

# Hydrogeologic Investigation Work Plan

Parchment, Michigan



**TETRA TECH**

**#117-4124071**  
October 19, 2018

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## PRESENTED BY

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## ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
CORS	Continuously Operating Reference Station
DO	Dissolved Oxygen
EPA	United States Environmental Protection Agency
GPS	Global Positioning System
ID	Location Identifier
IDW	Investigation Derived Waste
LLC	Limited Liability Corporation
MDEQ	Michigan Department of Environmental Quality
MDOT	Michigan Department of Transportation
mg/L	Milligrams per Liter
MS/MSD	Matrix Spike and Matrix Spike Duplicate
NAD	North American Datum
NAVD	North American Vertical Datum
n/L	Nanograms/liter
ORP	Oxidation-Reduction Potential
PFAS	Perfluoroalkyl and Polyfluoroalkyl Substances
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane Sulfonate
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
ROW	Rights of Way
SOP	Standard Operating Procedure
SWP	Safe Work Practice
TCLP	Toxic Characteristic Leaching Procedure
VOCs	Volatile Organic Compounds

## 1.0 INTRODUCTION

On behalf of Georgia-Pacific LLC, Tetra Tech, Inc. (Tetra Tech), has prepared this Hydrogeologic Investigation Work Plan (work plan) to detail the hydrogeologic investigation of the presence of perfluoroalkyl and polyfluoroalkyl substances (PFAS) in relation to portions of Kalamazoo Township and Cooper Township east of the Kalamazoo river, including the city of Parchment (study area). A location map depicting the study area is presented in **Figure 1**. The Michigan Department of Environmental Quality (MDEQ) identified PFAS concentrations in groundwater samples collected from the City of Parchment municipal wells, select residential wells and monitoring wells located at the former Crown Vantage paper mill and associated landfills. These impacts were identified during sampling events that were completed by MDEQ and their contractors June through September 2018. This work plan provides a scope of work to initiate a hydrogeological investigation to determine the nature and extent of the PFAS impact. A description of the study area, well locations, investigation methodologies and reporting are provided. A Sampling and Analysis Plan, MDEQ's PFAS Minimum Laboratory Analyte List, applicable Tetra Tech Standard Operating Procedures, and select residential well logs located in proximity to proposed monitoring well locations, are included as attachments.

## 2.0 PROJECT OBJECTIVES AND SCOPE OF WORK

A hydrogeological investigation of the study area will be completed to evaluate the nature and extent of PFAS in groundwater that have been detected in the City of Parchment municipal wells and that were subsequently detected at the nearby former Crown Vantage paper mill and associated landfills, as well as nearby properties. Locations where drinking water or groundwater samples have been collected and tested for PFAS during investigations conducted by MDEQ, are presented in **Figure 2** and are color coded based on the measured concentration of perfluorooctanoic acid (PFOA) plus perfluorooctane sulfonate (PFOS), that was detected. PFOA and PFOS, are the two PFAS that are regulated by the MDEQ. The United States Environmental Protection Agency (EPA) has established drinking water health advisory concentration of 70 nanograms per liter (n/L) for PFOA and PFOS. The MDEQ has adopted this 70 ng/L as Drinking Water Criteria under Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994, PA 451, as amended, and the Part 201 Administrative Rules. The MDEQ Drinking Water Criteria are published in Table 1. Groundwater: Residential and Nonresidential Part 201 Generic Cleanup Criteria and Screening Levels, dated January 10, 2018 and updated June 25, 2018.

The hydrogeologic investigation described in this work plan, will be completed in a phased approach. This work plan describes Phase I of the investigation that will begin in November 2018. This work plan provides Investigation Methodologies (Section 3.0) that will be employed during Phase I and subsequent phases of the investigation. It is anticipated that one or more additional phases of investigation will be completed beginning in December 2018 and continuing into 2019. Technical memorandums will be prepared to provide results of completed phases of work and will include scopes of work for subsequent phases. The technical memorandums will reference methods and controls prescribed herein unless otherwise noted. Subsequent phases will be executed following consultation with MDEQ.

The scope of work for Phase I was developed in concert with the MDEQ to focus on:

- Groundwater quality evaluation in priority areas identified by MDEQ. The priority areas are the northern and eastern extent of where PFAS impacts have been identified. Based on nondetect results in wells located west of the Kalamazoo River and the regional upland-to-river pattern of groundwater flow, it appears that the Kalamazoo River defines the extent of PFAS impacts to the west. The southern extent of PFAS impacts will be investigated in subsequent phases of work.
- Depths of impacts where relatively higher concentrations of PFAs were detected and well depths at the sample collection point were unknown. One of the locations is on Keyes Dr. and the other is on Riverview Rd.
- Definition of hydraulic gradients and groundwater flow directions. Nested wells at different depths will be used to calculate gradients between multiple aquifers that may be present in the study area.

The Phase I scope of work includes:

- The installation of eighteen monitoring wells at ten locations.
- Collection of groundwater samples from the newly installed monitoring wells.
- Collection of nine surface water samples from the study area.

The location of the monitoring wells and surface waters are discussed below in Section 2.2 and installation and sample methodologies are detailed in Section 3.0. After monitoring well installation and development activities have been completed, groundwater samples will be collected from each of the Phase I monitoring wells using field methods described in EPA Ground Water Issue number EPA/540/S-95/50, Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures, by Robert W. Puls and Michael J. Barcelona. Groundwater samples will be shipped to a laboratory and analyzed for PFAS using Modified EPA Method 537. **Table 1** provides a sampling and analysis plan for the groundwater sampling event.

Surface water samples will be collected from nine locations within the study area. Surface water sample locations include ponds, municipal drains, creeks and drainage ditches. Surface water samples will be shipped to a laboratory and analyzed for PFAS using Modified EPA Method 537. **Table 2** provides a sampling and analysis plan for the surface water sampling event.

Groundwater and surface water data collected during Phase I and subsequent phases will be evaluated to identify potential PFAS sources. Soil sampling will be proposed to further evaluate PFAS sources once identified.

## 2.1 STUDY AREA DESCRIPTION

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The study area (**Figure 1**) covers portions of Kalamazoo Township and Cooper Township east of the Kalamazoo river, including the city of Parchment. Residential, commercial and industrial properties are present within this area. The local geology is comprised of glacial drift and alluvial deposits that have been reworked by human activity in some locations. These materials generally consists of approximately 20-70 feet of sand and gravel underlain by interbedded clay, sand and gravel. The bedrock beneath the glacial drift and alluvial deposits consists of the Lower Mississippian Coldwater Shale. Bedrock has been encountered in select well locations at a depth of approximately 100 feet. The main surface waters on site consist of the north flowing Kalamazoo River and Spring Brook, a tributary that flows westward into the Kalamazoo River. A portion of the eastern extent the Kalamazoo river valley is present in the study area, generally southwest to northeast trending, along Riverview Road. The water table is located at shallow depths in the western portion of the study area, west of Riverview Road, whereas, depths to water are greater in the eastern portion of the study area, east of Riverview Road, where the surface elevation is as much as 60 feet higher. The City of Parchment Wellhead Protection Program Report (1992), describes the general direction of groundwater flow as towards the northwest.

## 2.2 WELL LOCATIONS

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**Figure 2** shows the locations for the planned soil borings and well installations. Locations may be adjusted based on the location of underground utilities. Each location in Phase I is on public road right of way (ROW) and has been marked in the field. ROW access permits are being applied for through the Kalamazoo County Road Commission. Future phases of investigation may include borings and wells on property parcels that will require individual owner access agreements.

The rationale for the selected monitoring well locations are included in **Table 1**, along with estimated well depths that are based on review of available well construction data from private wells installed within the study area. Water supply wells may withdraw groundwater from more than one aquifer within the study area. Therefore, at select locations, nested monitoring wells will be installed at different depths within the subsurface to understand vertical distribution of PFAS impacts and vertical and horizontal hydraulic gradients.

A location identifier (ID) will be assigned for each well (or well nest) location shown in **Figure 2**. The location IDs will have the form “LOC YY##” where YY is the last two digits of the calendar year of establishment and ## is a unique two-character sequence to identify the location. For instance, LOC1805 represents sampling location number 5 established in 2018 for this study.

## 2.3 SURFACE WATER LOCATIONS

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The study area was canvassed, and surface water locations were identified. Locations for proposed surface water sample collection are presented in **Figure 2**. The locations were selected based on water bodies that have not been sampled to date, by the MDEQ. Locations that are on private property will not be sampled until individual owner access agreements are obtained.

## 3.0 INVESTIGATION METHODOLOGY

Due to the nature of PFAS and their prevalence in many consumer products, special precautions will be taken to avoid introducing PFAS during drilling and sampling. Groundwater sampling activities will be conducted according to methods and protocols for collecting and handling groundwater samples analyzed for PFAS as outlined in Tetra Tech SOP 1, included in **Appendix A**. SOP 1 is consistent with EPA prescribed sampling methods. The planned field activities include the following:

- Collection of continuous soil cores to a maximum depth of 150 feet for geologic logging.
- Installation and development of monitoring wells. Shallow monitoring wells will be installed and screened within the first encountered water table aquifer. The well screen will intersect the observed water table with approximately 1-foot of the top of the well screen placed above the observed water table. Intermediate and deep monitoring wells will be installed with screens below the upper confining unit (if present).
- Measurement of groundwater levels.
- Collection of groundwater samples using minimal drawdown (low-flow) techniques from the new monitoring wells for PFAS analysis.
- Collection of surface water samples for PFAS analysis.
- Handling and disposal of investigation derived waste (IDW) in accordance with local, state and federal regulations.
- Surveying of installed well locations.

### 3.1 SOIL BORINGS

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Prior to drilling, the soil boing locations will be checked for buried utilities. Utility locating will be completed by utilizing Michigan Utility Notification Center in addition to a private utility locating service. Soil borings will be completed at each monitoring well location using sonic drilling methods. A core barrel assembly will be advanced into the subsurface to obtain continuous soil cores. For the shallow soil borings, the boring will be advanced through the first encountered water bearing formation until an underlying clay layer, greater than 1.5-foot in thickness (upper clay) is identified. For the deeper soil borings advanced for the nested wells, a temporary surficial casing will be installed into the upper clay, prior to advancing tooling further, to prevent vertical migration of groundwater between water bearing units. It is anticipated that the shallow soil borings will be advanced to a depth ranging from 40 feet to 70 feet and the deeper soil borings will be advanced to a maximum depth of 150 feet, or until bedrock is encountered, whichever comes first. The exact depth will be determined based on field observations.

As the soil cores are brought to the surface, they will be placed on plastic so that they can be logged and photographed by the onsite Tetra Tech geologist. Each soil core will be described including sample recovery and lithology description using the Unified Soil Classification System. Signs of contamination

(staining and odor), moisture content, and other notable observations/information will be noted. Photographs will be taken of the soil cores in their entirety and close-up photographs will be taken where essential information requires greater detail (lithologic contacts, staining, grain size differences, etc.). The photographs will include a scale and written details to convey the important aspects of the soil cores. All this information will be used to identify target depths for well installation. Soil boring installation is discussed in Tetra Tech SOP 4 and Safe Work Practice SWP-5.4. Soil logging procedures are described in Tetra Tech SOP 6. Applicable Tetra Tech SOPs are included in **Appendix A**.

Soil-boring IDs will be assigned in the format "SB YY##X" where the year (YY) and number (##) are taken from the location ID. The final character in the soil-boring ID will be used to distinguish multiple borings at the same location (e.g. for nested wells). Thus, SB1802A and SB1802B are two soil borings installed at the map location with location ID: LOC1802.

## 3.2 MONITORING WELL INSTALLATION

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The anticipated monitoring locations and well installation details, based on lithology obtained from the well logs associated with existing nearby wells, are presented in **Table 1**. For reference, the well logs for the nearby wells are included in **Appendix B**.

General monitoring well construction is as follows:

- 2-inch diameter polyvinyl chloride (PVC) casing with 10-feet of 0.010-inch slot PVC screen.
- Placement of a locking well cap.
- A sand filter pack placed to a minimum of 2-feet above the well screen.
- A bentonite pellet seal (hydrated in-place) placed on top of the sand filter pack, 2-inch minimal thickness.
- Bentonite grout to bottom of flush mount protective well casing.

At nested monitoring well locations, two of the nested wells will be installed in a single boring (**Figure 3**) as follows:

- The deep well screen will be installed in the semi-confined aquifer, below the upper clay, while a temporary shallow isolation casing is in place to isolate the surficial unconfined aquifer from the lower, semi-confined aquifer.
- A sand filter pack will be placed to a minimum of 2-feet above the well screen.
- A bentonite pellet seal (hydrated in-place) will be placed on top of the sand filter pack, 2-inch in thickness.
- Bentonite grout will be placed to the bottom of the shallow isolation casing.
- The shallow well screen will be installed in the first encountered, water table aquifer with 1-foot of well screen above the observed water table.

- A sand filter pack will be placed to a minimum of 2-feet above the well screen.
- A bentonite pellet seal (hydrated in-place) will be placed on top of the sand filter pack, 2-inch minimal thickness.
- Bentonite grout will be placed to bottom of the flush mount protective well casing.
- The intermediate well will be installed in a second boring near the first boring, in the semi-confined aquifer, below the upper clay, while a temporary shallow isolation casing is in place to isolate the surficial unconfined aquifer from the lower, semi-confined aquifer. The well construction will be in accordance with the general well construction description above.

Monitoring well installation procedures are discussed in Tetra Tech SOP 4. Twelve or more hours after the installation is completed, but not sooner than 12 hours after, the monitoring wells will be developed to remove fines from the gravel pack, well screen and casing in general accordance with Tetra Tech SOP 7.

Monitoring well IDs will be assigned in the format “MW YY##X” where the year (YY) and number (##) are taken from the location ID. The final character in the well ID will be used to distinguish multiple wells in the same nest, with A used for shallow (unconfined aquifer) wells, B for intermediate (upper semi-confined glacial outwash aquifer) wells, and C for deep (lower semi-confined glacial outwash aquifer) wells. Thus, wells MW1810A, MW1810B, and MW1810C are the shallow, intermediate, and deep wells (respectively) at the map location with location ID: LOC1810.

### **3.3 SURVEY**

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The horizontal and vertical locations of the monitoring wells will be established with a professional survey as follows:

- A Leica Global Positioning System (GPS) receiver, will be connected to the local Michigan Department of Transportation (MDOT) Continuously Operating Reference Station (CORS) tower to achieve less than 0.10-foot (or better) accuracy.
- At least two National Geodetic Survey monuments will be located and used to verify the datum broadcast from the CORS tower. (Datum is State Plane Coordinates, Michigan South Zone (2113), NAD83NAVD88, International feet, Geoid 12).
- Monitoring wells that cannot be measured directly by GPS will be surveyed with Leica robotic total station from temporary control points established by GPS.
- At each monitoring well, the ground surface, top of well casing/pipe, and top of protective casing will be surveyed.

## 3.4 WATER-LEVEL MEASUREMENT

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Depth to water at all monitoring wells will be measured to 0.01-foot, from the newly installed monitoring wells using an electronic water level meter in accordance with Tetra Tech SOP 10. To have contemporaneous water-level data, a round of water level measurement at all wells will be obtained on a single day prior to collecting groundwater samples. Depth to water will be relative to the top of well casing elevations determined by survey.

## 3.5 GROUNDWATER SAMPLING

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Groundwater samples will be collected after the Phase I monitoring well installations are completed. Groundwater sampling will be conducted in general accordance with EPA low-flow (minimal drawdown) sampling procedures (SOP 9), sample acquisition for PFAS analysis (SOP 1), and groundwater sampling procedures (SOP 8). For groundwater sample collection at a depth of less than 25 feet, the sampling will be performed using a peristaltic pump with HDPE and silicone tubing. When groundwater samples are collected at a depth greater than 25-feet, the sampling will be performed using a submersible stainless-steel pump with HDPE tubing. New tubing will be used for each monitoring well to avoid cross-contamination between wells. If practical, the tubing will be left in the well for use in future groundwater sampling events. The submersible groundwater pump will be decontaminated prior to use and after use at each sampling location in general accordance with SOP 1 and SOP 8. Alconox detergent and distilled water will be placed in a cylinder with the pump. The detergent/water mixture will be recirculated through the pump and tubing for approximately 5 minutes. After rinsing the outside of the pump and tubing with distilled water, approximately four liters of distilled water will be circulated through the pump and tubing as a final rinse.

Prior to sampling, groundwater will be purged using low-flow purging techniques. During the purging of each well, water level drawdown, flow rate, and water quality readings will be recorded on the groundwater water quality data sheet, **Appendix B**. Groundwater will be pumped through a flow-through cell and water quality parameters of pH, conductivity, temperature, dissolved oxygen (DO), oxidation-reduction potential (ORP), and turbidity will be measured with a QED MP20DT multi-parameter water quality meter or equivalent. The instrument will be calibrated according to the manufacturer's specifications prior to sampling and will be documented per Tetra Tech SOP 3. The water quality parameters will be collected at 3 to 5-minute intervals until all parameters have stabilized for three consecutive readings and are within the following limits:

- Turbidity (10% if greater than 5 Nephelometric Turbidity Units)
- DO (10% for values greater than 2 milligrams per Liter (mg/L); 0.5 mg/L for values less than 2 mg/L)
- Specific conductance (3%)
- Temperature (3%)
- pH (0.1 unit)

- ORP (10 millivolts)

Drawdown will be maintained at 0.3 foot or less during purging and sampling. If water quality parameters do not stabilize or meet the limits within a 1- hour time period, three well volumes will be removed from the well and a groundwater sample will be collected.

Groundwater samples will be collected in clean, pre-labeled, laboratory supplied bottles. These sample containers will be placed in a cooler for shipment to an offsite laboratory where the samples will be analyzed for the MDEQ's PFAS Minimum Laboratory Analyte List of compounds (**Appendix C**) via modified EPA Method 537. The groundwater sampling and analysis plan is presented in **Table 2**. Groundwater sample IDs will reflect the source well and the date of collection as shown in **Table 2**.

## 3.6 SURFACE WATER SAMPLING

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Surface water samples will be collected from nine locations depicted in **Figure 2**. Surface sample locations include ponds, municipal drains, creeks and drainage ditches. Surface water samples will be collected with disposable HDPE dipper samplers. A new dipper sampler will be used at each sample location. The surface water sample will be collected from the center of the water body cross-section, just below the surface. To avoid sample dilution, surface water samples will be collected at least 72 hours after any rain event. Water collected in the dipper will be poured directly into clean, pre-labeled, laboratory-provided bottles. These sample containers will be placed in a cooler for shipment to an offsite laboratory where the samples will be analyzed for the MDEQ's PFAS Minimum Laboratory Analyte List of compounds (**Appendix C**) via modified EPA Method 537. The surface water sampling and analysis plan, including sample IDs, is presented in **Table 3**.

## 3.7 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) SAMPLES

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QA/QC samples will be collected to assure PFAS contamination is not introduced to the investigation samples from the drilling equipment or water used for equipment decontamination. **Table 2** includes the QA/QC samples that will be collected, and sample collection methodology is provided below.

- Drilling Activities
  - Once after the drilling tooling is decontaminated, an equipment blank will be collected. The equipment blank will be collected by pouring clean water used in decontamination over deconned drilling tooling and into laboratory supplied containers.
- Sample Collection Events
  - Equipment blank samples will be collected at a rate of at least one equipment blank sample per ten environmental samples.
  - The sample equipment that will be used at the equipment blank sample location, will be decontaminated. Following decontamination, laboratory provided reagent-free water will

be run through (pumps and tubing) and over equipment (water level meters and dippers). The rinseate will be collected into laboratory supplied containers.

- Field duplicate samples will be collected at a rate of at least one duplicate sample per ten samples.
- Matrix spike and matrix spike duplicate (MS/MSD) samples will be collected at a rate of at least one MS/MSD sample per twenty samples.

The QA/QC samples collected will be analyzed for the MDEQ's PFAS Minimum Laboratory Analyte List of compounds (**Appendix C**) via modified EPA Method 537. Laboratory reports for the monitoring well samples will include a level IV data package that will be validated by Tetra Tech. Laboratory reports for the drilling QC samples and surface water samples will include a level IIB data package that will be verified by Tetra Tech.

### **3.8 SAMPLE HANDLING**

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Procedures for sample handling, including the field-related considerations concerning sample preservation, packaging, and shipping are described below. As stated previously, due to the nature of PFAS and their prevalence in many consumer products, special precautions and procedures will be required for the handling, packaging, and shipment of samples analyzed for PFAS. These protocols are provided in Tetra Tech SOP 1. Samples will be collected directly into clean, laboratory provided bottles. Sample bottle sets will be placed into zip lock bags and placed on ice for preservation from the time of collection through shipment to the analytical laboratory. Custody of the samples will be maintained and documented through chain-of-custody forms as described in Tetra Tech SOP 12. Chain-of-custody begins with the collection of the samples in the field and ends at the analytical laboratory receiving department. The samples will be shipped to the analytical laboratory via overnight courier service.

### **3.9 DECONTAMINATION PROCEDURES**

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All drilling equipment will be decontaminated before being brought to the work site and between each of the boring locations. A temporary decontamination pad will be constructed at a location that is agreeable to/and approved by, the City of Parchment or Cooper Township. All decontamination water will be containerized for offsite disposal as described in Section 3.10. Alconox detergent and a steam pressure washer will be used with clean water to decontaminate drilling equipment.

All non-disposable sampling equipment will be decontaminated prior to use and after each use (except for dedicated tubing left in monitoring wells). Non-disposable sampling equipment will be decontaminated using Alconox detergent and distilled water. All decontamination water will be containerized for offsite disposal.

### **3.10 INVESTIGATION-DERIVED WASTE MANAGEMENT**

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Purge water, decontamination water, and well development water generated during monitoring well installation and groundwater sampling will be containerized and stored in 55-gallon drums and/or bulk storage containers (i.e., frac tank or poly tank). Tetra Tech SOP 13 describes drum and container handling procedures. Soil cutting IDW generated during well installation will be containerized in 55-gallon drums or a roll-off container. IDW containers will be properly labeled identifying the contents. While awaiting disposal, IDW will be staged at a location that is agreeable to/and approved by, the City of Parchment or Cooper Township. IDW generated during well installation and subsequent groundwater sampling will be sampled for waste characterization as necessary, as requested by the waste disposal facility. It is anticipated that analytical results for PFAS, toxic characteristic leaching procedure (TCLP) volatile organic compounds (VOCs), TCLP semi VOCs, TCLP metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver) and polychlorinated biphenyls will be required. Analytical results will be used to coordinate offsite transportation and proper disposal at an appropriate facility in accordance with local, state and federal regulations. Disposable sampling supplies and materials (i.e., nitrile gloves and sample tubing) will be bagged and disposed of as general refuse/garbage.

## 4.0 REPORTING

A Technical Memorandum will be prepared following review of data collected pursuant to this work plan. The Technical Memorandum will provide a summary of field activities performed that will include soil boring logs and well installation details. Groundwater and surface water sampling results will be summarized in table format and on an updated site-area concentration map. Laboratory reports and data verification/validation reports will be included as attachments and figures consisting of geologic cross sections, surveyed well locations and a potentiometric surface map will be provided. The technical memorandum will also include scopes of work for a subsequent phase of investigation, if warranted. The scopes of work will reference methods and controls prescribed in Section 3.0 of this work plan.

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## TABLES

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## Hydrogeologic Investigation Work Plan

Georgia-Pacific  
Parchment, Michigan

TABLE 1  
PROPOSED LOCATION DESCRIPTION

Location	Proposed Soil Boring	Proposed Monitoring Wells	Estimated Monitoring Well Depth (feet)	Location Rationale	Nearest Address to Road Rights-of-Way where Monitoring Well will be installed	Nearby Residential Well IDs
LOC1801	SB1801A	MW1801A	39	Location was selected by MDEQ. Location may define the northern extent of impacts in the first encountered aquifer. Residential well logs have depths ranging between 30 and 44 feet near this location. This location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the first encountered aquifer.	6259 Polk St.	39000002217 39000002219 39000002226 39000002227 39000012162 39000012417
LOC1802	SB1802A	MW1802A	39	Location was selected by MDEQ and adjusted to be located in a public road rights-of-way. Location may define the northern extent of impacts in the first encountered aquifer. Residential well logs have depths ranging between 30 and 44 feet near this location. This location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the first encountered aquifer and to evaluate vertical hydraulic gradients using data from intermediate and deep wells that are planned for this location.	6304 Riverview Rd.	same well IDs as LOC1801
LOC1802	SB1802B	MW1802B	70	Location may define the northern extent of impacts in the intermediate aquifer that underlies a potential clay layer that provides separation from the shallow aquifer. Depth of the intermediate aquifer is reported on residential well logs at depths between 67-74 feet at this location. This location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the aquifer that may be semi-confined and to evaluate vertical hydraulic gradients using data from shallow and deep wells that are planned for this location.	6304 Riverview Rd.	39000002228
LOC1802	SB1802A	MW1802C	100	To evaluate the presence of deeper aquifer or deeper intervals of the intermediate aquifer and potential impact in the northern extent of the study area. The depth of the deeper aquifers is unknown at this location. This location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the aquifer that may be semi-confined and to evaluate vertical hydraulic gradients using data from shallow and intermediate wells that are planned for this location.	6304 Riverview Rd.	Not Available
LOC1803	SB1803A	MW1803A	39	Location was selected by MDEQ. Location may define the northeastern extent of impacts in the first encountered aquifer. Residential well logs have depths ranging between 30 and 44 feet near this location. This location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the first encountered aquifer.	6190 N. Riverview Dr.	same well IDs as LOC1801
LOC1804	SB1804A	MW1804A	57	Location was selected by MDEQ. Location may define the eastern extent of impacts in the first encountered aquifer. Residential well logs have depths ranging between 50 and 75 feet near this location. This location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the first encountered aquifer.	5701 Mount Olivet Rd.	39000011218 39000011320 39000011406 39000011444
LOC1805	SB1805A	MW1805A	86	Location was selected by MDEQ. Location may define the eastern extent of impacts in the first encountered aquifer. Residential well logs have depths ranging between 77 and 95 feet near this location. This location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the first encountered aquifer.	5485 Lindenwood St.	39000002462 39000002463 39000002506 39000002517 39000002529
LOC1806	SB1806A	MW1806A	86	Location was selected by MDEQ. Location may define the eastern extent of impacts in the first encountered aquifer. Residential well logs have depths ranging between 77 and 95 feet near this location. This location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the first encountered aquifer and to evaluate vertical hydraulic gradients using data from intermediate and deep wells that are planned for this location.	5363 Lindenwood St.	same well IDs as LOC1805

## Hydrogeologic Investigation Work Plan

Georgia-Pacific  
Parchment, Michigan

**TABLE 1**  
**PROPOSED LOCATION DESCRIPTION**

Location	Proposed Soil Boring	Proposed Monitoring Wells	Estimated Monitoring Well Depth (feet)	Location Rationale	Nearest Address to Road Rights-of-Way where Monitoring Well will be installed	Nearby Residential Well IDs
LOC1806	SB1806B	MW1806B	102	Location may define the eastern extent of impacts in the intermediate aquifer that underlies a potential clay layer that provides separation from the shallow aquifer. The depth of the intermediate aquifer is reported on residential well logs at depths ranging between 94-122 feet near this location. This location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the aquifer(s) that may be semi-confined and to evaluate vertical hydraulic gradients using data from shallow and deep wells that are planned for this location.	5363 Lindenwood St.	39000002460 39000002465 39000002516 39000002526 39000012757 39000011414
LOC1806	SB1806A	MW1806C	150	To evaluate the presence of the deeper aquifer or deeper intervals of the intermediate aquifer and potential impact in the eastern extent of the study area. Depth of the deeper aquifer is unknown at this location. This location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the aquifer that may be semi-confined and to evaluate vertical hydraulic gradients using data from shallow and intermediate wells that are planned for this location.	5363 Lindenwood St.	Not Available
LOC1807	SB1807A	MW1807A	86	Location was selected by MDEQ. Location may define the eastern extent of impacts in the first encountered aquifer. Residential well logs have depths ranging between 75 and 105 feet near this location. This location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the first encountered aquifer.	2881 Summerdale Ave.	39000002488 39000011206 39000002528
LOC1808	SB1808A	MW1808A	94	To evaluate groundwater quality at the southeastern extent of the study area within the first encountered aquifer. Residential well logs that have depths ranging between 80 and 109 feet near this location. This location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the first encountered aquifer.	Vacant Parcel near Mount Olivet Road and Wolverine Dr.	39000002533 39000002534 39000002683 39000011572
LOC1809	SB1809A	MW1809A	36	This location is where a relatively high concentration of impact was detected in a residential well. Well depth for the residential well is unknown; therefore, it is unknown at what depth the impacts were detected. A well will be installed in the first encountered aquifer to evaluate groundwater quality. The first encountered aquifer that is reported on residential well logs that have depths ranging between 34.5 and 44 feet near this location. This location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the first encountered aquifer and to evaluate vertical hydraulic gradients using data from intermediate and deep wells that are planned for this location.	5616 N. Riverview Dr.	39000002429 39000002443 39000012447
LOC1809	SB1809B	MW1809B	90	This location is where a relatively high concentration of impact was detected in a residential well. Well depth for the residential well is unknown; therefore, it is unknown at what depth the impacts were detected. A well will be installed in aquifer(s) that may be present beneath a clay layer that underlies the shallow aquifer. Depth of an intermediate aquifer is reported on a residential well log at a depth of 91 feet near this location. This location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the aquifer(s) that may be semi-confined and to evaluate vertical hydraulic gradients using data from shallow and deep wells that are planned for this location.	5616 N. Riverview Dr.	39000002422
LOC1809	SB1809A	MW1809C	130	This location is where a relatively high concentration of impact was detected in a residential well. Well depth for the residential well is unknown; therefore, it is unknown at what depth the impacts were detected. A well will be installed in deeper aquifer(s) or deeper intervals of intermediate aquifers. Depth of deeper aquifers is unknown at this location. This location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the aquifer(s) that may be semi-confined and to evaluate vertical hydraulic gradients using data from shallow and intermediate wells that are planned for this location.	5616 N. Riverview Dr.	Not Available

## Hydrogeologic Investigation Work Plan

Georgia-Pacific  
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TABLE 1  
PROPOSED LOCATION DESCRIPTION

Location	Proposed Soil Boring	Proposed Monitoring Wells	Estimated Monitoring Well Depth (feet)	Location Rationale	Nearest Address to Road Rights-of-Way where Monitoring Well will be installed	Nearby Residential Well IDs
LOC1810	SB1810A	MW1810A	30	This location is where a relatively high concentration of impact was detected in a residential well. Well depth for the residential well is unknown; therefore, it is unknown at what depth the impacts were detected. A well will be installed in the first encountered aquifer to evaluate groundwater quality. The first encountered aquifer that is reported on residential well logs that have depths ranging between 25 and 42 feet near this location. This location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the first encountered aquifer and to evaluate vertical hydraulic gradients using data from intermediate and deep wells that are planned for this location.	5280 Keyes Dr.	39000002438 39000002448 39000002489
LOC1810	SB1810B	MW1810B	90	This location is where a relatively high concentration of impact was detected in a residential well. Well depth for the residential well is unknown; therefore, it is unknown at what depth the impacts were detected. A well will be installed in aquifer(s) that may be present beneath a clay layer that underlies the shallow aquifer. Depth of an intermediate aquifer is unknown at this location. This location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the aquifer(s) that may be semi-confined and to evaluate vertical hydraulic gradients using data from shallow and deep wells that are planned for this location.	5280 Keyes Dr.	Not Available
LOC1810	SB1810A	MW1810C	130	This location is where a relatively high concentration of impact was detected in a residential well. Well depth for the residential well is unknown; therefore, it is unknown at what depth the impacts were detected. A well will be installed in deeper aquifer(s) or deeper intervals of intermediate aquifers. Depth of deeper aquifers is unknown at this location. This location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the aquifer(s) that may be semi-confined and to evaluate vertical hydraulic gradients using data from shallow and intermediate wells that are planned for this location.	5280 Keyes Dr.	Not Available

## Notes

1. Estimated monitoring well depths are approximated based on referenced residential monitoring wells construction.
2. Residential monitoring well logs referenced in this table are from the Michigan Department of Environmental Quality Wellogic System. Referenced well logs are provided in Appendix B of the Hydrogeologic Study Work Plan.
3. Actual well depths will be adjusted based on observed field conditions.
4. Impacts referenced in this Table are Perfluorooctanoic Acid (PFOA plus Perfluorooctanoic Sulfonate (PFOS).
5. Nomenclature definition for LOC1801  
"LOC" = location  
"18" = year  
"01" = location number  
6. Nomenclature definitions for SB1801A or B  
"SB" = soil boring  
"18" = year of installation  
"01" = location number  
"A" = first soil boring drilled at location  
"B" = second soil boring drilled at location
7. Nomenclature definitions for MW1801A, B or C  
"MW" = monitoring well  
"18" = year of installation  
"01" = location number  
"A" = shallowest well at location  
"B" = intermediate well at location (between shallow and deep)  
"C" = deepest well at location

## Hydrogeologic Investigation Work Plan

Georgia-Pacific

Parchment, Michigan

**TABLE 2****SAMPLING AND ANALYSIS PLAN - MONITORING WELL SAMPLING EVENT**

Location	Sample Type	Sample From	Sample ID
LOC1801	Normal	MW1801A	MW1801A-YYMMDD
LOC1802	Normal	MW1802A	MW1802A-YYMMDD
LOC1802	Normal	MW1802B	MW1802B-YYMMDD
LOC1802	Normal	MW1802C	MW1802C-YYMMDD
LOC1803	Normal	MW1803A	MW1803A-YYMMDD
LOC1804	Normal	MW1804A	MW1804A-YYMMDD
LOC1805	Normal	MW1805A	MW1805A-YYMMDD
LOC1806	Normal	MW1806A	MW1806A-YYMMDD
LOC1806	Normal	MW1806B	MW1806B-YYMMDD
LOC1806	Normal	MW1806C	MW1806C-YYMMDD
LOC1807	Normal	MW1807A	MW1807A-YYMMDD
LOC1808	EB	Reagent-free rinse water	EB1808-YYMMDD
LOC1808	MS/MSD	MW1808A	MS1808A-YYMMDD
LOC1808	Normal	MW1808A	MW1808A-YYMMDD
LOC1808	Duplicate	MW1808A	DUP01-YYMMDD
LOC1809	Normal	MW1809A	MW1809A-YYMMDD
LOC1809	Normal	MW1809B	MW1809B-YYMMDD
LOC1809	Normal	MW1809C	MW1809C-YYMMDD
LOC1810	EB	Reagent-free rinse water	EB1810-YYMMDD
LOC1810	Normal	MW1810A	MW1810A-YYMMDD
LOC1810	Duplicate	MW1810A	DUP02-YYMMDD
LOC1810	Normal	MW1810B	MW1810B-YYMMDD
LOC1810	Normal	MW1810C	MW1810C-YYMMDD

Quantity by Type	
18	Normal
2	Duplicate
2	Equipment
2	Blank
1	Matrix
	Spike/Matrix
1	Spike
1	Duplicate
23	Total

Notes: "LOC" = location

Nomenclature for Sample IDs EB1801-YYMMDD,

MW1801A-YYMMDD and DUP01-YYMMDD

"EB" = equipment blank

"MW"= monitoring well

"DUP"= duplicate sample

"MS/MSD" = Matrix Spike/Matrix Spike Duplicate

"18" = year

"01" = location number

"YY"= last two digits of year of sample collection

"MM" = month of sample collection

"DD" = day of sample collection

## Hydrogeologic Investigation Work Plan

Georgia-Pacific  
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## TABLE 3

## SAMPLING AND ANALYSIS PLAN - SURFACE WATER SAMPLING EVENT

Location	Sample Type	Sample From	Sample ID
LOC1811	Normal	Surface Water	SW1811-YYMMDD
LOC1811	Duplicate	Surface Water	DUP03-YYMMDD
LOC1812	Normal	Surface Water	SW1812-YYMMDD
LOC1813	Normal	Surface Water	SW1813-YYMMDD
LOC1814	Normal	Surface Water	SW1814-YYMMDD
LOC1815	EB	Reagent-free rinse water	EB1815-YYMMDD
LOC1815	MS/MSD	Surface Water	MS1815-YYMMDD
LOC1815	Normal	Surface Water	SW1815-YYMMDD
LOC1816	Normal	Surface Water	SW1816-YYMMDD
LOC1817	Normal	Surface Water	SW1817-YYMMDD
LOC1818	Normal	Surface Water	SW1818-YYMMDD
LOC1819	Normal	Surface Water	SW1819-YYMMDD

Quantity by Type	
9	Normal
1	Duplicate
1	Equipment
1	Blank
	Matrix
	Spike/Matrix
1	Spike Duplicate
12	Total

Notes      "LOC" = location

Nomenclature for Sample IDs EB1801-YYMMDD,  
SW1801A-YYMMDD and DUP01-YYMMDD

"EB" = equipment blank

"SW"= surface water sample

"DUP"= duplicate sample

"MS/MSD" = Matrix Spike/Matrix Spike Duplicate

"18" = year

"01" = location number

"YY"= last two digits of year of sample collection

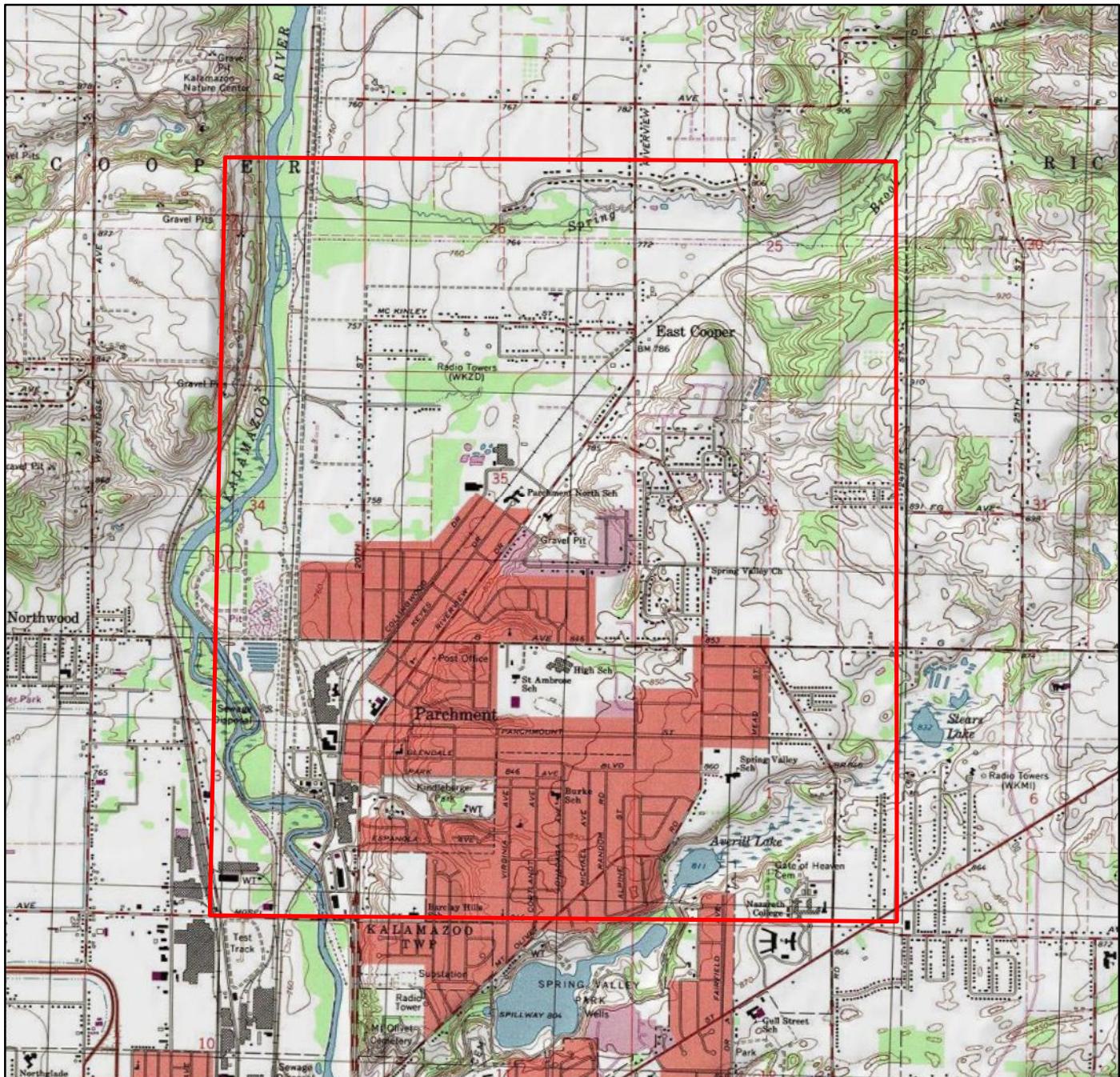
"MM" = month of sample collection

"DD" = day of sample collection

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## FIGURES

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BASE MAP: Copyright © 2013 National Geographic Society, i-cubed

