Illinois
Environmental
Protection Agency

Bureau of Land
1021 North Grand Avenue East
Box 19276
Springfield, IL 62794-9276

RCRA FACILITY GROUNDWATER, LEACHATE AND GAS REPORTING FORM

This form must be used as a cover sheet for the notices and reports, identified below as required by: (1) a facility's RCRA interim status closure plan; (2) the RCRA interim status regulations; or (3) a facility's RCRA permit. All reports must be submitted to the Illinois EPA's Bureau of Land Permit Section. This form is for use by Hazardous Waste facilities only. Reporting for Solid Waste facilities should be submitted on a separate form. All reports submitted to the Illinois EPA's Bureau of Land Permit Section must contain an original, plus a minimum of two copies.

Note: This form is not to be used with permit or closure plan modification requests. The facility's approved permit or closure plan will state whether the document you are submitting is required as a report or a modification request.

Facility Name: Fermi National Accelerator Laboratory Site ID #: 0890105010
Facility Address: Kirk Road and Pine Street, Batavia, IL Fed ID #: IL6890030046

Check the appropriate heading. Only one heading may be checked for each corresponding submittal. Check the appropriate sub-heading, where applicable. Attach the original and all copies behind this form.

___ LPC-160 Forms

Groundwater
___ Quarterly – Indicate one: 1 2 3 4
___ Semi-Annual
___ Annual
___ Biennial

Leachate
___ Quarterly – Indicate one: 1 2 3 4
___ Semi-Annual
___ Annual
___ Biennial

X Groundwater Data (without LPC-160 Forms)
___ Quarterly – Indicate one: 1 2 3 4
___ Annual X Semi-Annual ___ Biennial

___ Well Construction Information
___ Well Construction Forms, Boring Logs and/or Abandonment Forms
___ Well Survey Data (e.g., Stick-up Elevation Data)

___ Notice of Statistically Significant Evidence of Groundwater Contamination (35 Ill. Adm. Code 724.198)

___ Notice of Exceedence of Groundwater Concentration Limit (35 Ill. Adm. Code 724.199(h))

___ Notice of Alternate Source or Error in Sampling Analysis or Evaluation of Groundwater (35 Ill. Adm. Code 724.199(i))

___ Gas Monitoring Reports

X Other (identify) Section III of the report contains the CD of electronic submission files.

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Fermi National Accelerator Laboratory (Fermilab) RCRA Facility Investigation Semi-Annual Groundwater Monitoring Report For CUB Pipe and Clay Tile Field (SWMU 12)

Monitoring Activities
January 1, 2018 through June 30, 2018

July 2018

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Section I
Illinois EPA RCRA Corrective Action Certification

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ILLINOIS EPA RCRA CORRECTIVE ACTION CERTIFICATION

This certification must accompany any document submitted to Illinois EPA in accordance with the corrective action requirements set forth in a facility's RCRA permit. The original and two copies of all documents submitted must be provided.

1.0 FACILITY IDENTIFICATION

Name: Fermi National Accelerator Laboratory (Fermilab) County: Kane

Street Address: Kirk Road and Pine Street Site No. (IEPA): 0890105010

City: Batavia Site No. (USEPA): IL6890090046

2.0 OWNER INFORMATION

Name: U.S. Department of Energy

Mailing Address: (DOE) Fermi Site Office

P.O. Box 2000, M.S. 118

Batavia, Illinois 60510-5011

Contact Name: Michael J. Weis

Contact Title: Site Manager

Phone No.: 630-840-3281

3.0 OPERATOR INFORMATION

Fermi Research Alliance, LLC

Fermi Research Alliance, LLC

P.O. Box 500, M.S. 105

Batavia, Illinois 60510-5011

Nigel S. Lockyer

Director

630-840-3211

4.0 TYPE OF SUBMISSION (check applicable item and provide requested information, as applicable)

☐ RFI Phase I Workplan/Report
☐ RFI Phase II Workplan/Report
☐ CMP Report; Phase _____
☒ Other (describe):
Semi-Annual GW Monitoring Report for SWMU12
Date of Submittal July 2018

IEPA Permit Log No. B-131R2-CA-1
Date of Last IEPA Letter on Project October 23, 2017
Log No. of Last IEPA Letter on Project B-131R2-CA-1
Does this submittal include groundwater information: ☒ Yes ☐ No

5.0 DESCRIPTION OF SUBMITTAL: (briefly describe what is being submitted and its purpose)

Report summarizing the results of semi-annual groundwater monitoring for the Central Utility Building Pipe and Clay Tile Field (SWMU 12) at Fermilab

6.0 DOCUMENTS SUBMITTED (identify all documents in submittal, including cover letter; give dates of all documents)

Fermi National Accelerator Laboratory (Fermilab), RCRA Facility Investigation, Semi-Annual Groundwater Report, CUB Pipe and Clay Tile Field (SWMU 12), with CD of Submission Files; RCRA Facility Groundwater, Leachate and Gas Reporting Form (LPC-592); and Cover Letter - all dated July 2018

7.0 CERTIFICATION STATEMENT - ***(This statement is part of the overall certification being provided by the owner/operator, professional and laboratory in Items 7.1, 7.2 and 7.3 below)***. The activities described in the subject submittals have been carried out in accordance with procedures approved by Illinois EPA. I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

SIGNED CERTIFICATION IN ORIGINAL SUBMITTAL

7.1 **OWNER/OPERATOR CERTIFICATION** (Must be completed for all submittals. Certification and signature requirements are set forth in 35 IAC 702.126.) All submittals pertaining to the corrective action requirements set forth in a RCRA Permit must be signed by the person designated below (or by a duly authorized representative of that person):

1. For a Corporation, by a principal executive officer of at least the level of vice-president.
2. For a Partnership or Sole Proprietorship, by a general partner or the proprietor, respectively.
3. For a Governmental Entity, by either a principal executive officer or a ranking elected official.

A person is a duly authorized representative only if:

1. the authorization is made in writing by a person described above; and
2. the written authorization is provided with this submittal (a copy of a previously submitted authorization can be used).

Owner Signature: _____ _____ (Date)

Title: Site Manager

Operator Signature: _____ _____ (Date)

Title: Director

7.2 **PROFESSIONAL CERTIFICATION** ***(if necessary)*** - Work carried out in this submittal or the regulations may also be subject to other laws governing professional services, such as the Illinois Professional Land Surveyor Act of 1989, the Professional Engineering Practice Act of 1989, the Professional Geologist Licensing Act, and the Structural Engineering Licensing Act of 1989. No one is relieved from compliance with these laws and the regulations adopted pursuant to these laws. All work that falls within the scope and definitions of these laws must be performed in compliance with them. The Illinois EPA may refer any discovered violation of these laws to the appropriate regulating authority.

Professional's Signature: _____ _____ Date:

Professional's Name: _____ Professional's Seal:

Professional's Address: _____

_____

_____

Professional's Phone No.: _____

7.3 **LABORATORY CERTIFICATION** ***(if necessary)*** - The sample collection, handling, preservation, preparation and analysis efforts for which this laboratory was responsible were carried out in accordance with procedures approved by Illinois EPA.

Name of Laboratory First Environmental Laboratories, Inc.

_____
Signature of Laboratory Responsible Officer Date

Mailing Address of Laboratory

_____
Name and Title of Laboratory Responsible Officer

1600 Shore Road

Naperville, IL 60563

_____

SIGNED CERTIFICATION IN ORIGINAL SUBMITTAL

Section II
Summary of Analytical Results

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CUB Pipe and Clay Tile Field: Groundwater Monitoring Results, January 1, 2018 through June 30, 2018

Glacial Deposit Monitoring Wells

PARAMETER	Class II GW Quality Standard	Lab MDL	Lab LOQ	Well MWD1 CUBD1	Well MWS1 CUBS1	Well MWS2 CUBS2	Well MWS3 CUBS3	Well MWS4 CUBS4	Well MWS5 CUBS5	FIELD BLANK
Sample Date				05/31/18	05/31/18	05/31/18	05/31/18	05/31/18	05/31/18	05/30/18
ToC Elevation (MSL)				747.91	747.54	747.21	745.85	748.34	745.21	X
Depth to Water from ToC (ft)				6.50	4.57	5.05	4.78	5.53	4.43	X
Depth to Water from LS (ft)				4.2	2.3	3.1	2.3	3.0	2.2	X
Water Elevation (MSL)				741.41	742.97	742.16	741.07	742.81	740.78	X
Well Depth from ToC (ft)				42.25	14.11	16.65	16.91	15.95	15.23	X
Bottom of Well Elevation (MSL)				705.66	733.43	730.56	728.94	732.39	729.98	X
pH				7.54	NO LONGER REQUIRED					X
Specific Conductivity (µS/cm)				2630						X
Temperature (ºC)				13.2						X
Temperature (ºF)				55.8						X
INORGANIC (mg/L)										
Chloride, Total	200	0.314	1	1010						2 J
Lead, Total	0.1	0.0006	0.002	0.002 J						U J

Grey Shading = Above the Class II GW Quality Standard
U = Undetected at the Lab Limit of Quantitation (LOQ)
J = Estimated
NA = Not Analyzed

Bedrock Monitoring Wells

PARAMETER	Class I GW Quality Standard	Lab MDL	Lab LOQ	Well MW6B CUBBd4	Well MW7B CUBBd3	Well MW8B CUBBd2	Well MW9B CUBBd1
Sample Date				05/29/18	05/29/18	05/29/18	05/29/18
ToC Elevation (MSL)				745.07	745.43	748.55	748.18
Depth to Water from ToC (ft)				57.75	58.29	59.57	58.97
Depth to Water from LS (ft)				55.5	55.9	57.0	56.1
Water Elevation (MSL)				687.32	687.14	688.98	689.21
Well Depth from ToC (ft)				92.90	71.57	92.56	94.11
Bottom of Well Elevation (MSL)				652.17	673.86	655.99	654.07
pH				7.44	7.74	7.77	7.43
Specific Conductivity (µS/cm)				667	479	NA*	585
Temperature (ºC)				15.4	12.5	12.3	12.1
Temperature (ºF)				59.7	54.5	54.1	53.8
INORGANIC (mg/L)							
Chloride, Total	200	0.314	1	21	3 J	3 J	5
Lead, Total	0.0075	0.0006	0.002	0.012	0.074	U J	U J

Grey Shading = Above the Class I GW Quality Standard
U = Undetected at the Lab Limit of Quantitation (LOQ)
J = Estimated
NA = Not Analyzed (*meter error while reading field parameters for MW-8B)

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Section III
Computer Disk of Submission Files

Fermi National Accelerator Laboratory (Fermilab)
RCRA Facility Investigation
Semi-Annual Groundwater Monitoring Report
CUB Pipe and Clay Tile Field (SWMU12)

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CD of Electronic Submission Files
(In Original Only)

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Section IV
Groundwater Sampling Procedure

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Procedure for Sampling Ground Water for Chemical Analysis at the CUB Tile Field

Objective

The objective is to determine the extent of contaminant migration from the historical discharge of wastewater, containing chromates and chlorides into the Central Utility Building (CUB) Tile Field.

Discussion

Trace amounts of heavy metals, including chromates, and copious quantities of sodium chloride were discharged into the CUB Tile Field inside the Main Ring (Tevatron) from the early 1970's to the early 1990's. Chromate discharges resulted from the use of zinc chromate as a corrosion inhibitor while chlorides and low-level radioactive discharges resulted from wastewater in the regeneration processes. Currently, Fermi National Accelerator Laboratory (FNAL) holds a pretreatment permit to discharge all wastewater for processing to the City of Batavia Sewage Treatment Plant.

