 hrs. at 80 GPM		Clay & Gravel	8.00	8.00
		Sand & Gravel	99.00	107.00
Screen Installed: Yes	Filter Packed: Yes			
Screen Diameter: 5.00 in.	Blank: 0.00 ft.			
Screen Material Type: PVC-slotted				
Slot	Length	Set Between		
20.00	10.00 ft.	97.00 ft. and 107.00 ft.		
Fittings: Other				
Well Grouted: Yes	Grouting Method: Grout pipe outside casing			
Grouting Material	Bags	Additives	Depth	
Bentonite slurry	9.00	None	0.00 ft. to 90.00 ft.	

Wellhead Completion: 12 inches above grade	Geology Remarks:

Nearest Source of Possible Contamination:	Drilling Machine Operator Name: JACOB WARNER
Type	Employment: Employee
None	
None	
	Contractor Type: Water Well Drilling Contractor Reg No: 70-2055
	Business Name: Raymer Company
	Business Address: 1357 Comstock Street, Marne, MI, 49435
	Water Well Contractor's Certification
	This well was drilled under my supervision and this report is true to the best of my knowledge and belief.
	Signature of Registered Contractor Date

General Remarks: Q/s= 20
Other Remarks: Screen Fittings:BELL END X CAP, Map Scale:Unknown



Failure to comply is a misdemeanor.

Import ID: 39731118005



Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.



Import ID: 39731118018

Failure to comply is a misdemeanor.

Tax No:	Permit No:	County: Kalamazoo		Township: Portage	
Well ID: 39000007220 Elevation: 908 ft. Latitude: 42.2072622481 Longitude: -85.6301168701 Method of Collection: Interpolation-Map		Town/Range: 03S 11W	Section: 18	Well Status:	WSSN:
		Source ID/Well No:			
		Distance and Direction from Road Intersection: 3000' S OF ROMENCE & 400' W OF 14TH			
		Well Owner: GESMUNDO REALTORS			
		Well Address: ROMENCE ROAD PORTAGE, MI 49002		Owner Address: MOORS INDEMENT GROUP PORTAGE, MI 49002	

Drilling Method: Cable Tool Well Depth: 148.00 ft. Well Type: Replacement Casing Type: PVC plastic Casing Joint: Welded Casing Fitting: Drive shoe Diameter: 12.00 in. to 103.00 ft. depth Borehole:	Well Use: Irrigation Date Completed: 8/6/1978 Height: 2.00 ft. above grade	Pump Installed: Yes Pump Installation Date: Manufacturer: Other Model Number: Drop Pipe Length: 105.00 ft. Drop Pipe Diameter: Draw Down Seal Used: No	Pump Installation Only: No HP: Pump Type: Other Pump Capacity: 0 GPM Pump Voltage: Drilling Record ID:
		Pressure Tank Installed: No Pressure Relief Valve Installed: No	

Static Water Level: 35.00 ft. Below Grade Well Yield Test: Pumping level 67.00 ft. after 4.00 hrs. at 800 GPM Yield Test Method: Unknown	<table border="1"> <thead> <tr> <th>Formation Description</th> <th>Thickness</th> <th>Depth to Bottom</th> </tr> </thead> <tbody> <tr><td>Loam Sandy</td><td>2.00</td><td>2.00</td></tr> <tr><td>Sand & Clay</td><td>30.00</td><td>32.00</td></tr> <tr><td>Sand Fine</td><td>19.00</td><td>51.00</td></tr> <tr><td>Sand</td><td>40.00</td><td>91.00</td></tr> <tr><td>Sand & Gravel</td><td>21.00</td><td>112.00</td></tr> <tr><td>Sand</td><td>19.00</td><td>131.00</td></tr> <tr><td>Sand & Gravel</td><td>18.00</td><td>149.00</td></tr> <tr><td>Clay</td><td>8.00</td><td>157.00</td></tr> <tr><td>Sand</td><td>11.00</td><td>168.00</td></tr> <tr><td>Sand & Gravel</td><td>7.00</td><td>175.00</td></tr> <tr><td>Clay</td><td>5.00</td><td>180.00</td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </tbody> </table>	Formation Description	Thickness	Depth to Bottom	Loam Sandy	2.00	2.00	Sand & Clay	30.00	32.00	Sand Fine	19.00	51.00	Sand	40.00	91.00	Sand & Gravel	21.00	112.00	Sand	19.00	131.00	Sand & Gravel	18.00	149.00	Clay	8.00	157.00	Sand	11.00	168.00	Sand & Gravel	7.00	175.00	Clay	5.00	180.00									
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Sand	11.00	168.00																																												
Sand & Gravel	7.00	175.00																																												
Clay	5.00	180.00																																												
Screen Installed: Yes Screen Diameter: 12.00 in. Screen Material Type: Slot Length Set Between 80.00 30.00 ft. 103.00 ft. and 148.00 ft. Fittings: None	Filter Packed: No Blank: 0.00 ft. Above																																													
Well Grouted: Yes Grouting Material: Bentonite slurry Bags: 0.00 Additives: None Depth: 0.00 ft. to 60.00 ft.	Grouting Method: Unknown																																													

Wellhead Completion: Other, 12 inches above grade	Geology Remarks:

Nearest Source of Possible Contamination: Type: Unknown Distance: 0 ft. Direction:	Drilling Machine Operator Name: Employment: Unknown
Abandoned Well Plugged: No Reason Not Plugged:	Contractor Type: Unknown Business Name: Business Address:

Water Well Contractor's Certification This well was drilled under my supervision and this report is true to the best of my knowledge and belief. Signature of Registered Contractor	Date
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General Remarks: Other Remarks: Wellhead Completion:12 inch Above Grade, Pump Manufacturer:PEERLESS, Pump Type:Type Unknown
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Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.