### Legend

Study Area



0 1,500 3,000 6,000  
Feet

Parchment, Michigan



Kalamazoo County, Michigan

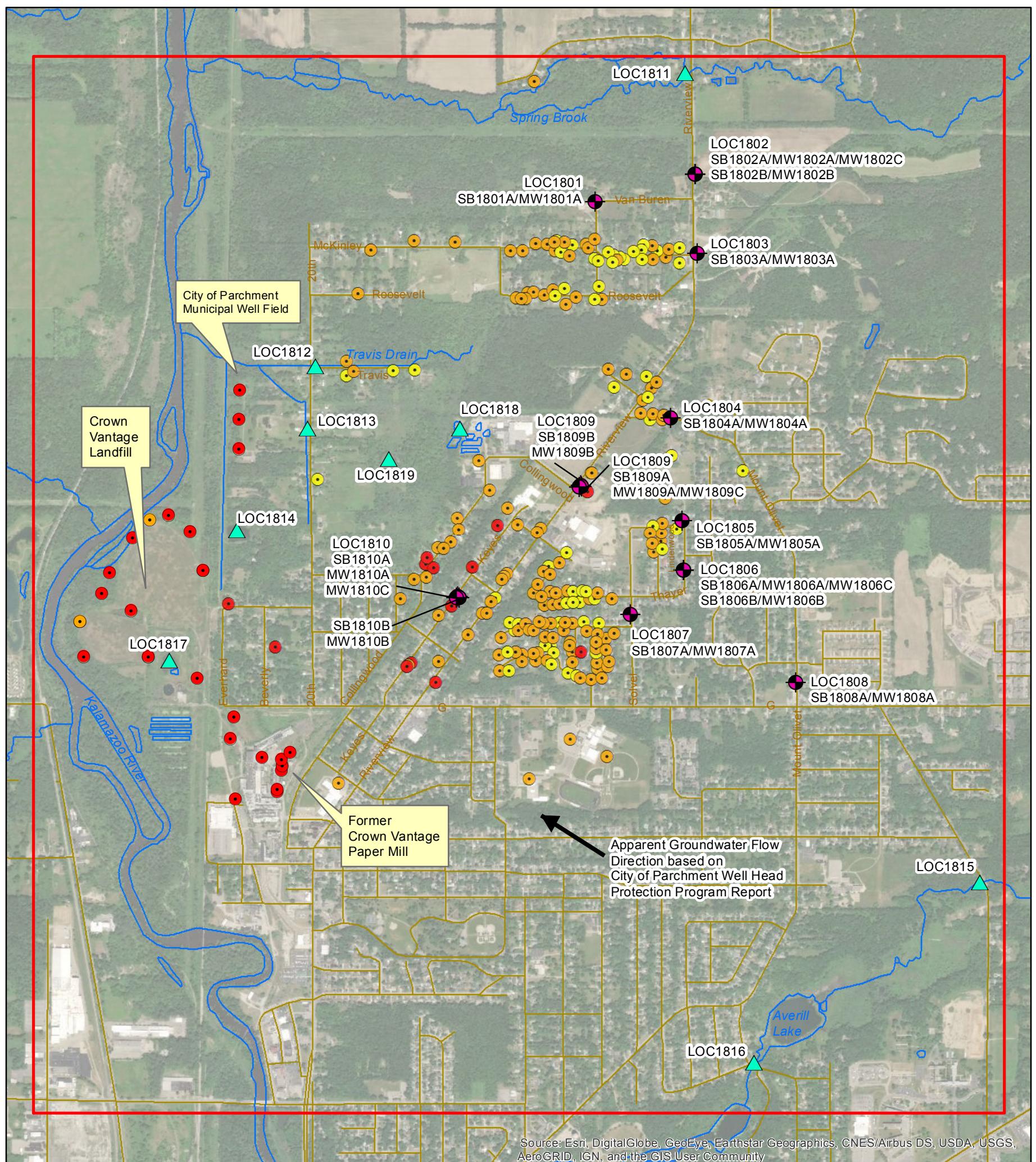


ORIGINAL BY: J. MCFETERS
DATE: 10/12/2018
REVISED BY: L. SWEET
DATE: 10/19/2018

### HYDROGEOLOGICAL INVESTIGATION WORK PLAN GEORGIA-PACIFIC PARCHMENT, MICHIGAN LOCATION MAP

FIGURE

1



#### Legend

- Study Area
- Surface Water

#### Proposed Sample Locations

- Monitoring Well
- Surface Water

#### Sample Locations with PFOA plus PFOS Results

- Non-Detect
- >1-70 ng/L
- >70 ng/L



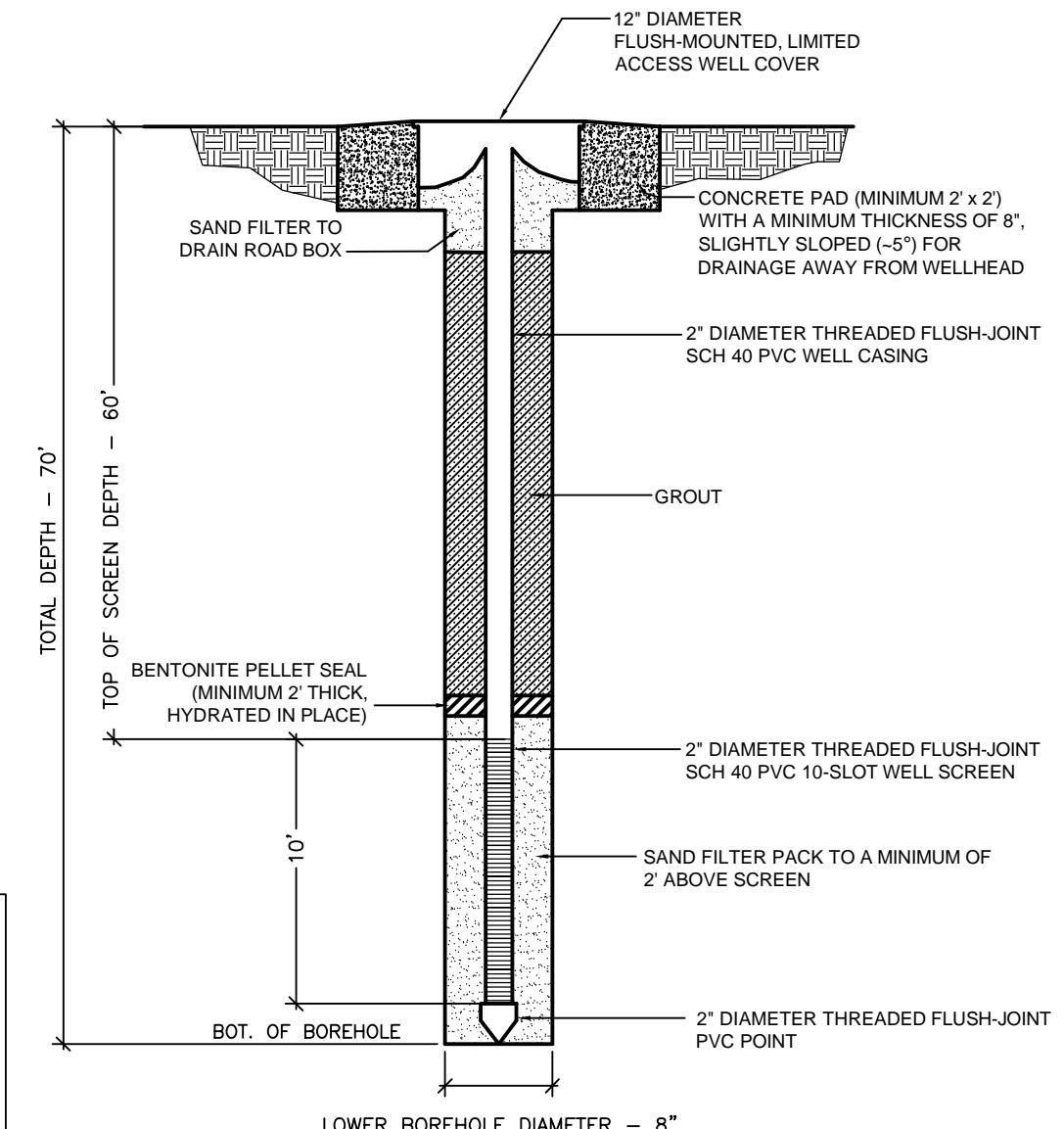
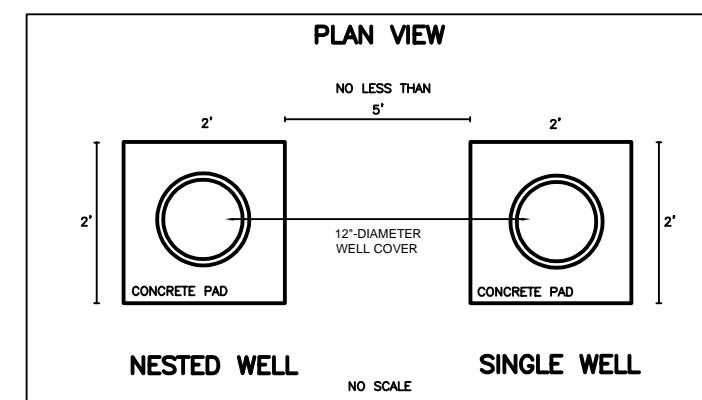
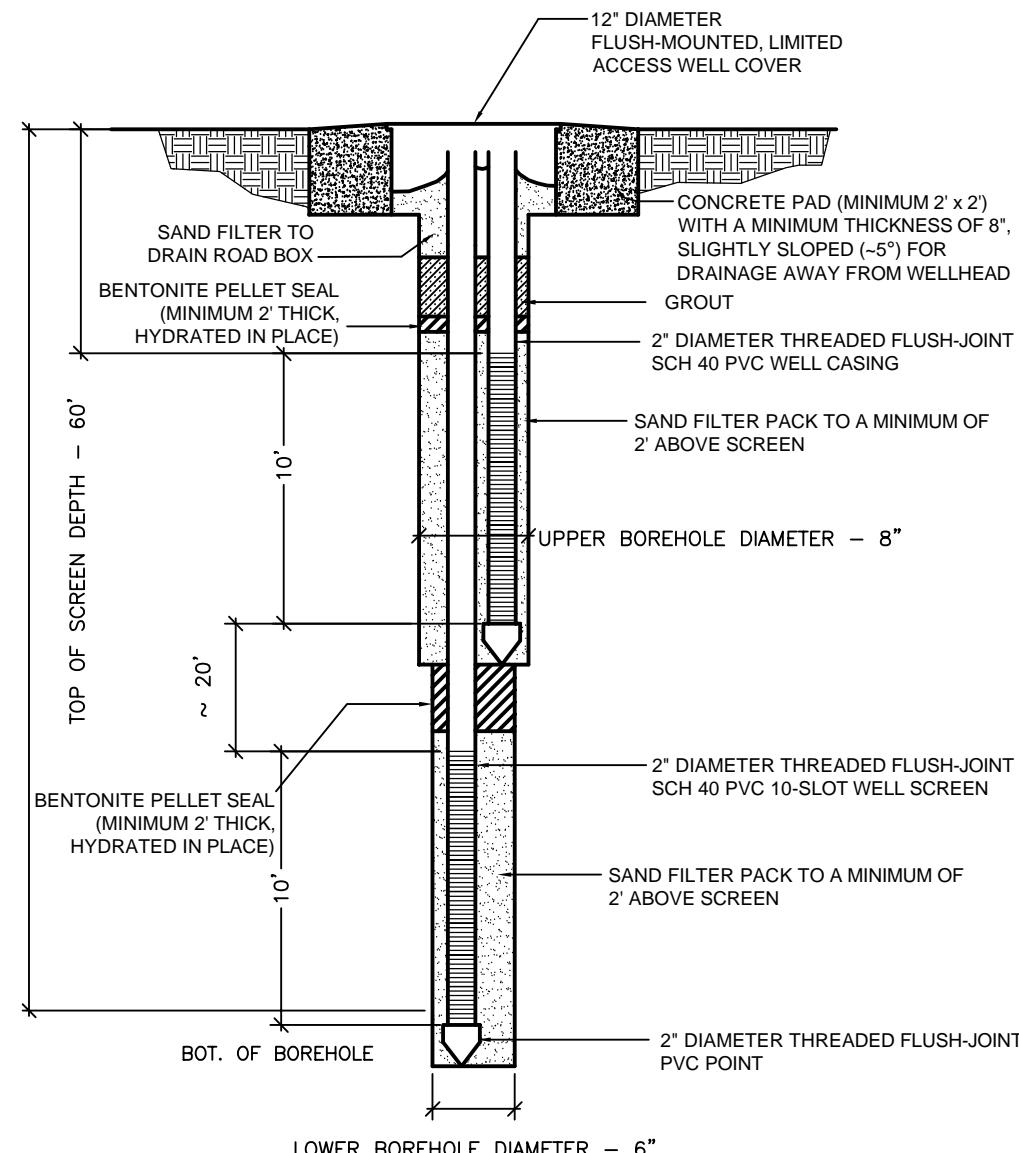
0 1,000 2,000 4,000 Feet



ORIGINAL BY: J. MCFETERS  
DATE: 10/12/2018  
REVISED BY: L. SWEET  
DATE: 10/17/2018

#### HYDROGEOLOGICAL INVESTIGATION WORK PLAN GEORGIA-PACIFIC PARCHMENT, MICHIGAN PROPOSED SAMPLE LOCATION MAP

FIGURE  
2



ORIGINAL: A. CUELLAR  
DATE: 10/16/2018  
EDITED: E. BAYS  
DATE: 10/22/2018

HYDROGEOLOGICAL INVESTIGATION  
WORK PLAN  
PARCHMENT, MICHIGAN  
MONITORING WELL CONSTRUCTION DIAGRAM

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## APPENDICES

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**APPENDIX A**  
**STANDARD OPERATING PROCEDURES**

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## **SOP 1**

Sample Acquisition for Polyfluorinated Compounds (PFCs) and Other  
Polyfluoroalkyl Substance Analysis



**STANDARD OPERATING PROCEDURE**  
**SAMPLE ACQUISITION FOR PERFLUORINATED COMPOUNDS (PFCs) AND OTHER**  
**POLYFLUOROALKYL SUBSTANCE ANALYSIS**

## **1.0 PURPOSE**

This Standard Operating Procedure (SOP) describes the methods and protocols to be used for collecting and handling samples to be analyzed for perfluorinated chemicals (PFCs), and other polyfluoroalkyl substances (PFASs). PFAS are present in many consumer products including some typical sampling equipment and are ubiquitous in the environment. Because regulatory screening criteria are very low, measurements of very low PFAS concentrations are required. These two conditions make the collection of samples for accurate quantitation of PFAS concentrations difficult unless special precautions are taken to avoid introducing contaminants into the samples. Instructions are provided herein for collection of environmental samples without contaminating them. This SOP is designed to supplement but not replace existing sampling SOPs. In addition, some clients and/or projects may have specific PFAS-related sampling requirements that extend beyond the procedures described in this SOP.

## **2.0 SCOPE AND APPLICABILITY**

This document provides information on proper sampling equipment and techniques for groundwater, surface water, sediment, and soil sampling for PFAS analysis. Sampling of air or biota is not addressed in this SOP, but the same principles would apply for those media.

## **3.0 BACKGROUND**

PFAS have been used since the 1940s as manufacturer-applied oil and water repellants on products such as clothing, upholstery, paper, and carpets; and in making fluoropolymers for non-stick cookware. They are found in textiles and leather products, mist suppressants for metal plating, the photography industry, photolithography, semi-conductors, paper and packaging coatings, cleaning products, pesticides, and cosmetics. They have been used in well-known consumer products including Teflon®, StainMaster®, Scotchgard®, and GoreTex®. In the 1960s, aqueous film-forming foam (AFFF) containing PFAS was developed for fighting flammable liquid fires, particularly petroleum-fueled (Class B) fires (ATSDR, 2009). The two most researched and most prevalent PFAS in the environment are perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) (ATSDR, 2009).



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PFAS are persistent in the environment, tend to bioaccumulate, and demonstrate toxicity in laboratory animals, enough to raise concerns about their presence in the environment. Some areas where PFAS may have been released to the environment include the following:

- Firefighting training areas
- Areas where firefighting products/materials are stored
- Aircraft crash sites
- Metal coating and plating facilities
- Water treatment systems and receiving water bodies
- Airport hangars and other facilities storing fire-fighting foams
- Fluorochemical manufacturing, use, and disposal facilities

PFAS are ubiquitous in consumer products and some materials used in environmental sampling (Teflon® tubing, waterproof logbooks, or GoreTex® field clothing). There are many potential sources of PFAS that are independent of media being sampled; therefore, it is essential to take special precautions to minimize the potential for contaminating environmental samples with PFAS during collection and handling. Laboratory detection limits are low for these compounds and contact of sample material or sampling equipment with any one of the multitude of PFAS sources could result in detectable contamination. In addition, PFAS tend to adsorb to glass so glass sample collection containers are inappropriate. Adsorption to glass sample containers may result in a low bias for measured PFAS concentrations.

Collection and analysis of Quality Control blanks is an important aspect of verifying that samples have not been contaminated during sample collection and handling. Use of additional blanks or blanks of a different type than usual may be required and the governing project planning documents should be consulted. Consult Section 7.7 of this SOP for instructions regarding collection of field reagent blanks (FRBs).

#### **4.0 DEFINITIONS AND ABBREVIATIONS**

FFF – Aqueous film-forming foam.

FRB – Field Reagent Blank. A blank sample prepared in the field by transferring laboratory-supplied, chemically-preserved deionized water to an empty, laboratory-supplied collection bottle.



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FRBs are typically analyzed only for PFAS and are treated as a site sample in all respects, including shipment to the sampling site, exposure to sampling site conditions, storage, preservation, and all PFAS analytical procedures. The purpose of FRBs is to indicate whether PFAS measured in corresponding site samples may have been introduced during sample collection and handling.

**PFASs** – Per- and polyfluoroalkyl Substances. A reference term currently in use, replacing “PFCs” in recent scientific and other technical literature. The term is inclusive of both perfluorinated chemicals like PFOA and PFOS and polyfluoroalkyl substances like fluorinated telomers.

**PFCs** – Perfluorinated Compounds or Chemicals. PFCs are a family of man-made chemicals that have been used for commercial, industrial, and military applications because they resist thermal degradation, and they repel oil, stains, grease, and water.

**PFOA** – Perfluorooctanoic Acid. PFOA is used as an aqueous dispersion agent and in the manufacture of fluoropolymers (including Teflon®) that are used in industrial components such as electrical wire casings, fire- and chemical-resistant tubing, and plumbing seal tape. PFOA is used in surface treatment products to impart oil, stain, grease, and water resistance. PFOA can also be produced by the breakdown of some fluorinated telomers.

**PFOS** – Perfluorooctane Sulfonate. PFOS was a key ingredient in Scotchgard® and used in the manufacture of Class B AFFF used per DoD military specifications. Phase out of AFFF by 3M occurred in 2002.

## **5.0 SAFETY PRECAUTIONS**

Sample acquisition activities shall be conducted in accordance health and safety requirements identified in the project-specific Health and Safety Plan (HASP), corporate health and safety policies, and individual sampling SOPs, as applicable.

## **6.0 PERSONNEL RESPONSIBILITIES, QUALIFICATIONS, AND TRAINING**

**Project Manager (PM)** – The PM is responsible for determining sampling objectives, initial sampling locations, and field procedures used in the collection of samples of environmental



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media. Additionally, in consultation with other project personnel (geologist, hydrogeologist, etc.), the PM is responsible for selecting and detailing the specific sampling techniques, equipment to be used, and providing detailed input in this regard to the project planning documents. The PM has the overall responsibility for ensuring that sampling activities are properly conducted by appropriately trained staff.

**Site Safety Officer (SSO)** – The SSO (or a qualified designee) is responsible for providing the technical support necessary to implement the project HASP, AP or equivalent. The SSO or SSO designee may also be required to advise the Field Operations Leader (FOL) on safety-related matters regarding sampling, such as measures to mitigate potential hazards from hazardous objects or conditions. The SSO may be referred to as the Site Safety and Health Officer (SSHO).

**Project Geologist/Sampler** – The project geologist/sampler is responsible for the proper acquisition of samples in accordance with this SOP or other project-specific documents. In addition, this individual is responsible for the completion of all required paperwork (e.g., sample log sheets, field notebook, boring logs, container labels, custody seals, and chain-of-custody forms) associated with the collection of those samples.

**Field Operations Leader (FOL)** – This individual is primarily responsible for the execution of the field sampling program in accordance with the project planning documents. This is accomplished through management of a field sampling team for the proper acquisition of samples.

- General personnel qualifications for environmental media sample collection include the following:
- Occupational Safety and Health Administration (OSHA) 40-hour HAZWOPER and applicable refresher training.
- Ability to perform field work under the expected physical and environmental (i.e., weather) conditions
- Familiarity with appropriate procedures for sample documentation, handling, packaging, and shipping
- Familiarity with chemical-specific requirements for collection and handling of samples for PFAS analysis as described in this procedure.



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- Personnel implementing this SOP must read and understand this SOP prior to collection of samples designated for PFAS analysis.

## **7.0 PROCEDURES**

All personnel involved in sample acquisition must strive to prevent contact of sample media with potential sources of PFAS contamination. Given the widespread use of PFAS in products including those typically preferred for environmental sampling, all samples for PFAS analysis are to be collected using precautions to avoid inadvertent contamination of the sample media. These precautions are identified below for selection of sampling equipment and general field equipment, field personnel clothing and protective gear, sample containers and sample handling activities.

### **7.1 Selection of Equipment**

It is important to research available equipment and materials at the planning stage to avoid last minute problems in the field; for example, ensuring compatibility of high-density polyethylene (HDPE) tubing with fittings for use in a peristaltic or other pump; or ensuring that equipment does not contain Teflon®.

#### **Sampling Equipment:**

- Avoid using any sampling equipment constructed of or containing polytetrafluoroethylene (PTFE) or Teflon® (DuPont brand name) or fluorinated ethylene propylene (FEP) during sample handling or mobilization/demobilization.
- Avoid using low-density polyethylene products (LDPE) if contamination from those products can be transferred to environmental samples or QC samples.
- Use sampling equipment made of stainless steel, acetate, silicone, high-density polyethylene (HDPE), or polypropylene. This applies to tubing, pumps and pump components, tape for plumbing fittings, trowels, mixing bowls or other equipment that could contact the sample media. Gasket and O-ring components of sampling equipment may contain fluoropolymers.

#### **Non-Sampling Field Equipment:**

- Avoid using waterproof field books or paper during sampling activities. Non-waterproof loose-leaf paper or notebooks are acceptable. Do not use plastic clipboards, binders, or



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**POLYFLUOROALKYL SUBSTANCE ANALYSIS**

spiral hard cover notebooks that may be coated; use Masonite or aluminum clipboards instead.

- Avoid using Post-it® notes or similar removable notes during sample handling or mobilization/demobilization activities.
- Avoid using Sharpies® or similar indelible markers; do use ball-point pens or pencils for note taking and sample bottle labeling.

Field Personnel Clothing and Protective Gear:

- Avoid wearing new clothing due to the possible treating of fabric with PFAS for stain resistance. Wear clothing made from natural fibers (e.g. cotton) to the extent possible. Clothing should have been washed at least several times between time of purchase and time of first use during sampling activities. Avoid using fabric softener when laundering clothing to be worn during sample collection.
- During wet weather, use rain gear made from polyurethane or wax-coated materials.
- Avoid wearing water-resistant (e.g., Gore-Tex® or similar material) clothing or footwear (i.e., boots) immediately prior to or during sample collection and management.
- Avoid wearing cosmetics, shampoos, moisturizers, or other similar personal hygiene products on the day of sampling.
- Use sunscreens and insect repellants with 100% natural ingredients. The following items are acceptable for use, but the suitability of these items has not been independently verified:
  - Sunscreens - Alba Organics Natural Sunscreen, Yes To Cucumbers, Aubrey Organics, Jason Natural Sun Block, Kiss my face, Baby sunscreens that are "free" or "natural."
  - Insect Repellents - Jason Natural Quit Bugging Me, Repel Lemon Eucalyptus Insect repellent, Herbal Armor, California Baby Natural Bug Spray, BabyGanics
  - Sunscreen and insect repellant - Avon Skin So Soft Bug Guard Plus – SPF 30 Lotion
- Avoid wearing Tyvek® suits.
- Wear un-powdered nitrile gloves at all times while collecting and handling samples and change gloves often.



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**POLYFLUOROALKYL SUBSTANCE ANALYSIS**

- Avoid unnecessary contact with automobile upholstery that may have been treated with PFAS. If practical, cover clothing and skin that has been in contact with such upholstery within non-fluorinated clothing.

**Sample Containers and Shipping Materials**

- Avoid the use of glass sample containers, which are believed to result in loss of PFAS from samples through adsorption to the container.
- Collect samples in laboratory-supplied plastic bottles only, typically polypropylene or HDPE.
- Confirm that Teflon®-lined caps are not used in sample containers; unlined polypropylene screw caps must be used.
- Avoid using Blue Ice® or similar items to cool samples and avoid placing such items in sample coolers for shipping. Use commercially available (e.g., from convenience stores or supermarkets) double-bagged ice instead.

**7.2 Other Precautions for Sample Handlin**

- Avoid handling or bringing pre-wrapped food or snacks (e.g., fast food, candy bars, microwave popcorn, etc.) into the sampling area before or during sampling, because many food and snack products are packaged in wrappers treated with PFAS. Only water or hydrating drinks (e.g., Gatorade) should be brought onsite or allowed in vehicles used for PFAS sampling activities.
- Wash hands thoroughly after handling fast food, carryout food, or snacks, or other items that may contain PFAS.
- Assume that shipping tape used for securing coolers could contain PFAS; therefore, take care not to transfer PFAS from tape to samples.

These precautions should be observed during sampling activities, especially during water sample collection (groundwater and surface water), given the high solubility of PFAS in water. Examples of how these precautions may be applied to sampling of specific media are provided in the following sections.

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### **7.3 Groundwater Sample Acquisition**

The precautions and requirements identified in the previous sections must be observed for groundwater sampling. Do not proceed any further without reviewing each of those precautions and requirements.

- Collect groundwater samples for PFAS analyses in accordance with this SOP, and/or project- or client-specific requirements.
- If non-dedicated, non-disposable equipment is used between sampling locations, it should be decontaminated with Alconox® or Liquinox®, unless 1,4-dioxane (a potential component of these detergents) is also a contaminant of concern. In that case Liquinox® should not be used. Products such as Decon 90 should not be used.
- If samples are to be collected for analysis of PFAS and other analytes, determine whether the same equipment can be used for all sample analyses. If Teflon® or LDPE materials are required for the non-PFAS analytes, then use multiple sets of equipment and determine a suitable sample collection sequence and protocol for collecting the groundwater samples for the analyte groups of interest. For example, purge and sample a monitoring well for PFAS first using a peristaltic pump with HDPE and silicone tubing. Then use a bladder pump with Teflon® tape on air-line fittings to purge the well and sample for VOCs with Teflon tubing, if the VOC protocol requires it. Or use silicone tubing for all parameters, if appropriate. Protocols and order of sampling should be clearly identified in the SAPs. If the sampling sequence is unclear, consult the FOL or Project Manager and record the actual sequence in the field notes.
- If tasked to sample monitoring wells that have or had dedicated Teflon® or FEP tubing that potentially contained PFAS, after removing the tubing, evacuate at least one well volume prior to sampling using silicone or HDPE tubing. This will ensure that standing water that was in contact with the tubing is removed from the water column prior to sampling.

### **7.4 Soil Sample Acquisition**

The precautions and requirements identified in Sections 7.1 and 7.2 must be observed for soil sampling. Do not proceed any further without reviewing each of those precautions and requirements.



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**SAMPLE ACQUISITION FOR PERFLUORINATED COMPOUNDS (PFCs) AND OTHER**  
**POLYFLUOROALKYL SUBSTANCE ANALYSIS**

- Collect soil samples for PFAS analyses in accordance with this SOP, and/or project- or client-specific requirements.
- Soil sampling equipment should not be constructed of or contain Teflon® materials. Acceptable materials for sampling include stainless steel, acetate, or polypropylene. If non-dedicated, non-disposable equipment is used between sample locations, it should be decontaminated with Alconox® or Liquinox®.
- Collect samples in laboratory-provided containers specifically designated for PFAS analysis. Do not use glass jars typically used for soil sample collection.

### **7.5 Surface Water and Sediment Sample Acquisition**

The precautions and requirements identified in Sections 7.1 and 7.2 must be observed for surface water and sediment sampling. Do not proceed any further without reviewing each of those precautions and requirements.

- Collect surface water and sediment samples for PFAS analysis in accordance with this SOP, and/or project- or client-specific requirements.
- Surface water and sediment samples should be collected in laboratory-supplied bottleware specifically designated for PFAS analysis (not glass). If transfer bottles are required for collection of surface water samples, the transfer bottles used should be the same material as the containers designated for submission to the laboratory.
- Surface water and sediment sampling equipment should not be constructed of or contain Teflon® or LDPE materials. Acceptable materials for sampling include HDPE, silicone, stainless steel, acetate, or polypropylene. If non-dedicated, non-disposable equipment is used between sample locations, it should be decontaminated with Alconox® or Liquinox®.

### **7.6 Water Supply Sampling**

This section applies to sampling from taps, spigots, faucets, or similar devices. The precautions and requirements identified in Sections 7.1 and 7.2 must be observed for water supply sampling. Do not proceed any further without reviewing each of those precautions and requirements.

- Collect water supply samples for PFAS analysis in accordance with applicable portions of this SOP, and/or project- or client-specific requirements.
- Water supply samples should be collected in laboratory-supplied bottleware specifically designated for PFAS analysis (not glass).



**STANDARD OPERATING PROCEDURE**  
**SAMPLE ACQUISITION FOR PERFLUORINATED COMPOUNDS (PFCs) AND OTHER**  
**POLYFLUOROALKYL SUBSTANCE ANALYSIS**

- Ensure that sample bottles used to collect chlorinated water samples contain the proper preservative; non-chlorinated water does not require chemical preservatives designed to remove chlorine.
- Water supply sampling equipment (if needed) should not be constructed of or contain Teflon® or LDPE materials. Acceptable materials for sampling include HDPE, silicone, stainless steel, acetate, or polypropylene. If non-dedicated, non-disposable equipment is used between sample locations, it should be decontaminated with Alconox® or Liquinox®.
- Locate the sampling point. If a specific sampling point has already been designated (e.g., a kitchen tap), plan to collect the sample from that point; otherwise, identify a location in the water supply line that is as close as possible to the water's point of origination (e.g., a well or other water source) and upstream of any local water treatment unit(s) that could affect PFAS levels (e.g., water softeners, activated carbon, or reverse osmosis treatment units). If a treatment unit is in use, a post-treatment sample may also be required in some cases, per project requirements.

**Note:** If treatment that could affect PFAS levels (e.g., carbon filtration or reverse osmosis) is part of the water distribution system, often a spigot will be present in the plumbing line between the water source and the treatment unit and this spigot should be used

- Remove any aerator/diffuser from the faucet, if possible. If removal is not possible, record this observation in the field notes.
- Allow the water to run freely from the tap until parameter stabilization per project-specific requirements is achieved, or as otherwise required by project-specific requirements. This will often require purging for 3 to 5 minutes.
- Reduce the water flow rate to minimize aeration of the sample. The water stream should be no wider than the diameter of a pencil.
- Fill the sample bottle (typically 250 mL) directly from the tap to the bottom of the neck of the bottle and cap the bottle immediately.
- After collecting the sample, cap the bottle and, if preservative is included, agitate by hand until the preservative is dissolved.



**STANDARD OPERATING PROCEDURE**  
**SAMPLE ACQUISITION FOR PERFLUORINATED COMPOUNDS (PFCs) AND OTHER**  
**POLYFLUOROALKYL SUBSTANCE ANALYSIS**

### **7.7 Field Reagent Blank Collection**

**Note:** EPA Method 537 and modifications thereof for PFAS analysis require an FRB to be handled along with each sample set. A sample set is described as samples collected from the same sample site and at the same time, but “sample site” and “same time” are not precisely defined. Therefore, it is important to verify that the correct number of FRBs will be collected.

*Collection of an FRB at every sampling point may be required.*

- Verify the number of FRBs to be collected for the project and where those samples must be collected. This should be described in the project planning documents such as work plans or sampling and analysis plans. If it is not, consult the PM.
- At the sampling site, when ready to collect an FRB, open the bottle of chemically preserved FRB reagent water provided by the laboratory and a corresponding empty bottle, also provided by the laboratory.
- Pour the preserved FRB reagent water into the empty sample bottle, close the cap, and label this filled bottle as the FRB.
- Pack and ship the FRB along with site samples and the required documentation (e.g., chain of custody form) to the laboratory.

**Note:** Although chain of custody forms will indicate that FRBs must be analyzed for PFAS, analysis of an FRB will be required only if site samples contain PFAS above a certain concentration. *If an FRB is analyzed and any PFAS concentration in the FRB exceeds 1/3 the laboratory MRL, then all samples collected with that FRB may be considered invalid and may require recollection and analysis of the recollected samples. Consult the project planning documents governing sample collection for specifics as to whether resampling is necessary. Care in collection and handling of site samples and FRBs in a way that avoids contamination cannot be overemphasized.*

## **SOP 2**

Field Documentation

## STANDARD OPERATING PROCEDURE

### FIELD DOCUMENTATION

#### 1. PURPOSE

To set environmental group criteria for content and form for Daily Report Sheets or project-specific field logbooks.

The standard procedure for field documentation requires the use of Daily Report Sheets. Part A of this standard operating procedure (SOP), Daily Report Sheet Content and Control, addresses use of the Daily Report sheet. For special cases, as may be required by the client, project-specific field logbooks may be used for field documentation. Part B of this SOP, Site-Specific Field Logbook Content and Control, addresses use of the project-specific field logbook.

Information recorded on daily report sheets or in field logbooks may include identification of field team personnel, visitors on-site, date, time, weather conditions, observations, data, calculations, description of the data collection or sampling activity, methods, instruments used, instrument calibration data, and results. In addition, the daily report sheets or logbooks may contain descriptions of geologic material, wastes generated or disposed, biota, and site features including sketches, maps, or drawings as appropriate. Entries will be described in as much detail as practical.

#### 2. PROCEDURE

##### 2.1 FIELD PREPARATION

###### ***2.1.1 Forms***

- Daily Report Sheets or field logbook

###### ***2.1.2 Equipment***

- Waterproof pen or marker (black ink preferable) and pencils for emergency backup
- Ruler or similar scale (in some circumstances)
- Watch or other timepiece
- Compass (in some circumstances)

###### ***2.1.3 Documents***

- Any site-specific plans required for field activities



## STANDARD OPERATING PROCEDURE

### FIELD DOCUMENTATION

#### 2.2 FIELD PROCEDURES

##### 2.2.1 *Part A – Daily Report Sheet Content and Control*

Upon arrival on-site and before the start of field activities, the following information shall be recorded in the heading section of the Daily Report sheet (see attached):

- Project name
- Tetra Tech Project number
- Date of site activity
- Site location
- Weather
- Contractors working for Tetra Tech
- Contractor's employees
- Contractor's equipment
- Equipment
- Visitors presently on-site

Daily Report sheets should be used to record a “summary” of daily field information. The following is a list of requirements that must be followed when using a Daily Report sheet:

- Record the following on a daily basis or if any conditions change on any given day:
  - Name of individual making entry and names of all field team members present
  - Date
  - Weather conditions (i.e., temperature, cloud cover, precipitation, wind direction and speed) and other pertinent data
  - Level of personal protection to be used
  - The names of all visitors to the site and the purpose of their visit
- Record the work performed, observations, data, quantities of materials, calculations, drawings, and related information directly on the Daily Report sheet. If data collection forms are specified by SOP, this information need not be duplicated; however, any forms used to record site information or measurement



## STANDARD OPERATING PROCEDURE

### FIELD DOCUMENTATION

data must be included with the Daily Report sheet and delivered to the Project Manager for review and filing.

- Do not skip lines on the Daily Report sheet. Do not start a new page until the previous one is full or has been marked with a single diagonal line so that additional entries cannot be made.
- Do not erase or blot out any entry at any time. Before an entry has been signed and dated, changes may be made but care must be taken not to obliterate what was written originally. Indicate any deletion by a single line through the material to be deleted.
- Record as much information as practical.
- Other events and observations that should be recorded include:
  - Changes in the weather that impact field activities or personal health and safety
  - Deviations from and reasons for deviations from procedures outlined in work plans or SOPs
  - Problems, down-times, or delays
  - Upgrade or downgrade of personal protective equipment

#### **Post-Operation:**

To guard against loss of data due to damage or disappearance of Daily Report sheets, completed pages shall be copied periodically (weekly, at a minimum) and securely stored at the appropriate office in two locations, project file and a separate field documentation file.

Documents which are separated from the Daily Report sheets shall be copied and submitted regularly and as promptly as possible to the appropriate office with the Daily Report sheets for similar review and filing. This includes all automatic data recording media (print-outs, logs, or disks) and activity-specific data collection forms required by other SOPs.

#### **Comments:**

Daily Report Sheets constitute the official record of on-site technical work, field investigations, and data collection activities. Their use, control, and ownership are restricted to activities pertaining to specific field operations carried out by Tetra Tech personnel and their subcontractors. They are documents that may be used in court to indicate and defend dates and times, personnel, procedures, and techniques employed during site activities. Entries made in these notebooks and on these sheets should be factual, clear, precise, and as non-subjective as possible.



## **STANDARD OPERATING PROCEDURE**

### **FIELD DOCUMENTATION**

In some adverse weather or work conditions, Daily Report sheets may become wet and will not accept ink. If this situation arises, attempt to dry the pages. If drying attempts fail, use a graphite pencil to continue with field documentation entries. Document this occurrence on the sheet and resume ink use when possible.



## STANDARD OPERATING PROCEDURE

### FIELD DOCUMENTATION

#### **2.2.2 Part B – Site-Specific Field Logbook Content and Control**

##### **Preparation:**

Field log information will be recorded in Tetra Tech field survey books or Project Manager-approved notebooks. Logbooks shall be bound and all pages must be numbered prior to initial use of the logbook.

The following information should be recorded inside the front cover prior to initial use of the logbook:

- Person to whom the logbook is assigned
- Office address and telephone number
- Logbook number
- Project name
- Project number
- Project start date

The first five pages of the logbook shall be reserved for a table of contents. Mark the first page with the heading and enter the following:

#### TABLE OF CONTENTS

Date/Description	Page
(Start Date)/ Reserved for TOC	1-5

The remaining pages of the Table of Contents will be designated as such with "TOC" written on the top-center of each page.



## STANDARD OPERATING PROCEDURE

### FIELD DOCUMENTATION

#### **Procedure:**

The following is a list of requirements that must be followed when using a site-specific field logbook:

- Record the following on a daily basis or if any conditions change on any given day:
  - Name of individual making entry and names of all field team members present
  - Date and time
  - Weather conditions (i.e., temperature, cloud cover, precipitation, wind direction and speed) and other pertinent data
  - Level of personal protection to be used
  - The names of all visitors to the site and the purpose of their visit
- Record the work performed, observations, data, quantities of materials, calculations, drawings, and related information directly in the logbook. If data collection forms are specified by another standard operating procedure (SOP), this information need not be duplicated in the logbook; however, any forms used to record site information or measurement data must be referenced in the logbook.
- Do not skip lines in the logbook. Do not start a new page until the previous one is full or has been marked with a single diagonal line so that additional entries cannot be made. Use both sides of the logbook page.
- Do not erase or blot out any entry at any time. Before an entry has been signed and dated, changes may be made but care must be taken not to obliterate what was written originally. Indicate any deletion by a single line through the material to be deleted.
- Do not remove any pages from the logbook.
- Record as much information as practical.
- Initial and date each page.
- Sign and date the final page entries for each day.
- Initial and date all changes.



## STANDARD OPERATING PROCEDURE

### FIELD DOCUMENTATION

- Multiple authors must sign out the logbook by inserting the following:
  - Above notes authored by:
    - (Sign name)
    - (Print name)
    - (Date)
- A new author must sign and print his/her name before additional entries are made.
- Draw a diagonal line through the remainder of the page at the end of the day.

Entries into the field logbook shall be preceded with the time (written in military units) of the observation. The time should be recorded frequently and at the point of events or measurements that are critical to the activity being logged. All measurements made and samples collected must be recorded unless they are documented by automatic methods (e.g., data logger) or on a separate form required by an SOP. In these cases the logbook entry must reference the automatic data record or form.

At each station where a sample is collected or an observation or measurement is made, a detailed description of the station location is required. Use a compass, scale, or nearby survey markers, as appropriate. A sketch of station location may be warranted. All maps or sketches made in the logbook should have descriptions of the features shown and a direction indicator. It is preferred that maps and sketches be oriented so that north is towards the top of the page. The number of photographs taken of the station or activity, if any, will also be noted.

Other events and observations that should be recorded include:

- Changes in the weather that impact field activities
- Deviations from and reasons for deviations from procedures outlined in work plans or SOPs
- Problems, down-times, or delays
- Upgrade or downgrade of personal protective equipment

#### **Post-Operation:**

To guard against loss of data due to damage or disappearance of site-specific field logbooks, completed pages shall be copied periodically (weekly, at a minimum) and securely stored at the appropriate office in two locations, project file and a separate field documentation file. Documents which are separated from the site-specific field logbooks shall be copied and submitted regularly and as promptly as possible to the appropriate office with the field logbook



## STANDARD OPERATING PROCEDURE

### FIELD DOCUMENTATION

copies for similar review and filing. This includes all automatic data recording media (print-outs, logs, or disks) and activity-specific data collection forms required by other SOPs.

#### **Comments:**

Field logbooks constitute the official record of on-site technical work, field investigations, and data collection activities. Their use, control, and ownership are restricted to activities pertaining to specific field operations carried out by Tetra Tech personnel and their subcontractors. They are documents that may be used in court to indicate and defend dates and times, personnel, procedures, and techniques employed during site activities. Entries made in these logbooks should be factual, clear, precise, and as non-subjective as possible.

In some adverse weather or work conditions, field logbooks become wet and will not accept ink. If this situation arises, attempt to dry the pages. If drying attempts fail, use a graphite pencil to continue with field documentation entries. Document this occurrence on the sheet and resume ink use when possible.

## **SOP 3**

Field Equipment Use and Calibration



## STANDARD OPERATING PROCEDURE

### FIELD EQUIPMENT USE AND CALIBRATION

#### **1. PURPOSE**

The purpose of this procedure is to set criteria for field equipment use and calibration.

#### **2. PROCEDURE**

A significant number of field activities involve usage of electronic instruments to monitor for environmental screening and health and safety purposes. It is imperative the instruments are used and maintained properly to optimize their performance and minimize the potential for inaccuracies in the data obtained, and to insure worker's health and safety is not compromised.

This SOP provides guidance on the usage, maintenance and calibration of electronic field equipment, whether for equipment owned by the Consultant or Contractor, or equipment obtained from a rental agency.

##### **2.1 FIELD PREPARATION**

###### ***2.1.1 Forms***

- Field Calibration Forms

###### ***2.1.2 Equipment***

- Monitoring equipment specific to work plan tasks.
- Associated calibration gases, aqueous standards, etc.
- Appropriate shipping containers to facilitate transport without damage to equipment.

###### ***2.1.3 Documents***

- Manufacturer's instructions, operation and maintenance information.

##### **2.2 FIELD PROCEDURES**

All monitoring equipment will be in proper working order, and operated for the purpose for which it was intended, in accordance manufacturer's recommendations.

Field personnel will be responsible for insuring the equipment is maintained and calibrated in the field to extent practical, or returned for office or manufacturer maintenance or calibration if warranted. Calibration is discussed in greater detail below.

A copy of the Operating Instructions, Maintenance and Service manual for each instrument used on a project will be kept on site at all times.



## **STANDARD OPERATING PROCEDURE**

### **FIELD EQUIPMENT USE AND CALIBRATION**

Instruments will be operated only by personnel trained in the proper usage and calibration. In the event certification of training is required, personnel will have documentation of such certification with them on site at all times.

Personnel must be aware that certain instruments are rated for operation within a limited range of conditions such as temperature and humidity. Usage of such instruments in conditions outside these ranges will only proceed with proper approval by a project manager and/or Health and Safety supervisor as appropriate.

Instruments that contain radioactive source material, such as x-ray fluorescence analyzers or moisture-density gauges require specific transportation, handling and usage procedures that are generally associated with a license from the Nuclear Regulatory Commission (NRC) or an NRC-Agreement State. Under no circumstance will operation of such instruments be allowed on site unless by properly authorized and trained personnel, using the proper personal dosimeter badges or monitoring instruments.

#### **Calibration**

Calibration of an electronic instrument is critical to insure it is operating properly for its intended use. Such instruments are often sensitive to changes in temperature or humidity, or chemical vapors in the working atmosphere, and as a result their response and ability to monitor conditions and provide data can change significantly.

#### **Parameters**

Calibration of instruments shall be performed in accordance with the manufacturer's recommendations. This includes the following parameters:

- Frequency
- Use of proper calibration Gases or Chemical Standards
- Requirements for Factory Calibration

#### **Calibration Gas Safety**

Several instruments such as photoionization detectors (PIDs), flame ionization detectors (@!IDS), oxygen meters, explosimeters, combustible gas indicators and many others require use of calibration gasses contained in compressed gas cylinders. Many of these gases are combustible or explosive. Care shall be taken to minimize the potential for injury from the use of such compressed gases. Transport, handling and storage of cylinders, where necessary, shall be performed in accordance with applicable DOT regulations and site requirements.



## STANDARD OPERATING PROCEDURE

### FIELD EQUIPMENT USE AND CALIBRATION

Calibration will only be performed in areas free of sources of spark, flame or excessive heat. Smoking will not be allowed in the vicinity of calibration gas usage areas.

#### **Documentation of Calibration**

Instrument Calibration activities will be documented on the field calibration form.

#### **Intrinsically Safe Requirements**

Certain work locations may be such that dangerous, ignitable or explosive conditions exist. In such cases, it may be necessary to utilize only equipment that is rated as "Intrinsically Safe." Intrinsically safe instrumentation is designed with limited electrical and thermal energy levels to eliminate the potential for ignition of hazardous mixtures.

For site work requiring operation of monitoring instruments in Class I, Division I locations (as defined by the National Fire Protection Agency (NFPA)) only instrumentation rated as Intrinsically Safe will be used. Such equipment (including all accessories and ancillary equipment) must be rated to conform to Underwriter's Laboratories (UL) Standard 913, for use in a Class I, Division 1 Groups A, B, C, and D locations. It is also recommended the equipment conform to CSA Standard 22.2, No. 157-92.

Upon completion of the field activities, equipment shall be returned to the possession of the Consultant, Contractor or Rental Agency accompanied by a written summary of any problems encountered with its use or calibration.

Equipment shall be properly prepared for shipping, including insuring that residual gases (if applicable) are removed from the instrument, and accompanying containers of compressed gases or fluids are properly labeled and sealed.

#### **Equipment Decontamination**

Equipment that comes in contact with Site media (water level meters, water quality meters) must be cleaned before removal from the site to ensure that chemicals are not transferred to other sites. It is the responsibility of the person who requisitioned the equipment to ensure appropriate cleaning before returning the equipment. Equipment decontamination procedures are typically site-specific for unique site compounds.

## **SOP 4**

### **Soil Boring and Monitoring Well Installation**



## STANDARD OPERATING PROCEDURE

### SOIL BORING AND MONITORING WELL INSTALLATION

#### **1. PURPOSE**

The purpose of this procedure is to install a soil boring or groundwater monitoring well to obtain soil and groundwater data. Monitoring wells are constructed to ensure that groundwater accessed is representative of in-situ conditions.

#### **2. PROCEDURE**

##### **2.1 FIELD PREPARATION**

Call Miss Dig at 1-800-482-7171 more than 72 hours in advance of field activity commencement to identify buried utilities in the area of subsurface activity.

Notify the client, property owner, and MDEQ as necessary.