The CUB Tile Field has been designated as a Solid Waste Management Unit (SWMU 12) by the Illinois Environmental Protection Agency (IEPA) according to the Resource Conservation and Recovery Act (RCRA) Part B permit issued to FNAL. In order to comply with the permit FNAL established a quarterly sampling program for monitoring the Class I and Class II ground water. IEPA has since reduced the sampling frequency to semi-annual.

In 1987 a series of seven monitoring wells was installed to allow sampling of ground water for analysis to Class II ground water standards per Title 35 Section 724 Appendix I of IAC. One of these wells (CUBD2) has subsequently been abandoned due to issues with the installation. Four wells (CUBS2, CUBS3, CUBS4, CUBD1) monitor ground water within the tile field, while two other wells (CUBS1, CUBS5) were installed as controls, up and down gradient respectively.

In 1997 four additional monitoring wells (CUBBd1, CUBBd2, CUBBd3, CUBBd4) were installed around the perimeter of the tile field to sample the ground water for analysis to Class I ground water standards per Title 35 Section 724 Appendix I of IAC. CUBBd1 was constructed up gradient for use as a background monitoring well. Results from this well are used as baseline values for comparison to the other wells. Appendix A illustrates the locations of the CUB Tile Field monitoring wells.

The six remaining original monitoring wells contain no instrumentation. Therefore, they must be purged manually using disposable Teflon™ bailers attached to dedicated reels of Teflon™ line. These samples will be collected after purging, as soon as the well has sufficiently recharged.

The four additional monitoring wells were installed with Grundfos® Redi-Flo 2 pumps. A Multi-probe Monitoring Chamber (MMC) is used in-line to enable real-time collection of pH, temperature, and conductivity data throughout the purge event. Evaluation of these three parameters allows the determination of their stabilization, indicating that water representative of the screened stratigraphic unit is being withdrawn, at which time a sample is collected.

The sample analysis parameters consist of routine field parameters and routine indicator parameters (Appendix B) set forth by the IEPA. Additionally, a sample blank of certified double-distilled deionized water must be prepared at some time within the period of sampling. The blank is prepared in the field and analyzed for the same parameters as the other samples. All samples are submitted for analysis to an off-site analytical laboratory.

Special Instructions

- Approximately two weeks prior to sampling, contact the chemical analysis laboratory (Appendix C) with the current sampling event's parameter list and arrange for the proper number and types of bottles (adding preservative when necessary) and coolers to be delivered to the FNAL Shipping/Receiving Warehouse 2 (where they may be picked up). The bottles should then be inspected to ensure the correct preservatives are in the appropriate bottles and the correct number of bottles has been received.
- Wear disposable latex or Nitrile™ gloves when inspecting the bottles in case any have leaked preservative. Be suspicious of any fluids found in the coolers.
- Personnel performing the sampling must have completed OS000146/CR 40-Hour Hazardous Waste Site Operations (HAZWOPER) with OS000144/CR annual refresher training as needed, and have current records on file.

- Successful completion of FN000125/CR (Material Move Survey) is required of all personnel using a Material Move Request (MMR) form.
- Sampling procedures should be performed carefully to prevent contamination:
  1. The field vehicle must not be running during the sampling event.
  2. A new pair of disposable latex or Nitrile™ gloves must be worn for each well sampled.
  3. Where applicable, use a new disposable Teflon™ bailer and dedicated Teflon™ line at each well.
  4. Do not allow sampling equipment to contact the ground.
  5. Collect samples up-wind away from the electrical generator to avoid gasoline and/or exhaust fumes.
  6. Decontaminate the pH/temperature and conductivity sensors with a distilled water rinse between uses.
- Manually purged wells must be purged for a minimum of two bore volumes **or** until they go dry. Each well purged using the Grundfos® system will be purged for a minimum of two bore volumes **and** until the pH, temperature, and conductivity parameters have stabilized **or** until it purges dry, whichever occurs first. After purging two bore volumes, the indicator parameters may be considered stabilized if, over the span of three consecutive minutes, the pH, temperature, and conductivity have not varied more than 0.01, 0.1 °C, and 10%, respectively.

Equation 1 gives the calculation for determining bore volume in gallons.

Equation 1. $V = \pi r^2 (A - B) \times 7.48$

Where:
V = Well bore volume (gallons)
A = Well total depth (feet)
B = Depth to water from the top of the casing (feet)
r = Radius of the well inner casing (feet)
7.48 = Conversion factor (ft^3 to gallons)

For two-inch diameter wells Equation 1 can be simplified to:

Equation 2. $V = (A - B) \times 0.163$

For four-inch diameter wells Equation 1 can be simplified to:

Equation 3. $V = (A - B) \times 0.653$

To convert the volume to liters, multiply the resulting volume by 3.785.

I) Till Wells (CUBS1, CUBS2, CUBS3, CUBS4, CUBS5, CUBD1)

Equipment

WH7E
CUB Tile Field Well Logbook
Chemical Analysis Laboratory Chain-of-Custody (COC)
Calculator
A6 Key

Site 39
Calibrated pH/Temperature Meter
Conductivity Meter
Electronic Water Level Meter
Decontaminated Teflon™ Line Dedicated to Each Well
Disposable Teflon™ Bailers
Disposable Latex or Nitrile™ Gloves
1-Liter Rinse Bottle of Distilled Water
5-Gallon Box of Double-Distilled Deionized Water
5-Gallon Rinse Bucket with Distilled Water

Appropriate Sample Bottles
Coolers with Ice

Procedure

1) Notify the chemical analysis laboratory prior to the sampling event to help ensure a smooth transition of samples from FNAL to the analytical lab. This is not necessary if the samples are to be taken directly to the laboratory following collection. Any additional sample preparation, such as filtering prior to analysis, will be completed at the analytical lab and should be noted on the COC.
2) At Site 39 decontaminate the dedicated Teflon™ lines and spools using Liqui-Nox™, tap water, and a final rinse of distilled water.
3) Calibrate the pH/temperature meter following the procedures outlined in EP Group procedure EP 091 (Calibration of the Orion Model 250A pH/Temperature Meter) and load all listed equipment into the field vehicle.
4) At the well site unlock the casing using the A6 key.
5) Record the field sampling conditions in the logbook.
6) Wearing a pair of disposable latex or Nitrile™ gloves use the electronic water level meter to measure the depth-to-water. Reference each measurement from the top of the outer protective casing. Decontaminate the water level meter tape by running it through the five-gallon bucket of distilled water.
7) Calculate the bore volume (using the equations given in the Special Instructions section of these procedures) to determine the number of bails required to purge two bore volumes (1 bail = 1 liter) or if the water volume is sufficient, to provide a representative ground water sample. Record the depth-to-water and the bore volume in the field logbook
8) Clip the Teflon™ line, dedicated to the well being sampled, to a disposable bailer.
9) Lower the bailer to the water allowing it to fill.
10) Retrieve the bailer by coiling the line back around the spool and pour the purge water onto the ground. Continue purging until the well is dry or two bore volumes have been purged. Under normal conditions the wells should recharge within about 30 minutes. If the ground is dry, the wells may take two or more days to recharge.

    Special Notes:
    - To prevent contamination, never allow the Teflon™ line or bailer to touch foreign objects or the ground.
    - Keep the samples away from any sources of contamination, i.e. samples from other wells, etc.

11) All samples will be taken as the wells are recharging. Sampling is accomplished by **slowly** lowering the bailer to the water and allowing it to fill. Perform this step methodically, to prevent agitation of the sediment at the bottom of the well.
12) Retrieve the bailer, as before, and carefully empty the contents into the sample bottle.
13) Repeat steps 11 & 12 until all the samples are collected.
14) Measure the pH, temperature, and conductivity in one of the non-preserved sample bottles.
15) Decontaminate each sensor with a distilled water rinse between uses.
16) Label the bottles with the proper Sample Identification (SID), location, date, and time then place in the cooler for storage.
17) Complete all appropriate entries in the field logbook and the COC.
18) At one of the sample locations, prepare a field blank by pouring reagent grade double-distilled deionized water into a new bailer then dispensing the water into the sample bottles provided by the chemical analysis laboratory.
19) Label the bottles with the proper SID, location (CUBS0), date, and time then place in the cooler for storage. The offsite laboratory is to analyze for the same parameters as the other samples collected.
20) Complete all appropriate entries on the COC.
21) Take the samples to Site 39 to ensure that all labels are accurate and attached securely to the bottles. Also ensure that the COC is complete and accurate.
22) Decontaminate the Teflon™ lines and spools with Liqui-Nox™, tap water, and a final rinse of distilled water.
23) Deliver the samples to Shipping/Receiving (Warehouse 2) and complete a MMR. Relinquish the samples to shipping personnel and instruct them to do the same when the chemical analysis laboratory's agent picks up the samples. Remove the bottom (pink) copies of both the signed COC and MMR. Return the copies to the

EP Group file on WH7E for storage until analytical results are received. Call the chemical analysis laboratory to confirm pickup of the samples. Alternatively, the samples may be taken directly to the chemical analysis laboratory. In this instance a MMR is not necessary.

24) At WH7E enter all depth-to-water data in their appropriate locations on the Fermilab Environmental Database (FED).

II) Dolomite Wells (CUBBd1, CUBBd2, CUBBd3, CUBBd4)

Equipment

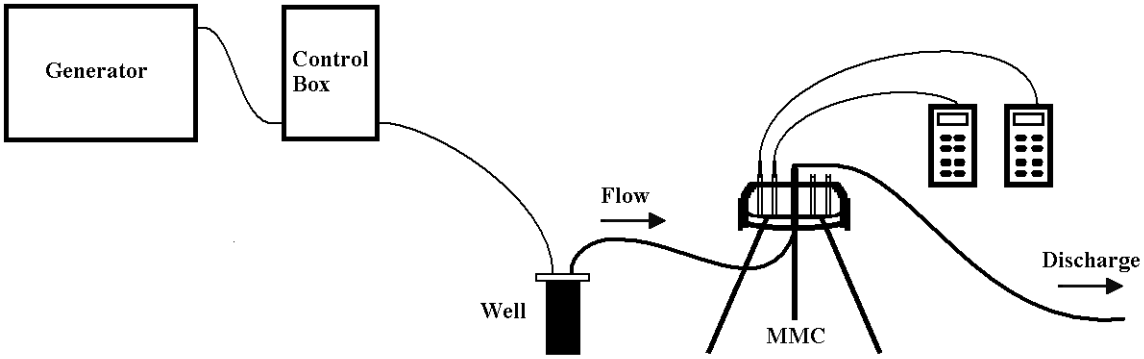
WH7E
CUB Tile Field Well Logbook
Flow Thru Cell Logsheets – Form EP 001
Chemical Analysis Laboratory Chain-of-Custody (COC)
Calculator
A6 Key

Site 39
Calibrated pH/Temperature Meter
Conductivity Meter
Electronic Water Level Meter
Multi-probe Monitoring Chamber (MMC)
Grundfos® Power Converter Box
Grundfos® Sampling Tube with Tubing Adapter
Electrical Generator with GFCI Cord
Disposable Latex or Nitrile™ Gloves
5-Gallon Rinse Bucket with Distilled Water
5-Gallon Carboy
Appropriate Sample Bottles
Coolers with Ice
Stopwatch

