INTEGRATED ANNUAL GROUNDWATER PERFORMANCE REPORT For 2012

STUDY AREAS 5, 6, AND 7 JERSEY CITY, NEW JERSEY

Prepared for

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1 INTRODUCTION

1.1 General

The Long Term Monitoring Plan (LTMP) for the Study Area 7 (SA-7) deep overburden and bedrock groundwater remedy was developed in 2008 to monitor groundwater conditions relative to the Groundwater Extraction and Treatment (GWET) system. Annual progress reports have been prepared in accordance with this plan since the startup of the GWET system in December 2008. This document represents the fourth such annual performance report and has been modified to provide a more integrated account of the various groundwater remedies within Study Areas 5, 6, and 7 (Project Area).

1.2 Purpose and Objectives

The purpose of this document is to provide an integrated annual reporting format that characterizes regional groundwater conditions and documents compliance with area-specific remedial objectives. The specific objectives of this approach are to:

- Improve consistency and efficiency in field procedures including sample collection and scheduling.
- Provide a central database for monitoring well specifications and status.
- Provide regional groundwater flow interpretations that consider the impact of features such as subsurface barrier walls, drains, caps, and drawdown from pumping.
- Provide localized groundwater flow maps consistent with the regional contour maps.
- Facilitate preparation of CEA biennial certifications.

1.3 Status of Integrated Monitoring Requirements for 2012

The two primary elements of groundwater monitoring within the Project Area are water level measurements and water quality sampling and analysis. Groundwater level monitoring is conducted quarterly in all available monitoring wells and piezometers. These data are used to fulfill various reporting requirements as shown on **Table 1-1**. Groundwater quality sampling is conducted in a subset of wells at various times in accordance with the requirements of the various monitoring plans. The status of groundwater sample collection in 2012 is shown on **Table 1-2**.

1.4 Document Organization

In accordance with the approved outline for the IGWPR, this report is organized in terms of its three primary elements; groundwater extraction (Section 3), groundwater elevations and flow direction (Section 4), and groundwater quality (Section 5). These sections are prefaced by a discussion of overall site conditions and events during the reporting period (Section 2). The status of the S-3 Injection/Mass Removal program is summarized in Section 6, and conclusions and recommendations for modifications to the LTMP are provided in Section 7.

2 GENERAL CONDITIONS

With the exception of hurricane Sandy as discussed below, overall conditions within the Project Area were uneventful throughout 2012. There were no barrier walls installed or dewatering activities to influence groundwater flow and the GWET system was operational at design rates with the exception of scheduled maintenance. Annual precipitation was below normal but was evenly distributed throughout the year and had little impact on groundwater elevations or flow directions. The Sediment Remedy and the S-3 Injection/mass Removal remedy were both initiated 2012. Dredging and capping of sediments in the Hackensack River did not impact groundwater in the Project Area and the influence of the calcium polysulfide injections have not yet been detected in downgradient wells.

The Jersey City area was significantly impacted by hurricane Sandy in early November, 2012. Although rainfall during the storm totaled only several inches, the associated tidal surge caused the Hackensack River to rise approximately 12 feet above mean tide elevation such that the western portions of SA-6 North and South and SA-7 were inundated with over 4 feet of water. Due to widespread electrical outages, the GWET extraction and treatment system was off line for approximately two weeks following the storm. However, based on the short duration of the tidal surge and the relatively slow groundwater flow rate, there were no long-term impacts to regional groundwater flow directions, groundwater quality, or the GWET system capture zone.

2.1 Annual Precipitation

Monthly precipitation data recorded at Newark Airport, approximately 2.5 miles southwest of SA-7 are provided in **Table 2-1** and shown on **Figure 2-1**. With the exception of June and December, monthly rainfall totals were below the 20-year average values for this station. Total precipitation in 2012 was 36.35 inches or approximately 10 inches below the annual average of 46.25 inches.

2.2 Tidal Monitoring

Tidal fluctuations in the Hackensack River were monitored at the SA-7 tide gage using a data logger (with pressure transducer) suspended in a 4-inch diameter conduit attached to the bulkhead. A reference point has been established on top of the bulkhead in NGVD-1929 vertical datum. This datum is used for all reported groundwater elevation data in this report. The data logger is programmed to record river stage at 6-minute intervals. These data are used to correct groundwater levels for tidal impacts based on tidal lag and efficiency values previously determined for monitoring wells screened in the Intermediate, Deep, and Bedrock zones. There are no tidal influences in the Shallow Zone monitoring wells.

Figure 2-2 illustrates typical tidal cycles recorded at the SA-7 bulkhead. The mean tidal elevation is approximately +1.2 feet (NGVD-1929). The tide gage was damaged during Hurricane Sandy and thus data from this period are not available. However, published data from the Hackensack River at Bergen Point, located approximately 4 miles south of the Project Area, are shown on **Figure 2-3** for this time period. A rise in stage of approximately 12 feet was recorded during Hurricane Sandy with tides returning to normal approximately two days later.

2.3 Monitoring Well Inventory

A list of the groundwater monitoring wells currently in service within the Project Area is provided on **Table 2-2**. The wells are organized by hydrogeologic zone. Information regarding the total depth, screen interval, and reference point elevation are also provided. The well locations are shown on the groundwater elevation contour maps provided in Section 4. There were no new wells installed in 2012, nor were any wells abandoned. The breakdown of the number of monitoring wells in the various sub-areas is as follows:

Number of Monitoring Wells in Various Study Areas

	Shallow	Intermediate	Deep	Bedrock
SA-6 North	25	15	15	3
SA-6 South	25	12	11	10
SA-7	7	12	4	3
SA-5	29	5	6	5
Outlying Areas	1	1	1	4
Total	87	45	37	25

3 GROUNDWATER EXTRACTION

The Deep Overburden Groundwater Extraction and Treatment (GWET) system was the only pumping system in operation in 2012. Pumping from the contingent pumping system at NJCU was not required and the contingent pumping systems in SA-6 North and South are in the design stage and have not yet been installed. The following operations and maintenance activities were conducted during 2012 relative to the GWET system. Activities specific to treatment plant operations are not within the scope of this report.

3.1 GWET System Operation

The GWET system consists of three extraction wells pumping at a combined rate of 54.5 gpm with discharge via independent force mains to the waste water treatment plant located on Kellogg Street. Wells PW-1 and PW-2 are located on the Difeo property on the north side of SA-6 North and pump from the Deep and Intermediate zones, respectively. Well 115-MW-203BR is located on Site 115 and pumps from the upper Bedrock zone.

3.1.1 Pumping Rates

Flow rate monitoring was conducted on each of the three force mains using flow meters located within the treatment plant, prior to flow equalization. The flow rates were controlled by a manually-operated valve and adjusted as necessary to maintain design rates of 40 gpm and 7.5 gpm for wells PW-1 and PW-2 respectively, and 7.5 gpm for well 115-MW-203BR. These rates were maintained throughout the period with the exception of occasional downtime for O&M activities. **Figure 3-1** illustrates the pumping history during 2012 and identifies the events that resulted in a shutdown of more than 8 hours. An explanation of each shutdown is provided on **Table 3-1.** In general, system shutdowns in 2012 were due to hurricane Sandy, routine force main cleaning/well development, and yield testing of bedrock well 115-MW-215BR.

3.1.2 Force Main Acid Flushing

The GWET force main from extraction well PW-2 to the treatment plant is subject to fouling due mineralization of groundwater from the Intermediate Zone. As a result, periodic cleaning of the line with hydrochloric acid is conducted on an as-needed basis as determined through monitoring of groundwater discharge trends and line pressures. There were four acid flushing events conducted in 2012 as follows:

- March 13, 2012
- July 11, 2012

- October 29, 2012
- December 4, 2012.

The acid flushing event conducted in December was marginally successful in improving the yield of PW-2. Upon further testing it was determined that the pump itself was not producing full flow and was replaced. Flow and pressure within the force main were thus restored to normal operating values.

3.1.3 Well Redevelopment

Routine groundwater level monitoring in the GWET extraction wells indicated that the pumping level in PW-2 was declining at an accelerated rate during the first quarter of 2012. As a result, PW-2 was redeveloped on March 13, 2012. This was a coordinated effort with the force main acid cleaning to reduce system down time. The well redevelopment procedures consisted of the following:

- The pump was removed from the well and set aside.
- The well was cleaned of loose debris by brushing the well screen and riser
- 10 gallons of Redux 520 were added to acidify the well.
- The well was surge-blocked for 4 hours.
- The acid was allowed to remain in the well overnight.
- The spent cleaning solution was removed via Vac truck.
- The well was surge-blocked and pumped until the water/effluent ran clear.
- Clean and return the pump to service

Groundwater levels during pumping were returned to typical levels after the well development procedures were completed.

3.2 SA-6 North Contingent Groundwater Pumping System

The SA-6 North contingent groundwater pumping system is planned for installation as part of the soil remedy scheduled for 2015.

3.3 SA-6 South Contingent Groundwater Pumping System

The SA-6 South contingent groundwater pumping system is planned for installation as part of the soil remedy scheduled for 2015.

3.4 SA-5 NJCU Contingent Groundwater Pumping System

In accordance with the performance criteria set forth in the Trigger document and the LTMP, the contingent groundwater pumping system at the NJCU site was not operated during 2012.

4 HYDRAULIC MONITORING

Hydraulic monitoring in 2012 consisted of four quarterly rounds of groundwater elevation measurements in available wells in March, June, September, and December. The measured depth to groundwater was subtracted from the reference point elevation to determine the elevation of the groundwater surface. For those wells that are tidally influenced, the measured values were adjusted using a time-series method developed by the U.S. Geological Survey (Halford, 2006). The results for the four quarterly rounds are provided in **Table 4-1**. Groundwater elevations from the December 2012 round, four years after startup of the GWET system, are plotted for the Shallow, Intermediate, Deep, and Bedrock zones on **Figures 4-1** through **4-4**, respectively. Groundwater elevation data are reported in units of feet above mean sea level (amsl) in the NGVD-29 vertical datum.

4.1 Regional Groundwater Flow

4.1.1 Shallow Zone

Groundwater elevations in the Shallow zone range from over 13 feet amsl on Site 154 to less than 3 feet amsl near the Hackensack River on Site 163. As a point of reference, the river has a mean tide elevation of approximately +1.2 feet relative to the NGVD-29 datum. As shown on **Figure 4-1**, shallow groundwater flow is generally from east to west across the region, but is locally impacted by subsurface features such as the SA-7 and SA-5 barrier walls, deep sewer lines that run beneath JCMUA, JCIA, and Route 440, and shallower storm sewers that run along most of the side streets. Other than the routine operation of the GWET extraction wells, there were no construction-dewatering projects in operation at the time of this measurement round.

Shallow groundwater flow is diverted around the SA-7 barrier wall and moves onto SA-6 North and SA-6 South, ultimately discharging to the River or into other subsurface sewers that serve as local groundwater sinks. Areas of locally elevated groundwater are observed in both SA-6 North and SA-6 South along the SA-7 perimeter wall. These elevated zones are likely caused in part by soils with locally reduced hydraulic conductivity, and in part due to their location midway between groundwater discharge areas associated with the River to the west and storm sewers near Route 440 to the east.

At the NJCU site in Study Area 5, groundwater flow is generally from east to west. The north-south oriented "cross-wall" causes groundwater elevations to build up slightly east of the wall relative to heads on the Home Depot property. This is evidenced by the difference in elevations reported in wells 090-PZ-06 and 117-MW-A62 on **Figure 4-1**.

Further discussion regarding localize groundwater flow on the NJCU site is provided in Section 4.3.

4.1.2 Intermediate Zone

Groundwater elevations in the Intermediate zone are shown on **Figure 4-2** and range from over 7 feet above msl in SA-5 to less than mean sea level in the vicinity of the GWET pumping wells. Groundwater is diverted around the SA-7 barrier wall but is not impacted by near-surface features on SA-6 North to the same degree as in the Shallow zone. Groundwater elevations within the SA-7 barrier wall are relatively uniform in the range of two to three feet amsl. Vertically, heads within the Intermediate zone are generally one to four feet lower than in the Shallow zone, which indicates a significant downward vertical gradient across Stratum D. This is especially the case west of Route 440 where Stratum D is nearly continuous across the site. **Figure 4-2** also illustrates that the combined groundwater depression in the vicinity of the GWET pumping wells fully encompasses the deep overburden plume and provides an effective capture zone in the upper lacustrine soils.

4.1.3 Deep Zone

Groundwater elevations in the Deep zone (**Figure 4-3**) are similar to those in the overlying Intermediate zone, although the influence of the SA-7 barrier wall is not as prominent. As noted in prior reports, groundwater flow in the Deep zone is, to a degree, able to move beneath the SA-7 barrier wall through gravel lenses in the underlying glacial till/ice contact deposits. At SA-5, the barrier wall does not extend down to the Deep zone and thus does not influence flow. The area of influence of the GWET pumping wells on groundwater flow in the Deep zone is also illustrated on **Figure 4-3**. This zone is wider than that in the Intermediate zone due to the larger pumping rate and the more permeable S-3 formation. The resulting combined groundwater depression in the vicinity of the GWET pumping wells fully encompasses the deep overburden plume and provides effective capture in this deeper flow zone.

4.1.4 Bedrock Zone

Groundwater elevation contours in the Upper Bedrock zone are shown on **Figure 4-4** and are relatively uniform compared to those in the overlying lacustrine units. The steeper contour intervals east of Route 440 reflect the generally lower hydraulic conductivity in that direction, whereas the more widely spaced contours to the west reflect decreased fracture spacing in the bedrock in this area. The impact of the GWET pumping well 115-MW-203BR on groundwater flow is evident from the closed contours along the western border of SA-7. This area is characterized by the southwest-northeast trending high-permeability fracture zone which aids in the propagation of the capture zone parallel to the bulkhead as shown on **Figure 4-4**.

4.2 GWET System Capture Zone

Figure 4-5 illustrates that pumping from PW-1 and PW-2 creates a combined zone of influence causing groundwater to flow both laterally and vertically into the capture zone of the wells. The capture zone spans the various semi-confining layers but considering that the vertical anisotropy of the soil is likely on the order of 10:1, the primary component of flow to the wells is horizontal rather than vertical. It should be noted that the cross-section is drawn with a vertical exaggeration of 5X which tends to over-emphasize the vertical component of flow (i.e., the same cross-section drawn at true scale would more effectively illustrate that the majority of flow is horizontal). Based on the data provided in both plan view on **Figures 4-2 and 4-3** and in cross section on **Figure 4-5,** the combined groundwater depression in the vicinity of the GWET pumping wells fully encompasses the deep overburden plume and provides an effective capture zone that meets it design objectives.

4.3 New Jersey City University

Quarterly groundwater elevation data for the NJCU property are compiled in **Table 4-2** and mapped on **Figures 4-6 through 4-9**. The results for each quarter are similar and indicate that groundwater flow is generally to the northwest as it moves onto Sites 90 and 184 from the east but then turns north as it is forced around the various barrier walls that block flow to the south and west. A "dead zone" is thus formed by the confluence of the two walls near the entrance to the Home Depot parking lot and the lack of recharge due to the overlying synthetic liner. As a result, groundwater largely bypasses the Commercial AOC located in this dead zone and thus does not promote the migration of hexavalent chromium to the north onto the Residential Area. This conclusion is supported by groundwater quality data from the sentinel wells as further discussed in Section 5-5.

Additional investigations were conducted in 2012 to further evaluate groundwater flow conditions and confirm that contaminated groundwater is not migrating from the Commercial AOC to the Residential Area. These investigations consisted of the following:

- Reference point elevations of monitoring wells, piezometers, and sumps were re-surveyed.
- Automatic data loggers were deployed in selected wells to record water levels during rainfall events from May 7 through June 12, 2012.
- A shallow temporary piezometer was installed above the liner near Sump A and monitored using data loggers.
- Groundwater levels were recorded during the inspection and dewatering of Catch Basin 126.
- The three sewer laterals that entered Catch Basin 126 were grouted.

- Water levels were monitored during rainfall events before and after grouting of the laterals.

The results of these activities have been documented in various technical memoranda throughout the year and are summarized as follows.

- The initial data logger study indicated that groundwater elevations in Sump A and adjacent monitoring well 184-MW-04 respond to precipitation events more quickly and to a greater magnitude than in Sump B and other wells.

- The inspection of the catch basin reviled that the laterals that entered the basin were not the cause of the observed response in Sump A.

- Data from the shallow piezometer installed by Sump A indicated that the stone on top of the liner floods with surface water runoff during rainfall events.

Additional investigations are planned for 2013, including testing of the integrity of the synthetic liner. Final conclusions regarding groundwater conditions on NJCU will be provided in subsequent reports and summarized in the IAGPR report for 2013.

4.4 SA-7 Perimeter Pools

The LTMP program includes monitoring of the hydraulic gradients across the subsurface containment barrier (SCB) around the perimeter of SA-7. This is accomplished through monitoring of the head in each of the ten "perimeter pools" and comparing these data to groundwater elevations in various shallow piezometers located just outside of the SCB. The location of the perimeter pools and the design pool elevations are shown on **Figure 4-10**. Water level trends are plotted on the hydrographs in **Appendix A** which indicate the average ground surface elevation, the design pool elevation, the measured pool elevation, and the groundwater elevation in the closest piezometer outside of the wall.

Overall, the data indicate that, with a few exceptions, water levels within the SA-7 pools are greater than those outside of the SCB and thus outward gradients are occurring. The exceptions include pools N-3, N-4, and S-3 at which water levels in the wells/piezometers were occasionally at or above the measured pool elevation. However, as shown on **Table 4-3**, the annual average head in these monitoring points was below the pool elevation. Thus, the net groundwater flow direction during the year was outward. Furthermore, a review of the trends in **Appendix A** reveals that the majority of the exceedances occurred following moderate to heavy rainfall events. This direct correlation between rainfall and water level rise suggests that the permeability of the soil adjacent to the SA-7 barrier wall is relatively low and thus the potential for groundwater to actually migrate through the wall is quite low. For example, using a nominal wall thickness of three feet, an inward head difference of six inches, a wall permeability of

1.0 x 10 -7 cm/s (0.00028 ft/d), and a porosity of 0.3, the velocity of water moving through wall is calculated at 0.00015 feet per day. The time required for water to pass through the wall under this scenario, therefore is calculated at 20,000 days or over 54 years.

Going forward, groundwater levels outside of the SA-7 SCB wall are expected to decline when the low permeability covers are installed in the open space areas for the SA-6 North and SA-6 South soil remedy/redevelopment. Groundwater modeling of this future scenario indicates that groundwater levels will be lowered to an elevation at or below +4.0 feet above mean sea level. If this is not the case, the contingent groundwater pumping systems will be available to lower water levels outside of the SA-7 barrier if warranted.

4.5 SA-6 North Containment Cell

A groundwater elevation contour map specific to SA-6 North will be provided in future annual reports after the containment cell has been constructed. Hydraulic gradients across the wall(s) will be determined at the perimeter piezometer locations and compared to performance criteria.

4.6 SA-6 South Containment Cell

A groundwater elevation contour map specific to SA-6 South will be provided in future annual reports after the containment cell has been constructed. Hydraulic gradients across the wall(s) will be determined at the perimeter piezometer locations and compared to performance criteria.

4.7 SA-5 Site 117

Groundwater beneath the majority of Site 117 is from northeast to southwest as illustrated on **Figures 4-1** through **4-3**. In the Shallow zone, the sewers beneath Route 440 serve as a groundwater sink and limit the further movement of groundwater to the south and west. In both the Shallow and Intermediate Zones, a component of groundwater in the northwestern corner of Site 117 is diverted to the northwest, passing between the SA-7 SCB and the NJCU sheet pile wall. The relatively low groundwater elevations in this area are caused by sewer systems that are actively dewatered by the Jersey City MUA. Groundwater in the Deep zone is also impacted to a degree by the SA-7 SCB with flow being partially diverted to the north and south.

4.8 Miscellaneous Events

4.8.1 Hydraulic Testing of Bedrock Well 115-MW-215BR

Yield testing of bedrock well 115-MW-215BR (215BR) was conducted in 2012 as the first step in relocating GWET pumping well 115-MW-203BR (203BR) closer to the groundwater treatment plant that is being constructed on SA-6 North. Subsequent groundwater modeling, conducted using the yield test data, confirmed that the chromium plume in the bedrock would be effectively captured by operating well 215BR at the same pumping rate (7 gpm) as is currently used in 203BR. These field tests are summarized as follows.

Antecedent Monitoring

In preparation for the yield test of 215BR, pumping from 203BR was terminated on August 27, 2012, approximately 72 hours prior to commencing the yield test. The hydraulic response to this shutdown was monitored in both 203BR and 215BR to provide a preliminary indication of the hydraulic connectivity between the two wells. The tide gauge at SA-7 was also monitored and the data used to correct the raw water level data for tidal fluctuations. The resulting "tidal-corrected" response during the initial 8 hours of the shutdown period confirmed that the wells are directly connected since the rise in water levels in both wells is rapid and of similar magnitude despite being over 500 feet apart.

Yield Test of Well 115-MW-215BR

A three-inch diameter Grundfos submersible pump was placed in 215BR on Thursday, August 30, 2012 and used to pump the well for an 8-hour period. The discharge was routed to the PW-2 force main to convey the discharge to the treatment plant on Kellogg Street. This required PW-2 to be shut down during the yield test. However, considering the distance to PW-2, its shallow screen interval, and low pumping rate, shutdown of this well had no bearing on the results of the bedrock yield test.

The target pumping rate for the yield test was 25 gpm. The pump was set 43 feet below the water table based on an anticipated drawdown of 15 feet. This estimate was based on the specific capacity of well 203BR of 1.5 gpm/ft. This value was determined during the 2006 aquifer test in which the well was pumped at 47 gpm for 30 hours with a total drawdown of approximately 30 feet.

The discharge rate was measured throughout the test at both the well head and in the PW-2 force main in the treatment plant. Data loggers were placed in nine nearby wells and used to monitor the response to pumping. Upon startup, the water level in 215BR declined such that the pumping rate had to be reduced from 25 gpm to 10 gpm to maintain a pumping level above the pump intake. The specific capacity of 215BR is thus calculated at approximately 0.3 gpm/ft which is lower than that of 203BR. However, since the well is over 100 feet deep, setting the pump deeper would increase the available drawdown and the potential yield of the well.

The groundwater level response in 203BR, corrected for tidal fluctuation, is plotted on **Figure 4-11** and indicates a drawdown of 1.9 feet after 8 hours. This is nearly identical to the response in well 215BR when 203BR was shut down for 8 hours and confirms that both wells are hydraulically connected via the fracture zone. Drawdown in the other monitoring wells ranged from 2.0 feet in 073-MW-10BR to no measureable response in wells 087-MW-3 and 140-MW-9BR. This is not unexpected considering their location perpendicular to the orientation of the fracture zone and the relatively short pumping period.

5 GROUNDWATER QUALITY MONITORING

Groundwater quality monitoring within the project area was conducted in 2012 in accordance with the GWET Long-Term Monitoring Plan (LTMP) and the other applicable area-specific monitoring plans as discussed in Section 1.3 and listed on **Table 1-2**.

5.1 Deep Overburden Regional Plume Monitoring

In 2012 it was agreed that the frequency of regional monitoring of the Deep Overburden Plume would be reduced from annual to biennial (every two years). This was based on a review of historical data that indicted the plume has not expanded beyond its originally-mapped extent in 2006. As a result, sampling of the 28 perimeter wells was not conducted in 2012. The next round of regional deep plume monitoring is scheduled for December, 2013.

5.2 GWET Extraction Wells

Groundwater from the three GWET pumping wells was sampled monthly during the first quarter of 2012 and quarterly for the remainder of the year. As a result, six sampling events were conducted in 2012 as shown in **Table 5-1**. (The monthly sampling was conducted on a voluntary basis by Honeywell as the LTMP only requires quarterly sampling.) Samples were analyzed for total and hexavalent chromium and volatile organic chemicals (VOC). The results for hexavalent chromium are plotted on **Figure 5-1** and indicate that concentrations in the Deep zone (PW-1) have declined in an asymptotic fashion to their current value of approximately 40 ppm. Concentrations in the Intermediate zone (PW-2) have also declined by about 50% in the last three years. The observed slow decline in concentration is likely due to cleaner water being pulled into the pumping wells as the capture zone establishes itself. The cleaner water originates at the margins of the capture zone including beneath the river as the plume is pulled back. Hexavalent chromium concentrations in the bedrock have been generally stable at approximately 15 ppm. There is no indication that the CaSx injections have impacted chromium concentrations in the GWET wells in 2012.

VOC data from the pumping wells are provided in **Table 5-1**. With the exception of carbon tetrachloride and occasionally chloroform (laboratory estimated values), VOCs have not been detected in the bedrock pumping well. Deep overburden pumping well PW-1 contains the highest VOC concentrations with the most prevalent compounds being chlorinated volatile organics such as trichloroethene (TCE) and its daughter products cis- and trans-dichloroethene and vinyl chloride. These same constituents were detected in the Intermediate zone pumping well PW-2 albeit at lower concentrations. Benzene was also detected in relatively low concentrations in PW-1 and PW-2 samples.

Figure 5-2 illustrates a time-series plot of TCE in each of the GWET pumping wells. The data indicate that concentrations in both PW-1 and PW-2 are in the 75 to 150 ppb range and are continuing to decline slowly. As previously reported, the source of the VOCs in the groundwater is not related to Honeywell.

5.3 SA-6 South

Groundwater samples were collected in 2012 from two Intermediate Zone wells and nine Shallow Zone monitoring wells on SA-6 South as shown on **Figure 5-3**. This sampling was conducted as part of a Treatment Works Approval (TWA) permit application to characterize the quality of groundwater that may be generated during dewater operations for the soil remedy. The results for inorganic constituents including total and hexavalent chromium are summarized in **Tables 5-2 and 5-3** for the Intermediate and Shallow Zones, respectively. The results are generally consistent with prior data and mapping in SA-6 South. Both Intermediate Zones wells were non-detect for hexavalent chromium and total chromium concentrations were below the NJGWQC of 70 ppb in the filtered and unfiltered samples. Three of the nine Shallow Zone wells (124-MW-02, 124-MW-07 and 134-MW-01) reported elevated chromium concentrations and each are located in areas that are associated with COPR-impacted soils. The remainder of the Shallow Zone wells were non-detect for hexavalent chromium.

5.4 SA-6 North

Groundwater samples were collected in 2012 from two Intermediate Zone wells and seven Shallow Zone monitoring wells at SA-6 North as shown on **Figure 5-4**. This sampling was conducted as part of a Treatment Works Approval permit application to characterize the quality of groundwater that may be produced during dewater operations for the soil remedy. The results for inorganic constituents including total and hexavalent chromium are summarized in **Tables 5-4 and 5-5** for the Intermediate and Shallow Zones, respectively. The results are generally consistent with prior data and mapping in SA-6 North. Both Intermediate Zones wells (087-OBS-6D and 088-MW-15) were non-detect for hexavalent chromium. Total chromium was reported above the NJGWQC in the unfiltered sample from both wells, however only 088-MW-15 contained detectable total chromium in the unfiltered sample. Both wells are on the fringe of the Intermediate Zone portion of the deep overburden plume (as mapped on Figure 4.4-4 of the Final Groundwater Investigation Report) and thus the results are not inconsistent with the prior conceptual model.

Only one of the seven Shallow Zone wells samples on SA-6 North (088-MW-108) reported detectable concentrations of hexavalent chromium. This well is located in an area previously associated with COPR-impacted soils. The remainder of the Shallow Zone wells were non-detect for hexavalent chromium.

5.5 New Jersey City University

Groundwater samples were collected quarterly in 2012 from the three "sentinel" wells at NJCU in accordance with the SA-5 Triggers Plan. The objective of the monitoring program is to provide early warning of potential chromium migration in groundwater from the Commercial AOC (in the southwest corner of Site 90) to the Residential Area to the north. The results are provided in **Table 5-6** and indicate that hexavalent chromium was detected above the detection limit (but below 70 ppb) in 184-MW-06 during the first two quarters but was ND during the third and fourth quarters of 2012. Since this well is upgradient of the Commercial AOC, these results are not indicative of groundwater migration from the "dead zone" in the southwest corner of Site 90. Total chromium was not detected above the NJGWQC of 70 ppb in any of the samples from 184-MW-06.

Total chromium was detected above 70 ppb on one occasion in well184-MW-04 (154 ppb in June 2012) and in all four rounds in well 184-MW-05. However, each of these results was from the unfiltered sample, whereas the associated filtered sample did not exceed 70 ppb for total chromium. This indicates that the reported total chromium is likely trivalent chromium sorbed on particulates within the sample.

5.6 Plume Diversion Area Monitoring

In accordance with the "L-well" monitoring plan, the following wells in the Plume Diversion Area of SA-6 South will be sampled in 2013 to provide a pre-remedy baseline. These wells will be sampled a second time after the remedy is complete to evaluate if the deep plume in this area has shifted position due to the installation of the soil containment cell. Depending on field conditions during remedy construction, some of the wells may abandoned and replaced, and those within the containment cell may be abandoned and the second sampling round conducted by collecting in-situ groundwater samples using a GeoProbe rather than installing a replacement well through the cap.

124-MW-106T;
124-MW-107T
124-MW-G02T;
119-MW-01T;
119-MW-02T.
124-MW-103L
124-MW-102T
124-MW-104T
124-MW-104L
124-MW-105T

5.7 SA-5 Site 117

Groundwater sampling for water quality analysis was not conducted at Site 117 in 2012.

5.8 SA-5 Sites 079/153

Groundwater sampling for water quality analysis was not conducted at Sites 079 or 153 in 2012.

6 S-3 INJECTION AND MASS REMOVAL PROGRAM

The S-3 injection and mass removal program was initiated in 2012. Calcium polysulfide (CaSx) was injected into the S-3 Sand beneath the project area in general accordance with the Operations Work Plan for In-Situ Chromium Mass Removal (Cornerstone, February 20, 2012). Changes to the plan were made throughout the year and included both the location of the injection wells and the sequence of the injections, as further described below.

6.1 CaSx Injection Events in 2012

Five CaSx injection events were conducted in 2012 as summarized on **Table 6-1**. The location of the injection wells is shown on **Figure 6-1**. The first two injection events (wells 088-IW-01 and 088-IW-02, respectively) were conducted in accordance with the original Operations Work Plan. However, since hexavalent chromium was not detected in the next planned injection well (087-IW-01) during pre-injection sampling, the well was removed from the program. Two alternate wells (115-PW-21 and 115-DP-2) were identified on Site 115 for use on a one-time basis for the third and fourth events, respectively. Well 088-IW-02 was then used for the fifth injection event in December 2012.

During each event approximately 4,300 gallons of CaSx was injected into the S-3 formation during an 8-hour period. This is the maximum volume that could be transported in a single tanker truck within DOT weight limitations. Gravity flow was used during the first three events to empty the tanker at rates ranging from 9 to 12 gpm. Slight pressurization of the tanker was used during the last two events to maintain a flow rate of approximately 10 gpm throughout the day.

During the second and third day of each event approximately 9,000 gallons of water (4,500 gallons each day) was injected into the well to aid flushing of the CaSx. The water was obtained from an adjacent JCMUA fire hydrant and the injection rates generally ranged from 9 to 12 gpm.

6.2 Mass Removal Summary

The amount of sulfide injected during each event has been determined through laboratory analysis of the percent sulfide in samples collected from the tanker prior to injection. Each sample was analyzed in triplicate and the geometric mean concentration calculated as shown in **Table 6-2**. For the first four events, CaSx was obtained from Tessenderlo Kerley, Inc. under the product name "Calmet." The mean sulfide content of this material ranged from 5.01 to 5.45%. For the fifth event, a different supplier (Graus Chemicals) was used in an effort to increase the sulfide content of the reductant. The analytical results are shown on **Table 6-2** and confirm that the sulfide content of this material is approximately 6.5% or one percentage point higher than Calmet.

Using these data, the stoichiometrically equivalent mass of reduced chromium represented by the injected CaSx is calculated on **Table 6-3** and graphed on **Figure 6-2**. These data indicate that the injections resulted in a stoichiometric-equivalent mass of 6.71 tons of reduced chromium in 2012. For comparison, the mass of hexavalent chromium removed from the Deep Overburden Plume through historic pumping has also been calculated. As shown on **Figure 6-3**, historic pumping includes operation of the two depressurization wells, 115-DP-1 and 115-DP-2 during the SA-7 soil excavation remedy, and the GWET system pumping that has been ongoing since December 2008. The mass removed was calculated by multiplying the pumping rate of each well by the hexavalent chromium concentration of the discharge. Values for both parameters were determined on a monthly basis from historic records. The results indicate that approximately 70 tons of hexavalent chromium have been removed through groundwater extraction through the end of 2012.

6.3 Groundwater Quality Monitoring

Groundwater monitoring of injection wells and monitoring wells was conducted in accordance with the Operations Work Plan. Injection wells were sampled several days prior to each injection event, whereas monitoring wells were sampled once prior to startup of the program in May 2012, and again in December 2012 (semi-annual frequency). Due to changes in the selection of injection wells during the year, a supplemental sampling round (Event 3A) was conducted between events 3 and 4 in August 2012.