###### **2.1.1 *Forms***

- Soil Boring and Monitoring Well Logs
- Purchase order form to ensure payment of the drillers
- Field Service Request
- Tailgate Health and Safety
- *Daily Report Sheets*

###### **2.1.2 *Equipment***

- Well caps - expanding, locking
- Locks (keyed alike)
- Latex or nitrile gloves
- *Typically provided by the drillers:*
- Well screen and casing
- Sand, bentonite chips/grout
- Concrete

## STANDARD OPERATING PROCEDURE

### SOIL BORING AND MONITORING WELL INSTALLATION

#### **2.1.3 *Documents***

- Site Access Agreements (if necessary)
- Site maps
- Workplan
- Health and Safety Plan

#### **2.1.4 *Other***

- Cellular telephone
- First aid kit
- Personal comfort items
- Stakes and flagging to mark location

## **2.2 FIELD PROCEDURES**

Build a berm or dike, if necessary, around the drilling area to divert surface water and run-off from the borehole, and avoid entry of surface water and run-off into the hole during drilling and well installation. Boreholes should not be left open (unsupported by casing, auger, or drilling fluid) if advanced through contaminated material to prevent contaminated soils from caving to the area of the well screen.

Segregate all well materials and drilling tools from potential sources of contamination. The drilling contractor should use new well casing and screen that has been sealed at the factory, or decontaminated and wrapped before arrival at the site. Handle casing and screen only while wearing clean gloves (this is most important if the wells are not expected to be in an affected area). Be sure to decontaminate all drilling tools and equipment before each well installation using a high-pressure steam cleaner.

Soil boring and monitoring well depth should be determined before field activity commencement, if appropriate. Reference the Field Service Request Form for the method to be used for field depth determination.

If nested wells (two or more closely spaced wells, screened at different depths) are installed, the deepest well in the grouping should be installed first. This allows for complete vertical characterization of the geology and verification of the proper depths for any shallower well. It also reduces the possibility of grout intrusion into the shallower wells.

For installing groundwater monitoring wells in unconsolidated geologic materials, hollow stem auger drilling is the method of choice, as vertical cross-contamination between depth intervals and extraneous handling of contaminated materials is avoided.

## STANDARD OPERATING PROCEDURE

### SOIL BORING AND MONITORING WELL INSTALLATION

- Determine position and depth of well to be installed.
- Complete the Soil Boring and Monitoring Well Log using military time and recording sample recovering in inches. Samples submitted for laboratory analysis are recorded on the log in parenthesis and are named as the soil boring or monitoring well name followed by the depth (ex. SB-02-4 30 feet). Split spoon (SS) samples are recorded consecutively starting with SS-1.
- As soils are retrieved from the split spoon sampling tool (or Shelby tube), the borings must be characterized based on their color, moisture content, odor, cohesive properties, grain size, and lithology (see soil classification SOP).
- Well materials may be schedule 40, 2" or 4" diameter with # 10 (or 0.010-inch) slot well screen with a schedule 40, 2" or 4" diameter PVC casing or a stainless steel screen with galvanized steel casing.
- If the well hole is advanced too far, backfill the bottom with sand before positioning the screen (unless a confining unit has been breached - then seal the breach with bentonite and grout the boring). Deposit appropriate sand filter pack around the well screen until measured at one foot above the screen. Then seal the top of the sand pack with a bentonite slurry (approx. 1-1.5 feet), bentonite chips or a grout mixture to the surface.
- A well cap with a watertight seal and lock must be affixed to the well top. For flush-mounted wells, have the drillers use a neat cement grout to form the annular seal surrounding the well casing. They should bring the grout to within 3 inches of the top of the monitoring well casing, tapering the grout away from the monitoring well to the edge of the bore hole. Place and center the metal manhole cover (minimum diameter 8") over the monitoring well casing. Cement the cover in place inside a square 2 x 2 foot (or 12" diameter round pad) 6-inch deep pad. Slope the concrete surface away from the well to promote surface drainage away from the monitoring well.
- Develop the well before conducting sampling or performing hydraulic conductivity tests by surging, pumping, or bailing, depending on the well depth, yield, diameter, contaminants present, and depth to water.

**SOP 5.4**  
Safe Drilling Practices



## **STANDARD OPERATING PROCEDURE**

### **SAFE DRILLING PRACTICES**

This document establishes safe work practices (SWP) to follow during drilling operations. These SWPs are based on suggested safety procedures provided in the National Drilling Association's "Drilling Safety Guide." Procedures to follow before, during, and after drilling are listed below.

Before beginning any drill operation, each employee must conform to the following requirements:

- Wear a hard hat, safety glasses or goggles, steel-toed work boots, a shirt and full-length pants when working with or near the drill rig. Shirts must be tucked in at the belt.
- Do not wear loose or frayed clothing, loose long hair, or loose jewelry while working with rotating equipment.
- Do not eat, drink, or smoke near the drill rig.
- Identify all underground utility and buried structure locations before drilling.
- Ensure that drill masts or other projecting devices will be farther than 25 feet in any direction from overhead power lines.
- Ensure that the drill rig and any other machinery used is inspected daily by competent, qualified individuals. The site safety coordinator (SSC) will ensure compliance with this precaution.
- Drill rig operators will be instructed to report any abnormalities, such as equipment failure, oozing liquids, and unusual odors, to their supervisors or the SSC.
- Establish hand-signal communications for use when verbal communication is difficult. One person per work team will be designated to give hand signals to equipment operators.

While the drill rig is operating, employees must:

- Wear appropriate respiratory and personal protective equipment (PPE) when conditions warrant their use.
- Avoid direct contact with known or suspected contaminated surfaces.
- Move tools, materials, cords, hoses, and debris to prevent tripping hazards and contact with moving drill rig parts.

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## STANDARD OPERATING PROCEDURE

### SAFE DRILLING PRACTICES

- Adequately secure tools, materials, and equipment subject to displacement or falling.
- Store flammable materials away from ignition sources and in approved containers.
- Maintain adequate clearance of the drill rig and mast from overhead transmission lines. The minimum clearance is 25 feet unless special permission is granted by the utility company. Call the local utility company for proper clearance.
- Only qualified and licensed personnel should operate drill rigs.
- Workers should not assume that the drill rig operator is keeping track of the rig's exact location. Workers should never walk directly behind or beside heavy equipment without the operator's knowledge.
- Workers should maintain visual contact with drill rig operators at all times.
- When an operator must maneuver equipment in tight quarters, the presence of a second person is required to ensure adequate clearance. If much backing is required, two ground guides will be used: one in the direction the equipment is moving, and the other in the operator's normal field of vision to relay signals.
- Auger sections and other equipment are extremely heavy. All lifting precautions should be taken before moving heavy equipment. Appropriate equipment, such as chains, hoists, straps, and other equipment, should be used to safely transport heavy equipment too heavy to safely lift.
- Proper personal lifting techniques will be used. Workers should lift using their legs, not their backs.
- Workers will not use equipment they are not familiar with. This precaution applies to heavy as well as light equipment.
- All personnel not essential to work activities will be kept out of the work area.
- Workers will be aware of their footing at all times.
- Workers will remain alert at all times.

After drilling operations are completed, employees should do the following:

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## STANDARD OPERATING PROCEDURE

### SAFE DRILLING PRACTICES

- Shut down machinery before repairing or lubricating parts (except parts that must be in motion for lubrication).
- Shut down mechanical equipment prior to and during fueling operations. When refueling or transferring fuel, containers and equipment must be bonded to prevent the buildup of static electricity.
- Keep drill rigs in the exclusion zone until work has been completed. Such equipment should then be decontaminated within the designated decontamination area.
- Engage parking brakes when equipment is not in use.
- Implement an ongoing maintenance program for all tools and equipment. All tools and moving equipment should be inspected regularly to ensure that parts are secured, are intact, and have no cracks or areas of weakness. The equipment must turn smoothly without wobbling and must operate in accordance with manufacturer specifications. Defective items should be promptly repaired or replaced. Maintenance and repair logs will be kept.
- Store tools in clean, secure areas to prevent damage, loss, or theft.

**Disclaimer:** This safe work practice (SWP) is the property of Tetra Tech, Inc. Any reuse of the SWP without Tetra Tech's permission is at the sole risk of the user. The user will hold harmless Tetra Tech for any damages that result from unauthorized reuse of this SWP. Authorized users are responsible for obtaining proper training and qualification from their employer before performing operations described in this SWP.

Revision Date	Document Authorizer	Revision Details
10/1/2008	Chris McClain	Update from 1998 format

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**SOP 6**  
Soil Descriptions



## STANDARD OPERATING PROCEDURE

### SOIL DESCRIPTIONS

#### 1. PURPOSE

The purpose of this procedure is to describe and classify soil samples in the field during soil boring advancement.

#### 2. PROCEDURE

##### 2.1 FIELD PREPARATION

Call Miss Dig (1-800-482-7171) at least 72 hours in advance to arrange utility staking in any subsurface boring or exploration area.

Notify client, property owner, and MDEQ if necessary.

###### *2.1.1 Forms*

- Soil Boring and Monitoring Well Logs
- Tailgate Health and Safety
- Field Service Request
- Daily Report Sheets

###### *2.1.2 Equipment*

- Knife or spatula
- Ruler, tape measure, or scale
- Latex or nitrile gloves
- Sand gauge and geotechnical gauge, if necessary

###### *2.1.3 Documents*

- Health and Safety Plan
- Work Plan
- Maps
- Site access agreements

## STANDARD OPERATING PROCEDURE

### SOIL DESCRIPTIONS

#### **2.1.4 Other**

- Cellular telephone
- First aid kit
- Personal comfort items

#### **2.2 FIELD PROCEDURES**

Include the following information in the soil sample description: color (including mottling); moisture; major and minor soil types; content and grain sizes; and other additional descriptors including contaminant observations; bedding and lamination. Particle shape or angularity is also useful for coarse-grained materials.

Record these descriptors in the following order: 1) color, 2) moisture content, 3) density (ONLY IF BLOW COUNTS ARE TAKEN), 4) composition and grain sizes, and 5) other descriptors.

1. **Color:** Use best judgment in describing soil color. Munsell color charts may be used on specific projects if required. Observed mottling should also be reported. Be sure to include corresponding quantity and contrast terms and specify the mottled colors.

##### **Mottling**

<b>If Mottling Is :</b>	<b>Use This Contrast Term:</b>
Indistinct	Faint
Easily seen	Distinct
Outstanding	Prominent

#### **2. Moisture Content**

<b>Dry</b>	Little or no perceptible moisture
<b>Damp</b>	Some perceptible moisture, not compactable
<b>Moist</b>	Compactable
<b>Wet</b>	Above compactable range
<b>Saturated</b>	Pores, voids filled with water

**STANDARD OPERATING PROCEDURE**  
**SOIL DESCRIPTIONS**

3. **Density:** Based upon blow counts (Note difference of terms for Sand/Gravel vs. Silt/Clay)

- ONLY LISTED IF BLOW COUNTS ARE TAKEN

<u>Sand or Gravel</u>	<u>Blows per foot</u>
<b>Very loose</b>	0 - 4
<b>Loose</b>	4 - 10
<b>Medium dense</b>	10 - 30
<b>Dense</b>	30 - 50
<b>Very dense</b>	>50

<u>Silt or Clay</u>	<u>Blows per foot</u>	<u>Thumb Penetration</u>
<b>Very soft</b>	0 - 2	Very easily
<b>Soft</b>	2 - 4	Easily
<b>Medium stiff</b>	4 - 8	Moderate effort
<b>Stiff</b>	8 - 15	Indented easily by nail
<b>Very stiff</b>	15 - 30	Indented by nail
<b>Hard</b>	>30	Difficult by nail

4. **USCS Texture/ Grain Size** (if gradation within class, list in ascending size order):

<u>Particle Size (mm)</u>	<u>Individual Particle Term</u>
>300	<b>Boulders</b>
75 - 300	<b>Cobbles</b>
75 - 19	<b>Coarse Gravel</b>
19 - 4.8	<b>Fine Gravel</b>
4.8 - 2.0	<b>Coarse Sand</b>
2.0 - 0.43	<b>Medium Sand</b>
0.43 – 0.08	<b>Fine Sand</b>
<0.08	<b>Silt</b>
<0.002	<b>Clay</b>

**STANDARD OPERATING PROCEDURE**  
**SOIL DESCRIPTIONS**

<u>Percentage Category:</u>	<u>%</u>
<b>Trace</b>	0 – 5
<b>Little</b>	5 - 20
<b>Some</b>	20 - 35
<b>With</b>	35 - 50
<b>And</b>	equal parts (if 2 categories, 50/50; if 3, 1/3 <sup>rd</sup> of each); list in descending grain-size order.

5. **Additional Descriptors**, such as:

<b>Lens</b>	Zone equal to or less than 1-inch (2.5 cm) in thickness
<b>Layer</b>	Zone greater than 1-inch (2.5 cm) in thickness
<b>Interbedded</b>	Alternating lenses and/or layers of different media types (The term <b>varved</b> is occasionally applied to some interbedded sediments, but only applies to interbedding that results from annual variation in sediment deposition rates/types.)

**Examples of soil descriptions:**

- Fine to coarse **GRAVEL** and medium to coarse **SAND**
- Fine **GRAVEL**, some fine to coarse Sand, little Silt, trace Clay
- Yellowish orange, dry, dense, medium to coarse **SAND**, trace fine Gravel and Silt
- Gray, wet, medium dense, fine to coarse **SAND**, some fine Gravel
- Brown, moist, soft, interbedded **SILT** and **CLAY**, trace fine Sand, very thinly bedded      Distinct gray mottling



## STANDARD OPERATING PROCEDURE

### SOIL DESCRIPTIONS

#### Notes

- Always use ALL CAPITAL LETTERS for the primary constituent, or for all primary constituents if you use "and". The first letter of each subsequent constituent of soil is capitalized. Still use all caps even if the primary constituents are human-made materials, such as ASPHALT and CONCRETE.
- Where there is variation within a texture class (i.e. Gravel, Sand, Silt, and Clay), indicate the entire range of grain size, listed in increasing size order (ex. fine to coarse Gravel).
- Within one percentage category, list in decreasing grain-size (ex. trace fine Gravel and coarse Sand).
- Avoid the temptation to create new categories intermediate to those listed here, such as "damp/moist" or "trace/little." If there is gradation vertically from top to bottom, indicate this with expressions such as "damp to moist;" other heterogeneity should be described in detail, as in "Brown, damp, soft SILT, with pockets of moist, firm Clay."
- Describe unusual features (inclusions, discontinuities, irregularities) in detail in the "remarks" column. If contamination of any kind is encountered, describe its properties instead of simply naming it. For example, instead of "Diesel Oil @ 6.5", it is better to say "Thin layer of oily material @ 6.5'; odor similar to diesel oil."

**STANDARD OPERATING PROCEDURE**  
**SOIL DESCRIPTIONS**

**SOIL LITHOLOGY “CHEAT SHEET”:**

Soil Color	Moisture Content:		Density (Based on BLOW COUNTS)				Percentage Category:	“Other”
(Mottling):	Term:	Features:	Gravel and Sand:		Silt and Clay:		(Descending order by prevalence)	
(Faint)	Dry	Little/no moisture	Term:	Blows per foot:	Term:	Blows per foot:	0-5%:Trace	Lens
(Distinct)	Damp	Some moisture, not compactable	Very loose	0-4	Very soft	0-2	5-20%: Little	Layer
(Prominent)	Moist	Compactable moisture	Loose	4-10	Soft	2-4	20 – 35%: Some	Interbedded
(Most clay formations cannot contain water above the “Wet” range, as clay micropores hold water with a force greater than can be overcome by gravity alone.)	Wet	Moisture content > compactable range	Medium dense	10-30	Medium stiff	4-8	35 – 50% With	Slickensided
	Saturated	Voids filled (water flows from sample)	Dense	30-50	Stiff	8-15	Equal % Parts: And	Pockets
			Very dense	>50	Very stiff	15-30		Residues
					Hard	>30		Olfactory Obs.
								No Recovery

**SOIL LITHOLOGY “CHEAT SHEET”:**

Soil Color	Moisture Content:		Density (Based on BLOW COUNTS)				Percentage Category:	“Other”
(Mottling):	Term:	Features:	Gravel and Sand:		Silt and Clay:		(Descending order by prevalence)	
(Faint)	Dry	Little/no moisture	Term:	Blows per foot:	Term:	Blows per foot:	0-5%:Trace	Lens
(Distinct)	Damp	Some moisture, not compactable	Very loose	0-4	Very soft	0-2	5-20%: Little	Layer
(Prominent)	Moist	Compactable moisture	Loose	4-10	Soft	2-4	20 – 35%: Some	Interbedded
(Most clay formations cannot contain water above the “Wet” range, as clay micropores hold water with a force greater than can be overcome by gravity alone.)	Wet	Moisture content > compactable range	Medium dense	10-30	Medium stiff	4-8	35 – 50% With	Slickensided
	Saturated	Voids filled (water flows from sample)	Dense	30-50	Stiff	8-15	Equal % Parts: And	Pockets
			Very dense	>50	Very stiff	15-30		Residues
					Hard	>30		Olfactory Obs.
								No Recovery

## **SOP 7**

Well Development

## STANDARD OPERATING PROCEDURE

### WELL DEVELOPMENT

#### 1. PURPOSE

The purpose of this procedure is to set criteria for well development after installation of new monitoring or production wells or wells that have not been sampled or used for an extended period of time.

#### 2. PROCEDURE

This procedure is for the development of groundwater monitoring wells. Before a newly constructed well can be used for water-quality sampling, measuring water levels, or aquifer testing, it must be developed. Well development refers to the procedure used to clear the well and formation around the screen of fine-grained materials (sands, silts, and clays) produced during drilling or naturally occurring in the formation.

Well development is completed to remove fine grained materials from the well casing, well screen and gravel pack. The time allotted and techniques used for well development will vary by well and depend on drilling method, well construction, geological formation and intended use for the well. In general, well development should continue until the well responds to water level changes in the formation (i.e., a good hydraulic connection is established between the well and formation) and the well produces clear, sediment-free water to the extent practical. In general, the method (disturbance) used to develop the well should be more rigorous than the amount of disturbance the well will experience during its regular or intended use. For example, if a well develops clear, sediment free water using a bailer, it is very well developed for low-flow sampling using a peristaltic pump. Please note that well development is especially important when contaminants of concern are sensitive to suspended solids (e.g., metals, PCBs, SVOCs).

#### 2.1 FIELD PREPARATION

##### ***2.1.1 Forms***

- Daily Log
- Well Development Form

##### ***2.1.2 Equipment***

- Required Health and Safety Equipment and PPE
- Well Keys
- General Tools: knife, socket set, vise grips, screwdriver, etc.
- Power Source: generator, extension cord

## STANDARD OPERATING PROCEDURE

### WELL DEVELOPMENT

- Well Development Device: water truck with hoist, surge block, bailer, submersible pump
- Discharge Line: tubing or hose (suitable for expected flow rates and chemicals of concern)
- Purge Water Container: Clear glass jars (e.g., drillers' jars), graduated pail, 55-gallon drum, polytank or frac tank
- Cleaning Supplies: non-phosphate soap, buckets, brushes, laboratory-supplied distilled/deionized water, tap water, cleaning solvent, aluminum foil, plastic sheeting, etc.
- Meters: water level, flow
- Water Quality Meter: pH, temperature, conductivity, turbidity, etc.

#### **2.1.3 Documents**

- Detailed Scope Work Summary
- Proposal
- Work Plan

## **2.2 FIELD PROCEDURES**

All wells must be developed and well development generally occurs with a few days of installation (please remember that some grouts require time to cure). Well development methods and procedures will vary as described above. In most cases, a monitoring well can be developed in less than one hour using a bailer, submersible pump, surge block and/or check valve and tubing (waterra tubing). Production or extraction wells may need to be developed by more rigorous methods and may require a specialized subcontractor. The following presents the minimum steps required to complete well development for a monitoring well and is generally acceptable for all well development activities. More rigorous methods may be required and will be detailed in project specific SOP.

1. Review HASP and don appropriate safety equipment and set up appropriate air monitoring equipment as needed.
2. Prior to introduction to a well, all non-dedicated equipment used for development purposes must be cleaned using a soapy wash (laboratory grade), tap water rinse, isopropyl alcohol rinse and distilled/deionized water rinse as appropriate.
3. Uncap and gauge well, record initial water level.
4. Place well development device (pump, bailer, surge block) into the well.



## STANDARD OPERATING PROCEDURE

### WELL DEVELOPMENT

5. Collect a baseline groundwater sample in a glass jar, or purge bucket to determine relative turbidity. Your project manager may also request that you measure and record the temperature, pH, turbidity, specific electrical conductance and other water quality parameters.
6. Surge the well.
7. Purge the well. If the well runs dry, stop purging and allow the well to recover. Sometimes purge water or distilled water must be added to the well initially to help clear the screen. Additional surging of the screen with the recycled purge water (or distilled water) will allow formation water to flow into the screen. Please make sure that three times the amount of water added is removed during the purging of the well.
8. Repeat steps 5 through 7 until groundwater is relatively clear (less than 4 NTUs) and if required, the water quality parameters are stable within 10%.
9. After development, the well should be allowed to rest and should not be sampled immediately. The period of rest will vary depending on the hydraulic properties of the aquifer or targeted water bearing unit and the intended use of the sample results obtained from the well. In general, a minimum of 2 to 3 days of rest should be adequate.

#### **Waste Disposal**

- All waste generated will be disposed in accordance to the methods and procedures contained in the Waste Disposal SOP.
- All water generated during cleaning and development procedures will be collected and contained in accordance to the site specific disposal requirements.
- All PPE, such as gloves, disposable clothing, and other disposable equipment used or generated during the development process, will be placed in plastic bags. These bags will be transferred into appropriately labeled 55-gallon drums or a covered roll-off box for appropriate disposal.

## **SOP 8**

### Water Sampling



## STANDARD OPERATING PROCEDURE

### WATER SAMPLING

#### 1. PURPOSE

The purpose of this procedure is to obtain representative groundwater samples from groundwater monitoring wells or piezometers with a bailer, peristaltic, submersible, or Keck™ pump. Site-specific groundwater sampling requirements, if necessary, will be described in work plans or field sampling plans.

#### 2. PROCEDURE

##### 2.1 FIELD PREPARATION

Notify client, property owner, and MDEQ as necessary.

###### 2.1.1 *Forms*

- Water Level Data Sheet
- *Daily Report Sheets*
- *Chain of Custodies*
- *Water Quality Data Sheet*
- Field Service Request
- Tailgate Health and Safety

###### 2.1.2 *Equipment*

- Laboratory provided containers and labels
- Laboratory-cleaned cooler
- Well keys
- Electronic water level indicator
- Interface probe (if free-product is expected at the site)
- Calculator
- Latex or nitrile gloves
- Tools to access wells
- metal detector, turkey baster or plastic cup
- Decontamination equipment including deionized or distilled water, Alconox, graduated cylinders, and paper towel



## STANDARD OPERATING PROCEDURE

### WATER SAMPLING

- Knife or scissors
- Garbage bags
- Two graduated 5-gallon pails to collect purge water
- pH, temperature, and specific conductivity meter

*One of:*

- Disposable high-density polyethylene sampling bailers and bailer rope
- Peristaltic pump and sufficient disposable Silicon (approximately 10 inches per sample) and Tygon tubing (length measured from pump head to sampling depth)
- Submersible pump and Tygon tubing
- Keck™ pump

*If needed:*

- DOT-approved sealed drums for storage of purged well water, or a suitable location to disperse of liquid (i.e., on-site treatment system)
- Quantab™ and Hach™ Titration kits

#### **2.1.3 Documents**

- Well Construction Log
- Well location map/site map
- Work Plan
- Health and Safety Plan
- Signed site access agreement

#### **2.1.4 Other**

- Cellular phone
- Replacement locks
- Writing implements and an indelible marker
- Crushed ice
- Bubble wrap if required to protect samples during shipment to the laboratory
- First aid kit



## STANDARD OPERATING PROCEDURE

### WATER SAMPLING

- Personal comfort items
- Machete or other vegetation-clearing tool

#### **2.2 FIELD PROCEDURES**

##### ***2.2.1 Well Purge***

Don a new pair of latex or nitrile gloves

First sample those wells with the lowest historical or suspected concentrations, and then advance to the wells more likely to be contaminated. Set plastic sheeting or a garbage bag near the well to set sample bottles on and to rest sampling equipment.

Obtain the water level measurement, noting any occurrence of LNAPL or DNAPL.

Calculate three or five times the volume of groundwater present in the well casing, as indicated on the *Field Service Request Form*.

Purge the well using a dedicated HDPE disposable bailer and a new length of clean rope, a peristaltic pump with new Teflon and Tygon tubing, a submersible pump with new Tygon tubing, or a Keck™ pump. Purge the groundwater monitoring well of a minimum of 3 to 5 well casing volumes prior to collecting the samples. Measure the volume of purged water using a graduated pail, or other container of known volume. Purging and sampling should be conducted using slow and steady motions to avoid excessive agitation, increased sample turbidity, and sample volatilization. Empty purge water onto the ground, away from the well, or in the event containerizing is required, transfer purged water from the pail into the appropriate storage container for storage until disposal is arranged.

NOTE: If well goes dry before 3 well volumes can be purged from the well, allow groundwater to recharge, then collect sample.

##### ***2.2.2 Field Measured Parameters***

After at least 3 well volumes have been purged from the well, measure temperature, pH, conductivity, and any other field parameters as specified in the *Field Service Request Form*. Once three measurements are obtained within 10-percent of each other, the groundwater quality may be considered representative of the groundwater as it exists in the formation.

If well goes dry before 3 well volumes can be purged from the well, a single round of field parameter measurements will be obtained following recharge of a sufficient amount of groundwater to complete the sampling activities.



## STANDARD OPERATING PROCEDURE

### WATER SAMPLING

#### **2.2.3 *Bottle Preparation***

Prior to sample collection; label all appropriate fields on the sample container labels with an indelible marker. Apply labels to appropriate containers.

#### **2.2.4 *Sample Collection***

##### **2.2.4.1 *Bailers***

Samples will be collected using the same HDPE disposable bailer used for purging. Transfer groundwater samples from the bailer to their appropriate sample bottle, minimizing turbulent flow between the bailer and the sample bottles. Place samples in the appropriate containers in decreasing order of volatility (e.g., purgeables and aromatics first, then PNAs and phenols, then cyanides, and lastly, nitrate, sulfate and metals). Samples for dissolved metals analysis may be field filtered. If there is insufficient sample volume to provide all sampling needs, retrieve additional bailer volumes until all samples are collected.

##### **2.2.4.2 *Peristaltic, Submersible, or Keck™ Pump***

Samples for laboratory analysis of parameters, other than VOCs, will be collected directly from the pump tubing following purging of 3 to 5 well volumes, and stabilization of field parameter measurements. A 0.45  $\mu\text{m}$  filter will be used to field filter samples for dissolved metals into a preserved laboratory container.

#### **2.2.5 *Sample Preservation***

Tighten lids of sample containers and place in coolers

Wrap all glass containers in bubble wrap or foam; then place into large 1-2 gallon zip-lock bags; label the outside of the bag, and place into the coolers.

Completely fill out the *Chain-of-Custody*. When shipping samples, seal *Chain-of-Custody* in a watertight zip-lock bag, and attach to the underside of the cooler lid with packaging tape. Ship coolers or arrange delivery to the laboratory as soon as possible and before the sample “hold-time” expires.

#### **2.2.6 *Decontamination***

Decontaminate electronic water level indicator, pH, temperature, and specific conductivity meter between sampling points.

If peristaltic pump is used, dispose used flow-through tubing and filters.

If submersible or Keck™ pump is used, place pump in a graduated cylinder filled with a solution of Alconox and deionized or distilled water. Allowing the soap and water solution to re-circulate through the pump and tubing for a maximum of five minutes. Rinse cylinder and outside of



## STANDARD OPERATING PROCEDURE

### WATER SAMPLING

pump and tubing with deionized or distilled water. Fill cylinder with deionized or distilled water and allow at least 4 liters to run through the pump and tubing and onto the ground away from the well.

NOTE: During pump use and decontamination, take care to assure tubing and pump does not come in contact with the ground or other surfaces. Following sampling of the last well, remove and throw away submersible pump tubing prior to decontamination of the pump.

Dispose of all gloves, bailers, rope/string, tubing, and filters used to collect the sample prior to accessing the next well.

### **3. QUALITY ASSURANCE**

Avoid cross-contamination of wells with the water level indicator, and sampling equipment by conducting proper decontamination procedures described above.

Take care in labeling the samples, and the corresponding *Chain-of-Custody* with the correct sample date, time and well identification. All labeling must be consistent between samples and the *Chain of Custody*.

Keep samples on ice following collection, and be conscience of "hold-times" for the samples. It is imperative that samples are submitted to the laboratory prior to the exceedence of hold times.

## **SOP 9**

EPA Low-Flow (Minimum Drawdown) Groundwater Sampling Procedures

# Ground Water Issue

## LOW-FLOW (MINIMAL DRAWDOWN) GROUND-WATER SAMPLING PROCEDURES

by Robert W. Puls<sup>1</sup> and Michael J. Barcelona<sup>2</sup>

### Background

The Regional Superfund Ground Water Forum is a group of ground-water scientists, representing EPA's Regional Superfund Offices, organized to exchange information related to ground-water remediation at Superfund sites. One of the major concerns of the Forum is the sampling of ground water to support site assessment and remedial performance monitoring objectives. This paper is intended to provide background information on the development of low-flow sampling procedures and its application under a variety of hydrogeologic settings. It is hoped that the paper will support the production of standard operating procedures for use by EPA Regional personnel and other environmental professionals engaged in ground-water sampling.

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### I. Introduction

The methods and objectives of ground-water sampling to assess water quality have evolved over time. Initially the emphasis was on the assessment of water quality of aquifers as sources of drinking water. Large water-bearing

units were identified and sampled in keeping with that objective. These were highly productive aquifers that supplied drinking water via private wells or through public water supply systems. Gradually, with the increasing awareness of subsurface pollution of these water resources, the understanding of complex hydrogeochemical processes which govern the fate and transport of contaminants in the subsurface increased. This increase in understanding was also due to advances in a number of scientific disciplines and improvements in tools used for site characterization and ground-water sampling. Ground-water quality investigations where pollution was detected initially borrowed ideas, methods, and materials for site characterization from the water supply field and water analysis from public health practices. This included the materials and manner in which monitoring wells were installed and the way in which water was brought to the surface, treated, preserved and analyzed. The prevailing conceptual ideas included convenient generalizations of ground-water resources in terms of large and relatively homogeneous hydrologic units. With time it became apparent that conventional water supply generalizations of homogeneity did not adequately represent field data regarding pollution of these subsurface resources. The important role of heterogeneity became increasingly clear not only in geologic terms, but also in terms of complex physical,

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Response, US EPA, Washington, DC

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Director

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chemical and biological subsurface processes. With greater appreciation of the role of heterogeneity, it became evident that subsurface pollution was ubiquitous and encompassed the unsaturated zone to the deep subsurface and included unconsolidated sediments, fractured rock, and *aquitards* or low-yielding or impermeable formations. Small-scale processes and heterogeneities were shown to be important in identifying contaminant distributions and in controlling water and contaminant flow paths.

It is beyond the scope of this paper to summarize all the advances in the field of ground-water quality investigations and remediation, but two particular issues have bearing on ground-water sampling today: aquifer heterogeneity and colloidal transport. Aquifer heterogeneities affect contaminant flow paths and include variations in geology, geochemistry, hydrology and microbiology. As methods and the tools available for subsurface investigations have become increasingly sophisticated and understanding of the subsurface environment has advanced, there is an awareness that in most cases a primary concern for site investigations is characterization of contaminant flow paths rather than entire aquifers. In fact, in many cases, plume thickness can be less than well screen lengths (e.g., 3-6 m) typically installed at hazardous waste sites to detect and monitor plume movement over time. Small-scale differences have increasingly been shown to be important and there is a general trend toward smaller diameter wells and shorter screens.

The hydrogeochemical significance of colloidal-size particles in subsurface systems has been realized during the past several years (Gschwend and Reynolds, 1987; McCarthy and Zachara, 1989; Puls, 1990; Ryan and Gschwend, 1990). This realization resulted from both field and laboratory studies that showed faster contaminant migration over greater distances and at higher concentrations than flow and transport model predictions would suggest (Buddemeier and Hunt, 1988; Enfield and Bengtsson, 1988; Penrose et al., 1990). Such models typically account for interaction between the mobile aqueous and immobile solid phases, but do not allow for a mobile, reactive solid phase. It is recognition of this third *phase* as a possible means of contaminant transport that has brought increasing attention to the manner in which samples are collected and processed for analysis (Puls et al., 1990; McCarthy and Degueldre, 1993; Backhus et al., 1993; U. S. EPA, 1995). If such a phase is present in sufficient mass, possesses high sorption reactivity, large surface area, and remains stable in suspension, it can serve as an important mechanism to facilitate contaminant transport in many types of subsurface systems.

Colloids are particles that are sufficiently small so that the surface free energy of the particle dominates the bulk free energy. Typically, in ground water, this includes particles with diameters between 1 and 1000 nm. The most commonly observed mobile particles include: secondary clay minerals; hydrous iron, aluminum, and manganese oxides; dissolved and particulate organic materials, and viruses and bacteria.

These reactive particles have been shown to be mobile under a variety of conditions in both field studies and laboratory column experiments, and as such need to be included in monitoring programs where identification of the *total* mobile contaminant loading (dissolved + naturally suspended particles) at a site is an objective. To that end, sampling methodologies must be used which do not artificially bias *naturally* suspended particle concentrations.

Currently the most common ground-water purging and sampling methodology is to purge a well using bailers or high speed pumps to remove 3 to 5 casing volumes followed by sample collection. This method can cause adverse impacts on sample quality through collection of samples with high levels of turbidity. This results in the inclusion of otherwise immobile artifactual particles which produce an overestimation of certain analytes of interest (e.g., metals or hydrophobic organic compounds). Numerous documented problems associated with filtration (Danielsson, 1982; Laxen and Chandler, 1982; Horowitz et al., 1992) make this an undesirable method of rectifying the turbidity problem, and include the removal of potentially mobile (contaminant-associated) particles during filtration, thus artificially biasing contaminant concentrations low. Sampling-induced turbidity problems can often be mitigated by using low-flow purging and sampling techniques.

Current subsurface conceptual models have undergone considerable refinement due to the recent development and increased use of field screening tools. So-called hydraulic *push* technologies (e.g., cone penetrometer, Geoprobe®, QED HydroPunch®) enable relatively fast screening site characterization which can then be used to design and install a monitoring well network. Indeed, alternatives to conventional monitoring wells are now being considered for some hydrogeologic settings. The ultimate design of any monitoring system should however be based upon adequate site characterization and be consistent with established monitoring objectives.

If the sampling program objectives include accurate assessment of the magnitude and extent of subsurface contamination over time and/or accurate assessment of subsequent remedial performance, then some information regarding plume delineation in three-dimensional space is necessary prior to monitoring well network design and installation. This can be accomplished with a variety of different tools and equipment ranging from hand-operated augers to screening tools mentioned above and large drilling rigs. Detailed information on ground-water flow velocity, direction, and horizontal and vertical variability are essential baseline data requirements. Detailed soil and geologic data are required prior to and during the installation of sampling points. This includes historical as well as detailed soil and geologic logs which accumulate during the site investigation. The use of borehole geophysical techniques is also recommended. With this information (together with other site characterization data) and a clear understanding of sampling

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objectives, then appropriate location, screen length, well diameter, slot size, etc. for the monitoring well network can be decided. This is especially critical for new in situ remedial approaches or natural attenuation assessments at hazardous waste sites.

In general, the overall goal of any ground-water sampling program is to collect water samples with no alteration in water chemistry; analytical data thus obtained may be used for a variety of specific monitoring programs depending on the regulatory requirements. The sampling methodology described in this paper assumes that the monitoring goal is to sample monitoring wells for the presence of contaminants and it is applicable whether mobile colloids are a concern or not and whether the analytes of concern are metals (and metalloids) or organic compounds.

## II. Monitoring Objectives and Design Considerations

The following issues are important to consider prior to the design and implementation of any ground-water monitoring program, including those which anticipate using low-flow purging and sampling procedures.

### A. Data Quality Objectives (DQOs)

Monitoring objectives include four main types: detection, assessment, corrective-action evaluation and resource evaluation, along with *hybrid* variations such as site-assessments for property transfers and water availability investigations. Monitoring objectives may change as contamination or water quality problems are discovered. However, there are a number of common components of monitoring programs which should be recognized as important regardless of initial objectives. These components include:

- 1) Development of a conceptual model that incorporates elements of the regional geology to the local geologic framework. The conceptual model development also includes initial site characterization efforts to identify hydrostratigraphic units and likely flow-paths using a minimum number of borings and well completions;
- 2) Cost-effective and well documented collection of high quality data utilizing simple, accurate, and reproducible techniques; and
- 3) Refinement of the conceptual model based on supplementary data collection and analysis.

These fundamental components serve many types of monitoring programs and provide a basis for future efforts that evolve in complexity and level of spatial detail as purposes and objectives expand. High quality, reproducible data collection is a common goal regardless of program objectives.

High quality data collection implies data of sufficient accuracy, precision, and completeness (i.e., ratio of valid analytical results to the minimum sample number called for by the program design) to meet the program objectives. Accuracy depends on the correct choice of monitoring tools and procedures to minimize sample and subsurface disturbance from collection to analysis. Precision depends on the repeatability of sampling and analytical protocols. It can be assured or improved by replication of sample analyses including blanks, field/lab standards and reference standards.

### B. Sample Representativeness

An important goal of any monitoring program is collection of data that is truly representative of conditions at the site. The term *representativeness* applies to chemical and hydrogeologic data collected via wells, borings, piezometers, geophysical and soil gas measurements, lysimeters, and temporary sampling points. It involves a recognition of the statistical variability of individual subsurface physical properties, and contaminant or major ion concentration levels, while explaining extreme values. Subsurface temporal and spatial variability are facts. Good professional practice seeks to maximize representativeness by using proven accurate and reproducible techniques to define limits on the distribution of measurements collected at a site. However, measures of representativeness are dynamic and are controlled by evolving site characterization and monitoring objectives. An evolutionary site characterization model, as shown in Figure 1, provides a systematic approach to the goal of consistent data collection.

Figure 1. Evolutionary Site Characterization Model

The model emphasizes a recognition of the causes of the variability (e.g., use of inappropriate technology such as using bailers to purge wells; imprecise or operator-dependent methods) and the need to control avoidable errors.

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## 1) Questions of Scale

A sampling plan designed to collect representative samples must take into account the potential scale of changes in site conditions through space and time as well as the chemical associations and behavior of the parameters that are targeted for investigation. In subsurface systems, physical (i.e., aquifer) and chemical properties over time or space are not statistically independent. In fact, samples taken in close proximity (i.e., within distances of a few meters) or within short time periods (i.e., more frequently than monthly) are highly auto-correlated. This means that designs employing high-sampling frequency (e.g., monthly) or dense spatial monitoring designs run the risk of redundant data collection and misleading inferences regarding trends in values that aren't statistically valid. In practice, contaminant detection and assessment monitoring programs rarely suffer these *over-sampling* concerns. In corrective-action evaluation programs, it is also possible that too little data may be collected over space or time. In these cases, false interpretation of the spatial extent of contamination or underestimation of temporal concentration variability may result.

## 2) Target Parameters

Parameter selection in monitoring program design is most often dictated by the regulatory status of the site. However, background water quality constituents, purging indicator parameters, and contaminants, all represent targets for data collection programs. The tools and procedures used in these programs should be equally rigorous and applicable to all categories of data, since all may be needed to determine or support regulatory action.

### **C. Sampling Point Design and Construction**

Detailed site characterization is central to all decision-making purposes and the basis for this characterization resides in identification of the geologic framework and major hydro-stratigraphic units. Fundamental data for sample point location include: subsurface lithology, head-differences and background geochemical conditions. Each sampling point has a proper use or uses which should be documented at a level which is appropriate for the program's data quality objectives. Individual sampling points may not always be able to fulfill multiple monitoring objectives (e.g., detection, assessment, corrective action).

#### 1) Compatibility with Monitoring Program and Data Quality Objectives

Specifics of sampling point location and design will be dictated by the complexity of subsurface lithology and variability in contaminant and/or geochemical conditions. It should be noted that, regardless of the ground-water sampling approach, few sampling points (e.g., wells, drive-points, screened augers) have zones of influence in excess of a few

feet. Therefore, the spatial frequency of sampling points should be carefully selected and designed.

#### 2) Flexibility of Sampling Point Design

In most cases *well-point* diameters in excess of 1 7/8 inches will permit the use of most types of submersible pumping devices for low-flow (minimal drawdown) sampling. It is suggested that *short* (e.g., less than 1.6 m) screens be incorporated into the monitoring design where possible so that comparable results from one device to another might be expected. *Short*, of course, is relative to the degree of vertical water quality variability expected at a site.

#### 3) Equilibration of Sampling Point

Time should be allowed for equilibration of the well or sampling point with the formation after installation. Placement of well or sampling points in the subsurface produces some disturbance of ambient conditions. Drilling techniques (e.g., auger, rotary, etc.) are generally considered to cause more disturbance than *direct-push* technologies. In either case, there may be a period (i.e., days to months) during which water quality near the point may be distinctly different from that in the formation. Proper development of the sampling point and adjacent formation to remove fines created during emplacement will shorten this water quality *recovery* period.

## **III. Definition of Low-Flow Purging and Sampling**

It is generally accepted that water in the well casing is non-representative of the formation water and needs to be purged prior to collection of ground-water samples. However, the water in the screened interval may indeed be representative of the formation, depending upon well construction and site hydrogeology. Wells are purged to some extent for the following reasons: the presence of the air interface at the top of the water column resulting in an oxygen concentration gradient with depth, loss of volatiles up the water column, leaching from or sorption to the casing or filter pack, chemical changes due to clay seals or backfill, and surface infiltration.

Low-flow purging, whether using portable or dedicated systems, should be done using pump-intake located in the middle or slightly above the middle of the screened interval. Placement of the pump too close to the bottom of the well will cause increased entrainment of solids which have collected in the well over time. These particles are present as a result of well development, prior purging and sampling events, and natural colloidal transport and deposition. Therefore, placement of the pump in the middle or toward the top of the screened interval is suggested. Placement of the pump at the top of the water column for sampling is only recommended in unconfined aquifers, screened across the water table, where this is the desired sampling point. Low-

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flow purging has the advantage of minimizing mixing between the overlying stagnant casing water and water within the screened interval.

### **A. Low-Flow Purging and Sampling**

Low-flow refers to the velocity with which water enters the pump intake and that is imparted to the formation pore water in the immediate vicinity of the well screen. It does not necessarily refer to the flow rate of water discharged at the surface which can be affected by flow regulators or restrictions. Water level drawdown provides the best indication of the stress imparted by a given flow-rate for a given hydrological situation. The objective is to pump in a manner that minimizes stress (drawdown) to the system to the extent practical taking into account established site sampling objectives. Typically, flow rates on the order of 0.1 - 0.5 L/min are used, however this is dependent on site-specific hydrogeology. Some extremely coarse-textured formations have been successfully sampled in this manner at flow rates to 1 L/min. The effectiveness of using low-flow purging is intimately linked with proper screen location, screen length, and well construction and development techniques. The reestablishment of natural flow paths in both the vertical and horizontal directions is important for correct interpretation of the data. For high resolution sampling needs, screens less than 1 m should be used. Most of the need for purging has been found to be due to passing the sampling device through the overlying casing water which causes mixing of these stagnant waters and the dynamic waters within the screened interval. Additionally, there is disturbance to suspended sediment collected in the bottom of the casing and the displacement of water out into the formation immediately adjacent to the well screen. These disturbances and impacts can be avoided using dedicated sampling equipment, which precludes the need to insert the sampling device prior to purging and sampling.

Isolation of the screened interval water from the overlying stagnant casing water may be accomplished using low-flow minimal drawdown techniques. If the pump intake is located within the screened interval, most of the water pumped will be drawn in directly from the formation with little mixing of casing water or disturbance to the sampling zone. However, if the wells are not constructed and developed properly, zones other than those intended may be sampled. At some sites where geologic heterogeneities are sufficiently different within the screened interval, higher conductivity zones may be preferentially sampled. This is another reason to use shorter screened intervals, especially where high spatial resolution is a sampling objective.

### **B. Water Quality Indicator Parameters**

It is recommended that water quality indicator parameters be used to determine purging needs prior to sample collection in each well. Stabilization of parameters such as pH, specific conductance, dissolved oxygen, oxida-

tion-reduction potential, temperature and turbidity should be used to determine when formation water is accessed during purging. In general, the order of stabilization is pH, temperature, and specific conductance, followed by oxidation-reduction potential, dissolved oxygen and turbidity. Temperature and pH, while commonly used as purging indicators, are actually quite insensitive in distinguishing between formation water and stagnant casing water; nevertheless, these are important parameters for data interpretation purposes and should also be measured. Performance criteria for determination of stabilization should be based on water-level drawdown, pumping rate and equipment specifications for measuring indicator parameters. Instruments are available which utilize in-line flow cells to continuously measure the above parameters.