Procedure

1) Notify the chemical analysis laboratory prior to the sampling event to help ensure a smooth transition of samples from FNAL to the analytical lab. This is not necessary if the samples are to be taken directly to the laboratory following collection. Any additional sample preparation, such as filtering prior to analysis, will be completed at the analytical lab and should be noted on the COC.
2) Calibrate the pH/temperature meter following the steps outlined in EP Group procedure EP 091 (Calibration of the Orion Model 250A pH/Temperature Meter), fill the generator with gasoline, and load all listed equipment into the field vehicle.
3) At the well site, unlock the casing using the A6 key.
4) Record the field sampling conditions in the logbook.
5) Wearing a pair of disposable latex or Nitrile™ gloves use the electronic water level meter to measure the depth-to-water. Reference each measurement from the top of the outer protective casing.
6) Decontaminate the water level meter tape by running it through the five-gallon bucket of distilled water.
7) Calculate the bore volume (gallons), using Equation 2 (given in the Special Instructions section of this document), and record the depth-to-water and the bore volume in the field logbook.
8) Assemble the MMC and generator apparatus (Figure 1). Loosen the appropriate fittings on the MMC and insert the pH/temperature and conductivity sensors. The sensors should be adjusted so that the tips are hanging just above the bottom of the MMC to ensure accurate readings. Carefully tighten the fittings. Do not over-tighten or the sensors may be damaged. Screw the threaded end of the tubing adapter to the sampling port on the well and clip the quick-connect together linking the well to the MMC. Fit one end of the motor lead plug to the power converter box and the other end to the well. Plug the power converter box into the GFCI outlet and plug the GFCI cord into the generator.

Figure 1: Equipment Setup



9) On the generator, set the Engine switch to the "on" position and the A/C circuit breaker to the "off" position then start the generator allowing it to warm if necessary. Adjust the choke as needed.
10) Turn the pH/temperature and conductivity meters on, making sure that the pH/temperature meter is in the measure mode and the conductivity meter is displaying µmho/sec. Consult the instruction manual in the top cover of the black carrying case for instructions.
11) Set the A/C circuit breaker on the generator to the "on" position.
12) Check the frequency display on the converter, it should read "0". Start the pump by turning the Start/Stop switch into the "Start" position. Increase the flow of water by turning the speed dial until water is steadily flowing out of the MMC discharge. **Do not exceed 8-psi inside the MMC. There is no gauge that shows the pressure reading inside the chamber, but a frequency setting of about 200 should ensure the 8-psi limit will not be exceeded.**
13) Record pH, temperature, and conductivity readings every minute on an EPG Form 001 (Flow Thru Cell). When at least two bore volumes have purged **and** the three parameters stabilize, as described in the Special Instructions, it is assumed water representative of the screened geological unit is being discharged and a sample is drawn from the MMC discharge tube. If the parameters do not stabilize after twenty minutes, readings should be taken every five minutes until stabilization or until the well purges dry.

    Special Note: Keep the samples away from any sources of contamination, i.e. the generator, samples from other wells, etc.

14) During the purge process, measure the time taken to fill the five-gallon carboy and record the flow rate.
15) Turn the Start/Stop switch on the converter box to the "Stop" position and, to prevent damage to the converter box, set the generator's A/C circuit breaker to the "off" position **BEFORE** shutting down the generator. Dismantle the sampling apparatus.
16) Label the bottles with the proper Sample Identification (SID), location, date, and time then place in the cooler for storage.
17) Fill out the appropriate entries in the field logbook and the COC.
18) Take the samples to Site 39 to ensure that all labels are accurate and attached securely to the bottles. Also ensure that the COC is complete and accurate.
19) Decontaminate the MMC and related tubing with Liqui-Nox™, tap water, and a final rinse of distilled water.
20) Deliver the samples to Shipping/Receiving (Warehouse 2) and complete a MMR. Relinquish the samples to shipping personnel and instruct them to do the same when the chemical analysis laboratory's agent picks up the samples. Remove the bottom (pink) copies of both the signed COC and MMR. Return the copies to the EP Group file on WH7E for storage until analytical results are received. Call the chemical analysis laboratory to confirm pickup of the samples. Alternatively, the samples may be taken directly to the chemical analysis laboratory. In this instance a MMR is not necessary.
21) At WH7E enter all depth-to-water and flow-thru-cell data in their appropriate locations on the Fermilab Environmental Database (FED).

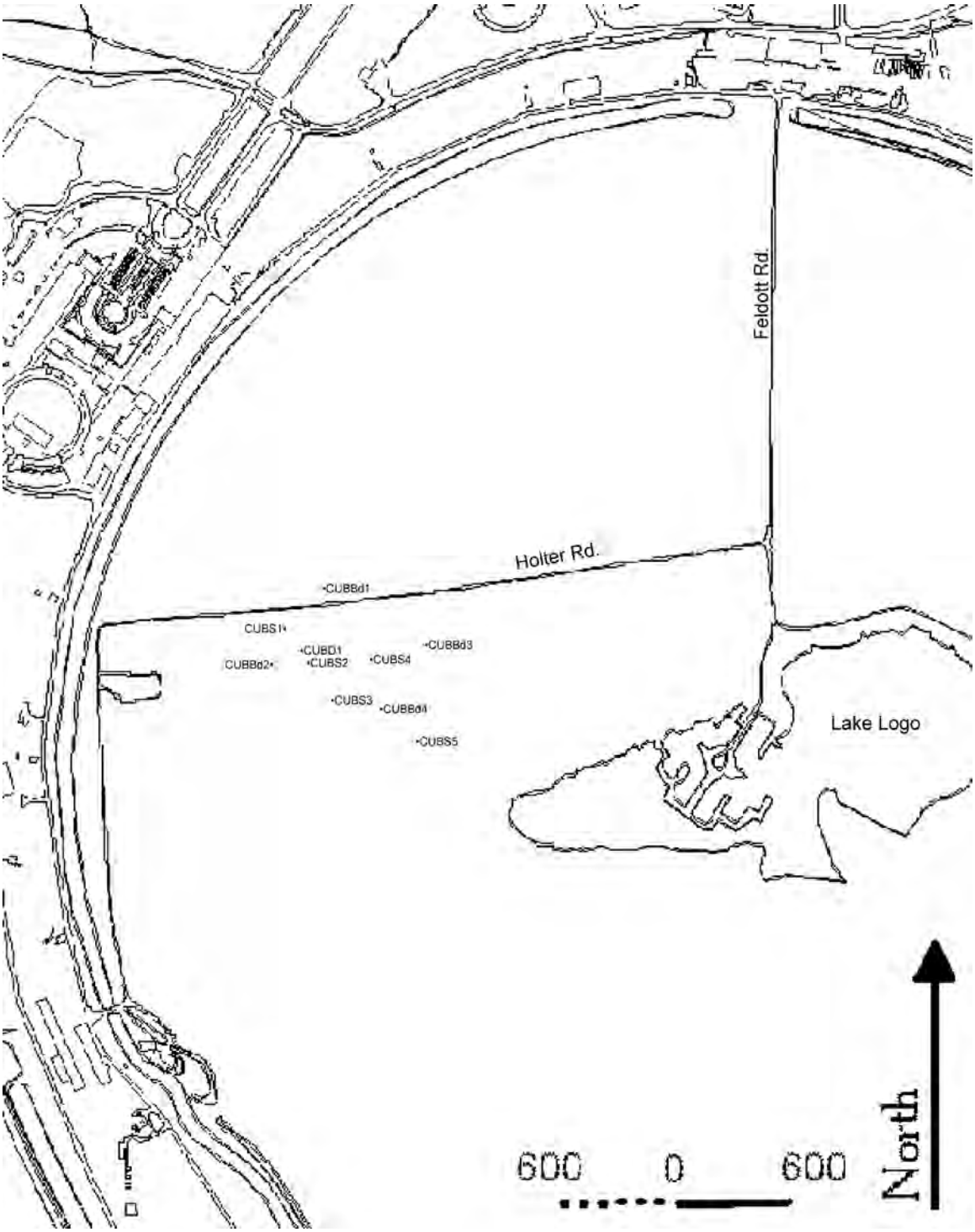
References

1) ASTM Standards, Volume 11.01, Designation: D 3370-82 Standard Practices for Sampling Water, 1988.
2) CUB Tile Field Corings Notebook.
3) Orion Laboratory Products Group Portable pH ISE Meters Instructions Manual Mode 250, Orion Research Incorporated, 1991.
4) Orion Model 124 Conductivity/TDS Meter Instruction Manual, Orion Research Incorporated, 1991.

Appendix A

Well Location Map

Central Utility Building (CUB) Pipe and Clay Tile Field (SWMU 12)
Bedrock and Glacial Till Monitoring Wells



Appendix B

Routine Field and Indicator Parameters

Routine Parameters

Field Parameters	**Indicator Parameters**
Bottom of Well Elevation (ft)	*Unfiltered*
Depth to Water (ft below LSD)	Chloride (total)
Depth to Water (ft from measuring point)	Lead (total)
Elevation of Ground Water Surface (ft)	
pH (SI units)	
Specific Conductance (µmhos/cm)	
Temperature of Water (ºF)	
Weather Conditions	

Appendix C

Chemical Analysis Laboratory Contact Information

First Environmental Laboratories, Inc.
1600 Shore Road, Suite D
Naperville, IL 60563

Contact: Lorrie Franklin
Office: 630-778-1200
Fax: 630-778-1233
Pager: 708-569-7507
Email: lorrie@firstenv.com

Section V
Photocopies of Field Log Book Entries

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2 MW-S1/CUBS1

Date/ Time	By	SID	Collection Type	Analysis	Container	Preservative	Temp. (°C)	pH	Conductivity (µS/cm)	DTW (ft)
11-9-16 1500	CG	161109CG06	G	Total Pb Total Chloride	1-250ml poly 1-250ml poly	HNO_3 NT	14.9	7.20	1046	8.00
6-6-17 1515	CG	170606CG05	G	Total Pb Total Chloride	1-250ml poly 1-250ml poly	HNO_3 NT	~~6.98~~ GP 6-6-17 17.6	6.98	819	6.64
11-8-17										5.81
5-31-18	—	—	—	—	—	—	—	—	—	4.57

MW-S1/CUBS1

Purge Volume (gal.)	Time Purged (min.)	Purge Rate (gpm)	Well Yield	Well Recovery	Internal Container Temp. (°C)	Field Conditions	Comments (BV, etc.)
~~6.5~~ 4.8 ~~CDA~~ 11/9/16	~~6.5~~ 10 ~~CDA~~ 11/9/16	~~1.0~~ 0.5 cquar 11/9/16	poor	mod.	on ice, 0.1°-6°C	Sunny, ~60°F lt. breeze	TD: 13.83' + 0.27' = 14.10'; 15 L/vol.; bailed dry at 18 L; sampled after recovery
10	25	0.4	Poor	mod	On ice, 0.1°-6°C	Sunny ~75°F light breeze	Using TD = 14.10', 7.46' H_2O × 0.653 g/ft = 4.9 g/vol (18.5 L); 38 L bailed to almost dry in 25 min. Sampled after recovery.
							Sampling no longer required as of IEPA letter dated 10-23-17 (Log No. B-131R2-CA-1).
—	—	—	—	—	—	—	W.L. only

