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US ARMY CORPS
OF ENGINEERS
New England District

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Interim Final Work Plan

Groundwater Elevation Data and Sample Collection

Centredale Manor Restoration Project Superfund Site North Providence, Rhode Island

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Groundwater Elevation Data and Sample Collection

Centredale Manor Restoration
Project Superfund Site
North Providence, Rhode Island

Prepared for:

U.S. Army Corps of Engineers, New England District

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1.0 INTRODUCTION

This work plan is based on the scope of work provided by the U.S. Army Corps of Engineers (COE) dated October 24, 2006. This work will be performed under Task Order No. 26 for Contract No. DACW33-03-D-0004, *Centredale Manor Restoration Project Superfund Site*. Data collection and groundwater sampling will be conducted at the Centredale Manor Restoration Project (CMRP) Superfund site in North Providence, Rhode Island. A groundwater sample will be collected from Monitoring Well MW-05S and analyzed for total petroleum hydrocarbons (TPH). Results from the TPH testing will be used to further assess the effectiveness and cost of the remedial alternatives for groundwater under consideration in the feasibility study. The surface water elevation of the Woonasquatucket River in the vicinity of Well MW-05S will be measured. Groundwater elevations will also be measured and recorded; these data will be used to prepare a map illustrating the current groundwater configuration, hydraulic gradient, and flow direction. The updated groundwater map will be used in conjunction with historical chemistry data from Well MW-05S to determine the potential dioxin flux to the Woonasquatucket River. Sampling is scheduled for December 27 and 28, 2006.

Sample collection and analysis will be conducted in accordance with the following documents:

> *Final Quality Assurance Project Plan Addendum, Interim Data Collection, Centredale Manor Restoration Project Site* (QAPP Addendum; September, 2002), as modified in the Errata Sheet (November, 2002).
>
> *Final Health and Safety Plan for the Interim Data Collection Remedial Investigation and Feasibility Study for the Centredale Manor Restoration Project Superfund Site* (HASP; September, 2002).
>
> *Final Field Sampling Plan for the Interim Data Collection Remedial Investigation and Feasibility Study for the Centredale Manor Restoration Project Superfund Site* (FSP; September, 2002).
>
> *Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells.* U.S. Environmental Protection Agency, Region I. (Revision 2, July 30, 1996)

Sample and data collection activities will be conducted during one two-day field event. The groundwater sample for TPH analysis will be collected during the first day. Additional details regarding data and sample collection are discussed below.

2.0 GROUNDWATER SAMPLE COLLECTION

One groundwater sample will be collected from Well MW-05S. The monitoring well is located on the eastern bank of the Woonasquatucket River in the Brook Village parking lot (Figure 1).

Field methods will follow the same protocol as described in the 2002 Interim Data Collection FSP (Battelle, 2002). The monitoring well will be purged and groundwater sample will be collected following the procedures specified in the USEPA Region I document *Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells* (July 30, 1996). Based on previous sampling records for this well, the volume of water purged from the well prior to sampling is not expected to exceed approximately 1 gallon and will be returned to the well after sample collection. Parameters that will be measured during purging include pH, conductivity, turbidity, dissolved oxygen, temperature, and oxidation/reduction potential. These parameters will be measured using a flow-through

cell attached to a YSI 6600 EDS (draft SOP 5-324). The YSI will be used and calibrated according to the manufacturer-supplied operations manual. The indicator parameters will be monitored and recorded every three to five minutes; purging will be considered complete when three consecutive readings are within the following limits:

- Turbidity - 10% (for values greater than 1 NTU)
- DO – 10%
- Conductivity – 3%
- Temperature – 3%
- pH - ± 0.1 unit
- Redox Potential – ± 10 millivolts

Groundwater samples will be collected into 1-L, certified, pre-cleaned amber jars using a MasterFlex peristaltic pump head modified to fit on the end of a battery-operated drill. Teflon-tubing will be attached to the pump and lowered approximately 5.5 ft into the well so water is being drawn from near the mid-point of the screened section of the well. A short length of silicone tubing will be used within the peristaltic pump. If the water level in the well is not sufficiently elevated the tubing will be lowered to the midpoint between the bottom of the screened section (-8.0 ft below the top of the riser) and the measured water surface. The sample containers will be preserved with hydrochloric acid (HCl) to reduce the pH to less than 2. Sample collection will be documented at the time of collection; an example data form is presented in Attachment 1. Samples will be maintained under Chain of Custody during collection, handling and shipping.

