

Annual Remedial Performance Report for Chromium and Perchlorate

Nevada Environmental Response Trust Site
Henderson, Nevada
July 2011 – June 2012

Prepared for:
Nevada Environmental Response Trust

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ENVIRON

Nevada Environmental Response Trust (NERT) Site
(Former Tronox LLC Site)
Clark County, Nevada

Nevada Environmental Response Trust (NERT) Representative Certification

I certify that this document and all attachments submitted to the Division were prepared at the request of, or under the direction or supervision of the Trust. Based on my own involvement and/or my inquiry of the person or persons who manage the system(s) or those directly responsible for gathering the information or prepared the document, or the immediate supervisor of such person(s), the information submitted and provided herein is, to the best of my knowledge and belief, true, accurate, and complete in all material respects.

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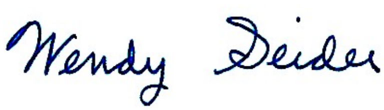

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1 Introduction

In accordance with the Interim Consent Agreement between the Nevada Environmental Response Trust (the Trust) and the Nevada Division of Environmental Protection (NDEP), ENVIRON International Corporation (ENVIRON) submits this remedial performance report to NDEP on behalf of the Trust for the Nevada Environmental Response Trust Site (the Site).

Tronox LLC (Tronox) formerly owned and operated the Site. In conjunction with the settlement of Tronox's bankruptcy proceeding, the Trust took title to the Site and the groundwater extraction and treatment system (GWETS). The effective date of the property transfer to the Trust and the Interim Consent Agreement between the Trust and NDEP was February 14, 2011. The Tronox facility remains on a portion of the Site leased from the Trust in order to continue manufacturing operations.

This report, covering the period July 2011 through June 2012, summarizes performance data for both the chromium and perchlorate remediation programs based on sampling performed during this period. Specifically, this report describes:

- Regional groundwater conditions based on July 2011 through June 2012 groundwater levels;
- The hexavalent chromium remediation system (consisting of the on-site Interceptor Well Field [IWF], the off-site Athens Road Well Field [AWF], and the related treatment systems) and its performance in carrying out the extraction and treatment of chromium-impacted groundwater;
- The perchlorate remediation system (consisting of the on-site IWF, the off-site AWF, the off-site Seep Well Field [SWF], the off-site seep surface-flow capture sump, and related treatment systems) and its performance in carrying out the extraction and treatment of perchlorate-impacted;
- The distribution of total dissolved solids (TDS) concentrations at the Site; and
- Recommendations to further evaluate and improve the performance of the GWETS[1].

Annual groundwater sampling (completed in the second calendar quarter) is a coordinated sampling event with several neighboring companies participating. Data from groundwater samples collected by neighboring companies are incorporated into the potentiometric, total chromium, perchlorate, and TDS maps. For the 2012 Annual Remedial Performance Report, the Trust received information from American Pacific Corporation (AMPAC), Olin/Stauffer/Syngenta/Montrose (OSSM), Southern Nevada Water Authority (SNWA), and Titanium Metals Corporation (TIMET); their data were integrated into the development of these maps.

[1] Herein "GWETS" will be used to refer to the entirety of all systems and components of the groundwater extraction and treatment systems owned and operated by the Trust, both on-site and off-site, including extraction well fields, treatment facilities, and groundwater conveyance systems.

This report is provided in both hard copy and electronic forms. Where electronic files are referenced or information is stated as provided on compact disc (CD), this information is contained on the CD attached to the hard copy report. Appendix A contains two tables (as hard copy and on the report CD): Table A-1, which has five quarters of analytical data from the Site, and Table A-2, which has May through June 2012 data from AMPAC, OSSM, SNWA, and TIMET used to supplement Plates 2, 6, 7, and 8 in this report. Appendix B contains the Electronic Data Deliverable (EDD). The EDD includes an Access© compatible data file (on the report CD) containing the analytical results from the period January to June 2012, and an Access© compatible data file (on the report CD) containing water level monitoring data from the period January to June 2012. Appendix C contains the Data Validation Summary Report (DVSR) (on the report CD). Appendix D contains the field records from January to June 2012 (on the report CD). Appendix E contains an analysis of groundwater extraction rates and capture at the IWF and AWF, and provides the basis for preliminary recommendations for alternative pumping schemes to maximize capture and mass removal at these two well fields.

2 Area Groundwater Conditions

The components of the groundwater recovery systems are shown on Figure 1, a location map covering the area between the Site and Las Vegas Wash. This section provides a discussion of the general hydrogeology of the Site and includes an evaluation of the performance of the groundwater recovery at each system (extraction well field) currently in operation at the Site; the Interceptor Well Field (IWF), Athens Road Well Field (AWF), and Seep Well Field (SWF). Plate 1 shows the locations of all former and current groundwater monitoring wells in the mapped area.

Ground surface elevations across the Site range from 1,677 to 1,873 feet above mean sea level. The ground surface across the Site generally slopes downward to the north at a gradient of approximately 0.022 feet per foot (ft/ft). Off-site to the north, the topographic surface continues at roughly the same gradient to approximately Sunset Road, at which point it flattens to a gradient of 0.011 ft/ft extending northward to the Las Vegas Wash. The shallow groundwater gradient is generally consistent with the surface topography.

The NDEP has defined three water-bearing zones (WBZs) that are of interest in the vicinity of the Site, including the Shallow, Middle, and Deep Zones. The Shallow Zone, which extends to approximately 90 feet below ground surface (bgs), is unconfined to partially confined, and is considered the water table aquifer. The Middle Zone is approximately 90 to 300 feet bgs, and the Deep Zone is defined as the contiguous water-bearing zone that is generally encountered between 300 to 400 feet bgs. The Trust maintains groundwater wells in all three of the WBZs, but unless otherwise stated, discussions of groundwater in this report refer to the Shallow Zone, which contains the saturated portions of the Quaternary alluvium (Qal) and the uppermost portion of the Muddy Creek Formation (UMCf).

Shallow groundwater is generally encountered in on-site wells between 20 and 75 feet bgs and is generally deepest in the southernmost portion of the Site. North of the Site, beyond Boulder Highway, shallow groundwater is generally encountered between 4 and 20 feet bgs, becoming shallower as it approaches the Las Vegas Wash. Plate 2, the *Potentiometric Surface Map: Shallow Water-Bearing Zone*, is based on groundwater elevation measurements taken in May-June 2012 by the Trust, AMPAC, OSSM, SNWA, and TIMET, and is interpreted with the KT3D_H2O v3.0[2], a program for kriging water level data. KT3D_H2O is limited in its ability to account for low or no flow conditions, such as a barrier wall. Hence, the resulting potentiometric surface generated out of KT3D_H2O is further interpolated in ARCGIS using Spatial Analyst, adjusting contours at the IWF on-site bentonite-slurry groundwater barrier wall (barrier wall). On Plate 2, wells where the potentiometric surface is located in the shallow UMCf are indicated by a yellow highlight over the well identifier. Wells where the potentiometric surface is located in the Qal overlying the UMCf are not highlighted.

