Final
Remedial Investigation Report
Glendale Chromium Operable Unit
San Fernando Valley Superfund Sites
Los Angeles County, California

Contract No. EP-S9-13-01
Task Order No. 005-RICO-09N2

PREPARED FOR:

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 9
75 HAWTHORNE STREET
SAN FRANCISCO, CALIFORNIA 94105

PREPARED BY:

317 E. MAIN STREET
VENTURA, CALIFORNIA 93001
OTIE PROJECT NUMBER: 2013152/09
WITH

6 Hutton Centre Drive
Suite 700
Santa Ana, California 92707

January 15, 2016

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY REGION 9

Report Title:	**Final Remedial Investigation Report, Glendale Chromium Operable Unit**
Site Name	Glendale Chromium Operable Unit
Location:	Area 2 of the San Fernando Valley Superfund Site Los Angeles County, California
EPA Contract No.:	EP-S9-13-01
Task Order No.:	005-RICO-09N2
OTIE Project #:	2013152
Report prepared by:	Oneida Total Integrated Enterprises (OTIE)
Address:	317 E. Main Street
City/State/Zip:	Ventura CA 93001
Telephone:	(805) 585-6396
	and
	CH2M Hill 1000 Wilshire, Suite 2100 Los Angeles, CA 90017 (213) 228-8285
EPA Project Manager:	Rebecca Connell
Address:	Environmental Protection Agency, Region 9
City/State/Zip:	75 Hawthorne Street
Telephone:	San Francisco, California 94105 (415) 947-4278

This report was prepared in accordance with currently accepted professional practices and under the direct supervision the Professional Geologist and Professional Engineer whose signatures appear below:

Nova Clite, PG
Oneida Total Integrated Enterprises

1/12/16
Date

PROFESSIONAL GEOLOGIST
NOVA CLITE
No. 8482
EXP. 11/17
STATE OF CALIFORNIA

David Towell, PE
CH2M Hill

1/12/16
Date

PROFESSIONAL ENGINEER STATE OF NEVADA
DAVID O. TOWELL, JR.
CIVIL
No. 10024

EXECUTIVE SUMMARY

The United States Environmental Protection Agency (EPA) has conducted a remedial investigation (RI) of chromium contamination in groundwater in the Glendale Chromium Operable Unit (GCOU) of the San Fernando Valley (SFV) Superfund Sites in Los Angeles County, California (Figure 1-1). EPA is pursuing cleanup of contaminated groundwater in the SFV under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). The study area for the GCOU RI comprises Area 2 (Glendale) of the SFV Superfund Sites.

EPA's overall objectives for conducting the GCOU Remedial Investigation (RI) were to evaluate the following within the GCOU study area:

- The nature and extent and distribution of chromium in groundwater;
- The fate and transport of chromium in groundwater;
- The potential risk to human health and the environment from exposure to chromium in groundwater; and
- Recommendations for further investigation.

The findings of this RI will be used to prepare a feasibility study (FS) to evaluate a range of remedial alternatives to address chromium in groundwater within the GCOU.

SITE BACKGROUND

In 1986, EPA placed four areas in the SFV on the National Priorities List based on the location of drinking water well fields that were known to be contaminated by volatile organic compounds (VOCs):

- **Area 1** - North Hollywood Operable Unit (NHOU) and Burbank Operable Unit (BOU);
- **Area 2** – Glendale (formerly referred to as Crystal Springs), consisting of Glendale North Operable Unit (GNOU) and Glendale South Operable Unit (GSOU), sometimes referred to collectively as the Glendale Operable Unit (GOU);
- **Area 3** – Verdugo; and
- **Area 4** – Pollock.

Between 1988 and 1992, a RI was conducted in the eastern portion of the SFV that covered the original four SFV Superfund Site areas listed above (JMM, 1992a). The purpose of the SFV RI was to characterize the nature and extent of the contamination on a regional scale in the SFV groundwater basins and assess the potential health risks associated with contaminated groundwater. Trichloroethylene (TCE) and perchloroethylene (PCE) were the most prevalent contaminants detected during the SFV RI at concentrations exceeding maximum contaminant levels (MCLs) for drinking water. A risk assessment conducted as part of the SFV RI identified TCE, PCE, 1,1-dichloroethylene, and carbon tetrachloride as the primary contributors to elevated human-health risk, assuming theoretical exposure to contaminated groundwater in the SFV Superfund Sites (JMM, 1992a).