Import ID: 39731118042

Failure to comply is a misdemeanor.

Tax No: 03761110042		Permit No:		County: Kalamazoo			Township: Portage		
Well ID: 39000007244 Elevation: 890 ft. Latitude: 42.2075351255 Longitude: -85.6389431223 Method of Collection: Interpolation-Map				Town/Range: 03S 11W	Section: 18	Well Status:	WSSN:	Source ID/Well No:	
				Distance and Direction from Road Intersection:					
				Well Owner:					
				Well Address: 4191 SQUIRE HEATH PORTAGE, MI 49002			Owner Address: 4191 SQUIRE HEATH PORTAGE, MI 49002		

Drilling Method: Cable Tool Well Depth: 94.00 ft. Well Type: Replacement Casing Type: Steel - black Casing Joint: Threaded & coupled Casing Fitting: Drive shoe Diameter: 4.00 in. to 88.00 ft. depth Borehole:	Well Use: Household Date Completed: 10/24/1984 Height:	Pump Installed: Yes Pump Installation Date: Manufacturer: Sta-Rite Model Number: Drop Pipe Length: 52.00 ft. Drop Pipe Diameter: Draw Down Seal Used: No Pressure Tank Installed: No Pressure Relief Valve Installed: No	Pump Installation Only: No HP: Pump Type: Submersible Pump Capacity: 0 GPM Pump Voltage: Drilling Record ID:
--	---	---	---

Static Water Level: 40.00 ft. Below Grade Well Yield Test: Yield Test Method: Unknown Pumping level 40.00 ft. after 1.00 hrs. at 57 GPM	Formation Description	Thickness	Depth to Bottom
	Sand & Gravel	40.00	40.00
	Sand & Gravel	54.00	94.00

Screen Installed: Yes	Filter Packed: No		
Screen Diameter: 4.00 in.	Blank: 0.00 ft. Above		
Screen Material Type:			
Slot	Length	Set Between	
12.00	6.00 ft.	88.00 ft. and 94.00 ft.	
Fittings: Neoprene packer			

Well Grouted: Yes Grouting Method: Unknown						
Grouting Material	Bags	Additives	Depth			
Bentonite slurry	0.00	None	0.00 ft. to 40.00 ft.	Geology Remarks:		

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:			Drilling Machine Operator Name:
Type	Distance	Direction	Employment: Unknown
Septic tank	90 ft.	South	
			Contractor Type: Unknown Reg No: 80-0112

Abandoned Well Plugged: No	Business Name:
Reason Not Plugged:	Business Address:

	Water Well Contractor's Certification This well was drilled under my supervision and this report is true to the best of my knowledge and belief.
	Signature of Registered Contractor
	Date

General Remarks:
Other Remarks:



Water Well And Pump Record



Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

Import ID: 39731118050

Tax No:	Permit No:	County: Kalamazoo		Township: Portage	
Well ID: 39000007252 Elevation: 918 ft. Latitude: 42.2075054964 Longitude: -85.6478019077 Method of Collection: Interpolation-Map		Town/Range: 03S 11W	Section: 18	Well Status:	WSSN:
		Source ID/Well No:			
		Distance and Direction from Road Intersection: 100' E OF 12TH STREET & 100' S OF NORFOLK			
		Well Owner: DELBERT HAMBLBY			
		Well Address: 7581 12TH STREET SOUTH PORTAGE, MI 49002		Owner Address: 7425 QUAIL STREET PORTAGE, MI 49002	

Drilling Method: Jetted		Pump Installed: Yes		Pump Installation Only: No	
Well Depth: 81.00 ft.		Pump Installation Date:		HP:	
Well Type: Replacement		Manufacturer: Tait		Pump Type: Submersible	
Well Use: Household		Model Number:		Pump Capacity: 0 GPM	
Date Completed: 4/12/1972		Drop Pipe Length: 63.00 ft.		Pump Voltage:	
Casing Type: Steel - black		Drop Pipe Diameter:		Drilling Record ID:	
Casing Joint: Threaded & coupled		Draw Down Seal Used: No			
Casing Fitting: Drive shoe		Pressure Tank Installed: No			
Diameter: 4.00 in. to 0.00 ft. depth		Pressure Relief Valve Installed: No			
Borehole:					
Static Water Level: 58.00 ft. Below Grade		Formation Description		Thickness	Depth to Bottom
Well Yield Test:		Yield Test Method: Unknown			
		Sand & Gravel		56.00	56.00
		Sand Fine		19.00	75.00
		Sand Coarse		6.00	81.00
Screen Installed: Yes		Filter Packed: No			
Screen Diameter: 4.00 in.		Blank: 0.00 ft. Above			
Screen Material Type:					
Slot	Length	Set Between			
12.00	5.00 ft.	0.00 ft. and 0.00 ft.			
Fittings: Neoprene packer					
Well Grouted: Yes		Grouting Method: Unknown			
Grouting Material	Bags	Additives	Depth		
Unknown	0.00	None	0.00 ft. to 0.00 ft.		
Wellhead Completion: Pitless adapter		Geology Remarks:			
Nearest Source of Possible Contamination:		Drilling Machine Operator Name:			
Type	Distance	Direction	Employment: Unknown		
Septic tank	75 ft.	Southeast			
Abandoned Well Plugged: No		Contractor Type: Unknown		Reg No:	
Reason Not Plugged:		Business Name:		Business Address:	
		Water Well Contractor's Certification			
		This well was drilled under my supervision and this report is true to the best of my knowledge and belief.			
		Signature of Registered Contractor		Date	
General Remarks:					
Other Remarks:					

Appendix 5

Hydrograph Data
Portage, Michigan, Site