At the southern end of the Site, the groundwater flow direction is generally north to northwesterly, whereas, north of the Site, the direction changes slightly to the north-northeast.

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[2] Karanovic, M., Tonkin, M., and Wilson, D. 2009. *KT3D_H2O:* A Program for Kriging Water Level Data Using Hydrologic Drift Terms. Ground Water, Vol. 47, N0. 4:580-586.

The map shows an average gradient of 0.016 to 0.02 feet per foot south of the AWF, flattening to 0.007 to 0.010 feet per foot north of the AWF. This generally uniform flow pattern may be modified locally by subsurface alluvial channels from the Qal cut into the underlying UMCf, the barrier wall, on- and off-site artificial groundwater highs or "mounds" created around the on-site recharge trenches[3] and City of Henderson (COH) Water Reclamation Facility (WRF) Rapid Infiltration Basins (RIBs)[4], and depressions created by the groundwater extraction wells at the three groundwater recovery well fields.

2.1 Interceptor Well Field Area

The location of the IWF area is shown on Figure 1 and Plate 2. A bentonite-slurry wall was constructed as a physical barrier across the higher concentration portion of the perchlorate/chromium plume on the Site in 2001. The barrier wall is approximately 1,600 feet in length and 60 feet deep and constructed to tie into approximately 30 feet of UMCf. The IWF consists of a series of 23 active groundwater extraction wells that are situated south (upgradient) of the barrier wall. Seven additional extraction wells (I-W, I-X, I-Y, I-AA, I-AB, I-AC, and I-AD) were installed and connected to the well field in 2010-2011; however, extraction from these wells has not commenced. The Trust understands that these additional extraction wells were installed in response to Data Gap #3 identified in the March 2010 Interim Groundwater Capture Evaluation and Vertical Delineation Report prepared by Northgate Environmental Management Inc. (Northgate) on behalf of Tronox.[5] The Trust has performed an analysis of current groundwater capture at the IWF and recommends adjusting extraction rates of currently active individual wells within the IWF and commencement of pumping from the seven additional extraction wells mentioned above to improve capture and mass removal efficiency at the IWF. The details of this analysis and the proposed changes to the extraction rates are included in Appendix E.

The annual average discharge rate for each IWF well active during July 2011 - June 2012 is shown on Table 1, along with the annual average discharge rates from the five previous years. The combined discharge of the IWF averaged 65.1 gallons per minute (gpm) over the last year (July 2011 - June 2012), which is generally consistent with the previous five years. Over the last five years of operation, the combined discharge of the IWF averaged 66.6 gpm. For comparison, in June 2001, prior to the installation of the barrier wall, the 22 wells comprising the IWF at that time averaged a combined discharge of 24.7 gpm.

Groundwater recharge trenches located downgradient (north) of the barrier wall were originally installed to receive extracted and treated groundwater, but have been used in the recent past to inject stabilized Lake Mead water into the subsurface to replace water extracted by the IWF. Reinjection ceased in September 2010 when the recharge trenches were removed to

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[3] Reinjection of stabilized Lake Mead water ceased in September 2010 as the recharge trenches were removed to accommodate soil excavation activities at the Site. They have not been replaced.

[4] Since the completion of the COH WRF in 2008, discharge of treated effluent to the Pabco Road RIBs has ceased; however, significant groundwater mounding events continue to be observed. The current mounding events are likely attributable to the operation of the birding preserve ponds located west of the RIBs.

[5] Northgate Environmental Management, Inc. 2010. Interim Groundwater Capture Evaluation and Vertical Delineation Report, Tronox LLC, Henderson, Nevada. March 23.

accommodate soil excavation and remediation activities at the Site. The Trust continues to evaluate the issue of artificial recharge at the Site. Specifically, the Trust has proposed to NDEP use of the site-specific calibrated groundwater flow model developed for the site and presented in Northgate's December 2010 Capture Zone Evaluation Report (2010 CZE Report)[6] to conduct further analysis and optimization of the GWETS, including evaluating the effectiveness of the recharge trench system and providing recommendations for the resumption of artificial recharge at the Site (if deemed to be an effective strategy and consistent with future Remedial Action Objectives for groundwater). The Trust is currently addressing NDEP's comments on the groundwater flow model and will conduct the above-described analyses upon NDEP's final approval.

Plate 3, *West-East Hydrogeologic Cross Section A-A' – Interceptor Well Field, Second Quarter 2012,* shows the current water levels in the pumping Interceptor wells and adjacent monitoring wells, and the relationships between the pre-pumping and current groundwater levels in the vicinity of the IWF. The cross section also shows the series of narrow subparallel alluvial channels separated by UMCf ridges, some of which are above the current groundwater level. In general, water elevations in the IWF in May 2012 are slightly lower than the water elevations from one year ago. Water levels in the pumping wells indicate that the individual wells are creating localized groundwater depression zones extending to the Qal/UMCf interface.

The Trust continues to monitor well recovery and modifies the pumping rates as necessary to maximize capture and mass removed. Figure E1 in Appendix E shows the detailed potentiometric map at the IWF along with the estimated capture zone. As shown on Figure E1, the IWF is capturing most of the high concentration perchlorate plume at the barrier wall. However, on both ends of the barrier wall, lower concentrations of perchlorate appear to be outside of the inferred capture zone of the IWF. The Trust recommends adjusting extraction rates of individual wells within the IWF and turning on the new extraction wells (wells I-W, I-X, I-Y, I-AA, I-AB, I-AC and I-AD) in order to improve capture efficiency. The details of this analysis and the proposed changes to the extraction rates are included in Appendix E.

Figures 2A through 2D present historic (May 2006 to June 2012) water elevations for selected pairs of monitoring wells located on opposite sides of the barrier wall. As shown on the figures, between July 2011 and June 2012, water levels in wells directly downgradient (north) of the barrier wall (wells M-69 through M-72) were generally five to eight feet lower than water elevations in corresponding wells upgradient (south) of the wall (wells I-Y, M-55, M-56, and M-58). The large drop in measured groundwater elevations across the barrier wall indicates that the wall is an effective barrier to shallow groundwater flow. Peaks in water levels in downgradient wells around July 2008 and May 2010 observed in Figures 2A through 2C (and to a lesser extent in Figure 2D) are responses to increased recharge rates during those times. These figures also show a significant decline in water elevations in the downgradient wells beginning around September 2010, when the recharge trenches were shut down and groundwater mounding associated with the recharge began to dissipate. The Trust understands

[6] Northgate Environmental Management, Inc. 2010. Capture Zone Evaluation Report, Tronox LLC, Henderson, Nevada. December 10.

that NDEP refers to this area between the barrier wall and the recharge trenches as a “dead zone” where elevated perchlorate concentrations have historically been observed. The Trust plans further analysis of the fate and transport of groundwater in this “dead zone” during the evaluation of the recharge trench system in the forthcoming capture zone analysis.