Interim pump-and-treat remedies for groundwater were constructed in 1989 for the NHOU, in 1996 for the BOU, and in 2000 for the GNOU and GSOU (see Figure 2-3 for the locations and key features of the SFV Superfund Sites). The interim remedies were designed for treatment of VOCs; chromium has only been addressed at specific extraction wells in GOU where the VOC remedy was being impacted.

Identification of Potential Chromium Source Facilities

In the late 1990s, EPA initiated a focused investigation of chromium in groundwater in the SFV by funding a study conducted by the state Regional Water Quality Control Board-Los Angeles Region (LARWQCB). Chromium concentrations in groundwater were subsequently evaluated for the potential to negatively affect the existing VOC remedies in GNOU and GSOU (CH2M HILL, 2005). The evaluations revealed the presence of total chromium (CrT) and hexavalent chromium (Cr6) contamination in groundwater from multiple known and suspected sources. In response to the data, EPA established the GCOU in 2007 to address data gaps regarding sources and to evaluate the nature and extent of CrT and Cr6 contamination in groundwater, focused primarily on Area 2 with consideration of contributions from Area 1 and potential migration to Area 4. EPA has worked with the LARWQCB and the California Department of Toxic Substances Control (DTSC) to identify and remediate chromium source facilities in the GCOU (see Figure 5-1 for the location of several potential or confirmed sources of chromium). Investigation and remediation of some facilities that appear to be sources of chromium are being conducted under State and EPA oversight on a site-specific basis. Significant remediation of Cr6 has occurred or is ongoing at nearly all of the chromium source facilities identified to date (as summarized in Table 5-1).

Study Area Investigation

The GCOU RI included a comprehensive assessment of groundwater conditions from multiple locations throughout the study area. The primary field activities completed during the RI included monitoring well installation, water level measurements, and groundwater sampling. In summary:

- EPA installed 19 groundwater monitoring wells and 13 cone penetrometer (CPT) borings between August 2012 and July 2014, using a phased approach to iteratively fill data gaps and optimize well locations as fieldwork progressed.
- The GCOU Respondents installed 12 groundwater monitoring wells from March-October 2012.
- EPA collected groundwater samples from 67 new and existing monitoring wells from September 2012 to July 2014.
- EPA measured groundwater levels between September 2012 and April 2014, during quarterly GCOU and semiannual SFV basin-wide monitoring events.

The locations of the monitoring wells used to evaluate groundwater conditions in the GCOU study area are presented on Figure 3-2. The wells selected for sampling span the GCOU study area.

Contaminant Nature and Extent

Evaluation of the nature and extent of chromium contamination was based on data collected by EPA and other parties within the GCOU study area during the GCOU RI. Chromium is present in groundwater at detectable concentrations across much of the GCOU study area. The source of low concentrations of chromium in the western and northern GCOU study area is likely historical migration of diffuse plumes from Area 1 (BOU and NHOU).

Based on data collected to date, the sources of elevated chromium concentrations (greater than the MCLs) in groundwater in the southern/eastern part of the GCOU study are likely facility (point source) releases. In almost all groundwater samples, results for CrT and Cr6 from individual wells were approximately equal; indicating that nearly all dissolved chromium in the GCOU study area groundwater consists of Cr6, rather than Cr3. The predominance of Cr6 is expected in GCOU groundwater, based on

geochemical conditions in the aquifer. Because Cr6 is the predominant dissolved chromium ion, and it has a lower MCL (10 µg/L) compared to the MCL for CrT (50 µg/L), the primary focus of the GCOU RI is on Cr6.

Essentially all areas of the GCOU study area that contain elevated concentrations of dissolved Cr6 in groundwater also contain commingled TCE and PCE plumes, indicating the likely contribution from common sources for these contaminants. However, the lateral and vertical extent of the TCE and PCE plumes exceeding the MCL is significantly larger than the extent of the Cr6 plumes exceeding the MCL.