4 MW-S2/CUBS2

Date/Time	By	SID	Collection Type	analysis	container	Preservative	Temp (°C)	pH	Conductivity (mS/cm)	DTW (ft)
11-7-16										7.96
11-9-16 1040	CG	1611092405	G	Total Pb Total Chloride	1-250 ml poly 1-250 ml poly	HNO_3 NT	15.5	7.36	1438	
6-6-17 1440	CG	1706066602	G	Total Pb Total Chloride	1-250 ml poly 1-250 ml poly	HNO_3 NT	19.5	7.59	1497	6.15
11-8-17										4.87
5-31-18	—	—	—	—	—	—	—	—	—	5.05

MW-S2/CUBS2

Purge volume (gal.)	Time Purged (min)	purge rate (gpm)	well yield	Well Recovery	Internal Container Temp (°C)	Field Conditions	Comments
10	15	0.67	mod	mod.		sunny, ~65°F breeze	Using TD = 16.43' + 0.27' = 16.70' − 7.96' = 8.74' H_2O × 0.653 g/ft = 5.7 gal/vol. (21.7 L); dry at 38 L.
					on ice, 0.1°-6°C	sunny, ~53°F lt. breeze	Sampled after recovery
13.7	45	0.30	Mod.	Mod.	on ice 0.1°-6°C	Sunny, ~75°F light breeze	Using TD = 16.43' + 0.27' = 16.70', 10.55' H_2O × 0.653 g/ft = 6.9 g/vol (26 L); 52 L bailed at dry sampled after recovery
							Sampling no longer required as of IEPA letter dated 10-23-97 (Log No. B-131R2-CA-1).
—	—	—	—	—	—	—	W.L. only

Rite in the Rain

6 MW-55/CUB55

Date/Time	By	SID	Collection Type	analysis	container	Preservative	Temp (°C)	pH	Conduct. (µS/cm)	DTW (ft)
11-7-16										6.61
11-9-16 1035	CG	161109CG04	G	Total Pb Total Chloride	1-250ml poly 1-250ml poly	HNO_3 NT	15.2	7.35	844	
6-6-17 1525	CG	170606CG06	G	Total Pb Total Chloride	1-250ml Poly 1-250ml Poly	HNO_3 NT	16.7	7.55	867	5.69
11-8-17										4.98
5-31-18	—	—	—	—	—	—	—	—	—	4.78

MW-33/CUB537

Purge Vol. (gal)	Time Purged (min)	Purge Rate (gpm)	Well yield	Well Recovery	Internal container temp (°C)	Field Conditions	Comments
10.8	15	0.7	mod.	mod.		sunny, ~69°F, breezy	TD = 16.66' + 0.27' = 16.93' − 6.61' = 10.32' × 0.653 gal/ft = 6.7 gal/vol. (25.5 L); dry at 41 L.
					on ice, 0.1°-6°C	sunny, ~53°F, lt. breeze	Sampled after recovery.
14.7	35	0.4	Mod.	Mod.	on ice, 0.1°-6°C	Sunny ~75°F light breeze	Along TD = 16.93', 11.24' H_2O × 0.653 gal/ft = 7.4 gal (28 L); 56 L bailed in 35 min; Sampled after recovery
							Sampling no longer required as of IEPA letter dated 10-23-17 (Log No. B-131R2-CA-1).
—	—	—	—	—	—	—	W.L. only

Rite in the Rain

8 MW-54/CUB34

Date/Time	by	SID	Collection Type	analysis	Container	Preservative	Temp (°C)	pH	conductivity (µS/cm)	DTW (ft)
11-7-16										9.23
11-9-16 1005	CG	161109CG01	G	Total Pb Total Chloride	1-250 ml poly 1-250 ml poly	HNO_3 NT	13.8	6.95	613	
6-6-17 1450	CG	170606CG03	G	Total Pb Total Chloride	1-250 ml poly 1-250 ml poly	HNO_3 NT	17.8	7.35	731	6.94
11-8-17										6.82
5-31-18										5.53

MW54/CUB54

Purge Volume (gal)	Time Purged (min.)	Purge Rate (gpm)	Well yield	Well Recovery	Internal Container Temp (°C)	Field Conditions	Comments
9.8	13	0.7	poor	mod/good		sunny, ~65°F breeze	TD=15.70'+0.27'=15.97'-9.23' =6.74' H_2O × 0.653 gal/ft = 4.4 gal/vol. (16.7L); bailed 3.6 L. ~~Sampled after~~
					on ice, 0.1°-6°C	sunny, ~55°F Hi breeze	Sampled after recovery.
12.	25	0.48	mod.	mod.	on ice, 0.1°-6°C	sunny, ~73°F, breeze.	Using TD=15.97', 9.03' H_2O ×0.653 gal/ft = 5.9 gal (22.4 L); 2 volumes (46L) bailed in 25 min.; Sampled after recovery
							Sampling no longer required as of USEPA letter dated 10-23-17 (Log. No. B-131R2-CA-1)
—	—	—	—	—	—	—	W.G. Cody

Rite in the Rain

10 MW-S5/CUBS5

Date/ Time	by	SID	collection type	analysis	container	Preservative	Temp (°C)	pH	conductivity (µS/cm)	DTW (ft)
11-8-16										6.37
11-9-16 1020	CG	161109CG03	G	Total Pb Total Chloride	1-250 ml poly 1-250 ml poly	HNO_3 NT	13.2	6.93	531	
6-6-17 1500	CG	170606CG04	G	Total Pb Total Chloride	1-250 ml poly 1-250 ml poly	HNO_3 NT	18.3	7.00	543	5.50
11-8-17										5.44
5-31-18	—	—	—	—	—	—	—	—	—	4.43

MW-S5/CVBS5

Purge Volume (gal)	Time Purged (min)	Purge Rate (gpm)	Well yield	Well recovery	Internal container temp (°C)	Field conditions	Comments
10.5	15	0.7	mod.	mod.		sunny, ~65°F, breezy	TD = 14.97' + 0.27' = 15.24' − 6.37' = 8.87' H_2O × 0.653 gal/ft = 5.8 gal/vol (22 L); dry at 40 L.
					on ice, 0.1°-6°C	sunny, ~65°F, lt. breeze	Sampled after recovery. ✱ Needs a new lock ✱ ✱ ✱
12.5	25	0.5	mod.	mod.	on ice, 0.1°C-6°C	sunny, ~75°F light breeze	Using TD = 15.24', 9.24' H_2O × 0.653 gal/ft = 6.4 gal/vol (24 L), 42.5 L bailed (to dry) in 25 min.. Sampled after recovery
							Sampling no longer required as of IEPA letter dated 10-23-17 (Log. No. B-13IR2-(A-1)).
—	—	—	—	—	—	—	W.L. only

Rite in the Rain

12 MW-D1/CUBSD1 6/17: A7 Req (not A6)

Date / Time	by	SID	collection type	analysis	container	Preservative	Temp (°C)	pH	conductivity (µS/cm)	DTW (ft)
11-7-16										9.90 15.40
11-11-16 1440	CG	161111CG01	G	Total Pb Total Chloride	1-250 ml poly 1-250 ml poly	HNO_3 NT	14.8	7.36	2,720	15.40
6-6-17 1430	CG	170606CG01	G	Total Pb Total Chloride	1-250 ml poly 1-250 ml poly	HNO_3 NT	18.9	7.77	3,010	7.77
11-8-17 1325	CG	171109CG03	G	Total Pb Total Chloride	1-250 ml poly 1-250 ml poly	HNO_3 NT	14.1	7.53	2.75 mS/cm	6.87
5-30-18										6.50
5-31-18 1005	CG	180531CG01	G	Total Pb Total Chloride	1-250 ml poly 1-250 ml poly	HNO_3 NT	13.2	7.54	2.63 mS/cm	(3.47)

MW-D1/CUBD1

Purge volume (gal.)	Time purged (min.)	Purge rate (gpm)	well yield	well recovery	internal container temp (°C)	field conditions	Comments
18.4	25	0.73	poor	slow		sunny, ~65°F breeze	Using TD = 42.25' - 9.90' = 32.35' H_2O × 0.653 gal/ft = 21.1 gal (80 L); Started bladder... DIDN'T start bladder - pump is clogged. @ 70 L clamp failed & lost bailer, but recovered on 11/8.
17.4	20	0.8	poor	slow	on ice, 0.1°-6°C	~~pt~~ cloudy, 50°F breeze	Bailed 66 L today; sampled after recovery
23	60	0.38	poor	slow	on ice, 0.1°-6°C	sunny, ~70°F, windy	Using TD = 42.25', 34.48' H_2O × 0.653 gal/ft = 22.5 gal/vol. (86 L); Bailed dry (23 gal) in 60 min. Sampled after recovery
23	~60	0.38	poor	slow	on ice, 0.1°-6°C	sunny, ~48°F, lt. breeze	Using TD = 42.25', 35.38' H_2O × 0.653 gal/ft = 23.1 gal/vol. (88 L); Bladder pump on at 1020 (5 sec fill, ~7 sec disch.), with 3 gal. purged in ~18 min.; 5 gal in 28 min; 15 gal at 1145 with DTW = 31.5' btoc; 12.5 gal at 1200; pulled pump & bailed to 23 gal. (dry at 1220).
23.5	~2.25 hr (~135 min.)	0.17	poor	slow		overcast, ~70°F, calm	TD = 41.95 + 0.27' = 42.22'; 35.17' H_2O × 0.653 gal/ft = 23.3 gal/vol. × 2 = 46.6 gal to purge. Bladder pump on at 0930 (~1 gal. in 7 minutes; ~4 gal. after 20 min.); 18 g purged at 1135 (DTW = 33.6'); total of 23.5 gal. purged & bailed dry at 1450.
					on ice, 0.1°-6°C		Sampled after overnight recovery.

