

# Results of the In Situ Reduction Pilot Test, Garfield Groundwater Contamination Superfund Site, New Jersey

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CH2M HILL prepared this technical memorandum for the U.S. Environmental Protection Agency (USEPA) Region 2 and the U.S. Army Corps of Engineers (USACE) Kansas City District to present the results of an in situ reduction (ISR) pilot test and associated groundwater performance monitoring completed at the Garfield Groundwater Contamination Superfund site in the city of Garfield, Bergen County, New Jersey (site). This memorandum has been prepared under Contract W912DQ-11-D-3005, Task Order 0003, for the USACE Kansas City District.

The ISR pilot test was conducted to obtain information regarding the practicability of the following: (1) injecting reagents into the overburden using direct-push injections, (2) achievably reducing hexavalent chromium [Cr(VI)] in overburden groundwater, and (3) creating reducing zone barriers as a component of the full-scale remedy. The ISR pilot test study was carried out in accordance with the *Final Work Plan for Aquifer Test, Pilot Test and Groundwater Modeling, Garfield Groundwater Contamination Superfund Site* (work plan) (CH2M HILL 2013a). Deviations from the work plan are summarized at the end of the Field and Analytical Methods section of this technical memorandum. The results of the ISR pilot test will support development of full-scale remedy alternatives, allowing the feasibility study to be completed with a greater degree of certainty. The pilot test was performed in two separate areas within the boundaries of the E.C. Electroplating (ECE) property, including within the vicinity of the former chromic acid tank storage tank (source area) and on the downgradient (western) side of ECE property along Lincoln Place (barrier area). The location of the ECE property is shown in Figure 1.

## Field and Analytical Methods

### Overburden Monitoring Well Installation

Four monitoring wells were installed between June 2 and 4, 2014, as performance monitoring wells to evaluate the effectiveness of the ISR pilot test. Three new monitoring wells were installed within the overburden material on the ECE property, and the fourth was installed along the eastern side of Lincoln Place, just west of the ECE property. One previously installed monitoring well, EPA-13-OB, located along the eastern side of Lincoln Place, was also used to monitor the pilot system. The locations of the wells are shown in Figure 2, and well screen interval information is provided in Table 1.

Drilling, construction, and development of the four new overburden monitoring wells (EPA-29-OB through EPA-32-OB) were performed by Parratt Wolff, the drilling contractor. Well borings were drilled using a Central Mine Equipment Company 55 hollow-stem auger drill rig with continuous split-spoon core sampling for observation of soil cores. The borings were continuously logged using the Unified Soil Classification System in accordance with ASTM International Method 422-D from the ground surface to the bottom of the borehole. Lithology within the ECE property indicates fill across the site from ground surface to a depth of up to 10 feet. Below the fill layer is reddish-brown silty sand to approximately 20 feet below ground surface (bgs), where weathered bedrock is encountered. The saturated zone exists at approximately 12 feet bgs within the ECE property. No problems were encountered during the drilling activities.

With the exception of EPA-30-OB, monitoring wells were installed above the contact between the overburden and weathered bedrock zone, as determined from observations of rock fragments in soil cores

and changes in auger drilling characteristics. EPA-30-OB was installed at a shallower depth (17 to 22 feet bgs) near EPA-13-OB, which is screened to a deeper depth (22 to 32 feet bgs) at the top of weathered bedrock, to provide monitoring data at different depths across the overburden. All wells were constructed following New Jersey Department of Environmental Protection (NJDEP) guidelines. The overburden wells were completed with a 2-inch-diameter, Schedule 40 polyvinyl chloride (PVC) casing, with 5- or 10-foot, 10-slot (0.01-inch) machine-slotted PVC well screen. The annular space between the well screen and borehole of each monitoring well was filled with NJ #0 sand to 2 feet above the top of the well screen and space between the bottom of the borehole and well screen. An annular seal of fine, NJ #00-type sand was installed to fill 2 feet of annular space above the filter sand. The remaining annular space was grouted to the surface using a slurry mixture of Portland cement and bentonite. The wells were then finished with a locking cap, outer steel protective casing, and a flush-mounted concrete pad at the surface.

The monitoring wells were developed using a combination surge and purge method over the entire well screen to remove fines from the filter pack and clear debris that settled at the bottom of the well during installation. Water quality parameters, consisting of conductivity, pH, turbidity, dissolved oxygen (DO), oxidation-reduction potential (ORP), and temperature, were recorded throughout development of each well. A total of five well volumes was removed from each well, ranging anywhere from 25 to 45 gallons. All parameters were fairly stable after removing five well volumes from each of the newly installed wells.

The four newly installed wells were registered with the NJDEP, and copies of the completed well permits are included in Attachment 1. Following installation, a New Jersey-licensed surveyor surveyed the monitoring wells using global positioning system (GPS) technology, and the survey report is provided in Attachment 2. Lithologic logs, well completion diagrams, and development forms are provided in Attachment 3, including the boring log for the previously installed monitoring well EPA-13-OB for reference.

## Baseline Groundwater Monitoring

Before the pilot test was initiated, a groundwater sampling event was conducted at the five monitoring wells (EPA-13-OB and EPA-29-OB through EPA-32-OB) to establish baseline Cr(VI) concentrations and geochemical conditions in the overburden aquifer.

The baseline groundwater sampling event was conducted on June 19, 2014, 2 weeks after the monitoring wells were installed, and 4 days before initiating injections. Before collecting groundwater samples, synoptic water level measurements were collected. An electronic water interface probe was used to record the depth to water at each well within an accuracy of  $\pm 0.01$  foot. Results of the baseline depth to water measurements are included in Table 2.

Groundwater samples were collected using USEPA-approved low-flow purging and sampling techniques. During purging of each well, field parameters were collected, including pH, temperature, conductivity, ORP, DO, and turbidity. Once field parameters had stabilized (depth to water, pH, conductivity, ORP, DO, and turbidity), samples were collected and sent to Australian Laboratory Services Group (ALS) in Rochester, New York, for Cr(VI) analysis, and USEPA's Contract Laboratory Program (CLP) and the Division of Environmental Science and Assessment (DESA) laboratory system for other analyses, as detailed in Table 3. Cr(VI) data were validated by the project chemist following the receipt of results and a Data Quality Evaluation Report is included in Attachment 4. Final field parameter readings for each well are included in Table 2, and groundwater monitoring forms are included in Attachment 5.

## Injections

Pilot test injections were carried out within the ECE property boundaries by Vironex between June 23 and July 2, 2014. Injections were carried out at 40 locations between two areas: 12 locations within an approximately 45-foot by 60-foot area situated over the former chromic acid tank storage area (IP-17B, IP-18, IP-19, IP-20A, IP-21, IP-22, IP-23, IP-24A, IP-25, IP-28, IP-29, and IP-30) and 28 locations along a 120-foot barrier downgradient of the source area near the western property boundary (IP-1, IP-1A, IP-2, IP-3, IP-4, IP-4A, IP-5B, IP-6, IP-6A, IP-7, IP-7A, IP-7B, IP-8B, IP-8C, IP-9, IP-10, IP-10A, IP-11, IP-12, IP-12A,

IP-13, IP-14, IP-14A, IP-15, IP-15A, IP-16A, IP-26, and IP-27D) (Figure 2). Attempts were made to space the injection points 15 feet from each other; however, because of refusal during implementation, some locations needed to be moved, so distances between each injection point varied. The initial work plan called for 25 injection points within the ECE property; however, because of refusal at shallower depths than anticipated, step-out injection points and additional injection point locations were drilled to deliver the total reagent mass and volume, as designed.

Injections were carried out using direct-push technology (DPT) drilling and, where possible, a top down injection approach in which injections are initiated at the water table and advanced in conjunction with the drive rods to the top of bedrock or refusal. At some locations, a bottom-up injection approach was used in order to guarantee delivery of injection fluids to deeper depth intervals. A 1.5-inch top-down injection tool with a 2-foot screen and injection cap was used to evenly distribute the reagent solution across each interval. Refusal within the barrier area was encountered at depths varying from 11 to 28 feet bgs, and from 15 to 20 feet bgs within the source area. Injection interval details for each injection location, including refusal depths, are included in the *Vironex Injections Services Report* included in Attachment 6.

A total of 28,701 gallons of reagent solution composed of emulsified vegetable oil (EVO), magnesium sulfate ( $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ ), and water was injected at the ECE property. During injections, 3,448 gallons of 60 percent Terra Systems SRS-SD EVO product, 1,374 pounds of  $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ , and 25,254 gallons of potable water were injected. Within the source area, a total volume of 4,800 gallons was injected at an average pressure of 14.8 pounds per square inch and an average flow rate of 2.9 gallons per minute. A total volume of 23,901 gallons was injected within the barrier area at an average flow rate of 2.6 gallons per minute and average pressure of 15.7 pounds per square inch. Injection parameter details for each injection location are included in the *Vironex Injections Services Report* included in Attachment 6.

Upon completion of each injection point, the injection rods were withdrawn, and the resulting voids were sealed with a cement-bentonite grout mixture. The injection points were surveyed by a New Jersey-licensed surveyor following injections using GPS technology, and the final survey report is included in Attachment 1.

Water levels and grab groundwater field parameters (DO, conductivity, ORP, pH, temperature, turbidity, and water color) were collected as part of the injection events to monitor groundwater mounding and indicators of reagent arrival and distribution. Before starting injections and following completion of injections (within 24 hours), the five overburden monitoring wells were monitored. Additionally, during the injection activities, monitoring wells EPA-29-OB and EPA-31-OB were monitored at the beginning of each day, every half hour during injections, and at the end of each day of injection activities conducted adjacent to the two wells. Field monitoring results from the injections are included in Attachment 6.

## Post-injection Grab Groundwater Sampling

Following the injection activities, grab groundwater samples were collected at 10 locations (GW-A through GW-J, see Figure 2) between July 29 and 31, 2014, approximately 4 weeks after the injection event. The grab groundwater samples were performed to evaluate the radius of influence (ROI) and distribution of EVO and sulfate achieved during injection, and post-injection advective transport. The 10 grab groundwater locations were determined based on observations during the injection activities. Grab groundwater locations GW-F, GW-G, and GW-H were installed around injection points IP-9 and IP-11, where larger injection volumes were achieved (1,300 to 1,400 gallons per point). The locations of GW-F, GW-G, and GW-H were selected to provide more information on the injection ROI in an area where larger injection volumes more representative of an optimized full-scale injection were achieved.

Grab groundwater samples were collected using DPT. Two sample depth intervals were targeted at each location—one at the bottom 2 feet of overburden and a second near the water table. However, at two of the locations (GW-A and GW-B), depth to water was within 3 feet of refusal, and only one grab groundwater sample was collected. At each grab groundwater location, the DPT was advanced to the target depth, and a 2-foot screen was deployed at the targeted depth. At three of the grab groundwater locations (GW-C,

GW-D, and GW-I), step-out borings (designated with an “a” suffix on Figure 2) were advanced to collect the deeper sample because of refusal in the initial boring. A peristaltic pump was deployed at each screened interval, and a grab groundwater sample was collected. Upon completion of each grab groundwater sample, the DPT rods were withdrawn, and the resulting voids were sealed with a cement-bentonite grout mixture. The grab groundwater points were surveyed using a handheld GPS Trimble unit.

Water levels and field parameters (DO, conductivity, ORP, pH, temperature, turbidity, and water color) were collected at each grab groundwater. Additionally, field kits were used to analyze the grab groundwater samples for Cr(VI) and ferrous iron. Samples were collected and sent for total organic carbon (TOC) and sulfate analysis through the USEPA CLP/DESA laboratory system, as detailed in Table 3. Cr(VI) data were validated following the receipt of results, as included in the Data Validation Report (Attachment 4). Water level, field parameter readings, and analytical results for the grab samples are summarized in Table 4, and groundwater monitoring forms are included in Attachment 5.

## pH Titration Tests

Based on low pH values observed during the initial baseline groundwater sampling, a soil pH titration test was carried out following the EVO injection event. A soil sample was collected from SO-B (Figure 2) during the grab groundwater sampling event and sent to ALS Laboratories in Corvallis, Oregon, for titration testing. Titrations were carried out using sodium hydroxide (NaOH) on a 1 to 1 soil to deionized water slurry. NaOH was added in increments of 50 micrograms per liter ( $\mu\text{g/L}$ ) (0.1 millimole hydroxide) until a pH of 7 was reached. The sample was then sealed and allowed to sit for 122 hours. During the 122 hours of the test, the pH was checked incrementally to ensure it had not drifted by more than 0.5 pH units. If the pH had drifted, NaOH was added in 50  $\mu\text{g/L}$  increments until a pH of 7 was reestablished. Details on the pH titration test are included in Attachment 7.

Results of the pH titration tests indicate that to neutralize the soil within the ECE property, NaOH or a similar base would need to be added at a dosing of 0.0161 micromoles per gram of dry soil, or approximately two pounds of NaOH per cubic yard of soil.

## Performance Monitoring

Following the injections, five rounds of groundwater sampling at the five monitoring wells (EPA-13-OB and EPA-29-OB through EPA-32-OB) were carried out over 7 months after the injection event to monitor the performance on the EVO injections. Performance monitoring events were carried out as follows:

- July 29–30, 2014 (Event 1)
- September 3–4, 2014 (Event 2)
- October 20–21, 2014 (Event 3)
- December 17–18, 2014 (Event 4)
- February 5–6, 2015 (Event 5)

Before collecting groundwater samples, synoptic water-level measurements were collected. An electronic water interface probe was used to record the depth to water level at each well within an accuracy of  $\pm 0.01$  foot. Results of the depth to water measurements are included in Table 2.

During performance monitoring, groundwater samples were collected using USEPA-approved low-flow purging and sampling techniques. During purging of each well, field parameters were collected including pH, temperature, conductivity, ORP, DO, and turbidity. Once field parameters had stabilized (depth to water, pH, conductivity, ORP, DO, and turbidity), samples were collected and sent to ALS in Rochester, New York, for Cr(VI) analysis, and USEPA’s CLP/DESA laboratory for analyses as detailed in Table 3. Data were validated following the receipt of results, as included in the Data Validation Report (Attachment 4). Final field parameter readings for each well are included in Table 2, and groundwater monitoring forms are included in Attachment 5.

## Investigation-Derived Waste Management

Investigation-derived waste (IDW) created throughout the pilot study was stored within the ECE property. IDW soil and water produced during the installation and subsequent sampling of each borehole and monitoring well was transferred to 55-gallon Department of Transportation-regulated drums. Copies of IDW disposal waste manifests and bills of lading are included in Attachment 8.

Three IDW samples were collected for various laboratory analyses, based on the media to be disposed of and the requirements of each disposal facility. In general, IDW samples were analyzed by a subcontracted laboratory (ALS) for the following:

- IDW water: Cr(VI), volatile organic carbons (VOCs), semivolatile organic carbons (SVOCs), polychlorinated biphenyls (PCBs), pesticides, metals (including mercury and cyanide), total petroleum hydrocarbons—gasoline and diesel ranges, corrosivity, and ignitability
- IDW soils cuttings: Cr(VI), toxicity characteristic leaching procedure – VOCs, SVOCs, pesticides, herbicides; PCBs, corrosivity, and ignitability

Wastewater from the pilot study activities were classified as hazardous based on analytical results of the IDW samples collected, and waste solids were classified as nonhazardous. Capitol Environmental managed disposal of the hazardous wastewater and nonhazardous waste solids. During the pilot study, approximately 730 gallons of hazardous wastewater and 3,000 pounds of nonhazardous waste solids were disposed of at the EQ Detroit facility in Detroit, Michigan.

## Work Plan Deviations

The ISR pilot test study was carried out in accordance with the work plan (CH2M HILL 2013a). Deviations from the work plan are summarized as follows:

- Three of the four monitoring wells installed (not including EPA-30-OB) were installed at depths shallower than anticipated in the work plan, due to refusal at a shallower depth. Additionally, EPA-29-OB was installed with a 5-foot screen, instead of a 10-foot screen as detailed in the work plan.
- During injections, 40 locations were advanced, including 12 within an approximately 45-foot by 60-foot area (source), and 28 along the 120 foot barrier. The 15 additional boring locations, above the 25 prescribed in the work plan, were advanced in order to deliver the design dosage of EVO substrate, after refusal was encountered at multiple injection locations. Additionally, due to refusal, not all locations were pushed on 15-foot centers, as established in the work plan.
- A bottom-up injection approach was used at some of the injection locations, in order to ensure that the substrate was delivered to deeper depths. The bottom-up approach was used most often when a top-down approach hit refusal at a shallow depth and a step out boring was advanced.
- Due to shallow refusal, not all borings received the proper dosage over a 10-foot (source) or 17-foot (barrier) interval, as prescribed in the work plan. However, additional step-out locations were drilled, and the overall dosing of EVO substrate to the subsurface was in accordance with the work plan.
- Grab groundwater samples were collected approximately 4 weeks after the completion of injections, 1 week longer than the prescribed 3-week timeframe in the work plan.
- A soil pH titration test was carried out to determine the buffering capacity of the soil after low pH was encountered in the source area.

## Health and Safety

The ISR pilot test study was carried out in compliance with the *Final-Accident Prevention Plan, Garfield Groundwater Contamination Superfund Site Remedial Investigation, Revision 1* (CH2M HILL 2013b). Prior to starting fieldwork, an Operational Readiness Review call was held in order to address possible health and safety issues that could be encountered during field activities. Additionally, prior to starting each task, an Activity Hazard Analysis was performed and reviewed with the field team. Each morning, prior to starting work, the team reviewed the tasks to be performed for the day and discussed possible health and safety issues that may be encountered. If change conditions were encountered, work was stopped, and the situation and its risks were discussed within the field team prior to resuming work. The ISR pilot study was performed with no health and safety incidents. Similar risks would be involved with a full-scale implementation, with an additional risk of working outside of the ECE property boundaries within public streets, and traffic-control planning would be necessary.

## Results

### Analysis of Pilot Study Performance

This section provides a summary and assessment of the pilot study performance monitoring data. Overall, the pilot study demonstrated that EVO can be injected and distributed at sufficient concentrations to stimulate the reduction of Cr(VI).

Several challenges were encountered during the pilot study that affected the effectiveness of Cr(VI) reduction. Heterogeneity in the overburden resulted in non-uniform distribution of injected solutions laterally across the site. However, at most injection locations, the distribution of injected solutions did not appear to be significantly affected by vertical short-circuiting up toward the water table or down toward the weathered bedrock. At injection points where surfacing was observed, minor amounts of injection solutions were observed, and in most cases reducing flow rates proved effective for reducing surfacing.

At the source area onsite, historical releases of chromic acid have affected groundwater conditions to the point of impacting the ability to treat Cr(VI) in situ. Low pH and elevated Cr(VI) concentrations impacted microbial growth, which effectively shut down the biogeochemical processes required to reduce Cr(VI) to trivalent chromium [Cr(III)]. Downgradient of the site where pH is neutral and Cr(VI) concentrations are lower, Cr(VI) treatment was most successful, as demonstrated by indicators of microbial activity and overall Cr(VI) concentration reductions.

Pilot study performance monitoring data are summarized in Table 2, and grab groundwater monitoring data are summarized in Table 4. Figures 3 and 4 summarize results from the grab groundwater monitoring and performance monitoring. Additional discussion and interpretation of the pilot study performance monitoring data is presented in the following subsections.

### TOC Concentrations and Substrate Distribution

- Refusal was encountered in many injection borings requiring step-out injection locations. In IP-4, IP-7, and IP-8, multiple step-out borings were required to complete injection of the approximate target reagent solution volume.
- At most locations, surfacing of injected reagents was not observed in the injection borings or adjacent borings and monitoring wells. In IP-4 and IP-8, surfacing was observed in the boring being injected, while in IP-7 surfacing was observed in the step-out injection boring and the adjacent original boring. Surfacing was easily mitigated by lowering the injection rates and volumes of surfaced material were minimal (less than 5 gallons). Additional grouting activities were also performed in the original IP-7 injection boring to ensure no further surfacing occurred through adjacent borings. Surfacing is an indicator of low permeability at a given location due to lithology, or smearing of the DPT boring wall causing reduction in permeability. These issues can be resolved for the most part by using properly

screened and developed permanent injection wells rather than DPT injection points. Groundwater mounding observed during injections ranged from approximately 1 foot in EPA-29-OB to 3 feet in EPA-31-OB.

- During the grab groundwater sampling event, TOC in grab groundwater samples was collected to assess substrate distribution 4 weeks after injection. The substrate used was a mixture of EVO and 4 percent lactate. The EVO itself is expected to mostly sorb to the soil particles; therefore, it is not measurable in groundwater. The lactate is soluble and can be measured in groundwater as TOC. In addition, as EVO ferments, it releases volatile fatty acids that are soluble and therefore can be measured as TOC in groundwater.
  - Baseline TOC concentrations at the site were less than 3 milligrams per liter (mg/L). Across the majority of the treatment area, TOC concentrations in grab groundwater samples were greater than 10 mg/L, but not uniformly greater than 20 mg/L (Figure 3). This suggests that substrate was distributed to most locations; however, it was not uniformly distributed to meet design concentrations at all locations. At two grab groundwater locations near the center of the barrier (GW-G and GW-H), TOC concentrations exceeded 200 mg/L. The high concentrations of TOC may be because of the presence of EVO droplets in the groundwater samples.
  - The overall TOC concentrations suggest that the distribution of the EVO was not ideally uniform, and at some locations, preferential lateral flow during injections may have carried the substrate further from the injection points. Across most of the site, vertical distribution of solutions during injection did not appear to be affected by short-circuiting up toward the water table or down toward the weathered bedrock. This was evidenced by similarities or limited differentiation between TOC and sulfate concentrations in grab samples collected near the water table versus near the weathered bedrock. The exceptions were near IP-9 and IP-11, where grab groundwater samples (GW-G and GW-H) collected near the water table contained much higher TOC concentrations than the deeper samples collected near the weathered bedrock. This could indicate localized heterogeneities that cause uneven reagent distribution during injection, and/or after injection during the first month of advective transport.
  - Due to overburden heterogeneities resulting in uneven lateral reagent distribution, a well-defined injection ROI could not be inferred from the monitoring data. On average, the estimated radius of influence achieved using DPT injection points was on the order of 5 to 10 feet, as confirmed in injection point/grab groundwater sample pairs IP-5B/GW-E, IP-9/GW-G, IP-17B/GW-A, IP-20A/GW-B and IP-23/GW-C(a).
  - Long-term TOC data were collected from monitoring wells over 8 months to evaluate the steady-state flux of organic carbon from the breakdown of the oil-based fraction of the EVO, as shown in Figure 5. Onsite TOC concentrations increased to as high as 18 mg/L in the source area and 20 mg/L inside the barrier. Downgradient of the barrier, TOC concentrations increased to as high as 38 mg/L in offsite monitoring well EPA-13-OB. Higher long-term TOC concentrations in this well suggests a greater level of microbial activity breaking down the long-chain fatty acids of the EVO.
  - The pilot test design target steady-state TOC concentration in groundwater was 60 mg/L, which is within the typical steady-state TOC range observed at other EVO injection sites (20 to 100 mg/L). Measured TOC concentrations in monitoring wells were all lower than 60 mg/L, indicating either non-uniform EVO distribution because of overburden heterogeneity, or limited microbial activity breaking down the long-chain fatty acids of the EVO.
  - TOC concentration trends over time appear to be decreasing or stable, with the exception of downgradient monitoring well EPA-13-OB, where TOC concentrations were still increasing as of the fifth performance monitoring event. The trends provide additional evidence of higher microbial activity breaking down the long-chain fatty acids of the EVO.

## Sulfate Concentrations and Distribution

- As discussed in the work plan, sulfate was added to stimulate the formation of iron sulfide minerals, which can abiotically reduce Cr(VI) to Cr(III), which then precipitates out with ferric oxide [Fe(III)] to form insoluble hydroxides and oxyhydroxides. Iron sulfide minerals will re-oxidize once EVO is depleted and aerobic conditions re-establish. The Cr(VI) that has already been reduced by the iron sulfide will not reoxidize.
- Baseline sulfate concentrations ranged from 33 mg/L downgradient of the site to 200 mg/L near the source area. Background overburden sulfate concentrations in the vicinity of the ECE property, as reported in the remedial investigation report, were approximately 30 mg/L. Elevated sulfate near the source area is likely because of sulfuric acid in historically released chrome plating solutions. Following the  $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$  injections, sulfate concentrations in grab groundwater samples collected during the first performance monitoring event were as high as 710 mg/L and averaged approximately 300 mg/L across the rest of the site (Figure 3), which is greater than the design target sulfate concentration of 250 mg/L. The application of the sulfate data as an indicator of distribution of the injected fluids is difficult because of the presence of elevated sulfate concentrations in the source area.
- Long-term sulfate data collected from monitoring wells over 8 months showed sulfate concentrations dropping back down to near baseline concentrations, as shown in Figure 6. Sulfide (resulting from the reduction of sulfate) was not detected in any onsite monitoring well, which suggests the decrease in sulfate onsite was most likely because of advective flushing and dilution. Sulfide was detected in downgradient monitoring well EPA-13-OB, which indicates that sulfate reducing conditions were achieved downgradient of the ECE property. Both iron and manganese concentrations also increased in this well because of reducing conditions, although dissolved iron did not increase to the same magnitude as manganese. The lower dissolved iron combined with the presence of sulfide indicates a higher likelihood that iron sulfide minerals were likely formed.

## Cr(VI) Concentration Trends

- Baseline Cr(VI) ranged from 224,000 to 275,000  $\mu\text{g/L}$  onsite, and from 18,400 to 125,000  $\mu\text{g/L}$  downgradient of the site (Figure 4). Cr(VI) concentrations decreased by more than 97 percent in offsite downgradient monitoring wells EPA-13-OB and EPA-30-OB (Figure 8). No appreciable Cr(VI) concentration decreases were observed onsite, as shown in Figure 7.
- The lack of Cr(VI) reduction onsite appears to be associated with low pH conditions inhibiting microbial activity, which requires neutral pH. Onsite, pH ranged from 3.1 to 6.1, whereas pH ranged from 6.2 to 7.7 offsite. Alkalinity also provides another indication of microbial activity since carbon dioxide ( $\text{CO}_2$ ) is produced from microbial activity as organic carbon (naturally occurring or from the EVO injections) is consumed and the  $\text{CO}_2$  converts to alkalinity. Alkalinity was lowest onsite closer to the source area (EPA-29-OB) and upgradient of the barrier (EPA-32-OB), and elevated within, offsite and downgradient of the barrier (greater than 250 mg/L), indicating increased microbial activity where pH was 6 or higher.
- The lack of Cr(VI) reduction also could be associated with toxic effects of high Cr(VI) concentrations on microbial growth. Studies have shown that Cr(VI) concentration greater than approximately 160,000 to 200,000  $\mu\text{g/L}$  are inhibitive for Cr(VI)-reducing bacteria (Frag and Zaki 2010). Cr(VI) concentrations onsite are above this threshold, whereas offsite concentrations are below this threshold.
- Dissolved total chromium also was analyzed to evaluate the potential for organic acids resulting from the breakdown of EVO to form soluble complexes with Cr(III). The complexation of Cr(III) by organic acids occurs after Cr(VI) is reduced either biologically or abiotically, so the presence of organic acids does not have a bearing on biotic or abiotic Cr(VI) reduction. The complexes, while stable and not likely to re-oxidize to Cr(VI), would allow Cr(III) to remain in solution at higher pH levels where Cr(III) is expected to precipitate. In most of the monitoring wells, Cr(VI) composed a majority of the dissolved chromium. In downgradient monitoring well EPA-13-OB, Cr(III) made up approximately 70 to 80 percent

of the dissolved chromium, an indication that Cr(III) had complexed with organic acids. However, the concentration of dissolved chromium in this well was still below the NJDEP Groundwater Quality Standard (GWQS) of 70 µg/L. Compared to the greater than two-orders-of magnitude reduction of total chromium and Cr(VI) concentrations in this well, the magnitude of Cr(III) complexation is not significant.

### Geochemical Parameter Trends

- Typical ORP in the environment ranges from hundreds of millivolts (mv) for very oxidizing conditions, to negative hundreds of mV for methanogenic conditions. Baseline groundwater ORP ranged from 103 to 530 mV, indicating oxidizing conditions. The high ORP was likely because of the high Cr(VI) concentrations in the source area. The ORP observed at the end of the performance monitoring period (greater than 400 mV at the source area to less than -200 mV at the furthest downgradient wells) is indicative of more reducing conditions downgradient of the barrier, which also corroborates the overall Cr(VI) reduction patterns observed.
- The terminal electron acceptors evaluated included nitrate, which reduces to nitrogen gas (with nitrite as a short-lived intermediate), manganese(IV) which reduces to dissolved manganese(II); Fe(III), which reduces to dissolved Fe(II); and CO<sub>2</sub>, which reduces to methane. Overall trends in groundwater electron acceptor concentrations also mirror the same general Cr(VI) reduction patterns, in that Cr(VI) reduction occurred where consistent reducing conditions resulting from the stimulation of microbial activity were observed downgradient of the site. Due mainly to low pH and elevated Cr(VI) concentrations, impacts to microbial activity, redox conditions observed during the pilot study ranged from oxidizing onsite to nitrate-reducing and methanogenic downgradient, as follows:
  - Background nitrate concentrations range from approximately 10 to 40 mg/L. Nitrate concentrations in all monitoring wells, except EPA-29-OB, decreased over time. The greatest nitrate decreases (decreased to less than 1 mg/L) were observed in downgradient monitoring wells EPA-13-OB and EPA-30-OB. Nitrate concentration decreases were caused by nitrate-reducing bacteria using it as a terminal electron acceptor, reducing it to nitrogen gas.
  - Iron and manganese concentration trends were difficult to interpret because of elevated background concentrations in the acidic onsite groundwater. The most significant increases in iron and manganese were observed in downgradient wells EPA-13-OB and EPA-30-OB. Iron and manganese concentrations in these wells were elevated above the NJDEP GWQSs during the fifth performance monitoring event. Concentrations are expected to drop back below maximum contaminant levels as the EVO is depleted over time and redox conditions return to background.
  - Background methane concentrations were predominately nondetect. Methane concentration increases were noted in most of the monitoring wells; however, the most significant increases were observed in downgradient monitoring wells EPA-13-OB and EPA-30-OB (1,360 and 427 µg/L, respectively). The increase of methane is a result of methanogenic bacteria using CO<sub>2</sub> as a terminal electron acceptor, reducing it to methane. Certain strains of methanogens are known to be tolerant of lower pH conditions, possibly explaining the slight increase in methane in EPA-29-OB. Methanogenic conditions can also exist in localized microenvironments near the EVO injections that are not representative of the overall surrounding aquifer conditions.

### Recommendations for Full-scale Application of In Situ Reduction

The overall results of the pilot study show that because of microbe-inhibitory low pH and elevated Cr(VI) concentrations at the source area, biological in situ reduction should not be considered for application in the overburden at the ECE property. Either chemical in situ reduction, or a combination of chemical with pH neutralization and biological reduction, should be considered.

In situ biological reduction has the potential to be a successful component of a full-scale remedy for the Cr(VI) plume downgradient of the ECE property. For example, in situ biological reduction could be used to create reducing barriers by injecting EVO in a line of wells parallel to the groundwater flow direction.

Uneven lateral distribution of injected solution was observed during the pilot study. Greater uniformity and injection ROI can likely be achieved by using permanent injection wells rather than DPT injection points, and increasing the total injection volume. Using injection wells and larger injection volumes would be beneficial for treatment barrier applications, where uniformity of treatment is important. For full-scale application, volatile fatty acids analysis would be performed periodically to confirm the distribution of EVO and TOC concentrations.

The dosage of EVO used during the pilot study resulted in sufficient TOC concentrations to support Cr(VI) reduction (at least 20 mg/L) where microbial activity was not inhibited. However, it is uncertain at this time how long reducing conditions will persist with a single injection at the pilot study dosage. For full-scale application, increasing the EVO dosage would be recommended to maximize the longevity of the reduction barriers and to provide contingency against non-uniform EVO distribution. Based on the pH data collected from the downgradient offsite monitoring wells, adding a buffer does not appear to be necessary in the downgradient plume area to maintain neutral pH levels.

For full-scale application, it is not anticipated that the addition of sulfate would be necessary for Cr(VI) reduction to occur. However, sulfate injections may extend the effectiveness (in areal extent and longevity) of full-scale in situ reduction barriers and reduce the EVO reinjection frequency. Additional monitoring data from EPA-13-OB collected after TOC has been depleted may provide additional insight into the benefits of sulfate amendment. If sulfate is injected along with the EVO during full-scale application, amendment of iron also is recommended to supplement the low naturally occurring iron in the aquifer.

## References

CH2M HILL. 2013a. *Final Work Plan for Aquifer Test, Pilot Test and Groundwater Modeling, Garfield Groundwater Contamination Superfund Site, Remedial Investigation/Feasibility Study, City of Garfield, Bergen Country, New Jersey*. September

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**ATTACHMENTS**

- 1 Well Permits
- 2 Survey Data
- 3 Boring Logs, Well Completion Diagrams, and Development Forms
- 4 Data Quality Evaluation Report
- 5 Groundwater Field Logs
- 6 Vironex Injection Services Report
- 7 pH Titration Results
- 8 IDW Manifest and Bill of Lading

## Tables

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TABLE 1

**Pilot Test Monitoring Wells***Results of In Situ Reduction Pilot Test**Garfield Groundwater Contamination Superfund Site, New Jersey*

Monitoring Well ID	Depth Interval	TOC Elevation ft amsl	Total Depth ft bgs	Screen Interval ft bgs	TOS Elevation ft amsl	BOS Elevation ft amsl	Pilot Study Location
EPA-13-OB	Overburden	55.54	32	22 to 32	33.54	23.54	Downgradient of Injection Barrier
EPA-29-OB	Overburden	58.23	20	15 to 20	43.23	38.23	Within Source Area
EPA-30-OB	Overburden	55.50	22	17 to 22	38.50	33.50	Downgradient of Injection Barrier
EPA-31-OB	Overburden	56.31	26	16 to 26	40.31	30.31	Within Injection Barrier
EPA-32-OB	Overburden	58.29	20.5	10.5 to 20.5	47.79	37.79	Upgradient of Injection Barrier, Downgradient of Source Area

**Notes:**

BOS = bottom of screen

ft amsl = ft above mean sea level

ft bgs = feet below ground surface

TOC = top of casing

TOS = top of screen

TABLE 2  
**Pilot Test Groundwater Analytical Results**  
*Results of In Situ Reduction Pilot Test*  
*Garfield Groundwater Contamination Superfund Site, New Jersey*

Analyte	Unit	Well Date Collected Event Sample ID	EPA-13-OB								EPA-29-OB							
			6/19/2014	6/19/2014	7/29/2014	9/3/2014	10/20/2014	10/20/2014	12/18/2014	12/18/2014	2/5/2015	6/19/2014	7/30/2014	9/4/2014	9/4/2014	10/21/2014	12/17/2014	2/6/2015
			Baseline EPA-13-OB- 061914	Event 1 D-06192014- 01	Event 1 - Dup EPA-13-OB- 072914	Event 2 EPA-13-OB- 090314	Event 3 EPA-13-OB- 102014	Event 3 - Dup D-01-102014	Event 4 GCGC-EPA-13- OB-05	Event 4 - Dup D-12182014- 01	Event 5 EPA-13-OB- 020515	Baseline EPA-29-OB- 061914	Event 1 EPA-29-OB- 072914	Event 2 EPA-29-OB- 090414	Event 2 - Dup D-01-090414	Event 3 EPA-29-OB- 102114	Event 4 GCGC-EPA-29- OB-05	Event 5 EPA-29-OB- 020615
Chromium , dissolved	µg/L	70	19,000	18,000	2,850	350	56.8	--	32.1	--	41	310,000	316,000	410,000	400,000	332,000	220,000	220,000
Chromium	µg/L	70	18,000	18,000	2,730	740	187	--	49.5	--	83 L	300,000	421,000	410,000	430,000	380,000	267,000	240,000
Chromium, Hexavalent (CrVI) , dissolved	µg/L	70	18,400	18,900	2,400	310	13.2 J	147 J	9	9	9	275,000	292,000	379,000	379,000	298,000	213,000	207,000
Iron , dissolved	µg/L	300	50 U	50 U	100 U	50 U	200 U	--	354	--	220	2,800	2,200	4,900	4,400	115,000	200 U	1,600
Iron	µg/L	300	50 U	50 U	100 U	50 U	200 U	--	395	--	290	3,300	6,510	4,700	5,000	128,000	1,820	1,800
Manganese , dissolved	µg/L	50	4.5	11	--	--	2,800	--	1,910	--	4,500	770	--	--	995	--	--	950
Manganese	µg/L	50	5.4	5.2	--	--	2,880	--	--	--	4,500	790	--	--	1,480	--	--	920
Methane , dissolved	µg/L		--	--	--	--	1	--	--	--	--	--	--	--	1.6	--	--	--
Methane	µg/L		2 U	--	--	--	--	--	--	--	1,360	2 U	--	--	--	--	--	47.8
Ethane	µg/L		2 U	--	--	--	--	--	--	--	2 U	2 U	--	--	--	--	--	2 U
Ethene	µg/L		2 U	--	--	--	--	--	--	--	2 U	2 U	--	--	--	--	--	2 U
ALKALINITY, TOTAL (AS CaCO3)	mg/L		210	--	--	--	262	--	--	--	280	1 U	--	--	--	2 U	--	1 U
Chloride (Cl)	mg/L		140	--	160	180	150	--	160	--	160	240	240	260	--	211	210	180
NITRATE-NITRITE (as Nitrogen)	mg/L		8.5	--	0.13	--	0.016 J	--	0.05 U	--	0.05 U	9.8	6.2	--	--	9.58	--	7.9
Sulfate	mg/L		33	--	56	57	13.5	--	12	--	3.2	160	200	190	--	214	92	110
Sulfide, Acid-Soluble	mg/L		0.01 U	--	0.01 UL	0.01 U	1.6	--	1.3	--	0.012	0.01 U	0.01 U	0.01 U	--	1 U	0.02 UL	0.01 UL
Total Organic Carbon	mg/L		1 U	1 U	13	5.2	17.3	10.6	7.4	--	38	2.6	18	10	9.9	14.3	6.3 J	7.5
Field Parameters	Unit																	
pH	s.u.		7.74	--	7.74	7.57	7.44	--	7.53	--	7.18	4.15	3.64	3.23		3.20	3.28	3.13
Temperature	°C		16.91	--	19.01	17.44	19.00	--	17.67	--	14.95	13.49	17.70	19.00		17.96	17.43	15.29
Conductivity	mS/cm		0.806	--	0.956	1.00	0.108	--	1.00	--	1.01	1.52	1.69	1.84		0.187	1.40	1.49
Oxidation-Reduction Potential	mV		149	--	17	-94	251	--	-229	--	-228	530	470	523		535	459	427
Dissolved Oxygen <sup>a</sup>	mg/L		1.12	--	0.00	0.00	0.00	--	1.98	--	0.00	2.95	0.00	0.51		0.40	0.00	0.00
Turbidity	NTU		2.85	--	191	40.5	6.03	--	7.07	--	9.3	98.3	339	93.1		48.4	7.09	19.6
Depth to Water	ft bgs		11.98	--	12.42	13.64	14.50	--	12.20	--	12.97	10.37	10.67	11.77		12.65	10.78	11.08
Water Elevation	ft amsl		43.56	--	43.12	41.90	41.04	--	43.34	--	42.57	47.86	47.56	46.46		45.58	47.45	47.15
Observations <sup>b</sup>			Yellow, Green	--	Clear, Slightly milky	Clear	Clear	--	Clear	--	Clear	Dark Yellow	Yellow, milky	Yellow		Yellow	Yellow, green	Yellow

**Notes:**  
Shading indicates concentrations in exceedance of NJDEP GWQS  
-- Analyte was not sampled for at that location  
NJDEP GWQS - New Jersey Department of Environmental Protection Groundwater Quality Standard  
CaCO3 - Calcium Carbonate  
Dup - Duplicate  
µg/L - microgram per liter  
mg/L - milligram per liter  
s.u. - standard pH units  
°C - degrees Celsius  
mS/cm - millisiemens per centimeter  
mV - millivolts  
NTU - Nephelometric Turbidity Units  
ft bgs - feet below ground surface  
ft amsl - feet above mean sea level

<sup>a</sup> Due to equipment limitations in the field during the six sampling events , dissolved oxygen measurements are inaccurate and were not used in the assessment of the Pilot Study.  
<sup>b</sup> Yellow to orange coloring is indicative of elevated concentrations of hexavalent chromium. Green coloring is indicative of elevated concentrations of trivalent chromium. Brown to red color may be indicative of elevated precipitation of iron as a result of EVO injections.  
J- The identification of the analyte is acceptable; the reported value is an estimate.  
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TABLE 2  
**Pilot Test Groundwater Analytical Results**  
*Results of In Situ Reduction Pilot Test*  
*Garfield Groundwater Contamination Superfund Site, New Jersey*

Analyte	Unit	NJDEP GWQS	Well													
			Date Collected	EPA-30-OB						EPA-31-OB						
				6/19/2014	7/29/2014	9/3/2014	10/20/2014	12/18/2014	2/5/2015	6/19/2014	7/30/2014	9/3/2014	10/20/2014	12/18/2014	2/6/2015	2/6/2015
Event	Baseline	Event 1	Event 2	Event 3	Event 4	Event 5	Baseline	Event 1	Event 2	Event 3	Event 4	Event 5	Event 5 - Dup			
Sample ID																
Chromium , dissolved	µg/L	70	130,000	76,800	25,000	8,400	6,940	2,300	250,000	264,000	250,000	275,000 J	211,000	250,000	250,000	
Chromium	µg/L	70	130,000	75,700	22,000	9,600	9,150	5,600	250,000	251,000	240,000	267,000	270,000	250,000	250,000	
Chromium, Hexavalent (CrVI) , dissolved	µg/L	70	125,000	68,100	25,300	10,000	9,880	2,880	241,000	237,000	246,000	288,000	241,000	249,000	253,000	
Iron , dissolved	µg/L	300	50 U	1,000 U	50 U	2,630	447	50 U	50 U	3,500 U	50 U	87,000 J	1,210	50 U	50 U	
Iron	µg/L	300	240	1,000 U	50 U	3,140	893	3,000	120	3,000 U	440	90,900	1,070	190	150	
Manganese , dissolved	µg/L	50	410	--	--	1,640	--	2,700	1,200	--	--	1,270 J	--	1,100	1,100	
Manganese	µg/L	50	420	--	--	1,830	--	2,800	1,200	--	--	772	--	1,200	1,100	
Methane , dissolved	µg/L		--	--	--	2.4	--	--	--	--	--	0.89 J	--	--	--	
Methane	µg/L		2.38	--	--	--	--	427	2 U	--	--	--	--	4.42	--	
Ethane	µg/L		2 U	--	--	--	--	2 U	2 U	--	--	--	--	2 U	--	
Ethene	µg/L		2 U	--	--	--	--	2 U	2 U	--	--	--	--	2 U	--	
ALKALINITY, TOTAL (AS CaCO3)	mg/L		250	--	--	273	--	290	210	--	--	265	--	150	--	
Chloride (Cl)	mg/L		160	160	180	163	160	170	190	190	--	170	180	170	--	
NITRATE-NITRITE (as Nitrogen)	mg/L		16	2.8	--	0.024 J	--	0.1	28	22	--	14.1	--	13	--	
Sulfate	mg/L		76	89	71	57.2	68	40	100	140	130	111	130	140	--	
Sulfide, Acid-Soluble	mg/L		0.01 U	0.01 U	0.01 U	1 U	0.02 U	0.01 U	0.01 U	0.01 U	0.01 U	1 U	0.02 U	0.01 U	--	
Total Organic Carbon	mg/L		1.7	12	3.6	3.5	3.7	6.4	2.3	20	11	12.6	8.6	6.9	7	
Field Parameters			Unit													
pH	s.u.		6.77	6.73	7.25	7.30	7.04	6.21	6.11	6.02	5.76	6.00	5.81	5.36	--	
Temperature	°C		18.35	16.91	20.16	21.30	18.72	13.24	16.90	17.98	20.50	18.32	16.91	15.29	--	
Conductivity	mS/cm		1.29	1.24	1.17	0.115	1.19	1.09	1.75	1.74	1.56	0.193	1.74	1.61	--	
Oxidation-Reduction Potential	mV		103	151	20	-84	-3	-49	202	259	206	290	331	350	--	
Dissolved Oxygen <sup>a</sup>	mg/L		0.83	0.00	0.75	0.73	2.17	0.00	1.49	0.00	0.00	0.41	0.00	0.00	--	
Turbidity	NTU		13.6	258	10.9	6.91	7.03	78	20.9	256	137	53.4	36.9	18.3	--	
Depth to Water	ft bgs		11.95	12.65	13.97	14.54	12.55	12.74	11.98	12.90	14.13	--	12.46	13.18	--	
Water Elevation	ft amsl		43.55	42.85	41.53	40.96	42.95	42.76	44.33	43.41	42.18	--	43.85	43.13	--	
Observations <sup>b</sup>			Yellow, green	Yellow	Yellow, green	Clear	Clear	Light brown	Dark Yellow	Yellow	Yellow	Yellow	Yellow	Yellow, green	--	

**Notes:**  
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CaCO3 - Calcium Carbonate  
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TABLE 2  
**Pilot Test Groundwater Analytical Results**  
*Results of In Situ Reduction Pilot Test*  
*Garfield Groundwater Contamination Superfund Site, New Jersey*

Analyte	Unit	Well		EPA-32-OB					
		Date Collected	6/19/2014	7/29/2014	7/29/2014	9/3/2014	10/20/2014	12/17/2014	2/5/2015
		Event	Baseline	Event 1	Event 1 - Dup	Event 2	Event 3	Event 4	Event 5
		Sample ID	EPA-32-OB-061914	EPA-32-OB-072914	D-07292014-01	EPA-32-OB-090314	EPA-32-OB-102014	GCGC-EPA-32-OB-05	EPA-32-OB-020515
	NJDEP GWQS								
Chromium , dissolved	µg/L	70	250,000	184,000	--	240,000	274,000	301,000	250,000
Chromium	µg/L	70	240,000	159,000	--	240,000	389,000	312,000	250,000
Chromium, Hexavalent (CrVI) , dissolved	µg/L	70	224,000	160,000	--	232,000	285,000	269,000	235,000
Iron , dissolved	µg/L	300	540	632	--	560	88,900	731	680
Iron	µg/L	300	690	2,040	--	1,100	105,000	2,250	2,300
Manganese , dissolved	µg/L	50	1,500	--	--	--	1,410	--	1,600
Manganese	µg/L	50	1,500	--	--	--	1,760	--	1,600
Methane , dissolved	µg/L		--	--	--	--	0.92 J	--	--
Methane	µg/L		2 U	--	--	--	--	--	2 U
Ethane	µg/L		2 U	--	--	--	--	--	2 U
Ethene	µg/L		2 U	--	--	--	--	--	2 U
ALKALINITY, TOTAL (AS CaCO3)	mg/L		1 U	--	--	--	4.4	--	1 U
Chloride (Cl)	mg/L		150	160	--	190	185	200	170
NITRATE-NITRITE (as Nitrogen)	mg/L		35	36	--	--	9.22	--	8.9
Sulfate	mg/L		200	260	--	200	169	150	200
Sulfide, Acid-Soluble	mg/L		0.01 U	0.01 U	--	0.01 U	1 U	0.02 U	0.01 U
Total Organic Carbon	mg/L		2.1	3.8	3.9	6.8	14.1	5.2	5.7
Field Parameters	Unit								
pH	s.u.		4.75	4.35	--	4.44	4.71	3.25	5.02
Temperature	°C		15.43	19.56	--	21.47	21.50	17.87	20.33
Conductivity	mS/cm		1.41	1.45	--	1.46	0.185	1.68	1.54
Oxidation-Reduction Potential	mV		474	406	--	462	375	488	419
Dissolved Oxygen <sup>a</sup>	mg/L		2.14	0.00	--	1.20	0.00	0.14	0.00
Turbidity	NTU		9.73	39.2	--	46.4	> 1,000	4.39	232
Depth to Water	ft bgs		12.40	13.01	--	14.35	15.20	12.79	13.40
Water Elevation	ft amsl		45.89	45.28	--	43.94	43.09	45.50	44.89
Observations <sup>b</sup>			Dark Yellow	Yellow	--	Yellow	Yellow-brown	Yellow - brown	Yellow, green