The results of the injection wells sampling have been compiled in **Tables B-1 through B-10** in **Appendix B**. The results indicate that hexavalent chromium is reduced to trivalent chromium in each injection well upon addition of the CaSx. The fact that detectable concentrations of hexavalent chromium have not been reported in these wells in subsequent sampling rounds is likely due to residual CaSx in the well sump below the screen. This residual product likely mixes with groundwater moving into the screen during sampling and reduces hexavalent chromium present in the groundwater prior to analysis. The detection of total chromium in the ppm range in a number of the post-injection samples (refer to Appendix B) supports this hypothesis as does the presence of various ancillary water quality parameters such as elevated sulfate and calcium.

Data from the two rounds of monitoring well sampling in 2012 are provided in **Tables C-1 through C-10** in **Appendix C**. Only the second round, collected December 2012 represents post-injection conditions. The available data does not indicate that the impact of the injections have reached downgradient monitoring wells. These data will be compared with the results from the two events planned for 2013 and further evaluated in the S-3 Injection/Mass Removal performance report due in May of 2014.

6.4 Planned Activities for 2013

In accordance with the Operations Work Plan, the goal for 2013 will be to inject sufficient reductant in the S-3 Sand to reduce the stoichiometric equivalent of 10 tons of hexavalent chromium. Based on the results from 2012, this will require eight injection events throughout the year. Efforts will also be made in 2013 to more aggressively purge the sumps of the injection wells prior to sampling.

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 Compliance with Monitoring Requirements

Hydraulic and groundwater quality monitoring conducted in 2012 have fulfilled the various monitoring plan requirements in accordance with Tables 1-1 and 1-2.

7.2 Status of Groundwater CEA Certifications

Groundwater Classification Exception Areas were approved by NJDEP on February 16, 2012 for the three principle water bearing zones in the Project Area (Shallow Zone, Deep Overburden, and Bedrock). A CEA biennial certification is due to NJDEP on February 16, 2014.

7.3 Recommendations for Monitoring Well Network

Recommendations for the abandonment and replacement of selected groundwater monitoring wells during the upcoming remedial actions on SA-6 North and South have been made in both the Well Abandonment Plan and the "L-well" Monitoring Plan recently submitted with the Study Area 6 Remedy Design. There are no proposed changes to these documents at this time.

7.4 Recommendations for Water Level Monitoring Frequency

Groundwater level monitoring will be conducted in accordance with the frequencies specified in the various hydraulic monitoring plans as summarized in Table 1-1. Changes to these frequencies will be evaluated in the next annual performance report.

7.5 Recommendations for Groundwater Quality Monitoring Frequency

Recommendations regarding the frequency of groundwater quality monitoring, well selection, and parameters for analysis have been put forth in the monitoring plans for the various sub-areas. There are no proposed changes to these documents at this time. Regional sampling of the deep overburden plume will be conducted in December 2013. Recommendations regarding the frequency of that event going forward will be made in next year's performance evaluation report based on the results.

7.6 Other Recommendations

There are no other recommendations regarding groundwater performance or monitoring in the Project Area at this time.

LIMITATIONS

The work product included in the attached was undertaken in full conformity with generally accepted professional consulting principles and practices and to the fullest extent as allowed by law we expressly disclaim all warranties, express or implied, including warranties of merchantability or fitness for a particular purpose. The work product was completed in full conformity with the contract with our client and this document is solely for the use and reliance of our client (unless previously agreed upon that a third party could rely on the work product) and any reliance on this work product by an unapproved outside party is at such party's risk.

The work product herein (including opinions, conclusions, suggestions, etc.) was prepared based on the situations and circumstances as found at the time, location, scope and goal of our performance and thus should be relied upon and used by our client recognizing these considerations and limitations. Cornerstone shall not be liable for the consequences of any change in environmental standards, practices, or regulations following the completion of our work and there is no warrant to the veracity of information provided by third parties, or the partial utilization of this work product.

TABLES

TABLE 1-1
SUMMARY OF GROUNDWATER LEVEL MONITORING REQUIREMENTS

Location	Monitoring Plan	Depth	Frequency	# Wells	2012 Activity (or Estimated Start Date)
Regional*	GWET Long Term Monitoring Plan	All Zones	Quarterly	150	Ongoing (refer to Section 4.1)
Study Area 7	SA-7 Perimeter Pools	Shallow and Interm.	Monthly	30	Ongoing (refer to Section 4.4)
SA-6 South	SA-6 South Containment Cell Perimeter	Shallow and Interm.	1st year - Monthly 2nd year - Quarterly 3rd year -Semi-Annual	13	Post Remedy (2016)
SA-6 North	SA-6 North Containment Cell Perimeter	Shallow and Interm.	1st year - Monthly 2nd year - Quarterly 3rd year -Semi-Annual	10	Post Remedy (2016)
SA-5; NJCU	NJCU Post Remedy "triggers" Plan	Shallow	Quarterly	7	Ongoing (refer to Section 4.3)
Study Area 6 N&S	"Long Term Monitoring Plan"	Shallow	Quarterly	TBD	Post Remedy (2016)
SA-5: sites 079/153 South	"Long Term Monitoring Plan"	Shallow	Biennial	2 to 4	Post Remedy (2014)

* Includes available wells on SA-5, SA-6, SA-7, and surrounding areas historically considered part of the Deep Overburden Plume investigation..

TABLE 1-2
SUMMARY OF GROUNDWATER QUALITY MONITORING REQUIREMENTS

Location	Monitoring Plan	Depth	Frequency	# Wells	2012 Activity (or Estimated Start Date)
Regional	GWET Long Term Monitoring Plan	Shallow	Biennial	0	
		Intermediate	Biennial	6	None - next event
		Deep	Biennial	12	scheduled for Dec. 2013
		Bedrock	Biennial	10	
Regional	S-3 Injection Mass Removal	Deep	Every injection event	4	Ongoing - refer to
			Semi-annual Sampling	6	Section 6
SA-6 South	TWA Permit Application Sampling	Shallow	one-time	9	Completed
		Intermediate	one-time	2	refer to Section 5
SA-6 South	SA-6 South Development AOC	Shallow	Qtly first year - then TBD	10	Post Remedy (2017)
SA-6 North	TWA Permit Application Sampling	Shallow	one-time	7	Completed
		Intermediate	one-time	2	refer to Section 5
SA-6 North	SA-6 North Development AOC	Shallow	TBD	TBD	Post Remedy (2017)
SA-6 South	L-zone Wells (Plume Diversion Area)	Deep	Pre-Remedy Baseline	10	Scheduled for 2013
			Post Remedy	10*	Post Remedy (2017)
Study Area 5	SA-5 Post Remedy "triggers" Plan	Shallow	Years 1 and 2 - Quarterly	3	Ongoing
			Year 3 + TBD	3	refer to Section 5
Sites 079/153 South	"Long Term Monitoring Plan"	Shallow	Biennial		Scheduled to begin in 2013

* Number and location of wells subject to field conditions during and after remedy construction.

Biennial = every two years

Note: Groundwater sampling for non-chromium activities is not within the scope of this report

Table 2-1
2012 Monthly Precipitation Data

Month	2012 Precipitation	Average Precipitation
January	2.89	3.98
February	1.33	2.96
March	1.05	4.21
April	3.45	3.92
May	4.32	4.46
June	5.02	3.4
July	2.27	4.68
August	2.56	4.02
September	3.13	4.01
October	3.65	3.16
November	1.62	3.88
December	5.06	3.57
Annual Total	36.35	46.25

Data Source: http://www.nc-climate.ncsu.edu/cronos/?station=286026&temporal=monthly
Station name: Newark International Airport
Station ID: 286026

Table 2-2
Groundwater Monitoring Well Inventory

Well ID	Screen Zone	Ref. Pt. Elev. (ft msl)	Well Depth (ft)	Screen Length (ft)
073-MW-5	Shallow	6.81	15	13
073-MW-BB11	Shallow	7.87	13	10
073-MW-Y10	Shallow	6.42	13	10
073-PZ-001	Shallow	7.24	13	5
079-MW-01	Shallow	8.8	NA	NA
079-MW-A2	Shallow	8.1	13	10
079-MW-C6	Shallow	11	13	10
087-MW-001	Shallow	12.67	15	13
087-MW-101	Shallow	12.21	12	NA
087-MW-102	Shallow	11.65	13	NA
087-MW-119	Shallow	12.97	11	NA
087-MW-120	Shallow	12.3	11	NA
087-MW-121	Shallow	11.76	12	NA
087-MW-A26	Shallow	10.1	13	10
087-MW-I30	Shallow	10.86	14	10
087-MW-O19	Shallow	13.5	13	10
087-MW-O23	Shallow	11.79	13	10
087-MW-O29	Shallow	10.08	14	10
087-MW-S19	Shallow	14.47	14	10
087-MW-U28	Shallow	14.08	16	10
087-MW-W25	Shallow	18.26	18	10
087-MW-Y20	Shallow	19.06	20	10
087-PZ-001	Shallow	17.5	18	5
087-PZ-003	Shallow	13.1	18	5
087-PZ-005	Shallow	14.92	20	5
088-MW-001	Shallow	9.34	15	13
088-MW-002	Shallow	12.81	15	13
088-MW-101	Shallow	11.56	12	NA
088-MW-102	Shallow	17.54	19	NA
088-MW-103	Shallow	11.44	35	NA
088-PZ-001	Shallow	10.67	12	5
088-PZ-003	Shallow	12.07	15	5
090-MW-F14	Shallow	20.5	15	10
090-PZ-05	Shallow	17.2	NA	NA
090-PZ-06	Shallow	17.6	NA	NA
115-E1-SO	Shallow	7.42	6.95	NA
115-E2-SO	Shallow	10.05	10	NA
115-E3-SO	Shallow	12.57	NA	NA

Table 2-2
Groundwater Monitoring Well Inventory

Well ID	Screen Zone	Ref. Pt. Elev.	Well Depth	Screen Length
		(ft msl)	(ft)	(ft)
115-E5-SO	Shallow	NA	NA	NA
115-W1-SO	Shallow	12.59	NA	NA
115-W3-SO	Shallow	NA	13.93	NA
115-W5-SO	Shallow	12.43	NA	NA
117-MW-A05	Shallow	18.48	16	NA
117-MW-A14	Shallow	17.33	17	NA
117-MW-A62	Shallow	18.32	15	NA
117-MW-A85	Shallow	17.4	15	NA
117-MW-A89	Shallow	13.17	16	NA
117-MW-A99	Shallow	15.95	14	NA
117-MW-I4S	Shallow	15.49	NA	NA
124-MW-02	Shallow	9	9.34	NA
124-MW-07	Shallow	NA	NA	NA
124-MW-09	Shallow	NA	NA	NA
124-MW-10	Shallow	10.06	11	8
124-MW-11	Shallow	9.05	8	6
125-MW-01	Shallow	8.71	NA	NA
125-PZ-001	Shallow	9.5	13	5
125-PZ-003	Shallow	8.89	8.5	5
134-MW-2	Shallow	7.36	10	9
134-MW-Q08	Shallow	8.37	13	10
134-MW-V09	Shallow	7.98	13	10
134-PZ-001	Shallow	7.47	16	5
134-PZ-003	Shallow	8.34	13	5
140-MW-04	Shallow	7.18	NA	NA
140-MW-06	Shallow	8.33	6	NA
140-MW-07	Shallow	7.7	6	NA
140-MW-08	Shallow	8.13	10	8
140-MW-1R	Shallow	7.61	11	NA
140-PZ-001	Shallow	8.29	11.5	5
153-MW-A13	Shallow	9.62	10	6
153-MW-A15	Shallow	11	12.15	10
154-MW-A01	Shallow	18.06	14.61	NA
154-MW-A06	Shallow	19.87	15.12	NA
154-MW-A5A	Shallow	19.16	14	NA
154-MW-B6A	Shallow	20.71	13.68	NA
154-MW-C6A	Shallow	20.37	13.41	NA
154-MW-D01	Shallow	18.78	14.28	NA
154-MW-E08	Shallow	22	14.4	NA
163-MW-1	Shallow	NA	NA	NA
163-MW-R05	Shallow	7.22	NA	NA

Table 2-2
Groundwater Monitoring Well Inventory

Well ID	Screen Zone	Ref. Pt. Elev.	Well Depth	Screen Length
		(ft msl)	(ft)	(ft)
184-MW-001	Shallow	12.09	12	10
184-MW-C10	Shallow	15.2	16	10
184-MW-04	Shallow	8.74	NA	NA
184-MW-05	Shallow	10.1	NA	NA
184-MW-06	Shallow	12.5	NA	NA
SA6-MW-AA1	Shallow	17.8	15	10
Sump A	Shallow	9.04	NA	NA
Sump B	Shallow	13.04	NA	NA
073-PZ-002	Intermediate	7.26	26.5	5
087-MW-13	Intermediate	12.93	40	10
087-MW-35	Intermediate	18.29	40	10
087-MW-A26D	Intermediate	10.35	28	10
087-MW-O29D	Intermediate	10.32	56	NA
087-MW-W25D	Intermediate	18.17	66	10
087-OBS-1D	Intermediate	15.13	42.8	NA
087-OBS-2D	Intermediate	12.68	NA	NA
087-OBS-5D	Intermediate	12.72	39.83	NA
087-OBS-6D	Intermediate	11.24	NA	NA
087-PW-2	Intermediate	13.02	NA	NA
087-PZ-002	Intermediate	17.44	36	5
087-PZ-004	Intermediate	13.18	29	5
087-PZ-006	Intermediate	15.06	36	5
088-MW-15	Intermediate	12.09	35	10
088-PZ-002	Intermediate	10.56	25	5
088-PZ-004	Intermediate	12.05	27	5
090-MW-07	Intermediate	14	40	10
115-E1-DI	Intermediate	16.72	44.85	NA
115-E1-DO	Intermediate	9.21	37.11	NA
115-E2-DO	Intermediate	10.24	35	NA
115-E3-DO	Intermediate	12.39	34	NA
115-E4-DO	Intermediate	17.87	NA	NA
115-E5-DO	Intermediate	15.72	NA	NA
115-E6-DI	Intermediate	19.89	48.35	NA
115-E6-DO	Intermediate	19.74	51.1	NA
115-MW-20	Intermediate	14.19	NA	NA
115-MW-E14D	Intermediate	18.05	35	10
115-W1-DO	Intermediate	12.63	NA	NA
115-W4-DO	Intermediate	8.79	41.22	NA
117-MW-I1	Intermediate	11.08	22	10
117-MW-I2	Intermediate	17.59	28	10
117-MW-I3	Intermediate	15.59	28	10

Table 2-2
Groundwater Monitoring Well Inventory

Well ID	Screen Zone	Ref. Pt. Elev.	Well Depth	Screen Length
		(ft msl)	(ft)	(ft)
117-MW-I5	Intermediate	18.76	37	15
124-MW-102D	Intermediate	9.38	30	10
124-MW-103D	Intermediate	9.58	29	10
124-MW-104D	Intermediate	9.08	26	10
124-MW-105D	Intermediate	9.63	24	10
124-MW-G02D	Intermediate	9.59	28	10
125-PZ-002	Intermediate	9.31	26	5
125-PZ-004	Intermediate	8.93	25	5
134-PZ-002	Intermediate	7.81	26.5	5
134-PZ-004	Intermediate	8.22	26.5	5
140-MW-P05D	Intermediate	7.44	30	10
140-PZ-002	Intermediate	8.08	25	5
SA6-MW-AA1D	Intermediate	19.36	32	10
087-IW-01	Deep	11.51	NA	NA
087-MW-01	Deep	12.8	60	10
087-MW-03	Deep	13.77	95	10
087-MW-08	Deep	12.98	99	10
087-MW-34	Deep	12.73	70	5
087-MW-A26T	Deep	9.92	56	15
087-MW-W25T	Deep	18.19	91	15
087-OBS-1L	Deep	15.27	67.05	NA
087-OBS-1T	Deep	15.23	100	NA
087-OBS-3L	Deep	12.88	65	NA
087-OBS-4T	Deep	11.6	75.5	NA
087-OBS-5T	Deep	12.62	81.9	NA
087-PW-1	Deep	12.66	NA	NA
088-MW-G19T	Deep	12.45	93	15
088-IW-01	Deep	11.57	NA	NA
088-IW-02	Deep	16.32	NA	NA
090-MW-09	Deep	10.7	75	5
115-MW-A12T	Deep	15.55	NA	NA
115-MW-E14T	Deep	21.33	71	15
115-OMW-E08TR	Deep	16.82	NA	NA
115-PW-21	Deep	15.13	71	10
117-MW-D1	Deep	11.08	41	10
117-MW-D2	Deep	17.62	48	10
117-MW-D3	Deep	18.85	80	10
117-MW-I4	Deep	15.49	75	10
119-MW-01T	Deep	10.78	62	10
119-MW-02T	Deep	8.8	70	10
124-MW-06	Deep	9.39	70	10

Table 2-2
Groundwater Monitoring Well Inventory

Well ID	Screen Zone	Ref. Pt. Elev.	Well Depth	Screen Length
		(ft msl)	(ft)	(ft)
124-MW-102T	Deep	9.33	75	10
124-MW-103L	Deep	9.77	110	10
124-MW-104L	Deep	9.22	43	10
124-MW-104T	Deep	9.31	67	10
124-MW-105T	Deep	9.33	62	10
124-MW-106T	Deep	9.28	78	10
124-MW-107T	Deep	9.08	70	10
124-MW-G02T	Deep	9.5	69	10
153-MW-A13T	Deep	9.34	58	15
SA6-MW-AA1T	Deep	15.31	70	10
073-MW-10BR-1	Rock	6.67	155	10
073-MW-10BR-2	Rock	6.67	170	10
073-MW-10BR-3	Rock	6.67	195	15
073-MW-10BR-4	Rock	6.67	227	15
073-MW-10BR-5	Rock	6.67	327	15
073-MW-1BR-1	Rock	7.58	144	15
073-MW-1BR-2	Rock	7.58	209	15
073-MW-1BR-3	Rock	7.58	264	15
073-MW-1BR-4	Rock	7.58	295	15
073-MW-1BR-5	Rock	7.58	329	15
079-MW-13BR-1	Rock	13.08	121	10
079-MW-13BR-2	Rock	13.08	214	15
079-MW-13BR-3	Rock	13.08	284	15
087-MW-14	Rock	10.68	97	10
087-MW-I30T	Rock	10.59	80	15
087-MW-O29T	Rock	9.98	102	15
090-MW-18BR	Rock	16.36	154	15
090-MW-7BR-1	Rock	12.66	134	15
090-MW-7BR-2	Rock	12.66	NA	NA
090-MW-7BR-3	Rock	12.66	NA	NA
115-MW-203BR	Rock	8.7	162	20
115-MW-211BR	Rock	17.41	NA	NA
115-MW-215BR	Rock	8.82	143	20
115-MW-216BR	Rock	18.02	131	20
117-MW-3BR-1	Rock	12.34	155	15
117-MW-3BR-2	Rock	12.34	263	15
117-MW-8BR	Rock	12.94	125	10
119-MW-11BR	Rock	10.75	159	20
119-MW-12BR	Rock	11.26	154	20
119-MW-16BR-1	Rock	8.61	151	15

Table 2-2
Groundwater Monitoring Well Inventory

Well ID	Screen Zone	Ref. Pt. Elev.	Well Depth	Screen Length
		(ft msl)	(ft)	(ft)
119-MW-16BR-2	Rock	8.61	187	15
119-MW-16BR-3	Rock	8.61	247	15
119-MW-2BR-1	Rock	8.43	163	15
119-MW-2BR-2	Rock	8.43	245	15
119-MW-2BR-3	Rock	8.43	315	15
119-MW-4BR-1	Rock	8.77	179	15
119-MW-4BR-2	Rock	8.77	229	15
119-MW-4BR-3	Rock	8.77	314	15
124-MW-17BR-1	Rock	9.56	153	15
124-MW-17BR-2	Rock	9.56	337	15
124-MW-8BR	Rock	9.71	NA	NA
140-MW-9BR-1	Rock	7.32	153	15
140-MW-9BR-2	Rock	7.32	222	15
140-MW-9BR-3	Rock	7.32	272	15
KP-MW-6BR-1	Rock	8.94	153	14
KP-MW-6BR-2	Rock	8.94	231	15
KP-MW-6BR-3	Rock	8.94	339	15
SA6-MW-14BR	Rock	9.99	85	10
SA6-MW-15BR	Rock	8.08	103	20
SA6-MW-5BR-1	Rock	17.06	106	15
SA6-MW-5BR-2	Rock	17.06	154	15
SA6-MW-5BR-3	Rock	17.06	204	13
SA6-MW-5BR-4	Rock	17.06	236	15
SA6-MW-5BR-5	Rock	17.06	281	15

Table 3-1

GWET Pumping Outages in 2012

Well ID	Start Date	End Date	Duration Days and	Hours	Comment
087-PW-1	12-Mar-12	13-Mar-12	1	3.3	Shut down for PW-2 acid line cleaning pump and soak.
087-PW-2	12-Mar-12	13-Mar-12	1	6.1	Shut down for PW-2 acid line cleaning pump and soak.
115-MW-203BR	12-Mar-12	13-Mar-12	1	1.3	Shut down for PW-2 acid line cleaning pump and soak.
087-PW-1	10-Jul-12	11-Jul-12	1	1.5	Shut down for PW-2 acid line cleaning pump and soak.
087-PW-2	10-Jul-12	11-Jul-12	1	2.1	Shut down for PW-2 acid line cleaning pump and soak.
115-MW-203BR	10-Jul-12	11-Jul-12	--	23.4	Shut down for PW-2 acid line cleaning pump and soak.
087-PW-2	27-Aug-12	31-Aug-12	3	23.4	Shut down for 115-MW-215BR pump test.
115-MW-203BR	27-Aug-12	31-Aug-12	3	19.9	Shut down for 115-MW-215BR pump test.
087-PW-1 and PW-2	29-Oct-12	14-Nov-12	16	3.8	Shut down and re-energized in preparation for hurricane Sandy.
115-MW-203BR	29-Oct-12	16-Nov-12	18	5.1	Shut down and re-energized in preparation for hurricane Sandy. Flow meter replaced.
087-PW-1	4-Dec-12	5-Dec-12	1	0.8	Shut down for PW-2 acid line cleaning pump and soak.
087-PW-2	4-Dec-12	5-Dec-12	1	3.3	Shut down for PW-2 acid line cleaning pump and soak.

Table 4-1
Groundwater Elevation Data from Quarterly Rounds in 2012

Well ID	Screen Zone	Ref. Pt. Elev.	Well Depth	Screen Length	Groundwater Elevation (NGVD-29)			
					Mar-12	Jun-12	Sep-12	Dec-12
		(ft msl)	(ft)	(ft)	(ft msl)	(ft msl)	(ft msl)	(ft msl)
073-MW-10BR-1	Rock	6.67	155	10	-1.63	-1.23	-1.39	-2.14
073-MW-10BR-2	Rock	6.67	170	10	-1.76	-4.57	-0.95	-1.81
073-MW-10BR-3	Rock	6.67	195	15	-4.09	-1.40	NA	-1.78
073-MW-10BR-4	Rock	6.67	227	15	-0.31	0.46	0.19	0.08
073-MW-10BR-5	Rock	6.67	327	15	NA	NA	NA	5.89
073-MW-1BR-1	Rock	7.58	144	15	-2.11	-1.73	-1.91	-2.40
073-MW-1BR-2	Rock	7.58	209	15	-1.63	-1.35	-1.03	-1.73
073-MW-1BR-3	Rock	7.58	264	15	-0.42	-0.26	-0.25	-0.46
073-MW-1BR-4	Rock	7.58	295	15	-0.38	-0.11	-0.72	-0.32
073-MW-1BR-5	Rock	7.58	329	15	0.57	-0.37	-0.18	0.01
073-MW-5	Shallow	6.81	15	13	3.14	3.89	2.89	3.77
073-MW-BB11	Shallow	7.87	13	10	3.05	3.59	3.20	3.65
073-MW-Y10	Shallow	6.42	13	10	3.46	4.18	3.66	4.19
073-PZ-001	Shallow	7.24	13	5	3.57	4.13	3.65	4.09
073-PZ-002	Intermediate	7.26	26.5	5	1.97	2.64	1.06	1.80
079-MW-01	Shallow	8.8	NA	NA	3.86	4.13	3.82	4.36
079-MW-13BR-1	Rock	13.08	121	10	7.09	7.76	7.29	7.55
079-MW-13BR-2	Rock	13.08	214	15	7.60	7.88	7.26	7.65
079-MW-13BR-3	Rock	13.08	284	15	7.62	7.71	7.27	6.91
079-MW-A2	Shallow	8.1	13	10	3.72	4.03	3.70	4.03
079-MW-C6	Shallow	11	13	10	5.41	5.83	5.39	5.77
087-IW-01	Deep	11.51	NA	NA	2.11	2.65	2.63	2.79
087-MW-001	Shallow	12.67	15	13	5.72	6.87	6.22	6.92
087-MW-01	Deep	12.8	60	10	2.92	3.44	3.52	3.58
087-MW-03	Deep	13.77	95	10	1.95	2.56	2.45	2.72
087-MW-08	Deep	12.98	99	10	0.66	1.34	0.96	0.84
087-MW-101	Shallow	12.21	12	NA	2.50	3.15	3.16	3.31
087-MW-102	Shallow	11.65	13	NA	2.68	2.82	3.14	3.34
087-MW-119	Shallow	12.97	11	NA	4.45	2.66	2.41	4.69
087-MW-120	Shallow	12.3	11	NA	4.21	4.40	4.22	4.29
087-MW-121	Shallow	11.76	12	NA	2.45	3.05	3.05	3.15
087-MW-13	Intermediate	12.93	40	10	1.01	-1.19	2.60	1.10
087-MW-14	Rock	10.68	97	10	3.70	3.33	3.11	2.73
087-MW-34	Deep	12.73	70	5	-1.02	-0.40	-0.71	-0.42
087-MW-35	Intermediate	18.29	40	10	0.62	1.52	1.24	1.05
087-MW-A26	Shallow	10.1	13	10	2.90	3.33	3.31	3.50
087-MW-A26D	Intermediate	10.35	28	10	2.74	3.22	3.27	3.39
087-MW-A26T	Deep	9.92	56	15	2.67	3.17	3.20	3.32
087-MW-I30	Shallow	10.86	14	10	3.47	4.09	3.71	4.07
087-MW-I30T	Rock	10.59	80	15	3.14	3.48	2.44	2.42
087-MW-O19	Shallow	13.5	13	10	6.03	7.12	5.99	7.12

Table 4-1
Groundwater Elevation Data from Quarterly Rounds in 2012

Well ID	Screen Zone	Ref. Pt. Elev.	Well Depth	Screen Length	Groundwater Elevation (NGVD-29)			
					Mar-12	Jun-12	Sep-12	Dec-12
		(ft msl)	(ft)	(ft)	(ft msl)	(ft msl)	(ft msl)	(ft msl)
087-MW-O23	Shallow	11.79	13	10	5.77	6.23	5.88	6.10
087-MW-O29	Shallow	10.08	14	10	3.61	4.11	3.80	4.22
087-MW-O29D	Intermediate	10.32	56	NA	0.91	1.60	1.32	1.71
087-MW-O29T	Rock	9.98	102	15	1.44	1.92	1.80	1.74
087-MW-S19	Shallow	14.47	14	10	NA	NA	NA	NA
087-MW-U28	Shallow	14.08	16	10	4.87	5.41	4.80	5.62
087-MW-W25	Shallow	18.26	18	10	4.20	4.73	4.35	4.75
087-MW-W25D	Intermediate	18.17	66	10	0.59	1.48	1.20	1.05
087-MW-W25T	Deep	18.19	91	15	0.54	1.19	1.05	1.00
087-MW-Y20	Shallow	19.06	20	10	2.67	3.50	3.02	4.03
087-OBS-1D	Intermediate	15.13	42.8	NA	1.10	1.86	2.78	1.68
087-OBS-1L	Deep	15.27	67.05	NA	2.15	1.40	2.90	1.36
087-OBS-1T	Deep	15.23	100	NA	1.06	1.68	1.92	1.88
087-OBS-2D	Intermediate	12.68	NA	NA	-2.20	-1.48	-1.93	-1.54
087-OBS-3L	Deep	12.88	65	NA	-0.57	-0.26	-0.20	-0.24
087-OBS-4T	Deep	11.6	75.5	NA	0.56	0.87	0.80	1.02
087-OBS-5D	Intermediate	12.72	39.83	NA	-0.21	1.29	0.71	1.16
087-OBS-5T	Deep	12.62	81.9	NA	-0.62	0.23	-0.10	0.16
087-OBS-6D	Intermediate	11.24	NA	NA	2.18	2.57	3.12	2.93
087-PW-1	Deep	12.66	NA	NA	-22.84	-22.08	-22.80	-21.78
087-PW-2	Intermediate	13.02	NA	NA	-13.72	-12.78	-14.93	-16.17
087-PZ-001	Shallow	17.5	18	5	3.48	NA	NA	4.54
087-PZ-002	Intermediate	17.44	36	5	NA	1.87	NA	NA
087-PZ-003	Shallow	13.1	18	5	4.85	5.75	4.89	NA
087-PZ-004	Intermediate	13.18	29	5	2.01	2.65	2.51	NA
087-PZ-005	Shallow	14.92	20	5	6.96	8.04	NA	NA
087-PZ-006	Intermediate	15.06	36	5	1.20	15.02	NA	NA
088-IW-01	Deep	11.57	NA	NA	3.33	3.71	3.58	3.88
088-IW-02	Deep	16.32	NA	NA	2.76	7.98	3.14	8.56
088-MW-001	Shallow	9.34	15	13	4.10	3.89	5.84	4.84
088-MW-002	Shallow	12.81	15	13	5.95	6.22	7.00	7.47
088-MW-101	Shallow	11.56	12	NA	2.61	3.28	3.14	3.68
088-MW-102	Shallow	17.54	19	NA	3.07	4.12	3.49	5.05
088-MW-103	Shallow	11.44	35	NA	2.75	3.53	4.40	3.53
088-MW-15	Intermediate	12.09	35	10	2.22	2.82	2.78	3.05
088-MW-G19T	Deep	12.45	93	15	2.69	3.14	2.93	3.18
088-PZ-001	Shallow	10.67	12	5	4.94	5.18	4.80	5.39
088-PZ-002	Intermediate	10.56	25	5	3.52	4.00	3.93	4.17
088-PZ-003	Shallow	12.07	15	5	5.18	5.90	5.23	5.75
088-PZ-004	Intermediate	12.05	27	5	2.34	2.60	2.78	2.84
090-MW-07	Intermediate	14	40	10	6.29	6.11	6.08	6.26

Table 4-1
Groundwater Elevation Data from Quarterly Rounds in 2012

Well ID	Screen Zone	Ref. Pt. Elev.	Well Depth	Screen Length	Groundwater Elevation (NGVD-29)			
					Mar-12	Jun-12	Sep-12	Dec-12
		(ft msl)	(ft)	(ft)	(ft msl)	(ft msl)	(ft msl)	(ft msl)
090-MW-09	Deep	10.7	75	5	5.25	5.51	5.19	5.21
090-MW-18BR	Rock	16.36	154	15	5.65	7.25	10.69	7.38
090-MW-7BR-1	Rock	12.66	134	15	4.65	4.91	4.62	4.98
090-MW-7BR-2	Rock	12.66	NA	NA	4.65	4.90	4.57	4.98
090-MW-7BR-3	Rock	12.66	NA	NA	4.71	4.95	4.63	5.04
090-MW-F14	Shallow	20.5	15	10	11.77	12.09	11.27	11.33
090-PZ-05	Shallow	17.2	NA	NA	8.26	8.83	8.31	8.22
090-PZ-06	Shallow	17.6	NA	NA	10.04	11.25	10.09	10.06
115-E1-DI	Intermediate	16.72	44.85	NA	2.22	2.83	2.77	3.15
115-E1-DO	Intermediate	9.21	37.11	NA	2.50	3.03	2.83	3.19
115-E1-SO	Shallow	7.42	6.95	NA	5.53	6.21	5.99	7.02
115-E2-DO	Intermediate	10.24	35	NA	4.30	4.53	4.28	4.50
115-E2-SO	Shallow	10.05	10	NA	5.53	5.78	5.77	5.98
115-E3-DO	Intermediate	12.39	34	NA	4.95	5.17	5.02	5.26
115-E3-SO	Shallow	12.57	NA	NA	5.90	6.15	5.82	6.20
115-E4-DO	Intermediate	17.87	NA	NA	3.14	3.72	3.60	3.86
115-E5-DO	Intermediate	15.72	NA	NA	2.14	2.70	2.62	2.88
115-E5-SO	Shallow	NA	NA	NA	NA	NA	NA	NA
115-E6-DI	Intermediate	19.89	48.35	NA	1.88	2.76	2.76	3.07
115-E6-DO	Intermediate	19.74	51.1	NA	2.08	2.67	2.79	3.11
115-MW-20	Intermediate	14.19	NA	NA	2.02	2.68	2.80	3.05
115-MW-203BR	Rock	8.7	162	20	-1.21	-2.16	-1.89	NA
115-MW-211BR	Rock	17.41	NA	NA	3.37	3.72	3.55	4.06
115-MW-215BR	Rock	8.82	143	20	-4.20	-3.81	-4.06	-4.43
115-MW-216BR	Rock	18.02	131	20	3.49	3.81	3.63	4.14
115-MW-A12T	Deep	15.55	NA	NA	0.18	-2.75	0.36	0.43
115-MW-E14D	Intermediate	18.05	35	10	1.83	2.41	2.36	2.65
115-MW-E14T	Deep	21.33	71	15	2.01	2.81	2.85	3.11
115-OMW-E08TR	Deep	16.82	NA	NA	2.58	3.11	3.03	3.38
115-PW-21	Deep	15.13	71	10	2.25	2.79	2.50	2.74
115-W1-DO	Intermediate	12.63	NA	NA	1.37	1.99	1.71	2.16
115-W1-SO	Shallow	12.59	NA	NA	6.54	7.34	7.34	7.41
115-W3-SO	Shallow	NA	13.93	NA	NA	NA	NA	NA
115-W4-DO	Intermediate	8.79	41.22	NA	1.44	2.96	2.54	2.55
115-W5-SO	Shallow	12.43	NA	NA	6.72	7.62	7.08	7.80
117-MW-3BR-1	Rock	12.34	155	15	9.14	6.36	5.14	7.54
117-MW-3BR-2	Rock	12.34	263	15	7.26	5.50	5.89	6.44
117-MW-8BR	Rock	12.94	125	10	5.25	5.60	5.20	5.48
117-MW-A05	Shallow	18.48	16	NA	6.84	7.37	6.43	6.49
117-MW-A14	Shallow	17.33	17	NA	5.11	5.24	4.93	5.31
117-MW-A62	Shallow	18.32	15	NA	6.26	6.07	5.90	5.87