It is important to establish specific well stabilization criteria and then consistently follow the same methods thereafter, particularly with respect to drawdown, flow rate and sampling device. Generally, the time or purge volume required for parameter stabilization is independent of well depth or well volumes. Dependent variables are well diameter, sampling device, hydrogeochemistry, pump flow rate, and whether the devices are used in a portable or dedicated manner. If the sampling device is already in place (i.e., dedicated sampling systems), then the time and purge volume needed for stabilization is much shorter. Other advantages of dedicated equipment include less purge water for waste disposal, much less decontamination of equipment, less time spent in preparation of sampling as well as time in the field, and more consistency in the sampling approach which probably will translate into less variability in sampling results. The use of dedicated equipment is strongly recommended at wells which will undergo routine sampling over time.

If parameter stabilization criteria are too stringent, then minor oscillations in indicator parameters may cause purging operations to become unnecessarily protracted. It should also be noted that turbidity is a very conservative parameter in terms of stabilization. Turbidity is always the last parameter to stabilize. Excessive purge times are invariably related to the establishment of too stringent turbidity stabilization criteria. It should be noted that natural turbidity levels in ground water may exceed 10 nephelometric turbidity units (NTU).

### **C. Advantages and Disadvantages of Low-Flow (Minimum Drawdown) Purging**

In general, the advantages of low-flow purging include:

- samples which are representative of the *mobile* load of contaminants present (dissolved and colloid-associated);
- minimal disturbance of the sampling point thereby minimizing sampling artifacts;
- less operator variability, greater operator control;

- reduced stress on the formation (minimal drawdown);
- less mixing of stagnant casing water with formation water;
- reduced need for filtration and, therefore, less time required for sampling;
- smaller purging volume which decreases waste disposal costs and sampling time;
- better sample consistency; reduced artificial sample variability.

Some disadvantages of low-flow purging are:

- higher initial capital costs,
- greater set-up time in the field,
- need to transport additional equipment to and from the site,
- increased training needs,
- resistance to change on the part of sampling practitioners,
- concern that new data will indicate a *change in conditions* and trigger an *action*.

#### **IV. Low-Flow (Minimal Drawdown) Sampling Protocols**

The following ground-water sampling procedure has evolved over many years of experience in ground-water sampling for organic and inorganic compound determinations and as such summarizes the authors' (and others) experiences to date (Barcelona et al., 1984, 1994; Barcelona and Helfrich, 1986; Puls and Barcelona, 1989; Puls et. al. 1990, 1992; Puls and Powell, 1992; Puls and Paul, 1995). High-quality chemical data collection is essential in ground-water monitoring and site characterization. The primary limitations to the collection of *representative* ground-water samples include: mixing of the stagnant casing and *fresh* screen waters during insertion of the sampling device or ground-water level measurement device; disturbance and resuspension of settled solids at the bottom of the well when using high pumping rates or raising and lowering a pump or bailer; introduction of atmospheric gases or degassing from the water during sample handling and transfer, or inappropriate use of vacuum sampling device, etc.

##### **A. Sampling Recommendations**

Water samples should not be taken immediately following well development. Sufficient time should be allowed for the ground-water flow regime in the vicinity of the monitoring well to stabilize and to approach chemical equilibrium with the well construction materials. This lag time will depend on site conditions and methods of installation but often exceeds one week.

Well purging is nearly always necessary to obtain samples of water flowing through the geologic formations in the screened interval. Rather than using a general but arbitrary guideline of purging three casing volumes prior to

sampling, it is recommended that an in-line water quality measurement device (e.g., flow-through cell) be used to establish the stabilization time for several parameters (e.g., pH, specific conductance, redox, dissolved oxygen, turbidity) on a well-specific basis. Data on pumping rate, drawdown, and volume required for parameter stabilization can be used as a guide for conducting subsequent sampling activities.

The following are recommendations to be considered before, during and after sampling:

- use low-flow rates (<0.5 L/min), during both purging and sampling to maintain minimal drawdown in the well;
- maximize tubing wall thickness, minimize tubing length;
- place the sampling device intake at the desired sampling point;
- minimize disturbances of the stagnant water column above the screened interval during water level measurement and sampling device insertion;
- make proper adjustments to stabilize the flow rate as soon as possible;
- monitor water quality indicators during purging;
- collect unfiltered samples to estimate contaminant loading and transport potential in the subsurface system.

##### **B. Equipment Calibration**

Prior to sampling, all sampling device and monitoring equipment should be calibrated according to manufacturer's recommendations and the site Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP). Calibration of pH should be performed with at least two buffers which bracket the expected range. Dissolved oxygen calibration must be corrected for local barometric pressure readings and elevation.

##### **C. Water Level Measurement and Monitoring**

It is recommended that a device be used which will least disturb the water surface in the casing. Well depth should be obtained from the well logs. Measuring to the bottom of the well casing will only cause resuspension of settled solids from the formation and require longer purging times for turbidity equilibration. Measure well depth after sampling is completed. The water level measurement should be taken from a permanent reference point which is surveyed relative to ground elevation.

##### **D. Pump Type**

The use of low-flow (e.g., 0.1-0.5 L/min) pumps is suggested for purging and sampling all types of analytes. All pumps have some limitation and these should be investigated with respect to application at a particular site. Bailers are inappropriate devices for low-flow sampling.

## 1) General Considerations

There are no unusual requirements for ground-water sampling devices when using low-flow, minimal drawdown techniques. The major concern is that the device give consistent results and minimal disturbance of the sample across a range of *low* flow rates (i.e., < 0.5 L/min). Clearly, pumping rates that cause minimal to no drawdown in one well could easily cause *significant* drawdown in another well finished in a less transmissive formation. In this sense, the pump should not cause undue pressure or temperature changes or physical disturbance on the water sample over a reasonable sampling range. Consistency in operation is critical to meet accuracy and precision goals.

## 2) Advantages and Disadvantages of Sampling Devices

A variety of sampling devices are available for low-flow (minimal drawdown) purging and sampling and include peristaltic pumps, bladder pumps, electrical submersible pumps, and gas-driven pumps. Devices which lend themselves to both dedication and consistent operation at definable low-flow rates are preferred. It is desirable that the pump be easily adjustable and operate reliably at these lower flow rates. The peristaltic pump is limited to shallow applications and can cause degassing resulting in alteration of pH, alkalinity, and some volatiles loss. Gas-driven pumps should be of a type that does not allow the gas to be in direct contact with the sampled fluid.

Clearly, bailers and other *grab* type samplers are ill-suited for low-flow sampling since they will cause repeated disturbance and mixing of *stagnant* water in the casing and the *dynamic* water in the screened interval. Similarly, the use of inertial lift foot-valve type samplers may cause too much disturbance at the point of sampling. Use of these devices also tends to introduce uncontrolled and unacceptable operator variability.

Summaries of advantages and disadvantages of various sampling devices are listed in Herzog et al. (1991), U. S. EPA (1992), Parker (1994) and Thurnblad (1994).

## E. Pump Installation

Dedicated sampling devices (left in the well) capable of pumping and sampling are preferred over any other type of device. Any portable sampling device should be slowly and carefully lowered to the middle of the screened interval or slightly above the middle (e.g., 1-1.5 m below the top of a 3 m screen). This is to minimize excessive mixing of the stagnant water in the casing above the screen with the screened interval zone water, and to minimize resuspension of solids which will have collected at the bottom of the well. These two disturbance effects have been shown to directly affect the time required for purging. There also appears to be a direct correlation between size of portable sampling devices relative to the well bore and resulting purge volumes and times. The key is to minimize disturbance of water and solids in the well casing.

## F. Filtration

Decisions to filter samples should be dictated by sampling objectives rather than as a *fix* for poor sampling practices, and field-filtering of certain constituents should not be the default. Consideration should be given as to what the application of field-filtration is trying to accomplish. For assessment of truly dissolved (as opposed to operationally *dissolved* [i.e., samples filtered with 0.45  $\mu$ m filters]) concentrations of major ions and trace metals, 0.1  $\mu$ m filters are recommended although 0.45  $\mu$ m filters are normally used for most regulatory programs. Alkalinity samples must also be filtered if significant particulate calcium carbonate is suspected, since this material is likely to impact alkalinity titration results (although filtration itself may alter the  $\text{CO}_2$  composition of the sample and, therefore, affect the results).

Although filtration may be appropriate, filtration of a sample may cause a number of unintended changes to occur (e.g. oxidation, aeration) possibly leading to filtration-induced artifacts during sample analysis and uncertainty in the results. Some of these unintended changes may be unavoidable but the factors leading to them must be recognized. Deleterious effects can be minimized by consistent application of certain filtration guidelines. Guidelines should address selection of filter type, media, pore size, etc. in order to identify and minimize potential sources of uncertainty when filtering samples.

In-line filtration is recommended because it provides better consistency through less sample handling, and minimizes sample exposure to the atmosphere. In-line filters are available in both disposable (barrel filters) and non-disposable (in-line filter holder, flat membrane filters) formats and various filter pore sizes (0.1-5.0  $\mu$ m). Disposable filter cartridges have the advantage of greater sediment handling capacity when compared to traditional membrane filters. Filters must be pre-rinsed following manufacturer's recommendations. If there are no recommendations for rinsing, pass through a minimum of 1 L of ground water following purging and prior to sampling. Once filtration has begun, a filter cake may develop as particles larger than the pore size accumulate on the filter membrane. The result is that the effective pore diameter of the membrane is reduced and particles smaller than the stated pore size are excluded from the filtrate. Possible corrective measures include prefiltering (with larger pore size filters), minimizing particle loads to begin with, and reducing sample volume.

## G. Monitoring of Water Level and Water Quality Indicator Parameters

Check water level periodically to monitor drawdown in the well as a guide to flow rate adjustment. The goal is minimal drawdown (<0.1 m) during purging. This goal may be difficult to achieve under some circumstances due to geologic heterogeneities within the screened interval, and may require adjustment based on site-specific conditions and personal experience. In-line water quality indicator parameters should be continuously monitored during purging. The water quality

indicator parameters monitored can include pH, redox potential, conductivity, dissolved oxygen (DO) and turbidity. The last three parameters are often most sensitive. Pumping rate, drawdown, and the time or volume required to obtain stabilization of parameter readings can be used as a future guide to purge the well. Measurements should be taken every three to five minutes if the above suggested rates are used. Stabilization is achieved after all parameters have stabilized for three successive readings. In lieu of measuring all five parameters, a minimum subset would include pH, conductivity, and turbidity or DO. Three successive readings should be within  $\pm 0.1$  for pH,  $\pm 3\%$  for conductivity,  $\pm 10$  mv for redox potential, and  $\pm 10\%$  for turbidity and DO. Stabilized purge indicator parameter trends are generally obvious and follow either an exponential or asymptotic change to stable values during purging. Dissolved oxygen and turbidity usually require the longest time for stabilization. The above stabilization guidelines are provided for rough estimates based on experience.

#### ***H. Sampling, Sample Containers, Preservation and Decontamination***

Upon parameter stabilization, sampling can be initiated. If an in-line device is used to monitor water quality parameters, it should be disconnected or bypassed during sample collection. Sampling flow rate may remain at established purge rate or may be adjusted slightly to minimize aeration, bubble formation, turbulent filling of sample bottles, or loss of volatiles due to extended residence time in tubing. Typically, flow rates less than 0.5 L/min are appropriate. The same device should be used for sampling as was used for purging. Sampling should occur in a progression from least to most contaminated well, if this is known. Generally, volatile (e.g., solvents and fuel constituents) and gas sensitive (e.g.,  $\text{Fe}^{2+}$ ,  $\text{CH}_4$ ,  $\text{H}_2\text{S}/\text{HS}^-$ , alkalinity) parameters should be sampled first. The sequence in which samples for most inorganic parameters are collected is immaterial unless filtered (dissolved) samples are desired. Filtering should be done last and in-line filters should be used as discussed above. During both well purging and sampling, proper protective clothing and equipment must be used based upon the type and level of contaminants present.

The appropriate sample container will be prepared in advance of actual sample collection for the analytes of interest and include sample preservative where necessary. Water samples should be collected directly into this container from the pump tubing.

Immediately after a sample bottle has been filled, it must be preserved as specified in the site (QAPP). Sample preservation requirements are based on the analyses being performed (use site QAPP, FSP, RCRA guidance document [U. S. EPA, 1992] or EPA SW-846 [U. S. EPA, 1982] ). It may be advisable to add preservatives to sample bottles in a controlled setting prior to entering the field in order to reduce the chances of improperly preserving sample bottles or

introducing field contaminants into a sample bottle while adding the preservatives.

The preservatives should be transferred from the chemical bottle to the sample container using a disposable polyethylene pipet and the disposable pipet should be used only once and then discarded.

After a sample container has been filled with ground water, a Teflon™ (or tin)-lined cap is screwed on tightly to prevent the container from leaking. A sample label is filled out as specified in the FSP. The samples should be stored inverted at 4°C.

Specific decontamination protocols for sampling devices are dependent to some extent on the type of device used and the type of contaminants encountered. Refer to the site QAPP and FSP for specific requirements.

#### **I. Blanks**

The following blanks should be collected:

- (1) field blank: one field blank should be collected from each source water (distilled/deionized water) used for sampling equipment decontamination or for assisting well development procedures.
- (2) equipment blank: one equipment blank should be taken prior to the commencement of field work, from each set of sampling equipment to be used for that day. Refer to site QAPP or FSP for specific requirements.
- (3) trip blank: a trip blank is required to accompany each volatile sample shipment. These blanks are prepared in the laboratory by filling a 40-mL volatile organic analysis (VOA) bottle with distilled/deionized water.

#### **V. Low-Permeability Formations and Fractured Rock**

The overall sampling program goals or sampling objectives will drive how the sampling points are located, installed, and choice of sampling device. Likewise, site-specific hydrogeologic factors will affect these decisions. Sites with very low permeability formations or fractures causing discrete flow channels may require a unique monitoring approach. Unlike water supply wells, wells installed for ground-water quality assessment and restoration programs are often installed in low water-yielding settings (e.g., clays, silts). Alternative types of sampling points and sampling methods are often needed in these types of environments, because low-permeability settings may require extremely low-flow purging (<0.1 L/min) and may be technology-limited. Where devices are not readily available to pump at such low flow rates, the primary consideration is to avoid dewatering of

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the well screen. This may require repeated recovery of the water during purging while leaving the pump in place within the well screen.

Use of low-flow techniques may be impractical in these settings, depending upon the water recharge rates. The sampler and the end-user of data collected from such wells need to understand the limitations of the data collected; i.e., a strong potential for underestimation of actual contaminant concentrations for volatile organics, potential false negatives for filtered metals and potential false positives for unfiltered metals. It is suggested that comparisons be made between samples recovered using low-flow purging techniques and samples recovered using passive sampling techniques (i.e., two sets of samples). Passive sample collection would essentially entail acquisition of the sample with no or very little purging using a dedicated sampling system installed within the screened interval or a passive sample collection device.

#### **A. Low-Permeability Formations (<0.1 L/min recharge)**

##### **1. Low-Flow Purging and Sampling with Pumps**

- a. "portable or non-dedicated mode" - Lower the pump (one capable of pumping at <0.1 L/min) to mid-screen or slightly above and set in place for minimum of 48 hours (to lessen purge volume requirements). After 48 hours, use procedures listed in Part IV above regarding monitoring water quality parameters for stabilization, etc., but do not dewater the screen. If excessive drawdown and slow recovery is a problem, then alternate approaches such as those listed below may be better.
- b. "dedicated mode" - Set the pump as above at least a week prior to sampling; that is, operate in a dedicated pump mode. With this approach significant reductions in purge volume should be realized. Water quality parameters should stabilize quite rapidly due to less disturbance of the sampling zone.

##### **2. Passive Sample Collection**

Passive sampling collection requires insertion of the device into the screened interval for a sufficient time period to allow flow and sample equilibration before extraction for analysis. Conceptually, the extraction of water from low yielding formations seems more akin to the collection of water from the unsaturated zone and passive sampling techniques may be more appropriate in terms of obtaining "representative" samples. Satisfying usual sample volume requirements is typically a problem with this approach and some latitude will be needed on the part of regulatory entities to achieve sampling objectives.

#### **B. Fractured Rock**

In fractured rock formations, a low-flow to zero purging approach using pumps in conjunction with packers to isolate the sampling zone in the borehole is suggested. Passive multi-layer sampling devices may also provide the most "representative" samples. It is imperative in these settings to identify flow paths or water-producing fractures prior to sampling using tools such as borehole flowmeters and/or other geophysical tools.

After identification of water-bearing fractures, install packer(s) and pump assembly for sample collection using low-flow sampling in "dedicated mode" or use a passive sampling device which can isolate the identified water-bearing fractures.

### **VI. Documentation**

The usual practices for documenting the sampling event should be used for low-flow purging and sampling techniques. This should include, at a minimum: information on the conduct of purging operations (flow-rate, drawdown, water-quality parameter values, volumes extracted and times for measurements), field instrument calibration data, water sampling forms and chain of custody forms. See Figures 2 and 3 and "Ground Water Sampling Workshop -- A Workshop Summary" (U. S. EPA, 1995) for example forms and other documentation suggestions and information. This information coupled with laboratory analytical data and validation data are needed to judge the "useability" of the sampling data.

### **VII. Notice**

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## Figure 2. Ground Water Sampling Log

Project \_\_\_\_\_ Site \_\_\_\_\_ Well No. \_\_\_\_\_ Date \_\_\_\_\_

**Well Depth** \_\_\_\_\_ **Screen Length** \_\_\_\_\_ **Well Diameter** \_\_\_\_\_ **Casing Type** \_\_\_\_\_

**Sampling Device** \_\_\_\_\_ **Tubing type** \_\_\_\_\_ **Water Level** \_\_\_\_\_

**Measuring Point** \_\_\_\_\_ **Other Infor** \_\_\_\_\_

**Sampling Personnel** \_\_\_\_\_

### Type of Samples Collected

Information: 2 in = 617 ml/ft, 4 in = 2470 ml/ft:  $\text{Vol}_{\text{cyl}} = \pi r^2 h$ ,  $\text{Vol}_{\text{sphere}} = \frac{4}{3}\pi r^3$

Figure 3. **Ground Water Sampling Log** (with automatic data logging for most water quality parameters)

Project \_\_\_\_\_ Site \_\_\_\_\_ Well No. \_\_\_\_\_ Date \_\_\_\_\_

Well Depth \_\_\_\_\_ Screen Length \_\_\_\_\_ Well Diameter \_\_\_\_\_ Casing Type \_\_\_\_\_

Sampling Device \_\_\_\_\_ Tubing type \_\_\_\_\_ Water Level \_\_\_\_\_

**Measuring Point** \_\_\_\_\_ **Other Infor** \_\_\_\_\_

**Sampling Personnel** \_\_\_\_\_

### Type of Samples Collected

Information: 2 in = 617 ml/ft, 4 in = 2470 ml/ft:  $\text{Vol}_{\text{cyl}} = \pi r^2 h$ ,  $\text{Vol}_{\text{sphere}} = \frac{4}{3} \pi r^3$

## **SOP 10**

Water Elevations



## STANDARD OPERATING PROCEDURE

### WATER ELEVATIONS

#### 1. PURPOSE

The purpose of this procedure is to obtain groundwater level measurements from wells and piezometers to assist in defining site hydrogeologic conditions.

#### 2. PROCEDURE

##### 2.1 FIELD PREPARATION

Notify client, property owner, and MDEQ as necessary.

###### *2.1.1 Forms*

- Water Level Data Sheet
- Daily Report Sheets
- Tailgate Health and Safety
- Field Service Request

###### *2.1.2 Equipment*

- Well keys
- Electronic water level indicator
- Calculator
- Latex or nitrile gloves
- Tools to access wells
- Metal detector, turkey baster or plastic cup
- Decontamination equipment including deionized or distilled water, Alconox®, and paper towel
- Garbage bags

## STANDARD OPERATING PROCEDURE

### WATER ELEVATIONS

#### **2.1.3 Documents**

- *Well Construction Log*, or total well depth and previous water level measurements
- Well location map/site map
- *Work Plan*
- *Health and Safety Plan*
- Signed site access agreement, as applicable

#### **2.1.4 Other**

- Cellular phone
- Replacement locks
- Writing implements and an indelible marker
- First aid kit
- Personal comfort items
- Machete or other vegetation-clearing tool

## **2.2 FIELD PROCEDURES**

Don a new pair of latex or nitrile gloves and open the well with a socket set if it is a flush grade manhole cover or a key if it is an above grade cover.

Beware of insects (particularly wasps and bees) that may be nesting within the protective casing. Bail out any standing water with a turkey baster or cup in flush-grade manholes. Note on presence and appearance of standing water, insects, and well condition.

Unlock, loosen, and carefully remove locking expandable well cap.

Well may be under pressure. Always face away from well when removing well cover. Allow groundwater elevation to stabilize for a minimum of five minutes prior to measuring depth to groundwater. When working on smaller sites, it may be appropriate to open all of the wells first, and then gauge them.

#### **2.2.1 Identify the Monitoring Point for the Well**

The well monitoring point may be the north side of the riser casing and marked with an indelible marker, or on the highest side of the top of casing. The top of an above-grade protector or flush-grade manhole should never be used as a reference point due to frost heave and settling. Note the reference point used on the *Water Level Data Sheet*



## STANDARD OPERATING PROCEDURE

### WATER ELEVATIONS

#### **2.2.2 Obtain the Water Level Measurement**

Water levels will be measured from suspected cleanest (up-gradient) well to the suspected most contaminated (down-gradient or near source) well.

Use a consistent sensitivity setting for all wells.

Lower the decontaminated probe into the well until a “beep” sound is heard. The probe should be raised and lowered to confirm the exact water level. NOTE: condensation inside the well casing can result in a premature sounding and contaminants can result in incorrect confirmatory measurements. Refer to previous depths to groundwater recorded on the *Field Groundwater Sample Form* to verify measurement, if available. When a false reading is suspected, gently shake the tape of the electronic water level indicator until the audible sound stops. Then proceed to lower the probe to confirm.

Read the tape at the monitoring point and recorded the measurement to the nearest 0.01-foot on the *Water Level Data Sheet*.

Lower probe to bottom of well and record total depth on *Field Groundwater Sample Form*, if necessary.

Complete all information on the *Water Level Data Sheet*.

#### **2.2.3 Decontamination**

The measuring device shall be decontaminated immediately after each use. The decontamination procedure should be initiated while reeling in the tape and probe: wipe tape with clean paper towel soaked with deionized or distilled water and Alconox® solution, rinse probe with deionized or distilled water and Alconox® solution, rinse tape and probe with deionized or distilled water, and dry probe with clean paper towel. Apply decontamination fluids with a labeled spray bottle.

**SOP 11**  
Surface Water Sampling



## STANDARD OPERATING PROCEDURE

### SURFACE WATER SAMPLING

#### 1. PURPOSE

The purpose of this procedure is to set criteria for the collection of surface water samples.

#### 2. PROCEDURE

Surface water sampling locations for water quality studies may be selected based on many factors, including: study objectives; the location of point source discharges, non-point source discharges and tributaries; the presence of structures (bridges, dams, etc.), and accessibility.

Before any sampling is conducted, the first requirement is to consider suitable sampling locations. Bridges and piers are normally good choices for surface water sampling since they provide access and permit water sampling at any point across the width of the water body. Sampling locations should be selected in accordance with the Work Plan and discussed with the Project Manager.

Wading for water samples in lakes, ponds, and slow-moving rivers and streams must be done with caution since bottom deposits are easily disturbed. Samples must be collected without entrained suspended sediments. All surface water samples are to be collected commencing with the most downstream sample to avoid sediment interference with other samples. A life vest and safety line will be worn in all cases where footing is unstable or where water is fast moving or over 3 feet (0.85 m) in depth. A second person may also be required for most of the sampling scenarios.

Prior to entering select areas it may be necessary to acquire property access permission from the land owner. Access permission must be acquired in advance of the sampling program and may require a written agreement.

##### 2.1 FIELD PREPARATION

###### **2.1.1 *Forms***

- Chain of Custody
- Daily Report Sheets
- Water Quality Data Sheet
- Field Service Request
- Tailgate Health and Safety

## STANDARD OPERATING PROCEDURE

### SURFACE WATER SAMPLING

#### **2.1.2 *Equipment***

- Sample labels and containers
- Waterproof pen or marker
- Sampling device (Plastic bucket, pump, depth integrated sampler)
- Flow measurement device (velocity meter, survey equipment, measuring tape)
- Sampling materials (sample containers, log book, cooler, chain-of-custody)
- Camera

#### **2.1.3 *Documents***

- Work Plan
- Health and Safety Plan
- Signed site access agreement

## **2.2 FIELD PROCEDURES**

### **Rivers, Streams and Creeks**

Surface water samples should usually be collected in areas of the surface water body that are representative of the surface water body conditions. Representative samples can usually be collected in portions of the surface water body that have a uniform cross section and flow rate. Since mixing is influenced by turbulence and water velocity, the selection of a site immediately downstream of a riffle area (e.g., fast flow zone) will ensure good vertical mixing. These locations are also likely areas for deposition of sediment since the greatest deposition occurs where stream velocity slows.

A site that is clear of immediate point sources (e.g., tributaries and industrial and municipal effluents) is preferred for the collection of surface water samples unless the sampling is being performed to assess these sources.

Tributaries should be sampled as near the mouth as is feasible. However, it is important to select the sample location taking into consideration the impact that the downstream receiving water body has on the tributary flow and sediments. The downstream water body may change the water quality (salinity), temperature, or turbidity in the tributary near its mouth.

Sediment samples shall be collected along a cross-section of a river or stream in order to adequately characterize the bed material or as described in the Work Plan. A common procedure is to sample at quarter points along the cross-section of the sampling site selected. Samples may be composited as described in the Work Plan.



## STANDARD OPERATING PROCEDURE

### SURFACE WATER SAMPLING

Samples of dissimilar composition should not be combined.

In some instances sediment sampling may be performed along the shore only; depending upon the study needs.

#### **Lakes, Ponds, and Impoundments**

The water in lakes, ponds, and impoundments has a much greater tendency to stratify than water in rivers and streams. The lack of mixing may require that more samples be obtained. An extreme turbidity difference may occur where a highly turbid river enters a lake. Therefore, each layer of the stratified water column may need to be considered separately. Stratification is caused by water temperature differences; the cooler, heavier water is beneath the warmer water.

Sample selection also should adequately represent the conditions of the lagoon or settling pond. Attention must be given to identify intakes and outflows within the lagoon or settling pond which may provide biased sample representation. Sample locations with adjacent structures (i.e., banks, piers, etc.) may also provide biased samples within active lagoons or settling ponds, as the potential for boundary flow and eddies exist.

The number of water sampling sites on a lake, pond, or impoundment will vary with the purpose of the investigation, as well as the size and shape of the basin. In ponds and small impoundments, a single sample should be collected at the deepest point. In naturally formed ponds, the deepest point is usually near the center. In impoundments the deepest point is usually near the dam.

In lakes and larger impoundments, several sub-samples may be composited to form a single sample. These vertical sampling locations are often taken along a grid.

In lakes with irregular shape, with several bays and coves that are protected from the wind, additional samples may be needed to represent water quality at various points in the lake. Additional samples may be taken where discharges, tributaries, and other such factors are suspected of influencing water quality.

When collecting sediment samples in lakes, ponds, and reservoirs, samples should be collected at approximately the center of the water body or as directed by the Work Plan. This is also the case for reservoirs that are formed by the impoundment of rivers or streams. The coarse grained sediments are deposited near the headwaters of the reservoir, and the fine grained sediments near the center. The shape, inflow pattern, and circulation must be considered when selecting sediment sampling sites in lakes and reservoirs.

In all instances, the sampling locations should be properly documented with field notes and photographs, as appropriate.

## STANDARD OPERATING PROCEDURE

### SURFACE WATER SAMPLING

#### **Sampling Techniques**

Any equipment or sampling technique(s) used to collect a sample is acceptable as long as it provides a sample which is representative of the stream being sampled and is consistent with the Work Plan. Typically sample aliquots are collected from the area of concern directly, or a compositing approach is considered using a plastic bucket to collect a representative sample, then individual aliquots are collected from the sample bucket.

When collecting surface water samples, direct dipping of the sample container into the stream is acceptable unless the sample bottles contain preservatives. If the bottles are preserved, then pre-cleaned unpreserved bottles should be used to collect the sample. The water sample should then be transferred to the appropriate preserved bottles. When collecting samples, submerge the inverted bottle to the desired sample depth and then tilt the opening of the bottle upstream to fill. When compositing across a stream and/or water channel is typically performed using a pre-rinsed 1 to 2 L plastic bottle collecting sub-samples for final mixing sample aliquot collection. VOC's must not be collected from the compositing bucket and are sampled directly from the stream cross section.

Wading may cause bottom sediment deposits to be re-suspended and therefore could result in a biased sample. Wading is acceptable if the stream has a noticeable current and the samples are collected directly into the bottle while pointed upstream. If the stream is too deep to wade or if the sample must be collected from more than one water depth, additional sampling equipment will be required. Samples should be collected approximately 6 inches (15 cm) below the surface with the sample bottles completely submerged. This will keep floating debris from entering the sample bottles. Floating debris could result in unrepresentative analytical data.

Sample collection when the flow depth is minimal (i.e., <1 inch (4.5 cm)) will require special consideration to prevent sediment disturbance. Sampling might be conducted with a container then transferred to the appropriate glassware, or collection may be permissible with a peristaltic pump using a 'fixed' suction line, secured to prevent sediment collection. A small excavation in the stream bed to create a 'sump' for sample collection may be permissible but should be prepared well in advance of the sample collection event to allow sediment settlement.

Teflon bailers may be used for surface water sampling if it is not necessary to collect a sample at a specified interval. A top-loading bailer with a bottom check-valve is sufficient for many studies. As the bailer is lowered through the water, water is continually displaced through the bailer until a desired depth is reached, at which point the bailer is removed. This technique is not suitable where strong currents are encountered (because the ball may not seat effectively), or where a discrete sample at a specific depth is required.

If discrete samples are required from a specific depth, and the parameters to be measured do not require a Teflon-coated sampler, a standard Kemmerer, or Van Dorn sampler may be used.



## **STANDARD OPERATING PROCEDURE**

### **SURFACE WATER SAMPLING**

The Kemmerer sampler is a brass cylinder with rubber stoppers that leave the ends of the sampler open while being lowered in a vertical position to allow for passage of water through the cylinder. The Van Dorn sampler is plastic and is lowered in a horizontal position. In each case, a messenger is sent down a rope when the sampler is at the required depth to cause the stoppers to close the cylinder. The sampler is then raised to the surface. Water is removed through a valve to fill respective sample bottles. Dissolved oxygen (DO) sample bottles can be properly filled by allowing overflow using a rubber tube attached to the valve. When performing multiple depth sampling, care should be taken not to stir up the bottom sediment.

A glass beaker or stainless steel scoop may be used to collect samples if the parameters to be analyzed are not interfered with. The beaker or scoop should be rinsed three times with the sample water prior to collection of the sample. All field equipment should follow standard cleaning procedures.

## **SOP 12**

Transfer of Sample Custody and Shipping

## STANDARD OPERATING PROCEDURE

### TRANSFER OF SAMPLE CUSTODY AND SHIPPING

#### 1. PURPOSE

The purpose of this procedure is to set criteria for transfer of sample custody and shipping of samples to the laboratory.

#### 2. PROCEDURE

##### 2.1 FIELD PREPARATION

###### *2.1.1 Forms and Documents*

- Chain of custody

###### *2.1.2 Equipment*

- Sample labels and containers
- Waterproof pen or marker
- Coolers and packing materials
- Ice

##### 2.2 FIELD PROCEDURES

- A chain-of-custody (COC) record will be completed during sample collection and will accompany each shipment identifying the contents of the shipment. The COC record will accompany the samples to the laboratory. The field personnel collecting the samples will be responsible for the custody of the samples until the samples are relinquished to the laboratory. Sample transfer will require the individuals relinquishing and receiving the samples to sign, date and note the time of sample transfer on the COC record. As few people as possible should handle the samples.
- Samples will be shipped or delivered in a timely fashion to the laboratory so that holding-times and/or analysis times as prescribed by the methodology can be met.
- Samples will also be transported in containers (coolers) packaged with ice to maintain the temperature prescribed in RRD Operational Memorandum No. 2 Attachment # 4. Samples will be packaged for shipment and shipped to the appropriate laboratory for analysis with a separate signed chain-of-custody record enclosed in each sample cooler. Water VOC samples will be placed in bubble wrap bags while soil VOC samples will be placed in sealed sample pouches. The remaining samples in glass containers will be wrapped in bubble wrap and placed in the sample cooler. Samples in polyethylene containers will be placed upright directly in the sample cooler. All samples will be placed



## **STANDARD OPERATING PROCEDURE**

### **TRANSFER OF SAMPLE CUSTODY AND SHIPPING**

in an upright position and limited to one layer of samples per each cooler. Additional bubble wrap or packaging material will be added to fill the cooler. Shipping containers will be secured with strapping tape and custody tape for shipment to the laboratory.

- When samples are split, a separate chain-of-custody will be prepared for the samples and marked to indicate to whom the samples are being split. The person relinquishing the samples to the split-sample representative will require the representative's signature acknowledging sample receipt.
- If samples are sent by a commercial carrier, a bill of lading will be used. A copy of the bill of lading will be retained as part of permanent documentation. Commercial carriers are not required to sign the custody record as long as the custody record is sealed inside the sample cooler and the custody tape remains intact.
- Samples will be picked up by a laboratory courier or transported overnight by a courier to the laboratory the same day they are collected or within twenty-four hours unless collected on a weekend or holiday. In these cases, the samples will be stored in a secure location until delivery to the lab. Additional ice will be added to the cooler as needed to maintain proper preservation temperatures.

## **SOP 13**

### Drum and Container Handling Practices



## **STANDARD OPERATING PROCEDURE**

### **DRUM AND CONTAINER HANDLING PRACTICES**

This safe work practice (SWP) establishes procedures to protect field personnel and the public from exposure to hazardous materials resulting from the handling, opening, sampling, transferring, overpacking, and shipping of drums.

All drum and container handling operations must adhere to all applicable federal, state, local, contractual, and company requirements. Preparation and shipping of containers of hazardous materials must comply with applicable U.S. Environmental Protection Agency (EPA) and U.S. Department of Transportation (DOT) regulations. All drums and containers used during hazardous waste operations must meet appropriate DOT regulations for the materials they contain.

Drum and container handling should be approached in a systematic, stepwise manner, especially when the contents are unknown or containers are in poor condition. Inspection, opening, sampling, overpacking, and staging requirements for drums and containers are described below

### **1.0 RESPONSIBILITIES**

Operating unit health and safety managers (HSMs) are responsible for providing technical guidance to project managers and site safety coordinators (SSC) on drum and container handling procedures. Project managers are responsible for ensuring implementation of this SWP, when warranted, on their projects. SSCs are responsible for enforcement of this SWP at the work site. Field personnel are required to adhere to drum and container handling guidelines and procedures.

### **2.0 DRUM AND CONTAINER INSPECTION**

Drums or containers must be visually inspected before any work is conducted in order to gain as much information as possible about their contents. Field personnel should document in the field logbook the following information:

- Any labels or other markings indicating possible contents;
- Drum or container condition (such as rusted, leaking, or dented);
- Signs of pressure (such as bulging or swelling);

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## STANDARD OPERATING PROCEDURE

### DRUM AND CONTAINER HANDLING PRACTICES

- Drum or container size, construction, and type; and
- Configuration of drum or container head (open or closed top).

After observations are documented in the field logbook, each drum or container should be labeled with an identification code for future tracking.

### **3.0 DRUM AND CONTAINER OPENING**

For efficient and safe drum or container opening, personnel must adhere to the guidelines below.

- If available, remote-controlled drum or container opening equipment should be used.
- In order to protect the employee, a suitable shield shall be placed between the employee and the drum being opened.
- Only spark-proof tools should be used to open drums and containers.
- Drums or containers containing unknown materials should be opened using Level B personal protection, including splash protection.
- Drums or containers containing radioactive material should not be opened or handled until the appropriate personnel with expertise in this area have been consulted.
- Air monitoring equipment should be available near the drum or container being opened, such as combination oxygen and combustible gas meters, colorimetric tubes, and photoionization detectors.
- Tools used for drum or container opening should be decontaminated after each use to avoid mixing incompatible wastes.
- Drums or containers should be resealed as soon as possible to minimize vapor generation.
- If possible, drums or containers exhibiting signs of pressure should not be opened.

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## **STANDARD OPERATING PROCEDURE**

### **DRUM AND CONTAINER HANDLING PRACTICES**

#### **4.0 DRUM AND CONTAINER SAMPLING**

Drum and container sampling poses a variety of potential hazards to worker health and safety, including direct contact with hazardous materials, inhalation of hazardous vapors, and the possibility of drum or container explosion or rupture. The guidelines below should be used to properly sample drums and containers.

- Prior to sampling, a sampling plan must be developed that includes the following information:
  - Background information on the waste;
  - Which drums or containers will be sampled;
  - Appropriate sampling devices; and
  - Sample containers to be used,
- Sampling personnel should not stand on drums or containers or lean over other drums or containers to obtain samples.
- All phases in the vertical cross section of each drum or container should be sampled.
- Disposable glass tubing or other disposable sampling devices should be used to sample liquid.
- When sampling liquids, absorbent pads should be placed on drum tops to collect spillage that may occur while transferring samples into containers.
- Sampling personnel should document container number, any container labeling, sampling date and time, and number and color of different phases.

#### **5.0 DRUM AND CONTAINER OVERPACKING**

During an emergency, drums and containers should be handled as detailed below.

- Leaks should be plugged or patched immediately if this can be done without risk.

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## STANDARD OPERATING PROCEDURE

### DRUM AND CONTAINER HANDLING PRACTICES

- Damaged drums and containers should be placed in an overpack container with absorbent pads to collect any spilled material or the contents transferred into a clean, compatible drum or container.
- Absorbent material should be used to collect any leakage that may occur during shipment.

During remedial actions, the procedures below apply to drum and container handling.

- Drums or containers should be placed in overpack containers, and any identification number assigned to the drum or container should be placed on the outside of the overpack container.
- If drum or container contents are to be bulked with other drum or container contents, the compatibility of the contents should be verified by a field characterization study prior to bulking.

### 6.0 DRUM AND CONTAINER STAGING

Staging refers to moving drums or containers in an organized manner to predesignated areas. Drums or containers may be staged to facilitate characterization and remedial action and also to protect drums or containers from potentially hazardous site conditions (such as high temperatures and proximity to ignition sources or heavy equipment). To ensure that staging is conducted in a safe and efficient manner, the guidelines below should be followed.

- Staging activities should be kept to a minimum to prevent hazards associated with increased handling of drums or containers.
- The staging area should be as close as possible to the site exit.
- The staging area should be level and covered with plastic sheeting or absorbent material.
- The staging area should be diked to contain possible spills.



## **STANDARD OPERATING PROCEDURE**

### **DRUM AND CONTAINER HANDLING PRACTICES**

- Drums or containers should be secured on pallets whenever possible to aid in the safe movement of drums or containers and to isolate the drums or containers from the soil surface.
- Drums or containers should not be stacked on top of each other.
- Drums or containers should be staged according to chemical composition of the contents. Drums or containers containing incompatible materials should be kept segregated.
- Drums and containers should be staged far enough apart to allow for the movement of equipment and personnel.

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Revision Date	Document Authorizer	Revision Details
10/1/2008	Chris McClain	Update from 1998 format

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**APPENDIX B**  
**WELL LOGS**

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# Water Well And Pump Record

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



Import ID: 39711126015

Failure to comply is a misdemeanor.

Tax No:	Permit No:	County: Kalamazoo	Township: Cooper			
Well ID: 39000002217		Town/Range: 01S 11W	Section: 26	Well Status:	WSSN:	
		Distance and Direction from Road Intersection:				Source ID/Well No:
		Well Owner: FRANCIS PUTMAN				
Latitude: 42.3499436566		Well Address: 2829 MCKINLEY	Owner Address: 2829 MCKINLEY			
Longitude: -85.5557709449		KALAMAZOO, MI 49004	KALAMAZOO, MI 49004			
Method of Collection: Interpolation-Map						

Drilling Method: Jetted	Pump Installed: No			
Well Depth: 44.00 ft.	Well Use: Household	Pressure Tank Installed: No		
Well Type: Replacement	Date Completed: 2/26/1976	Pressure Relief Valve Installed: No		
Casing Type: Steel - black	Height: 0.00 ft. below grade			
Casing Joint: Threaded & coupled				
Casing Fitting: None				
Diameter: 2.00 in. to 0.00 ft. depth				
Borehole:				
Static Water Level: 10.00 ft. Below Grade	Formation Description			Thickness
Well Yield Test: Yield Test Method: Unknown				Depth to Bottom
Pumping level 10.00 ft. after 2.00 hrs. at 13 GPM	Sand & Gravel	18.00 18.00		
	Sand & Clay	18.00 36.00		
	Sand Fine	5.00 41.00		
Screen Installed: Yes	Filter Packed: No			
Screen Diameter: 1.25 in.	Blank: 1.00 ft. Above			
Screen Material Type:				
Slot	Length	Set Between		
10.00	3.00 ft.	41.00 ft. and 44.00 ft.		
Fittings: Neoprene packer				
Well Grouted: Yes	Grouting Method: Unknown			
Grouting Material	Bags	Additives	Depth	
Bentonite slurry	0.00	None	0.00 ft. to 0.00 ft.	
Wellhead Completion: Pitless adapter	Geology Remarks:			
Nearest Source of Possible Contamination:	Drilling Machine Operator Name:			
Type	Distance	Direction	Employment: Unknown	
Unknown	0 ft.			
Abandoned Well Plugged: No	Contractor Type: Unknown Reg No:			
Reason Not Plugged:	Business Name:			
	Business Address:			
<b>Water Well Contractor's Certification</b>				
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: 39711126017

Failure to comply is a misdemeanor.

Tax No:	Permit No:	County: Kalamazoo	Township: Cooper			
Well ID: 39000002219		Town/Range: 01S 11W	Section: 26	Well Status:	WSSN:	
		Distance and Direction from Road Intersection: CORNER RIVERVIEW & MCKINLEY				Source ID/Well No:
		Well Owner: COOPER TOWNSHIP FIRE DEPT				
Well Address: MCKINLEY KALAMAZOO, MI 49004		Owner Address: D AVENUE KALAMAZOO, MI 49004				

Drilling Method: Hollow Rod	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 42.00 ft.	Pump Installation Date:	HP:	
Well Type: Replacement	Manufacturer: Other	Pump Type: Jet	
Casing Type: Steel - black	Model Number:	Pump Capacity:	
Casing Joint: Threaded & coupled	Drop Pipe Length: 31.00 ft.	Pump Voltage:	
Casing Fitting: None	Drop Pipe Diameter:	Drilling Record ID:	
Diameter: 2.00 in. to 39.00 ft. depth	Draw Down Seal Used: No		
Borehole:	Pressure Tank Installed: No		
Static Water Level: 15.00 ft. Below Grade	Pressure Relief Valve Installed: No		
Well Yield Test: Pumping level 18.00 ft. after 1.00 hrs. at 15 GPM	Formation Description	Thickness	Depth to Bottom
	Brown Gravel Dry	5.00	5.00
	Gravel	12.00	17.00
	Sand	12.00	29.00
Screen Installed: Yes	Clay & Sand	2.00	31.00
Screen Diameter: 1.25 in.	Sand Wet/Moist	11.00	42.00
Screen Material Type:			
Slot Length	Set Between		
10.00 3.00 ft.	39.00 ft. and 42.00 ft.		
Fittings: None			
Well Grouted: No	Geology Remarks:		
Wellhead Completion: Pitless adapter			
Nearest Source of Possible Contamination: Type Unknown	Drilling Machine Operator Name: Employment: Unknown		
Distance 0 ft.	Contractor Type: Unknown	Reg No:	
Direction	Business Name:		
Abandoned Well Plugged: No	Business Address:		
Reason Not Plugged:	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: Well Use:Type Use Unknown, Pump Manufacturer:RAPIDAYTON

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LHD 2/17/2000 1:00 PM



# Water Well And Pump Record

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



Import ID: 39711126024

Failure to comply is a misdemeanor.

