US Army Corps of Engineers

Injection Completion Report

Full Scale In-Situ Chemical Oxidation Remedial Action

3800 Area PCE Site

Fort Drum Installation Restoration Program
Fort Drum, New York

October 2017

Contract No.: W912DR-12-D-0007
Delivery Order No.: 0003

Prepared For:

U.S. ARMY CORPS OF ENGINEERS BALTIMORE DISTRICT
10 South Howard Street
Baltimore, Maryland 21201-2536

Prepared By:

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Our Ref.:
GP14DRUM.RIFS
Date:
26 October 2017

Table of Contents

Figures

Tables

Appendices

Acronyms and Abbreviations

bgs	below ground surface
CVOC	Chlorinated Volatile Organic Compound
DMP	Data Management Plan
DPW	Department of Public Works
g/kg	grams per kilogram
gpm	gallons per minute
IRP	Installation Restoration Program
ISCO	In-Situ Chemical Oxidation
JV	Joint Venture
MAES	Multiple Award Environmental Services
$NaMnO_4$	Sodium Permanganate
NOD	Natural Oxidant Demand
NYSDEC	New York State Department of Environmental Conservation
ORP	Oxidation-Reduction Potential
PCE	Tetrachloroethene
psi	pounds per square inch
PVC	polyvinyl chloride
RI	Remedial Investigation
ROD	Record of Decision
ROI	Radius of Influence
RPZ	Reduced Pressure Zone
QAPP	Quality Assurance Project Plan

TCMI	Temporary Central Mixing and Injection
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency

1. Introduction

The PIKA - MP Joint Venture (JV), LLC[1] (hereinafter referred to as the JV) has prepared this Injection Completion Report to document the activities and procedures used to perform a full-scale chemical oxidant (sodium permanganate) injection at the 3800 Area Tetrachloroethene (PCE) Site (the Site). Oxidant injection activities (including injection well installation and oxidant application) were completed between April and July 2017.

This work was conducted in support of the Installation Restoration Program (IRP) at Fort Drum, New York in accordance with the New York State Department of Environmental Conservation (NYSDEC)-approved *In-Situ Chemical Oxidation Remedial Action Work Plan – 3800 Area PCE Site* (ISCO Remedial Action Work Plan; PIKA-MP JV, 2017). Additionally, field and laboratory activities were conducted in accordance with the Quality Assurance Project Plan (QAPP) and Data Management Plan (DMP) submitted as Appendix A and Appendix B to the NYSDEC-approved *Work Plan, Installation Restoration Program, Fort Drum, New York* (IRP Work Plan; PIKA-MP JV, 2015a). Field work followed the health and safety procedures described in the *Accident Prevention Plan, Installation Restoration Program, Fort Drum, New York* (PIKA-MP JV, 2015b). This work is funded under the United States (US) Army Corps of Engineers (USACE) Baltimore District Multiple Award Environmental Services (MAES) contract, Award No. W912DR-12-D-0007, Delivery Order 0003.

[1] The PIKA-MP LLC Joint Venture is comprised of PIKA International, Inc. and its mentor ARCADIS-U.S. Inc.

2. In-Situ Chemical Oxidation (ISCO) Activities

2.1 Site Background

A Draft Final Remedial Investigation Report (RIR) was completed in February 2013 (PARS, 2013a) and presents the findings of field investigation activities performed between 2010 and 2012 to characterize the extent of PCE and other chlorinated volatile organic compounds (CVOCs) at the Site. A Draft Final addendum to the RIR was prepared in August 2013 (PARS, 2013b) and includes the results of a bench study and a 2012 ISCO pilot study performed at the Site. The target area for the ISCO pilot study was a 0.5-acre area approximately 200 feet down-gradient of Building 1885 in the shallow zone (i.e., 30 to 40 feet below ground surface [bgs]) (Figure 1). Forty injection wells were installed at variable spacing ranging from 15 to 25 feet with screened intervals at 30 to 40 feet bgs. Five-hundred gallons of 10% $NaMnO_4$ solution were injected at each well at flow rates that ranged from 1 to 8 gallons per minute (gpm) and at pressures that ranged from 10 to 60 pounds per square inch (psi). Details of the November 2012 ISCO pilot study are provided in the Draft Final Remedial Investigation Report – Addendum: Pilot Testing of Permanganate Injection (PARS, 2013b).

In mid-2015, the JV performed a second ISCO pilot study at the Site focused on the presumed source area in the vicinity of Bldg. 1885. The design for the second ISCO pilot study optimized the initial pilot approach by injecting a larger volume of $NaMnO_4$ solution to improve oxidant distribution. To focus resources on volume distribution, the injected $NaMnO_4$ concentration was reduced from 10% $NaMnO_4$, used for the initial pilot study, to approximately 2.6% $NaMnO_4$. Approximately 1,460 pounds of 40% by weight (wt%) of $NaMnO_4$ solution were applied per injection well, as compared to approximately 1,100 pounds of 40 wt% $NaMnO_4$ applied per injection well during the 2012 pilot study (note: liquid $NaMnO_4$ is obtained from the manufacturer as a 40 wt% solution). Two dose response monitoring wells (IMW-05 and IMW-06) were installed and monitoring well PCERI-MW19S was replaced on May 12 and 13, 2015. Thirty-five ISCO injection wells (designated IW-01 through IW-35) were installed in May and June 2015.

Pilot oxidant injections conducted by the JV took place in June and July 2015. A total of 98,934 gallons of 2.6% $NaMnO_4$ solution was injected into the 35 newly installed injection wells (Figure 2). With the exception of IW-10, which received 2,714 gallons of solution, all the injection wells achieved the target volume of 2,800 gallons. The average injection rate was 3.55 gpm, with the minimum average rate observed at IW-

16 (1.46 gpm) and the maximum average rate observed at IW-07 (9.03 gpm). Additional details related to the 2015 ISCO Pilot Study are provided in the Final Injection Completion Report (PIKA-MP JV, 2015c).

2.2 Full Scale Remedy Overview

The full scale ISCO remedy for the 3800 Area PCE Site was implemented between May and July 2017, and completed as described in the Record of Decision (ROD) (NYSDEC, 2016) and ISCO Remedial Action Work Plan (PIKA-MP JV, 2017). The ISCO remedy focused on the treatment of silty sands in the lower shallow and upper intermediate zones, where the bulk of the PCE mass is located, and which is the primary source for the PCE mass flux down-gradient. The injection strategy and design parameters were based on data from the RI (PARS, 2013a) as well as the 2012 and 2015 pilot test injections. The 2015 pilot study expanded the original treatment footprint to target dissolved phase PCE upgradient of the original pilot test injection wells, including injection up-gradient of Building1885. The 2015 injection well network was optimized even further for the 2017 injections event through the installation of seven additional injection wells (designated IW-76 through IW-82) to improve remedy effectiveness within the source area as shown in Figure 2.

The design for the full-scale injection optimized the initial pilot approaches by injecting a larger volume of permanganate solution to improve oxidant distribution. To focus resources on volume distribution, the permanganate injection concentration used during the injection was approximately 5% $NaMnO_4$ at source area wells (IW-08 through IW-18 and IW-76 through IW-78), 3% $NaMnO_4$ at up-gradient wells (IW-01 through IW-07), and 3% $NaMnO_4$ at down-gradient wells (IW-19 through IW-75 and IW-79 through IW-82). This translates to approximately 1.02 lbs of 40% permanganate solution applied per gallon of injectate at 5% by weight injection wells and 0.62 lbs of 40% permanganate solution applied per gallon of injectate at 3% by weight injection wells (see Figure 3).

Baseline groundwater monitoring was conducted in May 2016 and post-injection monitoring will commence in August 2017. The ISCO full scale remedy performance monitoring results will be discussed in a future report.

2.2.1 ISCO Full Scale Design

As discussed in the ISCO Remedial Action Work Plan, an oxidant loading evaluation was conducted using the analytical data from the RI and the bench-testing data from the 2012 pilot study (PIKA-MP JV, 2017). This evaluation included stoichiometric

consideration of the contaminant mass based on analytical data, the laboratory-determined natural oxidant demand (NOD), and a safety factor of 20%. Potassium permanganate NOD testing was completed by Carus Remediation Technologies in November 2012 following ASTM D7262-07 Test Method A (PARS, 2013b). The results of the test showed the NOD of the soil is between 0.615 grams per kilogram (g/kg) and 0.664 g/kg. Generally, an oxidant demand less than 20 g/kg is favorable (PARS, 2013b), and the low NOD of the soils will result in minor NaMnO4 utilization by competing organic material. Based on the stoichiometric evaluation, the target injection concentration was approximately 3% NaMnO4 by weight. Based on the analytical and investigation data provided from the RI and the previous oxidant injections, the target injection concentration was increased to approximately 5% NaMnO4 by weight for select injection wells located in the area near Bldg. 1885 (i.e., presumed source area) and in the area near PCERI-MW-04 (Figure 2).

The injection wells installed during the 2012 pilot study are spaced from 15 to 25 feet apart and have 10 ft. screens. The injection wells installed during the 2015 pilot study and prior to the 2017 injection event are spaced approximately 25 feet apart and have 5 foot screens. The target injection volume, $V_{injection}$, necessary to achieve breakthrough of a working strength concentration of permanganate at the injection radius for each injection well was estimated using the following equation, based on the volume of a cylinder:

$$V_{injection} = z^{*}\pi^{*}r^{2*}N_m$$

Where: $V_{injection}$ = Required injection volume

z = Saturated injection interval (5 feet for the 2015 and 2017 wells, 10 feet for 2012 wells)
r = Target radius of influence (ROI) (12.5 ft. for the 2015, 2017, and some of the 2012 wells; average of 9 feet for some of the 2012 injection wells)
N_m= Mobile fraction of soils (15 percent [%])

For the ISCO injections:

$V_{injection}\,(z=10,r=9) = 10\ ft * \pi * (9.0)^2 * 0.15 = 381\ ft^3 * 7.48\ gal/ft^3 = 2{,}855\ gallons$
$V_{injection}\,(z=5,r=12.5) = 5\ ft * \pi * (12.5)^2 * 0.15 = 368\ ft^3 * 7.48\ gal/ft^3 = 2{,}752\ gallons$
$V_{injection}\,(z=10,r=12.5) = 10\ ft * \pi * (12.5)^2 * 0.15 = 736\ ft^3 * 7.48\ gal/ft^3 = 5{,}507\ gallons$

The 15% mobile fraction determination for the injection was based on site soil conditions presented in historical documents and those observed during well installation.

The design volume of solution ranged from 2,800 gallons to 5,500 gallons for each injection well, as shown in **Table 1**. The target volume was increased by 50% (i.e. to 4,200 gallons) at IW-01 to IW-07, with a target permanganate concentration of 3% to improve oxidant distribution beneath Bldg. 1885. All injection wells and their respective target and actual volumes are shown in **Table 1**. Dose response wells (PCERI-IMW-01, PCERI-IMW-02, PCERI-IMW-03, PCERI-IMW-04, IMW-05, IMW-06, PCERI-MW19S, PCERI-MW19I, PCERI-MW25S, and PCERI-MW25I) were used to confirm the target ROI and to assess whether distribution of the injected solution was achieved.

2.2.2 Permitting

A United Stated Environmental Protection Agency (USEPA) Inventory of Injection Wells Form 7520-16 was filed with the USEPA Underground Injection Control Section, USEPA Region II Offices in New York City and approved prior to ISCO implementation (**Appendix A**). Borehole and well construction permits were secured through the Fort Drum Department of Public Works (DPW).

2.2.3 Injection Well Installation

This section discusses specific components of the injection well installation including utility clearance, drilling and well installation, well development, and waste characterization.

2.2.3.1 Utility Clearance

Prior to drilling activities, three lines of evidence were utilized to clear utilities. The following lines of evidence were used:

- A Fort Drum Dig Permit was obtained and known utilities were marked by Fort Drum personnel.
- Dig Safely New York One-Call was notified.
- Site-specific markout was performed using a privately contracted utility locator using ground penetrating radar and magnetic locating equipment to identify utilities.
- Boring locations were each cleared to five feet vertical depth by advancing an auger by hand.

2.2.3.2 Drilling and Well Installation

Seven new injections wells were installed (IW-76, IW-77, IW-78, IW-79, IW-80, IW-81, and IW-82) between April 24 to May 3, 2017. The target permanganate injection depths and the total depth of monitoring wells in the area were based on RI results as discussed in the ISCO Remedial Action Work Plan. Injection well construction details are as follows:

- Separate boreholes were advanced using hollow stem auger drilling methods with 6.25-inch inner diameter steel augers. Total depth of the injection wells is approximately 42 feet bgs. The injection wells were constructed of 2-inch diameter, Schedule 40 PVC casing and ten feet of PVC wire-wrapped screen. Approximately six inches of sand was placed in the borehole prior to installing the screen. After installing the sand pack, a three foot layer of choker sand was placed above the sand pack. No. 0 sand was used for the filter packs and No. 00 sand for the choker sand. The annular seal consisted of neat cement, which was tremie-grouted from the choker sand to within two feet bgs. The neat-cement consisted of a mixture of 6.5 to 7 gallons of water to one 94-pound sack of Portland cement. Well construction and development logs are provided in **Appendix B**.

- The injection wells were fitted with locking, steel protective casings (flush-mount), set in concrete well pads.

2.2.3.3 Well Development

The wells were developed to improve their hydraulic properties by removing sediment and clearing the well screen of fine particles. Well development was performed no sooner than 24 hours after well installation to allow the neat cement to set and no later than six days after the well has been installed. Prior to developing each injection well, the initial water level and total depth was measured. Following well development, the total depth was again measured to evaluate the quantity of sediment removed (if any).

Well development proceeded with repeated alternating sequences of surging and removal of water from the well. The effectiveness of the development procedure was monitored after each well volume was removed by measurements of field parameters, such as turbidity, pH, oxidation-reduction potential (ORP), temperature, and specific conductivity. Monitoring well development was discontinued after a minimum of 10 well volumes were removed and stabilization of field parameter measurements occurred, or

when the turbidity of the discharge water measured 50 nephelometric turbidity units or less.

2.2.3.4 Investigation Derived Waste

Drill cuttings and well development water were staged on-site in 30 cubic yard roll offs and 55-gal drums, respectively, pending waste characterization and appropriate off-site disposal. The drill cuttings and well development water were transported and disposed of by Environmental Products & Services of Vermont; bills of lading are provided in **Appendix C**.

2.2.4 Baseline Groundwater Sampling

Baseline groundwater sampling was conducted in May 2016, prior to initiation of the ISCO injection to establish pre-injection baseline conditions. Groundwater sampling was performed in accordance with the ISCO Pilot Study Work Plan (PIKA-MP JV, 2015d). Baseline and post-ISCO performance monitoring results will be discussed in a future report.

2.2.5 Injection Equipment and Methodology

This section discusses the equipment and procedures used to implement the oxidant injection. Oxidant injection activities were performed between May 22, 2017 and July 6, 2017. Oxidant injection field logs are provided in **Appendix D**.

2.2.5.1 Injection Equipment

Oxidant ($NaMnO_4$) injections were performed using a temporary central mixing and injection (TCMI) system. Therefore, no permanent injection solution mixing and distributing infrastructure was needed. The injection system consisted of a 6,500-gallon solution storage tank, chemically compatible injection/mixing pump, two chemically compatible dosing pumps, injection manifolds, and well head assemblies (flow meter and pressure gauge). In consultation with Fort Drum DPW, injection water was obtained from one of the fire hydrants located near Bldg 1885. A certified Reduced Pressure Zone (RPZ) backflow device was placed between the hydrant and discharge hose to prevent backflow of water into the distribution system. Additionally, a pressure relieving valve was placed in-line at the hydrant to reduce operating pressures to within safe levels for the TCMI system. The injection water was chemically dosed with sodium permanganate (3% and 5%) using chemically compatible dosing pumps and the

solution was deposited into the 6,500-gallon solution storage tank. The injection solution was distributed via above grade hose/pipe to each injection area. Each injection area had a manifold, allowing concurrent injection of at least half of the injection wells. Secondary containment was utilized at the mixing area and each manifold location. Injection solution was delivered in 66 263 gallon totes of $NaMnO_4$ as a 40% solution. Photographs of injection setup including dosing pumps, 40% $NaMnO_4$ solution totes, conveyance hoses, and secondary containment can be seen in Appendix E.

Several Fort Drum departments, including Public Works Environmental and Directorate of Emergency Services Fire Department were notified of the oxidant delivery and use before mobilizing to the Site. Fort Drum personnel were also provided a site plan of where the oxidant would be stored and quantity of reagent. In addition, the Safety Data Sheet for $NaMnO_4$ (**Appendix F**) was provided to site personnel and taped to the mixing tank while work was conducted onsite.

2.2.5.2 Injection Implementation

Following mobilization and setup of the ISCO distribution equipment, initial injection activities included injection startup/shakedown procedures, operation, and performance monitoring. Startup/shakedown procedures were conducted using clean water prior to injecting reagent solutions through the mixing and delivery system. During startup/shakedown operation, system piping, valves, and appurtenances were checked for leaks and proper operation. Based on the clean water prove out two cracked gate valves were replaced and several cam-lock fitting gaskets were replaced and/or supplemented with a bead of silicone. Buckets were added as needed to capture minor leaking. At the conclusion of the clean water prove out, all leaks were fully addressed.

After the clean water injection was completed and the injection piping was primed, oxidant was prepared and injected. During mixing, oxidant was handled in accordance with manufacturer's instructions and with appropriate personal protective equipment. The $NaMnO_4$ solution was dosed in route to the solution storage tank. In order to mix the 5% solution required for the source area, approximately 10 gallons of concentrated solution was needed per 100 gallons of water. For the 3% solution required at all other wells, approximately 5.5 gallons of concentrated solution was needed per 100 gallons of water. At the target injection concentrations, $NaMnO_4$ is highly soluble; gentle agitation/stirring with solution recirculation using an in-line diaphragm pump achieved adequate mixing.

The dilute $NaMnO_4$ injection solution was pumped to the injection well manifold. Injection solution flow rate, cumulative injected volume, and observed wellhead pressure were monitored and recorded at each injection well periodically throughout the injection (i.e., once per every few hundred gallons injected per well). Injection pressures were monitored to reduce the risk of well failure or surfacing of the injection solution. The injection pressure did not exceed 5 pounds per square inch (psi) at any time during the event. The piping components conveying the injection solution were chemically compatible hoses and/or PVC (compatible with $NaMnO_4$) and were connected via cam locks that were zip tied during use. Flow meters and pressure gauges with chemically compatible wetted components were used to measure injection flow rates, injection pressures, and cumulative volume injected.

A total of 47,483 gallons of 5% sodium permanganate solution was injected into the 14 injection wells located in the source area (IW-08, -09, -10, 11, 12, 13, 14, 15, 16, 17, 18, 76, 77, and 78). A total of 244,938 gallons of 3% sodium permanganate solution was injected into the remaining 67 injection wells. All injection wells achieved respective target volumes ranging from 2,800 to 5,500 gallons. The average injection rate was 2.61 gpm with the minimum average rate observed at IW-10 (0.46 gpm) and the maximum average rate observed at IW-18 (8.15 gpm). All injection wells and their respective target and actual volumes are summarized in **Table 1**.

Observed flow rates and injection pressures were consistent with data collected during the 2015 pilot study. No clogging, apparent fouling, or surface breakthrough was observed during the injection event. All 66 totes of 40% NaMnO4 solution delivered to the site were used during the injection event. Daily safety briefings and inspections were conducted and no important safety issues were identified; the work was successfully completed without incidents or accidents.

Some of the older injection wells at the site were installed within 4” curb boxes and not centered, necessitating removal of one of the attachment bolt anchors to create space for injection hose connection. Any well curb box that was not able to be secured after the injection and/or had damaged covers or other components was replaced at the conclusion of the event.

2.2.5.3 Process Monitoring

Monitoring wells PCERI-IMW-01, PCERI-IMW-02, PCERI-IMW-03, PCERI-IMW-04, IMW-05, IMW-06, PCERI-MW19I, PCERI-MW19S, PCERI-MW25I, and PCERI-MW25S were used as dose response wells. The injection volume necessary to

influence particular ROIs was established by analyzing the specific conductance and pH response at respective dose response wells, compared to the injected volume (see specific conductance and pH graphs in **Appendix D**). Grab samples were collected using a bailer and examined for visual evidence of permanganate (i.e., via visual color analysis). Additionally, a field colorimeter was provided by the permanganate manufacturer as a method for gathering quantitative data throughout the event. Approximately 30 millimeters of the bailed sample was placed in a vial and inserted into the colorimeter that displayed the concentrations of permanganate in milligrams per liter. Data obtained from both colorimetric and permanganate concentration testing on grab samples is provided on Table 2. Manual depth to water measurements were also collected to understand the aquifer response to the applied hydraulic pressure (see Appendix G). Positive dose response was observed at PCERI-IMW-01, PCERI-IMW-04, IMW-05, PCERI-MW19I, PCERI-MW25S, and PCERI-MW25I with both conductivity measurements and visual confirmation of permanganate arrival.

While injection wells PCERI-IMW-2, PCERI-IMW-3 and IMW-6 showed no visual sign of breakthrough during the full-scale injection event, hydraulic response was observed at all three wells as groundwater elevations increased by as much as 0.5 to 1.4 feet during the event. Minimal changes in conductivity and pH were observed throughout the event as shows in the Oxidant Injection Field Logs (Appendix D). Based on these observations permanganate was successfully delivered to the target areas, with 70% of the monitoring wells showing visual breakthrough during the injection event and 100% of the wells showing either positive visual or hydraulic response.

2.2.6 Post Injection Performance Monitoring

Post-injection performance monitoring will be initiated in August 2017. Three rounds of ISCO performance monitoring (i.e., at the same wells sampled for baseline conditions) will be conducted at approximately 45 days, 90 days, and 180 days after injection. Performance monitoring results will be presented in the Remedial Action Construction Completion Report after the third planned groundwater monitoring event.

3. References

PARS, 2013a. *Draft Final Remedial Investigation Report for Chlorinated Solvent Contaminants*, *Fort Drum, New York*. February.