2.2 Athens Road Well Field Area

Figure 1 and Plate 2 show the location of the AWF, which is approximately 8,200 feet north (downgradient) of the barrier wall and the IWF. Although Athens Road has been renamed Galleria Drive, the Athens Road designation has been retained for the well field to maintain consistency with past reports. The AWF was constructed as a series of 14 groundwater extraction wells screened in the Qal at seven paired well locations that span approximately 1,200 feet across two alluvial paleochannels located on either side of an UMCf ridge. The AWF was completed in March 2002 and continuous pumping began in mid-October of that year. The well pairs act in concert with one well pumping while the adjacent well is used to measure water levels and monitor the effect of pumping on the aquifer. In September 2006, a 15th standalone well, ART-9, began full-time operation replacing ART-6A after groundwater elevations at the AWF dropped below a level where ART-6/6A could be effective.

The annual average discharge rate for each AWF pumping well during July 2011 - June 2012 is shown on Table 2, along with the average annual discharge rates for the five previous years. The combined discharge rate of the AWF averaged 271.6 gpm over the last year (July 2011 - June 2012), which is generally consistent with the previous five years. Over the last five years of operation, the combined discharge of the AWF averaged 265.7 gpm.

Plate 4, *West-East Hydrogeologic Cross Section B-B' – Athens Road Well Field, Second Quarter 2012*, shows the current water levels in the AWF pumping wells and adjacent monitoring wells, and the relationships between the pre-pumping and current groundwater levels in the vicinity of the AWF. As shown on Plate 4, the extraction wells in the AWF target two alluvial sub-channels separated by a ridge of UMCf. Groundwater levels are currently much lower than they were in 2002 before pumping began, and the Qal overlying the UMCf ridge has been partially dewatered. Historical groundwater level trends for selected wells are shown in Figure 3. In general, the water elevations in the AWF in May 2012 are slightly lower than the water elevations from one year ago.

In June/July 2010, additional groundwater wells were installed in the AWF including seven monitoring wells (PC-141 through PC-147) and four large diameter monitoring wells (ART-7B, PC-148, PC-149, and PC-150) that could be (but are not currently) used as additional extraction wells. The new eight-inch diameter well, ART-7B, is co-located with the ART-7/ART-7A extraction well pair, but with a screen interval extending deeper down to the Qal/UMCf interface to the reported bottom of the eastern alluvial channel. Two new six-inch diameter wells, PC-148 and PC-149, are standalone wells that are situated across the top of the UMCf ridge with screened intervals almost entirely within the UMCf. Another new six-inch diameter well, PC-150, is a standalone well located west of the UMCf ridge in the western channel and is screened entirely within the Qal. Based on the boring log from monitoring well PC-141, which was installed in June 2010, the deepest part of the western channel may not be as wide as previously thought.

As with the IWF, Appendix E provides an analysis of current groundwater capture at the AWF. Figure E3 in Appendix E shows the detailed potentiometric map at the AWF along with the estimated capture zone. There is a potential gap in the capture zone identified at the center of the AWF centered at well PC-149 and extending to the east and west past wells PC-148 and PC-150, respectively. The Trust recommends adjusting extraction rates of individual wells within the AWF and turning on wells ART-7B and PC-150 in order to improve capture efficiency and address the shallow groundwater in the UMCf ridge.

2.3 Seep Well Field Area

The SWF and the seep surface-flow capture sump, located approximately 4,500 feet north (downgradient) of the AWF near the Las Vegas Wash, are shown on Figure 1 and Plate 2. When pumping began in July 2002, the SWF consisted of three recovery wells (PC-99R2/R3, PC-115R, and PC-116R) situated over the deepest part of the alluvial channel and a surface-capture pump for an intermittent surface stream. Five additional wells (PC-117 to PC-121) were completed in February 2003 and an additional well (PC-133) was completed in December 2004, all in the SWF area. Presently, the SWF consists of 10 extraction wells—two of which (PC-99R2 and 99R3) are connected and operate as a single combined well. The SWF has been effective in lowering groundwater levels in this vicinity, such that the seep stream has not flowed since April 2007. The wells comprising the SWF are screened across the full thickness of the Qal and across the deepest portion of an alluvial channel.

The annual average discharge rate for each SWF pumping well during July 2011 - June 2012 is shown on Table 3, along with the average annual discharge rates for the five previous years. The combined discharge rate of the SWF averaged 510.4 gpm over the last year (July 2011-June 2012), which is the lowest combined discharge in the previous five years. Over the last five years of operation, the combined discharge of the AWF has steadily decreased from 622.3 gpm to 510.4 gpm.

Plate 2 shows that south of the SWF (north of the AWF) the gradient of the north-northeast sloping potentiometric surface decreases to about 0.007 ft/ft. Recent depth to water measurements north of the COH WRF show that water elevations are up to 17 feet lower now than they were in May 2008, particularly to the south-southeast of the SWF (wells HM-2, HSW-1). This water elevation decrease is believed to be due to cessation of the discharge of treated effluent to the Pabco Road RIBs since the completion of the COH WRF in 2008.

Plate 5, *West-East Hydrogeologic Cross Section C-C' – Seep Well Field, Second Quarter 2012*, shows the current water levels in the SWF pumping wells and adjacent monitoring wells, and the relationships between the pre-pumping and current groundwater levels in the vicinity of the SWF. Plate 5 shows that the alluvial channel in the SWF is much less incised into the underlying UMCf than at the AWF, and that the configuration of the alluvial channel is a broad shallow feature about 800 feet wide and averaging about 45 feet thick. In May 2001, before pumping began, the groundwater level in the area was very shallow and would surface every winter. Based on water level measurements collected in May 2012, water levels in the SWF are generally five to ten feet lower than pre-pumping levels.

2.4 Groundwater Treatment Overview

Treatment of chromium-contaminated groundwater (primarily from the IWF) occurs via the on-site Groundwater Treatment Plant (GWTP) [7], which chemically reduces hexavalent chromium and removes total chromium via chemical precipitation. A small ferrous sulfate drip system is located at the AWF lift station (Lift Station #3) to treat chromium present (at lower concentrations) in groundwater extracted by the AWF. Treatment of perchlorate-contaminated groundwater from all well fields occurs via the on-site fluidized bed reactors (FBRs), which biologically remove perchlorate as well as chlorate, nitrate, and trace concentrations of residual chromium. A simplified process flow diagram is presented on Figure 4. Routine maintenance is completed as needed at the GWTP and FBRs. The performances of the chromium and perchlorate treatment systems are described in Sections 3.2 and 4.2, respectively.