Tax No:	Permit No:	County: Kalamazoo	Township: Cooper			
Well ID: 39000002226		Town/Range: 01S 11W	Section: 26	Well Status:	WSSN:	
		Distance and Direction from Road Intersection:				Source ID/Well No:
		Well Owner: PARMAN, JOHN				
Elevation: 780 ft.		Well Address: 2983 MCKINLEY	Owner Address: 2983 MCKINLEY			
Latitude: 42.3520738442		KALAMAZOO, MI 49004	KALAMAZOO, MI 49004			
Longitude: -85.5535741012						
Method of Collection: Interpolation-Map						

Drilling Method: Cable Tool	Pump Installed: Yes	Pump Installation Only: No		
Well Depth: 40.00 ft.	Pump Installation Date:	HP:		
Well Type: Replacement	Manufacturer: Flint & Walling	Pump Type: Submersible		
Casing Type: Steel - black	Model Number:	Pump Capacity: 0 GPM		
Casing Joint: Threaded & coupled	Drop Pipe Length: 21.00 ft.	Pump Voltage:		
Casing Fitting: Drive shoe	Drop Pipe Diameter:	Drilling Record ID:		
Diameter: 4.00 in. to 36.00 ft. depth	Draw Down Seal Used: No			
Borehole:	Pressure Tank Installed: No			
Static Water Level: 13.00 ft. Below Grade	Pressure Relief Valve Installed: No			
Well Yield Test: Pumping level 35.00 ft. after 2.00 hrs. at 30 GPM	Formation Description	Thickness	Depth to Bottom	
	Sand & Gravel Coarse	40.00	40.00	
Screen Installed: Yes				
Screen Diameter: 3.75 in.				
Screen Material Type: Blank: 1.00 ft. Above				
Slot Length	Set Between			
10.00 4.00 ft.	36.00 ft. and 40.00 ft.			
Fittings: Neoprene packer				
Well Grouted: Yes	Grouting Method: Unknown			
Grouting Material Bentonite slurry	Bags 0.00	Additives None	Depth 1.00 ft. to 36.00 ft.	Geology Remarks:
Wellhead Completion: Pitless adapter				
Nearest Source of Possible Contamination: Septic tank	Distance 50 ft.	Direction South	Drilling Machine Operator Name: Employment: Unknown	
Abandoned Well Plugged: Yes	Casing Removed:	Contractor Type: Unknown	Reg No: 03-1203	
		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:				



# Water Well And Pump Record

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



Import ID: 39711126025

Failure to comply is a misdemeanor.

Tax No:	Permit No:	County: Kalamazoo		Township: Cooper	
Well ID: 39000002227		Town/Range:	Section:	Well Status:	WSSN:
		01S 11W	26		
		Distance and Direction from Road Intersection:			
Elevation: 780 ft.					
Latitude: 42.3494726548					
Longitude: -85.5535822832					
Method of Collection: Interpolation-Map		Well Owner: BRAINARD, HOWARD		Well Address: 2982 MCKINLEY KALAMAZOO, MI 49004	
				Owner Address:	

Drilling Method: Cable Tool	Pump Installed: Yes	Pump Installation Only: No
Well Depth: 40.00 ft.	Pump Installation Date:	HP:
Well Type: Replacement	Manufacturer: F.E. Myers	Pump Type: Submersible
Casing Type: Steel - black	Model Number:	Pump Capacity: 0 GPM
Casing Joint: Threaded & coupled	Drop Pipe Length: 21.00 ft.	Pump Voltage:
Casing Fitting: Drive shoe	Drop Pipe Diameter:	Drilling Record ID:
Diameter: 4.00 in. to 36.00 ft. depth	Draw Down Seal Used: No	
Borehole: 6.00 in. to 25.00 ft. depth	Pressure Tank Installed: No	
Static Water Level: 14.00 ft. Below Grade	Pressure Relief Valve Installed: No	
Well Yield Test: Yield Test Method: Unknown	Formation Description	
Pumping level 14.00 ft. after 1.00 hrs. at 60 GPM		Thickness
Screen Installed: Yes	Topsoil	1.00
Screen Diameter: 3.00 in.	Brown Clay	3.00
Screen Material Type: Blank: 1.00 ft. Above	Sand	10.00
Slot Length	Gravel	21.00
10.00 4.00 ft.	Sand Medium	35.00
Set Between 36.00 ft. and 40.00 ft.		40.00
Fittings: Neoprene packer		
Well Grouted: Yes	Geology Remarks:	
Grouting Material Bags Additives Depth		
Bentonite slurry 0.00 None 0.00 ft. to 25.00 ft.		
Wellhead Completion: Pitless adapter		
Nearest Source of Possible Contamination: Type Distance Direction	Drilling Machine Operator Name: KAL C. LOVETT	
Septic tank 57 ft. Southwest	Employment: Unknown	
Abandoned Well Plugged: Yes	Contractor Type: Unknown	Reg No: 03-1984
Casing Removed:	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:		



# Water Well And Pump Record

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

**Welloptic**

### Import ID:

Failure to comply is a misdemeanor.

Tax No:	Permit No:	County: Kalamazoo	Township: Cooper	
Well ID: 39000012162		Town/Range: 01S 11W	Section: 26	Well Status: Active
Elevation: 774 ft.		Distance and Direction from Road Intersection:		
Latitude: 42.34998775		Well Owner: DERITE, DEVON		
Longitude: -85.55871579		Well Address: 2549 MCKINLEY KALAMAZOO, MI 49004		Owner Address: 2549 MCKINLEY KALAMAZOO, MI 49004
Method of Collection: Address Matching-House Number				
Drilling Method: Cable Tool		Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 30.00 ft.		Pump Installation Date:	HP: 0.50	
Well Type: Replacement		Manufacturer: F.E. Myers	Pump Type: Submersible	
Casing Type: Steel - black		Model Number:	Pump Capacity: 12 GPM	
Casing Joint: Threaded & coupled		Drop Pipe Length: 20.00 ft.	Pump Voltage:	
Casing Fitting: Drive shoe		Drop Pipe Diameter:	Drilling Record ID:	
Diameter: 4.00 in. to 26.00 ft. depth		Draw Down Seal Used: No		
3.00 in. to 30.00 ft. depth		Pressure Tank Installed: Yes		
Borehole:		Pressure Tank Type: Unknown	Tank Capacity:	
Static Water Level: 10.00 ft. Below Grade		Manufacturer: Well-Mate	Pressure Relief Valve Installed: No	
Well Yield Test: Yield Test Method: Test pump		Model Number: 203		
Pumping level 15.00 ft. after 2.00 hrs. at 12 GPM				
Screen Installed: Yes		Formation Description	Thickness	Depth to Bottom
Screen Diameter: 3.00 in.		Topsoil	1.00	1.00
Screen Material Type: Stainless steel-slotted		Sand & Gravel	9.00	10.00
Slot 12.00	Length 4.00 ft.	Clay	6.00	16.00
Set Between 26.00 ft. and 30.00 ft.		Sand	6.00	22.00
Fittings: Neoprene packer		Sand & Gravel	8.00	30.00
Well Grouted: Yes				
Grouting Material Unknown		Geology Remarks:		
Bags 0.00				
Additives Other				
Depth 0.00 ft. to 25.00 ft.				
Wellhead Completion: Pitless adapter, 12 inches above grade				
Nearest Source of Possible Contamination: Type Septic tank		Drilling Machine Operator Name: GEORGE KELLER		
Distance 50 ft.		Employment: Employee		
Direction North		Contractor Type: Water Well Drilling Contractor	Reg No: 39-2067	
Abandoned Well Plugged: Yes		Business Name: KELLER AND SON		
Casing Removed:		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				

### 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:

Tax No:	Permit No:	County: Kalamazoo		Township: Cooper	
Well ID: 39000012417		Town/Range: 01S 11W	Section: 26	Well Status: Active	WSSN:
		Distance and Direction from Road Intersection:			
		Well Owner: WARREN BLDR. INC.			
		Well Address: 3003 ROOSEVELT KALAMAZOO, MI 49004		Owner Address: 22725 ULDRIKS BATTLE CREEK, MI 49017	

Drilling Method: Rotary	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 40.00 ft.	Pump Installation Date:	HP: 0.50	
Well Type: New	Manufacturer: Red Jacket	Pump Type: Submersible	
Casing Type: PVC plastic	Model Number:	Pump Capacity: 10 GPM	
Casing Joint: Solvent welded/glued	Drop Pipe Length: 20.00 ft.	Pump Voltage:	
Casing Fitting: Unknown	Drop Pipe Diameter:	Drilling Record ID:	
Diameter: 5.00 in. to 35.00 ft. depth	Draw Down Seal Used: No		
Borehole: 8.00 in. to 40.00 ft. depth	Pressure Tank Installed: Yes		
Static Water Level: 13.00 ft. Below Grade	Pressure Tank Type: Unknown		
Well Yield Test: Pumping level 30.00 ft. after 1.00 hrs. at 40 GPM	Manufacturer: Well-X-Trol		
Yield Test Method: Air	Model Number: 203	Tank Capacity:	
	Pressure Relief Valve Installed: No		
Screen Installed: Yes	Formation Description		Thickness
Screen Diameter: 3.00 in.	Sand & Gravel Fine		10.00
Screen Material Type: Stainless steel-slotted	Brown Clay		2.00
Slot Length	Set Between		12.00
15.00 5.00 ft.	35.00 ft. and 40.00 ft.		28.00
Fittings: Unknown			
Well Grouted: Yes	Geology Remarks:		
Grouting Material Unknown	Bags 2.00	Additives Other	Depth 5.00 ft. to 25.00 ft.
Wellhead Completion: Pitless adapter			
Nearest Source of Possible Contamination: Septic tank	Drilling Machine Operator Name: MIKE JR.		
Type Distance 50 ft.	Employment: Employee		
Direction North	Contractor Type: Water Well Drilling Contractor Reg No: 08-1793		
	Business Name: SMITH		
	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



# Water Well And Pump Record

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



Import ID: 39711126026

Failure to comply is a misdemeanor.

Tax No:	Permit No:	County: Kalamazoo	Township: Cooper			
Well ID: 39000002228		Town/Range: 01S 11W	Section: 26	Well Status:	WSSN:	
		Distance and Direction from Road Intersection:				Source ID/Well No:
		Well Owner: SHALOM INC.				
Elevation: 780 ft.		Well Address: 2936 VANBUREN	Owner Address: 2936 VANBUREN			
Latitude: 42.3516090941		KALAMAZOO, MI 49004	KALAMAZOO, MI 49004			
Longitude: -85.5546429577						
Method of Collection: Interpolation-Map						

Drilling Method: Rotary	Pump Installed: Yes	Pump Installation Only: No		
Well Depth: 74.00 ft.	Pump Installation Date:	HP:		
Well Type: New	Manufacturer: Sta-Rite	Pump Type: Submersible		
Casing Type: PVC plastic	Model Number:	Pump Capacity: 0 GPM		
Casing Joint: Welded	Drop Pipe Length: 46.00 ft.	Pump Voltage:		
Casing Fitting: None	Drop Pipe Diameter:	Drilling Record ID:		
Diameter: 5.00 in. to 70.00 ft. depth	Draw Down Seal Used: No			
Borehole:	Pressure Tank Installed: No			
Static Water Level: 19.00 ft. Below Grade	Pressure Relief Valve Installed: No			
Well Yield Test:	Yield Test Method: Unknown	Formation Description	Thickness	Depth to Bottom
Screen Installed: Yes	Filter Packed: No	Sand & Gravel	38.00	38.00
Screen Diameter: 4.00 in.	Blank: 0.00 ft. Above	Gray Clay	7.00	45.00
Screen Material Type:		Sand	10.00	55.00
Slot Length	Set Between	Gray Clay	12.00	67.00
15.00 4.00 ft.	70.00 ft. and 74.00 ft.	Sand	7.00	74.00
Fittings: None				
Well Grouted: Yes	Grouting Method: Unknown			
Grouting Material	Bags	Additives	Depth	
Bentonite slurry	0.00	None	0.00 ft. to 25.00 ft.	
Wellhead Completion: Other, 12 inches above grade	Geology Remarks:			
Nearest Source of Possible Contamination:	Drilling Machine Operator Name: LYN BRACEY			
Type	Distance	Direction	Employment: Unknown	
Septic tank	50 ft.	East	Contractor Type: Unknown Reg No: 39-1972	
			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: Wellhead Completion: 12 inch Above Grade



# 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:

Tax No:	Permit No:	County: Kalamazoo	Township: Cooper			
		Town/Range: 01S 11W	Section: 35	Well Status:	WSSN:	Source ID/Well No:
Distance and Direction from Road Intersection:						
Well Owner: ROBINSON, MIKE						
Well Address: 5752 MOUNT OLIVET KALAMAZOO, MI 49004			Owner Address: 5752 MOUNT OLIVET KALAMAZOO, MI 49004			

Drilling Method: Cable Tool	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 50.00 ft.	Pump Installation Date:	HP: 0.50	
Well Type: Replacement	Manufacturer: F.E. Myers	Pump Type: Submersible	
Casing Type: Steel - black	Model Number:	Pump Capacity: 12 GPM	
Casing Joint: Threaded & coupled	Drop Pipe Length: 35.00 ft.	Pump Voltage:	
Casing Fitting: Drive shoe	Drop Pipe Diameter:	Drilling Record ID:	
Diameter: 4.00 in. to 46.00 ft. depth	Draw Down Seal Used: No		
Borehole:	Pressure Tank Installed: Yes		
	Pressure Tank Type: Unknown		
	Manufacturer: Well-X-Trol		
	Model Number: 202	Tank Capacity: 40.0 Gallons	
	Pressure Relief Valve Installed: No		
Static Water Level: 25.00 ft. Below Grade	Formation Description	Thickness	Depth to Bottom
Well Yield Test: Yield Test Method: Plunger	Topsoil	1.00	1.00
Pumping level 35.00 ft. after 2.00 hrs. at 12 GPM	Sand & Gravel	6.00	7.00
	Sand & Gravel	13.00	20.00
Screen Installed: Yes	Sand	15.00	35.00
Screen Diameter: 3.00 in.	Sand Water Bearing	15.00	50.00
Screen Material Type:			
Slot Length	Set Between		
10.00 4.00 ft.	46.00 ft. and 50.00 ft.		
Fittings: None			
Well Grouted: Yes	Grouting Method: Unknown		
Grouting Material	Bags	Additives	Depth
Unknown	0.00	Other	0.00 ft. to 40.00 ft.
Geology Remarks:			
Wellhead Completion: Pitless adapter, 12 inches above grade			
Nearest Source of Possible Contamination:	Drilling Machine Operator Name: GEORGE KELLER		
Type	Distance	Direction	Employment: Employee
Septic tank	50 ft.	North	Contractor Type: Water Well Drilling Contractor Reg No: 39-2067
Abandoned Well Plugged: Yes	Business Name: KELLER AND SON		
	Business Address:		
	Water Well Contractor's Certification		
Casing Removed:	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:

Tax No:	Permit No:	County: Kalamazoo		Township: Cooper	
Well ID: 39000011320		Town/Range:	Section:	Well Status:	WSSN:
		01S 11W	35		
		Distance and Direction from Road Intersection:			
Elevation: 797 ft.					
Latitude: 42.343346					
Longitude: -85.551661					
Method of Collection: Address Matching-House Number		Well Owner: MILLER, JULIUS		Well Address: 5725 MOUNT OLIVET KALAMAZOO, MI 49004	
		Owner Address: 5725 MOUNT OLIVET KALAMAZOO, MI 49004			

Drilling Method: Cable Tool	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 50.00 ft.	Pump Installation Date:	HP: 0.50	
Well Type: New	Manufacturer: F.E. Myers	Pump Type: Submersible	
Casing Type: Steel - black	Model Number:	Pump Capacity: 12 GPM	
Height:	Drop Pipe Length: 34.00 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 46.00 ft. depth	Pressure Tank Installed: Yes		
Borehole:	Pressure Tank Type: Unknown		
Static Water Level: 25.00 ft. Below Grade	Manufacturer: Champion		
Well Yield Test: Yield Test Method: Unknown	Model Number:	Tank Capacity: 20.0 Gallons	
Pumping level 45.00 ft. after 1.00 hrs. at 50 GPM	Pressure Relief Valve Installed: No		
Screen Installed: Yes	Formation Description		Thickness
Screen Diameter: 4.00 in.	Sand		25.00
Screen Material Type: Blank: 1.00 ft. Above	Sand Water Bearing		25.00
Slot Length			50.00
7.00 4.00 ft.			
Set Between			
46.00 ft. and 50.00 ft.			
Fittings: Neoprene packer			
Well Grouted: Yes	Geology Remarks:		
Grouting Material	Bags	Additives	Depth
Unknown	4.00	Other	0.00 ft. to 46.00 ft.
Wellhead Completion: Pitless adapter			
Nearest Source of Possible Contamination:	Drilling Machine Operator Name: JIM DOORNHAAG		
Type	Distance	Direction	Employment: Unknown
Septic tank	75 ft.	South	Contractor Type: Water Well Drilling Contractor Reg No: 08-1771
			Business Name: DOPP
			Business Address:
<b>Water Well Contractor's Certification</b>			
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.



Import ID:

Failure to comply is a misdemeanor.

Tax No:	Permit No:	County: Kalamazoo		Township: Cooper		
Well ID: 39000011406		Town/Range: 01S 11W	Section: 36	Well Status:	WSSN:	
		Distance and Direction from Road Intersection:				Source ID/Well No:
		Well Owner: MUIR, ROBERT				
Well Address: 5695 MOUNT OLIVET KALAMAZOO, MI 49004		Owner Address: 5695 MOUNT OLIVET KALAMAZOO, MI 49004				

Drilling Method: Rotary	Pump Installed: Yes	Pump Installation Only: No		
Well Depth: 75.00 ft.	Pump Installation Date:	HP: 0.50		
Well Type: New	Manufacturer: Red Jacket	Pump Type: Submersible		
Casing Type: PVC plastic	Model Number:	Pump Capacity: 10 GPM		
Casing Joint: Solvent welded/glued	Drop Pipe Length: 65.00 ft.	Pump Voltage:		
Casing Fitting: Unknown	Drop Pipe Diameter:	Drilling Record ID:		
Diameter: 5.00 in. to 70.00 ft. depth	Draw Down Seal Used: No			
Borehole: 7.88 in. to 75.00 ft. depth	Pressure Tank Installed: Yes			
Static Water Level: 54.00 ft. Below Grade	Pressure Tank Type: Diaphragm/bladder			
Well Yield Test: Pumping level 65.00 ft. after 2.00 hrs. at 30 GPM	Manufacturer: Well-X-Trol			
Yield Test Method: Air	Model Number: 203	Tank Capacity:		
	Pressure Relief Valve Installed: No			
Screen Installed: Yes	Formation Description		Thickness	Depth to Bottom
Screen Diameter: 4.00 in.	Sand & Gravel		54.00	54.00
Screen Material Type: Blank:	Sand & Gravel Water Bearing		21.00	75.00
Slot Length	Set Between			
12.00 5.00 ft.	70.00 ft. and 75.00 ft.			
Fittings: Neoprene packer				
Well Grouted: Yes	Grouting Method: Unknown			
Grouting Material Unknown	Bags 0.00	Additives None	Depth 0.00 ft. to 65.00 ft.	
Geology Remarks:				
Wellhead Completion: Pitless adapter, 12 inches above grade				
Nearest Source of Possible Contamination:				
Type Other	Distance 100 ft.	Direction East	Drilling Machine Operator Name: MIKE SMITH	
Employment: Subcontractor				
Contractor Type: Water Well Drilling Contractor Reg No: 39-0209				
Business Name: CS AND S				
Business Address:				
<b>Water Well Contractor's Certification</b>				
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: Contamination Source 1:SUMP



# 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:

Tax No:	Permit No:	County: Kalamazoo		Township: Cooper	
		Town/Range: 01S 11W	Section: 36	Well Status:	WSSN:
Source ID/Well No:					
Distance and Direction from Road Intersection:					
Well Owner: WABER, JOHN					
Well Address: 5705 MOUNT OLIVET KALAMAZOO, MI 49004			Owner Address: 5705 MOUNT OLIVET KALAMAZOO, MI 49004		
Method of Collection: Address Matching-House Number					

Drilling Method: Cable Tool	Pump Installed: Yes	Pump Installation Only: No		
Well Depth: 122.00 ft.	Pump Installation Date:	HP: 0.75		
Well Type: New	Manufacturer: Other	Pump Type: Submersible		
Casing Type: Steel - black	Model Number:	Pump Capacity: 12 GPM		
Casing Joint: Threaded & coupled	Drop Pipe Length: 105.00 ft.	Pump Voltage:		
Casing Fitting: Drive shoe	Drop Pipe Diameter:	Drilling Record ID:		
Diameter: 4.00 in. to 118.00 ft. depth	Draw Down Seal Used: No			
Borehole:	Pressure Tank Installed: Yes			
	Pressure Tank Type: Unknown			
	Manufacturer: Champion			
	Model Number:	Tank Capacity: 50.0 Gallons		
	Pressure Relief Valve Installed: No			
Static Water Level: 82.00 ft. Below Grade	Formation Description		Thickness	
Well Yield Test: Yield Test Method: Plunger			Depth to Bottom	
Pumping level 82.00 ft. after 1.00 hrs. at 30 GPM	Sand & Stones	85.00	85.00	
	Sand Water Bearing	15.00	100.00	
	Gray Clay	12.00	112.00	
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	4.00 ft.	118.00 ft. and 122.00 ft.		
Fittings: Neoprene packer				
Well Grouted: Yes	Grouting Method: Unknown			
Grouting Material	Bags	Additives	Depth	
Unknown	5.00	Other	0.00 ft. to 118.00 ft.	
Wellhead Completion: Pitless adapter	Geology Remarks:			
Nearest Source of Possible Contamination:	Drilling Machine Operator Name: JIM DOORNHAAG			
Type	Distance	Direction	Employment: Employee	
Septic tank	57 ft.	Southeast		
	Contractor Type: Water Well Drilling Contractor Reg No: 08-1771			
	Business Name: DOPP			
	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, Pump Manufacturer:FAIRBANKS, Screen Fittings:Blank Above Screen				



# Water Well And Pump Record

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



Import ID: 39711135048

Failure to comply is a misdemeanor.

Tax No:	Permit No:	County: Kalamazoo	Township: Cooper			
Well ID: 39000002462		Town/Range: 01S 11W	Section: 35	Well Status:	WSSN:	
		Distance and Direction from Road Intersection:				Source ID/Well No:
		Well Owner: AVE ADAMS				Well Address: 5458 LINDENWOOD PARCHMENT, MI 49004
Method of Collection: Interpolation-Map		Owner Address: 5458 LINDENWOOD PARCHMENT, MI 49004				

Drilling Method: Cable Tool	Pump Installed: No			
Well Depth: 95.00 ft.	Well Use: Household	Pressure Tank Installed: No		
Well Type: Replacement	Date Completed: 1/26/1990	Pressure Relief Valve Installed: No		
Casing Type: Steel - black	Height:			
Casing Joint: Threaded & coupled				
Casing Fitting: Drive shoe				
Diameter: 4.00 in. to 90.00 ft. depth				
Borehole:				
Static Water Level: 55.00 ft. Below Grade	Formation Description			Thickness
Well Yield Test: Yield Test Method: Unknown				Depth to Bottom
Pumping level 0.00 ft. after 0.00 hrs. at 50 GPM	Sand & Stones	60.00 60.00		
	Sand Wet/Moist	35.00 95.00		
Screen Installed: Yes	Filter Packed: No			
Screen Diameter: 4.00 in.	Blank: 1.00 ft. Above			
Screen Material Type:				
Slot	Length	Set Between		
12.00	5.00 ft.	90.00 ft. and 95.00 ft.		
Fittings: Neoprene packer				
Well Grouted: Yes	Grouting Method: Unknown			
Grouting Material	Bags	Additives	Depth	
Bentonite slurry	0.00	None	0.00 ft. to 0.00 ft.	
Wellhead Completion: Pitless adapter	Geology Remarks:			
Nearest Source of Possible Contamination:	Drilling Machine Operator Name:			
Type	Distance	Direction	Employment: Unknown	
Unknown	0 ft.			
Abandoned Well Plugged: No	Contractor Type: Unknown Reg No: 43-0436			
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:				



# Water Well And Pump Record

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



Import ID: 39711135049

Failure to comply is a misdemeanor.

Tax No:	Permit No:	County: Kalamazoo	Township: Cooper			
Well ID: 39000002463		Town/Range: 01S 11W	Section: 35	Well Status:	WSSN:	
		Distance and Direction from Road Intersection:				Source ID/Well No:
		Well Owner: PHIL ROMCZAK				Well Address: 5464 LINDENWOOD PARCHMENT, MI 49004
Method of Collection: Interpolation-Map		Owner Address: 5464 LINDENWOOD PARCHMENT, MI 49004				

Drilling Method: Cable Tool	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 77.00 ft.	Pump Installation Date:	HP:	
Well Type: Replacement	Manufacturer: Other	Pump Type: Submersible	
Casing Type: Steel - black	Model Number:	Pump Capacity: 0 GPM	
Casing Joint: Threaded & coupled	Drop Pipe Length: 63.00 ft.	Pump Voltage:	
Casing Fitting: Drive shoe	Drop Pipe Diameter:	Drilling Record ID:	
Diameter: 4.00 in. to 72.00 ft. depth	Draw Down Seal Used: No		
Borehole:	Pressure Tank Installed: No		
Static Water Level: 58.00 ft. Below Grade	Pressure Relief Valve Installed: No		
Well Yield Test: Yield Test Method: Unknown	Formation Description	Thickness	Depth to Bottom
Pumping level 0.00 ft. after 0.00 hrs. at 50 GPM	Sand & Stones	60.00	60.00
	Sand Wet/Moist	17.00	77.00
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 5.00 ft.	72.00 ft. and 77.00 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.
Geology Remarks:			
Wellhead Completion: Pitless adapter			
Nearest Source of Possible Contamination:	Drilling Machine Operator Name:		
Type	Distance	Direction	Employment: Unknown
Unknown	0 ft.		
Abandoned Well Plugged: No	Contractor Type: Unknown Reg No:		
Reason Not Plugged:	Business Name:		
Business Address:			
<b>Water Well Contractor's Certification</b>			
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: Pump Manufacturer: BURKS



# 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: Cooper			
Well ID: 39000002506		Town/Range: 01S 11W	Section: 35	Well Status: Active	WSSN:	
		Distance and Direction from Road Intersection: Corner of Thayer & Lindenwood on Lindenwood.				
		Well Owner: LIKE, RICHARD Well Address: 5328 LINDENWOOD KALAMAZOO, MI 49004				
Method of Collection: Interpolation-Map		Owner Address: 5328 LINDENWOOD KALAMAZOO, MI 49004				

Drilling Method: Cable Tool	Pump Installed: Yes	Pump Installation Only: No		
Well Depth: 94.00 ft.	Pump Installation Date:	HP: 2.00		
Well Type: Replacement	Manufacturer: Red Jacket	Pump Type: Submersible		
Casing Type: Steel - black	Model Number: CN9BC	Pump Capacity: 10 GPM		
Casing Joint: Threaded & coupled	Drop Pipe Length: 75.00 ft.	Pump Voltage: 230		
Casing Fitting: Drive shoe	Drop Pipe Diameter:	Drilling Record ID:		
Diameter: 4.00 in. to 90.00 ft. depth	Draw Down Seal Used: No			
Borehole:	Pressure Tank Installed: Yes			
Static Water Level: 54.00 ft. Below Grade	Pressure Tank Type: Unknown			
Well Yield Test: Pumping level 54.00 ft. after 0.50 hrs. at 60 GPM	Manufacturer: Well-X-Trol			
Yield Test Method: Unknown	Model Number: WX-202	Tank Capacity: 20.0 Gallons		
	Pressure Relief Valve Installed: No			
Screen Installed: Yes	Formation Description		Thickness	Depth to Bottom
Screen Diameter: 4.00 in.	Topsoil	1.00		1.00
Screen Material Type: Stainless steel-wire wrapped	Brown Clay Gravel Sand W/Stones	6.00		7.00
Slot Length	Gravel & Sand	21.00		28.00
10.00 4.00 ft.	Sand	10.00		38.00
	Sand & Stones	17.00		55.00
	Sand & Stones Water Bearing	22.00		77.00
	Stones Wet/Moist	11.00		88.00
	Sand & Stones Wet/Moist	6.00		94.00
Fittings: Neoprene packer				
Well Grouted: Yes	Geology Remarks:			
Grouting Material Bentonite dry granular	Bags 0.00	Additives None	Depth	
Wellhead Completion: Pitless adapter				
Nearest Source of Possible Contamination: Type Unknown	Distance	Direction	Drilling Machine Operator Name: Employment: Unknown	
Abandoned Well Plugged: Yes	Contractor Type: Unknown Reg No: 39-1711			
Plugging Material: Unknown	Business Name: Glen Leversee Well Drilling			
Casing Removed: No	Business Address:			
<b>Water Well Contractor's Certification</b>				
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: 39711135103

Failure to comply is a misdemeanor.

Tax No:	Permit No:	County: Kalamazoo	Township: Cooper			
Well ID: 39000002517		Town/Range: 01S 11W	Section: 35	Well Status:	WSSN:	
		Distance and Direction from Road Intersection:				Source ID/Well No:
		Well Owner: SIWIK, DON				Well Address: 5470 LINDENWOOD KALAMAZOO, MI 49004
Method of Collection: Interpolation-Map		Owner Address: 5470 LINDENWOOD KALAMAZOO, MI 49004				

Drilling Method: Cable Tool	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 91.00 ft.	Pump Installation Date:	HP:	
Well Type: Replacement	Manufacturer: F.E. Myers	Pump Type: Submersible	
Casing Type: Steel - black	Model Number:	Pump Capacity: 0 GPM	
Casing Joint: Threaded & coupled	Drop Pipe Length: 75.00 ft.	Pump Voltage:	
Casing Fitting: Drive shoe	Drop Pipe Diameter:	Drilling Record ID:	
Diameter: 4.00 in. to 87.00 ft. depth	Draw Down Seal Used: No		
Borehole:	Pressure Tank Installed: No		
Static Water Level: 55.00 ft. Below Grade	Pressure Relief Valve Installed: No		
Well Yield Test: Yield Test Method: Unknown	Formation Description	Thickness	Depth to Bottom
Pumping level 0.00 ft. after 0.00 hrs. at 50 GPM	Sand & Stones	55.00	55.00
	Sand Wet/Moist	36.00	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		
12.00 4.00 ft.	87.00 ft. and 91.00 ft.		
Fittings: Neoprene packer			
Well Grouted: Yes	Grouting Method: Unknown		
Grouting Material Bentonite slurry	Bags 0.00	Additives None	Depth 0.00 ft. to 0.00 ft.
Geology Remarks:			
Wellhead Completion: Pitless adapter			
Nearest Source of Possible Contamination: Type Unknown	Distance 0 ft.	Direction	Drilling Machine Operator Name: JIM DOORNHAAG
			Employment: Unknown
Abandoned Well Plugged: Yes	Contractor Type: Unknown Reg No: 43-0436		
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:			



# Water Well And Pump Record

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



Import ID: 39711135116

Failure to comply is a misdemeanor.

Tax No:	Permit No:	County: Kalamazoo	Township: Cooper			
Well ID: 39000002529		Town/Range: 01S 11W	Section: 35	Well Status:	WSSN:	
		Distance and Direction from Road Intersection:				Source ID/Well No:
		Well Owner: STAGIS, VILIS				Well Address: 5346 LINDENWOOD KALAMAZOO, MI 49004
Method of Collection: Interpolation-Map		Owner Address: 5346 LINDENWOOD KALAMAZOO, MI 49004				

Drilling Method: Cable Tool	Pump Installed: Yes	Pump Installation Only: No			
Well Depth: 94.00 ft.	Pump Installation Date:	HP:			
Well Type: Replacement	Manufacturer: Other	Pump Type: Submersible			
Casing Type: Steel - black	Model Number:	Pump Capacity: 0 GPM			
Casing Joint: Threaded & coupled	Drop Pipe Length: 75.00 ft.	Pump Voltage:			
Casing Fitting: Drive shoe	Drop Pipe Diameter:	Drilling Record ID:			
Diameter: 4.00 in. to 90.00 ft. depth	Draw Down Seal Used: No				
Borehole:	Pressure Tank Installed: No				
Static Water Level: 54.00 ft. Below Grade	Pressure Relief Valve Installed: No				
Well Yield Test: Yield Test Method: Unknown	Formation Description	Thickness	Depth to Bottom		
Pumping level 0.00 ft. after 0.00 hrs. at 50 GPM	Sand & Stones	60.00	60.00		
	Sand Wet/Moist	34.00	94.00		
Screen Installed: Yes	Filter Packed: No				
Screen Diameter: 4.00 in.	Blank: 1.00 ft. Above				
Screen Material Type:					
Slot 10.00	Length 4.00 ft.	Set Between 90.00 ft. and 94.00 ft.			
Fittings: Neoprene packer					
Well Grouted: Yes	Grouting Method: Unknown				
Grouting Material Bentonite slurry	Bags 0.00	Additives None	Depth 0.00 ft. to 0.00 ft.		
Wellhead Completion: Pitless adapter	Geology Remarks:				
Nearest Source of Possible Contamination: Type Unknown	Distance 0 ft.	Direction			
Abandoned Well Plugged: Yes	Drilling Machine Operator Name: JIM DOORNHAAG				
	Employment: Unknown				
	Contractor Type: Unknown Reg No: 08-1771				
Casing Removed:	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: Pump Manufacturer: MYERS

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# 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: 39711135046

Tax No:	Permit No:	County: Kalamazoo	Township: Cooper			
Well ID: 39000002460		Town/Range: 01S 11W	Section: 35	Well Status:	WSSN:	
		Distance and Direction from Road Intersection:				Source ID/Well No:
		Well Owner: LEWIS ROBERTS				Well Address: 5397 LINDENWOOD PARCHMENT, MI 49004
Method of Collection: Interpolation-Map		Owner Address: 5397 LINDENWOOD PARCHMENT, MI 49004				

Drilling Method: Cable Tool	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 100.00 ft.	Pump Installation Date:	HP:	
Well Type: Replacement	Manufacturer: Tait	Pump Type: Submersible	
Casing Type: Steel - black	Model Number:	Pump Capacity: 0 GPM	
Casing Joint: Threaded & coupled	Drop Pipe Length: 84.00 ft.	Pump Voltage:	
Casing Fitting: Drive shoe	Drop Pipe Diameter:	Drilling Record ID:	
Diameter: 4.00 in. to 95.00 ft. depth	Draw Down Seal Used: No		
Borehole:	Pressure Tank Installed: No		
Static Water Level: 50.00 ft. Below Grade	Pressure Relief Valve Installed: No		
Well Yield Test: Pumping level 0.00 ft. after 0.00 hrs. at 50 GPM	Formation Description	Thickness	Depth to Bottom
	Sand & Stones	60.00	60.00
	Sand Wet/Moist	5.00	65.00
	Gray Clay	30.00	95.00
Screen Installed: Yes	Filter Packed: No	Sand Wet/Moist	5.00
Screen Diameter: 4.00 in.	Blank: 1.00 ft. Above		100.00
Screen Material Type:			
Slot 12.00	Length 5.00 ft.	Set Between 95.00 ft. and 100.00 ft.	
Fittings: Neoprene packer			
Well Grouted: Yes	Grouting Method: Unknown		
Grouting Material Bentonite slurry	Bags 0.00	Additives None	Depth 0.00 ft. to 0.00 ft.
Wellhead Completion: Pitless adapter	Geology Remarks:		
Nearest Source of Possible Contamination: Type Unknown	Distance 0 ft.	Direction	Drilling Machine Operator Name: Employment: Unknown
Abandoned Well Plugged: No	Contractor Type: Unknown Reg No: 43-0436		
Reason Not Plugged:	Business Name: Business Address:		
<b>Water Well Contractor's Certification</b> 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: 39711135051

Failure to comply is a misdemeanor.

Tax No:	Permit No:	County: Kalamazoo	Township: Cooper			
Well ID: 39000002465		Town/Range: 01S 11W	Section: 35	Well Status:	WSSN:	
		Distance and Direction from Road Intersection:				Source ID/Well No:
		Well Owner: SIG SZATKOWSKI				Well Address: 5485 LINDENWOOD PARCHMENT, MI 49004
Method of Collection: Interpolation-Map		Owner Address: 5485 LINDENWOOD PARCHMENT, MI 49004				

Drilling Method: Cable Tool	Pump Installed: Yes	Pump Installation Only: No		
Well Depth: 113.00 ft.	Pump Installation Date:	HP:		
Well Type: Replacement	Manufacturer: Other	Pump Type: Submersible		
Casing Type: Steel - black	Model Number:	Pump Capacity: 0 GPM		
Casing Joint: Threaded & coupled	Drop Pipe Length: 84.00 ft.	Pump Voltage:		
Casing Fitting: Drive shoe	Drop Pipe Diameter:	Drilling Record ID:		
Diameter: 4.00 in. to 108.00 ft. depth	Draw Down Seal Used: No			
Borehole:	Pressure Tank Installed: No			
Static Water Level: 55.00 ft. Below Grade	Pressure Relief Valve Installed: No			
Well Yield Test: Pumping level 0.00 ft. after 0.00 hrs. at 50 GPM	Formation Description	Thickness	Depth to Bottom	
	Sand & Stones	60.00	60.00	
	Sand Wet/Moist	30.00	90.00	
	Clay Sandy	15.00	105.00	
Screen Installed: Yes	Filter Packed: No	Sand Wet/Moist	8.00	113.00
Screen Diameter: 4.00 in.	Blank: 1.00 ft. Above			
Screen Material Type:				
Slot 12.00	Length 5.00 ft.	Set Between 108.00 ft. and 113.00 ft.		
Fittings: Neoprene packer				
Well Grouted: Yes	Grouting Method: Unknown			
Grouting Material Bentonite slurry	Bags 0.00	Additives None	Depth 0.00 ft. to 0.00 ft.	
Wellhead Completion: Pitless adapter	Geology Remarks:			
Nearest Source of Possible Contamination: Type Unknown	Distance 0 ft.	Direction	Drilling Machine Operator Name: Employment: Unknown	
Abandoned Well Plugged: No	Contractor Type: Unknown Reg No: 43-0436			
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: Pump Manufacturer: BURKS				



# Water Well And Pump Record

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



Import ID: 39711135102

Failure to comply is a misdemeanor.

Tax No:	Permit No:	County: Kalamazoo	Township: Cooper			
Well ID: 39000002516		Town/Range: 01S 11W	Section: 35	Well Status:	WSSN:	
		Distance and Direction from Road Intersection:				Source ID/Well No:
		Well Owner: DONITHAN, GARY				
Well Address: 5386 HILLSITE KALAMAZOO, MI 49004		Owner Address: 5386 HILLSITE KALAMAZOO, MI 49004				
Method of Collection: Interpolation-Map						

Drilling Method: Rotary	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 116.00 ft.	Pump Installation Date:	HP:	
Well Type: Replacement	Manufacturer: Other	Pump Type: Submersible	
Casing Type: PVC plastic	Model Number:	Pump Capacity: 0 GPM	
Casing Joint: Welded	Drop Pipe Length: 86.00 ft.	Pump Voltage:	
Casing Fitting: None	Drop Pipe Diameter:	Drilling Record ID:	
Diameter: 5.00 in. to 108.00 ft. depth	Draw Down Seal Used: No		
Borehole:	Pressure Tank Installed: No		
Static Water Level: 60.00 ft. Below Grade	Pressure Relief Valve Installed: No		
Well Yield Test:	Formation Description	Thickness	Depth to Bottom
	Clay Sandy	2.00	2.00
	Gravel & Sand	86.00	88.00
	Brown Clay	2.00	90.00
Screen Installed: Yes	Gray Clay	4.00	94.00
Screen Diameter: 4.00 in.	Sand	22.00	116.00
Screen Material Type:			
Slot Length	Set Between		
12.00 8.00 ft.	108.00 ft. and 116.00 ft.		
Fittings: None			
Well Grouted: Yes	Grouting Method: Unknown		
Grouting Material Bentonite slurry	Bags 0.00	Additives None	Depth 0.00 ft. to 106.00 ft.
Geology Remarks:			
Wellhead Completion: Pitless adapter			
Nearest Source of Possible Contamination: Type Septic tank	Distance 50 ft.	Direction East	Drilling Machine Operator Name: LYNN BRACEY
			Employment: Unknown
Abandoned Well Plugged: Yes	Contractor Type: Unknown		
			Reg No: 39-1972
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: Pump Manufacturer:EAGLE 2000



# Water Well And Pump Record

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



Import ID: 39711135113

Failure to comply is a misdemeanor.