Table 1 lists the sample ID numbers which will be assigned to samples collect during this survey. Sample container, volume requirements, storage conditions, holding times and receiving laboratories are defined in Table 2. Field quality control samples will include a field duplicate; no other field QC will be collected.

Table 1. Sample IDs for Groundwater Sampling.

Medium/ Matrix	Sample location	Sample ID	Sample Description	Analytical Parameter
Groundwater	MW05S	CMS-GW-MW05S-06	Well MW05S	TPH
		CMS-GW-MW05S-06DU	Field Duplicate Well MW05S	

Table 2. Groundwater Sample Container, Sample Size, Preservation Requirements, Holding Times and Analytical Laboratories.

Medium/ Matrix	Analytical Parameter	Minimum Sample Volume	Containers	Preservation Requirements	Maximum Holding Time	Laboratory for Shipping
Groundwater	TPH	Full w/ ½ inch headspace	2-L amber glass bottle (Teflon lined caps) per sample	Cold (4±2°C), bottles pre-acidified with HCl (pH<2)	7 days	Andrea Colby Katahdin Analytical Services 600 Technology Way Scarborough, ME 04074 Telephone: (207) 874-2400 Fax: (207) 775-4029

3.0 GROUNDWATER ELEVATION DATA COLLECTION

The locations of all monitoring wells, gauge stations, and piezometers are shown in Figure 1. Table 3 presents the coordinates and elevation data for all wells. A water level meter (Heron Dipper-T) will be used to determine the distance from the top of the well head to the water level. The water level meter is composed of stainless steel and Teflon™ components attached to a medium density polyethylene jacketed tape. When the meter is lowered into a well it will produce an audible sound when the sensor on the end of the tape encounters the water surface. The distance from the top of the riser to the standing water level will be recorded (see Attachment 2). The groundwater elevation is determined by subtracting the depth to the water surface from the elevation of the well riser. This instrument does not require calibration.

The surface water elevation of the Woonasquatucket River, adjacent to Well MW-05S, will be measured using standard survey equipment.

Table 3. Monitoring Well, Piezometer, and Staff Gauge Locations and Elevations. (a)

Boring ID	Northing	Easting	Top of Riser Elevation (ft)	Boring ID	Northing	Easting	Top of Riser Elevation (ft)
GEC-1	282460.55	331644.27	104.32	MW-13B	281288.18	332129.87	98.48
GEC-2	282219.95	331641.29	103.80	MW-13D	281283.26	332131.30	98.43
GEC-3	282243.93	331684.41	103.67	MW-13S	281287.17	332135.38	98.85
GEC-4	282142.86	331616.28	102.34	MW-14M	282015.56	331645.60	99.31
GEC-5	282112.10	331662.12	103.51	MW-15D	282204.45	331619.16	102.69
GEC-6	282028.49	331650.67	99.70	P1	282194.89	331791.27	98.79
GEC-7	281990.25	331696.75	98.90	P10	281476.69	331835.15	98.14
MW-01S	281970.35	331841.81	99.23	P11	281464.85	331943.05	98.20
MW-02D	281435.54	332002.13	99.95	P12	281251.54	331898.86	98.26
MW-02M	281446.73	331999.44	99.78	P13	281254.18	331963.42	97.45
MW-02S	281459.31	332019.46	97.16	P14	281261.57	332062.35	94.77
MW-03S	282104.34	331787.56	100.59	P15	281122.37	331985.28	94.91
MW-04B	281137.18	331994.98	98.17	P16	282477.80	331655.35	105.01
MW-04D	281142.69	331986.75	98.70	P17	281148.37	331885.20	95.89
MW-04S	281148.63	331981.18	98.79	P2	282123.78	331613.82	102.63
MW-05S	282100.30	331613.19	102.34	P20	282078.96	331620.95	102.25
MW-06S	281925.58	331684.87	100.50	P21	281974.73	331635.36	98.98
MW-07D	281671.71	331660.74	97.91	P3	282133.12	331663.37	103.40
MW-07S	281685.78	331657.53	98.32	P4	282140.10	331743.58	98.63
MW-08S	281409.29	331727.56	96.33	P5	281922.30	331605.21	101.59
MW-09S	281241.86	331797.08	100.55	P6	281955.45	331773.16	97.59
MW-10B	282151.72	331826.13	108.11	P7	281710.53	331726.37	97.61
MW-10D	282155.94	331824.98	107.99	P8	281715.46	331785.48	98.79
MW-11B	281773.14	331366.64	119.30	P9	281765.54	331879.58	97.57
MW-11M	281774.41	331373.63	118.73	SP-01	281342.32	332090.74	96.35
MW-11S	281775.08	331361.73	119.42	SP-02	281118.23	332016.87	94.62
MW-12B	280888.55	331817.24	105.40	SP-03	281122.48	331880.05	97.46
MW-12D	280894.13	331815.50	105.62	SP-04	282586.61	331515.14	99.10