[7] By convention, the "GWTP" consists of only the on-site hexavalent chromium treatment plant. The name pre-dates the installation of any of the perchlorate treatment systems and related components.

3 Chromium Mitigation Program

The components of the chromium capture system consist of the IWF, the barrier wall, the former recharge trenches, and the AWF. The locations of these components are shown on Figure 1. For the 12-month period from July 2011 to June 2012, a total of approximately 3,000 pounds of chromium were captured and removed from groundwater. The treatment of chromium-contaminated groundwater is discussed in Section 3.2.

To evaluate alternatives for effective operation and to enhance the performance of the GWETS, historical chromium mass removal estimates were calculated for each well in the IWF and AWF using available extraction rates and total chromium concentration data for the time period July 1, 2002 to June 30, 2012. The details of this analysis are included in Appendix E.

3.1 Chromium Plume Configuration

Table A-1 in Appendix A contains analytical and groundwater elevation data for the last five quarters. Plate 6 presents an isoconcentration map of the chromium plume from its on-site source northward to the Las Vegas Wash. In general, the current isoconcentration map is similar to the 2011 map with some local variances. The portion of the chromium plume with the highest concentrations remains south of the barrier wall where it is captured by the IWF. In this area, the highest total chromium concentration occurred in wells I-T and I-Q (29 mg/L) in May 2012. North of the barrier wall, the highest total chromium concentration was 8.4 mg/L in well M-73, located north of wells I-I/I-Z. This is a decrease from 9.1 mg/L measured in May 2011. North of the former recharge trenches, the highest total chromium concentration detected was 4.6 mg/L in well PC-136, located in the alluvial sub-channel east of the UMCf ridge at the AWF. This concentration is an increase from 2.1 mg/L measured in May 2011. Concentrations in well M-12A, located on the trailing edge of the main plume, have generally been slowly declining. In May 2012, the concentration in M-12A was 8.5 mg/L compared with 25 mg/L in May 2002.

Total chromium concentrations in wells immediately downgradient of the barrier wall (M-70, M-71, M-72, M-74, M-79, and M-83) in the so called “dead zone” have increased slightly, except in well M-73 where, as noted above, the concentration decreased from last year. Soil excavation activities in the vicinity of the former recharge trenches in 2010/2011 resulted in the plugging and abandonment of groundwater monitoring wells in this area including M-84, M-85, M-86A, M-87, and M-88. As mentioned above, the Trust plans further analysis of the fate and transport of groundwater in the “dead zone” during the evaluation of the recharge trench system in the forthcoming capture zone analysis. Replacement of monitoring wells in this area will also be evaluated as part of this analysis.

3.1.1 Interceptor Well Field Area

The IWF captures the highest concentrations and the main portion of the groundwater plume located downgradient of the on-site source areas. Plate 3 shows the current total chromium concentration in each well. Figure 5 shows the concentrations of total chromium in the 23 active IWF pumping wells over the last five quarters. Appendix E provides an evaluation of the current groundwater capture in the IWF and proposes alternative extraction rates to improve capture efficiency. The proposed changes to the IWF extraction rates are summarized in Table 8 of this report (and Table E2 in Appendix E).

Chromium concentration data from select wells (M-11, M-23, M-36, M-72, and M-86)[8] over time are presented in Figure 6. In monitoring well M-11, located immediately downgradient of the former primary source area (Units 4 and 5), concentrations have remained relatively stable over the last six years with a concentration of 2.3 mg/L reported in May 2012. Total chromium concentrations measured in well M-36, located upgradient of the IWF, declined over the reporting period (to 28 mg/L in May 2012), a continuation of a trend dating back to 2004 when the concentration was 45 mg/L. Concentrations in well M-72, located in the so-called "dead zone" between the barrier wall and former recharge trenches, have increased slightly during the reporting period to a concentration of 5.6 mg/L in May 2012. Between May 2006 and May 2008, concentrations increased slightly (from 0.43 mg/L to 2.7 mg/L) in well M-86, located just northeast of the former recharge trenches. Well M-86 was damaged during recharge trench refurbishment activities in 2008 and was subsequently plugged and abandoned. Concentrations in monitoring well M-23, located downgradient of the IWF, barrier wall, and former recharge trenches near Warm Springs Road, have been relatively stable over the last five years, ranging from 0.88 mg/L in May 2007 to 0.56 mg/L in May 2012.

3.1.2 Athens Road Well Field / Seep Well Field Areas

The AWF is designed to intercept residual chromium in groundwater downgradient of the IWF and the Site. As shown on Plate 6, based on total chromium concentrations in groundwater downgradient of the AWF, the system appears to be operating effectively and capturing the most highly concentrated portion of the chromium plume. Downgradient of the AWF in the Athens Road Piezometer or "ARP" well line, the highest measured concentration of total chromium during the second quarter 2012 sampling event was 0.34 mg/L in well MW-K4.

Plate 4 shows the current total chromium concentration in each AWF well including wells PC-148, PC-149, and PC-150, which were installed in June 2010. Figure 7 shows the concentrations of total chromium across the seven AWF pumping wells in addition to monitoring wells PC-18, PC-55, PC-122, PC-148, PC-149, and PC-150 over the last five quarters. As mentioned previously, PC-148 and PC-149 are wells that are situated across the top of the UMCf ridge with screened intervals almost entirely within the UMCf. As shown on the figure, chromium concentrations in the western sub-channel (represented by wells west of PC-149) have been low relative to those in the eastern sub-channel (represented by wells east of PC-148). This narrow plume in the eastern sub-channel can be seen also on Plates 4 and 6. An additional recovery well, ART-9, was installed in this area in 2006 to capture this narrow channel of chromium-impacted groundwater. Consequently, a dramatic decline in chromium concentrations occurred in well PC-122 from 1.5 mg/L to 0.10 mg/L between November 2006 and February 2007. Total chromium concentrations in well PC-122 have remained relatively low since the start-up of ART-9. Well PC-122 contained a total chromium concentration of 0.18 mg/L in May 2012. Total chromium present in groundwater collected in this area continues to be treated at Lift Station #3, where metered ferrous sulfate is added before the water is sent to the on-site perchlorate treatment system. An evaluation of the current groundwater capture in the AWF along with proposed extraction rates to improve capture efficiency is included in

[8] These wells were selected because they are the five "Consent Order Appendix J Wells".

Appendix E. The proposed changes to the AWF extraction rates are summarized in Table 8 of this report (and Table E3 in Appendix E).

