2010 Annual Performance Evaluation Report
Volume 1

Baldwin Park Operable Unit of the
San Gabriel Valley Superfund Sites
Los Angeles County, California

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Submitted to:

Baldwin Park Operable Unit Cooperating Respondents

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Abbreviations

1,1-DCE	1,1-Dichloroethene
1,2-DCA	1,2-Dichloroethane
1,2,3-TCP	1,2,3-Trichloropropane
AAWC	Azusa Agricultural Water Company
AJ	Aerojet
ALR	Azusa Land Reclamation Company, Inc.
AMEC	AMEC Earth & Environmental, Inc. (formerly AMEC Geomatrix, Inc.)
ARARs	Applicable or Relevant and Appropriate Requirements
AVWC	Azusa Valley Water Company
bgs	below ground surface
BPOU	Baldwin Park Operable Unit
BPOUSC	Baldwin Park Operable Unit Steering Committee
CC	Conrock Company
CDM	Camp, Dresser, and McKee
CDWC	California Domestic Water Company
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cis-1,2-dce	Cis-1,2-Dichloroethene
COC	Chemical of Concern
COI	City of Industry
CRs	Cooperating Respondents
DPH	California Department of Public Health, Drinking Water Section (formerly Department of Health Services [DHS]).
DQO	Data Quality Objectives
EDB	Ethylene Dibromide
EPA	U.S. Environmental Protection Agency
ERM	ERM-West, Inc.
ESD	Explanation of Significant Differences
FSP	Field Sampling Plan
f.k.a	Formerly Known As
GAC	Granular Activated Carbon
gpm	gallons per minute
HLA	Harding Lawson Associates
ISEP®	Calgon Ionic Separation Process
LACO	Los Angeles County
LACFD	Los Angeles County Flood Control District
LACDPW	Los Angeles County Department of Public Works
LACSD	Los Angeles County Sanitation Districts
LDC	Laboratory Data Consultants, Inc.
LPGAC	Liquid-Phase Granular Activated Carbon
LPVCWD	La Puente Valley County Water District
MCL	Maximum Contaminant Level
MICR	Maximum Individual Cancer Risk
MS	Matrix spike
MSD	Matrix spike duplicate
msl	Mean Sea Level
NDMA	N-Nitrosodimethylamine
NL	Drinking Water Notification Level
ng/L	Nanograms Per Liter
PCE	Tetrachloroethene
PE	Performance Evaluation
PHG	Public Health Goal

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PRP	Potentially Responsible Party
PSEP	Performance Standards Evaluation Plan
PVOU	Puente Valley Operable Unit
QAPP	Quality Assurance Project Plan
QC	Quality Control
RFP	Request for Proposal
RFQ	Request for Qualifications
RI	Remedial Investigation
ROD	Record of Decision
RMSE	Root-mean squared error
RWQCB	Regional Water Quality Control Board – Los Angeles Region
SA	Subarea
SCAQMD	South Coast Air Quality Management District
SGVWC	San Gabriel Valley Water Company
SOW	Statement of Work
SMR	Self Monitoring Reports
SVOC	Semi-Volatile Organic Compound
SWS	Suburban Water Systems
TIC	Tentatively Identified Compound
TCE	Trichloroethene
UAO	Unilateral Administrative Order
µg/L	Micrograms Per Liter
UV	Ultraviolet
VCWD	Valley County Water District
VFD	Variable Frequency Drive
VOC	Volatile Organic Compound
VPGAC	Vapor-Phase Granulated Activated Carbon
WE	Water Entity
WY	Water Year

2010 ANNUAL PERFORMANCE EVALUATION REPORT
Baldwin Park Operable Unit
San Gabriel Valley, California

1.0 INTRODUCTION

This document presents the 2010 Annual Performance Evaluation (PE) Report for the Baldwin Park Operable Unit (BPOU) of the San Gabriel Valley Superfund Sites, located in the San Gabriel Basin, Los Angeles County, California. This report was prepared jointly by AMEC Earth and Environmental, Inc. (AMEC) and ERM-West, Inc. (ERM), on behalf of the BPOU Cooperating Respondents (CRs). The CRs are:

- Aerojet-General Corporation
- Azusa Land Reclamation Company, Inc. (ALR)
- Hartwell Corporation
- Chemical Waste Management (as successor to Oil and Solvent Process Company)
- Reichhold, Inc.
- Winco Enterprises Inc. (formerly known as [f.k.a.] Wynn Oil Company)

This report meets the requirements for the Annual PE Report, as required by Unilateral Administrative Order 2000-13 (UAO) and the supporting Statement of Work (SOW), issued by the U.S. Environmental Protection Agency (EPA) Region IX on June 30, 2000, and amended on February 28, 2002.

1.1 Background

Beginning in 1979, volatile organic compounds (VOCs) were detected in groundwater within the San Gabriel Basin (the Basin). In May 1984, four areas of groundwater contamination were listed as San Gabriel Valley Areas 1-4 on EPA's National Priorities List based on available water-quality data. Subsequent investigation by EPA and others revealed widespread VOC contamination in the Basin. As a result, EPA subsequently divided the Basin into seven Remedial Investigation (RI) areas to focus characterization on the extent of contamination and plan remedial actions. EPA later designated some of these RI areas as operable units. RI Area 5 was designated as the BPOU.

Although many of the figures provided in this report depict a generalized boundary to the area of impacted groundwater in the BPOU (Figure 1-1), the precise boundary of the BPOU has not been determined, but an approximate boundary is presented to provide a point of reference on the figures.

Since 1986, EPA, various Potentially Responsible Parties (PRPs), and numerous other entities have compiled and evaluated groundwater-quality data from the Basin. Initial field investigations conducted by EPA in the BPOU included the installation and sampling of one multiport monitoring well and the sampling of water-supply wells. In 1990, EPA issued a Basin-wide Technical Plan that described options for remediation of VOC plumes through the Basin. In 1992, EPA published an Interim RI Report for the Basin.

In 1993, EPA issued a Feasibility Study Report for the BPOU. This report evaluated various remedial alternatives for the remediation of groundwater in the BPOU. In 1994, EPA issued a Record of Decision (ROD) for the BPOU interim remedy. The ROD identified 17 chemicals of concern (COCs), all of which were VOCs. EPA's selected remedy consisted of pumping and treating approximately 19,000 gallons per minute (gpm) of contaminated groundwater. In approximately 1995, the Baldwin Park Operable Unit Steering Committee (BPOUSC) began to perform pre-remedial design activities, including additional characterization of the extent of VOC-contaminated groundwater and the development of a groundwater extraction plan. Eight multiport monitoring wells were installed and sampled and 26 existing water-supply and monitoring wells were sampled to provide additional characterization of the extent of VOC contamination in the BPOU. The results of these pre-remedial design activities were submitted to EPA in the Draft Pre-Remedial Design Report, dated December 1996 (Camp, Dresser, and McKee [CDM], 1996). The groundwater extraction plan was revised on several occasions. Following review and comment by EPA, the Final Draft Pre-Remedial Design Report, dated September 1997 (CDM, 1997), was issued.

In mid-1997 and then in 1998, certain constituents that were not previously considered as COCs in the ROD, including perchlorate, N-nitrosodimethylamine (NDMA), and 1,4-dioxane were discovered in groundwater within the BPOU. Consequently, EPA requested that the BPOUSC characterize the distribution of these constituents, as well as conduct further characterization of VOCs in groundwater within the BPOU. As a result, the BPOUSC installed and sampled four additional multiport monitoring wells and conducted additional groundwater sampling to evaluate the extent of VOCs, perchlorate, NDMA, and 1,4-dioxane in groundwater in the BPOU.

The results of these investigations and several groundwater extraction plan options were presented to EPA in the Draft Addendum to the Pre-Remedial Design Report, dated January 14, 1999 (Harding Lawson Associates [HLA], 1999). Throughout 1999, these groundwater extraction plan options were refined and new options were formulated. These changes were made in response to comments from EPA and the Main San Gabriel Basin Watermaster (Watermaster). This resulted in a range of candidate groundwater extraction plans with total groundwater extraction rates ranging from 19,500 to 21,500 gpm.

In May 1999, EPA issued an Explanation of Significant Differences (ESD) to supplement the 1994 ROD. The ESD depicted an expanded area of the groundwater contamination in the southern portion of the BPOU to reflect the results of the additional investigations related to the characterization of perchlorate, NDMA, and 1,4-dioxane in groundwater. The ESD also added perchlorate, NDMA, and 1,4-dioxane to the list of COCs defined in the ROD. In June 2000, EPA issued the UAO, requiring various PRPs (identified in the UAO as “Respondents”), including but not limited to the CRs, to design, construct, and operate the BPOU interim remedy identified in the ROD, as revised by the ESD. In addition, beginning in the late 1990s, various water agencies, producers, and other water entities (collectively, the “Water Entities” or “WEs”) with regulatory oversight and/or financial or other interests in the BPOU groundwater filed lawsuits or asserted claims against the BPOU PRPs for damages allegedly suffered as a result of contamination of the groundwater and water-supply wells in the BPOU area. Thereafter, the CRs entered into negotiations with the WEs, which culminated in March 2002 with the CRs and WEs executing the BPOU Project Agreement to implement the BPOU Project. The BPOU Project Agreement was declared effective as of May 9, 2002.

While the BPOU Project Agreement negotiations were underway, the CRs prepared the Final Remedial Design/Remedial Action Work Plan and the Draft Final Conceptual Design Report for the implementation of the remedy (HLA, 2000a and HLA, 2000b). The Preliminary Design Report was prepared by the WEs and submitted to EPA in April, 2001 (Watermaster, 2001).

In January 2006, EPA's Remedial Project Manager notified the CRs that EPA was concerned about the detection of 1,2,3-trichloropropane (1,2,3-TCP) in certain wells within the BPOU. This compound does not have a federal Maximum Contaminant Level (MCL), but does have a California state Drinking Water Notification Level (NL) of 5 nanograms per liter (ng/L)[1]. In response to EPA's requirements, the CRs funded a further modification of the Valley County Water District (VCWD) Lante Treatment Plan to include Liquid-Phase Granular Activated Carbon (LPGAC) treatment to address EPA's concerns about the presence of 1,2,3-TCP.

In August 2006, EPA requested that the CRs include in the BPOU monitoring program additional sampling for non-COC VOCs and non-target volatile and semi-volatile compounds (Tentatively Identified Compounds, or TICs) including 1,2,3-TCP. In response to EPA's request, the CRs provided a proposal for non-COC groundwater analysis and reporting in a technical memorandum dated August 24, 2006 (Geomatrix, 2006a). This proposal included the following:

- Information on sampling and analysis of 1,2,3-TCP;
- A proposal for reporting results for non-COC VOCs in a subset of multiport monitoring wells located upgradient of each groundwater extraction and treatment facility (i.e. "early warning" wells);
- A proposal for monitoring of non-target VOCs and semi-volatile organic compounds (SVOCs) in a subset of multiport monitoring wells located upgradient of each groundwater extraction and treatment facility (i.e. "early warning" wells), and;
- A proposal for periodic analysis of 1,2,3-TCP in selected wells.

EPA approved the August 24, 2006, proposal in a letter dated September 13, 2006, subject to the addition of several wells. The complete requirements for non-COC groundwater analysis and reporting were summarized in a technical memorandum dated September 29, 2006 (ERM, 2006).

On October 3, 2006, EPA provided a letter approving the BPOU Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP) subject to submittal of final versions of these documents with the complete requirements for non-COC groundwater analysis and reporting. Final versions of the QAPP and FSP for groundwater were submitted in November 2006 (Geomatrix, 2006b; Stetson, 2006a) and were approved by EPA in a letter dated February 12, 2007. In the February 12, 2007, letter EPA also requested that a data management plan be prepared as an addendum to the QAPP. The report, Data Management Plan for the Baldwin Park Operable Unit Performance Standards Evaluation Plan Monitoring Program, was submitted to EPA on May 17, 2007 (Laboratory Data Consultants, Inc. [LDC] 2007).

[1] In August 2009, the State of California's Office of Environmental Health Hazard Assessment adopted a final Public Health Goal (PHG) for 1,2,3-trichloropropane of 0.7 nanograms per liter, or 0.0007 parts per billion. While DPH considers a PHG in setting a state MCL, to date no final MCL has been established.

A separate FSP for Off-Gas Air, Waste Brine, and Treated Water was submitted to EPA on August 14, 2006 (Stetson 2006b) and the corresponding QAPP for Air, Brine, and Treated Water was submitted on March 16, 2007 (Geomatrix, 2007a).

Numerous minor modifications have been proposed and approved for the BPOU PSEP monitoring program since 2007. In 2010, the QAPP for Groundwater (AMEC Geomatrix, 2010a), the FSP for Groundwater (AMEC Geomatrix, 2010b), and the Revised Final Performance Standards Evaluation Plan (PSEP) were updated (AMEC Geomatrix, 2010c) to incorporate the modifications that were approved since the previous versions of these documents were issued. These modifications are described in detail in Section 3.0 of this report.

1.2 Overview of Remedial Action

The UAO and SOW direct the Respondents to design, construct, and implement the remedy described in the ROD and ESD, and to achieve the Performance Standards in accordance with the UAO. The WEs (either directly or through contractors) designed the groundwater extraction and treatment facilities (Subprojects), and construction is largely completed. The WEs are now operating the Subprojects, which provide for groundwater extraction and treatment in two general areas of the BPOU (Figure 1-2). The treated groundwater is supplied for direct potable use.

Upon completion of the various Subprojects, a total of approximately 23,250 gpm of groundwater are to be extracted, 7,000 gpm from the northern portion of the plumes (Subarea 1), and 16,250 gpm from the southern portion of the plumes (Subarea 3). Extracted groundwater is to be treated using a treatment train that is designed to remove all COCs to levels acceptable for direct potable use. The treatment train varies among the treatment plants but generally consists of a series of contaminant treatment processes including air stripping and/or LPGAC to remove VOCs, ion exchange to remove perchlorate, and ultraviolet (UV)/oxidation to remove 1,4-dioxane and NDMA.

1.3 Summary of Remedial Action Objectives and Performance Standards

Two of the key performance standards are defined in the UAO as follows:

> *The remedial objectives of the Baldwin Park OU are to prevent future increases in, and begin to reduce concentrations of, trichloroethene, tetrachloroethene, carbon tetrachloride, and other VOCs, along with perchlorate, N-nitrosodimethylamine, and 1,4-dioxane in groundwater in the Baldwin Park area (hereafter referred to as contaminants or contaminated groundwater) by limiting further migration of contaminated groundwater into clean and less contaminated areas or depths that would benefit most from additional protection and by removing contaminants from the aquifer.*

The BPOU Project involves the design, installation, operation, and maintenance of groundwater extraction systems in two areas of the BPOU. The two areas are designated in the ROD and ESD as Subarea 1 (the upper area) and Subarea 3 (the lower area). Remedial objectives for the two Subareas are described below.

1.3.1 Subarea 1 Remedial Objectives

In Subarea 1, the movement of COCs in groundwater will be limited by groundwater extraction at rates and locations that will establish the necessary groundwater flow field, such that the resultant capture zone limits migration from known or suspected source areas and depths and removes chemical mass. Source areas and depths include locations believed to contain a significant mass of soil contamination (i.e., vadose zone) or a subsurface source of dissolved-phase groundwater contamination. In Subarea 1, the remedial objectives are designed to prevent groundwater near source areas with higher concentrations of COCs from moving downgradient toward areas with lower concentrations of COCs. As part of the groundwater extraction process, chemical mass will be removed from Subarea 1 groundwater.