Table 4-1
Groundwater Elevation Data from Quarterly Rounds in 2012

Well ID	Screen Zone	Ref. Pt. Elev.	Well Depth	Screen Length	Groundwater Elevation (NGVD-29)			
					Mar-12	Jun-12	Sep-12	Dec-12
		(ft msl)	(ft)	(ft)	(ft msl)	(ft msl)	(ft msl)	(ft msl)
117-MW-A85	Shallow	17.4	15	NA	5.37	5.47	5.27	6.19
117-MW-A89	Shallow	13.17	16	NA	4.25	4.63	4.42	4.87
117-MW-A99	Shallow	15.95	14	NA	5.83	5.85	5.68	5.93
117-MW-D1	Deep	11.08	41	10	3.16	3.51	3.40	3.60
117-MW-D2	Deep	17.62	48	10	4.97	4.74	4.65	4.91
117-MW-D3	Deep	18.85	80	10	6.00	6.34	6.01	6.21
117-MW-I1	Intermediate	11.08	22	10	3.78	4.18	4.26	4.77
117-MW-I2	Intermediate	17.59	28	10	5.85	5.20	5.11	5.45
117-MW-I3	Intermediate	15.59	28	10	5.04	5.33	5.09	5.36
117-MW-I4	Deep	15.49	75	10	NA	5.78	6.07	6.20
117-MW-I4S	Shallow	15.49	NA	NA	NA	5.98	5.88	5.99
117-MW-I5	Intermediate	18.76	37	15	6.69	6.66	6.39	6.38
119-MW-01T	Deep	10.78	62	10	2.68	3.11	3.03	3.28
119-MW-02T	Deep	8.8	70	10	3.22	3.44	3.42	3.64
119-MW-11BR	Rock	10.75	159	20	3.29	3.77	3.49	6.15
119-MW-12BR	Rock	11.26	154	20	4.87	5.20	4.84	4.48
119-MW-16BR-1	Rock	8.61	151	15	4.72	4.79	5.89	7.97
119-MW-16BR-2	Rock	8.61	187	15	4.09	4.21	3.91	4.29
119-MW-16BR-3	Rock	8.61	247	15	4.01	4.19	3.07	4.41
119-MW-2BR-1	Rock	8.43	163	15	-1.51	-1.60	NA	-2.02
119-MW-2BR-2	Rock	8.43	245	15	-1.26	-0.83	-0.84	-1.54
119-MW-2BR-3	Rock	8.43	315	15	-0.46	-0.16	-0.49	-1.02
119-MW-4BR-1	Rock	8.77	179	15	3.47	3.89	3.79	3.61
119-MW-4BR-2	Rock	8.77	229	15	3.39	3.83	3.38	3.59
119-MW-4BR-3	Rock	8.77	314	15	3.63	4.02	3.57	3.74
124-MW-02	Shallow	9	9.34	NA	5.56	6.78	5.34	5.95
124-MW-06	Deep	9.39	70	10	2.88	3.31	3.17	3.49
124-MW-07	Shallow	NA	NA	NA	NA	NA	NA	NA
124-MW-09	Shallow	NA	NA	NA	NA	NA	NA	NA
124-MW-10	Shallow	10.06	11	8	4.61	4.91	4.57	4.84
124-MW-102D	Intermediate	9.38	30	10	2.40	2.92	2.74	3.10
124-MW-102T	Deep	9.33	75	10	3.13	3.50	3.48	3.75
124-MW-103D	Intermediate	9.58	29	10	2.60	3.02	2.95	3.28
124-MW-103L	Deep	9.77	110	10	2.76	3.19	3.05	3.26
124-MW-104D	Intermediate	9.08	26	10	2.54	3.01	2.79	3.19
124-MW-104L	Deep	9.22	43	10	3.02	3.41	3.21	3.57
124-MW-104T	Deep	9.31	67	10	3.24	3.53	3.40	3.77
124-MW-105D	Intermediate	9.63	24	10	2.83	3.34	3.12	3.50
124-MW-105T	Deep	9.33	62	10	2.72	2.91	3.07	3.23
124-MW-106T	Deep	9.28	78	10	2.62	3.10	3.07	3.14
124-MW-107T	Deep	9.08	70	10	2.54	2.94	2.95	2.90

Table 4-1
Groundwater Elevation Data from Quarterly Rounds in 2012

Well ID	Screen Zone	Ref. Pt. Elev.	Well Depth	Screen Length	Groundwater Elevation (NGVD-29)			
					Mar-12	Jun-12	Sep-12	Dec-12
		(ft msl)	(ft)	(ft)	(ft msl)	(ft msl)	(ft msl)	(ft msl)
124-MW-11	Shallow	9.05	8	6	3.84	4.01	3.44	4.59
124-MW-17BR-1	Rock	9.56	153	15	3.44	3.75	3.37	3.49
124-MW-17BR-2	Rock	9.56	337	15	3.35	3.51	3.23	3.51
124-MW-8BR	Rock	9.71	NA	NA	3.40	3.74	2.43	3.13
124-MW-G02D	Intermediate	9.59	28	10	2.55	2.96	2.89	3.25
124-MW-G02T	Deep	9.5	69	10	3.26	3.26	3.05	3.79
125-MW-01	Shallow	8.71	NA	NA	5.50	6.40	5.82	6.50
125-PZ-001	Shallow	9.5	13	5	6.61	7.56	6.98	7.83
125-PZ-002	Intermediate	9.31	26	5	2.24	3.40	2.88	3.06
125-PZ-003	Shallow	8.89	8.5	5	5.03	5.67	4.71	5.59
125-PZ-004	Intermediate	8.93	25	5	2.44	2.70	2.98	3.12
134-MW-2	Shallow	7.36	10	9	4.76	NA	NA	NA
134-MW-Q08	Shallow	8.37	13	10	5.66	6.54	5.62	6.59
134-MW-V09	Shallow	7.98	13	10	4.85	5.62	5.19	5.75
134-PZ-001	Shallow	7.47	16	5	4.08	5.00	4.28	5.12
134-PZ-002	Intermediate	7.81	26.5	5	1.27	2.66	1.89	2.22
134-PZ-003	Shallow	8.34	13	5	6.13	7.00	6.25	7.40
134-PZ-004	Intermediate	8.22	26.5	5	1.59	2.71	2.08	2.63
140-MW-04	Shallow	7.18	NA	NA	4.59	5.37	4.62	5.22
140-MW-06	Shallow	8.33	6	NA	6.05	6.97	6.38	7.02
140-MW-07	Shallow	7.7	6	NA	4.75	5.45	4.82	5.42
140-MW-08	Shallow	8.13	10	8	5.01	5.68	4.98	5.49
140-MW-1R	Shallow	7.61	11	NA	4.71	5.45	4.76	5.24
140-MW-9BR-1	Rock	7.32	153	15	1.34	1.06	0.94	1.62
140-MW-9BR-2	Rock	7.32	222	15	2.59	2.70	2.50	2.96
140-MW-9BR-3	Rock	7.32	272	15	2.77	2.67	2.49	3.10
140-MW-P05D	Intermediate	7.44	30	10	2.07	2.54	2.69	2.94
140-PZ-001	Shallow	8.29	11.5	5	5.35	2.50	5.58	6.24
140-PZ-002	Intermediate	8.08	25	5	1.69	2.39	2.28	2.55
153-MW-A13	Shallow	9.62	10	6	3.52	4.01	3.71	4.23
153-MW-A13T	Deep	9.34	58	15	3.17	3.46	3.61	3.83
153-MW-A15	Shallow	11	12.15	10	2.68	3.16	2.99	3.26
154-MW-A01	Shallow	18.06	14.61	NA	11.11	11.45	10.67	11.14
154-MW-A06	Shallow	19.87	15.12	NA	12.09	13.06	11.25	13.36
154-MW-A5A	Shallow	19.16	14	NA	11.30	11.64	10.80	11.18
154-MW-B6A	Shallow	20.71	13.68	NA	11.99	12.63	11.64	12.22
154-MW-C6A	Shallow	20.37	13.41	NA	12.04	12.47	11.51	12.12
154-MW-D01	Shallow	18.78	14.28	NA	12.17	12.60	11.41	11.90
154-MW-E08	Shallow	22	14.4	NA	12.95	13.59	12.24	13.12
163-MW-1	Shallow	NA	NA	NA	NA	NA	NA	NA
163-MW-R05	Shallow	7.22	NA	NA	4.75	5.15	4.60	5.19

Table 4-1
Groundwater Elevation Data from Quarterly Rounds in 2012

Well ID	Screen Zone	Ref. Pt. Elev.	Well Depth	Screen Length	Groundwater Elevation (NGVD-29)			
					Mar-12	Jun-12	Sep-12	Dec-12
		(ft msl)	(ft)	(ft)	(ft msl)	(ft msl)	(ft msl)	(ft msl)
184-MW-001	Shallow	12.09	12	10	7.51	8.00	7.64	7.83
184-MW-04	Shallow	8.74	NA	NA	3.80	4.20	3.80	4.24
184-MW-05	Shallow	10.1	NA	NA	6.14	6.89	6.57	6.88
184-MW-06	Shallow	12.5	NA	NA	8.69	9.20	8.77	9.03
184-MW-C10	Shallow	15.2	16	10	10.15	10.83	9.68	9.96
KP-MW-6BR-1	Rock	8.94	153	14	7.06	-1.16	0.99	4.98
KP-MW-6BR-2	Rock	8.94	231	15	0.86	-1.57	-0.96	-0.57
KP-MW-6BR-3	Rock	8.94	339	15	0.96	-27.21	-10.11	-5.73
SA6-MW-14BR	Rock	9.99	85	10	3.01	3.32	3.21	3.77
SA6-MW-15BR	Rock	8.08	103	20	0.94	1.44	1.50	1.78
SA6-MW-5BR-1	Rock	17.06	106	15	2.23	2.37	3.32	2.69
SA6-MW-5BR-2	Rock	17.06	154	15	2.42	2.69	2.67	3.25
SA6-MW-5BR-3	Rock	17.06	204	13	3.15	3.17	3.07	3.75
SA6-MW-5BR-4	Rock	17.06	236	15	3.00	3.35	3.19	3.63
SA6-MW-5BR-5	Rock	17.06	281	15	3.38	3.45	3.37	3.83
SA6-MW-AA1	Shallow	17.8	15	10	3.72	4.04	3.32	3.91
SA6-MW-AA1D	Intermediate	19.36	32	10	0.79	1.47	1.16	1.62
SA6-MW-AA1T	Deep	15.31	70	10	0.67	1.30	1.08	1.50
Sump A	Shallow	9.04	NA	NA	5.94	6.73	6.37	7.23
Sump B	Shallow	13.04	NA	NA	7.58	7.81	7.57	7.49

Table 4-2
Summary of Groundwater Elevations Near NJCU

		March 21, 2012		June 12, 2012		September 25, 2012		December 18, 2012	
Location	Ref. pt.* Elev. (ft, msl)	Depth to GW (ft,)	GW Elev. (ft., msl)	Depth to GW (ft,)	GW Elev. (ft., msl)	Depth to GW (ft,)	GW Elev. (ft., msl)	Depth to GW (ft,)	GW Elev. (ft., msl)
079-MW-01	8.80	4.94	3.86	4.67	4.13	4.98	3.82	4.44	4.36
079-MW-A02	8.10	4.38	3.72	4.07	4.03	4.4	3.7	4.07	4.03
079-MW-C06	11.00	5.59	5.41	5.17	5.83	5.61	5.39	5.23	5.77
Sump A (North)	9.04	3.1	5.94	2.31	6.73	2.67	6.37	1.81	7.23
Sump B (South)	13.04	5.46	7.58	5.23	7.81	5.47	7.57	5.55	7.49
090-PZ-5	17.24	8.94	8.3	8.37	8.87	8.89	8.35	8.98	8.26
090-PZ-6	17.64	7.56	10.08	6.35	11.29	7.51	10.13	7.54	10.1
090-MW-07	14.04	7.71	6.33	7.89	6.15	7.82	6.22	7.74	6.3
090-MW-09	10.72	5.45	5.27	5.19	5.53	5.31	5.41	5.49	5.23
090-MW-F14	20.50	8.73	11.77	8.41	12.09	9.23	11.27	9.17	11.33
184-MW-4	8.74	4.94	3.8	4.54	4.2	4.94	3.8	4.5	4.24
184-MW-5	10.14	3.96	6.18	3.21	6.93	3.53	6.61	3.22	6.92
184-MW-6	12.51	3.81	8.7	3.3	9.21	3.73	8.78	3.47	9.04
184-MW-C10	15.20	5.05	10.15	4.37	10.83	5.52	9.68	5.24	9.96

* NGVD29 site datum

Table 4-3
Annual Average Groundwater Elevations Near Perimeter Pools

Pool ID	Pool Elevation (ft., msl)	Monitoring Well ID	Annual Average Groundwater Elevation (ft., msl)
N-1	10.0	115-E4-SO	6.00
		115-E5-SO	6.38
N-2	8.0	087-MW-001	6.48
N-3	7.5	115-W1-SO	7.21
		087-MW-O19	6.60
N-4	6.5	087-MW-Y20	3.45
		115-W6-SO	5.60
E-1	9.0	115-E3-SO	6.12
E-2	8.0	115-E2-SO	5.58
S-1	8.0	115-E1A-SO	5.90
S-2	7.5	115-E1A-SO	5.90
		140-MW-06	6.57
		140-MW-07	5.16
S-3	7.0	115-W5-SO	6.95
		134-MW-V09	5.25
		134-MW-Q08	6.10
S-4	6.0	115-W3-SO	4.71
		073-MW-B11	3.46
		073-MW-Y10	3.81

Bold: Outside Head Exceeds Pool Elevation

Table 5-1
Summary of Groundwater Quality Data from GWET Wells

Parameter	16-Jan-12			15-Feb-12			22-Mar-12		
	PW-1 (ug/L)	**PW-2** (ug/L)	**115-MW-203BR** (ug/L)	**PW-1** (ug/L)	**PW-2** (ug/L)	**115-MW-203BR** (ug/L)	**PW-1** (ug/L)	**PW-2** (ug/L)	**115-MW-203BR** (ug/L)
Benzene	3.9	7.4	ND	4.1	6.6	ND	5.8	5.7	ND
Carbon Tetrachloride	5.5	5.4	2.2	7.4	4.6	1.9	11.6	4.6	1.7
Chloroform	36.2	88.2	ND	36.2	64.2	0.16J	54.0	59.9	ND
1,1-Dichloroethene	0.90J	ND	ND	1.2J	ND	ND	1.7	ND	ND
cis-1,2-Dichloroethene	230	25.8	ND	244	24.0	ND	266	21.4	ND
trans-1,2-Dichloroethene	7.1	0.45J	ND	8.2	0.51J	ND	10.6	0.35J	ND
Toluene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	139	93.3	ND	155	82.4	ND	164	74.0	ND
1,1-Dichloroethane	0.56J	ND	ND	0.55J	ND	ND	0.84J	ND	ND
Methylene chloride	1.2	2.0	ND	ND	1.4	ND	1.6	1.3	ND
Vinyl chloride	9.3	7.7	ND	13.7	8.6	ND	15.9	6.0	ND
1,2-Dichlorobenzene	0.89J	ND	ND	0.89J	ND	ND	1.2	ND	ND
Chlorobenzene	0.51J	ND	ND	ND	ND	ND	0.70J	ND	ND
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Xylenes (total)	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexavalent Chromium	42,600	17,000	16,800	40,700	14,600	14,900	40,900	15,300	16,200
Total Chromium	45,500	17,500	18,000	42,900	15,900	16,600	42,200	19,000	16,500

ND = Not detected above reporting limit.

J = estimated value.

Table 5-1 (continued)
Summary of Groundwater Quality Data from GWET Wells

Parameter	12-Jun-12			3-Oct-12			4-Dec-12		
	PW-1 (ug/L)	**PW-2** (ug/L)	**115-MW-203BR** (ug/L)	**PW-1** (ug/L)	**PW-2** (ug/L)	**115-MW-203BR** (ug/L)	**PW-1** (ug/L)	**PW-2** (ug/L)	**115-MW-203BR** (ug/L)
Benzene	4.4	6.4	ND	4.6	5.8	ND	3.3	5.7	ND
Carbon Tetrachloride	7.2	4.9	2.1	6.3	3.6	1.8	4.9	4.1	1.9
Chloroform	38.2	52.7	ND	43.3	42.1	0.24	32.3	47.2	0.21J
1,1-Dichloroethene	1.0	ND	ND	1.1	ND	ND	0.60J	ND	ND
cis-1,2-Dichloroethene	218	21.7	ND	223	20.7	ND	156	16.7	ND
trans-1,2-Dichloroethene	7.2	0.59	ND	7.6	0.66	ND	4.7	0.38J	ND
Toluene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	114	74.0	ND	148	62.4	ND	105	65.5	ND
1,1-Dichloroethane	0.6	ND	ND	0.69	ND	ND	0.46J	ND	ND
Methylene chloride	1.1	0.8	ND	1.4	0.84	ND	0.97J	1.8	ND
Vinyl chloride	12.4	9.3	ND	11.7	7.0	ND	8.7	6.3	ND
1,2-Dichlorobenzene	0.8	ND	ND	0.94	ND	ND	0.79J	ND	ND
Chlorobenzene	0.5	ND	ND	0.54	ND	ND	0.39J	ND	ND
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Xylenes (total)	ND	ND	ND	ND	ND	ND	ND	0.22J	ND
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexavalent Chromium	42,200	12,600	15,500	39,900	12,400	15,700	45,100	15,600	18,300
Total Chromium	44,300	14,800	17,100	40,600	14,400	16,100	37,900	14,800	16,900

ND = Not detected above reporting limit.
J = estimated value.

Note:
Sampling frequency was changed from monthly to quarterly.

Table 5-2
Summary of Groundwater Quality in Intermediate Zone
TWA Permit Application Investigation - Study Area 6 South

Client Sample ID		124-MW-105D		140-MW-P05D	
Filtered/unfiltered		unfiltered	filtered	unfiltered	filtered
Lab Sample ID	NJDEP	JB14757-1	JB14757-1F	JB14815-2	JB14815-2F
Sample Collection Date	GWQC	8/27/2012	8/27/2012	8/28/2012	8/28/2012
Metals Analysis (ug/l)					
Aluminum	200	**19,500**	ND	**786**	ND
Antimony	6	ND	ND	ND	ND
Arsenic	3	ND	ND	**11.0**	ND
Barium	6000	ND	ND	720	644
Beryllium	1	ND	ND	ND	ND
Cadmium	4	ND	ND	ND	ND
Calcium	-	69,100	70,500	91,500	98,400
Chromium	70	61.8	ND	22.0	10.0
Cobalt	-	ND	ND	ND	ND
Copper	1300	38.6	ND	ND	ND
Iron	300	**28,800**	ND	**14,300**	226
Lead	5	**27.4**	ND	4.2	ND
Magnesium	-	12,600	7,230	78300	85,700
Manganese	50	**482**	**290**	**1,100**	**1,160**
Mercury	2	ND	ND	ND	ND
Molybdenum	40	ND	ND	ND	ND
Nickel	100	24.6	ND	ND	ND
Potassium	-	ND	ND	38,800	42,300
Selenium	40	ND	ND	ND	ND
Silver	40	ND	ND	ND	ND
Sodium	50000	**102,000**	**107,000**	**884,000**	**971,000**
Thallium	2	ND	ND	ND	ND
Vanadium	-	ND	ND	ND	ND
Zinc	2000	418	ND	51.1	ND
General Chemistry					
pH	6.5-8.5	6.28	NA	7.86	NA
HEM Petroleum Hydrocarbons (mg/l)	-	ND	NA	ND	NA
Phosphorus, Total (mg/l)	-	0.56	NA	0.098	NA
Phenols (mg/l)	-	ND	NA	ND	NA
Solids, Total Dissolved (mg/l)	500	**523**	NA	**3,630**	NA
Solids, Total Suspended (mg/l)	-	975	NA	58.0	NA
Nitrogen, Ammonia (mg/l)	3	1.8	NA	2.8	NA
BOD, 5 Day (mg/l)	-	15.9	NA	20.7	NA
Chromium, Hexavalent (mg/l)	-	ND	ND	ND	ND
Chloride (mg/l)	250	112	NA	**1,830**	NA
Color, Apparent (CU)	10	**75**	NA	**250**	NA

Table 5-3
Summary of Groundwater Quality in Shallow Zone
TWA Permit Application Investigation - Study Area 6 South

Client Sample ID		073-MW-3		124-MW-02		124-MW-07		124-MW-09		125-MW-01	
Filtered/unfiltered		unfiltered	filtered	unfiltered	filtered	unfiltered	filtered	unfiltered	filtered	unfiltered	filtered
Lab Sample ID	NJDEP	JB15082-1	JB15082-1F	JB15007-1	JB15007-1F	JB15081-1	JB15081-1F	JB15085-1	JB15085-1F	JB14925-1	JB14925-1F
Sample Collection Date	GWQC	8/30/2012	8/30/2012	8/29/2012	8/29/2012	8/30/2012	8/30/2012	8/30/2012	8/30/2012	8/29/2012	8/29/2012
Metals Analysis (ug/l)											
Aluminum	200	**4,170**	**672**	**19,000**	**15,200**	**348**	ND	**2,890**	**296**	**290**	**252**
Antimony	6	ND	ND	**431**	**405**	ND	ND	ND	ND	ND	ND
Arsenic	3	**7.3**	**7.1**	**354**	ND	**7.8**	**5.1**	**11.7**	**4.1**	**3.5**	**3.7**
Barium	6000	323	ND	ND	ND	395	ND	ND	ND	ND	ND
Beryllium	1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Calcium	-	21,900	15,800	70600	40,900	352,000	150,000	81,100	76,100	8,380	7,480
Chromium	70	**443**	**334**	**87,800**	**82,800**	**3,140**	**1,490**	45.9	32.3	**184**	**150**
Cobalt	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Copper	1300	ND	ND	108	107	12.6	ND	ND	ND	ND	ND
Iron	300	**7,350**	**1,130**	**12,300**	**8,100**	182	135	**9,170**	**6,530**	181	ND
Lead	5	**8.1**	ND	**146**	**133**	**18.4**	ND	**7.6**	ND	ND	ND
Magnesium	-	7,270	5,170	ND	ND	5,140	ND	10,300	9,190	ND	ND
Manganese	50	**496**	**121**	**445**	**350**	ND	ND	**1,570**	**1,430**	22.9	19.6
Mercury	2	ND (0.40) [a]	ND (0.40) [a]	ND	ND	ND	ND	ND	ND	ND	ND
Molybdenum	40	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nickel	100	16.9	10	**1,110**	**1,010**	ND	ND	ND	ND	11.3	10.3
Potassium	-	12,500	12,000	55300	51500	ND	ND	14,300	13,300	31,000	29,800
Selenium	40	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver	40	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	50000			**2,040,000**	**1,940,000**	32,000	26,000	**120,000**	**124,000**	**774,000**	**729,000**
Thallium	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	-	93.9	79.7	2,020	1,920	ND	ND	ND	ND	ND	ND
Zinc	2000	31.3	ND	324	235	ND	ND	1,370	170	ND	ND
General Chemistry											
pH	6.5-8.5	**9.16** [b]	-	**10.72**	NA	**10.09**	NA	**6.36** [a]	-	8.29	NA
HEM Petroleum Hydrocarbons (mg/l)	-	ND	-	ND	NA	ND	NA	ND	-	ND	NA
Phosphorus, Total (mg/l)	-	1.3	-	4.2	NA	ND	NA	0.2	-	0.40	NA
Phenols (mg/l)	-	ND	-	0.54	NA	ND	NA	ND	-	ND	NA
Solids, Total Dissolved (mg/l)	500	**1,250**	-	**12,300**	NA	20.0	NA	487	-	**1,320**	NA
Solids, Total Suspended (mg/l)	-	228	-	390	NA	873	NA	366	-	27.0	NA
Nitrogen, Ammonia (mg/l)	3	2.6	-	**108**	NA	2.0	NA	2.4	-	**17.5**	NA
BOD, 5 Day (mg/l)	-	58.1	-	169	NA	ND	NA	33.3	-	26.5	NA
Chromium, Hexavalent (mg/l)	-	ND	ND	0.080	0.12	1.7	0.77	ND	ND	ND	ND
Chloride (mg/l)	250	**452**	-	**1,440**	NA	21.7	NA	154	-	**379**	NA
Color, Apparent (CU)	10	**500**	-	**40,000**	NA	**100**	NA	**60**	-	**50**	NA

Table 5-3
Summary of Groundwater Quality in Shallow Zone
TWA Permit Application Investigation - Study Area 6 South

Client Sample ID		134-MW-01		134-MW-V09		140-MW-01		140-MW-08	
Filtered/unfiltered		unfiltered	filtered	unfiltered	filtered	unfiltered	filtered	unfiltered	filtered
Lab Sample ID	NJDEP	JB14926-1	JB14926-1F	JB14926-2	JB14926-2F	JB14904-1	JB14904-1F	JB14815-1	JB14815-1F
Sample Collection Date	GWQC	8/29/2012	8/29/2012	8/29/2012	8/29/2012	8/28/2012	8/28/2012	8/28/2012	8/28/2012
Metals Analysis (ug/l)									
Aluminum	200	**6,360**	**2,610**	**1,910**	ND	**1,900**	**1,850**	ND	ND
Antimony	6	**18.6**	**14.0**	ND	ND	ND	ND	ND	ND
Arsenic	3	**15.2**	**10.2**	**8.4**	**3.3**	**75.2**	**80.3**	ND	ND
Barium	6000	ND	ND	218	ND	ND	ND	1,920	1,720
Beryllium	1	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	4	ND	ND	ND	ND	ND	ND	ND	ND
Calcium	-	212,000	191,000	91,600	100,000	16,800	16,100	32,200	30,100
Chromium	70	**3,430**	**2,570**	**197**	26.6	**521**	**501**	ND	ND
Cobalt	-	ND	ND	ND	ND	ND	ND	ND	ND
Copper	1300	24.7	ND	102	ND	19.9	21.5	ND	ND
Iron	300	**3,360**	ND	**23,800**	296	294	253	**422**	140
Lead	5	**43.9**	ND	**23.8**	ND	**44.7**	**39.9**	ND	ND
Magnesium	-	ND	ND	12,000	13,100	ND	ND	ND	ND
Manganese	50	**57.3**	ND	**3,410**	**3,450**	ND	ND	**118**	**104**
Mercury	2	ND	ND	ND	ND	ND	ND	ND	ND
Molybdenum	40	ND	ND	NA	NA	**185**	**227**	**943**	**895**
Nickel	100	19.3	12.7	17.4	ND	22.1	21.0	17.6	13.3
Potassium	-	10,500	11,300	10,600	11,900	17,200	17,200	13,300	12,000
Selenium	40	ND	ND	ND	ND	ND	ND	ND	ND
Silver	40	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	50000	**159,000**	**189,000**	**78,900**	**92,800**	**188,000**	**187,000**	**234,000**	**219,000**
Thallium	2	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	-	ND	ND	ND	ND	53.5	52.7	ND	ND
Zinc	2000	180	ND	298	20.6	31.3	29.3	ND	ND
General Chemistry									
pH	6.5-8.5	**>10**	NA	NA	NA	**11.41**	NA	7.84	NA
HEM Petroleum Hydrocarbons (mg/l)	-	ND	NA	NA	NA	ND	NA	ND	NA
Phosphorus, Total (mg/l)	-	ND	NA	NA	NA	0.18	NA	0.16	NA
Phenols (mg/l)	-	ND	NA	NA	NA	ND	NA	ND	NA
Solids, Total Dissolved (mg/l)	500	**555**	NA	NA	NA	**615**	NA	**692**	NA
Solids, Total Suspended (mg/l)	-	375	NA	NA	NA	ND	NA	ND	NA
Nitrogen, Ammonia (mg/l)	3	8.5	NA	NA	NA	**8.4**	NA	**3.1**	NA
BOD, 5 Day (mg/l)	-	ND	NA	NA	NA	14.9	NA	26.3	NA
Chromium, Hexavalent (mg/l)	-	2.4	2.4	ND	ND	ND	ND	ND	ND
Chloride (mg/l)	250	124	NA	27.4	NA	82.9	NA	**329**	NA
Color, Apparent (CU)	10	**80**	NA	NA	NA	**300**	NA	30	NA

Table 5-4
Summary of Groundwater Quality in Intermediate Zone
TWA Permit Application Investigation - Study Area 6 North

Client Sample ID		087-OBS-6D		088-MW-15	
Filtered/unfiltered		unfiltered	filtered	unfiltered	filtered
Lab Sample ID	NJDEP	JB14905-1	JB14905-1F	JB14766-1	JB14766-1F
Sample Collection Date	GWQC	8/28/2012	8/28/2012	8/27/2012	8/27/2012
Metals Analysis (ug/l)					
Aluminum	200	**17,400**	ND	**10,700**	**8,550**
Antimony	6	ND	ND	ND	ND
Arsenic	3	**17.8**	ND	ND	ND
Barium	6000	1,020	488	ND	ND
Beryllium	1	**1.3**	ND	ND	ND
Cadmium	4	ND	ND	ND	ND
Calcium	-	96,800	74,600	30,000	25,000
Chromium	70	**583**	ND	**697**	**622**
Cobalt	-	ND	ND	ND	ND
Copper	1300	141	ND	ND	ND
Iron	300	**36,200**	ND	**10,200**	**8070**
Lead	5	**695**	ND	**113**	**91.0**
Magnesium	-	74,500	66,200	ND	ND
Manganese	50	**709**	**274**	**199**	**170**
Mercury	2	**2.9**	ND	ND	ND
Molybdenum	40	ND	ND	ND	ND
Nickel	100	61.1	19.5	ND	ND
Potassium	-	69,400	73,600	ND	ND
Selenium	40	ND	ND	ND	ND
Silver	40	ND	ND	ND	ND
Sodium	50000	**568,000**	**630,000**	**853,000**	**739,000**
Thallium	2	ND	ND	ND	ND
Vanadium	-	ND	ND	497	447
Zinc	2000	707	ND	108	ND
General Chemistry					
pH	6.5-8.5	7.39	NA	7.53	NA
HEM Petroleum Hydrocarbons (mg/l)	-	ND	NA	ND	NA
Phosphorus, Total (mg/l)	-	1.1	NA	2.4	NA
Phenols (mg/l)	-	ND	NA	ND	NA
Solids, Total Dissolved (mg/l)	500	**2,090**	NA	**3,010**	NA
Solids, Total Suspended (mg/l)	-	408	NA	40.0	NA
Nitrogen, Ammonia (mg/l)	3	**41.6**	NA	**27.7**	NA
BOD, 5 Day (mg/l)	-	422	NA	ND	NA
Chromium, Hexavalent (mg/l)	-	ND	ND	ND	ND
Chloride (mg/l)	250	**1,050**	NA	**1,410**	NA
Color, Apparent (CU)	10	**50**	NA	**10,000**	NA