Wells in the SWF continue to contain generally less than 0.01 mg/L total chromium. Total chromium concentrations in wells to the east of the SWF are slightly higher. East of the well field, concentrations of total chromium in monitoring well PC-94 were measured at 0.031 mg/L in May 2012, compared to concentrations of 0.038 mg/L in May 2011, 0.054 mg/L in May 2010, and 0.067 in June 2009. As mapped on Plate 6, chromium-impacted groundwater flowing from the Upper BMI Ponds east of Pabco Road appears to be co-mingling with the residual chromium plume north of the AWF. This has been presented in previous annual reports. As discussed in Section 2.3, water elevations in this area dropped between three and 17 feet between 2008 and 2009 due to cessation of discharge of treated effluent in the Pabco Road RIBs.

3.2 Chromium Treatment System and Remediation

The operation and maintenance of the chromium mitigation program as well as the rest of the GWETS was contracted to Veolia Water North America (Veolia) (formerly US Filter Operating Services) in 2003. The Trust took title to the GWETS in February 2011 and Veolia continues to operate and maintain the GWETS on behalf of the Trust.

Table 4 contains the July 2011 to June 2012 process treatment data from the on-site GWTP. The treated groundwater from the GWTP is pumped to the equalization tanks, where it is combined with water from the off-site groundwater collection systems. From the equalization tanks, the blended water flows through activated carbon beds before being filtered and pumped to the FBRs for treatment to remove perchlorate, chlorate, and nitrate.

As shown in Table 4, the total chromium inflow concentration to the GWTP has been relatively stable in the range of 9.3 to 10.2 mg/L, which is slightly lower than the range of 9.4 to 11.6 mg/L one year ago. The chemical reduction of hexavalent chromium and removal of total chromium via the GWTP during the reporting period has been consistently effective. Total chromium outflow concentrations for the last 12 months ranged from 0.083 to 0.26 mg/L. The hexavalent chromium outflow concentration during the reporting period ranged from non-detectable (<0.000009 mg/L) to 0.007 mg/L. For the period between July 2011 and June 2012, approximately 2,800 pounds of chromium were removed from the groundwater by the GWTP.

A lesser amount of chromium is also removed in the FBRs. Results of total chromium analysis from weekly FBR influent and effluent samples are presented in Table 5. Between July 2011 and June 2012, the FBRs' influent total chromium concentrations varied from 0.0032J[9] to 0.14 mg/L. Based on an average influent total chromium concentration of 0.053 mg/L and an average flow rate of 901 gpm, the FBRs were receiving about 0.58 pounds of chromium per day from the equalization tanks. This total includes chromium captured in the AWF and reductively treated with ferrous sulfate drip at Lift Station #3.

[9] Result was "J"-flagged by the laboratory. A J flag indicates results that are an estimate because they were detected above the Sample Quantitation Limit (SQL), but below the Method Reporting Limit (MRL).

The FBRs discharge treated water to the Las Vegas Wash just upgradient of the Pabco Road erosion control structure under authority of National Pollutant Discharge Elimination System (NPDES) Permit NV0023060. Results of discharge monitoring performed between July 2011 and June 2012 are presented in Table 5. Effluent hexavalent chromium concentrations have been non-detectable (<0.000009 mg/L) with the exception of five samples collected the weeks of December 12, 2011, December 27, 2011, February 13, 2012, May 29, 2012, and June 25, 2012, which had reported concentrations of 0.000018J, 0.000018J, 0.000015J, 0.000046, and 0.000081 mg/L, respectively. All detected concentrations were well below the effluent discharge limitation of 0.01 mg/L (7-day average). Total chromium was detected in effluent samples at concentrations ranging from 0.00061J to 0.013 mg/L, with an average concentration of 0.007 mg/L – well below the effluent discharge limitation of 0.1 mg/L (7-day average).

The FBR system removed an additional approximately 200 pounds of chromium over the 12-month period. The sum of the chromium captured and removed from groundwater between July 2011 and June 2012 by the GWTP and by the FBRs totaled approximately 3,000 pounds.

4 Perchlorate Recovery Program

The components of the perchlorate capture system consist of the IWF, the barrier wall, the former recharge trenches, the AWF, the SWF, and the seep surface-flow capture sump. The locations of these components are shown on Figure 1. The daily average mass of perchlorate removed by the IWF, AWF, and SWF is presented in Table 6. Figure 8 presents the monthly perchlorate recovery totals and the relative contribution of the IWF, AWF, and SWF.

During the period July 2011 through June 2012, a total of approximately 503,000 pounds of perchlorate (approximately 1,374 pounds per day) were captured and removed from groundwater by the GWETS. Of this total, approximately 262,800 pounds (approximately 718 pounds per day) were captured on-site in the IWF; approximately 224,900 pounds (approximately 614 pounds per day) were captured by the AWF; and approximately 15,300 pounds (42 pounds per day) were captured by the SWF.

To evaluate alternatives for effective operation and to enhance the performance of the GWETS, historical perchlorate mass removal estimates were calculated for each well in the IWF, AWF, and SWF using available extraction rates and perchlorate concentration data for the time period July 1, 2002 to June 30, 2012. The details of this analysis are included in Appendix E.

4.1 Perchlorate Plume Configuration

Plate 7 shows the contoured perchlorate plume from the south end of the Site to the Las Vegas Wash, based on data collected in May and June 2012. Based on this sampling, the highest perchlorate concentration south of the barrier wall occurred in well I-AR (2,200 mg/L). North of the barrier wall, the highest perchlorate concentration detected was 1,300 mg/L in well M-72. North of the former recharge trenches, the highest perchlorate concentration was 700 mg/L in well M-44, located between Warm Springs Road and Boulder Highway. North of the AWF, the highest concentration was 350 mg/L in well PC-144, located just north of the well field. The highest perchlorate concentration reported in the SWF was 14 mg/L in well PC-99R2/R3. In general, the current isoconcentration map is generally similar to the 2011 map with some local variances. The 100 and 25 mg/L contour lines on the western side of the UMCf ridge downgradient of the AWF appear to extend further downgradient in comparison to the 2011 map. Similarly, the 25 mg/L contour line on the eastern side of the UMCf ridge downgradient of the AWF has extended beyond the ARP well line. As discussed in Appendix E, there is a potential gap in the capture zone identified at the center of the AWF centered at well PC-149 and extending to the east and west past wells PC-148 and PC-150, respectively. Some variations in the contour lines immediately downgradient of the IWF and barrier wall are evident due to the availability of data from M-81A, which was not sampled in 2011. Table A-1 in Appendix A contains analytical and groundwater elevation data for the last five quarters.