(a) Data source: Battelle (2003).

4.0 SAMPLE ANALYSIS

The groundwater sample will be analyzed for TPH. Sample analyses will be conducted by Katahdin Analytical Services, Scarborough, ME, in accordance with the *Final Quality Assurance Project Plan Addendum, Interim Data Collection, Centredale Manor Restoration Project Site* (QAPP Addendum; September, 2002), as modified in the Errata Sheet (November, 2002). Planned deviations include:

a. Field samples will be analyzed for extractable total petroleum hydrocarbons (TPH) within the diesel range organics (DRO) consisting of the alkanes nonane through octacosane (C9 through C28) using EPA Method 8015.
b. Investigation derived waste (IDW) will not be created or stored at the CMRP site. The purge water from Well MW-05S will be returned to the well after sample collection. Nitrile gloves used for sampling activities will be returned to Battelle and will enter the routine laboratory waste stream. Wastes from the project will be treated as routine laboratory waste, unless notified otherwise in writing from USEPA.
c. Laboratory-based QC samples for the TPH testing will include one procedural blank (PB) and one laboratory control sample (LCS). Results from the laboratory-based QC samples will be used to monitor data quality in terms of accuracy. Data quality in terms of precision will be monitored using the field duplicates.
d. TPH data will not receive third party validation. These data are used for qualitative purposes only to evaluate remedial alternatives as part of the feasibility study.

5.0 DIOXIN FLUX DETERMINATION

Battelle will estimate the potential bulk flux of dioxin from groundwater to surface water using available hydrogeologic and groundwater chemical concentration data in the vicinity of Brook Village and a simplistic fate and transport model. It is expected that a range of values will be determined because many of the site-specific parameters are variable. Specifically, values for the mean hydraulic conductivity and effective porosity will be obtained from the *Draft Technical Memorandum – Source Area Investigation* (TTNUS, 2002) and used along with the most recent hydraulic gradient to estimate the groundwater velocity towards the Woonasquatucket River. Groundwater velocity is calculated using the following equation:

$$GW_v = (K*I)/n_e$$

Where:

GW_v = the groundwater velocity
K = hydraulic conductivity (generally presented in ft/day)
I = gradient (unitless, this is calculated as feet of drop over feet of distance)
n_e = effective porosity (unitless, this is a percentage of the available porosity for fluid movement compared to the total void space in a material)

The discharge volume of water is defined as follows:

$$Q = KIA$$

Where:

Q = specific discharge (typically cubic feet/day)
A = cross sectional area (square feet)