Rite in the Rain

14 MW-6B / CUBBd4

Date / Time	by	SID	collection type	analysis	container	Preservative	temp (°C)	pH	conductivity (mS/cm)	DTW (ft)
11-8-16										58.24
11-9-16 1010	CG	161109CG02	G	Total Pb Total Chloride	1-250 ml poly 1-250 ml poly	HNO_3 NT	12.1	7.19	549	
6-7-17 1530	CG	170607CG04	G	Total Pb Total Chloride	1-250 ml poly 1-250 ml poly	HNO_3 NT	13.4	7.46	638	58.05
11-8-17										59.23
11-9-17 1330	CG	171109CG04	G	Total Pb Total Chloride	1-250 ml poly 1-250 ml poly	HNO_3 NT	12.1	7.59	661	
5-29-17 1455	CG	180529CG03	G	Total Pb Total Chloride	1-250 ml poly 1-250 ml poly	HNO_3 NT	15.4	7.44	667	57.75

MW-6B/CVBBd4

Purge Volume (gal)	Time Purged (min)	Purge Rate (gpm)	well yield	well recovery	internal container temp (°C)	field conditions	Comments
9.3 (2BV)	6.5	1.0	mod.	mod.		sunny, 65°F, breeze	Using TD=92.90', 34.16' H_2O; 4.65 gallons/well volume; Dry @ 6.5 min;
					on ice, 0.1°-6°C	sunny, ~55°F, H. breeze	Sampled after recovery
6.4	9	0.71	mod.	mod.	on ice, 0.1°-6°C	sunny, ~70°F windy	Using TD=92.90'; Dry @ 10 min, sampled after recovery
						Sunny, ~40°F H. wind	Using TD=92.90', 33.62' H_2O × 0.46 gal/ft = 5.55 gal/vol.
6.5	6.5	1.0	mod.	mod.	on ice, 0.1°-6°C	sunny, ~40°F, H. wind	Dry at 6.5 gal.; sampled after recovery
6.8	12.25	0.55	mod.	mod.	on ice, 0.1°-6°C	sunny, ~88°F, H. breeze	Dry at 6.8 gal.; sampled after recovery

16 MW-7B/CUBBd 3

Date/ Time	by	SID	collection type	analysis	container	preservative	Temp (°C)	pH	conductivity (mS/cm)	DTW (ft)
11-9-16 1510	CG	161109CG07	G	Total Pb Total Chloride	1-250ml poly 1-250ml poly	HNO_3 NT	11.8	7.30	462	60.30
6-7-17 1400	CG	170607CG05	G	Total Pb Total chloride	1-250ml poly 1-250ml poly	HNO_3 NT	12.1	7.46	551	59.24
11-8-17										60.51
11-9-17 1345	CG	171109CG05	G	Total Chloride Total Pb	1-250ml poly 1-250ml poly	NT HNO_3	11.9	7.73	476	
5-29-18 1505	CG	180529CG04	G	Total Chloride Total Pb	1-250ml poly 1-250ml poly	NT HNO_3	12.5	7.74	479	58.29

MW-7B/CUBBd3

Purge volume (gal)	Time Purged (min)	Purge Rate (gpm)	well yield	well recovery	internal container temp (°C)	field conditions	Comments
1.5	1.5	1.0	poor	slow	on ice, 0.1°-6°C	sunny, ~60°F, lt. breeze	using TD = 71.57', 11.19' H_2O; sampled after recovery.
2.5	2	1.25	Poor	Slow	on ice 0.1°-6°C	Sunny ~70°F windy	Dry at 2 mins, using TD = 71.57' Sampled after recovery
						Sunny, ~40°F, lt. wind	using TD = 71.57', 11.06' H_2O × 0.165 gal/ft = 1.8 gal./vol.
			poor	slow	on ice. 0.1°-6°C	sunny, ~40°F lt. wind	Dry at 1.5 gal; sampled after recovery.
2	3.75	0.53	poor	slow	on ice, 0.1°-6°C	sunny, ~75°F lt. wind	Dry at 2 gal.; sampled after recovery

18 MW-8B/CUBB22

Date/Time	by	SID	collection type	analysis	container	preservative	Temp (°C)	pH	conductivity (mS/cm)	DTW (ft)
11-8-16 1536	CG	161108CG01	G	Total Pb Total Chloride	1-250ml poly 1-250ml poly	HNO_3 NT	11.9	7.58	399	60.94
6-7-17 1415	CG	170607CG01	G	Total Pb Total Chloride	1-250ml poly 1-250ml poly	HNO_3 NT	12.8	7.80	406	60.10
11-8-17 1109	CG ER	171109CG01	G	Total Pb Total Chloride	1-250ml poly 1-250ml poly	HNO_3 NT	11.7	7.48	405	61.06
5-29-18 1052	CG	180529CG01	G	Total Pb Total Chloride	1-250ml poly 1-250ml poly	HNO_3 NT	12.3	7.77	Meter error	59.57

MW-8B/CUBBd2

Purge volume (gal)	Time Purged (min)	Purge rate (gpm)	well yield	well recovery	internal container temp (°C)	field conditions	Comments
5	5	1.0	good	fast	0.1°-6°C, on ice	sunny, 65°F, breeze.	Using TD=92.56', 31.62' H_2O; 5.5 gallons/well volume; Sampled after stabilization.
10.8	14	0.77	good	fast	0.1°-6°C on ice	Sunny, ~70°F Windy	using TD=92.56', Sampled after Stabilization
11.25	9	1.25	good	fast	0.1°-6°C on ice	sunny, ~40°F H. wind.	Using TD=92.56', 31.5' H_2O x 0.165 gal/ft = 5.2 gal. Vol.; Sampled after stabilization
10.9	12	0.91	good	fast	0.1°-6°C on ice	sunny, ~70°F H. wind	Sampled after stabilization

Rite in the Rain

20 MW-9B/CUBBd1

Date/Time	by	SID	collection type	analysis	containers	preservative	Temp (°C)	pH	Conductivity (mS/cm)	DTW (ft)
11-8-16 1601	CG	161108CG02	G	Total Pb Total Chloride	1-250 ml poly 1-250 ml poly	HNO_3 NT	11.8	7.53	593	60.51
6-7-17 1445	CG EK	170607CG02	G	Total Pb Total chloride	1-250 ml poly 1-250 ml poly	HNO_3 NT	12.5	7.42	598	59.58
11-8-17 1115	CG EK	171108CG02	G	Total Pb Total Chloride	1-250 ml poly 1-250 ml poly	HNO_3 NT	11.6	7.24	580	60.58
5-29-18 1443	CG	180529CG02	G	Total Pb Total Chloride	1-250 ml poly 1-250 ml poly	HNO_3 NT	12.1	7.43	585	58.97

MW-9B/CUBBd1

Purge volume (gal)	Time Purged (min)	Purge Rate (gpm)	well yield	well recovery	internal container temp (°C)	field conditions	Comments
11	11	1.0	good	fast	on ice, 0.1°-6°C	Sunny ~60°F breeze	Using TD = 94.11', 33.60' H_2O, 5.7 gallons/well volume; Sampled after stabilization.
11	16	0.71	good	fast	on ice 0.1°-6°C	Sunny ~70°F windy	Using TD = 94.11 Sampled after stabilization
11.25	9	1.25	good	fast	on ice 0.1°-6°C	Sunny, ~40°F, H-wind	Using TD = 94.11', 33.53' H_2O ×0.165 gal/ft = 5.53 gal/ft; Sampled after stabilization.
11.5	13	0.91	good	fast	on ice, 0.1°-6°C	Sunny, ~70°F H-wind	Sampled after stabilization

Rite in the Rain

Section VI
Analytical Data with Chain-of-Custody Records

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First Environmental Laboratories, Inc.
IL ELAP / NELAC Accreditation # 100292
1600 Shore Road • Naperville, Illinois 60563 • Phone (630) 778-1200 • Fax (630) 778-1233

June 07, 2018

Mr. Eric Korzeniowski
FERMI NATIONAL ACCELERATOR LABORATORY
P.O. Box 500
MS 355
Batavia, IL 60510-0500

Project ID: CUB Tile Field - 642081
First Environmental File ID: 18-3040
Date Received: May 31, 2018

Dear Mr. Eric Korzeniowski:

The above referenced project was analyzed as directed on the enclosed chain of custody record.

All Quality Control criteria as outlined in the methods and current IL ELAP/NELAP have been met unless otherwise noted. QA/QC documentation and raw data will remain on file for future reference. Our accreditation number is 100292 and our current certificate is number 004324: effective 02/27/2018 through 02/28/2019.

I thank you for the opportunity to be of service to you and look forward to working with you again in the future. Should you have any questions regarding any of the enclosed analytical data or need additional information, please contact me at (630) 778-1200.

Sincerely,

Stan Zaworski
Project Manager

First Environmental Laboratories, Inc.

IL ELAP / NELAC Accreditation # 100292

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Case Narrative

FERMI NATIONAL ACCELERATOR LABORATORY

Lab File ID: **18-3040**

Project ID: **CUB Tile Field - 642081**

Date Received: **May 31, 2018**

All quality control criteria, as outlined in the methods, have been met except as noted below or on the following analytical report.

The results in this report apply to the samples in the following table:

Laboratory Sample ID	Client Sample Identifier	Date/Time Collected	
18-3040-001	180529CG01	05/29/18	10:52
18-3040-002	180529CG02	05/29/18	14:43
18-3040-003	180529CG03	05/29/18	14:55
18-3040-004	180529CG04	05/29/18	15:05
18-3040-005	180530CG01	05/29/18	9:55
18-3040-006	180531CG01	05/29/18	10:05

Sample Batch Comments:

Sample acceptance criteria were met.

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Case Narrative

FERMI NATIONAL ACCELERATOR LABORATORY

Lab File ID: **18-3040**

Project ID: **CUB Tile Field - 642081**

Date Received: **May 31, 2018**

All quality control criteria, as outlined in the methods, have been met except as noted below or on the following analytical report.

The following is a definition of flags that may be used in this report:

Flag	Description	Flag	Description
A	Method holding time is 15 minutes from collection. Lab analysis was performed as soon as possible.		
B	Analyte was found in the method blank.	L	LCS recovery outside control limits.
<	Analyte not detected at or above the reporting limit.	M	MS recovery outside control limits; LCS acceptable.
C	Sample received in an improper container for this test.	P	Chemical preservation pH adjusted in lab.
D	Surrogates diluted out; recovery not available.	Q	Result was determined by a GC/MS database search.
E	Estimated result; concentration exceeds calibration range.	S	Analysis was subcontracted to another laboratory.
G	Surrogate recovery outside control limits.	T	Result is less than three times the MDL value.
H	Analysis or extraction holding time exceeded.	W	Reporting limit elevated due to sample matrix.
J	Estimated result; concentration is less than routine RL but greater than MDL.	N	Analyte is not part of our NELAC accreditation or accreditation may not be available for this parameter.
RL	Routine Reporting Limit (Lowest amount that can be detected when routine weights/volumes are used without dilution.)	ND	Analyte was not detected using a library search routine; No calibration standard was analyzed.

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Analytical Report

Client:	FERMI NATIONAL ACCELERATOR LABORATORY	**Date Collected:**	05/29/18
Project ID:	CUB Tile Field - 642081	**Time Collected:**	10:52
Sample ID:	180529CG01	**Date Received:**	05/31/18
Sample No:	18-3040-001	**Date Reported:**	06/07/18

Analyte		Result	R.L.	Units	Flags
Chloride Analysis Date: 06/01/18	**Method: 4500Cl, E 1997**				
Chloride		3	5	mg/L	J
Total Metals Analysis Date: 06/05/18	**Method: 6010C**		**Preparation Method 3010A** Preparation Date: 06/04/18		
Lead		< 0.002	0.005	mg/L	J

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Analytical Report

Client:	FERMI NATIONAL ACCELERATOR LABORATORY	**Date Collected:**	05/29/18
Project ID:	CUB Tile Field - 642081	**Time Collected:**	14:43
Sample ID:	180529CG02	**Date Received:**	05/31/18
Sample No:	18-3040-002	**Date Reported:**	06/07/18

Analyte		Result	R.L.	Units	Flags
Chloride	**Method: 4500Cl, E 1997**				
Analysis Date: 06/01/18					
Chloride		5	5	mg/L	
Total Metals	**Method: 6010C**		**Preparation Method 3010A**		
Analysis Date: 06/05/18			Preparation Date: 06/04/18		
Lead		< 0.002	0.005	mg/L	J

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Analytical Report

Client:	FERMI NATIONAL ACCELERATOR LABORATORY	**Date Collected:**	05/29/18
Project ID:	CUB Tile Field - 642081	**Time Collected:**	14:55
Sample ID:	180529CG03	**Date Received:**	05/31/18
Sample No:	18-3040-003	**Date Reported:**	06/07/18