Comparing Plate 7 with Plate 7A, which shows the contoured perchlorate plume from second quarter 2002, it is clear that significant changes in the perchlorate plume have occurred over the last 10 years. In 2002, the highest perchlorate concentration (at well M-37, adjacent to well I-A-R) contained 5,300 mg/L, whereas by 2012 the perchlorate concentration had decreased to 1,200 mg/L. As shown on Plate 7A, in 2002 a large area downgradient of the barrier wall contained perchlorate in excess of 1,000 mg/L, including wells M-23 and M-44 with concentrations of 1,430 mg/L and 1,400 mg/L, respectively. Concentrations at the downgradient edge of the plume in 2002 were as high as 160 mg/L (wells PC-115R, PC-116R, PC-99R2/R3) adjacent to the Las Vegas Wash. In 2012, wells M-23 and M-44 had perchlorate concentrations of 340 mg/L and 700 mg/L, respectively, and the highest perchlorate concentration reported in the SWF was 14 mg/L in well PC-99R2/R3.

4.1.1 Interceptor Well Field Area

The IWF targets the highest concentrations of perchlorate at the Site. In general, perchlorate concentrations in groundwater downgradient of the IWF and barrier wall (up to 1,300 mg/L) are significantly below concentrations observed in groundwater upgradient of the IWF and barrier wall (up to 2,200 mg/L). Plate 3 shows the IWF in cross-section with the current perchlorate concentration for each well. Figure 9 represents a west-east transect through the IWF showing perchlorate concentrations for the 23 active IWF wells in May 2002 compared to the last five quarters. Figure 9 indicates that the perchlorate plume captured by the IWF is divided into two areas of higher perchlorate concentrations separated by an area of lower concentrations centered on well I-M. The elevated perchlorate concentrations west of well I-M exist in a relatively narrow area centered on wells I-R, I-AR[10], and I-L, while the elevated perchlorate concentrations east of well I-M span a broader area extending from wells I-E to I-I. Perchlorate concentrations in both of the areas have significantly decreased since May 2002. Figure 10 shows perchlorate concentrations for select wells at the IWF over time and shows generally decreasing trends since sampling for perchlorate began in 2002. Figure 10A shows perchlorate concentrations at the IWF over the last five quarters indicating that concentrations have been relatively stable over this time period. Appendix E provides an evaluation of the current groundwater capture in the IWF. As detailed in Appendix E, the Trust recommends adjusting extraction rates of individual wells within the IWF and turning on the new extraction wells I-W, I-X, I-Y, I-AA, I-AB, I-AC and I-AD in order to improve capture efficiency and maximize mass removal. The proposed changes to the IWF extraction rates are summarized in Table 8 of this report (and Table E2 in Appendix E).

Figure 11 is a west-east transect through the IWF which charts total dissolved solids (TDS) concentrations over the last five quarters. A comparison of Figure 9 and Figure 11, which show perchlorate and TDS, respectively, in each of the IWF wells, indicates that a broad zone of high TDS in the central part of the IWF remains present and coincides with the eastern area of elevated perchlorate concentrations. Contrastingly, the high perchlorate area on the western side of the IWF is not associated with high TDS. It is possible that the area of high perchlorate on the western side of the IWF, having comparatively low concentrations of TDS, represents a separate perchlorate source from the high perchlorate concentrations east of well I-E.

As shown in Figure 12, the monthly average perchlorate concentrations captured at the IWF generally decreased from a high of about 1,890 mg/L in October 2002 to an average of approximately 911 mg/L between July 2011 and June 2012. The calculated perchlorate mass removal has generally followed a similar trend, from a high of about 45,000 pounds removed in

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[10] Well I-AR is a pumping well located approximately 350 feet south of the primary IWF well line.

the month of January 2003 to an average of approximately 22,000 pounds removed per month between July 2011 and June 2012.

Figure 13 charts perchlorate concentration and water elevation trends in monitoring wells M-100 and M-23, located approximately 700 and 1,300 feet north (downgradient) of the former recharge trenches, respectively. Figure 13 indicates a sharp decrease in perchlorate concentrations in both wells beginning in early 2002, shortly after the barrier wall was installed at the IWF. Water level trends reflect infiltration and mounding of water recharged to the subsurface through the former recharge trenches. Clogging of the trenches and reduced infiltration are reflected in the decreasing water levels beginning about May 2007. The trenches were subsequently refurbished in February 2008 with water levels in well M-100 quickly rebounding and water levels in well M-23 rebounding somewhat slower. Due to conflicts with the soil excavation program at the Site, operation of the trenches was suspended in September 2010, which corresponds with decreases in water levels in both wells M-100 and M-23. Well M-100 has been dry since December 2010. The water level in well M-23 has decreased approximately seven feet since the trenches were shut down. Perchlorate concentrations in well M-100 remained relatively stable from 2008 through 2010. Perchlorate concentrations in well M-23 have remained relatively stable since July 2006 (to May 2012) with an average concentration of 401 mg/L. As mentioned previously, upon NDEP's final approval of the site-specific calibrated groundwater flow model, the Trust plans to conduct further analysis and optimization of the GWETS, including evaluating the effectiveness of the recharge trench system.

4.1.2 Athens Road Well Field Area

The AWF captures perchlorate in groundwater at concentrations generally less than 500 mg/L. Plate 4 shows the AWF in cross-section with the current perchlorate concentration for each well including wells PC-148, PC-149, and PC-150. Figure 14 is a west-east transect through the AWF which charts perchlorate concentrations for the last five quarters. Perchlorate concentrations in the seven pumping wells are shown, in addition to monitoring wells PC-18, PC-55, PC-122, PC-148, PC-149, and PC-150. As shown on the figure, the plume is stable and perchlorate concentrations on the western (PC-55 and ART-1) and eastern (PC-122) edges of the well field continue to remain relatively low.

The perchlorate concentration trends of the pumping wells in the AWF are shown in Figures 15 and 15A. Figure 15 shows that overall perchlorate concentrations in the AWF have generally been slowly declining since 2002. Concentrations in individual wells fluctuate with each sampling event, but for most wells these fluctuations have moderated with time. Figure 15A, an expanded view of the last five quarters of Figure 15, indicates that recent concentrations in the AWF pumping wells have either remained relatively stable or increased slightly. This recent trend could be related to the shutdown of the recharge trenches in September 2010. An evaluation of the current groundwater capture in the AWF along with proposed extraction rates to improve capture efficiency is included in Appendix E. The Trust is recommending adjusting extraction rates of individual wells within the AWF and turning on wells ART-7B and PC-150 in order to improve capture efficiency and address the shallow groundwater in the UMCf ridge. The proposed changes to the AWF extraction rates are summarized in Table 8 of this report (and Table E3 in Appendix E). The Trust plans further analysis of the fate and transport of groundwater in the AWF area during its evaluation of the recharge trench system using the approved groundwater flow model.

As shown in Figure 16, the monthly average perchlorate concentration captured at the AWF generally decreased from a high of about 387 mg/L in December 2002 to an average of approximately 188 mg/L between July 2011 and June 2012. The calculated perchlorate mass removal has generally followed a similar trend, from a high of about 36,100 pounds removed in the month of December 2002 to an average of approximately 18,700 pounds removed per month between July 2011 and June 2012.