1.3.2 Subarea 3 Remedial Objectives

In Subarea 3, the movement of COCs in groundwater will be limited by groundwater extraction at rates and locations that will establish the necessary groundwater flow field to reduce the potential for groundwater containing unacceptable concentrations of tetrachloroethene (PCE), trichloroethene (TCE), carbon tetrachloride, perchlorate, NDMA, 1,4-dioxane or other COCs from moving into areas where these chemicals are not present at unacceptable concentrations. As part of the groundwater extraction process, chemical mass will be removed from Subarea 3 groundwater.

1.3.3 Performance Standards

Two distinct performance standards have been derived from the Remedial Objectives cited above: 1) limit further migration of COCs in groundwater, and 2) remove COCs from groundwater. Achievement of these performance standards will prevent future increases in concentrations, begin to reduce concentrations, and prevent the spread of COCs from more contaminated areas to less contaminated areas. These two performance standards are described in more detail below.

1.3.3.1 Performance Standard 1 - Limit Migration of Chemicals of Concern

The BPOU extraction plan was developed using an EPA-approved three-dimensional finite-element groundwater flow model, DYNFLOW. In 2002, the model was updated using a similar code, FEFLOW. The construction and calibration of this model relies on many years of data collection activities in the BPOU, including water level measurements and water-quality sampling. The model was calibrated using water level data from a 20-year period (1982 to 2002). Following calibration, the model was run in a forward/predictive manner to select locations and depths of groundwater extraction wells that would allow the remedy to achieve the objectives described above. Review of geophysical logs from exploratory borings at the extraction well locations as well as logs from other wells in the BPOU suggested the presence of relatively thick, fine-grained layers that can be correlated across Subarea 3 but do not extend north to Subarea 1. These layers are present at approximately -200 and -500 feet mean sea level (msl). As a result, the well screened intervals for new extraction wells in Subarea 3 were designed so that they could capture the entire vertical extent of contaminated groundwater without creating hydraulic connections across these layers. Therefore, shallow extraction wells were screened above the layer at -500 feet msl and deep extraction wells were screened below the layer at -500 feet msl. Aquifer testing in the extraction wells confirmed that the layer at -500 feet msl acts as a confining unit that provides hydraulic separation between the shallow and deep elevation intervals. In 2005, the groundwater flow model was modified to incorporate the confining units in Subarea 3. The groundwater flow model is updated annually with quarterly pumping and recharge data that are compiled from various sources. The CR group will continue to make refinements to the groundwater model to incorporate the results of field testing and other information, such as aquifer testing at new extraction and production wells, and thereby improve the model's ability to simulate observed groundwater conditions in localized areas. Updates and refinements to the groundwater model will be reported in Annual PE Reports as necessary. The calibrated model is the primary tool that will be used to assess system performance in terms of limiting the migration of COCs.

1.3.3.2 Performance Standard 2 - Removal of Chemical Mass

This performance standard, removal of chemical mass, will be met through extraction and treatment of groundwater from the BPOU plumes. Documentation of the removal of chemical mass will use measured flow rates from groundwater extraction wells and results of water-quality sampling and analysis for these same extraction wells. Using these data, the mass removal for selected COCs will be estimated on an annual basis. Cumulative chemical mass removed from the aquifer will also be reported.

1.4 Approach to Performance Monitoring and Evaluation

Performance monitoring and evaluation focuses on the operation of the proposed groundwater extraction system as it relates to: 1) limiting further migration of groundwater contamination into less contaminated areas, and 2) removing chemical mass from groundwater. As described in the PSEP (AMEC Geomatrix, 2010c), the CRs approach to performance monitoring relies upon: 1) past and future basin-wide groundwater monitoring activities performed by the Watermaster, 2) performance monitoring data collected by the Water Entities, the CRs, or other agents acting on behalf of the CRs, and 3) the use of an EPA-approved groundwater flow model to predict the effectiveness of the groundwater extraction system. At any time, should EPA determine that Performance Standards related to migration control and mass removal are not being met, the CRs will use these same methods of data collection and modeling to modify operation of the groundwater extraction system such that Performance Standards are achieved.

Watermaster basin-wide monitoring activities have served as the baseline monitoring program from which additional monitoring needs have been defined. The Watermaster has the responsibility to ensure that comprehensive water-quality monitoring meets their court-decreed mission of managing Basin water production and quality, provides for predictive vulnerability assessments, and provides for monitoring so that California Department of Public Health (DPH; formerly the Department of Health Services ([DHS]) requirements for public water supplies are met. The Watermaster performs routine basin-wide water level monitoring of over 170 wells on a semi-annual basis.

In summary, the approach to performance monitoring and evaluation consists of the following, components:

- Potentiometric head measurements in BPOU piezometers and multiport monitoring wells. These data are used to generate potentiometric surface maps for comparison to model simulation results.
- Groundwater flow modeling and particle tracking to evaluate hydraulic performance of the extraction system as it relates to limiting further migration of groundwater contamination.

- Water-quality sampling of production and multiport monitoring wells to provide information on the distribution of chemicals of concern in BPOU groundwater, specifically to produce plume maps.
- Integration of the results of groundwater modeling with current plume maps and known source locations to determine whether the groundwater extraction systems are appropriately limiting the migration of COCs.
- Water-quality sampling and measurement of extraction well pumping rates and production volumes.
- Use of flow rate and water-quality data from extraction wells to calculate the mass of chemicals of concern removed from the aquifer by the extraction and treatment system.

1.5 Content of Performance Evaluation Reports

As outlined in the PSEP, the Annual PE Reports should generally contain the following:

- BPOU potentiometric maps to assist in evaluating changes in groundwater flow patterns in the BPOU;
- Groundwater plume maps and chemical cross sections and an evaluation of any changes in the extent of groundwater contamination within the BPOU;
- Time-concentration plots for selected key constituents for selected monitoring wells;
- Contaminant mass-removal estimates for each extraction well using average flow rates and water-quality sampling results from the extraction wells;
- Results of computer model simulations of extraction system performance and a description of any refinements to groundwater flow models used to evaluate system performance;
- An overall assessment of remedial system performance in relation to Performance Standards established for the BPOU Project; and
- Recommendations for changes to the monitoring program outlined in the PSEP including scheduled changes to the monitoring frequency or monitoring locations.

Although not specifically outlined in the PSEP, EPA has requested that Annual PE Reports also address the performance of the BPOU Project relative to "other project requirements" associated with the implementation of the BPOU Project. These “other project requirements” are not considered Performance Standards, as they do not directly relate to the remedial objectives of the BPOU Project as defined by EPA, but rather relate to the operational performance of, or discharge requirements for, the various Subprojects following construction. Consequently, only those "other project requirements" that are considered "Other Potential Performance Standards" during system operation are addressed in this Annual PE Report. These “Other Potential Performance Standards” include the following:

- Achievement of treated water effluent requirements in accordance with DPH Drinking Water Operating permits;

- Air-emission monitoring requirements in accordance with EPA Applicable or Relevant and Appropriate Requirements (ARARs) or EPA risk-based limits;
- Monitoring and reporting of brine discharges to the Los Angeles County Sanitation Districts (LACSD) system in accordance with Industrial Waste Discharge permits; and
- Demonstration of proper disposal of waste associated with treatment operations. Applicable waste streams include, but are not limited to, spent granular activated carbon and spent ion exchange resins.

2.0 STATUS OF REMEDIAL ACTIONS

This section presents the status of remedial actions undertaken in 2010 to implement the BPOU interim remedy. These actions include operation of the VCWD Lante Subproject in Subarea 1; operation of the La Puente Valley County Water District (LPVCWD) Subproject; operation of the San Gabriel Valley Water Company (SGVWC) B6 Subproject; and startup testing and operation of the SGVWC B5 Subproject in Subarea 3. The status of the BPOU Subprojects is also described in the monthly progress reports submitted to EPA pursuant to Paragraph 85, Section XV of the UAO.

2.1 Subarea 1 Remedial Action Status

Subarea 1 remedial actions consist of groundwater extraction from the VCWD SA1-1, SA1-2, and SA1-3 (Lante) wells and treatment at the VCWD Lante Treatment Plant, which is owned and operated by VCWD. The report, "Revised Draft Interim Remedial Action Report" (Stetson, 2005), prepared and submitted to EPA in March 2005, provides a summary of the VCWD Lante Subproject background, construction, and completion activities. Construction of the VCWD Lante Treatment Plant began in 2002 and was completed in 2005. The original construction activities included drilling and equipping two new extraction wells (SA1-1 and SA1-2), re-equipping the SA1-3 (Lante) well, installing associated piezometers, constructing raw and treated water pipelines, and constructing the treatment plant. Additional construction work in 2006 and 2007 included adding LPGAC treatment and replacing the resin-based vapor control system with vapor-phase granular activated carbon (VPGAC). The treatment plant consists of four air-stripping towers and associated VPGAC off-gas treatment units for VOC removal, LPGAC for 1,2,3-TCP removal, two regenerable ion exchange carousels (Calgon Ionic Separation Process [ISEP®]) for perchlorate removal, and four UV/oxidation units for 1,4-dioxane and NDMA removal. Treated water is conveyed via a treated water pipeline to Suburban Water Systems (SWS) Plant 121, however, a portion of the treated water can be directed to the VCWD distribution system if desired.

On November 11, 2005, DPH issued domestic water supply Permit Amendment 1910009PA 003, authorizing VCWD to operate the VCWD Lante Treatment Plant. In January 2006, 1,2,3-TCP was detected in the VCWD extraction wells. Subsequent testing confirmed the presence of 1,2,3-TCP. Beginning on February 21, 2006, VCWD began discharging treated water to Big Dalton Wash while a 1,2,3-TCP treatment technology was selected and constructed. LPGAC was selected as the treatment technology and the design and construction of a LPGAC system was completed in Spring 2007. LPGAC startup testing was completed in May 2007 and on July 18, 2007, DPH issued an amended permit to VCWD to resume delivering potable water.

As a result of operational problems, the resin-based off-gas control system was removed and replaced with VPGAC. A temporary VPGAC system was installed while a permanent system was designed and constructed. The temporary system was operational in June 2007 and the permanent system became fully operational in April 2008. The permanent VPGAC system consists of four 20,000-pound adsorbers with associated heaters operated in parallel.

The air strippers also experienced operational problems with calcium carbonate precipitation in the towers and packing. Tower cleaning was initiated in October 2007 and was completed in February 2008. A study was conducted to evaluate precipitation mitigation alternatives that included anti-scalant dosing, acid cleaning, and packing replacement. Anti-scalant testing began in October 2008 and is on hold pending resolution of potential impacts on ISEP® and single-pass ion exchange resins. One air stripper was acid washed in December 2008 to test the efficacy and cost of this alternative. The results of the acid wash testing were summarized in a February 18, 2009, memorandum “Summary and Evaluation Air Stripper No. 4 Acid Cleaning” (Stetson, 2009a). Based on the pilot testing, the acid washing was not a cost effective method to mitigate calcium carbonate precipitation problems.

The process to replace the ISEP® with single-pass ion exchange was initiated in 2008. A request for proposal was released in January 2008 and bids were received and evaluated in April and May of 2008. The work was awarded to RC Foster and a notice to proceed was issued in August of 2008. California Environmental Quality Act (CEQA) work associated with the single-pass ion exchange was completed in September 2008 and design work was completed in early 2009. As part of the ISEP® replacement work, nitrate treatment alternatives were also evaluated (Malcolm Pirnie, 2008).

Design and construction of the single-pass ion exchange system was completed in 2009. The associated booster pump upgrade was completed in November 2009. Start-up testing of the single-pass ion exchange system is on hold until issues regarding nitrate treatment, ISEP® by-pass configurations, and ISEP® modifications are evaluated and resolved. Although the ISEP® by-pass piping bids were received and reviewed, the ISEP® by-pass piping bids and the DPH permit application and related documents for DPH approval of the single-pass ion exchange system for the VCWD system are on hold while the BPOU Project Committee determines how to address the nitrate treatment issue. In October 2010, VCWD and the CRs released a Request for Qualifications (RFQ) requesting process engineering and nitrate management qualifications to selected engineering firms. Qualifications were received, reviewed, and CDM was selected as the firm to provide process treatment and nitrate management engineering expertise. This work will be initiated in 2011. In addition, approvals to discharge water to waste during startup are being negotiated with the Los Angeles County Flood Control District (LACFD).

Other VCWD Lante Treatment Plant improvements or evaluations initiated in 2010 included:

- In January, water-quality samples were collected from the Arrow Well, which indicated similar concentrations as those observed in the SA1-3 (Lante) well;
- Several of the air stripper pressure gauges were replaced in February;
- Stetson conducted quarterly inspections of the VCWD Subproject air strippers as part of the BPOU Air Stripper Monitoring and Maintenance Plan as documented in reports of April 4, July 8, September 29, and December 27;
- In June, the LACSD performed an inspection of the brine lines at the VCWD treatment facility;
- Flow scenarios from the various VCWD wells were evaluated in relation to the nitrate concentration issue. DPH reported that the nitrate concentration issue will not be addressed by adjusting flows from these wells (Watermaster, 2010);
- Rehabilitation work on SA1-2 was completed in August and a variable-frequency drive (VFD) pump was installed in September. VCWD and the EPA continue attempts to obtain a discharge permit for SA1-2 so redevelopment work can begin. On December 2, 2010 the

EPA sent an additional email request to the LACFD to permit the discharge of test waters into the District's channel;

- Wet well sealing occurred in November;
- Management of the salt wash down water was completed in 2010; and
- As described above, an RFQ was issued for nitrate management.

Technical performance reports are prepared under Provision 42 of the DPH operating permit and are required to be submitted annually to DPH. The most recent of these reports, "2009 Annual Technical Performance Report for the Lante Plant" (Stetson, 2010b), describes the status and performance of the VCWD Lante Treatment Plant for the period January 1 to December 31, 2009. In addition, VCWD submits monthly compliance reports to DPH; these compliance reports are included in monthly progress reports provided to EPA.

In 2010, VCWD treated 6,888 acre-feet of water with an average flowrate of 4,262 gpm (Table 2-1) which is approximately 71% of the EPA-approved extraction rate of 6,000 gpm. Production decreased from the prior year's average flowrate of 5,092 gpm due primarily to ISEP® limitations. The VCWD Treatment Plant did not operate for the month of November due to clogged distributors inside the ISEP® vessels causing high pressure on both ISEP® systems. Treatment train B was down for an additional 652 hours during the month of December to clean the ISEP® distributors and resin.

2.2 Subarea 3 Remedial Action Status

Subarea 3 remedial actions consist of the LPVCWD, SGVWC B6, and SGVWC B5 Subprojects that are designed to extract and treat a combined average flowrate of 15,750 gpm (design capacity 18,100 gpm) as discussed below.

2.2.1 La Puente Valley County Water District Subproject Status

The LPVCWD Subproject extracts, treats, and delivers water to the public under a DPH permit that was issued on February 15, 2001, and amended as Permit No. 1910060PA-000 issued on May 8, 2002 with subsequent amendments. The LPVCWD Subproject consists of extraction wells LPVCWD 2, LPVCWD 3, LPVCWD 5, two air strippers and associated off-gas treatment for VOC removal, single-pass ion exchange (replacing ISEP® in July) for perchlorate removal, and UV/oxidation for 1,4-dioxane and NDMA removal operating at a capacity of up to 2,500 gpm. Treated water is conveyed to LPVCWD's distribution system and, when available, a portion of the treated water is also provided to SWS.