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New York State Department of Environmental Conservation (NYSDEC) Division of Environmental Remediation, 2016. *Record of Decision, Fort Drum – Waste Disposal Areas, Operable Unit number 02: 3800 PCE Site.State Superfund Project Fort Drum, Jefferson County, Site No. 623008.* March

Figures

LEGEND

Approximate 3800 Area PCE Site Boundary

0 400 800

GRAPHIC SCALE

FORT DRUM
FORT DRUM, NEW YORK

INJECTION COMPLETION REPORT

3800 AREA PCE SITE AND VICINITY

FIGURE 1

CITY:(CHARLOTTE) DIV/GROUP:(ENV/GIS) DB:ssutton LD: S.SUTTON PIC: PM: TM:
PROJECT: XX000000.0000.00000 PATH: Z:\GIS\PROJECTS_ENV\ENV_FORTDRUM_IRP\MXD\PCE Site Injection Completion ReportF1_SITE PLAN.mxd

ONEIDA AVE

ONTARIO AVE

1999

PCERI-MW20I
PCERI-MW20D
PCERI-MW20S

3805-MW41

PCERI-IMW-01
PCE-IW-74
PCE-IW-75
PCE-IW-72
PCE-IW-73
PCE-IW-71
PCE-IW-68
PCE-IW-67
PCE-IW-70
PCE-IW-66
PCE-IW-69
PCE-IW-64
PCE-IW-65
PCERI-MW19I
PCE-IW-62
PCE-IW-63
PCERI-IMW-02
PCERI-MW19D
PCE-IW-61
PCE-IW-81
PCERI-MW19S
PCE-IW-58
PCE-IW-60
PCE-IW-82
PCE-IW-59
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PCE-IW-15
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PCE-IW-10
PCE-IW-13
PCE-IW-11
PCE-IW-08
PCE-IW-76
PCE-IW-09
PCE-IW-77
PCE-IW-78

3805-001
PCERI-MW10D
PCERI-MW10I

PCERI-MW18I
PCERI-MW18D

PCERI-MW17I
PCERI-MW17S
PCERI-MW17D

PCERI-MW21S
PCERI-MW21I
PCERI-MW21D

PCERI-IMW-03

PCERI-MW25S
PCERI-MW25I
PCERI-MW25D

PCERI-MW24S
PCERI-MW24D
PCERI-MW24I

PCERI-MW22S
PCERI-MW22D
PCERI-MW22I

PCE-IMW-06

PCE-IW-07
PCE-IW-06
PCE-IW-02
PCE-IW-05
PCE-IW-04
PCE-IW-03
PCE-IW-01

PCERI-MW23I
PCERI-MW23D
PCERI-MW23S

1885
1886
1887
1888
1880
1762

LEGEND

- 2017 ISCO INJECTION DOSE-RESPONSE WELLS
- 2017 ISCO INJECTION WELLS
- MONITORING WELL
- PCE SITE RI MONITORING WELL
- HYDRANT
- FENCE LINE
- ROAD CENTERLINE
- BUILDING
- PARKING AREA

0 80 160

GRAPHIC SCALE

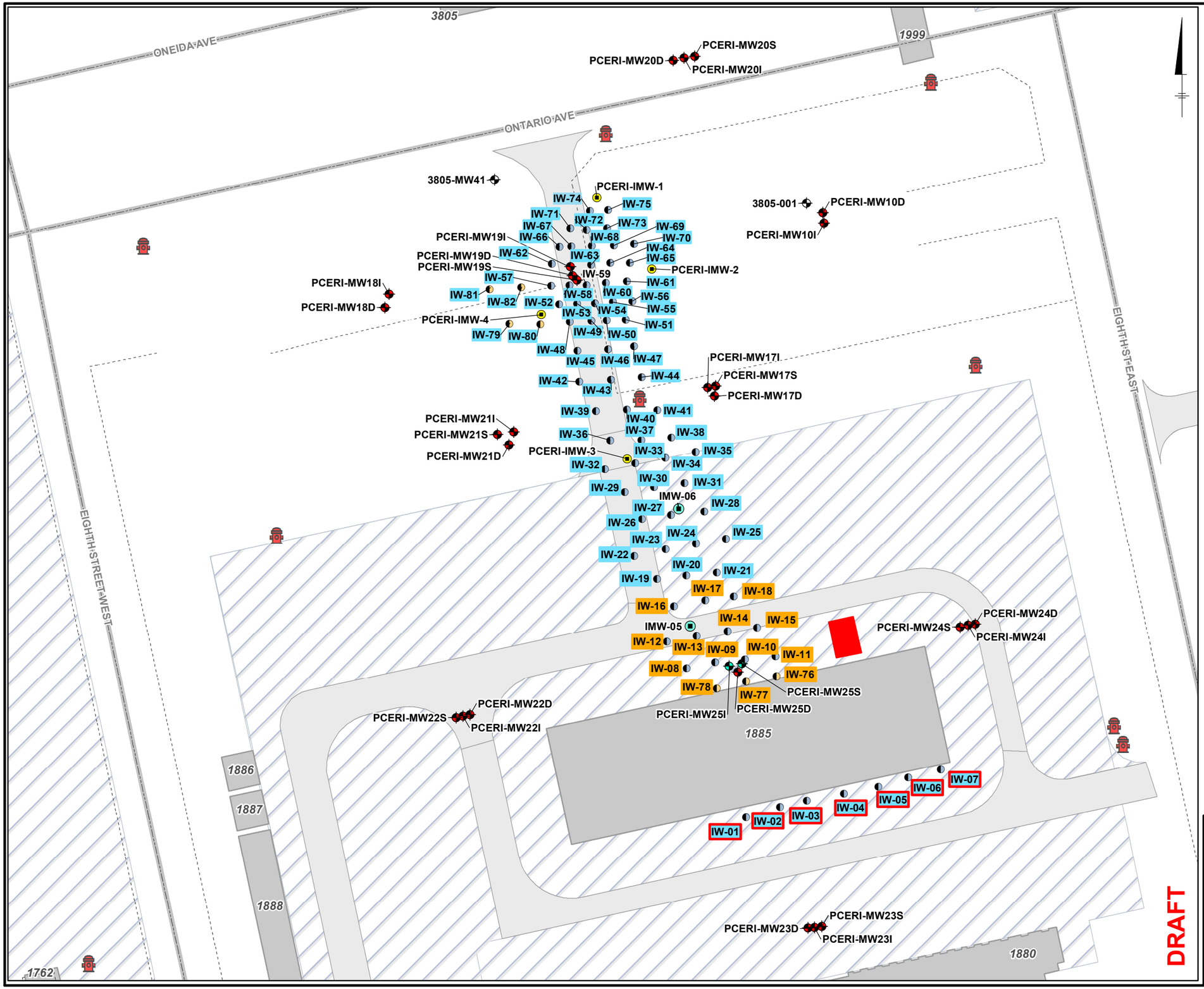
FORT DRUM
FORT DRUM, NEW YORK

INJECTION COMPLETEION REPORT

ISCO INJECTION AND MONITORING WELL NETWORK
3800 PCE SITE

PIKA INTERNATIONAL, INC. — A JOINT VENTURE — MALCOLM PIRNIE

FIGURE
2



DRAFT

LEGEND

- EXISTING ISCO INJECTION WELLS
- NEW INJECTION WELLS
- ISCO DOSE-RESPONSE WELLS
- MONITORING WELL
- PCE SITE RI MONITORING WELL
- INJECTION MIXING EQUIPMENT LOCATION
- HYDRANT
- FENCE LINE
- DRUM ROAD CENTERLINE
- BUILDING
- PARKING
- IW-35 3% NaMnO4 SOLUTION
- IW-35 5% NaMnO4 SOLUTION
- IW-35 3% NaMnO4 SOLUTION WITH 50% ADDITIONAL VOLUME

NOTES:

1. Injection wells IW-01 to IW-35 were installed in May to June, 2015.
2. Injection wells IW-36 to IW-75 were installed in October to November, 2012.
3. Injection wells IW-76 to IW-82 were installed in May 2017.

0 80 160

GRAPHIC SCALE

FORT DRUM
FORT DRUM, NEW YORK
3800 AREA PCE SITE-ISCO REMEDIAL ACTION

ISCO INJECTION CONCENTRATIONS

PIKA INTERNATIONAL, INC. — A JOINT VENTURE — MALCOLM PIRNIE

FIGURE
3

Tables

Table 1
ISCO Injection Summary
Fort Drum IRP - 3800 PCE Site
Fort Drum, New York

Injection Well ID	Target Injectate Volume (gal)	Actual Injectate Volume (gal)	$NaMnO_4$ Target Concentration (% by weight)	$NaMnO_4$ Actual Concentration (% by weight)	Mass of 40% $NaMnO_4$ (pounds)	Average Flow Rate (gpm)
IW-1	4,200	4,200	3.0	2.8	903	2.40
IW-2	4,200	4,200	3.0	2.8	903	2.58
IW-3	4,200	4,201	3.0	2.8	903	3.56
IW-4	4,200	4,202	3.0	2.8	903	4.27
IW-5	4,200	4,200	3.0	2.8	903	2.35
IW-6	4,200	4,200	3.0	2.8	903	3.10
IW-7	4,200	4,201	3.0	2.8	903	2.53
IW-8	2,800	2,820	5.0	4.4	1,366	2.82
IW-9	2,800	2,810	5.0	4.4	1,366	2.14
IW-10	2,800	2,805	5.0	4.4	1,366	2.87
IW-11	2,800	2,811	5.0	4.4	1,366	2.16
IW-12	2,800	2,818	5.0	4.4	1,366	2.02
IW-13	2,800	2,816	5.0	4.4	1,366	2.18
IW-14	2,800	2,815	5.0	4.4	1,366	2.20
IW-15	2,800	2,826	5.0	4.4	1,366	1.96
IW-16	2,800	2,834	5.0	4.4	1,366	2.23
IW-17	2,800	2,802	5.0	4.4	1,366	2.54
IW-18	2,800	2,805	5.0	4.4	1,366	3.98
IW-19	2,800	2,802	3.0	2.8	903	1.77
IW-20	2,800	2,801	3.0	2.8	903	2.10
IW-21	2,800	2,801	3.0	2.8	903	1.74
IW-22	2,800	2,801	3.0	2.8	903	1.70
IW-23	2,800	2,800	3.0	2.8	903	2.07
IW-24	2,800	2,801	3.0	2.8	903	1.89
IW-25	2,800	2,810	3.0	2.8	903	2.86
IW-26	2,800	2,801	3.0	2.8	903	4.33
IW-27	2,800	2,802	3.0	2.8	903	4.13
IW-28	2,800	2,801	3.0	2.8	903	3.08
IW-29	2,800	2,801	3.0	2.8	903	4.32
IW-30	2,800	2,819	3.0	2.8	903	4.32
IW-31	2,800	2,808	3.0	2.8	903	1.98
IW-32	2,800	2,801	3.0	2.8	903	2.52
IW-33	2,800	2,801	3.0	2.8	903	2.57
IW-34	2,800	2,801	3.0	2.8	903	2.50
IW-35	2,800	2,801	3.0	2.8	903	2.31
IW-36	5,500	5,501	3.0	2.8	903	1.57
IW-37	5,500	5,501	3.0	2.8	903	2.67
IW-38	5,500	5,501	3.0	2.8	903	1.61
IW-39	5,500	5,501	3.0	2.8	903	2.10
IW-40	5,500	5,501	3.0	2.8	903	5.30
IW-41	5,500	5,505	3.0	2.8	903	1.81
IW-42	5,500	5,501	3.0	2.8	903	2.86
IW-43	5,500	5,502	3.0	2.8	903	1.95
IW-44	5,500	5,502	3.0	2.8	903	2.23
IW-45	5,500	5,501	3.0	2.8	903	2.88
IW-46	5,500	5,502	3.0	2.8	903	1.58
IW-47	5,500	5,500	3.0	2.8	903	2.88
IW-48	2,850	2,852	3.0	2.8	903	2.98
IW-49	2,850	2,851	3.0	2.8	903	2.31
IW-50	2,850	2,851	3.0	2.8	903	2.26
IW-51	2,850	2,851	3.0	2.8	903	2.06
IW-52	2,850	2,851	3.0	2.8	903	1.65
IW-53	2,850	2,851	3.0	2.8	903	1.64
IW-54	2,850	2,852	3.0	2.8	903	2.03

Table 1
ISCO Injection Summary
Fort Drum IRP - 3800 PCE Site
Fort Drum, New York

Injection Well ID	Target Injectate Volume (gal)	Actual Injectate Volume (gal)	$NaMnO_4$ Target Concentration (% by weight)	$NaMnO_4$ Actual Concentration (% by weight)	Mass of 40% $NaMnO_4$ (pounds)	Average Flow Rate (gpm)
IW-55	2,850	2,851	3.0	2.8	903	2.21
IW-56	2,850	2,863	3.0	2.8	903	2.63
IW-57	2,850	2,855	3.0	2.8	903	2.17
IW-58	2,850	2,851	3.0	2.8	903	2.38
IW-59	2,850	2,851	3.0	2.8	903	2.17
IW-60	2,850	2,850	3.0	2.8	903	2.38
IW-61	2,850	2,851	3.0	2.8	903	2.58
IW-62	2,850	2,851	3.0	2.8	903	2.11
IW-63	2,850	2,851	3.0	2.8	903	1.93
IW-64	2,850	2,851	3.0	2.8	903	2.53
IW-65	2,850	2,851	3.0	2.8	903	1.62
IW-66	2,850	2,850	3.0	2.8	903	2.72
IW-67	2,850	2,850	3.0	2.8	903	2.21
IW-68	2,850	2,850	3.0	2.8	903	2.48
IW-69	2,850	2,852	3.0	2.8	903	2.18
IW-70	2,850	2,851	3.0	2.8	903	2.13
IW-71	2,850	2,852	3.0	2.8	903	1.87
IW-72	2,850	2,852	3.0	2.8	903	1.92
IW-73	2,850	2,862	3.0	2.8	903	2.54
IW-74	2,850	2,851	3.0	2.8	903	2.63
IW-75	2,850	2,851	3.0	2.8	903	2.16
IW-76	5,500	5,507	5.0	4.4	1,366	3.81
IW-77	5,500	5,506	5.0	4.4	1,366	3.70
IW-78	5,500	5,508	5.0	4.4	1,366	3.64
IW-79	5,500	5,502	3.0	2.8	903	2.79
IW-80	5,500	5,505	3.0	2.8	903	2.38
IW-81	5,500	5,501	3.0	2.8	903	2.21
IW-82	5,500	5,501	3.0	2.8	903	2.57
TOTAL:	**292,100**	**292,422**			**80,558**	

Notes:
gal - gallons
gpm - gallons per minute

Table 2
Sodium Permanganate Concentrations at Monitoring Wells
Fort Drum IRP - 3800 PCE Site
Fort Drum, New York

Monitoring Well	PCERI-IMW-1		PCERI-IMW-2		PCERI-IMW-3		PCERI-IMW-4		IMW-05		IMW-06		PCERI-MW19S		PCERI-MW-19I		PCERI-MW25S		PCERI-MW25I	
	$NaMnO_4$ Concentration (mg/L)	Visual Color	$NaMnO_4$ Concentration (mg/L)	Visual Color	$NaMnO_4$ Concentration (mg/L)	Visual Color	$NaMnO_4$ Concentration (mg/L)	Visual Color	$NaMnO_4$ Concentration (mg/L)	Visual Color	$NaMnO_4$ Concentration (mg/L)	Visual Color	$NaMnO_4$ Concentration (mg/L)	Visual Color	$NaMnO_4$ Concentration (mg/L)	Visual Color	$NaMnO_4$ Concentration (mg/L)	Visual Color	$NaMnO_4$ Concentration (mg/L)	Visual Color
Date																				
6/5/2017	--	--	--	--	--	--	--	--	138.00	--	--	--	--	--	--	--	140.20	Purple	--	Clear
6/6/2017	--	--	--	--	--	--	--	--	134.30	Purple	--	--	--	--	--	--	139.40	Purple	--	Clear
6/7/2017	--	--	--	--	--	--	--	--	138.60	Purple	--	Clear	--	--	--	--	131.60	Purple	--	Clear
6/8/2017	--	--	--	--	--	--	--	--	139.20	Purple	--	Clear	--	--	--	--	130.40	Purple	--	Clear
6/9/2017	--	--	--	--	--	--	--	--	111.50	Purple	--	Clear	--	--	--	--	140.10	Purple	--	Clear
6/12/2017	--	--	--	--	--	--	--	--	140.10	Purple	--	Clear	--	--	--	--	140.30	Purple	139.60	Purple
6/13/2017	--	--	--	--	--	--	--	--	137.40	Purple	--	Clear	--	--	--	--	139.90	Purple	139.90	Purple
6/14/2017	--	--	--	--	--	Clear	--	--	136.80	Purple	--	Clear	--	--	--	--	136.20	Purple	138.20	Purple
6/15/2017	--	Clear	--	Clear	--	Clear	--	Clear	--	--	--	Clear	--	Clear	--	--	--	--	--	--
6/18/2017	--	Clear	--	Clear	--	Clear	--	Clear	137.10	Purple	--	Clear	--	Clear	--	--	134.20	Purple	136.20	Purple
6/19/2017	--	Clear	--	Clear	--	Clear	--	Clear	121.90	Purple	--	Clear	--	Clear	140.40	Purple	136.70	Purple	139.90	Purple
6/20/2017	--	Clear	--	Clear	--	Clear	--	Clear	130.40	Purple	--	Clear	--	Clear	139.70	Purple	132.40	Purple	135.80	Purple
6/21/2017	--	Clear	--	Clear	--	Clear	--	Clear	139.60	Purple	--	Clear	--	Clear	139.10	Purple	138.20	Purple	137.10	Purple
6/22/2017	--	Clear	--	Clear	--	Clear	--	Clear	--	--	--	Clear	--	Clear	78.14	Purple	--	--	--	--
6/26/2017	--	Clear	--	Clear	--	Clear	82.74	Purple	139.20	Purple	--	Clear	--	Clear	53.15	Purple	100.50	Purple	139.70	Purple
6/27/2017	--	Clear	--	Clear	--	Clear	140.10	Purple	140.10	Purple	--	Clear	--	Clear	39.95	Purple	55.64	Purple	140.10	Purple
6/28/2017	--	Clear	--	Clear	--	Clear	139.70	Purple	140.10	Purple	--	Clear	--	Clear	40.77	Purple	76.00	Purple	140.40	Purple
6/29/2017	--	Clear	--	Clear	--	Clear	140.10	Purple	138.90	Purple	--	Clear	--	Clear	38.69	Purple	--	--	140.10	Purple
6/30/2017	--	Clear	--	Clear	--	Clear	140.10	Purple	137.40	Purple	--	Clear	--	Clear	39.21	Purple	49.27	Purple	138.00	Purple
7/5/2017	139.90	Purple	--	Clear	--	Clear	140.10	Purple	138.70	Purple	--	Clear	140.70	Purple	45.22	Purple	31.42	Purple	138.70	Purple
7/6/2017	140.10	Purple	--	Clear	--	Clear	139.90	Purple	139.80	Purple	--	Clear	140.40	Purple	44.84	Purple	25.89	Purple	139.60	Purple

Created by: AB 8/28/2017
QC'd by: JM 8/29/2017

APPENDIX A

Underground Injection Control
Program Permit

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 2
290 BROADWAY
NEW YORK, NY 10007-1866

APR - 6 2017

Paul Zang
Fort Drum Department of Public Works
85 First Street W
Fort Drum, NY 13602

Re: Underground Injection Control (UIC) Program Regulation
Fort Drum Area 3800 PCE Site (**Reference UICID: 15NY04599040**)
Ontario Avenue
Fort Drum, NY 13602
Jefferson County
Authorization to Inject

Dear Mr. Zang:

This letter serves to inform you that the U.S. Environmental Protection Agency is in receipt of inventory information addressing wells authorized by rule located at the above-referenced facility in accordance with 40 Code of Federal Regulations (CFR) §144.26. The operation of the following Underground Injection Control wells are authorized by rule, pursuant to 40 CFR §144.24:

> **As detailed in the workplan submitted via letter dated March 28, 2017, Fort Drum will utilize 82 injection wells to inject 292,100 gallons of sodium permanganate solution to remediate groundwater contamination.**

Should any conditions change in the operation of any of the wells listed above (such as injectate composition, closure of the well, injection of cooling water greater than 98 degrees Fahrenheit, construction of additional wells, etc.) you are required to notify this office within five (5) days. Any accidental spills into a well should be reported within twenty-four (24) hours after the event. Change in operation information should be addressed to:

Nicole Foley Kraft, Chief
Groundwater Compliance Section
United States Environmental Protection Agency
290 Broadway, 20th Floor
New York, NY 10007-1866
Re: 15NY04599040
Attn: Frank Brock

Should you own or operate **other** facilities using underground injection wells, please use the enclosed inventory form (EPA Form 7520-16) and instructions, copy for multiple facilities, and submit them to the address listed above. The form can also be found on the internet at:

https://www.epa.gov/sites/production/files/2015-10/documents/7520-16_508c.pdf

Failure to respond to this letter truthfully and accurately within the time provided may subject you to sanctions authorized by federal law. Please also note that all information submitted by you may be used in an administrative, civil judicial, or criminal action. In addition, making a knowing submission of materially false information to the U.S. Government may be a criminal offense.

Should you have any questions, please contact Frank Brock of my staff at (212) 637-3762 or brock.frank@epa.gov.

Sincerely,

for Nicole Foley Kraft, Chief
Groundwater Compliance Section

Enclosure

cc: Steven Botsford, P.E.
NYSDEC, Region 6
317 Washington St.
Watertown, NY 13601-3787

Stefan Bagnato, P.E.
PIKA-MP JV, Inc.
855 Route 146, Suite 210
Clifton Park, NY 12065

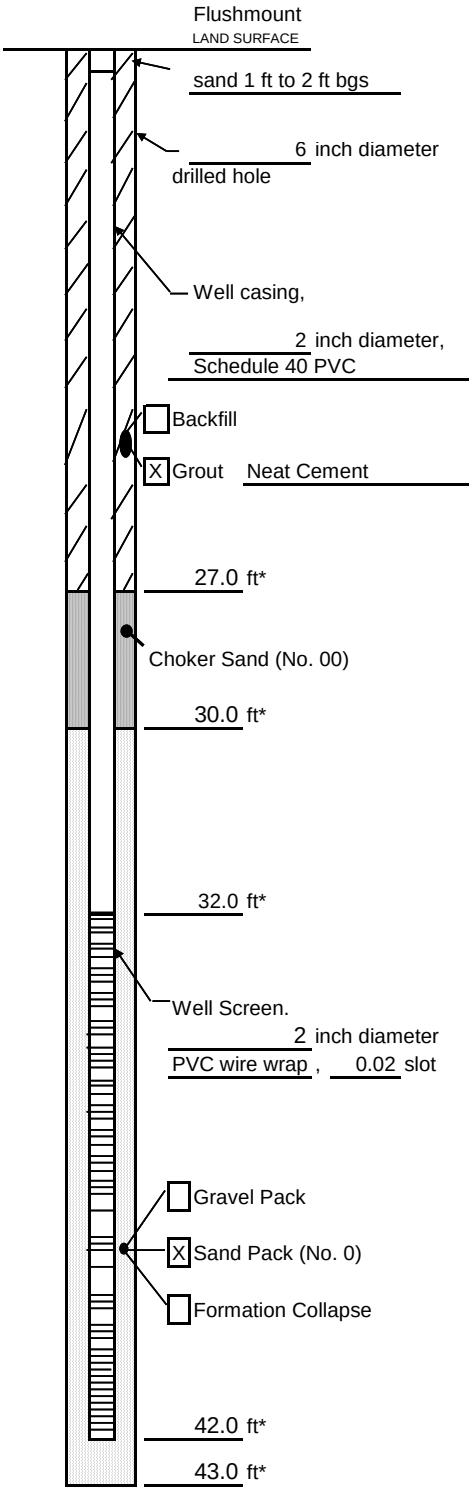
APPENDIX B

Well Construction and
Development Logs

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE Site Well IW-76

Town/City Fort Drum

County Jefferson State NY

Permit No.

Land-Surface Elevation and Datum:

feet ☐ Surveyed ☐ Estimated

Installation Date(s) 4/28/2017-5/1/2017

Drilling Method Hollow Stem Auger

Drilling Contractor Northnagle

Drilling Fluid None

Development Technique(s) and Date(s)

5/3/2017 Air Lifting

Fluid Loss During Drilling gallons

Water Removed During Development 53 gallons

Static Depth to Water 18.60 feet below M.P.

Pumping Depth to Water feet below M.P.