Table 5-5
Summary of Groundwater Quality in Shallow Zone
TWA Permit Application Investigation - Study Area 6 North

Client Sample ID		087-MW-01		087-MW-O23		087-MW-W25		087-MW-118	
Filtered/unfiltered		unfiltered	filtered	unfiltered	filtered	unfiltered	filtered	unfiltered	filtered
Lab Sample ID	NJDEP	JB14814-1	JB14814-1F	JB15009-1	JB15009-1F	JB15084-1	JB15084-1F	JB14927-1	JB14927-1F
Sample Collection Date	GWQC	8/28/2012	8/28/2012	8/29/2012	8/29/2012	8/30/2012	8/30/2012	8/29/2012	8/29/2012
Metals Analysis (ug/l)									
Aluminum	200	ND	ND	**1,700**	<200	ND	ND	ND	ND
Antimony	6	ND	ND	ND	<6.0	ND	ND	ND	ND
Arsenic	3	**28.5**	**27.0**	**11.5**	<3.0	ND	ND	ND	ND
Barium	6000	ND	ND	805	596	1,070	907	1,190	838
Beryllium	1	ND	ND	ND	<1.0	ND	ND	ND	ND
Cadmium	4	ND	ND	ND	<3.0	ND	ND	ND	ND
Calcium	-	33,200	33,200	37,100	41,700	135,000	136,000	169,000	154,000
Chromium	70	**2,790**	**2,720**	**93.9**	<10	ND	ND	ND	ND
Cobalt	-	ND	ND	ND	<50	ND	ND	ND	ND
Copper	1300	ND	ND	141	<10	10.5	ND	ND	ND
Iron	300	**1960**	**1,630**	**30,300**	**437**	**7,140**	**435**	**25,400**	**1,180**
Lead	5	**29.0**	**28.5**	**117**	<3.0	3.0	ND	**5.4**	ND
Magnesium	-	ND	ND	ND	5,510	43,800	44,200	41,000	37,600
Manganese	50	ND	ND	**269**	**226**	**703**	**702**	**270**	**254**
Mercury	2	ND	ND	1.5	<0.20	ND	ND	ND	ND
Molybdenum	40	ND	ND	ND	<20	ND	ND	ND	ND
Nickel	100	**208**	**197**	38.1	<10	ND	ND	ND	ND
Potassium	-	ND	ND	ND	<10,000	38,100	38,900	39,500	36,800
Selenium	40	ND	ND	ND	<10	ND	ND	ND	ND
Silver	40	ND	ND	ND	<10	ND	ND	ND	ND
Sodium	50000	**316,000**	**328,000**	**160,000**	**187,000**	**174,000**	**175,000**	**349,000**	**325,000**
Thallium	2	ND	ND	ND	<2.0	ND	ND	ND	ND
Vanadium	-	407	388	ND	<50	ND	ND	ND	ND
Zinc	2000	186	175	551	<20	86.0	ND	23.2	ND
General Chemistry									
pH	6.5-8.5	6.79	NA	6.92	NA	7.25	NA	6.69	NA
HEM Petroleum Hydrocarbons (mg/l)	-	ND	NA	ND	NA	ND	NA	6.8	NA
Phosphorus, Total (mg/l)	-	0.48	NA	0.44	NA	0.55	NA	0.66	NA
Phenols (mg/l)	-	0.55	NA	ND	NA	ND	NA	ND	NA
Solids, Total Dissolved (mg/l)	500	**1,990**	NA	**580**	NA	**1,040**	NA	**1,510**	NA
Solids, Total Suspended (mg/l)	-	ND	NA	217	NA	84.0	NA	79.0	NA
Nitrogen, Ammonia (mg/l)	3	**13.8**	NA	2.5	NA	**16.1**	NA	**30.9**	NA
BOD, 5 Day (mg/l)	-	304	NA	14.4	NA	53.4	NA	116	NA
Chromium, Hexavalent (mg/l)	-	ND	ND	<0.0055	<0.0055	ND	ND	ND	ND
Chloride (mg/l)	250	127	NA	188	NA	**390**	NA	**569**	NA
Color, Apparent (CU)	10	**10,000**	NA	**700**	NA	**125**	NA	**250**	NA

Table 5-5
Summary of Groundwater Quality in Shallow Zone
TWA Permit Application Investigation - Study Area 6 North

Client Sample ID		088-MW-01		088-MW-108		088-MW-111	
Filtered/unfiltered		unfiltered	filtered	unfiltered	filtered	unfiltered	filtered
Lab Sample ID	NJDEP	JB14813-1	JB14813-1F	JB14766-3	JB14766-3F	JB14766-2	JB14766-2F
Sample Collection Date	GWQC	8/28/2012	8/28/2012	8/27/2012	8/27/2012	8/27/2012	8/27/2012
Metals Analysis (ug/l)							
Aluminum	200	ND	ND	**293**	ND	ND	ND
Antimony	6	ND	ND	**49.9**	**58.9**	ND	ND
Arsenic	3	ND	ND	**7.2**	ND	**3.9**	ND
Barium	6000	237	244	ND	ND	1,720	1,220
Beryllium	1	ND	ND	ND	ND	ND	ND
Cadmium	4	ND	ND	ND	ND	ND	ND
Calcium	-	130,000	135,000	216,000	62,600	47,500	47,400
Chromium	70	ND	ND	**9,210**	**11,200**	11.1	ND
Cobalt	-	ND	ND	ND	ND	ND	ND
Copper	1300	ND	ND	ND	ND	ND	ND
Iron	300	**2,020**	**1,280**	208	ND	**9,430**	198
Lead	5	ND	ND	ND	ND	ND	ND
Magnesium	-	14,600	15,100	9,120	ND	10,100	10,100
Manganese	50	**117**	**123**	ND	ND	**97.8**	**84.4**
Mercury	2	<0.20	ND	ND	ND	ND	ND
Molybdenum	40	ND	ND	ND	ND	ND	ND
Nickel	100	ND	ND	30.8	27.8	ND	ND
Potassium	-	ND	ND	77,800	85,500	37,700	38,800
Selenium	40	ND	ND	ND	ND	ND	ND
Silver	40	ND	ND	ND	ND	ND	ND
Sodium	50000	36,900	38,300	**1,210,000**	**1,380,000**	**229,000**	**237,000**
Thallium	2	ND	ND	ND	ND	ND	ND
Vanadium	-	ND	ND	ND	ND	ND	ND
Zinc	2000	46.2	ND	ND	ND	ND	ND
General Chemistry							
pH	6.5-8.5	**10.00**	NA	**12.09**	NA	7.24	NA
HEM Petroleum Hydrocarbons (mg/l)	-	ND	NA	<5.0	NA	ND	NA
Phosphorus, Total (mg/l)	-	0.052	NA	0.11	NA	0.39	NA
Phenols (mg/l)	-	ND	NA	ND	NA	<0.20	NA
Solids, Total Dissolved (mg/l)	500	**555**	NA	**4,680**	NA	**787**	NA
Solids, Total Suspended (mg/l)	-	11.0	NA	783	NA	12.0	NA
Nitrogen, Ammonia (mg/l)	3	0.39	NA	**66.4**	NA	**14.1**	NA
BOD, 5 Day (mg/l)	-	ND	NA	36.9	NA	47.3	NA
Chromium, Hexavalent (mg/l)	-	ND	ND	16.3	16.6	ND	ND
Chloride (mg/l)	250	86.1	NA	**1,860**	NA	194	NA
Color, Apparent (CU)	10	**40**	NA	**750**	NA	**300**	NA

Table 5-6
Summary of Quarterly Groundwater Quality Monitoring
NJCU

	First Quarter 2012				Second Quarter 2012			
Sentinel Well 184-MW-04								
Field Sample ID	184-MW-04-030712		184-MW-04-030712F		184-MW-04-061812		184-MW-04-061812F	
Filtered/Unfiltered	Unfiltered		Filtered		Unfiltered		Filtered	
Sample Date	03/07/2012		03/07/2012		06/18/2012		06/18/2012	
Total Chromium (ppb)	4	U	4	U	154*		4	U
Hexavalent Chromium (ppb)	5.5	U	5.5	U	5.3	U	5.3	U
Sentinel Well 184-MW-05								
Field Sample ID	184-MW-05-030712		184-MW-05-030712F		184-MW-05-061812		184-MW-05-061812F	
Filtered/Unfiltered	Unfiltered		Filtered		Unfiltered		Filtered	
Sample Date	03/07/2012		03/07/2012		06/18/2012		06/18/2012	
Total Chromium (ppb)	14400*		5		171*		7.5	
Hexavalent Chromium (ppb)	5.5	U	5	U	5.3	U	5.3	U
Sentinel Well 184-MW-06								
Field Sample ID	184-MW-06-030712		184-MW-06-030712F		184-MW-06-061812		184-MW-06-061812F	
Filtered/Unfiltered	Unfiltered		Filtered		Unfiltered		Filtered	
Sample Date	03/07/2012		03/07/2012		06/18/2012		06/18/2012	
Total Chromium (ppb)	17.7		14.6		38.3		32.4	
Hexavalent Chromium (ppb)	8		9.7		13		6.2	

U = Not detected above reporting limit

Table 5-6
Summary of Quarterly Groundwater Quality Monitoring
NJCU

	Third Quarter 2012				Fourth Quarter 2012			
	Sentinel Well 184-MW-04							
Field Sample ID	184-MW-04-090612		184-MW-04-090612F		184-MW-04-120612		184-MW-04-120612F	
Filtered/Unfiltered	Unfiltered		Filtered		Unfiltered		Filtered	
Sample Date	09/06/2012		09/06/2012		12/06/2012		12/06/2012	
Total Chromium (ppb)	47		4	U	4	U	4	U
Hexavalent Chromium (ppb)	5.5	U	5.5	U	5.5	U	5.5	U
	Sentinel Well 184-MW-05							
Field Sample ID	184-MW-05-090612		184-MW-05-090612F		184-MW-05-120612		184-MW-05-120612F	
Filtered/Unfiltered	Unfiltered		Filtered		Unfiltered		Filtered	
Sample Date	09/06/2012		09/06/2012		12/06/2012		12/06/2012	
Total Chromium (ppb)	1320*		4	U	133*		16.8	
Hexavalent Chromium (ppb)	5.5	U	5.5	U	5.5	U	5.5	U
	Sentinel Well 184-MW-06							
Field Sample ID	184-MW-06-090612		184-MW-06-090612F		184-MW-06-120612		184-MW-06-120612F	
Filtered/Unfiltered	Unfiltered		Filtered		Unfiltered		Filtered	
Sample Date	09/06/2012		09/06/2012		12/06/2012		12/06/2012	
Total Chromium (ppb)	24.3		10.6		17.6		7.9	
Hexavalent Chromium (ppb)	5.5	U	5.5	U	5.5	U	5.5	U

U = Not detected above reportin

Table 6-1
Summary of S-3 Injection Events for 2012

Event #	2012 Injection Dates	Injection Well	Injection History	Volume Calmet Injected (gallons)	Volume Water Injected (gallons)	Average Injection Rate (gpm)	Pressurization Required
1	May 20-22	088-IW-01	First	4,291	9,135	9.0 to 10.9	0
2	July 1-3	088-IW-02	First	4,267	9,000	10.0	0
3	August 20-22	115-PW-21	First	4,350	9,440	12.0	0
4	October 1-3	115-DP-2	First	4,340	9,022	10-11.5	3-5 psi
5	December 9-11	088-IW-02	Second	4,230	9,006	11-12.5	0-2 psi

Table 6-2
Calculation of Percent Sulfide in CaSx Samples

Event	Date Sampled	Date Analyzed	Product Name	CaSx Manufacturer	Sulfide % T-1	Sulfide % T-2	Sulfide % T-3	Sulfide % Geometric Mean
1	5/20/2012	6/12/2012	Calmet	TKI	5.10	4.91	5.01	5.01
2	7/1/2012	7/6/2012	Calmet	TKI	5.31	5.12	5.44	5.29
3	8/20/2012	8/22/2012	Calmet	TKI	5.19	5.25	5.19	5.21
4	10/1/2012	10/3/2012	Calmet	TKI	5.48	5.41	5.45	5.45
5	12/9/2012	12/15/2012	Calcium Polysulfide	Graus	6.48	6.48	6.56	6.51

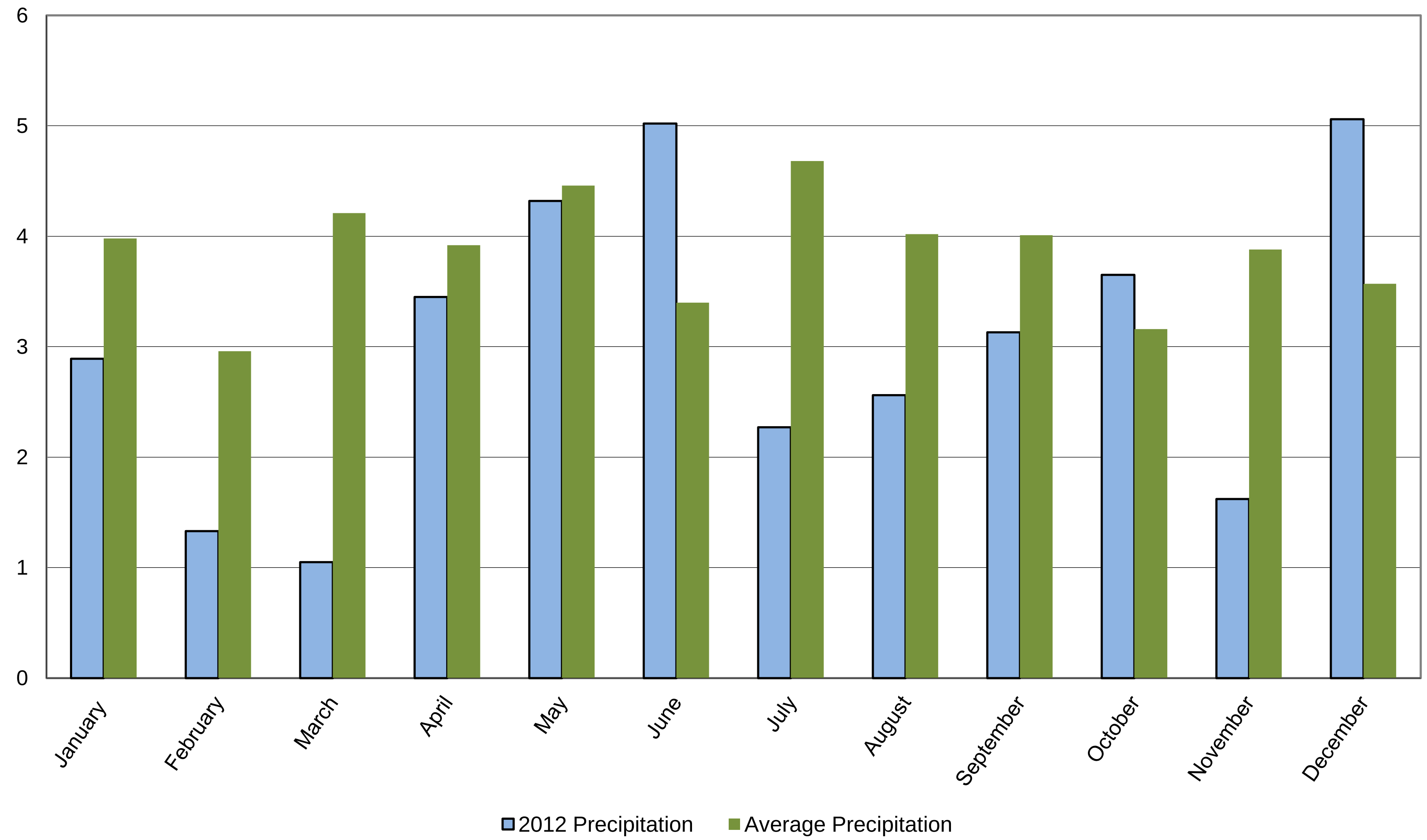
TKI = Tessenderlo Kerley, Inc.
Graus = Graus Chemicals
T- Triplicate #

Table 6-3
Cumulative Cr(VI) Mass Reduced
S-3 Injection/Mass Removal Program

Event #	Injection Date	Injection Well	Mass CaSx Delivered (tons)	Volume CaSx Injected[a] (gallons)	Geometric mean [b] Sulfide %	Mass Cr(VI) Reduced[c] (tons)	Cumulative Mass Cr(VI) Reduced (tons)
1	5/20/12	088-IW-01	22.53	4,291	5.01%	1.22	1.22
2	7/1/12	088-IW-02	22.40	4,267	5.29%	1.28	2.50
3	8/20/12	115-PW-21	22.84	4,350	5.21%	1.29	3.79
4	10/1/12	115-DP-2	22.79	4,340	5.45%	1.34	5.13
5	12/9/12	088-IW-02	22.42	4,230	6.51%	1.58	6.71

(a) Volume Injected = Mass CaSx Delivered / CaSx density
(b) see Table 6.2
(c) Mass Cr(VI) Reduced = Mass CaSx Delivered × Sulfide% × (51.996/32.065) / 1.5;
The factor 1.5 represents the molar ratio of S(−II) to Cr(VI) in the balanced redox reaction:
$1.5CaS_{4.2} + CrO_4^{2-} + 5H^+ = Cr(OH)_3(s) + 6.3S(s) + 1.5Ca^{2+} + H_2O$
51.996 and 32.065 are the atomic masses of Cr and S, respectively

FIGURES



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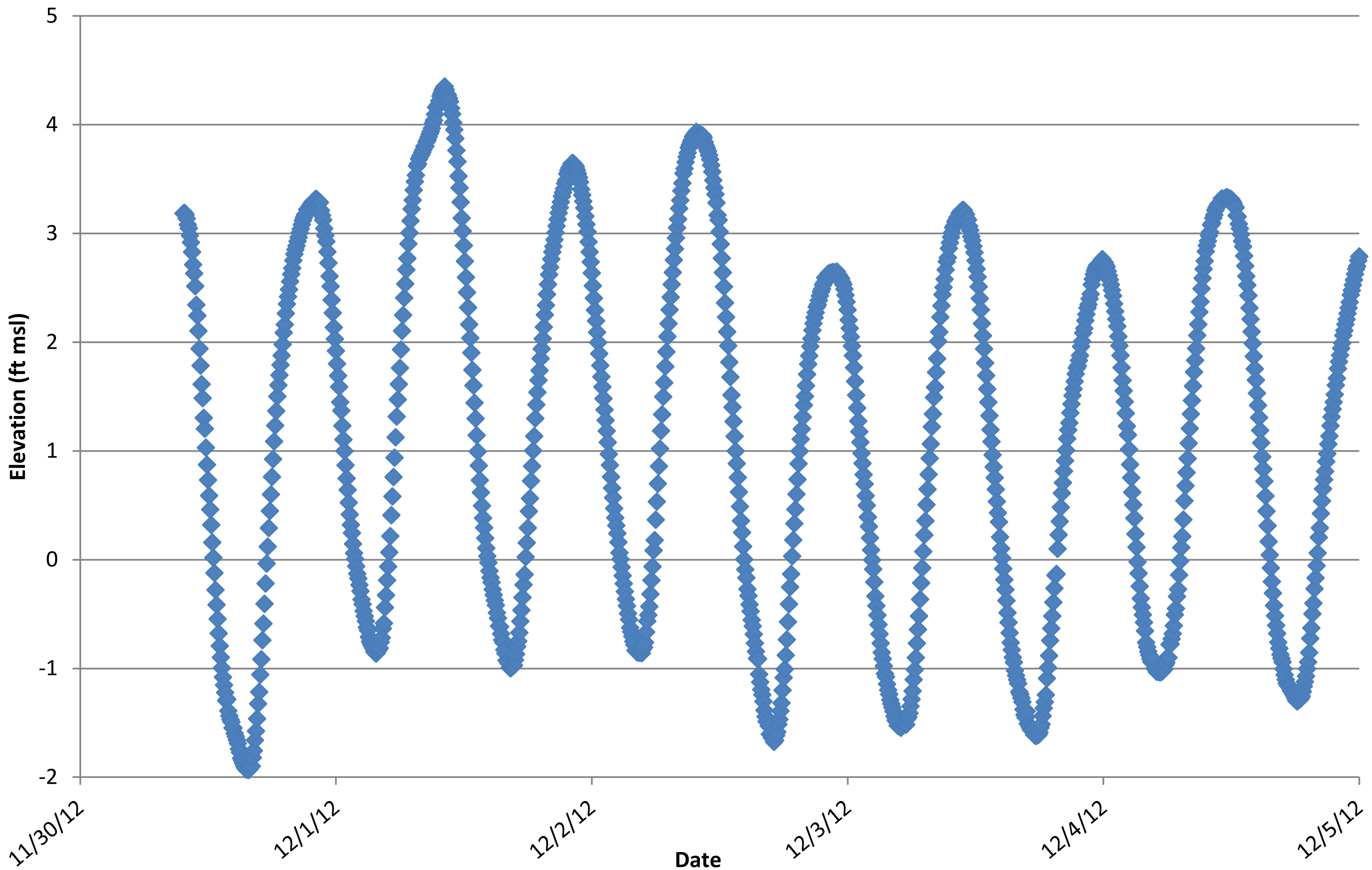
HONEYWELL
Jersey City, New Jersey
2012 Monthly Precipitation

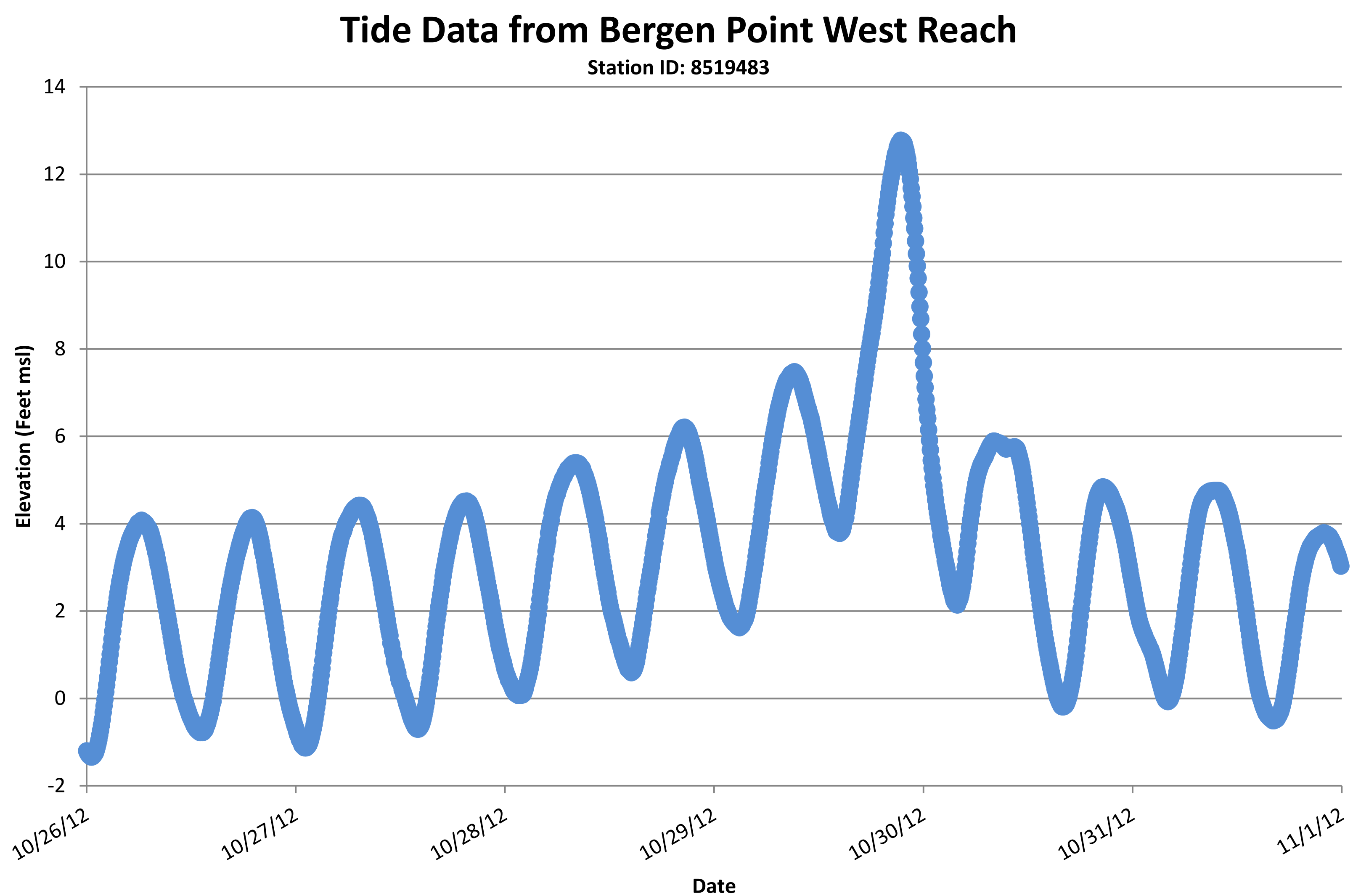
Figure 2-1



CORNERSTONE Engineering Group, LLC

HONEYWELL
Jersey City, New Jersey
Typical Hackensack River Tides
at SA-7 Bulkhead

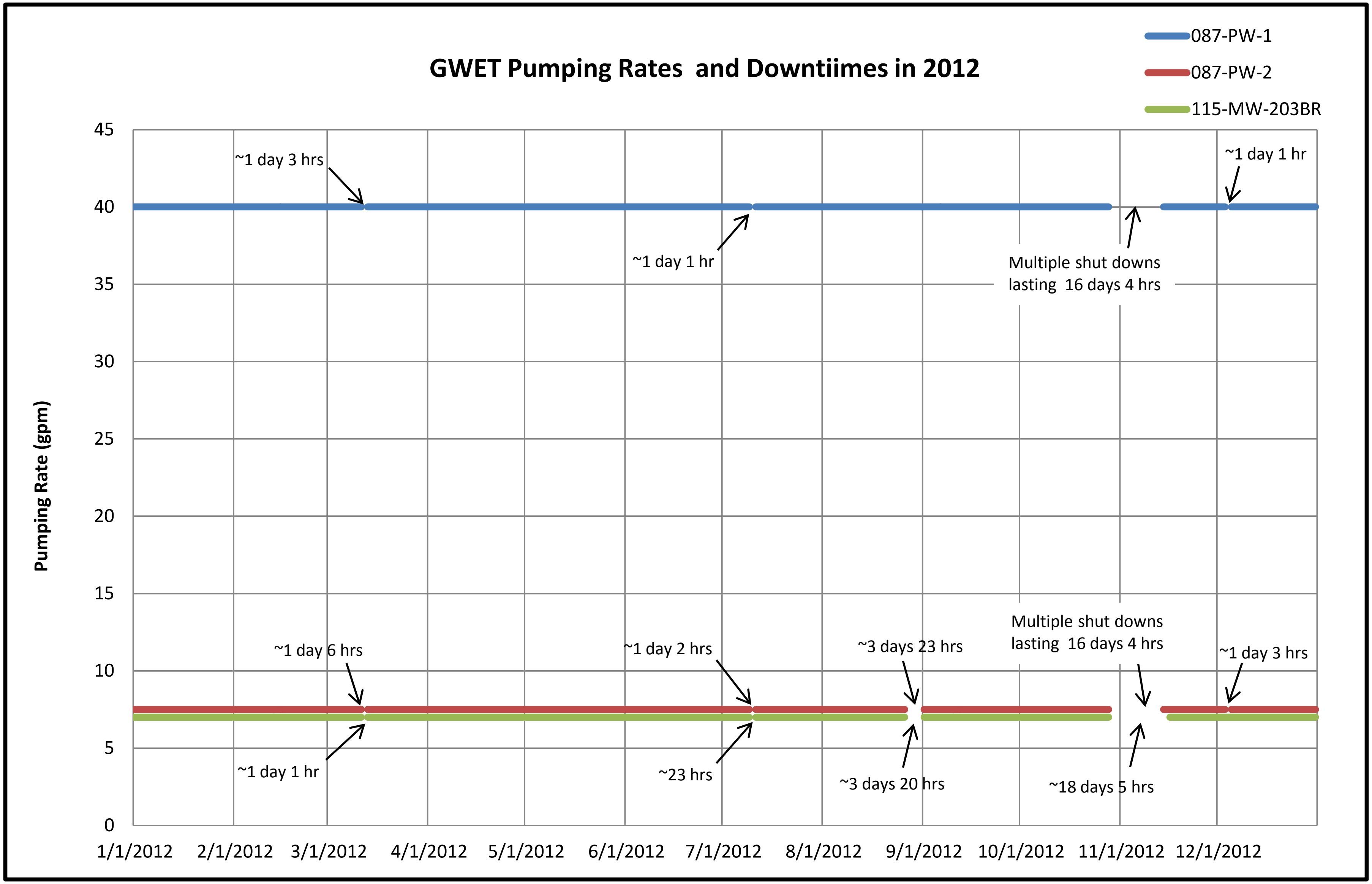
Figure
2-2



CORNERSTONE Engineering Group, LLC

HONEYWELL
Jersey City, New Jersey
Hackensack River Tides
During Hurricane Sandy

Figure
2-3

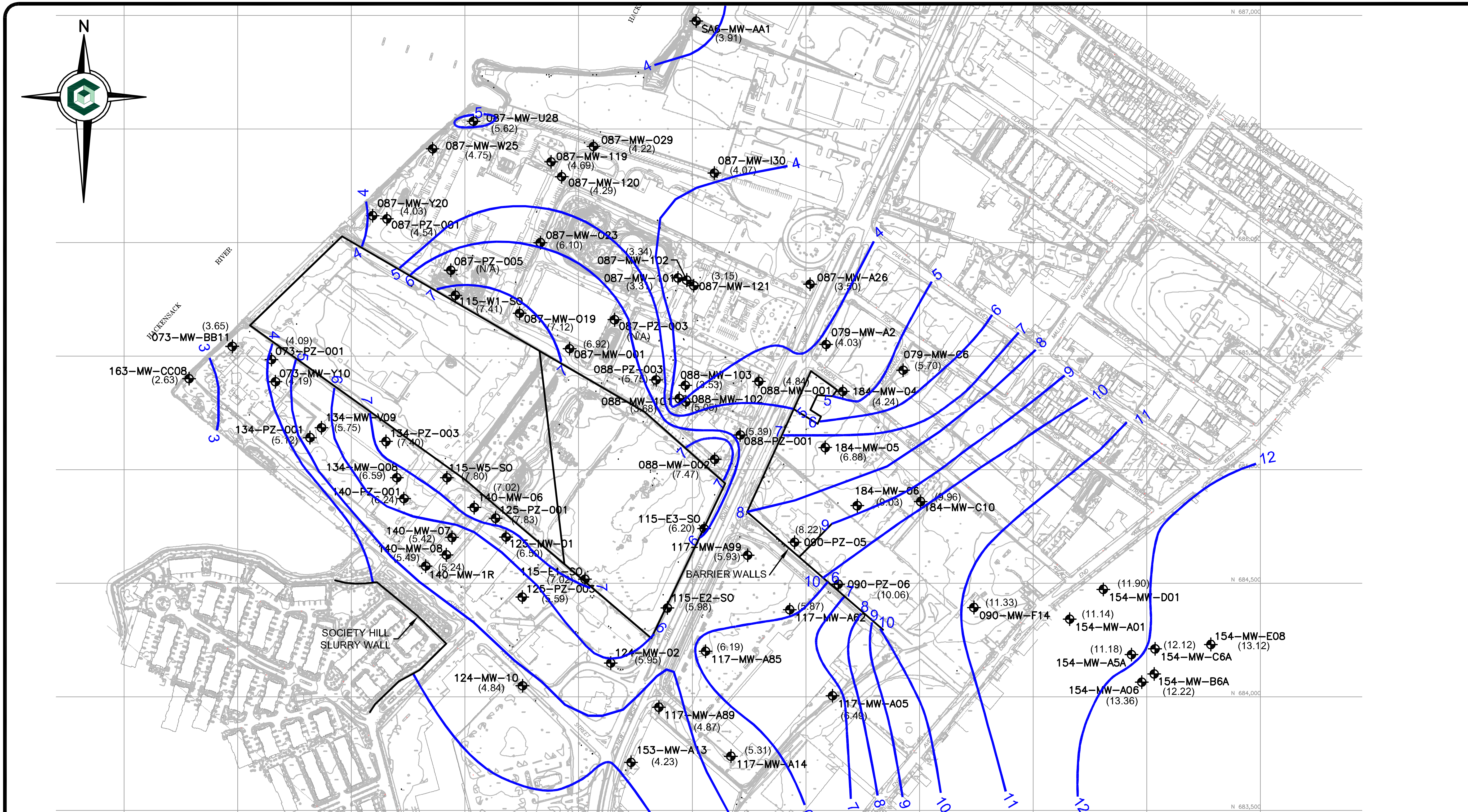


Date

CORNERSTONE Engineering Group, LLC

HONEYWELL
Jersey City, New Jersey
GWET Pumping Rates
and Downtime in 2012

Figure
3-1



LEGEND:

154-MW-E08	SHALLOW MONITORING WELL
(13.12)	WATER LEVEL ELEVATION (FT, MSL)
1.0	GROUNDWATER CONTOUR (FT, MSL)

0 400 800
SCALE IN FEET

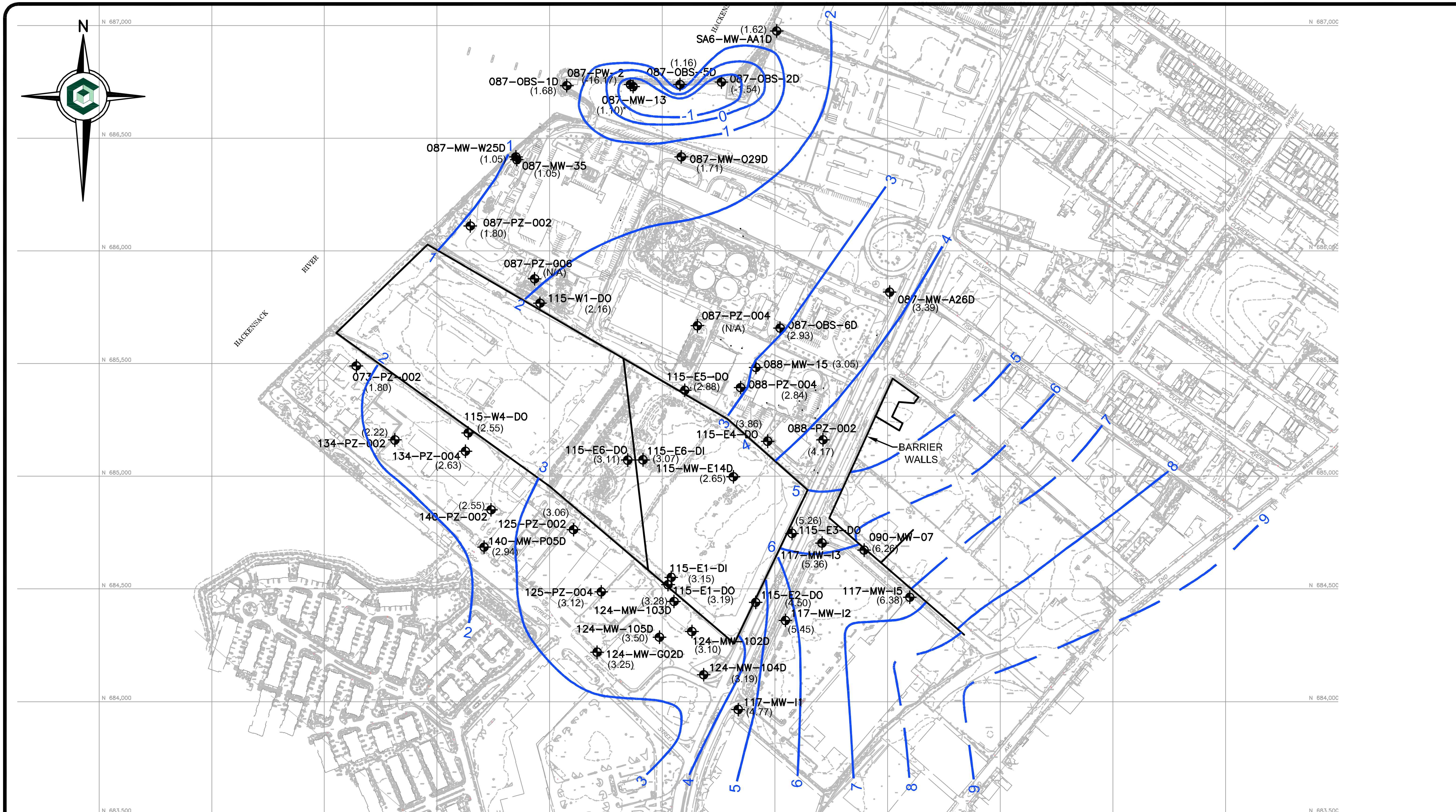
CORNERSTONE
Environmental Group, LLC

HONEYWELL
STUDY AREA 7

GROUNDWATER ELEVATION CONTOURS
SHALLOW ZONE - DECEMBER 18, 2012

FIGURE NO.
4-1
PROJECT NO.
120040

File: X:\PROJECTS\HONEYWELL\090354 - SA7_PROJECT DRAWINGS\2012- 4Q - Annual Figures\MIHONSF-01.dwg Layout: FIGURE 4-1 SHALLOW ZONE User: magda.mendola Mar 23, 2013 - 11:21am



LEGEND:

087-MW-029D	INTERMEDIATE ZONE MONITORING WELL
(1.71)	WATER LEVEL ELEVATION (FT, MSL)
1.0	GROUNDWATER CONTOUR (FT, MSL)
*	DATA SUSPECT - NOT USED IN CONTOURING

0 400 800
SCALE IN FEET

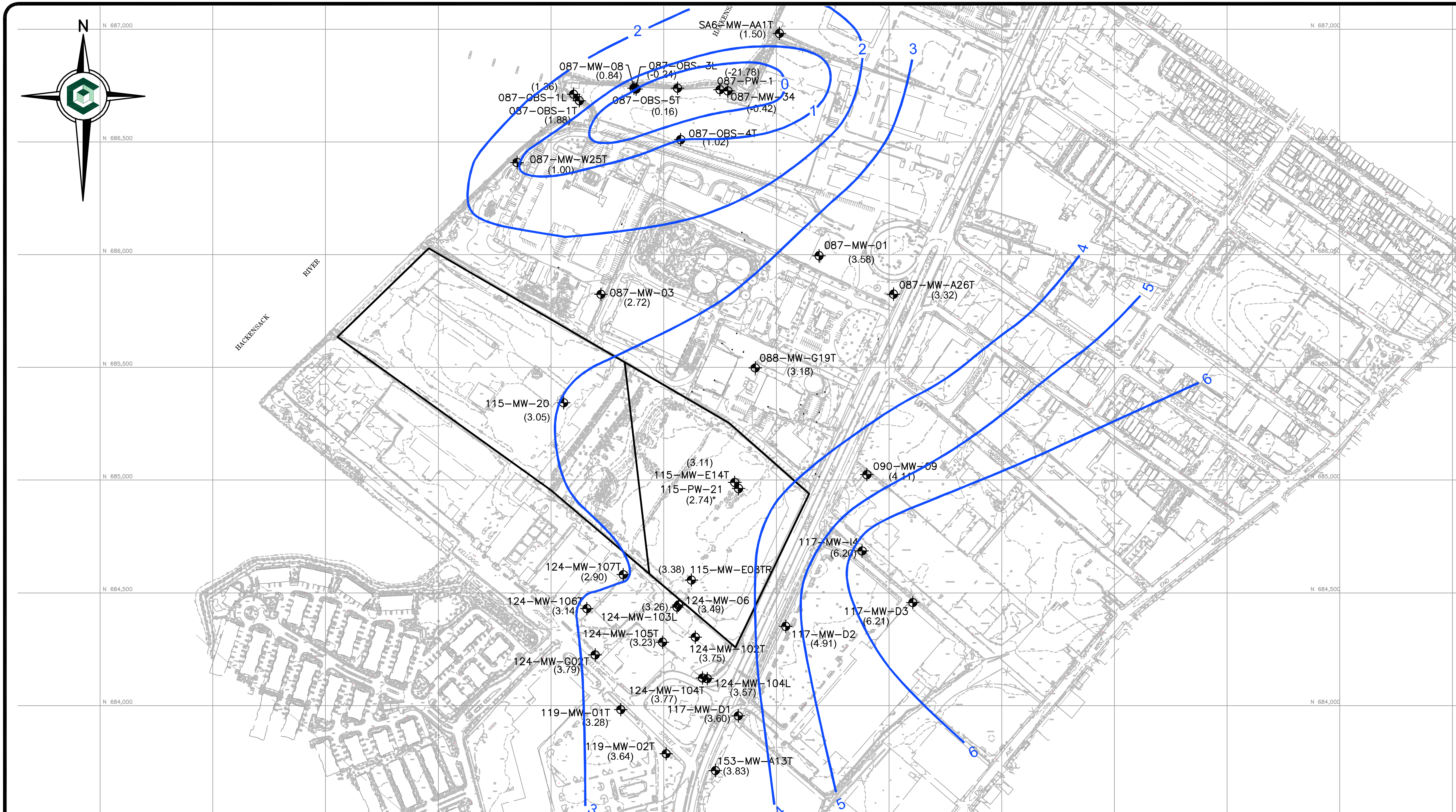
CORNERSTONE
Environmental Group, LLC

HONEYWELL
STUDY AREA 7

GROUNDWATER ELEVATION CONTOURS
INTERMEDIATE ZONE - DECEMBER 18, 2012

FIGURE NO.
4-2
PROJECT NO.
120040

File: X:\PROJECTS\HONEYWELL\090354 - SA7_PROJECT DRAWINGS\2012- 4Q - Annual Figures\MIHONSF-02.dwg Layout: FIGURE 2-3 INTERMEDIATE ZONE User: magda.mendola Mar 23, 2013 - 11:17am



LEGEND:

087–MW–08	DEEP ZONE MONITORING WELL
(0.84)	WATER LEVEL ELEVATION (FT, MSL)
1.0	GROUNDWATER CONTOUR (FT, MSL)
*	DATA SUSPECT - NOT USED FOR CONTOURING

0 400 800

SCALE IN FEET

CORNERSTONE
Environmental Group, LLC

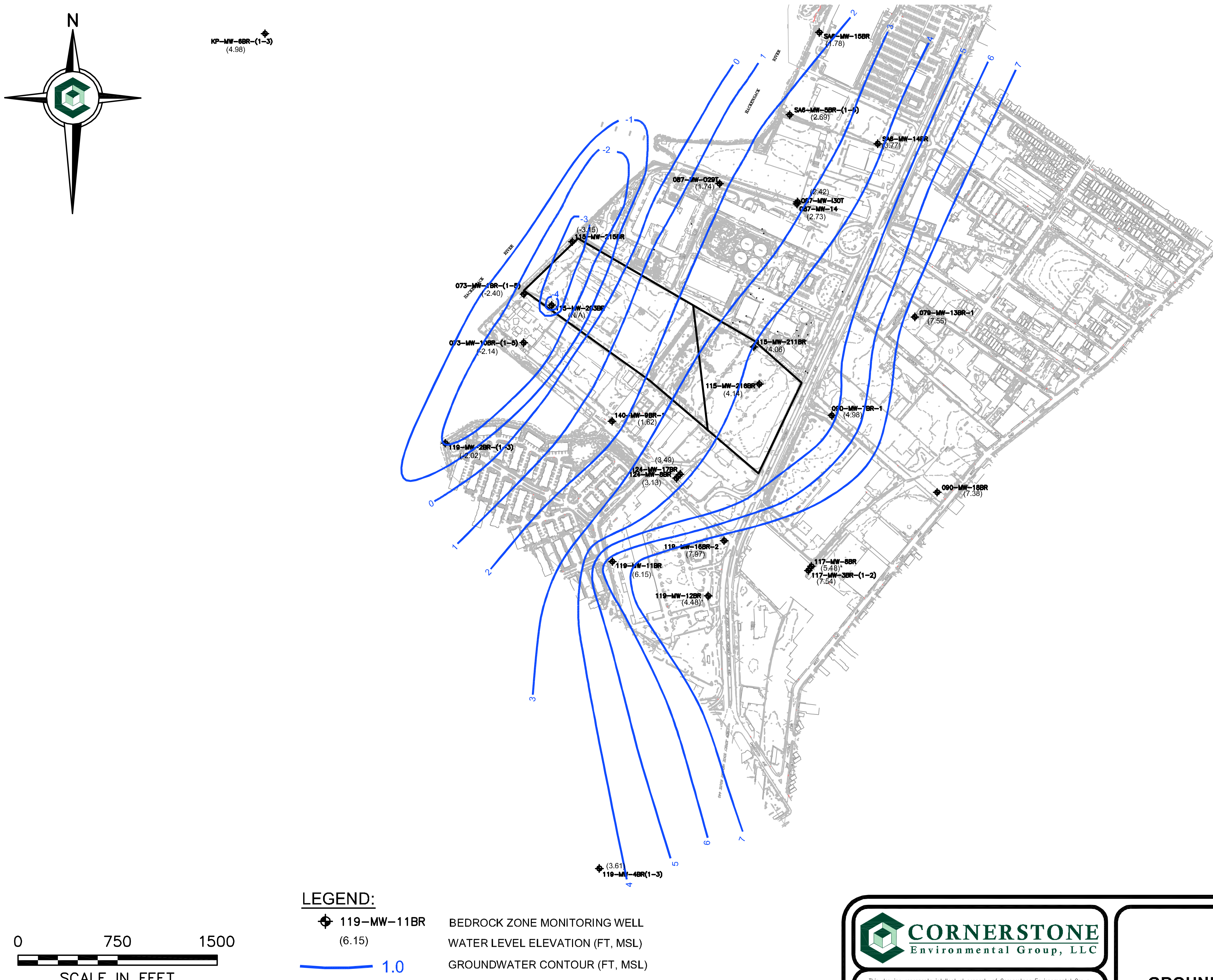
HONEYWELL
STUDY AREA 7

GROUNDWATER ELEVATION CONTOURS
DEEP ZONE - DECEMBER 18, 2012

FIGURE NO.
4-3

PROJECT NO.
120040

File: X:\PROJECTS\HONEYWELL\090354 – SA7_PROJECT DRAWINGS\2012– 4Q – Annual Figures\MIHONSF-03.dwg Layout: FIGURE 4-3 DEEP ZONE User: magda.mendola Mar 23, 2013 – 11:23am



LEGEND:

119–MW–11BR	BEDROCK ZONE MONITORING WELL
(6.15)	WATER LEVEL ELEVATION (FT, MSL)
1.0	GROUNDWATER CONTOUR (FT, MSL)
*	DATA SUSPECT - NOT USED FOR CONTOURING

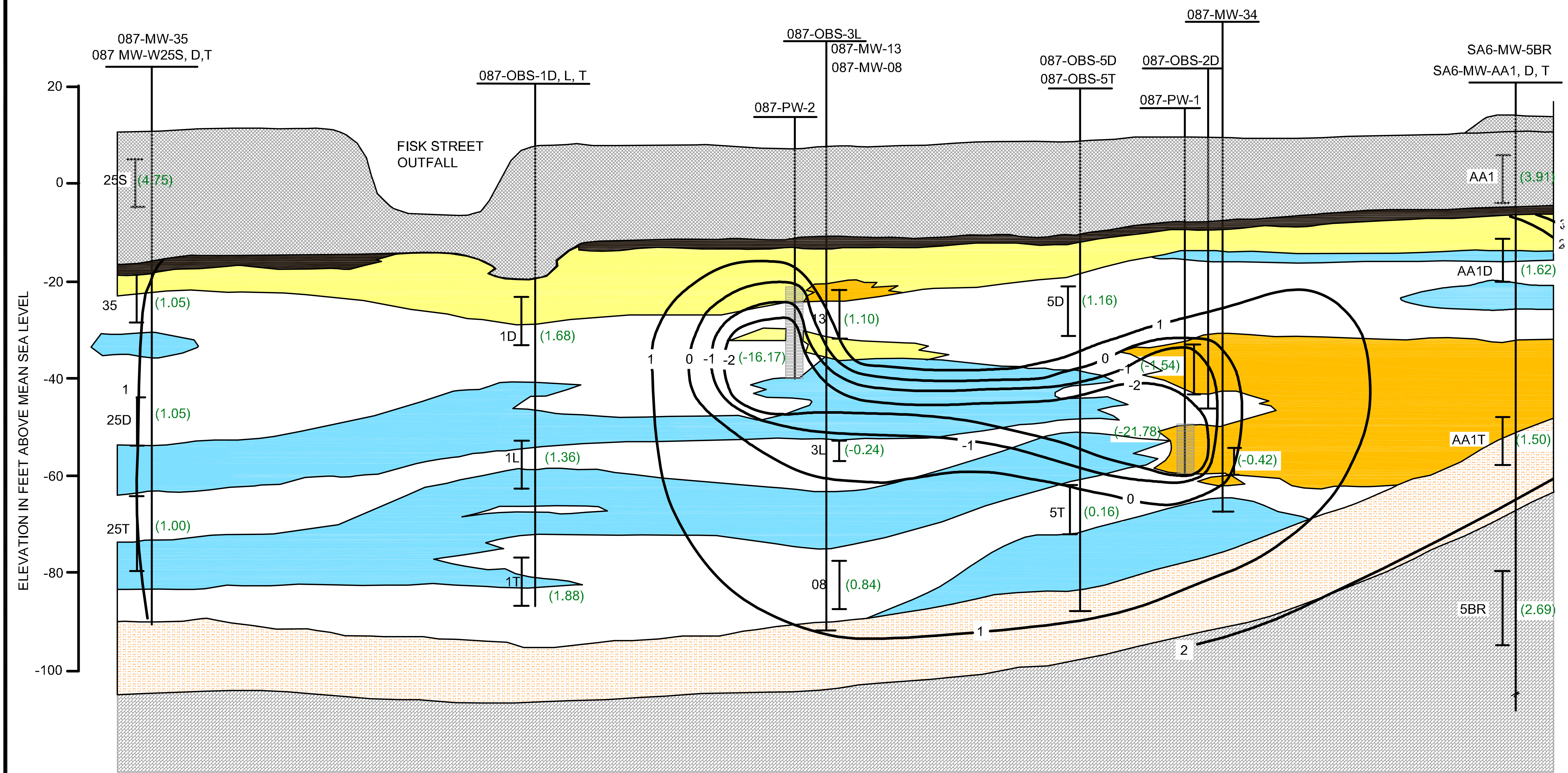
CORNERSTONE
Environmental Group, LLC

HONEYWELL
STUDY AREA 7

GROUNDWATER ELEVATION CONTOURS
BEDROCK ZONE - DECEMBER 18, 2012

FIGURE NO.
4-4

PROJECT NO.
090354



LEGEND:

- FILL
- MEADOW MAT
- FINE TO MEDIUM SAND
- FINE, MEDIUM TO COARSE SAND
- INTERBED SILTS AND CLAYS
- GLACIAL TILL
- PASSAIC FORMATION
- FINE TO VERY FINE SAND

087-MW-W25T — WELL DESIGNATION

GROUND SURFACE

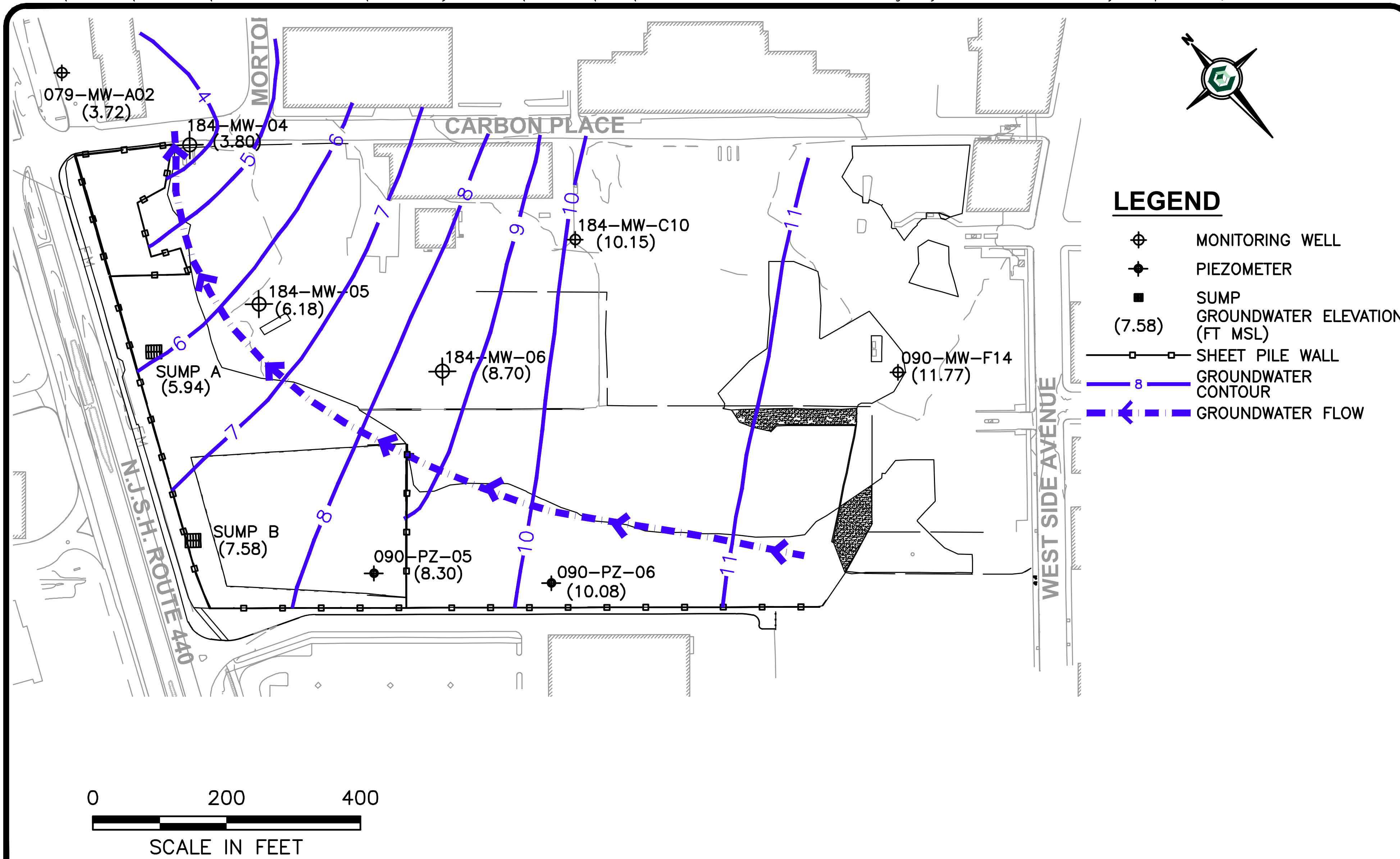
25T — SCREENED INTERVAL

CORNERSTONE
Environmental Group, LLC

HONEYWELL
STUDY AREA 7
GROUNDWATER ELEVATIONS IN CROSS-SECTION
DECEMBER 18, 2012

FIGURE NO.
4-5
PROJECT NO.
120040

File: X:\PROJECTS\HONEYWELL\090354 - SA7_PROJECT DRAWINGS\2012- 4Q - Annual Figures\MIHONSF-05.dwg Layout: FIGURE 2-1 BEDROCK ZONE User: magda.mendola Mar 23, 2013 - 11:15am



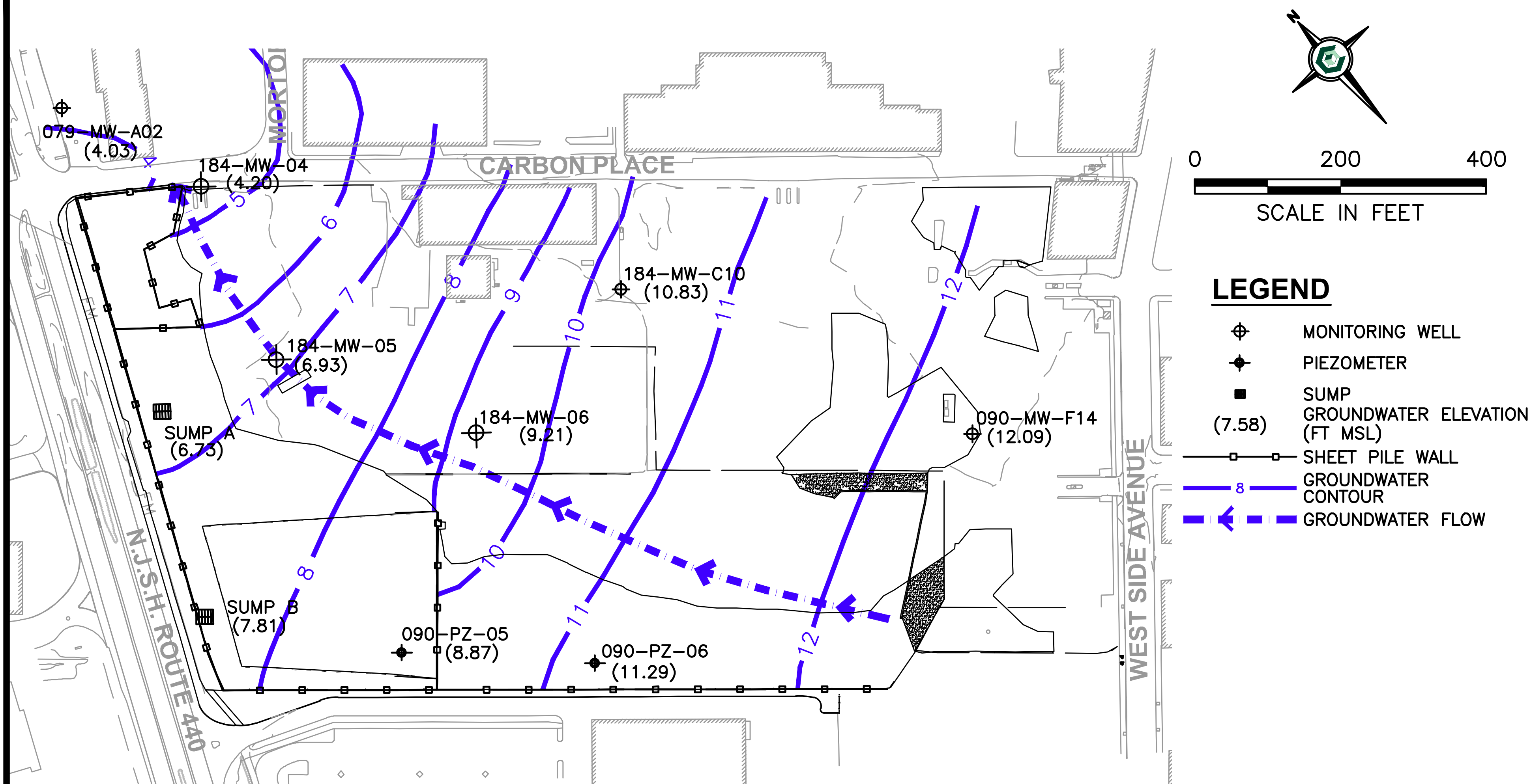
CORNERSTONE Environmental Group, LLC

SA–5 / NJCU

GROUNDWATER ELEVATION CONTOURS
SHALLOW ZONE - MARCH 21, 2012

FIGURE NO.
4-6

PROJECT NO.
100414.02



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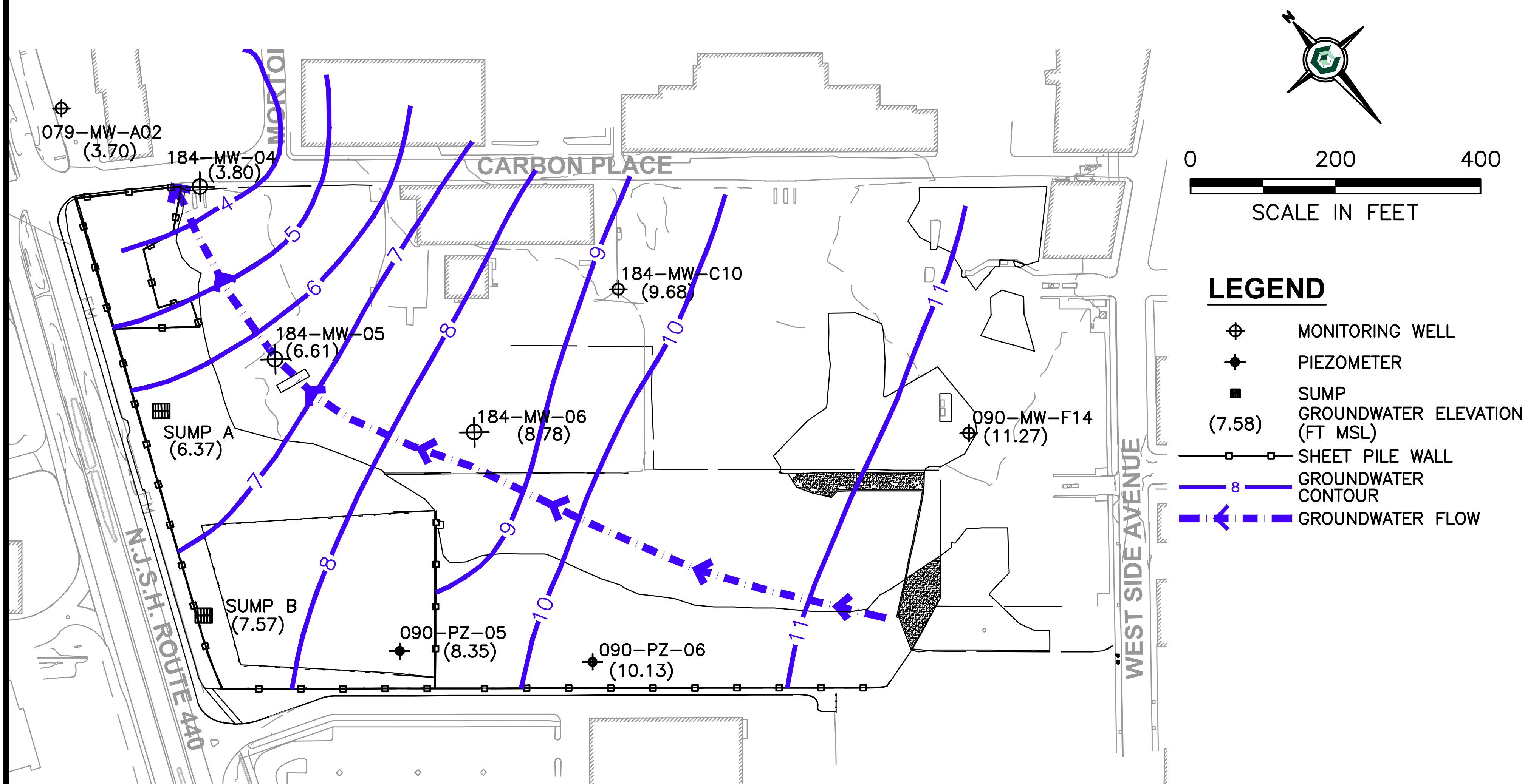
SA-5 / NJCU

GROUNDWATER ELEVATION CONTOURS SHALLOW ZONE - JUNE 12, 2012

FIGURE NO.
4-7

PROJECT NO.
100414.02

File: X:\PROJECTS\HONEYWELL\100241 – SA5 100414\Post–remedy Evaluation\RTC–2013\MAPS\FIG 4–8 SHALLOW GW CONTS 092512.dwg Layout: SHALLOW 092512 User: thierry.dechape Mar 22, 2013 – 10:22am



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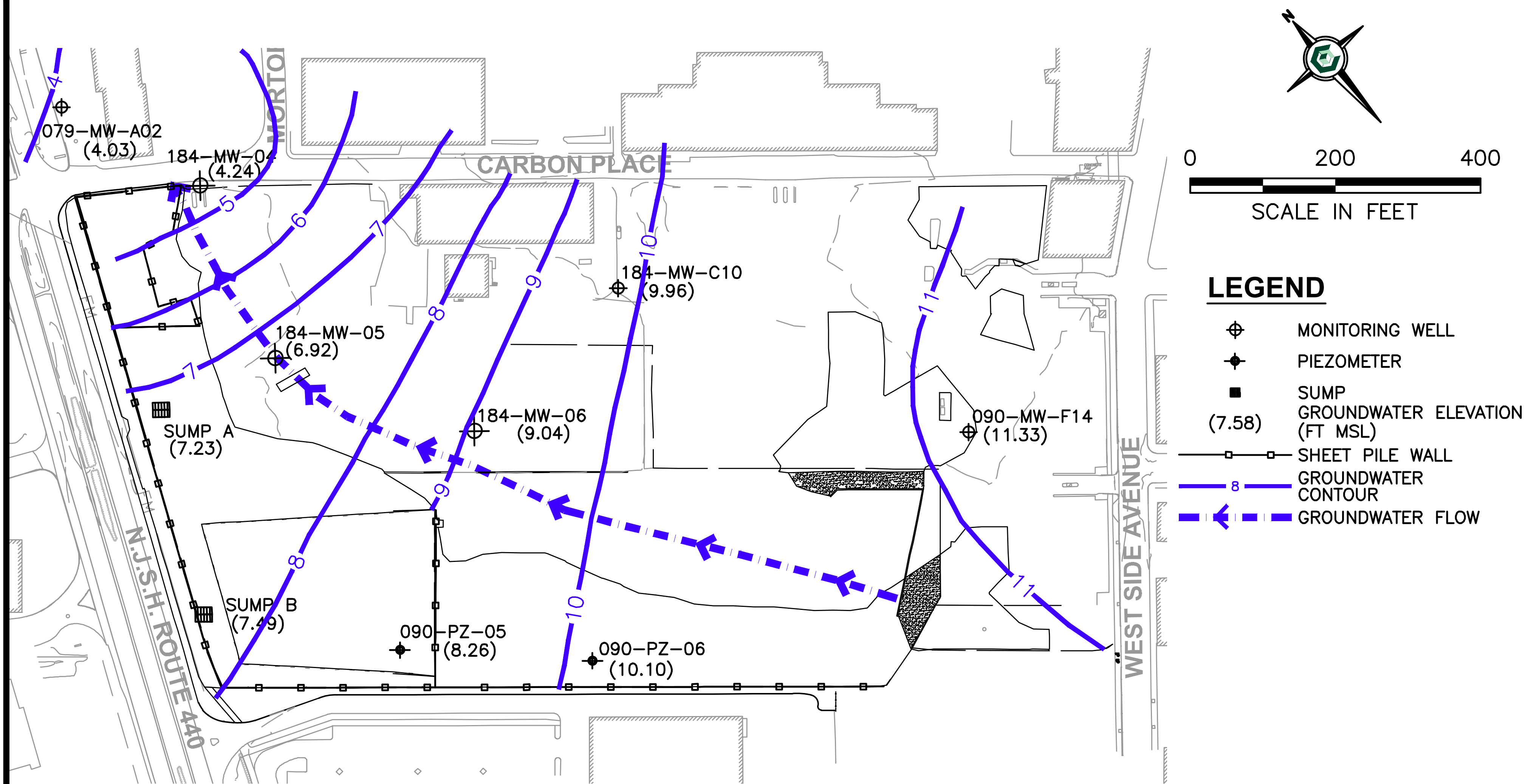
SA–5 / NJCU