To address sanding problems in LPVCWD 2 and 3, a new well, LPVCWD 5, was drilled and installed in 2007. The LPVCWD 5 well was equipped, developed, and tested in 2008. On December 19, 2008, DPH issued an amended permit to allow LPVCWD 5 to be used as a drinking water source. The well became operational in January 2009 and is LPVCWD's primary water supply well, with LPVCWD 2 and 3 used as backup water supply wells. The LPVCWD 5 well installation activities are summarized in, "Well No. 5 Well Completion Report" prepared by Stetson and submitted in final on July 2, 2008 (Stetson 2008). DPH issued a permit amendment for the operation of the LPVCWD 5 well on December 19, 2008.

To mitigate perchlorate-bearing brine discharges to the LACSD brine line and reduce treatment costs, the LPVCWD Subproject Committee approved replacing the ISEP® with single-pass ion exchange equipment.

The single-pass ion exchange system was designed and construction was completed in 2009. A draft Compliance Test Plan and Operation, Maintenance, and Monitoring Plan for the single-pass ion exchange system was prepared and submitted to DPH for review. In June 2009, the EPA issued a letter supporting temporary discharges of water during startup testing of the new single-pass ion exchange system to the Walnut Wash. The LACSD issued a discharge permit for LPVCWD on November 17, 2009. The ion exchange system was tested during startup activities in December 2009. The DPH issued an amended permit for the single-pass ion exchange system on June 15, 2010, and the system became operational on July 30, 2010.

Technical performance reports are prepared under Provision 33 of the DPH operating permit and are required to be submitted annually to DPH. The most recent of these reports, "Technical Performance Report (2009–2010) for the La Puente Valley County Water District Treatment Facility" (Stetson, 2010c), describes the status and performance of the LPVCWD facility for the period May 1, 2009, to April 30, 2010. In addition, LPVCWD submits monthly compliance reports to DPH; these compliance reports are included in monthly progress reports provided to EPA.

Treatment system improvements or evaluations initiated in 2010 included:

- In January 2010 Stetson Engineering conducted an inspection of the air strippers to evaluate scaling potential;
- Per the EPA's request, failure analysis was initiated. Locus Technologies began controls testing in December 2009 and concluded the testing in March 2010;
- In March 2010 a new flow meter was installed at the Hudson Booster Station;
- LPVCWD 5 well, which typically extracts the majority of the water treated in the LPVCWD Treatment Plant was taken out of service in October 2010 for repairs and is expected to be back online in January 2011;
- Secondary containment around chemical storage areas was upgraded; and
- Plans are being developed to decommission the ISEP® system.

In 2010, approximately 3,693 acre-feet of groundwater were extracted and treated for an average annual flowrate of 2,288 gpm (Table 2-1). This average annual flowrate exceeded the EPA approved extraction rate of 2,250 gpm and was generally consistent with the prior year's production (3,701 acre-feet and 2,295 gpm).

2.2.2 San Gabriel Valley Water Company B6 Subproject Status

The SGVWC B6 Subproject remedial action consists of groundwater extraction from the SGVWC B25A, B25B, B26A, and B26B wells (with B6C and B6D included as backup wells) and treatment at the SGVWC B6 Treatment Plant, which is owned and operated by SGVWC. Construction of the SGVWC B6 Subproject began in 2002 and the SGVWC B6 Treatment Plant was completed in 2005. Construction activities included drilling, installing, and equipping the new extraction wells, installing associated piezometers, constructing raw and treated water pipelines, and constructing the treatment plant. The treatment plant consists of four air-stripping towers and associated carbon off-gas treatment units for VOC removal, two ISEP® carousels (A and B) for perchlorate removal, and four UV/oxidation units for 1,4-

dioxane and NDMA removal. Treated water is conveyed to the SGVWC distribution system. The “Interim Remedial Action Report” (Stetson, 2004) prepared and submitted to EPA in September 2004 provides a summary of SGVWC B6 Subproject background, construction, and completion activities.

On June 8, 2005, DPH issued domestic water supply Permit Amendment No. 1910039PA-002, authorizing SGVWC to operate the SGVWC B6 Treatment Plant using the existing onsite B6C and B6D wells. SGVWC began delivering potable water from the SGVWC B6 Treatment Plant to customers on July 12, 2005. The permit was further amended by DPH with Permit Amendment No. 1910039-004 on February 17, 2006, to incorporate the operation of offsite wells B25A, B25B, B26A, and B26B.

To mitigate perchlorate-bearing brine discharges to the LACSD brine line and reduce treatment costs, the SGVWC B6 Subproject Committee approved replacing the ISEP® treatment system with single-pass ion exchange equipment. The single-pass ion exchange design was initiated in June 2008. Since there is limited space at the SGVWC B6 Treatment Plant, the single-pass ion exchange equipment was constructed on three properties that were purchased on the north side of Corak Street. Geotechnical work was completed on the properties in July and existing structures were demolished in the fall of 2008. CEQA documentation related to the single-pass ion exchange project was filed and the public review process closed on October 6, 2008, without any comments received.

Construction of the single-pass ion exchange system was completed in November 2009. On December 8, 2009, EPA issued a letter requesting that the Regional Water Quality Control Board (RWQCB) inform Los Angeles County (LACO) that BPOU discharges fall within the non-prohibited “Potable Drinking Water Supply and Distribution System Releases” category listed in LACO’s MS4 permit. Testing of the single-pass ion exchange system is on hold while SGVWC considers nitrate treatment or management alternatives. On November 1, 2010, SGVWC issued a Request For Proposal (RFP) to selected engineering firms to provide design services for an ion exchange system to treat nitrate. Bids will be evaluated and an engineering firm selected in 2011.

Technical performance reports are prepared under Provision 15 of the DPH operating permit and are required to be submitted annually to DPH. The most recent report, “Technical Performance Report for the San Gabriel Valley Water Company Plant B6 Water Treatment Facility” (Stetson, 2010d), describes the status and performance of the SGVWC B6 Treatment Plant for the period April 1, 2009, to March 31, 2010 was submitted on October 28, 2010. In addition, SGVWC submits monthly compliance reports to DPH; these compliance reports are included in monthly progress reports provided to EPA.

Treatment system improvements or evaluations initiated in 2010 included:

- In April 2010 a new brine flow meter was installed for ISEP® B;
- As part of the Air Stripper Monitoring and Maintenance Plan, Stetson conducted an inspection of the SGVWC B6 air strippers on April 23, 2010, to evaluate the calcium carbonate buildup and an inspection report was produced in July 2010;
- In December 2010 the P201 pressure relief pump on ISEP® A was replaced; and
- As discussed above, SGVWC released an RFP for the nitrate treatment design.

In 2010, the SGVWC B6 Subproject extracted and treated approximately 7,325 acre-feet of water with an average annual flowrate of 4,531 gpm (Table 2-1). This average annual flowrate was 70% of the EPA-approved extraction rate of 6,500 gpm and was below the prior year's annual average flowrate of 6,694 gpm. The operational issues experienced during the first quarter of 2010, when extraction rates were lowest, were associated with ISEP® operation. These issues were corrected to some degree, but ISEP® operational problems continued throughout the year.

2.2.3 San Gabriel Valley Water Company B5 Subproject Status

The SGVWC B5 Subproject remedial actions consist of groundwater extraction from the SGVWC B5B, B5E, and City of Industry (COI) 5 wells and treatment at the SGVWC B5 Treatment Plant, which is owned and operated by SGVWC. In addition, the SGVWC B5D well is used as a standby water source. The treatment plant consists of LPGAC for VOC removal, single-pass ion exchange for perchlorate removal, and UV/oxidation units for 1,4-dioxane and NDMA removal. The "Interim Remedial Action Report" (Stetson, 2006c) prepared and submitted to EPA in September 2006 provides a summary of SGVWC B5 Subproject background, construction, and completion activities. Construction was largely completed in early 2007.

Startup testing conducted to support permitting was completed in March 2007 and DPH issued amended drinking water permit 1910039PA-008 for the B5 Treatment Plant on April 21, 2008. SGVWC began delivering potable water to their system on July 8, 2008. Prior to delivering potable water, extracted water was treated and discharged to the San Gabriel River. The DPH issued a permit amendment to allow for the addition of the COI 5 well in July 2009. The COI 5 well went online in July 2009.

Technical performance reports are prepared under Provision 53 of the DPH operating permit and are required to be submitted annually to DPH. The annual report, "Technical Performance Report for the San Gabriel Valley Water Company Plant B5 Water Treatment Facility" (Stetson, 2010e), describes the status and performance of the SGVWC B5 Treatment Plant for the period July 1, 2009 to June 30, 2010. In addition, SGVWC submits monthly compliance reports to DPH; these compliance reports are included in monthly progress reports provided to EPA.

In 2010, the SGVWC B5 Subproject extracted and treated approximately 11,024 acre-feet of water with an average flowrate of 6,833 gpm (Table 2-1), slightly more than last year's production (10,157 acre-feet and 6,294 gpm), and about 98% of the EPA-approved extraction rate of 7,000 gpm. The target extraction rate for 2010 was not achieved because of reduced flow rates during the month of June during battery backup repair on COI 5.

3.0 PERFORMANCE MONITORING ACTIVITIES

As described in the PSEP, monitoring activities for the assessment of the interim remedy performance consist of two phases. The first phase consisted of baseline potentiometric and water-quality monitoring prior to extraction well startup and was completed in April 2005. The second phase involves more frequent potentiometric and water-quality monitoring during startup and initial operation of the extraction wells, followed by reduced monitoring frequencies after several years of continuous operation. The second phase of monitoring began in April 2005, although not all of the extraction wells were fully operational at that time. Potentiometric monitoring was performed on an increased frequency, as required, from April 2005 through November 2006. Water-quality monitoring was performed on an increased frequency, as required, during all of 2006. As described in Section 1.1 of this report, the CRs recommended several modifications to the PSEP, including reduced monitoring frequencies, in technical memoranda dated August 24, September 29, and November 2, 2006 (Geomatrix, 2006a; ERM, 2006; Geomatrix, 2006c) and the changes were incorporated into the final versions of the FSP and QAPP dated November 6, 2006 (Stetson, 2006a; Geomatrix, 2006b). The FSP and QAPP were approved with the modifications to the PSEP by EPA in a letter dated February 12, 2007. In accordance with the approved modifications to the PSEP, reduced monitoring frequencies and several other changes to monitoring activities began in December 2006, as follows:

- Potentiometric monitoring in piezometers and multiport wells was reduced from monthly to quarterly beginning in December 2006.
- Water-quality sampling at MW 5-24, MW 5-25, MW 5-26, and MW 5-27 was reduced from quarterly to semi-annual beginning in Spring 2007.
- Low-flow sampling was implemented at the Key Well beginning in 2007 to reduce the volume of purge water requiring disposal.
- At the request of EPA, annual monitoring for “non-target” VOC and SVOC TICs was implemented in a subset of the multiport wells and in VCWD Big Dalton beginning in 2007.
- At the request of EPA, annual monitoring for non-COC VOCs (including analysis of ethylene dibromide [EDB] by EPA Method 504.1) was implemented in a subset of the multiport wells and in VCWD Big Dalton in 2007.
- At the request of EPA, annual monitoring for 1,2,3-TCP was implemented in a subset of the multiport wells beginning in Fall 2006.

As proposed by the CRs and approved by EPA, the requirements for monitoring of additional constituents including VOC and SVOC TICs, non-COC VOCs (including EDB), and 1,2,3-TCP were to be re-evaluated after the first sampling event. Results for these constituents in the BPOU were presented in the 2007 Annual PE Report (Geomatrix and ERM, 2008). Based on the results, the CRs included recommendations for additional modifications to monitoring activities in the 2007 Annual PE Report (Geomatrix and ERM, 2008). The CRs refined the recommended modifications in a memorandum to EPA dated September 9, 2008 (AMEC Geomatrix, 2008). EPA approved the recommended modifications with several changes via e-mail correspondence on September 24, 2008, and the recommendations were implemented beginning in October 2008 as follows:

- Potentiometric monitoring in the multiport wells was reduced from quarterly to semi-annual.
- Water-quality sampling in selected multiport wells was reduced from semi-annual to annual. Semi-annual sampling continued in MW 5-03 (ports 5-10), MW 5-19 (ports 3-5), MW 5-24 (all ports), MW 5-25 (all ports), MW 5-26 (all ports), and MW 5-27 (all ports).
- Based on the distribution of 1,4-dioxane, the sampling frequency for 1,4-dioxane was reduced to annual and the number of monitoring locations for 1,4-dioxane was also reduced.
- Based on the limited detections of non-COC VOCs (including EDB) and VOC and SVOC TICs, and based on the redundancy between the PSEP and DPH sampling requirements, monitoring for these compounds as part of the PSEP monitoring program was reduced beginning in 2009. EPA agreed to accept the DPH-required monitoring for these compounds to fulfill the requirements of the PSEP as long as the results are maintained the BPOU project database and are provided to EPA in monthly progress reports. The results for non-COC VOCs (including EDB) and VOC and SVOC TICs are also summarized in Annual PE Reports.

The CRs recommended two additional modifications to the PSEP in the 2008 Annual PE Report (AMEC Geomatrix and ERM, 2009) and in a memorandum to EPA dated June 5, 2009 (AMEC Geomatrix, 2009). The recommended modifications were as follows:

- Continue to work with EPA to eliminate redundancies between DPH-required monitoring and the PSEP monitoring program, and
- Consistent with the recommendation above, reduce quarterly sampling in the BPOU Project extraction wells under the PSEP program since this sampling is redundant with sampling that is required under each of the BPOU treatment plant's DPH drinking water permits.

EPA agreed via e-mail correspondence on June 23, 2009, to reduce PSEP sampling of the extraction wells beginning in the third quarter of 2009 provided that the CRs provide additional information to EPA to compare the PSEP and DPH monitoring requirements. The CRs provided the additional information to EPA, including a table comparing PSEP and DPH monitoring requirements, via e-mail on August 5, 2009. EPA approved the additional modifications via e-mail on March 25, 2009, thus allowing the DPH-required monitoring in the extraction wells to fulfill the requirements of the PSEP as long as the results are maintained the BPOU project database and are also summarized in Annual PE Reports. As described in Section 1.1 of this report, the QAPP for Groundwater (AMEC Geomatrix, 2010a), the FSP for Groundwater (AMEC Geomatrix, 2010b), and the Revised Final Performance Standards Evaluation Plan (PSEP) were updated in 2010 (AMEC Geomatrix, 2010c) to incorporate numerous modifications that were approved since the previous versions of these documents were issued.

Potentiometric monitoring, water-quality monitoring, and groundwater modeling activities that were completed in support of performance assessment activities during 2010 are discussed in the following sections.

3.1 Potentiometric Monitoring

Potentiometric monitoring of wells included in the PSEP monitoring program continued to be conducted by the Watermaster and CRs throughout 2010. Locations of the wells included in the BPOU potentiometric monitoring program are shown on Figure 3-1 and their monitoring schedules are presented in Table 3-1. Potentiometric monitoring completed for the PSEP monitoring program during 2010 is summarized below.

- Potentiometric data were collected quarterly in 11 extraction wells, with one exception: potentiometric data were not collected in 2010 in SA1-3 (Lante) because the well was not accessible for water level measurement during the scheduled monitoring events.
- Potentiometric data were collected quarterly in 16 piezometer clusters and three single piezometers.
- Potentiometric data were collected semi-annually in 18 multiport monitoring wells.
- Potentiometric data were collected weekly in one conventional monitoring well, the LACO Key Well.
- Potentiometric data were collected semi-annually in four conventional monitoring wells. Monitoring wells Aerojet (AJ) MW-2, AJ MW-3, and AJ MW-5 were dry in 2010. These wells were destroyed in 2010 as described in the updated PSEP (AMEC Geomatrix, 2010c).
- Potentiometric data were collected semi-annually in 27 existing production wells.