The cross sectional area of discharge has a length and width component; some initial assumptions will be made to determine reasonable values for these parameters. The length of the potential cross-sectional area of discharge will be determined using the results of the USGS Vapor Diffusion Study (USGS, 2000) and the 2005 Semi-permeable Membrane Device (SPMD) study (Battelle, 2005). The USGS study identified the seepage of VOC-contaminated groundwater to the Woonasquatucket River in the vicinity of Well MW-05S, along approximately 50 feet of its eastern bank. Tetrachloroethylene (PCE) and trichloroethylene (TCE) were the principal VOCs detected. The Remedial Investigation speculated that PCE and TCE in soil and groundwater in the vicinity of Well MW-05S may be mobilizing dioxin, but that it was not known whether dioxin is being discharged to the river with this plume. The SPMD investigation was conducted in 2005 to gain a better understanding of the potential migration of dioxin with the groundwater plume. Results from the vapor diffusion and SPMD investigations will be used to identify a range of lengths of dioxin discharge in the flux estimates.

The width (depth) of the discharge area will be selected based on the well logs, water depth in the river, and observations from the 2005 SPMD study (Battelle, 2005). Specifically, the boring log for well MW-05S indicated that from four to six feet below the ground surface a green non-aqueous phase liquid (NAPL) was present; this corresponds to the depth interval with the highest VOC and dioxin concentrations detected in soil. Additionally, the top 50 cm (approximately 19 inches) of the SPMD deployed in well MW-05S in 2005 exhibited staining upon retrieval. Multiplying the specific discharge value(s) by recent dioxin concentrations measured in MW-05S will allow the dioxin flux towards the river to be estimated.

The application of a chemical retardation factor by aquifer materials may be considered in the dioxin flux estimate; however, this factor is expected to be low, as it is dependent on the mechanism that is mobilizing the dioxins in the groundwater. If a chemical retardation factor is applied it will be based on the properties of TCE and PCE, which are likely the mechanism by which the dioxin is being mobilized. The retardation factor is calculated using the following equation:

$$R = 1 + r_b k_d / q$$

Where:

R = retardation factor
r_b = bulk density = $r_s(1-q)$
r_s = solids density
q = porosity
k_d = (soil) distribution coefficient = $f_{oc} * K_{oc}$
f_{oc} = fraction organic carbon
K_{oc} = organic carbon/water partition coefficient

6.0 DATA MANAGEMENT AND REPORTING

Field and final, quality-assured analytical data will be loaded into the project database in accordance with the *Final Data Management Plan Update, Interim Data Collection, Centredale Manor Restoration Project Site* (DMP Update; September, 2002), as modified in the *Addendum to the Data Management Plan* (January, 2004). TPH data entered into the CMRP database will be documented as not receiving third-party validation.

Project deliverables will include an email summary of the field survey, a groundwater flow direction map, and a range of estimated dioxin flux from groundwater to surface water. The email summary of the survey will be provided to USACE and USEPA within five business days of survey completion. Sample

collection and analysis results, as well as the dioxin flux estimate and groundwater flow map will be incorporated into the Feasibility Study.

7.0 REFERENCES

Battelle. 2002. *Final Field Sampling Plan for the Interim Data Collection Remedial Investigation and Feasibility Study for the Centredale Manor Restoration Project Superfund Site.* Prepared for U.S. Army Corps of Engineers New England District. September.

Battelle. 2003. *Final Data Summary Report, Interim Data Collection for the Remedial Investigation/Feasibility Study, Centredale Manor Restoration Project Superfund Site, North Providence, Rhode Island.* Prepared for U.S. Army Corps of Engineers New England District. September.

Battelle. 2005. *Task RI-13 Semi-permeable Membrane Device (SPMD) Investigation, Chemistry Data Report.* Prepared for U.S. Army Corps of Engineers New England District. November.

Tetra Tech NUS (TTNUS). 2002. Draft Technical Memorandum—Source Area Investigation Technical Assistance, Centredale Manor Restoration Project Site, North Providence, Rhode Island. January.