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NJDEP GWQS - New Jersey Department of Environmental Protection Groundwater Quality Standard  
CaCO3 - Calcium Carbonate  
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°C - degrees Celsius  
mS/cm - millisiemens per centimeter  
mV - millivolts  
NTU - Nephelometric Turbidity Units  
ft bgs - feet below ground surface  
ft amsl - feet above mean sea level

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TABLE 3

**Pilot Test Monitoring Analysis***Results of In Situ Reduction Pilot Test**Garfield Groundwater Contamination Superfund Site, New Jersey*

Analysis	Post-Injection						
	Baseline Groundwater Sampling	Grab Groundwater Sampling	Performance Monitoring Event 1	Performance Monitoring Event 2	Performance Monitoring Event 3	Performance Monitoring Event 4	Performance Monitoring Event 5
Chromium, Hexavalent (CrVI) , dissolved	X		X	X	X	X	X
Dissolved total chromium	X		X	X	X	X	X
Total chromium	X		X	X	X	X	X
Total Organic Carbon	X	X	X	X	X	X	X
Sulfide	X		X	X	X	X	X
Chloride	X		X	X	X	X	X
Sulfate	X	X	X	X	X	X	X
Nitrate	X		X		X		X
Dissolved Iron	X		X	X	X	X	X
Total Iron	X		X	X	X	X	X
Alkalinity	X				X		X
Methane	X				X		X
Dissolved Manganese	X				X		X
Total Manganese	X				X		X
Field test kits:							
Cr(VI)		X					
Ferrous Iron							
Field measurements: pH, temperature, dissolved oxygen, turbidity, conductivity, oxidation- reduction potential	X	X	X	X	X	X	X

TABLE 4  
**Pilot Test Grab Groundwater Results**  
*Results of In Situ Reduction Pilot Test*  
*Garfield Groundwater Contamination Superfund Site, New Jersey*

Analyte	Well	GW-A	GW-B	GW-C(a)	GW-C	GW-D(a)	GW-D	GW-E	GW-F	GW-G	GW-H	GW-I(a)	GW-I	GW-J					
	Date Collected	7/30/2014	7/29/2014	7/30/2014	7/29/2014	7/30/2014	7/30/2014	7/29/2014	7/30/2014	7/30/2014	7/31/2014	7/30/2014	7/31/2014	7/31/2014					
	Sample ID	GW-A-14-16	GW-B-12-14	GW-C(A)-17.5-19.5	GW-C-10.5-12.5	GW-D(A)-16-18	GW-D-13-15	GW-E-13-15	GW-E-16.5-18.5	GW-F-15-17	GW-F-21.5-23.5	GW-G-15-17	GW-G-24-26	GW-H-21-23	GW-H-26-28	GW-I(A)-21.5-23.5	GW-I-19-21	GW-J-15-17	GW-J-20-22
	Unit																		
Sulfate	mg/L	270	710	94	530	120	190	590	190	270	240	360	550	480	310	160	95	160	120
Total Organic Carbon	mg/L	9.2	14	25	5.1	12	13	26	16	36	65	250	18	200	59	21	12	17	23
<b>Field Parameter</b>	<b>Unit</b>																		
pH	s.u.	3.79	*	5.72	6.82	4.79	4.25	4.34	5.81	7.18	4.69	6.27	7.19	6.95	7.93	6.76	7.15	8.02	7.68
Temperature <sup>a</sup>	°C	18.45	*	21.88	27.15	22.30	19.43	28.01	25.64	35.03	19.90	26.44	21.98	21.25	27.01	18.34	25.98	27.73	24.74
Conductivity	mS/cm	2.02	*	1.18	1.62	1.56	1.30	1.45	1.49	1.36	0.670	1.48	2.08	1.56	1.04	0.957	0.75	0.654	1.25
Oxidation-Reduction Potential	mV	435	*	176	322	345	385	376	343	113	360	34	-210	-22	-9	-172	192	125	-300
Dissolved Oxygen <sup>b</sup>	mg/L	2.13	*	0.43	3.98	0.19	--	--	4.05	2.21	2.00	0.87	1.29	3.30	0.63	73	2.95	0.42	0.00
Turbidity <sup>c</sup>	NTU	586	*	> 1,000	--	> 1,000	> 1,000	>1,000	> 1,000	--	246	> 1,000	> 1,000	> 1,000	> 1,000	604	--	> 1,000	> 1,000
Ferrous Iron (field test)	mg/L	0.35	*	> 3.30	2.63	> 3.30	0	0	0.05	0	0.51	1.62	0	0.35	2.13	--	0	1.13	0
Hexavalent Chromium (field test) <sup>d</sup>	mg/L	> 0.70	*	> 0.70	> 0.70	> 0.70	> 0.70	> 0.70	> 0.70	> 0.70	> 0.70	0.1	0.35	0.17	> 0.70	--	> 0.70	> 0.70	0.12
Depth to Water	ft bgs	12.5	*	11.20	10.90	11.60	12.70	13.10	13.12	15.21	22.01	15.40	15.20	18.05	24.80	13.40	19.85	13.20	17.85
Observations <sup>e</sup>		Yellow	Yellow	Reddish/Yellow	White, milky	Red/Yellow	Reddish/Brown	Yellowish/Red	Reddish Brown	Light Brown	Clear/light brown	Red	Brown	Light Brown	Reddish brown	Cloudy/White	Brown	Reddish/brown	Light Brown

**Notes:**  
 -- Field parameter was not recorded at the location  
 mg/L - milligram per liter  
 s.u. - standard pH units  
 °C - degrees Celsius  
 mS/cm - millisiemens per centimeter  
 mV - millivolts  
 NTU - Nephelometric Turbidity Units  
 ft bgs - feet below ground surface  
 \* - unable to collect field parameters due to lack of water

<sup>a</sup> Increased temperatures may be due to field methodology and may not be representative of aquifer conditions, due to the grab nature in which the field parameters were collected.

<sup>b</sup> Due to equipment error in the field, dissolved oxygen measurements are inaccurate and were not used in the assessment of the Pilot Study.  
<sup>c</sup> "> 1,000" indicates turbidity measurements exceeded the limits of the field equipment.

<sup>d</sup> "> 0.70" indicates field tested hexavalent chromium measurements exceeded the limits of the field testing kit.

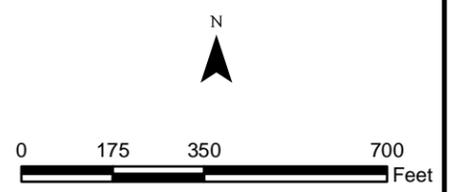
<sup>e</sup> Yellow to orange coloring is indicative of elevated concentrations of hexavalent chromium. Green coloring is indicative of elevated concentrations of trivalent chromium. Brown to red color may be indicative of elevated precipitation of iron as a result of EVO injections.

**Figures**

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- Legend**
-  E.C. Electroplating - Pilot Test Study Area
  -  Groundwater Flow Direction

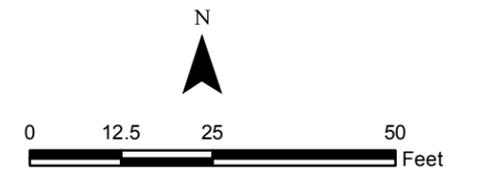


**Figure 1**  
**Site Location**  
In situ Reduction Pilot Test  
Garfield Groundwater Contamination  
Superfund Site, Garfield NJ, 07026



**Legend**

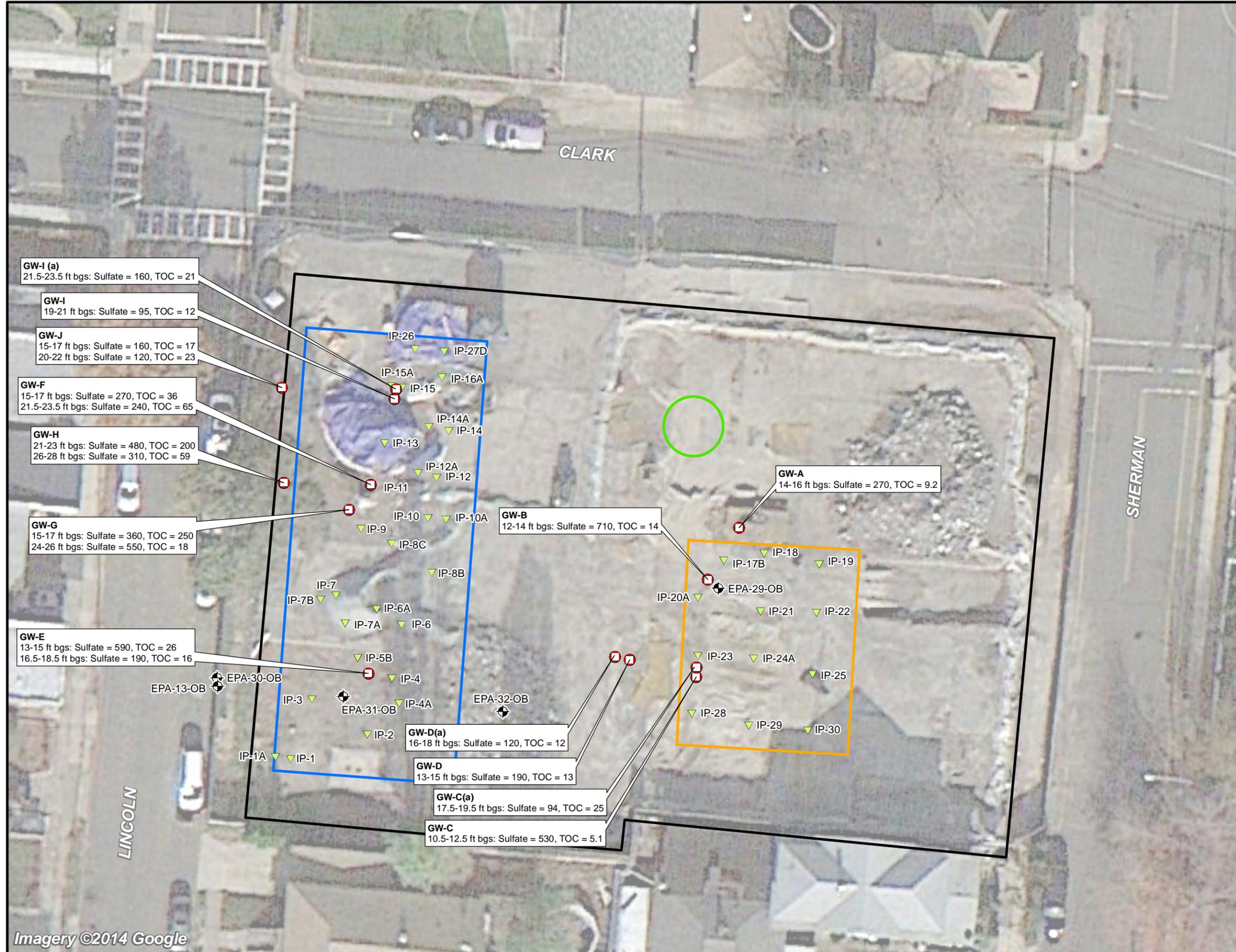
- Monitoring Well Location
- Injection Point
- Groundwater Grab Location
- Soil Sample Location – pH Titration
- E.C. Electroplating - Pilot Test Study Area
- Barrier Area
- Former Chromatic Acid Tank
- Source Area



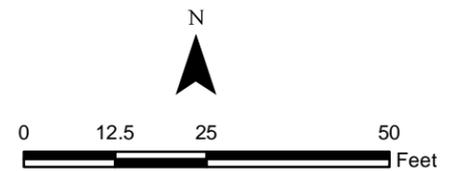
**NOTES:**  
 New Jersey State Plane Coordinate System, Horizontal Datum NAD83, US Survey Feet  
 Imagery Source: Google Earth, 2014.

**Figure 2**

**Pilot Study Site Map**  
 In situ Reduction Pilot Test  
 Garfield Groundwater Contamination  
 Superfund Site, Garfield NJ, 07026

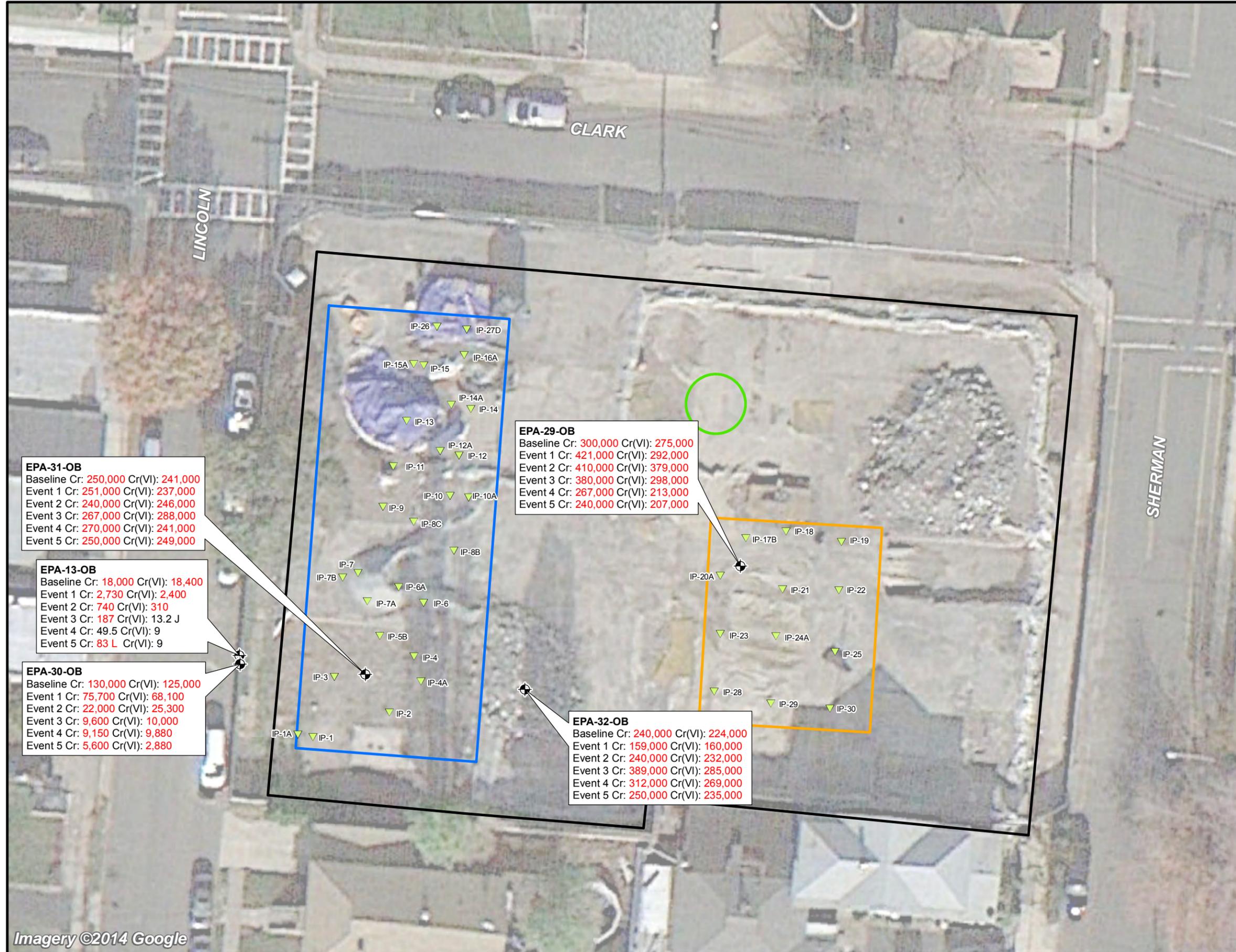


- Legend**
- Monitoring Well Location
  - Injection Point
  - Groundwater Grab Location
  - E.C. Electroplating - Pilot Test Study Area
  - Barrier Area
  - Former Chromatic Acid Tank
  - Source Area



**Notes:**  
 Grab Groundwater Samples were collected on July 29 – 31, 2014, four weeks after injections were completed.  
 mg/L = milligrams per liter.  
 ft gbs = feet below ground surface.  
 TOC = Total Organic Carbon.  
 TOC and Sulphate measured in mg/L.  
 New Jersey State Plane Coordinate System, Horizontal Datum NAD83, US Survey Feet.  
 Imagery Source: Google Earth, 2014.

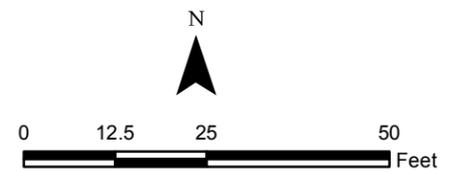
**Figure 3**  
**Grab Groundwater Sample Results**  
 In situ Reduction Pilot Test  
 Garfield Groundwater Contamination  
 Superfund Site, Garfield NJ, 07026



**Legend**

- Monitoring Well Location
- Injection Point
- E.C. Electroplating - Pilot Test Study Area
- Barrier Area
- Former Chromatic Acid Tank
- Source Area

**Sampling Schedule:**  
 Baseline – June 19, 2014  
 Event 1 – July 29-30, 2014  
 Event 2 – September 3-4, 2014  
 Event 3 – October 20-21, 2014  
 Event 4 – December 17-18, 2014  
 Event 5 – February 5-6, 2015



**Notes:**  
 Cr = Total Chromium.  
 Cr(VI) = Hexavalent Chromium.  
 J = The identification of the analyte is acceptable; the reported value is an estimate.  
 NJDEP GWQS = New Jersey Department of Environmental Protection Groundwater Quality Standards.  
 Hexavalent/Total Chromium concentrations given in micrograms per liter (µg/L)  
 Concentrations shown in red are exceedances of the NJDEP GWQS for Total Cr = 70 µg/L and Hexavalent Cr = 70 µg/L.  
 New Jersey State Plane Coordinate System, Horizontal Datum NAD83, US Survey Feet  
 Imagery Source: Google Earth, 2014.

**EPA-31-OB**  
 Baseline Cr: 250,000 Cr(VI): 241,000  
 Event 1 Cr: 251,000 Cr(VI): 237,000  
 Event 2 Cr: 240,000 Cr(VI): 246,000  
 Event 3 Cr: 267,000 Cr(VI): 288,000  
 Event 4 Cr: 270,000 Cr(VI): 241,000  
 Event 5 Cr: 250,000 Cr(VI): 249,000

**EPA-13-OB**  
 Baseline Cr: 18,000 Cr(VI): 18,400  
 Event 1 Cr: 2,730 Cr(VI): 2,400  
 Event 2 Cr: 740 Cr(VI): 310  
 Event 3 Cr: 187 Cr(VI): 13.2 J  
 Event 4 Cr: 49.5 Cr(VI): 9  
 Event 5 Cr: 83 L Cr(VI): 9

**EPA-30-OB**  
 Baseline Cr: 130,000 Cr(VI): 125,000  
 Event 1 Cr: 75,700 Cr(VI): 68,100  
 Event 2 Cr: 22,000 Cr(VI): 25,300  
 Event 3 Cr: 9,600 Cr(VI): 10,000  
 Event 4 Cr: 9,150 Cr(VI): 9,880  
 Event 5 Cr: 5,600 Cr(VI): 2,880

**EPA-29-OB**  
 Baseline Cr: 300,000 Cr(VI): 275,000  
 Event 1 Cr: 421,000 Cr(VI): 292,000  
 Event 2 Cr: 410,000 Cr(VI): 379,000  
 Event 3 Cr: 380,000 Cr(VI): 298,000  
 Event 4 Cr: 267,000 Cr(VI): 213,000  
 Event 5 Cr: 240,000 Cr(VI): 207,000

**EPA-32-OB**  
 Baseline Cr: 240,000 Cr(VI): 224,000  
 Event 1 Cr: 159,000 Cr(VI): 160,000  
 Event 2 Cr: 240,000 Cr(VI): 232,000  
 Event 3 Cr: 389,000 Cr(VI): 285,000  
 Event 4 Cr: 312,000 Cr(VI): 269,000  
 Event 5 Cr: 250,000 Cr(VI): 235,000

**Figure 4**  
**Total/Hexavalent Chromium Results – Performance Monitoring**  
 In situ Reduction Pilot Test  
 Garfield Groundwater Contamination Superfund Site, Garfield NJ, 07026

FIGURE 5

**Total Organic Carbon Concentration Trends in Groundwater**

*Results of In Situ Reduction Pilot Test*

*Garfield Groundwater Contamination Superfund Site, New Jersey*

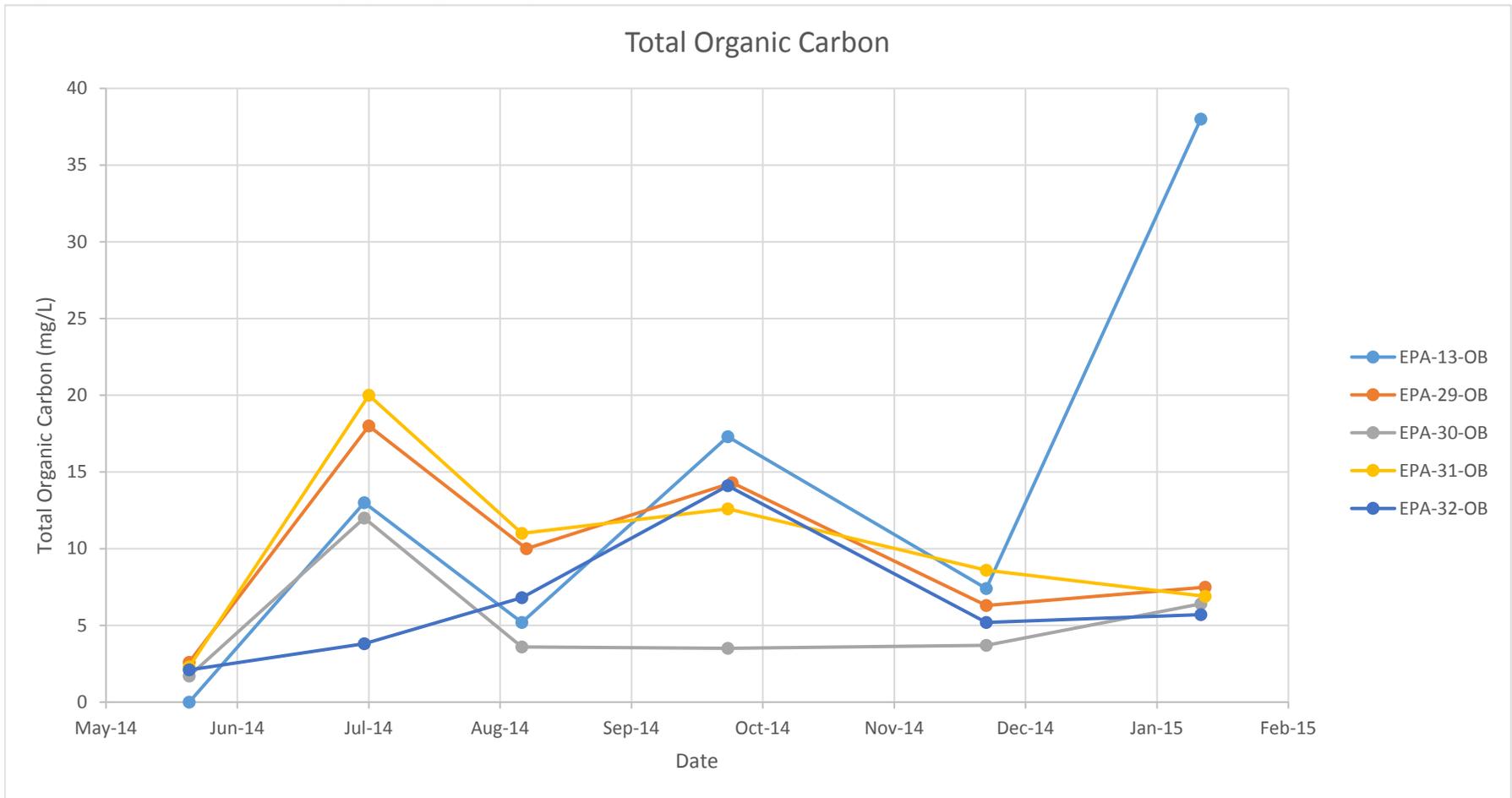


FIGURE 6

**Sulfate Concentration Trends in Groundwater**

*Results of In Situ Reduction Pilot Test*

*Garfield Groundwater Contamination Superfund Site, New Jersey*

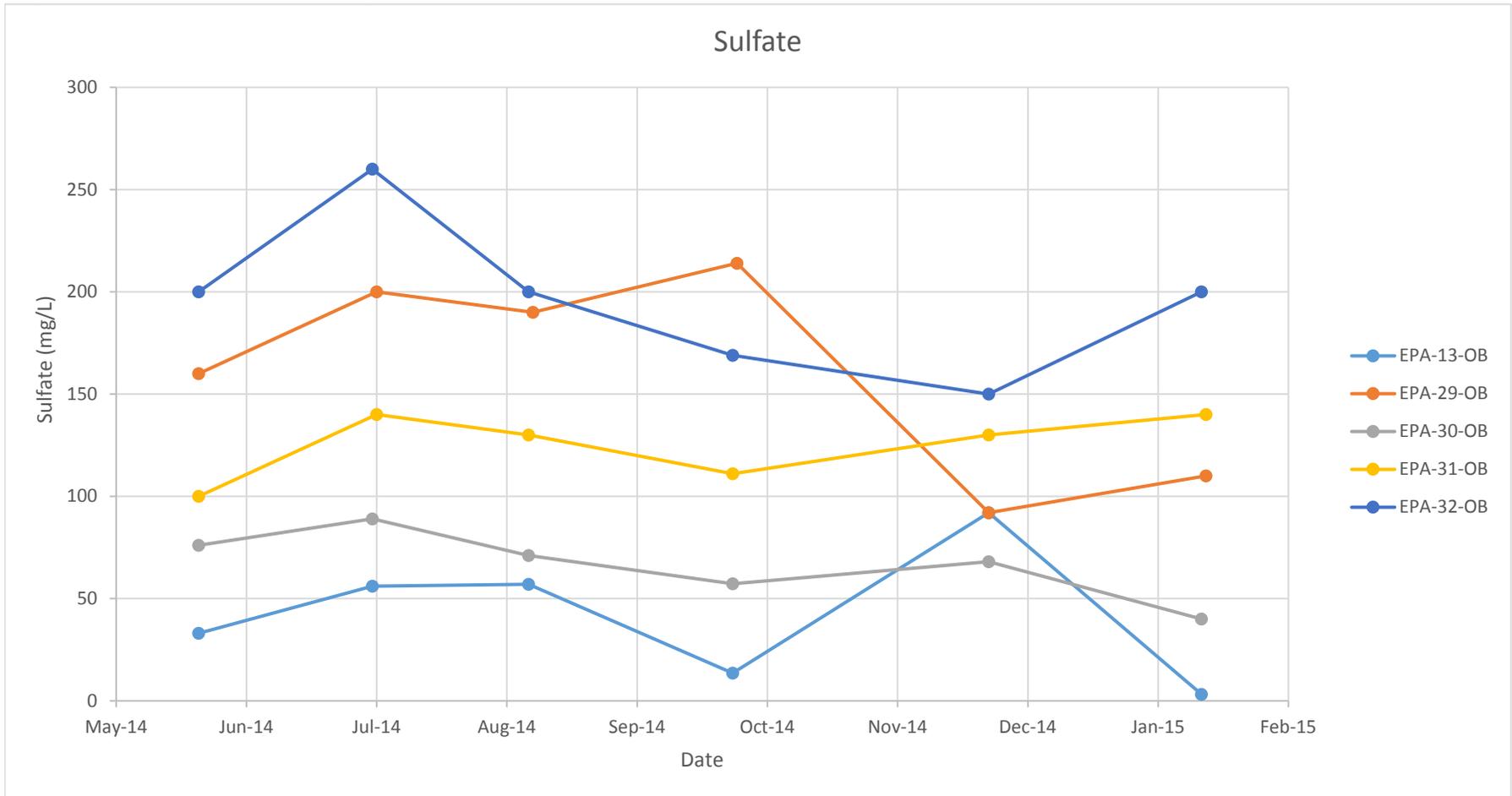


FIGURE 7

**Hexavalent Chromium Concentration Trends in Groundwater - Source Area and within Treatment Barrier**

*Results of In Situ Reduction Pilot Test*

*Garfield Groundwater Contamination Superfund Site, New Jersey*

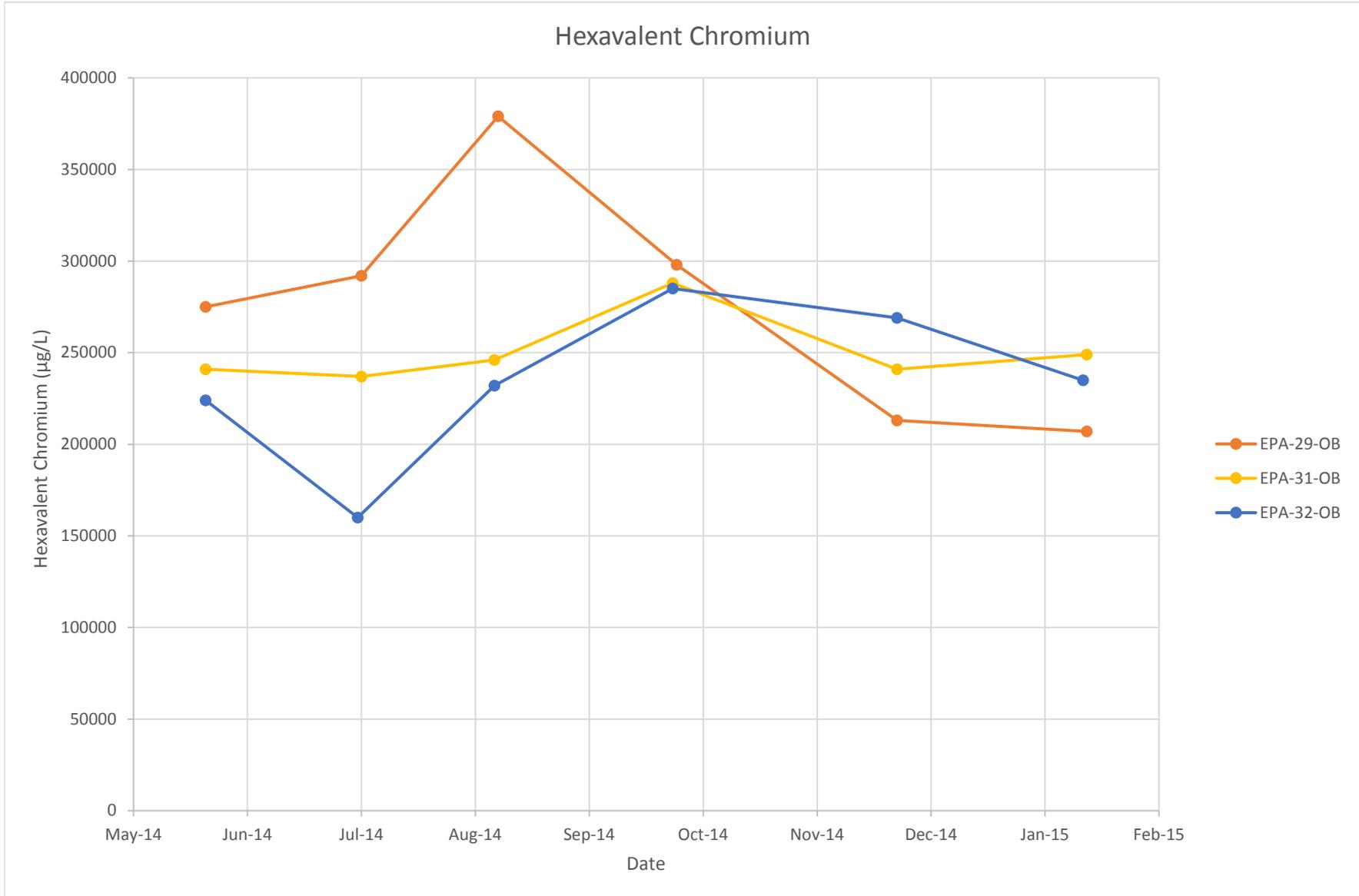
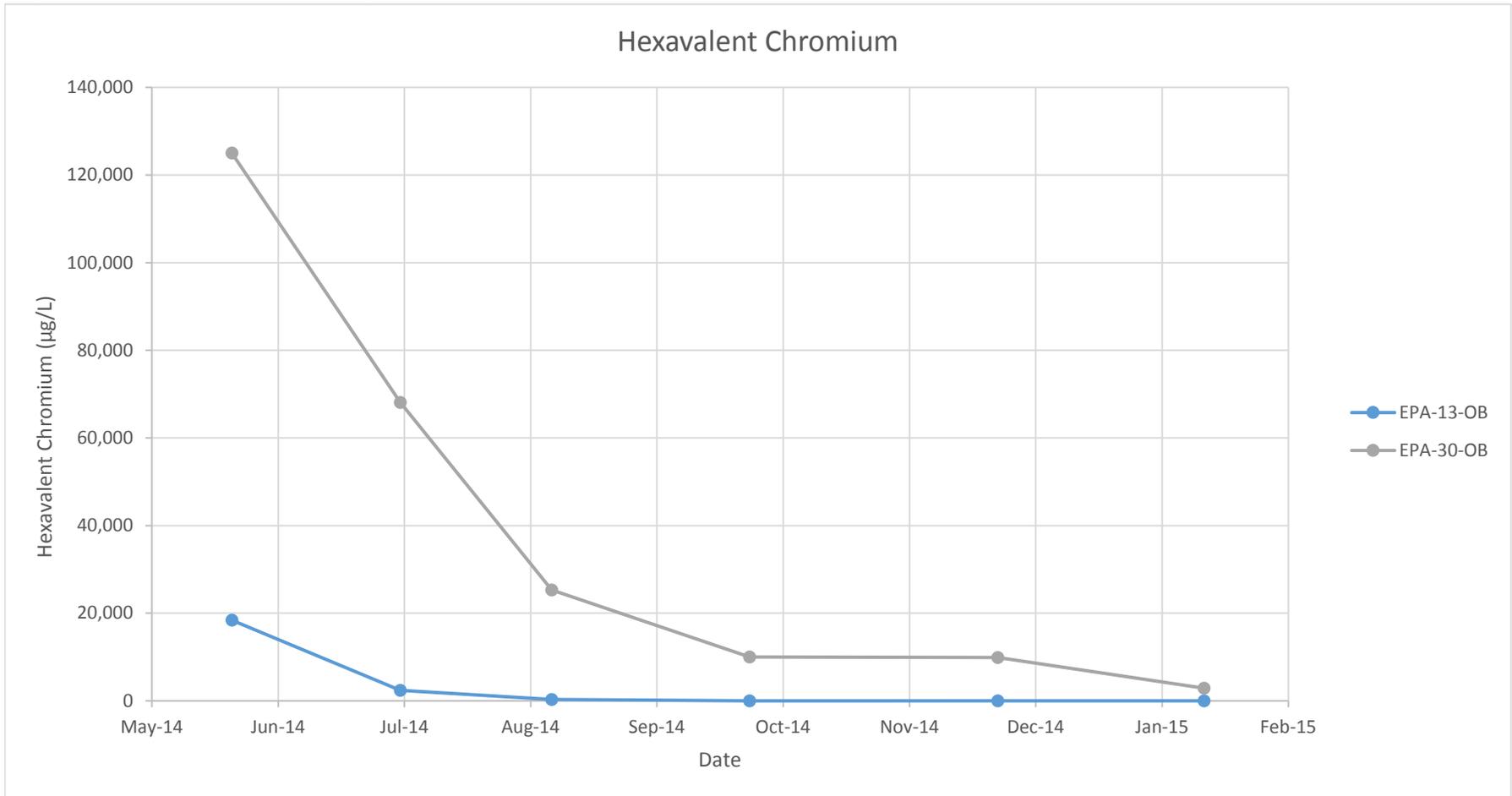


FIGURE 8  
**Hexavalent Chromium Concentration Trends in Groundwater - Downgradient of Treatment Barrier**  
*Results of In Situ Reduction Pilot Test*  
*Garfield Groundwater Contamination Superfund Site, New Jersey*



**Attachment 1**  
**Well Permits**

---

**WELL PERMIT**

The New Jersey Department of Environmental Protection grants this permit in accordance with your application, attachments accompanying same application, and applicable laws and regulations. This permit is also subject to further conditions and stipulations enumerated in the supporting documents which are agreed to by the permittee upon acceptance of the permit

**Certifying Driller:** MICHAEL ELLINGWORTH, JOURNEYMAN LICENSE # 0002725

**Permit Issued to:** PARRATT-WOLFF INC

**Company Address:** PO BOX 56 5879 FISHER RD EAST SYRACUSE, NY 13057

**PROPERTY OWNER**

Name: ANDREW PAVLICA

Organization: City of Garfield

Address: 111 Outwater Lane

City: Garfield City State: New Jersey Zip Code: 07026

**PROPOSED WELL LOCATION**

Facility Name: Garfield Groundwater Contamination Superfund Site

Address: Lincoln Place

County: Bergen Municipality: Garfield City Lot: ROW Block: ROW

Easting (X): 601872 Northing (Y): 742961  
Coordinate System: NJ State Plane (NAD83) - USFEET

**Local ID:** EPA-30-OB

**SITE CHARACTERISTICS**

**PROPOSED CONSTRUCTION**

**WELL USE:** MONITORING

Other Use(s): \_\_\_\_\_

Diameter (in.): 2

Regulatory Program

Requiring Wells/Borings: \_\_\_\_\_

Depth (ft.): 27

Case ID Number: \_\_\_\_\_

Pump Capacity (gpm): 0

Deviation Requested: N

Drilling Method: Hollow Stem Augers

Attachments: \_\_\_\_\_

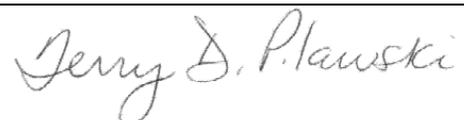
**SPECIFIC CONDITIONS/REQUIREMENTS**

**Approval Date:** May 15, 2014

**Expiration Date:** May 15, 2015

Approved by the authority of:

Bob Martin  
Commissioner



Terry Pilawski, Chief  
Bureau of Water Allocation and Well Permitting

**WELL PERMIT**

<b>DEVIATION INFORMATION</b>	
Purpose:	
Unusual Conditions:	
Reason for Deviation:	
Proposed Well Construction	

<b>GENERAL CONDITIONS/REQUIREMENTS</b>
A copy of this permit shall be kept at the worksite / on the property and shall be exhibited upon request. [N.J.A.C. 7:9D-1]
A well record must be submitted by the well driller to the Bureau of Water Systems and Well Permitting. Unless prior written approval is obtained from the Bureau of Water Systems and Well Permitting the well record shall be submitted electronically through the New Jersey Department of Environmental Protection's Regulatory Services Portal Submit Well Record: within ninety (90) days after the well is completed.[N.J.A.C. 7:9D-1]
All well drilling/pump installation activities shall comply with N.J.A.C. 7:9D-1 et seq. [N.J.A.C. 7:9D-1]
For this permit to remain valid, the well approved in this permit shall be constructed within one year of the effective date of the permit. [N.J.A.C. 7:9D-1]
If the pump capacity applied for is less than 70 gpm, no subsequent increase to 70 gpm or more shall be made without prior approval of the Bureau of Water Systems and Well Permitting. [N.J.A.C. 7:9D-1]
If the use of the well is to be changed a well permit for the proposed use of the well shall be submitted for review and approval. [N.J.A.C. 7:9D-1]
If you or a future property owner intend to redesignate this well as a Category 1 well (domestic, non-public, community water supply or public non-community water supply wells), the well must be constructed as a Category 1 well per the Well Construction and Abandonment Regulations at N.J.A.C. 7:0D-1.1 et seq. In addition, if the current or future property owner intends to have this well redesignated as a community water supply well, the well must be constructed by a Master well driller, which would include having a Master well driller on-site at all times during construction of the well, as specified in the Well Construction and Abandonment Regulations. Otherwise, the New Jersey Department of Environmental Protection will not allow the well to be redesignated, and a new well would have to be installed. [N.J.A.C. 7:9D-1.7((a)1i)]
In accepting this permit the Property Owner and Driller agree to abide by the following terms and conditions [N.J.A.C. 7:9D-1]
In the event that this well is not constructed the well driller shall notify the Bureau of Water Systems and Well Permitting of the permit cancellation. Unless prior written approval is obtained from the Bureau of Water Systems and Well Permitting the Cancellation notification shall be submitted electronically through the New Jersey Department of Environmental Protection's Regulatory Services Portal Submit Well Permit Cancellation : by the expiration date of this permit.[N.J.A.C. 7:9D-1]
In the event this well is abandoned, the Owner or Well driller shall assume full responsibility for having the well decommissioned in a manner satisfactory to the New Jersey Department of Environmental Protection in accordance with the provisions of N.J.A.C. 7:9D-1 et seq. [N.J.A.C. 7:9D-1]
The granting of this permit shall not be construed in any way to affect the title or ownership of property, and shall not make the New Jersey Department of Environmental Protection or the State a party in any suit or question of ownership of property. [N.J.A.C. 7:9D-1]
The issuance of this permit shall not be deemed to affect in any way action by the New Jersey Department of Environmental Protection on any future application. [N.J.A.C. 7:9D-1]
This permit conveys no rights, either expressed, or implied to divert water. [N.J.A.C. 7:9D-1]
This permit does not waive the obtaining of Federal or other State or local Government consent when necessary. This permit is not valid and no work shall be undertaken until such time as all other required approvals and permits have been obtained. [N.J.A.C. 7:9D-1]
This permit is NONTRANSFERABLE [N.J.A.C. 7:9D]
This well shall not be used for the supply of potable / drinking water. [N.J.A.C. 7:9D-1]

**WELL PERMIT**

The New Jersey Department of Environmental Protection grants this permit in accordance with your application, attachments accompanying same application, and applicable laws and regulations. This permit is also subject to further conditions and stipulations enumerated in the supporting documents which are agreed to by the permittee upon acceptance of the permit

**Certifying Driller:** MICHAEL ELLINGWORTH, JOURNEYMAN LICENSE # 0002725

**Permit Issued to:** PARRATT-WOLFF INC

**Company Address:** PO BOX 56 5879 FISHER RD EAST SYRACUSE, NY 13057

**PROPERTY OWNER**

Name: MARY PETTIT (CALDERIO)

Organization: Property Owner

Address: 115 Sherman Place

City: Garfield City State: New Jersey Zip Code: 07026

**PROPOSED WELL LOCATION**

Facility Name: Garfield Groundwater Contamination Superfund Site

Address: 97 Sherman Place

County: Bergen Municipality: Garfield City Lot: 15 Block: 38.01

Easting (X): 601986 Northing (Y): 743001  
Coordinate System: NJ State Plane (NAD83) - USFEET

**Local ID:** EPA-29-OB

**SITE CHARACTERISTICS**

**PROPOSED CONSTRUCTION**

**WELL USE:** MONITORING

Other Use(s): \_\_\_\_\_

Diameter (in.): 2

Regulatory Program

Requiring Wells/Borings: \_\_\_\_\_

Depth (ft.): 27

Case ID Number: \_\_\_\_\_

Pump Capacity (gpm): 0

Deviation Requested: N

Drilling Method: Hollow Stem Augers

Attachments: \_\_\_\_\_

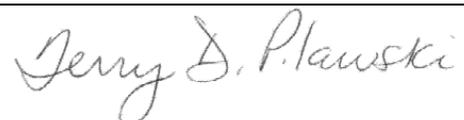
**SPECIFIC CONDITIONS/REQUIREMENTS**

**Approval Date:** May 15, 2014

**Expiration Date:** May 15, 2015

Approved by the authority of:

Bob Martin  
Commissioner



Terry Pilawski, Chief  
Bureau of Water Allocation and Well Permitting

**WELL PERMIT**

<b>DEVIATION INFORMATION</b>	
Purpose:	
Unusual Conditions:	
Reason for Deviation:	
Proposed Well Construction	

<b>GENERAL CONDITIONS/REQUIREMENTS</b>
A copy of this permit shall be kept at the worksite / on the property and shall be exhibited upon request. [N.J.A.C. 7:9D-1]
A well record must be submitted by the well driller to the Bureau of Water Systems and Well Permitting. Unless prior written approval is obtained from the Bureau of Water Systems and Well Permitting the well record shall be submitted electronically through the New Jersey Department of Environmental Protection's Regulatory Services Portal Submit Well Record: within ninety (90) days after the well is completed.[N.J.A.C. 7:9D-1]
All well drilling/pump installation activities shall comply with N.J.A.C. 7:9D-1 et seq. [N.J.A.C. 7:9D-1]
For this permit to remain valid, the well approved in this permit shall be constructed within one year of the effective date of the permit. [N.J.A.C. 7:9D-1]
If the pump capacity applied for is less than 70 gpm, no subsequent increase to 70 gpm or more shall be made without prior approval of the Bureau of Water Systems and Well Permitting. [N.J.A.C. 7:9D-1]
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**PROPERTY OWNER**

Name: MARY PETTIT (CALDERIO)

Organization: Property Owner

Address: 115 Sherman Place

City: Garfield City State: New Jersey Zip Code: 07026

**PROPOSED WELL LOCATION**

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Address: 194 Lincoln Place

County: Bergen Municipality: Garfield City Lot: 8 Block: 38.01

Easting (X): 601905 Northing (Y): 742957  
Coordinate System: NJ State Plane (NAD83) - USFEET