Quarterly potentiometric monitoring at the MW 5-28 monitoring well cluster was conducted in 2010 to supplement the PSEP monitoring program upgradient of SWS wellfields located to the east of the BPOU.

3.2 Water-Quality Monitoring

Water-quality monitoring of new and existing wells included in the PSEP continued to be conducted by the Watermaster and the CRs throughout 2010. Locations of wells included in the BPOU groundwater-quality monitoring program are shown on Figure 3-2 and their monitoring schedules are presented in Table 3-2. Groundwater samples were analyzed for the 20 COCs listed in PSEP Table 2-1, including: 1,4-dioxane, NDMA, perchlorate, and VOCs. Groundwater samples were also analyzed for nitrate and sulfate because of their importance to treatment plant operations and potable use. Groundwater-quality monitoring completed for the PSEP monitoring program during 2010 is summarized below.

- Monthly DPH-required groundwater samples collected in 11 extraction wells were used to fulfill the quarterly monitoring requirements for the PSEP with a few exceptions as follows:
    - Groundwater samples were not collected from SA1-2 because this well was offline during 2010.
    - Groundwater samples from wells COI 5, SGVWC B5B and SGVWC B5E were not analyzed for sulfate.
    - Groundwater samples in the extraction wells were not analyzed for acetone and carbon disulfide.

- Groundwater samples were collected annually from selected ports at 14 multiport wells except for the shallowest ports in and MW 5-17 (port 3) and WHICO (port 6) because these ports were dry during the annual sampling event
- Groundwater samples were collected semi-annually from selected ports at six multiport wells except for the shallowest port in MW 5-03 (port 10) because the port was dry during the semi-annual sampling events.
- Groundwater samples were collected annually from four conventional monitoring wells. Monitoring wells AJ MW-2 and AJ MW-3 were dry in 2010 and could not be sampled. These wells were destroyed in 2010 as described in the updated PSEP (AMEC Geomatrix, 2010c).
- Groundwater samples were collected annually from 16 production wells except for Conrock Company (CC) E Durbin, California Domestic Water Company (CDWC) 14, SWS 139W4, and SWS 140W3 because these four wells were offline during 2010.

In addition to groundwater-quality monitoring required by the PSEP, other groundwater-quality monitoring was performed to supplement the PSEP monitoring program during 2010 including the following:

- Groundwater-quality samples for the COCs and chemicals of interest were collected quarterly from the MW 5-28 monitoring well cluster. Groundwater-quality data at the MW 5-28 monitoring well cluster is used to supplement the PSEP monitoring program upgradient of SWS well fields that are located to the east of the BPOU.
- Additional groundwater-quality monitoring is performed by the WEs to satisfy the requirements of DPH drinking water permits. As described in Sections 1.1 and 3.0, EPA has agreed to accept the results of the DPH required monitoring to satisfy certain PSEP monitoring requirements. These results are to be presented in monthly progress reports and summarized in BPOU Annual PE Reports. The DPH monitoring requirements are summarized in Table 3-3.

Results of the water-quality monitoring are presented in Section 5.2.

3.3 Groundwater Modeling

As described in Section 5.1 of the PSEP (AMEC Geomatrix, 2010c), the BPOU groundwater model is the primary tool for assessing extraction system performance. Annual simulations consist of quarterly stress periods of basin-wide groundwater flow conditions. The BPOU groundwater model is described in the Comprehensive Groundwater Modeling Report, dated July 29, 2005 (Geomatrix, 2005). Previous updates to the model are described in the Addendum to the Comprehensive Groundwater Modeling Report, dated September 8, 2006, (Geomatrix, 2006d), a technical memorandum dated December 14, 2007 (Geomatrix, 2007b), and in the 2007 Annual PE Report (Geomatrix, and ERM, 2008). Updates and modifications to the groundwater model are described in Sections 3.3.1 and 3.3.2 below and updated model results are described in Section 5.3.

3.3.1 Model Update

The groundwater model was updated through the end of water year (WY) 2009-10 with current recharge, pumping, and water level data. Water level data from WY2009-10 were obtained from LACDPW to update the time-variant head boundaries that are used to simulate inflows from the Chino Basin and outflows to Whittier Narrows. Spreading basin recharge data for WY 2009-10 were obtained from LACDPW. Table 3-4 summarizes the quarterly recharge rates for each spreading basin and river reach used in the model for the entire model simulation period (WY1982-2010). Records for WY2009-10 were obtained from LACDPW for the precipitation stations used to update the portion of basin recharge that is derived from precipitation and irrigation return flows. Table 3-5 summarizes the quarterly recharge rates from precipitation and irrigation return flows for each precipitation zone used in the model for the entire simulation period. Figure 3-3 shows the quarterly recharge volumes from all water conservation facilities (spreading basins and river reaches) and from aerially distributed recharge (precipitation and irrigation return flows) for the entire model simulation period. Groundwater pumping for WY2009-10 was updated based on production records obtained from the Watermaster and supplemented with pumping rates for project extraction wells as reported in monthly progress reports submitted to EPA. Figure 3-4 shows the quarterly pumping from all wells for the entire simulation period. Groundwater pumping in WY2009-10 continued to exhibit similar seasonal trends as previous years; the largest amount of pumping occurred during the peak of the dry season in the third quarter of the calendar year, and the smallest amount of pumping occurred during the peak of the wet season in the first quarter of the calendar year. Table 3-6 provides a list of all pumping wells used in the BPOU groundwater model, including the observed and simulated well screened intervals. Figure 3-5 shows a comparison of annual recharge and annual pumping throughout the entire model simulation period. As shown on Figure 3-5, annual recharge exceeded annual pumping during WY2009-10.

3.3.2 Modifications to the Groundwater Model

EPA's comments on the groundwater model dated December 16, 2005, January 8, 2007, and October 1, 2008, requested improvements to the calibration of the groundwater model. As described in Section 3.3, the CRs made several refinements to the groundwater model in 2006 and 2007. In 2010 and 2011, the CRs made the following additional refinements to the groundwater model in response to EPA's comments:

- Hydraulic conductivities were adjusted in the southern part of the San Gabriel Valley to improve the model calibration near the mouth of Puente Valley.
- Hydraulic conductivities were adjusted in the vicinity of the Santa Fe spreading grounds and along the San Gabriel River to improve the simulation of transient water levels in the vicinity of Subarea 1. Specifically, EPA noted that the simulated water levels in Subarea 1 were up to 20 feet higher than observed water levels during WY2005-06.

Revised hydraulic conductivities for each layer in the groundwater model are presented in Figures 3-6 through 3-14.

In addition to the refinements that were made in response to specific EPA comments, recharge from irrigation return flows was modified on a trial and error basis to improve the match between simulated and observed water levels during the 29-year period simulated by the groundwater model, with emphasis on improving the match to peak high and low water levels. This calibration approach focused on recharge from irrigation return flows as a key calibration parameter because it is the model input parameter with the greatest uncertainty. This input parameter was previously estimated using a percentage of the long-term average precipitation, and the recharge was modified by using a percentage of the measured monthly/quarterly precipitation. The modified recharge from precipitation and return flows is summarized in Table 3-5.

3.3.3 Model Simulations of Extraction System Performance

Model simulations of extraction system performance were conducted using the updated BPOU groundwater model and the transient particle tracking methods. As requested by EPA, forward particle tracking methods were used to evaluate the hydraulic performance of the project extraction wells under actual pumping conditions during WY 2009-10. As described in previous submittals, AMEC developed the FETRAC transient particle tracking code to perform both forward and reverse particle tracking under transient conditions. In the course of performing the forward particle tracking requested by EPA, the FETRAC code was updated and renamed to FETRAC-II. Code modifications were made to FETRAC-II to allow for variable time steps, thus allowing for the use of smaller tracking time steps near pumping wells where velocities are higher and elements are finer and the use of larger tracking time steps where velocities are lower and elements are larger. Additionally, FETRAC-II has been modified to: 1) restrict particles from “zig-zagging” between two elements; 2) allow particles to move vertically through non-pumping FEFLOW wellbore conditions; and 3) allow the user to select a single flow time step to perform pseudo-steady state particle tracking assuming uniform flow conditions.

As described in the Comprehensive Report (Geomatrix, 2005) and in the PSEP (AMEC Geomatrix, 2010c), the groundwater model simulates transient boundary conditions using quarterly stress periods. Therefore, groundwater withdrawals from project extraction wells and other production wells are simulated using average quarterly pumping rates. The average quarterly pumping rates for each well are estimated by measuring the total volume (in acre-feet) that was pumped during the quarter, dividing the total volume by the number of days in the quarter, and then converting the result to an average quarterly pumping rate (in gpm). Simulated pumping rates are summarized in Table 3-7.

In response to requests from EPA, forward particle tracking was conducted to evaluate the hydraulic effects of the operation of project extraction wells in 2010. Forward particle tracking was performed by starting particles at the beginning of each quarterly stress period in WY2009-10 and then simulating the forward paths of the particles under the quarterly groundwater flow conditions. The starting locations for the particles were representative of the approximate horizontal and vertical extent of various contaminants in areas upgradient of the Subarea 1 and Subarea 3 extraction wells. The release of these particles is not intended to display actual contaminant sources nor the actual locations where "initial particles" of contamination were originally released into groundwater. The particles do not represent contaminant mass; rather, they solely represent hypothetical particles in groundwater in order to depict the likely zones of hydraulic capture as the particles move downgradient in groundwater. The resulting particle tracks cannot be utilized to infer, suggest, or demonstrate the source of any contamination with any degree of precision. Further, since these particles do not represent mass and are not modeling solute transport, they do not incorporate processes such as retardation and degradation.

Because transient particle tracks simulated for quarterly or annual periods were too short to provide meaningful results for the short-term evaluation of hydraulic performance, the quarterly particle tracks were extended to a length consistent with a three-year period. This approach provides results that are representative of the hydraulic performance of the project extraction wells under actual pumping conditions during each quarter in WY2009-10 by assuming that the quarterly flow conditions for each quarter persisted for three years. This approach has limitations in that it exaggerates the length of the particle tracks and suggests that groundwater was captured over a larger area than likely occurred given the relatively short travel time available for groundwater to reach an extraction well during one quarter of pumping. In addition, the particle tracking simulations assume that the extraction wells operated on a continuous basis and, therefore, the volume of water pumped during the quarter was simulated using an average pumping rate for the quarterly stress period. This approach generally accounts for periods when extraction wells were not in operation but does not implicitly simulate periods when wells are cycling on and off in response to water supply demands. Consequently, the actual hydraulic control provided by an extraction well may be greater than predicted during periods of continuous well operation and less than predicted during periods of discontinuous operation. Further, quarterly particle tracking simulations show considerable temporal variability associated with seasonal changes in groundwater recharge and pumping stresses that are not representative of longer-term transient groundwater flow conditions.

Given the limitations of quarterly forward particle tracking results, depictions of hydraulic capture presented in this report should not be considered representative of longer-term extraction system performance. Results of forward particle tracking to evaluate extraction system performance are presented in Section 5.3.2 and an overall discussion of the hydraulic capture at various extraction well locations is presented in Section 7.1.1.

4.0 TREATMENT PLANT MONITORING ACTIVITIES

This section summarizes methods used to monitor treatment plant performance. Treatment plant operational results are presented in Section 6.0.

4.1 Subarea 1 – Valley County Water District Lante Treatment Plant

The VCWD Lante Treatment Plant operated on a nearly full-time basis until November 2010, experiencing downtime associated with routine maintenance and unplanned operational interruptions. Rehabilitation of SA1-2 caused that well to be non-operational from February 2010 through the end of the year, resulting in a reduced total extraction rate for the VCWD system. The VCWD treatment plant did not operate during the month of November and part of December 2010 due to high pressure on both ISEP® systems caused by clogged distributors inside the ISEP® vessels. These distributors were cleaned to reduce the pressure buildup.

Raw water, partially treated water, and fully treated water were routinely sampled and analyzed for COCs, 1,2,3-TCP, inorganic chemicals, and other diagnostic parameters to evaluate the effectiveness of treatment processes and to monitor the quality of the fully treated water. Treated water was primarily delivered to SWS Plant 121. Water-quality data, as obtained, are summarized in the DPH compliance reports appended to the monthly progress reports to EPA.

In August 2006, by mutual agreement among EPA, South Coast Air Quality Management District (SCAQMD), and VCWD, air stripper and off gas control system permits with SCAQMD were cancelled and EPA assumed compliance oversight with respect to operations formerly covered by the SCAQMD permits. The air stripper vapor abatement equipment consists of four 20,000-pound VPGAC adsorbers equipped with heaters. Air compliance samples were collected according to the revised protocol approved by EPA on November 18, 2008. The revised protocol requires air sampling immediately after a carbon change out, monthly while the Maximum Individual Cancer Risk (MICR) control efficiency remains above 75%, and weekly when the control efficiency falls below 75%. All air samples were analyzed by EPA Method TO-15.

A single VPGAC changeout occurred in September 2010 where 40,000 lbs of VPGAC were replaced. Two LPGAC changeouts occurred in 2010, where 200,000 lbs of LPGAC were replaced. The first changeout occurred in February and the second during the end of September through the beginning of October. Carbon and resin changeouts are summarized in Table 4-1. The LPGAC is managed at facilities that are authorized to accept Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) wastes. As they are received, certificates of disposal or reactivation are provided to EPA in the monthly progress reports.

Waste brine and water softener wastes produced by the ISEP® system were discharged under Industrial Wastewater Permit No. 016112 from the LACSD, issued on August 5, 2004 and subsequently revised and reissued on March 23, 2010. Brine discharges occurred throughout 2010 while the treatment plant was operating. Brine discharge samples were collected and analyzed in accordance with permit requirements. Quarterly Self Monitoring Reports (SMRs) were submitted to LACSD and EPA on or before April 15, and July 15, and per the reissued permit, were submitted on a semi-annual basis thereafter. The SMRs summarize flow, pH, and brine quality data collected during the reporting period.

4.2 Subarea 3 – La Puente Valley County Water District Treatment Plant

The LPVCWD Treatment Plant operated on a full-time basis in 2010, experiencing periodic downtime associated with routine maintenance and infrequent and unplanned operational interruptions. In general, LPVCWD experienced a minimal amount of unplanned downtimes during 2010. Prior to 84.5 hours of downtime in December, the most downtime LPVCWD experienced in a month during 2010 was 42.2 hours. LPVCWD had two months with no downtime and another three months with less than 12 hours of downtime. As a result, the LPVCWD Subproject exceeded its target extraction rate in 2010. Raw and treated water sampling was performed in accordance with the DPH permit and included weekly sampling for VOCs, perchlorate, 1,4-dioxane, NDMA, and various inorganic and physical parameters. The weekly sampling results are included in monthly progress reports submitted to DPH as a requirement of LPVCWD's drinking water permit. These results are also included in the monthly progress reports to EPA.