Analyte		Result	R.L.	Units	Flags
Chloride	**Method: 4500Cl, E 1997**				
Analysis Date: 06/01/18					
Chloride		21	5	mg/L	
Total Metals	**Method: 6010C**		**Preparation Method 3010A**		
Analysis Date: 06/05/18			Preparation Date: 06/04/18		
Lead		0.012	0.005	mg/L	

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Analytical Report

Client:	FERMI NATIONAL ACCELERATOR LABORATORY	**Date Collected:**	05/29/18
Project ID:	CUB Tile Field - 642081	**Time Collected:**	15:05
Sample ID:	180529CG04	**Date Received:**	05/31/18
Sample No:	18-3040-004	**Date Reported:**	06/07/18

Analyte		Result	R.L.	Units	Flags
Chloride	**Method: 4500Cl, E 1997**				
Analysis Date: 06/01/18					
Chloride		3	5	mg/L	J
Total Metals	**Method: 6010C**		**Preparation Method 3010A**		
Analysis Date: 06/05/18			Preparation Date: 06/04/18		
Lead		0.074	0.005	mg/L	

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Analytical Report

Client:	FERMI NATIONAL ACCELERATOR LABORATORY	**Date Collected:**	05/29/18
Project ID:	CUB Tile Field - 642081	**Time Collected:**	9:55
Sample ID:	180530CG01	**Date Received:**	05/31/18
Sample No:	18-3040-005	**Date Reported:**	06/07/18

Analyte		Result	R.L.	Units	Flags
Chloride	**Method: 4500Cl, E 1997**				
Analysis Date: 06/01/18					
Chloride		2	5	mg/L	J
Total Metals	**Method: 6010C**		**Preparation Method 3010A**		
Analysis Date: 06/05/18			Preparation Date: 06/04/18		
Lead		< 0.002	0.005	mg/L	J

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Analytical Report

Client:	FERMI NATIONAL ACCELERATOR LABORATORY	**Date Collected:**	05/29/18
Project ID:	CUB Tile Field - 642081	**Time Collected:**	10:05
Sample ID:	180531CG01	**Date Received:**	05/31/18
Sample No:	18-3040-006	**Date Reported:**	06/07/18

Analyte		Result	R.L.	Units	Flags
Chloride	**Method: 4500Cl, E 1997**				
Analysis Date: 06/06/18					
Chloride		1,010	5	mg/L	
Total Metals	**Method: 6010C**		**Preparation Method 3010A**		
Analysis Date: 06/05/18			Preparation Date: 06/04/18		
Lead		0.002	0.005	mg/L	J

CHAIN OF CUSTODY RECORD

First Environmental Laboratories, Inc.

First Environmental Laboratories
1600 Shore Road, Suite D
Naperville, Illinois 60563
Phone: (630) 778-1200 • Fax: (630) 778-1233
E-mail: firstinfo@firstenv.com
IEPA Certification #100292

Company Name: Fermilab
Street Address: P.O. Box 500
City: Batavia State: IL Zip: 60510
Phone: (630)840-4847 e-mail: cgreer@fnal.gov
Send Report To: Chris Greer
Sampled By: Chris Greer

Project I.D.: CUB Tile field
P.O. #: 642081

Matrix Codes: S = Soil W = Water O = Other

Analyses

Date/Time Taken	Sample Description	Matrix	Total Pb	Total Chloride							Hold – Do Not Analyze	Comments	Lab I.D.
5-29-18 1052	180529CG01	W	X	X								8B	18-3040-001
1443	180529CG02											9B	002
1455	180529CG03											6B	003
1505	180529CG04											7B	004
5-30-18 0955	180530CG01											S4	005
5-31-18 1005	180531CG01											D1	006

FOR LAB USE ONLY:

Cooler Temperature: 0.1-6°C Yes ✓ No.__ 4 °C
Received within 6 hrs. of collection:____
Ice Present: Yes ✓ No__

Sample Refrigerated: Yes__ No__
Refrigerator Temperature:____°C
5035 Vials Frozen: Yes__ No__
Freezer Temperature:____°C

Program: ☐ TACO ☐ CCDD ☐ NPDES ☐ LUST

Notes and Special Instructions: Email report to cgreer@fnal.gov.

Relinquished By: Chris Greer Date/Time 5-31-18 1050 Received By: Eric Kozemchak Date/Time 5/31/18 1050
Relinquished By: Eric Kozemchak Date/Time 5-31-18 1630 Received By: [illegible] Date/Time 5-31-18 1630

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Quality Control Summary

Client: FERMI NATIONAL ACCELERATOR LABORATORY **Lab File ID:** 18-3040

Project ID: CUB Tile Field - 642081

QC Lab#	Time QC Code	Parameter	Reported Result	Units	QC Result	%R Limits Low High	RPD Limit
Parameter: Chloride		**Analytical Method:**	4500Cl, E 1997		**Analytical WS #:** 169239	**Analysis Date:**	06/01/18
18-3040-002MS	MS	Chloride	24	mg/L	%R: 94.7	90 - 110	
18-3040-002MSD	MSD	Chloride	23	mg/L	%R: 89.3 *	90 - 110	RPD: 5 20
		MSD outside control limits. All other QCIs are within acceptance limits.					
CCB474300	CB	Chloride	< 5	mg/L	0	-	
CCB474301	CB	Chloride	< 5	mg/L	0	-	
CCVS474302	CCVS	Chloride	47	mg/L	%R: 94	90 - 110	
CCVS474303	CCVS	Chloride	51	mg/L	%R: 101.6	90 - 110	
Parameter: Chloride		**Analytical Method:**	4500Cl, E 1997		**Analytical WS #:** 169469	**Analysis Date:**	06/06/18
CCB475537	CB	Chloride	< 5	mg/L	0	-	
CCB475538	CB	Chloride	< 5	mg/L	0	-	
CCVS475539	CCVS	Chloride	53	mg/L	%R: 105.1	90 - 110	
CCVS475540	CCVS	Chloride	52	mg/L	%R: 103.6	90 - 110	

* The QC indicator is outside control limits. %R = percent recovery; RPD = Relative percent difference
CB = Calibration Blank; CCVS = Continuing Calibration Verification Standard; MS = Matrix Spike;
MSD = Matrix Spike Duplicate; LCS = Laboratory Control Spike; SURR = Surrogate Spiking Compound;
PB = Procedure Blank; BLK = Method Blank; D = QCI diluted out.

NELAP ACCREDITED TNI LABORATORY

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Quality Control Summary

Client: FERMI NATIONAL ACCELERATOR LABORATORY **Lab File ID:** 18-3040

Project ID: CUB Tile Field - 642081

QC Lab#	QC Code	Parameter	Reported Result	Units	QC Result	%R Limits Low High	RPD Limit
Parameter: Total Metals		**Analytical Method:** 6010C			**Analytical WS #:** 169361	**Analysis Date:** 06/05/18	
		Prep Method: 3010A			**Prep WS#:** 27311	**Prep Date:** 06/04/18	
18-3040-003MS	MS	Lead	0.1105	mg/L	%R: 98.5	75 - 125	
18-3040-003MSD	MSD	Lead	0.1103	mg/L	%R: 98.3	75 - 125	RPD: 0 20
LCS475025	LCS	Lead	0.1022	mg/L	%R: 102.2	80 - 120	
PB475028	PB	Lead	< 0.0050	mg/L	0	-	

* The QC indicator is outside control limits. %R = percent recovery; RPD = Relative percent difference
CB = Calibration Blank; CCVS = Continuing Calibration Verification Standard; MS = Matrix Spike;
MSD = Matrix Spike Duplicate; LCS = Laboratory Control Spike; SURR = Surrogate Spiking Compound;
PB = Procedure Blank; BLK = Method Blank; D = QCI diluted out.

NELAP ACCREDITED TNI LABORATORY

Section VII
Annual Water Level Summary and Vertical Gradient Evaluation

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CUB Pipe and Clay Tile Field: Groundwater Monitoring Wells, Annual Water Level Summary

Well ID	Total Depth (ft BGS)	Top of Casing (ft MSL)	Water Levels							
			11/08/2017		05/29/2018		05/30/2018		05/31/2018	
			DTW (ft)	MSL (ft)	DTW (ft)	MSL (ft)	DTW (ft)	MSL (ft)	DTW (ft)	MSL (ft)
MWD1/CUBD1	39.6	747.91	6.87	741.04			6.50	741.41		
MWS1/CUBS1	11.8	747.54	5.81	741.73					4.57	742.97
MWS2/CUBS2	14.2	747.21	4.87	742.34					5.05	742.16
MWS3/CUBS3	14.9	745.85	4.98	740.87					4.78	741.07
MWS4/CUBS4	12.9	748.34	6.82	741.52					5.53	742.81
MWS5/CUBS5	13.0	745.21	5.44	739.77					4.43	740.78
MW-6B/CUBBd4	90.7	745.07	59.23	685.84	57.75	687.32				
MW-7B/CUBBd3	69.2	745.43	60.51	684.92	58.29	687.14				
MW-8B/CUBBd2	90.0	748.55	61.06	687.49	59.57	688.98				
MW-9B/CUBBd1	91.2	748.18	60.58	687.60	58.97	689.21				

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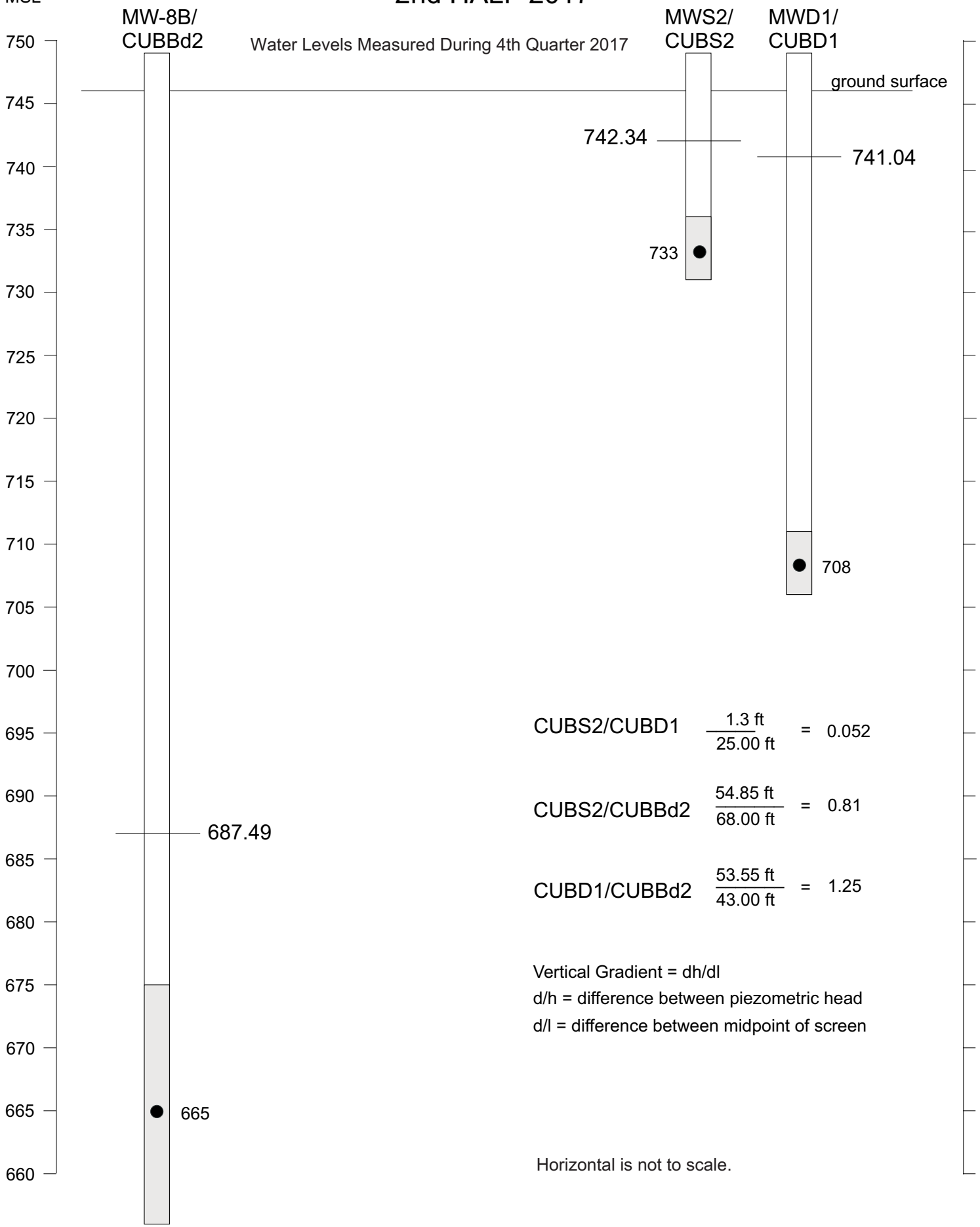
CUB PIPE & CLAY TILE FIELD MONITORING WELLS
VERTICAL GRADIENT CALCULATIONS
2nd HALF 2017