**Local ID:** EPA-31-OB

**SITE CHARACTERISTICS**

**PROPOSED CONSTRUCTION**

**WELL USE:** MONITORING

Other Use(s): \_\_\_\_\_

Diameter (in.): 2

Regulatory Program

Requiring Wells/Borings: \_\_\_\_\_

Depth (ft.): 27

Case ID Number: \_\_\_\_\_

Pump Capacity (gpm): 0

Deviation Requested: N

Drilling Method: Hollow Stem Augers

Attachments: \_\_\_\_\_

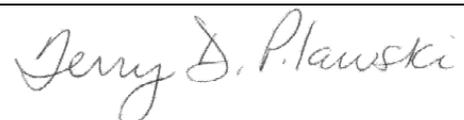
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Bob Martin  
Commissioner



Terry Pilawski, Chief  
Bureau of Water Allocation and Well Permitting

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In the event that this well is not constructed the well driller shall notify the Bureau of Water Systems and Well Permitting of the permit cancellation. Unless prior written approval is obtained from the Bureau of Water Systems and Well Permitting the Cancellation notification shall be submitted electronically through the New Jersey Department of Environmental Protection's Regulatory Services Portal Submit Well Permit Cancellation : by the expiration date of this permit.[N.J.A.C. 7:9D-1]
In the event this well is abandoned, the Owner or Well driller shall assume full responsibility for having the well decommissioned in a manner satisfactory to the New Jersey Department of Environmental Protection in accordance with the provisions of N.J.A.C. 7:9D-1 et seq. [N.J.A.C. 7:9D-1]
The granting of this permit shall not be construed in any way to affect the title or ownership of property, and shall not make the New Jersey Department of Environmental Protection or the State a party in any suit or question of ownership of property. [N.J.A.C. 7:9D-1]
The issuance of this permit shall not be deemed to affect in any way action by the New Jersey Department of Environmental Protection on any future application. [N.J.A.C. 7:9D-1]
This permit conveys no rights, either expressed, or implied to divert water. [N.J.A.C. 7:9D-1]
This permit does not waive the obtaining of Federal or other State or local Government consent when necessary. This permit is not valid and no work shall be undertaken until such time as all other required approvals and permits have been obtained. [N.J.A.C. 7:9D-1]
This permit is NONTRANSFERABLE [N.J.A.C. 7:9D]
This well shall not be used for the supply of potable / drinking water. [N.J.A.C. 7:9D-1]

**WELL PERMIT**

The New Jersey Department of Environmental Protection grants this permit in accordance with your application, attachments accompanying same application, and applicable laws and regulations. This permit is also subject to further conditions and stipulations enumerated in the supporting documents which are agreed to by the permittee upon acceptance of the permit

**Certifying Driller:** MICHAEL ELLINGWORTH, JOURNEYMAN LICENSE # 0002725

**Permit Issued to:** PARRATT-WOLFF INC

**Company Address:** PO BOX 56 5879 FISHER RD EAST SYRACUSE, NY 13057

**PROPERTY OWNER**

Name: MARY PETTIT (CALDERIO)

Organization: Property Owner

Address: 115 Sherman Place

City: Garfield City State: New Jersey Zip Code: 07026

**PROPOSED WELL LOCATION**

Facility Name: Garfield Groundwater Contamination Superfund Site

Address: 97 Sherman Place

County: Bergen Municipality: Garfield City Lot: 9 Block: 38.01

Easting (X): 601954 Northing (Y): 742955  
Coordinate System: NJ State Plane (NAD83) - USFEET

**Local ID:** EPA-32-OB

**SITE CHARACTERISTICS**

**PROPOSED CONSTRUCTION**

**WELL USE:** MONITORING

Other Use(s): \_\_\_\_\_

Diameter (in.): 2

Regulatory Program

Requiring Wells/Borings: \_\_\_\_\_

Depth (ft.): 27

Case ID Number: \_\_\_\_\_

Pump Capacity (gpm): 0

Deviation Requested: N

Drilling Method: Hollow Stem Augers

Attachments: \_\_\_\_\_

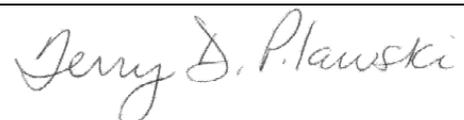
**SPECIFIC CONDITIONS/REQUIREMENTS**

**Approval Date:** May 16, 2014

**Expiration Date:** May 16, 2015

Approved by the authority of:

Bob Martin  
Commissioner



Terry Pilawski, Chief  
Bureau of Water Allocation and Well Permitting

**WELL PERMIT**

<b>DEVIATION INFORMATION</b>	
Purpose:	
Unusual Conditions:	
Reason for Deviation:	
Proposed Well Construction	

<b>GENERAL CONDITIONS/REQUIREMENTS</b>
A copy of this permit shall be kept at the worksite / on the property and shall be exhibited upon request. [N.J.A.C. 7:9D-1]
A well record must be submitted by the well driller to the Bureau of Water Systems and Well Permitting. Unless prior written approval is obtained from the Bureau of Water Systems and Well Permitting the well record shall be submitted electronically through the New Jersey Department of Environmental Protection's Regulatory Services Portal Submit Well Record: within ninety (90) days after the well is completed.[N.J.A.C. 7:9D-1]
All well drilling/pump installation activities shall comply with N.J.A.C. 7:9D-1 et seq. [N.J.A.C. 7:9D-1]
For this permit to remain valid, the well approved in this permit shall be constructed within one year of the effective date of the permit. [N.J.A.C. 7:9D-1]
If the pump capacity applied for is less than 70 gpm, no subsequent increase to 70 gpm or more shall be made without prior approval of the Bureau of Water Systems and Well Permitting. [N.J.A.C. 7:9D-1]
If the use of the well is to be changed a well permit for the proposed use of the well shall be submitted for review and approval. [N.J.A.C. 7:9D-1]
If you or a future property owner intend to redesignate this well as a Category 1 well (domestic, non-public, community water supply or public non-community water supply wells), the well must be constructed as a Category 1 well per the Well Construction and Abandonment Regulations at N.J.A.C. 7:0D-1.1 et seq. In addition, if the current or future property owner intends to have this well redesignated as a community water supply well, the well must be constructed by a Master well driller, which would include having a Master well driller on-site at all times during construction of the well, as specified in the Well Construction and Abandonment Regulations. Otherwise, the New Jersey Department of Environmental Protection will not allow the well to be redesignated, and a new well would have to be installed. [N.J.A.C. 7:9D-1.7((a))1i]
In accepting this permit the Property Owner and Driller agree to abide by the following terms and conditions [N.J.A.C. 7:9D-1]
In the event that this well is not constructed the well driller shall notify the Bureau of Water Systems and Well Permitting of the permit cancellation. Unless prior written approval is obtained from the Bureau of Water Systems and Well Permitting the Cancellation notification shall be submitted electronically through the New Jersey Department of Environmental Protection's Regulatory Services Portal Submit Well Permit Cancellation : by the expiration date of this permit.[N.J.A.C. 7:9D-1]
In the event this well is abandoned, the Owner or Well driller shall assume full responsibility for having the well decommissioned in a manner satisfactory to the New Jersey Department of Environmental Protection in accordance with the provisions of N.J.A.C. 7:9D-1 et seq. [N.J.A.C. 7:9D-1]
The granting of this permit shall not be construed in any way to affect the title or ownership of property, and shall not make the New Jersey Department of Environmental Protection or the State a party in any suit or question of ownership of property. [N.J.A.C. 7:9D-1]
The issuance of this permit shall not be deemed to affect in any way action by the New Jersey Department of Environmental Protection on any future application. [N.J.A.C. 7:9D-1]
This permit conveys no rights, either expressed, or implied to divert water. [N.J.A.C. 7:9D-1]
This permit does not waive the obtaining of Federal or other State or local Government consent when necessary. This permit is not valid and no work shall be undertaken until such time as all other required approvals and permits have been obtained. [N.J.A.C. 7:9D-1]
This permit is NONTRANSFERABLE [N.J.A.C. 7:9D]
This well shall not be used for the supply of potable / drinking water. [N.J.A.C. 7:9D-1]

**Attachment 2**  
**Survey Data**

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# Borbas Surveying & Mapping, LLC

402 Main Street, Boonton, New Jersey 07005 Phone (973) 316-8743 Fax (973) 402-6627 www.borbas.com

## MONITORING WELL CHART

Garfield Groundwater Contamination Superfund Site  
 125 Clark Street  
 Garfield, New Jersey 07026  
 July 15, 2014

Monitor Well ID	Grade Elev	Outer Casing	Inner Casing	Northing	Easting	Latitude North	Longitude West	Survey Date
EPA-29-OB	58.6	58.56	58.23	742985.6	602009.5	40°52'20.89"	74°06'09.51"	7/15/2014
EPA-30-OB	55.9	55.86	55.50	742960.1	601879.0	40°52'20.65"	74°06'11.21"	7/15/2014
EPA-31-OB	56.7	56.71	56.31	742957.4	601911.7	40°52'20.62"	74°06'10.78"	7/15/2014
EPA-32-OB	58.7	58.67	58.29	742953.5	601953.3	40°52'20.58"	74°06'10.24"	7/15/2014
IP-1	56.0	-	-	742941.1	601898.0	40°52'20.46"	74°06'10.96"	7/15/2014
IP-1A	55.8	-	-	742941.7	601894.1	40°52'20.46"	74°06'11.01"	7/15/2014
IP-2	56.4	-	-	742947.5	601918.0	40°52'20.52"	74°06'10.70"	7/15/2014
IP-3	56.5	-	-	742956.7	601903.6	40°52'20.61"	74°06'10.89"	7/15/2014
IP-4	57.0	-	-	742962.1	601924.4	40°52'20.66"	74°06'10.62"	7/15/2014
IP-4A	56.7	-	-	742955.6	601926.2	40°52'20.60"	74°06'10.60"	7/15/2014
IP-5B	56.8	-	-	742967.4	601915.5	40°52'20.72"	74°06'10.73"	7/15/2014
IP-6	58.7	-	-	742976.0	601926.9	40°52'20.80"	74°06'10.59"	7/15/2014
IP-6A	58.8	-	-	742980.1	601920.4	40°52'20.84"	74°06'10.67"	7/15/2014
IP-7	58.8	-	-	742983.7	601909.8	40°52'20.88"	74°06'10.81"	7/15/2014
IP-7A	58.8	-	-	742976.4	601912.2	40°52'20.81"	74°06'10.78"	7/15/2014
IP-7B	58.8	-	-	742982.6	601905.8	40°52'20.87"	74°06'10.86"	7/15/2014
IP-8B	58.6	-	-	742989.6	601934.8	40°52'20.94"	74°06'10.48"	7/15/2014
IP-8C	58.5	-	-	742997.1	601924.3	40°52'21.01"	74°06'10.62"	7/15/2014
IP-9	58.4	-	-	743001.0	601916.3	40°52'21.05"	74°06'10.72"	7/15/2014
IP-10	58.5	-	-	743003.8	601933.8	40°52'21.08"	74°06'10.49"	7/15/2014
IP-10A	58.4	-	-	743003.4	601938.6	40°52'21.07"	74°06'10.43"	7/15/2014
IP-11	58.3	-	-	743011.5	601919.0	40°52'21.15"	74°06'10.69"	7/15/2014
IP-12	58.3	-	-	743014.3	601936.1	40°52'21.18"	74°06'10.46"	7/15/2014
IP-12A	58.3	-	-	743015.5	601931.2	40°52'21.19"	74°06'10.53"	7/15/2014
IP-13	58.1	-	-	743023.3	601922.5	40°52'21.27"	74°06'10.64"	7/15/2014

Monitor Well ID	Grade Elev	Outer Casing	Inner Casing	Northing	Easting	Latitude North	Longitude West	Survey Date
IP-14	58.1	-	-	743026.4	601939.2	40°52'21.30"	74°06'10.42"	7/15/2014
IP-14A	58.1	-	-	743027.5	601934.1	40°52'21.31"	74°06'10.49"	7/15/2014
IP-15	58.1	-	-	743037.7	601927.0	40°52'21.41"	74°06'10.58"	7/15/2014
IP-15A	58.1	-	-	743038.1	601924.3	40°52'21.42"	74°06'10.62"	7/15/2014
IP-16A	58.1	-	-	743040.4	601937.5	40°52'21.44"	74°06'10.44"	7/15/2014
IP-17B	58.5	-	-	742992.8	602010.9	40°52'20.96"	74°06'09.49"	7/15/2014
IP-18	58.5	-	-	742994.6	602021.4	40°52'20.98"	74°06'09.36"	7/15/2014
IP-19	58.6	-	-	742991.8	602035.8	40°52'20.95"	74°06'09.17"	7/15/2014
IP-20A	58.6	-	-	742983.1	602004.2	40°52'20.87"	74°06'09.58"	7/15/2014
IP-21	58.6	-	-	742979.5	602020.5	40°52'20.83"	74°06'09.37"	7/15/2014
IP-22	58.7	-	-	742979.2	602035.1	40°52'20.83"	74°06'09.18"	7/15/2014
IP-23	58.7	-	-	742967.9	602004.2	40°52'20.72"	74°06'09.58"	7/15/2014
IP-24A	58.7	-	-	742967.3	602018.7	40°52'20.71"	74°06'09.39"	7/15/2014
IP-25	58.8	-	-	742963.2	602034.1	40°52'20.67"	74°06'09.19"	7/15/2014
IP-26	58.1	-	-	743047.8	601930.4	40°52'21.51"	74°06'10.54"	7/15/2014
IP-27D	58.1	-	-	743047.1	601938.1	40°52'21.50"	74°06'10.44"	7/15/2014
IP-28	58.8	-	-	742952.9	602002.6	40°52'20.57"	74°06'09.60"	7/15/2014
IP-29	58.7	-	-	742949.8	602017.4	40°52'20.54"	74°06'09.41"	7/15/2014
IP-30	58.8	-	-	742948.5	602032.8	40°52'20.53"	74°06'09.21"	7/15/2014

Notes:

1. The horizontal datum is the New Jersey State Plane Coordinate System NAD83 determined by differential GPS observations from the NGS CORS Network on July 25, 2012. Reference Stations: NJI2, NJTP, NYVH .
2. The vertical datum is the North American Vertical Datum of 1988 (NAVD88) GEOID09 verified by differential GPS observation from the NGS CORS Network on July 25, 2012. New Jersey Geodetic Control Survey Monument # 9818 (NAVD88 Elevation = 28.7372') was held. NJGCS monument elevation was converted using US Army Corps of Engineers Corpscon Software version 6.0.1.
3. All coordinates and elevations shown hereon are in U.S. Survey Feet.

John D. Beattie, P.L.S.  
 NJGS 24GS04331900  
 July 15, 2014

**Attachment 3**  
**Boring Logs, Well Completion Diagrams, and**  
**Development Forms**

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**Project No:** WA-120

**Project:** EC Electroplating

**Client:** EPA/ERT

**Location:** Lincoln Place/Clark Street, Garfield, NJ

## Log of Well: EPA-13-OB

**Northing (ft):** 742962.30 **Elevation (ft AMSL):** 55.54

**Easting (ft):** 601878.85 **Logged By:** J. Bolduc

SUBSURFACE PROFILE				SAMPLE			FID/PID Concentration ppmv 3 9 15 21 27 33	VOC Concentration ug/L 5 15 25 35 45 55	Well Completion Details
Depth	Symbol	Description	Elev.	Number	Type	Recovery			
0		Ground Surface	55.74						
0-7		Drilex cleared borehole of underground utilities to a depth of 7 feet. Cuttings not logged during utility clearance.							
7		<b>CLAY (CL)</b> Weak red, some fine to coarse sand, little coarse angular gravel, moist.	48.74						
10		<b>GRAVEL (GW)</b> Weak red, fine to coarse angular sandstone gravel, some fine to coarse sand, some silt and clay, sandstone cobble at 14 feet, moist to damp.	45.74						
15		<b>SAND (SW)</b> Weak red, fine to coarse grained, and fine to coarse subangular sandstone gravel, trace sandstone cobbles, wet at 16 feet.	40.74						
16-25									
25									

Drill Method: Rotary Sonic

Start Date: 2/28/11

Hole Size: 6-inch

Lockheed Martin/SERAS  
2890 Woodbridge Avenue  
Building 209 Annex  
Edison, NJ 08837

Drill Company: Boart Longyear

End Date: 2/28/11

Sheet: 1 of 2

**Project No:** WA-120

**Project:** EC Electroplating

**Client:** EPA/ERT

**Location:** Lincoln Place/Clark Street, Garfield, NJ

## Log of Well: EPA-13-OB

**Northing (ft):** 742962.30 **Elevation (ft AMSL):** 55.54

**Easting (ft):** 601878.85 **Logged By:** J. Bolduc

SUBSURFACE PROFILE				SAMPLE			FID/PID Concentration ppmv 3 9 15 21 27 33	VOC Concentration ug/L 5 15 25 35 45 55	Well Completion Details
Depth	Symbol	Description	Elev.	Number	Type	Recovery			
26	8		28.74					<p>2-inch ID Schedule 40 PVC 0.01 Slot</p> <p>Bentonite Grout</p>	
27		<b>BEDROCK (MUDSTONE)</b> Grayish red, clayey, highly weathered, pulverized zone, dry to wet at 30.5 to 31.5 feet.							
28									
29	9								
30									
31									
32			23.74						
33	10	<b>BEDROCK (SANDSTONE)</b> Grayish red, fine grained, micaceous, massive, dry.							
34									
35		End of Borehole	20.74						
36	11								
37									
38									
39	12								
40									
41									
42	13								
43									
44									
45	14								
46									
47									
48	15								
49									
50									

Drill Method: Rotary Sonic

Start Date: 2/28/11

Hole Size: 6-inch

Lockheed Martin/SERAS  
2890 Woodbridge Avenue  
Building 209 Annex  
Edison, NJ 08837

Drill Company: Boart Longyear

End Date: 2/28/11

Sheet: 2 of 2





<b>PROJECT NUMBER:</b> <b>431007</b>	<b>BORING NUMBER:</b> <b>EPA-29-OB</b>	<b>SHEET 1 OF 1</b>
<b>SOIL BORING LOG</b>		

PROJECT : Garfield Groundwater Contamination Superfund Site      LOCATION : Garfield, NJ

ELEVATION :      DRILLING CONTRACTOR : Parratt Wolff/Cushing & Sons

DRILLING EQUIPMENT AND METHOD : CME Hollow Stem Auger Rig      ORIENTATION :

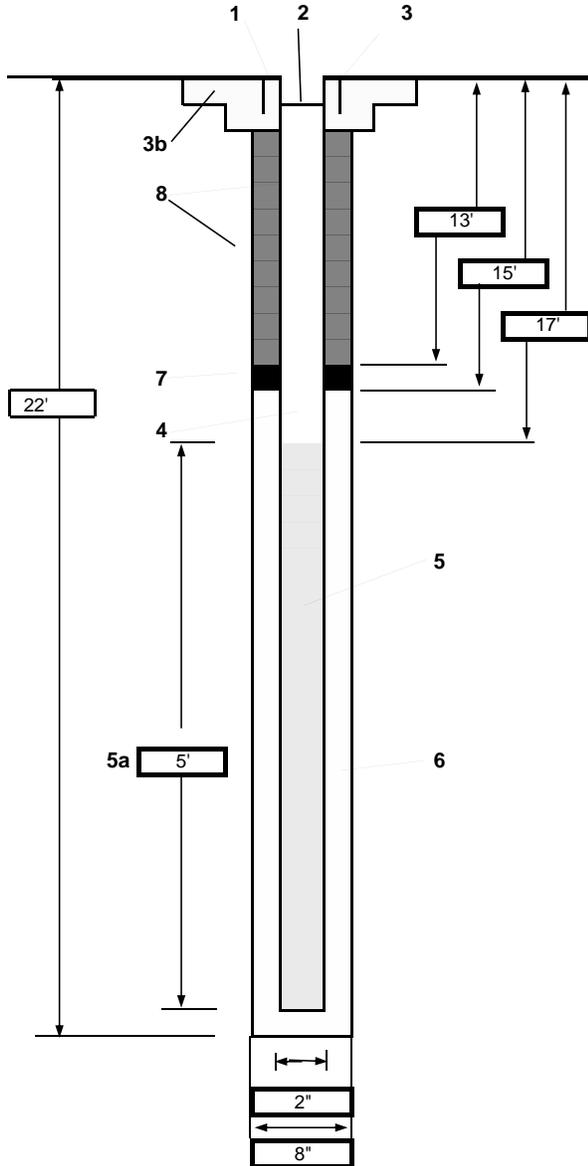
WATER LEVELS : 12.8 ft bgs      START : 6/3/14 13:50      END : 6/3/14 16:15      LOGGER : J. Balas

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)		STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS	
	RECOVERY (in)	#TYPE					SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
0.0	10.8	SS-1	7-9-2 (11)	<b>Asphalt</b> 0-0.5'		BZ: H2S = 0, VOC = 0, CO = 0, LEL = 0, O2 = 20.5, Dust = 0.006 PID = 0.0 ppm	
2.0	24.0	SS-2	6-6-5-5 (11)	<b>Gravel (GW-GM)</b> 0.5-10.4' - gray, dry, medium dense, little silt, fine grained, angular, FILL 2' - Same as above except FILL, trace medium to coarse gravel		PID = 0.0 ppm	
4.0	18.0	SS-3	3-3-1-2 (4)	4' - Same as above		PID = 0.0 ppm	
6.0	13.2	SS-4	1-3-2-1 (5)	6' - Same as above except 6.7'-6.9' red colored brick		PID = 0.0 ppm	
8.0	14.4	SS-5	3-1-1-1 (2)	8' - Same as above except moist		PID = 0.0 ppm	
10.0	12.0	SS-6	1-1-1-9 (2)	10' - wet <b>Sandy Silt (ML)</b> 10.4-12.4' - dark reddish brown, (5YR 3/3), moist to wet, medium stiff, non-cohesive, trace fine to medium gravel		PID = 0.0 ppm	
12.0	16.8	SS-7	7-9-20-19 (29)	<b>Silt (ML)</b> 12.4-14' - dark yellowish brown, (10YR 4/4), moist, stiff, non-cohesive, few mottling reddish brown (5YR 5/3), increasing medium to fine gravel with depth 13.2' - 1" diameter sandstone piece noted at bottom of recovery		Does not look like traditional native PID = 0.0 ppm	
14.0	18.0	SS-8	10-16-16-20 (32)	<b>Silty Sand (SW-SM)</b> 14-14.5' - dark reddish brown, (2.5YR 3/3), moist, medium dense, fine to very fine sand, SANDSTONE pieces 1/4"-1" diameter noted throughout		BZ: H2S = 0, VOC = 0, CO = 0, LEL = 0, O2 = 20, Dust = 0.016 PID = 0.0 ppm	
16.0	13.2	SS-10	14-30-50/4 (80/10")	<b>Sandy Silt (ML)</b> 14.5-16' - dark reddish brown, (2.5YR 3/3), moist, very stiff, non-cohesive, trace coarse to medium gravel, subrounded		PID = 0.0 ppm	
18.0	50/4 (50/4")	SS-11	50/4 (50/4")	<b>Silty Sand (SW-SM)</b> 16-19.1' - dark reddish brown, (2.5YR 3/3), wet, very dense, trace gravel, angular, increased gravel at bottom, SANDSTONE noted throughout, 1" diameter 18' - Same as above except larger SANDSTONE pieces, weathered bedrock 18.9'-19.1'		PID = 0.0 ppm	
20.0				<b>No Recovery</b> 19.1-20.3' Bottom of Boring at 20.3 ft bgs on 6/3/14 16:15			
22.0							
24.0							
26.0							
28.0							
30.0							



<b>PROJECT NUMBER</b> 431007.06.06.02	<b>WELL NUMBER</b> <b>EPA-30-OB</b>
<b>SHEET 1 OF 1</b>	
<b>WELL COMPLETION DIAGRAM</b>	

PROJECT : Garfield Groundwater Contamination Superfund Site      LOCATION : Garfield, NJ  
 DRILLING CONTRACTOR : Parratt Wolff  
 DRILLING METHOD AND EQUIPMENT USED CME 55 Drill Rig - 8" Hollow Stem Auger - 2" Stainless Steel Split Spoons  
 WATER LEVELS : 12.8 ft BGS      START : 6/4/2014      END : 6/4/2014      LOGGER : Balas



1- Ground elevation at well	55.9 ft. above mean sea level
2- Top of casing elevation	55.50 ft. above mean sea level
3- Wellhead protection cover type	8" Steel Manhole Cover
b) concrete pad dimensions	18" diameter by 6" deep
4- Dia./type of well casing	2" Schedule 40 PVC
5- Type/slot size of screen	.010 machine slot PVC
a) length of screen	5 ft
6- Type screen filter	NJ #0, 50 lb bags
a) Quantity used	5 bags
7- Type of seal	NJ #00 choker sand, 50 lb bags
a) Quantity used	1 bag
8- Grout	4 bags 50 lbs portland cement / 20 lbs bentonite / 25 gallons water
b) Method of placement	Pressure grouted
c) Vol. of well casing grout	30 gallons
Development method	Surge/Purge
Development time	40 minutes
Estimated purge volume	30
Comments	_____
	_____
	_____
	_____
	_____



<b>PROJECT NUMBER:</b> <b>431007</b>	<b>BORING NUMBER:</b> <b>EPA-30-OB</b>	<b>SHEET 1 OF 1</b>
<b>SOIL BORING LOG</b>		

PROJECT : Garfield Groundwater Contamination Superfund Site      LOCATION : Garfield, NJ

ELEVATION :      DRILLING CONTRACTOR : Parratt Wolff/Cushing & Sons

DRILLING EQUIPMENT AND METHOD : CME Hollow Stem Auger Rig      ORIENTATION :

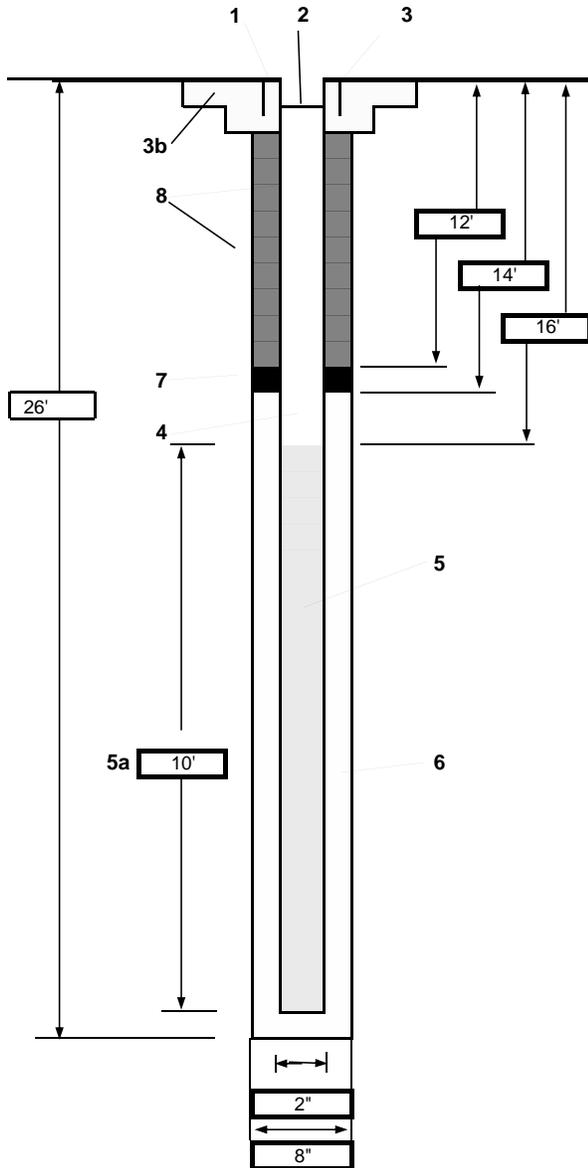
WATER LEVELS : ---      START : 6/4/2014      END : 6/4/2014      LOGGER : J. Balas

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)		STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS	
	RECOVERY (in)	#TYPE					6"-6"-6"-6" (N)
0.0	14.4	SS-1	3-4-3-2 (7)	<b>Silty Sand (SW-SM)</b> 0-2' - dark brown, (7.5YR 3/3), fine sand, round gravel 1/2" diameter, concrete/bricks noted at 0.3'-0.5' bgs, organic material		BZ: H2S = 0, VOC = 0, CO = 0, LEL = 0, O2 = 19.9, Dust = 0.011 PID = 0.0 ppm	
2.0	18.0	SS-2	2-5-6-7 (11)	<b>Sand (SW-SM)</b> 2-2.6' - reddish brown, (7.5YR 4/3), moist, loose, some silt, fine to very fine sand, well graded		PID = 0.0 ppm	
4.0	19.2	SS-3	5-5-6-5 (11)	<b>Sand And Silt (SW-SM)</b> 2.6-8' - dark reddish brown, (5YR 3/4), moist, loose, fine to very fine sand, trace fine gravel (mica), well graded, pieces of sandstone 1" diameter noted at bottom of recovery, increasing silt with depth		PID = 0.0 ppm	
6.0	20.4	SS-4	7-11-11-7 (22)	4' - Same as above except slightly cohesive, trace gravel and sandstone noted 6' - Same as above except increase silt/clay content with depth		PID = 0.0 ppm	
8.0	9.6	SS-5	20-43-15-8 (58)	<b>Large Gravel Chunk</b> 8-8.4' - 1"-2" diameter - pulverized boulder		BZ: H2S = 0, VOC = 0, CO = 0, LEL = 0, O2 = 20.1, Dust = 0.036 PID = 0.0 ppm	
10.0	8.4	SS-6	13-13-5-5 (18)	<b>Sand Silt (ML)</b> 8.4-12' - dark reddish brown, (5YR 3/4), dry to moist, firm, non-cohesive, sandstone pieces 1/4" throughout, very fine to fine sand 10' - Same as above except moist		PID = 0.0 ppm	
12.0	6.0	SS-7	4-5-5-7 (10)	<b>Silty Sand (SW-SM)</b> 12-14.7' - dark reddish brown, (5YR 3/4), moist to wet, loose, little gravel/sandstone 1/4"-1" diameter		PID = 0.0 ppm	
14.0	14.4	SS-8	11-6-9-5 (15)	14' - Same as above <b>Sand Some Silt (SW-SM)</b> 14.7-16' - dark reddish brown, (5YR 3/4), wet, loose, little very fine gravel, fine to medium sand		PID = 0.0 ppm	
16.0	19.2	SS-9	9-7-9-8 (16)	<b>Silty Sand (SW-SM)</b> 16-18.5' - dark reddish brown, (5YR 3/4), wet, loose, trace fine gravel, increase density and silt with depth, 1/4"=1/2" diameter sandstone pieces throughout		PID = 0.0 ppm	
18.0	10.8	SS-10	6-50/.5 (50/.5")	<b>Silty Sand (SW-SM)</b> 18' - dark reddish brown, (5YR 3/4), wet, dense, trace gravel, higher silt content at top of recovery, sandstone		BZ: H2S = 0, VOC = 0, CO = 0, LEL = 0, O2 = 20.3, Dust = 0.011 PID = 0.0 ppm	
20.0	15.6	SS-11	10-20-20-15 (40)	<b>Weathered Sandstone</b> 18.5-20.4' - dark reddish brown, (5YR 3/4), moist, hard, pulverized <b>Weathered Sandstone</b> 20' - dark reddish brown, (5YR 3/4), wet, hard, pulverized <b>Silty Sand (SW-SM)</b> 20.4-22' - dark reddish brown, (5YR 3/4), wet, dense, few gravel (gravel is 1/2" sandstone pieces) 20.9' - Same as above Bottom of Boring at 22.0 ft bgs on 6/4/2014		PID = 0.0 ppm	
22.0							
25							
30							



<b>PROJECT NUMBER</b> 431007.06.06.02	<b>WELL NUMBER</b> EPA-31-OB	SHEET 1 OF 1
<b>WELL COMPLETION DIAGRAM</b>		

PROJECT : Garfield Groundwater Contamination Superfund Site      LOCATION : Garfield, NJ  
 DRILLING CONTRACTOR : Parratt Wolff  
 DRILLING METHOD AND EQUIPMENT USED CME 55 Drill Rig - 8" Hollow Stem Auger - 2" Stainless Steel Split Spoons  
 WATER LEVELS : ###      START : 6/4/2014      END : 6/4/2014      LOGGER : Balas



1- Ground elevation at well	56.7 ft. above mean sea level
2- Top of casing elevation	56.31 ft. above mean sea level
3- Wellhead protection cover type	8" Steel Manhole Cover
b) concrete pad dimensions	18" diameter by 6" deep
4- Dia./type of well casing	2" Schedule 40 PVC
5- Type/slot size of screen	.010 machine slot PVC
a) length of screen	5 ft
6- Type screen filter	NJ #0, 50 lb bags
a) Quantity used	6 bags
7- Type of seal	NJ #00 choker sand, 50 lb bags
a) Quantity used	1 bag
8- Grout	4 bags 50 lbs portland cement / 25 lbs bentonite / 25 gallons water
b) Method of placement	Pressure grouted
c) Vol. of well casing grout	35 gallons
Development method	Surge/Purge
Development time	1 hr 15 min
Estimated purge volume	45
Comments	



<b>PROJECT NUMBER:</b> <b>431007</b>	<b>BORING NUMBER:</b> <b>EPA-31-OB</b>	<b>SHEET 1 OF 2</b>
<b>SOIL BORING LOG</b>		

PROJECT : Garfield Groundwater Contamination Superfund Site      LOCATION : Garfield, NJ

ELEVATION :      DRILLING CONTRACTOR : Parratt Wolff/Cushing & Sons

DRILLING EQUIPMENT AND METHOD : CME Hollow Stem Auger Rig      ORIENTATION :

WATER LEVELS : ---      START : 6/4/2014      END : 6/4/2014      LOGGER : J. Balas

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)		STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION		SYMBOLIC LOG	COMMENTS
	RECOVERY (in)	#TYPE		SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY			
				6"-6"-6"-6" (N)			
0.0	16.8	SS-1	4-7-7-7 (14)	#2 Gravel 0-0.2'		BZ: H2S = 0, VOC = 0, CO = 0, LEL = 0, O2 = 20.4, Dust = 0.011 PID = 0.0 ppm	
2.0	2.4	SS-2	50/2 (50/2")	Silty Sand (SW-SM) 0.2-1.4' - dark brown, (7.5YR 3/3), dry, loose, few fine to medium gravel, organic material noted, some brick fragments noted throughout		PID = 0.0 ppm	
4.0				#2 Gravel 1.4-4' - concrete below 2.4' bgs		PID = 0.0 ppm	
5.0	9.6	SS-3	7-9-11-11 (20)	Sand And Silt (SW-SM) 4-6' - dark reddish brown, (5YR 3/4), dry, dense, trace gravel		PID = 0.0 ppm	
6.0				Sandstone 6-6.3' - dark reddish brown, (5YR 3/4), pulverized boulder		PID = 0.0 ppm	
8.0				Silty Sand (SW-SM) 6.3-8' - dark reddish brown, (5YR 3/4), dry, medium dense, trace gravel			
10.0	0.0	SS-5	50/2 (50/2")	No Recovery 8-10'		PID = 0.0 ppm	
10.0	9.6	SS-6	21-28-13-14 (41)	Sandstone 10-10.4' - dark reddish brown, (5YR 3/4), pulverized boulder			
12.0				Silty Sand (SW-SM) 10.4-13.7' - dark reddish brown, (5YR 3/4), dry, dense, trace gravel		BZ: H2S = 0, VOC = 0, CO = 0, LEL = 0, O2 = 20.3, Dust = 0.012 PID = 0.0 ppm	
14.0	24.0	SS-8	13-10-13-16 (23)	Silty Sand (SW-SM) 12' - dark reddish brown, (5YR 3/4), moist to wet, loose, trace gravel, fine sand, well graded		PID = 0.0 ppm	
15.0	8.4	SS-9	10-20-27-20 (47)	Sand (SW-SM) 13.7-18.6' - dark reddish brown, (5YR 3/4), moist to wet, loose, little silt, few gravel, fine to medium sand, poorly graded		PID = 0.0 ppm	
16.0				Sand (SW-SM) 14' - dark reddish brown, (7YR 4/4), moist to wet, loose, some silt, trace fine gravel, fine to medium sand, well graded, some pulverized sandstone at bottom of recovery		PID = 0.0 ppm	
18.0	24.0	SS-10	14-16-25-22 (41)	Sand (SW-SM) 14.7' - dark reddish brown, (5YR 3/4), wet, dense, some silt, trace gravel, fine to very fine sand, 1" rounded gravel		PID = 0.0 ppm	
20.0	21.6	SS-11	38-20-12-29 (32)	18' - Same as above		PID = 0.0 ppm	
20.0	21.6	SS-12	5-4-19-15 (23)	Silty Sand (SW-SM) 18.6-20.5' - dark reddish brown, (5YR 3/4), wet, dense, few gravel 1/4"-1" diameter, some is sandstone		PID = 0.0 ppm	
22.0				20' - Same as above		PID = 0.0 ppm	
24.0	9.6	SS-13	15-50/3 (50/3")	Sand 20.5-22' - very dusky red, (2.5YR 2.5/2), moist to wet, very dense, little silt, trace gravel, gravel is sandstone			
25.0				Sandy Silt (ML) 22-22.4' - dark reddish brown, (5YR 4/3), wet, trace gravel			
26.0				Silt (ML) 22.4-24' - dark reddish brown, (5YR 4/3), moist, very hard, some sand, trace gravel, non-cohesive			
30.0							



PROJECT NUMBER: <b>431007</b>	BORING NUMBER: <b>EPA-31-OB</b>	SHEET 2 OF 2
<b>SOIL BORING LOG</b>		

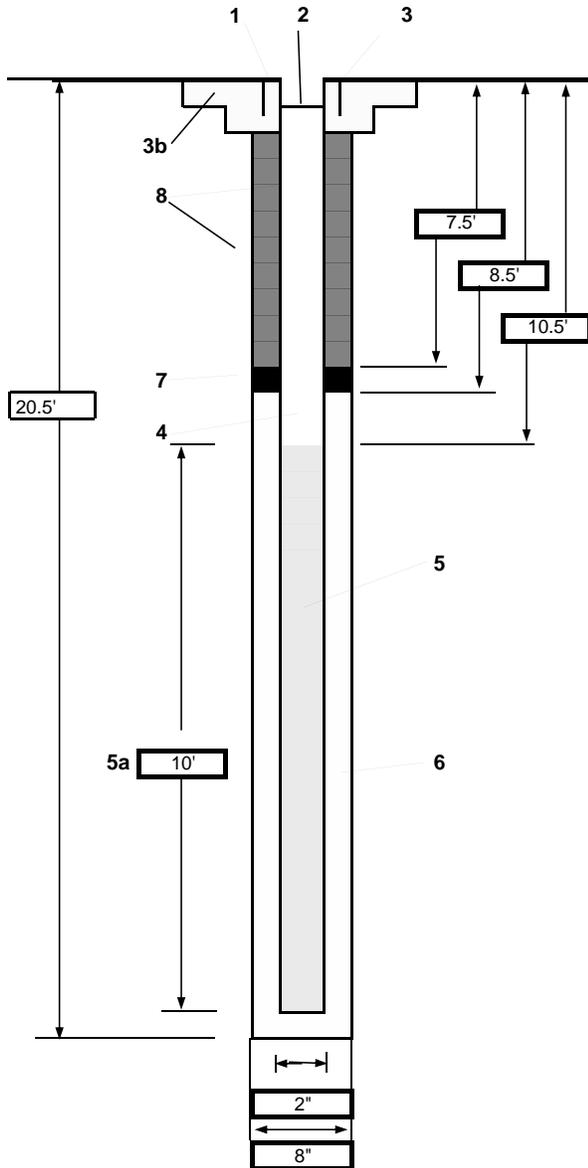
PROJECT : Garfield Groundwater Contamination Superfund Site      LOCATION : Garfield, NJ  
 ELEVATION :      DRILLING CONTRACTOR : Parratt Wolff/Cushing & Sons  
 DRILLING EQUIPMENT AND METHOD : CME Hollow Stem Auger Rig      ORIENTATION :  
 WATER LEVELS : ---      START : 6/4/2014      END : 6/4/2014      LOGGER : J. Balas

DEPTH BELOW EXISTING GRADE (ft)	STANDARD PENETRATION TEST RESULTS			SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL (ft)	RECOVERY (in)	#TYPE			
	6"-6"-6"-6" (N)					
35				<b>Sandstone</b> 24-26' - dark reddish brown, (5YR 4/3) Bottom of Boring at 26.0 ft bgs on 6/4/2014		
40						
45						
50						
55						
60						



<b>PROJECT NUMBER</b> 431007.06.06.02	<b>WELL NUMBER</b> EPA-32-OB	SHEET 1 OF 1
<b>WELL COMPLETION DIAGRAM</b>		

PROJECT : Garfield Groundwater Contamination Superfund Site      LOCATION : Garfield, NJ  
 DRILLING CONTRACTOR : Parratt Wolff  
 DRILLING METHOD AND EQUIPMENT USED CME 55 Drill Rig - 8" Hollow Stem Auger - 2" Stainless Steel Split Spoons  
 WATER LEVELS : 12.5 ft BGS      START : 6/3/2014      END : 6/3/2014      LOGGER : Balas



1- Ground elevation at well	58.7 ft. above mean sea level
2- Top of casing elevation	58.29 ft. above mean sea level
3- Wellhead protection cover type	8" Steel Manhole Cover
b) concrete pad dimensions	18" diameter by 6" deep
4- Dia./type of well casing	2" Schedule 40 PVC
5- Type/slot size of screen	.010 machine slot PVC
a) length of screen	10 ft
6- Type screen filter	NJ #0, 50 lb bags
a) Quantity used	7 bags
7- Type of seal	NJ #00 choker sand, 50 lb bags
a) Quantity used	1 bag
8- Grout	94 lbs portland cement / 5 lbs bentonite / 6 gallons water
b) Method of placement	Pressure grouted
c) Vol. of well casing grout	10 gallons
Development method	Surge/Purge
Development time	1 hr 45 min
Estimated purge volume	25 gallons
Comments	During development, well never cleared up after more than 5 purge volumes were removed. Limited sediment still remains at bottom of the well.