In August 2006, by mutual agreement among EPA, SCAQMD, and LPVCWD, air strippers and off-gas unit permits were cancelled and EPA assumed compliance oversight with respect to operations formerly covered by the SCAQMD permits. The VOC treatment equipment consists of a 30-foot tall air-stripping tower with a single 7,000-pound VPGAC adsorber and a 41-foot tall air-stripping tower with a single 20,400-pound VPGAC adsorber. Air compliance samples were collected and analyzed by EPA Method TO-15 according to the revised protocol approved by EPA on April 24, 2008. The revised protocol requires air sampling immediately after a carbon change out and monthly thereafter. The VPGAC was changed out on April 28, July 7, September 14, and November 23, 2010, according to the 70-day change out criteria. Carbon changeouts are summarized in Table 4-1. All carbon was managed at the Carbon Activated Corporation (Carbon Activated) facility in Compton, California, which is authorized to accept CERCLA wastes. As they are received, copies of disposal manifests for change out of spent VPGAC are provided to EPA in the monthly progress reports.

Waste brine and water softener wastes were discharged under temporary Industrial Wastewater Discharge Permit 17128 issued by LACSD. The temporary permit was issued while a new permit, due to a requested ownership change to BPOU, LLC., is under review by LACSD. Quarterly brine discharge sampling was performed in accordance with permit requirements. Four quarterly SMRs were prepared and submitted to LACSD and EPA on or before April 15, July 15, and October 15, 2010, and January 15, 2011.

4.3 Subarea 3 – San Gabriel Valley Water Company B6 Treatment Plant

The SGVWC B6 Treatment Plant experienced operation issues, mainly related to ISEP® operational problems, during the first quarter of 2010 that caused it to operate at approximately 40% its target extraction rate during that time (production ranged from 2,425 gpm to 2,644 gpm during that time). Although these issues were largely resolved, the SGVWC B6 Treatment Plant continued to experience ISEP® problems throughout the year. As a result, the SGVWC B6 Subproject did not meet its target extraction rate in 2010. Production was primarily from SGVWC B25A, B25B, B26A, and B26B; SGCWC B6C and B6D were infrequently operated as standby drinking water sources.

Raw and treated water sampling were performed in accordance with the DPH permit and included sampling for COCs, inorganic chemicals, and other diagnostic parameters. Water-quality data are summarized in monthly reports to DPH and are included in the monthly progress reports to EPA.

In August 2006, by mutual agreement among EPA, SCAQMD, and SGVWC, permits for the four air strippers and off-gas units were cancelled and EPA assumed compliance oversight with respect to operations formerly covered by the SCAQMD permits. Air compliance samples were collected according to the revised protocol approved by EPA on April 24, 2008. The revised protocol requires air sampling immediately after a carbon change out, every two months while the MICR control efficiency is greater than 90%, monthly while the MICR control efficiency is less than 90% but greater than 75%, and weekly when MICR control efficiency is less than 75%. The air compliance sampling data were included in the monthly progress reports to EPA. Carbon change outs occurred in March (40,000 pounds) and November (20,000 pounds) 2010. Carbon changeouts are summarized in Table 4-1. The VPGAC is managed at facilities approved by EPA to accept CERCLA wastes. As they are received, copies of disposal manifests for change out of spent VPGAC are provided to EPA in the monthly progress reports.

Waste brine and water softener wastes produced by the ISEP® system were discharged under Industrial Wastewater Permit No. 16499 issued on February 17, 2004. Brine discharges occurred throughout 2010. Quarterly brine discharge sampling is required, and was performed for VOCs, SVOCs, perchlorate, 1,4-dioxane, sulfide, oil and grease, chloride, alkalinity, calcium, magnesium, total toxic organics, suspended solids, and chemical oxygen demand. Four quarterly SMRs that summarize 2010 discharges and brine quality data were submitted to LACSD and EPA on or before April 15, July 15, and October 15, 2010, and January 15, 2011.

4.4 Subarea 3 – San Gabriel Valley Water Company B5 Treatment Plant

The SGVWC B5 Treatment Plant operated continuously in 2010, experiencing periodic downtime associated with routine maintenance and infrequent unplanned interruptions. Production was primarily from wells B5B, B5E, and COI 5, with average annual production rates of 2,685 gpm; 2,611 gpm; and 1,206 gpm; respectively. SGVWC B5D was used as a standby drinking water source, making significant contributions to water supplies in June and July of 2010. B5D is typically used while LPGAC changeouts are scheduled.

Raw and treated water sampling was performed in accordance with the DPH permit and included sampling for COCs, inorganic chemicals, and other diagnostic parameters. Water-quality data are summarized in monthly reports to DPH and are included in the monthly progress reports to EPA.

VOCs are removed using LPGAC and the carbon was replaced in February, June, August, and November 2010. Carbon changeouts are summarized in Table 4-1. Copies of disposal manifests for change out of spent LPGAC are provided as they are received in monthly progress reports to EPA.

Resin for the single-pass ion exchange used to remove perchlorate was replaced in April and June 2010. Carbon and resin changeouts are summarized in Table 4-1. Copies of disposal manifests for the change out of spent resins are provided as they are received in the monthly progress reports to EPA.

5.0 PERFORMANCE MONITORING RESULTS

Potentiometric and groundwater-quality monitoring data obtained for the PSEP monitoring program during 2010 were collected in support of performance monitoring during continued construction, testing, and operation of the BPOU remedy. Results of potentiometric monitoring, water-quality sampling, and groundwater modeling activities are presented in the following sections.

5.1 Potentiometric Monitoring Results

The primary objective of the potentiometric monitoring described in Section 3.1 is to verify that the BPOU groundwater flow model accurately reflects the observed flow field and to verify that the remedy is limiting further migration of COCs in groundwater. As noted in Section 6.1.2 of the PSEP, results from potentiometric monitoring are also used to develop potentiometric surface maps to assist in evaluating changes in groundwater flow patterns in the BPOU.

Key components of the assessment of potentiometric data include the following:

- Regional water level fluctuations due to basin-wide recharge and pumping conditions;
- Local-scale water level fluctuations due to ongoing groundwater production and extraction system pumping;
- Regional and local-scale lateral hydraulic gradients and flow directions; and
- Regional and local-scale vertical hydraulic gradients and flow directions.

Potentiometric monitoring results for 2010 are discussed in the following sections.

5.1.1 Water Level Fluctuations

Long-term regional water level conditions in the BPOU are evaluated using water level data for the LACO Key Well. Figure 5-1 shows the water levels measured in the Key Well from 1982 through 2010. During 2010, groundwater levels in the LACO Key Well increased from approximately 190.0 feet mean sea level (msl) in January 2010 to approximately 212.7 feet msl in December 2010. Review of 2010 monitoring data suggests that the observed water level increase in the LACO Key Well occurred in response to recharge volumes exceeding groundwater production in WY2009-10 as described in Section 3.3.1.

Figures 5-2 and 5-3 show water levels in multiport monitoring wells MW 5-03 and MW 5-20. The hydrographs for MW 5-03 and MW 5-20 represent water level conditions in Subarea 1, in the northern portion of the BPOU, and in Subarea 3, in the southern portion of the BPOU, respectively. As shown on Figures 5-2 and 5-3, water levels in both Subarea 1 and Subarea 3 increased in 2010 as compared to the prior year's recorded water levels. Water levels in Subarea 1 increased approximately 21.2 feet between September 2009 and October 2010, while water levels in Subarea 3 increased approximately 6.7 to 18.2 feet during the same period. Water level data depicted on Figure 5-2 indicate that all ports in MW 5-03 exhibit similar trends. As shown on Figure 5-3, water levels in the deeper ports of MW 5-20 (Ports 1 – 5) exhibited higher rates of rise than the shallow ports during 2010. As discussed in Section 1.3.3.1, the difference in the observed water level trend between the shallow and deep ports is likely the result of confining units in Subarea 3 that provide hydraulic separation between pumping in different elevation intervals.

5.1.2 Lateral Hydraulic Gradients

Generalized potentiometric surface maps for the shallow and deep elevation intervals were developed based on water level data collected in the multiport monitoring wells to assess observed groundwater flow patterns and hydraulic gradients across the BPOU. Figures 5-4 and 5-5 show observed groundwater flow conditions in the shallow (above -500 feet msl) and deep (below -500 feet msl) elevation intervals in April 2010. Figures 5-6 and 5-7 show observed groundwater flow conditions in the shallow and deep elevation intervals in October 2010. Evaluation of observed groundwater flow patterns on a more detailed scale is limited by spatial variations in hydrostratigraphy and significant short-term water level fluctuations that occur in response to variations in local recharge and pumping.

As shown on Figures 5-4 through 5-7, lateral hydraulic gradients are towards the west-southwest, with a more westerly gradient in Subarea 3 in the vicinity of the SGVWC B5 Subproject and the CDWC Bassett wellfield. Although it is difficult to generalize groundwater flow directions given the seasonality of pumping and recharge in the San Gabriel Basin, groundwater flow directions are generally more southerly during higher water level conditions and are more westerly during lower water level conditions.

Regional-scale lateral hydraulic gradients were estimated using water levels measured in MW 5-03 and MW 5-20 during April and October 2010. Estimated lateral hydraulic gradients are summarized in Table 5-1. The following observations are presented based on the results shown in Table 5-1:

- Estimated lateral hydraulic gradients in the shallow elevation interval ranged from 5.9×10^{-4} to 9.1×10^{-4} toward the west-southwest.
- Estimated lateral hydraulic gradients in the deep elevation interval ranged from 7.4×10^{-4} to 1.1×10^{-3} toward the west-southwest.
- Lateral hydraulic gradients continue to be lower in the shallow elevation interval above -500 feet msl compared to lateral hydraulic gradients in the deep elevation interval below -500 feet msl.

5.1.3 Vertical Hydraulic Gradients

Water level measurements in multiport monitoring wells and piezometer clusters installed near extraction wells indicate that vertical hydraulic gradients vary throughout the BPOU. As discussed in Section 5.1.1, hydrographs shown on Figures 5-2 and 5-3 represent water level conditions in Subarea 1 (MW 5-03), in the northern portion of the BPOU, and in Subarea 3 (MW 5-20), in the southern portion of the BPOU, respectively. As shown on Figure 5-2, hydrographs for ports at different depths in MW 5-03 plot essentially on top of each other, indicating that there is no significant vertical hydraulic gradient in Subarea 1. However, as shown on Figure 5-3, water levels measured at different depths in MW 5-20 are separated by up to 25 feet, indicating that there are significant downward vertical hydraulic gradients in Subarea 3.

Vertical hydraulic gradients calculated at selected multiport wells and piezometer clusters located in Subarea 1 and Subarea 3 are summarized in Table 5-2. The estimates summarized in Table 5-2 are based on semi-annual water level conditions in March/April 2010 and October 2010. As shown in Table 5-2, vertical hydraulic gradients continue to be lower in Subarea 1 compared to vertical hydraulic gradients in Subarea 3. Estimated vertical hydraulic gradients in Subarea 1 ranged from 2.1×10^{-3} upward to 1.3 x 10^{-3} downward. Estimated vertical hydraulic gradients in Subarea 3 ranged from 3.4 x 10^{-3} to 1.2 x 10^{-2} and are consistently downward.

5.2 Groundwater Quality

Groundwater samples were collected from wells in the PSEP monitoring program to evaluate groundwater-quality conditions in the BPOU. As described in Section 3.2, groundwater samples were analyzed for the 20 COCs listed in PSEP Table 2-1 including: 1,4-dioxane, NDMA, perchlorate, and VOCs. Groundwater samples were also analyzed for nitrate and sulfate because of their importance to treatment plant operations and potable use. As described in Section 3.2, groundwater-quality monitoring data collected to satisfy DPH permit requirements were used to supplement the PSEP monitoring program during 2010. Groundwater-quality monitoring results for 2010 are discussed in the following sections.

5.2.1 Water-Quality Results

Groundwater-quality results for the PSEP monitoring program in 2010 are summarized in Table 5-3. Table 5-3 also includes results from the MW 5-28 monitoring well cluster. The presentation of groundwater-quality results in this report focuses on the evaluation of the spatial distribution and temporal trends for seven selected COCs in groundwater including: 1,2-dichloroethane (1,2-DCA); 1,4-dioxane; carbon tetrachloride; NDMA; perchlorate; PCE; and TCE. This evaluation relies on approximate depictions of the interpreted current spatial distribution and concentration trends of the seven COCs in groundwater. The depictions are approximate and are further evaluated in Sections 5.2.3 and 5.2.4 as well as Section 4.0 of Appendix A.

Results for other water-quality monitoring that was performed by the WEs to satisfy the requirements of DPH drinking water permits presented in Table 3-3 are summarized as follows:

- The DPH-required monitoring for the BPOU COCs in the extraction wells fulfills the requirements of the PSEP, and the DPH requirements also include more frequent monitoring (weekly or monthly) in these wells than the PSEP requires (quarterly). Therefore, in some instances Table 5-3 includes additional water-quality results for BPOU COCs in the extraction wells as required by DPH.
- Water-quality results for 1,2,3-TCP are presented in Table 5-4. Concentrations of 1,2,3-TCP were detected at levels that exceeded the NL (5 ng/L) only at SA1-3 (Lante). As shown in Table 5-4, DPH-required monitoring data for a few monitoring events were not available at the time of this report. Table 5-4 also provides results from several additional monitoring events that were not required under either the PSEP or DPH monitoring requirements as presented in Table 3-3.
- Water-quality results for EDB analyses are presented in Table 5-5. DPH-required monitoring data for EDB in the multiport wells and in VCWD Big Dalton were not available at the time of this report.
- Water-quality results for non-COC VOCs are presented in Table 5-6. All available DPH-required data are included. Five non-COC VOCs were detected in various wells at levels below their respective MCL or NL. Table 5-6 also provides results from several additional

monitoring events that were not required according to the DPH monitoring requirements as presented in Table 3-3. For non-COC VOCs that have no MCL and NL, EPA Regional Screening Levels are shown in Table 5-3 as requested by EPA.

- Water-quality results for VOC and SVOC TICs are presented in Table 5-7. All available DPH-required data are included. PCE was tentatively identified above the MCL in SA1-3 (Lante) using SVOC analysis; this compound is currently monitored using EPA Method 8260 and is addressed by the remedy for VOC treatment within the BPOU. Five other compounds were tentatively assigned a specific chemical association with no current regulatory standard or limit. Table 5-7 also provides results from several additional monitoring events that were not required according to the DPH monitoring requirements as presented in Table 3-3.

5.2.2 Data Validation and Data Quality Assessment

Data management activities for the BPOU Project are managed by LDC under contract to the Watermaster. LDC utilizes EDMSi, an EQUIS web-based database, for the management of historical data that was compiled from the EPA San Gabriel Basin database, CRs, WEs, and other relevant sources. New water-quality data that are collected for the PSEP monitoring program are reported to LDC by laboratories and are validated in EDMSi as part of the real-time automated Tier 1A/1B process and Tier 3 selection. As specified by the QAPP (AMEC Geomatrix, 20010a), Tier 1A/1B validation was performed by LDC on all water-quality data collected in support of the PSEP monitoring program and Tier 3 review was performed on approximately ten percent of the PSEP monitoring data. Results of the data validation are used to evaluate laboratory performance and ensure that data quality is acceptable to meet BPOU Project objectives.

Data qualifiers that were assigned during the Tier 1A/1B and Tier 3 reviews are shown with the groundwater-sampling results summarized in Table 5-3. Based on the data validation efforts and the evaluation of field quality control (QC) samples all analytical sample results are considered usable to support the BPOU Project Data Quality Objectives (DQOs). Results of the Tier 3 review are described as follows:

- Results for acetone were qualified as J (all detects) and UJ (all non-detects) due to low Matrix Spike(MS)/Matrix Spike Duplicate (MSD) recovery in the trip blank for samples collected on October 25, 2010, in MW 5-03 (ports 5, 6, and 7). No other VOCs were qualified by the Tier 3 review.