Water Levels Measured During 4th Quarter 2017



CUBS2/CUBD1 $\frac{1.3 \text{ ft}}{25.00 \text{ ft}} = 0.052$

CUBS2/CUBBd2 $\frac{54.85 \text{ ft}}{68.00 \text{ ft}} = 0.81$

CUBD1/CUBBd2 $\frac{53.55 \text{ ft}}{43.00 \text{ ft}} = 1.25$

Vertical Gradient = dh/dl

d/h = difference between piezometric head

d/l = difference between midpoint of screen

Horizontal is not to scale.

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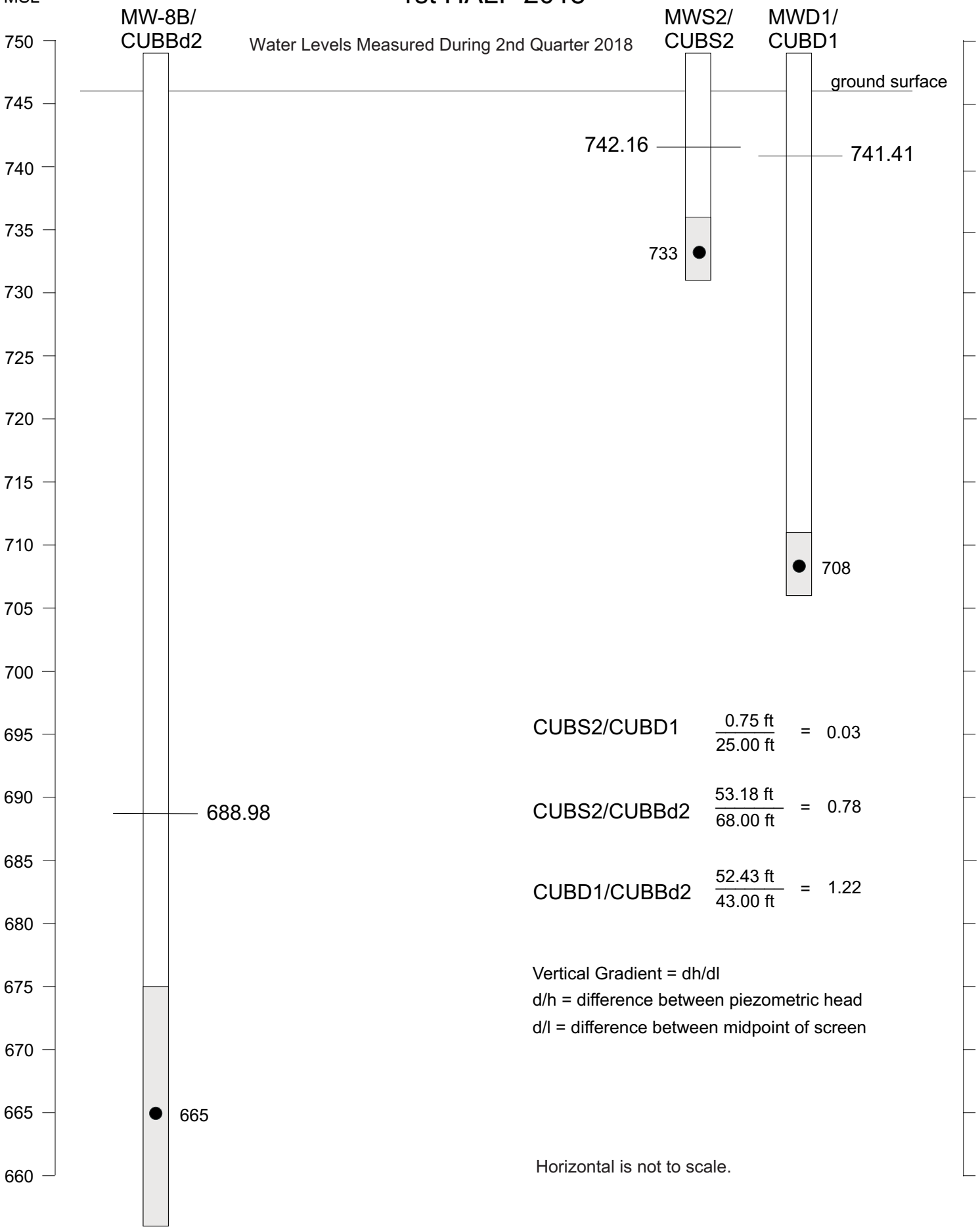
CUB PIPE & CLAY TILE FIELD MONITORING WELLS
VERTICAL GRADIENT CALCULATIONS
1st HALF 2018

Water Levels Measured During 2nd Quarter 2018



CUBS2/CUBD1	$\frac{0.75 \text{ ft}}{25.00 \text{ ft}}$	=	0.03
CUBS2/CUBBd2	$\frac{53.18 \text{ ft}}{68.00 \text{ ft}}$	=	0.78
CUBD1/CUBBd2	$\frac{52.43 \text{ ft}}{43.00 \text{ ft}}$	=	1.22

Vertical Gradient = dh/dl

d/h = difference between piezometric head

d/l = difference between midpoint of screen

Horizontal is not to scale.

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Section VIII
Annual Groundwater Flow Evaluation

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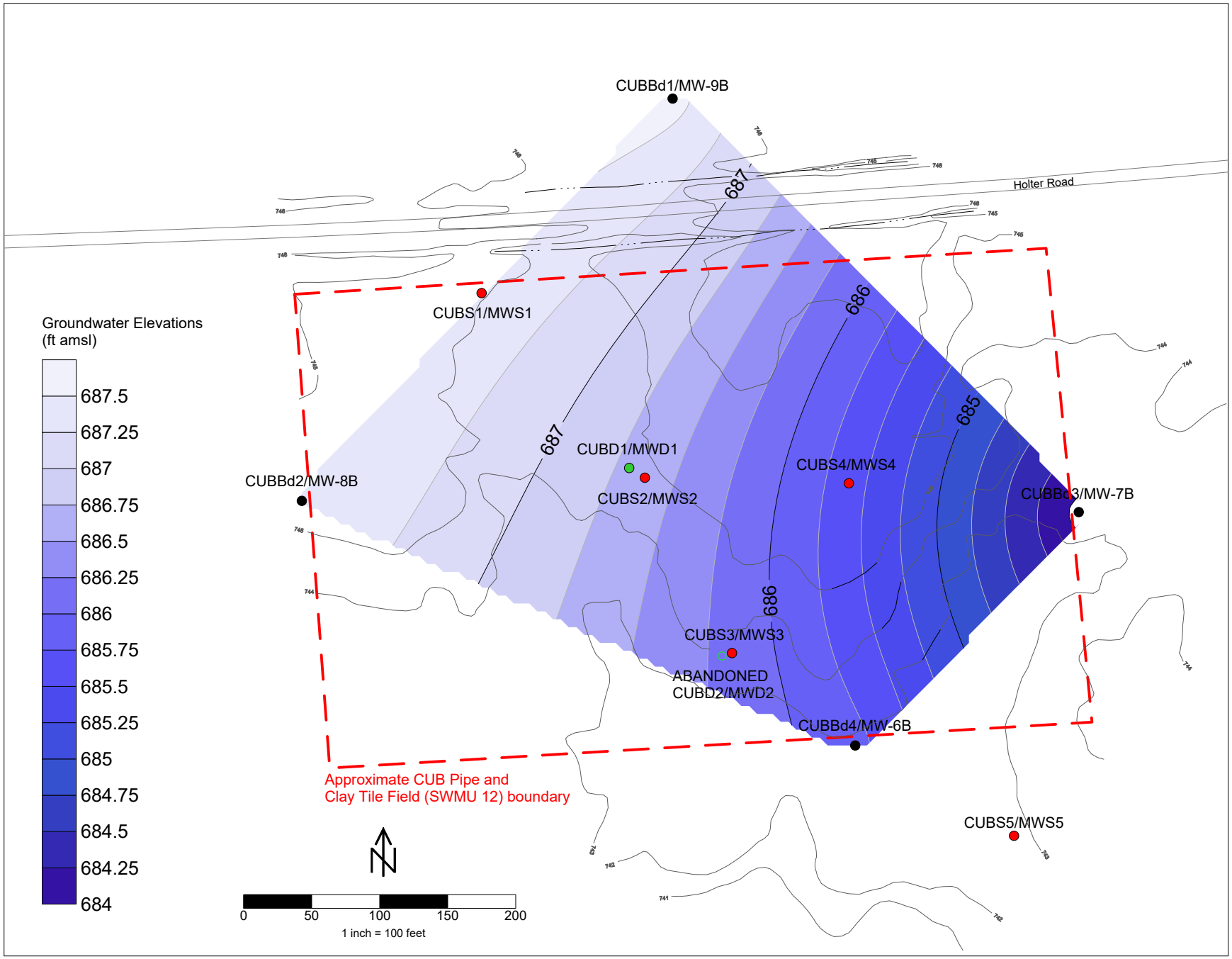

Groundwater elevations across the four bedrock zone wells (MW-6B through MW-9B), 4th Quarter 2017 at the CUB Pipe and Clay Tile Field (SWMU 12), Fermi National Accelerator Laboratory.