U.S. Geological Survey. 2000. Distribution of Selected Volatile Organic Compounds Determined with Water-to-Vapor Diffusion Samplers at the Interface Between Ground Water and Surface Water, Centredale Manor Site, North Providence, Rhode Island, September 1999. USGS Open File Report No. 00-276.

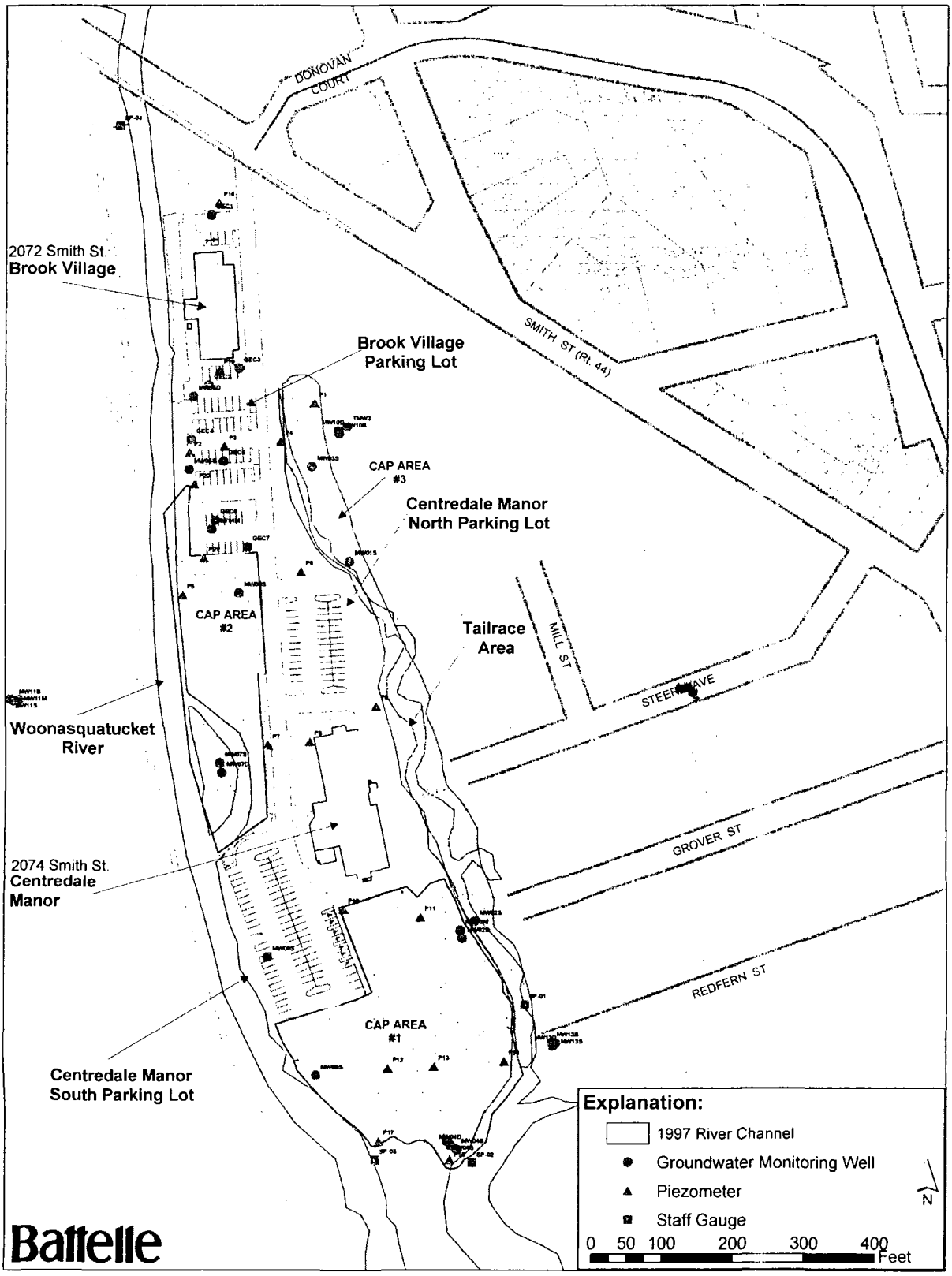

Figure 1. Monitoring Well, Piezometer and Staff Gauge Locations.