<b>PROJECT NUMBER:</b> <b>431007</b>	<b>BORING NUMBER:</b> <b>EPA-32-OB</b>	<b>SHEET 1 OF 1</b>
<b>SOIL BORING LOG</b>		

PROJECT : Garfield Groundwater Contamination Superfund Site      LOCATION : Garfield, NJ

ELEVATION :      DRILLING CONTRACTOR : Parratt Wolff/Cushing & Sons

DRILLING EQUIPMENT AND METHOD : CME Hollow Stem Auger Rig      ORIENTATION :

WATER LEVELS : 12.5 ft bgs      START : 6/2/2014      END : 6/3/2014      LOGGER : J. Balas

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)		STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS	
	RECOVERY (in)	#TYPE					SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
2.0				<b>Reinforced Concrete</b> 0-2'		BZ: H2S = 0, VOC = 0, CO = 0, LEL = 0, O2 = 20, Dust = 0.075 Refusal at 8" bgs, move north 10', resume	
4.0	8.4	SS-1	2-3-3-2 (6)	<b>Fill, Silty Sand(SM)</b> 2-4' - dark brown, (7.5YR 3/2), dry, loose, trace gravel, fine sand and gravel, black slag noted		PID = 0.0 ppm	
5.0	12.0	SS-2	2-1-3-4 (4)	<b>Sand (SW-SM)</b> 4-8' - dark yellowish brown, (10YR 4/6), dry, medium dense, little silt, trace subangular gravel, fine sand, some of the gravel is red sandstone well graded		BZ: H2S = 0, VOC = 0, CO = 0, LEL = 0, O2 = 20.5, Dust = 0.008 PID = 0.0 ppm	
6.0	14.4	SS-3	5-5-5-7 (10)	6' - dark reddish brown, (2.5YR 3/4), dry, medium dense, some silt, fine sand, trace round quartz noted, well graded		PID = 0.0 ppm	
8.0	14.4	SS-4	5-9-5-4 (14)	<b>Sandy Silt (ML)</b> 8-10' - dark reddish brown, (2.5YR 3/4), moist, dense, non-cohesive, trace cobbles of 1" diameter sandstone, trace quartz and mica noted throughout, fine sand		PID = 0.0 ppm	
10.0	18.0	SS-5	5-8-9-10 (17)	<b>Silty Sand (SW-SM)</b> 10-20.5' - dark reddish brown, (2.5YR 3/4), moist, medium dense, fine sand, well graded, trace sandstone 1" diameter, trace quartz and mica		PID = 0.0 ppm	
12.0	20.4	SS-6	9-10-11-13 (21)	<b>Silty Sand (SW-SM)</b> 12' - dark reddish brown, (2.5YR 4/3), moist to wet, medium dense, well graded, trace gravel, subangular to rounded, trace sandstone 1" diameter, trace quartz and mica		BZ: H2S = 0, VOC = 0, CO = 0, LEL = 0, O2 = 20.9, Dust = 0.011 PID = 0.0 ppm	
14.0	14.4	SS-7	18-23-18-25 (41)	14' - dark reddish brown, (2.5YR 3/3), moist, dense, fine sand, weathered bedrock-sandstone (14.1'-14.4' bgs, 14.9'-15' bgs), trace mica, 1" diameter sandstone chunks throughout		PID = 0.0 ppm	
15.0	16.0	SS-8	26-28-11-8 (39)	16' - dark reddish brown, (2.5YR 3/3), wet, very dense, fine sand, weathered/incompetent bedrock, 1" diameter pieces of sandstone throughout, trace quartz 1/4" diameter		PID = 0.0 ppm	
18.0	15.6	SS-8	26-28-11-8 (39)	16' - dark reddish brown, (2.5YR 3/3), wet, very dense, fine sand, weathered/incompetent bedrock, 1" diameter pieces of sandstone throughout, trace quartz 1/4" diameter		PID = 0.0 ppm	
20.0	6.0	SS-9	6-8-50/4 (58/10")	18' - dark reddish brown, (2.5YR 3/3), wet, very dense, fine to very fine sand, 2" diameter piece of sandstone in shoe		PID = 0.0 ppm	
22.0		SS-10	29-50/1 (50/1")	20' - dark reddish brown, (2.5YR 3/3), wet, very dense, fine to very fine sand, weathered pieces 1"-2" diameter sandstone, trace quartz		PID = 0.0 ppm	
25.0				Bottom of Boring at 20.5 ft bgs on 6/3/2014			
30.0							







PROJECT NUMBER 431007	WELL NUMBER EPA-31-013	SHEET 1 OF 1
<b>WELL DEVELOPMENT LOG</b>		

PROJECT : Garfield Superfund Site      LOCATION: Garfield, NJ  
 Development Contractor: Pa  
 START Time: 0756      END Time: 0919      LOGGER : Balas

Diameter of Well (inches) & Type: \_\_\_\_\_  
 Depth of Well (feet): 23.25  
 Depth to Water (feet) 12.23  
 Water Column Height (feet): 11.02  
 Gallons per Foot:  $.163 \times 11.02 + 10 \times .5 =$   
 One Well Volume (gallons):  $1.8 + 5 = 6.8$   
 Five Well Volumes (gallons): 35

Development Method: Surge/Purge  
 Surge Block Used: Yes  
 Screen Interval Surged: 15-25

Water Quality Meter (Manufacturer/Model/Serial #):  
 Horiba U-52

Maximum Drawdown During Pumping: 7'  
 Average Discharge Rate & Range: 1 gal  
 Total Quantity of Water Discharged: 45  
 Disposition of Discharge Water: clean up

Dia. (in)	Gal./Ft.	Dia. (in)	Gal./Ft.
1"	0.041	5"	1.02
2"	0.163	6"	1.469
3"	0.367	8"	2.611
4"	0.653	10"	4.08

pump slowed

Time	Water Volume Discharged (gal)	Water Level (ft BTIC)	Turbidity (NTU)	Temperature (°C)	pH (Std. Units)	Conductivity (µmhos/cm)	Remarks (color, odor, sheen, sediment, etc.)
0800	4	19.50	OR	14.93	6.05	1.90	dark reddish brown
0807	11	18.91	OR	14.27	6.36	1.90	dark reddish/yellow brown
0815	20	18.22	OR	13.93	6.36	1.93	reddish brown yellow tint
0828	30	16.90	OR	14.02	6.36	1.92	reddish brown yellow tint
0915	45	15.81	OR	14.91	6.42	1.86	yellow
END development							

DOP

5.21 221  
 2.73 138  
 1.80 152  
 1.93 185  
 2.00 201

Comments:  
 High over range

NJDEP Well Permit # \_\_\_\_\_



PROJECT NUMBER 431007	WELL NUMBER EPA-32-OB	SHEET 1 OF 1
<b>WELL DEVELOPMENT LOG</b>		

PROJECT : Garfield Superfund Site      LOCATION: Garfield, NJ  
 Development Contractor: Pa  
 START Time: 1030      END Time : 1215      LOGGER : Balas

Diameter of Well (inches) & Type: 2"  
 Depth of Well (feet): 19.30  
 Depth to Water (feet) 11.28  
 Water Column Height (feet): 8.02  
 Gallons per Foot: 163 + 4.5  
 One Well Volume (gallons): 4.7  
 Five Well Volumes (gallons): 23.5

Development Method: Surge/Purge  
 Surge Block Used: Yes  
 Screen Interval Surged: 15-20

Water Quality Meter (Manufacturer/Model/Serial #):  
 Horiba U-52

Maximum Drawdown During Pumping: dry  
 Average Discharge Rate & Range: variable  
 Total Quantity of Water Discharged: 29  
 Disposition of Discharge Water: never cleared

Dia. (in)	Gal./Ft.	Dia. (in)	Gal./Ft.
1"	0.041	5"	1.02
2"	0.163	6"	1.469
3"	0.367	8"	2.611
4"	0.653	10"	4.08

Time	Water Volume Discharged (gal)	Water Level (ft BTIC)	Turbidity (NTU)	Temperature (°C)	pH (Std. Units)	Conductivity (µmhos/cm)	Remarks (color, odor, sheen, sediment, etc.)	Do	Q
1030	5	dry	OR	17.74	5.62	2.33	dark red - sheen	4.9	378
1102	9	dry	OR	15.06	6.53	2.22	dark red - sheen	5.2	150
1120	14	dry	OR	17.97	6.43	1.95	dark red/yellow	7.28	177
1142	18.5	dry	OR	17.87	6.33	1.88	dark red/yellow	2.76	194
1213	25	dry	OR	17.82	6.07	1.83	yellow tint	7.8	215
	closed up	up a + very		end of page					

Comments: whole pump pumps at high rate surge between crowing dry - will pump 5 well volumes  
 Hexchrome over limit

NJDEP Well Permit # \_\_\_\_\_

**Attachment 4**  
**Data Validation Report**

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*Data Quality Evaluation Report*

# 2014/2015 Garfield Groundwater Pilot Test

Garfield Groundwater Contamination Superfund Site  
City of Garfield, Bergen County, New Jersey

Prepared for

**U.S. Army Corps of Engineers**

Contract No. W912DQ-11-D-3005, Task Order 0003

May 2015

Revised July 2015

Prepared by

**CH2MHILL®**

119 Cherry Hill Road  
Suite 300  
Parsippany, NJ 07054

**DATA QUALITY EVALUATION REPORT  
2014/2015 GARFIELD GROUNDWATER PILOT TEST  
GARFIELD GROUNDWATER CONTAMINATION SUPERFUND SITE**

**CITY OF GARFIELD  
BERGEN COUNTY, NEW JERSEY**

USACE Contract No. W912DQ-11-D-3005  
Task Order No. 0003

May 2015  
Revised July 2015

**NONDISCLOSURE STATEMENT**

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## Tables

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2	Sample Chronology—Data Summary
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4	Field Duplicate—Qualified Data
5	Site Completeness

# Acronyms and Abbreviations

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ALS	Australian Laboratory Services
DESA	Division of Environmental Science and Assessment (USEPA)
FD	field duplicate
IDW	investigation-derived waste
LCS	laboratory control sample
MS	matrix spike
MSD	matrix spike duplicate
QAPP	quality assurance project plan
QC	quality control
RL	reporting limit
SDG	sample delivery group
USEPA	U.S. Environmental Protection Agency

# Introduction

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This data quality evaluation report contains an assessment of the quality and usability of analytical data from environmental groundwater samples collected during the 2014 and 2015 U.S. Environmental Protection Agency (USEPA) pilot testing sampling events at the Garfield Groundwater Contamination Superfund Site in Garfield, Bergen County, New Jersey, by CH2M HILL, on behalf of the U.S. Army Corps of Engineers.

The analytical work was conducted in accordance with the Remedial Investigation Uniform Federal Policy for Quality Assurance Project Plan, Garfield Groundwater Contamination Superfund Site, Aquifer Test and Pilot Test, Garfield, Bergen County, New Jersey (project QAPP; CH2M HILL 2012).

This report discusses the details of groundwater sample results that were collected and validated during the 2014 and 2015 sampling events and were analyzed outside of the USEPA Division of Environmental Science and Assessment (DESA) and Contract Laboratory Program laboratory systems. USEPA data validation reports are not provided by the DESA laboratory. Samples collected as part of the investigation-derived waste (IDW) samples are not included in this data quality discussion because the data were not validated in accordance with the project QAPP.

## 1.1 Analytical Laboratories and Analytical Methods

Australian Laboratory Services (ALS), (formerly Columbia Analytical Services) of Rochester, New York, performed all sample analyses. After collection, the samples were delivered to the ALS laboratories by overnight courier for analysis. The analytical methods used were as follows:

- USEPA Method EPA 218.6 Hexavalent Chromium

SECTION 2

## Field Sample Collection

---

Six sample delivery groups (SDGs) of analytical data were evaluated for data quality. Table 1 lists the SDGs, sample identifications, and collection and analysis chronology associated with the project samples.

Thirty groundwater samples were collected between June 19, 2014 and February 6, 2015. Field duplicate (FD) collection goals were met with four groundwater FDs completed. Other quality control (QC) samples including matrix spike (MS)/matrix spike duplicates (MSDs) and field blanks were collected and analyzed in accordance with the project QAPP (CH2M HILL 2012). Table 2 summarizes the field samples collected by date.

# Data Review and Validation Process

---

## 3.1 Data Validation Definition

All analytical data from this investigation were evaluated as described in the project QAPP (CH2M HILL 2012). All (100 percent) of the hexavalent chromium analytical results were validated, except for IDW samples not included in this report. The data assessment included reviewing the following laboratory summary forms:

- Chain-of-custody documentation
- Holding time
- QC sample frequencies
- Method blanks
- Laboratory control samples (LCSs)
- Surrogate spikes
- MS/MSDs
- Initial and continuing calibration information
- FD precision
- Case narrative review and other method-specific criteria

Data flags (if applicable) were assigned using the QC acceptance limits and procedures defined in the project QAPP (CH2M HILL 2012). Data flags, and the reason for each flag, were entered into an electronic database and are available to the data users. Multiple flags can be routinely applied to a specific sample method/matrix/analyte combination, but only one final flag is applied to the data according to the most conservative of the validation flags.

## 3.2 Overall Data Validation Findings

Table 3 presents an overall summary of definitive data sample results and the reasons each sample was flagged. The information in Table 3 is presented so that each flag applied to a method, matrix, and analyte is shown. In addition, a statistical evaluation of the results is provided so the percentage of results affected by a specific data quality condition or flag, with respect to the total results available for any target analyte/matrix, is shown. Only out-of-control conditions noted during the data validation are discussed in Table 3 and in the following subsections.

## 3.3 Results Detected between the Method Detection Limit and Reporting Limit

Analytes that were detected at concentrations greater than the method detection limit, but less than the reporting limit (RL), were qualified as “J” and are considered to be qualitative concentrations.

## 3.4 Field Duplicates

FDs were submitted at a minimum frequency of 1 per 20 project samples. Four FDs were submitted for the effort in a manner such that the duplicate association was “blind” to the laboratory. FD precision for hexavalent chromium in groundwater was out of control for the duplicate pair EPA-13-OB-102014 and D-01-102014. Out-of-control detected results from the FD were qualified as estimated concentrations, flagged “J”, and are believed to be caused by sample heterogeneity or matrix interference in the analytical process. Table 4 presents results that were qualified because of out-of-control FD precision.

# Summary of Precision, Accuracy, Representativeness, Comparability, and Completeness

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The quality of the field sampling efforts and laboratory results were evaluated for compliance with project data quality objectives by reviewing overall precision, accuracy, representativeness, comparability, and completeness. Procedures used to assess these criteria were in accordance with the respective analytical methods and the project QAPP (CH2M HILL 2012) and QAPP addendum (CH2M HILL 2013) requirements.

## 4.1 Precision

Matrix precision from MS/MSDs was in control. Matrix precision also was evaluated through the results of FD samples. The results of the FD sample were out of control. The FD sample was within the oxidizing sample group and may indicate the other oxidizing samples have similar amounts of imprecision or uncertainty. Laboratory precision was acceptable as shown by the repeated in-control performance (accuracy) of the LCSs.

## 4.2 Accuracy

Matrix accuracy from MS/MSDs was in control. The laboratory accuracy of LCSs and calibrations was in control. The accuracy of blanks was in control overall and contamination was not significant to the sample concentrations. Both laboratory and matrix accuracy were acceptable.

## 4.3 Representativeness

Sample data were representative of the site conditions at the time of sample collection. All samples were properly stored and preserved. Analytical data were reported from an analysis conducted within the project-specified hold time. Blank contamination was not an issue with this data set.

## 4.4 Appropriateness of Reporting Limits

This project was designed to allow risk-based decisions to be made based on the results of common USEPA-approved analytical methodologies. Sample dilutions required from matrix interference and/or high target analyte concentrations resulted in elevated RLs for sample data. The RLs achieved were the best possible based on sample variables.

## 4.5 Comparability

All samples were reported in industry standard units. Analytical protocols for the methods were followed. Results obtained were comparable to industry standards in that collection and analytical techniques followed approved, documented procedures.

## 4.6 Completeness

Project completeness for hexavalent chromium is 100 percent. No results were qualified as unusable for project objectives. Table 5 presents the completeness results.

## 4.7 Conclusions

The data generated from groundwater sample analyses were of sufficient quality and quantity necessary for accomplishing the project objectives. Sample results indicate the presence and/or absence of target analyte

contamination at sampled locations when considering the accuracy and precision bias as discussed in this report.

Samples were collected and analyzed as specified in the project QAPP (CH2M HILL 2012). Sample results are believed to be representative of site conditions at the time of collection. Results obtained are comparable to industry standards in that collection, and analytical techniques followed approved, documented procedures. All results were reported in industry standard units. Although field blank contamination from equipment blanks did occur, it was not significant to the sample data. The results obtained for sample analyses reflect the best achievable data for the site-specific conditions.

## SECTION 5

# Reference

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CH2M HILL. 2012. *Remedial Investigation Sampling Uniform Federal Policy for Quality Assurance Project Plan, Garfield Groundwater Contamination Superfund Site, Garfield, Bergen County, New Jersey*. March.

CH2M HILL. 2013. *Remedial Investigation - Uniform Federal Policy for Quality Assurance Project Plan, Aquifer Test and Pilot Test, Garfield Groundwater Contamination Superfund Site, Garfield, Bergen County, New Jersey*. September.

## Tables

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**TABLE 1**  
**Sample Chronology – Data Summary**

Laboratory	SDG	Sample ID	Method	Sample Date	Receive Date	Extract Date	Analysis Date	
CASR	R1404720	D-06192014-01	E218.6	6/19/2014	6/20/2014		6/23/2014	
		EPA-13-OB-061914	E218.6	6/19/2014	6/20/2014		6/23/2014	
		EPA-29-OB-061914	E218.6	6/19/2014	6/20/2014		6/23/2014	
		EPA-30-OB-061914	E218.6	6/19/2014	6/20/2014		6/23/2014	
		EPA-31-OB-061914	E218.6	6/19/2014	6/20/2014		6/23/2014	
		EPA-32-OB-061914	E218.6	6/19/2014	6/20/2014		6/23/2014	
	R1405819	EPA-13-OB-072914	E218.6	7/29/2014	7/30/2014		7/30/2014	
		EPA-29-OB-072914	E218.6	7/30/2014	7/31/2014		7/31/2014	
		EPA-30-OB-072914	E218.6	7/29/2014	7/30/2014		7/30/2014	
		EPA-30-OB-072914MS	E218.6	7/29/2014	7/30/2014		7/30/2014	
		EPA-30-OB-072914SD	E218.6	7/29/2014	7/30/2014		7/30/2014	
		EPA-31-OB-073014	E218.6	7/30/2014	7/31/2014		7/31/2014	
		EPA-31-OB-073014MS	E218.6	7/30/2014	7/31/2014		7/31/2014	
		EPA-31-OB-073014SD	E218.6	7/30/2014	7/31/2014		7/31/2014	
		EPA-32-OB-072914	E218.6	7/29/2014	7/30/2014		7/30/2014	
		R1406953	D-01-090414	E218.6	9/4/2014	9/5/2014		9/10/2014
			EPA-13-OB-090314	E218.6	9/3/2014	9/5/2014		9/5/2014
			EPA-29-OB-090414	E218.6	9/4/2014	9/5/2014		9/10/2014
			EPA-30-OB-090314	E218.6	9/3/2014	9/5/2014		9/5/2014
			EPA-31-OB-090314	E218.6	9/3/2014	9/5/2014		9/10/2014
	EPA-32-OB-090314		E218.6	9/3/2014	9/5/2014		9/10/2014	
	R1408420	D-01-102014	E218.6	10/20/2014	10/23/2014		11/3/2014	
		EPA-13-OB-102014	E218.6	10/20/2014	10/23/2014		11/4/2014	
		EPA-29-OB-102114	E218.6	10/21/2014	10/23/2014		11/3/2014	
		EPA-30-OB-102014	E218.6	10/20/2014	10/23/2014		11/3/2014	
		EPA-31-OB-102014	E218.6	10/20/2014	10/23/2014		11/3/2014	
		EPA-32-OB-102014	E218.6	10/20/2014	10/23/2014		11/3/2014	
	ALSR	R1410146	GCGC-EPA-13-OB-05	E218.6	12/18/2014	12/19/2014		12/29/2014
			GCGC-EPA-13-OB-05MS	E218.6	12/18/2014	12/19/2014		12/29/2014
			GCGC-EPA-13-OB-05SD	E218.6	12/18/2014	12/19/2014		12/29/2014
GCGC-EPA-29-OB-05			E218.6	12/17/2014	12/18/2014		12/29/2014	
GCGC-EPA-30-OB-05			E218.6	12/18/2014	12/19/2014		12/29/2014	
GCGC-EPA-31-OB-05			E218.6	12/18/2014	12/19/2014		12/29/2014	
GCGC-EPA-32-OB-05			E218.6	12/17/2014	12/18/2014		12/29/2014	
R1500842			D-02062015-01	E218.6	2/6/2015	2/7/2015		2/10/2015

**TABLE 1**  
**Sample Chronology – Data Summary**

<b>Laboratory</b>	<b>SDG</b>	<b>Sample ID</b>	<b>Method</b>	<b>Sample Date</b>	<b>Receive Date</b>	<b>Extract Date</b>	<b>Analysis Date</b>
ALSR	R1500842	EPA-13-OB-020515	E218.6	2/5/2015	2/6/2015		2/10/2015
		EPA-29-OB-020615	E218.6	2/6/2015	2/7/2015		2/10/2015
		EPA-30-OB-020515	E218.6	2/5/2015	2/6/2015		2/10/2015
		EPA-31-OB-020615	E218.6	2/6/2015	2/7/2015		2/10/2015
		EPA-32-OB-020515	E218.6	2/5/2015	2/6/2015		2/10/2015

**TABLE 2**  
**Sample Summary by Chain of Custody – Data Summary**

CoC Number	Sample Date	Matrix	Sample ID / QAQC Type	SDG	Laboratory
R1404720	19-Jun-14	WATER	D-06192014-01 / FD	R1404720	CASR
			EPA-13-OB-061914 / N	R1404720	CASR
			EPA-29-OB-061914 / N	R1404720	CASR
			EPA-30-OB-061914 / N	R1404720	CASR
			EPA-31-OB-061914 / N	R1404720	CASR
			EPA-32-OB-061914 / N	R1404720	CASR
R1405819	29-Jul-14	WATER	EPA-13-OB-072914 / N	R1405819	CASR
	30-Jul-14		EPA-29-OB-072914 / N	R1405819	CASR
	29-Jul-14		EPA-30-OB-072914 / N	R1405819	CASR
			EPA-30-OB-072914MS / MS	R1405819	CASR
			EPA-30-OB-072914SD / SD	R1405819	CASR
	30-Jul-14		EPA-31-OB-073014 / N	R1405819	CASR
			EPA-31-OB-073014MS / MS	R1405819	CASR
			EPA-31-OB-073014SD / SD	R1405819	CASR
	29-Jul-14		EPA-32-OB-072914 / N	R1405819	CASR
R1406953	04-Sep-14	WATER	D-01-090414 / FD	R1406953	CASR
	03-Sep-14		EPA-13-OB-090314 / N	R1406953	CASR
	04-Sep-14		EPA-29-OB-090414 / N	R1406953	CASR
	03-Sep-14		EPA-30-OB-090314 / N	R1406953	CASR
			EPA-31-OB-090314 / N	R1406953	CASR
			EPA-32-OB-090314 / N	R1406953	CASR
R1408420	20-Oct-14	WATER	D-01-102014 / FD	R1408420	CASR
	21-Oct-14		EPA-13-OB-102014 / N	R1408420	CASR
			EPA-29-OB-102114 / N	R1408420	CASR
			EPA-30-OB-102014 / N	R1408420	CASR
			EPA-31-OB-102014 / N	R1408420	CASR
			EPA-32-OB-102014 / N	R1408420	CASR
			20-Oct-14		
R1410146	18-Dec-14	WATER	GCGC-EPA-13-OB-05 / N	R1410146	ALSR

**TABLE 2**  
**Sample Summary by Chain of Custody – Data Summary**

CoC Number	Sample Date	Matrix	Sample ID / QAQC Type	SDG	Laboratory
R1410146	18-Dec-14	WATER	GCGC-EPA-13-OB-05MS / MS	R1410146	ALSR
			GCGC-EPA-13-OB-05SD / SD	R1410146	ALSR
	17-Dec-14		GCGC-EPA-29-OB-05 / N	R1410146	ALSR
	18-Dec-14		GCGC-EPA-30-OB-05 / N	R1410146	ALSR
			GCGC-EPA-31-OB-05 / N	R1410146	ALSR
	17-Dec-14		GCGC-EPA-32-OB-05 / N	R1410146	ALSR
	R1500842	06-Feb-15	WATER	D-02062015-01 / FD	R1500842
05-Feb-15		EPA-13-OB-020515 / N		R1500842	ALSR
06-Feb-15		EPA-29-OB-020615 / N		R1500842	ALSR
05-Feb-15		EPA-30-OB-020515 / N		R1500842	ALSR
06-Feb-15		EPA-31-OB-020615 / N		R1500842	ALSR
05-Feb-15		EPA-32-OB-020515 / N		R1500842	ALSR

**QAQC Type**

N = normal environmental sample  
 FD = field duplicate  
 MS = matrix spike  
 SD = spike duplicate  
 TB = trip blank  
 EB = equipment blank  
 AB = ambient blank  
 FB = field blank

**TABLE 3**  
**Site Completeness by Analyte – Flagging Statistics**

Matrix	Method	Analyte	Number of Samples
<b>WATER</b>			
	<b>E218.6</b>		
		<b>Chromium, Hexavalent, Dissolved</b>	34
		<i>Validation Flag Category:</i> FieldDuplicate	2 J Flags ( 5.88% ) for Field duplicate exceeds RPD criteria

Note: The total number of validation flags may exceed the actual number of samples if multiple flags were applied to the same sample. Consequently, the percentage of total flags (flags applied/number of samples) may exceed 100 percent.

\* The most severe flag for each analyte becomes the final validation flag.

**Qualifier Description:**

J = The analyte was positively identified, the quantitation is an estimate.

**TABLE 4**  
**Field Duplicate Precision – Qualified Data**

Method	Matrix	Sample ID	Analyte	Result	Field Duplicate Qualifier*	Criteria
E218.6	WATER		<b>Chromium, Hexavalent, Dissolved</b>			
		D-01-102014		147 UG/L	J	FD>RPD
		EPA-13-OB-102014		13.2 UG/L	J	FD>RPD

\* The most severe flag for each analyte becomes the final validation flag.

**Qualifier Description:**

J = The analyte was positively identified, the quantitation is an estimate.

**Criteria:**

FD>RPD = Field duplicate exceeds RPD criteria

**TABLE 5**  
**Site Completeness by Analyte – Qualified Data**

Method	Analyte	Units	Number of Occurrences					Contractor R-Flags	Total R-Flags	Contractor Completeness (%)	Overall Completeness (%)
			Analyses	Detects	Non- detects	Blank Flags	J-Flags				
E218.6	Chromium, Hexavalent, Dissolved	MG/L	28	28			2		100	100	
E218.6	Chromium, Hexavalent, Dissolved	UG/L	6	6			2		100	100	

**Attachment 5**  
**Groundwater Field Logs**

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**Low-Flow Groundwater Sampling: Field Data Sheet**

Well Number: <u>EPA-29-03</u>		Site: <u>Garfield Groundwater Contamination Superfund Site</u>	
Field Crew: <u>J. Balas + P. Reamer</u>		Date: <u>6/19/14</u>	Project #: <u>431007</u>
Well Depth (ft.): <u>19.65</u>	Purge Methodology:	Diameter	Gal. Per Foot
DTW (ft.): <u>10.37</u>	USEPA - Low Flow	<u>2"</u>	<u>.163</u>
Water Column (ft.): <u>9.28</u>	Sampling Procedures	3"	.367
Well Diameter (in.): <u>2</u>	with submersible pump	4"	.653
Gal. per ft.: <u>0.163</u>	Water Quality Meter:	Diameter	Gal. Per Foot
Well Volume (gal.): <u>1.51</u>	Horiba U-52	5"	1.020
Depth of Screen (ft.): <u>~15-20' BGS</u>		6"	1.469
		8"	2.611

Field Parameters												
Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity <sup>1</sup> (PPT)	Color/Odor	
Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%			
Initial	1454	10.92	400	1.5	4.06	13.58	1.59	535	2.81	254	0.8	Yellow / no odor
	1500	10.96	400	2.4	4.10	13.57	1.57	533	2.74	185	0.8	Dark Yellow / no od.
	1505	10.98	400	3.0	4.14	13.48	1.55	530	2.82	108	0.8	" / "
	1510	10.99	400	3.5	4.15	13.52	1.53	530	2.90	94.5	0.8	" / "
	1515	11.00	400	3.1	4.15	13.49	1.52	530	2.95	98.3	0.8	" / "
				3.	13.66	(DF)						
Post-Purge	1540	11.27	400	3.1	3.96	13.96	1.58	540	3.57	46.2	0.8	"

Remarks: Pump Intake Depth: 816 sample Control Box Setting (Hz): NA Sampling: (Sample at 100-250 ml/min) 200

16' BTIC

17.5'

Fe = 0.07 mg/l

**SAMPLING**

Depth to Water Before Sampling: 11.00

Sample Methodology: USEPA - Low Flow Sampling Procedures with submersible pump

Sample Name: EPA-29-03 QC Sample: NA

Sample Date/Time: 6/19/14 @ 1520

Sampler / Signature: P. Reamer

Filtered Metals Collected: (Y) (K) (P) (S) (V) (W) (Z) Filter Size: 0.45

Sample Observations: Yellow no odor

Notes: 1 = stabilization of this parameter is not required prior to collecting sample

Parameters: Select total + dissolved metals/anions / TOC / nitrate + nitrite

**Low-Flow Groundwater Sampling: Field Data Sheet**

<b>Well Number:</b> EPA-30-013		<b>Site:</b> Garfield Groundwater Contamination Superfund Site	
<b>Field Crew:</b> Balas		<b>Date:</b> 6/19/14	<b>Project #:</b> 431007
<b>Well Depth (ft.):</b> 21.40 <b>DTW (ft.):</b> 11.95 <b>Water Column (ft.):</b> 10.45 <b>Well Diameter (in.):</b> 2" <b>Gal. per ft.:</b> 163 <b>Well Volume (gal.):</b> 1.7 <b>Depth of Screen (ft.):</b> 17-22	<b>Purge Methodology:</b> USEPA - Low Flow Sampling Procedures with submersible pump		<b>Water Quality Meter:</b> Horiba U-52
	<b>Diameter</b>	<b>Gal. Per Foot</b>	<b>Diameter</b>
	2" .163	5"	1.020
	3" .367	6"	1.469
	4" .653	8"	2.611

Field Parameters											
Time	DTW (ft)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity <sup>1</sup> (PPT)	Color/Odor
Stabilization	< 0.3'	Purge at 200-500		± 0.1		± 3 %	± 10 mV	± 10%	± 10%		
Initial 1007	12.98	350	-	6.72	19.86	1.25	112	3.74	OR	.6	bram yellow
1021	12.71	300	1.0	6.25	18.16	1.07	107	.94	85.5	.7	yellow
1026	12.73	300	1.5	6.33	18.01	1.31	103	.89	56.2	.7	yellow/green
1031	12.78	300	1.8	6.35	18.02	1.30	101	.87	40.8	.7	yellow/green
1041	12.80	300	2.5	6.38	18.10	1.29	100	.92	16.9	.6	yellow/green
1046	12.75	300	2.8	6.41	18.12	1.29	104	.85	12.5	.6	yellow/green
1051	12.76	300	3.1	6.46	18.27	1.29	103	.83	12.6	.6	yellow/green
1056	12.72	300	3.6	6.77	18.35	1.29	103	.83	13.6	.6	yellow/green
1100	- collect sample										
Post-Purge 1130	12.75	200	-	6.50	16.82	1.34	101	2.97	55.2	.7	yellow/green

**Remarks:** Pump Intake Depth: ~ 20      Control Box Setting (Hz): 100      Sampling: (Sample at 100-250 ml/min) green

Cr VI - OR  
 Ferrous Iron - 0.00 mg/l

**SAMPLING**

Depth to Water Before Sampling: 12.69

Sample Methodology: USEPA - Low Flow Sampling Procedures with submersible pump

Sample Name: EPA-30-013-061914      QC Sample: none

Sample Date/Time: 6/19/14 1100

Sampler / Signature: \_\_\_\_\_

Filtered Metals Collected:  N      Filter Size: .45

Sample Observations:

Notes: 1 = stabilization of this parameter is not required prior to collecting sample

Parameters: select metals, anions, CH<sub>4</sub>, NO<sub>2</sub>, TOC, Cr VI, 6/19/14

105  
 .163  
 ---  
 315  
 630  
 105  
 ---  
 17.

**Low-Flow Groundwater Sampling: Field Data Sheet**

<b>Well Number:</b> EPA-13-03		<b>Site:</b> Garfield Groundwater Contamination Superfund Site	
<b>Field Crew:</b> J. Balas + D. Reamer		<b>Date:</b> 6-19-14 <b>Project #:</b> 431007	
<b>Well Depth (ft.):</b> 22 <del>32</del> 32.10 <b>DTW (ft.):</b> 11.98 <b>Water Column (ft.):</b> 20.12 <b>Well Diameter (in.):</b> 2 <b>Gal. per ft.:</b> 0.163 → 3.3 <b>Well Volume (gal.):</b> 22-32 <b>Depth of Screen (ft.):</b> 22-32	<b>Purge Methodology:</b> USEPA - Low Flow Sampling Procedures with submersible pump		<b>Diameter</b> <b>Gal. Per Foot</b>
	<b>Water Quality Meter:</b> Horiba U-52		<b>Diameter</b> <b>Gal. Per Foot</b>
		2"      .163	5"      1.020
		3"      .367	6"      1.469
		4"      .653	8"      2.811

**Field Parameters**

	Time	DTW (ft)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity <sup>1</sup> (PPT)	Color/Odor
	Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%		
Initial	1016	12.60	300	0.7	7.84	16.77	0.789	150	1.42	9.94	0.4	Yellowish green / no odor
	1021	12.62	300	1.2	7.79	16.86	0.791	150	1.24	6.42	0.4	" / "
	1026	12.64	300	1.7	7.76	16.48	0.794	150	1.16	5.62	0.4	" / "
	1031	12.64	300	2.1	7.76	16.83	0.796	149	1.05	5.20	0.4	" / "
	1036	12.65	300	2.4	7.75	16.83	0.800	149	1.09	3.10	0.4	" / "
	1041	12.65	300	2.7	7.74	16.84	0.803	149	1.08	3.09	0.4	" / "
	1046	12.65	300	3.2	7.74	16.91	0.806	149	1.12	2.85	0.4	
		<del>12.9</del> (PR)										
Post-Purge	1131	12.90	250	3.2	7.74	17.48	0.820	158	1.17	4.06	0.4	" / "

**Remarks:** Pump Intake Depth: 27' plus sample      Control Box Setting (Hz): 111      Sampling: (Sample at 100-250 ml/min) 250

Fe: 0.00mg/L

**SAMPLING**

**Depth to Water Before Sampling:** 16.65

**Sample Methodology:** USEPA - Low Flow Sampling Procedures with submersible pump

**Sample Name:** EPA-13-03-061914      **QC Sample:** Dup: D-06192014-01

**Sample Date/Time:** 6-19-14 @ 1050

**Sampler/Signature:** D. Reamer

**Filtered Metals Collected:** (V) Ni      **Filter Size:** 0.45

**Sample Observations:** Yellowish green color

**Notes:** 1 = stabilization of this parameter is not required prior to collecting sample

**Parameters:** Cu, metals, TOC, anions, nitrate/nitrite (select)

**Low-Flow Groundwater Sampling: Field Data Sheet**

Well Number: <u>EPA-31-0B</u>		Site: <u>Garfield Groundwater Contamination Superfund Site</u>	
Field Crew: <u>J. Balas / D. Ream</u>		Date: <u>6/19/14</u>	Project #: <u>431007</u>
Well Depth (ft.): <u>24.91</u>	Purge Methodology:	Diameter	Gal. Per Foot
DTW (ft.): <u>11.98</u>	USEPA - Low Flow	<u>2"</u>	<u>.163</u>
Water Column (ft.):	Sampling Procedures	3"	.367
Well Diameter (in.): <u>2</u>	with submersible pump	4"	.653
Gal. per ft.: <u>0.163</u>	Water Quality Meter:	Diameter	Gal. Per Foot
Well Volume (gal.):	Horiba U-52	5"	1.020
Depth of Screen (ft.): <u>15-25</u>		6"	1.469
		8"	2.611

Field Parameters												
Time	DTW (ft)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity <sup>1</sup> (PPT)	Color/Odor	
Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%			
Initial	1329	12.90	300	1.55	6.24	16.62	1.68	184	2.60	275	1.8	dark yellow
	1334	12.95	300	1.6	6.23	16.45	1.67	187	2.24	189	0.8	" "
	1349	12.98	300	3.0	6.22	16.19	1.69	194	2.09	69.6	0.9	" "
	1359	12.98	300	3.7	6.22	16.14	1.90	195	1.78	33.9	0.9	" "
	1404	12.98	300	4.0	6.21	16.02	1.72	196	1.64	22.5	0.9	" "
	1409	12.98	300	4.4	6.16	16.72	1.73	199	1.51	21.4	0.9	" "
	1414	12.98	300	4.8	6.12	16.87	1.74	202	1.47	22.6	0.9	" "
	1419	12.98	300	5.1	6.11	16.90	1.75	202	1.79	20.9	0.9	" "
	1425	collect sample										
Post-Purge	1445	12.98	200	-	6.22	16.24	1.77	207	1.86	47.9	0.9	yellow

Remarks: Pump Intake Depth: \_\_\_\_\_ Control Box Setting (Hz): \_\_\_\_\_ Sampling: (Sample at 100-250 ml/min)

~ 20.5 BTIC started at 1316

Ferrous Iron - 0.0 mg/L

Cr VI check - OR

**SAMPLING**

Depth to Water Before Sampling: 12.91

Sample Methodology: USEPA - Low Flow Sampling Procedures with submersible pump

Sample Name: EPA-31-0B-061914 QC Sample: None

Sample Date/Time: 6/19/14 1425

Sampler / Signature: \_\_\_\_\_

Filtered Metals Collected: Y Filter Size: \_\_\_\_\_

Sample Observations:

Notes: 1 = stabilization of this parameter is not required prior to collecting sample

Parameters: select metals (dissolved) anions, NOx, NH4, TOC, sulfates, Cr VI

### Low-Flow Groundwater Sampling: Field Data Sheet

<b>Well Number:</b> EPA-32-013 <b>Field Crew:</b> J. Balas / P. Ream <b>Well Depth (ft.):</b> 19.92 <b>DTW (ft.):</b> 12.40 <b>Water Column (ft.):</b> 7.52 <b>Well Diameter (in.):</b> 2 <b>Gal. per ft.:</b> 0.163 <b>Well Volume (gal.):</b> → 1.2 <b>Depth of Screen (ft.):</b> -10-20 BGS	<b>Site:</b> Garfield Groundwater Contamination Superfund Site <b>Date:</b> _____ <b>Project #:</b> 431007 <b>Pump Methodology:</b> USEPA - Low Flow Sampling Procedures with submersible pump <b>Water Quality Meter:</b> Horiba U-52																
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Diameter</th> <th>Gal. Per Foot</th> <th>Diameter</th> <th>Gal. Per Foot</th> </tr> </thead> <tbody> <tr> <td>2"</td> <td>.163</td> <td>5"</td> <td>1.020</td> </tr> <tr> <td>3"</td> <td>.367</td> <td>6"</td> <td>1.469</td> </tr> <tr> <td>4"</td> <td>.653</td> <td>8"</td> <td>2.611</td> </tr> </tbody> </table>		Diameter	Gal. Per Foot	Diameter	Gal. Per Foot	2"	.163	5"	1.020	3"	.367	6"	1.469	4"	.653	8"	2.611
Diameter	Gal. Per Foot	Diameter	Gal. Per Foot														
2"	.163	5"	1.020														
3"	.367	6"	1.469														
4"	.653	8"	2.611														

Field Parameters												
Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity <sup>1</sup> (PPT)	Color/Odor	
Stabilization	< 0.3'	Purge at 200-500		± 0.1		± 3 %	± 10 mV	± 10%	± 10%			
Initial	1330	12.77	300	0.9	4.80	15.77	1.33	454	2.41	over	0.7	Yellowish brown/none
	1343	12.86	300	2.0	4.70	15.11	1.36	472	2.30	38.3	0.7	Brownish yellow/none
	1348	12.90	300	2.6	4.70	15.28	1.37	472	2.25	16.1	0.7	Dark yellow/none
	1358	12.92	300	3.0	4.71	15.31	1.38	472	2.17	12.8	0.7	" / "
	1358	12.93	300	3.4	4.72	15.29	1.39	472	2.13	10.5	0.7	" / "
	1403	12.94	300	3.8	4.73	15.36	1.40	474	2.15	9.67	0.7	" / "
	1408	12.96	300	4.3	4.75	15.43	1.41	474	2.14	9.73	0.7	" / "
	142	(DN) (DN)	250									
Post-Purge	1428	13.15	250	4.3	4.70	15.30	1.46	469	3.44	36.3	0.7	" / "

**Remarks:** Pump Intake Depth: <sup>plus sample</sup> -19' BTIC Control Box Setting (Hz): 44.99 Sampling: (Sample at 100-250 ml/min) 250  
 Ferrous Iron = 0.00 mg/l

**SAMPLING**

Depth to Water Before Sampling: 12.96  
 Sample Methodology: USEPA - Low Flow Sampling Procedures with submersible pump  
 Sample Name: EPA-32-013-061914 QC Sample: None  
 Sample Date/Time: 6/19/14 @ 1410  
 Sampler / Signature: David Ream  
 Filtered Metals Collected: YDN Filter Size: 0.45  
 Sample Observations: yellow / no odor  
 Notes: 1 = stabilization of this parameter is not required prior to collecting sample  
 Parameters: Select total + dissolved metals / Anions / Nitrite + Nitrate / Hex chromium

### Low-Flow Groundwater Sampling: Field Data Sheet

Well Number: <u>EPA-30-03</u>	Site: <u>Garfield Groundwater Contamination Superfund Site</u>																				
Field Crew: <u>T. SHELTON / T. B. ALLEN</u>	Date: <u>7/29/14</u> Project #: <u>431007</u>																				
Well Depth (ft.): <u>21.40</u>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="4">Purge Methodology:</th> </tr> <tr> <td>Diameter</td> <td>Gal. Per Foot</td> <td>Diameter</td> <td>Gal. Per Foot</td> </tr> <tr> <td>2"</td> <td>.163</td> <td>5"</td> <td>1.020</td> </tr> <tr> <td>3"</td> <td>.367</td> <td>6"</td> <td>1.469</td> </tr> <tr> <td>4"</td> <td>.653</td> <td>8"</td> <td>2.611</td> </tr> </table>	Purge Methodology:				Diameter	Gal. Per Foot	Diameter	Gal. Per Foot	2"	.163	5"	1.020	3"	.367	6"	1.469	4"	.653	8"	2.611
Purge Methodology:																					
Diameter		Gal. Per Foot	Diameter	Gal. Per Foot																	
2"		.163	5"	1.020																	
3"		.367	6"	1.469																	
4"	.653	8"	2.611																		
DTW (ft.): <u>12.65'</u>	USEPA - Low Flow																				
Water Column (ft.): <u>8.75'</u>	Sampling Procedures with submersible pump																				
Well Diameter (in.): <u>2"</u>	Water Quality Meter:																				
Gal. per ft.: <u>0.163</u>	Horiba U-52																				
Well Volume (gal.): <u>1.42</u>																					
Depth of Screen (ft.): <u>17-22</u>																					

**Field Parameters**

Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity <sup>1</sup> (PPT)	Color/Odor
Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%		
<u>267 Initial</u> 1259	<u>15.17</u>	<u>650</u>	<u>0.5</u>	<u>6.63</u>	<u>17.11</u>	<u>1.30</u>	<u>158</u>	<u>2.47</u>	<u>408</u>	<u>0.10</u>	<u>Yellow - Brown</u>
<u>140</u> 1304	<u>14.00</u>	<u>600</u>	<u>0.8</u>	<u>6.71</u>	<u>16.66</u>	<u>1.20</u>	<u>153</u>	<u>0.00</u>	<u>235</u>	<u>0.10</u>	<u>Yellow</u>
<u>193</u> 1309	<u>14.55</u>	<u>500</u>	<u>1.4</u>	<u>6.74</u>	<u>16.92</u>	<u>1.25</u>	<u>149</u>	<u>0.00</u>	<u>273</u>	<u>0.10</u>	<u>Yellow</u>
<u>182</u> 1314	<u>14.60</u>	<u>450</u>	<u>2.0</u>	<u>6.74</u>	<u>16.90</u>	<u>1.24</u>	<u>150</u>	<u>0.00</u>	<u>264</u>	<u>0.10</u>	<u>Yellow</u>
<u>175</u> 1319	<u>14.58</u>	<u>450</u>	<u>2.6</u>	<u>6.74</u>	<u>16.91</u>	<u>1.24</u>	<u>150</u>	<u>0.00</u>	<u>255</u>	<u>0.10</u>	<u>Yellow</u>
<u>1724</u>				<u>COLLECT SAMPLE</u>							
<u>1324</u>	<u>14.57</u>	<u>500</u>	<u>3.3</u>	<u>6.73</u>	<u>16.91</u>	<u>1.24</u>	<u>151</u>	<u>0.00</u>	<u>258</u>	<u>0.10</u>	<u>Yellow</u>
<u>1329</u>				<u>COLLECT SAMPLE</u>							
<u>170 Post-Purge</u> 1310	<u>14.60</u>	<u>500</u>	<u>5</u>	<u>6.74</u>	<u>17.50</u>	<u>1.23</u>	<u>151</u>	<u>0.00</u>	<u>207</u>	<u>0.10</u>	<u>Yellow</u>

Remarks: Pump Intake Depth: 20' Control Box Setting (Hz): 100 Hz @ 1259 Sampling: (Sample at 100-250 ml/min)  
FC → 0.50 mg/L 96 Hz @ 1304  
CFC → 0.70 LIMIT 93 Hz @ 1309  
\* DID NOT COLLECT SAMPLE DUE TO TURBIDITY @ 1324; COLLECT @ 1329

**SAMPLING**

Depth to Water Before Sampling: \_\_\_\_\_

Sample Methodology: USEPA - Low Flow Sampling Procedures with submersible pump

Sample Name: \_\_\_\_\_ QC Sample: \_\_\_\_\_

Sample Date/Time: 13:29 7/29/14

Sampler / Signature: \_\_\_\_\_

Filtered Metals Collected: Y / N Filter Size: \_\_\_\_\_

Sample Observations: \_\_\_\_\_

Notes: 1 = stabilization of this parameter is not required prior to collecting sample

Parameters: \_\_\_\_\_

### Low-Flow Groundwater Sampling: Field Data Sheet

Well Number: <u>EAP-13-03</u>	Site: <u>Garfield Groundwater Contamination Superfund Site</u>																				
Field Crew: <u>J. SANCHEZ / J. BILALIS</u>	Date: <u>7/24/14</u> Project #: <u>431007</u>																				
Well Depth (ft.): <u>21.90 32.10</u>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="4">Purge Methodology:</th> </tr> <tr> <td>Diameter</td> <td>Gal. Per Foot</td> <td>Diameter</td> <td>Gal. Per Foot</td> </tr> <tr> <td>2"</td> <td>.163</td> <td>5"</td> <td>1.020</td> </tr> <tr> <td>3"</td> <td>.367</td> <td>6"</td> <td>1.469</td> </tr> <tr> <td>4"</td> <td>.653</td> <td>8"</td> <td>2.611</td> </tr> </table>	Purge Methodology:				Diameter	Gal. Per Foot	Diameter	Gal. Per Foot	2"	.163	5"	1.020	3"	.367	6"	1.469	4"	.653	8"	2.611
Purge Methodology:																					
Diameter		Gal. Per Foot	Diameter	Gal. Per Foot																	
2"		.163	5"	1.020																	
3"		.367	6"	1.469																	
4"	.653	8"	2.611																		
DTW (ft.): <u>12.42</u>	USEPA - Low Flow																				
Water Column (ft.): <u>19.68</u>	Sampling Procedures																				
Well Diameter (in.): <u>2"</u>	with submersible pump																				
Gal. per ft.: <u>0.163</u>	Water Quality Meter:																				
Well Volume (gal.): <u>3.3</u>	Horiba U-52																				
Depth of Screen (ft.): <u>11.22 22.32</u>																					

Initial

86

108

121

120

142

140

137

150 Post-Purge

Field Parameters												
Time	DTW (ft)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity <sup>1</sup> (PPT)	Color/Odor	
Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%			
1104	14.60	900	1.5	7.43	16.76	0.886	75	0.18	59.1	0.4	MILKY WHITE	
1109	14.67	900	2.5	7.54	16.36	0.938	34	0.00	124	0.5	" "	
1114	14.67	650	3.25	7.64	16.29	0.954	23	0.00	167	0.5	" "	
1119	13.41	500	3.9	7.72	17.82	0.945	15	0.00	161	0.5	CLEARING UP	
1124	13.11	450	4.4	7.72	18.58	0.958	16	0.00	192	0.5	CLEAR SUBFLO	
1129	13.11	450	4.9	7.72	18.86	0.957	17	0.00	194	0.5	" "	
1134	13.10	450	5.4	7.74	19.01	0.954	17	0.00	191	0.5	" "	
1139				SAMPLE COLLECTED								
1155				7.74	18.99	0.956	19	0.00	212	0.5	CLEAR, SCREAMY	

Remarks: Pump Intake Depth: 27'      Control Box Setting (Hz): 115 Hz @ 1104      Sampling: (Sample at 100-250 ml/min)

111 Hz @ 1109

108 Hz @ 1114

Fe → 0.00 mg/L

Cr6 → 0.70 mg/L LIMIT

SAMPLING	
Depth to Water Before Sampling: <u>13.10</u>	
Sample Methodology: <u>USEPA - Low Flow Sampling Procedures with submersible pump</u>	
Sample Name:	QC Sample:
Sample Date/Time: <u>11:39 7/29/14</u>	
Sampler / Signature: <u>[Signature]</u>	
Filtered Metals Collected: <u>Y / N</u> Filter Size:	
Sample Observations: <u>Clear, slightly milky appearance</u>	
Notes: 1 = stabilization of this parameter is not required prior to collecting sample	
Parameters:	

### Low-Flow Groundwater Sampling: Field Data Sheet

Well Number: <u>EPA-32-03</u>		Site: <u>Garfield Groundwater Contamination Superfund Site</u>	
Field Crew: <u>T. R. AUSTIN, K. J. B. M. A. S.</u>		Date: <u>7/29/14</u>	Project #: <u>431007</u>
Well Depth (ft.): <u>19.92</u>	Purge Methodology:	Diameter	Gal. Per Foot
DTW (ft.): <u>13.01</u>	USEPA - Low Flow	2"	.163
Water Column (ft.): <u>6.91</u>	Sampling Procedures	5"	1.020
Well Diameter (in.): <u>2"</u>	with submersible pump	6"	1.469
Gal. per ft.: <u>0.163</u>	Water Quality Meter:	8"	2.611
Well Volume (gal.): <u>1.13</u>	Horiba U-52		
Depth of Screen (ft.): <u>10.2 - 19.92</u>			