- Results for 1,4-dioxane were qualified as J (all detects) and UJ (all non-detects) due to low internal standard recovery for samples collected on May 13, 2010, in MW 5-28I and MW 5-28D and for samples collected on May 20, 2010, in MW 5-18 (port 2) and MW 5-19 (port 6).

- Results for NDMA were qualified as non-detect at the reporting limit (0.002U) due to method blank contamination for samples collected on October 25, 2010, in MW 5-06 (ports 5 and 6).

- Results for NDMA were qualified as J (all detects) and UJ (all non-detects) due to high percent difference in the continuing calibration for samples collected on May 13, 2010, in MW 5-28S, MW 5-28I, MW 5-28D, VCWD E Maine and VCWD W Maine and for samples collected on May 20, 2010, in MW 5-18 (ports 1-3) and MW 5-19 (ports 1-6).

- Results for nitrate were qualified as J (all detects) due to high percent difference in the continuing calibration for samples collected on May 20, 2010, in MW 5-18 (ports 1-3) and MW 5-19 (ports 1-3).
- No results for sulfate and perchlorate were qualified.

Final Tier 3 validation reports were submitted by LDC to the Watermaster on August 31, 2010, and February 22, 2011 (LDC, 2010, 2011). The Tier 3 results were submitted by the Watermaster to EPA via e-mail and are also posted on a secure LDC BPOU web portal.

5.2.3 Distribution of Selected Chemicals of Concern

Consistent with previous Annual PE Reports, water-quality data from wells screened at selected depths within the aquifer were interpreted using the three-dimensional geospatial modeling software, EarthVision®. A detailed description of the approach used for the development of plume maps and chemical cross sections for the seven selected COCs is presented in Appendix A. Isoconcentration contours for these seven COCs are shown on the generalized distribution maps on Figures 5-8 through 5-14. The isoconcentration contours shown on the generalized distribution maps represent the composite lateral extent of each individual chemical at all depths in groundwater. The lateral distribution of the selected COCs is also shown in plan view at three specific elevation intervals in Appendix A. The three elevation intervals are as follows:

- Elevations between the water table (or potentiometric surface) and -200 feet msl;
- Elevations between -200 feet and -500 feet msl; and
- Elevations below -500 feet msl.

The plume maps for the three elevation intervals shown in Appendix A include two sets of isoconcentration contours on each map. Isoconcentration contours at "discrete" elevations are shown for horizontal slices through the plumes at -50, -350 and -550 feet msl. Isoconcentration contours for "composite" elevation intervals are also shown through the plumes for elevation intervals extending from the water table to -200 feet msl, between -200 and -500 feet msl, and below -500 feet msl.

Given the three-dimensional nature of the plumes, the reader should consider the three-dimensional visualization that is inset in the corner of each figure when reviewing the two-dimensional plume maps and chemical cross sections. The three-dimensional visualizations provide the appropriate context within which to review the two-dimensional isoconcentration contours shown on each plume map and chemical cross section. It should be noted that the water-quality data used to create the three-dimensional plume interpretations are posted on the plume maps according to the composite elevation intervals described above. Therefore, in many instances the discrete contours may not appear to correspond to water-quality data that are within the composite elevation interval but that are either above or below the elevation of the discrete contours.

Chemical cross sections showing the vertical distribution of selected COCs along four discrete transects are also shown in Appendix A. Cross section A-A' represents a north-south transect that is aligned generally with the longitudinal axis of the COC plumes. Cross sections B-B', C-C', and D-D' represent east-west or northwest-southeast transects that are aligned generally perpendicular to the dominant groundwater flow direction in the BPOU. Cross sections B-B', C-C', and D-D' show the distribution of the COC plumes in the upgradient, mid-plume, and downgradient areas of the BPOU and include various production wells that are vulnerable to lateral migration of COC plumes towards the west or east.

The depictions of plume geometry presented in Appendix A and summarized on Figures 5-8 through 5-14 represent the estimates of the distribution of the COCs in the BPOU in 2010. However, as with any approach used to interpolate data between known data points, there are uncertainties and limitations to the approach that may result in alternative interpretations of the distribution of COCs in groundwater. These uncertainties and limitations are summarized as follows:

- For clarity, and as requested by EPA, we have depicted the seven principal COCs in separate plume maps at three elevations. Plumes for the various COCs overlap (and/or diverge) at various depths throughout the impacted areas.
- The plume maps and chemical cross sections attempt to depict the dynamic and temporally changing three-dimensional distribution of COCs in groundwater with static two-dimensional images. While these maps and cross sections show two-dimensional isoconcentration contours of the COC plumes in plan view and in profile, they represent interpolated approximations of the distribution of COCs in groundwater based on available data. The exact subsurface distribution of the COCs cannot be completely ascertained given these and other potential limitations. The spatial and temporal spread of the chemical data may not encompass the entire distribution of chemicals in the groundwater (i.e., additional assumptions are necessary as to chemical concentrations in areas that may not be completely represented by monitoring wells). In particular, results of the interpolation should be carefully evaluated in areas where available data are limited or concentrations change significantly over short distances.
- Alternative interpretations of the distribution of the COC plumes are possible and may differ from the plume depicted here by utilizing plumes drawn manually using professional judgment. For example, plume maps and chemical cross sections for certain COCs portray discontinuous plumes in areas where the plumes may in fact be continuous.
- As described in Appendix A, the plume interpretations generally incorporate water-quality data collected in May 2010. However, where data were not available for that time period, data from the next closest date during the April through October 2010 time period were utilized. While using such an expanded data set is helpful to some degree in the contouring exercise, it introduces additional uncertainties in comparing data taken from different time periods and assuming that the ultimate projection is a consistent one. Moreover, even using this temporally diverse data set, there are inevitable gaps in the existing data that limit our ability to define the distribution of COCs in groundwater completely. In addition, the EarthVision® software used to create the plume maps and chemical cross sections utilizes certain algorithms to interpolate or "fill in" data gaps in order to provide a more comprehensive picture of the distribution of COCs. Although the EarthVision® software objectively applies the selected interpolation scheme, other software and other interpolation schemes may be applied that may generate reasonable, yet differing, results, each appropriately honoring the available monitoring data. This is not a unique limitation of the

EarthVision® software, but simply a limitation of any methodology with limited data. Consequently, the interpretation may result in differences between actual and interpreted concentrations at any given point in the Project area.

- The Duarte Fault is represented as a diffuse zone of faulting on the plume maps and chemical cross sections. However, no faulting was explicitly represented in any way in the three-dimensional grid used to interpolate the plumes. The diffuse fault zone is considered to be a reasonable representation of the uncertainty in the fault's location as it has several fault splays concealed beneath alluvial deposits.
- The northern-most limits of some COCs depicted on the plume maps are uncertain due to the limited amount of data available to the CR group from other EPA-named PRPs, including the Mobil/Lockheed/Valspar group, as well as other entities that may be PRPs in the northern portions of the BPOU. In consideration of the lack of recent available groundwater data from several PRP facilities and historical detections of several COCs such as TCE and PCE in the area north of the Duarte Fault zone, isoconcentration contours for TCE and PCE are truncated at the downgradient (southern) extent of the Duarte Fault zone.

Evaluation of both the generalized plume maps shown on Figures 5-8 through 5-14 and the detailed elevation-specific plume maps and chemical cross sections that are shown in Appendix A resulted in the following general observations of the spatial distribution of COCs in the BPOU:

- The longitudinal extent of the longest COC plumes extends from north of the Duarte Fault zone in Subarea 1, approximately 7.5 miles towards the southwest, where the plumes terminate near the confluence of Avocado Creek and the San Gabriel River.
- The maximum lateral extent of the various COC plumes generally overlap throughout their extent, with the exception of the perchlorate plume, which extends slightly farther to the east in the mid-plume area in comparison to other COC plumes.
- The vertical extent of the various COC plumes ranges from depths of approximately 600 feet below ground surface (bgs) to the north of Arrow Highway, in Subarea 1, to approximately 1,000 feet bgs in Subarea 3.

In addition to the general observations described above, minor changes in the COC concentrations in various wells resulted in slightly different interpretations of the extent of the COC plumes compared to the previous year. In particular, concentrations of COCs in several wells that are located near the edges of the plumes changed relative the respective MCL (or NL); the concentrations of some COCs in some wells located near the edges of the plumes increased above MCLs (or NLs) whereas the concentrations of some COCs in some wells decreased below MCLs (or NLs). Such changes in concentration resulted in a slightly different location of the isoconcentration contours at the MCL (or NL) compared to the previous year. Also, the NL for 1,4-dioxane was decreased from 3 micrograms per liter (µg/L) to 1 µg/L compared to the previous year. Changes in the concentrations of COCs relative to the MCL (or NL) that resulted in a different location of the isoconcentration contours at the MCL (or NL) compared to the previous year are as follows:

- As compared to the 2009 plume maps and chemical cross sections, the lateral and vertical extent of the 1,4-dioxane plume exceeding the NL in 2010 was larger due to the decrease in the NL for 1,4-dioxane from 3 µg/L to 1 µg/L. It should be noted that the lowermost contour interval of 1 ug/l is at or near the reporting limit (RL) for the constituent and as such may represent an approximate extent of this constituent at the location portrayed by the contour.

- In Subarea 1, the NDMA plume appears to extend slightly deeper compared to the previous year due to higher concentrations of NDMA in the deepest port in MW 5-13 as shown on Figure A-26.
- In Subarea 1, the lateral extent of the perchlorate plume appears to extend slightly farther to the west compared to the previous year due primarily to higher concentrations of perchlorate in well MW 5-24 in 2010. However, slightly lower concentrations of perchlorate also were detected in wells MW-5-13 and MW 5-17 compared to the previous year.
- In Subarea 3, the distributions of the seven COC plumes appear to be generally unchanged compared to the previous year.

When reviewing the evaluation presented above, apparent changes in the interpreted spatial distribution of a particular COC plume from year to year should be evaluated with considerable caution. Historical variations in chemical concentrations have been observed seasonally and from year to year as basin water levels vary. In some instances, very slight differences in measured concentrations at or above the RL, or values that are qualified (J-flagged) may result in apparent changes in the interpreted extent of a particular COC plume as depicted on the plume maps and chemical cross sections. Such short-term changes in the interpreted extent of a particular COC plume may or may not be representative of a particular seasonal or annual change. But, particularly with concentrations that are measured at very low levels, such apparent short-term changes should not be considered as representative of longer-term (multi-year) trends until such observations can be confirmed over several years. This is particularly important for wells located along the perimeter of the COC plumes.

5.2.4 Temporal Trends

Temporal trends in chemical concentrations for the seven selected COCs were evaluated by updating time-concentration graphs for all wells in the PSEP water-quality monitoring network as presented on Figures 5-15 through 5-21. Time-concentration graphs were updated for selected multiport wells included in the BPOU water-quality monitoring program for the most recent five-year period from 2006 through December 2010 using available data in the BPOU Project database. The graphs include data that were collected for BPOU performance monitoring activities as well as DPH and other regulatory agency monitoring requirements. Concentrations of chemicals detected in groundwater samples are plotted using closed circles; chemicals not detected in groundwater samples were plotted at the RL using open circles. Groundwater-quality results in multiport monitoring wells are grouped on the time-concentration graphs according to measurement port elevations in three elevation intervals as follows: between the water table and -200 feet msl, between -200 and -500 feet msl, and below -500 feet msl.

Based on a review of the time-concentration graphs shown on Figures 5-15 through 5-21, the following observations were noted:

- Monitoring wells MW 5-11, MW 5-13, and MW 5-18 are located in the upgradient area of the COC plumes, north of Arrow Highway in the Subarea 1 portion of the BPOU. These wells are considered to be general indicators of the quality of groundwater that is flowing toward downgradient extraction wells installed for the VCWD Lante Subproject. Concentrations of most COCs in these wells were generally consistent in 2010 in comparison to the previous year with a few exceptions: Concentrations of 1,4-dioxane, NDMA, and perchlorate in MW 5-11 (port 3) increased slightly in 2010; concentrations of 1,4-dioxane and PCE increased slightly in MW 5-13 ports 1 and 2, respectively, in 2010.

- Monitoring wells MW 5-24 and MW 5-25 are located in the upgradient area of the COC plumes, south of Arrow Highway in the Subarea 1 portion of the BPOU. These wells are considered to be general indicators of the quality of groundwater that is flowing downgradient away from extraction wells installed for the VCWD Lante Subproject. Concentrations of most COCs in these wells were generally consistent in 2010 in comparison to the previous year. The largest variations in concentrations of COCs occurred generally in the shallowest three ports in MW 5-24.
- Monitoring wells MW 5-05, MW 5-08, and MW 5-15 are located in the mid-plume area of the COC plumes, downgradient of Subarea 1 and upgradient of Subarea 3. These wells are considered to be general indicators of the quality of groundwater that is flowing downgradient toward the SGVWC B5, SGVWC B6, and LPVCWD Subproject extraction wells. Concentrations of most COCs in MW 5-05 and MW 5-15, which are located toward the center of most of the COC plumes, remained consistent with concentrations observed in previous years.
- Monitoring wells MW 5-19 and MW 5-23 are located within Subarea 3, upgradient of the SGVWC B5 Subproject extraction wells and the CDWC Bassett wellfield. These wells are considered to be general indicators of groundwater quality in the southern portion of the BPOU and representative of the quality of groundwater that is flowing downgradient toward the SGVWC B5 Subproject extraction wells and CDWC Bassett wellfield. Concentrations of most COCs remain generally unchanged at all depths in these two multiport wells compared to the previous year.
- Monitoring wells MW 5-26 and MW 5-27 are located within Subarea 3, downgradient of the SGVWC B5 Subproject extraction wells and the CDWC Bassett wellfield. These wells are considered to be general indicators of groundwater quality in the southern portion of the BPOU and representative of the quality of groundwater that is flowing downgradient away from the SGVWC B5 Subproject extraction wells and CDWC Bassett wellfield. Monitoring results for these wells were consistent with previous years with concentrations of the seven selected COCs at non-detect levels or below MCLs (or NLs).

Observed increases or decreases in the concentration of a particular COC during a single sampling event should not be considered as a significant change in the overall trend of chemical concentrations at a particular well. Historical variations in chemical concentrations have been observed seasonally and from year to year as basin water levels vary

5.3 Groundwater Modeling Results

As described in Section 3.3, the BPOU groundwater model was updated with pumping and recharge data through the end of WY2009-10 and recalibrated for a 29-year simulation period extending from WY1982-83 through WY2009-10. The adequacy of groundwater model calibration continued to be evaluated using water level observations at 76 monitoring and production well locations that were selected as long-term basin-wide calibration targets, including 36 targets located in the BPOU area. Water level observations for WY2009-10 were updated from the San Gabriel Basin Database, California Department of Water Resources, LACDPW, the United States Geological Survey National Water Information System, and from data collected as part of the PSEP monitoring program.

As described in Section 3.3.2, the groundwater model also was modified by adjusting hydraulic conductivities and recharge to improve the model calibration in Subarea 1 and in the vicinity of Puente Valley.

5.3.1 Updated Model Calibration Results

Updated model calibration statistics are summarized in Table 5-8. The average basin-wide model residual (the average difference between model simulated and observed heads) for the 29-year simulation period is 0.71 feet. The average model residual for the 36 observation wells within the BPOU area is 0.46 feet for the same period. The root-mean squared error (RMSE) for the calibrated model is 16.17 feet for the entire model and 6.46 feet for the BPOU area. The updated annual model water balance for each water year is summarized in Table 5-9.