Beginning in August 2006, TDS data have been collected from the AWF. Figure 17 is a west-east transect through the AWF which charts TDS concentrations for the last five quarters. The figure shows that two zones of higher TDS exist at the AWF, centered on PC-18 on the west (9,900 mg/L in May 2012) and highest at PC-122 on the east (9,700 mg/L in May 2012).

Approximately 250 feet north of the AWF, eight wells comprise the Athens Road Piezometer or "ARP" well line. A graph of perchlorate concentrations across the ARP well line transect is presented in Figure 18, and perchlorate concentrations in these wells over time are shown on Figures 19 and 19A. Figure 19 contains concentration-time plots beginning in late 2001, and Figure 19A shows an expanded view of the last five quarters. As shown in Figure 18, perchlorate concentrations in the western side of the well line (represented by ARP-1, ARP-2/2A, and ARP-3/3A) and the eastern side of the well line (represented by ARP-4/4A, ARP-5/5A, ARP-6/6A/6B and ARP-7) have significantly decreased since 2002. This indicates that the AWF has been effective in capturing perchlorate contaminated groundwater in these sections of the plume. Perchlorate concentrations in the center of the ARP well line at MW-K4 are significantly lower than in 2002, but remain elevated relative to the other sections of the plume. As shown in Figures 19 and 19A, with the exception of wells MW-K4 and ART-6/6A/6B, concentration trends in the ARP well line appear relatively stable. Concentrations in well MW-K4 initially declined with the onset of AWF operation in 2002 and dropped further when ART-9 began pumping in September 2006. Perchlorate concentrations in well MW-K4 generally trended upwards from mid-2008 to the beginning of 2010, rising from 57.8 mg/L in June 2008 to 300 mg/L in January 2010. Perchlorate concentrations in MW-K4 generally declined between January 2010 (300 mg/L) and December 2011 (150 mg/L), but have rebounded for the last six months (through June 2012) to 300 mg/L. Concentrations in well ARP-6/6A/6B have increased slightly in the past six months from 21 mg/L in December 2011 to 46 mg/L in June 2012. The fate and transport of groundwater in the AWF area and the observation of increasing concentrations in wells MW-K4 and ARP-6/6A/6B will be evaluated upon NDEP's approval of the groundwater flow model in the forthcoming capture zone analysis. In addition, as mentioned previously, the Trust recommends adjusting extraction rates of individual wells within the AWF and turning on wells ART-7B and PC-150 in order to improve capture efficiency and maximize mass removal.

Between the ARP well line and the SWF are the City of Henderson (COH) WRF and the Lower Ponds monitoring well lines. Perchlorate concentrations in the COH WRF wells on a west-east transect are shown on Figure 20. Figures 21 and 21A present perchlorate concentration trends for these same wells over time. As shown in the figures, current perchlorate concentrations are well below levels measured in the same wells in May 2002, especially in the center of the well line as shown on Figure 20. As shown in Figure 21, perchlorate concentrations at the COH WRF well line have been stable since mid-2007.

Figure 22 shows historical water elevations at the COH WRF well line. This figure indicates that many of the historical low-concentration events in the wells appear to be associated with a rapid increase in the water levels, likely the result of increased infiltration from the COH WRF surface ponds. These significant groundwater “mounding events” due to surface water infiltration continue to occur sporadically, but are now presumed to be related to operation of the COH birding ponds.

The Lower Ponds well line is approximately 2,200 feet north of the COH WRF well line. Figures 23, 24, and 24A, the perchlorate west-east transect and trend graphs for the Lower Ponds well line, show that current perchlorate concentrations are well below levels measured in the same wells in May 2002, especially at well PC-56 (Figure 23). Figure 24 shows that perchlorate concentrations present in the Lower Ponds well line are generally low and have been relatively stable since 2007. As shown on Figures 24 and 24A, perchlorate concentrations in well PC-56 historically have been more variable than in other wells on the Lower Ponds well line. Concentrations in well PC-56 were at 16 mg/L in November 2010, decreased to 3.3 mg/L in January 2011, increased to 12 mg/L in February 2011, decreased to 7 mg/L in June 2011, and increased to 18 mg/L in June 2012.

4.1.3 Seep Well Field Area

The SWF contributes the highest flows (average of 510.3 gpm between July 2011 and June 2012) compared with the IWF (65.1 gpm) and the AWF (252.8 gpm) to the GWETS, but captures significantly lower concentrations of perchlorate (less than 15 mg/L). Because of the low concentrations captured at the SWF, the perchlorate mass removed from the environment via the SWF is substantially less than that removed via the IWF or AWF (see Figure 8 and Table 6).

The original three recovery wells in the SWF commenced pumping in August 2002. In February 2003, five additional wells (PC-117, PC-118, PC-119, PC-120, and PC-121), and in December 2004, one additional well (PC-133), were completed in the SWF. At present, the SWF consists of ten extraction wells – two of which (PC-99R2 and -99R3) are connected and operate as one – positioned over the deepest part of the alluvium channel that contains the highest concentrations of perchlorate (relative to other SWF wells). The well field is located approximately 600 feet upgradient of the seep surface flow capture sump; however, the seep stream has not flowed since April 2007.

Plate 5 shows the perchlorate concentrations in individual wells in the SWF as of May 2012. Figure 25 shows perchlorate concentrations of the SWF wells for the last five quarters along with concentrations in the original pumping wells in May 2002. The figure shows that perchlorate concentrations have significantly decreased in the original pumping wells since 2002. Figures 26 and 26A present the perchlorate trend graphs for the SWF. Figure 26 shows the steep decreases in perchlorate concentrations that occurred after pumping began. As shown on Figure 26A, perchlorate concentrations in the SWF appear to have been relatively stable with some slight increases and some slight decreases in concentrations over the last year with the exception of PC-133 which increased from 0.63 mg/L in May 2012 to 6.4 mg/L in June 2012. The concentration in PC-133 in June 2011 was 3.1 mg/L. TDS concentrations in the SWF wells for the last five quarters are plotted on Figure 27. The highest TDS concentration (4,600 mg/L) is currently measured in well PC-99R2/R3, which corresponds with the highest perchlorate concentration for the SWF (14 mg/L). The TDS concentrations in the SWF wells are stable over the same period, and appear to be associated with the perchlorate plume.

As shown in Figure 28, the monthly average perchlorate concentrations captured at the SWF generally decreased from a high of about 77 mg/L in February 2003 to an average of approximately 6.9 mg/L between July 2011 and June 2012. The calculated perchlorate mass removal has generally followed a similar trend, from a high of about 21,700 pounds removed in the month of May 2003 to an average of approximately 1,300 pounds removed per month between July 2011 and June 2012.