Attachment 1. Example Groundwater Sampling Data Collection Form

FIELD DATA RECORD - GROUNDWATER SAMPLING

Project _____
Well ID _____
Measured Well Depth (ft) _____
Depth to Water (ft) _____
Height of Water Column (ft) _____
Screen Length (ft) _____

PURGE DATA

Time:						
Depth to Water (ft):						
Purge Volume (L):						
Temperature (degrees Celsius):						
pH (units):						
Turbidity (ntu):						
Conductivity (uhmos/cm):						
Dissolved Oxygen (mg/L):						

Sample Observations:

Sample Id's	Date/Time	Sampler	Analysis

Attachment 2: Groundwater Elevation Data Collection Form

Boring	Northing	Easting	TOR Elevation (ft)	Measured Depth to Groundwater (ft)	Date/ Initials	Observations
GEC-1	282460.55	331644.27	104.32			
GEC-2	282219.95	331641.29	103.80			
GEC-3	282243.93	331684.41	103.67			
GEC-4	282142.86	331616.28	102.34			
GEC-5	282112.10	331662.12	103.51			
GEC-6	282028.49	331650.67	99.70			
GEC-7	281990.25	331696.75	98.90			
MW-01S	281970.35	331841.81	99.23			
MW-02D	281435.54	332002.13	99.95			
MW-02M	281446.73	331999.44	99.78			
MW-02S	281459.31	332019.46	97.16			
MW-03S	282104.34	331787.56	100.59			
MW-04B	281137.18	331994.98	98.17			
MW-04D	281142.69	331986.75	98.70			
MW-04S	281148.63	331981.18	98.79			
MW-05S	282100.30	331613.19	102.34			
MW-06S	281925.58	331684.87	100.50			
MW-07D	281671.71	331660.74	97.91			
MW-07S	281685.78	331657.53	98.32			
MW-08S	281409.29	331727.56	96.33			
MW-09S	281241.86	331797.08	100.55			
MW-10B	282151.72	331826.13	108.11			
MW-10D	282155.94	331824.98	107.99			
MW-11B	281773.14	331366.64	119.30			
MW-11M	281774.41	331373.63	118.73			
MW-11S	281775.08	331361.73	119.42			
MW-12B	280888.55	331817.24	105.40			
MW-12D	280894.13	331815.50	105.62			
MW-13B	281288.18	332129.87	98.48			
MW-13D	281283.26	332131.30	98.43			
MW-13S	281287.17	332135.38	98.85			
MW-14M	282015.56	331645.60	99.31			
MW-15D	282204.45	331619.16	102.69			
P1	282194.89	331791.27	98.79			
P10	281476.69	331835.15	98.14			
P11	281464.85	331943.05	98.20			
P12	281251.54	331898.86	98.26			
P13	281254.18	331963.42	97.45			
P14	281261.57	332062.35	94.77			
P15	281122.37	331985.28	94.91			
P16	282477.80	331655.35	105.01			

Attachment 2: Groundwater Elevation Data Collection Form (continued)

Boring	Northing	Easting	TOR Elevation (ft)	Measured Depth to Groundwater (ft)	Date/ Initials	Observations
P17	281148.37	331885.20	95.89			
P2	282123.78	331613.82	102.63			
P20	282078.96	331620.95	102.25			
P21	281974.73	331635.36	98.98			
P3	282133.12	331663.37	103.40			
P4	282140.10	331743.58	98.63			
P5	281922.30	331605.21	101.59			
P6	281955.45	331773.16	97.59			
P7	281710.53	331726.37	97.61			
P8	281715.46	331785.48	98.79			
P9	281765.54	331879.58	97.57			
SP-01	281342.32	332090.74	96.35			
SP-02	281118.23	332016.87	94.62			
SP-03	281122.48	331880.05	97.46			
SP-04	282586.61	331515.14	99.10			