Field Parameters												
Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity <sup>1</sup> (PPT)	Color/Odor	
Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3%	+/- 10 mV	+/- 10%	+/- 10%			
451 Initial	13.96	300	0.2	5.77	19.26	1.35	265	2.50	757	0.7	Yellow - 3000 NTU	
328	14.10	300	0.7	4.97	19.43	1.28	329	0.20	439	0.6	" "	
371	14.02	300	1.1	4.80	19.89	1.30	343	0.11	339	0.6	" "	
425	14.07	300	1.6	4.78	20.29	1.31	343	0.00	569	0.7	Yellow	
193	14.19	300	2.1	4.68	19.86	1.33	355	0.00	241	0.7	" "	
447	14.25	300	2.6	4.59	19.52	1.38	370	0.06	116	0.7	Yellow	
493	14.29	300	3.2	4.52	19.44	1.39	380	0.09	69.0	0.7	Yellow	
36.4	14.29	300	3.8	4.47	19.49	1.41	387	0.06	51.6	0.7	Yellow	
31.5	14.30	300	4.4	4.45	19.46	1.42	390	0.03	44.6	0.7	Yellow	
25.0	14.29	300	5.0	4.43	19.45	1.43	394	0.00	36.5	0.7	Yellow	
21.5	14.31	300	5.6	4.40	19.41	1.44	399	0.00	30.9	0.7	Yellow	
22.1 Post-Purge	14.30	300	6.2	4.39	19.41	1.45	401	0.00	29.2	0.9	Yellow	

Remarks: Pump Intake Depth: 17' Control Box Setting (Hz): 85 Hz @ 1449 Sampling: (Sample at 100-250 ml/min)

Fe → 0.01 mg/L      90 Hz @ 1450

Cd → 0.70 mg/L LIMIT

FLIP OVER

**SAMPLING**

Depth to Water Before Sampling: \_\_\_\_\_

Sample Methodology: USEPA - Low Flow Sampling Procedures with submersible pump

Sample Name: \_\_\_\_\_ QC Sample: D-07292014-01

Sample Date/Time: 16:00 7/29/14 0800

Sampler / Signature: [Signature]

Filtered Metals Collected: Y / N Filter Size: \_\_\_\_\_

Sample Observations: \_\_\_\_\_

Notes: 1 = stabilization of this parameter is not required prior to collecting sample

Parameters: \_\_\_\_\_

CONT. ON BACK

TURB	TIME	DTW	Flav	Vol	PH	TEMP	COND	ORP	DO	TURB	SAL
32.0	1551	14.30	300	6.7	4.38	19.36	1.45	403	0.00	53.0	0.7
31.2	1560	14.31	300	7.2	4.37	19.57	1.45	404	0.00	47.1	0.7
30.4	1601	14.30	300	7.7	4.35	19.56	1.45	406	0.00	39.2	0.7

COLLECT SAMPLE

88.3									(DROPPING)		
OST → 1622		14.00	300	8.5	4.53	20.09	1.49	407	0.81	221	0.7

### Low-Flow Groundwater Sampling: Field Data Sheet

Well Number: <u>EPA-29-0B</u> Field Crew: <u>T. S. HOSKINSON</u> Well Depth (ft.): <u>19.65</u> DTW (ft.): <u>10.67</u> Water Column (ft.): <u>8.98</u> Well Diameter (in.): <u>2</u> Gal. per ft.: <u>.163</u> Well Volume (gal.): <u>1246</u> Depth of Screen (ft.): <u>15-20</u>	Site: <b>Garfield Groundwater Contamination Superfund Site</b> Date: <u>7/30/14</u> Project #: <b>431007</b> Purge Methodology: USEPA - Low Flow Sampling Procedures with submersible pump Water Quality Meter: Horiba U-52																
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Diameter</th> <th>Gal. Per Foot</th> <th>Diameter</th> <th>Gal. Per Foot</th> </tr> </thead> <tbody> <tr> <td>2"</td> <td>.163</td> <td>5"</td> <td>1.020</td> </tr> <tr> <td>3"</td> <td>.367</td> <td>6"</td> <td>1.469</td> </tr> <tr> <td>4"</td> <td>.653</td> <td>8"</td> <td>2.611</td> </tr> </tbody> </table>		Diameter	Gal. Per Foot	Diameter	Gal. Per Foot	2"	.163	5"	1.020	3"	.367	6"	1.469	4"	.653	8"	2.611
Diameter	Gal. Per Foot	Diameter	Gal. Per Foot														
2"	.163	5"	1.020														
3"	.367	6"	1.469														
4"	.653	8"	2.611														

Field Parameters												
Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity <sup>1</sup> (PPT)	Color/Odor	
Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%			
Initial	11:50	12.15	400	0.2	3.62	15.10	1.75	470	4.62	OVER	1.0	Yellow-CREAMY
	11:55	11.23	400	0.9	3.65	17.05	1.71	464	0.00	788	0.9	" "
	12:00	11.22	450	1.7	3.58	17.77	1.69	472	0.00	607	0.9	" "
	12:05	11.23	450	2.4	3.58	18.02	1.71	473	0.00	577	0.9	" "
	12:10	11.21	400	3.0	3.62	18.46	1.70	470	0.00	559	0.9	" "
	12:15	11.22	400	3.7	3.62	17.49	1.71	470	0.51	434	0.9	" "
	12:20	11.38	400	4.2	3.05	17.70	1.69	468	0.27	402	0.9	" "
	12:25	11.32	400	4.9	3.65	17.21	1.69	469	0.00	354	0.8	" "
	12:30	11.31	400	5.5	3.66	17.54	1.68	469	0.00	346	0.8	" "
	12:35	11.32	400	6.1	3.64	17.70	1.69	470	0.00	359	0.9	" "
	12:40				COLLECT	SAMPLE						
Post-Purge	1:04	11.28			3.53	17.13	1.74	480	0.00	436	0.9	

Remarks: Pump Intake Depth: 17.5 Control Box Setting (Hz): 120 Hz @ 11:50  
100 Hz @ 11:52  
90 Hz @ 11:57  
Fe → 0.00  
Cr6 → 0.70 LIMIT  
MICR

**SAMPLING**

Depth to Water Before Sampling: 11.32

Sample Methodology: USEPA - Low Flow Sampling Procedures with submersible pump

Sample Name: EPA-29-0B-073014 QC Sample:

Sample Date/Time: 1240 7/30/14

Sampler / Signature:

Filtered Metals Collected: Y / N Filter Size:

Sample Observations:

Notes: 1 = stabilization of this parameter is not required prior to collecting sample

Parameters:

### Low-Flow Groundwater Sampling: Field Data Sheet

Well Number: <u>EPA-31-03</u>						Site: <u>Garfield Groundwater Contamination Superfund Site</u>					
Field Crew: <u>T. SHERBORN</u>						Date: <u>7/30/14</u>			Project #: <u>431007</u>		
Well Depth (ft.): <u>24.91</u>						<u>Purge</u> Methodology:					
DTW (ft.): <u>12.90</u>						USEPA - Low Flow					
Water Column (ft.): <u>12.01</u>						Sampling Procedures					
Well Diameter (in.): <u>2</u>						with submersible pump					
Gal. per ft.: <u>0.103</u>						<u>Water Quality Meter:</u>					
Well Volume (gal.): <u>1.957</u>						Horiba U-52					
Depth of Screen (ft.): <u>15-25</u>											
Field Parameters											
Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity <sup>1</sup> (PPT)	Color/Odor
Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%		
Initial	0923	14.54	900	0.4	5.15	15.93	140	247	10.74	0.7	Yellow
	0929	13.65	600	1.3	5.75	16.49	160	247	6.64	0.8	Yellow
	0933	13.67	400	2.0	5.78	16.84	163	250	6.08	0.8	Yellow
	0938	13.40	400	2.7	5.80	16.86	164	250	5.54	0.8	Yellow
	0943	13.82	400	3.4	5.86	16.41	167	248	4.73	0.8	Yellow
	0948	13.80	400	4.1	5.90	16.82	169	249	3.95	0.9	Yellow
	0953	13.78	400	4.8	5.92	17.22	169	251	3.43	0.9	Yellow
	0958	13.77	400	5.5	5.93	18.18	169	252	2.98	0.9	Yellow
	1003	13.35	400	6.1	5.94	18.13	170	252	2.70	0.9	" "
	1008	13.30	400	6.6	5.94	18.42	170	253	2.30	0.9	" "
	1013	13.30	400	7.1	5.94	18.56	170	254	2.06	0.9	" "
Post-Purge	1018	13.29	400	7.7	5.95	18.39	172	256	1.54	0.9	" "
Remarks: <u>Pump Intake Depth: 20.5</u> <u>Control Box Setting (Hz): 94Hz @ 0920, 87Hz @ 0929, 85Hz @ 1000</u> <u>Sampling: (Sample at 100-250 ml/min)</u> <u>Fe → 0.00</u> <u>Cd → 0.70 LIMIT</u> <u>Yellow color is bold, mostly opaque</u>											
SAMPLING											
Depth to Water Before Sampling: <u>13.40</u>											
Sample Methodology: <u>USEPA - Low Flow Sampling Procedures with submersible pump</u>											
Sample Name: <u>EPA-31-03-073014</u>						QC Sample:					
Sample Date/Time: <u>1019 7/30/14</u>											
Sampler / Signature:											
Filtered Metals Collected: <u>Y / N</u> Filter Size:											
Sample Observations:											
Notes: 1 = stabilization of this parameter is not required prior to collecting sample											
Parameters:											

TIME	DTW	Flow	VEL	PH	TEMP	COND	ORP	DO	TURB	SILK	Color
1023	13.41	400	8.3	5.98	17.20	1.73	256	1.04	281	0.9	Yellow
1028	13.40	400	8.9	5.98	17.74	1.73	257	0.64	278	0.9	Yellow
1033	13.43	400	9.6	6.00	17.77	1.74	258	0.35	269	0.9	Yellow
1038	13.44	400	10.3	6.01	17.91	1.74	259	0.02	260	0.9	Yellow
1044	13.40	400	10.4	6.02	17.48	1.74	259	0.0	256	0.9	Yellow
1079	SAMPLE										
1105 (Post)	13.38	400	~12	6.03	17.68	1.75	261	0.05	264	0.9	Yellow

SOP No-24b: Pilot Test Direct-Push Groundwater sampling

Low-Flow Groundwater Sampling: Field Data Sheet

Well Number: E-16.5-18.5				Site: Carthage 12						
Field Crew: Balas				Date: 7/29/14 Project #: 431007.06-06.02						
Well Depth (ft.): DTW		Purge Methodology: peristaltic		Diameter		Gal. Per Foot				
DTW (ft.): 13.12				2"		.163				
Water Column (ft.):				3"		.367				
Well Diameter (in.): 16.5-18.5				4"		.653				
Gal. per ft.:		Water Quality Meter:		5"		1.020				
Well Volume (gal.):				6"		1.469				
Depth of Screen (ft.):				8"		2.611				
Field Parameters										
Time	DTW (ft)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Color/Odor
Stabilization	< 0.3'	300 - 500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%	
1212	N/A	N/A	N/A	5.18	25.64	1.49	343	4.05	OK	Reddish brown
Blank										
Remarks: Pump Intake Depth: Control Box Setting (Hz):										
Interval does not produce a continuous flow of water - will grab readings + sample										
SAMPLING										
Depth to Water Before Sampling:										
Sample Methodology: grab										
Sample Name: HW-E-16.5-18.5 QC Sample: none										
Sample Date/Time: 7/29/14 1220										
Sampler / Signature:										
Filtered Metals Collected: TTN Filter Size:										
Sample Observations:										
Parameters: TOC / sulfate										

Fe Ion = .05 mg/L  
 Cr VI = 8.70 mg/L - over range

# SOP No-24b: Pilot Test Direct-Push Groundwater sampling

## Low-Flow Groundwater Sampling: Field Data Sheet

Well Number: <b>B-12-14</b>					Site: <b>Garfield</b>						
Field Crew: <b>Bales</b>					Date: <b>7/29/14</b> Project #: <b>781007.06.06.02</b>						
Well Depth (ft.): <b>14.1</b>		Purge Methodology: <b>Peristaltic</b>		Diameter		Gal. Per Foot		Diameter		Gal. Per Foot	
DTW (ft.): <b>12.72</b>				2"		.163		5"		1.020	
Water Column (ft.): <b>12-14'</b>				3"		.367		6"		1.469	
Well Diameter (in.): <b>12-14'</b>				4"		.653		8"		2.611	
Gal. per ft.:		Water Quality Meter: <b>N/A</b>									
Well Volume (gal.):											
Depth of Screen (ft.): <b>12-14</b>											
Field Parameters											
Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Color/Odor	
Stabilization	< 0.3'	300 - 500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%		
N/A Blank											
Remarks: Pump Intake Depth: _____ Control Box Setting (Hz): _____ Does not produce much water - only enough for sample containers. Purge/sample water has yellowish coloring indicative of high Cr VI											
SAMPLING											
Depth to Water Before Sampling: _____											
Sample Methodology: <b>Peristaltic GW-B-12-14</b>											
Sample Name: <b>B-12-14 GW-B-12-14</b> QC Sample: <b>none</b>											
Sample Date/Time: <b>7/29/14 1350</b>											
Sampler / Signature: _____											
Filtered Metals Collected: <input checked="" type="checkbox"/> Y / <input type="checkbox"/> N Filter Size: _____											
Sample Observations: _____											
Parameters: <b>TOT sulfates</b>											

SOP No-24b: Pilot Test Direct-Push Groundwater sampling

Low-Flow Groundwater Sampling: Field Data Sheet

Well Number: <del>E-13-15</del> E-13-15					Site: Gert's 1d					
Field Crew: Balas					Date: 7/29 Project #: 431007.06.06.02					
Well Depth (ft.): 15-13 DTW (ft.): 13.10 Water Column (ft.): Well Diameter (in.): Gal. per ft.: Well Volume (gal.): Depth of Screen (ft.): 13-15					Purge Methodology: peristaltic Water Quality Meter: Hanna U-53					
Diameter					Gal. Per Foot					
2"					.163					
3"					.367					
4"					.653					
Diameter					Gal. Per Foot					
5"					1.020					
6"					1.469					
8"					2.611					
Field Parameters										
Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Color/Odor
Stabilization	< 0.3'	300 - 500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%	
1525	N/A	N/A	N/A	4.37	28.01	1.45	376		OR	yellowish Red/none
Blank										
Remarks: Pump Intake Depth: Control Box Setting (Hz):										
Peristaltic pump Fe - 0.0 mg/L Cr VI - 7.70 mg/L over range										
SAMPLING										
Depth to Water Before Sampling: N/A										
Sample Methodology: Peristaltic										
Sample Name: GW-E-13-15 QC Sample: none										
Sample Date/Time: 7/29/14 15:40										
Sampler / Signature:										
Filtered Metals Collected: Y <input checked="" type="checkbox"/> N <input type="checkbox"/> Filter Size:										
Sample Observations:										
Parameters: TOC / SVI Gate										



# SOP No-24b: Pilot Test Direct-Push Groundwater sampling

## Low-Flow Groundwater Sampling: Field Data Sheet

Well Number: <b>C-10.5-12.5</b>					Site: <b>Garfield</b>						
Field Crew: <b>Balas</b>					Date: <b>7/29/14</b> Project #: <b>431007.06.06.02</b>						
Well Depth (ft.): <b>12.8</b>					Purge Methodology:						
DTW (ft.): <b>10.9</b>					Diameter		Gal. Per Foot		Diameter		Gal. Per Foot
Water Column (ft.):					2"		.163		5"		1.020
Well Diameter (in.): <b>10.5-12.5</b>					3"		.367		6"		1.469
Gal. per ft.:					4"		.653		8"		2.611
Well Volume (gal.):					Water Quality Meter:						
Depth of Screen (ft.):											
Field Parameters											
Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Color/Odor	
Stabilization	< 0.3'	300 - 500		+/- 0.1		+/- 3%	+/- 10 mV	+/- 10%	+/- 10%		
<b>1650</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>6.82</b>	<b>27.15</b>	<b>1.02</b>	<b>322</b>	<b>3.98</b>	<b>NA</b>	<b>white milky/noise</b>	
<b>Blank</b>											
Remarks: Pump Intake Depth: Control Box Setting (Hz):											
<b>Fe - 263 mg/L</b> <b>Cr VI - 1.70 mg/L</b> <b>over range</b>											
SAMPLING											
Depth to Water Before Sampling:											
Sample Methodology: <b>perzaltic</b>											
Sample Name: <b>GW-C-10.5-12.5</b>					QC Sample: <b>none</b>						
Sample Date/Time: <b>7/29/14 1655</b>											
Sampler / Signature: 											
Filtered Metals Collected: <input checked="" type="checkbox"/> Y <input type="checkbox"/> N Filter Size:											
Sample Observations:											
Parameters: <b>POC / sulfate</b>											

# SOP No-24b: Pilot Test Direct-Push Groundwater sampling

## Low-Flow Groundwater Sampling: Field Data Sheet

Well Number: <u>A-14-16</u>				Site: <u>Garfield</u>						
Field Crew: <u>Balas</u>				Date: <u>7/30/14</u>		Project #: <u>471007.06.00.03</u>				
Well Depth (ft.): <u>15.8</u>		Purge Methodology: <u>peristaltic</u>		Diameter	Gal. Per Foot	Diameter	Gal. Per Foot			
DTW (ft.): <u>12.5</u>				2"	.163	5"	1.020			
Water Column (ft.):				3"	.367	6"	1.469			
Well Diameter (in.):				4"	.653	8"	2.611			
Gal. per ft.:		Water Quality Meter: <u>Hanba U-52</u>								
Well Volume (gal.):										
Depth of Screen (ft.):										
Field Parameters										
Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Color/Odor
Stabilization	< 0.3'	300 - 500		+/- 0.1		+/- 3%	+/- 10 mV	+/- 10%	+/- 10%	
<u>0730</u>	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>	<u>3.79</u>	<u>18.45</u>	<u>2.02</u>	<u>435</u>	<u>2.13</u>	<u>586</u>	<u>yellow</u>
Blank										
Remarks: Pump Intake Depth: _____ Control Box Setting (Hz): _____										
<p><u>Fe - .35 mg/L</u>  <u>Cr VI - 7.70 mg/L</u>  <u>over range</u></p>										
SAMPLING										
Depth to Water Before Sampling: _____										
Sample Methodology: <u>Peristaltic</u>										
Sample Name: <u>GW-A-14-16</u>						QC Sample: <u>none</u>				
Sample Date/Time: <u>7/30/14 0730</u>										
Sampler / Signature: <u>[Signature]</u>										
Filtered Metals Collected: <u>Y / N</u> Filter Size: _____										
Sample Observations: _____										
Parameters: <u>DC, sulfate</u>										

# SOP No-24b: Pilot Test Direct-Push Groundwater sampling

## Low-Flow Groundwater Sampling: Field Data Sheet

Well Number: <b>CA 17.5-19.5</b>				Site: <b>Garter 1b</b>			
Field Crew: <b>Balas</b>				Date: <b>7/30/14</b> Project #: <b>431007.06-06.02</b>			
Well Depth (ft.): <b>19.5'</b>		Purge Methodology: <b>peristaltic</b>		Diameter		Gal. Per Foot	
DTW (ft.): <b>11.2</b>		Water Column (ft.): <b>N/A</b>		Well Diameter (in.): <b>N/A</b>		Gal. Per Foot	
Gal. per ft.: <b>17.5/19.5</b>		Water Quality Meter: <b>Hanna US</b>		2"		.163	
Well Volume (gal.): <b>17.5/19.5</b>		Depth of Screen (ft.): <b>17.5/19.5</b>		3"		.367	
				4"		.653	
				5"		1.020	
				6"		1.469	
				8"		2.611	

Field Parameters										
Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Color/Odor
Stabilization	< 0.3'	300 - 500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%	
<b>1015</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>5.72</b>	<b>21.88</b>	<b>1.18</b>	<b>176</b>	<b>43</b>	<b>OR</b>	<b>reddish yellow</b>
Blank										

**Remarks:** Pump Intake Depth: \_\_\_\_\_ Control Box Setting (Hz): \_\_\_\_\_

Cr VI - 7.70 mg/L over range  
Fe Iron - 3.30 mg/L over range

**SAMPLING**

Depth to Water Before Sampling: _____	
Sample Methodology: <b>peristaltic</b>	QC Sample: <b>0-0730-2014-01-02800</b>
Sample Name: <b>CA-17.5-19.5</b>	Filter Size: <b>TOC only</b>
Sample Date/Time: <b>7/30/14 10:20</b>	
Sampler / Signature: _____	
Filtered Metals Collected: <b>Y / O</b>	
Sample Observations: <b>refusal at 19.5'</b>	
Parameters: <b>TOC / sulfate</b>	

SOP No-24b: Pilot Test Direct-Push Groundwater sampling

Low-Flow Groundwater Sampling: Field Data Sheet

Well Number: <u>D-13-15</u>					Site: <u>Garfield Superfund</u>							
Field Crew: <u>Balas</u>					Date: <u>7/30/14</u> Project #: <u>62107.06.06.02</u>							
Well Depth (ft.): <u>13-15</u>		Purge Methodology: <u>peristaltic</u>			Diameter		Gal. Per Foot		Diameter		Gal. Per Foot	
DTW (ft.): <u>12.7</u>					2"		.163		5"		1.020	
Water Column (ft.): <u>N/A</u>					3"		.367		6"		1.469	
Well Diameter (in.): <u>N/A</u>					4"		.653		8"		2.611	
Gal. per ft.:		Water Quality Meter: <u>Hanna U-92</u>										
Well Volume (gal.):												
Depth of Screen (ft.): <u>13-15</u>												
Field Parameters												
Time	DTW (ft)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Color/Odor		
Stabilization	< 0.3'	300 - 500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%			
<u>11:20</u>	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>	<u>4.25</u>	<u>19.43</u>	<u>1.30</u>	<u>385</u>		<u>OR</u>	<u>reddish/brown</u>		
<u>Blank</u>												
Remarks: Pump Intake Depth: Control Box Setting (Hz): <u>purge water cleared up</u>												
<u>Cr VI - 8.70 mg/L average</u>												
<u>Fe - 0 mg/L</u>												
SAMPLING												
Depth to Water Before Sampling:												
Sample Methodology: <u>peristaltic</u>												
Sample Name: <u>GW-D-13-15</u>						QC Sample: <u>None</u>						
Sample Date/Time: <u>7/30/14 11:25</u>												
Sampler / Signature: <u>[Signature]</u>												
Filtered Metals Collected: <u>(N)</u> Filter Size:												
Sample Observations:												
Parameters: <u>TOC / 516</u>												

# SOP No-24b: Pilot Test Direct-Push Groundwater sampling

## Low-Flow Groundwater Sampling: Field Data Sheet

Well Number: <b>16-18</b>				Site: <b>Castle Soper</b>						
Field Crew: <b>SAK</b>				Date: <b>7/30/14</b> Project #: <b>43107-06-0602</b>						
Well Depth (ft.): <b>17.95</b>		Purge Methodology: <b>Penstaltic</b>		Diameter		Gal. Per Foot				
DTW (ft.): <b>11.6</b>				2"		.163				
Water Column (ft.):				3"		.367				
Well Diameter (in.):				4"		.653				
Gal. per ft.:		Water Quality Meter: <b>Horiba U-52</b>		5"		1.020				
Well Volume (gal.):				6"		1.469				
Depth of Screen (ft.): <b>16-18</b>				8"		2.811				
Field Parameters										
Time	DTW (ft)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Color/Odor
Stabilization	< 0.3'	300 - 500		+/- 0.1		+/- 3%	+/- 10 mV	+/- 10%	+/- 10%	
<b>1318</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>4.79</b>	<b>22.30</b>	<b>150</b>	<b>345</b>	<b>19</b>	<b>OR</b>	<b>Red/Yellow</b>
Remarks: Pump Intake Depth: _____ Control Box Setting (Hz): _____										
<p><b>Cr6 - 8.70 mg/L over range</b>  <b>Fe - 75.30 mg/L OR</b></p>										
SAMPLING										
Depth to Water Before Sampling: <b>NA</b>										
Sample Methodology: <b>Penstaltic</b>										
Sample Name: <b>GW-NA 16-18</b> QC Sample: <b>none</b>										
Sample Date/Time: <b>7/30/14 1320</b>										
Sampler / Signature: _____										
Filtered Metals Collected: <b>Y / N</b> Filter Size: _____										
Sample Observations: _____										
Parameters: <b>TOC / SAG</b>										

SOP No-24b: Pilot Test Direct-Push Groundwater sampling

Low-Flow Groundwater Sampling: Field Data Sheet

Well Number: <u>0-15-17</u>		Site: <u>Westfield Superfund</u>								
Field Crew: <u>Balas</u>		Date: <u>7/30/14</u> Project #: <u>431007-06-06-03</u>								
Well Depth (ft.): <u>17</u>	Purge Methodology: <u>peristaltic</u>	Diameter	Gal. Per Foot	Diameter	Gal. Per Foot					
DTW (ft.): <u>15.4</u>		2"	163	5"	1.020					
Water Column (ft.): <u>N/A</u>		3"	367	6"	1.489					
Well Diameter (in.): <u>N/A</u>		4"	653	8"	2.611					
Gal. per ft.: <u>N/A</u>	Water Quality Meter: <u>Hanba U-50</u>									
Well Volume (gal.): <u>15-17</u>										
Depth of Screen (ft.): <u>15-17</u>										
Field Parameters										
Time	DTW (ft)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Color/Odor
Stabilization	< 0.3'	300 - 500		+/- 0.1		+/- 3%	+/- 10 mV	+/- 10%	+/- 10%	
<u>1910</u>	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>	<u>6.27</u>	<u>26.47</u>	<u>1.48</u>	<u>34</u>	<u>1.87</u>	<u>0.0</u>	<u>red / none</u>
<u>Blank</u>										
Remarks: Pump Intake Depth: _____ Control Box Setting (Hz): _____										
<u>Fe - 1.62 mg/L</u> <u>Cr VI - 1.0 mg/L</u> <u>depth to water not stable</u>										
SAMPLING										
Depth to Water Before Sampling: _____										
Sample Methodology: <u>peristaltic</u>										
Sample Name: <u>0-15-GW-0-15-17</u> QC Sample: <u>none</u>										
Sample Date/Time: <u>7/30/14 1915</u>										
Sampler / Signature: _____										
Filtered Metals Collected: <u>Y/N</u> Filter Size: _____										
Sample Observations: _____										
Parameters: <u>TOC / sulfate</u>										

**SOP No-24b: Pilot Test Direct-Push Groundwater sampling**

**Low-Flow Groundwater Sampling: Field Data Sheet**

Well Number: <b>F-15-17</b>					Site:							
Field Crew: <b>T. S. McSweeney</b>					Date: <b>7/30/14</b> Project #:							
Well Depth (ft.): <b>15-17</b>		Purge Methodology: <b>Peri</b>			Diameter		Gal. Per Foot		Diameter		Gal. Per Foot	
DTW (ft.): <b>15.21</b>		<b>N/A</b>			2"		.163		5"		1.020	
Water Column (ft.):					3"		.367		6"		1.469	
Well Diameter (in.):					4"		.653		8"		2.611	
Gal. per ft.:		Water Quality Meter:										
Well Volume (gal.):		Depth of Screen (ft.): <b>15-17</b> <b>Hanna U-52</b>										
Field Parameters												
Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. (Surface) (mg/l)	Turbidity (NTU)	Color/Odor		
Stabilization	< 0.3'	300 - 500		+/- 0.1		+/- 3%	+/- 10 mV	+/- 10%	+/- 10%			
<b>1605</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>7.18</b>	<b>35.03</b>	<b>1.36</b>	<b>113</b>	<b>2.21</b>		<b>LT BRAWN</b>		
<b>Blank</b>												
Remarks: Pump Intake Depth: Control Box Setting (Hz):												
<b>Fe → 0.0</b> <b>CFE → LIMIT</b>												
SAMPLING												
Depth to Water Before Sampling:												
Sample Methodology: <b>PERISPARTIC</b>												
Sample Name: <b>GW-F-15-17</b>						QC Sample: <b>none</b>						
Sample Date/Time: <b>1600 7/30/14</b>												
Sampler / Signature: _____												
Filtered Metals Collected: Y / N Filter Size:												
Sample Observations:												
Parameters: <b>FOC / S.P.A.T.E</b>												

**SOP No-24b: Pilot Test Direct-Push Groundwater sampling**

**Low-Flow Groundwater Sampling: Field Data Sheet**

Well Number: <u>G-24-26</u>					Site: <u>Gciffell</u>					
Field Crew: <u>Balas / Salsburg</u>					Date: <u>7/30/14</u> Project #: <u>431007.06.06.03</u>					
Well Depth (ft.): <u>26'</u> DTW (ft.): <u>24.2'</u> Water Column (ft.): Well Diameter (in.): Gal. per ft.: Well Volume (gal.): Depth of Screen (ft.): <u>24-26</u>					Parge Methodology: <u>Peristaltic</u> Diameter Gal. Per Foot Diameter Gal. Per Foot 2" .163 5" 1.020 3" .367 6" 1.469 4" .653 8" 2.611 Water Quality Meter:					
Field Parameters										
Time	DTW (ft)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Color/Odor
Stabilization	< 0.3'	300 - 500		+/- 0.1		+/- 3%	+/- 10 mV	+/- 10%	+/- 10%	
<u>10:40</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>7.19</u>	<u>21.98</u>	<u>2.08</u>	<u>-210</u>	<u>1.29</u>	<u>OVER</u>	<u>BPrw14</u>
Blank										
Remarks: Pump Intake Depth: Control Box Setting (Hz):										
Fe → 0.0 Mg/L Cr6 → 0.35 Mg/L DRW → 15:20' AFTER RECHARGE W/ TEMP W/ EN										
SAMPLING										
Depth to Water Before Sampling: <u>15:20</u>										
Sample Methodology: <u>Peristaltic</u>										
Sample Name: <u>GW-G-24-26</u>					QC Sample: <u>D-073007-02 @ 09:00</u>					
Sample Date/Time: <u>7/30/14 10:35</u>					<u>TOC only.</u>					
Sampler / Signature: <u>[Signature]</u>										
Filtered Metals Collected: <u>Y / N</u> Filter Size:										
Sample Observations:										
Parameters: <u>TOC / Silica</u>										

SOP No-24b: Pilot Test Direct-Push Groundwater sampling

Low-Flow Groundwater Sampling: Field Data Sheet

Well Number: <b>F-19-21</b>		Site: <b>Carfite Id Superfund</b>								
Field Crew: <b>T. SITESBUKON</b>		Date: <b>7/30/14</b> Project #:								
Well Depth (ft.): <b>21.06</b>	Purge Methodology: <b>Per</b>	Diameter	Gal. Per Foot							
DTW (ft.): <b>19.85</b>	Water Quality Meter: <b>Hanna U-5</b>	2"	163							
Water Column (ft.): <b>N/A</b>		3"	367							
Well Diameter (in.): <b>N/A</b>		4"	653							
Gal. per ft.:		5"	1.020							
Well Volume (gal.):		6"	1.469							
Depth of Screen (ft.): <b>19-21</b>		8"	2.611							
Field Parameters										
Time	DTW (ft)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. (Surface) (mg/l)	Turbidity (NTU)	Color/Odor
Stabilization	< 0.3'	300 - 500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%	
<b>1710</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>7.15</b>	<b>25.98</b>	<b>0.749</b>	<b>192</b>	<b>2.8</b>		<b>Brown</b>
<b>Blank</b>										
Remarks: Pump Intake Depth: Control Box Setting (Hz):										
<b>Fe → 0.0</b> <b>Cr6 → 0.70 LIMIT</b>										
SAMPLING										
Depth to Water Before Sampling:										
Sample Methodology: <b>peristaltic</b>										
Sample Name: <b>GW-F-19-21</b> QC Sample: <b>none</b>										
Sample Date/Time: <b>1705 7/30/14</b>										
Sampler / Signature: 										
Filtered Metals Collected: Y / N Filter Size:										
Sample Observations:										
Parameters: <b>TOC / sulfate</b>										

# SOP No-24b: Pilot Test Direct-Push Groundwater sampling

## Low-Flow Groundwater Sampling: Field Data Sheet

Well Number: <u>F-21.5-23.5</u>				Site: <u>Barfield</u>						
Field Crew: <u>Balg</u>				Date: <u>7/31</u>		Project #: <u>43107.06.06.02</u>				
Well Depth (ft.): <u>23.5</u>	Purge Methodology: <u>pen</u>			Diameter	Gal. Per Foot	Diameter	Gal. Per Foot			
DTW (ft.): <u>22.011</u>				2"	.183	5"	1.020			
Water Column (ft.): <u>22.011</u>				3"	.367	6"	1.469			
Well Diameter (in.):				4"	.653	8"	2.611			
Gal. per ft.:	Water Quality Meter:									
Well Volume (gal.): <u>21.5-23.5</u>	<u>1 tank</u>									
Depth of Screen (ft.): <u>21.5-23.5</u>	<u>1.52</u>									
Field Parameters										
Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Color/Odor
Stabilization	< 0.3'	300 - 500		+/- 0.1		+/- 3%	+/- 10 mV	+/- 10%	+/- 10%	
<u>0745</u>	<u>————</u>	<u>————</u>	<u>————</u>	<u>9.09</u>	<u>19.90</u>	<u>0.670</u>	<u>300</u>	<u>2.00</u>	<u>246</u>	<u>CLEAR/LT BRN</u>
<u>Blank</u>										
Remarks: Pump Intake Depth: _____ Control Box Setting (Hz): _____										
<u>Started on 7/30</u> <u>Fe - .51 mg/L</u> <u>Cr VI - 7.70 mg/L over</u>										
SAMPLING										
Depth to Water Before Sampling: <u>13.55</u>										
Sample Methodology: <u>pen</u>										
Sample Name: <u>GW-F-21.5-23.5</u>						QC Sample: <u>none</u>				
Sample Date/Time: <u>750 7/31/14</u>										
Sampler / Signature: _____										
Filtered Metals Collected: <u>Y / N</u> Filter Size: _____										
Sample Observations: _____										
Parameters: <u>TOC / Sulfate</u>										

SOP No-24b: Pilot Test Direct-Push Groundwater sampling

Low-Flow Groundwater Sampling: Field Data Sheet

21.5-23.5

Well Number: <u>Ja-2638</u>				Site: <u>Leptail</u>						
Field Crew: <u>Belas/Selsburg</u>				Date: <u>7/31</u>		Project #: <u>Y31067.CK.OG.O2</u>				
Well Depth (ft.): <u>23.5</u>	Purge Methodology: <u>Peri</u>			Diameter	Gal. Per Foot	Diameter	Gal. Per Foot			
DTW (ft.): <u>13.4</u>				2"	163	5"	1020			
Water Column (ft.):				3"	367	6"	1469			
Well Diameter (in.):				4"	653	8"	2611			
Gal. per ft.:	Water Quality Meter:									
Well Volume (gal.): <u>21.5-23.5</u>	<u>Hanba US 2</u>									
Depth of Screen (ft.): <u>21.5-23.5</u>										
Field Parameters										
Time	DTW (ft)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. (Surface) (mg/l)	Turbidity (NTU)	Color/Odor
Stabilization	< 0.3'	300 - 500		+/- 0.1		+/- 3%	+/- 10 mV	+/- 10%	+/- 10%	
<u>0855</u>	<u>13.4</u>	<u>400</u>	<u>160</u>	<u>6.70</u>	<u>18.34</u>	<u>957</u>	<u>-172</u>	<u>73</u>	<u>604</u>	<u>cloudy white</u>
<i>[Large handwritten signature]</i>										
Remarks: Pump Intake Depth: _____ Control Box Setting (Hz): _____										
ATTEMPT TO RETRACT SCREEN 1' INSTEAD OF 2 TO ATTEMPT TO CAPTURE THE PROPOSED INTERVAL. LET SIT OVER NIGHT TO RECHARGE										
SAMPLING										
Depth to Water Before Sampling: <u>13.4</u>										
Sample Methodology: <u>Peri</u>										
Sample Name: <u>GW-1A-21.5-23.5</u> QC Sample: <u>none</u>										
Sample Date/Time: <u>7/31/14</u> <u>0900-0900</u>										
Sampler / Signature: <u>[Signature]</u>										
Filtered Metals Collected: <u>Y</u> <u>N</u> Filter Size: _____										
Sample Observations: _____										
Parameters: <u>TOC / sulfate</u>										

# SOP No-24b: Pilot Test Direct-Push Groundwater sampling

## Low-Flow Groundwater Sampling: Field Data Sheet

Well Number: <u>H-21-23</u>				Site: <u>Garfield</u>						
Field Crew: <u>Ba. Lo. S / Sclsburg</u>				Date: <u>7/31</u>		Project #: <u>4/91007-06-06-02</u>				
Well Depth (ft.): <u>23</u>	Purge Methodology: <u>Peri</u>			Diameter	Gal. Per Foot	Diameter	Gal. Per Foot			
DTW (ft.): <u>18.05</u>				2"	.163	5"	1.020			
Water Column (ft.): <u>18.05</u>				3"	.367	6"	1.469			
Well Diameter (in.):				4"	.653	8"	2.611			
Gal. per ft.:	Water Quality Meter: <u>Hanbe U-52</u>									
Well Volume (gal.):										
Depth of Screen (ft.): <u>21-23</u>										
Field Parameters										
Time	DTW (ft)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. (Surface) (mg/l)	Turbidity (NTU)	Color/Odor
Stabilization	< 0.3'	300 - 500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%	
<u>10:35</u>	<u>18.05</u>	<u>-</u>	<u>-</u>	<u>6.95</u>	<u>21.25</u>	<u>1.56</u>	<u>-22</u>	<u>3.30</u>	<u>OVER</u>	<u>in Brown</u>
Blank										
Remarks: Pump Intake Depth: _____ Control Box Setting (Hz): _____										
<p>Ferrous = .35 mg/L</p> <p>Cr VI = .17 mg/L</p>										
SAMPLING										
Depth to Water Before Sampling: _____										
Sample Methodology: <u>Peri</u>										
Sample Name: <u>GW-H-21-23</u>						QC Sample: <u>None</u>				
Sample Date/Time: <u>10:30 7/31/14</u>										
Sampler / Signature: _____										
Filtered Metals Collected: <u>YIN</u> Filter Size: _____										
Sample Observations: _____										
Parameters: <u>TOC / Sulfate</u>										

# SOP No-24b: Pilot Test Direct-Push Groundwater sampling

## Low-Flow Groundwater Sampling: Field Data Sheet

Well Number: <b>H-26-28</b>				Site: <b>Garfield</b>						
Field Crew: <b>T. Salszda / J. Brooks</b>				Date: <b>7/31/14</b> Project #: <b>431007.01c.06.02</b>						
Well Depth (ft.): <b>28</b>		Purge Methodology: <b>PERISTALTIC</b>		Diameter		Gal. Per Foot				
DTW (ft.): <b>29.80</b>				2"		163				
Water Column (ft.):				3"		367				
Well Diameter (in.):				4"		653				
Gal. per ft.:		Water Quality Meter:		5"		1020				
Well Volume (gal.):		<b>ITRIBA</b>		6"		1469				
Depth of Screen (ft.): <b>20-28</b>				8"		2611				
Field Parameters										
Time	DTW (ft)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Color/Odor
Stabilization	< 0.3'	300 - 500		+/- 0.1		+/- 3%	+/- 10 mV	+/- 10%	+/- 10%	
<b>1210</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>7.93</b>	<b>27.0</b>	<b>1.04</b>	<b>-9</b>	<b>.63</b>	<b>OR</b>	<b>reddish brown</b>
<b>Blank</b>										
Remarks: Pump Intake Depth: Control Box Setting (Hz):										
<b>2.13 - Fe mg/L</b>										
<b>Co II - 7.7 mg/L OR</b>										
SAMPLING										
Depth to Water Before Sampling:										
Sample Methodology:										
Sample Name: <b>GW-H-26-28</b>						QC Sample: <b>none</b>				
Sample Date/Time: <b>7/31/14 1140</b>										
Sampler / Signature: <i>[Signature]</i>										
Filtered Metals Collected: Y / N Filter Size:										
Sample Observations:										
Parameters: <b>TIC / Sulfate</b>										

SOP No-24b: Pilot Test Direct-Push Groundwater sampling

Low-Flow Groundwater Sampling: Field Data Sheet

Well Number: 1-15-17		Site: GORC 6								
Field Crew: Balas / Sals / ...		Date: Project #: 4/3/007 OG - 00.0								
Well Depth (ft.): 17	Purge Methodology:	Diameter	Gal. Per Foot							
DTW (ft.): 13.2		2"	163							
Water Column (ft.):		5"	1.020							
Well Diameter (in.):		3"	367							
Gal. per ft.:	Water Quality Meter:	6"	1.469							
Well Volume (gal.): 15-17		4"	653							
Depth of Screen (ft.): 15-17		8"	2.611							
Field Parameters										
Time	DTW (ft)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	DO (Surface) (mg/l)	Turbidity (NTU)	Color/Odor
Stabilization	< 0.3'	300 - 500		+/- 0.1		+/- 3%	+/- 10 mV	+/- 10%	+/- 10%	
1205	-	-	-	8.02	27.73	859	125	0.2	OR	reddish brown / ...
Blank										
Remarks: Pump Intake Depth: Control Box Setting (Hz):										
Cr VI - OR 7.70 mg/L Fe - 1.13 mg/L										
SAMPLING										
Depth to Water Before Sampling:										
Sample Methodology: Push										
Sample Name: Gw-#1-15-17										
Sample Date/Time: 7/31/15 1200										
QC Sample: none										
Sampler / Signature:										
Filtered Metals Collected: Y / N Filter Size:										
Sample Observations:										
Parameters: #OC / SW / G / k										

2022  
1230

# SOP No-24b: Pilot Test Direct-Push Groundwater sampling

## Low-Flow Groundwater Sampling: Field Data Sheet

Well Number: <u>5-20-22</u>		Site: <u>GRANFIELD</u>								
Field Crew: <u>T. Salsbury / J. Bylles</u>		Date: <u>7/31/14</u> Project #: <u>431007.06.07</u>								
Well Depth (ft.): <u>22</u>	Purge Methodology: <u>Penetration</u>	Diameter	Gal. Per Foot	Diameter	Gal. Per Foot					
DTW (ft.): <u>17.93</u>	Water Quality Meter: <u>Hanover V-52</u>	2"	163	5"	1020					
Water Column (ft.):		3"	367	6"	1469					
Well Diameter (in.): <u>N/A</u>		4"	653	8"	2611					
Gal. per ft.:										
Well Volume (gal.):										
Depth of Screen (ft.): <u>20-22</u>										
Field Parameters										
Time	DTW (ft)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Color/Odor
Stabilization	< 0.3'	300 - 500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%	
<u>1235</u>	<u>17.90</u>	<u>-</u>	<u>-</u>	<u>7.08</u>	<u>24.74</u>	<u>1.25</u>	<u>-300</u>	<u>0.00</u>	<u>OVER</u>	<u>LT Brown</u>
<u>Blank</u>										
Remarks: Pump Intake Depth: _____ Control Box Setting (Hz): _____										
<u>CFE → 0.12 MB/L</u> <u>Fe → 0.00</u>										
SAMPLING										
Depth to Water Before Sampling: _____										
Sample Methodology: _____										
Sample Name: <u>GW-J-20-22</u> QC Sample: <u>None</u>										
Sample Date/Time: <u>1230</u> <u>7/31/14</u>										
Sampler / Signature: _____										
Filtered Metals Collected: <u>Y</u> <u>N</u> Filter Size: _____										
Sample Observations: _____										
Parameters: <u>TOC / sulfate</u>										

**Low-Flow Groundwater Sampling: Field Data Sheet**

<b>Well Number:</b> EPA-13-0B		<b>Site:</b> Garfield Groundwater Contamination Superfund Site	
<b>Field Crew:</b> T. SALSBUCK		<b>Date:</b> 9/3/14	<b>Project #:</b> 431007
<b>Well Depth (ft.):</b> 32	<b>Purge Methodology:</b>	<b>Diameter</b>	<b>Gal. Per Foot</b>
<b>DTW (ft.):</b> 13.64	USEPA - Low Flow	2" (circled)	.163 (circled)
<b>Water Column (ft.):</b> 21.99	<b>Sampling Procedures</b>	5"	1.020
<b>Well Diameter (in.):</b> 2"	with submersible pump	6"	1.469
<b>Gal. per ft.:</b> 0.163	<b>Water Quality Meter:</b>	4"	2.611
<b>Well Volume (gal.):</b> 2.99	Horiba U-52		
<b>Depth of Screen (ft.):</b> 22-32			

Field Parameters												
Time	DTW (ft)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity <sup>1</sup> (PPT)	Color/Odor	
Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%			
Initial 1034	15.13	600	0.2	7.14	17.88	0.870	-75	0.00	69.2	0.4	CLEAR, LITTLE MILKY	
1039	15.01	500	1.1	7.33	17.60	0.905	-79	0.00	50.3	0.4	" "	
1044	15.02	480	2.1	7.39	17.58	0.938	-86	0.00	26.8	0.5	" "	
1049	15.01	480	3.0	7.40	17.47	0.958	-89	0.00	<del>38.2</del> 20.5	0.5	" "	
1054	15.01	480	4.0	7.40	17.40	0.961	-89	0.00	32.6	0.5	BEARING UP	
1059	15.01	480	4.8	7.40	17.41	0.973	-90	0.00	<del>38.4</del> 0.5	0.5	" "	
1104	15.00	480	5.6	7.58	17.46	0.999	-99	0.00	35.5	0.5	CLEAR	
1109	15.00	480	6.4	7.57	17.47	0.997	-97	0.00	38.4	0.5	CLEAR	
1114	15.00	480	7.2	7.57	17.44	1.00	-94	0.00	40.5	0.5	CLEAR	
1120	→			COLLECT SAMPLE								
1125	→											
Post-Purge												

**Remarks:** Pump Intake Depth: 27'      Control Box Setting (Hz): 89.3 Hz      Sampling: (Sample at 100-250 ml/min) 89%

**SAMPLING**

Depth to Water Before Sampling: 15.00

Sample Methodology: USEPA - Low Flow Sampling Procedures with submersible pump

Sample Name: EPA-13-0B-090314      QC Sample: ✓

Sample Date/Time: 1125 9/3/14

Sampler / Signature: *[Signature]*

Filtered Metals Collected:  Ni      Filter Size:

Sample Observations: CLEAR

Notes: 1 = stabilization of this parameter is not required prior to collecting sample

Parameters: Cr Fe TOL SURFACE Hex Cr

**Low-Flow Groundwater Sampling: Field Data Sheet**

Well Number: <u>EPA-29-0B</u>		Site: <u>Garfield Groundwater Contamination Superfund Site</u>	
Field Crew: <u>T. SALSBURG</u>		Date: <u>9/4/14</u>	Project #: <u>431007</u>
Well Depth (ft.): <u>20</u>	<u>Purge Methodology:</u> USEPA - Low Flow Sampling Procedures with submersible pump  <u>Water Quality Meter:</u> Horiba U-52	Diameter	Gal. Per Foot
DTW (ft.): <u>11.77</u>		2"	.163
Water Column (ft.): <u>8.23</u>		3"	.367
Well Diameter (in.): <u>2"</u>		4"	.653
Gal. per ft.: <u>0.163</u>		Diameter	Gal. Per Foot
Well Volume (gal.): <u>1.34</u>		5"	1.020
Depth of Screen (ft.): <u>15'-20'</u>		6"	1.469
		8"	2.611

Field Parameters											
Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity <sup>1</sup> (PPT)	Color/Odor
Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%		/
Initial 0817	12.09	480	—	3.10	17.93	1.90	523	1.08	OVER	0.9	CREAMY YELLOW
0822	12.89	480	1.5	3.25	17.52	1.89	522	1.01	OVER	1.0	" "
0827	12.90	440	2.5	3.23	17.70	1.89	523	0.72	OVER	1.0	" "
0832	12.81	440	3.9	3.19	17.96	1.88	525	0.68	OVER	0.9	CLEAR YELLOW
0837	12.78	440	4.2	3.21	18.19	1.88	523	0.65	173	1.0	YELLOW
0842	12.78	440	4.8	3.25	18.27	1.90	521	0.64	135	1.0	YELLOW
0847	12.75	440	5.5	3.18	17.87	1.92	527	0.59	423	1.0	YELLOW
0852	12.78	425	6.2	3.21	18.31	1.81	520	0.57	0.303	0.9	YELLOW
0857	12.73	425	6.9	3.22	18.75	1.82	520	0.55	173	0.9	YELLOW
0902	12.68	425	7.6	3.26	18.94	1.81	517	0.54	125	0.9	YELLOW
0907	12.67	425	8.3	3.28	19.24	1.81	517	0.53	115	0.9	YELLOW
Post-Purge 0912	12.80	425	9.0	3.21	18.80	1.90	527	0.52	91.2	1.0	" "

Remarks: Pump Intake Depth: 17.5' Control Box Setting (Hz): 87.1 Sampling: (Sample at 100-250 ml/min)

**SAMPLING**

Depth to Water Before Sampling: \_\_\_\_\_

Sample Methodology: USEPA - Low Flow Sampling Procedures with submersible pump

Sample Name: \_\_\_\_\_ QC Sample: DUP

Sample Date/Time: \_\_\_\_\_

Sampler / Signature: \_\_\_\_\_

Filtered Metals Collected: Y / N Filter Size: \_\_\_\_\_

Sample Observations: \_\_\_\_\_

Notes: 1 = stabilization of this parameter is not required prior to collecting sample

Parameters: \_\_\_\_\_



**Low-Flow Groundwater Sampling: Field Data Sheet**

Well Number: <u>EPA-30-05</u>		Site: <u>Garfield Groundwater Contamination Superfund Site</u>	
Field Crew: <u>D. Reamer</u>		Date: <u>9/3/14</u>	Project #: <u>431007</u>
Well Depth (ft.): <u>~22' BGS</u>	Purge Methodology: USEPA - Low Flow Sampling Procedures with submersible pump	Diameter	Gal. Per Foot
DTW (ft.): <u>13.97</u>		<u>2"</u>	<u>.163</u>
Water Column (ft.): <u>8.3</u>	Water Quality Meter: Horiba U-52	Diameter	Gal. Per Foot
Well Diameter (in.): <u>2"</u>		3"	.367
Gal. per ft.: <u>0.163</u>		4"	.653
Well Volume (gal.): <u>1.35</u>		5"	1.020
Depth of Screen (ft.): <u>17'-22"</u>		6"	1.469
		8"	2.611

Field Parameters												
Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. (Surface) (mg/l)	Turbidity (NTU)	Salinity <sup>1</sup> (PPT)	Color/Odor	
Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3%	+/- 10 mV	+/- 10%	+/- 10%			
Initial 10:40	15.28	450	0	7.10	19.45	1.14	93	1.69	NM	0.6	pinkish / no odor	
10:45	<del>14.66</del> 15.28	450	1.5	7.23	19.66	1.13	12	0.99	64.9	0.6	clear / no odor	
10:50	15.29	450	2.25	7.25	19.89	1.13	14	0.89	46.4	0.6	" / "	
11:00	15.28	450	2.75	7.25	20.03	1.14	16	0.81	18.1	0.6	" / "	
11:05	15.28	450	4.25	7.24	19.96	1.14	18	0.75	12.7	0.6	slightly yellow / no odor	
11:10	15.28	450	4.75	7.24	20.05	1.15	17	0.70	11.9	0.6	yellowish greenish	
11:15	15.28	450	5.25	7.24	20.17	1.17	19	0.80	11.4	0.6	" / " / no odor	
11:20	15.28	450	5.75	7.25	20.16	1.17	20	0.75	10.9	0.6	" / " / "	
Post-Purge												

Remarks: Pump Intake Depth: ~20' BGS Control Box Setting (Hz): 91.70 Sampling: (Sample at 100-250 ml/min) 150

Turbidity HACH 2100 Q SN 13080027512 Horiba U52 - SN MUKY25M8 Pine Env.