Tax No:	Permit No:	County: Kalamazoo	Township: Cooper			
Well ID: 39000002526		Town/Range: 01S 11W	Section: 35	Well Status:	WSSN:	
		Distance and Direction from Road Intersection:				Source ID/Well No:
		Well Owner: KNIGHT, ANDREW				Well Address: 5410 HILLSIGHT KALAMAZOO, MI 49004
Method of Collection: Interpolation-Map		Owner Address: 5410 HILLSIGHT KALAMAZOO, MI 49004				

Drilling Method: Rotary	Well Use: Household	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 116.00 ft.	Date Completed: 8/22/1995	Pump Installation Date:	HP:	
Well Type: Replacement	Casing Type: PVC plastic	Manufacturer: Other	Pump Type: Submersible	
Casing Joint: Welded	Height: 0.00 ft. below grade	Model Number:	Pump Capacity: 0 GPM	
Casing Fitting: None	Diameter: 5.00 in. to 108.00 ft. depth	Drop Pipe Length: 86.00 ft.	Pump Voltage:	
Borehole:		Drop Pipe Diameter:	Drilling Record ID:	
		Draw Down Seal Used: No		
Static Water Level: 61.00 ft. Below Grade	Well Yield Test: Yield Test Method: Unknown	Pressure Tank Installed: No		
		Pressure Relief Valve Installed: No		
Screen Installed: Yes	Filter Packed: No	Formation Description	Thickness	Depth to Bottom
Screen Diameter: 4.00 in.	Blank: 0.00 ft. Above	Clay Sandy	7.00	7.00
Screen Material Type:	Slot Length	Sand & Gravel	90.00	97.00
	12.00 8.00 ft.	Clay Sandy	7.00	104.00
Fittings: None	Set Between 108.00 ft. and 116.00 ft.	Sand	12.00	116.00
Well Grouted: Yes	Grouting Method: Unknown			
Grouting Material	Bags	Additives	Depth	
Bentonite slurry	0.00	None	0.00 ft. to 108.00 ft.	
Wellhead Completion: Pitless adapter		Geology Remarks:		
Nearest Source of Possible Contamination:	Type	Distance	Direction	
Septic tank		50 ft.	East	
Abandoned Well Plugged: Yes		Drilling Machine Operator Name: LYN BRACEY		
		Employment: Unknown		
		Contractor Type: Unknown Reg No: 39-1972		
		Business Name:		
		Business Address:		
	Casing Removed:	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: Pump Manufacturer:EAGLE 4000

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# 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: Cooper	
Well ID: 39000012757		Town/Range:	Section:	Well Status:	WSSN:
		01S 11W	35	Active	
Distance and Direction from Road Intersection:					
Well Owner: FLETCHER, RICHARD					
Well Address: 5423 HILLSIGHT KALAMAZOO, MI 49004			Owner Address: 5423 HILLSIGHT KALAMAZOO, MI 49004		

Drilling Method: Cable Tool	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 104.00 ft.	Pump Installation Date:	HP: 0.75	
Well Type: Replacement	Manufacturer: Fairbanks-Morse	Pump Type: Submersible	
Casing Type: Steel - black	Model Number:	Pump Capacity: 14 GPM	
Casing Joint: Threaded & coupled	Drop Pipe Length: 84.00 ft.	Pump Voltage:	
Casing Fitting: Drive shoe	Drop Pipe Diameter:	Drilling Record ID:	
Diameter: 4.00 in. to 100.00 ft. depth	Draw Down Seal Used: No		
Borehole:	Pressure Tank Installed: No		
Static Water Level: 65.00 ft. Below Grade	Pressure Relief Valve Installed: No		
Well Yield Test: Yield Test Method: Plunger	Formation Description		
Pumping level 65.00 ft. after 1.00 hrs. at 50 GPM	Thickness		
Screen Installed: Yes	Sand & Stones	65.00	65.00
Screen Diameter: 4.00 in.	Sand Water Bearing	13.00	78.00
Screen Material Type: Stainless steel-slotted	Gray Clay	11.00	89.00
Slot Length	Sand Water Bearing	15.00	104.00
10.00 4.00 ft.			
Set Between			
100.00 ft. and 104.00 ft.			
Fittings: Neoprene packer			
Well Grouted: Yes	Grouting Method: Unknown		
Grouting Material	Bags	Additives	Depth
Bentonite dry granular	4.00	None	0.00 ft. to 100.00 ft.
Geology Remarks:			
Wellhead Completion: Pitless adapter			
Nearest Source of Possible Contamination:	Drilling Machine Operator Name: JIM DOORNHAAG		
Type	Distance	Direction	Employment: Employee
Septic tank	65 ft.	West	Contractor Type: Water Well Drilling Contractor Reg No: 08-1771
Abandoned Well Plugged: Yes	Business Name: DOPP		
Casing Removed:	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:Blank Above Screen



# 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: Cooper	
		Town/Range: 01S 11W	Section: 35	Well Status:	WSSN:
Source ID/Well No:					
Distance and Direction from Road Intersection:					
Well Owner: ADAMS, DAVE					
Well Address: 5327 HILLSIGHT KALAMAZOO, MI 49004			Owner Address: 5327 HILLSIGHT KALAMAZOO, MI 49004		
Method of Collection: Address Matching-House Number					

Drilling Method: Cable Tool	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 122.00 ft.	Pump Installation Date:	HP: 1.00	
Well Type: New	Manufacturer: Other	Pump Type: Submersible	
Casing Type: Steel - black	Model Number:	Pump Capacity: 18 GPM	
Casing Joint: Threaded & coupled	Drop Pipe Length: 105.00 ft.	Pump Voltage:	
Casing Fitting: Drive shoe	Drop Pipe Diameter:	Drilling Record ID:	
Diameter: 4.00 in. to 118.00 ft. depth	Draw Down Seal Used: No		
Borehole:	Pressure Tank Installed: Yes		
Static Water Level: 63.00 ft. Below Grade	Pressure Tank Type: Unknown		
Well Yield Test: Pumping level 63.00 ft. after 1.00 hrs. at 50 GPM	Manufacturer: Champion		
Yield Test Method: Unknown	Model Number:	Tank Capacity: 50.0 Gallons	
	Pressure Relief Valve Installed: No		
Screen Installed: Yes	Formation Description		Thickness
Screen Diameter: 4.00 in.	Sand & Stones		65.00
Screen Material Type: Blank: 1.00 ft. Above	Sand Water Bearing		25.00
Slot Length	Gray Clay Sandy		20.00
7.00 4.00 ft.	Set Between 118.00 ft. and 122.00 ft.		12.00
Fittings: Neoprene packer			122.00
Well Grouted: Yes	Geology Remarks:		
Grouting Material Unknown	Bags 5.00	Additives Other	Depth 0.00 ft. to 118.00 ft.
Wellhead Completion: Pitless adapter			
Nearest Source of Possible Contamination: Septic tank	Drilling Machine Operator Name: JIM DOORNHAAG		
Type Distance 76 ft.	Employment: Unknown		
Direction West	Contractor Type: Water Well Drilling Contractor Reg No: 08-1771		
	Business Name: DOPP		
	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, Pump Manufacturer:FAIRBANKS, Screen Fittings:Blank Above Screen



# 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: Cooper	
Well ID: 39000002488		Town/Range:	Section:	Well Status:	WSSN:
		01S 11W	35	Active	
		Distance and Direction from Road Intersection:			
1 block north of G Ave.					
		Well Owner: JACK FLORA			
		Well Address: 5180 SOLVEL Kalamazoo, MI 49004		Owner Address: 5180 SOLVEL PARCHMENT, MI 49004	

Drilling Method: Other	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 75.00 ft.	Pump Installation Date:	HP: 0.75	
Well Type: Unknown	Manufacturer: Goulds	Pump Type: Jet	
Casing Type: Unknown	Model Number: j70L	Pump Capacity:	
Casing Joint: Unknown	Drop Pipe Length: 65.00 ft.	Pump Voltage:	
Casing Fitting: Drive shoe	Drop Pipe Diameter:	Drilling Record ID:	
Diameter: 2.00 in. to 72.00 ft. depth	Draw Down Seal Used: No		
Borehole:	Pressure Tank Installed: No		
Static Water Level: Below Grade	Pressure Relief Valve Installed: No		
Well Yield Test:	Formation Description		Thickness
	Sand & Gravel		75.00
			75.00
Screen Installed: Yes	Filter Packed: No		
Screen Diameter: in.	Blank:		
Screen Material Type: Unknown			
Slot Length	Set Between		
10.00	3.00 ft. 72.00 ft. and 75.00 ft.		
Fittings: Unknown			
Well Grouted: Yes	Grouting Method: Unknown		
Grouting Material	Bags	Additives	Depth
Unknown		None	
Geology Remarks:			
Wellhead Completion: Pitless adapter			
Nearest Source of Possible Contamination:	Drilling Machine Operator Name:		
Type	Distance	Direction	Employment: Unknown
Septic tank	50 ft.	Southeast	
Abandoned Well Plugged: No	Contractor Type: Water Well Drilling Contractor Reg No:		
Reason Not Plugged: Unknown	Business Name: Newman Pump Co Business Address:		
<b>Water Well Contractor's Certification</b>			
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: Contractor Reg #0208

Other Remarks: Drilling Method:Hollow Rod & Driven



# 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: Cooper	
Well ID: 39000011206		Town/Range:	Section:	Well Status:	WSSN:
		01S 11W	35		
Distance and Direction from Road Intersection:					
Well Owner: LAHAIE					
Well Address: 2881 SUMMERDALE KALAMAZOO, MI 49004			Owner Address: 2881 SUMMERDALE KALAMAZOO, MI 49004		

Drilling Method: Rotary	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 105.00 ft.	Pump Installation Date:	HP: 0.75	
Well Type: Replacement	Manufacturer: Aermotor	Pump Type: Submersible	
Casing Type: Steel - black	Model Number:	Pump Capacity: 18 GPM	
Casing Joint: Threaded & coupled	Drop Pipe Length: 80.00 ft.	Pump Voltage:	
Casing Fitting: Unknown	Drop Pipe Diameter:	Drilling Record ID:	
Diameter: 4.00 in. to 97.00 ft. depth	Draw Down Seal Used: No		
Borehole: 6.00 in. to 125.00 ft. depth	Pressure Tank Installed: Yes		
Static Water Level: 40.00 ft. Below Grade	Pressure Tank Type: Unknown		
Well Yield Test: Yield Test Method: Air	Manufacturer: Well-Rite-Flexcon		
Pumping level 80.00 ft. after 1.00 hrs. at 40 GPM	Model Number:	Tank Capacity: 12.0 Gallons	
Screen Installed: Yes	Pressure Relief Valve Installed: No		
Screen Diameter: 4.00 in.	Formation Description	Thickness	Depth to Bottom
Screen Material Type:	Clay & Sand	10.00	10.00
Slot Length	Sand & Gravel Coarse	50.00	60.00
15.00 8.00 ft.	Sand Fine Water Bearing	30.00	90.00
Fittings: Unknown	Clay	2.00	92.00
Well Grouted: Yes	Sand Coarse Water Bearing	16.00	108.00
Grouting Material	Gray Clay	17.00	125.00
Bags			
Unknown			
Additives			
0.00			
Depth			
0.00 ft. to 80.00 ft.			
Geology Remarks:			
Wellhead Completion: Pitless adapter			
Nearest Source of Possible Contamination:			
Type	Distance	Direction	Drilling Machine Operator Name: ANDY
Septic tank	50 ft.	South	Employment: Employee
Abandoned Well Plugged: Yes	Contractor Type: Water Well Drilling Contractor Reg No: 13-1911		
Casing Removed:	Business Name: WALTERS		
	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



# Water Well And Pump Record

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



Import ID: 39711135115

Failure to comply is a misdemeanor.

Tax No:	Permit No:	County: Kalamazoo	Township: Cooper			
Well ID: 39000002528		Town/Range: 01S 11W	Section: 35	Well Status:	WSSN:	
		Distance and Direction from Road Intersection:				Source ID/Well No:
		Well Owner: THOMAS, RICK				
Latitude: 42.3359583554		Well Address: 2851 SUMMERDALE	Owner Address: 2851 SUMMERDALE			
Longitude: -85.5544335601		KALAMAZOO, MI 49004	KALAMAZOO, MI 49004			
Method of Collection: Interpolation-Map						

Drilling Method: Rotary	Well Use: Household	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 123.00 ft.	Date Completed: 8/14/1995	Pump Installation Date:	HP:	
Well Type: Replacement		Manufacturer: Other	Pump Type: Submersible	
Casing Type: PVC plastic	Height:	Model Number:	Pump Capacity: 0 GPM	
Casing Joint: Welded		Drop Pipe Length: 90.00 ft.	Pump Voltage:	
Casing Fitting: None		Drop Pipe Diameter:	Drilling Record ID:	
Diameter: 5.00 in. to 118.00 ft. depth		Draw Down Seal Used: No		
3.00 in. to 123.00 ft. depth		Pressure Tank Installed: No		
Borehole: 8.00 in. to 123.00 ft. depth		Pressure Relief Valve Installed: No		
Static Water Level: 60.00 ft. Below Grade				
Well Yield Test: Pumping level 63.00 ft. after 1.00 hrs. at 35 GPM	Yield Test Method: Unknown	Formation Description	Thickness	Depth to Bottom
		Topsoil	1.00	1.00
		Red Clay W/Stones	4.00	5.00
		Gray Gravel Medium	11.00	16.00
Screen Installed: Yes	Filter Packed: No	Light Brown Gravel Fine	6.00	22.00
Screen Diameter: 3.00 in.	Blank: 1.00 ft. Above	Light Brown Gravel	8.00	30.00
Screen Material Type: Slot	Length	Tan Gravel Fine	17.00	47.00
12.00	5.00 ft.	Tan Sand Coarse	38.00	85.00
		Tan Sand Medium	5.00	90.00
		Gray Clay	2.00	92.00
		Gray Sand Fine	3.00	95.00
Fittings: Neoprene packer		Gray Clay	5.00	100.00
		Gray Sand Medium	5.00	105.00
Well Grouted: Yes	Grouting Method: Unknown	Gray Clay	2.00	107.00
Grouting Material: Bentonite slurry	Bags: 0.00	Additives: None	Depth: 0.00 ft. to 118.00 ft.	(Continued On Page 2)
Wellhead Completion: Pitless adapter		Geology Remarks:		
Nearest Source of Possible Contamination: Type	Distance	Direction	Drilling Machine Operator Name: RICK CLARK	
Sewer line	55 ft.	Southwest	Employment: Unknown	
Abandoned Well Plugged: Yes			(Continued on page 2)	
		Casing Removed:		

General Remarks:

Other Remarks: Pump Manufacturer:F&W



# Water Well And Pump Record

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



Import ID: 39711136004

Failure to comply is a misdemeanor.

Tax No:	Permit No:	County: Kalamazoo	Township: Cooper			
Well ID: 39000002533		Town/Range: 01S 11W	Section: 36	Well Status:	WSSN:	
		Distance and Direction from Road Intersection:				Source ID/Well No:
		Well Owner: TIM BOYD				
Well Address: 5058 MT OLIVET PARCHMENT, MI 49004		Owner Address: 5058 MT OLIVET PARCHMENT, MI 49004				
Method of Collection: Interpolation-Map						

Drilling Method: Cable Tool	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 109.00 ft.	Pump Installation Date:	HP:	
Well Type: Replacement	Manufacturer: Sta-Rite	Pump Type: Submersible	
Casing Type: Steel - black	Model Number:	Pump Capacity: 0 GPM	
Casing Joint: Threaded & coupled	Drop Pipe Length: 84.00 ft.	Pump Voltage:	
Casing Fitting: Drive shoe	Drop Pipe Diameter:	Drilling Record ID:	
Diameter: 4.00 in. to 105.00 ft. depth	Draw Down Seal Used: No		
Borehole:	Pressure Tank Installed: No		
Static Water Level: 45.00 ft. Below Grade	Pressure Relief Valve Installed: No		
Well Yield Test: Yield Test Method: Unknown	Formation Description	Thickness	Depth to Bottom
Pumping level 45.00 ft. after 1.00 hrs. at 50 GPM	Sand & Gravel	25.00	25.00
	Brown Clay & Gravel	20.00	45.00
	Sand	20.00	65.00
Screen Installed: Yes	Gray Clay & Gravel	25.00	90.00
Screen Diameter: 4.00 in.	Sand Wet/Moist	2.00	92.00
Screen Material Type: Blank: 1.00 ft. Above	Sand Fine Wet/Moist	8.00	100.00
Slot Length	Sand Coarse	9.00	109.00
12.00 4.00 ft.			
Fittings: Neoprene packer			
Well Grouted: Yes	Grouting Method: Unknown		
Grouting Material	Bags	Additives	Depth
Bentonite slurry	0.00	None	0.00 ft. to 25.00 ft.
Geology Remarks:			
Wellhead Completion: Pitless adapter			
Nearest Source of Possible Contamination:			
Type	Distance	Direction	Drilling Machine Operator Name:
Septic tank	60 ft.	East	Employment: Unknown
Abandoned Well Plugged: Yes	Contractor Type: Unknown Reg No: 80-0112		
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:			



# Water Well And Pump Record

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



Import ID: 39711136005

Failure to comply is a misdemeanor.

Tax No:	Permit No:	County: Kalamazoo	Township: Cooper			
Well ID: 39000002534		Town/Range: 01S 11W	Section: 36	Well Status:	WSSN:	
		Distance and Direction from Road Intersection:				Source ID/Well No:
		Well Owner: HARRY WATTS				
Method of Collection: Interpolation-Map		Well Address: 5070 MT OLIVET PARCHMENT, MI 49004	Owner Address: 2221 ABBOTT PORTAGE, MI 49002			

Drilling Method: Jetted	Pump Installed: No						
Well Depth: 98.00 ft.	Well Use: Household	Pressure Tank Installed: No					
Well Type: Replacement	Date Completed: 3/1/1972	Pressure Relief Valve Installed: No					
Casing Type: Steel - black	Height:						
Casing Joint: Threaded & coupled							
Casing Fitting: Drive shoe							
Diameter: 2.00 in. to 0.00 ft. depth							
Borehole:							
Static Water Level: 70.00 ft. Below Grade	Formation Description			Thickness	Depth to Bottom		
Well Yield Test:	Yield Test Method: Unknown	Sand & Gravel		30.00	30.00		
		Clay		4.00	34.00		
		Sand		16.00	50.00		
Screen Installed: Yes	Filter Packed: No	Clay		10.00	60.00		
Screen Diameter: 1.25 in.	Blank: 1.00 ft. Above	Sand		38.00	98.00		
Screen Material Type:							
Slot Length	Set Between						
10.00 4.00 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: Other, 12 inches above grade	Geology Remarks:						
Nearest Source of Possible Contamination:	Drilling Machine Operator Name:						
Type	Distance	Direction	Employment: Unknown				
Unknown	0 ft.						
Abandoned Well Plugged: No	Contractor Type: Unknown Reg No:						
Reason Not Plugged:	Business Name:						
	Business Address:						
<b>Water Well Contractor's Certification</b>							
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							



# Water Well And Pump Record

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



Import ID: 39711136155

Failure to comply is a misdemeanor.

Tax No:	Permit No:	County: Kalamazoo	Township: Cooper			
Well ID: 39000002683		Town/Range: 01S 11W	Section: 36	Well Status:	WSSN:	
		Distance and Direction from Road Intersection:				Source ID/Well No:
		Well Owner: ANGEL, LEROY				
Well Address: 5169 MOUNT OLIVET KALAMAZOO, MI 49004		Owner Address: 5169 MOUNT OLIVET KALAMAZOO, MI 49004				

Drilling Method: Rotary	Well Use: Household	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 80.00 ft.	Date Completed: 9/20/1994	Pump Installation Date:	HP:	
Well Type: Replacement		Manufacturer: F.E. Myers	Pump Type: Submersible	
Casing Type: PVC plastic	Height:	Model Number:	Pump Capacity: 0 GPM	
Casing Joint: Welded		Drop Pipe Length: 65.00 ft.	Pump Voltage:	
Casing Fitting: None		Drop Pipe Diameter:	Drilling Record ID:	
Diameter: 5.00 in. to 75.00 ft. depth		Draw Down Seal Used: No		
Borehole: 8.00 in. to 80.00 ft. depth		Pressure Tank Installed: No		
Static Water Level: 43.00 ft. Below Grade		Pressure Relief Valve Installed: No		
Well Yield Test: Pumping level 80.00 ft. after 3.00 hrs. at 30 GPM	Yield Test Method: Unknown	Formation Description	Thickness	Depth to Bottom
		Sand & Gravel	19.00	19.00
		Brown Clay	5.00	24.00
		Sand & Gravel	21.00	45.00
Screen Installed: Yes	Filter Packed: No	Brown Clay	6.00	51.00
Screen Diameter: 3.00 in.	Blank: 0.00 ft. Above	Sand & Gravel Wet/Moist	28.00	79.00
Screen Material Type: Slot	Length	Gray Clay Sand Gravel	30.00	109.00
15.00	5.00 ft.	Red Clay Hard	19.00	128.00
Fittings: None				
Well Grouted: Yes	Grouting Method: Unknown			
Grouting Material	Bags	Additives	Depth	
Other	0.00	None	0.00 ft. to 0.00 ft.	
Wellhead Completion: Pitless adapter		Geology Remarks:		
Nearest Source of Possible Contamination: Type	Distance	Direction	Drilling Machine Operator Name: MIKE SMITH JR.	
Septic tank	79 ft.	West	Employment: Unknown	
Abandoned Well Plugged: Yes			Contractor Type: Unknown	Reg No: 39-0209
			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: Grouting Material 1: Listed as other in Wellkey



# 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:

Tax No:	Permit No:	County: Kalamazoo		Township: Cooper	
Well ID: 39000011572		Town/Range: 01S 11W	Section: 36	Well Status: Active	WSSN:
		Distance and Direction from Road Intersection:			
		Well Owner: PALLETT, SHERRY			
		Well Address: 5077 MOUNT OLIVET KALAMAZOO, MI 49004		Owner Address: 5077 MOUNT OLIVET KALAMAZOO, MI 49004	

Drilling Method: Cable Tool	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 86.00 ft.	Pump Installation Date:	HP: 0.50	
Well Type: Replacement	Manufacturer: F.E. Myers	Pump Type: Submersible	
Casing Type: Steel - black	Model Number:	Pump Capacity: 12 GPM	
Casing Joint: Threaded & coupled	Drop Pipe Length: 63.00 ft.	Pump Voltage:	
Casing Fitting: Drive shoe	Drop Pipe Diameter:	Drilling Record ID:	
Diameter: 4.00 in. to 82.00 ft. depth	Draw Down Seal Used: No		
Borehole:	Pressure Tank Installed: Yes		
	Pressure Tank Type: Unknown		
	Manufacturer: Well-X-Trol		
	Model Number:	Tank Capacity: 50.0 Gallons	
	Pressure Relief Valve Installed: No		
Static Water Level: 45.00 ft. Below Grade	Formation Description		Thickness
Well Yield Test: Yield Test Method: Plunger			Depth to Bottom
Pumping level 45.00 ft. after 1.00 hrs. at 50 GPM	Sand	45.00	45.00
	Sand Water Bearing	15.00	60.00
	Gray Clay	11.00	71.00
Screen Installed: Yes	Sand Water Bearing	15.00	86.00
Screen Diameter: 4.00 in.			
Screen Material Type: Stainless steel-wire wrapped			
Slot Length	Set Between		
10.00	4.00 ft.	82.00 ft. and 86.00 ft.	
Fittings: Neoprene packer			
Well Grouted: Yes	Grouting Method: Unknown		
Grouting Material	Bags	Additives	Depth
Unknown	4.00	Other	0.00 ft. to 82.00 ft.
Wellhead Completion: Pitless adapter	Geology Remarks:		
Nearest Source of Possible Contamination:	Drilling Machine Operator Name: JIM DOORNHAAG		
Type	Distance	Direction	Employment: Employee
Septic tank	70 ft.	West	
Abandoned Well Plugged: Yes	Contractor Type: Water Well Drilling Contractor Reg No: 08-1771		
	Business Name: DOPP		
	Business Address:		
Casing Removed:	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.



Import ID: 39711135015

Failure to comply is a misdemeanor.

Tax No:	Permit No:	County: Kalamazoo	Township: Cooper			
Well ID: 39000002429		Town/Range: 01S 11W	Section: 35	Well Status:	WSSN:	
		Distance and Direction from Road Intersection: 400' N OF BRACKETT & 150' E OF RIVERVIEW				Source ID/Well No:
		Well Owner: DON AIRE 5496 RIVERVIEW KALAMAZOO, MI 49004			Well Address: 5496 RIVERVIEW KALAMAZOO, MI 49004	
Owner Address:						

Drilling Method: Cable Tool	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 45.00 ft.	Pump Installation Date:	HP:	
Well Type: Replacement	Manufacturer: Flint & Walling	Pump Type: Submersible	
Casing Type: Steel - black	Model Number:	Pump Capacity: 0 GPM	
Casing Joint: Threaded & coupled	Drop Pipe Length: 30.00 ft.	Pump Voltage:	
Casing Fitting: Drive shoe	Drop Pipe Diameter:	Drilling Record ID:	
Diameter: 4.00 in. to 40.00 ft. depth	Draw Down Seal Used: No		
Borehole:	Pressure Tank Installed: No		
Static Water Level: 20.00 ft. Below Grade	Pressure Relief Valve Installed: No		
Well Yield Test: Yield Test Method: Unknown	Formation Description	Thickness	Depth to Bottom
Pumping level 3.00 ft. after 1.00 hrs. at 30 GPM	Gravel & Clay	21.00	21.00
	Gravel Wet/Moist	24.00	45.00
Screen Installed: Yes			
Screen Diameter: 3.00 in.	Filter Packed: No		
Screen Material Type:	Blank: 1.00 ft. Above		
Slot Length	Set Between		
10.00 5.00 ft.	40.00 ft. and 45.00 ft.		
Fittings: Neoprene packer			
Well Grouted: Yes	Grouting Method: Unknown		
Grouting Material	Bags	Additives	Depth
Bentonite slurry	0.00	None	0.00 ft. to 0.00 ft.
Geology Remarks:			
Wellhead Completion: Pitless adapter			
Nearest Source of Possible Contamination:	Drilling Machine Operator Name:		
Type	Distance	Direction	Employment: Unknown
Septic tank	100 ft.	North	
Abandoned Well Plugged: Yes	Contractor Type: Unknown Reg No: 39-1288		
	Business Name:		
	Business Address:		
Casing Removed:	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:

Tax No:	Permit No:	County: Kalamazoo		Township: Cooper	
Well ID: 39000012447		Town/Range:	Section:	Well Status:	WSSN:
		01S 11W	35	Active	
Distance and Direction from Road Intersection:					
Well Owner: ALTERNATIVES OF KALAMAZOO					
Well Address: 5640 RIVERVIEW KALAMAZOO, MI 49004			Owner Address: 435 WHITCOMB KALAMAZOO, MI 49001		

Drilling Method: Cable Tool	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 44.00 ft.	Pump Installation Date:	HP: 1.00	
Well Type: New	Manufacturer: Sta-Rite	Pump Type: Submersible	
Casing Type: Steel - black	Model Number:	Pump Capacity: 20 GPM	
Casing Joint: Threaded & coupled	Drop Pipe Length: 30.00 ft.	Pump Voltage:	
Casing Fitting: Drive shoe	Drop Pipe Diameter:	Drilling Record ID:	
Diameter: 4.00 in. to 38.00 ft. depth	Draw Down Seal Used: No		
Borehole: 4.00 in. to 44.00 ft. depth	Pressure Tank Installed: Yes		
Static Water Level: 24.00 ft. Below Grade	Pressure Tank Type: Unknown		
Well Yield Test: Yield Test Method: Plunger	Manufacturer: Well-Mate		
Pumping level 24.00 ft. after 1.00 hrs. at 40 GPM	Model Number:	Tank Capacity:	
Screen Installed: Yes	Pressure Relief Valve Installed: No		
Screen Diameter: 4.00 in.	Formation Description	Thickness	Depth to Bottom
Screen Material Type: Stainless steel-slotted	Sand Dry	24.00	24.00
Slot Length	Sand Coarse Wet/Moist	18.00	42.00
12.00 6.00 ft.	Gravel	2.00	44.00
Fittings: Neoprene packer	Gray Clay & Gravel Hard	56.00	100.00
Well Grouted: Yes			
Grouting Material	Bags	Additives	Depth
Bentonite dry granular	5.00	None	0.00 ft. to 25.00 ft.
Wellhead Completion: Pitless adapter	Geology Remarks:		
Nearest Source of Possible Contamination:	Drilling Machine Operator Name: CHARLIE JR.		
Type	Distance	Direction	Employment: Employee
Septic tank	70 ft.	North	Contractor Type: Water Well Drilling Contractor Reg No: 80-0112
			Business Name: EARL SANDERS
			Business Address:
			<b>Water Well Contractor's Certification</b>
			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:Blank Above Screen



# 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: Cooper	
Well ID: 39000002422		Town/Range:	Section:	Well Status:	WSSN:
		01S 11W	35	Active	
		Distance and Direction from Road Intersection: SW700' N OF G & 100' E OF RIVERVIEW			
Well Owner: SARA COLLISON		Well Address:		Owner Address:	
5152 RIVERVIEW KALAMAZOO, MI 49004		5152 RIVERVIEW KALAMAZOO, MI 49004			
Method of Collection: Interpolation-Map					

<p><b>Drilling Method:</b> Rotary  <b>Well Depth:</b> 97.00 ft.  <b>Well Type:</b> Replacement</p> <p><b>Casing Type:</b> PVC plastic  <b>Casing Joint:</b> Welded  <b>Casing Fitting:</b> Drive shoe</p> <p><b>Diameter:</b> 5.00 in. to 92.00 ft. depth</p> <p><b>Borehole:</b> 8.00 in. to 92.00 ft. depth</p>			<p><b>Pump Installed:</b> No  <b>Pressure Tank Installed:</b> No  <b>Pressure Relief Valve Installed:</b> No</p>																																																										
<p><b>Static Water Level:</b> 28.00 ft. Below Grade  <b>Well Yield Test:</b> Yield Test Method: Unknown  Pumping level 28.00 ft. after 1.00 hrs. at 25 GPM</p> <p><b>Screen Installed:</b> Yes      <b>Filter Packed:</b> No  <b>Screen Diameter:</b> 5.00 in.      <b>Blank:</b> 0.00 ft. Above  <b>Screen Material Type:</b> PVC-slotted  <b>Slot Length:</b> 5.00 ft.      <b>Set Between:</b> 92.00 ft. and 97.00 ft.</p> <p><b>Fittings:</b> None</p>			<table border="1"> <thead> <tr> <th colspan="2">Formation Description</th> <th>Thickness</th> <th>Depth to Bottom</th> </tr> </thead> <tbody> <tr> <td colspan="2">Gravel Sand Clay Stringers</td> <td>10.00</td> <td>10.00</td> </tr> <tr> <td colspan="2">Gravel &amp; Sand</td> <td>33.00</td> <td>43.00</td> </tr> <tr> <td colspan="2">Sand &amp; Clay Brown</td> <td>13.00</td> <td>56.00</td> </tr> <tr> <td colspan="2">Gray Clay</td> <td>36.00</td> <td>92.00</td> </tr> <tr> <td colspan="2">Gravel Water Bearing</td> <td>5.00</td> <td>97.00</td> </tr> <tr> <td colspan="2"></td> <td></td> <td></td> </tr> </tbody> </table>			Formation Description		Thickness	Depth to Bottom	Gravel Sand Clay Stringers		10.00	10.00	Gravel & Sand		33.00	43.00	Sand & Clay Brown		13.00	56.00	Gray Clay		36.00	92.00	Gravel Water Bearing		5.00	97.00																																
Formation Description		Thickness	Depth to Bottom																																																										
Gravel Sand Clay Stringers		10.00	10.00																																																										
Gravel & Sand		33.00	43.00																																																										
Sand & Clay Brown		13.00	56.00																																																										
Gray Clay		36.00	92.00																																																										
Gravel Water Bearing		5.00	97.00																																																										
<p><b>Well Grouted:</b> Yes      <b>Grouting Method:</b> Unknown  <b>Grouting Material:</b> Bentonite slurry      <b>Bags:</b> 0.00      <b>Additives:</b> None      <b>Depth:</b> 0.00 ft. to 92.00 ft.</p> <p><b>Wellhead Completion:</b> 12 inches above grade</p>			<p><b>Geology Remarks:</b></p>																																																										
<p><b>Nearest Source of Possible Contamination:</b>  <b>Type:</b> Septic tank      <b>Distance:</b> 52 ft.      <b>Direction:</b> West</p> <p><b>Abandoned Well Plugged:</b> No  <b>Reason Not Plugged:</b> Unknown</p>			<p><b>Drilling Machine Operator Name:</b> Rich Fry  <b>Employment:</b> Unknown</p> <p><b>Contractor Type:</b> Unknown      <b>Reg No:</b> 13-0393  <b>Business Name:</b> Katz Well Drilling Inc  <b>Business Address:</b></p>																																																										
			<p><b>Water Well Contractor's Certification</b>  This well was drilled under my supervision and this report is true to the best of my knowledge and belief.</p>																																																										
			<b>Signature of Registered Contractor</b>		<b>Date</b>																																																								
<p><b>General Remarks:</b></p> <p><b>Other Remarks:</b></p>																																																													



## Water Well And Pump Record

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

**Wellogic**

Import ID: 39711135024

Tax No:	Permit No:	County: Kalamazoo		Township: Cooper	
		Town/Range:	Section:	Well Status:	WSSN:
01S 11W 35					
Distance and Direction from Road Intersection:					
<b>Well ID:</b> 39000002438 <b>Elevation:</b> 773 ft. <b>Latitude:</b> 42.3373301805 <b>Longitude:</b> -85.5631705031 <b>Method of Collection:</b> Interpolation-Map					
<b>Well Owner:</b> BETTY ROBERTS <b>Well Address:</b> 5305 KEYES PARCHMENT, MI 49004					
<b>Owner Address:</b> 5305 KEYES PARCHMENT, MI 49004					

<b>Drilling Method:</b> Hollow Rod <b>Well Depth:</b> 42.00 ft. <b>Well Type:</b> Replacement		<b>Well Use:</b> Household <b>Date Completed:</b> 4/8/1985		<b>Pump Installed:</b> No <b>Pressure Tank Installed:</b> No <b>Pressure Relief Valve Installed:</b> No	
<b>Casing Type:</b> Steel - black <b>Casing Joint:</b> Threaded & coupled <b>Casing Fitting:</b> Drive shoe  <b>Diameter:</b> 2.00 in. to 42.00 ft. depth					
<b>Borehole:</b>					
<b>Static Water Level:</b> 8.00 ft. Below Grade <b>Well Yield Test:</b> Yield Test Method: Unknown Pumping level 8.00 ft. after 1.00 hrs. at 10 GPM		<b>Formation Description</b>		<b>Thickness</b>	<b>Depth to Bottom</b>
		Sand & Gravel		25.00	25.00
		Clay		11.00	36.00
		Gravel Water Bearing		6.00	42.00
<b>Screen Installed:</b> Yes <b>Screen Diameter:</b> 1.25 in. <b>Screen Material Type:</b> Slot                    Length                    Set Between 10.00            3.00 ft.                    39.00 ft. and 42.00 ft.					
<b>Fittings:</b> Neoprene packer					
<b>Well Grouted:</b> No		<b>Geology Remarks:</b>			
<b>Wellhead Completion:</b> Pitless adapter					
<b>Nearest Source of Possible Contamination:</b> Type                    Distance                    Direction Septic tank            60 ft.                    West		<b>Drilling Machine Operator Name:</b> Employment: Unknown			
<b>Abandoned Well Plugged:</b> No <b>Reason Not Plugged:</b>		<b>Contractor Type:</b> Unknown <b>Reg No.:</b> <b>Business Name:</b> <b>Business Address:</b>			
		<b>Water Well Contractor's Certification</b> This well was drilled under my supervision and this report is true to the best of my knowledge and belief.			
		<b>Signature of Registered Contractor</b>		<b>Date</b>	
<b>General Remarks:</b> <b>Other Remarks:</b>					



# Water Well And Pump Record

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



Import ID: 39711135034

Failure to comply is a misdemeanor.

Tax No:	Permit No:	County: Kalamazoo	Township: Cooper			
Well ID: 39000002448		Town/Range: 01S 11W	Section: 35	Well Status:	WSSN:	
		Distance and Direction from Road Intersection:				Source ID/Well No:
		Well Owner: ROBERT ALFERINK				Well Address: 5334 COLLINGWOOD PARCHMENT, MI 49004
Well Address: 5334 COLLINGWOOD PARCHMENT, MI 49004				Owner Address: 5334 COLLINGWOOD PARCHMENT, MI 49004		
Method of Collection: Interpolation-Map						

Drilling Method: Jetted	Pump Installed: No		
Well Depth: 25.00 ft.	Well Use: Household	Pressure Tank Installed: No	
Well Type: Replacement	Date Completed:	Pressure Relief Valve Installed: No	
Casing Type: Steel - black	Height:		
Casing Joint: Threaded & coupled			
Casing Fitting: Drive shoe			
Diameter: 2.00 in. to 22.00 ft. depth			
Borehole:			
Static Water Level: 10.00 ft. Below Grade	Formation Description		
Well Yield Test: Yield Test Method: Unknown	Thickness		
Sand & Gravel	10.00	10.00	
Clay	3.00	13.00	
Gravel	5.00	18.00	
Screen Installed: Yes	Filter Packed: No	Sand Wet/Moist	25.00
Screen Diameter: 1.25 in.	Blank: 1.00 ft. Above		
Screen Material Type:			
Slot	Length	Set Between	
10.00	3.00 ft.	22.00 ft. and 25.00 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
Sewer line	50 ft.	North	
Abandoned Well Plugged: No	Contractor Type: Unknown Reg No:		
Reason Not Plugged:	Business Name:		
	Business Address:		
<b>Water Well Contractor's Certification</b>			
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: 39711135075

Failure to comply is a misdemeanor.

Tax No:	Permit No:	County: Kalamazoo	Township: Cooper			
Well ID: 39000002489		Town/Range: 01S 11W	Section: 35	Well Status:	WSSN:	
		Distance and Direction from Road Intersection:				Source ID/Well No:
		Well Owner: JOHN MEYER Well Address: 5231 RIVERVIEW PARCHMENT, MI 49004				Owner Address: 5231 RIVERVIEW PARCHMENT, MI 49004

Drilling Method: Jetted	Pump Installed: No			
Well Depth: 30.00 ft.	Well Use: Household	Pressure Tank Installed: No		
Well Type: Replacement	Date Completed: 10/12/1974	Pressure Relief Valve Installed: No		
Casing Type: Steel - black	Height:			
Casing Joint: Threaded & coupled				
Casing Fitting: Drive shoe				
Diameter: 2.00 in. to 25.00 ft. depth				
Borehole:				
Static Water Level: 19.00 ft. Below Grade	Formation Description			Thickness
Well Yield Test: Yield Test Method: Unknown				Depth to Bottom
Pumping level 20.00 ft. after 1.00 hrs. at 15 GPM	Brown Clay & Sand			17.00
Pumping level 20.00 ft. after 1.00 hrs. at 15 GPM	Stones			17.00
	Sand			4.00
				21.00
Screen Installed: Yes	Filter Packed: No			
Screen Diameter: 1.20 in.	Blank: 1.00 ft. Above			
Screen Material Type:				
Slot	Length	Set Between		
70.00	4.00 ft.	26.00 ft. and 30.00 ft.		
Fittings: Neoprene packer				
Well Grouted: No	Geology Remarks:			
Wellhead Completion: Other, 12 inches above grade				
Nearest Source of Possible Contamination:	Drilling Machine Operator Name:			
Type	Distance	Direction	Employment: Unknown	
Septic tank	65 ft.	West		
Abandoned Well Plugged: No	Contractor Type: Unknown Reg No:			
Reason Not Plugged:	Business Name:			
	Business Address:			
<b>Water Well Contractor's Certification</b>				
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				

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## APPENDIX C

### **MDEQ'S PFAS MINIMUM LABORATORY ANALYTE LIST OF COMPOUNDS**

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## PERFLUOROALKYL AND POLYFLUOROALKYL SUBSTANCES (PFAS)

### MINIMUM LABORATORY ANALYTE LIST

Below is the minimum laboratory PFAS analyte list for analysis of deer, drinking water, groundwater, surface water, soil, wastewater effluent, and landfill leachate collected by Michigan's Departments of Environmental Quality (MDEQ), Health and Human Services (MDHHS), Agriculture and Rural Development, and Natural Resources.

This minimum analyte list was developed based on the potential for these chemicals to be found in Michigan, the availability of the chemical standards used for testing, and the ability of available laboratories to test for these PFAS. This list includes PFAS that can be tested for in drinking water using United States Environmental Protection Agency (USEPA) Method 537 Rev.1.1, which is the only method that should be used when analyzing drinking water samples. Other testing methodology may be used to test for PFAS in other media (**not** drinking water). This list is not exhaustive of PFAS in Michigan's environment.

A fish icon (🐟) precedes those compounds that are also currently being tested for in fish tissue.

Analyte Name	Acronym	Fluorinated Carbon Chain Length	Molecular Formula	CAS Number	USEPA Method 537 Rev. 1.1
🐟 Perfluorotetradecanoic acid	PFTeA	C <sub>14</sub>	C <sub>13</sub> F <sub>27</sub> COOH	376-06-7	X
🐟 Perfluorotridecanoic acid	PFTriA	C <sub>13</sub>	C <sub>12</sub> F <sub>25</sub> COOH	72629-94-8	X
🐟 Perfluorododecanoic acid	PFDoA	C <sub>12</sub>	C <sub>11</sub> F <sub>23</sub> COOH	307-55-1	X
🐟 Perfluoroundecanoic acid	PFUnA	C <sub>11</sub>	C <sub>10</sub> F <sub>21</sub> COOH	2058-94-8	X
🐟 Perfluorodecanoic acid	PFDA	C <sub>10</sub>	C <sub>9</sub> F <sub>19</sub> COOH	335-76-2	X
🐟 Perfluorononanoic acid	PFNA	C <sub>9</sub>	C <sub>8</sub> F <sub>17</sub> COOH	375-95-1	X
🐟 Perfluorooctanoic acid	PFOA	C <sub>8</sub>	C <sub>7</sub> F <sub>15</sub> COOH	335-67-1	X
🐟 Perfluoroheptanoic acid	PFHpA	C <sub>7</sub>	C <sub>6</sub> F <sub>13</sub> COOH	375-85-9	X
🐟 Perfluorohexanoic acid	PFHxA	C <sub>6</sub>	C <sub>5</sub> F <sub>11</sub> COOH	307-24-4	X
🐟 Perfluoropentanoic acid	PFPeA	C <sub>5</sub>	C <sub>4</sub> F <sub>9</sub> COOH	2706-90-3	
🐟 Perfluorobutanoic acid	PFBA	C <sub>4</sub>	C <sub>3</sub> F <sub>7</sub> COOH	375-22-4	
🐟 Perfluorodecanesulfonic acid	PFDS	C <sub>10</sub>	C <sub>10</sub> F <sub>21</sub> SO <sub>3</sub> H	335-77-3	
Perfluorononanesulfonic acid	PFNS	C <sub>9</sub>	C <sub>9</sub> F <sub>19</sub> SO <sub>3</sub> H	68259-12-1	
🐟 Perfluorooctanesulfonic acid	PFOS	C <sub>8</sub>	C <sub>8</sub> F <sub>17</sub> SO <sub>3</sub> H	1763-23-1	X
Perfluoroheptanesulfonic acid	PFHpS	C <sub>7</sub>	C <sub>7</sub> F <sub>15</sub> SO <sub>3</sub> H	375-92-8	
🐟 Perfluorohexanesulfonic acid	PFHxS	C <sub>6</sub>	C <sub>6</sub> F <sub>13</sub> SO <sub>3</sub> H	355-46-4	X
Perfluoropentanesulfonic acid	PFPeS	C <sub>5</sub>	C <sub>5</sub> F <sub>11</sub> SO <sub>3</sub> H	2706-91-4	

**Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS)**  
**Minimum Laboratory Analyte List**

Analyte Name	Acronym	Fluorinated Carbon Chain Length	Molecular Formula	CAS Number	USEPA Method 537 Rev. 1.1
Perfluorobutanesulfonic acid	PFBS	C <sub>4</sub> 0MG	C <sub>4</sub> F <sub>9</sub> SO <sub>3</sub> H	375-73-5	X
Perfluorooctanesulfonamide	PFOSA	C <sub>8</sub>	C <sub>8</sub> F <sub>17</sub> SO <sub>2</sub> NH <sub>2</sub>	754-91-6	
Fluorotelomer sulphonic acid 8:2	FtS 8:2	C <sub>8</sub>	C <sub>8</sub> F <sub>17</sub> CH <sub>2</sub> CH <sub>2</sub> SO <sub>3</sub>	39108-34-4	
Fluorotelomer sulphonic acid 6:2	FtS 6:2	C <sub>6</sub>	C <sub>6</sub> F <sub>13</sub> CH <sub>2</sub> CH <sub>2</sub> SO <sub>3</sub>	27619-97-2	
Fluorotelomer sulphonic acid 4:2	FtS 4:2	C <sub>4</sub>	C <sub>4</sub> F <sub>9</sub> CH <sub>2</sub> CH <sub>2</sub> SO <sub>3</sub>	757124-72-4	
2-(N-Ethylperfluorooctanesulfonamido) acetic acid	N-EtFOSAA	C <sub>8</sub>	C <sub>8</sub> F <sub>17</sub> SO <sub>2</sub> N(C <sub>2</sub> H <sub>5</sub> )CH <sub>2</sub> COOH	2991-50-6	X
2-(N-Methylperfluorooctanesulfonamido) acetic acid	N-MeFOSAA	C <sub>8</sub>	C <sub>8</sub> F <sub>17</sub> SO <sub>2</sub> N(CH <sub>3</sub> )CHCOOH	2355-31-9	X

## Laboratories Providing PFAS Analytical Services

*(The provision of the following links does not constitute an endorsement of the firms that may be identified by those links, nor is it a statement against any firm not on the lists generated. Additionally, the capacity of any identified laboratories to provide services consistent with the MDEQ recommendations above has not been verified and these details should be addressed prior to contracting with any laboratory.)*

- The **U.S. Environmental Protection Agency (US EPA)** has a list of laboratories approved under the UCMR3 program using US EPA Method 537 Rev. 1.1 for PFAS in drinking water: [www.epa.gov/dwucmr/third-unregulated-contaminant-monitoring-rule](http://www.epa.gov/dwucmr/third-unregulated-contaminant-monitoring-rule)
- The **U.S. Department of Defense, Environmental Laboratory Accreditation Program (US DoD ELAP)** maintains a list of labs for the determination of PFAS in various environmental media other than drinking water on the Defense Environmental Network Information Exchange (DENIX) server: [www.denix.osd.mil/edgw/accreditation/accreditedlabs/](http://www.denix.osd.mil/edgw/accreditation/accreditedlabs/)

## Contact Information

Questions regarding PFAS in general, contact:

- **MDHHS Toxics and Health Hotline:**  
800-648-6942
- **MDEQ Environmental Assistance Center**  
800-662-9278

Questions regarding laboratory information, contact:

- **MDHHS Toxics and Health Hotline:**  
800-648-6942
- **MDEQ Drinking Water Analysis Laboratory**  
517-335-8184

January 3, 2019

Mr. David Harn  
Michigan Department of Environmental Quality  
Remediation and Redevelopment Division  
Kalamazoo District Office  
7953 Adobe Road  
Kalamazoo, Michigan 49009

**RE: Hydrogeologic Investigation Work Plan Addendum**

Dear Mr. Harn:

Tetra Tech Inc. (Tetra Tech) on behalf of Georgia-Pacific (GP), is providing this Hydrogeological Investigation Work Plan Addendum (Addendum) to document the proposed supplemental investigation in portions of Kalamazoo Township and Cooper Township, east of the Kalamazoo River, and the City of Parchment (Study Area). The location of the Study Area is provided in Figure 1.

The purpose of this Addendum is to describe additional tasks that will be completed to further the evaluation of per- and poly- fluoroalkyl substances (PFAS) detected in samples collected from municipal, residential and monitoring wells within the Study Area. This Addendum includes a summary of hydrogeological investigation activities that have been completed to date, and supplementary investigation work that is proposed.

**HYDROGEOLOGIC INVESTIGATION RESULTS**

Hydrogeological investigation activities that have been completed in general accordance with the Michigan Department of Environmental Quality (MDEQ) approved Hydrogeologic Investigation Work Plan (Work Plan), Tetra Tech, October 19, 2019, include:

- Installation of 15 monitoring wells at locations depicted in Figure 2 and described in Table 1. Three planned monitoring wells (MW1802B, MW1802C and MW1809B) were not installed due to the observed geology. At the location of MW1802A, the water table aquifer was the only identified aquifer within the maximum depth of the soil boring, 150 feet. At the location of MW1809A and MW1809C, the water table aquifer and a deeper aquifer were observed. Since a third aquifer was not identified within the maximum depth of the soil boring, 150 feet, installation of a third well, MW1809B was deemed unnecessary.
- Collection of groundwater samples from 10 monitoring wells depicted in Figure 2 and described in Table 2. The remaining groundwater samples will be collected in January 2019.
- Collection of six surface water samples at locations depicted in Figure 2 and described in Table 3. The remaining surface water samples will be collected upon the receipt of property access agreements.

Groundwater and surface water samples, and associated quality assurance and quality control samples, were submitted to Vista Laboratories for analysis of the MDEQ's PFAS Minimum Laboratory Analyte List of compounds provided in the Work Plan. At the time of this Addendum, laboratory results were pending.