The main Cr6 plume has been delineated laterally based on groundwater samples collected from the expanded monitoring well network. Releases from several facilities appear to have commingled, resulting in an elongated, main plume with Cr6 and CrT concentrations ranging from 10 µg/L to more than 1,000 µg/L. The main plume encompasses an area of approximately 1.1 square miles, extends from near the northern boundary of Area 2 to about 750 feet south of the Area 2/4 boundary, and is up to 1,500 feet wide (see Figures 5-2 through 5-4). Some uncertainty on horizontal extent remains in the area north and south of two of the identified Cr6 sources, the Drilube-Wilson and Drilube-Broadway facilities. In addition, there are two point source releases from individual facilities (Dynamic Plating and All Metals); there are currently insufficient data to determine if the plumes associated with these sites are discrete or comingled with the main plume. The main plume has been delineated vertically, with chromium impacts present to approximately 100 feet below the water table at the north end of the main plume, decreasing to approximately 50 feet below the water table at the southern end of the main plume in the Los Angeles River Narrows.

Fate and Transport

Dissolved chromium in groundwater is transported through the GCOU study area under the influence of the southeasterly to southerly regional hydraulic gradients. Along the migration pathway, impacted groundwater that is not withdrawn by the GNOU and GSOU extraction wells may be discharged to the Los Angeles River in the Los Angeles River Narrows or continue into Area 4 (Pollock OU). The transport of chromium in groundwater to water-supply wells or to the Los Angeles River could potentially result in exposure of human or ecological receptors.

The GNOU and GSOU extraction well fields were designed to inhibit the vertical and horizontal migration of groundwater VOC contamination and, based on elevated Cr6 concentrations in nearby downgradient monitoring wells, may not be effectively capturing Cr6 contaminated groundwater.

Increasing chromium concentration trends were detected in a shallow well located approximately one mile south of the GNOU extraction well field (CS-VPB-06). The increasing concentration trend in CS-VPB-06 may be the result of a portion of the chromium plume from the GNOU migrating into the GSOU or there may be a source south of the GNOU extraction well field. Remedy enhancements, approved by EPA, are being implemented by the GRG to improve hydraulic containment of VOCs and add treatment for chromium where chromium concentrations threatened the existing remedy.

EPA conducted a preliminary evaluation of the potential for groundwater discharge into the Los Angeles River as part of work on the GOU. The evaluation concluded that groundwater in the southern portion of the Los Angeles River Narrows area could potentially discharge to surface water where groundwater elevations are higher than the bottom of the unlined river channel or during high groundwater conditions. An evaluation of the potential rates of groundwater discharge and the potential contaminant

mass flux to the Los Angeles River was beyond the scope of EPA's initial assessment, but will be studied further by the GRG under EPA oversight.

Chromium contamination detected south of the GSOU extraction wells appears to be entering Area 4. The presence of chromium in Area 4 may also be explained by sources downgradient from the GSOU extraction wells or sources that migrated downgradient from the GSOU well area before those wells went into operation in 2000. Chromium contamination in the Pollock OU was not fully assessed during the GCOU RI; a separate investigation planned by EPA in Area 4 will complete the chromium delineation in that area.

Risk Assessment

A Human Health Risk Assessment (HHRA) addendum was prepared in support of the GCOU RI. The Cr6 concentration data were grouped into six well groups based primarily on geographic distribution, well depth, and proximity to known sources of Cr6 contamination. An exposure point concentration (EPC) for Cr6 was calculated for each well group. Results of the HHRA addendum indicate that only one well group (in the western GCOU study area) has an EPC less than the state MCL for Cr6 of 10 µg/L. The other five well groups have an EPC that exceeds the state MCL for Cr6. Although the EPC values can be used to assess the impacts of hypothetical future residential exposure to untreated groundwater, it should be recognized that these values are not likely indicative of actual health outcomes and only provide a general frame of reference for risk management decision making. Any actual impacts are expected to be much lower, considering existing state and federal regulations that prohibit municipal use of water containing contaminant concentrations that exceed an MCL.