NM - Not measured

**SAMPLING**

Depth to Water Before Sampling: 15.28

Sample Methodology: USEPA - Low Flow Sampling Procedures with submersible pump

Sample Name: EPA-30-05-090314 QC Sample: None

Sample Date/Time: 9/3/14 1120

Sampler / Signature: David Reamer

Filtered Metals Collected:  Y  N Filter Size: 0.45

Sample Observations: clear - to yellowish green water

Notes: 1 = stabilization of this parameter is not required prior to collecting sample

Parameters: Select total + dissolved metals (iron + chromium) sulfate + chloride, hex. chrom, sulfite

**Low-Flow Groundwater Sampling: Field Data Sheet**

Well Number: <u>EPA-31-03</u>		Site: <u>Garfield Groundwater Contamination Superfund Site</u>	
Field Crew: <u>T. SALSBURG</u>		Date: <u>9/3/14</u>	Project #: <u>431007</u>
Well Depth (ft.): <u>25'</u>	Purge Methodology: USEPA - Low Flow Sampling Procedures with submersible pump	Diameter	Gal. Per Foot
DTW (ft.): <u>14.13</u>		2"	.163
Water Column (ft.):	Water Quality Meter: Horiba U-52	3"	.367
Well Diameter (in.): <u>2"</u>		4"	.653
Gal. per ft.: <u>0.163</u>		5"	1.020
Well Volume (gal.): <u>1.77</u>		6"	1.469
Depth of Screen (ft.): <u>15-25</u>		8"	2.611

Field Parameters											
Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. (Surface) (mg/l)	Turbidity (NTU)	Salinity <sup>1</sup> (PPT)	Color/Odor
Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3%	+/- 10 mV	+/- 10%	+/- 10%		
Initial 1357	14.60	300	—	5.50	23.05	1.26	214	1.32	632	0.6	YELLOW
1356	14.65	350	0.6	5.38	20.58	1.38	230	0.00	717	0.7	YELLOW
1401	14.64	350	1.6	5.39	20.32	1.42	209	0.00	552	0.7	YELLOW
1406	14.65	<del>380</del>	2.0	5.42	20.24	1.45	197	0.00	381	0.7	YELLOW
1411	14.64	300	2.4	5.47	20.19	1.46	205	0.00	308	0.7	YELLOW
1416	14.64	300	2.8	5.53	20.15	1.49	197	0.00	254	0.7	YELLOW
1421	14.64	300	3.3	5.63	20.01	1.52	183	0.00	<del>534</del> 192	0.8	YELLOW
1426	14.64	300	3.8	5.69	19.97	1.54	202	0.00	161	0.8	YELLOW
1431	14.64	300	4.3	5.74	20.29	1.56	207	0.00	149	0.8	YELLOW
1436	14.65	300	4.8	5.70	20.50	1.56	206	0.00	137	0.8	" "
1440				CONC OF SAMPLE							
Post-Purge 1510	14.65	300	—	5.82	21.70	1.53	222	0.00	129	0.8	YELLOW

Remarks: Pump Intake Depth: 20' Control Box Setting (Hz): 91.1 Sampling: (Sample at 100-250 ml/min)

**SAMPLING**

Depth to Water Before Sampling: 14.65

Sample Methodology: USEPA - Low Flow Sampling Procedures with submersible pump

Sample Name: EPA-31-03-090314 QC Sample: ✓

Sample Date/Time: 9/3/14 1440

Sampler / Signature: Jylee [Signature]

Filtered Metals Collected: 0/1 N Filter Size: \_\_\_\_\_

Sample Observations: yellow

Notes: 1 = stabilization of this parameter is not required prior to collecting sample

Parameters: CS FE TOC HEX CS SULFIDE



### Low-Flow Groundwater Sampling: Field Data Sheet

<b>Well Number:</b> EPA-30-083 <b>Field Crew:</b> T. SALSBURY/K. NOBLE <b>Well Depth (ft.):</b> 21.34 <b>DTW (ft.):</b> 14.54 <b>Water Column (ft.):</b> 6.8 <b>Well Diameter (in.):</b> 2" <b>Gal. per ft.:</b> 0.163 <b>Well Volume (gal.):</b> 1.108 <b>Depth of Screen (ft.):</b> 21.34'	<b>Site:</b> Garfield Groundwater Contamination Superfund Site <b>Date:</b> 10/20/14 <b>Project #:</b> 431007 <b>Purge Methodology:</b> USEPA - Low Flow Sampling Procedures with submersible pump <b>Water Quality Meter:</b> Horiba U-52																
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>Diameter</th> <th>Gal. Per Foot</th> <th>Diameter</th> <th>Gal. Per Foot</th> </tr> <tr> <td>2"</td> <td>.163</td> <td>5"</td> <td>1.020</td> </tr> <tr> <td>3"</td> <td>.367</td> <td>6"</td> <td>1.469</td> </tr> <tr> <td>4"</td> <td>.653</td> <td>8"</td> <td>2.611</td> </tr> </table>		Diameter	Gal. Per Foot	Diameter	Gal. Per Foot	2"	.163	5"	1.020	3"	.367	6"	1.469	4"	.653	8"	2.611
Diameter	Gal. Per Foot	Diameter	Gal. Per Foot														
2"	.163	5"	1.020														
3"	.367	6"	1.469														
4"	.653	8"	2.611														

#### Field Parameters

Time	DTW (ft)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity <sup>1</sup> (PPT)	Color/Odor
Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3%	+/- 10 mV	+/- 10%	+/- 10%		
Initial 1153	15.60	350	✓	7.4	18.29	0.119	-5	2.45	OVER	0.1	CLEAR/LTBROWN
1158	15.64	350	0.4	7.4	20.38	0.093	-79	1.60	33.2	0.1	CLEAR/CHEM O <sub>2</sub> DOR
1203	15.65	350	0.75	7.4	20.84	0.112	-115	1.36	14.0	0.1	CLEAR
1208	15.72	300	1.1	7.4	21.02	0.119	-128	1.25	10.1	0.1	CLEAR
1213	15.71	300	1.4	7.4	21.18	0.119	-129	1.14	9.62	0.1	CLEAR
1218	15.70	300	1.7	7.4	21.46	0.116	-119	1.06	8.37	0.1	CLEAR
1223	15.68	300	2.0	7.3	21.69	0.120	-103	1.00	7.91	0.0	CLEAR
1228	15.68	300	2.2	7.3	21.87	0.120	-87	0.99	7.80	0.1	↓
1233	15.60	300	2.4	7.3	21.78	0.121	-87	0.70	7.33	0.1	↓
1238	15.56	300	2.7	7.3	21.57	0.118	-85	0.72	7.20	0.1	↓
1243	15.54	300	3.0	7.3	21.30	0.115	-84	0.73	6.91	0.1	
Post-Purge 1330	15.64	300	✓	7.3	22.04	0.112	-66	3.71	5.36	0.1	CLEAR

**Remarks:** Pump Intake Depth: 18.6'      Control Box Setting (Hz): 95      Sampling: (Sample at 100-250 ml/min) 200

#### SAMPLING

**Depth to Water Before Sampling:** 15.54  
**Sample Methodology:** USEPA - Low Flow Sampling Procedures with submersible pump  
**Sample Name:** EPA-30-08-102014      **QC Sample:** ✓  
**Sample Date/Time:** 10/20/14 1300  
**Sampler / Signature:** [Signature]  
**Filtered Metals Collected:**  N      **Filter Size:**  
**Sample Observations:** CLEAR  
**Notes:** 1 = stabilization of this parameter is not required prior to collecting sample  
**Parameters:** Hex Cr, METALS, Cl/Sulfate, SULFIDE, TOC, ALK, METHANE, NITRATE, NITRITE

**Low-Flow Groundwater Sampling: Field Data Sheet**

Well Number: <u>EPA-29-0B</u>		Site: <u>Garfield Groundwater Contamination Superfund Site</u>	
Field Crew: <u>T. SALSBURY</u>		Date: <u>10/21/14</u>	Project #: <u>431007</u>
Well Depth (ft.):	<u>Purge</u>	Diameter	Gal. Per Foot
DTW (ft.): <u>12.65'</u>	<u>Methodology:</u>	2"	.163
Water Column (ft.):	<u>USEPA - Low Flow</u>	5"	1.020
Well Diameter (in.):	<u>Sampling Procedures</u>	3"	.367
Gal. per ft.:	<u>with submersible pump</u>	4"	.653
Well Volume (gal.):	<u>Water Quality Meter:</u>		
Depth of Screen (ft.): <u>15-20</u>	<u>Horiba U-52</u>		

Field Parameters											
Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity <sup>1</sup> (PPT)	Color/Odor
Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%		
Initial	0915	13.30	500	4.3	16.25	0.134	412	2.41	245	0.1	YELLOW
	0920	13.50	500	0.9	3.2	17.34	0.176	530	0.86	0.1	YELLOW
	0925	13.54	500	1.9	3.1	17.73	0.186	540	0.61	0.1	YELLOW
	0930	13.58	500	2.9	3.1	17.79	0.187	540	0.48	0.1	YELLOW
	0935	13.60	500	3.9	3.2	17.93	0.185	535	0.44	0.1	YELLOW
	0940	13.61	500	4.8	3.2	17.96	0.187	535	0.40	0.1	YELLOW
Post-Purge	1063			3.0	17.86	0.149	571	2.68		0.1	

Remarks: Pump Intake Depth: 17.5'      Control Box Setting (Hz): 87      Sampling: (Sample at 100-250 ml/min) 200

**SAMPLING**

Depth to Water Before Sampling: 13.61

Sample Methodology: USEPA - Low Flow Sampling Procedures with submersible pump

Sample Name: EPA-29-0B-102114      QC Sample:

Sample Date/Time: 10/21/14 9:45

Sampler / Signature: [Signature]

Filtered Metals Collected:  N      Filter Size: \_\_\_\_\_

Sample Observations: YELLOW

Notes: 1 = stabilization of this parameter is not required prior to collecting sample

Parameters: Hex CC, THE METALS (FILTER/UNFILTER) Cl/SULFATE/SULFIDE, TOC, ALK, METHANE, NITRATE/NITRATA

### Low-Flow Groundwater Sampling: Field Data Sheet

Well Number: <u>EPA 13-013</u> Field Crew: <u>Kevin Nubic / Taylor Selberg</u> Well Depth (ft.): <u>32.1</u> DTW (ft.): <u>14.5</u> Water Column (ft.): <u>17.6'</u> Well Diameter (in.): <u>2"</u> Gal. per ft.: <u>163</u> Well Volume (gal.): <u>2.97</u> Depth of Screen (ft.): _____	Site: <u>Garfield Groundwater Contamination Superfund Site</u> Date: <u>10-20-14</u> Project #: <u>431007</u> Purge Methodology: USEPA - Low Flow Sampling Procedures with submersible pump Water Quality Meter: Horiba U-52
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#### Field Parameters

Time	DTW (ft)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity (PPT)	Color/Odor
Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3%	+/- 10 mV	+/- 10%	+/- 10%		
Initial 12:15	15.75	250	-	7.27	17.4	0.104	242	0.0	12.0	0.0	clear
12:20	15.75	250	1.9	7.50	18.3	0.105	246	0.0	9.11	0.0	clear
12:25	15.75	250	1.50	7.49	18.5	0.105	244	0.0	7.49	0.0	clear
12:30	15.75	250	2.0	7.44	19.0	0.107	247	0.0	5.75	0.0	clear
12:35	15.75	250	2.5	7.46	19.1	0.107	250	0.0	5.51	0.0	clear
12:40	15.75	250	3.0	7.46	19.0	0.107	249	0.0	6.12	0.0	clear
12:45	15.75	250	3.5	7.46	19.0	0.108	250	0.0	6.14	0.0	clear
12:50	15.75	250	4.0	7.44	19.0	0.104	251	0.0	6.03	0.0	clear
12:55	collect			sample							
209' 30mg/L 10/21/13 Post-Purge 13:15	15.75	-	-	7.49	19.0	0.109	252	0.0	6.14	0.0	clear

Remarks: Pump Intake Depth: 29.6'      Control Box Setting (Hz): 91.0      Sampling: (Sample at 100-250 ml/min) 250 ml/min

#### SAMPLING

Depth to Water Before Sampling: 15.75  
 Sample Methodology: USEPA - Low Flow Sampling Procedures with submersible pump  
 Sample Name: EPA 13-013-102014      QC Sample: DUP  
 Sample Date/Time: 10-20-14      12:55  
 Sampler / Signature: \_\_\_\_\_  
 Filtered Metals Collected: TDN      Filter Size: \_\_\_\_\_  
 Sample Observations: clear no taste rotten egg  
 Notes: 1 = stabilization of this parameter is not required prior to collecting sample  
 Parameters: \_\_\_\_\_

**Low-Flow Groundwater Sampling: Field Data Sheet**

Well Number: <u>EPA - 320B</u> Field Crew: Well Depth (ft.): <u>20'</u> DTW (ft.): <u>15.3</u> Water Column (ft.): <u>4-7</u> Well Diameter (in.): <u>2'</u> Gal. per ft.: <u>0.163</u> Well Volume (gal.): <u>0.7661</u> Depth of Screen (ft.):	Site: <u>Garfield Groundwater Contamination Superfund Site</u> Date:                      Project #: <u>431007</u> <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th colspan="2">Purge Methodology:</th> <th colspan="2">Water Quality Meter:</th> </tr> <tr> <td colspan="2">USEPA - Low Flow</td> <td colspan="2">Horiba U-52</td> </tr> <tr> <td colspan="4">Sampling Procedures with submersible pump</td> </tr> </table> <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th>Diameter</th> <th>Gal. Per Foot</th> <th>Diameter</th> <th>Gal. Per Foot</th> </tr> <tr> <td align="center">2"</td> <td align="center">.163</td> <td align="center">5"</td> <td align="center">1.020</td> </tr> <tr> <td align="center">3"</td> <td align="center">.367</td> <td align="center">6"</td> <td align="center">1.469</td> </tr> <tr> <td align="center">4"</td> <td align="center">.653</td> <td align="center">8"</td> <td align="center">2.611</td> </tr> </table>	Purge Methodology:		Water Quality Meter:		USEPA - Low Flow		Horiba U-52		Sampling Procedures with submersible pump				Diameter	Gal. Per Foot	Diameter	Gal. Per Foot	2"	.163	5"	1.020	3"	.367	6"	1.469	4"	.653	8"	2.611
Purge Methodology:		Water Quality Meter:																											
USEPA - Low Flow		Horiba U-52																											
Sampling Procedures with submersible pump																													
Diameter	Gal. Per Foot	Diameter	Gal. Per Foot																										
2"	.163	5"	1.020																										
3"	.367	6"	1.469																										
4"	.653	8"	2.611																										

**Field Parameters**

Time	DTW (ft)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity <sup>1</sup> (PPT)	Color/Odor
Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%		
Initial 15:15	15.8	200	-	5.60	19.4	0.199	294	0.0	1K	0.1	yellow Brown/none
15:20	15.8	200	0.25	5.48	19.5	0.198	306	0.0	1K	0.1	yellow Brown/none
15:25	15.8	200	0.5g	5.05	19.5	0.195	339	0.0	1K	0.1	yellow Brown/none
15:30	15.8	200	0.75	5.05	22.1	0.198	358	0.0	1K	0.1	
15:35	15.8	200	1g	4.15	21.4	0.180	416	0.0	1K	0.1	
15:40	17.4	200	1.5	4.12	21.2	0.189	409	0.0	1K	0.1	
15:45	17.8	200	1.75	4.11	21.5	0.185	375	0.0	1K	0.1	
15:50	17.8	200	2g	4.71	21.5	0.185	374	0.0	1K	0.1	
15:55	17.8	200	2.25	4.71	21.5	0.185	377	0.0	1K	0.1	
16:00	17.8	200	3g	4.71	21.5	0.185	375	0.0	1K	0.1	
16:30	collect			sample							
Post-Purge											

Remarks: Pump Intake Depth: 18'                      Control Box Setting (Hz): 111Hz                      Sampling: (Sample at 100-250 ml/min)

Water level continues to drop having draw down issues. Dialed pump down. 16:00 pump off well dry will be back for half hour sample -

**SAMPLING**

Depth to Water Before Sampling: <u>15.8</u> <u>At the surface -</u>
Sample Methodology: <u>USEPA - Low Flow Sampling Procedures with submersible pump</u>
Sample Name: <u>EPA-320B-102014</u> QC Sample: <u>NONE</u>
Sample Date/Time: <u>10-20-14</u> <u>16:30</u>
Sampler / Signature: <u>[Signature]</u>
Filtered Metals Collected: <u>(Y) N</u> Filter Size:
Sample Observations: <u>yellow Brown Uggie 0.1, 50211</u>
Notes: 1 = stabilization of this parameter is not required prior to collecting sample
Parameters:

**Low-Flow Groundwater Sampling: Field Data Sheet**

2 16

Well Number: <u>EPA-31-08</u>		Site: <u>Garfield Groundwater Contamination Superfund Site</u>	
Field Crew: <u>T. SMITH/BAK/K. NUBLE</u>		Date: <u>10/20/14</u>	Project #: <u>431007</u>
Well Depth (ft.):	<u>Purge Methodology:</u>	Diameter	Gal. Per Foot
DTW (ft.):	<u>USEPA - Low Flow</u>	2"	.163
Water Column (ft.):	<u>Sampling Procedures</u>	5"	1.020
Well Diameter (in.):	<u>with submersible pump</u>	6"	1.469
Gal. per ft.:	<u>Water Quality Meter:</u>	8"	2.611
Well Volume (gal.):	<u>Horiba U-52</u>		
Depth of Screen (ft.): <u>15.25</u>			

Field Parameters											
Time	DTW (ft)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity (PPT)	Color/Odor
Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%		
Initial 1532	15.70	400	✓	6.0	18.14	0.176	254	3.21	OVER	0.1	Yellow Brown
1537	15.82	500	0.4	5.9	18.51	0.183	265	1.32	OVER	0.1	" "
1542	15.91	500	1.8	6.0	18.28	0.183	273	0.88	957	0.1	" "
1547	15.93	500	2.8	6.0	18.12	0.141	279	0.69	OVER	0.1	" "
1552	15.95	500	3.8	6.0	18.15	0.184	285	0.51	OVER	0.1	" "
1557	15.97	500	4.8	6.0	18.17	0.185	286	0.49	77.9	0.1	" "
1602	15.96	500	5.8	6.0	18.06	0.179	288	0.45	62.5	0.1	" "
1607	15.95	500	6.8	6.0	18.48	0.143	289	0.43	58.1	0.1	" "
1612	15.95	500	7.8	6.0	18.32	0.143	290	0.41	53.4	0.1	" "
Post-Purge 1641	15.75	300	✓	6.1	18.36	0.148	272	2.45	40.2	0.1	Yellow

Remarks: Pump Intake Depth: 20.5      Control Box Setting (Hz): 95      Sampling: (Sample at 100-250 ml/min) 250

**SAMPLING**

Depth to Water Before Sampling: 15.95

Sample Methodology: USEPA - Low Flow Sampling Procedures with submersible pump

Sample Name: EPA-31-08-102014      QC Sample:

Sample Date/Time: 10/20/14      16:20

Sampler / Signature: [Signature]

Filtered Metals Collected: ND      Filter Size: \_\_\_\_\_

Sample Observations: Yellow

Notes: 1 = stabilization of this parameter is not required prior to collecting sample

Parameters: HEX CF, METALS, Cl/SULFATE, SULFIDE, TOC, ALK, METHANE, NITRATE, NITRATE

0

**Low-Flow Groundwater Sampling: Field Data Sheet**

<b>Well Number:</b> EPA-13-0B		<b>Site:</b> Garfield Groundwater Contamination Superfund Site	
<b>Field Crew:</b> D. Holmes		<b>Date:</b> 12/18/14 <b>Project #:</b> 431007.04.03.05	
Well Depth (ft.): 32 DTW (ft.): 12.2 Water Column (ft.): 19.8 Well Diameter (in.): 2 Gal. per ft.: 0.163 Well Volume (gal.): 3.23 Depth of Screen (ft.): 22-32	<b>Purge Methodology:</b> USEPA - Low Flow Sampling Procedures with submersible pump  <b>Water Quality Meter:</b> Horiba U-52	<b>Diameter</b>	<b>Gal. Per Foot</b>
		2" 1.63 3" .367 4" .653	5" 1.020 6" 1.469 8" 2.611

**Field Parameters**

Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity <sup>1</sup> (PPT)	Color/Odor
Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%		
Initial 1118	13.30	500	0.0	7.59	16.17	0.987	-155	2.19	12.7	0.5	Clear/sulfur-like color
1123	13.40	400	0.6	7.55	16.98	0.994	-185	2.02	11.04	0.5	" "
1128	13.40	400	1.2	7.55	17.25	0.997	-200	1.97	7.52	0.5	" "
1133	13.40	400	1.8	7.54	17.32	1.00	-212	1.94	5.53	0.5	" "
1138	13.40	400	2.5	7.54	17.40	1.00	-218	1.92	5.29	0.5	" "
1143	13.40	400	3.1	7.53	17.63	1.00	-224	2.04	5.15	0.5	" "
1148	13.40	400	3.6	7.53	17.67	1.00	-229	1.98	7.07	0.5	" "
1155				Collect Sample							
Post-Purge 1217	13.58	400	5.5	7.54	17.85	1.02	-172	1.79	8.74	0.5	" "

**Remarks:** Pump Intake Depth: 27'      Control Box Setting (Hz): 85.4      Sampling: (Sample at 100-250 ml/min)

Ferrous Iron: 0.00 mg/L

**SAMPLING**

Depth to Water Before Sampling: 13.40

Sample Methodology: USEPA - Low Flow Sampling Procedures with submersible pump

Sample Name: GUGC-EPA-13-0B-03      QC Sample: Field Dip for Hex Chrom and Total Chrom

Sample Date/Time: 12/18/14

Sampler / Signature: D. Holmes / Daniel Holman

Filtered Metals Collected: P/N      Filter Size: 0.45 mm

Sample Observations: No issues

Notes: 1 = stabilization of this parameter is not required prior to collecting sample

Parameters: Hex Chrom, Total Chrom, Pilot Study Parameters

**Low-Flow Groundwater Sampling: Field Data Sheet**

Well Number: <u>EPA-29-013</u> Field Crew: <u>A Harderick</u> Well Depth (ft.): <u>19.30</u> DTW (ft.): <u>10.78</u> Water Column (ft.): <u>8.52</u> Well Diameter (in.): <u>2</u> Gal. per ft.: <u>0.163</u> Well Volume (gal.): <u>1.4</u> Depth of Screen (ft.): <u>15-20</u>	Site: <u>Garfield Groundwater Contamination Superfund Site</u> Date: <u>12/17/14</u> Project #: <u>431007.04.03.05</u> Purge Methodology: USEPA - Low Flow Sampling Procedures with submersible pump Water Quality Meter: Horiba U-52
PAGE 1 of 2	

Field Parameters											
Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity <sup>1</sup> (PPT)	Color/Odor
Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%		
Initial 9:10	11.44	320	-	5.11	16.01	1.17	266	0.57	30.1	0.6	yellow, no odor
9:15	11.48	330	0.7	4.45	16.44	1.17	268	0.24	21.7	0.6	greenish yellow, no odor
9:20	No measurements - phone call from James										
9:25	11.50	340	2.1	4.68	16.86	1.20	296	0.00	13.15	0.6	Same as above (SAA)
9:30	11.50	330	2.5	4.58	16.89	1.21	313	0.00	11.47	0.6	SAA
9:35	11.48	330	3.0	4.43	16.93	1.24	333	0.00	9.58	0.6	SAA
9:40	11.49	330	3.7	4.30	17.01	1.26	355	0.00	8.86	0.6	SAA
9:45	11.49	330	4.2	4.20	17.10	1.29	372	0.00	8.65	0.6	SAA
9:50	11.49	340	5.0	4.00	17.08	1.31	394	0.00	7.39	0.7	SAA
9:55	11.46	340	5.4	3.84	17.05	1.32	411	0.00	7.05	0.7	SAA
10:00	11.47	340	5.8	3.73	17.17	1.34	421	0.00	6.71	0.7	SAA
Post-Purge 10:57	11.48	350	8.9	3.12	17.33	1.44	478	0.00	6.95	0.7	SAA

Remarks: Pump Intake Depth: 17.5 Control Box Setting (Hz): 79.70 Sampling: (Sample at 100-250 ml/min)

- Ferrrous Iron hatch result: 0.00 mg/L

**SAMPLING**

Depth to Water Before Sampling: 10.48

Sample Methodology: USEPA - Low Flow Sampling Procedures with submersible pump

Sample Name: GCGC - EPA-29-013-05 QC Sample: None

Sample Date/Time: 12/17/14 / 10:35

Sampler / Signature: A Harderick / [Signature]

Filtered Metals Collected:  N Filter Size: 0.45 um

Sample Observations: Greenish yellow color, no odor observed

Notes: 1 = stabilization of this parameter is not required prior to collecting sample

Parameters: Hexavalent chromium, total chromium, dissolved chromium-iron, total iron, sulfide, sulfate, chloride, total organic carbon

**Low-Flow Groundwater Sampling: Field Data Sheet**

Well Number: <u>EPA-29-08</u>		Site: <u>Garfield Groundwater Contamination Superfund Site</u>	
Field Crew: <u>A. Arclerode</u>		Date: <u>12/17/14</u>	Project #: <u>431007.04.03.05</u>
Well Depth (ft.): <u>See page 1</u>	<u>Purge</u>	Diameter	Gal. Per Foot
DTW (ft.):	<u>Methodology:</u>	2"	.163
Water Column (ft.):	<u>USEPA - Low Flow</u>	3"	.367
Well Diameter (in.):	<u>Sampling Procedures</u>	4"	.653
Gal. per ft.:	<u>with submersible pump</u>	Diameter	Gal. Per Foot
Well Volume (gal.):	<u>Water Quality Meter:</u>	5"	1.020
Depth of Screen (ft.):	<u>Horiba U-52</u>	6"	1.469
		8"	2.611

**PAGE 2 of 2**

Field Parameters											
Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity <sup>1</sup> (PPT)	Color/Odor
Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3%	+/- 10 mV	+/- 10%	+/- 10%		
Initial 10:05	11.47	330	6.3	3.57	17.15	1.35	435	0.00	6.99	0.7	greenish yellow, no odor
10:10	11.46	330	6.7	3.50	17.25	1.37	443	0.00	6.53	0.7	Same as above (SAA)
10:15	11.41	320	7.1	3.48	17.24	1.37	446	0.00	7.13	0.7	SAA
10:20	11.41	330	7.5	3.36	17.35	1.38	456	0.00	6.84	0.7	SAA
10:25	11.38	320	8.0	3.31	17.59	1.37	462	0.00	6.82	0.7	SAA
10:31	11.48	350	8.6	3.28	17.43	1.40	459	0.00	7.09	0.7	SAA
10:35	Collect	Sample	—————→								
Post-Purge	See Page 1										

Remarks: Pump Intake Depth: \_\_\_\_\_ Control Box Setting (Hz): \_\_\_\_\_ Sampling: (Sample at 100-250 ml/min)

*See Page 1* ↗

**SAMPLING**

Depth to Water Before Sampling: \_\_\_\_\_

Sample Methodology: USEPA - Low Flow Sampling Procedures with submersible pump

Sample Name: \_\_\_\_\_ QC Sample: \_\_\_\_\_

Sample Date/Time: \_\_\_\_\_

Sampler / Signature: \_\_\_\_\_

Filtered Metals Collected: Y / N Filter Size: \_\_\_\_\_

Sample Observations: \_\_\_\_\_

Notes: 1 = stabilization of this parameter is not required prior to collecting sample

Parameters: \_\_\_\_\_

Low-Flow Groundwater Sampling: Field Data Sheet

Well Number: <u>EPA-30-013</u>		Site: <u>Garfield Groundwater Contamination Superfund Site</u>	
Field Crew: <u>D. Helmes</u>		Date: <u>12/18/14</u>	Project #: <u>431007.04.03.05</u>
Well Depth (ft.): <u>22</u>	<u>Purge Methodology:</u> USEPA - Low Flow Sampling Procedures with submersible pump  <u>Water Quality Meter:</u> Horiba U-52	Diameter	Gal. Per Foot
DTW (ft.): <u>12.55</u>		<u>2"</u>	<u>.183</u>
Water Column (ft.): <u>9.45</u>		3"	.367
Well Diameter (in.): <u>2</u>		4"	.653
Gal. per ft.: <u>0.163</u>		Diameter	Gal. Per Foot
Well Volume (gal.): <u>1.54</u>		5"	1.020
Depth of Screen (ft.): <u>17-22</u>		6"	1.469
		8"	2.611

Field Parameters

Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity (PPT)	Color/Odor
Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3%	+/- 10 mV	+/- 10%	+/- 10%		
Initial 0844	13.20	320	0.0	7.39	12.22	1.30	73	9.43	88	0.6	Brownish, cloudy/No odor
0849	13.29	320	0.3	6.93	13.96	1.27	76	5.14	63	0.6	" "
0854	13.53	320	0.6	7.00	15.28	1.27	-12	4.16	23.6	0.6	" "
0859	13.53	300	0.9	7.02	15.62	1.26	-20	3.72	12.9	0.6	Clear/No odor
0904	13.48	300	1.2	7.02	15.89	1.26	-22	3.43	11.64	0.6	" "
0909	13.45	300	1.5	7.62	15.93	1.26	-19	3.31	10.02	0.6	" "
0914	13.25	150	1.8	7.04	15.48	1.26	-17	3.24	19.2	0.6	" "
0919	13.20	150	2.1	7.06	15.97	1.27	-14	3.12	11.5	0.6	" "
0924	13.95	500	2.6	7.05	16.57	1.25	-13	3.09	14.68	0.6	" "
0929	13.05	100	2.8	7.06	15.79	1.26	-12	3.02	14.08	0.6	" "
0934	12.96	150	3.0	7.06	15.64	1.25	-9	2.93	11.54	0.6	" "
Post-Purge 0939	12.95	150	3.2	7.07	16.26	1.25	-5	2.83	10.87	0.6	" "

Remarks: Pump Intake Depth: 19.5' Control Box Setting (Hz): 97.30 Sampling: (Sample at 100-250 ml/min)  
158.40

- Issues getting consistent flow rate

SAMPLING

Depth to Water Before Sampling: \_\_\_\_\_

Sample Methodology: USEPA - Low Flow Sampling Procedures with submersible pump

Sample Name: \_\_\_\_\_ QC Sample: \_\_\_\_\_

Sample Date/Time: \_\_\_\_\_

Sampler / Signature: \_\_\_\_\_

Filtered Metals Collected: Y / N Filter Size: \_\_\_\_\_

Sample Observations: \_\_\_\_\_

Notes: 1 = stabilization of this parameter is not required prior to collecting sample

Parameters: \_\_\_\_\_

Low-Flow Groundwater Sampling: Field Data Sheet

Well Number: EPA-30-05 (cont.)		Site: Garfield Groundwater Contamination Superfund Site	
Field Crew:		Date: Project #: 431007.04.03.05	
Well Depth (ft.):	Purge Methodology:	Diameter	Gal. Per Foot
DTW (ft.):	USEPA - Low Flow	2"	.163
Water Column (ft.):	Sampling Procedures	3"	.367
Well Diameter (in.):	with submersible pump	4"	.653
Gal. per ft.:	Water Quality Meter:	Diameter	Gal. Per Foot
Well Volume (gal.):	Horiba U-52	5"	1.020
Depth of Screen (ft.):		6"	1.469
		8"	2.611

Field Parameters												
Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity <sup>1</sup> (PPT)	Color/Odor	
Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3%	+/- 10 mV	+/- 10%	+/- 10%			
Initial 0944	14.48	500	3.7	7.09	19.48	1.25	-9	5.54	24.4	0.6	Clear/No odor	
0949	14.10	400	4.1	7.07	19.15	1.23	-7	5.07	15.1	0.6	" "	
0954	13.70	350	4.4	7.03	18.66	1.21	3	2.26	11.53	0.6	" "	
0959	13.84	350	4.9	7.08	18.00	1.19	-16	2.29	9.36	0.6	" "	
1004	13.95	350	5.5	7.07	18.82	1.19	-10	2.17	8.28	0.6	" "	
1009	14.10	350	5.9	7.04	18.72	1.19	-3	2.17	7.03	0.6	" "	
1015	Collect Sample											
Post-Purge 1033	15.0		9.0	7.06	19.14	1.21	8	2.09	51.5	0.6		

Remarks: Pump Intake Depth: Control Box Setting (Hz): Sampling: (Sample at 100-250 ml/min)

Ferrous Iron: 0.15 mg/L

**SAMPLING**

Depth to Water Before Sampling: 14.1'

Sample Methodology: USEPA - Low Flow Sampling Procedures with submersible pump

Sample Name: GCGC-EPA-30-05 QC Sample: None

Sample Date/Time: 12/18/14 / 1015

Sampler / Signature: D. Holmes / Daniel Holmes

Filtered Metals Collected: M/N Filter Size: 0.45 μm

Sample Observations: No issues

Notes: 1 = stabilization of this parameter is not required prior to collecting sample

Parameters: Hex Chrom, Total Chrom, Pilot Study Parameters

Low-Flow Groundwater Sampling: Field Data Sheet

Well Number: EPA-31-03		Site: Garfield Groundwater Contamination Superfund Site	
Field Crew: B9193		Date: 12/18	Project #: 431007.04.03.05
Well Depth (ft.): 25.0	Purge Methodology: USEPA - Low Flow Sampling Procedures with submersible pump  Water Quality Meter: Horiba U-52	Diameter	Gal. Per Foot
DTW (ft.): 12.46		2"	.163
Water Column (ft.): 12.54		3"	.367
Well Diameter (in.): 2"		4"	.653
Gal. per ft.: 1.63		Diameter	Gal. Per Foot
Well Volume (gal.): 2.0-2.5		5"	1.020
Depth of Screen (ft.): 14-25		6"	1.469
		8"	2.611

Field Parameters												
Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity (PPT)	Color/Odor	
Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3%	+/- 10 mV	+/- 10%	+/- 10%			
Initial 0848	13.25	425	0.6	7.49	12.81	1.50	266	3.15	488	0.8	yellow/more	
0853	13.02	350	0.6	5.44	14.43	1.60	347	1.02	270	0.8	yellow/more	
0858	13.05	350	1.1	5.34	15.93	1.61	347	.72	202	0.8	yellow/more	
0903	13.00	350	1.6	5.36	16.24	1.63	347	.57	186	0.8	yellow/more	
0908	13.02	350	2.0	5.40	16.44	1.64	346	.44	144	0.8	yellow/more	
0918	13.02	350	3.0	5.50	16.73	1.66	343	.24	89.3	0.8	yellow/more	
0928	13.00	350	3.8	5.95	14.85	1.68	340	.10	64.6	0.8	yellow/more	
0933	13.00	350	4.3	5.62	16.89	1.69	338	0.00	56.4	0.9	yellow/more	
0938	13.00	350	4.8	5.66	16.94	1.70	337	0.00	52.0	0.9	yellow/more	
0943	13.00	350	5.3	5.74	16.88	1.72	334	0.00	47.1	0.9	yellow/more	
0948	13.00	350	5.8	5.77	16.88	1.73	334	0.00	40.8	0.9	yellow/more	
Post-Purge 0953	13.00	350	6.3	5.78	16.97	1.73	333	0.00	38.7	0.9	yellow/more	

Remarks: Pump Intake Depth: 20 Control Box Setting (Hz): 86.40 Sampling: (Sample at 100-250 ml/min) 250

Interrows Iron - Error limit - yellow water color interference w/ readings

SAMPLING

Depth to Water Before Sampling: 13.00

Sample Methodology: USEPA - Low Flow Sampling Procedures with submersible pump

Sample Name: GCGC - EPA-31-03-05 : QC Sample: none

Sample Date/Time: 12/18/14 1010

Sampler / Signature: [Signature]

Filtered Metals Collected: 0/1 N Filter Size: .45

Sample Observations:

Notes: 1 = stabilization of this parameter is not required prior to collecting sample

Parameters: 0.56 / Pilot Study

12.5  
1.63  
3.75  
7.50

Low-Flow Groundwater Sampling: Field Data Sheet

Well Number: EPA-31-013		Site: Garfield Groundwater Contamination Superfund Site	
Field Crew: Balas		Date: 12/18/10	Project #: 431007.04.03.05
Well Depth (ft.):	Purge Methodology: USEPA - Low Flow Sampling Procedures with submersible pump  Water Quality Meter: Horiba U-52	Diameter	Gal. Per Foot
DTW (ft.):		2"	.163
Water Column (ft.):		3"	.367
Well Diameter (in.):		4"	.653
Gal. per ft.:		Diameter	Gal. Per Foot
Well Volume (gal.):		5"	1.020
Depth of Screen (ft.):		6"	1.469
		8"	2.611

Field Parameters												
Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity <sup>1</sup> (PPT)	Color/Odor	
Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3%	+/- 10 mV	+/- 10%	+/- 10%			
Initial 0958	13.00	350	6.8	5.80	14.94	1.74	331	0.00	35.2	0.9	yellow/none	
1003	13.00	350	7.3	5.81	16.92	1.74	331	0.00	36.9	0.9	yellow/none	
1010	collect sample											
Blank												
Post-Purge 1028	13.00	250	-	5.90	16.08	1.79	326	0.00	34.1	0.9	yellow/none	

Remarks: Pump Intake Depth: Control Box Setting (Hz): Sampling: (Sample at 100-250 ml/min)

See page 1

SAMPLING

Depth to Water Before Sampling:

Sample Methodology: USEPA - Low Flow Sampling Procedures with submersible pump

Sample Name: QC Sample:

Sample Date/Time:

Sampler / Signature: See page 1

Filtered Metals Collected: Y / N Filter Size:

Sample Observations:

Notes: 1 = stabilization of this parameter is not required prior to collecting sample

Parameters:

**Low-Flow Groundwater Sampling: Field Data Sheet**

Well Number: <u>EPA-32-03</u>		Site: <u>Garfield Groundwater Contamination Superfund Site</u>	
Field Crew: <u>A. Harclerode</u>		Date: <u>12/17/14</u>	Project #: <u>431007.04.03.05</u>
Well Depth (ft.): <u>19.55</u>	<u>Purge</u> Methodology: USEPA - Low Flow Sampling Procedures with submersible pump  <u>Water Quality Meter:</u> Horiba U-52	Diameter	Gal. Per Foot
DTW (ft.): <u>12.79</u>		<u>2"</u>	.163
Water Column (ft.): <u>6.76</u>		3"	.367
Well Diameter (in.): <u>2</u>		4"	.653
Gal. per ft.: <u>0.163</u>		Diameter	Gal. Per Foot
Well Volume (gal.): <u>1.1</u>		5"	1.020
Depth of Screen (ft.): <u>10-20</u>		6"	1.469
		8"	2.611

Field Parameters											
Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity (PPT)	Color/Odor
Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3%	+/- 10 mV	+/- 10%	+/- 10%		
Initial 11:40	13.30	400	-	3.51	16.22	1.73	462	0.76	50.7	0.9	brownish yellow, no odor
11:45	13.77	390	1.0	3.75	17.62	1.71	440	0.00	33.8	0.9	Same as above (SAA)
11:50	14.06	410	1.6	3.74	18.01	1.71	439	0.00		0.9	SAA
11:55	No measurements - pump rate inconsistency										
12:00	14.01	310	2.5	3.60	18.62	1.67	451	0.00	35.3	0.8	SAA
12:10	16.90	420	4.0	3.46	18.07	1.70	466	0.00	34.1	0.9	SAA
12:15	16.35	400	4.5	3.26	17.79	1.68	485	0.19	13.9	0.8	SAA
12:20	16.18	410	5.1	3.25	17.91	1.68	487	0.17	9.81	0.8	SAA
12:25	15.90	420	5.6	3.25	17.91	1.67	488	0.14	6.86	0.8	SAA
12:30	15.95	400	6.0	3.25	17.87	1.68	488	0.14	4.39	0.8	SAA
12:35	Collect Sample →										
Post-Purge 12:45	15.05	330	6.2	3.37	17.28	1.68	476	0.59	4.05	0.8	SAA

Remarks: Pump Intake Depth: 15' b/c - lowered to 16.8' b/c of pumping issues      Control Box Setting (Hz): 90.80 - 97.50      Sampling: (Sample at 100-250 ml/min) 90.50

Ferrous Iron Hach Result: 0.27 mg/L

**SAMPLING**

Depth to Water Before Sampling: \_\_\_\_\_

Sample Methodology: USEPA - Low Flow Sampling Procedures with submersible pump

Sample Name: GLGC - EPA - 32 - 03 - 05      QC Sample: None

Sample Date/Time: 12/17/14 12:35

Sampler / Signature: A. Harclerode / [Signature]

Filtered Metals Collected: 0/1 N      Filter Size: 0.45 µm

Sample Observations: brownish yellow, no odor

Notes: 1 = stabilization of this parameter is not required prior to collecting sample

Parameters: Hexavalent chromium, total and dissolved chromium and iron,

**Low-Flow Groundwater Sampling: Field Data Sheet**

<b>Well Number:</b> EPA-32-03		<b>Site:</b> Garfield Groundwater Contamination Superfund Site	
<b>Field Crew:</b> D. Holmes		<b>Date:</b> 2/5/15 <b>Project #:</b> 431007.06.06.02	
<b>Well Depth (ft.):</b> 20 <b>DTW (ft.):</b> 13.40 <b>Water Column (ft.):</b> 6.60 <b>Well Diameter (in.):</b> 2 <b>Gal. per ft.:</b> 0.163 <b>Well Volume (gal.):</b> 1.08 <b>Depth of Screen (ft.):</b> 10-20	<b>Purge Methodology:</b> USEPA - Low Flow Sampling Procedures with submersible pump		<b>Water Quality Meter:</b> Horiba U-52
	<b>Diameter</b>	<b>Gal. Per Foot</b>	<b>Diameter</b>
	2" (circled)	.163	5"
	3"	.367	6"
	4"	.653	8"

**Field Parameters**

Time	DTW (ft)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity <sup>1</sup> (PPT)	Color/Odor	
Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%			
Initial	13.52	13.70	200	0.0	5.81	11.77	1.64	381	0.93	121	0.8	Yellow/Green, No odor
	13.57	13.68	200	0.4	5.31	13.05	1.57	414	0.00	74.6	0.8	" "
	14.02	13.55	200	0.6	5.20	13.90	1.58	422	0.00	48.7	0.8	" "
	14.07	13.60	150	0.7	5.14	12.70	1.60	427	0.00	37.5	0.8	" "
	14.12	13.60	100	1.0	5.12	14.32	1.56	428	0.00	48.9	0.8	" "
	14.17	13.64	100	1.2	5.09	15.76	1.56	434	0.00	57.6	0.8	" "
	14.22	13.62	100	1.5	5.05	15.55	1.58	435	0.00	73.7	0.8	" "
	14.27	13.62	100	1.7	5.04	17.51	1.55	420	0.00	170	0.8	" "
	14.32	13.65	150	2.0	5.05	19.18	1.54	418	0.00	265	0.8	" "
	14.37	13.68	100	2.2	5.02	20.33	1.54	419	0.00	232	0.8	" "
	14.45	Collect Sample										
Post-Purge	15.25	13.65	150	3.2	5.05	17.03	1.56	444	0.20	102	0.8	" "