Mr. David Harn  
January 3, 2019

## SUPPLEMENTAL INVESTIGATION SCOPE OF WORK

This section describes the scope of work that will be completed to further the evaluation of PFAS that have been detected in the Study Area. All work will be conducted in general accordance with Section 3, Investigation Methodology, of the Work Plan. The scope of work described in this Addendum, was developed in concert with the MDEQ to focus on:

- Groundwater quality evaluation in the southern extent of where PFAS impacts have been identified.
- Depths of impacts where relatively higher concentrations of PFAS were detected (MW1919 on Figure 2).
- Groundwater quality evaluation near MDEQ identified potential source areas (MW1915 and MW1920 on Figure 2).

The scope of work includes:

- The installation of 12 monitoring wells at 10 locations.
- Collection of groundwater samples from the newly installed monitoring wells.
- Collection of one additional surface water samples from the study area.

The location of the monitoring wells and surface water sample are depicted in Figure 2. After monitoring well installation and development activities have been completed, groundwater samples will be collected from each of the Phase II monitoring wells using field methods described in EPA Ground Water Issue number EPA/540/S-95/50, Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures, by Robert W. Puls and Michael J. Barcelona. Groundwater samples will be shipped to Vista Analytical Laboratory in Eldorado Hills, California (Vista), and analyzed for PFAS using Modified EPA Method 537. Table 5 provides a sampling and analysis plan for the groundwater sampling event.

A surface water sample will be collected from one location on the former wastewater treatment facility property located west of the former mill property and south of G Avenue. The surface water sample will be shipped to Vista and analyzed for PFAS using Modified EPA Method 537. Table 6 provides a sampling and analysis plan for the surface water sampling event.

Groundwater and surface water data collected during the Work Plan and Addendum implementation will be evaluated to understand the direction of groundwater flow and extent (and potential sources) of PFAS impacts within the study area. Additional investigation may be proposed, if warranted, to further delineate PFAS impacts.

A Technical Memorandum will be prepared following review of data collected pursuant to the Work Plan and Addendum. The Technical Memorandum will provide a summary of field activities performed that will include soil boring logs and well installation details. Groundwater and surface water sampling results will be summarized in table format and on an updated site-area concentration map. Laboratory reports and data verification/validation reports will be included as attachments and figures consisting of geologic cross sections, surveyed well locations and a potentiometric surface map will be provided. The technical memorandum will also include scopes of work for a subsequent phase of investigation which would include additional monitoring well installations to complete horizontal and vertical delineation of impacts, if needed. The scopes of work will reference methods and controls prescribed in Section 3.0 of the Work Plan.

Sincerely,



Lesa A. Sweet, CHMM, CPG  
Principal Hydrogeologist

Mr. David Harn  
January 3, 2019

Attachments:

Figure 1 Site Location Map

Figure 2 Proposed Sample Location Map

Table 1 Completed Monitoring Well Description

Table 2 Completed Monitoring Well Sampling Event

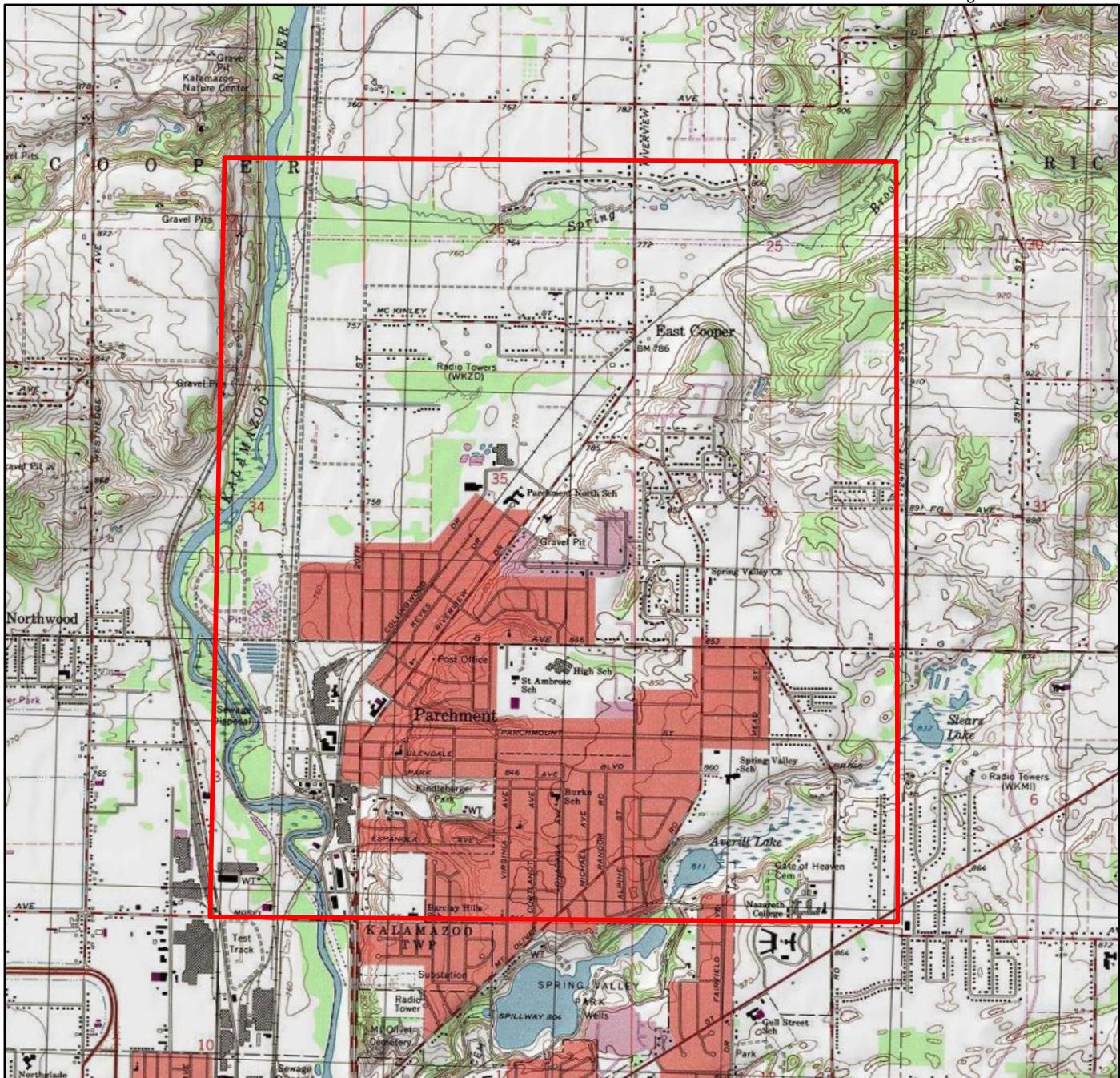
Table 3 Completed Surface Water Sampling Event

Table 4 Proposed Location Description

Table 5 Sampling and Analysis Plan – Monitoring Well Sampling Event

Table 6 Sampling and Analysis Plan – Surface Water Sampling Event

Attachment I – Area Well Logs



BASE MAP: Copyright © 2013 National Geographic Society, i-cubed

### Legend

Study Area



0 1,500 3,000 6,000  
Feet

Parchment, Michigan



Kalamazoo County, Michigan

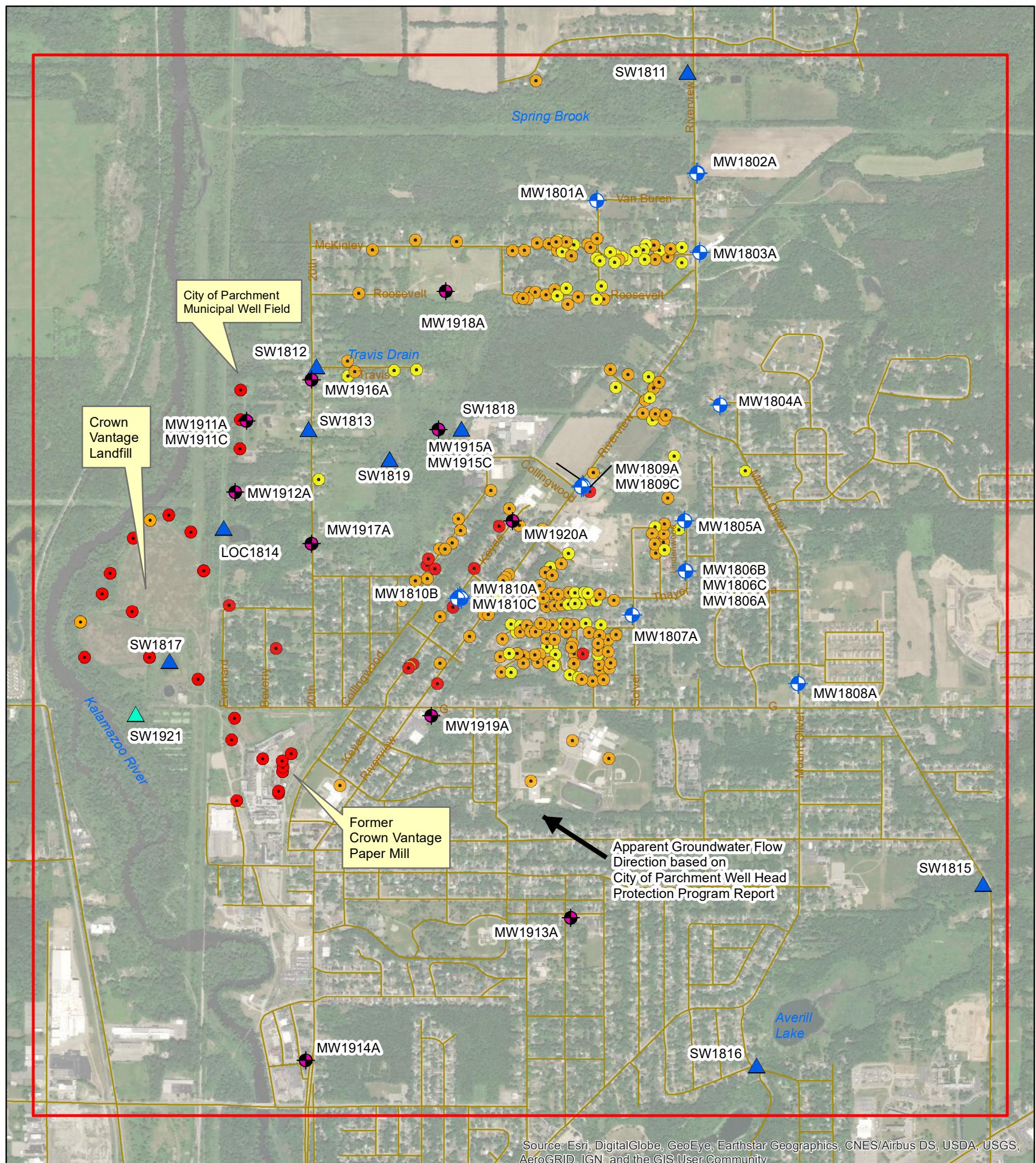


ORIGINAL BY: J. MCFETERS
DATE: 10/12/2018
REVISED BY: L. SWEET
DATE: 10/19/2018

HYDROGEOLOGICAL INVESTIGATION  
WORK PLAN ADDENDUM  
GEORGIA-PACIFIC  
PARCHMENT, MICHIGAN  
LOCATION MAP

FIGURE

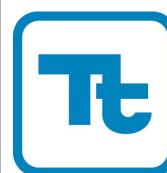
1



#### Sample Locations with PFOA plus PFOS Results

- Non-Detect
- >1-70 ng/L
- >70 ng/L

0 1,000 2,000 4,000  
Feet



ORIGINAL BY: J. MCFETERS  
DATE: 10/12/2018  
REVISED BY: J. DEMOSS  
DATE: 1/3/2019

#### HYDROGEOLOGICAL INVESTIGATION WORK PLAN ADDENDUM GEORGIA-PACIFIC PARCHMENT, MICHIGAN PROPOSED SAMPLE LOCATION MAP

FIGURE  
2

## Hydrogeologic Investigation Work Plan

Georgia-Pacific

Parchment, Michigan

TABLE 1

## COMPLETED MONITORING WELL DESCRIPTION

Soil Boring/ Monitoring Well	Soil Boring Depth (feet)	Monitoring Well Depth (feet)	Depth to Water (feet)/Date	Generalized Soil Boring Information
SB1801A/MW1801A	40	33	10.67 12/13/18	Sand and gravel layers were noted from the surface to an approximate depth of 33 feet where silt and then clay was observed to the terminus of the soil boring at 40 feet. Monitoring well MW1801A was installed with a well screen from 23 to 33 feet below surface grade (bsg).
SB1802A/MW1802A	150	22	3.44 12/13/18	Sand and gravel layers were noted from the surface to an approximate depth of 52 feet where clay was observed to the terminus of the soil boring at 150 feet. Monitoring well MW1802A was installed with a well screen from 11 to 22 feet bsg.
SB1803A/MW1803A	50	30	16.83 12/13/18	Sand and gravel layers were noted from the surface to an approximate depth of 46 feet where clay and silt was observed to the terminus of the soil boring at 50 feet. Monitoring well MW1802A was installed with a well screen from 20 to 30 feet bsg.
SB1804A/MW1804A	86	80	62.16 12/12/18	Sand and gravel layers were noted from the surface to the terminus of the soil boring at 86 feet. Monitoring well MW1804A was installed with a well screen from 70 to 80 feet bsg.
SB1805A/MW1805A	66	65	54.55 12/11/18	Sand and gravel layers were noted from the surface to the terminus of the soil boring at 66 feet. Monitoring well MW1805A was installed with a well screen from 55 to 65 feet bsg.
SB1806A/MW1806A/ MW1806C	156	A - 63 C - 155	A - 48.18 C - 39.61 12/13/18	Sand with intermittent silt layers was noted from the surface to an approximate depth of 109.5 feet where a 38.5 feet thick clay layer was observed. Beneath the clay layer, sand and gravel layers were noted to a depth of 154.5 feet bsg where clay was encountered to the terminus of the soil boring at 156 feet. Monitoring well MW1806A was installed with a well screen from 53 to 63 feet bsg and monitoring well 1806C was installed with a well screen from 145 to 155 feet bsg.
SB1806B/MW1806B	110	107.5	48.38 12/11/18	Sand with intermittent silt layers was noted from the surface to the terminus of the soil boring at 110 feet. Monitoring well MW1806B was installed with a well screen from 97.5 to 107.5 feet bsg.
SB1807A/MW1807A	115	104	54.45 12/12/18	Sand and gravel layers were noted from the surface to an approximate depth of 111 feet where clay was observed to the terminus of the soil boring at 115 feet. Monitoring well MW1807A was installed with a well screen from 94 to 104 feet bsg.
SB1808A/MW1808A	80	78.6	37.95 12/12/18	Sand with intermittent clay and silt layers was noted from the surface to the terminus of the soil boring at 80 feet. The clay layers were less than 2 feet in thickness and the sand formations above the clay layers were not saturated. Monitoring well MW1808A was installed with a well screen from 68.6 to 78.6 feet bsg.
SB1809A/MW1809A/ MW1809C	154	A - 32 C - 86	A - 20.8* C - 12.8* 12/18/18	Sand and gravel layers were noted from the surface to an approximate depth of 54 feet where a 25 feet thick clay and silt layer was observed. Beneath the clay layer, intermittent sand, silt and clay layers were noted to the terminus of the soil boring at 154 feet. Monitoring well MW1809A was installed with a well screen from 22 to 32 feet bsg and monitoring well 1809C was installed with a well screen from 76 to 86 feet bsg.
SB1810A/MW1810A/ MW1810C	150	A - 20 C - 82	A - 9* C - 6.6* 12/18/18	Sand and gravel with intermittent clay and silt layers were noted from the surface to an approximate depth of 93.5 feet where clay was observed to the terminus of the soil boring at 150 feet. Monitoring well MW1810A was installed with a well screen from 10 to 20 feet bsg and monitoring well 1810C was installed with a well screen from 77 to 82 feet bsg.
SB1810B/MW1810B	75	68	7.7* 12/18/18	Sand and gravel with intermittent clay and silt layers were noted from the surface to the terminus of the soil boring at 75 feet. Monitoring well MW1810B was installed with a well screen from 58 to 68 feet bsg.

\* Pre-well development water levels

1. Nomenclature definitions for SB1801A or B

"SB" = soil boring

"18" = year of installation

"01" = location number

"A" = first soil boring drilled at location

"B" = second soil boring drilled at location

2. Nomenclature definitions for MW1801A, B or C

"MW" = monitoring well

"18" = year of installation

"01" = location number

"A" = shallowest well at location

"B" = intermediate well at location (between shallow and deep)

"C" = deepest well at location

**TABLE 2**  
**COMPLETED MONITORING WELL SAMPLING EVENT**

Sample Type	Sample From	Sample ID	Sample Date
Normal	MW1801A	MW1801A-181213	12/13/2018
Normal	MW1802A	MW1802A-181213	12/13/2018
<i>Normal</i>	<i>MW1802B</i>	<i>well not installed</i>	<i>sample will not be collected</i>
<i>Normal</i>	<i>MW1802C</i>	<i>well not installed</i>	<i>sample will not be collected</i>
Normal	MW1803A	MW1803A-181213	12/13/2018
Normal	MW1804A	MW1804A-181212	12/12/2018
Normal	MW1805A	MW1805A-181211	12/11/2018
Normal	MW1806A	MW1806A-181211	12/11/2018
Normal	MW1806B	MW1806B-181211	12/11/2018
Normal	MW1806C	MW1806C-181213	12/13/2018
Normal	MW1807A	MW1807A-181212	12/12/2018
EB	Reagent-free rinse water	EB1808-181212	12/12/2018
MS/MSD	MW1808A	MS1808A-181212	12/12/2018
Normal	MW1808A	MW1808A-181212	12/12/2018
Duplicate	MW1808A	DUP01-181212	12/12/2018
Normal	MW1809A	MW1809A-YYMMDD	TBD
<i>Normal</i>	<i>MW1809B</i>	<i>well not installed</i>	<i>sample will not be collected</i>
Normal	MW1809C	MW1809C-YYMMDD	TBD
EB	Reagent-free rinse water	EB1810-YYMMDD	TBD
Normal	MW1810A	MW1810A-YYMMDD	TBD
Duplicate	MW1810A	DUP02-YYMMDD	TBD
MS/MSD	MW1810A	MS1810A-YYMMDD	TBD
Normal	MW1810B	MW1810B-YYMMDD	TBD
Normal	MW1810C	MW1810C-YYMMDD	TBD

Quantity by Type	
15	Normal
2	Duplicate
2	Equipment Blank
	Matrix Spike/Matrix Spike
2	Duplicate
21	Total

TBD - To be determined. Samples will be collected in January 2019

Notes:

"LOC" = location  
 Nomenclature for Sample IDs EB1801-YYMMDD,  
 MW1801A-YYMMDD and DUP01-YYMMDD  
 "EB" = equipment blank  
 "MW"= monitoring well  
 "DUP"= duplicate sample  
 "MS/MSD" = Matrix Spike/Matrix Spike Duplicate  
 "18" = year  
 "01" = location number  
 "YY"= last two digits of year of sample collection  
 "MM" = month of sample collection  
 "DD" = day of sample collection

Georgia-Pacific  
Parchment, Michigan

**TABLE 3**  
**COMPLETED SURFACE WATER SAMPLING EVENT**

Sample Type	Sample From	Sample ID	Sample Date
Normal	Surface Water	SW1811-181129	11/29/2018
Duplicate	Surface Water	DUP03-181129	11/29/2018
Normal	Surface Water	SW1812-181129	11/29/2018
Normal	Surface Water	SW1813-181129	11/29/2018
Normal	Surface Water	SW1814-YYMMDD	TBD
EB	Reagent-free rinse water	EB1815-181129	11/29/2018
MS/MSD	Surface Water	MS1815-181129	11/29/2018
Normal	Surface Water	SW1815-181129	11/29/2018
Normal	Surface Water	SW1816-181129	11/29/2018
Normal	Surface Water	SW1817-181129	11/29/2018
Normal	Surface Water	SW1818-YYMMDD	TBD
Normal	Surface Water	SW1819-YYMMDD	TBD

Quantity by Type	
9	Normal
1	Duplicate
1	Equipment Blank
	Matrix Spike/Matrix Spike
1	Duplicate
12	Total

TBD - To be determined. Samples will be collected when property access agreements are obtained

Notes: Nomenclature for Sample IDs EB1801-YYMMDD,  
SW1801A-YYMMDD and DUP01-YYMMDD  
"EB" = equipment blank  
"SW"= surface water sample  
"DUP"= duplicate sample  
"MS/MSD" = Matrix Spike/Matrix Spike Duplicate  
"18" = year  
"01" = location number  
"YY"= last two digits of year of sample collection  
"MM" = month of sample collection  
"DD" = day of sample collection

## Hydrogeologic Investigation Work Plan Addendum

Georgia-Pacific  
Parchment, MichiganTABLE 4  
PROPOSED LOCATION DESCRIPTION

Proposed Monitoring Wells	Estimated Monitoring Well Depth (feet)	Location Rationale	Nearby Residential Well IDs
MW1911A, C	60', 100'	This location was selected by MDEQ. This location is where a relatively high concentration of impact was detected in the municipal well field. Municipal well logs have depths ranging between 58 and 60 feet. In addition to water quality data, this location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the aquifer(s) that may be present. Vertical hydraulic gradients will be calculated using data from shallow and deep wells that are planned for this location.	39000002413 39000002401
MW1912A	60'	This location will be used to evaluate groundwater quality south of the municipal wells. Municipal well logs have depths ranging between 58 and 60 feet. A nearby residential well is installed at a depth of 82 feet. In addition to water quality data, this location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the first encountered aquifer.	39000002412 39000023626
MW1913A	80'	This location will be used to evaluate groundwater quality at the southeastern extent of the study area within the first encountered aquifer and semi-confined aquifers if present. Residential well logs are not available in the area. In addition to water quality data, this location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the first encountered aquifer.	N/A
MW1914A	50'	This location was selected by MDEQ. This location will be used to evaluate groundwater quality in the southern extent of the study area. Residential well logs are not available in the area. This location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the first encountered aquifer.	N/A
MW1915A, C	50', 100'	This location was selected to evaluate groundwater quality in the central portion of the study area, hydraulically upgradient of the municipal well field, where MDEQ has identified a potential source of PFAS. Residential well logs indicate that wells are installed between 30 and 53 feet in the first encountered aquifer and at 93 to 125 feet in a confined aquifer beneath a clay layer that is noted as 63 and 99 feet thick in nearby well logs. In addition to water quality data, this location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the aquifer(s) that may be present. Vertical hydraulic gradients will be calculated using data from shallow and deep wells that are planned for this location.	39000002437 39000002451 39000017106 39000011911 39000023484 39000023564
MW1916A	50'	This location was selected by MDEQ to evaluate groundwater quality east of the municipal well field. Residential well logs have depths ranging from 28 and 44 feet. In addition to water quality data, this location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the first encountered aquifer.	39000002399 39000002400 39000002417 39000023528
MW1917A	50'	This location was selected by MDEQ to evaluate groundwater quality southeast of the municipal well field. A nearby residential well log has a depth of 28 feet. In addition to water quality data, this location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the first encountered aquifer.	39000002444
MW1918A	50'	This location was selected to evaluate groundwater quality north of where MDEQ has identified a potential source of PFAS. Residential well logs indicated that wells are installed between 26 to 125 feet. In addition to water quality data, this location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the first encountered aquifer.	39000002437 39000002215 39000002214 39000023605 39000015963 39000011911 39000023606
MW1919A	50'	This location will be used to evaluate groundwater quality east of where MDEQ has identified a potential source of PFAS. Residential well logs have depths ranging from 42 to 46 feet. In addition to water quality data, this location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the first encountered aquifer.	39000002420 39000002418 39000002419 39000023624
MW1920A	40'	This location was selected by MDEQ to evaluate groundwater quality in the central portion of the study area where MDEQ has identified a potential source of PFAS. Residential well logs have depths ranging from 34.5 to 44 feet. In addition to water quality data, this location will provide groundwater elevation data for the purpose of calculating groundwater flow direction in the first encountered aquifer.	39000002429 39000002443 39000012447

1. Nomenclature definitions for MW1911A, C

"MW" = monitoring well

"19" = year of installation

"01" = location number

"A" = shallowest well at location

"C" = deepest well at location

Georgia-Pacific  
Parchment, Michigan

**TABLE 5****SAMPLING AND ANALYSIS PLAN - MONITORING WELL SAMPLING EVENT**

Sample From	Sample Type	Sample ID
MW1911A	Normal	MW1911A-YYMMDD
MW1911A	Duplicate	DUP01-YYMMDD
MW1911A	MS/MSD	MS1911A-YYMMDD
MW1911C	Normal	MW1911C-YYMMDD
Reagent-free rinse water	EB	EB1911A-YYMMDD
MW1912A	Normal	MW1912A-YYMMDD
MW1913A	Normal	MW1913A-YYMMDD
MW1914A	Normal	MW1914A-YYMMDD
MW1915A	Normal	MW1915A-YYMMDD
MW1915C	Normal	MW1915C-YYMMDD
MW1916A	Normal	MW1916A-YYMMDD
MW1917A	Normal	MW1917A-YYMMDD
MW1918A	Normal	MW1918A-YYMMDD
MW1918A	Duplicate	DUP02-YYMMDD
Reagent-free rinse water	EB	EB1918A-YYMMDD
MW1919A	Normal	MW1919A-YYMMDD
MW1920A	Normal	MW1920A-YYMMDD

Normal	12
Duplicate	2
Equipment Blank	2
Matrix Spike/Matrix Spike	
Duplicate	1
Total	17

Notes: Nomenclature for Sample IDs EB1911-YYMMDD,

MW1911A-YYMMDD and DUP01-YYMMDD

"EB" = equipment blank

"MW" = monitoring well

"DUP" = duplicate sample

"MS/MSD" = Matrix Spike/Matrix Spike Duplicate

"19" = year

"11" = location number

"YY" = last two digits of year of sample collection

"MM" = month of sample collection

"DD" = day of sample collection

**TABLE 6****SAMPLING AND ANALYSIS PLAN - SURFACE WATER SAMPLING EVENT**

Sample From	Sample Type	Sample ID
SW1921	Normal	SW1921-YYMMDD
Reagent-free rinse water	EB	EB1921-YYMMDD
SW1921	Duplicate	DUP03-YYMMDD
SW1921	MS/MSD	MS1921-YYMMDD

Normal	1
Duplicate	1
Equipment Blank	1
Matrix Spike/Matrix Spike	
Duplicate	1
Total	4

Notes: Nomenclature for Sample IDs EB1921-YYMMDD,

SW1921-YYMMDD and DUP03-YYMMDD

"EB" = equipment blank

"SW" = surface water sample location

"DUP" = duplicate sample

"MS/MSD" = Matrix Spike/Matrix Spike Duplicate

"19" = year

"21" = location number

"YY" = last two digits of year of sample collection

"MM" = month of sample collection

"DD" = day of sample collection

**ATTACHMENT I**  
**AREA WELL LOGS**



# 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: 39711134302

Tax No:	Permit No:	County: Kalamazoo	Township: Cooper		
Well ID: 39000002413		Town/Range: 01S 11W	Section: 34	Well Status: Active	WSSN: 5200
Distance and Direction from Road Intersection: WSSN# 05200; 400' NORTH OF CITY WELL #1					
Well Owner: PARCHMENT					
Well Address: PARCHMENT WELL #2 PARCHMENT, MI		Owner Address: PARCHMENT, MI			

Drilling Method: Rotary	Pump Installed: No			
Well Depth: 58.00 ft.	Pressure Tank Installed: No			
Well Type: New	Pressure Relief Valve Installed: No			
Casing Type: Unknown	Height: 0.00 ft. below grade			
Casing Joint: Unknown				
Casing Fitting: None				
Diameter: 34.00 in. to 28.00 ft. depth				
Borehole:				
Static Water Level: 8.00 ft. Below Grade	Formation Description	Thickness	Depth to Bottom	
Well Yield Test: Yield Test Method: Unknown	Lithology Unknown Fill	7.00	7.00	
Pumping level 0.00 ft. after 0.00 hrs. at 1640 GPM	Topsoil	1.00	8.00	
	Sand & Gravel Coarse	15.00	23.00	
Screen Installed: Yes	Sand Fine	2.00	25.00	
Screen Diameter: 12.00 in.	Clay	3.00	28.00	
Screen Material Type: Blank: 0.00 ft. Above	Sand & Gravel Coarse	3.00	31.00	
Slot Length	Clay	7.00	38.00	
15.00 15.00 ft.	Sand & Gravel Coarse	22.00	60.00	
Fittings: None				
Well Grouted: Yes Grouting Method: Unknown				
Grouting Material Bags Additives Depth				
Unknown 0.00 None 0.00 ft. to 0.00 ft.	Geology Remarks:			
Wellhead Completion: Unknown				
Nearest Source of Possible Contamination: Type	Drilling Machine Operator Name:			
Unknown	Employment: Unknown			
Distance 0 ft.	Contractor Type: Unknown Reg No:			
Direction	Business Name:			
	Business Address:			
	<b>Water Well Contractor's Certification</b>			
	This well was drilled under my supervision and this report is true to the best of my knowledge and belief.			
	<b>Signature of Registered Contractor</b> <b>Date</b>			

General Remarks: LIMITED WELL LOG PROVIDED; DRILLERS STOPPED IN HARD SANDY CLAY; SCREEN TYPE LISTED AS EVERDUR LAYNE SHUTTER;

Other Remarks:



Import ID: 39711134004

# Water Well And Pump Record

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

Failure to comply is a misdemeanor.

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Tax No:	Permit No:	County: Kalamazoo	Township: Cooper	
Well ID: 39000002401		Town/Range: 01S 11W	Section: 34	Well Status:
		Distance and Direction from Road Intersection:		
		Well Owner: CITY OF PARCHMENT		
Latitude: 42.3444227253		Well Address: 20TH STREET NORTH	Owner Address: 20TH STREET NORTH	
Longitude: -85.5742567211		KALAMAZOO, MI 49007	KALAMAZOO, MI 49007	
Method of Collection: Interpolation-Map				

Drilling Method: Other	Well Depth: 58.00 ft.	Well Use: Other	Pump Installed: Yes	Pump Installation Only: No
Well Type: Replacement	Date Completed: 4/11/1973		Pump Installation Date:	HP:
Casing Type: Steel - black	Height: 2.00 ft. above grade	Manufacturer: Other	Pump Type: Unknown	Pump Capacity: 0 GPM
Casing Joint: Threaded & coupled		Model Number:	Pump Voltage:	Drilling Record ID:
Casing Fitting: None		Drop Pipe Length: 0.00 ft.		
Diameter: 34.00 in. to 38.00 ft. depth		Drop Pipe Diameter:		
Borehole:		Draw Down Seal Used: No		
Static Water Level: 8.00 ft. Below Grade			Pressure Tank Installed: No	
Well Yield Test: Pumping level 14.00 ft. after 24.00 hrs. at 1000 GPM	Yield Test Method: Unknown		Pressure Relief Valve Installed: No	
Screen Installed: Yes	Filter Packed: No	Formation Description	Thickness	Depth to Bottom
Screen Diameter: 11.75 in.	Blank: 1.00 ft. Above	Lithology Unknown Fill	7.00	7.00
Screen Material Type: Slot	Length	Clay	2.00	9.00
50.00	15.00 ft.	Sand & Gravel Coarse	13.00	22.00
Fittings: Neoprene packer		Clay	10.00	32.00
		Sand & Gravel Coarse	26.00	58.00
Well Grouted: Yes	Grouting Method: Unknown			
Grouting Material	Bags	Additives	Geology Remarks:	
Neat cement	0.00	None		
Distance	Depth			
0.00 ft. to 38.00 ft.				
Wellhead Completion: Other, 12 inches above grade				
Nearest Source of Possible Contamination: Type	Distance	Direction	Drilling Machine Operator Name:	
Unknown	0 ft.		Employment: Unknown	
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: Well Use:Public Well Type Unknown, Drilling Method:Drilling Method unknown, Wellhead Completion:12 inch Above Grade, Pump Manufacturer:PEERLESS				



Import ID: 39711134301

# Water Well And Pump Record

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

Failure to comply is a misdemeanor.

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Tax No:	Permit No:	County: Kalamazoo		Township: Cooper	
Well ID: 39000002412		Town/Range: 01S 11W	Section: 34	Well Status: Active	WSSN: 5200
Distance and Direction from Road Intersection: WSSN# 05200; 900' WEST 20TH ST & 800' E OF KAZOO RIVER					Source ID/Well No: WELL 1
Well Owner: PARCHMENT					Well Address:
PARCHMENT WELL #1 PARCHMENT, MI		Owner Address:		PARCHMENT, MI	

Drilling Method: Cable Tool	Pump Installed: No		
Well Depth: 60.00 ft.	Pressure Tank Installed: No		
Well Type: Replacement	Pressure Relief Valve Installed: No		
Casing Type: Unknown	Formation Description	Thickness	Depth to Bottom
Casing Joint: Unknown	Topsoil	1.00	1.00
Casing Fitting: None	Clay Gravely	2.00	3.00
Diameter: 8.00 in. to 0.00 ft. depth	Sand & Gravel	15.00	18.00
Borehole:	Clay Silty	14.00	32.00
Static Water Level: 3.00 ft. Below Grade	Sand & Gravel Gray	26.00	58.00
Well Yield Test: Unknown	Clay	2.00	60.00
Yield Test Method: Unknown			
Screen Installed: No			
Intake: Unknown			
Well Grouted: Yes	Geology Remarks:		
Grouting Material	Grouting Method: Unknown		
Unknown	Bags	Additives	Depth
	0.00	None	0.00 ft. to 0.00 ft.
Wellhead Completion: Unknown	Drilling Machine Operator Name:		
	Employment: Unknown		
Nearest Source of Possible Contamination:	Contractor Type: Unknown	Reg No:	
Type	Business Name:		
Unknown	Business Address:		
Abandoned Well Plugged: No	Water Well Contractor's Certification		
Reason Not Plugged:	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: LIMITED INFORMATION ON WELL LOG;			
Other Remarks:			



Import ID: 39711135023

# Water Well And Pump Record

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

Failure to comply is a misdemeanor.

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Tax No:	Permit No:	County: Kalamazoo		Township: Cooper	
Well ID: 39000002437		Town/Range:	Section:	Well Status:	WSSN:
		01S 11W	35		
		Distance and Direction from Road Intersection: 1 MILE W OF RIVERVIEW & 80' S OF TRAVERSE			
Well Owner: RAND RIGGS					
Well Address: 2048 TRAVIS PARCHMENT, MI 49004			Owner Address: 2048 TRAVIS PARCHMENT, MI 49004		

Drilling Method: Rotary	Pump Installed: No				
Well Depth: 182.00 ft.	Pressure Tank Installed: No				
Well Type: Replacement	Pressure Relief Valve Installed: No				
Casing Type: PVC plastic	Height:				
Casing Joint: Threaded & coupled					
Casing Fitting: Drive shoe					
Diameter: 5.00 in. to 131.00 ft. depth					
Borehole: 8.00 in. to 119.00 ft. depth					
Static Water Level: 0.00 ft. Above Grade (Flowing)	Formation Description				
Well Yield Test: Yield Test Method: Unknown	Thickness				
Pumping level 120.00 ft. after 1.00 hrs. at 3 GPM	Depth to Bottom				
Unrestricted Flow Rate:					
Screen Installed: Yes	Shale W/Clay Coldwater Shale 6.00 131.00				
Screen Diameter: 5.00 in.	Shale Water Bearing 51.00 182.00				
Screen Material Type:					
Slot Length					
0.00 3.00 ft.					
Set Between					
119.00 ft. and 122.00 ft.					
Fittings: Neoprene packer					
Well Grouted: Yes	Grouting Method: Unknown				
Grouting Material	Bags	Additives	Depth	Geology Remarks:	
Bentonite slurry	0.00	None	0.00 ft. to 119.00 ft.		
Wellhead Completion: Other, 12 inches above grade					
Nearest Source of Possible Contamination:	Drilling Machine Operator Name:				
Type	Distance	Direction	Employment: Unknown		
Septic tank	150 ft.	South			
Abandoned Well Plugged: Yes	Contractor Type: Unknown Reg No: 13-0393				
Casing Removed:	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: Wellhead Completion: 12 inch Above Grade



Import ID: 39711135037

# Water Well And Pump Record

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

Failure to comply is a misdemeanor.

Page 17 of 39



Tax No:	Permit No:	County: Kalamazoo		Township: Cooper	
Well ID: 39000002451		Town/Range:	Section:	Well Status:	WSSN:
		01S 11W	35		
		Distance and Direction from Road Intersection:			
Elevation: 769 ft.		Well Owner: SANDALICK MACHINE CO.			
Latitude: 42.3419303535		Well Address:		Owner Address:	
Longitude: -85.5619127591		5585 COLLINGWOOD PARCHMENT, MI 49004		5585 COLLINGWOOD PARCHMENT, MI 49004	
Method of Collection: Interpolation-Map					

Drilling Method: Driven Hand	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 30.00 ft.	Pump Installation Date:	HP:	
Well Type: Replacement	Manufacturer: Goulds	Pump Type: Submersible	
Casing Type: Steel - black	Model Number:	Pump Capacity:	
Casing Joint: Threaded & coupled	Drop Pipe Length: 20.00 ft.	Pump Voltage:	
Casing Fitting: Drive shoe	Drop Pipe Diameter:	Drilling Record ID:	
Diameter: 4.00 in. to 26.00 ft. depth	Draw Down Seal Used: No		
Borehole:	Pressure Tank Installed: No		
Static Water Level: 8.00 ft. Below Grade	Pressure Relief Valve Installed: No		
Well Yield Test: Yield Test Method: Unknown	Formation Description	Thickness	Depth to Bottom
	Sand & Gravel	20.00	20.00
	Clay	1.00	21.00
	Gravel	9.00	30.00
Screen Installed: Yes	Filter Packed: No		
Screen Diameter: 0.00 in.	Blank: 1.00 ft. Above		
Screen Material Type:			
Slot	Length	Set Between	
30.00	4.00 ft.	26.00 ft. and 30.00 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	80 ft.	West	
Abandoned Well Plugged: No	Contractor Type: Unknown Reg No:		
Reason Not Plugged:	Business Name:		
	Business Address:		
<b>Water Well Contractor's Certification</b>			
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:

Tax No:	Permit No:	050123	County:	Kalamazoo	Township:	Cooper	
Well ID: 39000017106		Town/Range:	01S 11W	Section:	35	Well Status:	Active
		Distance and Direction from Road Intersection: 1mi north of g-ave. on west side of riverview					
		Well Owner:	tom scheerenberg				
		Well Address:	5797 riverview dr.		Owner Address:	5797 riverview dr. kal., MI 49004	
Method of Collection: QQQ - Centroid							

Drilling Method:	Rotary	Pump Installed:	No
Well Depth:	53.00 ft.	Well Use:	Household
Well Type:	Replacement	Date Completed:	4/5/2005
Casing Type:	PVC plastic	Height:	1.00 ft. above grade
Casing Joint:	Solvent welded/glued		
Casing Fitting:	None		
Diameter:	5.00 in. to 48.00 ft. depth		
Borehole:	9.00 in. to 48.00 ft. depth		
Static Water Level:	12.00 ft. Below Grade		
Well Yield Test:	Yield Test Method: Air 1.00 hrs. at 30 GPM		
Screen Installed:	Yes	Filter Packed:	No
Screen Diameter:	3.00 in.	Blank:	1.00 ft. Above
Screen Material Type:	PVC-saw cut		
Slot	Length	Set Between	
12.00	5.00 ft.	48.00 ft. and 53.00 ft.	
Fittings:	Neoprene packer		
Well Grouted:	Yes	Grouting Method:	Grout pipe outside casing
Grouting Material	Bags	Additives	Depth
Bentonite slurry	2.00	None	0.00 ft. to 48.00 ft.
Wellhead Completion:	12 inches above grade		
Nearest Source of Possible Contamination:			
Type	Distance	Direction	Drilling Machine Operator Name:
Septic tank	50 ft.	East	bob
Employment:	Employee		
Pump Installer:	dan wood co.		
Contractor Type:	Water Well Drilling Contractor	Reg No:	39-1288
Business Name:	American Well Drilling		
Business Address:	8621 East C Ave, Richland, MI, 49083		
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: Coordinate Source:Google well address geocoding			



# 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:**

Tax No:	Permit No:	County: Kalamazoo		Township: Cooper	
Well ID: 39000011911		Town/Range:	Section:	Well Status:	WSSN:
		01S 11W	35	Active	Source ID/Well No:
Distance and Direction from Road Intersection:					
<b>Elevation:</b> Latitude: 42.345432 Longitude: -85.558379 <b>Method of Collection:</b> QQQ - Centroid					
<b>Well Owner:</b> CELLUNETT, CENTURY <b>Well Address:</b> 5928 TRAVIS KALAMAZOO, MI 49004					
<b>Owner Address:</b> 5928 TRAVIS KALAMAZOO, MI 49004					

<b>Drilling Method:</b> Rotary <b>Well Depth:</b> 52.00 ft. <b>Well Type:</b> New		<b>Well Use:</b> Household <b>Date Completed:</b> 2/4/1998		<b>Pump Installed:</b> Yes <b>Pump Installation Date:</b> <b>Manufacturer:</b> A.Y. McDonald <b>Model Number:</b> <b>Drop Pipe Length:</b> 38.00 ft. <b>Drop Pipe Diameter:</b> <b>Draw Down Seal Used:</b> No	<b>Pump Installation Only:</b> No <b>HP:</b> 0.50 <b>Pump Type:</b> Submersible <b>Pump Capacity:</b> 10 GPM <b>Pump Voltage:</b> <b>Drilling Record ID:</b>
<b>Casing Type:</b> PVC plastic <b>Casing Joint:</b> Solvent welded/glued <b>Casing Fitting:</b> Shale packer/trap		<b>Height:</b>			
<b>Diameter:</b> 5.00 in. to 47.00 ft. depth				<b>Pressure Tank Installed:</b> Yes <b>Pressure Tank Type:</b> Unknown <b>Manufacturer:</b> Other <b>Model Number:</b> <b>Tank Capacity:</b> 5.0 Gallons <b>Pressure Relief Valve Installed:</b> No	
<b>Borehole:</b> 8.00 in. to 47.00 ft. depth					
<b>Static Water Level:</b> 26.00 ft. Below Grade <b>Well Yield Test:</b> <b>Yield Test Method:</b> Air Pumping level 45.00 ft. after 1.00 hrs. at 6 GPM				<b>Formation Description</b>	<b>Thickness</b>
				Gravel & Sand Coarse	24.00
				Gray Clay Soft	12.00
				Gravel	2.00
				Gray Clay	1.00
				Sand	8.00
				Sand Water Bearing	5.00
<b>Fittings:</b> Neoprene packer					
<b>Well Grouted:</b> Yes <b>Grouting Method:</b> Unknown <b>Grouting Material</b> <b>Bags</b> <b>Additives</b> <b>Depth</b> Unknown      0.00      Other      0.00 ft. to 47.00 ft.				<b>Geology Remarks:</b>	
<b>Wellhead Completion:</b> 12 inches above grade					
<b>Nearest Source of Possible Contamination:</b> <b>Type</b> <b>Distance</b> <b>Direction</b> Septic tank      90 ft.      West				<b>Drilling Machine Operator Name:</b> RICK FREY <b>Employment:</b> Employee  <b>Contractor Type:</b> Water Well Drilling Contractor <b>Reg No:</b> 13-1593 <b>Business Name:</b> KATZ <b>Business Address:</b>	
				<b>Water Well Contractor's Certification</b> This well was drilled under my supervision and this report is true to the best of my knowledge and belief.	
				<b>Signature of Registered Contractor</b>	<b>Date</b>
<b>General Remarks:</b>					

### General Remarks:

**Other Remarks:** Grouting Additive 1:Bentonite, Tank Manufacturer:MYERS, 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:

Tax No:	Permit No:	County: Kalamazoo	Township: Cooper		
Well ID: 39000023484		Town/Range: 01S 11W	Section: 26	Well Status: Active	WSSN:
Distance and Direction from Road Intersection: 1 mile west of Riverview. 80 feet south of Traverse Ave.					
Well Owner: Rand Riggs					
Well Address: 2048 Traverse Ave Kalamazoo, MI 49004		Owner Address: 2048 Traverse Ave Kalamazoo, MI 49004			

Drilling Method: Rotary	Pump Installed: No		
Well Depth: 93.00 ft.	Pressure Tank Installed: No		
Well Type: New	Pressure Relief Valve Installed: No		
Casing Type: PVC plastic	Formation Description	Thickness	Depth to Bottom
Casing Joint: Unknown	Gravel & Sand	20.00	20.00
Casing Fitting: Other	Clay	68.00	88.00
Diameter: 88.00 ft. depth	Gravel Water Bearing	5.00	93.00
Borehole: 8.00 in. to 88.00 ft. depth			
Static Water Level: 36.00 ft. Below Grade			
Well Yield Test: Pumping level 60.00 ft. after 1.00 hrs. at 20 GPM			
Yield Test Method: Unknown			
Screen Installed: Yes			
Screen Diameter: 4.00 in.			
Screen Material Type: PVC-slotted			
Slot Length	Set Between		
15.00	4.00 ft.	88.00 ft. and 93.00 ft.	
Fittings: Neoprene packer			
Well Grouted: Yes	Grouting Method: Unknown		
Grouting Material: Bentonite slurry	Bags: None	Additives: None	Depth: 0.00 ft. to 88.00 ft.
Wellhead Completion: 12 inches above grade	Geology Remarks:		
Nearest Source of Possible Contamination: Type: Septic tank	Distance: 100 ft.	Direction: South	Drilling Machine Operator Name: Employment: Unknown
			Contractor Type: Water Well Drilling Contractor Reg No: 13-0393
			Business Name: Katz Well Drilling Inc
			Business Address:
			<b>Water Well Contractor's Certification</b>
			This well and/or pump installation was performed under my registration.
			Signature of Registered Contractor
			Date
General Remarks: Old Well Plugged			
Other Remarks: Casing Fitting:Formation Packer			



# 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:

Tax No:	Permit No:	County: Kalamazoo		Township: Cooper	
		Town/Range: 01S 11W	Section: 35	Well Status: Active	WSSN:
Distance and Direction from Road Intersection:					
Well Owner: Sandwick Machine Co					
Well Address: 5585 Collingwood Ave Kalamazoo, MI 49004			Owner Address: 5585 Collingwood Ave Kalamazoo, MI 49004		

Drilling Method: Driven Hand	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: ft.	Pump Installation Date:	HP: 0.75	
Well Type: Unknown	Manufacturer: Goulds	Pump Type: Submersible	
Casing Type: Unknown	Date Completed: 1/26/1979	Model Number: 13EM07	Pump Capacity:
Casing Joint: Threaded & coupled		Drop Pipe Length: 20.00 ft.	Pump Voltage: 230
Casing Fitting: Drive shoe		Drop Pipe Diameter:	Drilling Record ID:
Diameter: 4.00 in. to 26.00 ft. depth		Draw Down Seal Used: No	
Borehole:		Pressure Tank Installed: No	
Static Water Level: 8.00 ft. Below Grade		Pressure Relief Valve Installed: No	
Well Yield Test:	Yield Test Method: Unknown	Formation Description	Thickness
		Sand & Gravel	20.00
		Clay	1.00
		Gravel	9.00
Screen Installed: Yes	Filter Packed: No		Depth to Bottom
Screen Diameter: in.	Blank:		
Screen Material Type: Stainless steel-wire wrapped			
Slot Length	Set Between		
30.00	26.00 ft. and 30.00 ft.		
Fittings: Neoprene packer			
Well Grouted: Unknown		Geology Remarks:	
Wellhead Completion: Pitless adapter			
Nearest Source of Possible Contamination:		Drilling Machine Operator Name:	
Type	Distance	Employment:	Unknown
Septic tank	80 ft.	Contractor Type:	Water Well Drilling Contractor
Abandoned Well Plugged: No		Reg No:	
Reason Not Plugged: Unknown		Business Name:	Newman Pump
		Business Address:	
		Water Well Contractor's Certification	
		This well and/or pump installation was performed under my registration.	
		Signature of Registered Contractor	Date
General Remarks: Contractor Reg #0208			
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: 39711134002

Tax No:	Permit No:	County: Kalamazoo		Township: Cooper		
Well ID: 39000002399		Town/Range: 01S 11W	Section: 34	Well Status:	WSSN:	
		Distance and Direction from Road Intersection: 50' S OF TRAVIS & 100' W OF 20TH				Source ID/Well No:
		Well Owner: CHARLES RONQUIST		Well Address: 5867 20TH STREET NORTH KALAMAZOO, MI 49007		
Method of Collection: Interpolation-Map		Owner Address: 5867 20TH STREET NORTH KALAMAZOO, MI 49007				

Drilling Method: Jetted	Pump Installed: No			
Well Depth: 30.00 ft.	Well Use: Household	Pressure Tank Installed: No		
Well Type: Replacement	Date Completed: 4/28/1978	Pressure Relief Valve Installed: No		
Casing Type: Steel - black	Height:			
Casing Joint: Threaded & coupled				
Casing Fitting: Drive shoe				
Diameter: 2.00 in. to 30.00 ft. depth				
Borehole:				
Static Water Level: 4.00 ft. Below Grade	Formation Description			Thickness
Well Yield Test: Yield Test Method: Unknown				Depth to Bottom
Pumping level 20.00 ft. after 1.00 hrs. at 550 GPM	Topsoil	5.00		
	Gravel Coarse	13.00		
	Clay & Gravel	4.00		
Screen Installed: Yes	Filter Packed: No	Sand Fine		
Screen Diameter: 1.25 in.	Blank: 1.00 ft. Above	8.00		
Screen Material Type:	Set Between			
Slot 80.00	Length 4.00 ft.	26.00 ft. and 30.00 ft.		
Fittings: Neoprene packer				
Well Grouted: Yes	Grouting Method: Unknown			
Grouting Material Unknown	Bags 0.00	Additives None	Depth 0.00 ft. to 0.00 ft.	
Wellhead Completion: Pitless adapter	Geology Remarks:			
Nearest Source of Possible Contamination: Type Septic tank	Distance 65 ft.	Direction North	Drilling Machine Operator Name: Employment: Unknown	
Abandoned Well Plugged: No	Contractor Type: Unknown Reg No: Business Name: Business Address:			
Reason Not Plugged:	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:				



Import ID: 39711134003

# Water Well And Pump Record

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

Failure to comply is a misdemeanor.