Pumping Duration 22 minutes

Pumping Rate ~2.5 gpm Date 5/3/2017

Specific Capacity NA gpm/ft

Well Purpose Injection Well

Remarks 6" pvc cap at 42 ft bgs

Final DTB = 41.89 ft bgs

Prepared by Levia Terrel

Fort Drum
Site

PCE 3800 ISCO Remedial Action
Event

WELL DEVELOPMENT LOG

Sampling Personnel: LEVIA TERRELL
Client / Job Number: USACE
Weather: CLOUDY

Well ID: IW-76
Date: 5-3-17
Time In: 1055 **Time Out:** 1130

Well Information

Depth to Water:	(feet)	18.60	(from MP)
Total Depth:	(feet)	39.98	(from MP)
Length of Water Column:	(feet)	21.38	
Volume of Water in Well:	(gal)	~3.5	

Well Type:		(Flushmount)	Stick-Up
Well Material:	Stainless Steel		(PVC)
Well Locked:		Yes	(No)
Measuring Point Marked:		Yes	(No)
Well Diameter:	1"	(2")	Other:

Purging Information

Purging Method:	Bailer	Peristaltic	Waterra	Other:	AIR LIFT
Tubing/Bailer Material:	Steel	Polyethylene	Waterra	Other:	PVC
Duration of Pumping:	(min)	22			
Average Pumping Rate:	(ml/min)	~2.5	Water-Quality Meter Type:		Horiba U-22/LaMotte 2020
Total Volume Removed:	(gal)	~53	Did well go dry:	Yes	(No)

Conversion Factors				
gal / ft. of water	1" ID	2" ID	4" ID	6" ID
	0.041	0.163	0.653	1.469
1 gal = 3.785 L =3785 ml = 0.1337 cubic feet				

Parameter:	1	2	3	4	5	6	7	8	9	10	11	12	13
	1105	1122											
Volume Purged (gal)													
Rate (mL/min)	~2.5	~2.5											
Depth to Water (ft.)	—	—											
pH	8.39	8.40											
Temp. (C)	11.33	11.65											
Conductivity (mS/cm)	0.708	0.732											
Dissolved Oxygen (mg/L)	10.12	7.91											
ORP (mV)	192	189											
Turbidity (NTU)	>1000	8.2											
Notes:													

Problems / Observations

11:00 BROWN, TURBID, ODORLESS

11 22 CLEAR, COLORLESS, ODORLESS

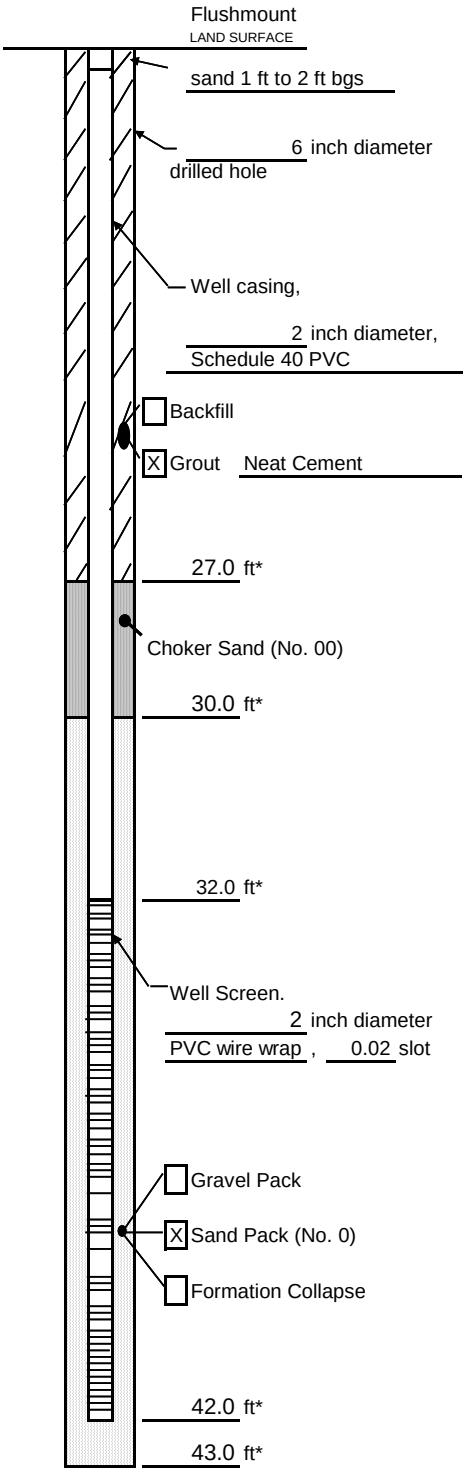
FINAL DTB (TIC) = 41.89

CAM LOCK COUPLING NOT INSTALLED

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE Site Well IW-77

Town/City Fort Drum

County Jefferson State NY

Permit No.

Land-Surface Elevation and Datum:

feet ☐ Surveyed ☐ Estimated

Installation Date(s) 5/1/2017

Drilling Method Hollow Stem Auger

Drilling Contractor Northnagle

Drilling Fluid None

Development Technique(s) and Date(s)

5/3/2017 Air Lift

Fluid Loss During Drilling gallons

Water Removed During Development 46 gallons

Static Depth to Water 18.69 feet below M.P.

Pumping Depth to Water feet below M.P.

Pumping Duration 20 minutes

Pumping Rate 2.3 gpm Date 5/3/2017

Specific Capacity NA gpm/ft

Well Purpose Injection

Remarks 6" pvc cap at 42 ft bgs

Final DTB = 41.84 ft bgs

Prepared by Levia Terrel

Fort Drum — *Site* | PCE 3800 ISCO Remedial Action — *Event*

WELL DEVELOPMENT LOG

Sampling Personnel: LEVLA TERRELL
Client / Job Number: USACE
Weather: CLOUDY

Well ID: IW-77
Date: 5-3-17
Time In: 1130 **Time Out:** 1155

Well Information

Depth to Water:	(feet)	18.69	(from MP)
Total Depth:	(feet)	40.77	(from MP)
Length of Water Column:	(feet)	22.08	
Volume of Water in Well:	(gal)	~3.5	

Well Type:		(Flushmount)	Stick-Up
Well Material:		Stainless Steel	(PVC)
Well Locked:		Yes	(No)
Measuring Point Marked:		Yes	(No)
Well Diameter:	1"	(2")	Other:

Purging Information

Purging Method:	Bailer	Peristaltic	Waterra	Other:	(AIR LIFT)
Tubing/Bailer Material:	Steel	Polyethylene	Waterra	Other:	(PVC)
Duration of Pumping:	(min)	20			
Average Pumping Rate:	(ml/min)	~2.3	Water-Quality Meter Type:	Horiba U-22/LaMotte 2020	
Total Volume Removed:	(gal)	46	Did well go dry:	Yes	(No)

Conversion Factors

gal / ft. of water	1" ID	2" ID	4" ID	6" ID
	0.041	0.163	0.653	1.469

1 gal = 3.785 L =3785 ml = 0.1337 cubic feet

Parameter:	1	2	3	4	5	6	7	8	9	10	11	12	13
	1140	1155											
Volume Purged (gal)													
Rate (mL/min)	~2.3	~2.3											
Depth to Water (ft.)	-	-											
pH	8.57	8.42											
Temp. (C)	11.04	11.85											
Conductivity (mS/cm)	0.601	0.985											
Dissolved Oxygen (mg/L)	9.95	10.09											
ORP (mV)	191	211											
Turbidity (NTU)	>100	29.7											
Notes:													

Problems / Observations

1135 BROWN, TURBID, ODORLESS

1155 COLORLESS, CLEAR, ODORLESS

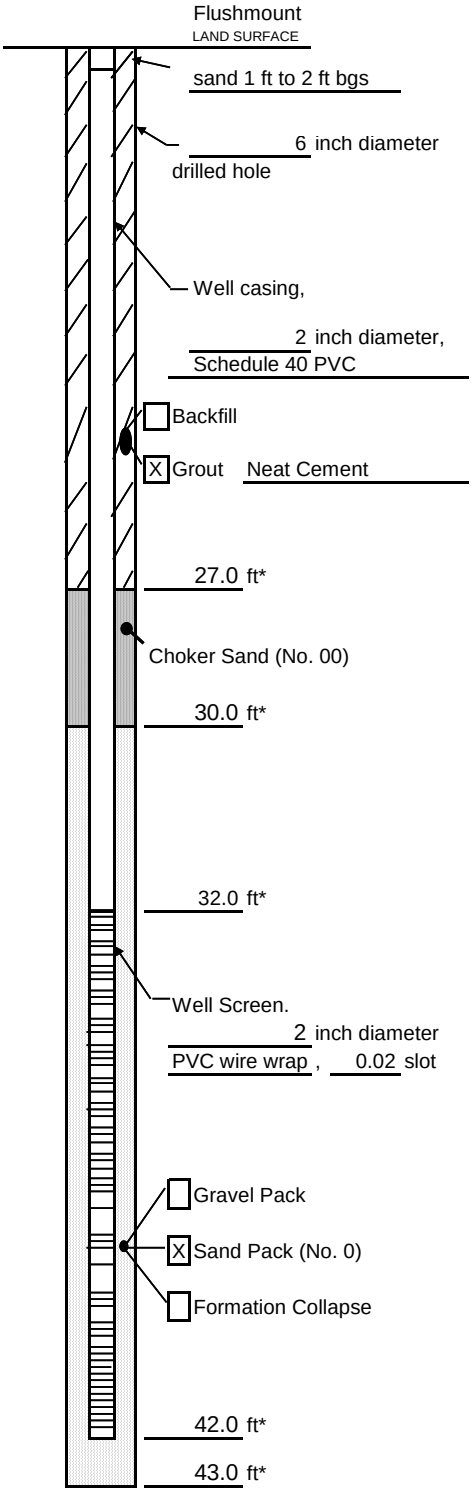
FINAL DTB (TIC) 41.84

CAM LOCK COUPLING NOT INSTALLED

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE Site Well IW-78

Town/City Fort Drum

County Jefferson State NY

Permit No.

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 5/2-5/3/2017

Drilling Method Hollow Stem Auger

Drilling Contractor Northnagle

Drilling Fluid None

Development Technique(s) and Date(s)

Air Lift 5/3/2017

Fluid Loss During Drilling _____ gallons

Water Removed During Development 48 gallons

Static Depth to Water 18.75 feet below M.P.

Pumping Depth to Water _____ feet below M.P.

Pumping Duration 20 minutes

Pumping Rate 2.5 gpm Date 5/3/2017

Specific Capacity _____ gpm/ft

Well Purpose Injection

Remarks 6" pvc cap at 42 ft bgs

Prepared by Levia Terrel

Fort Drum — *Site* | PCE 3800 ISCO Remedial Action — *Event*

WELL DEVELOPMENT LOG

Sampling Personnel: LEVIA TERRELL
Well ID: TW-78
Client / Job Number: USACE / GP14DRUM.RIFS. G3801
Date: 0-3-17
Weather: CLOUDY 42°F
Time In: 1200 **Time Out:** 1230

Well Information

Depth to Water:	(feet)	18.75	(from MP)
Total Depth:	(feet)	41.48	(from MP)
Length of Water Column:	(feet)	22.73	
Volume of Water in Well:	(gal)	~3.7	

Well Type:	(Flushmount)		Stick-Up
Well Material:	Stainless Steel		(PVC)
Well Locked:	Yes		(No)
Measuring Point Marked:	Yes		(No)
Well Diameter:	1"	(2")	Other:

Purging Information

Purging Method:	Bailer	Peristaltic	Waterra	Other:	AIR LIFT
Tubing/Bailer Material:	Steel	Polyethylene	Waterra	Other:	(PVC)
Duration of Pumping:	(min)	20			
Average Pumping Rate:	(ml/min)	~2.5	Water-Quality Meter Type:	Horiba U-22/LaMotte 2020	
Total Volume Removed:	(gal)	48	Did well go dry:	Yes	(No)

Conversion Factors

gal / ft. of water	1" ID	2" ID	4" ID	6" ID
	0.041	0.163	0.653	1.469

1 gal = 3.785 L =3785 ml = 0.1337 cubic feet

Parameter:	1	2	3	4	5	6	7	8	9	10	11	12	13
	1206	1222											
Volume Purged (gal)													
Rate (mL/min)													
Depth to Water (ft.)	–	–											
pH	8.45	8.39											
Temp. (C)	11.91	11.63											
Conductivity (mS/cm)	0.160	0.195											
Dissolved Oxygen (mg/L)	10.49	10.39											
ORP (mV)	190	196											
Turbidity (NTU)	>1000	5.4											
Notes:													

Problems / Observations

1202 BROWN, TURBID, ODORLESS

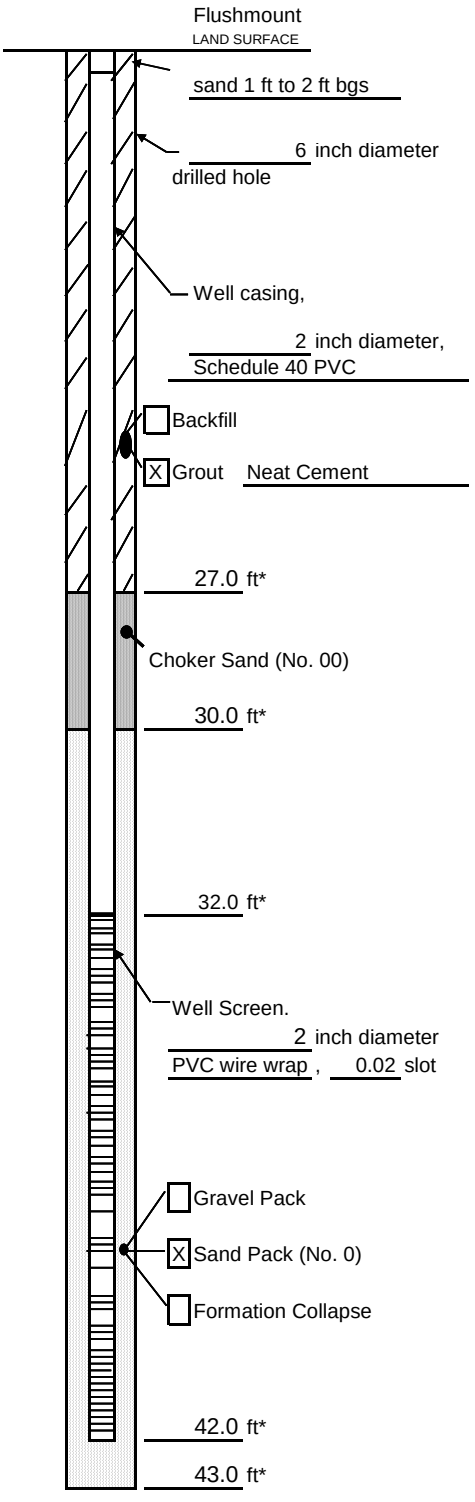
1222 CLEAR, COLORLESS, ODORLESS

CAM LOCK COUPLING NOT INSTALLED - ALL MEASUREMENTS MADE FROM TOP OF PVC

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE Site Well IW-79

Town/City Fort Drum

County Jefferson State NY

Permit No.

Land-Surface Elevation and Datum:

feet ☐ Surveyed ☐ Estimated

Installation Date(s) 4/26 -4/27/2017

Drilling Method Hollow Stem Auger

Drilling Contractor Northnagle

Drilling Fluid None

Development Technique(s) and Date(s)

Air Lift 5/3/2017

Fluid Loss During Drilling gallons

Water Removed During Development 49 gallons

Static Depth to Water 15.49 feet below M.P.

Pumping Depth to Water feet below M.P.

Pumping Duration 15 minutes

Pumping Rate 3.25 gpm Date 5/3/2017

Specific Capacity gpm/ft

Well Purpose Injection

Remarks 6" pvc cap at 42 ft bgs

Final DTB (TOC) = 41.43 ft

Prepared by Levia Terrel

Fort Drum — *Site* | PCE 3800 ISCO Remedial Action — *Event*

WELL DEVELOPMENT LOG

Sampling Personnel: LEVIA TERRELL | **Well ID:** IW-79
Client / Job Number: USACE | **Date:** 5-3-17
Weather: CLOUDY, 41°F | **Time In:** 1000 | **Time Out:**

Well Information

Depth to Water:	(feet)	15.49	(from MP)
Total Depth:	(feet)	39.82	(from MP)
Length of Water Column:	(feet)	24.33	
Volume of Water in Well:	(gal)	~4.0	

Well Type:		(Flushmount)	Stick-Up
Well Material:		Stainless Steel	(PVC)
Well Locked:		Yes	(No)
Measuring Point Marked:		Yes	(No)
Well Diameter:	1"	(2")	Other:

Purging Information

Purging Method:	Bailer	Peristaltic	Waterra	Other:	AIR LIFT
Tubing/Bailer Material:	Steel	Polyethylene	Waterra	Other:	PVC
Duration of Pumping:	(min)	15			
Average Pumping Rate:	(ml/min)	~3.25	Water-Quality Meter Type:	Horiba U-22/LaMotte 2020	
Total Volume Removed:	(gal)	49	Did well go dry:	Yes	(No)

Conversion Factors				
gal / ft. of water	1" ID	2" ID	4" ID	6" ID
	0.041	0.163	0.653	1.469
1 gal = 3.785 L =3785 ml = 0.1337 cubic feet				

Parameter:	1	2	3	4	5	6	7	8	9	10	11	12	13
	1005	1015											
Volume Purged (gal)													
Rate (mL/min)	~3.25	3.25											
Depth to Water (ft.)	—	—											
pH	8.32	8.30											
Temp. (C)	10.04	10.16											
Conductivity (mS/cm)	0.896	0.910											
Dissolved Oxygen (mg/L)	7.41	11.09											
ORP (mV)	196	190											
Turbidity (NTU)	102	3.8											
Notes:													

Problems / Observations

1000 BROWN, TURBID, ODORLESS

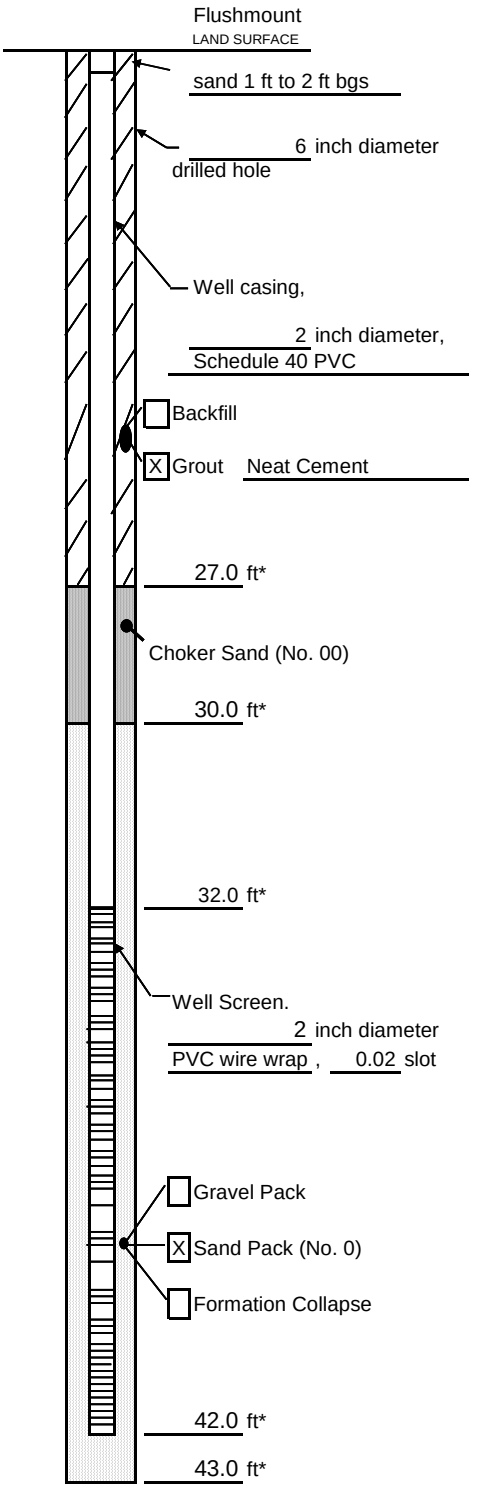
1015 CLEAR, COLORLESS, ODORLESS

FINAL DTB(TIC) = 41.43 HB

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project	3800 PCE Site	Well	IW-80
Town/City	Fort Drum		
County	Jefferson	State	NY
Permit No.			

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s)	4/27/2017
Drilling Method	Hollow Stem Auger
Drilling Contractor	Northnagle
Drilling Fluid	None

Development Technique(s) and Date(s)

Air Lift 5/3/2017

Fluid Loss During Drilling		gallons
Water Removed During Development	58	gallons
Static Depth to Water	15.59	feet below M.P.
Pumping Depth to Water		feet below M.P.
Pumping Duration	16	minutes
Pumping Rate	3.5 gpm	Date 5/3/2017
Specific Capacity		gpm/ft
Well Purpose	Injection	

Remarks 6" pvc cap at 42 ft bgs

Prepared by Levia Terrel

Fort Drum — *Site* | PCE 3800 ISCO Remedial Action — *Event*

WELL DEVELOPMENT LOG

Sampling Personnel: LEVIA TERRELL | **Well ID:** IW-80
Client / Job Number: USACE | **Date:** 5-3-17
Weather: CLOUDY | **Time In:** 910 | **Time Out:** 955

Well Information

Depth to Water:	(feet)	15.59	(from MP)
Total Depth:	(feet)	40.10	(from MP)
Length of Water Column:	(feet)	24.51	
Volume of Water in Well:	(gal)	~4.0	

Well Type:	(Flushmount)		Stick-Up
Well Material:	Stainless Steel		(PVC)
Well Locked:	Yes		(No)
Measuring Point Marked:	Yes		(No)
Well Diameter:	1"	(2")	Other:

Purging Information

Purging Method:	Bailer	Peristaltic	Waterra	Other: AIR LIFT
Tubing/Bailer Material:	Steel	Polyethylene	Waterra	Other: PVC
Duration of Pumping:	(min) 16			
Average Pumping Rate:	(ml/min) ~3.5	Water-Quality Meter Type:	Horiba U-22/LaMotte 2020	
Total Volume Removed:	(gal) ~5	Did well go dry:	Yes	(No)

Conversion Factors

gal / ft. of water	1" ID	2" ID	4" ID	6" ID
	0.041	0.163	0.653	1.469

1 gal = 3.785 L =3785 ml = 0.1337 cubic feet

Parameter:	1	2	3	4	5	6	7	8	9	10	11	12	13
	918	934											
Volume Purged (gal)													
Rate (mL/min)	~3.5	~3.5											
Depth to Water (ft.)	—	—											
pH	8.25	8.27											
Temp. (C)	10.32	9.91											
Conductivity (mS/cm)	0.940	0.921											
Dissolved Oxygen (mg/L)	9.27	8.94											
ORP (mV)	202	208											
Turbidity (NTU)	>1000	16.4											
Notes:													

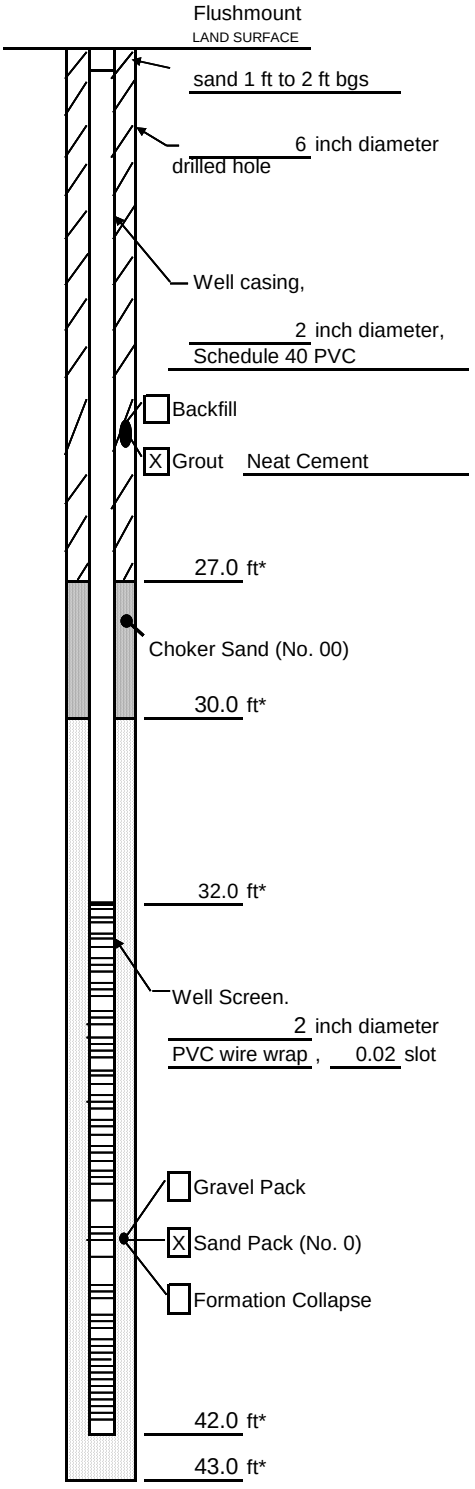
Problems / Observations 915 BROWN, TURBID, ODORLESS

935 CLEAR COLORLESS ODORLESS

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE Site Well IW-81

Town/City Fort Drum

County Jefferson State NY

Permit No.