GROUNDWATER ELEVATION CONTOURS SHALLOW ZONE - SEPTEMBER 25, 2012

FIGURE NO. **4-8**

PROJECT NO. 100414.03

File: X:\PROJECTS\HONEYWELL\100241 – SA5 100414\Post-remedy Evaluation\RTC-2013\MAPS\FIG 4-9 SHALLOW GW CONTS 121812.dwg Layout: SHALLOW 121812 User: thierry.dechape Mar 22, 2013 – 11:33am



CORNERSTONE
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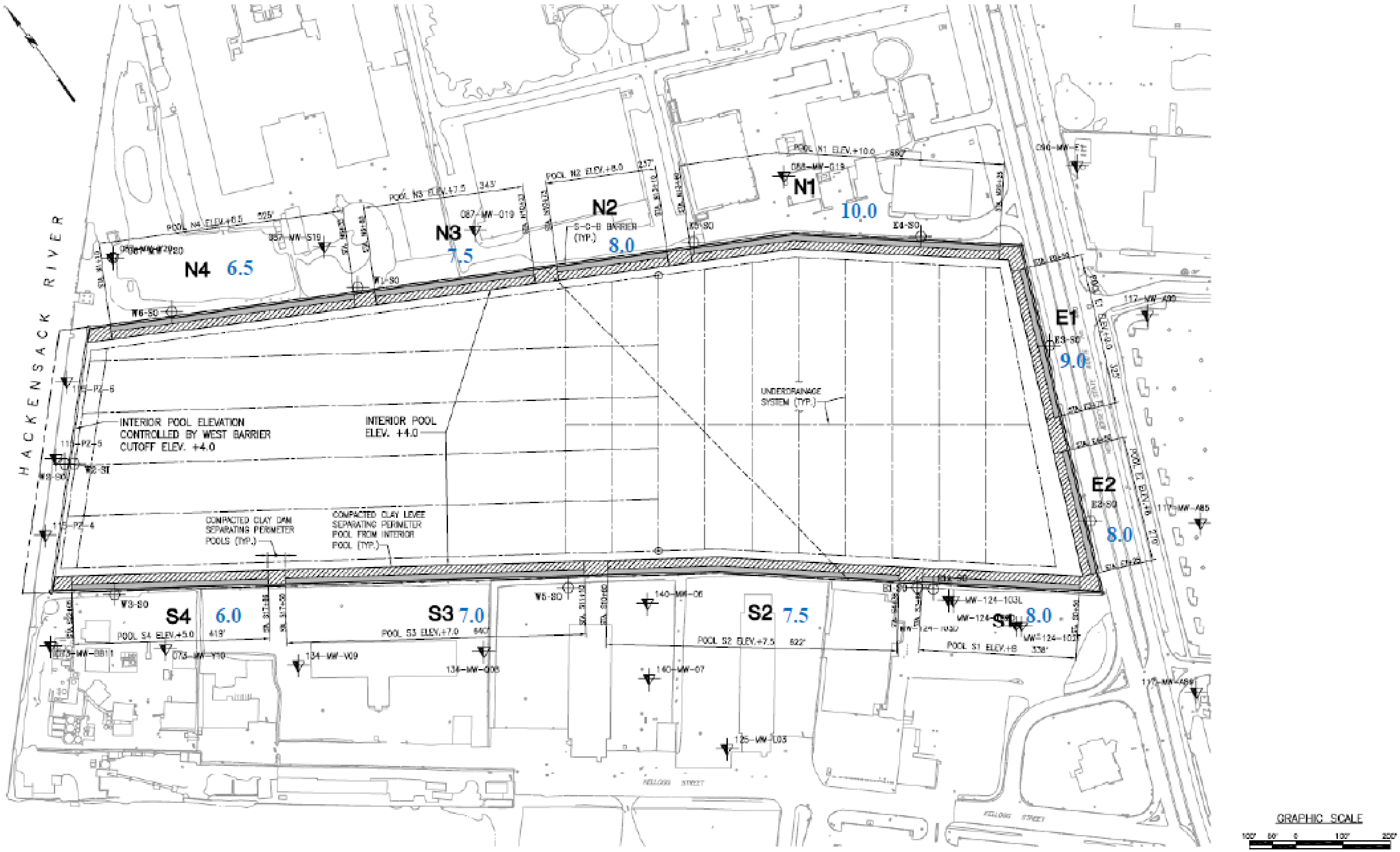
SA–5 / NJCU

GROUNDWATER ELEVATION CONTOURS
SHALLOW ZONE - DECEMBER 18, 2012

FIGURE NO.
4-9

PROJECT NO.
100414.03



LEGEND:

N2 – Perimeter Pool

8.0 – Design Elevation of Perimeter Pool Water Level (ft, msl)

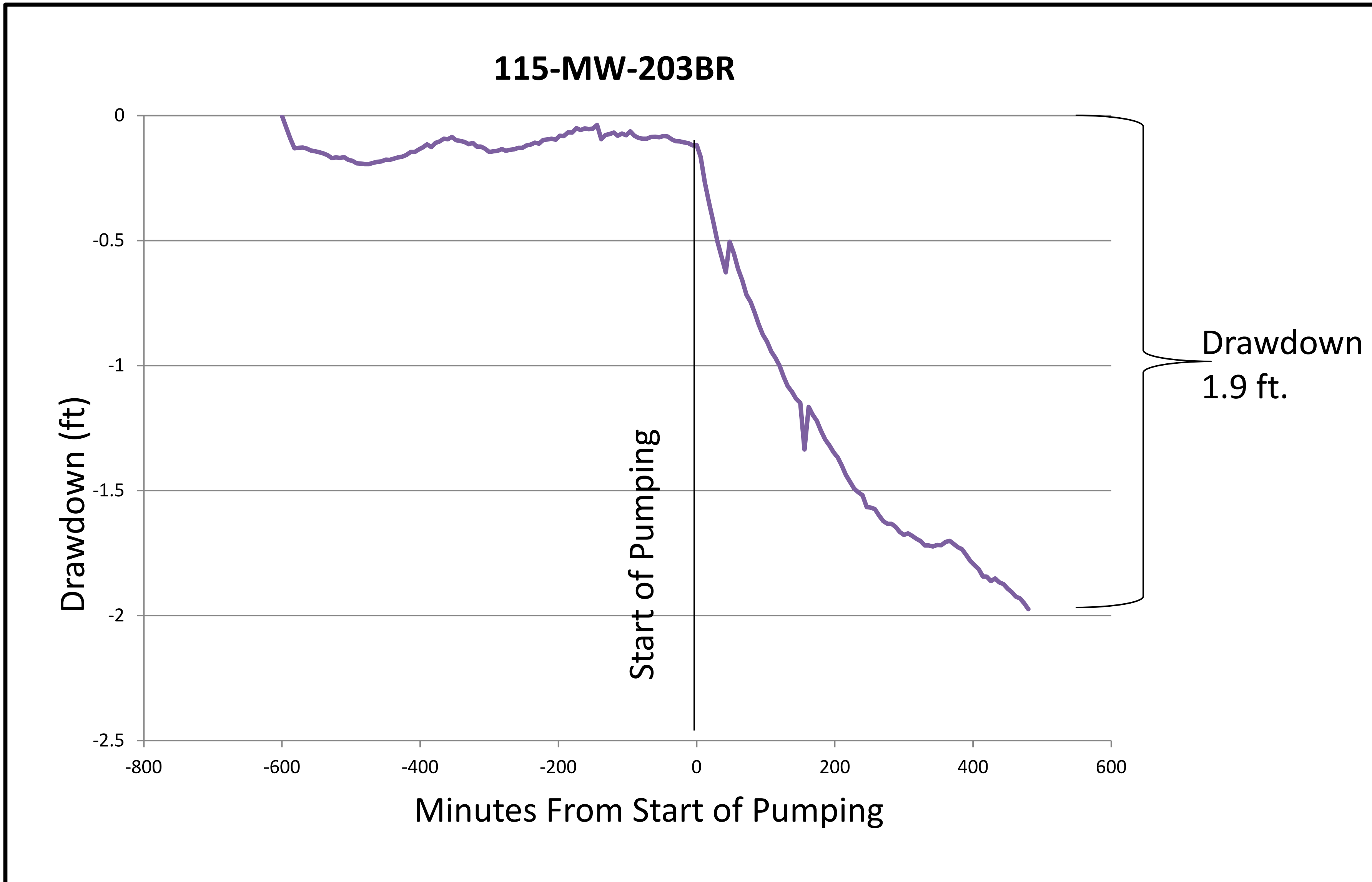
CORNERSTONE Engineering Group, LLC

HONEYWELL

Jersey City, New Jersey

Location of SA-7 Perimeter Pools

Figure 4-10



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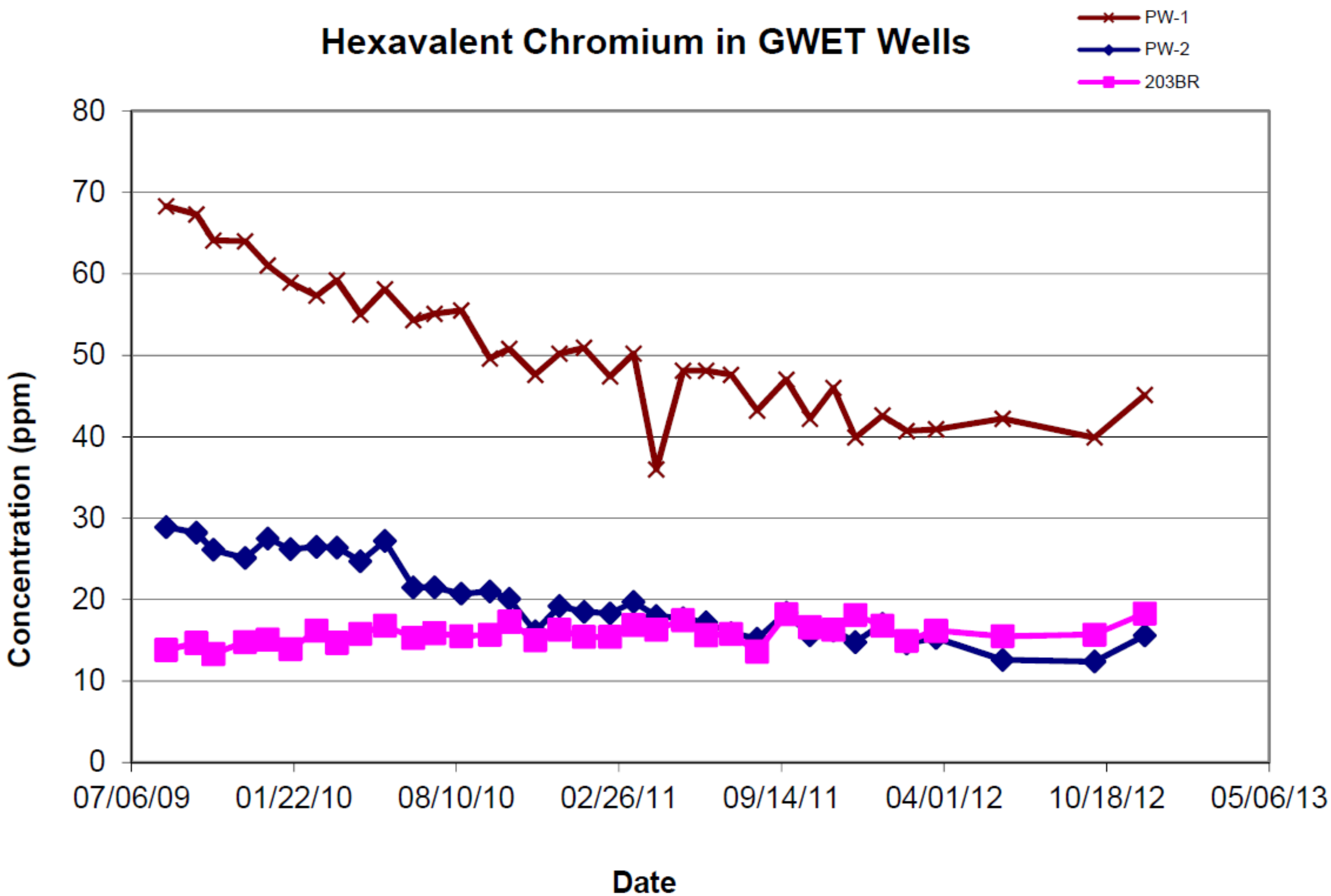
HONEYWELL
Jersey City, New Jersey
Drawdown at 203BR
During Yield Test of 215BR

Figure
4-11



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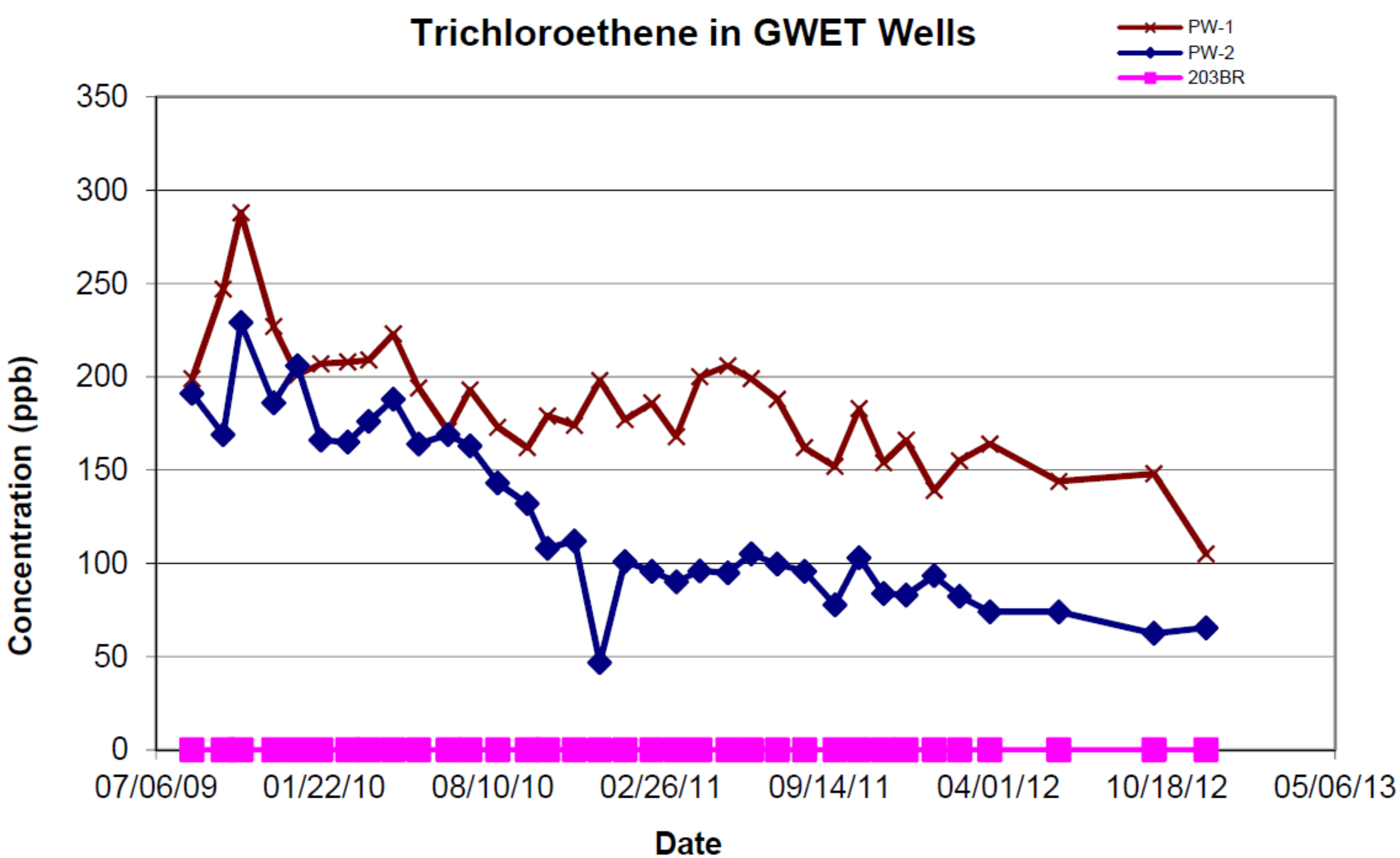
HONEYWELL
Jersey City, New Jersey

Hexavalent Chromium Trends in GWET Extraction Wells

Figure 5-1



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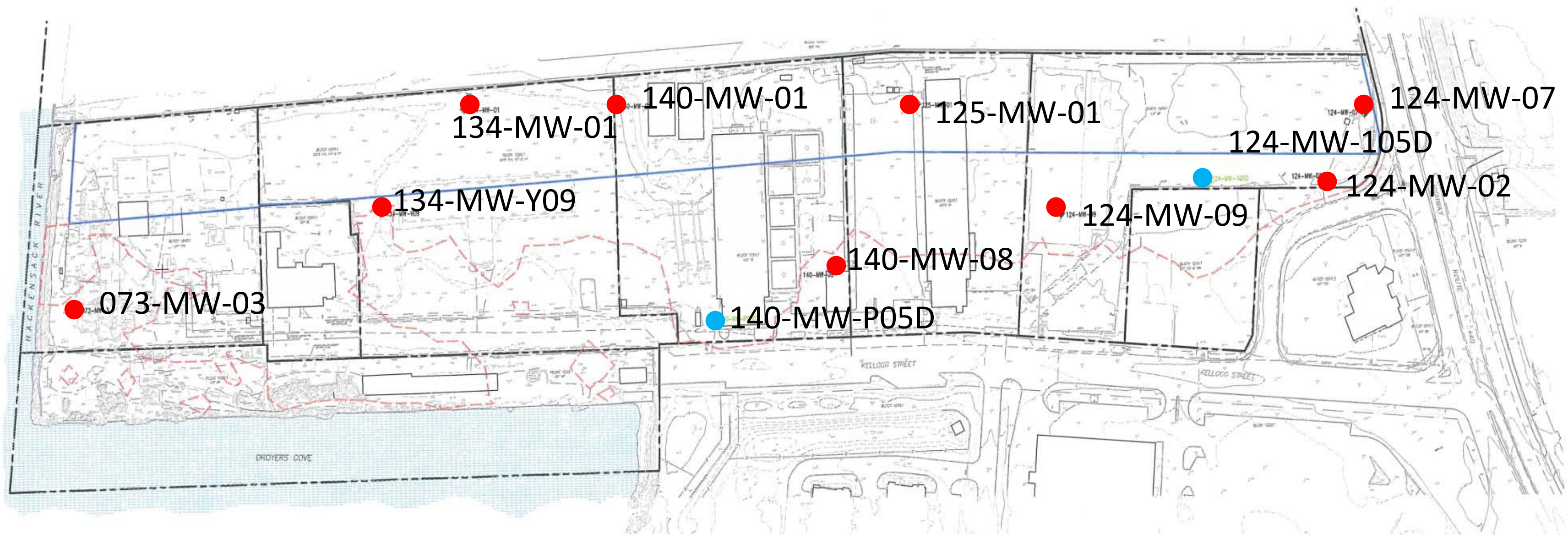
HONEYWELL
Jersey City, New Jersey
Trichloroethylene Trends in GWET Extraction Wells

Figure 5-2



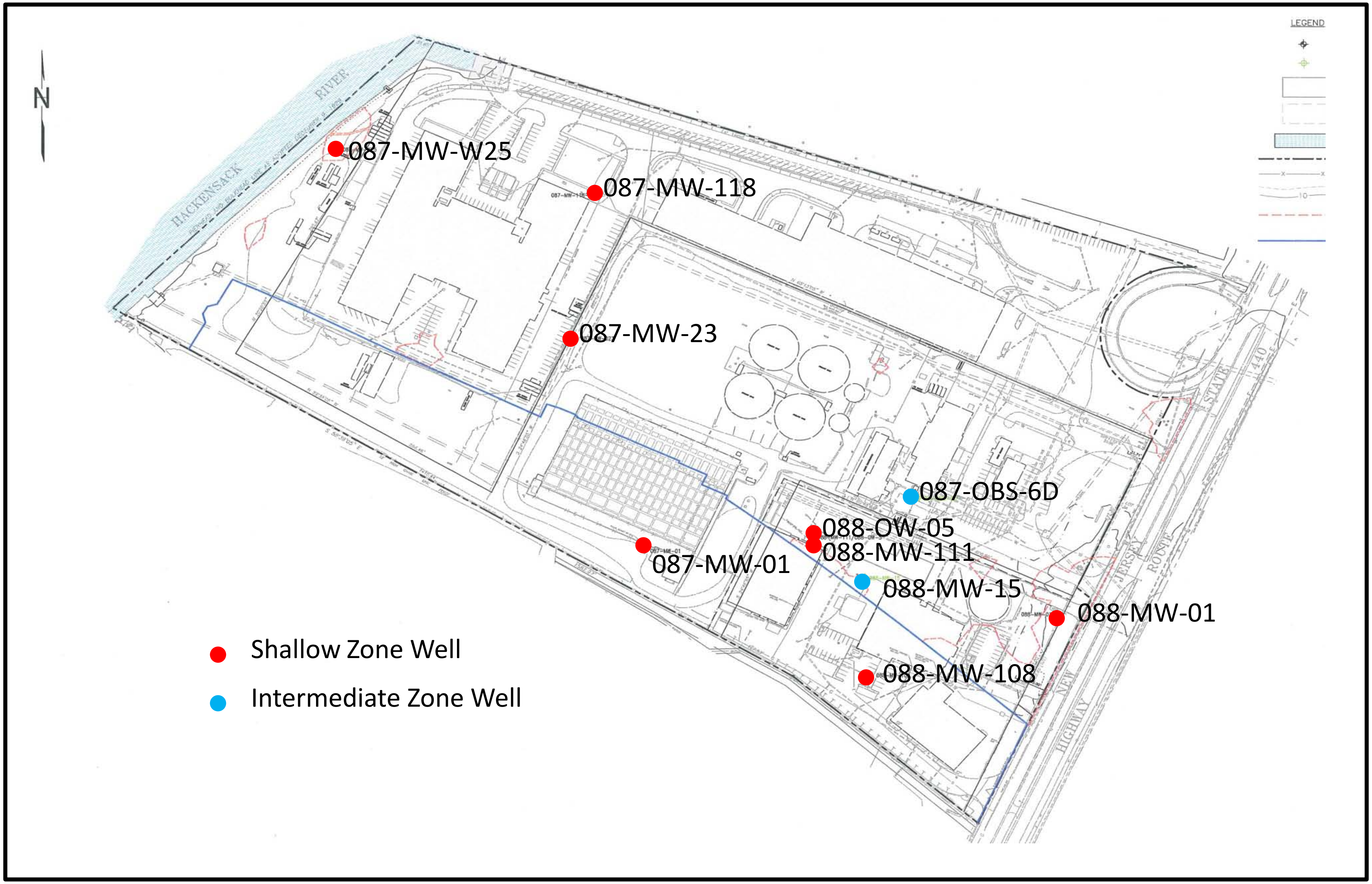
● Shallow Zone Well

● Intermediate Zone Well

CORNERSTONE
Engineering Group, LLC

HONEYWELL
Jersey City, New Jersey
Location of Monitoring Wells Sampled on SA-6 South for TWA Permit Application

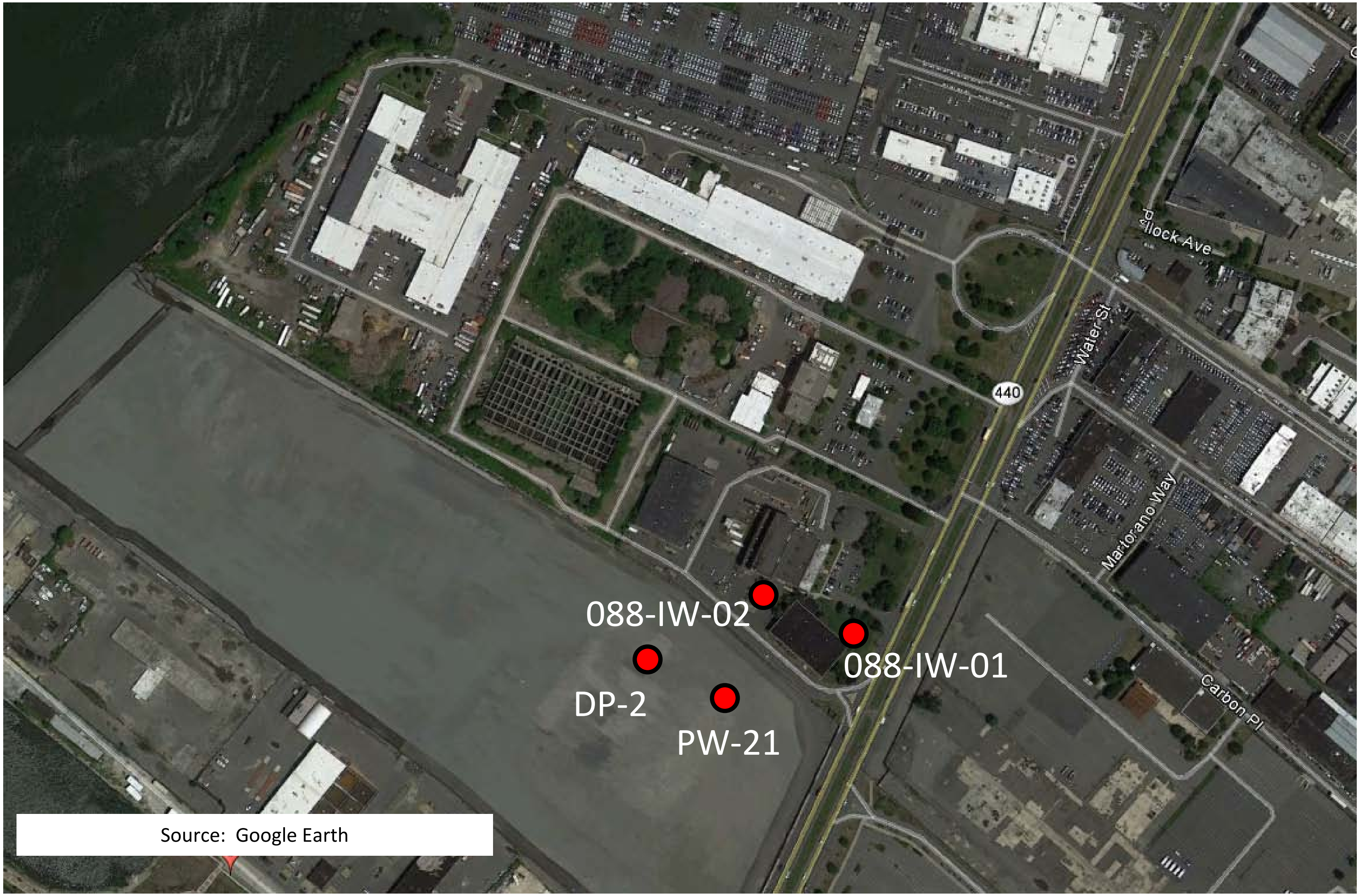
Figure 5-3



CORNERSTONE Engineering Group, LLC

HONEYWELL
Jersey City, New Jersey
Location of Monitoring Wells Sampled on SA-6 North for TWA Permit Application