In the BPOU, simulated and observed water levels for the entire 29-year model simulation period are compared on hydrographs that are presented on Figures 5-22 through 5-26. As shown on the figures, simulated water levels in the Subarea 1 (Figures 5-22 through 5-24) and Subarea 3 (Figures 5-25 and 5-26) portions of the BPOU generally are within six feet of observed water levels throughout the entire 29-year model simulation period. However, in Subarea 3, simulated water levels in the shallowest ports in MW 5-23 (ports 4 through 6), generally are underestimated by up to 15 feet (Figure 5-25). These differences are most likely attributable to the smaller (local) scale of heterogeneities that are present in the aquifer compared to the broader scale of heterogeneities that are represented in the model. As described in the 2007 model update (Geomatrix, 2007b), the groundwater model represents larger scale heterogeneities by varying the hydraulic conductivity by up to several orders of magnitude between adjacent model layers. Smaller scale heterogeneities are represented using vertical anisotropy within the model layers. Using this approach, the model is able to simulate the vertical head differences that are measured using longer (50 feet or more) well screened intervals such as those in the Subarea 1 and Subarea 3 piezometers (Figures 5-24 and 5-26). The model is also able to simulate some of the vertical variations in head that are measured using shorter (10-feet) well screened intervals in the multiport monitoring wells (Figures 5-23 and 5-25).

Potentiometric surfaces simulated using the BPOU groundwater model are compared to observed water levels in Fall 2009 and Spring 2010 on Figures 5-27 through 5-34. The simulated results were exported from the model for approximately the same time period as the observed water levels. As shown on Figures 5-27 and 5-28, simulated water levels in Subarea 1 are generally within five feet (higher and lower) of observed water levels in Fall 2009 and Spring 2010. Simulated potentiometric surfaces in

Subarea 3 are compared to observed water levels on Figures 5-29 through 5-34 for three different elevations intervals, including above -200 feet msl, between -200 and -500 feet msl, and below -500 feet msl. These elevation intervals correspond to the approximate elevations of hydrostratigraphic separating units interpreted in Subarea 3. As shown on Figures 5-29 through 5-34, simulated water levels at all three elevation intervals in Subarea 3 are generally within five feet (higher and lower) of observed water levels in Fall 2009 and Spring 2010. Locally, differences up to 10 to 20 feet occur above -200 feet msl in Subarea 3 (Figures 5-29 and 5-32) with the largest differences observed in the immediate vicinity of the SGVWC B5 and CDWC pumping wells. The largest differences likely occur in this area because CDWC frequently cycles their pumping between different wells as compared to the average pumping rates that are simulated using quarterly stress periods in the model.

Outside of the BPOU, model results near the mouth of Puente Valley are presented on Figures 5-35 through 5-36. Hydraulic conductivities in this area of the model were adjusted to improve the model calibration in response to EPA's comments. As shown on Figure 5-35, simulated water levels at well Z1000007 are significantly improved compared to the previous model calibration. Because of the limited water level data that are available for well SWS 151W1 it is difficult to evaluate the calibration as shown on Figure 5-36.

In summary, refinements to the BPOU groundwater flow model have significantly improved the model calibration in areas that are both inside and outside of the BPOU. The overall quality of the calibration demonstrates that the model is capable of adequately simulating transient water levels and groundwater flows for the entire 29-year period of the historical observations. The model is capable of simulating the historical minimum and maximum water levels and groundwater flows that occurred in response to changes in recharge and pumping stresses.

5.3.2 Results of Performance Evaluation Simulations

As described in Section 3.3.3, groundwater flow simulations with forward particle tracking were performed on quarterly basis to evaluate the performance of the groundwater extraction system as requested by EPA. Simulations were performed by simulating groundwater flow conditions and actual groundwater extraction during four quarterly stress periods in WY2009-10 (July 2009 – June 2010). Quarterly forward particle tracks presented on Figures 5-37 through 5-41 assume that groundwater flow conditions for each quarter were uniform for a three-year period. Results of quarterly model simulations of extraction system performance are presented in plan view for Subarea 1 on Figure 5-37. Results for Subarea 3 are presented in plan view at three elevation intervals on Figures 5-38 through 5-40. Figure 5-41 presents the results of the quarterly particle tracking results in cross section. Particle tracks are color coded on these figures; particles that are captured by project extraction wells are shown as green tracks, particles captured by the CDWC production wells are shown in blue, and particles not captured during the three-year simulation period are shown in gray. Starting particle locations are shown on the figures as solid circles located at the upgradient end of each particle track. As described in Section 3.3.3, the starting locations for the particles were assigned to provide a generalized representation of the approximate horizontal and vertical extent of various COCs in areas upgradient of the Subarea 1 and Subarea 3 extraction wells. To aid the reader in evaluating the results, the interpreted extent of the TCE plume in 2010 is shown on Figures 5-37 through 5-41 for reference.

Given the limitations of quarterly forward particle tracking results described in Section 3.3.3, depictions of short-term hydraulic control presented in this report should not be considered representative of long-term extraction system performance. Additional discussion of forward particle tracking results in relation to remedy performance is presented in Section 7.1.4.

5.4 Groundwater Extraction and Chemical Mass Removal

Monthly groundwater extraction volumes for 2010 were compiled from monthly reports submitted to DPH and EPA in monthly progress reports. Groundwater extraction volumes for all extraction wells that were operational in 2010 are shown in Table 2-1. Average monthly and average annual extraction rates are also provided in Table 2-1 together with design extraction rates for each extraction well, target operational extraction rates, and EPA-approved extraction rates for each well. Design extraction rates are based on the peak design capacity of the treatment plants whereas target operational extraction rates generally assume ten percent downtime for each well for treatment plant maintenance. The EPA-approved extraction rates shown in Table 2-1 are based on groundwater flow model simulations performed in 2000 and 2001 and represent the average extraction rates necessary to achieve the remedial action objectives.

Estimates of chemical mass removed from extracted groundwater in 2010 for the LPVCWD, SGVWC B5, SGVWC B6, and VCWD Lante Subprojects are presented in Section 6.0 below.

6.0 TREATMENT PLANT PERFORMANCE RESULTS

This section presents a summary of the operational performance results for those treatment plants that were operational in 2010.

6.1 Subarea 1 – Valley County Water District Lante Subproject

As described earlier in this report, with the exception of the month of November and a portion of December, the VCWD Lante Treatment Plant operated throughout 2010. Extraction well SA1-2 extracted 72.5 acre-feet of water during the month of January and was inactive for the rest of the year. Approximately 6,888 acre-feet of groundwater were extracted and treated from the production wells for an annualized production rate of approximately 4,262 gpm.

Water-quality data collected from the individual production wells and from the fully treated water are summarized in Table 6-1. No samples were collected from SA1-2, as it was inoperable for most of the year. Table 6-1 also includes the design concentrations and expected average influent concentrations for the VCWD Lante Treatment Plant together with applicable MCLs and NLs for the COCs. Raw water concentrations for the compounds reported in Table 6-1 did not exceed design concentrations. No COCs were detected at concentrations exceeding MCLs or NLs in the fully treated water. Figures 6-1 to 6-14 illustrate raw and treated water concentration trends relative to the applicable MCL or NL. With the exception of nitrate and sulfate, SA1-3 (Lante) consistently showed higher concentrations of the COCs than SA1-1. In general, COC concentrations appeared to be relatively constant or slightly decreasing in the two production wells. The one exception to this trend was perchlorate, where concentrations in SA1-3 (Lante), and to a lesser extent SA1-1, increased during 2010. 1,4-dioxane concentrations in SA1-3 (Lante) have displayed a steady decrease during 2010 from over 6 μg/L in February to approximately 3 μg/L in October. Concentrations of carbon tetrachloride, NDMA, cis-1,2-dichloroethene (cis-1,2-DCE), TCE, and PCE were higher during the summer months, than the rest of the year, particularly in SA1-3 (Lante). Chloroform concentrations in the treated water displayed an increasing trend during 2010. However, the highest concentration observed during 2010 was below 3 μg/L, which is considerably less than the MCL of 100 μg/L.

Average concentrations for untreated influent and fully treated water are summarized in Table 6-2. Mass removed was calculated by using the average raw water concentration for each COC from each of the three production wells and multiplying that result by the volume of water treated, with the appropriate dimensional conversion. In these calculations, concentrations below the DL were treated as zero. For the compounds considered, approximately 6,381 pounds of chemical mass were removed by the VCWD Lante Treatment Plant in 2010. This is less than the 7,424 pounds of mass removed in 2009. Similar to 2009, perchlorate, TCE, PCE, 1,1-dichloroethene (1,1-DCE), and cis-1,2-DCE represent most of the total mass removed, with TCE and PCE representing the vast majority of the total mass removed.

Inlet and exhaust air quality data for 2010 are summarized in Table 6-3 for the four air strippers and carbon off-gas abatement systems. As expected from water-quality data, PCE, TCE, 1,1-DCE, and cis-1,2-DCE were the primary VOCs detected in the vapor phase. Table 6-4 provides a summary of air risk and hazard calculated from compounds detected in the air exhaust. Risk was calculated using SCAQMD Tier 4 procedures and compared against ARARs. Calculated risk and hazard values were below ARARs for the MICR, acute hazard, chronic hazard, and cancer burden.

In 2010, the VCWD Treatment Plant discharged approximately 51,343,000 gallons of waste brine to the LACSD sewer with an annual average discharge rate of approximately 97 gpm. Discharges met permit requirements, with the exception of infrequent brine pH excursions. Brine flows and pH data are summarized in Table 6-5.

6.2 Subarea 3 – La Puente Valley County Water District Subproject

In 2010, the average annual flowrate at the LPVCWD Treatment Plant was 2,288 gpm, which exceeded the EPA-approved extraction rate of 2,250 gpm. Approximately 3,693 acre-feet of groundwater were extracted during 2010. LPVCWD 5 extracted the majority of water treated from January until September 2010. LPVCWD 5 was taken offline in October for repairs and is expected to return to operation in January 2011. Wells LPVCWD 2 and 3 were operated during that time to make up for LPVCWD 5 being out of service.

Water-quality data are summarized in Table 6-6. Figures 6-15 to 6-25 illustrate raw and treated water concentration trends relative to the applicable MCL or NL for selected COCs. All treated water concentrations were below the MCLs and NLs. TCE and carbon tetrachloride measured in the LPVCWD 2 extraction well were the only compounds detected in the raw water at concentrations exceeding the design concentrations. In general, COC concentrations in LPVCWD 2 were greater than those observed in LPVCWD 3 and LPVCWD 5. For most COCs, influent concentrations were generally stable to decreasing during the year.

Average chemical concentrations for treatment plant influent and treated water are summarized in Table 6-7 together with the volume of water treated and the total mass removed per chemical. In these calculations, concentrations below the DL were treated as zero. For the COCs considered, approximately 658 pounds of chemical mass were removed from the aquifer. This is slightly more than the 612 pounds removed in 2009.

Air quality data collected monthly from the Small Tower and Large Tower inlet and outlet are summarized in Table 6-8. A summary of the air risk and hazard associated with the off-gas VPGAC systems is provided in Table 6-9. The MICR, acute hazard, chronic hazard, and cancer burden ARARs were not exceeded in 2010.

The LPVCWD Treatment Plant discharged approximately 5,196,000 gallons of waste brine to the LACSD sewer in 2010 with an average annual discharge rate of 10 gpm. Brine flows and pH data are summarized in Table 6-10. Discharges met permit requirements, with the exception of infrequent brine pH excursions. As evident from Table 6-10, brine discharges from the ISEP® were eliminated when perchlorate treatment changed from ISEP® to single-pass ion exchange on July 30, 2010.

6.3 Subarea 3 – San Gabriel Valley Water Company B6 Subproject

In 2010, the average annual flowrate at the SGVWC B6 Treatment Plant was 4,531 gpm, which was below the EPA-approved extraction rate of 6,500 gpm, due to operational problems associated with the ISEP® treatment system. Approximately 7,325 acre-feet of groundwater were extracted and treated in 2010.

SGVWC B6 Treatment Plant raw water-quality data are collected monthly and treated water data are collected weekly (Table 6-11). Table 6-11 also includes the design and expected average influent concentrations for the SGVWC B6 Treatment Plant together with applicable MCLs and NLs for the COCs. With the exception of carbon tetrachloride in SGVWC B26B, raw water concentrations did not exceed design concentrations in the production wells. No COCs were detected at concentrations exceeding MCLs or NLs in the fully treated water. Figures 6-26 to 6-37 illustrate raw and treated water concentration trends relative to the applicable MCL or NL. PCE, TCE, cis-1,2-DCE, and 1,1-DCE concentrations in Well B25A showed increasing trends during the first half of 2010 and were stable for the remainder of the year. Raw water COC concentrations in the other extraction wells were relatively constant or showed slight decreases through the year.

Average chemical concentrations for raw influent and fully treated effluent are summarized in Table 6-12, together with the volume of water treated and the total mass removed per chemical. In these calculations, concentrations below the DL were treated as zero. For the compounds considered, approximately 1,743 pounds of chemical mass were removed from the aquifer, an increase from 2009 (1,553 pounds removed). Carbon tetrachloride, perchlorate, PCE, and TCE represented nearly 93 percent of the mass removed, with TCE and perchlorate alone accounting for 76 percent of the mass removed.

SGVWC B6 Treatment Plant air quality data are summarized in Table 6-13. Table 6-14 provides summary of air risk and hazard calculated from compounds detected in the air exhaust. Risk was calculated using SCAQMD Tier 4 procedures and compared against ARARs. Average calculated risk values were below ARARs for MICR, acute hazard, chronic hazard, and cancer burden. The annual average rolling MICR, acute hazard, chronic hazard and cancer burden ARARs were not exceeded in 2010.

The SGVWC B6 Treatment Plant discharged approximately 44,570,000 gallons of waste brine to the LACSD sewer in 2010 with an average flowrate of 85 gpm. Brine flows and pH data are summarized in Table 6-15. Discharges met permit requirements.

6.4 Subarea 3 – San Gabriel Valley Water Company B5 Subproject

The average annual extraction rate for the SGVWC B5 Subproject was about 6,833 gpm, about 98 percent of the EPA-approved extraction rate of 7,000 gpm, due in part to lower production in June. Approximately 11,024 acre-feet of water were extracted and treated.

Raw water-quality data for the SGVWC B5 Treatment Plant are provided in Table 6-16, which also includes the design and expected average influent concentrations for the SGVWC B5 Treatment Plant and applicable MCLs and NLs for the COCs. Raw water concentrations did not exceed design concentrations in the production wells. COCs were not detected at concentrations exceeding MCLs or NLs in the fully treated water during 2010. Figures 6-38 to 6-46 show raw and treated water concentration trends relative to the applicable MCL or NL. COC concentrations in the raw water were relatively constant. No COCs monitored in COI 5 during 2010 exceeded MCLs or NLs, and most compounds were not detected.

Average chemical concentrations for raw influent and fully treated effluent are summarized in Table 6-17, together with the volume of water treated and the total mass removed per chemical. In these calculations, concentrations below the DL were treated as zero. For the compounds considered, approximately 455 pounds of chemical mass were removed from the aquifer, compared to 427 pounds in

2009. Perchlorate accounted for nearly 50 percent of the mass removed. Perchlorate, PCE, and TCE represented approximately 87 percent of the mass removed.