Land-Surface Elevation and Datum:

feet ☐ Surveyed ☐ Estimated

Installation Date(s) 4/27-4/28/2017

Drilling Method Hollow Stem Auger

Drilling Contractor Northnagle

Drilling Fluid None

Development Technique(s) and Date(s)

Air Lift 5/3/2017

Fluid Loss During Drilling gallons

Water Removed During Development 65 gallons

Static Depth to Water 15.72 feet below M.P.

Pumping Depth to Water feet below M.P.

Pumping Duration 25 minutes

Pumping Rate 2.6 gpm Date 5/3/2017

Specific Capacity gpm/ft

Well Purpose Injection

Remarks 6" pvc cap at 42 ft bgs

Final DTB (BGS) = 42.43 ft

Prepared by Levia Terrel

Fort Drum
Site

PCE 3800 ISCO Remedial Action
Event

WELL DEVELOPMENT LOG

Sampling Personnel:	LEVI A TERRELL	**Well ID:**	~~IW-79~~ ~~TT~~ IW-81
Client / Job Number:	USACE	**Date:**	5-3-17
Weather:	RAIN 39°F	**Time In:**	0730
		Time Out:	830

Well Information

Depth to Water:	(feet)	15.72 (BGS)	(from MP)
Total Depth: 42.43 FINAL DTB	(feet)	~~41.25 (BGS)~~ 41.91	(from MP) FB
Length of Water Column:	(feet)	26.19	
Volume of Water in Well:	(gal)	~ 4.27	

Well Type:	(Flushmount)	Stick-Up	
Well Material:	Stainless Steel	(PVC)	
Well Locked:	Yes	(No)	
Measuring Point Marked:	Yes	(No)	
Well Diameter:	1"	(2")	Other:

Purging Information

Purging Method:	Bailer	Peristaltic	Waterra	Other: AIR LIFT
Tubing/Bailer Material:	Steel	Polyethylene	Waterra	Other: PVC
Duration of Pumping:	(min)			
Average Pumping Rate:	(ml/min)	Water-Quality Meter Type:		Horiba U-22/~~LaMotte 2020~~
Total Volume Removed:	(gal) 65	Did well go dry:	Yes	(No)

Conversion Factors

gal / ft. of water	1" ID	2" ID	4" ID	6" ID
	0.041	0.163	0.653	1.469

1 gal = 3.785 L =3785 ml = 0.1337 cubic feet

Parameter:	1	2	3	4	5	6	7	8	9	10	11	12	13
	805	823											
Volume Purged (gal)		65											
Rate (mL/min)	~3.25 gpm ~~1 gpm~~	3.25 gpm											
Depth to Water (ft.)	–	–											
pH	7.90	6.30											
Temp. (C)	8.89	8.71											
Conductivity (mS/cm)	1.16	0.984											
Dissolved Oxygen (mg/L)	16.45	9.12											
ORP (mV)	184	287											
Turbidity (NTU)	735	8.4											
Notes:													

Problems / Observations

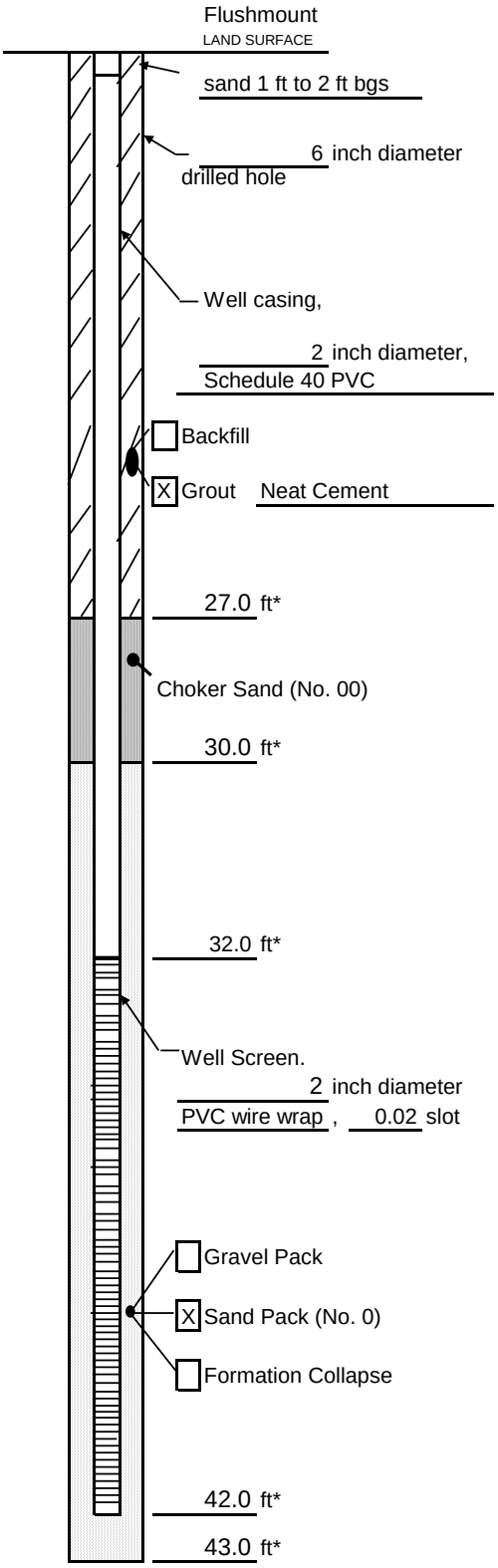
800 PUMP ON
BROWN, TURBID, ODORLESS
825 PUMP OFF
CLEAR, COLORLESS ODORLESS

FINAL DTB (BGS) = 42.43 HB

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project	3800 PCE Site	Well	IW-82
Town/City	Fort Drum		
County	Jefferson	State	NY
Permit No.			

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s)	4/26 -4/27/2017
Drilling Method	Hollow Stem Auger
Drilling Contractor	Northnagle
Drilling Fluid	None

Development Technique(s) and Date(s)

Air Lift 5/3/2017

Fluid Loss During Drilling		gallons
Water Removed During Development	50	gallons
Static Depth to Water	15.76	feet below M.P.
Pumping Depth to Water		feet below M.P.
Pumping Duration	20	minutes
Yield	2.5 gpm	Date
Specific Capacity		gpm/ft
Well Purpose	Injection	

Remarks 6" pvc cap at 42 ft bgs

Final DTB = 42.24 ft bgs

Prepared by Levia Terrel

Fort Drum — PCE 3800 ISCO Remedial Action

Site — **WELL DEVELOPMENT LOG** — *Event*

Sampling Personnel: LEVIA TERRELL
Well ID: ~~IEW~~ IW-82
Client / Job Number: USACE
Date: 5-3-17
Weather: CLOUDY, 39°F WINDY
Time In: 830 **Time Out:** 905

Well Information

Depth to Water:	(feet)	15.76	(from MP)
Total Depth:	(feet)	41.25 (FB)	(from MP)
Length of Water Column:	(feet)	25.49	
Volume of Water in Well:	(gal)	~ 4.15	

Well Type:		(Flushmount)	Stick-Up
Well Material:		Stainless Steel	(PVC)
Well Locked:		Yes	(No)
Measuring Point Marked:		Yes	(No)
Well Diameter:	1"	(2")	Other:

Purging Information

Purging Method:	Bailer	Peristaltic	Waterra	Other: (AIR LIFT)
Tubing/Bailer Material:	Steel	Polyethylene	Waterra	Other: (PVC)
Duration of Pumping:	(min)			
Average Pumping Rate:	(ml/min)		Water-Quality Meter Type:	Horiba U-22/LaMotte 2020
Total Volume Removed:	(gal) ~ 50		Did well go dry:	Yes (No)

Conversion Factors

gal / ft. of water	1" ID	2" ID	4" ID	6" ID
	0.041	0.163	0.653	1.469

1 gal = 3.785 L =3785 ml = 0.1337 cubic feet

Parameter:	1	2	3	4	5	6	7	8	9	10	11	12	13
	840	855											
Volume Purged (gal)													
Rate ~~(mL/min)~~ gpm	~~~2.5~~ ~~2.25~~	~~~2.5~~ ~~3.25~~											
Depth to Water (ft.)	-	-											
pH	7.78	8.16											
Temp. (C)	9.51	9.57											
Conductivity (mS/cm)	1.03	1.02											
Dissolved Oxygen (mg/L)	11.15	11.35											
ORP (mV)	226	203											
Turbidity (NTU)	>1000	8.1											
Notes:													

Problems / Observations

835 BROWN, TURBID, ODORLESS

855 CLEAR, COLORLESS, ODORLESS

FINAL DTB - 42.24' BGS

APPENDIX C

Bills of Lading for Investigation-Derived Waste

ENVIRONMENTAL PRODUCTS & SERVICES OF VERMONT, INC.

24-Hour Emergency Phone Number 1-800-843-8265

Please print or type

BILL OF LADING

Generator EPA ID #	1. Document No. SYR15202	2. Page 1 of 1

3. Generator's Name and Mailing Address
DIRECTORATE OF PUBLIC WORKS, ENVIRONMENTAL DIVISION
4896 NININGER ST.
FORT DRUM NY 13602

4. Generator's Phone (315) 772-6312

Site Address
EIGHTH STREET EAST, BUILDING 1685
FORT DRUM NY 13602

5. Transporter 1 Company Name: RICCELLI TRUCKING, INC.
6. EPA ID #:

A. State Transporter's ID: 7A434 NY
B. Transporter 1 Phone: 315 701-0002

7. Transporter 2 Company Name:
8. EPA ID #:

C. State Transporter's ID:
D. Transporter 2 Phone:

9. Designated Facility Name and Site Address
DANC RODMAN LANDFILL
23680 NYS ROUTE 177
RODMAN NY 13682

10. EPA ID #:

E. State Facility's ID:
F. Facility's Phone: 315 232-3236

GENERATOR

HM	11. Shipping Name	12. Containers No.	12. Containers Type	13. Total Quantity	14. Unit Wt./Vol.
	a. NON-RCRA, NON-DOT SOLIDS, N.O.S. (Trace Organics Contaminated Soil)	001	CM		T
	b.				
	c.				
	d.				

G. Additional Descriptions for Materials Listed Above
a. APP#SW17-21, ___YRD ROLLOFF
b.
c.
d. JOB#N15589, PO#38032N

15. Special Handling Instructions and Additional Information
1)TRACE PCE CONTAMINATION <0.01 mg/L

16. GENERATOR'S CERTIFICATION: I hereby certify that the above named materials are properly classified, described, packaged, marked and labeled and are in proper condition for transportation according to the applicable regulation of the Department of Transportation. The materials described on this document are not subject to federal uniform hazardous waste manifest requirements.

Printed/Typed Name	Signature	Date Month	Day	Year
Paul Zaing	[signature]	6	7	17

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Date Month	Day	Year
Tom Shenk	[signature]	6	9	17

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Date Month	Day	Year

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator; Certification of receipt of the materials covered by this bill of lading except as noted in item 19.

Printed/Typed Name	Signature	Date Month	Day	Year
Jamie Perry	[signature]	6	9	17

Development Authority of the North Country
Solid Waste Management Facility
23400 NYS Route 177
Rodman, New York 13682
Tel: (315) 661-3230

DATE:06/07/17 **TICKET #: 391921**
TIME IN: 10:41 TIME OUT:10:55

Bill Acct:ENVPROVT
Company:Environmental Prod & Svc of Verm
532 State Fair Blvd
Syracuse NY 13204

Haul Acct:RICCTRUC
Company:Riccelli Trucking, Inc.

TRUCK#:5516 License#:34033PC
Container#: License#:

	LBS	Tons
GROSS:	56680	28.34
TARE:	34720	17.36
NET:	**21960**	**10.98**

MATERIAL:600 - Contaminated Soil
County :10 - Jefferson
W/C: 3125 - #SW17-21 EIGHTH ST. E

TIP FEE:
:
TOTAL FEE:

NOTE:PO-38032N

Weighmaster:Jamie Perry
THANK YOU!

ENVIRONMENTAL PRODUCTS & SERVICES OF VERMONT, INC.

24-Hour Emergency Phone Number
1-800-843-8265

Please print or type

BILL OF LADING

Generator EPA ID #

1. Document No. SYR15271 | 2. Page 1 of 1

3. Generator's Name and Mailing Address
DIRECTORATE OF PUBLIC WORKS, ENVIRONMENTAL DIVISION
4896 NININGER ST.
FORT DRUM NY, 13602

4. Generator's Phone (315) 772-6312

Site Address
EIGHTH STREET EAST, BUILDING 1665
FORT DRUM NY 13602

5. Transporter 1 Company Name: ENVIRONMENTAL PROD & SVCS OF VT, INC
6. EPA ID #: NYR000115733
A. State Transporter's ID: 2-8(7)71 VT
B. Transporter 1 Phone: 800 843-8265
C. State Transporter's ID
D. Transporter 2 Phone

7. Transporter 2 Company Name
8. EPA ID #
E. State Facility's ID

9. Designated Facility Name and Site Address
ENVIRONMENTAL PROD & SVCS OF VT, INC
532 STATE FAIR BLVD.
HM SYRACUSE NY 13204
10. EPA ID # NYR000115733
F. Facility's Phone 800 843-8265

GENERATOR

	11. Shipping Name	12. Containers No.	Type	13. Total Quantity	14. Unit Wt./Vol.
a.	NON-RCRA, NON-DOT, LIQUIDS, N.O.S. (TRACE ORGANICS CONTAMINATED WATER)	8	DM	400	G
b.					
c.					
d.					

G. Additional Descriptions for Materials Listed Above

a. APP #: 0617063-OT, 8 X 55 GAL
b.
c.
d.

15. Special Handling Instructions and Additional Information
1)GWM WATER WITH TRACE ORGANICS

16. GENERATOR'S CERTIFICATION: I hereby certify that the above named materials are properly classified, described, packaged, marked and labeled and are in proper condition for transportation according to the applicable regulation of the Department of Transportation. The materials described on this document are not subject to federal uniform hazardous waste manifest requirements.

Printed/Typed Name: Paul G. Zwo | Signature | Date: Month 6 Day 13 Year 11

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name: William G. Power | Signature | Date: Month 6 Day 13 Year 11

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name | Signature | Date: Month Day Year

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator; Certification of receipt of the materials covered by this bill of lading except as noted in item 19.

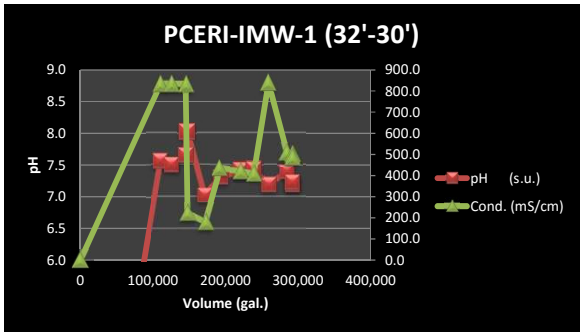
Printed/Typed Name: RON POKRZYWINSKI | Signature | Date: Month 6 Day 13 Year 11

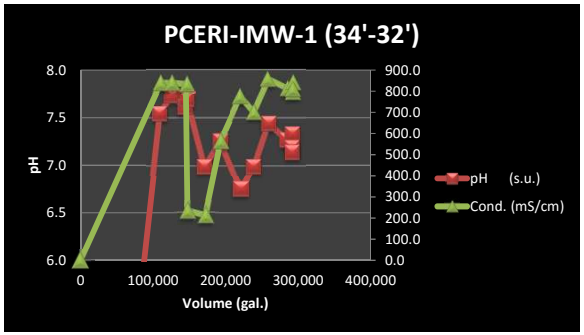
BILL OF LADING

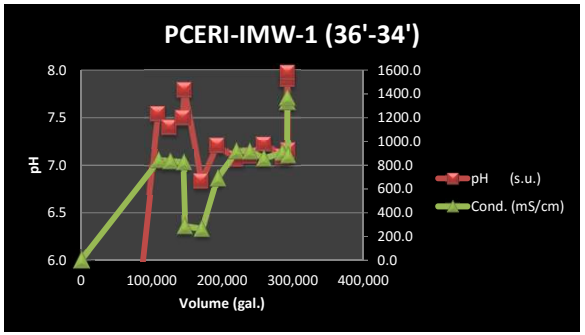
APPENDIX D

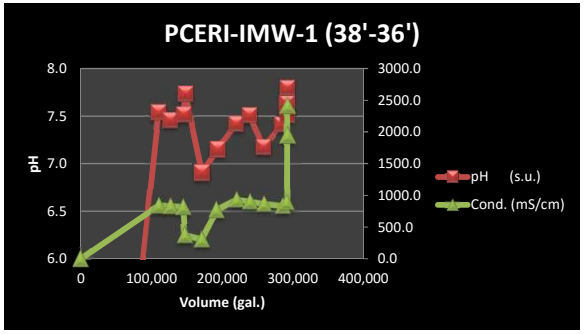
Oxidant Injection Field Logs

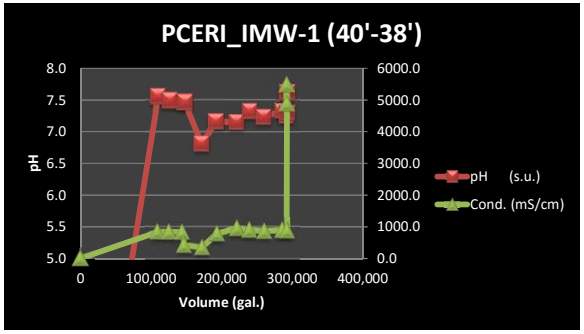
PCERI-IMW-1
pH and Conductivity Measurements
Fort Drum IRP - 3800 Area PCE Site



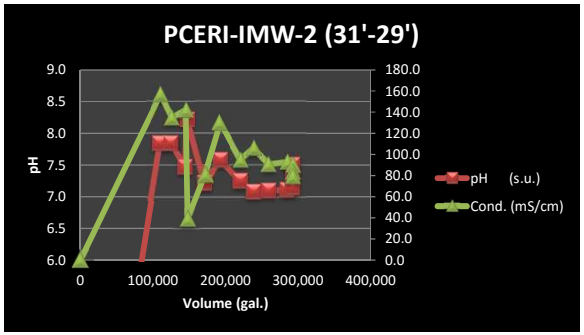


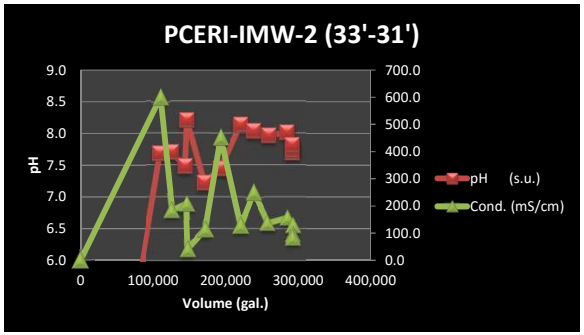


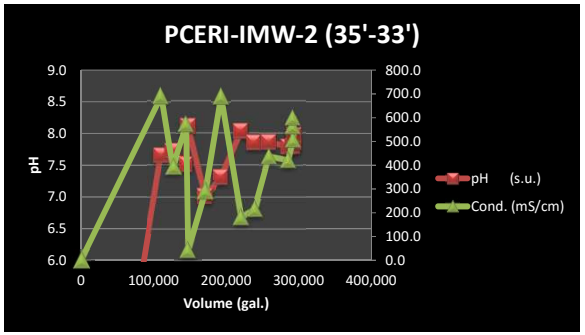


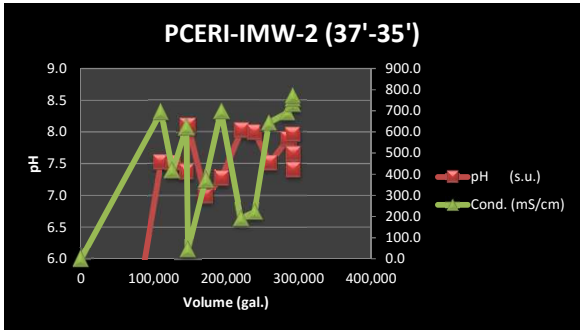


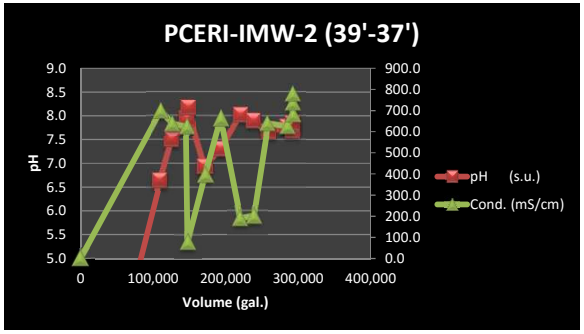
PCERI-IMW-2
pH and Conductivity Measurements
Fort Drum IRP - 3800 Area PCE Site