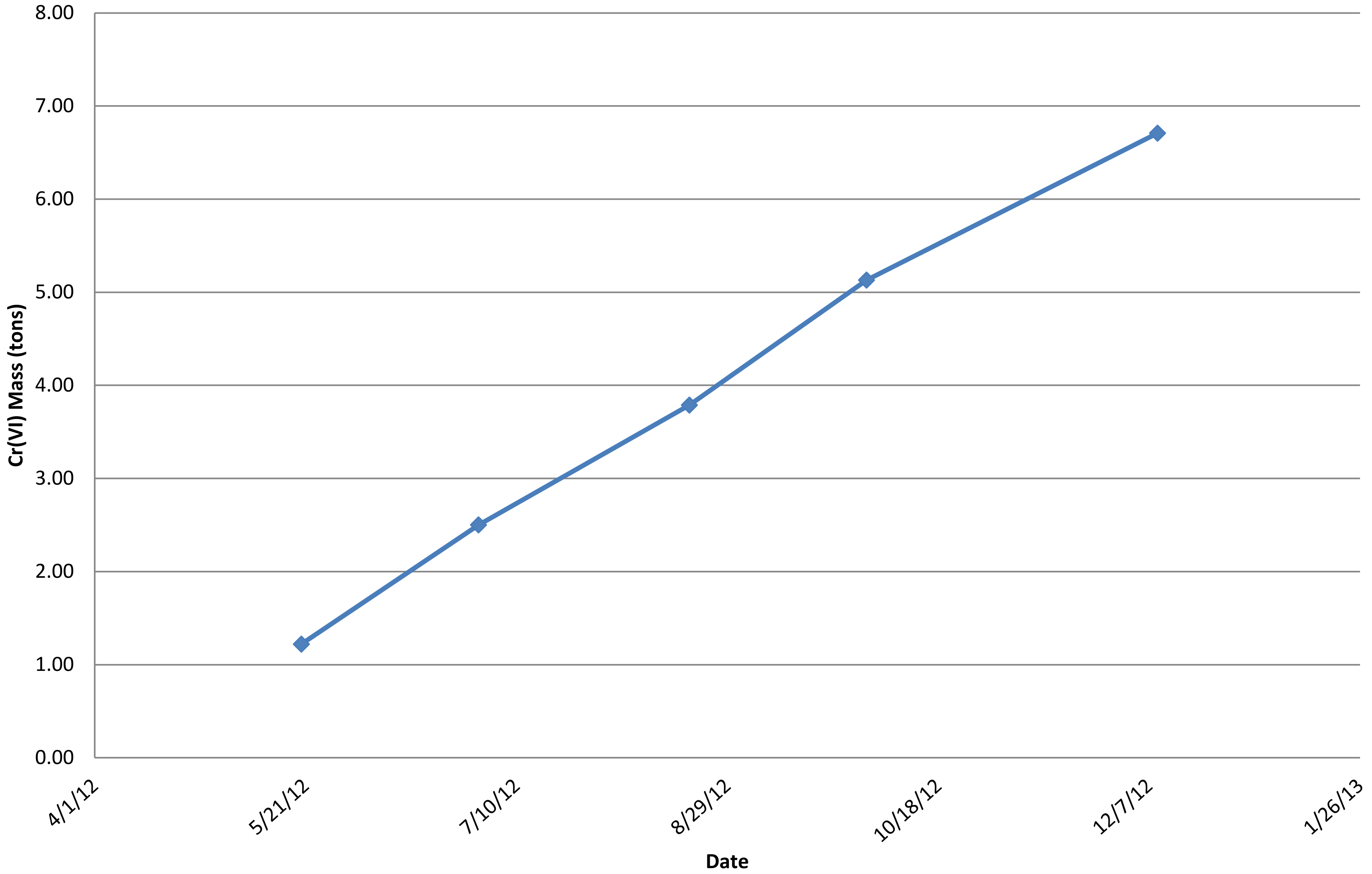
Figure 5-4



CORNERSTONE
Engineering Group, LLC

HONEYWELL
Jersey City, New Jersey
Location of S-3 Injection Wells
Used in 2012

Figure
6-1

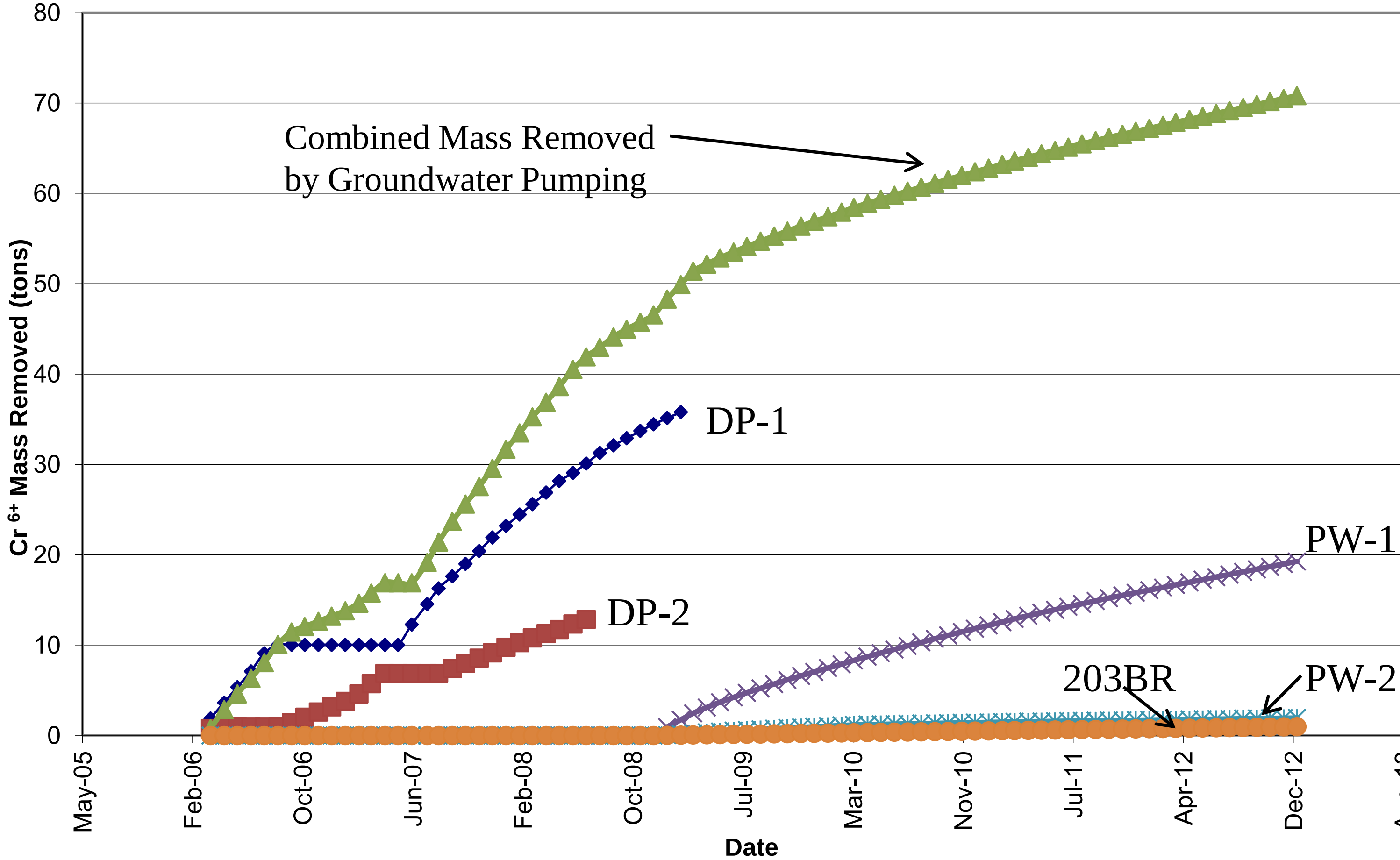


CORNERSTONE Engineering Group, LLC

HONEYWELL
Jersey City, New Jersey

Cumulative Cr(VI) Mass Reduced in S-3 Sand by Injection

Figure 6-2



CORNERSTONE Engineering Group, LLC

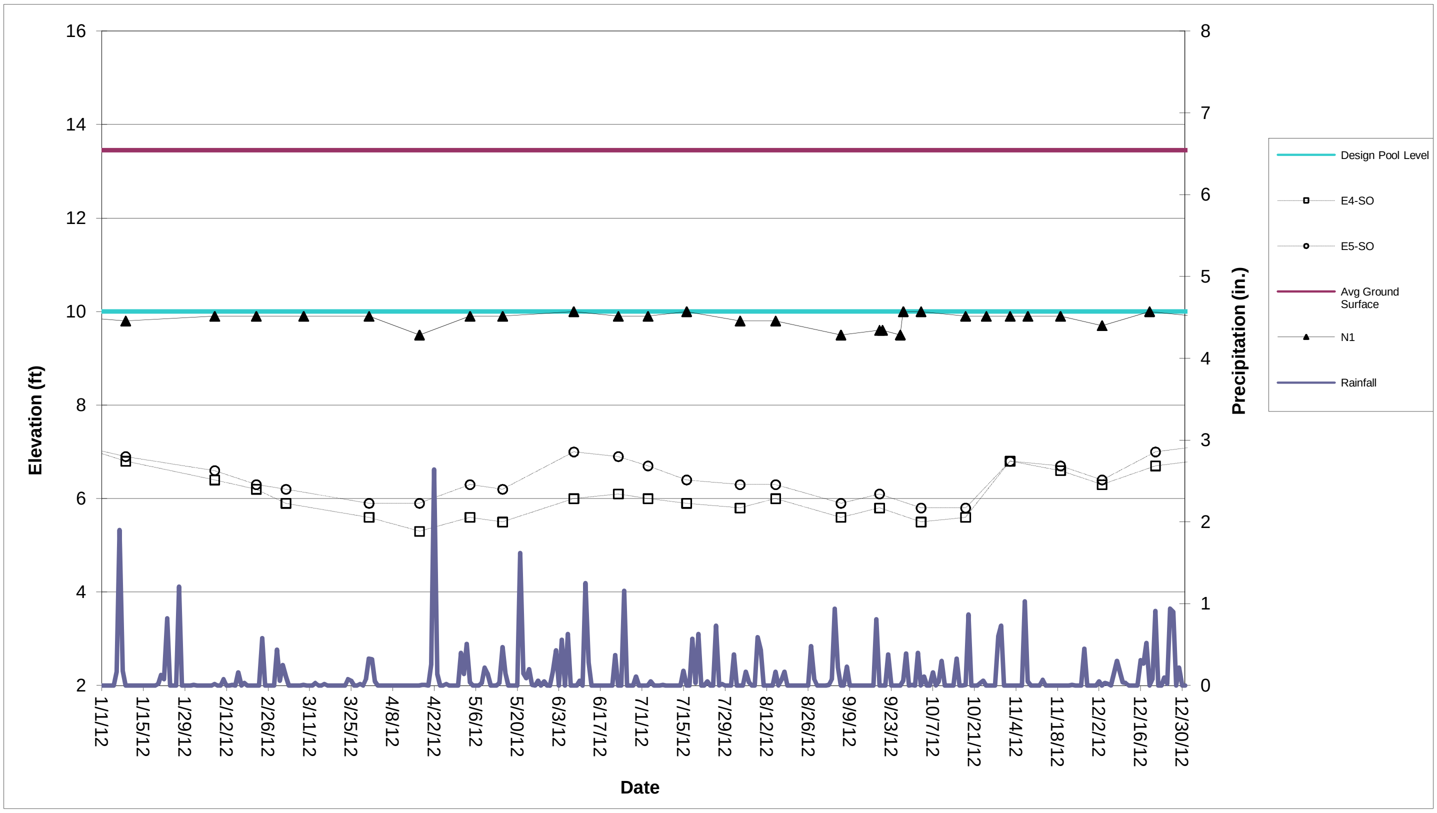
HONEYWELL
Jersey City, New Jersey
Cumulative Cr(VI) Mass Removed From Groundwater by Pumping

Figure 6-3

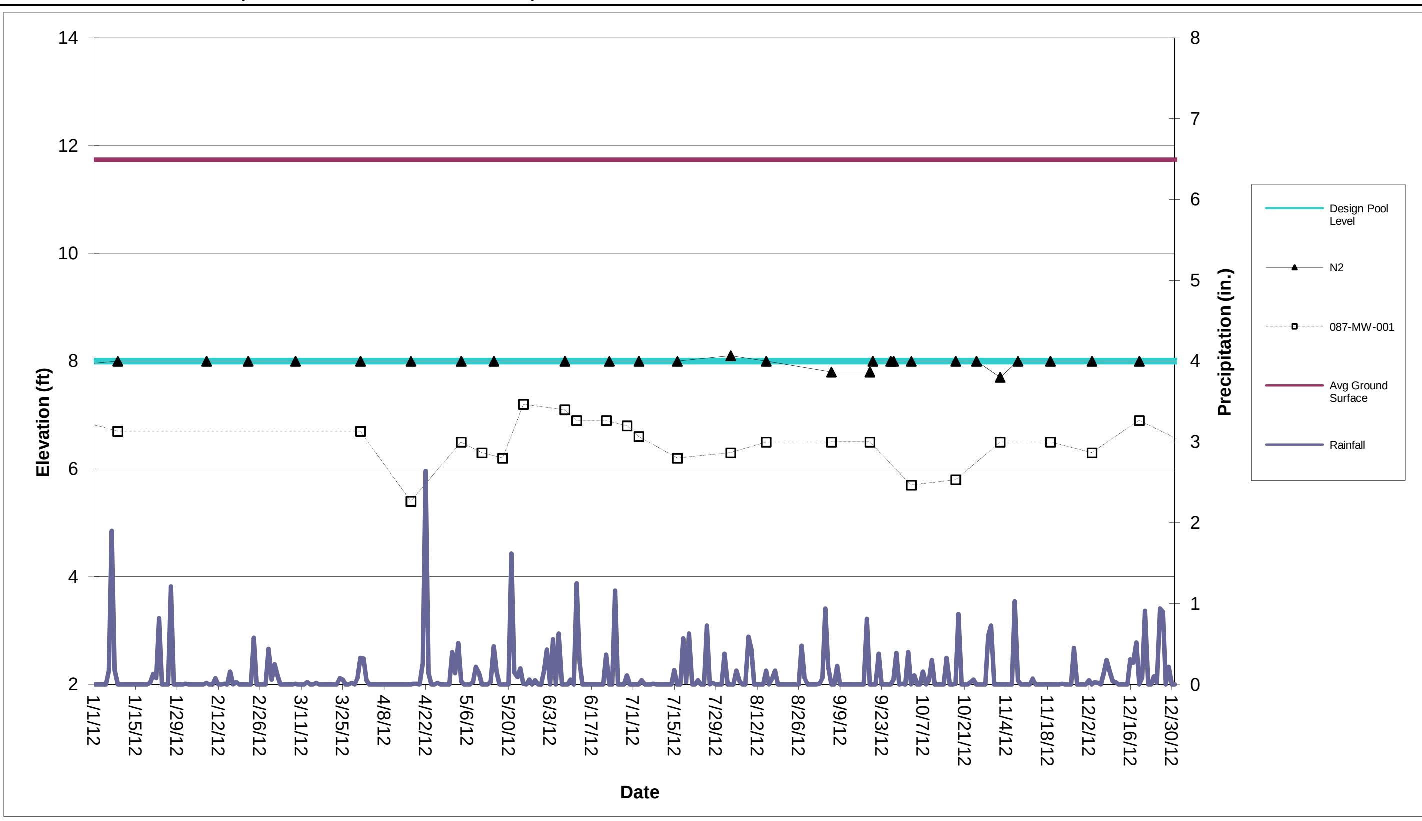
APPENDIX A

SA-7 PERIMETER POOL HYDROGRAPHS

Attachment C: Perimeter Pools

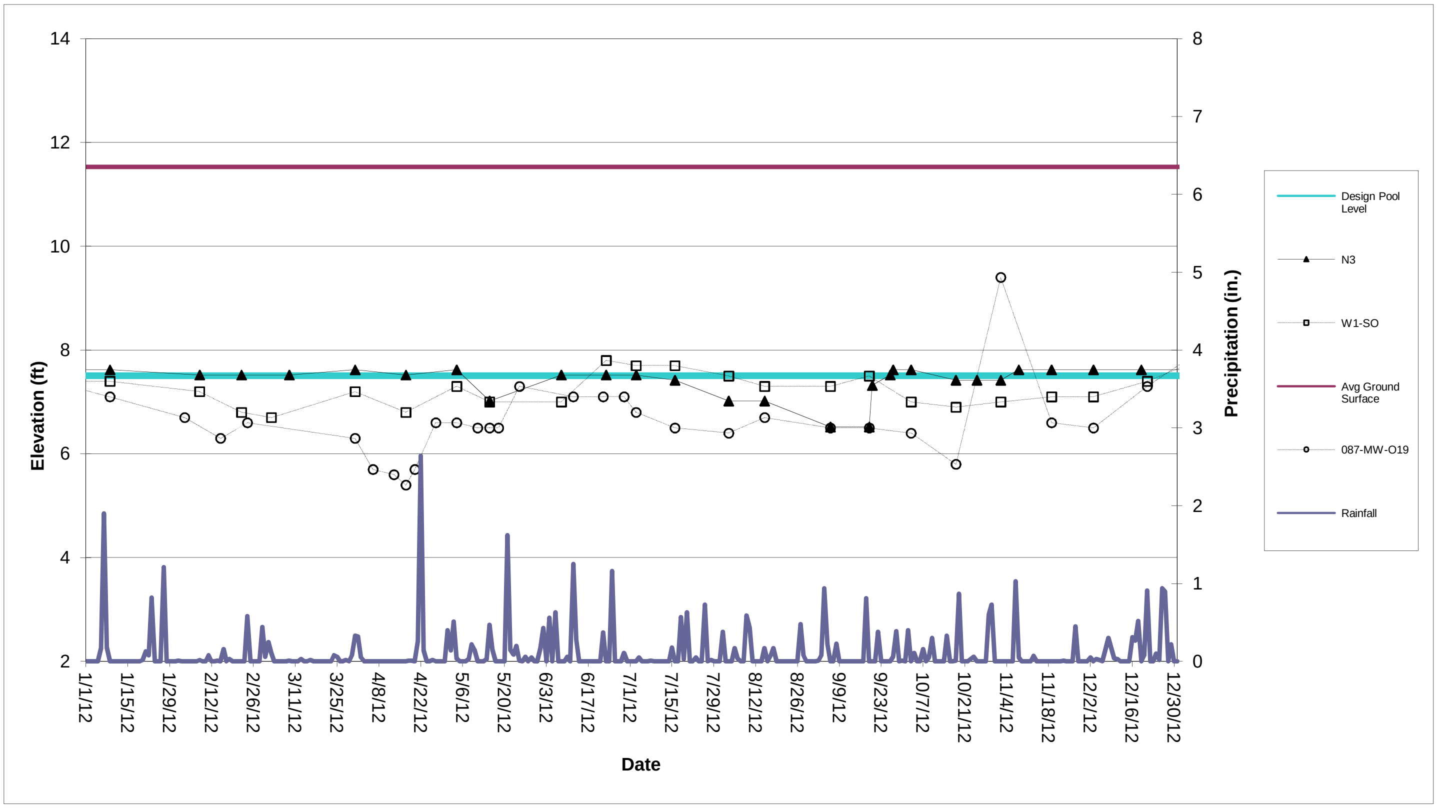


Perimeter Pool N1 (Sta. N13+60 to N20+25)

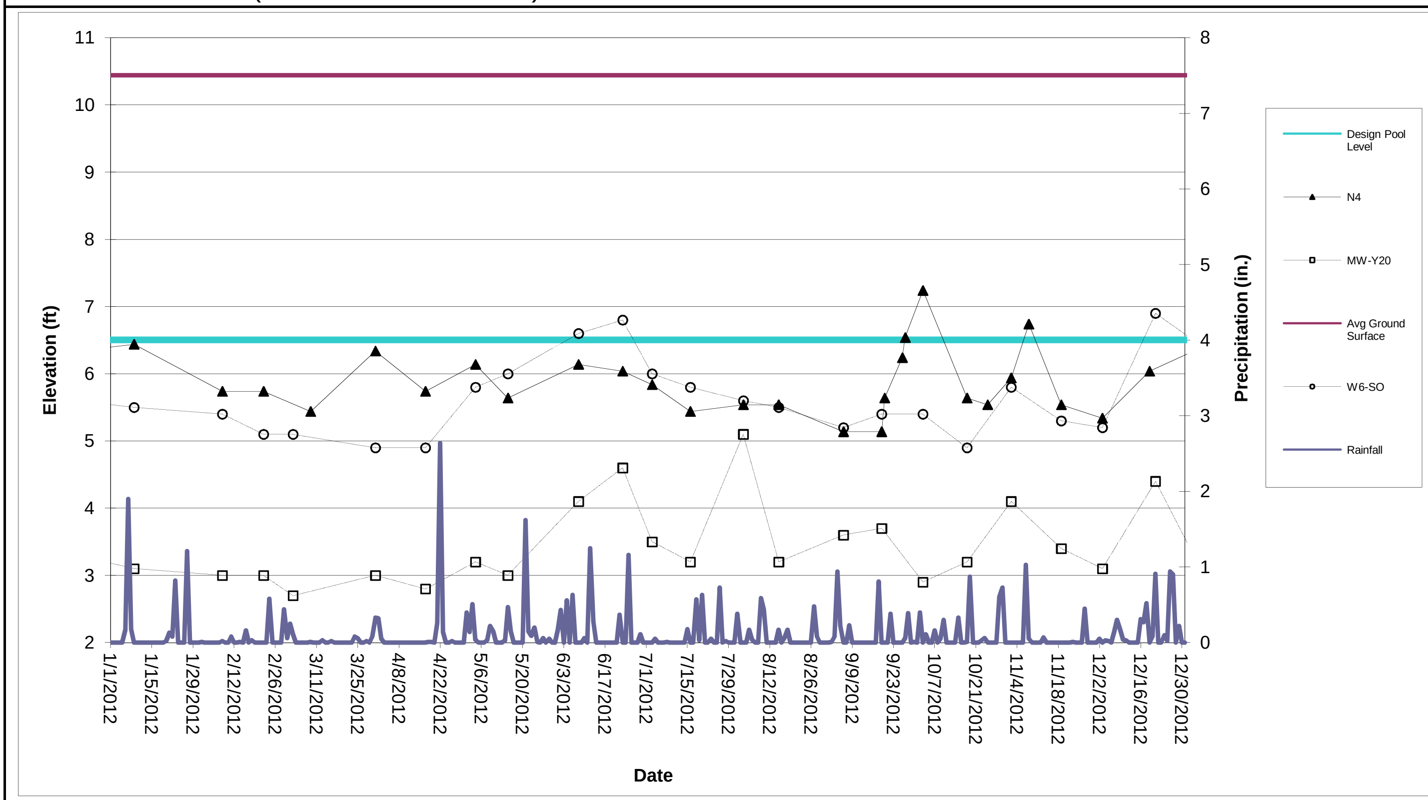


Perimeter Pool N2 (Sta. N10+73 to N13+10)

Attachment C: Perimeter Pools

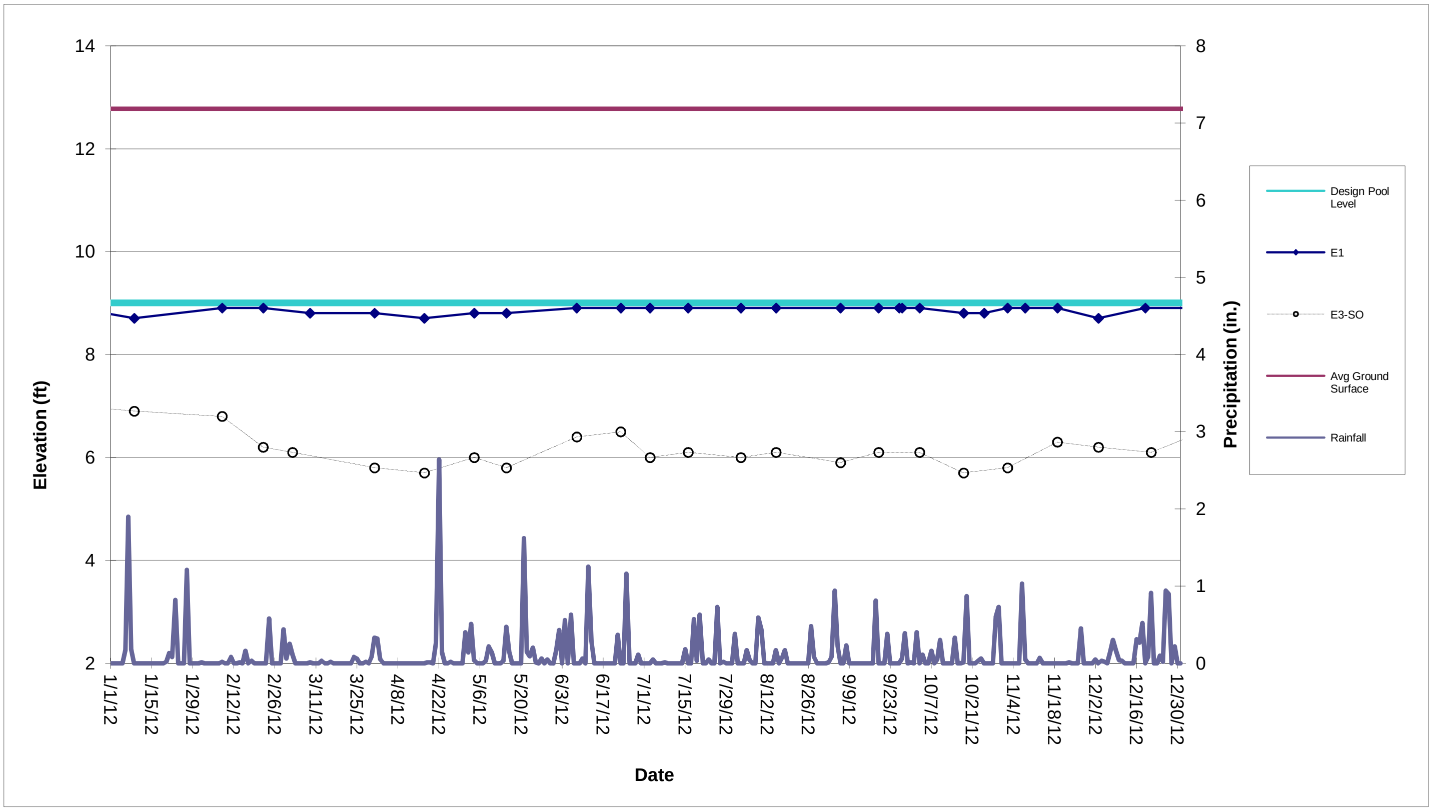


Perimeter Pool N3 (Sta. N6+80 to N10+23)

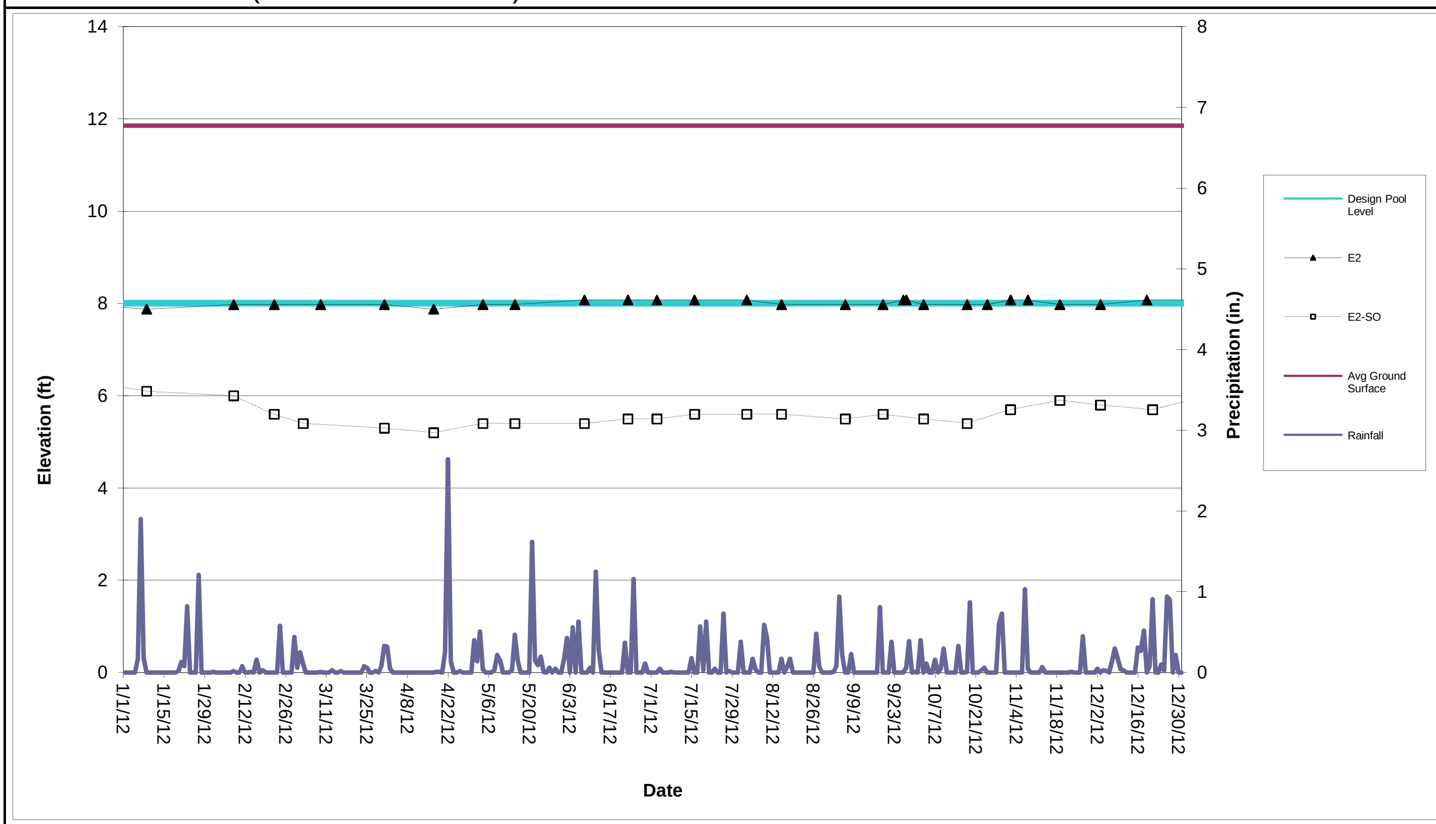


Perimeter Pool N4 (Sta. N6+80 to N10+23)

Attachment C: Perimeter Pools

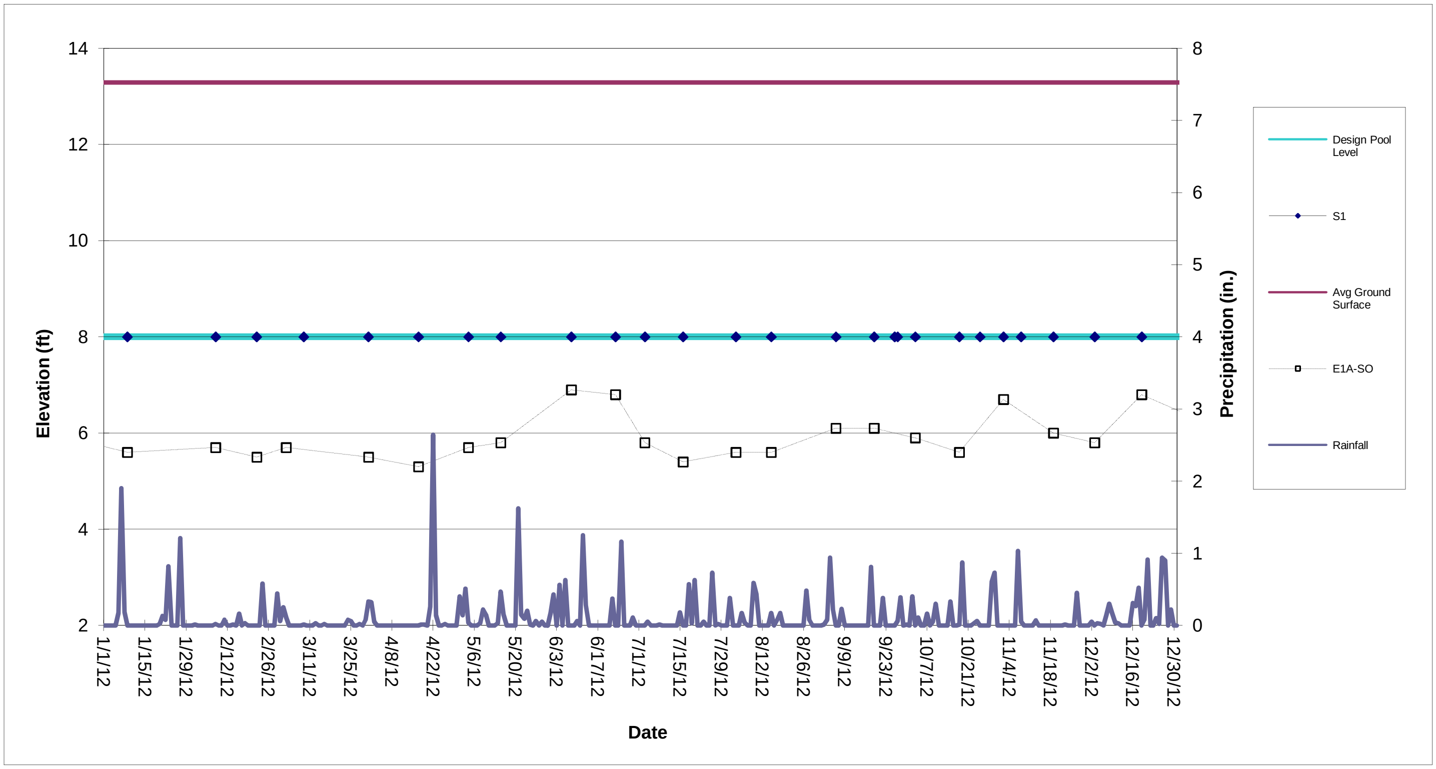


Perimeter Pool E1 (Sta. E0+50 to E3+75)

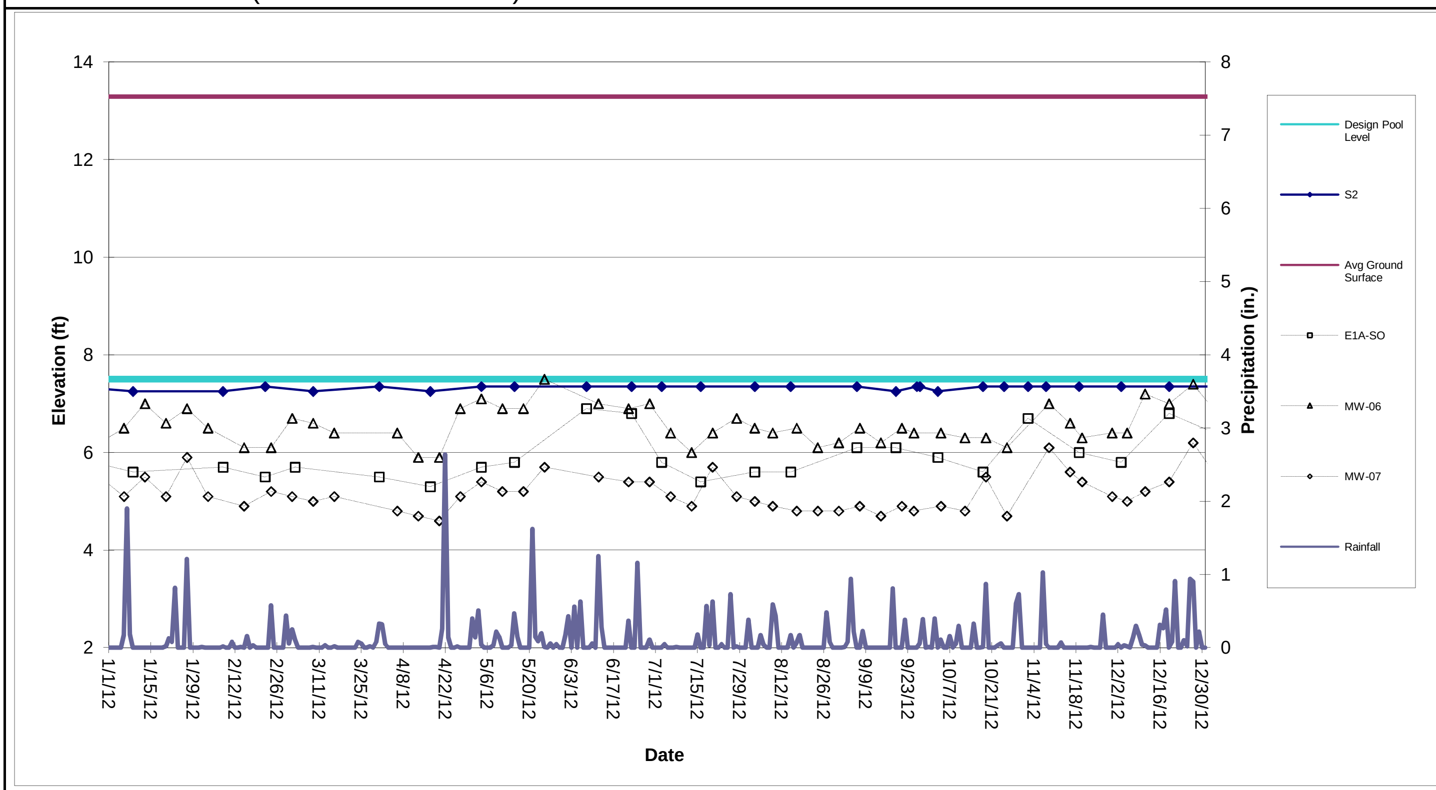


Perimeter Pool E2 (Sta. E4+50 to E7+25)