A Screening-Level Ecological Risk Assessment (SLERA) addendum was also prepared in support of the GCOU RI. Results of the SLERA indicate that there are not likely to be unacceptable risks to aquatic organisms, aquatic bird populations, or mammals from potential groundwater discharge to the Los Angeles River. Based on the results for aquatic birds, unacceptable risks to aquatic reptiles are also unlikely. Additionally, there are not likely to be unacceptable risks to rooted aquatic plants or deep-rooted riparian plants (such as trees and shrubs) from potential groundwater discharge to sediment pore water or to deep-rooted riparian plants from direct contact with groundwater.

Overall Conclusions

The overall conclusions from the GCOU RI are as follows (see Section 8):

1. Groundwater impacts are primarily the result of point source facilities within the GCOU study area as well as historical contributions from upgradient sources;
2. Nearly all chromium impacts consist of hexavalent chromium, and are within the footprint of larger VOC impacts;
3. The lateral and vertical extents of the main plume have been largely delineated; and
4. The GNOU/GSOU extraction system may not provide complete capture of the chromium plume.

In summary, remedial actions to address chromium contamination in groundwater are needed to ensure overall protection of human health and the existing interim VOC remedies in Area 2. The RI report will be used to support an FS of remedial alternatives to address chromium in groundwater.

TABLE OF CONTENTS

1.0 INTRODUCTION 1-1

1.1. Purpose of Report 1-2

1.2. Key Documents and Guidance 1-2

1.3. GCOU Stakeholders 1-2

1.4. Report Organization 1-3

2.0 SITE BACKGROUND 2-1

2.1. Location and Description 2-1

2.2. History and Development of the San Fernando Valley Superfund Sites 2-1

2.2.1. Area 1 – North Hollywood and Burbank 2-3

2.2.2. Area 2 – Glendale 2-4

2.2.3. Area 4 – Pollock 2-5

2.3. History and Development of the GCOU 2-5

3.0 STUDY AREA INVESTIGATION 3-1

3.1. Preliminary Data Evaluation And Planning 3-1

3.1.1. GCOU RI Data Quality Objectives 3-2

3.1.2. GCOU RI Community Involvement Activities 3-2

3.2. GCOU RI Field Activities 3-3

3.2.1. Installation of EPA GCOU RI Monitoring Wells 3-4

3.2.2. Groundwater Level Measurements 3-7

3.2.3. Groundwater Sampling 3-7

3.2.4. Laboratory Analysis of Groundwater Samples 3-8

3.2.5. Investigation-Derived Waste Management 3-8

3.3. Summary of Data Used for the Remedial Investigation 3-9

3.4. Summary of Data Quality and Usability Assessment 3-10

4.0 PHYSICAL CHARACTERISTICS OF THE GLENDALE CHROMIUM OPERABLE UNIT 4-1

4.1. Surface Features 4-1

4.2. Meteorology 4-1

4.3. Surface Water Hydrology 4-2

4.4. Geology 4-3
4.4.1. Regional Geology 4-3
4.4.2. GCOU Study Area Geology 4-4
4.5. Hydrogeology 4-5
4.5.1. Regional Hydrogeologic Setting 4-5
4.5.2. Hydrogeologic Conditions in the GCOU Study Area 4-8
4.6. Population and Land Use 4-12
4.7. Groundwater Use 4-13
4.7.1. Glendale Area 4-15
4.7.2. Operation of GNOU and GSOU Extraction Well Fields and Treatment System 4-16
4.8. Ecology 4-18
5.0 CONTAMINANT NATURE AND EXTENT 5-1
5.1. Identification of Potential Chromium Sources 5-1
5.2. Potential Sources of Chromium Contamination 5-2
5.2.1. Point Sources 5-3
5.2.2. Potential Non-point Sources 5-6
5.3. Extent of Chromium in Groundwater in the GCOU 5-7
5.3.1. Chromium Distribution in Western and Northern Study Areas 5-8
5.3.2. Chromium Distribution in Eastern and Southern Study Areas 5-8
5.4. Other Related Contaminants in Groundwater 5-10
5.5. Nature and Extent Summary 5-12
6.0 CHROMIUM FATE AND TRANSPORT 6-1
6.1. Potential Routes of Migration 6-1
6.2. Persistence 6-1
6.3. Migration in Groundwater 6-2
6.3.1. Geochemical Factors Influencing Chromium Solubility and Mobility 6-2
6.3.2. Advection and Related Transport Processes 6-3
6.4. Chromium Distribution, Fate, and Transport in Groundwater 6-5
6.4.1. Historical Migration from Source Areas 6-5