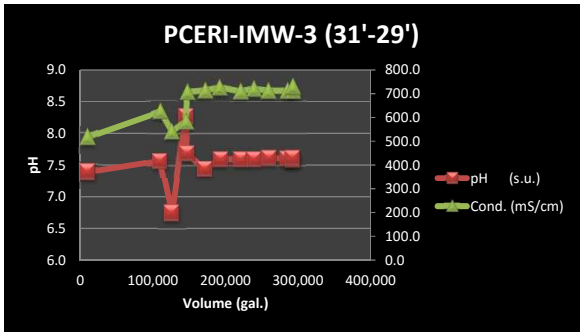


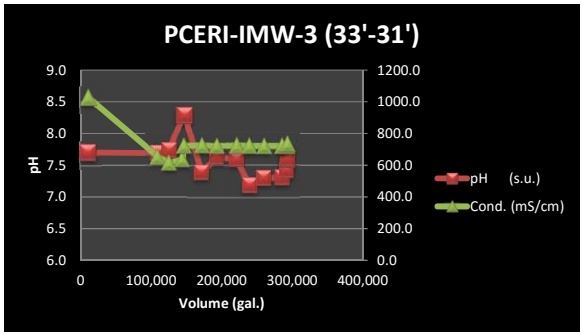


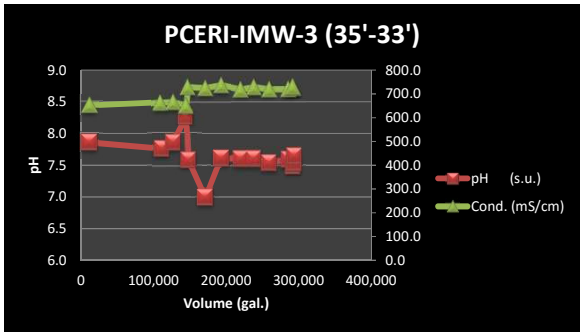


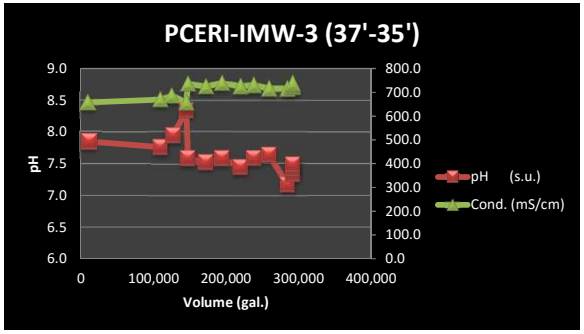


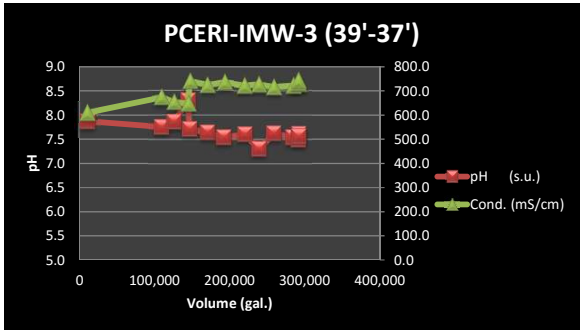
PCERI-IMW-3
pH and Conductivity Measurements
Fort Drum IRP - 3800 Area PCE Site



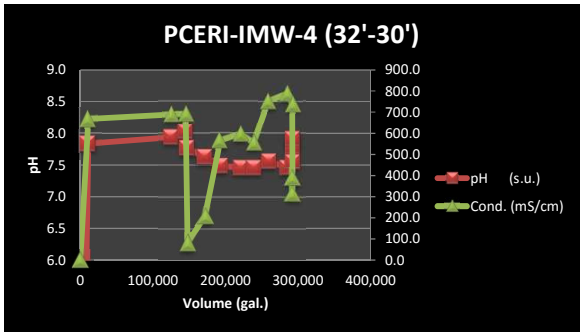


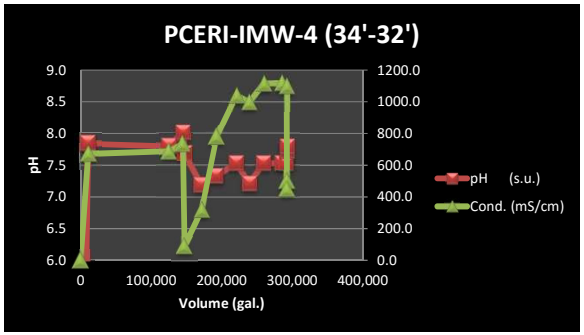


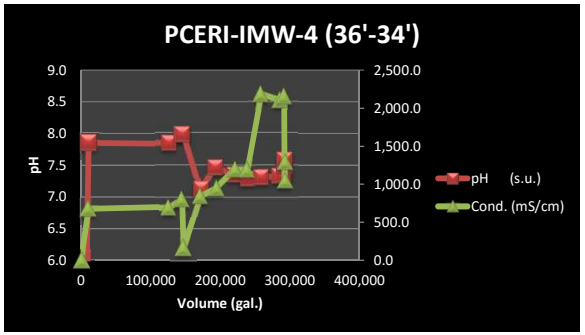


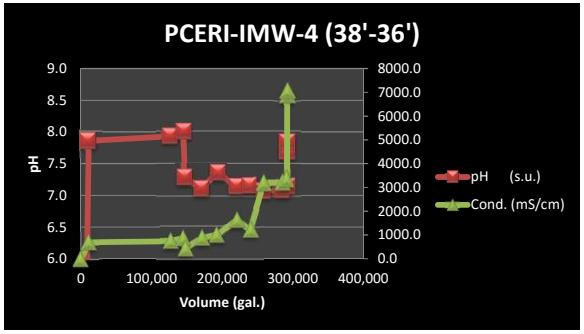


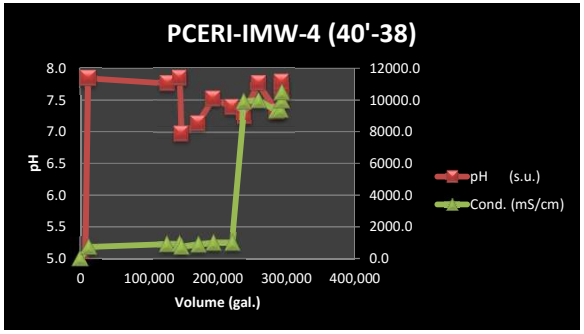
PCERI-IMW-4
pH and Conductivity Measurements
Fort Drum IRP - 3800 Area PCE Site



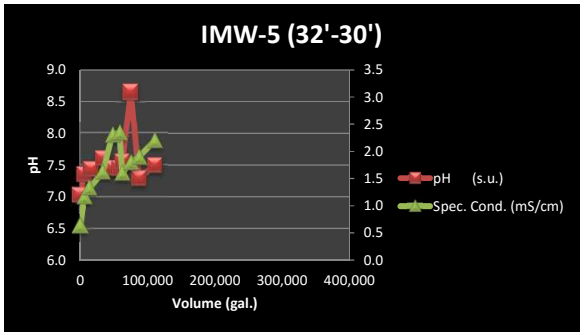


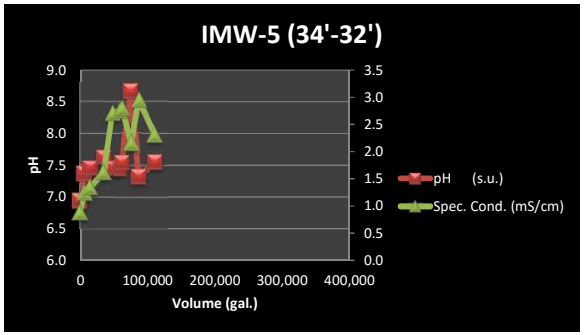


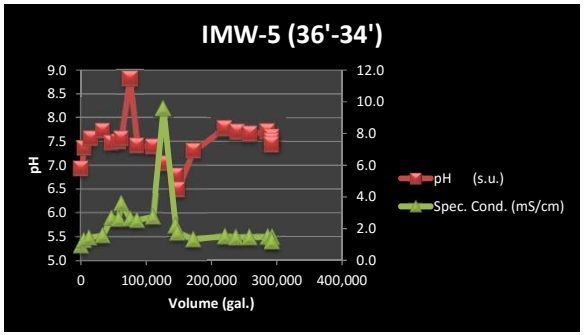


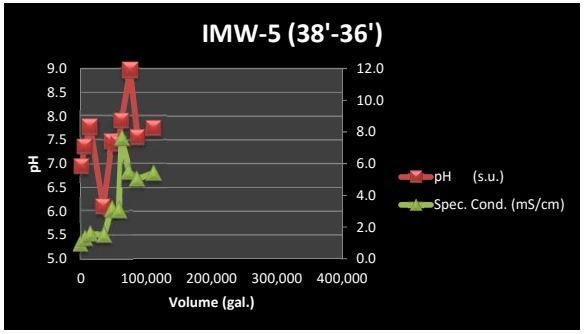


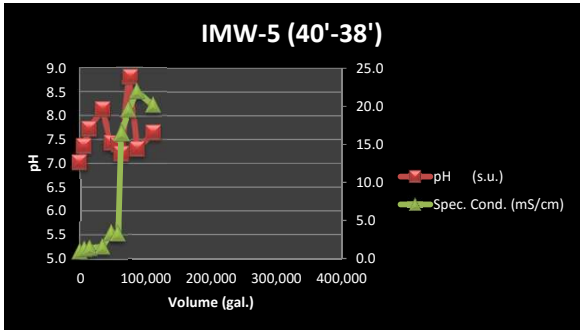
IMW-5
pH and Specific Conductivity Measurements
Fort Drum IRP - 3800 Area PCE Site



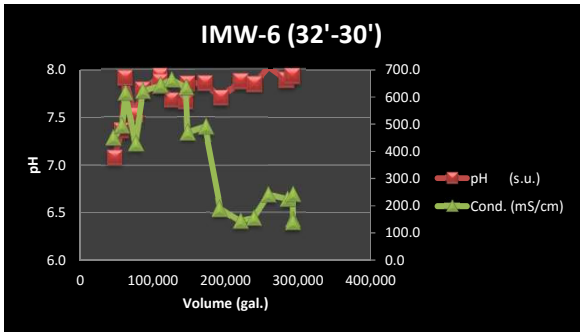


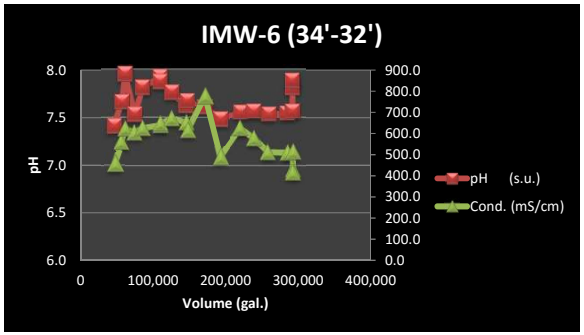


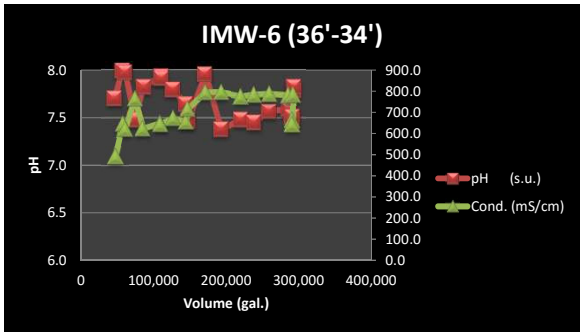


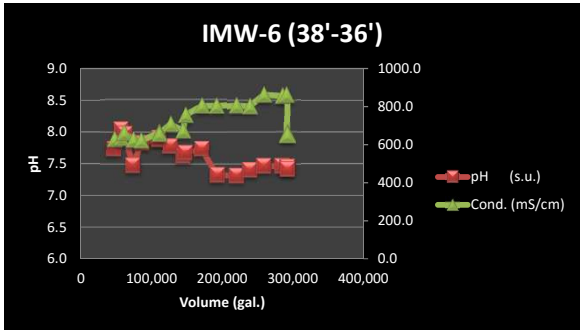


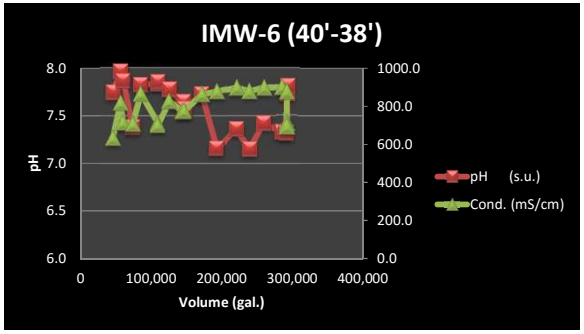
IMW-6
pH and Conductivity Measurements
Fort Drum IRP - 3800 Area PCE Site



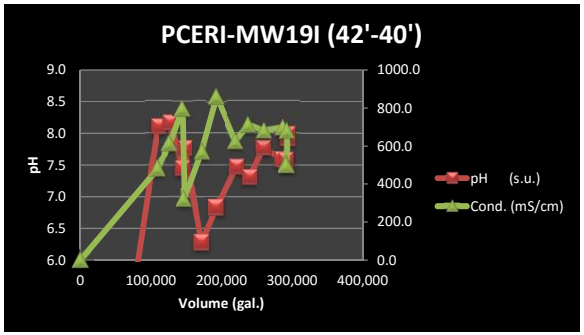


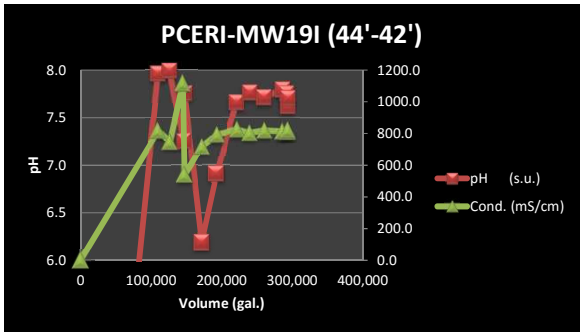


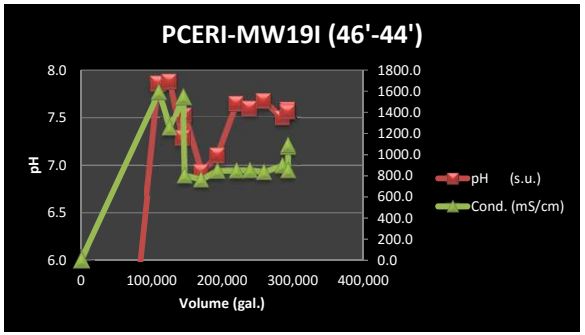


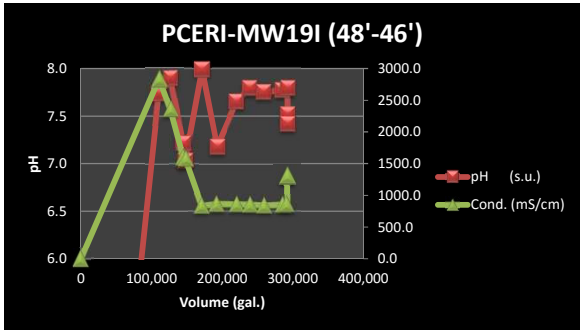


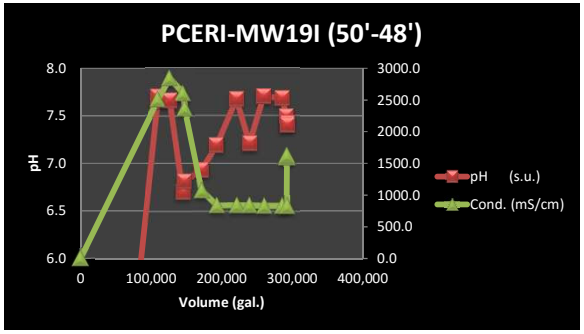
PCERI-MW19I
pH and Conductivity Measurements
Fort Drum IRP - 3800 Area PCE Site



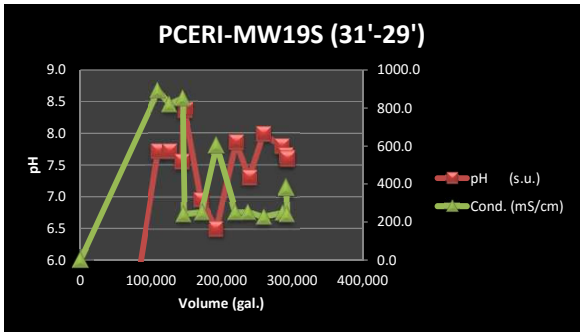


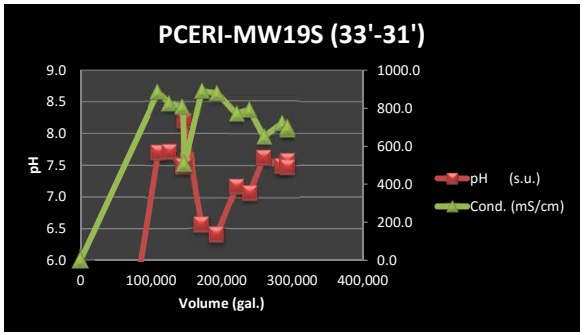


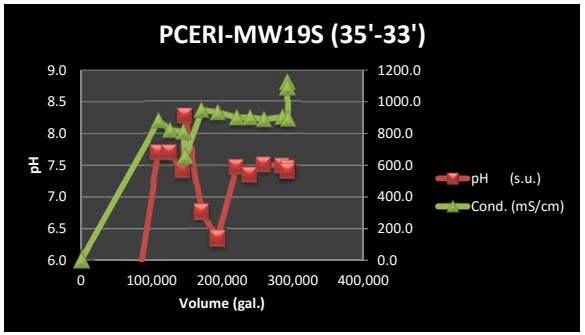


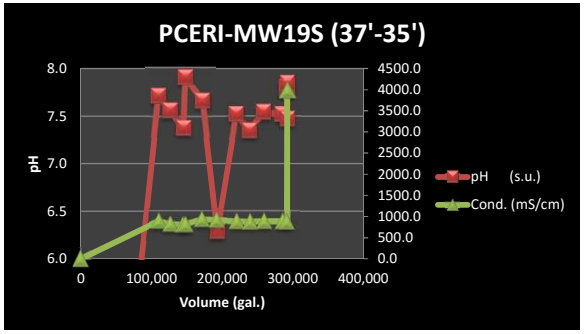


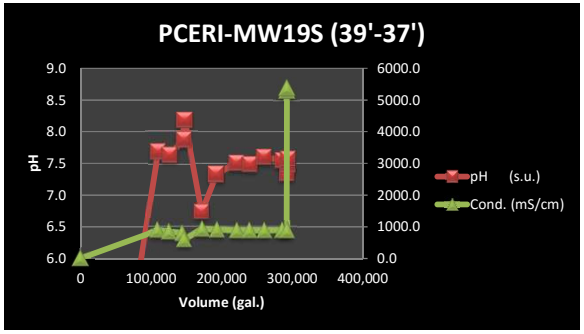
PCERI-MW19S
pH and Conductivity Measurements
Fort Drum IRP - 3800 Area PCE Site



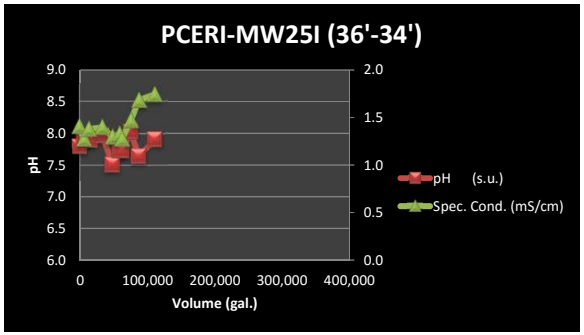


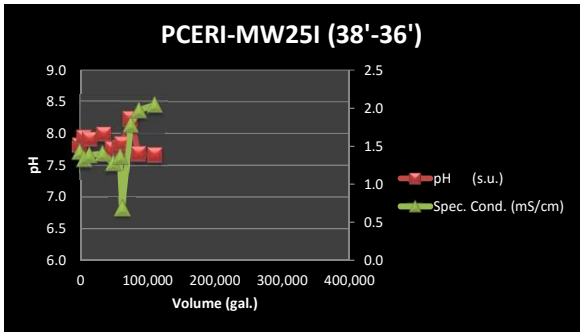


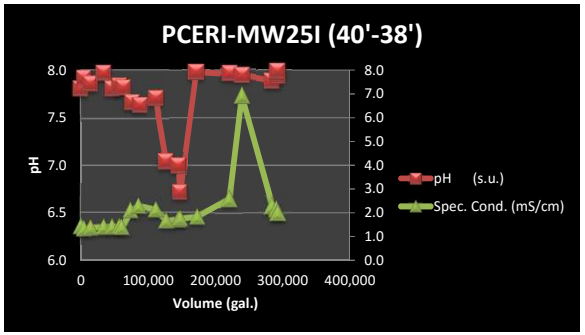


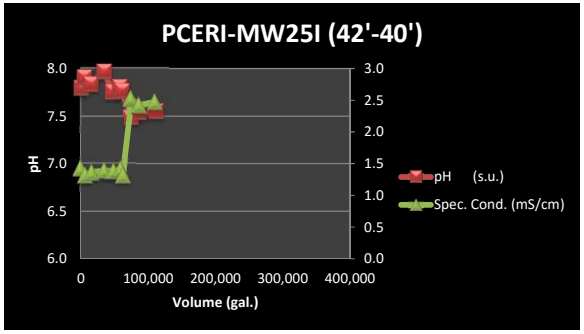


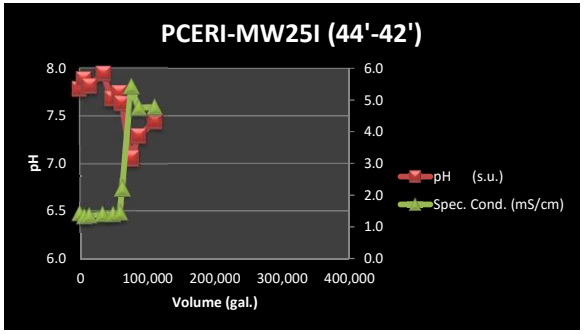
PCERI-MW25I
pH and Specific Conductivity Measurements
Fort Drum IRP - 3800 Area PCE Site



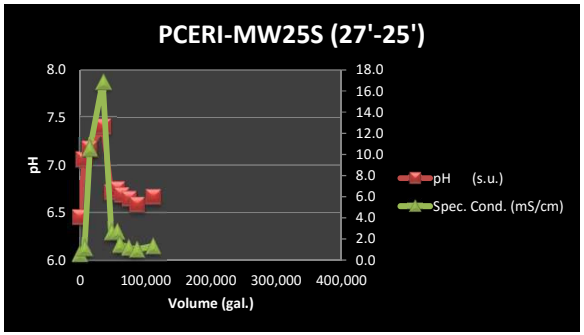


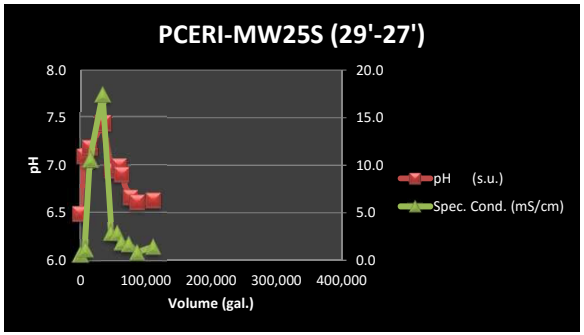


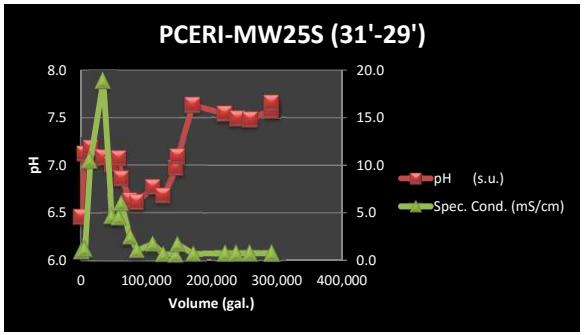


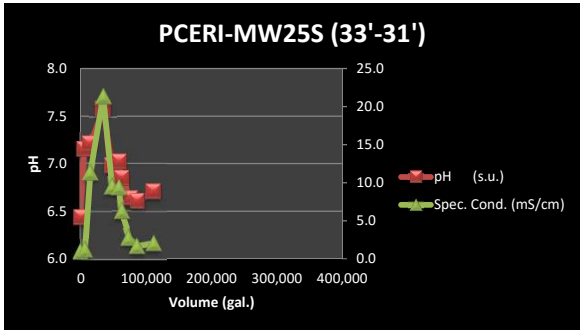


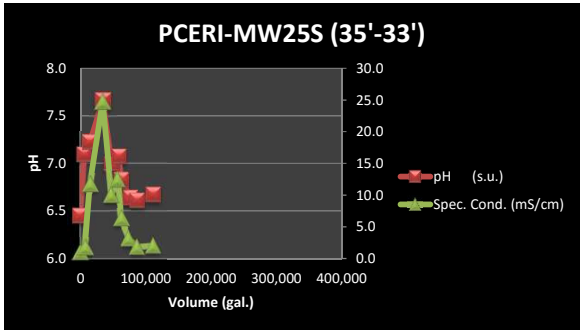
PCERI-MW25S
pH and Specific Conductivity Measurements
Fort Drum IRP - 3800 Area PCE Site











ARCADIS Design & Consultancy for natural and built assets

Daily Log

Project: Fort Drum Project No. GP14DRUM Page 1 of 1

Site Location: Fort Drum, NY

Prepared By: M. Pinsiten (MP) Staff: C. Glidden (CG)

05/22/17 - Monday

Date/Time	Description of Activities
0645	MP and CG on-Site to obtain Base passes. Met w/ Paul Zang (USACE).
0730	MP and CG met at the Arcadis trailer for H&S Tailgate with Mike Valve, (PFKA). Review HASP and basic H&S topics for the Base.
0830	MP and CG obtain and mobilize new equipment (cones, hoses, pumps, fittings) and old equipment on-Site (manifolds, hoses, flow meters, fire hose). to the Site from various locations on Base.
1330	MP and CG begin fusing 2" pipe w/ Con-Loc connections and building dosing pump set-up for 40% solution at Bldg 1549
1730	MP and CG mobilize to the Site (1885) to set-up cone delineators to place around the mobilized equipment.
1815	MP and CG off-Site. Mobilized to Home Depot for additional supplies.