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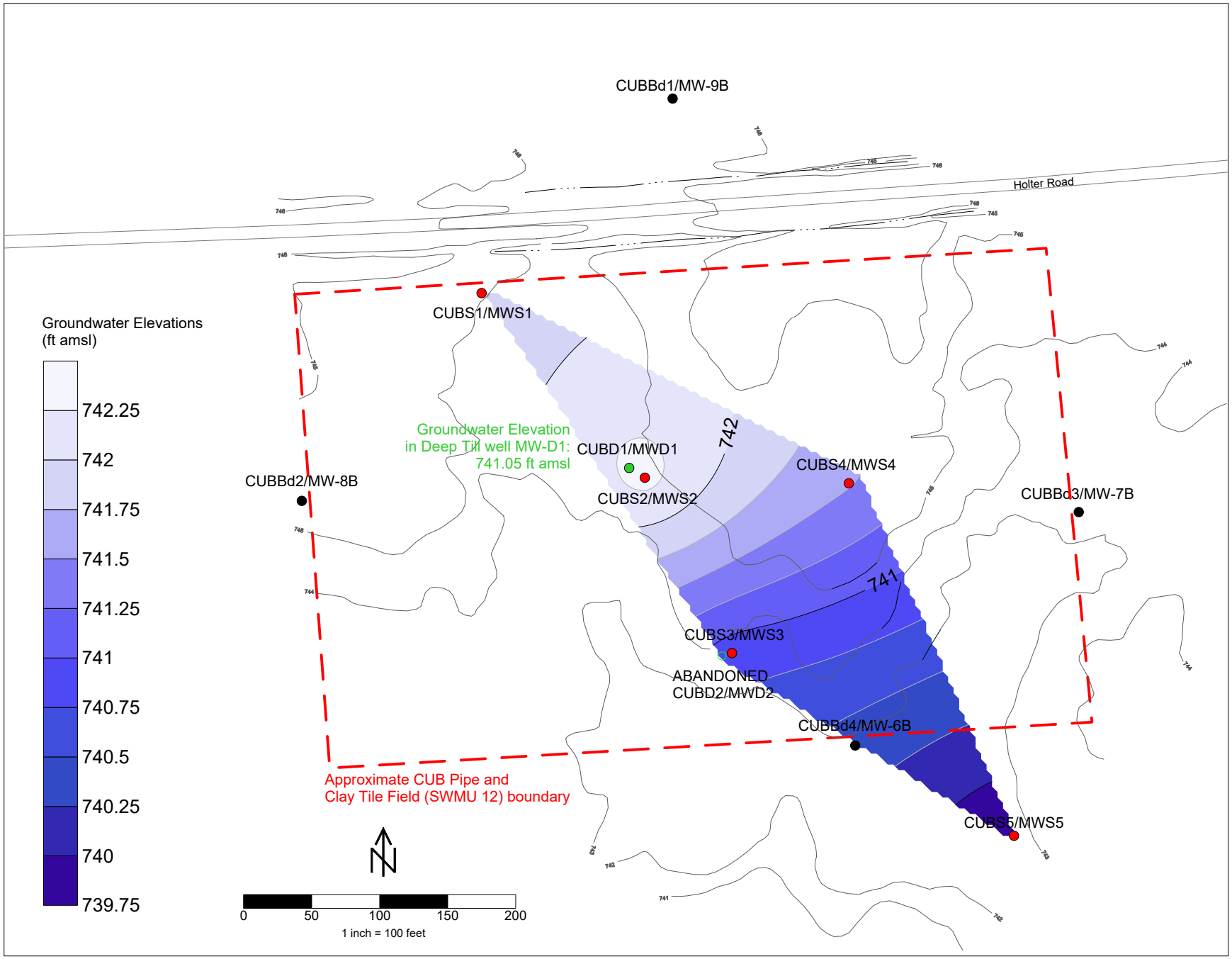

Groundwater elevations across the five shallow till zone wells (MW-S1 through MW-S5), 4th Quarter 2017 at the CUB Pipe and Clay Tile Field (SWMU 12), Fermi National Accelerator Laboratory.

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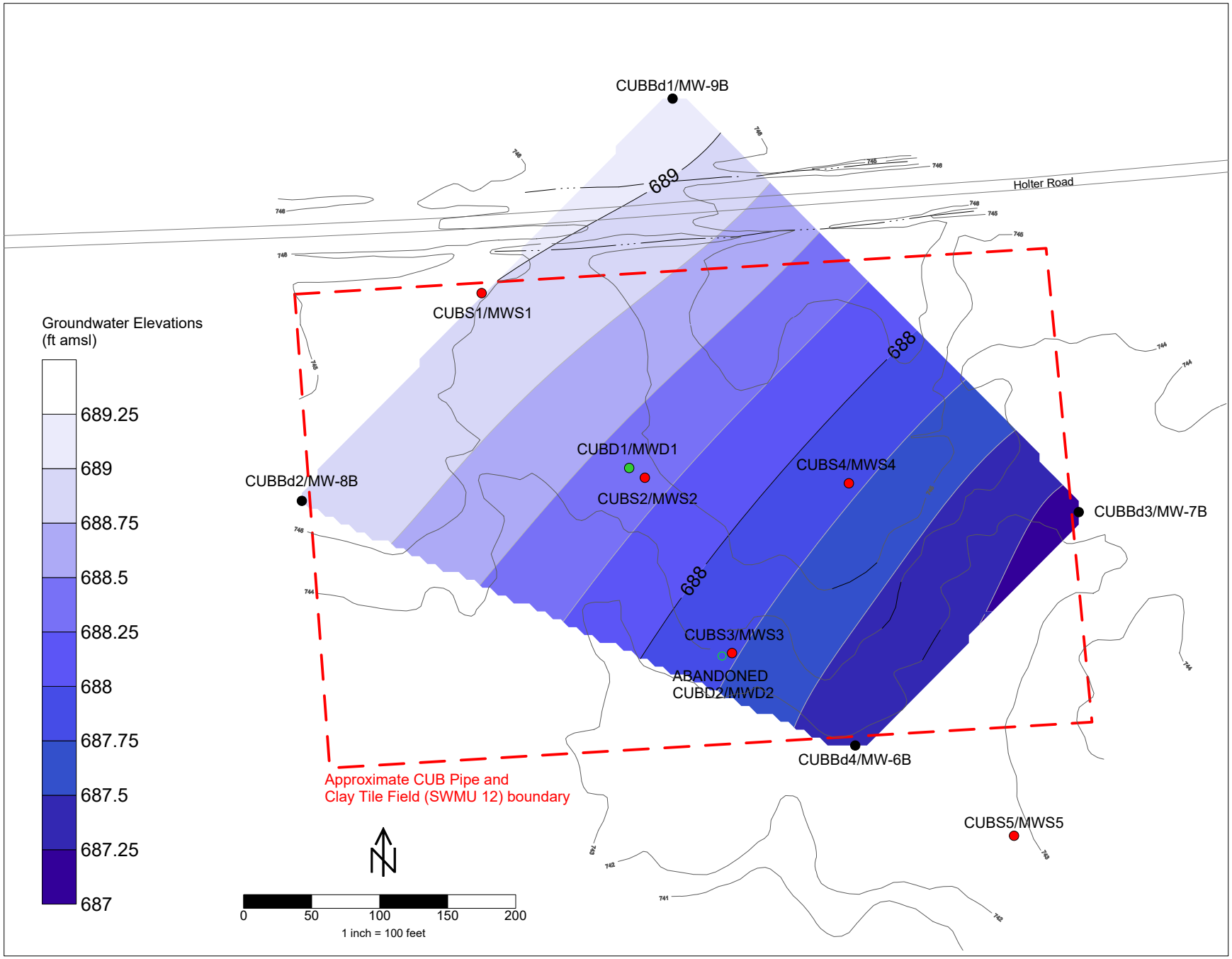

Groundwater elevations across the four bedrock zone wells (MW-6B through MW-9B), 2nd Quarter 2018 at the CUB Pipe and Clay Tile Field (SWMU 12), Fermi National Accelerator Laboratory.

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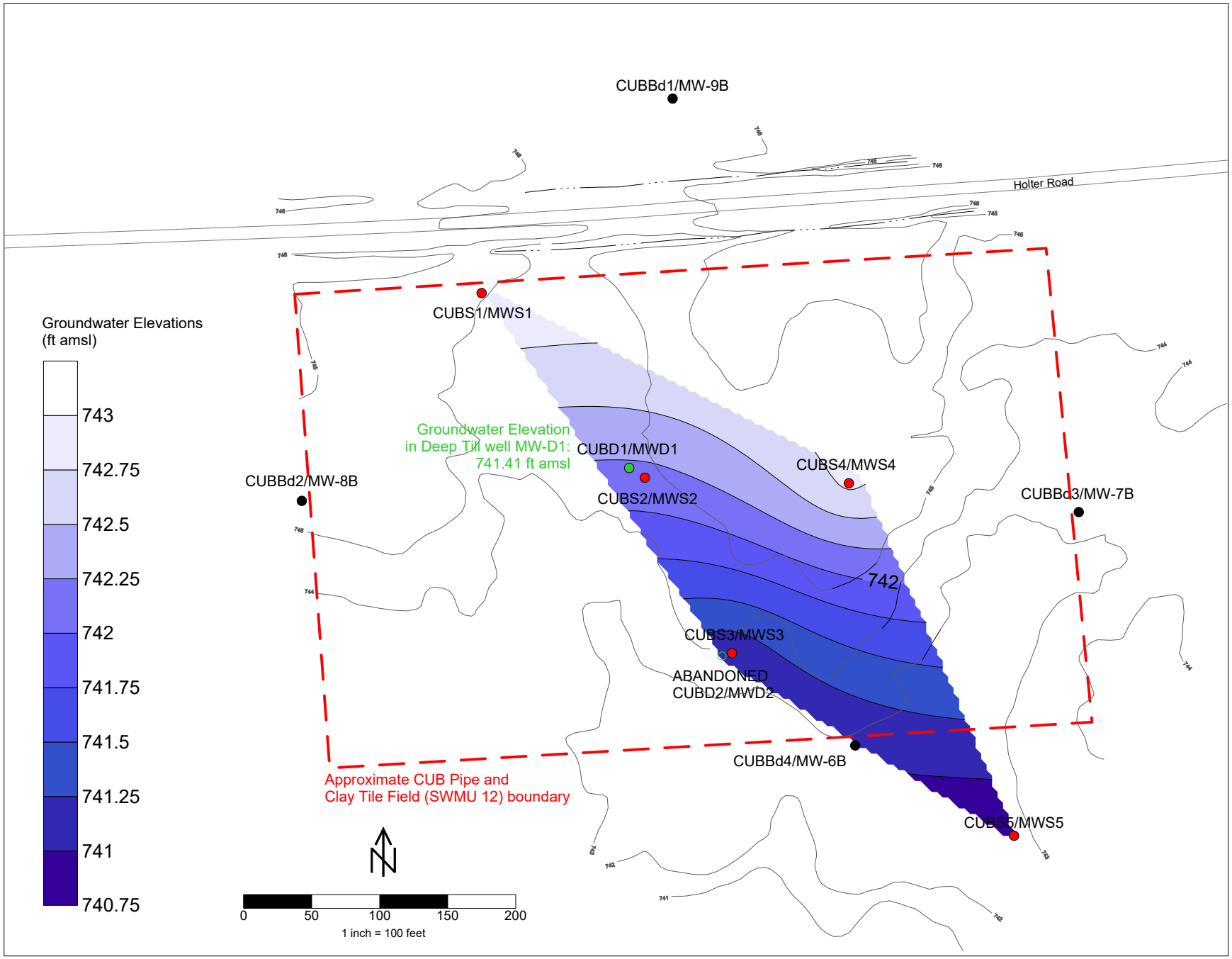

Groundwater elevations across the five shallow till zone wells (MW-S1 through MW-S5), 2nd Quarter 2018 at the CUB Pipe and Clay Tile Field (SWMU 12), Fermi National Accelerator Laboratory.

End of report.