Attachment C: Perimeter Pools

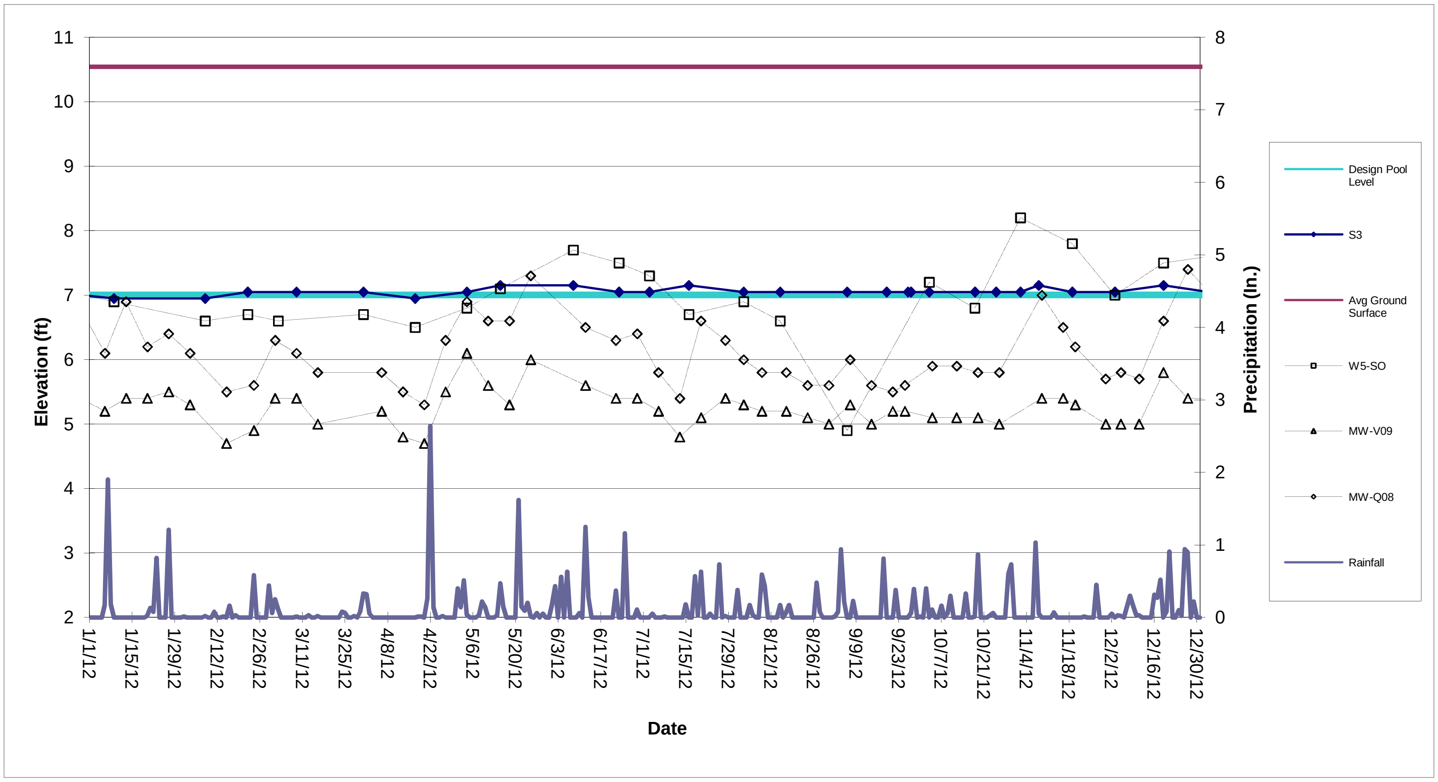


Perimeter Pool S1 (Sta. S0+50 to S3+88)

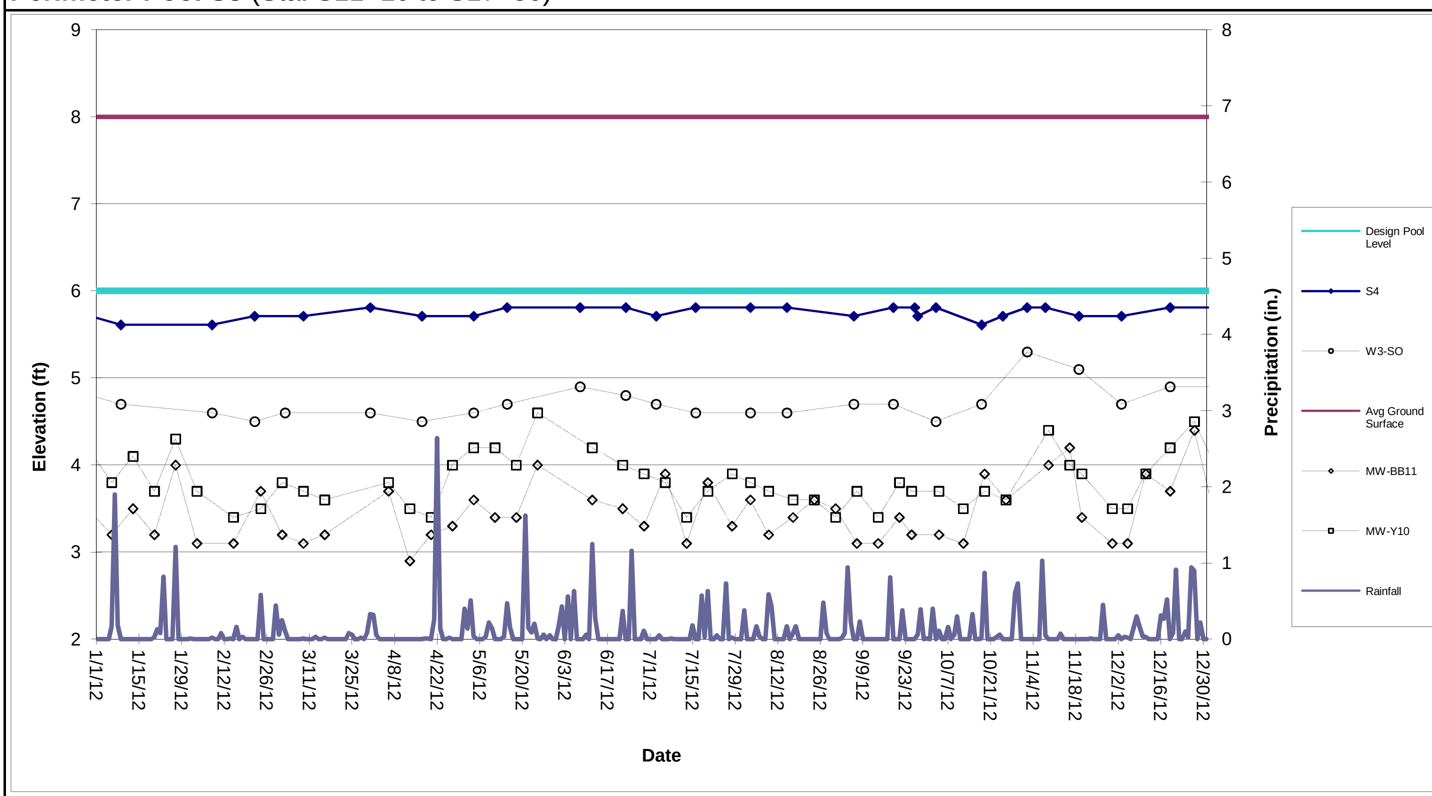


Perimeter Pool S2 (Sta. S4+38 to S10+60)

Attachment C: Perimeter Pools



Perimeter Pool S3 (Sta. S11+10 to S17+50)



Perimeter Pool S4 (Sta. S17+86 to S22+05)

Table 1

Shallow Groundwater Data

										087-MW-			134-MW-		073-MW-		140-	
Date	E1A-SO	E2-SO	E3-SO	E4-SO	E5-SO	W1-SO	W3-SO	W5-SO	W6-SO	Y20	001	O19	V09	Q08	BB-11	Y10	MW-06	MW-07
7/3/2012	5.8	5.5	6.0	6.0	6.7	7.7	4.7	7.3	6.0	3.5	6.6	6.8						
7/6/2012													5.2	5.8	3.9	3.8	6.4	5.1
7/13/2012													4.8	5.4	3.1	3.4	6.0	4.9
7/16/2012	5.4	5.6	6.1	5.9	6.4	7.7	4.6	6.7	5.8	3.2	6.2	6.5						
7/20/2012													5.1	6.6	3.8	3.7	6.4	5.7
7/28/2012													5.4	6.3	3.3	3.9	6.7	5.1
8/3/2012	5.6	5.6	6.0	5.8	6.3	7.5	4.6	6.9	5.6	5.1	6.3	6.4	5.3	6.0	3.6	3.8	6.5	5.0
8/9/2012													5.2	5.8	3.2	3.7	6.4	4.9
8/15/2012	5.6	5.6	6.1	6.0	6.3	7.3	4.6	6.6	5.5	3.2	6.5	6.7						
8/17/2012													5.2	5.8	3.4	3.6	6.5	4.8
8/24/2012													5.1	5.6	3.6	3.6	6.1	4.8
8/31/2012													5.0	5.6	3.5	3.4	6.2	4.8
9/6/2012	6.1	5.5	5.9	5.6	5.9	7.3	4.7	4.9	5.2	3.6	6.5	6.5						
9/7/2012													5.3	6.0	3.1	3.7	6.5	4.9
9/14/2012													5.0	5.6	3.1	3.4	6.2	4.7
9/19/2012	6.1	5.6	6.1	5.8	6.1	7.5	4.7		5.4	3.7	6.5	6.5						
9/21/2012													5.2	5.5	3.4	3.8	6.5	4.9
9/25/2012													5.2	5.6	3.2	3.7	6.4	4.8
10/3/2012	5.9	5.5	6.1	5.5	5.8	7.0	4.5	7.2	5.4	2.9	5.7	6.4						
10/4/2012													5.1	5.9	3.2	3.7	6.4	4.9
10/12/2012													5.1	5.9	3.1	3.5	6.3	4.8
10/18/2012	5.6	5.4	5.7	5.6	5.8	6.9	4.7	6.8	4.9	3.2	5.8	5.8						
10/19/2012													5.1	5.8	3.9	3.7	6.3	5.5
10/26/2012													5.0	5.8	3.6	3.6	6.1	4.7
11/2/2012	6.7	5.7	5.8	6.8	6.8	7.0	5.3	8.2	5.8	4.1	6.5	9.4						
11/9/2012													5.4	7.0	4.0	4.4	7.0	6.1
11/16/2012													5.4	6.5	4.2	4.0	6.6	5.6
11/19/2012	6.0	5.9	6.3	6.6	6.7	7.1	5.1	7.8	5.3	3.4	6.5	6.6						
11/20/2012													5.3	6.2	3.4	3.9	6.3	5.4
11/30/2012													5.0	5.7	3.1	3.5	6.4	5.1
12/3/2012	5.8	5.8	6.2	6.3	6.4	7.1	4.7	7.0	5.2	3.1	6.3	6.5						
12/5/2012													5.0	5.8	3.1	3.5	6.4	5.0
12/11/2012													5.0	5.7	3.9	3.9	7.2	5.2
12/19/2012	6.8						4.9	7.5			6.9		5.8	6.6	3.7	4.2	7.0	5.4
12/21/2012		5.7	6.1	6.7	7.0	7.4			6.9	4.4		7.3						
12/27/2012													5.4	7.4	4.4	4.5	7.4	6.2

APPENDIX B

RESULTS OF PRE-INJECTION MONITORING IN INJECTION WELLS

Table B1
Results of Pre-injection Monitoring of Injection Wells

Total Chromium in Unfiltered Samples (ppm)

Event #	Sample Date	088-IW-01	088-IW-02	115-PW-21	115-DP-2	087-IW-01	117-MW-I4
1	5/16/2012	72.40	255.0	NS	NS	0.047	6,980
2	6/28/2012	0.52	111.0	NS	NS	0.026	8,900
3	7/31/2012	0.14	4.33	NS	NS	0.019	NS
3A	8/16/2012	NS	NS	536	NS	NS	NS
4	10/1/2012	0.16	4.19	<0.020	40.4	NS	NS
5	12/9/2012	0.06	2.82	<0.050	NS	NS	NS

Total Chromium in Filtered Samples (ppm)

Event #	Sample Date	088-IW-01	088-IW-02	115-PW-21	115-DP-2	087-IW-01	117-MW-I4
1	5/16/2012	56.50	250.0	NS	NS	0.037	7120
2	6/28/2012	0.56	104.0	NS	NS	0.022	7540
3	7/31/2012	<.1	<.1	NS	NS	0.017	NS
3A	8/16/2012	NS	NS	532	NS	NS	NS
4	10/1/2012	<0.020	0.071	<0.020	41.4	NS	NS
5	12/9/2012	<0.050	0.143	<0.050	NS	NS	NS

(Blue shading) Sample collected just prior to first injection in indicated well
(Pink shading) Sample collected just prior to second injection in indicated well

Table B2
Results of Pre-injection Monitoring of Injection Wells

Hexavalent Chromium in Unfiltered Samples (ppm)

Event #	Sample Date	088-IW-01	088-IW-02	115-PW-21	115-DP-2	087-IW-01	117-MW-I4	088-IW-03
1	5/16/2012	48.8	94.2	NS	NS	<0.010	7,250	NS
2	6/28/2012	<0.55	130.0	NS	NS	<0.005	9,130	NS
3	7/31/2012	<.55	<.55	NS	NS	<0.0055	NS	NS
3A	8/16/2012	NS	NS	594	NS	NS	NS	NS
4	10/1/2012	<0.55	<0.55	<0.50	40.9	NS	NS	NS
5	12/9/2012	<0.14	<0.14	<0.14	NS	NS	NS	NS

Hexavalent Chromium in Filtered Samples (ppm)

Event #	Sample Date	088-IW-01	088-IW-02	115-PW-21	115-DP-2	087-IW-01	117-MW-I4	088-IW-03
1	5/16/2012	54.2	98.7	NS	NS	<0.010	7,390	NS
2	6/28/2012	<0.55	126.0	NS	NS	<0.005	8,760	NS
3	7/31/2012	<100	<.55	NS	NS	<.0055	NS	NS
3A	8/16/2012	NS	NS	621	NS	NS	NS	NS
4	10/1/2012	44.7*	<0.55	<0.55	44.7	NS	NS	NS
5	12/9/2012	<0.14	<0.14	<0.14	NS	NS	NS	NS

* reported concentration questionable due to matrix interference

Sample collected just prior to first injection in indicated well (blue shading)
Sample collected just prior to second injection in indicated well (pink shading)

Table B3
Results of Pre-injection Monitoring of Injection Wells

Sulfate in Unfiltered Samples (ppm)

Event #	Sample Date	088-IW-01	088-IW-02	115-PW-21	115-DP-2	087-IW-01
1	5/16/2012	147	95.7	NS	NS	49.6
2	6/28/2012	861	315	NS	NS	50.6
3	7/31/2012	474	1390	NS	NS	40.3
3A	8/16/2012	NS	NS	1290	NS	NS
4	10/1/2012	<400	479	740	395	NS
5	12/9/2012	244	227	830	NS	NS

Sulfate in Filtered Samples (ppm)

Event #	Sample Date	088-IW-01	088-IW-02	115-PW-21	115-DP-2	087-IW-01
1	5/16/2012	157	111	NS	NS	50.0
2	6/28/2012	1010	290	NS	NS	56.2
3	7/31/2012	506	1390	NS	NS	39.9
3A	8/16/2012	NS	NS	1250	NS	NS
4	10/1/2012	424	468	867	392	NS
5	12/9/2012	249	229	856	NS	NS

(blue) Sample collected just prior to first injection in indicated well
(pink) Sample collected just prior to second injection in indicated well

Table B4
Results of Pre-injection Monitoring of Injection Wells

Calcium in Unfiltered Samples (ppm)

Event #	Sample Date	088-IW-01	088-IW-02	115-PW-21	115-DP-2	087-IW-01	117-MW-I4
1	5/16/2012	34.7	51.2	NS	NS	73.0	1,590
2	6/28/2012	7,760	<50	NS	NS	69.3	1,370
3	7/31/2012	2,900	14,300	NS	NS	603	NS
3A	8/16/2012	NS	NS	370	NS	NS	NS
4	10/1/2012	1,400	1,800	3,900	97.4	NS	NS
5	12/9/2012	827	970	2,280	NS	NS	NS

Calcium in Filtered Samples (ppm)

Event #	Sample Date	088-IW-01	088-IW-02	115-PW-21	115-DP-2	087-IW-01	117-MW-I4
1	5/16/2012	24.2	48.2	NS	NS	72.7	1,550
2	6/28/2012	7,280	<50	NS	NS	69.0	1,460
3	7/31/2012	3,310	12,900	NS	NS	58.8	NS
3A	8/16/2012	NS	NS	366	NS	NS	NS
4	10/1/2012	2,220	1,670	3,840	95.4	NS	NS
5	12/9/2012	695	1,040	2,630	NS	NS	NS

Sample collected just prior to first injection in indicated well (blue shading)
Sample collected just prior to second injection in indicated well (red shading)

Table B5
Results of Pre-injection Monitoring of Injection Wells

Iron in Unfiltered Samples (ppm)

Event #	Sample Date	088-IW-01	088-IW-02	115-PW-21	115-DP-2	087-IW-01	117-MW-I4
1	5/16/2012	5.060	4.070	NS	NS	0.516	<50
2	6/28/2012	<5.0	1.900	NS	NS	0.502	<20
3	7/31/2012	4.68	<0.5	NS	NS	NS	NS
3A	8/16/2012	NS	NS	0.861	NS	NS	NS
4	10/1/2012	0.835	0.255	0.464	<0.1	NS	NS
5	12/9/2012	0.504	0.517	<0.5	NS	NS	NS

Iron in Filtered Samples (ppm)

Event #	Sample Date	088-IW-01	088-IW-02	115-PW-21	115-DP-2	087-IW-01	117-MW-I4
1	5/16/2012	0.327	<.2	NS	NS	0.386	<50
2	6/28/2012	<5.0	<1.0	NS	NS	0.475	<10
3	7/31/2012	<1.0	<0.5	NS	NS	0.41	NS
3A	8/16/2012	NS	NS	<5.0	NS	NS	NS
4	10/1/2012	<0.2	<0.2	0.429	<0.1	NS	NS
5	12/9/2012	<0.5	<0.5	<0.5	NS	NS	NS

(blue) Sample collected just prior to first injection in indicated well
(pink) Sample collected just prior to second injection in indicated well

Table B6
Results of Pre-injection Monitoring of Injection Wells

		Field pH (pH units)					
Event #	Sample Date	088-IW-01	088-IW-02	115-PW-21	115-DP-2	087-IW-01	117-MW-I4
1	5/16/2012	8.08	7.46	NS	NS	7.21	6.91
2	5/28/2012	10.98	7.53	NS	NS	7.42	7.13
3	7/31/2012	10.56	10.38	NS	NS	6.96	NS
3A	8/16/2012	NS	NS	6.56	NS	NS	NS
4	10/1/2012	10.95	11.19	11.52	7.65	NS	NS
5	12/9/2012	8.27	9.46	10.74	NS	NS	NS

(blue) Sample collected just prior to first injection in indicated well
(pink) Sample collected just prior to second injection in indicated well

Table B7
Results of Pre-injection Monitoring of Injection Wells

		Field Specific Conductivity (ms/cm)					
Event #	Sample Date	088-IW-01	088-IW-02	115-PW-21	115-DP-2	087-IW-01	117-MW-I4
1	5/16/2012	1.78	1.68	NS	NS	2.81	6.27
2	6/28/2012	32.7	1.41	NS	NS	2.11	30.3
3	7/31/2012	14.2	47.0	NS	NS	2.33	NS
3A	8/16/2012	NS	NS	5.16	NS	NS	NS
4	10/1/2012	7.1	10.0	17.7	1.8	NS	NS
5	12/9/2012	37.6	5.89	13.0	NS	NS	NS

(blue shading) Sample collected just prior to first injection in indicated well
(pink shading) Sample collected just prior to second injection in indicated well

Table B8
Results of Pre-injection Monitoring of Injection Wells

		Field Redox Potential (mv)					
Event #	Sample Date	088-IW-01	088-IW-02	115-PW-21	115-DP-2	087-IW-01	117-MW-I4
1	5/16/2012	93	230	NS	NS	-38	362
2	6/28/2012	-533	140	NS	NS	-128	298
3	7/31/2012	-498	-507	NS	NS	-49	NS
3A	8/16/2012	NS	NS	263	NS	NS	NS
4	10/1/2012	-508	-510	-498	170	NS	NS
5	12/9/2012	-497	-497	-493	NS	NS	NS

(blue) Sample collected just prior to first injection in indicated well
(pink) Sample collected just prior to second injection in indicated well

Table B9
Results of Pre-injection Monitoring of Injection Wells

Field Dissolved Oxygen (mg/L)

Event #	Sample Date	088-IW-01	088-IW-02	115-PW-21	115-DP-2	087-IW-01	117-MW-I4
1	5/16/2012	0.38	0.51	NS	NS	1.02	0.37
2	6/28/2012	0.00	0.00	NS	NS	0.00	0.10
3	7/31/2012	0.52	4.73	NS	NS	0.00	NS
3A	8/16/2012	NS	NS	0.00	NS	NS	NS
4	10/1/2012	2.70	5.88	5.00	1.02	NS	NS
5	12/9/2012	5.16	0.43	1.49	NS	NS	NS

(Blue shading) Sample collected just prior to first injection in indicated well
(Pink shading) Sample collected just prior to second injection in indicated well

Table B10
Results of Pre-injection Monitoring of Injection Wells

Field Turbidity (NTU)

Event #	Sample Date	088-IW-01	088-IW-02	115-PW-21	115-DP-2	087-IW-01	117-MW-I4
1	5/16/2012	15.2	39.4	NS	NS	0.0	3.6
2	6/28/2012	>800	24.1	NS	NS	8.5	609
3	7/31/2012	13.0	113	NS	NS	18.1	NS
3A	8/16/2012	NS	NS	12.5	NS	NS	NS
4	10/1/2012	0.0	34.1	0.0	0.0	NS	NS
5	12/9/2012	0.0	0.0	0.0	NS	NS	NS

(blue shading) Sample collected just prior to first injection in indicated well
(pink shading) Sample collected just prior to second injection in indicated well

APPENDIX C

RESULTS OF PRE-INJECTION MONITORING IN MONITORING WELLS

Table C1
Results of Pre-injection Monitoring of Monitoring Wells

Total Chromium in Unfiltered Samples (ppm)

Event #	Sample Date	087-PW-1	087-PW-2	090-MW-09	115-DP-1	088-MW-G19T	087-MW-O29D	087-MW-03
1	5/16/2012	46.9	16.2	1,680	307	762	180	NS
2	6/28/2012	NS	NS	NS	NS	889	NS	NS
3	7/31/2012	NS	NS	NS	NS	989	NS	155
3A	8/16/2012	NS	NS	NS	NS	NS	NS	NS
4	10/1/2012	NS	NS	NS	NS	NS	NS	NS
5	12/9/2012	37.9	14.8	2,220	359	985	171	NS

Total Chromium in Filtered Samples (ppm)

Event #	Sample Date	087-PW-1	087-PW-2	090-MW-09	115-DP-1	088-MW-G19T	087-MW-O29D	087-MW-03
1	5/16/2012	46.1	17.1	1,680	274	817	220	NS
2	6/28/2012	NS	NS	NS	NS	871	NS	NS
3	7/31/2012	NS	NS	NS	NS	993	NS	168
3A	8/16/2012	NS	NS	NS	NS	NS	NS	NS
4	10/1/2012	NS	NS	NS	NS	NS	NS	NS
5	12/9/2012	NS	NS	2,180	38	994	197	NS

Table C2
Results of Pre-injection Monitoring of Monitoring Wells

Hexavalent Chromium in Unfiltered Samples (ppm)

Event #	Sample Date	087-PW-1	087-PW-2	090-MW-09	115-DP-1	088-MW-G19T	087-MW-O29D	087-MW-03
1	5/16/2012	43.9	15.1	2,600	389.0	777	189	NS
2	6/28/2012	NS	NS	NS	NS	933	NS	NS
3	7/31/2012	NS	NS	NS	NS	897	NS	195
3A	8/16/2012	NS	NS	NS	NS	NS	NS	NS
4	10/1/2012	NS	NS	NS	NS	NS	NS	NS
5	12/9/2012	45.1	15.6	2,690	39.3	1,150	235	NS

Hexavalent Chromium in Filtered Samples (ppm)

Event #	Sample Date	087-PW-1	087-PW-2	090-MW-09	115-DP-1	088-MW-G19T	087-MW-O29D	087-MW-03
1	5/16/2012	42.8	14.9	2,210	375.0	1,120	199	NS
2	6/28/2012	NS	NS	NS	NS	909	NS	NS
3	7/31/2012	NS	NS	NS	NS	897	NS	203
3A	8/16/2012	NS	NS	NS	NS	NS	NS	NS
4	10/1/2012	NS	NS	NS	NS	NS	NS	NS
5	12/9/2012	NS	NS	2,590	45.4	1,210	233	NS

Table C3
Results of Pre-injection Monitoring of Monitoring Wells

Sulfate in Unfiltered Samples (ppm)

Event #	Sample Date	087-PW-1	087-PW-2	090-MW-09	115-DP-1	088-MW-G19T	087-MW-O29D	087-MW-03
1	5/16/2012	320	613	1,000	749	843	604	NS
2	6/28/2012	NS	NS	NS	NS	1,030	NS	NS
3	7/31/2012	NS	NS	NS	NS	1,020	NS	850
3A	8/16/2012	NS	NS	NS	NS	NS	NS	NS
4	10/1/2012	NS	NS	NS	NS	NS	NS	NS
5	12/9/2012	307	671	1,110	202	1,020	688	NS

Sulfate in Filtered Samples (ppm)

Event #	Sample Date	087-PW-1	087-PW-2	090-MW-09	115-DP-1	088-MW-G19T	087-MW-O29D	087-MW-03
1	5/16/2012	318.0	639	1,030	607	880	639	NS
2	6/28/2012	NS	NS	NS	NS	1,030	NS	NS
3	7/31/2012	NS	NS	NS	NS	945	NS	859
3A	8/16/2012	NS	NS	NS	NS	NS	NS	NS
4	10/1/2012	NS	NS	NS	NS	NS	NS	NS
5	12/9/2012	NS	NS	1,130	222	1,030	671	NS

Table C4
Results of Pre-injection Monitoring of Monitoring Wells

Calcium in Unfiltered Samples (ppm)

Event #	Sample Date	087-PW-1	087-PW-2	090-MW-09	115-DP-1	088-MW-G19T	087-MW-O29D	087-MW-03
1	5/16/2012	97.7	169	547	112	287	48.2	NS
2	6/28/2012	NS	NS	NS	NS	293	NS	NS
3	7/31/2012	NS	NS	NS	NS	284	NS	207
3A	8/16/2012	NS	NS	NS	NS	NS	NS	NS
4	10/1/2012	NS	NS	NS	NS	NS	NS	NS
5	12/9/2012	88.4	146	492	370	336	52.1	NS

Calcium in Filtered Samples (ppm)

Event #	Sample Date	087-PW-1	087-PW-2	090-MW-09	115-DP-1	088-MW-G19T	087-MW-O29D	087-MW-03
1	5/16/2012	97.0	163	503	106	289	57.9	NS
2	6/28/2012	NS	NS	NS	NS	320	NS	NS
3	7/31/2012	NS	NS	NS	NS	314	NS	219
3A	8/16/2012	NS	NS	NS	NS	NS	NS	NS
4	10/1/2012	NS	NS	NS	NS	NS	NS	NS
5	12/9/2012	NS	NS	477	367	340	61.7	NS

Table C5
Results of Pre-injection Monitoring of Monitoring Wells

Iron in Unfiltered Samples (ppm)

Event #	Sample Date	087-PW-1	087-PW-2	090-MW-09	115-DP-1	088-MW-G19T	087-MW-O29D	087-MW-03
1	5/16/2012	<.5	< .5	< 25	0.764	<2	1.12	NS
2	6/28/2012	NS	NS	NS	NS	<10	NS	NS
3	7/31/2012	NS	NS	NS	NS	4.79	NS	1.62
3A	8/16/2012	NS	NS	NS	NS	NS	NS	NS
4	10/1/2012	NS	NS	NS	NS	NS	NS	NS
5	12/9/2012	<0.1	<0.1	NS	0.954	NS	<0.5	NS

Iron in Filtered Samples (ppm)

Event #	Sample Date	087-PW-1	087-PW-2	090-MW-09	115-DP-1	088-MW-G19T	087-MW-O29D	087-MW-03
1	5/16/2012	< .5	< .5	<25	<.5	<2	0.517	NS
2	6/28/2012	NS	NS	NS	NS	<3	NS	NS
3	7/31/2012	NS	NS	NS	NS	<2.5	NS	<0.5
3A	8/16/2012	NS	NS	NS	NS	NS	NS	NS
4	10/1/2012	NS	NS	NS	NS	NS	NS	NS
5	12/9/2012	NS	NS	NS	0.171	NS	<0.5	NS

Table C6
Results of Pre-injection Monitoring of Monitoring Wells

Field pH (pH units)

Event #	Sample Date	090-MW-09	115-DP-1	088-MW-G19T	087-MW-O29D	087-MW-03
1	5/16/2012	6.84	7.29	7.72	7.73	NS
2	5/28/2012	NS	NS	7.83	NS	NS
3	7/31/2012	NS	NS	7.41	NS	7.15
3A	8/16/2012	NS	NS	NS	NS	NS
4	10/1/2012	NS	NS	NS	NS	NS
5	12/9/2012	7.36	7.97	7.47	7.35	NS

Table C7
Results of Pre-injection Monitoring of Monitoring Wells

Field Specific Conductivity (ms/cm)

Event #	Sample Date	090-MW-09	115-DP-1	088-MW-G19T	087-MW-O29D	087-MW-03
1	5/16/2012	12.20	5.45	7.56	5.09	NS
2	6/28/2012	NS	NS	7.21	NS	NS
3	7/31/2012	NS	NS	7.66	NS	15.8
3A	8/16/2012	NS	NS	NS	NS	NS
4	10/1/2012	NS	NS	NS	NS	NS
5	12/9/2012	11.70	3.03	8.10	4.85	NS

Table C8
Results of Pre-injection Monitoring of Monitoring Wells

Field Redox Potential (mv)

Event #	Sample Date	090-MW-09	115-DP-1	088-MW-G19T	087-MW-O29D	087-MW-03
1	5/16/2012	347	276	251	244	NS
2	6/28/2012	NS	NS	184	NS	NS
3	7/31/2012	NS	NS	187	NS	173
3A	8/16/2012	NS	NS	NS	NS	NS
4	10/1/2012	NS	NS	NS	NS	NS
5	12/9/2012	300	-153	104	-7.0	NS

Table C9
Results of Pre-injection Monitoring of Monitoring Wells

Field Dissolved Oxygen (mg/L)

Event #	Sample Date	090-MW-09	115-DP-1	088-MW-G19T	087-MW-O29D	087-MW-03
1	5/16/2012	0.46	2.25	0.43	0.67	NS
2	6/28/2012	NS	NS	0.00	NS	NS
3	7/31/2012	NS	NS	0.00	NS	0.00
3A	8/16/2012	NS	NS	NS	NS	NS
4	10/1/2012	NS	NS	NS	NS	NS
5	12/9/2012	0.99	1.22	1.02	1.07	NS

Table C10
Results of Pre-injection Monitoring of Monitoring Wells

Field Turbidity (NTU)

Event #	Sample Date	090-MW-09	115-DP-1	088-MW-G19T	087-MW-O29D	087-MW-03
1	5/16/2012	0.0	0.0	74.3	0.0	NS
2	6/28/2012	NS	NS	64.0	NS	NS
3	7/31/2012	NS	NS	157	NS	19.0
3A	8/16/2012	NS	NS	NS	NS	NS
4	10/1/2012	NS	NS	NS	NS	NS
5	12/9/2012	177	0.0	650	708	NS