ARCADIS Design & Consultancy for natural and built assets

Daily Log

Project: Fort Drum Project No. GP14 DRUM Page 1 of 2

Site Location: Fort Drum, NY

Prepared By: M. Pinsker (MP) Other Staff: C. Glotfelty (CG)

Tuesday - 05/23/17

Date/Time	Description of Activities
0630	MP and CG on-Site. Headed to Bldg 1555 to continue backfilling the drains set-up for tubes and injection hoses.
0645	MP and CG conduct H&S Tailgate meeting and reviewed the daily SOW and deliveries. Rain for Rent and Bobcat deliveries
0730	MP off-Site to McCabe's Supply to drop-off back flow preventer for re-certification. CG working on plumbing
0830	MP back on-Site to Bldg 1549.
0900	Bobcat on-Site (Bldg 1885) to deliver air compressor and fork lift. Driver reviewed fork lift operations w/ CG.
0930	Bobcat off-Site. CG negotiated lower rental w/ Ron at Bobcat to a month rental based on our utilization. MP and CG sweeping for contamin
1330	Rain for Rent on-Site. Called Paul Zang for an escort to Bldg 1885. Delivered one 6,900 Poly Tank, Float alarm, 2 qty 10'x50' containments, one qty 28'x50' containment (for tank) and one qty 2" double-diaphragm tetlon pump. The 28'x50' containment was unloaded and was apparently never cleaned from the previous job. Approximately one 5 gallon bucket was filled with debris (pipe shavings, rocks, mud). MP and CG had to clean the containment prior to setting the poly tanks. Damage was found on the 28'x50' containment, 3 rips and missing legs).

ARCADIS Design & Consultancy for natural and built assets

Daily Log

Project: Fort Drum Project No. GP14DRUM Page 2 of 2

Site Location: Fort Drum, NY

Prepared By: M. Pingitore (MP) Other Staff: C. Glidden (CG)

Tuesday – 05/23/17

Date/Time	Description of Activities
	The 2" tetlon pump was also found to be missing the flange and cam-lock fittings along with no supports from keeping the pump upright. CG contacted Rich for Rent about the issues. They are going to send out someone to repair the rips and bolts less. CG and MP set-up the 28' by 50' containment and Rich for Rent dropped the poly tanks in place. MP and CG to set-up the 2 ea 12' x 50' containments. 28'x50' containment set-up and support area.
1515	Rich for Rent off-Site.
	MP and CG sweep the area for the 2 ea 12' x 50' containments to clear rocks. MP and CG set-up containments.
1730	MP and CG set-up further work zone delineation around the containments and equipment.
1800	MP and CG off-Site. Mobilized to Home Depot for field supplies

ARCADIS Design & Consultancy for natural and built assets

Daily Log

Project: Fort Drum | Project No. 6P14 DRUM | Page 1 of 2

Site Location: Fort Drum, NY

Prepared By: M. Pfeiffer (MP) Other Staff: C. Glidden (CG)

Wednesday, 5/24/17

Date/Time	Description of Activities
0645	MP and CT on-Site. Headed to Bldg 1885
0700	Conducted H&S Tailgate Meeting and reviewed daily SOW
0710	MP and CT began changing out cam-loc and union fittings seals with PTFE seals. Old seals were eroded due to exposure during the pilot test. MP and CG also adding legs to the Rain for Rent pump for stability.
1000	MP and CG on kick-off call with Team to review progress this week and plans moving forward.
1030	Finished call and MP and CG headed to McCabe's Supply to pick-up back flow preventor and to the hotel for McMaster-Carr order (misc. supplies)
1130	MP and CG on-Site. Rain for Rent on-Site to repair damaged containments (holes and broken legs). CG called Paul Zang for an escort for Rain for Rent. MP and CG continue to set-up injection system (recirculation loop, float/alarm for tanks, and plumbing hoses).
1330	Rain for Rent off-Site, all containments repaired. MP and CG continue plumbing Stage 1 wells and injection trailer and pumps area. Also set-up further delineation at the exclusion zones and

ARCADIS Design & Consultancy for natural and built assets

Daily Log

Project: Fort Drum Project No. GP14 Drum Page 2 of 2

Site Location: Fort Drum, NY

Prepared By: M. Pingitore (MP) Other Staff: C. Glidden (CG)

Wednesday, 5/24/17

Date/Time	Description of Activities
	injection well network. MP and CG charged seals on totalizers.
1500	MP and CG stopped by DPW to have them check the back-flow preventer. Plumbers off-Site for the day. Received permit and directions for tomorrow. MP and CG will drop off back-flow preventer at 0630 tomorrow with permit.
1530	MP and CG back at Bldg 1885 to continue injection skid set-up.
1830	MP and CG off-Site

ARCADIS Design & Consultancy for natural and built assets

Daily Log

Project: Fort Drum | Project No. GP14 DRUM | Page 1 of 2

Site Location: Fort Drum, NY

Prepared By: M. Pinster (MP) | Other Staff: G. Glidden (CG)

Thursday, 5/25/17 | Cloudy, H=61°F, L=53°F, Rain / Cloudy

Date/Time	Description of Activities
0615	MP and CG on-Site. Went to DPW for BFP permit and inspection.
0645	MP and CG head to Station #2 for Fire Chief signature / approval of hydrant use and BFP permit.
0700	MP and CG head to Bldg. 1885 to continue injection set-up
0745	Landstar on-Site with 14 totes of sodium permanganate (40%). CG called Paul Zay for an escort to Bldg 1885.
0800	Landstar arrives at Bldg 1885. Determine they do not have a pallet jack to move totes to the end of the trailer for removal by fork lift. Paul says there is a pallet jack at DPW, MP and CG pick it up and bring it to the Site.
0820	MP and CG begin unloading trucks. MP spotting CG on the fork lift. MP moving totes to back of the trailer for unloading.
0945	All totes unloaded and into secondary containments (7 qty in each containment). MP and CG place labels on the totes for compliance.
1000	Landstar off-Site. MP and CG return pallet jack to DPW and head to Oasis to get supplies. MP and CG build PRV for BFP and re-plumb fertilizer (2") for the hydrant since the old fertilizer went missing. Mike Valva provided the a different one for us to use for the job.

ARCADIS Design & Consultancy for natural and built assets

Daily Log

Project: Fort Dam Project No. GP14 DAM Page 2 of 2

Site Location: Fort Dam, NY

Prepared By: M. Pingree (MP) C. Glidden (CG)

Thursday, 5/25/17

Date/Time	Description of Activities
1430	Tested BFP, PRV and tetalizer on the hydrant. Everything functioning properly. MP and CG connect hydrant to desired set-up and make final connections to the injection system for a clean water test.
1530	Started clean water test. Flowing through design setup, pumps, manifolds and hoses at ≈25 gpm. Leaks were found at various locations, MP and CG began addressing leaks. 2 gate valves broken on the injection manifolds, need replacing.
1700	Heavy rain causing issues with detecting leaks, flooding containments MP and CG gather tools and secure Site for the night. Clean water test and leak fixes will be finished tomorrow.
1730	MP and CG off-Site

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Daily Log

Project: Fort Drum Project No. GP14DRUM Page 1 of 1

Site Location: Fort Drum, NY

Prepared By: M. Pingitore (MP) Other Staff: G. Gladden (GG)

Friday, 05/26/17 Cloudy, Rain, 47°F, H=57°F, L=43°F

Date/Time	Description of Activities
0615	MP and GG on-Site to Bldg ~~188~~ 1599 to work on system plumbing
0630	Conducted H&S Tailgate
0700	MP and GG head to Bldg 1885. Gate is locked. Contacted Mike Valvo and he stated that most operations were shutdown due to the Memorial Day Holiday. Mike instructed GG to contact DPW or the Fire Department. Paul Zang was off as well. MP reaches out to Chief Hopkins with no response. MP and GG head to DPW to look for a key to the gate. DPW does not have a key to Bldg 1885 gate, only meter pad does. DPW contacted Paul Zang, Paul confirmed base shutdown and suggested reaching out to Chief Hopkins. MP and GG exhausted all options with no access. MP and GG mobilize equipment and supplies to Bldg 1599 for the weekend
0900	MP and GG off-Site. Mobilizing back home for the weekend

ARCADIS Design & Consultancy for natural and built assets

Daily Log

Project: Fort Drum | Project No. GP14DRUM | Page 1 of 2

Site Location: Fort Drum, NY

Prepared By: M. Pingitore (MP), M. Redmond (MR)

Tuesday, 05/30/17 Cloudy, Rain, 54°F, H=63°F, L=55°F, Showers

Date/Time	Description of Activities
0700	MP and MR on-Site at the main gate to get MR his pass
0730	MP and MR arrive to the Arcadis/PERA Trailer for MR HaS briefing and weekly SOW review with Mike Vokes (MV).
0800	MP and MR arrive to Bldg 1599 to get equipment and supplies dropped-off on Friday. Mobilized to Bldg 1885 (Site). Conducted our own HaS Tailgate and signed HASP. Walked MR through the system, first set of wells and additional work to be completed. MR mobilized hose ranges for injection lines from the CT at tree.
0830	MP and MR meeting on addressing leaks in the system, replacing old/broken parts (valves, PVC fittings and seals), and setting up HaS items (eye wash, delineations and signage).
0915	Dan (USACE) on-Site. MP walked the Site with him to field questions about the set-up and work plan. He mentioned poly tank signage (which we planned to do today since the tank was still empty) and checking the dosing pump for proper operation.
1230	MV called and UPS was there with our additional 2" hoses. MP mobilized to the Arcadis trailer to pick it up.
~~1245~~ 1300	MP back at Bldg. 1885 and began baseline monitoring at PMW-05, ~~water testing the system.~~ (MP)
	PCERF-MW25S and PCERF-MW25I prior to clean water test. ~~Leaks observed, MP and MR to address leaks and re-try water test.~~ MP

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Daily Log

Project: Fort Drum Project No. GP14DRUM Page 2 of 2

Site Location: Fort Drum, NY

Prepared By: M. Pinsito (MP) M. Redmon (MR)

Tuesday, 05/30/12

Date/Time	Description of Activities
1345	MP and MR elevated manifolds on cinder blocks to further detect leaks during the pump test (clean water)
1400	Conducted an additional leak test, still leaks at 1" com-locks on the injection manifold. MP ~~elevated~~ decideds to head plumb in the totalizers on the influent side to eliminate leaks at these com-locks. MP and MR re-plumb injection manifolds.
1515	Started on additional water test (≈26 spm from hydrant) and turned on pump to simulate injection operations. Small leaks at some 2" connections and 1" connections at some effluent com-locks on the totalizers and at the well-heads. Leaks are due to the Teflon tape not compressing enough within the com-locks to seal properly. Threaded connections with Teflon seals are sealed once we could wrench down on them.
1600	Stopped water test. Hydrant Start: Hydrant Stop: 401295
1630	Thunder Storm w/ lightening, temporary shutdown.
1700	Work resumes, daily clean-up and list of items from Home Depot needed for small existing leaks. MP and MR mobilize new hoses and equipment to Bldg. 1555.
1745	MP and MR off-Site and heading to Home Depot

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Daily Log

Project: Fort Drum Project No. GP14DRUM Page 1 of 2

Site Location: Fort Drum NY

Prepared By: Matt Piggatore Other Staff: Mike Redman

Date/Time 5/31	Description of Activities
07:30	Arrive on site, tailgate
	* Create inner exclusion around 14 totes of (SP)
0800	*Reducing all 1"-2" cam connection to prevent leaking. Adding silicone to the gasket of each connection which should prevent leaking
	* Making a 2" hose connection at EQ tank to allow for fresh water flush
	* Zip tie all 1", 2" camlock connections
16:00	*Performed a freshwater injection test. Detimed (2) 2" camlock connections needed additional silicone added to stop the leaking.
	* Fix (2) 2" connections
10:45	Record flow meter reading
11:05	*Begin Filling up EQ tank w/ 3000 gallons of Sodium permanganate. Pump @ 30gpm.
11:51	* 1451 gallons of sodium permanganate in EQ 402746

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Daily Log

Project: Fort Drum | Project No. GP14DRUM | Page 2 of 2

Site Location: Fort Drum, NY

Prepared By: Matt Pingatore | Other Staff: Mike Redman

Date/Time 5/31/17	Description of Activities
12:40	* Stop pumping solution into EQ tank due to volume of sodium permanganate remaining in tote does not correlate to volume of water in tank. Stop Work declared.
	*talk with Chris Glidel, determine the dosing pumps should be in series, not parallel. (Time 13:30)
13:45	Purge 2" line going to EQ tank w/ fresh water until solution was removed from hose.
14:50	*Matt P. begins re-engineering of dosing pump to put pump in series
	* Mike R goes to plumbing supply store for additional parts to pump remaining solution from tote to EQ tank.
16:10	*Mike Redman returns to site w/ needed plumbing supplies
	*Matt Pingatore completed re-engineering of dosing pump set up.
16:20	MR + MP begin setting up pump to transer solution.
17:05	MR + MP off site for day, go to Home Depot for additional supplies.

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Daily Log

Project: Fort Drum Project No. GP140RUM Page 1 of 2

Site Location: Fort Drum, NY

Prepared By: Matt Pingatore Other Staff: Mike Redman

Weather: Low 46° High 60 - Partly: Cloudy - Wind WSW 9mph

Date/Time 6/1/2017	Description of Activities
07:00	*Matt Pingatore (MP) and Mike Redman (MR) arrive on site.
	* Tailgate - Discuss DOW + ADOW when in inner exclusion area
07:25	* Begin to transfer solution of sodium permanganate (SP)
	from tote to EQ tank.
07:30	* Trouble shoot mechanical issue w/ 1" pneumatic pump.
08:10	* Retro fit tote w/ 2" male cam lock connection
	* Use 2" pneumatic pump to transfer SP from tote to EQ tank.
08:20	* Begin transferring solution.
08:45	* Transferring SP solution to EQ tank completed
	* Begin fresh water flush of lines w/ 400 gallons of
	water
09:15	* Complete fresh water flush
	* Check in w/ Chris Glidden (CG).

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Daily Log

Project: Fort Drum | Project No. GFORUM | Page 2 of 2

Site Location: Fort Drum, NY

Prepared By: Matt Pingatore | Other staff: Mike Redman

Date/Time 6/1/17	Description of Activities
10:00	Begin injection w/ 2600 gallons
11:35	* Stop injection - Average gallons per minute (GPM) - 2.28 per well
	* Re-engineer dosing set-up for PVC braided hose to vacuum solution from tote
	* Take flow totalizer readings
	* Make connections on new flow totalizer, and swap out old flow totalizer for new one
14:00	Re-install dosing pumps on 2nd tote, piping to begin dosing
14:30	* Begin dosing SP to EQ tank at 22 gpm * Totalizer reading - 100 gallons
16:25	* Begin fresh water flush of 2nd Tote
17:00	Begin injection
18:30	* Complete daily injection - Total volume 6,256.45 gal * Secure site
18:50	MR + MP off site

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Daily Log

Project: Fort Drum | Project No. GPDRUM | Page 1 of 3

Site Location: Fort Drum, NY

Prepared By: Matt Pingatore | other Steff: Mike Redmen

Weather :- Temp Lo, 47° High 60° - Overcast w/ chance of rain - Wind SSW 5mph

Date/Time 6/2/17	Description of Activities
06:15	*Matt Pingatore (MP) and Mike Redman (MR) on site
	* Tail gate and unload supplies gathered from Home Depot and supermarket on 6/1.
	* Mix up 2 batches of neutralizer and spray down area in containment berm where a leak of sodium permanganate (SP) occured.
06:50	*Begin dosing - MP
	* Begin performance well monitoring - MR
07:45	*Completion of dosing 3rd tote.
	* MP re-engineers the method of how the suction tubing is kept at the bottom of the tote to extract solution. 1.5" PVC pipe does not keep suction tubing at the bottom of the tote.
08:30	*Delivery of the next 15 totes has arrived on site
	* Off loading of totes w/ fork lift is being done buy
09:43	MR begin injection

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Daily Log

Project: Fort Drum | Project No. GPDRUM | Page 2 of 3

Site Location: Fort Drum, NY

Prepared By: Matt Pingator | Other Staff: Mike Redman

Date/Time 6/2/17	Description of Activities
10:00	*MP+MR begin dosing
11:04	*Suspend injection temporarily to read flow totalizer reading.
11:45	*Continue injection.
	* Between 10:00-11:04, inject 3434 gal of SP into 12 wells at an average rate of 4.47 gpm / per each well
12:15	*MP goes to hotel to pick up parts being shipped in for project
	* MR maintains oversight of dosing into EQ tank.
12:30	Client visited the site
13:15	*MR gets parameters of solution w/ YSI
	*MP puts up placards on totes
	* Continue dosing

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Daily Log

Project: Fort Drum Project No. 6P DRUM Page 3 of 3

Site Location: Fort Drum, NY

Prepared By: Matt Pingatore Other Staff: Mike Redmer

Date/Time	Description of Activities
14:00	AMP + MP incorporate a ball valve to the EQ tank to stop a SR leak
14:30	Begin securing site
15:20	MP + MR leave site

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Daily Log

Project: Fort Drum Project No. GPDRum Page 1 of

Site Location: Fort Drum, NY

Prepared By: Matt Pingitore other staff: Mike Redman

Date/Time	Description of Activities
07:00	Matt Pingitore (MP) and Mike Redman (MR) meet at the Arcadis trailer off site for monday morning check-in and tailgate
	* Discuss having an operator to come on site to use fork lift to take delivery of next Sodium Permanganate (SP) shipment
07:20	*MP begins dosing at ~25 gallons per minute (GPM).
	*MR perform routine site O+M.
08:15	MR begins injecting on all 12 wells @ ~2.0 GPM
11:00	*MR performs a round of performance monitoring
	* Visual observation of break through @ PCERT-MW-25S
14:05	Perform titrimetric analysis on PCERT-MW-25S = 0.93% $KMnO_4$
	* Calorimeter reading of PCERT-MW25S - 140.2 mg/L
	* Other wells do not show signs of break through

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Daily Log

Project: Fort Drum Project No. GPDRhm Page 2 of 2

Site Location: Fort Drum, NY

Prepared By: Matt Pingitore Other Staff: Mike Redmen

Date/Time 6/5/17	Description of Activities
18:15	*Stop injection of SP, continue dosing to keep ahead of injection
	-Total Volume Injected on 6/5/17 - 19,919.73 gal
	-Total Volume Injected to date - 29,610.29 gallons
19:00	Stop dosing, secure site
	-MR + MP offsite @ 19:30

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Daily Log

Project: Fort Drum | Project No. GP14DRUM | Page 1 of 2

Site Location: Fort Drum, NY

Prepared By: Matt Pingitore

Weather: Rain - 54° - Humidity 94% - Dewpoint 52° - Wind East by NE @ 10mph

Date/Time 6/6/17	Description of Activities
07:00	MR + MP on Site Matt Pingitore (MP). Mike Redman (MR)
	* Perform tailgate, discuss weather conditions and staying dry.
07:20	Begin dosing
08:00	Begin injecting on wells
09:45	18- off line, ~~target volume~~ achieved
10:00	*MW-17 Online
	*IMW-05 - Signs of visual breakthrough
11:10	*mw-10 taken off line, target volume achived
12:20	~~*MW-16 taken off line, target volume achieved~~
12:25	* MW-16 put online.

*See Network Log for when wells achieved target volumes and were taken off ~~line~~ line or were put online.