Data provided by the SNWA for the irrigation wells, WMW-6.15S and WMW-5.7N (shown on Plate 7), completed in the Las Vegas Wash provide further evidence that the GWETS is effective in reducing concentrations of perchlorate in the Las Vegas Wash. Well WMW-6.15S, which contained 45.6 mg/L in June 2002, had a reported perchlorate concentration of 1.0 mg/L in May 2012, representing a 98% decrease. Well WMW-5.7N, located further to the east, had a reported concentration of 0.014 mg/L in May 2012, compared to a concentration of 0.43 mg/L in October 2003.

4.2 Perchlorate Treatment System and Remediation

Throughout the reporting period, groundwater was captured both on-site and off-site, conveyed to the on-site treatment facilities and treated biologically in the FBRs to remove nitrate, chlorate and perchlorate. Effluent from the FBRs has been discharged into Las Vegas Wash consistently within the limits specified in the NPDES NV0023060 discharge permit. As shown on Table 7, between July 2011 and June 2012, the perchlorate influent to the FBRs ranged from 95 mg/L to 140 mg/L. Perchlorate was not detected at concentrations exceeding the laboratory sample quantitation level (SQL) (ranging from 0.00025 to 0.0025) in effluent discharged to Las Vegas Wash during this time.

5 Total Dissolved Solids

Plate 8 shows the isoconcentration contours for TDS from the southern end of the Site to the Las Vegas Wash, based on data collected in May through June 2012 by the Trust, AMPAC, OSSM, SNWA, and TIMET. The 2012 TDS map does not differ significantly from the 2011 map. As shown previously, TDS mapping shows that the Site is located between two high TDS zones originating from off-site sources to the west and east. The highest TDS concentration occurred at the Site (20,000 mg/L) in well MC-29, located on the western side of the Site to the south of Warm Springs Road and downgradient of the off-site TDS source west of the NERT property. Figures 11, 17, and 27 show the distribution of TDS across the IWF, AWF and SWF, respectively.

6 Conclusions

The GWETS consists of three groundwater capture well fields: the IWF, the AWF, and the SWF. The IWF coupled with the barrier wall provides capture of the highest concentrations of perchlorate and chromium at the Site and significantly reduces the amount of perchlorate and chromium in downgradient groundwater. The off-site AWF, located approximately 8,200 feet downgradient of the IWF, has been in continuous operation since October 2002. Although the AWF captures lower concentrations of both perchlorate and chromium, it contributes significantly to the overall mass of perchlorate removed from the environment and mitigates its impact in downgradient groundwater. The SWF, located over the main part of the alluvium channel in close proximity to the Las Vegas Wash, contributes the highest flows (average of 510.3 gpm between July 2011 and June 2012) compared with the IWF (65.1 gpm) and the AWF (252.8 gpm) to the GWETS, but captures significantly lower concentrations than the other well fields. The seep stream has not flowed since April 2007.

Treatment of chromium-contaminated groundwater (primarily from the IWF) occurs via the on-site GWTP, which chemically reduces hexavalent chromium and removes total chromium. A small ferrous sulfate drip system also treats lower concentrations of chromium from the AWF. Treatment of perchlorate-contaminated groundwater from all well fields occurs via the on-site FBRs, which biologically remove perchlorate as well as chlorate, nitrate, and residual chromium. Routine maintenance is completed as needed at the GWTP and FBRs.

For the 12-month period ending in June 2012, the capture of chromium-contaminated groundwater at the IWF and AWF, and treatment at the on-site GWTP, has removed approximately 2,800 pounds of chromium. Adding the approximately 200 pounds of chromium removed by the FBRs for the same period, a total of approximately 3,000 pounds of chromium was removed from the groundwater between July 2011 and June 2012.

For the same 12-month period, the capture of perchlorate-contaminated groundwater from all three well fields, and biological treatment in the on-site FBRs, has removed a total of approximately 503,000 pounds of perchlorate from the environment.

7 Proposed Future Activities

Now that the major soil excavation efforts at the Site have been completed, the Trust is re-evaluating Site conditions, the performance of the GWETS, and the groundwater monitoring program.

The Trust has performed an analysis of current groundwater capture at the IWF and recommends adjusting extraction rates of individual wells within the IWF and commencement of pumping from seven additional extraction wells (I-W, I-X, I-Y, I-AA, I-AB, I-AC and I-AD) to improve capture efficiency and maximize mass removal. Similarly, the Trust has performed an analysis of current groundwater capture at the AWF and recommends adjusting extraction rates of individual wells within the AWF and commencement of pumping from two additional wells (ART-7B and PC-150) to improve capture efficiency and maximize mass removal. The proposed changes to the extraction rates for the IWF and AWF wells are summarized in Table 8. With the proposed pumping rates, perchlorate and chromium mass removals at the IWF are anticipated to increase by 22 percent and 29 percent, respectively. Similarly, with the proposed pumping rates, perchlorate and chromium mass removals at the AWF are anticipated to increase by 20 percent and 19 percent, respectively. Further, an expansion of the capture zone is expected in both well fields. As this proposed work will require NDEP approval and coordination among numerous entities, including the operators and maintenance providers for the GWETS and the City of Henderson (owners of the property on which the AWF is situated), a work plan will be prepared describing the steps for construction, startup, and testing of the new extraction wells.

In addition, the Trust will be refining a groundwater capture analysis as part of forthcoming work. Specifically, the Trust has proposed to NDEP use of the site-specific calibrated groundwater flow model developed for the site and presented in Northgate's 2010 CZE Report to conduct further analysis and optimization of the GWETS. The Trust is currently addressing NDEP's comments on the groundwater flow model and will conduct further analysis to optimize the GWETS upon NDEP's final approval. The Trust anticipates using the approved groundwater flow model to analyze the fate and transport of groundwater in the IWF, the barrier wall, the "dead zone", the former recharge trenches, the AWF, and the SWF areas; to conduct a capture zone analysis for perchlorate and chromium in all of the well fields; to evaluate the effect of the proposed operational changes of the extraction wells in the IWF and AWF (described above) on the capture zones of the IWF and AWF; and to evaluate the effectiveness of the former recharge trench system.

Other proposed future activities include implementation of the proposed Long-Term Monitoring Optimization upon NDEP approval (draft submitted to NDEP in November 2011), which has recommended changes to the current groundwater sampling and analysis program. Also, a Remedial Investigation/Feasibility Study (RI/FS) Work Plan is anticipated to be submitted in 2012.

Tables

Figures

Plates

Appendix A

Groundwater Elevations and Analytical Data Tables

Appendix B

Electronic Data Deliverable (EDD)

(Database files provided electronically or on CD separately)

Appendix C

Data Validation Summary Report (DVSR)

Appendix D

Groundwater Field Records

Appendix E

Groundwater Extraction and Treatment System Optimization Study: Analysis of Groundwater Extraction Rates and Capture at the Interceptor and Athens Road Well Fields