6.4.2. Current Distribution 6-7
6.4.3. Concentration Trends 6-8
6.4.4. Effects of Source Cleanups on Fate and Transport 6-9
7.0 RISK ASSESSMENT UPDATES 7-1
7.1. Human Health Risk Assessment Addendum 7-1
7.1.1. Exposure Assessment 7-1
7.1.2. Toxicity Assessment and Risk Characterization 7-3
7.2. Screening-Level Ecological Risk Assessment Addendum 7-4
7.2.1. Background, Approach and Problem Formation 7-4
7.2.2. Risk Characterization 7-6
8.0 SUMMARY AND CONCLUSIONS 8-1
8.1. Project Objectives 8-1
8.2. Scope Of Work Overview 8-1
8.3. Findings 8-1
8.3.1. Primary Sources 8-1
8.3.2. Nature and Extent of Contamination 8-2
8.3.3. Fate and Transport 8-2
8.3.4. Risk Assessment 8-3
8.4. Overall Conclusions 8-3
8.5. Data Limitations and Recommendations for Future Work 8-4
9.0 REFERENCES 9-1

EXHIBITS (IN-TEXT TABLES)

EXHIBIT 1-1 Key Terms Used Throughout This Report 1-1
EXHIBIT 1-2 GCOU Stakeholders 1-3
EXHIBIT 2-1 Chronology of Significant Developments in the GCOU Study Area 2-6
EXHIBIT 3-1 GCOU RI Planning Documents 3-1
EXHIBIT 3-2 Community Involvement Activities Performed by EPA during the GCOU RI 3-2
EXHIBIT 3-3 Summary of Groundwater Monitoring Wells Sampled by EPA during the GCOU RI 3-7
EXHIBIT 3-4 Analytical Methods of Groundwater Samples Obtained by EPA during the GCOU RI 3-8

EXHIBIT 4-1 Summary of Hydraulic Properties Estimated From 2012 Pumping Tests for Glendale North and South Extraction Wells 4-11
EXHIBIT 4-2 Demographics Summary for GCOU Study Area 4-13
EXHIBIT 4-3 San Fernando Basin Groundwater Operations Summary 4-14
EXHIBIT 4-4 Groundwater Withdrawals in the GCOU Study Area and Surface Water Imports by the Cities of Los Angeles, Burbank, and Glendale 4-15
EXHIBIT 4-5 Spreading Grounds and Water-Supply Well Fields in the GCOU Study Area 4-16
EXHIBIT 6-1 Distribution of Chromium Contamination in GCOU Study Area 6-7
EXHIBIT 6-2 Trends in Chromium Contamination in GCOU Study Area 6-8
EXHIBIT 7-1 MCL Exceedance Ratios for Total and Hexavalent Chromium 7-4

FIGURES

Figure 1-1 San Fernando Valley Location Map
Figure 2-1 San Fernando Valley Physical Features
Figure 2-2 San Fernando Valley Superfund Sites Operable Units
Figure 2-3 Production Well Fields and Recharge Basins in the Eastern San Fernando Basin
Figure 3-1 Data Gap Areas That Required Additional Data Collection for Remedial Investigation
Figure 3-2 Remedial Investigation Groundwater Sampling Locations
Figure 3-3 Remedial Investigation Phase 3 Cone Penetrometer Test Borings and Grab Sample Locations
Figure 4-1 Groundwater Elevations in Eastern San Fernando Basin, April 2014
Figure 4-2 Groundwater Elevations in GCOU Study Area, April 2014
Figure 4-3 Locations for Cross Sections
Figure 4-4 Cross Section A-A’
Figure 4-5 Cross Section B-B’
Figure 4-6 Cross Section C-C’
Figure 4-7 Cross Section D-D’
Figure 4-8 Cross-Section E-E’
Figure 4-9 Land Use in Southeastern San Fernando Valley
Figure 5-1 Facilities Under Investigation as Potential or Confirmed Sources of Chromium
Figure 5-2 Hexavalent Chromium (Cr6) in Groundwater, GCOU Area (Jan 2010-Aug2014)
Figure 5-3 Total Chromium (CrT) in Groundwater, GCOU Area (Jan 2010-Aug2014)