**Remarks:** Pump Intake Depth: 15      Control Box Setting (Hz): 123      Sampling: (Sample at 100-250 ml/min)

- Issues maintaining flow rate, equipment issue

**SAMPLING**

**Depth to Water Before Sampling:** 13.65

**Sample Methodology:** USEPA - Low Flow Sampling Procedures with submersible pump

**Sample Name:** GCL-EPA-32-03-05      **QC Sample:** None

**Sample Date/Time:** 2/5/15 / 1445

**Sampler / Signature:** D. Holmes / [Signature]

**Filtered Metals Collected:** 0/1 N      **Filter Size:** 0.45 um

**Sample Observations:** Flow rate issues

**Notes:** 1 = stabilization of this parameter is not required prior to collecting sample

**Parameters:** Hex Chrom, full suite

### Low-Flow Groundwater Sampling: Field Data Sheet

Well Number: <b>GA-30-05</b>						Site: <b>Garfield Groundwater Contamination Superfund Site</b>							
Field Crew: <b>T. SULLIVAN</b>						Date: <b>2/5/15</b> Project #: <b>431007.06.06.02</b>							
Well Depth (ft.): <b>22</b>			Purge Methodology:			Diameter		Gal. Per Foot		Diameter		Gal. Per Foot	
DTW (ft.): <b>12.74</b>			USEPA - Low Flow			2"		.163		5"		1.020	
Water Column (ft.):			Sampling Procedures			3"		.367		6"		1.469	
Well Diameter (in.): <b>2"</b>			with submersible pump			4"		.653		8"		2.611	
Gal. per ft.: <b>0.165</b>			Water Quality Meter:										
Well Volume (gal.):			Horiba U-52										
Depth of Screen (ft.): <b>17-22</b>													
Field Parameters													
Time	DTW (ft)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity <sup>1</sup> (PPT)	Color/Odor		
Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%				
Initial	1316	13.30	300	-	6.90	10.90	1.10	-27	0.30	210	0.5	LT BROWN	
	1321	13.89	300	0.3	6.67	12.42	1.09	-53	0.00	66.5	0.5	" "	
	1326	13.85	300	0.6	6.44	12.79	1.09	-65	0.00	78.3	0.5	37.7 NTU	
	1331	13.81	300	0.9	6.37	13.01	1.09	-63	0.00	90.9	0.5	CLEAR	
	1336	13.83	300	1.2	6.31	13.16	1.09	-63	0.00	180	0.5	LIGHT BROWN	
	1341	13.84	300	1.6	6.25	13.31	1.09	-60	0.00	159	0.5	LIGHT BROWN	
	1346	13.84	300	1.9	6.22	13.23	1.09	-57	0.00	88	0.5	" "	
	1351	13.83	300	2.3	6.21	13.27	1.09	-51	0.00	79	0.5	" "	
	1356	13.82	300	2.6	6.21	13.24	1.09	-49	0.00	78	0.5	" "	
	1405	COLLECT SAMPLE											
Post-Purge	1415	13.78	300	-	6.38	13.85	1.08	-78	0.00	252	0.5	LT BROWN	
Remarks: Pump Intake Depth: <b>19.5'</b> Control Box Setting (Hz): <b>85</b> Sampling: (Sample at 100-250 ml/min)													
SAMPLING													
Depth to Water Before Sampling:													
Sample Methodology: USEPA - Low Flow Sampling Procedures with submersible pump													
Sample Name: <b>GA-30-05-020515</b> QC Sample: <b>X</b>													
Sample Date/Time: <b>1405 2/5/15</b>													
Sampler / Signature: <i>[Signature]</i>													
Filtered Metals Collected: <b>0/1 N</b> Filter Size:													
Sample Observations: <b>LT BROWN</b>													
Notes: 1 = stabilization of this parameter is not required prior to collecting sample													
Parameters: <b>SULL</b>													

**Low-Flow Groundwater Sampling: Field Data Sheet**

<b>Well Number:</b> <u>EPA-13-08</u>		<b>Site:</b> Garfield Groundwater Contamination Superfund Site	
<b>Field Crew:</b> <u>T. SALAS</u>		<b>Date:</b> <u>2/5/15</u>	<b>Project #:</b> 431007.06.06.02
<b>Well Depth (ft.):</b> <u>32'</u>	<b>Purge Methodology:</b>	<b>Diameter</b>	<b>Gal. Per Foot</b>
<b>DTW (ft.):</b> <u>12.97</u>	USEPA - Low Flow	<u>2"</u>	<u>.163</u>
<b>Water Column (ft.):</b>	Sampling Procedures	3"	.367
<b>Well Diameter (in.):</b> <u>2</u>	with submersible pump	4"	.653
<b>Gal. per ft.:</b> <u>0.163</u>	<b>Water Quality Meter:</b>	5"	1.020
<b>Well Volume (gal.):</b>	Horiba U-52	6"	1.469
<b>Depth of Screen (ft.):</b> <u>22-32</u>		8"	2.611

**Field Parameters**

	Time	DTW (ft)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity <sup>1</sup> (PPT)	Color/Odor
	Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%		
Initial	1142	14.40	400	/	7.35	13.35	0.961	-188	0.70	63.3	0.5	CLEAR
	1147	13.95	300	0.4	7.17	13.01	0.945	-201	0.05	12.1	0.5	CLEAR
	1152	13.85	250	0.6	6.85	14.05	0.975	-190	0.00	12.1	0.5	CLEAR
	11:57	13.82	250	0.8	6.63	14.45	0.983	-192	0.00	10.5	0.5	CLEAR
	1202	13.82	250	1.0	6.60	14.52	0.997	-192	0.00	9.3	0.5	CLEAR
	1207	13.83	250	1.2	6.59	14.69	0.996	-194	0.00	10.9	0.5	" "
	1212	13.83	250	1.4	6.77	14.68	1.01	-207	0.00	10.4	0.5	" "
	1217	13.82	250	1.6	7.07	14.75	1.01	-223	0.00	9.2	0.5	" "
	1222	13.82	250	1.9	7.18	14.87	1.01	-229	0.00	9.6	0.5	" "
	1227	13.81	250	2.2	7.18	14.95	1.01	-228	0.00	9.3	0.5	" "
	1236	COLLECT SAMPLE										
Post-Purge	1245	3.87	250	-	7.23	14.01	1.07	-218	0.00	8.3	0.5	CLEAR

**Remarks:** Pump Intake Depth: 27 Control Box Setting (Hz): 87 Sampling: (Sample at 100-250 ml/min)

**SAMPLING**

Depth to Water Before Sampling: \_\_\_\_\_

Sample Methodology: USEPA - Low Flow Sampling Procedures with submersible pump

Sample Name: GLGC-EPA-13-08-020515 QC Sample:

Sample Date/Time: 2/5/15 1230

Sampler / Signature: Tyler Jones

Filtered Metals Collected:  N Filter Size: \_\_\_\_\_

Sample Observations: CLEAR

Notes: 1 = stabilization of this parameter is not required prior to collecting sample

Parameters: Full

**Low-Flow Groundwater Sampling: Field Data Sheet**

<b>Well Number:</b> <u>EPA-29</u>		<b>Site:</b> <u>Garfield Groundwater Contamination Superfund Site</u>	
<b>Field Crew:</b> <u>T. S. SORRELL</u>		<b>Date:</b> <u>2/16/15</u> <b>Project #:</b> <u>431007.06.06.02</u>	
<b>Well Depth (ft.):</b> <u>20 20</u> <b>DTW (ft.):</b> <u>11.08</u> <b>Water Column (ft.):</b> <b>Well Diameter (in.):</b> <u>2"</u> <b>Gal. per ft.:</b> <u>0.163</u> <b>Well Volume (gal.):</b> <b>Depth of Screen (ft.):</b> <u>15-20 15-70</u>	<b>Purge Methodology:</b>		<b>Diameter</b> <b>Gal. Per Foot</b>
	USEPA - Low Flow		<b>5"</b> <b>1.020</b>
	Sampling Procedures with submersible pump		<b>6"</b> <b>1.469</b>
	<b>Water Quality Meter:</b>		<b>8"</b> <b>2.611</b>
	Horiba U-52		

**Field Parameters**

Time	DTW (ft)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity <sup>1</sup> (PPT)	Color/Odor
<b>Stabilization</b>	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%		
Initial 1116	11.50	300	-	3.11	12.40	1.57	449	0.00	39.2	0.8	YELLOW
1121	11.56	300	0.3	3.13	14.37	1.50	435	0.00	48.7	0.7	YELLOW
1126	11.58	300	0.6	3.13	14.75	1.49	432	0.00	117	0.7	" "
1131	11.61	300	0.9	3.14	15.06	1.48	428	0.00	109	0.7	" "
1136	11.61	300	1.2	3.15	15.17	1.47	427	0.00	24.7	0.7	" "
1141	11.62	300	1.5	3.15	15.25	1.47	425	0.00	22.0	0.7	" "
1146	11.63	300	1.8	3.13	15.29	1.49	427	0.00	19.6	0.7	" "
1150		COLLECT SAMPLE									
Post-Purge 1216	11.64	300	-	3.10	15.46	1.61	447	0.00	29.6	0.8	YELLOW

**Remarks:**      Pump Intake Depth: 17.5      Control Box Setting (Hz): 81      Sampling: (Sample at 100-250 ml/min)

**SAMPLING**

**Depth to Water Before Sampling:** 11.63

**Sample Methodology:** USEPA - Low Flow Sampling Procedures with submersible pump

**Sample Name:** GALGAL-EPA-29-08-020615      **QC Sample:** X

**Sample Date/Time:** 2/16/15 1150

**Sampler / Signature:** [Signature]

**Filtered Metals Collected:** 0 N      **Filter Size:**

**Sample Observations:** yellow

**Notes:** 1 = stabilization of this parameter is not required prior to collecting sample

**Parameters:** FULL SUITE

**Low-Flow Groundwater Sampling: Field Data Sheet**

<b>Well Number:</b> EPA-31-08		<b>Site:</b> Garfield Groundwater Contamination Superfund Site	
<b>Field Crew:</b> D. Holmes		<b>Date:</b> 2/6/15 <b>Project #:</b> 431007.06.06.02	
<b>Well Depth (ft.):</b> 25 <b>DTW (ft.):</b> 13.18 <b>Water Column (ft.):</b> 11.82 <b>Well Diameter (in.):</b> 2 <b>Gal. per ft.:</b> 0.163 <b>Well Volume (gal.):</b> 1.93 <b>Depth of Screen (ft.):</b> 15-25	<b>Purge Methodology:</b> USEPA - Low Flow Sampling Procedures with submersible pump  <b>Water Quality Meter:</b> Horiba U-52	<b>Diameter</b>	<b>Gal. Per Foot</b>
		<b>Diameter</b>	<b>Gal. Per Foot</b>
		2" .163	5" 1.020
		3" .367	6" 1.469
		4" .653	8" 2.611

Field Parameters												
Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Salinity <sup>1</sup> (PPT)	Color/Odor	
Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%			
Initial	1031	13.60	400	0.0	4.69	10.97	1.50	387	2.05	113	0.7	Yellow/green
	1036	13.68	480	0.6	4.83	14.26	1.49	378	0.00	92.8	0.7	" "
	1041	13.68	480	1.2	4.89	14.79	1.50	374	0.00	75.2	0.8	" "
	1046	13.70	480	1.8	4.95	15.00	1.52	371	0.00	55.6	0.8	" "
	1051	13.70	480	2.4	5.02	15.11	1.54	367	0.00	39.9	0.8	" "
	1056	13.70	480	3.0	5.09	15.14	1.56	364	0.00	32.0	0.8	" "
	1101	13.70	480	3.6	5.17	15.21	1.58	359	0.00	23.3	0.8	" "
	1106	13.70	480	4.2	5.23	15.23	1.59	356	0.00	20.3	0.8	" "
	1111	13.70	480	4.8	5.28	15.32	1.60	354	0.00	19.7	0.8	" "
	1116	13.70	480	5.4	5.36	15.29	1.61	350	0.00	18.3	0.8	" "
	1120	Collect Sample										
Post-Purge	1150	13.80	480	8.0	5.46	12.74	1.72	341	2.82	0.9	" "	

**Remarks:** Pump Intake Depth: 20      Control Box Setting (Hz): 87      Sampling: (Sample at 100-250 ml/min)

**SAMPLING**

Depth to Water Before Sampling: 13.70

Sample Methodology: USEPA - Low Flow Sampling Procedures with submersible pump

Sample Name: CGC-EPA-31-08-05      QC Sample: Field Dup

Sample Date/Time: 2/6/15 / 1120

Sampler / Signature: D. Holmes / Daniel Holmes

Filtered Metals Collected:  / N      Filter Size: 0.45 um

Sample Observations: None

Notes: 1 = stabilization of this parameter is not required prior to collecting sample

Parameters: Full suite

**Attachment 6**  
**Vironex Injection Services Report**

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# Injection Services Report

Prepared for:



Prepared by:



Garfield Groundwater Contamination Superfund Site

Garfield, NJ

June 23, 2014 – July 2, 2014

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## Project Summary

Project Name: Garfield Superfund Site

Project Dates: June 23, 2014 – July 2, 2014

Manpower: Brendan Gerber (Regional Manager); Robert Jones (Technician); Mat Bacher (Technician)

Equipment: DC5 (Truck Platform) equipped with two stainless steel batch mixing tanks, integrated secondary containment, safety shower and eye wash, Air Diaphragm Pump for distribution.

Tooling: 1.5 inch top down injection tools with a 2 foot screen length and equipped with injection caps

Rental Equipment: Forklift (chemical management) Conex Box (chemical management)

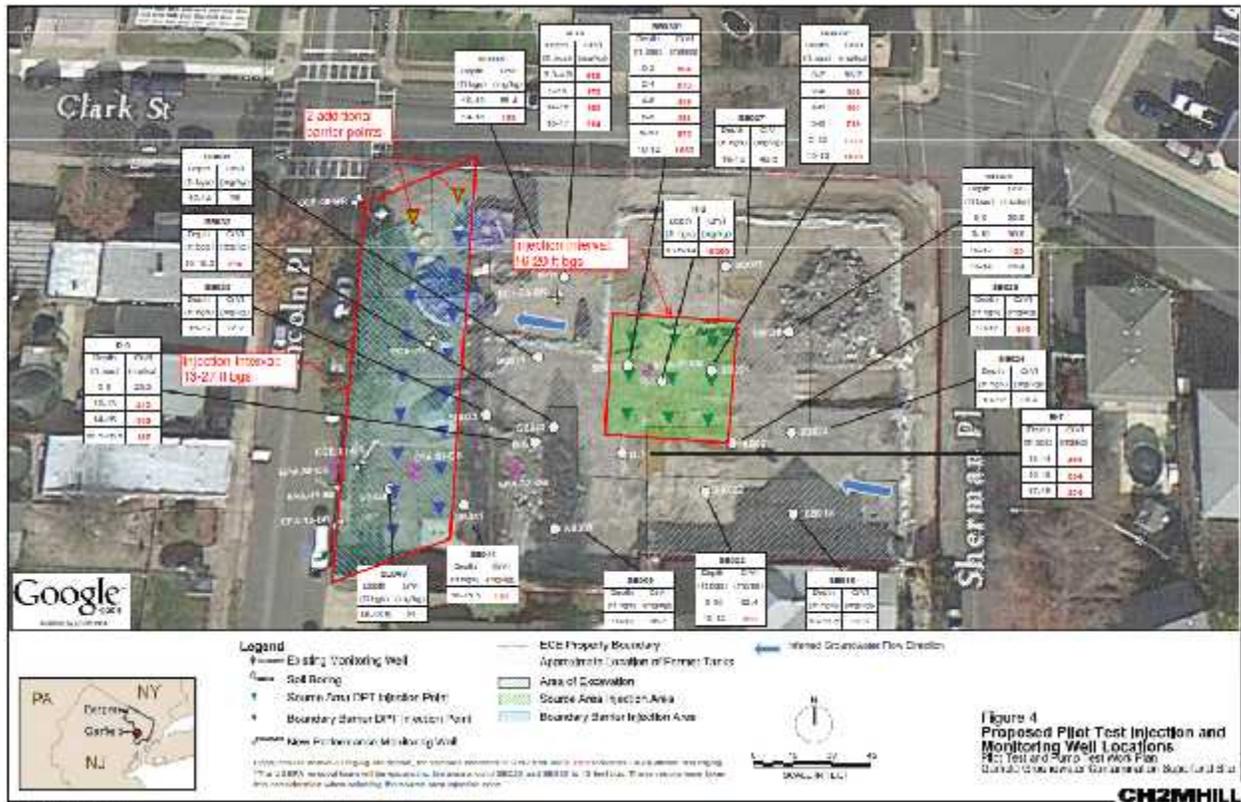
Water Source: Fire Hydrant

Proposed Scope of Work: Vironex proposed to prepare, batch, mix and inject a total of 36,200 gallons of a 60% solution of EVO, Magnesium Sulfate and Water under low pressure and low flow conditions into 25 total locations across the site. Vironex was to provide 3,453 gallons of 60% SRS-SD and 1,347 pounds of Magnesium Sulfate. Vironex proposed to use a 2 foot, top down injection tool for distribution. While injecting at the Reactive Barrier, Vironex proposed a 10 foot to 27 foot injection zone, injecting 1,700 gallons per point at 18 locations. While in the Source Area Vironex proposed a 10 foot to 20 foot injection zone, 1,000 gallons per point at 9 locations.

Project Summary: While injecting into the Reactive Barrier, Vironex encountered difficult drilling; refusal was met between 17 feet and 24 feet causing the injection zones to be adjusted. Vironex switched from a top down 2.25 inch injection tool with pre strung tooling to a 1.5 inch injection tool with an injection cap. Certain locations specified in the injection field logs were offset in the event there was surfacing or refusal was met before an acceptable zone was achieved to start injections.

While injecting into the Source Area, Vironex continued with the 1.5 inch injection tooling. The injection zones again were adjusted due to shallow refusal. Due to the difficult drilling encountered throughout this site, there were a total of 7 injection tools that were lost or broken.

### Site Map



### Injection Summary

	Date	Time On-Site	Time Off-Site	Lunch Break (hrs)	Total EVO Injected (gal)	Total Magnesium Sulfate Injected (lbs)	Total Water Injected (gal)	Total Solution Volume Injected (gal)	DPT Injection Points Completed
	Running Total >				3,448	1,374	25,254	28,701	29.1
Monday	6/23/2014	10:15 AM	5:00 PM	0.75	-	-	-	-	-
Tuesday	6/24/2014	7:00 AM	5:15 PM	0	115	42	802	916	0.7
Wednesday	6/25/2014	7:00 AM	5:15 PM	0	359	131	2,515	2,875	2.0
Thursday	6/26/2014	7:00 AM	6:00 PM	0	367	135	2,573	2,940	2.1
Friday	6/27/2014	7:00 AM	6:15 PM	0	445	162	2,604	3,049	2.2
Saturday	6/28/2014	7:00 AM	6:30 PM	0	490	179	3,429	3,919	2.8
Sunday	6/29/2014	7:00 AM	5:40 PM	0	503	184	3,520	4,023	2.9
Monday	6/30/2014	7:00 AM	6:10 PM	0	441	162	3,088	3,529	2.5
Tuesday	7/1/2014	7:00 AM	6:00 PM	0	467	209	3,821	4,288	6.0
Wednesday	7/2/2014	7:00 AM	3:00 PM	0	261	170	2,902	3,162	7.9
				<b>Injected</b>	<b>3,448</b>	<b>1,374</b>	<b>25,254</b>	<b>28,701</b>	<b>29</b>

### Project Photographs



Vironex Injection Platform



Vironex Direct Push Rig



Injection Manifold



Safety Shower & Eyewash Station



EVO in Secondary Containment



Batch Tank



Magnesium Sulphate



Field Computer for Data Entry



Completed Injection Locations

## Appendix – Injection Logs

CH2M HILL  
EVO Injections  
Garfield Superfund Site, NJ

Vironex Field Data Sheet

Injection Point ID	Start Date	Start Time	End Date	End Time	Depth	Start Up Pressure (psi)	Average Pressure (psi)	Average Flow Rate (gpm)	EVO Injected (gal)	Epsom Salt Injected (lbs)	H <sub>2</sub> O Injected (gal)	Amended Total Gal	Notes
IP-01	6/25/14	1:42 PM	6/25/14	2:58 PM	15' - 17'	25	7	3.0	25	9.1	175	200	
	6/25/14	3:10 PM	6/25/14	4:08 PM	13' - 15'	8	7	3.5	25	9.1	175	200	
IP-01a	6/29/14	10:18 AM	6/29/14	1:15 PM	13' - 15'	30	20	2.0	38	13.7	263	300	
	6/29/14	1:27 PM	6/29/14	5:26 PM	15' - 17'	25	10	3.5	63	22.9	438	500	
	6/30/14	7:41 AM	6/30/14	8:15 AM	15' - 17'	15	15	4.5	19	6.9	131	150	Location complete.
Total H <sub>2</sub> O 1181	Total EVO 169	Total Epsom Salt 62	Total Solution 1350	Additional Notes: Hit refusal at 17'. Offset location. Put extra volume into IP-04 due to shallow refusal on IP-01.									
IP-02	6/27/14	7:55 AM	6/27/14	8:40 AM	21' - 19'	25	20	2.5	9	3.4	66	75	
	6/27/14	9:36 AM	6/27/14	11:05 AM	21' - 19'	20	19	2.3	42	15.3	125	167	
	6/27/14	11:29 AM	6/27/14	11:48 AM	19' - 17'	10	7	1.0	5	1.9	16	21	
	6/27/14	12:26 PM	6/27/14	3:26 PM	19' - 17'	16	10	2.0	38	13.7	263	300	
	6/27/14	3:35 PM	6/27/14	5:48 PM	17' - 15'	16	14	3.0	32	11.7	224	256	
	6/28/14	8:10 AM	6/28/14	8:24 AM	17' - 15'	15	15	3.0	6	2.0	39	44	
	6/28/14	8:42 AM	6/28/14	12:04 PM	15' - 13'	2	2	2.0	43	15.8	302	345	Location complete.
Total H <sub>2</sub> O 1034	Total EVO 175	Total Epsom Salt 64	Total Solution 1208	Additional Notes: Bottom up. Refusal at 21'.									
IP-03	6/27/14	2:00 PM	6/27/14	4:25 PM	13' - 15'	35	25	2.5	38	13.7	263	300	
	6/27/14	4:34 PM	6/27/14	5:48 PM	15' - 17'	25	20	3.0	26	9.6	185	211	
	6/28/14	8:10 AM	6/28/14	8:24 AM	15' - 17'	20	20	3.0	6	2.2	43	49	
	6/28/14	8:30 AM	6/28/14	10:44 AM	17' - 19'	15	15	3.0	35	12.8	245	280	
	6/28/14	10:47 AM	6/28/14	1:38 PM	19' - 21'	35	20	2.5	35	12.8	245	280	
	6/28/14	1:45 PM	6/28/14	3:27 PM	21' - 23'	45	20	3.5	35	12.8	245	280	Refusal at 23'. Location complete.
Total H <sub>2</sub> O 1225	Total EVO 175	Total Epsom Salt 64	Total Solution 1400	Additional Notes:									
IP-04	6/26/14	8:15 AM	6/26/14	11:56 AM	13' - 15'	5	5	2.0	25	9.1	175	200	Surfacing through the annulus.
	6/26/14	12:04 PM	6/26/14	1:49 PM	15' - 17'	28	16	2.0	25	9.1	175	200	
	6/26/14	2:18 PM	6/26/14	3:36 PM	17' - 19'	25	12	2.5	25	9.1	175	200	
	6/26/14	3:43 PM	6/26/14	5:13 PM	19' - 21'	40	20	2.5	25	9.1	175	200	
	6/26/14	5:30 PM	6/26/14	5:48 PM	20' - 22'	28	20	2.8	5	2.0	38	43	
	6/27/14	7:50 AM	6/27/14	8:40 AM	20' - 22'	30	25	2.5	20	7.2	137	157	
	6/27/14	9:36 AM	6/27/14	9:56 AM	20' - 22'	27	24	2.5	13	4.6	38	50	
	6/27/14	10:43 AM	6/27/14	11:48 AM	19' - 21'	7	7	2.0	18	6.6	54	72	Surfacing through the annulus. Lowered flow rate.
	6/27/14	12:26 PM	6/27/14	1:16 PM	19' - 21'	16	15	2.0	9	3.1	60	68	Surfacing through the annulus. Abandoned location.
IP-04a	6/29/14	4:28 PM	6/29/14	5:27 PM	19' - 21'	30	25	3.0	17	6.4	122	139	Refusal at 21'. Location complete.
Total H <sub>2</sub> O 1148	Total EVO 181	Total Epsom Salt 66	Total Solution 1329	Additional Notes: Extra volume into this location due to shallow refusal on IP-01.									

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Injection Point ID	Start Date	Start Time	End Date	End Time	Depth	Start Up Pressure (psi)	Average Pressure (psi)	Average Flow Rate (gpm)	EVO Injected (gal)	Epsom Salt Injected (lbs)	H <sub>2</sub> O Injected (gal)	Amended Total Gal	Notes
IP-05b	6/28/14	4:15 PM	6/28/14	6:01 PM	13' - 15'	25	20	2.0	27	9.9	190	217	
	6/29/14	7:46 AM	6/29/14	8:11 AM	13' - 15'	22	22	2.5	8	2.9	55	63	
	6/29/14	8:17 AM	6/29/14	10:27 AM	15' - 17'	25	20	3.0	35	12.8	245	280	
	6/29/14	10:38 AM	6/29/14	12:18 PM	17' - 19'	7	7	2.8	35	12.8	245	280	
	6/29/14	12:28 PM	6/29/14	2:34 PM	18' - 20'	7	7	2.8	38	13.7	263	300	Refusal at 20'.
	6/29/14	2:38 PM	6/29/14	3:37 PM	16' - 18'	5	5	3.0	28	10.1	193	220	
6/29/14	3:40 PM	6/29/14	3:56 PM	16' - 14'	10	10	3.5	5	1.8	35	40	Location complete.	
Total H <sub>2</sub> O 1225	Total EVO 175	Total Epsom Salt 64	Total Solution 1400	Additional Notes: Hit refusal at 5' on IP-05 and IP-05a.									
IP-06	6/25/14	8:53 AM	6/25/14	10:38 AM	15' - 17'		15	2.5	25	9.1	175	200	
	6/25/14	10:50 AM	6/25/14	12:07 PM	17' - 19'		20	2.8	25	9.1	175	200	
	6/25/14	12:15 PM	6/25/14	12:58 PM	18' - 20'		13	3.0	13	4.6	88	100	Hit refusal at 20'. 100 gal into this interval per client request.
IP-06a	6/30/14	8:21 AM	6/30/14	10:23 AM	15' - 17'	15	15	3.0	38	13.7	263	300	
	6/30/14	10:28 AM	6/30/14	1:04 PM	17' - 19'	25	15	3.0	50	18.3	350	400	
	6/30/14	1:15 PM	6/30/14	3:30 PM	19' - 21'	40	20	2.0	25	9.1	175	200	Location complete.
Total H <sub>2</sub> O 1225	Total EVO 175	Total Epsom Salt 64	Total Solution 1400	Additional Notes:									
IP-07	6/24/14	1:19 PM	6/24/14	2:00 PM	15' - 17'		25	0.5	2	0.7	14	16	Clogged injection tool. Ceased pumping and removed tooling.
	6/26/14	2:42 PM	6/26/14	3:05 PM	21' - 19'	5	4	1.5	5	1.8	35	40	Bottom up injection. Surfacing from annulus.
IP-07a	6/26/14	4:00 PM	6/26/14	5:12 PM	21' - 19'	20	10	2.0	18	6.6	126	144	
	6/26/14	5:28 PM	6/26/14	5:44 PM	19' - 17'	10	3	1.0	2	0.8	16	18	Surfacing through the annulus.
	6/27/14	8:05 AM	6/27/14	8:37 AM	19' - 17'	3	3	1.5	5	1.8	35	40	Surfaced from annulus again.
	6/27/14	9:36 AM	6/27/14	11:22 AM	19' - 17'	2	2	1.0	22	8.0	66	88	Surfaced from annulus again. Abandoned location.
IP-07b	6/30/14	8:45 AM	6/30/14	11:00 AM	24' - 22'	45	40	1.5	25	9.1	175	200	
	6/30/14	11:06 AM	6/30/14	2:00 PM	22' - 20'	40	40	1.5	25	9.1	175	200	
	6/30/14	2:08 PM	6/30/14	3:30 PM	20' - 18'	35	35	1.5	13	4.6	88	100	
	6/30/14	3:40 PM	6/30/14	4:07 PM	18' - 16'	20	15	1.5	7	2.5	47	54	Surfacing from annulus. Remaining volume into IP-08c.
Total H <sub>2</sub> O 777	Total EVO 124	Total Epsom Salt 45	Total Solution 900	Additional Notes: Lowered flow rate to .5 GPM, however surfacing continued through the annulus. Multiple offsets at this location due to refusal and surfacing. Remaining 500 gallons injected into IP-08c.									
IP-08b	6/28/14	1:08 PM	6/28/14	5:35 PM	15' - 17'	15	15	1.8	35	12.8	245	280	
	6/29/14	7:48 AM	6/29/14	8:47 AM	15' - 17'	5	5	1.5	9	3.4	66	75	Refusal at 17'. Surfacing from annulus.
IP-08c	6/30/14	4:03 PM	6/30/14	6:01 PM	17' - 19'	10	10	3.0	37	13.5	258	295	
	7/1/14	7:40 AM	7/1/14	8:21 AM	17' - 19'	15	15	4.0	31	11.4	219	250	
	7/1/14	8:23 AM	7/1/14	10:58 AM	19' - 21'	17	15	3.5	63	22.9	438	500	
	7/1/14	11:02 AM	7/1/14	1:10 PM	20' - 22'	20	20	4.0	63	22.9	438	500	Refusal at 22'. Location complete.
Total H <sub>2</sub> O 1663	Total EVO 238	Total Epsom Salt 87	Total Solution 1900	Additional Notes: Hit refusal 3 times at 3'. Refusal on IP-08 at 3' and IP-08a at 5'. Additional 500 gallons injected from IP-07.									

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EVO Injections  
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Injection Point ID	Start Date	Start Time	End Date	End Time	Depth	Start Up Pressure (psi)	Average Pressure (psi)	Average Flow Rate (gpm)	EVO Injected (gal)	Epsom Salt Injected (lbs)	H <sub>2</sub> O Injected (gal)	Amended Total Gal	Notes
IP-09	6/24/14	3:35 PM	6/24/14	4:35 PM	15' - 17'		5	1.5	13	4.6	88	100	
	6/25/14	8:00 AM	6/25/14	8:45 AM	15' - 17'		13	2.8	13	4.6	88	100	
	6/25/14	9:00 AM	6/25/14	11:10 AM	17' - 19'		10	2.5	25	9.1	175	200	
	6/25/14	11:15 AM	6/25/14	12:30 PM	19' - 21'	40	20	2.8	25	9.1	175	200	Minor surfacing around point. Reduced flow and continued.
	6/25/14	12:43 PM	6/25/14	2:20 PM	21' - 23'		15	2.8	25	9.1	175	200	
	6/25/14	2:33 PM	6/25/14	3:46 PM	23' - 25'	35	10	3.8	25	9.1	175	200	
	6/25/14	3:52 PM	6/25/14	4:52 PM	25' - 27'	30	10	3.5	22	8.0	153	175	
	6/26/14	8:12 AM	6/26/14	8:20 AM	25' - 27'	15	12	3.5	3	1.1	22	25	
6/26/14	9:00 AM	6/26/14	9:52 AM	26' - 28'	35	35	4.0	25	9.1	175	200	Refusal at 28'. Location complete.	
Total H <sub>2</sub> O 1225	Total EVO 175	Total Epsom Salt 64	Total Solution 1400	Additional Notes: Injection point complete.									
IP-10	6/24/14	1:03 PM	6/24/14	3:16 PM	15' - 17'		10	2.0	25	9.1	175	200	
	6/24/14	3:35 PM	6/24/14	4:40 PM	17' - 19'		10	2.5	25	9.1	175	200	Refusal at 19'.
IP-10a	6/30/14	5:30 PM	6/30/14	6:01 PM	22' - 20'	45	25	3.0	13	4.6	88	100	
	7/1/14	7:50 AM	7/1/14	9:40 AM	22' - 20'	25	25	3.0	38	13.7	263	300	
	7/1/14	9:45 AM	7/1/14	11:15 AM	20' - 18'	20	20	3.5	38	13.7	263	300	
	7/1/14	11:19 AM	7/1/14	12:53 PM	18' - 16'	20	20	3.5	38	13.7	263	300	Location complete.
Total H <sub>2</sub> O 1225	Total EVO 175	Total Epsom Salt 64	Total Solution 1400	Additional Notes:									
IP-11	6/26/14	10:55 AM	6/26/14	11:35 AM	15' - 17'	28	28	2.0	9	3.4	66	75	
	6/26/14	12:28 PM	6/26/14	1:32 PM	15' - 17'		22	2.0	16	5.7	109	125	
	6/26/14	1:36 PM	6/26/14	3:09 PM	17' - 19'	30	15	2.0	25	9.1	175	200	
	6/26/14	3:27 PM	6/26/14	5:10 PM	19' - 21'	15	10	2.0	25	9.1	175	200	
	6/26/14	5:18 PM	6/26/14	5:48 PM	21' - 23'	25	15	2.5	9	3.2	61	70	
	6/27/14	8:04 AM	6/27/14	8:40 AM	21' - 23'	12	12	2.5	10	3.5	67	76	
	6/27/14	9:36 AM	6/27/14	10:32 AM	21' - 23'	25	24	2.5	25	9.1	75	100	
	6/27/14	11:40 AM	6/27/14	11:48 AM	22' - 24'	25	25	2.5	3	1.2	10	13	
	6/27/14	12:26 PM	6/27/14	2:17 PM	22' - 24'	30	22	2.5	29	10.5	201	230	
	6/27/14	2:25 PM	6/27/14	4:29 PM	20' - 22'	20	17	2.5	28	10.3	197	225	Location complete.
Total H <sub>2</sub> O 1136	Total EVO 178	Total Epsom Salt 65	Total Solution 1314	Additional Notes: Refusal at 24'.									
IP-12	6/28/14	8:10 AM	6/28/14	8:40 AM	15' - 17'	50	50	0.2	1	0.2	4	5	Clogged injection tool. Ceased pumping and removed tooling.
IP-12a	6/28/14	9:17 AM	6/28/14	11:16 AM	25' - 23'	10	10	3.0	34	12.6	241	275	
	6/28/14	11:20 AM	6/28/14	1:34 PM	23' - 21'	10	10	3.0	35	12.8	245	280	
	6/28/14	1:37 PM	6/28/14	4:25 PM	21' - 19'	7	7	2.0	40	14.6	280	320	Surfacing from annulus. Reduced flow rate.
	6/28/14	4:31 PM	6/28/14	6:01 PM	19' - 17'	15	15	2.5	17	6.3	120	137	
	6/29/14	7:46 AM	6/29/14	8:54 AM	19' - 17'	10	10	2.5	15	5.6	108	123	
6/29/14	8:58 AM	6/29/14	11:30 AM	17' - 15'	5	5	1.5	33	11.9	228	260	Location complete.	
Total H <sub>2</sub> O 1225	Total EVO 175	Total Epsom Salt 64	Total Solution 1400	Additional Notes:									

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Injection Point ID	Start Date	Start Time	End Date	End Time	Depth	Start Up Pressure (psi)	Average Pressure (psi)	Average Flow Rate (gpm)	EVO Injected (gal)	Epsom Salt Injected (lbs)	H <sub>2</sub> O Injected (gal)	Amended Total Gal	Notes
IP-13	6/25/14	9:23 AM	6/25/14	11:01 AM	15' - 17'		7	2.5	25	9.1	175	200	
	6/25/14	11:10 AM	6/25/14	12:40 PM	17' - 19'		10	3.0	25	9.1	175	200	
	6/25/14	12:53 PM	6/25/14	1:47 PM	19' - 21'		12	3.5	25	9.1	175	200	
	6/25/14	2:00 PM	6/25/14	2:57 PM	21' - 23'		10	3.5	25	9.1	175	200	
	6/25/14	3:05 PM	6/25/14	3:42 PM	22' - 24'	15	12	3.0	13	4.6	88	100	Refusal at 24'. 100 gal into this interval per client request.
Total H <sub>2</sub> O 788	Total EVO 113	Total Epsom Salt 41	Total Solution 900	Additional Notes: Extra volume injected into IP-14a. Remaining volume will be injected in the source area.									
IP-14	6/24/14	11:40 AM	6/24/14	1:52 PM	15' - 17'		20	1.5	25	9.1	175	200	
	6/24/14	2:18 PM	6/24/14	3:43 PM	17' - 19'		17	2.8	25	9.1	175	200	Hit refusal at 19'. Pulled tooling and abandoned location.
IP-14a	6/30/14	1:58 PM	6/30/14	4:10 PM	22' - 20'	25	22	3.0	50	18.3	350	400	
	6/30/14	4:17 PM	6/30/14	6:01 PM	20' - 18'	17	17	3.0	38	13.7	263	300	
	7/1/14	7:40 AM	7/1/14	9:55 AM	20' - 18'	20	20	3.8	63	22.9	438	500	Location complete. Additional 200 gallons injected from IP-13.
Total H <sub>2</sub> O 1400	Total EVO 200	Total Epsom Salt 73	Total Solution 1600	Additional Notes: Hit refusal when trying to advance to the 19'-21' zone. Pulled tooling and abandoned location. Location will be offset. Additional 200 gallons injected from IP-13.									
IP-15	6/26/14	10:15 AM	6/26/14	11:33 AM	15' - 17'	45	30	3.0	25	9.1	175	200	
	6/26/14	11:45 AM	6/26/14	1:49 PM	17' - 19'	45	25	3.0	25	9.1	175	200	
	6/26/14	1:56 PM	6/26/14	2:17 PM	19' - 21'	30	20	3.0	25	9.1	175	200	
	6/26/14	2:28 PM	6/26/14	3:53 PM	21' - 23'	35	18	3.0	25	9.1	175	200	Began surfacing around annulus. Reduced flow to 2 GPM.
	6/26/14	4:11 PM	6/26/14	5:34 PM	23' - 25'	15	15	3.0	25	9.1	175	200	Refusal at 25'.
IP-15a	6/30/14	12:10 PM	6/30/14	1:28 PM	22' - 20'	15	15	3.0	25	9.1	175	200	
Total H <sub>2</sub> O 1050	Total EVO 150	Total Epsom Salt 55	Total Solution 1200	Additional Notes: Refusal at 25'. Remaining 200 gallons will be injected in the source area.									
IP-16a	6/28/14	3:47 PM	6/28/14	6:01 PM	22' - 20'	40	25	3.5	41	14.9	286	327	
	6/29/14	7:46 AM	6/29/14	7:56 AM	22' - 20'	20	20	3.0	3	1.1	20	23	
	6/29/14	8:10 AM	6/29/14	10:27 AM	21' - 19'	10	10	3.5	44	16.0	306	350	
	6/29/14	10:40 AM	6/29/14	2:58 PM	19' - 17'	10	10	3.0	84	30.6	586	670	
	6/29/14	3:00 PM	6/29/14	5:27 PM	17' - 15'	10	10	3.0	50	18.3	350	400	
	6/30/14	7:41 AM	6/30/14	9:17 AM	17' - 15'	10	10	4.0	41	15.1	289	330	Location complete.
Total H <sub>2</sub> O 1838	Total EVO 263	Total Epsom Salt 96	Total Solution 2100	Additional Notes: Hit refusal on first attempt with 2.25" inner hose tooling. Switched to 1.5" tooling. Injecting extra volume into this location due to multiple refusals at IP-27.									