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Daily Log

Project: Fort Drum Project No. GP14WRUM Page 2 of 2

Site Location: Fort Drum, NY

Prepared By: Matt Pingitore Other Staff: Mike Redmen

Date/Time 6/6/17	Description of Activities
13:00	Performance monitoring of IMW-05 w/ colorimeter from Cargus - 134.3 mg/L
13:15	Performance monitoring of PCERI-MW25S w/ colorimeter from Cargus - 139.4 mg/L
18:00	Completed dosing of total volume of solution that is 5% by volume of SF
18:00	~~Tate~~ Stop Injection, secure site + Total volume injected today: 16,631.21 gallons *Total volume injected to date: 43,625.16 gallons
18:20	MP + MR off site

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Daily Log

Project: Fort Drum Project No. GP14DRUM Page 1 of

Site Location: Fort Drum, NY

Prepared By: Matt Pingitore Other Staff: Mike Redman

Date/Time 6/7/17	Description of Activities
07:00	Matt Pingitore (MP) and Mike Redman (MR) on site. Tailgate
07:30	Begin injecting on well 16, 17, 77+78
08:00	MR begins making 2" hoses for the IW-01 through IW-07 transect.
10:00	Begin exending exclusion zone to the south of the source area.
11:00	MR begins setting up all injection equipment for the IW-01 through IW-07 transect.
12:[illegible]	** See AAG for Injection results and when wells went off line.
[illegible]	[illegible]
11:45	Begin fresh water flush of wells
[illegible]	[illegible]

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Daily Log

Project: Fort Drum Project No. GP14DRhm Page 2 of 2

Site Location: Fort Drum, NY

Prepared By: Matt Pingitore Other Staff: Mike Redmen

Date/Time 6/7	Description of Activities
12:45	Begin dosing 3% to EQ tank.
	+ Continue setting up transects to
	stage 2+3. Dosed 283 gallons of 3% solution (≈ 5700 gallons)
13:45	Site visit from client Paul.
17:30	Stop dosing @ 3%
	+ Secure site
18:00	MP + MR offsite

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Daily Log

Project: Fort Drum | Project No. GP14DRUM | Page 1 of 2

Site Location: Fort Drum, NY

Prepared By: M. Pinaire (MP) and M. Redmen (MR)

Thursday, 6/8/17 Sunny, Light Wind, 62°F, H=78°F, L=54°F

Date/Time	Description of Activities
0700	MP and MR on-Site. Conducted H&S Tailgate and daily SOW
	Finished Stage Two and Three set-up and placing secondary
	containment around the hose connection to Stage Two.
0830	Conducted clean water test on new set-up. Some leaks
	found on the 2" conveyance line and some 1" lines. MP
	and MR fixed leaks and conducted another clean water test.
	No leaks found. Hydrant = Start=47074 Stop=47274
1000	Started 3% solution injection into Stages Two and Three
	IW-01 to 07 (Stage Two) and IW-19 to 24 (Stage Three). IW-03
	totalizer not working, stopped flow to the well and took apart the
	totalizer and flushed with neutralizer and water.
1200	IW-03 online, totalizer working now.
1300	Started dosing 3% solution into the EQ Tank (Hydrant Start =
	47274) ≃ 243 gallons of 40% solution left in the current tote to
	dose into the EQ Tank
1330	Andy Vitolins on-Site with Season Eterly. Off-Site at 1345.
1500	Moved to next full tote (263 gallons) of 40% solution, dosing 3%
1630	EQ Tank empty, stopped injection and collected totalizer readings.
	Kept dosing 3% into EQ tank. Total Injected Volume Today = 10443.69 gal

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Daily Log

Project: Fort Drum Project No. GP14DRUM Page 2 of 2

Site Location: Fort Drum, New York

Prepared By: M. Pingitore (MP) and M. Redmon (MR)

Date/Time	Description of Activities
1700	Finished tote two and moved to next 263 gallon tote, 40% solution
1900	Stopped dosing (≈90 gallon left in tote to dose).
	Secured Site and shut valves
1915	MP and MR off-Site

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Daily Log

Project: Fort Drum Project No. GP14 DRum Page 1 of 1

Site Location: Fort Drum, NY

Prepared By: M. Pinsker (MP)

Date/Time 6/9/17	Description of Activities
06:30	MP + MR on site. Begin dosing @ 3%
07:00	Begin injection of stage 2 wells.
11:00-11:30	Dose response
	x IWM-05 - 111.5 mg/L + PCERT-MW25S - 140.1 mg/L
14:00	Stop injection + Dosing - Secure site
14:20	MP + MR - off site

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Daily Log

Project: Fort Drum Project No. GP14DRUM Page 1 of 2

Site Location: Fort Drum, NY

Prepared By: Matt Pingitore other staff: mike Redman

Date/Time 6/12/17	Description of Activities
07:00	MP+MR - Arcadis trailer for Monday safety meeting.
07:30	MP+MR - onsite. Restore site due to windy weather conditions from the weekend.
07:45	Begin dosing.
08:15	Begin dose response monitoring. *See dose response @ 25T
09:00	Beging injection
09:45	Truck arrives with shippment of totes containing sodium permanganate.
10:30	Truck leaves site. Delivery accepted. 14 totes total received.
16:30	Well 3 off line, target volume achieved
16:40	Well 4 - on Line
17:30	Well 6 off line, target volume achieved
18:10	Well 20 off line, target volume achieved
18:15	Well 25 on line
18:30	Well 23 off line, target volume achieved
18:35	Well 28 on line

19:00 Stop daily injection activities, secure site

19:25 MP+MR leave site

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Daily Log

Project: Fort Drum Project No. GP14DRUM Page 1 of 1

Site Location: Fort Drum, NY

Prepared By: Matt Pingitore other Staff: Mike Redman

Date/Time 6/13/17	Description of Activities
06:45	MP+MR on Site - Tailgate
07:00	Begin dosing
07:45	Begin injecting
08:05	Well 5 - offline, target volume achieved
08:15	Well 7 - offline, target volume achieved
09:20	Well 24 - offline, target volume achieved
10:10	Well 27 - Goes online
11:00	Well 21 - offline, target volume achieved
11:30	Well 26 - Goes online
11:35	Well 19 - offline - Target volume achieved.
*12:30	Well 2 - offline - Target volume achieved
12:40	Well 22 - offline - Target volume achieved
+11:45	Well 30 - Goes online
~~12:30~~ 12:45	Well 29 - Goes online
14:45	Well 1 - Goes offline, target volume achieved.
18:45	Well 4 - offline, target volume achieved,
19:00	Stop dosing + injection, secure site
19:20	MP+MR leave site

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Daily Log

Project: Fort Drum Project No. GP14Drum Page 1 of 1

Site Location: Fort Drum, NY

Prepared By: Matt Pingitore Other Staff: Mike Redman

Date/Time 6/14/17	Description of Activities
06:45	mp + MR onsite, tailgate
07:00	Begin dosing, MR begin setting up Stage 3 + 4
07:45	Begin injection
12:05	Well 27 + 28 go offline, target injection volume achieved
12:15	Well 26 + 27 offline, target injection volume achieved
12:35	Well 25 offline, target injection volume achieved.
13:35	Well 30 offline, target injection volume achieved
12:45	Well 29 offline, target injection volume achieved, Cont. dosing
12:50	Begin setting up exclusion zone around remaining ~~stag~~ transects for entire injection. Relocate manifolds to new locations to adequately inject in all the remaining wells. Run 2" hosing to T and manifolds. Set up injection assembly on wells 31, 32, 33, 34, 35, 38, 52, 53, 54, 55, 81, 82. Run 1" hosing from manifolds to all injection points. Secure all connections w/ silicone and zip ties to prevent leaks. Put catch pans/buckets under all connections, manifolds or injection points. Label each tubing back @ manifolds. Gauge all wells between 1400-1500
18:00	Stop dosing + secure site
18:40	MR + MP off site

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Daily Log

Project: Fort Drum Project No. 6P14DRUM Page 1 of 1

Site Location: Fort Drum, NY

Prepared By: Matt Pingitore

Date/Time 6/15/17	Description of Activities
06:45	MR+MP onsite, tailgate
07:00	Beging performance monitoring ~~and gaugint~~ gauging of all wells @ the site.
8:00	Beging gravity injection on all wells @ the site.
8:10	Turn pneumatic pump on, inject under pressure.
~~12:50~~	Perform O+M on all wells, regulate flow to distribute evenly to ~~each~~ each well, ~~each~~.
12:50	Go to off site storage to ~~get extra~~ backup supply of 1" hosing. Make extensions of 1" hosing.
18:00	Stop injection to wells, continue dosing.
18:30	Stop dosing, secure site.
18:50	MR+MP - leave site.

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Daily Log

Project: Fort Drum Project No. 6P14DRum Page 1 of 1

Site Location: Fort Drum, NY

Prepared By: Mike Redman + Matt Pingitore

Date/Time 6/16/17	Description of Activities
06:35	Mike Redman + matt pingitore onsite, tailgate and begin dosing. Begin 1st round of performance monitoring.
07:30	Begin injection of Sodium permanganate.
08:20	Shippment of sodium permanganate arrives to base
08:50	Begin off loading totes of sodium ~~permanganate~~ permanganate from 18 wheeler. Continue dosing and injection activities
9:45	Unloading of shipment of sodium permanganate completed, driver leaves site
13:30	Stop injection, continue dosing
14:30	Stop dosing secure site
14:45	MP + MR leave site

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Daily Log

Project: Fort Drum Project No. GP140RUm Page 1 of _____

Site Location: Fort Drum, NY

Prepared By: Matt Pingitore other Staff: Mike Redman

Date/Time 6/19	Description of Activities
6:30	MR + MP Onsite, begin dosing
6:55	Stop dosing, go to trailer for Monday meeting.
7:25	Back on site, continue dosing
8:30	Start injection, continue dosing
10:40	Well 34 offline, target volume of 5500 gallons achieved
10:45	well 33 offline, target volume for injection achieved
10:50	well 36 online
10:55	Well 32 offline, target volume for injection achieved.
	Well 37 online *** Bad glue fitting, restart well @ 14:50
11:00	Well 39 online
12:40	Well 35 offline, target volume for injection achieved
12:45	Well 41 online
13:15	Well 55 offline, target volume achieved.
13:20	Well 61 online
15:30	Well 54 offline, target volume achieved.
15:35	Well 51 + 100 online
20:00	Stop ~~inj~~ injection into wells, continue dosing
20:30	Stop dosing, secure site
20:40	MP + MR offsite

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Daily Log

Project: Fort Drum Project No. 6P14DRUM Page 1 of 1

Site Location: Fort Drum, NY

Prepared By: Matt Pingitore other Staff: Mike Redman

Date/Time	6/20 Description of Activities
06:15	MP+MR onsite, tail gate + start dosing * 7:30 begin injection
9:40	Well 52 offline, target volume achieved
9:45	Well 58 online
10:15	# Temporary hault injection to go 2nd renew day pass to base
10:35	Continue injection
15:50	Well 82 offline, target volume achieved
15:55	Well 79 online
19:30	Stop injection + dosing, secure Site
20:00	MP+MR offsite

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Daily Log

Project: Fort Drum Project No. 6P14Drum Page 1 of

Site Location: Fort Drum, NY

Prepared By: Matt Pingitore other steff: mike Redman

Date/Time	Description of Activities
06:15	onsite. Tailgate, begin dosing
06:30	Start injection
07:35	Well 61 offline, target volume of injection achieved
	Well 65 online
09:55	Well 60 offline, target volume of injection achieved.
10:00	Well 64 online
13:25	Well 51 offline, target volume of injection achieved
13:30	Well 50 online
16:40	Well 59 offline due to target volume of injection was achieved
16:45	Well 63 ~~Well~~ online
17:05	Well 58 offline, target volume achieved
	Well 62 online

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Daily Log

Project: Fort Drum Project No. 6P14DRUM Page 1 of

Site Location: Fort Drum, NY

Prepared By: Matt Pinzino Other staff: Mike Redmen

Date/Time	Description of Activities
06:15	On site, Tailgate
06:30	Begin injection and dosing
07:00	well 38, offline, target volume achieved
07:10	Well 46 online
15:50	Well 37 offline, target volume achieved
16:00	Well 43 - online
16:30	Well 64 offline, target volume achieved
16:40	Well 69 online
17:10	Well 46 offline, target volume achieved
17:20	Well 45 online
18:30	Stop injection + dosing, secure site.
18:50	MP + MR offsite

Fort Drum NY 6/23/17

06:00 MR+MP onsite, Tailgate, begin dosing.

06:30 ~~Begin~~ start injection.

8:45 Last delivery of totes containing sodium permanganate arrives on site
- Unload totes w/ assistance from PIKA.

9:00 Well 50 offline, target volume achieved

9:20 Well 49 online
Well 65 offline, target volume achieved

9:30 Well 70 online

10:00 Well 79 offline, target volume achieved

10:10 Well 57, online

Fort Drum 6/23/17

1430 Stop injection + dosing, secure site

15:00 - Offsite

Fort Drum, NY 06/26/17

06:15 MR and MP onsite. Tailgate and begin dosing

07:00 Monday morning tailgate w/ PIKA. -Stop dosing

07:30 End monday morning tailgate -begin dosing

08:00 Begin injection.

09:50 Well 62 offline, target volume achieved
09:55 Well 67 online

10:00 Well 36 offline, target volume achieved.
10:05 Well 42 online.

10:35 Well 63 offline, target volume achieved
10:40 Well 72 online
~11:00 Performance monitoring
14:00 Well 80 offline, target volume achieved
14:10 Well 71 online.

13:50 Begin breaking down berm. Spraying ~~with~~ concrete neutralizes to remove staining

Fort Drum, NY - ISCO Injection 06/27/17
Cloudy, Rain Showers, T-Storm Possible, 61°F, H-66°F, L-53°F

0615 - MP and MR on-Site. Conducted H&S tailgate meeting, review daily SOW and began dosing

0630 - Began injection (12 wells). Start gravity feed then turn on pump, monitor pressures and bleed-off air at well heads.

0750 - IW-69 off-line (2850 gallons), reached target volume.
0800 - IW-68 on-line (2850 gallon)

0930 - Paul Zang on-Site. Discussed daily SOW and forecasted injection completion date.
0945 - Paul Zang off-Site.

1000 - MP and MR begin breaking down one of the 10'x50' spill berms. Berm was neutralized of any chemical and rinsed. Picked up debris and swept the berm. Folded berm and associated rubber mats.

1030 - IW-49 off-line (2850 gallons) reached target volume.
1035 - IW-56 on-line (2850 gallons)

2/2 Fort Drum, NY - ISCO Injection 06/27/17

1210 - IW-70 off-line (2850 gal) reached volume

1215 - IW-73 off-line (2850 gallons)

1520 - IW-57 off-line (2850 gallons) reached volume

1525 - IW-48 on-line (2850 gallons)

1800 Well 67 offline

1810 Well 66 online

2000 stop dosing and injection, secure site

2015 Everyone off site

Fort Drum, NY 6/28/17

Weather - Sun, Windy Temp 59°-72°

06:07 On site, tailgate, begin dosing.

07:00 Begin injection

07:30 Well 72 offline, target volume of solution achieved

07:40 Well 74 online

08:30 Performance monitoring started

09:20 Well 45 offline, target volume for injection achieved.

09:30 Well 40 online

13:10 Well 71 offline, target volume of solution for injection achieved

13:20 Well 75 online

15:20 Well 68 ~~online~~ offline, target volume achieved

15:30 Well 47 online

15:40 - well 56 offline, target volume for injection achieved

16:45 Well 43 offline, target volume of solution achieved

1/

Fort Drum, NY - ISCO Injection 6/29/17

Cloudy, Rain, 64°F, H=71°F, L=66°F

0615 - MP and MR on-Site.

- Conducted H2S Tailgate
- Began docks into the EQ Tank
- MP plumbs IW-75 with a drop tube due to a poor seal on the injection well. Well looks it was repaired at some point ≈ 1' down. You can see a seam in the PVC and it is shifted slightly (which explains the added concrete in the curb box).

0700 - Start injection pump and monitor pressures and bleed off air in the lines

- MP monitors IW-75 drop tube to make sure it does not flow over the PVC. Well is taking at ≈ 3 gpm with minimal water table change.

0830 - IW-42 off-line, reached target volume of 5500 gallons.

- Recirculation loop opened on the injection pump to reduce well pressures due to limited wells on-line (7 wells).

0835 - IW-46 off-line, reached target volume of 5,500 gallons.

1120 - IW-66 off-line, reached target volume of 2850 gallons

1200 - IW-44 off-line, reached target volume of 5500 gallons

2/

6/29/17

1345 - IW-74 off-line, reached target volume of 2850 gallons

14:30 IW-40 off-line, target volume of 5500 gallons.

15:00 Begin breaking down site and preparing for demobilization

20:00 Stop injection, secure site

20:20 MP, MR offsite

Fort Drum - ISCO Injection 6/30/17

Weather - 60's - Rain w/ some wind

06:00 Onsite, ~~continue~~ begin injection and continue breaking down site.

07:40 IW-75 offline, target volume of 2850 achieved.

09:00 Begin fresh water flush of ~~upper~~ northern transect. Approximately 60 gallons of water used for total flush.

11:30 Begin bringing equipment ~~to~~ storage shed for ISCO injection equipment.

~~11:30~~

~~16:00~~ ~~stop injection~~, secure site

16:25 Offsite

Fort Drum Injection 7/5/17

Weather: Sunny, 88°

10:00 MP Arrives on site, begin injection
* Continue breakdown + demob

11:00 MR onsites
Continue bringing equipment to ~~off~~ site storage.

13:00 IW-47 offline, target volume achieved:
292,000 gallons of sodium permanganate injection event completed.
Begin - Purge ~~the~~ fresh water to flush lines w/ 60 gallons of water.

14:00 Flush completed
Rinse ~~tank~~, break down 2" tubing, clean w/ neutralizer
Condensing equipment

17:35 Offsite

* ~~12:00~~ Begin round of performance monitoring

Fort Drum Investigation 7/6/17

Weather 85° Sunny

07:30 Onsite
+ Continue Breakdown and rinsing equipment w/ neutralizer.

08:30 PIKA arrives to assist w/ moving dilinectors to off site Storage and relocating empty totes to NW corner of site.

12:30 MR + MP go to Lowes for rehab equipment to fix curb boxes.

14:30 Back on site.
Perform a final round of ~~performan~~ performance monitoring.

~~17:00~~ Rehab work on wells

~~18:00~~ Bring garbage and last of supplies over to 1599

18:30 Offsite

APPENDIX E

Photo Log

ARCADIS

PHOTOGRAPHIC LOG

Project:	Location:	Project No.:
Fort Drum IRP	3800 Area PCE Site	GP14DRUM.RIFS

Photo No.	Date:
1	5/29/17

Description:

Photo view looking at dosing pump setup mounted to a tote containing 40% sodium permanganate solution.

ARCADIS

PHOTOGRAPHIC LOG

Project:	Location:	Project No.:
Fort Drum IRP	3800 Area PCE Site	GP14DRUM.RIFS

Photo No.	Date:
2	5/24/17

Description:

Photo view looking at secondary containment for 6900-gallon storage tank. Tank was used to store 3-5% bw sodium permanganate solution prior to injection.

ARCADIS

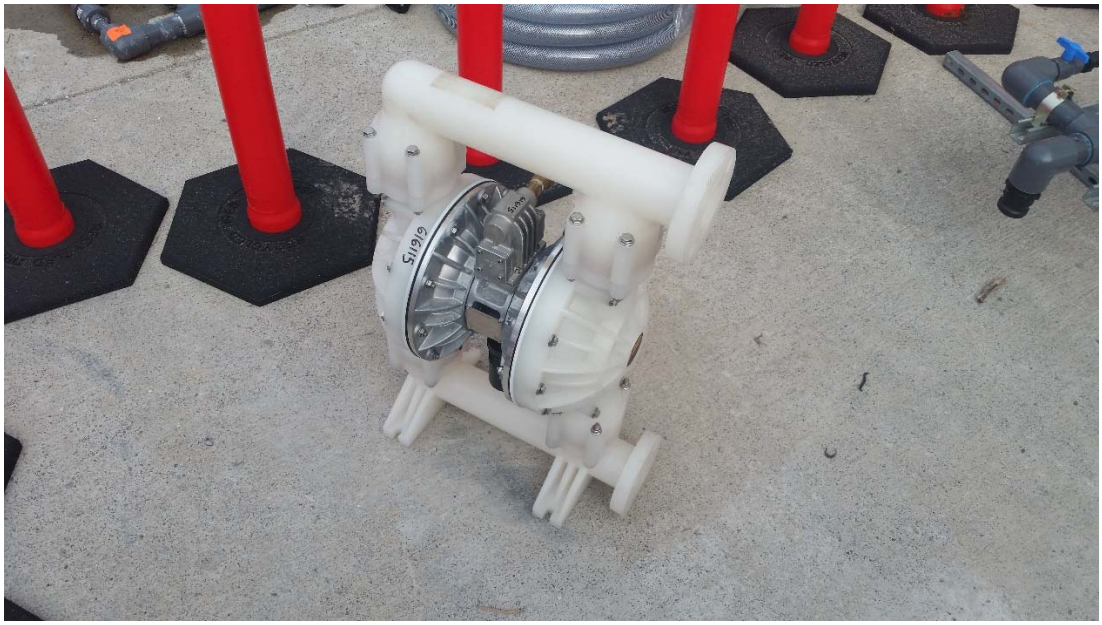
PHOTOGRAPHIC LOG

Project:	Location:	Project No.:
Fort Drum IRP	3800 Area PCE Site	GP14DRUM.RIFS

Photo No.	Date:
3	5/24/17

Description:

Photo view looking at rental pneumatic double diaphragm pump used to move solution from the 6,900-gallon storage tank to the injection well network.



ARCADIS

PHOTOGRAPHIC LOG

Project:	Location:	Project No.:
Fort Drum IRP	3800 Area PCE Site	GP14DRUM.RIFS

Photo No.	Date:
4	5/31/17

Description:

Photo view looking at injection solution distribution manifold within secondary containment. Each manifold contained a analogue totalizer and gate valve to control pressure and flow.

ARCADIS

PHOTOGRAPHIC LOG

Project:	Location:	Project No.:
Fort Drum IRP	3800 Area PCE Site	GP14DRUM.RIFS

Photo No.	Date:
5	5/31/17

Description:

Photo view looking at well head setup for injections. This was the general setup for all wells used for sodium permanganate injections.

ARCADIS

PHOTOGRAPHIC LOG

Project:	Location:	Project No.:
Fort Drum IRP	3800 Area PCE Site	GP14DRUM.RIFS

Photo No.	Date:
6	5/31/17

Description:

Photo view looking at audible high-level alarm on injection solution storage tank. Alarm was installed to prevent tank from overflowing and would emit an audible alarm if volume in the tank rose to a level greater than 4 ft. below the tank opening.

ARCADIS

PHOTOGRAPHIC LOG

Project:	Location:	Project No.:
Fort Drum IRP	3800 Area PCE Site	GP14DRUM.RIFS

Photo No.	Date:
7	6/7/17

Description:

Photo view looking at tote storage area, dosing pump setup, and injection solution storage tank, all in secondary containment.

ARCADIS

PHOTOGRAPHIC LOG

Project:	Location:	Project No.:
Fort Drum IRP	3800 Area PCE Site	GP14DRUM.RIFS

Photo No.	Date:
8	6/7/17

Description:

Photo view looking at remediation work site with all injection system conveyance piping to individual wells for the first phase of injection wells.

ARCADIS

PHOTOGRAPHIC LOG

Project:	Location:	Project No.:
Fort Drum IRP	3800 Area PCE Site	GP14DRUM.RIFS

Photo No.	Date:
9	6/13/15

Description:

Photo view looking at injection manifold and conveyance piping for injection wells located upgradient of building 1886. This well set received 50% extra volume to account for mass stored under the building.

ARCADIS

PHOTOGRAPHIC LOG

Project:	Location:	Project No.:
Fort Drum IRP	3800 Area PCE Site	GP14DRUM.RIFS

Photo No.	Date:
10	6/15/17

Description:

Photo view looking at injection well IW-45 before installation of injection wellhead.

ARCADIS

PHOTOGRAPHIC LOG

Project:	Location:	Project No.:
Fort Drum IRP	3800 Area PCE Site	GP14DRUM.RIFS

Photo No.	Date:
11	6/15/17

Description:

Photo view looking at hydrant setup with pressure reducing valve, backflow preventer and cold-water analogue totalizer.

ARCADIS

PHOTOGRAPHIC LOG

Project:	Location:	Project No.:
Fort Drum IRP	3800 Area PCE Site	GP14DRUM.RIFS

Photo No.	Date:
12	6/23/17

Description:

Photo view looking at analogue totalizer for individual injection leg.