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Tax No:	Permit No:	County: Kalamazoo		Township: Cooper	
Well ID: 39000002400		Town/Range:	Section:	Well Status:	WSSN:
		01S 11W	34		
		Distance and Direction from Road Intersection: 200' N OF TRAVIS & 100' W OF 20TH			
Well Owner: ANTHONY BYASSE		Well Address: 5899 20TH STREET NORTH KALAMAZOO, MI 49007		Owner Address: 5899 20TH STREET NORTH KALAMAZOO, MI 49007	
Method of Collection: Interpolation-Map					

Drilling Method: Hollow Rod	Pump Installed: Yes	Pump Installation Only: No		
Well Depth: 40.00 ft.	Pump Installation Date:	HP:		
Well Type: Replacement	Manufacturer: Flint & Walling	Pump Type: Submersible		
Casing Type: Steel - black	Model Number:	Pump Capacity: 0 GPM		
Casing Joint: Threaded & coupled	Drop Pipe Length: 21.00 ft.	Pump Voltage:		
Casing Fitting: Drive shoe	Drop Pipe Diameter:	Drilling Record ID:		
Diameter: 2.00 in. to 36.00 ft. depth	Draw Down Seal Used: No			
Borehole:	Pressure Tank Installed: No			
Static Water Level: 2.00 ft. Below Grade	Pressure Relief Valve Installed: No			
Well Yield Test: Pumping level 20.00 ft. after 0.50 hrs. at 0 GPM	Formation Description		Thickness	
Yield Test Method: Unknown	Sand		18.00	18.00
Pumping level 10.00 ft. after 0.00 hrs. at 0 GPM	Gray Clay		12.00	30.00
Screen Installed: Yes	Sand Wet/Moist		10.00	40.00
Screen Diameter: 2.00 in.	Filter Packed: No			
Screen Material Type: Blank: 1.00 ft. Above				
Slot Length	Set Between			
10.00 4.00 ft.	36.00 ft. and 40.00 ft.			
Fittings: Neoprene packer				
Well Grouted: Yes	Grouting Method: Unknown			
Grouting Material Unknown	Bags 0.00	Additives None	Depth 0.00 ft. to 0.00 ft.	
Geology Remarks:				
Wellhead Completion: Other, 12 inches above grade				
Nearest Source of Possible Contamination:				
Type Unknown	Distance 50 ft.	Direction West	Drilling Machine Operator Name: Employment: Unknown	
Contractor Type: Unknown Reg No: 43-0436				
Business Name: Business Address:				
<b>Water Well Contractor's Certification</b> 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				



# 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:

Tax No:	Permit No:	County: Kalamazoo		Township: Cooper	
Well ID: 39000002417		Town/Range:	Section:	Well Status:	WSSN:
		01S 11W	35	Active	
Distance and Direction from Road Intersection: 200' N OF TRAVIS & 100' E OF 20TH					
Well Owner: Nelson Dungey					
Well Address: 5912 20TH STREET NORTH KALAMAZOO, MI 49004			Owner Address: 5912 20TH STREET NORTH KALAMAZOO, MI 49004		

Drilling Method: Jetted	Pump Installed: No						
Well Depth: 28.00 ft.	Well Use: Household	Pressure Tank Installed: No					
Well Type: Replacement	Date Completed: 7/30/1968	Pressure Relief Valve Installed: No					
Casing Type: Steel - unknown	Height: 0.00 ft. below grade						
Casing Joint: Threaded & coupled							
Casing Fitting: Drive shoe							
Diameter: 3.00 in. to 28.00 ft. depth							
Borehole:							
Static Water Level: 5.00 ft. Below Grade	Formation Description			Thickness	Depth to Bottom		
Well Yield Test: Yield Test Method: Unknown	Muck W/Clay	18.00			18.00		
	Clay & Sand	7.00			25.00		
	Sand	3.00			28.00		
Screen Installed: Yes	Filter Packed: No						
Screen Diameter: 1.25 in.	Blank: 1.00 ft. Above						
Screen Material Type: Unknown							
Slot Length	Set Between						
10.00	3.00 ft.	25.00 ft. and 28.00 ft.					
Fittings: Neoprene packer							
Well Grouted: Yes	Grouting Method: Unknown						
Grouting Material	Bags	Additives	Depth				
Unknown		None		Geology Remarks:			
Wellhead Completion: Other							
Nearest Source of Possible Contamination:	Drilling Machine Operator Name:						
Type	Distance	Direction	Employment: Unknown				
Unknown							
Abandoned Well Plugged: No	Contractor Type: Water Well Drilling Contractor					Reg No:	
Reason Not Plugged: Unknown	Business Name: J C Newman						
	Business Address:						
<b>Water Well Contractor's Certification</b>							
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: Contractor Reg #0208

Other Remarks: Wellhead Completion:Approved Pit



# 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:

Tax No:	Permit No:	County: Kalamazoo		Township: Cooper	
		Town/Range: 01S 11W	Section: 35	Well Status: Active	WSSN:
Distance and Direction from Road Intersection: 5/8 north. 1 mile east.					
Well Owner: Robert Simpson					
Well Address: 5988 N 20th St Kalamazoo, MI 49004			Owner Address: 5988 N 20th St Kalamazoo, MI 49004		

Drilling Method: Hollow Rod	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 40.00 ft.	Pump Installation Date:	HP: 0.33	
Well Type: Unknown	Manufacturer: Other	Pump Type: Jet	
Casing Type: Unknown	Model Number: 5E1	Pump Capacity: 8 GPM	
Casing Joint: Threaded & coupled	Drop Pipe Length:	Pump Voltage: 110	
Casing Fitting: Drive shoe	Drop Pipe Diameter:	Drilling Record ID:	
Diameter: 2.00 in. to	Draw Down Seal Used: No		
Borehole:	Pressure Tank Installed: No		
Static Water Level: 5.00 ft. Below Grade	Pressure Relief Valve Installed: No		
Well Yield Test: Yield Test Method: Unknown	Formation Description		Thickness
Pumping level 5.00 ft. after 1.00 hrs. at 8 GPM	Sand & Gravel		18.00
	Sand & Clay		18.00
	Sand Water Bearing		8.00
Screen Installed: Yes	Filter Packed: No		
Screen Diameter: 1.25 in.	Blank:		
Screen Material Type: Stainless steel-wire wrapped			
Slot Length	Set Between		
3.00 ft.			
Fittings: Coupling, Bremer check valve			
Well Grouted: No	Geology Remarks:		
Wellhead Completion: 12 inches above grade			
Nearest Source of Possible Contamination:	Drilling Machine Operator Name:		
Type	Distance	Direction	Employment: Unknown
Septic tank	50 ft.	Northwest	
Abandoned Well Plugged: No	Contractor Type: Water Well Drilling Contractor Reg No:		
Reason Not Plugged: Unknown	Business Name: B&H Well Drilling Business Address:		
	Water Well Contractor's Certification This well and/or pump installation was performed under my registration.		
	Signature of Registered Contractor		Date

General Remarks: Contractor Registration #0267

Other Remarks: Pump Manufacturer: Rapidayton



Import ID: 39711135030

# Water Well And Pump Record

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

Failure to comply is a misdemeanor.

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Tax No:	Permit No:	County: Kalamazoo		Township: Cooper	
		Town/Range: 01S 11W	Section: 35	Well Status:	WSSN:
Distance and Direction from Road Intersection:					
Well Owner: MR. BILL FOLLOWELL					
Well Address: 1925 COLBY PARCHMENT, MI 49004			Owner Address: 1925 COLBY PARCHMENT, MI 49004		
Method of Collection: Interpolation-Map					

Drilling Method: Hollow Rod	Pump Installed: No			
Well Depth: 28.00 ft.	Pressure Tank Installed: No			
Well Type: Replacement	Pressure Relief Valve Installed: No			
Casing Type: Unknown	Height: 0.00 ft. below grade			
Casing Joint: Unknown				
Casing Fitting: Drive shoe				
Diameter: 2.00 in. to 0.00 ft. depth				
Borehole:				
Static Water Level: 10.00 ft. Below Grade	Formation Description			Thickness
Well Yield Test:	Yield Test Method: Unknown			Depth to Bottom
	Sand & Clay Hard			8.00
	Clay & Gravel			10.00
	Sand & Gravel Hard			4.00
Screen Installed: Yes	Filter Packed: No	Sand & Gravel Wet/Moist		
Screen Diameter: 1.25 in.	Blank: 1.00 ft. Above			
Screen Material Type:				
Slot	Length	Set Between		
10.00	3.00 ft.	25.00 ft. and 28.00 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	57 ft.	Northwest		
Abandoned Well Plugged: No	Contractor Type: Unknown Reg No: 11-0579			
Reason Not Plugged:	Business Name:			
	Business Address:			
<b>Water Well Contractor's Certification</b>				
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:				



Import ID: 39711135023

# Water Well And Pump Record

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

Failure to comply is a misdemeanor.

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Tax No:	Permit No:	County: Kalamazoo		Township: Cooper	
Well ID: 39000002437		Town/Range:	Section:	Well Status:	WSSN:
		01S 11W	35		
		Distance and Direction from Road Intersection: 1 MILE W OF RIVERVIEW & 80' S OF TRAVERSE			
Well Owner: RAND RIGGS		Well Address:		Owner Address:	
2048 TRAVIS PARCHMENT, MI 49004		2048 TRAVIS PARCHMENT, MI 49004			

Drilling Method: Rotary	Pump Installed: No				
Well Depth: 182.00 ft.	Pressure Tank Installed: No				
Well Type: Replacement	Pressure Relief Valve Installed: No				
Casing Type: PVC plastic	Height:				
Casing Joint: Threaded & coupled					
Casing Fitting: Drive shoe					
Diameter: 5.00 in. to 131.00 ft. depth					
Borehole: 8.00 in. to 119.00 ft. depth					
Static Water Level: 0.00 ft. Above Grade (Flowing)	Formation Description		Thickness	Depth to Bottom	
Well Yield Test: Yield Test Method: Unknown	Gravel & Sand		20.00	20.00	
Pumping level 120.00 ft. after 1.00 hrs. at 3 GPM	Clay		99.00	119.00	
Unrestricted Flow Rate:	Gravel & Clay Dry		3.00	122.00	
Screen Installed: Yes	Filter Packed: No	Clay		3.00	125.00
Screen Diameter: 5.00 in.	Blank: 1.00 ft. Above	Shale W/Clay Coldwater Shale		6.00	131.00
Screen Material Type:	Set Between	Shale Water Bearing		51.00	182.00
Slot	Length				
0.00	3.00 ft.				
	119.00 ft. and 122.00 ft.				
Fittings: Neoprene packer					
Well Grouted: Yes	Grouting Method: Unknown				
Grouting Material	Bags	Additives	Depth	Geology Remarks:	
Bentonite slurry	0.00	None	0.00 ft. to 119.00 ft.		
Wellhead Completion: Other, 12 inches above grade					
Nearest Source of Possible Contamination:			Drilling Machine Operator Name:		
Type	Distance	Direction	Employment: Unknown		
Septic tank	150 ft.	South			
Abandoned Well Plugged: Yes			Contractor Type: Unknown	Reg No: 13-0393	
			Business Name:		
			Business Address:		
	Casing Removed:		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



Import ID: 39711126013

# Water Well And Pump Record

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

Failure to comply is a misdemeanor.

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Tax No:	Permit No:	County: Kalamazoo		Township: Cooper	
Well ID: 39000002215		Town/Range:	Section:	Well Status:	WSSN:
		01S 11W	26		
		Distance and Direction from Road Intersection:			
Elevation: 763 ft.		Well Owner: HERMAN WEAVER			
Latitude: 42.3501920112		Well Address:		Owner Address:	
Longitude: -85.563535709		2217 MCKINLEY KALAMAZOO, MI 49004		2217 MCKINLEY KALAMAZOO, MI 49004	
Method of Collection: Interpolation-Map					

Drilling Method: Cable Tool	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 35.00 ft.	Pump Installation Date:	HP:	
Well Type: Replacement	Manufacturer: Flint & Walling	Pump Type: Submersible	
Casing Type: Steel - black	Model Number:	Pump Capacity: 0 GPM	
Casing Joint: Threaded & coupled	Drop Pipe Length: 20.00 ft.	Pump Voltage:	
Casing Fitting: Drive shoe	Drop Pipe Diameter:	Drilling Record ID:	
Diameter: 4.00 in. to 30.00 ft. depth	Draw Down Seal Used: No		
Borehole:	Pressure Tank Installed: No		
Static Water Level: 6.00 ft. Below Grade	Pressure Relief Valve Installed: No		
Well Yield Test: Yield Test Method: Unknown	Formation Description		Thickness
Pumping level 30.00 ft. after 1.00 hrs. at 60 GPM	Topsoil	2.00	2.00
Screen Installed: Yes	Blue Clay	2.00	4.00
Screen Diameter: 4.00 in.	Sand & Gravel	14.00	18.00
Screen Material Type:	Blue Clay	7.00	25.00
Slot Length	Gravel	10.00	35.00
10.00 4.00 ft.	Set Between		
10.00 4.00 ft.	31.00 ft. and 35.00 ft.		
Fittings: Neoprene packer			
Well Grouted: No	Geology Remarks:		
Wellhead Completion: Pitless adapter			
Nearest Source of Possible Contamination:	Drilling Machine Operator Name:		
Type	Distance	Direction	Employment: Unknown
Septic tank	50 ft.	North	
Abandoned Well Plugged: No	Contractor Type: Unknown Reg No: 39-0444		
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:			



# 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: 39711126012

Tax No:	Permit No:	County: Kalamazoo	Township: Cooper			
Well ID: 39000002214		Town/Range: 01S 11W	Section: 26	Well Status:	WSSN:	
		Distance and Direction from Road Intersection:				Source ID/Well No:
		Well Owner: SCOTT SHINGLEDECKER				Well Address: 1982 MCKNILEY KALAMAZOO, MI 49004
Method of Collection: Interpolation-Map		Owner Address: 1982 MCKNILEY KALAMAZOO, MI 49004				

Drilling Method: Cable Tool	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 33.00 ft.	Pump Installation Date:	HP:	
Well Type: Replacement	Manufacturer: Flint & Walling	Pump Type: Submersible	
Casing Type: Steel - black	Model Number:	Pump Capacity: 0 GPM	
Casing Joint: Threaded & coupled	Drop Pipe Length: 20.00 ft.	Pump Voltage:	
Casing Fitting: Drive shoe	Drop Pipe Diameter:	Drilling Record ID:	
Diameter: 4.00 in. to 29.00 ft. depth	Draw Down Seal Used: No		
Borehole:	Pressure Tank Installed: No		
Static Water Level: 3.00 ft. Below Grade	Pressure Relief Valve Installed: No		
Well Yield Test: Pumping level 25.00 ft. after 0.50 hrs. at 15 GPM	Formation Description	Thickness	Depth to Bottom
	Clay	5.00	5.00
	Sand	10.00	15.00
	Clay	10.00	25.00
Screen Installed: Yes	Sand	8.00	33.00
Screen Diameter: 3.00 in.			
Screen Material Type: Blank: 1.00 ft. Above			
Slot Length	Set Between		
12.00 4.00 ft.	29.00 ft. and 33.00 ft.		
Fittings: Neoprene packer			
Well Grouted: Yes	Grouting Method: Unknown		
Grouting Material Bentonite slurry	Bags 0.00	Additives None	Depth 0.00 ft. to 0.00 ft.
Geology Remarks:			
Wellhead Completion: Pitless adapter			
Nearest Source of Possible Contamination: Type Septic tank	Distance 100 ft.	Direction North	Drilling Machine Operator Name: Employment: Unknown
Abandoned Well Plugged: Yes	Contractor Type: Unknown Reg No: 08-1771		
Casing Removed:	Business Name: Business Address:		
<b>Water Well Contractor's Certification</b>			
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:

Tax No:	Permit No:	County: Kalamazoo		Township: Cooper	
		Town/Range: 01S 11W	Section: 35	Well Status: Active	WSSN:
Distance and Direction from Road Intersection:					
Well Owner: Jerry Fulbright					
Well Address: 1970 Roosevelt Ave Kalamazoo, MI 49004			Owner Address: 1970 Roosevelt Ave Kalamazoo, MI 49004		

**Well ID: 39000023605**

**Elevation:**  
Latitude: 42.347728  
Longitude: -85.566127  
Method of Collection: Interpolation-Aerial Photo

Drilling Method: Cable Tool	Pump Installed: Yes	Pump Installation Only: No
Well Depth: 27.00 ft.	Pump Installation Date:	HP:
Well Type: New	Manufacturer: Flint & Walling	Pump Type: Submersible
Casing Type: Steel - unknown	Model Number:	Pump Capacity:
Casing Joint: Threaded & coupled	Drop Pipe Length: 17.00 ft.	Pump Voltage: 230
Casing Fitting: Drive shoe	Drop Pipe Diameter:	Drilling Record ID:
Diameter: 4.00 in. to 24.00 ft. depth	Draw Down Seal Used: No	
Borehole:	Pressure Tank Installed: No	
Static Water Level: 5.00 ft. Below Grade	Pressure Relief Valve Installed: No	
Well Yield Test: Pumping level 24.00 ft. after 1.00 hrs.	Formation Description	Thickness
	Sand	10.00
	Clay	10.00
	Sand	7.00
Screen Installed: Yes	Filter Packed: No	
Screen Diameter: in.	Blank: 1.00 ft. Above	
Screen Material Type: Stainless steel-wire wrapped		
Slot Length	Set Between	
10.00	24.00 ft. and 29.00 ft.	
Fittings: Neoprene packer		
Well Grouted: No	Geology Remarks: *Geology section was very faded on the log but the above geology is what the writing appears to say.*	
Wellhead Completion: Pitless adapter, 12 inches above grade		
Nearest Source of Possible Contamination: Type Septic tank	Drilling Machine Operator Name: Lyle Lumbard Employment: Unknown	
Distance 50 ft.	Contractor Type: Water Well Drilling Contractor Business Name: Business Address:	Reg No:
	<b>Water Well Contractor's Certification</b> This well and/or pump installation was performed under my registration.	
	Signature of Registered Contractor	Date

General Remarks: Contractor Reg #0444

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:

Tax No:	Permit No:	County: Kalamazoo Township: Cooper				
Well ID: 39000015963		Town/Range:	Section:	Well Status:	WSSN:	Source ID/Well No:
		01S 11W	26	Active		
		Distance and Direction from Road Intersection: 1/4 mile sw of mckinnley st.				
		Well Owner: connie klinger				
		Well Address:		Owner Address: 2478 roosevelt parchment, MI 49004		

Drilling Method: Cable Tool	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 26.00 ft.	Pump Installation Date: 9/25/2003	HP: 0.50	
Well Type: Replacement	Manufacturer: Eagle	Pump Type: Submersible	
Casing Type: Steel - black	Model Number: 10ep05	Pump Capacity: 10 GPM	
Casing Joint: Threaded & coupled	Drop Pipe Length: 18.00 ft.	Pump Voltage:	
Casing Fitting: Drive shoe	Drop Pipe Diameter: 1.00 in.	Drilling Record ID:	
Diameter: 4.00 in. to 22.00 ft. depth	Draw Down Seal Used: No		
Borehole: 4.00 in. to 22.00 ft. depth	Pressure Tank Installed: Yes		
Static Water Level: 9.00 ft. Below Grade	Pressure Tank Type: Diaphragm/bladder		
Well Yield Test: 1.00 hrs. at 30 GPM	Manufacturer: Well-X-Trol		
	Model Number: 203	Tank Capacity: 8.0 Gallons	
	Pressure Relief Valve Installed: No		
Screen Installed: Yes	Formation Description	Thickness	Depth to Bottom
Screen Diameter: 3.00 in.	Brown Gravel	18.00	18.00
Screen Material Type: Stainless steel-slotted	Brown Gravel & Sand	8.00	26.00
Slot Length	Gray Clay Gravel Stones	55.00	81.00
10.00 4.00 ft.	Dark Gray Shale	19.00	100.00
Fittings: None			
Well Grouted: Yes	Geology Remarks:		
Grouting Material Bentonite dry granular			
Bags 2.00			
Additives None			
Depth 0.00 ft. to 22.00 ft.			
Wellhead Completion: Pitless adapter			
Nearest Source of Possible Contamination: Septic tank	Drilling Machine Operator Name: bob		
Type Distance 50 ft.	Employment: Employee		
Direction South	Contractor Type: Water Well Drilling Contractor	Reg No: 39-1288	
Abandoned Well Plugged: Yes	Business Name: American Well Drilling		
Casing Diameter: 1.25 in.	Business Address: 8621 East C Ave, Richland, MI, 49083		
Casing Removed: No	Water Well Contractor's Certification		
Plugging Material: Bentonite chips/pellets	This well was drilled under my supervision and this report is true to the best of my knowledge and belief.		
No. of Bags: 1.00	Signature of Registered Contractor	Date	
Well Depth: 18 ft.			
General Remarks: got a variance from health dept. only water available			
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:

Tax No:	Permit No:	County: Kalamazoo		Township: Cooper			
Well ID: 39000023606		Town/Range: 01S 11W		Section: 35	Well Status: Active		
Distance and Direction from Road Intersection: From G Ave & Riverview go North on Riverview about 1 mile and east almost 150 feet.							
Well Owner: Toms Place							
Well Address: 5384 N Riverview Dr Kalamazoo, MI 49004		Owner Address: 5384 N Riverview Dr Kalamazoo, MI 49004					

Drilling Method: Other	Pump Installed: No		
Well Depth: 31.00 ft.	Well Use: Unknown	Pressure Tank Installed: No	
Well Type: Unknown	Date Completed:	Pressure Relief Valve Installed: No	
Casing Type: Steel - unknown	Height: 1.00 ft. above grade		
Casing Joint: Threaded & coupled			
Casing Fitting: Drive shoe			
Diameter: 2.00 in. to 27.00 ft. depth			
Borehole:			
Static Water Level: 20.00 ft. Below Grade	Formation Description	Thickness	Depth to Bottom
Well Yield Test: Yield Test Method: Unknown	Gravel	21.00	21.00
Pumping level 26.00 ft. after 1.00 hrs. at 10 GPM	Gravel Water Bearing	10.00	31.00
Screen Installed: Yes	Filter Packed: No		
Screen Diameter: 0.25 in.	Blank:		
Screen Material Type: Stainless steel-wire wrapped			
Slot Length	Set Between		
10.00 4.00 ft.	27.00 ft. and 31.00 ft.		
Fittings: Coupling			
Well Grouted: Yes	Grouting Method: Unknown		
Grouting Material	Bags	Additives	Depth
Bentonite dry granular	1.00	None	
Wellhead Completion: 12 inches above grade	Geology Remarks:		
Nearest Source of Possible Contamination:	Drilling Machine Operator Name:		
Type	Employment:	Unknown	
Septic tank			
Distance	Contractor Type:	Water Well Drilling Contractor	Reg No: 39-0444
100 ft.	Business Name:	Lumbard Pump Sales & Service	
Direction	Business Address:		
Northwest	Water Well Contractor's Certification		
Abandoned Well Plugged: No	This well and/or pump installation was performed under my registration.		
Reason Not Plugged: Unknown	Signature of Registered Contractor	Date	
General Remarks:			
Other Remarks: Drilling Method:Driven & Jetted			



Import ID: 39711135006

# Water Well And Pump Record

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

Failure to comply is a misdemeanor.

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Tax No:	Permit No:	County: Kalamazoo		Township: Cooper	
Well ID: 39000002420		Town/Range:	Section:	Well Status:	WSSN:
		01S 11W	35		
		Distance and Direction from Road Intersection: 300' N OF G & 100' E OF RIVERVIEW			
Well Owner: LESLEE GIDEON		Well Address:		Owner Address:	
5060 RIVERVIEW KALAMAZOO, MI 49004		5060 RIVERVIEW KALAMAZOO, MI 49004			

Drilling Method: Jetted	Pump Installed: No				
Well Depth: 44.00 ft.	Pressure Tank Installed: No				
Well Type: Replacement	Pressure Relief Valve Installed: No				
Casing Type: Steel - black	Height:				
Casing Joint: Threaded & coupled					
Casing Fitting: Drive shoe					
Diameter: 2.00 in. to 0.00 ft. depth					
Borehole:					
Static Water Level: 15.00 ft. Below Grade	Formation Description			Thickness	Depth to Bottom
Well Yield Test: Yield Test Method: Unknown	Sand & Gravel			44.00	44.00
Screen Installed: Yes	Filter Packed: No				
Screen Diameter: 1.25 in.	Blank: 1.00 ft. Above				
Screen Material Type:					
Slot Length	Set Between				
12.00 4.00 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: Other, 12 inches above grade	Geology Remarks:				
Nearest Source of Possible Contamination:	Drilling Machine Operator Name:				
Type	Distance	Direction	Employment: Unknown		
Unknown	0 ft.				
Abandoned Well Plugged: No	Contractor Type: Unknown Reg No:				
Reason Not Plugged:	Business Name:				
	Business Address:				
<b>Water Well Contractor's Certification</b>					
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					



# 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: 39711135004

Tax No:	Permit No:	County: Kalamazoo	Township: Cooper			
Well ID: 39000002418		Town/Range: 01S 11W	Section: 35	Well Status:	WSSN:	
		Distance and Direction from Road Intersection: 100' N OF G & 100' W OF RIVERVIEW				Source ID/Well No:
		Well Owner: PROGRESSIVE OIL CO. Well Address: RIVERVIEW KALAMAZOO, MI 49004				Owner Address: INDIANA INC. FORT WAYNE, IN

Drilling Method: Jetted	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 46.00 ft.	Pump Installation Date:	HP:	
Well Type: Replacement	Manufacturer: Tait	Pump Type: Submersible	
Casing Type: Steel - black	Model Number:	Pump Capacity: 0 GPM	
Casing Joint: Threaded & coupled	Drop Pipe Length: 35.00 ft.	Pump Voltage:	
Casing Fitting: Drive shoe	Drop Pipe Diameter:	Drilling Record ID:	
Diameter: 4.00 in. to 0.00 ft. depth	Draw Down Seal Used: No		
Borehole:	Pressure Tank Installed: No		
Static Water Level: 16.00 ft. Below Grade	Pressure Relief Valve Installed: No		
Well Yield Test: Yield Test Method: Unknown	Formation Description		Thickness
Pumping level 16.00 ft. after 0.00 hrs. at 0 GPM	Yellow Sand	16.00	16.00
Screen Installed: Yes	White Sand	8.00	24.00
Screen Diameter: 4.00 in.	Sand W/Gravel W/Clay	10.00	34.00
Screen Material Type:	Sand Coarse	12.00	46.00
Slot Length			
12.00 5.00 ft.	Set Between		
	0.00 ft. and 0.00 ft.		
Fittings: Neoprene packer			
Well Grouted: No	Geology Remarks:		
Wellhead Completion: Pitless adapter			
Nearest Source of Possible Contamination:	Drilling Machine Operator Name:		
Type	Distance	Direction	Employment: Unknown
Septic tank	80 ft.	North	Contractor Type: Unknown Reg No:
Abandoned Well Plugged: No	Business Name:		
Reason Not Plugged:	Business Address:		
<b>Water Well Contractor's Certification</b>			
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: Well Use:Public Well Type Unknown			



Import ID: 39711135005

# Water Well And Pump Record

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

Failure to comply is a misdemeanor.

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Tax No:	Permit No:	County: Kalamazoo	Township: Cooper	
		Town/Range: 01S 11W	Section: 35	Well Status:
		WSSN: Source ID/Well No:		
Well ID: 39000002419		Distance and Direction from Road Intersection: 200' N OF G & 100' E OF RIVERVIEW		
Elevation: 790 ft. Latitude: 42.3331713354 Longitude: -85.5644737459 Method of Collection: Interpolation-Map		Well Owner: RICHARD BOGREN Well Address: 5048 RIVERVIEW KALAMAZOO, MI 49004 Owner Address: 5048 RIVERVIEW KALAMAZOO, MI 49004		

Drilling Method: Cable Tool Well Depth: 42.00 ft. Well Type: Replacement	Well Use: Household Date Completed: 2/13/1986	Pump Installed: Yes Pump Installation Date: Manufacturer: Flint & Walling Model Number: Drop Pipe Length: 30.00 ft. Drop Pipe Diameter: Draw Down Seal Used: No	Pump Installation Only: No HP: Pump Type: Submersible Pump Capacity: 0 GPM Pump Voltage: Drilling Record ID:	
Casing Type: Steel - black Casing Joint: Threaded & coupled Casing Fitting: Drive shoe Diameter: 4.00 in. to 36.00 ft. depth Borehole:		Pressure Tank Installed: No Pressure Relief Valve Installed: No		
Static Water Level: 24.00 ft. Below Grade Well Yield Test: Yield Test Method: Unknown Pumping level 30.00 ft. after 1.00 hrs. at 40 GPM		Formation Description Sand Sand & Gravel Gray Clay	Thickness 9.00 13.00 2.00	Depth to Bottom 9.00 22.00 24.00
Screen Installed: Yes Screen Diameter: 3.00 in. Screen Material Type: Slot Length 7.00 6.00 ft.	Filter Packed: No Blank: 1.00 ft. Above Set Between 36.00 ft. and 42.00 ft.	Sand Clay Gravel Fine Sand No Lithology Information	3.00 9.00 6.00	27.00 36.00 42.00
Fittings: Neoprene packer				
Well Grouted: Yes Grouting Material Bentonite slurry	Grouting Method: Unknown Bags 0.00 Additives None Depth 0.00 ft. to 25.00 ft.	Geology Remarks:		
Wellhead Completion: Pitless adapter				
Nearest Source of Possible Contamination: Type Septic tank		Distance 50 ft. Direction East	Drilling Machine Operator Name: Employment: Unknown	
Abandoned Well Plugged: No Reason Not Plugged:			Contractor Type: Unknown Business Name: Business Address:	Reg No:
		<b>Water Well Contractor's Certification</b> This well was drilled under my supervision and this report is true to the best of my knowledge and belief. Signature of Registered Contractor <span style="float: right;">Date</span>		
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:

Tax No:	Permit No:	County: Kalamazoo		Township: Cooper	
		Town/Range: 01S 11W	Section: 35	Well Status: Active	WSSN:
Distance and Direction from Road Intersection: 1/10th mile north of G Ave. On east side of Riverview.					
Well Owner: Leslee Gideon					
Well Address: 5060 N Riverview Dr Kalamazoo, MI 49004		Owner Address: 5060 N Riverview Dr Kalamazoo, MI 49004			

Drilling Method: Jetted	Pump Installed: No				
Well Depth: 44.00 ft.	Well Use: Household	Pressure Tank Installed: No			
Well Type: Unknown	Date Completed: 3/20/1967	Pressure Relief Valve Installed: No			
Casing Type: Unknown	Height: 1.00 ft. above grade				
Casing Joint: Threaded & coupled					
Casing Fitting: Drive shoe					
Diameter: 2.00 in. to					
Borehole:					
Static Water Level: 15.00 ft. Below Grade	Formation Description	Thickness	Depth to Bottom		
Well Yield Test: Yield Test Method: Unknown	Sand & Gravel	44.00	44.00		
Screen Installed: Yes					
Screen Diameter: 1.25 in.	Filter Packed: No				
Screen Material Type: Stainless steel-wire wrapped	Blank:				
Slot Length	Set Between				
12.00	4.00 ft.				
Fittings: Bremer check valve					
Well Grouted: Unknown	Geology Remarks:				
Wellhead Completion: Other					
Nearest Source of Possible Contamination:	Drilling Machine Operator Name:				
Type	Employment: Unknown				
None					
Abandoned Well Plugged: No	Contractor Type: Water Well Drilling Contractor	Reg No:			
Reason Not Plugged: Unknown	Business Name:				
	Business Address:				
	<b>Water Well Contractor's Certification</b>				
	This well and/or pump installation was performed under my registration.				
	Signature of Registered Contractor	Date			
<b>General Remarks:</b> Contractor Reg #117					
<b>Other Remarks:</b> Wellhead Completion: In Approved Pit					



Import ID: 39711135015

# Water Well And Pump Record

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

Failure to comply is a misdemeanor.

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Tax No:	Permit No:	County: Kalamazoo	Township: Cooper	
Well ID: 39000002429		Town/Range: 01S 11W	Section: 35	Well Status:
		Distance and Direction from Road Intersection: 400' N OF BRACKETT & 150' E OF RIVERVIEW		
		Well Owner: DON AIRE Well Address: 5496 RIVERVIEW KALAMAZOO, MI 49004		
Method of Collection: Interpolation-Map		Owner Address: 5496 RIVERVIEW KALAMAZOO, MI 49004		

Drilling Method: Cable Tool	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 45.00 ft.	Pump Installation Date:	HP:	
Well Type: Replacement	Manufacturer: Flint & Walling	Pump Type: Submersible	
Casing Type: Steel - black	Model Number:	Pump Capacity: 0 GPM	
Casing Joint: Threaded & coupled	Drop Pipe Length: 30.00 ft.	Pump Voltage:	
Casing Fitting: Drive shoe	Drop Pipe Diameter:	Drilling Record ID:	
Diameter: 4.00 in. to 40.00 ft. depth	Draw Down Seal Used: No		
Borehole:	Pressure Tank Installed: No		
Static Water Level: 20.00 ft. Below Grade	Pressure Relief Valve Installed: No		
Well Yield Test: Yield Test Method: Unknown	Formation Description	Thickness	Depth to Bottom
Pumping level 3.00 ft. after 1.00 hrs. at 30 GPM	Gravel & Clay	21.00	21.00
	Gravel Wet/Moist	24.00	45.00
Screen Installed: Yes			
Screen Diameter: 3.00 in.	Filter Packed: No		
Screen Material Type:	Blank: 1.00 ft. Above		
Slot Length	Set Between		
10.00 5.00 ft.	40.00 ft. and 45.00 ft.		
Fittings: Neoprene packer			
Well Grouted: Yes	Grouting Method: Unknown		
Grouting Material	Bags	Additives	Depth
Bentonite slurry	0.00	None	0.00 ft. to 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	100 ft.	North	
Abandoned Well Plugged: Yes	Contractor Type: Unknown Reg No: 39-1288		
	Business Name:		
	Business Address:		
Casing Removed:	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:			



Import ID: 39711135029

# Water Well And Pump Record

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

Failure to comply is a misdemeanor.

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Tax No:	Permit No:	County: Kalamazoo	Township: Cooper			
Well ID: 39000002443		Town/Range: 01S 11W	Section: 35	Well Status:	WSSN:	
		Distance and Direction from Road Intersection:				Source ID/Well No:
		Well Owner: PARCHMENT SCHOOLS				
Well Address: 5535 KEYES PARCHMENT, MI 49004		Owner Address: 5535 KEYES PARCHMENT, MI 49004				

Drilling Method: Cable Tool	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 39.00 ft.	Pump Installation Date:	HP:	
Well Type: Replacement	Manufacturer: Other	Pump Type: Submersible	
Casing Type: Steel - black	Model Number:	Pump Capacity: 0 GPM	
Casing Joint: Threaded & coupled	Drop Pipe Length: 20.00 ft.	Pump Voltage:	
Casing Fitting: Drive shoe	Drop Pipe Diameter:	Drilling Record ID:	
Diameter: 4.00 in. to 30.00 ft. depth	Draw Down Seal Used: No		
Borehole:	Pressure Tank Installed: No		
Static Water Level: 15.00 ft. Below Grade	Pressure Relief Valve Installed: No		
Well Yield Test: Yield Test Method: Unknown	Formation Description		Thickness
Pumping level 0.00 ft. after 2.00 hrs. at 100 GPM	Sand		20.00
	Gravel		10.00
	Gravel & Stones		9.00
Screen Installed: Yes	Filter Packed: No		
Screen Diameter: 4.00 in.	Blank: 1.00 ft. Above		
Screen Material Type:			
Slot 20.00	Length 9.00 ft.	Set Between 30.00 ft. and 39.00 ft.	
Fittings: Neoprene packer			
Well Grouted: Yes	Grouting Method: Unknown		
Grouting Material Other	Bags 0.00	Additives None	Depth 0.00 ft. to 0.00 ft.
Geology Remarks:			
Wellhead Completion: Pitless adapter			
Nearest Source of Possible Contamination:			
Type Unknown	Distance 0 ft.	Direction	Drilling Machine Operator Name: Employment: Unknown
Abandoned Well Plugged: No			Contractor Type: Unknown Reg No: 43-0436
Reason Not Plugged:			Business Name: Business Address:
<b>Water Well Contractor's Certification</b>			
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: Well Use:Public Well Type Unknown, Grouting Material 1:Listed as other in Wellkey, Pump Manufacturer:BURKS

EQP-2017 (4/2010)

Page 1 of 1

LHD 2/17/2000 1:04 PM



# 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:

Tax No:	Permit No:	County: Kalamazoo		Township: Cooper	
Well ID: 39000012447		Town/Range:	Section:	Well Status:	WSSN:
		01S 11W	35	Active	
Distance and Direction from Road Intersection:					
Well Owner: ALTERNATIVES OF KALAMAZOO					
Well Address: 5640 RIVERVIEW KALAMAZOO, MI 49004			Owner Address: 435 WHITCOMB KALAMAZOO, MI 49001		

Drilling Method: Cable Tool	Pump Installed: Yes	Pump Installation Only: No	
Well Depth: 44.00 ft.	Pump Installation Date:	HP: 1.00	
Well Type: New	Manufacturer: Sta-Rite	Pump Type: Submersible	
Casing Type: Steel - black	Model Number:	Pump Capacity: 20 GPM	
Casing Joint: Threaded & coupled	Drop Pipe Length: 30.00 ft.	Pump Voltage:	
Casing Fitting: Drive shoe	Drop Pipe Diameter:	Drilling Record ID:	
Diameter: 4.00 in. to 38.00 ft. depth	Draw Down Seal Used: No		
Borehole: 4.00 in. to 44.00 ft. depth	Pressure Tank Installed: Yes		
Static Water Level: 24.00 ft. Below Grade	Pressure Tank Type: Unknown		
Well Yield Test: Yield Test Method: Plunger	Manufacturer: Well-Mate		
Pumping level 24.00 ft. after 1.00 hrs. at 40 GPM	Model Number:	Tank Capacity:	
Screen Installed: Yes	Pressure Relief Valve Installed: No		
Screen Diameter: 4.00 in.	Formation Description	Thickness	Depth to Bottom
Screen Material Type: Stainless steel-slotted	Sand Dry	24.00	24.00
Slot Length	Sand Coarse Wet/Moist	18.00	42.00
12.00 6.00 ft.	Gravel	2.00	44.00
Fittings: Neoprene packer	Gray Clay & Gravel Hard	56.00	100.00
Well Grouted: Yes			
Grouting Material	Bags	Additives	Depth
Bentonite dry granular	5.00	None	0.00 ft. to 25.00 ft.
Wellhead Completion: Pitless adapter	Geology Remarks:		
Nearest Source of Possible Contamination:	Drilling Machine Operator Name: CHARLIE JR.		
Type	Distance	Direction	Employment: Employee
Septic tank	70 ft.	North	Contractor Type: Water Well Drilling Contractor Reg No: 80-0112
Business Name: EARL SANDERS			
Business Address:			
<b>Water Well Contractor's Certification</b>			
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:Blank Above Screen