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Injection Point ID	Start Date	Start Time	End Date	End Time	Depth	Start Up Pressure (psi)	Average Pressure (psi)	Average Flow Rate (gpm)	EVO Injected (gal)	Epsom Salt Injected (lbs)	H <sub>2</sub> O Injected (gal)	Amended Total Gal	Notes
IP-26	6/27/14	12:42 PM	6/27/14	3:17 PM	24' - 22'	30	20	2.5	38	13.7	263	300	
	6/27/14	3:26 PM	6/27/14	5:37 PM	22' - 20'	15	12	3.0	38	13.7	263	300	
	6/28/14	8:35 AM	6/28/14	10:43 AM	20' - 18'	15	12	3.0	33	12.1	232	265	
	6/28/14	10:38 AM	6/28/14	1:13 PM	18' - 16'	8	8	3.0	33	12.1	232	265	
	6/28/14	1:22 PM	6/28/14	3:05 PM	17' - 15'	10	10	3.0	34	12.3	236	270	Location complete.
Total H <sub>2</sub> O 1225	Total EVO 175	Total Epsom Salt 64	Total Solution 1400	Additional Notes: Refusal at 24'.									
IP-27d	6/30/14	9:42 AM	6/30/14	11:05 AM	22' - 20'	17	13	3.0	25	9.1	175	200	
	6/30/14	11:09 AM	6/30/14	11:34 AM	20' - 18'	11	11	3.0	6	2.3	44	50	
	6/30/14	11:38 AM	6/30/14	11:54 AM	18' - 16'	10	10	3.5	6	2.3	44	50	
Total H <sub>2</sub> O 263	Total EVO 38	Total Epsom Salt 14	Total Solution 300	Additional Notes: Hit refusal at 11' on first attempt. Refusal at 11' on IP-27a. Refusal at 10' on IP-27b. Refusal at 15' on IP27c and broke injection tool.									
						Average Pressure (psi)	Average Pressure (psi)	Average Flow Rate	EVO Injected (gal)	Epsom Salt Injected (lbs)	H <sub>2</sub> O Injected (gal)	Amended Total (gal)	Points Complete (based on volume of 1400/point)
						20.8	15.7	2.6	3,051.5	1,115.6	20,850	23,901	17.1

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Vironex Field Data Sheet

Injection Point ID	Start Date	Start Time	End Date	End Time	Depth	Start Up Pressure (psi)	Average Pressure (psi)	Average Flow Rate (gpm)	EVO Injected (gal)	Epsom Salt Injected (lbs)	H <sub>2</sub> O Injected (gal)	Amended Total Gal	Notes
IP-17b	7/1/14	4:31 PM	7/1/14	5:50 PM	14' - 16'	10	5	2.5	15.84	10.32	176	192	Refusal at 16'.
	7/2/14	7:39 AM	7/2/14	8:59 AM	14' - 16'	6	6	3.0	17.16	11.18	191	208	Location complete.
Total H <sub>2</sub> O 176	Total EVO 16	Total Epsom Salt 10.3	Total Solution 192	Additional Notes:									
IP-18	7/1/14	3:43 PM	7/1/14	5:19 PM	20' - 18'	30	30	2.0	17	10.8	184	200	
	7/1/14	5:40 PM	7/1/14	5:50 PM	18' - 16'	20	18	2.5	1	0.8	14	15	
	7/2/14	7:39 AM	7/2/14	9:32 AM	18' - 16'	30	30	2.0	15	9.9	170	185	Location complete.
Total H <sub>2</sub> O 367	Total EVO 33	Total Epsom Salt 21.5	Total Solution 400	Additional Notes:									
IP-19	7/1/14	1:45 PM	7/1/14	2:35 PM	13' - 15'	25	20	3.0	17	10.8	184	200	
	7/1/14	3:40 PM	7/1/14	5:04 PM	14' - 16'	22	15	3.0	17	10.8	184	200	Refusal at 16'. Location complete.
Total H <sub>2</sub> O 367	Total EVO 33	Total Epsom Salt 21.5	Total Solution 400	Additional Notes:									
IP-20a	7/1/14	5:37 PM	7/1/14	5:50 PM	15' - 13'	10	8	2.5	3	1.7	28	31	Refusal at 15'.
	7/2/14	7:39 AM	7/2/14	10:10 AM	15' - 13'	17	15	3.0	30	19.8	339	369	Location complete.
Total H <sub>2</sub> O 367	Total EVO 33	Total Epsom Salt 21.5	Total Solution 400	Additional Notes:									
IP-21	7/1/14	10:25 AM	7/1/14	2:40 PM	15' - 13'	25	15	2.0	33	21.5	367	400	Refusal at 15'. Minor surfacing from annulus. Lowered flow rate.
Total H <sub>2</sub> O 367	Total EVO 33	Total Epsom Salt 21.5	Total Solution 400	Additional Notes: Refusal at 15'.									
IP-22	7/2/14	8:01 AM	7/2/14	10:28 AM	16' - 14'	22	20	3.0	33	21.5	367	400	Refusal at 16'. Location complete.
Total H <sub>2</sub> O 367	Total EVO 33	Total Epsom Salt 21.5	Total Solution 400	Additional Notes:									
IP-23	7/1/14	2:15 PM	7/1/14	4:46 PM	14' - 16'	10	5	2.5	33	21.5	367	400	Refusal at 16'. Location complete.
Total H <sub>2</sub> O 367	Total EVO 33	Total Epsom Salt 21.5	Total Solution 400	Additional Notes:									
IP-24a	7/2/14	9:47 AM	7/2/14	12:03 PM	16' - 14'	15	12	3.5	33	21.5	367	400	Refusal at 16'. Location complete.
Total H <sub>2</sub> O 367	Total EVO 33	Total Epsom Salt 21.5	Total Solution 400	Additional Notes:									

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Injection Point ID	Start Date	Start Time	End Date	End Time	Depth	Start Up Pressure (psi)	Average Pressure (psi)	Average Flow Rate (gpm)	EVO Injected (gal)	Epsom Salt Injected (lbs)	H <sub>2</sub> O Injected (gal)	Amended Total Gal	Notes
IP-25	7/2/14	10:15 AM	7/2/14	12:22 PM	16' - 14'	22	20	3.0	33	21.5	367	400	Location complete.
Total H <sub>2</sub> O 367	Total EVO 33	Total Epsom Salt 21.5	Total Solution 400	Additional Notes:									
IP-28	7/2/14	11:31 AM	7/2/14	12:40 PM	18' - 16'	10	10	3.0	17	10.8	184	200	Refusal at 18'.
	7/2/14	12:44 PM	7/2/14	1:43 PM	16' - 14'	15	15	3.0	17	10.8	184	200	Location complete.
Total H <sub>2</sub> O 367	Total EVO 33	Total Epsom Salt 21.5	Total Solution 400	Additional Notes:									
IP-29	7/2/14	11:31 AM	7/2/14	1:13 PM	20' - 18'	10	10	3.8	17	10.8	184	200	Refusal at 18'.
	7/2/14	1:16 PM	7/2/14	2:05 PM	18' - 16'	10	10	4.0	17	10.8	184	200	Location complete.
Total H <sub>2</sub> O 367	Total EVO 33	Total Epsom Salt 21.5	Total Solution 400	Additional Notes:									
IP-30	7/2/14	12:32 PM	7/2/14	1:25 PM	14' - 16'	25	17	2.8	17	10.8	184	200	
	7/2/14	1:30 PM	7/2/14	2:18 PM	16' - 18'	15	15	4.0	17	10.8	184	200	Location complete.
Total H <sub>2</sub> O 367	Total EVO 33	Total Epsom Salt 21.5	Total Solution 400	Additional Notes:									
						<b>Average Pressure (psi)</b>	<b>Average Pressure (psi)</b>	<b>Average Flow Rate</b>	<b>EVO Injected (gal)</b>	<b>Epsom Salt Injected (lbs)</b>	<b>H<sub>2</sub>O Injected (gal)</b>	<b>Amended Total (gal)</b>	<b>Points Complete (based on volume of 400/point)</b>
						17.5	14.8	2.9	396.0	258.0	4,404	4,800	12.0

## **Pilot Test Injection Field Parameters**

## Pilot Test Injection Field Parameters

Results of In Situ Reduction Pilot Test

Garfield Groundwater Contamination Superfund Site, New Jersey

Well ID	Date	Time	DTW (ft BTIC)	Temp (°C)	Cond. (us/cm)	DO (mg/L)	pH	ORP (eV)	Observations	Injection Point	
EPA-13-OB	6/24/2014	8:33	12.47	14.35	593	5.09	7.38	72.6	yellow	Pre-Injection	
	7/2/2014	10:40	12.27	14.29	668	0.60	6.81	273.0	slight yellow, milky color	Post-Injection	
EPA-29-OB	6/24/2014	8:44	10.58	11.85	602	11.85	5.06	365.3		Pre-Injection	
	7/1/2014	10:30	10.52	12.26	1212	NR	3.35	416.20		IP-21	
	7/1/2014	11:00	10.62	11.71	1397	NR	3.18	490.40		IP-21	
	7/1/2014	11:30	10.64	11.62	1509	NR	3.01	508.00		IP-21	
	7/1/2014	12:00	10.62	11.57	1541	NR	3.02	511.50		IP-21	
	7/1/2014	12:30	10.62	11.82	1595	NR	2.98	516.00		IP-21	
	7/1/2014	13:00	10.61	11.69	1633	2.43	2.92	524.70		IP-21	
	7/1/2014	13:30	10.58	11.64	1668	2.34	2.89	526.70		IP-21	
	7/1/2014	14:00	10.62	11.60	1696	2.09	2.87	528.80		IP-21, IP-19	
	7/1/2014	14:30	10.61	11.58	1733	2.06	2.84	532.90		IP-21, IP-19, IP-23	
	7/1/2014	15:00	10.58	11.56	1788	1.90	2.80	535.50		IP-23	
	7/1/2014	15:30	10.56	11.55	1830	1.82	2.78	534.10		IP-23	
	7/1/2014	16:00	9.73	11.61	885	5.03	4.40	433.00		IP-18, IP-19, IP-23	
	7/1/2014	16:30	9.63	11.64	2472	4.85	6.13	312.70		IP-17B, IP-18, IP-19, IP-23	
	7/1/2014	17:00	9.73	11.66	3552	4.10	6.35	242.90		IP-17B, IP-18, IP-19	
	7/1/2014	17:30	10.20	11.64	3408	4.37	6.37	210.40		IP-17B, IP-18	
	7/1/2014	18:00	10.16	11.63	3353	4.37	6.35	204.40		IP-17B, IP-18, IP-20A	
	7/2/2014	11:00	10.57	12.34	1495	1.17	3.29	391.00		IP-24A, IP-25	
	7/2/2014	11:30	10.05	11.90	1557	0.79	3.15	458.80		IP-24A, IP-25, IP-28, IP-29	
	7/2/2014	12:00	10.17	NR	NR	NR	NR	NR		IP-24A, IP-25, IP-28, IP-29	
	7/2/2014	12:30	9.77	11.63	2078	1.04	4.62	317.60		IP-28, IP-29, IP-30	
	7/2/2014	13:00	9.18	11.64	2529	1.24	5.12	257.30		IP-28, IP-29, IP-30	
	7/2/2014	13:30	9.22	11.65	2516	1.26	5.19	230.00		IP-28, IP-29, IP-30	
	7/2/2014	14:00	9.38	11.64	2474	1.30	5.29	218.80		IP-29, IP-30	
	7/2/2014	14:30	10.10	11.60	2432	1.32	5.25	216.30			
	7/2/2014	14:30	10.10	11.60	2432	1.32	5.25	216.30			Post-Injection
EPA-30-OB	6/24/2014	8:36	12.36	13.99	887	5.77	6.48	182.3		Pre-Injection	
	7/2/2014	10:20	12.15	15.43	1023	3.04	5.60	297.2		Post-Injection	
EPA-31-OB	6/24/2014	9:00	12.75	13.38	1174	8.36	6.23	353.4		Pre-Injection	
	6/24/2014	12:30	12.75	13.17	1009	4.02	6.06	321.3	Dark yellow color	IP-14	
	6/24/2014	13:45	12.78	13.21	1012	1.83	6.06	327.8		IP-07, IP-10, IP-14	
	6/24/2014	14:35	12.80	13.20	1035	1.58	6.07	328.9		IP-10	
	6/24/2014	16:20	12.79	13.21	1010	1.24	6.04	327.7		IP-09, IP-10	
	6/24/2014	16:50	12.78	13.21	1009	1.17	6.04	326.9			
	6/25/2014	8:32	12.81	13.90	1232	2.68	5.95	302.1		IP-09	
	6/25/2014	12:12	12.65	13.30	1249	2.56	5.86	339.8		IP-07, IP-09, IP-13	
	6/25/2014	13:50	12.64	13.30	1235	2.58	5.89	342.6		IP-07, IP-09, IP-13	
	6/25/2014	14:30	12.63	13.30	1236	2.43	5.92	342.8		IP-07, IP-09, IP-13	
	6/25/2014	15:00	12.61	13.30	1239	2.56	5.91	343.7		IP-07, IP-09, IP-13	
	6/25/2014	15:30	12.56	13.29	1251	2.57	5.93	343.8		IP-07, IP-09, IP-13	
	6/25/2014	16:00	12.57	13.30	1240	2.58	5.93	341.5		IP-01, IP-09	
	6/25/2014	16:30	12.56	13.30	1249	2.55	5.92	345.0	Heavy rain at night	IP-09	
	6/26/2014	8:00	12.57	13.93	1283	3.59	6.02	296.4		IP-04	
	6/26/2014	8:30	12.56	13.56	1271	3.55	5.99	324.0		IP-04, IP-09	
	6/26/2014	9:00	12.52	13.37	1273	2.79	6.00	335.9		IP-04, IP-09	
	6/26/2014	9:30	12.52	13.38	1273	2.51	6.01	334.9		IP-04, IP-09	
	6/26/2014	10:00	12.55	13.35	1242	2.36	5.95	342.3		IP-04	
	6/26/2014	10:30	12.55	13.34	1237	2.27	5.95	343.8		IP-04, IP-15	
	6/26/2014	11:00	12.56	13.34	1244	2.23	5.97	343.6		IP-04, IP-11, IP-15	
	6/26/2014	11:30	12.56	13.35	1247	2.28	5.98	342.9		IP-04, IP-11, IP-15	
	6/26/2014	12:00	12.56	13.34	1245	2.28	5.99	341.9		IP-04, IP-15	
	6/26/2014	12:30	12.56	13.34	1252	2.25	6.00	345.1		IP-04, IP-11, IP-15	
	6/26/2014	13:00	12.56	13.35	1245	2.24	5.98	343.9		IP-04, IP-11, IP-15	
	6/26/2014	13:30	12.56	13.35	1246	2.25	5.98	343.7		IP-04, IP-11, IP-15	
	6/26/2014	14:00	12.55	13.34	1244	2.23	5.98	347.1		IP-04, IP-11, IP-15	
	6/26/2014	14:30	12.53	13.35	1244	2.31	5.98	346.5		IP-04, IP-11, IP-15	
	6/26/2014	15:00	12.53	13.35	1235	2.36	5.95	350.0		IP-04, IP-07, IP-11, IP-15	
	6/26/2014	15:30	12.52	13.35	1228	2.19	5.96	347.6		IP-04, IP-11, IP-15	
	6/26/2014	16:00	12.46	13.34	1224	2.13	5.94	350.0		IP-04, IP-07A, IP-11, IP-15	
	6/26/2014	16:30	12.42	13.35	1227	2.27	5.95	348.0		IP-04, IP-07A, IP-11, IP-15	
	6/26/2014	17:00	12.41	13.35	1228	2.23	5.95	349.1		IP-04, IP-07A, IP-11, IP-15	
	6/26/2014	17:30	12.41	13.35	1228	2.16	5.94	349.1		IP-04, IP-07A, IP-11, IP-15	
	6/26/2014	18:00	12.42	13.36	1244	2.27	5.99	347.2		IP-04	
	6/27/2014	8:30	11.97	13.86	1197	2.85	5.61	291.2		IP-02, IP-04, IP-07, IP-11	
	6/27/2014	9:00	12.42	13.45	1300	4.59	5.80	321.9	DO begins to increase then dropping later	IP-02, IP-04	
	6/27/2014	9:30	12.23	13.35	1177	4.01	5.72	333.5		IP-02, IP-04, IP-07A, IP-11	
	6/27/2014	10:00	12.24	13.33	1181	3.30	5.61	335.6		IP-02, IP-04, IP-07A, IP-11	
	6/27/2014	10:30	12.38	13.34	1223	4.04	5.70	334.3		IP-02, IP-04, IP-07A, IP-11	
	6/27/2014	11:00	Color changed to milky white. Purged 4.5 gallons total							Color Change and conductivity changing more significantly	IP-02, IP-04, IP-07A, IP-11
	6/27/2014	11:30	12.35	13.29	1390	4.03	5.89	342.3		IP-02, IP-04	
	6/27/2014	12:00	12.43	13.32	1401	4.10	5.84	345.4		IP-02, IP-04	
	6/27/2014	12:30	12.28	13.30	1383	4.10	5.87	347.0		IP-02, IP-04, IP-11, IP-26	
	6/27/2014	13:00	12.28	13.31	1370	3.86	5.85	348.1		IP-02, IP-04, IP-11, IP-26	
	6/27/2014	13:30	12.27	13.32	1408	3.98	5.87	349.6		IP-02, IP-11, IP-26	
	6/27/2014	14:00	12.28	13.32	1433	4.15	5.90	351.0		IP-02, IP-03, IP-11, IP-26	
	6/27/2014	14:30	12.25	13.34	1457	4.49	5.93	353.0		IP-02, IP-03, IP-11, IP-26	
	6/27/2014	15:00	12.26	13.34	1474	4.54	5.95	353.5		IP-02, IP-03, IP-11, IP-26	
	6/27/2014	15:30	12.23	13.34	1466	4.60	5.96	354.5		IP-02, IP-03, IP-11, IP-26	
	6/27/2014	16:00	12.25	13.35	1468	4.39	5.96	354.7		IP-02, IP-03, IP-11, IP-26	
	6/27/2014	16:30	12.25	13.35	1470	4.27	5.96	354.4		IP-02, IP-03, IP-11, IP-26	
	6/27/2014	17:00	12.25	13.35	1482	4.43	5.97	355.0		IP-02, IP-03, IP-26	
6/28/2014	8:40	12.35	13.87	1485	3.73	6.03	304.1		IP-02, IP-03, IP-12, IP-26		
6/28/2014	9:00	12.35	13.66	1562	4.90	6.06	318.4		IP-02, IP-03, IP-26		
6/28/2014	9:30	12.25	13.42	1554	4.65	6.03	330.1		IP-02, IP-03, IP-12A, IP-26		
6/28/2014	10:00	12.25	13.40	1534	4.59	5.99	341.2		IP-02, IP-03, IP-12A, IP-26		
6/28/2014	10:30	12.25	13.40	1517	3.98	5.99	344.9		IP-02, IP-03, IP-12A, IP-26		
6/28/2014	11:00	12.09	13.40	1539	4.16	6.01	348.0		IP-02, IP-03, IP-12A, IP-26		
6/28/2014	11:30	12.03	13.41	1563	4.88	6.09	348.5		IP-02, IP-03, IP-12A, IP-26		
6/28/2014	12:00	12.00	13.41	1549	4.24	6.10	347.6		IP-02, IP-03, IP-12A, IP-26		
6/28/2014	12:30	12.20	13.42	1534	4.58	6.09	346.8		IP-03, IP-12, IP-26		
6/28/2014	13:00	12.18	13.40	1570	4.63	6.04	348.6		IP-03, IP-12, IP-26		
6/28/2014	13:30	12.11	13.40	1555	4.28	6.05	350.0		IP-03, IP-08, IP-12, IP-26		
6/28/2014	14:00	11.88	13.41	1566	4.50	6.06	352.5		IP-03, IP-08, IP-12, IP-26		
6/28/2014	14:30	12.01	13.42	1622	4.99	6.13	351.0		IP-03, IP-08, IP-12, IP-26		
6/28/2014	15:00	11.89	13.43	1627	4.41	6.12	348.7		IP-03, IP-08, IP-12, IP-26		
6/28/2014	15:30	12.03	13.43	1619	4.36	6.13	350.3		IP-08B, IP-12		
6/28/2014	16:00	12.00	13.42	1625	4.14	6.10	348.1		IP-08B, IP-12, IP-16A		
6/28/2014	16:30	12.00	13.41	1541	4.28	6.11	348.9		IP-05, IP-08B, IP-12, IP-16A		
6/28/2014	17:00	12.00	13.41	1543	4.02	6.12	348.7		IP-05, IP-08B, IP-12, IP-16A		

**Pilot Test Injection Field Parameters**

Results of In Situ Reduction Pilot Test

Garfield Groundwater Contamination Superfund Site, New Jersey

Well ID	Date	Time	DTW (ft BTIC)	Temp (°C)	Cond. (us/cm)	DO (mg/L)	pH	ORP (eV)	Observations	Injection Point
	6/29/2014	13:00	12.04	13.46	1347	3.56	6.09	367.7		IP-01A, IP-05B, IP-16A
	6/29/2014	13:30	12.04	13.46	1348	3.42	6.08	368.6		IP-01A, IP-05B, IP-16A
	6/29/2014	14:00	12.04	13.46	1347	3.27	6.08	368.0		IP-01A, IP-05B, IP-16A
	6/29/2014	14:30	12.00	13.46	1345	3.23	6.09	365.4		IP-01A, IP-05B, IP-16A
	6/29/2014	15:00	11.98	13.47	1341	3.21	6.06	368.6		IP-01A, IP-05B, IP-16A
	6/29/2014	15:30	11.95	13.47	1346	3.00	6.09	369.3		IP-01A, IP-05B, IP-16A
	6/29/2014	16:00	11.96	13.47	1345	2.90	6.09	369.5		IP-01A, IP-05B, IP-16A
	6/29/2014	16:30	11.15	13.42	1379	2.76	6.11	363.8		IP-01A, IP-04A, IP-16A
	6/29/2014	16:45	9.80	13.37	1302	2.42	6.07	358.9	rapid water table increase	IP-01A, IP-04A, IP-16A
	6/29/2014	17:00	9.32	13.41	1435	2.44	6.09	345.1		IP-01A, IP-04A, IP-16A
	6/29/2014	17:30	11.20	13.60	1427	2.51	6.07	352.5		IP-04A, IP-16A
	6/30/2014	7:40	12.15	14.00	1211	6.90	5.86	341.2		IP-01A, IP-07B, IP-16A
	6/30/2014	8:00	12.05	14.00	1211	6.10	5.87	346.1		IP-01A, IP-07B, IP-16A
	6/30/2014	8:30	12.03	13.57	1211	4.66	5.87	364.2		IP-01A, IP-07B, IP-16A
	6/30/2014	9:00	11.96	13.50	1199	4.35	5.89	376.2		IP-01A, IP-07B, IP-16A
	6/30/2014	10:15	11.92	13.49	1192	4.36	5.91	380.3		IP-06A, IP-07B, IP-27D
	6/30/2014	10:45	11.91	13.50	1197	4.34	5.91	381.1		IP-06A, IP-07B, IP-27D
	6/30/2014	11:00	11.91	13.49	1199	4.35	5.92	380.4		IP-06A, IP-07B, IP-27D
	6/30/2014	11:30	11.91	13.49	1210	4.33	5.90	381.5		IP-06A, IP-07B, IP-27D
	6/30/2014	12:00	11.91	13.49	1198	4.19	5.91	381.8		IP-06A, IP-07B, IP-27D
	6/30/2014	12:30	11.92	13.49	1208	4.25	5.90	382.9		IP-06A, IP-07B, IP-15A
	6/30/2014	13:00	11.92	13.49	1210	4.27	5.90	383.2		IP-06A, IP-07B, IP-15A
	6/30/2014	13:30	11.93	13.50	1217	4.17	5.91	383.9		IP-06A, IP-07B, IP-15A
	6/30/2014	14:00	11.91	13.50	1215	4.10	5.90	348.1		IP-06A, IP-07B, IP-14A
	6/30/2014	14:30	11.90	13.50	1201	4.00	5.91	385.1		IP-06A, IP-07B, IP-14A
	6/30/2014	15:00	11.88	13.50	1211	3.97	5.90	385.6		IP-06A, IP-07B, IP-14A
	6/30/2014	15:30	11.87	13.50	1198	3.88	5.92	386.2		IP-06A, IP-07B, IP-14A
	6/30/2014	16:00	11.86	13.51	1207	3.82	5.90	385.3		IP-07, IP-08, IP-14
	6/30/2014	16:30	11.84	13.51	1206	3.69	5.90	386.4		IP-08C, IP-14
	6/30/2014	17:00	11.83	13.51	1206	3.63	5.90	386.0		IP-08C, IP-14
	6/30/2014	17:30	11.86	13.51	1208	3.62	5.90	385.7		IP-08C, IP-10A, IP-14
	7/2/2014	9:20	12.42	14.16	1122	2.99	5.86	244.9		Post-Injection
EPA-32-OB	6/24/2014	8:57	12.74	13.16	924	7.17	5.28	381.2		Pre-Injection
	7/2/2014	9:40	12.43	13.86	891	2.72	5.11	289.0		Post-Injection

**Attachment 7**  
**pH Titration Results**

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Benchsheet

**Soil Buffering Capacity**

Garfield, NJ Superfund Site

Analyst: DRVB

Date/Time: 7/31/14 @ 15:20

**Moisture Content**

Sample	Tin Tare	Tin + Soil <sub>wet</sub>	Tin + Soil <sub>dry</sub>	MC (% <sub>wet</sub> basis)	MC (% <sub>dry</sub> basis)
SO-B-14-16	1.2846	14.4717	13.1614	10%	11%

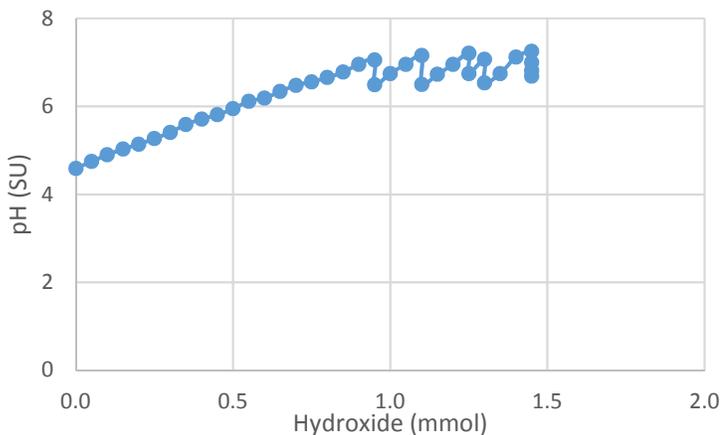
**Base Titration Test**

Soil Sample: SO-B-14-16  
 Water Sample: DI Water  
 Base: NaOH

Wet Mass (g): 100  
 Volume (mL): 100  
 Strength (N): 1

Dry Mass (g): 90.06  
 Base ID: 3-OR-19-04

Time (hrs)	NaOH (µL)	OH-mmol	pH
-	0	0.0	4.59
-	50	0.1	4.75
-	100	0.1	4.90
-	150	0.2	5.03
-	200	0.2	5.14
-	250	0.3	5.27
-	300	0.3	5.41
-	350	0.4	5.59
-	400	0.4	5.71
-	450	0.5	5.81
-	500	0.5	5.95
-	550	0.6	6.12
-	600	0.6	6.19
-	650	0.7	6.34
-	700	0.7	6.48
-	750	0.8	6.56
-	800	0.8	6.66
-	850	0.9	6.78
-	900	0.9	6.96
0	950	1.0	7.06
4	950	1.0	6.49
-	1000	1.0	6.75
-	1050	1.1	6.96
-	1100	1.1	7.16
16	1100	1.1	6.50
-	1150	1.2	6.73
-	1200	1.2	6.96
-	1250	1.3	7.21
23	1250	1.3	6.75
-	1300	1.3	7.07
51	1300	1.3	6.54
-	1350	1.4	6.75
-	1400	1.4	7.12
-	1450	1.5	7.25
74	1450	1.5	7.00
97	1450	1.5	6.82
122	1450	1.5	6.69



Target pH: 7
Needed Base: 0.0161 mmol/g dry soil



CH2MHILL

PROJECT NUMBER  
431007

BORING NUMBER  
B

SHEET 1 OF 1

### Soil Boring Log

PROJECT : Garfield Groundwater Contamination Superfund Site      LOCATION: Garfield, NJ

ELEVATION :      DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : *Geoprobe*

WATER LEVELS : *12.5' BGS*      START : *7/30*      END : *7/30*      LOGGER : *Ba/g*

DEPTH BELOW SURFACE (FT) *EPA-9-09*      SOIL DESCRIPTION      COMMENTS

INTERVAL (FT)
RECOVERY (FT)

SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.

DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.  
PID (ppm): Breathing Zone Above Hole

		<i>0-14 - discrete sample - no recovery - targeted 14-16' BGS</i>	
--	--	---	--

<i>14-16</i>	<i>2'</i>	<i>silty SAND, (M), trace f-gravel, dark reddish brown (7.5YR 3/3), wet at 14.5; stiff/hard</i>	<i>0 pid SO-B-14-16 - required 2 runs to fill up volume</i>
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**Attachment 8**  
**IDW Manifest and Bill of Lading**

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# FREEHOLD CARTAGE INC.

P.O. BOX 5010 • FREEHOLD, NJ 07728-5010  
(732) 462-1001 • FAX (732) 308-0924

**BILL OF LADING**  
FCI EPA ID NO. NJD054126164

## \$ 416958

350 Pigeon Point Road  
New Castle, DE 19720  
Phone: (302) 658-2005  
Fax: (302) 658-6229

175 Bartow Mun. Airport  
Bartow, FL 33830  
Phone: (863) 533-4599  
Fax: (863) 533-1613

5533 Dunham Road  
Maple Heights, OH 44137  
Phone: (330) 835-3473  
Fax: (330) 835-3732

108 Monahan Avenue  
Dunmore, PA 18512  
Phone: (570) 342-7232  
Fax: (570) 342-7367

132 Myrtle Beach Hwy.  
Sumter, SC 29153  
Phone: (803) 773-2611  
Fax: (803) 773-2942

SHIPPER NAME/ADDRESS <i>US EPA 120 CLARK STREET BARTOW FL 33830</i>		PHONE <i>800 623 8253</i>		APPOINTMENT TIME	
		(AREA CODE) <i>813</i>			
		TRACTOR <i>6104</i>	TRAILER <i>4334</i>		
FCI REP. LOADING (PRINT)	PROCEDURE	EQUIP. SPOTTED	EQUIP. REMOVED	TIME AT SHIPPER <i>12:45</i>	(MILITARY TIME ONLY)
				ARRIVAL TIME	DEPARTURE TIME
COMMENTS OR DELAYS AT SHIPPER				EQUIPMENT USED	

BROKER:		MANIFEST / DOCUMENT NO. <i>013831738 J514</i>
PO#:	WO# <i>109-266</i>	

(X) HM	PROPER U.S. D.O.T. SHIPPING NAME	U.S. D.O.T. HAZARDOUS CLASS	NA/UN/NO.	PACKING GROUP	NO. CONT.	CONT. TYPE	NET QUANTITY	UNIT MEASURE	WASTE NO.	FORM
X 1	<i>REG UN 3052 EQUIPMENT - ALLY HAD AERIOUS SUBSTANCE</i>	<i>9</i>	<i>UN3052</i>	<i>PG11</i>	<i>2</i>	<i>DM</i>	<i>70</i>	<i>G</i>	<i>0007</i>	<i>L</i>
2										
3										

SPECIAL HANDLING INSTRUCTIONS INCLUDING CONTAINER EXEMPTION NUMBER.

SHIPPER'S CERTIFICATION: This is to 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 regulations of the Department of Transportation, U.S. EPA and the State. The materials described above were consigned to the Transporter named. The consignee can and will accept the shipment and has a valid permit to do so if required. I certify that the foregoing is true and correct to the best of my knowledge.

Payment to the contractor for waste removal does not constitute payment to the carrier and if the contractor does not pay the carrier, the shipper is obligated to pay the agreed rate offered to the contractor.

PLEASE PRINT NAME/TITLE <i>David Roemer / Ecology</i>	SHIPPER'S SIGNATURE <i>[Signature]</i>	DATE LOADED <i>11/04/14</i>
I HAVE READ THE ABOVE AND UNDERSTAND AND AGREE TO ALL OF ITS CONTENT.		MO. DAY YR.

CONSIGNEE NAME/ADDRESS <i>Egy Detroit, Inc 1923 FREDERICK STREET DETROIT MI 48211</i>		PHONE		APPOINTMENT TIME	
		(AREA CODE)			
		TRACTOR	TRAILER		
FCI REP. UNLOADING (PRINT)	PROCEDURE	EQUIP. SPOTTED	EQUIP. REMOVED	TIME AT CONSIGNEE <i>12:45</i>	(MILITARY TIME ONLY)
				ARRIVAL TIME	DEPARTURE TIME
COMMENTS OR DELAYS AT CONSIGNEE				EQUIPMENT USED	

PLEASE PRINT NAME/TITLE	CONSIGNEE SIGNATURE <i>X</i>	DATE UNLOADED <i>11/04/14</i>
		MO. DAY YR.

AR H-0257	MD HWH-167	MO H-1490	OH UPW-0190713-OH	TX 40705
CT CT-HW-307	2001-OPV-2335	ND WH-429	OK UPW-0190713-OH	WI 11602
DE DE-HW-203	ME ME-HWT-47	NH TNH-0047	ONTARIO, CANADA A 840943	WV UPW-0190713-OH
DE-SW-203	ME-WOT-47	NJ S-2265	PA PA-AH-0067	
IL UPW-0190713-OH	MI UPW-0190713-OH	15939	QUEBEC, CANADA QC-6ML-047	
MA MA-294	MN UPW-0190713-OH	NY NJ-113	RI RI-535	

White - FCI Original  
Yellow - FCI Billing  
Blue - FCI Office/ Customer  
Green - Retained by TSDF  
Gold - Retained by Generator

## \$ 416958

<b>UNIFORM HAZARDOUS WASTE MANIFEST</b>		1. Generator ID Number <b>NJN-000-206-317</b>	2. Page 1 of 1	3. Emergency Response Phone <b>800-633-8253 contract 8790</b>	4. Manifest Tracking Number <b>013831738 JJK</b>		
5. Generator's Name and Mailing Address <b>United States Env. Protection Agency 200 Broadway 19th Floor, New York, NY 10007-1866</b>				Generator's Site Address (if different than mailing address) <b>United States Env. Protection Agency Willard Street and Pierre Avenue Garfield, NJ 07026</b>			
Generator's Phone: <b>212 637-3735 Attn: Kathryn Flynn</b>							
6. Transporter 1 Company Name <b>Freehold Cartage, Inc.</b>				U.S. EPA ID Number <b>NJ/D 054 126 164</b>			
7. Transporter 2 Company Name				U.S. EPA ID Number			
8. Designated Facility Name and Site Address <b>EQ Detroit, Inc. 1823 Frederick Street Detroit, MI 48211</b>				U.S. EPA ID Number <b>MI/D 960 591 556</b>			
Facility's Phone: <b>313-347-1300</b>							
9a. HM	9b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	10. Containers		11. Total Quantity	12. Unit Wt./Vol.	13. Waste Codes	
		No.	Type				
<b>X</b>	<b>1. RQ, UN3082, Environmentally hazardous substances, liquid, N.O.S. (chromium), 9, PGIII</b>	<b>2</b>	<b>DM</b>	<b>70</b>	<b>G</b>	<b>D007</b>	
	2.						
	3.						
	4.						
14. Special Handling Instructions and Additional Information <b>1. G140087DET chromium contaminated groundwater ERG# 171</b>  <b>CESI JOB: ROAN-TFORT-4187-23881</b>							
15. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. If export shipment and I am the Primary Exporter, I certify that the contents of this consignment conform to the terms of the attached EPA Acknowledgment of Consent. I certify that the waste minimization statement identified in 40 CFR 262.27(a) (if I am a large quantity generator) or (b) (if I am a small quantity generator) is true.							
Generator's/Offoror's Printed/Typed Name <i>Kathryn Flynn</i>				Signature <i>Kathryn Flynn</i>		Month Day Year <i>11 14 14</i>	
16. International Shipments <input type="checkbox"/> Import to U.S. <input type="checkbox"/> Export from U.S. Port of entry/exit: _____ Date leaving U.S.: _____							
17. Transporter Acknowledgment of Receipt of Materials							
Transporter 1 Printed/Typed Name <i>Jeff Amburg</i>				Signature <i>Jeff Amburg</i>		Month Day Year <i>11 14 14</i>	
Transporter 2 Printed/Typed Name				Signature		Month Day Year	
18. Discrepancy							
18a. Discrepancy Indication Space <input type="checkbox"/> Quantity <input type="checkbox"/> Type <input type="checkbox"/> Residue <input type="checkbox"/> Partial Rejection <input type="checkbox"/> Full Rejection							
Manifest Reference Number: _____							
18b. Alternate Facility (or Generator)				U.S. EPA ID Number			
Facility's Phone: _____							
18c. Signature of Alternate Facility (or Generator)						Month Day Year	
19. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)							
1.		2.		3.		4.	
20. Designated Facility Owner or Operator: Certification of receipt of hazardous materials covered by the manifest except as noted in Item 18a							
Printed/Typed Name				Signature		Month Day Year	



# FREEHOLD CARTAGE INC.

P.O. BOX 5010 • FREEHOLD, NJ 07728-5010  
(732) 462-1001 • FAX (732) 308-0924

**BILL OF LADING**  
FCI EPA ID NO. NJD054126164

## S 540856

350 Pigeon Point Road  
New Castle, DE 19720  
Phone: (302) 658-2005  
Fax: (302) 658-6229

175 Bartow Mun. Airport  
Bartow, FL 33830  
Phone: (863) 533-4599  
Fax: (863) 533-1613

5533 Dunham Road  
Maple Heights, OH 44137  
Phone: (330) 835-3473  
Fax: (330) 835-3732

108 Monahan Avenue  
Dunmore, PA 18512  
Phone: (570) 342-7232  
Fax: (570) 342-7367

132 Myrtle Beach Hwy.  
Sumter, SC 29153  
Phone: (803) 773-2611  
Fax: (803) 773-2942

SHIPPER NAME/ADDRESS <i>US EPA 125 Clark St. Garfield NJ 07026</i>		PHONE <i>202-637-3735</i>		APPOINTMENT TIME <i>15 Nov 02 06 30</i>	
		(AREA CODE)			
FCI REP. LOADING (PRINT) <i>C. A. Roberts</i>		PROCEDURE <i>LTC</i>	EQUIP. SPOTTED <i>-</i>	EQUIP. REMOVED <i>-</i>	TIME AT SHIPPER (MILITARY TIME ONLY) ARRIVAL TIME : DEPARTURE TIME
TRACTOR <i>898</i>		TRAILER <i>4731</i>		EQUIPMENT USED	
COMMENTS OR DELAYS AT SHIPPER					

BROKER: <i>Capital Env.</i>		MANIFEST / DOCUMENT NO. <i>01271128130</i>
PO#:	WO#:	

(X) HM	PROPER U.S. D.O.T. SHIPPING NAME	U.S. D.O.T. HAZARDOUS CLASS	NA/UN/NO.	PACKING GROUP	NO. CONT.	CONT. TYPE	NET QUANTITY	UNIT MEASURE	WASTE NO.	FORM
1	<i>See Manifest</i>				<i>03</i>	<i>DM</i>	<i>165</i>	<i>G</i>		
2										
3										

SPECIAL HANDLING INSTRUCTIONS INCLUDING CONTAINER EXEMPTION NUMBER.

SHIPPER'S CERTIFICATION: This is to 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 regulations of the Department of Transportation, U.S. EPA and the State. The materials described above were consigned to the Transporter named. The consignee can and will accept the shipment and has a valid permit to do so if required. I certify that the foregoing is true and correct to the best of my knowledge.

Payment to the contractor for waste removal does not constitute payment to the carrier and if the contractor does not pay the carrier, the shipper is obligated to pay the agreed rate offered to the contractor.

PLEASE PRINT NAME/TITLE <i>David Power</i>	SHIPPER'S SIGNATURE <i>[Signature]</i> X	DATE LOADED <i>04/02/15</i> MO. DAY YR.
---	--	---

CONSIGNEE NAME/ADDRESS <i>EA 1923 Fredrick St. Detroit MI 48211</i>		PHONE <i>313-923-0080</i>		APPOINTMENT TIME <i>15 Nov 02 09 15</i>	
		(AREA CODE)			
FCI REP. UNLOADING (PRINT)		PROCEDURE	EQUIP. SPOTTED	EQUIP. REMOVED	TIME AT CONSIGNEE (MILITARY TIME ONLY) ARRIVAL TIME : DEPARTURE TIME
TRACTOR		TRAILER		EQUIPMENT USED	
COMMENTS OR DELAYS AT CONSIGNEE					

PLEASE PRINT NAME/TITLE	CONSIGNEE SIGNATURE X	DATE UNLOADED / / MO. DAY YR.
-------------------------	--------------------------	-------------------------------------

AR H-0257	MD HWH-167	MO H-1490	OH UPW-0190713-OH	TX 40705
CT CT-HW-307	2001-OPV-2335	ND WH-429	OK UPW-0190713-OH	WI 11602
DE DE-HW-203	ME ME-HWT-47	NH TNH-0047	ONTARIO, CANADA A 840943	WV UPW-0190713-OH
DE-SW-203	ME-WOT-47	NJ S-2265	PA PA-AH-0067	
IL UPW-0190713-OH	MI UPW-0190713-OH	15939	QUEBEC, CANADA QC-6ML-047	
MA MA-294	MN UPW-0190713-OH	NY NJ-113	RI RI-535	

White - FCI Original  
Yellow - FCI Billing  
Blue - FCI Office/ Customer  
Green - Retained by TSDF  
Gold - Retained by Generator

## S 540856

<b>UNIFORM HAZARDOUS WASTE MANIFEST</b>		1. Generator ID Number <b>NJN-000-206-317</b>	2. Page 1 of	3. Emergency Response Phone <b>900-633-8253 contract 8790</b>	4. Manifest Tracking Number <b>012711281 JJK</b>			
5. Generator's Name and Mailing Address <b>United States Env. Protection Agency 200 Broadway 19th Floor, New York, NY 10007-1566</b>				Generator's Site Address (if different than mailing address) <b>United States Env. Protection Agency Willard Street and Pierre Avenue Garfield, NJ 07026</b>				
Generator's Phone: <b>212 637-3735 Attn: Kathryn Flynn</b>								
6. Transporter 1 Company Name <b>Freehold Cartage, Inc.</b>				U.S. EPA ID Number <b>NJ0084 126 164</b>				
7. Transporter 2 Company Name				U.S. EPA ID Number				
8. Designated Facility Name and Site Address <b>EQ Detroit, Inc. 1923 Frederick Street Detroit, MI 48211</b>				U.S. EPA ID Number <b>MID 980 991 556</b>				
Facility's Phone: <b>313-347-1300</b>								
9a. HM	9b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	10. Containers		11. Total Quantity	12. Unit Wt./Vol.	13. Waste Codes		
		No.	Type					
X	1. <b>RQ, UN3082, Environmentally hazardous substances, liquid, N.O.S. (chromium), 9, PGIII</b>	03	DM	165	G	D007		
	2.							
	3.							
	4.							
14. Special Handling Instructions and Additional Information <b>1. G140067DET chromium contaminated groundwater ERG# 171</b>								
15. <b>GENERATOR'S/OFFEROR'S CERTIFICATION:</b> I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. If export shipment and I am the Primary Exporter, I certify that the contents of this consignment conform to the terms of the attached EPA Acknowledgment of Consent. I certify that the waste minimization statement identified in 40 CFR 262.27(a) (if I am a large quantity generator) or (b) (if I am a small quantity generator) is true.								
Generator's/Offeror's Printed/Typed Name				Signature		Month	Day	Year
						4	1	11
16. International Shipments <input type="checkbox"/> Import to U.S. <input type="checkbox"/> Export from U.S. Port of entry/exit: _____ Transporter signature (for exports only): _____ Date leaving U.S.: _____								
17. Transporter Acknowledgment of Receipt of Materials								
Transporter 1 Printed/Typed Name				Signature		Month	Day	Year
<b>Chris Adams</b>						11	01	11
Transporter 2 Printed/Typed Name				Signature		Month	Day	Year
18. Discrepancy								
18a. Discrepancy Indication Space <input type="checkbox"/> Quantity <input type="checkbox"/> Type <input type="checkbox"/> Residue <input type="checkbox"/> Partial Rejection <input type="checkbox"/> Full Rejection								
Manifest Reference Number: _____								
18b. Alternate Facility (or Generator)						U.S. EPA ID Number		
Facility's Phone: _____								
18c. Signature of Alternate Facility (or Generator)						Month	Day	Year
19. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)								
1.	2.	3.	4.					
20. Designated Facility Owner or Operator: Certification of receipt of hazardous materials covered by the manifest except as noted in Item 18a								
Printed/Typed Name				Signature		Month	Day	Year



# FREEHOLD CARTAGE INC.

P.O. BOX 5010 • FREEHOLD, NJ 07728-5010  
(732) 462-1001 • FAX (732) 308-0924

**BILL OF LADING**  
FCI EPA ID NO. NJD054126164

## S 509458

350 Pigeon Point Road  
New Castle, DE 19720  
Phone: (302) 658-2005  
Fax: (302) 658-6229

175 Bartow Mun. Airport  
Bartow, FL 33830  
Phone: (863) 533-4599  
Fax: (863) 533-1613

5533 Dunham Road  
Maple Heights, OH 44137  
Phone: (330) 835-3473  
Fax: (330) 835-3732

108 Monahan Avenue  
Dunmore, PA 18512  
Phone: (570) 342-7232  
Fax: (570) 342-7367

132 Myrtle Beach Hwy.  
Sumter, SC 29153  
Phone: (803) 773-2611  
Fax: (803) 773-2942

SHIPPER NAME/ADDRESS <i>USE PA Willard St + Pierre Ave Freehold NJ 07026</i>		PHONE <i>732-637-3735</i>		APPOINTMENT TIME <i>08/06/17</i>	
		(AREA CODE)			
		TRACTOR <i>678</i>	TRAILER <i>4731</i>	ARRIVAL TIME <i>08:00</i>	
FCI REP. LOADING (PRINT) <i>C. Roberts</i>	PROCEDURE <i>676</i>	EQUIP. SPOTTED <i>-</i>	EQUIP. REMOVED	TIME AT SHIPPER (MILITARY TIME ONLY) <i>08:00</i>	(MILITARY TIME ONLY) <i>08:55</i>
COMMENTS OR DELAYS AT SHIPPER				ARRIVAL TIME	DEPARTURE TIME
				EQUIPMENT USED	

BROKER: *Capital Env.*

PO #: \_\_\_\_\_ WO #: \_\_\_\_\_

**MANIFEST / DOCUMENT NO.** *012714495X*

(X) HM	PROPER U.S. D.O.T. SHIPPING NAME	U.S. D.O.T. HAZARDOUS CLASS	NA/UN/NO.	PACKING GROUP	NO. CONT.	CONT. TYPE	NET QUANTITY	UNIT MEASURE	WASTE NO.	FORM
1	<i>See Manifest</i>				<i>109 DM</i>		<i>495</i>	<i>55 @ L</i>		
2					<i>107 DM</i>		<i>3,000 P</i>			
3										

SPECIAL HANDLING INSTRUCTIONS INCLUDING CONTAINER EXEMPTION NUMBER.

SHIPPER'S CERTIFICATION: This is to 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 regulations of the Department of Transportation, U.S. EPA and the State. The materials described above were consigned to the Transporter named. The consignee can and will accept the shipment and has a valid permit to do so if required. I certify that the foregoing is true and correct to the best of my knowledge.

Payment to the contractor for waste removal does not constitute payment to the carrier and if the contractor does not pay the carrier, the shipper is obligated to pay the agreed rate offered to the contractor.

PLEASE PRINT NAME/TITLE <i>Andy Watson / Field Engineer</i>	SHIPPER'S SIGNATURE <i>[Signature]</i>	DATE LOADED <i>08/06/17</i>
I HAVE READ THE ABOVE AND UNDERSTAND AND AGREE TO ALL OF ITS CONTENT.		MO. DAY YR.

CONSIGNEE NAME/ADDRESS <i>68 1923 Frederick St. Dobson NJ 07021</i>		PHONE <i>923-0080</i>		APPOINTMENT TIME	
		(AREA CODE)			
		TRACTOR	TRAILER	ARRIVAL TIME	
FCI REP. UNLOADING (PRINT)	PROCEDURE	EQUIP. SPOTTED	EQUIP. REMOVED	TIME AT CONSIGNEE (MILITARY TIME ONLY)	(MILITARY TIME ONLY)
COMMENTS OR DELAYS AT CONSIGNEE				ARRIVAL TIME	DEPARTURE TIME
				EQUIPMENT USED	

PLEASE PRINT NAME/TITLE	CONSIGNEE SIGNATURE <i>X</i>	DATE UNLOADED <i>/ /</i>
		MO. DAY YR.

AR H-0257	MD HWH-167	MO H-1490	OH UPW-0190713-OH	TX 40705
CT CT-HW-307	2001-OPV-2335	ND WH-429	OK UPW-0190713-OH	WI 11602
DE DE-HW-203	ME ME-HWT-47	NH TNH-0047	ONTARIO, CANADA A 840943	WV UPW-0190713-OH
DE-SW-203	ME-WOT-47	NJ S-2265	PA PA-AH-0067	
IL UPW-0190713-OH	MI UPW-0190713-OH	15939	QUEBEC, CANADA QC-6ML-047	
MA MA-294	MN UPW-0190713-OH	NY NJ-113	RI RI-535	

White - FCI Original  
Yellow - FCI Billing  
Blue - FCI Office/ Customer  
Green - Retained by TSDF  
Gold - Retained by Generator

## S 509458

<b>UNIFORM HAZARDOUS WASTE MANIFEST</b>		1. Generator ID Number <b>NJN-000-206-317</b>	2. Page 1 of <b>1</b>	3. Emergency Response Phone <b>800-633-8253 ext 0790</b>	4. Manifest Tracking Number <b>012711444 JJK</b>		
5. Generator's Name and Mailing Address <b>United States Env. Protection Agency 200 Broadway 19th Floor, New York, NY 10007-1866</b>				Generator's Site Address (if different than mailing address) <b>United States Env. Protection Agency Willard Street and Pierre Avenue Garfield, NJ 07026</b>			
Generator's Phone: <b>212 637-3735 Attn: Kathryn Flynn</b>							
6. Transporter 1 Company Name <b>Freehold Cartage, Inc.</b>				U.S. EPA ID Number <b>NJD 054 126 164</b>			
7. Transporter 2 Company Name				U.S. EPA ID Number			
8. Designated Facility Name and Site Address <b>EQ Detroit, Inc. 1923 Frederick Street Detroit, MI 48211</b>				U.S. EPA ID Number <b>MID 950 991 556</b>			
Facility's Phone: <b>313-347-1300</b>							
9a. HM	9b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	10. Containers		11. Total Quantity	12. Unit Wt./Vol.	13. Waste Codes	
		No.	Type				
<b>X</b>	<b>1. RQ, UN3082, Environmentally hazardous substances, liquid, N.O.S. (chromium), 9, PGIII</b>	<b>09</b>	<b>DM</b>	<b>495</b>	<b>G</b>	<b>D007</b>	
	<b>2. RCRA Nonhazardous, DOT Non Regulated soil and PPE</b>	<b>07</b>	<b>DM</b>	<b>3,700</b>	<b>P</b>	<b>None</b>	
	<b>3.</b>						
	<b>4.</b>						
14. Special Handling Instructions and Additional Information <b>1. G140087DET chromium contaminated groundwater ERG# 171</b> <b>2. G140086DET NH soil and PPE</b> <b>CESI JOB: ROAN-TFORT 4187 23422</b>							
15. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. If export shipment and I am the Primary Exporter, I certify that the contents of this consignment conform to the terms of the attached EPA Acknowledgment of Consent. I certify that the waste minimization statement identified in 40 CFR 262.27(a) (if I am a large quantity generator) or (b) (if I am a small quantity generator) is true.							
Generator's/Offoror's Printed/Typed Name <b>Kathryn Flynn</b>				Signature <i>Kathryn Flynn</i>		Month Day Year <b>8 5 11</b>	
16. International Shipments <input type="checkbox"/> Import to U.S. <input type="checkbox"/> Export from U.S. Port of entry/exit: _____ Transporter signature (for exports only): _____ Date leaving U.S.: _____							
17. Transporter Acknowledgment of Receipt of Materials							
Transporter 1 Printed/Typed Name <b>Sharon Roberts</b>				Signature <i>Sharon Roberts</i>		Month Day Year <b>08 12 11</b>	
Transporter 2 Printed/Typed Name				Signature		Month Day Year	
18. Discrepancy							
18a. Discrepancy Indication Space <input type="checkbox"/> Quantity <input type="checkbox"/> Type <input type="checkbox"/> Residue <input type="checkbox"/> Partial Rejection <input type="checkbox"/> Full Rejection							
Manifest Reference Number: _____							
18b. Alternate Facility (or Generator)						U.S. EPA ID Number	
Facility's Phone: _____							
18c. Signature of Alternate Facility (or Generator)						Month Day Year	
19. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)							
1. _____		2. _____		3. _____		4. _____	
20. Designated Facility Owner or Operator: Certification of receipt of hazardous materials covered by the manifest except as noted in Item 18a							
Printed/Typed Name				Signature		Month Day Year	