7.0 EVALUATION OF REMEDY PERFORMANCE AND TREATMENT PLANT OPERATIONS

7.1 Groundwater Extraction System Performance

As described in the PSEP (AMEC Geomatrix, 2010c) and in Section 1.4 of this report, the CRs approach to performance monitoring relies upon: 1) past and future basin-wide groundwater monitoring activities performed by the Watermaster, 2) performance monitoring data collected by the Water Entities, the CRs, or other agents acting on behalf of the CRs, and 3) the use of the BPOU groundwater flow model to predict the effectiveness of the groundwater extraction system. Annual PE Reports evaluate the performance of the groundwater extraction system using groundwater modeling and empirical data to assess whether extraction well operation is limiting further migration of groundwater contamination into less contaminated areas. Groundwater extraction system performance is discussed in the following sections.

7.1.1 Extraction Well Performance

Based on step-drawdown testing, aquifer testing, and DPH-permitted operation, the VCWD Lante, LPVCWD, SGVWC B6, and SGVWC B5 Subproject wells are capable of achieving design extraction rates. In addition to the three existing and permitted wells, SA1-1, SA1-2, and SA1-3 (Lante), VCWD and the CRs are evaluating the use of the Arrow well as an alternative extraction location based on lower nitrate concentrations and higher mass removal. LPVCWD 5 replaced LPVCWD 2 and 3 as the primary extraction well at the LPVCWD Subproject in early 2009. LPVCWD 5 was taken offline in October of 2010 for repairs and is expected to return to operation in January 2011. The SGVWC B6 extraction plan is evaluating various pumping alternatives to flow balance nitrate loading among the four extraction wells, B25A/B and B26A/B. At SGVWC B5, the COI 5 well was permitted and became operational in 2009 and exceeded its target extraction rate in 2010; however, COI 5 has very low COC concentrations (below MCLs and NLs) and, as a result, removes very little chemical mass.

7.1.2 Groundwater-Quality Trends

Spatial and temporal trends in groundwater quality in the BPOU as observed during 2010 are described in Sections 5.2.3 and 5.2.4. Short-term changes in groundwater quality are observed seasonally and from year-to-year. These short-term changes occur primarily in response to dynamic variations in both local and regional groundwater flow conditions throughout the Basin. Changes in groundwater quality that result from the operation of the remedy will likely be discernable only over longer timeframes (e.g. 5 to 10 or more years of continuous operation of the project extraction wells). Therefore, groundwater-quality trends will be used to evaluate the performance of the remedy in Five Year Reviews.

7.1.3 Groundwater Extraction and Chemical Mass Removal

The VCWD, LPVCWD, SGVWC B6, and SGVWC B5 Treatment Plants were all operational in 2010. The VCWD and the SGVWC B6 facilities experienced significant down time in operations as described previously in Sections 6.1 and 6.3, respectively.

Overall, BPOU extraction from the combined four primary treatment facilities averaged 17,913 gpm on an annual basis, compared to the EPA-approved extraction rate of 21,750 gpm. Although this extraction rate was less than the EPA-approved extraction rate, it was sufficient to achieve remedial objectives related to limiting migration of the COC plumes. As described in Section 5.2.4, monitoring wells downgradient of Subarea 1 show relatively consistent levels of selected COCs, and monitoring wells downgradient of Subarea 3 show continued 'non-detect' or levels below any applicable MCL or NL, demonstrating on an empirical basis that hydraulic control of the plume continues to occur.

With regard to the remedial objectives related to chemical mass removal, the VCWD Lante, LPVCWD, SGVWC B6 and SGVWC B5 Treatment Subprojects removed 6,384 pounds, 658 pounds, 1,743 pounds, and 455 pounds, respectively, of COCs in 2010. The total COC mass removal for the BPOU project in 2010 was 9,240 pounds, which was less than the 2009 total of 10,016 pounds. Since 2004, the cumulative chemical mass removed is 41,908 pounds (Table 7-1).

7.1.4 Extraction System Performance

As described in Section 5.1 of the PSEP (AMEC Geomatrix, 2010c) and in Section 3.3 of this report, the BPOU groundwater model is the primary tool for assessing extraction system performance. Evaluations of extraction system performance were performed using the updated BPOU groundwater model and forward particle tracking based on actual pumping and water level conditions from WY2009-10. Results of the extraction system performance simulations are presented in Section 5.3 and mass removal is discussed in Sections 6.1 though 6.4. As described in Section 3.3.3, particle tracking results based on short-term quarterly simulations of groundwater flow are subject to various limitations and should not be considered representative of long-term extraction system performance.

Based on the evaluation of forward particle tracking results and chemical mass removal rates presented in this report, the following general observations regarding extraction system performance were developed:

- Operation of the VCWD Lante extraction well in 2010 had a significant effect on hydraulic control and chemical mass removal in Subarea 1. Pumping of the SA1-1 and SA1-2 extraction wells had a lesser effect on hydraulic control and chemical mass removal due to the location of these wells in relation to the distribution of COCs, and the resultant lower COC concentrations in groundwater extracted from these wells.
- Although some of the SGVWC B6 extraction wells experienced reduced pumping rates in 2010 because of operational problems associated with the ISEP® treatment system, and some extraction planned for shallower extraction wells was re-distributed to deeper extraction wells, the amount of chemical mass removed by the B6 extraction wells in 2010 increased from 2009.
- Operation of the SGVWC B5 extraction wells combined with the operation of the CDWC production wells provided significant hydraulic control in the downgradient portion of Subarea 3 in 2010, although mass removal at SGVWC B5 was significantly lower than for other BPOU extraction and treatment facilities, particularly when considering the volume of water treated. Operation of the COI No. 5 extraction well provided little benefit relative to hydraulic control or chemical mass removal.

- The operation of LPVCWD extraction well(s) at or above their target extraction rates provided consistent hydraulic control and chemical mass removal throughout 2010.

In summary, the overall performance of project extraction wells, as supplemented by production wells in the CDWC Bassett wellfield, continued to limit the migration of COCs in groundwater and removed chemical mass consistent with the Performance Standards established in the PSEP.

7.2 Treatment System Operations

The treatment plant operations were described in detail earlier in Section 6 of this report. In addition, for the VCWD, LPVWC, and SGVWC B6 Treatment Plants, a modified air monitoring program will be developed in 2011 based on comments received from EPA in a letter dated June 15, 2009.

7.2.1 Subarea 1 – Valley County Water District Lante Subproject

The VCWD Lante Treatment Plant operated under its DPH drinking water permit and delivered fully treated water to SWS. The treatment plant reliably treated extracted water to drinking water standards.

Improvements, operational problems, and issues that impacted operations and performance in 2010 and future operational improvements include:

- In January, water-quality samples were collected from the Arrow well, which indicated similar concentrations as those observed in the SA1-3 (Lante) well;
- Several of the air stripper pressure gauges were replaced in February;
- Stetson conducted quarterly inspections of the VCWD SA1 air stripper as part of the BPOU air Stripper Monitoring and Maintenance Plan;
- In June the LACSD performed an inspection of the brine lines at the VCWD treatment facility;
- Flow scenarios from the various VCWD wells were evaluated relative to nitrate concentrations. DPH reported that the nitrate concentration issue cannot be addressed by adjusting flows from these wells;
- Rehabilitation work on SA1-2 was completed in August and a VFD was installed in September. VCWD and the EPA continue attempts to obtain a discharge permit for SA1-2 so the well can be redevelopment and brought back online;
- VCWD contracted with Locus Technologies to provide controls and programming support to the ISEP® systems;
- An RFQ was issued for process engineering and nitrate management; and
- The single-pass ion exchange system was completed but startup testing and operation is on hold while nitrate treatment and ISEP® bypass options are evaluated.
- In 2010, the VCWD Treatment Plant continued to experience excessive downtime associated with the ISEP® systems, including being offline all of November due to ISEP® back pressure problems. VCWD has retained an engineering firm to evaluate nitrate management approaches. Once the single-pass ion exchange systems are tested and approved for use

by DPH and the nitrate issue resolved through blending or treatment, the VCWD Treatment Plant should be capable of achieving the target extraction rate.

7.2.2 Subarea 3 – La Puente Valley County Water District Subproject

The LPVCWD Subproject extracted and treated groundwater at an annual rate of about 2,288 gpm, exceeding the extraction target. The plant reliably treated raw water to drinking water standards for all COCs.

Improvements, operational problems, and issues that impacted operations and performance in 2010 and future operational issues include:

- In January 2010 Stetson Engineering conducted an inspection of the air strippers to evaluate scaling potential;
- Per EPA's request, a failure analysis was initiated. Locus Technologies began controls testing in December 2009 and concluded the testing in March 2010;
- In March 2010 a new flow meter was installed at the Hudson Booster Station;
- The single-pass ion exchange equipment construction was completed, DPH issued an amended permit for the single-pass ion exchange system on 15 June 2010 and the system became operational on 30 July 2010;
- LPVCWD 5 will be repaired and brought back online in 2011;
- Chemical dosing including peroxide, sodium hypochlorite, ortho/polyphosphate, and acid will be optimized; and
- The ISEP® system will be decommissioned.

7.2.3 Subarea 3 – San Gabriel Valley Water Company B6 Subproject

The SGVWC B6 Treatment Plant extracted and treated water at an annual rate of 4,531 gpm, below the EPA approved extraction rate of 6,500 gpm. The plant reliably treated raw water to drinking water standards for all COCs.

Improvements, operational problems, and issues that impacted operations and performance in 2010 and future operational improvements include:

- The continued ISEP® problems resulted in substantial down time and a reduced annual extraction rate relative to target;
- In April 2010 a new brine flow meter was installed for ISEP® B;
- As part of the Air Stripper Monitoring and Maintenance Plan, Stetson conducted an inspection of the SGVWC B6 air strippers on 23 April 2010 to evaluate the calcium carbonate build and an inspection report was produced in July 2010;
- In December 2010 the P201 pressure relief pump on ISEP® A was replaced;
- SGVWC released an RFP for the design of additional treatment for nitrates;

- The single-pass ion exchange construction was completed in 2010, but testing is on hold while SGVWC considers nitrate treatment or management alternatives; and
- Work to optimize chemical dosing and other operational parameters should be initiated in 2011.

As with the VCWD Treatment Plant, the SGVWC B6 Treatment Plant experienced excessive downtime associated with ISEP® systems. SGVWC has installed single-pass ion exchange treatment to replace the ISEP® systems, but these have not yet been tested or permitted because of nitrate management issues. SGVWC is evaluating nitrate treatment options and is in the process of retaining an engineering firm to design a nitrate ion exchange treatment system. Once the single-pass ion exchange system is permitted and operational and a nitrate treatment or management approach is identified, the B6 Treatment Plant is capable of treating water at the target extraction rate.

7.2.4 Subarea 3 – San Gabriel Valley Water Company B5 Subproject

The SGVWC B5 Treatment Plant operated at an average annual flowrate of 6,833 gpm. The plant reliably treated raw water to drinking water standards for all COCs.

Improvements, operational problems, and issues that impacted operations and performance in 2010 and future operational improvements include:

- Evaluate the utility of continued extraction from the COI 5 well with respect to mass removal and hydraulic control of COC plumes;
- Although the B5 Treatment Plant operated at 98 percent of the target extraction rate, continue to evaluate improvements to increase production; and
- Work to optimize chemical dosing and other operational parameters should be initiated in 2011.

8.0 SUMMARY AND RECOMMENDATIONS

Although two of the four operating treatment facilities (VCWD Lante and SGVWC B6) experienced significant operational interruptions in 2010, operation of project extraction wells as supplemented by production wells and treatment facilities in the CDWC Bassett wellfield continued to limit the migration of COCs in groundwater and removed chemical mass consistent with the remedial objectives established in the UAO.

As described in Sections 1.1 and 3.0, the QAPP for Groundwater (AMEC Geomatrix, 2010a), FSP for Groundwater (AMEC Geomatrix, 2010b), and PSEP (AMEC Geomatrix, 2010c) were updated in 2010 to incorporate numerous modifications that had previously been approved for the performance monitoring program. The PSEP also proposed three additional recommended changes for the performance monitoring program beginning in 2011 as follows:

- Three inactive production wells (CDWC 14, SWS 139W4, and SWS 140W3) are proposed for removal from the PSEP water-quality monitoring program. These wells are no longer active and are therefore inaccessible for water-quality sampling due to logistical constraints and regulatory approvals needed to discharge purge water to surface water features. Sampling results from these wells are not needed to assess remedy performance because monitoring of adjacent production wells provides water-quality data for this purpose.
- Eight conventional monitoring wells (AJ MW-1, AJ MW-2, AJ MW-3, AJ MW-4, AJ MW-5, ALR MW-1R, ALR MW-8, and ALR MW-9) are proposed for removal from the PSEP monitoring program because these wells have been abandoned, are no longer accessible, or are being monitored under the requirements of Cleanup and Abatement Orders issued by the RWQCB. Water level data for these wells are no longer used in the development of potentiometric surface maps for the BPOU and are no longer reported in Annual PE Reports at the request of EPA. Available water-quality data from these monitoring wells and other monitoring wells in the BPOU will continue to be used to supplement sampling results from wells in the PSEP monitoring program for the development of plume maps submitted in Annual PE Reports.
- Production wells in the basin-wide potentiometric monitoring program implemented by the Watermaster are proposed for removal from the PSEP monitoring program. Potentiometric monitoring data from these wells are not used in the development of potentiometric surface maps in the BPOU and are not used to assess remedy performance. It is assumed that the Watermaster will continue to perform basin-wide potentiometric monitoring and report the results in various Watermaster publications.

As summarized in Section 5.3.1, the BPOU groundwater flow model has been updated and recalibrated at the request of EPA. Considerable effort was placed into the improvement of model calibration to ensure that the model accurately represents groundwater flow conditions in the BPOU. The average basin-wide model residual (the average difference between model simulated and observed heads) for the 29-year simulation period was reduced to 0.71 feet and the average model residual for the 36 observation wells within the BPOU area was reduced to 0.46 feet for the same period. In addition to this statistical comparison of simulated and observed water levels, a visual evaluation of the model's ability to simulate seasonal changes in groundwater levels and flow directions indicates that the groundwater flow model is capable of accurately simulating groundwater flow conditions under the highly variable groundwater conditions observed in the BPOU. Consequently, the model was used for the assessment of groundwater extraction system performance presented in this report and is considered a useful predictive tool for future assessments of remedy performance.

Recommendations and operational issues to be addressed for the BPOU treatment plants in 2011 include:

- Complete startup testing, DPH permitting, and operation of single-pass ion exchange systems at the VCWD and SGVWC B6 Treatment Plants;
- Complete assessment of nitrate-related management and/or treatment alternatives at the VCWD and SGVWC B6 Treatment Plants;
- Prepare a revised air monitoring and carbon change-out criteria implementation plan for the VCWD, LPVCWD, and SGVWC B6 VPGAC systems;
- Update air portions of the SAP and QAPP based on the revised air monitoring program;
- Secure agreement and permits among WEs, EPA, RWQCB, LACFD, and other parties to discharge water from startup testing, well development, and other high volume discharges;
- Optimize chemical amendment dosing at all treatment plants including peroxide (1,4-dioxane treatment), sodium hydroxide (pH adjustment), sodium hypochlorite (chlorination), ortho/poly phosphate (red water control), and acid (pH adjustment and calcium carbonate precipitation control); and
- Assess operational management approaches to achieve EPA-approved extraction rates for the VCWD, SGVWC B6, and SGVWC B5 Subprojects.

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