APPENDIX F

Sodium Permanganate Safety Data Sheet

SAFETY DATA SHEET

1. Identification

Product identifier	**RemOx® L ISCO Reagent**
Other means of identification	Not available.
Recommended use	Liquid oxidant recommended for applications that require a concentrated permanganate solution.
Recommended restrictions	Use in accordance with supplier's recommendations.

Manufacturer / Importer / Supplier / Distributor information

Manufacturer/Supplier	CARUS CORPORATION
Address	315 Fifth Street, Peru, IL 61354, USA
Telephone	815 223-1500 - All other non-emergency inquiries about the product should be directed to the company
E-mail	salesmkt@caruscorporation.com
Website	www.caruscorporation.com
Contact person	Dr. Chithambarathanu Pillai
Emergency Telephone	For Hazardous Materials [or Dangerous Goods] Incidents ONLY (spill, leak, fire, exposure or accident), call CHEMTREC at CHEMTREC®, USA: 001 (800) 424-9300 CHEMTREC®, Mexico (Toll-Free - must be dialed from within country): 01-800-681-9531 CHEMTREC®, Other countries: 001 (703) 527-3887

2. Hazard(s) identification

Physical hazards	Oxidizing liquids	Category 2
Health hazards	Acute toxicity, oral	Category 4
	Skin corrosion/irritation	Category 1B
	Serious eye damage/eye irritation	Category 1
	Specific target organ toxicity, single exposure	Category 3 respiratory tract irritation
OSHA defined hazards	Not classified.	

Label elements

Signal word	Danger
Hazard statement	May intensify fire; oxidizer. Harmful if swallowed. Causes severe skin burns and eye damage. May cause respiratory irritation.

Precautionary statement

Prevention	Keep away from heat. Take any precaution to avoid mixing with combustibles. Keep/Store away from clothing//combustible materials. Use only outdoors or in a well-ventilated area. Do not breathe mist or vapor. Wear protective gloves/protective clothing/eye protection/face protection. Do not eat, drink or smoke when using this product. Wash thoroughly after handling.
Response	In case of fire: Use water for extinction. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower. Wash contaminated clothing before reuse. If swallowed: Rinse mouth. Do NOT induce vomiting. If inhaled: Remove person to fresh air and keep comfortable for breathing.
Storage	Store locked up. Store in a well-ventilated place. Keep container tightly closed.
Disposal	Dispose of contents/container in accordance with local/regional/national/international regulations.

Hazard(s) not otherwise classified (HNOC)	Not classified.	
Environmental hazards	Hazardous to the aquatic environment, acute hazard	Category 1
	Hazardous to the aquatic environment, long-term hazard	Category 1

Supplemental information

Hazard symbol

Hazard statement Very toxic to aquatic life with long lasting effects.

Precautionary statement

Prevention Avoid release to the environment.

Response Collect spillage.

3. Composition/information on ingredients

Mixtures

Chemical name	CAS number	%
Sodium permanganate	10101-50-5	36 - 40

Composition comments All concentrations are in percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

4. First-aid measures

Inhalation If breathing is difficult, remove to fresh air and keep at rest in a position comfortable for breathing. Remove victim to fresh air and keep at rest in a position comfortable for breathing. Move to fresh air. For breathing difficulties, oxygen may be necessary. Call a physician or poison control center immediately. Get medical attention immediately. Call a physician if symptoms develop or persist. Get medical attention if symptoms persist.

Skin contact Take off immediately all contaminated clothing. (Caution: Solution may ignite certain textiles). Immediately flush skin with plenty of water. Get medical attention immediately. Wash contaminated clothing before reuse.

Contact with skin may leave a brown stain of insoluble manganese dioxide. This can be easily removed by washing with a mixture of equal volume of household vinegar and 3% hydrogen peroxide, followed by washing with soap and water.

Eye contact Immediately flush with plenty of water for up to 15 minutes. Remove any contact lenses and open eyelids wide apart. Continue rinsing. Get medical attention immediately.

Ingestion Immediately rinse mouth and drink plenty of water. Never give anything by mouth to a victim who is unconscious or is having convulsions. Do not induce vomiting. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs. Get medical attention immediately.

Before using, read Material Safety Data Sheet (MSDS) for this product. Rinse container at least three times to an absence of pink color before disposing.

Most important symptoms/effects, acute and delayed Contact with this material will cause burns to the skin, eyes and mucous membranes. Corrosive effects. Irritation of eyes and mucous membranes. Symptoms may include stinging, tearing, redness, swelling, and blurred vision. May cause temporary blindness and severe eye damage. Permanent eye damage including blindness could result. Show this safety data sheet to the doctor in attendance.

Indication of immediate medical attention and special treatment needed Provide general supportive measures and treat symptomatically. In case of shortness of breath, give oxygen. Decomposition products are alkaline. Brown stain is insoluble manganese dioxide.

General information In the case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). If you feel unwell, seek medical advice (show the label where possible). Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. For personal protection, see Section 8 of the MSDS. Show this safety data sheet to the doctor in attendance. Wash contaminated clothing before reuse.

5. Fire-fighting measures

Suitable extinguishing media Flood with water from a distance, water spray or fog.

Unsuitable extinguishing media The following extinguishing media are ineffective: Dry chemical. Foam. Carbon dioxide (CO2). Halogenated materials.

Specific hazards arising from the chemical May intensify fire; oxidizer. May ignite combustibles (wood, paper, oil, clothing, etc.). Contact with incompatible materials or heat (135 ºC / 275 ºF) could result in violent exothermic chemical reaction. Oxidizing agent, may cause spontaneous ignition of combustible materials. By heating and fire, corrosive vapors/gases may be formed.

Special protective equipment and precautions for firefighters Self-contained breathing apparatus and full protective clothing must be worn in case of fire. Selection of respiratory protection for firefighting: follow the general fire precautions indicated in the workplace.

Fire-fighting equipment/instructions

Move container from fire area if it can be done without risk. Cool containers exposed to flames with water until well after the fire is out. Prevent runoff from fire control or dilution from entering streams, sewers, or drinking water supply. Dike fire control water for later disposal. Water runoff can cause environmental damage.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

Keep unnecessary personnel away. Keep upwind. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Avoid inhalation of vapors and contact with skin and eyes. Wear protective clothing as described in Section 8 of this safety data sheet. Local authorities should be advised if significant spillages cannot be contained.

Methods and materials for containment and cleaning up

Keep combustibles (wood, paper, oil, etc.) away from spilled material. Should not be released into the environment. This product is miscible in water.

Large Spills: Stop leak if possible without any risk. Dike the spilled material, where this is possible. Proceed with either of the following two options depending upon the size of the spill and the availability of the neutralizing agents:

Option # 1: Dilute to approximately 6% with water, and then reduce with sodium thiosulfate, a bisulfite or ferrous salt solution. The bisulfite or ferrous salt may require some dilute sulfuric acid (10% w/w) to promote reduction. Neutralize with sodium carbonate to neutral pH, if acid was used. Decant or filter and deposit sludge in approved landfill. Where permitted, the sludge may be drained into sewer with large quantities of water.

Option # 2: Absorb with inert media like diatomaceous earth or inert floor dry, collect into a drum and dispose of properly. Do not use saw dust or other incompatible media. Disposal of all materials shall be in full and strict compliance with all federal, state, and local regulations pertaining to permanganates.

To clean contaminated floors, flush with abundant quantities of water into sewer, if permitted by federal, state, and local regulations. If not, collect water and treat as described above. Cover with reducing agent (e.g. sodium bisulphite/thiosulphate or a ferrous salt plus 2M H_2SO_4). Transfer to container with water and neutralize with soda ash. Otherwise, absorb spill with vermiculite or other inert material, then place in a container for chemical waste. Do not use sawdust or other combustible material. Following product recovery, flush area with water. Prevent product from entering drains.

Small Spills: Cover with reducing agent (e.g. sodium bisulphite/thiosulphate or a ferrous salt plus 2M H_2SO_4). Transfer to container with water and neutralize with soda ash. Clean surface thoroughly to remove residual contamination.

Never return spills in original containers for re-use. Never return spills in original containers for re-use.

Environmental precautions

Do not allow to enter drains, sewers or watercourses. Contact local authorities in case of spillage to drain/aquatic environment.

7. Handling and storage

Precautions for safe handling

Take any precaution to avoid mixing with combustibles. Keep away from clothing and other combustible materials. Do not get this material in your eyes, on your skin, or on your clothing. Do not breathe mist or vapor. If clothing becomes contaminated, remove and wash off immediately. Spontaneous ignition may occur in contact with cloth or paper. When using, do not eat, drink or smoke. Good personal hygiene is necessary. Wash hands and contaminated areas with water and soap before leaving the work site. Avoid release to the environment.

Conditions for safe storage, including any incompatibilities

Store locked up. Keep container tightly closed and in a well-ventilated place. Store in a cool, dry place. Store away from incompatible materials (See Section 10). Follow applicable local/national/international recommendations on storage of oxidizers. Store in accordance with NFPA 430 requirements for Class II oxidizers.

8. Exposure controls/personal protection

Occupational exposure limits

No exposure limits noted for ingredient(s).

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value
Sodium permanganate (CAS 10101-50-5)	Ceiling	5 mg/m3

US. ACGIH Threshold Limit Values

Components	Type	Value	Form
Sodium permanganate (CAS 10101-50-5)	TWA	0.1 mg/m3	Inhalable fraction.
		0.02 mg/m3	Respirable fraction.

US NIOSH Pocket Guide to Chemical Hazards: Recommended exposure limit (REL)

Components	Type	Value	Form
Sodium permanganate (CAS 10101-50-5)	TWA	1 mg/m3	Fume.

US NIOSH Pocket Guide to Chemical Hazards: Short Term Exposure Limit (STEL)

Components	Type	Value	Form
Sodium permanganate (CAS 10101-50-5)	STEL	3 mg/m3	Fume.

Biological limit values No biological exposure limits noted for the ingredient(s).

Exposure guidelines Follow standard monitoring procedures.

Appropriate engineering controls Provide adequate general and local exhaust ventilation. An eye wash and safety shower must be available in the immediate work area.

Individual protection measures, such as personal protective equipment

Eye/face protection Wear safety glasses with side shields (or goggles). Wear face shield if there is risk of splashes.

Skin protection

Hand protection Wear chemical-resistant, impervious gloves. Use protective gloves made of: Rubber or plastic. Suitable gloves can be recommended by the glove supplier.

Other Wear appropriate chemical resistant clothing. Rubber or plastic apron.

Respiratory protection In case of inadequate ventilation or risk of inhalation of vapors, use suitable respiratory equipment. In the United States of America, if respirators are used, a program should be instituted to assure compliance with OSHA 29 CFR 1910.134.

Thermal hazards Wear appropriate thermal protective clothing, when necessary.

General hygiene considerations When using, do not eat, drink or smoke. Keep from contact with clothing and other combustible materials. Remove and wash contaminated clothing promptly. Wash hands before breaks and immediately after handling the product. Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Appearance Dark purple liquid.

Physical state Liquid.

Form Aqueous solution.

Color Dark purple.

Odor Odorless.

Odor threshold Not available.

pH 5 - 8

Melting point/freezing point < 24.8 °F (< -4 °C)

Initial boiling point and boiling range > 213.8 °F (> 101 °C)

Flash point Does not flash.

Evaporation rate As water.

Flammability (solid, gas) Not applicable.

Upper/lower flammability or explosive limits

Flammability limit - lower (%) Not applicable.

Flammability limit - upper (%) Not applicable.

Vapor pressure 760 mm Hg (105 °C)

Vapor density Not available.

Relative density 1.37 - 1.4 (20 °C) (Water = 1)

Solubility(ies) Miscible with water.

Partition coefficient (n-octanol/water) Not available.

Auto-ignition temperature Not available.

Decomposition temperature Not available.

Viscosity Not available.

Other information

Explosive properties	Not explosive. Can explode in contact with sulfuric acid, peroxides and metal powders.
Oxidizing properties	Strong oxidizing agent.

10. Stability and reactivity

Reactivity	The product is non-reactive under normal conditions of use, storage and transport.
Chemical stability	Stable at normal conditions.
Possibility of hazardous reactions	Contact with combustible material may cause fire. Can explode in contact with sulfuric acid, peroxides and metal powders.
Conditions to avoid	Contact with incompatible materials or heat (135 °C / 275 °F) could result in violent exothermic chemical reaction.
Incompatible materials	Acids. Peroxides. Reducing agents. Combustible material. Metal powders.
Hazardous decomposition products	By heating and fire, corrosive vapors/gases may be formed. Contact with hydrochloric acid liberates chlorine gas.

11. Toxicological information

Information on likely routes of exposure

Ingestion	Causes digestive tract burns. Harmful if swallowed. Ingestion causes burns of the upper digestive and respiratory tracts.
Inhalation	May cause irritation to the respiratory system.
Skin contact	Causes severe skin burns.
Eye contact	Causes serious eye damage.
Symptoms related to the physical, chemical and toxicological characteristics	Contact with this material will cause burns to the skin, eyes and mucous membranes. Permanent eye damage including blindness could result.

Information on toxicological effects

Acute toxicity Causes severe skin burns and eye damage. Causes burns. Harmful if swallowed. Health injuries are not known or expected under normal use. Harmful if swallowed.

Components	Species	Test Results
Potassium permanganate (CAS 7722-64-7)		
Acute		
Dermal		
LD50	Rat	2000 mg/kg
Oral		
LD50	Rat	2000 mg/kg

Toxicity data are not available for sodium permanganate. Toxicity is expected to be similar to that of potassium permanganate.

Skin corrosion/irritation	Causes severe skin burns.
Serious eye damage/eye irritation	Causes serious eye damage.
Respiratory sensitization	Not classified.
Skin sensitization	Not classified.
Germ cell mutagenicity	Not classified.
Carcinogenicity	Not classified.
Reproductive toxicity	Not classified.
Specific target organ toxicity - single exposure	May cause irritation of respiratory tract.
Specific target organ toxicity - repeated exposure	Not classified.
Aspiration hazard	Not classified.
Further information	Chronic effects are not expected when this product is used as intended. Prolonged exposure, usually over many years, to manganese oxide fume/dust can lead to chronic manganese poisoning, chiefly affecting the central nervous system.

12. Ecological information

Ecotoxicity Very toxic to aquatic life with long lasting effects.

Components		Species	Test Results
Potassium permanganate (CAS 7722-64-7)			
Aquatic			
Fish	LC50	Bluegill (Lepomis macrochirus)	2.7 mg/l, 96 hours, static
			2.3 mg/l, 96 hours, flow through
			2.3 mg/l, 96 hours
			1.8 - 5.6 mg/l
		Carp (Cyprinus carpio)	3.16 - 3.77 mg/l, 96 hours
			2.97 - 3.11 mg/l, 96 hours
		Goldfish (Carassius auratus)	3.3 - 3.93 mg/l, 96 hours, static
		Milkfish, salmon-herring (Chanos chanos)	> 1.4 mg/l, 96 hours
		Rainbow trout (Oncorhynchus mykiss)	1.8 mg/l, 96 hours
			1.08 - 1.38 mg/l, 96 hours
			0.77 - 1.27 mg/l, 96 hours
		Rainbow trout,donaldson trout (Oncorhynchus mykiss)	0.275 - 0.339 mg/l, 96 hours

Toxicity data are not available for sodium permanganate. Toxicity is expected to be similar to that of potassium permanganate.

Persistence and degradability Expected to be readily converted by oxidizable materials to insoluble manganese oxide.

Bioaccumulative potential Potential to bioaccumulate is low.

Mobility in soil The product is miscible with water. May spread in water systems.

Mobility in general The product is miscible with water. May spread in water systems.

Other adverse effects None known.

13. Disposal considerations

Disposal instructions Dispose of contents/container in accordance with local/regional/national/international regulations.

Local disposal regulations Rinse container at least three times to an absence of pink color before disposing.

Hazardous waste code D001: Ignitable waste
The Waste code should be assigned in discussion between the user, the producer and the waste disposal company.

Waste from residues / unused products Do not allow this material to drain into sewers/water supplies. Dispose of in accordance with local regulations.

Contaminated packaging Since emptied containers may retain product residue, follow label warnings even after container is emptied. Rinse container at least three times to an absence of pink color before disposing. Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport information

DOT

UN number UN3214
UN proper shipping name Permanganates, inorganic, aqueous solution, n.o.s. (Sodium permanganate)
Transport hazard class(es) 5.1
Subsidiary class(es) -
Packing group II
Environmental hazards
Marine pollutant Yes
Special precautions for user Read safety instructions, SDS and emergency procedures before handling.
Special provisions 26, 353, IB2, T4, TP1
Packaging exceptions 152
Packaging non bulk 202
Packaging bulk 242

IATA

UN number UN3214
UN proper shipping name Permanganates, inorganic, aqueous solution, n.o.s. (Sodium permanganate)
Transport hazard class(es) 5.1
Subsidiary class(es) -
Packing group II
Environmental hazards Yes
Labels required 5.1
ERG Code 5L

Special precautions for user Read safety instructions, SDS and emergency procedures before handling.

IMDG

UN number	UN3214
UN proper shipping name	PERMANGANATES, INORGANIC, AQUEOUS SOLUTION, N.O.S. (Sodium permanganate)
Transport hazard class(es)	5.1
Subsidiary class(es)	-
Packaging group	II
Environmental hazards	
Marine pollutant	Yes
Labels required	5.1
EmS	F-H, S-Q
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code This substance/mixture is not intended to be transported in bulk.

15. Regulatory information

US federal regulations This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.
All components are on the U.S. EPA TSCA Inventory List.

CERCLA/SARA Hazardous Substances - Not applicable.

Drug Enforcement Administration (DEA) (21 CFR 1310.02 (b) 8: List II chemical.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

CERCLA Hazardous Substance List (40 CFR 302.4)

Sodium permanganate (CAS 10101-50-5) LISTED

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories Immediate Hazard - Yes
Delayed Hazard - No
Fire Hazard - Yes
Pressure Hazard - No
Reactivity Hazard - No

SARA 302 Extremely hazardous substance No

SARA 311/312 Hazardous chemical Yes

SARA 313 (TRI reporting)

Chemical name	CAS number	% by wt.
Sodium permanganate	10101-50-5	36 - 40
Potassium permanganate	7722-64-7	2

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Sodium permanganate (CAS 10101-50-5)

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA) Not regulated.

Drug Enforcement Administration (DEA). List 2, Essential Chemicals (21 CFR 1310.02(b) and 1310.04(f)(2) and Chemical Code Number

Sodium permanganate (CAS 10101-50-5) 6588

Drug Enforcement Administration (DEA). List 1 & 2 Exempt Chemical Mixtures (21 CFR 1310.12(c))

Sodium permanganate (CAS 10101-50-5) 15 % wt

DEA Exempt Chemical Mixtures Code Number

Sodium permanganate (CAS 10101-50-5) 6588

Food and Drug Administration (FDA) Not regulated.

US state regulations This product does not contain a chemical known to the State of California to cause cancer, birth defects or other reproductive harm.

US. Massachusetts RTK - Substance List

Not regulated.

US. New Jersey Worker and Community Right-to-Know Act

Sodium permanganate (CAS 10101-50-5) 500 lbs

US. Pennsylvania RTK - Hazardous Substances

Not regulated.

US. Rhode Island RTK

Sodium permanganate (CAS 10101-50-5)

US. California Proposition 65

US - California Proposition 65 - Carcinogens & Reproductive Toxicity (CRT): Listed substance

Not listed.

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	No
Canada	Non-Domestic Substances List (NDSL)	Yes
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	Yes
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

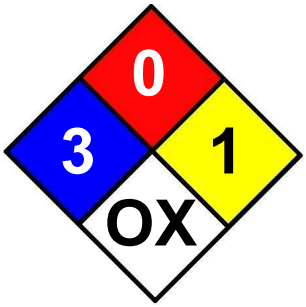
16. Other information, including date of preparation or last revision

Issue date 27-November-2013

Revision date -

Version # 01

NFPA Ratings



References

HSDB® - Hazardous Substances Data Bank
Registry of Toxic Effects of Chemical Substances (RTECS)
EPA: AQUIRE database
NLM: Hazardous Substances Data Base
US. IARC Monographs on Occupational Exposures to Chemical Agents
IARC Monographs. Overall Evaluation of Carcinogenicity
National Toxicology Program (NTP) Report on Carcinogens
ACGIH Documentation of the Threshold Limit Values and Biological Exposure Indices

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APPENDIX G

Monitoring Well Water Level Measurements

Appendix G
Injection Gauging Data
Fort Drum IRP - 3800 PCE Site
Fort Drum, New York

Depth to Water (ft bTOC)											
Date	Total Injected Volume (gal)	PCERI-IMW-1	PCERI-IMW-2	PCERI-IMW-3	PCERI-IMW-4	IMW-05	IMW-06	PCERI-MW19S	PCERI-MW19I	PCERI-MW25S	PCERI-MW-25I
5/31/2017	0	14.86	15.19	--	15.92	17.97	--	15.21	15.26	18.44	18.49
6/2/2017	6256	--	--	--	--	17.91	--	--	--	18.39	18.38
6/5/2017	14593	--	--	--	--	15.89	--	--	--	17.20	15.82
6/6/2017	34167	--	--	--	--	17.03	--	--	--	16.20	16.62
6/7/2017	47474	--	--	--	--	17.79	16.38	--	--	18.31	17.29
6/8/2017	57927	--	--	--	--	17.77	16.03	--	--	18.28	17.31
6/9/2017	62141	--	--	--	--	16.90	15.61	--	--	18.11	17.91
6/12/2017	75185	--	--	--	--	17.82	16.42	--	--	18.31	18.31
6/13/2017	86678	--	--	--	--	17.45	15.78	--	--	18.11	18.08
6/14/2017	110527	--	--	16.03	--	17.59	16.02	--	--	18.09	18.05
6/15/2017	110527	15.02	15.15	16.84	15.78	17.13	16.34	15.14	15.30	18.19	18.23
6/16/2017	126542	15.00	15.11	16.75	15.72	17.63	16.31	15.29	15.23	18.20	18.14
6/19/2017	145112	14.69	14.37	16.72	15.61	17.79	16.12	15.29	15.14	18.33	18.35
6/20/2017	147644	14.63	15.12	16.77	15.58	17.85	16.42	15.23	15.13	18.36	18.36
6/21/2017	171614	14.51	14.26	15.58	13.48	17.78	16.46	13.44	13.93	18.37	18.35
6/22/2017	193102	14.21	14.11	15.54	13.11	17.75	16.07	13.25	13.27	18.34	18.35
6/26/2017	220827	13.83	15.98	15.89	14.69	17.61	16.01	13.08	12.89	18.19	18.27
6/27/2017	239200	13.58	13.62	15.77	13.62	17.56	15.91	13.91	13.60	18.14	18.11
6/28/2017	259200	12.87	13.67	15.79	13.83	17.52	15.89	13.22	12.88	18.13	18.10
6/29/2017	285114	13.46	14.03	15.98	14.64	17.45	15.74	14.14	14.07	18.04	18.04
6/30/2017	291966	13.55	14.05	16.01	14.05	17.47	15.97	14.13	13.99	18.02	18.02
7/5/2017	292421	14.30	14.41	16.33	15.06	17.48	16.00	14.64	14.51	18.00	18.05
7/6/2017	292421	14.31	14.45	16.36	15.08	17.48	16.01	14.66	14.53	18.00	18.03

Notes:
gal - gallons
bTOC - below top of casing