FIGURES (CONTINUED)

Figure 5-4 Hexavalent Chromium (Cr6) in Groundwater, Central GCOU, Expanded View (Jan 2010-Aug2014)

Figure 5-5 TCE in Groundwater, GCOU Area (Jan 2010-Aug2014)

Figure 5-6 PCE in Groundwater, GCOU Area (Jan 2010-Aug2014)

Figure 5-7 1,4-Dioxane in Groundwater, GCOU Area (Jan 2010-Aug2014)

Figure 6-1 Modeled Capture Zones for GNOU and GSOU Extraction Wells

TABLES (AFTER-TEXT)

Table 3-1 Construction Details and Survey Data for Monitoring Wells Installed During GCOU Remedial Investigation

Table 3-2 Construction Information for Existing Monitoring Wells Sampled During GCOU Remedial Investigation

Table 3-3 Variances from the Field Sampling Plans during Installation of EPA's GCOU Remedial Investigation Monitoring Wells

Table 3-4 Sampling Details for Cone Penetrometer Test Borings, Phase 3 of GCOU Remedial Investigation

Table 4-1 Groundwater Level Measurements Obtained During GCOU Remedial Investigation

Table 4-2 Analytical Results for Major Cations, Anions, Metals, and General Chemistry Parameters in Groundwater Samples Obtained During GCOU Remedial Investigation

Table 4-3 Results for Routine Field Parameter Measurements in Groundwater Samples Obtained During GCOU Remedial Investigation

Table 4-4 Analyte List for Groundwater Samples Obtained During GCOU Remedial Investigation

Table 5-1 History and Remediation Status of Facilities Investigating Chromium Discharges to Groundwater

Table 5-2 Analytical Results for Total and Hexavalent Chromium in Groundwater Samples Obtained During GCOU Remedial Investigation

Table 5-3 Analytical Results for Volatile Organic Compounds, Nitrate, and Emerging Contaminants in Groundwater Samples Obtained During GCOU Remedial Investigation

APPENDICES

Appendix A Boring and Well Construction Logs, Well Development Logs, Geophysical Logs

Appendix B Groundwater Monitoring Field Records

Appendix C IDW Disposal Records

Appendix D Data Quality and Usability Assessment Report

Appendix E Hydrographs and Hexavalent Chromium Concentrations for Selected Monitoring Wells

Appendix F Groundwater Geochemistry Stiff Diagrams

Appendix G Screening Level Ecological Risk Assessment Addendum

Appendix H Human-Health Risk Assessment Addendum

ACRONYMS AND ABBREVIATIONS

µg/L	micrograms per liter
1,1-DCE	1,1-dichloroethylene
1,2,3-TCP	1,2,3-trichloropropane
AF	acre-feet
AF/yr	acre-feet per year
Amec	Amec Foster Wheeler Environment & Infrastructure, Inc.
amsl	above mean sea level
AOC	Administrative Order on Consent
bgs	below ground surface
BOU	Burbank Operable Unit
CAO	cleanup and abatement order
CCC	criterion-continuous concentration
CD	Consent Decree
CDFW	California Department of Fish and Wildlife
CDPH	California Department of Public Health
CDWR	California Department of Water Resources
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CLP	contract laboratory program
cm/sec	centimeters per second
COC	contaminant of concern
COPC	chemical of potential concern
CPT	cone penetrometer test
Cr3	trivalent chromium
Cr6	hexavalent chromium
CrO_4^{-2}	chromate oxyanion
CrT	total chromium (sum of hexavalent and trivalent chromium)
CSM	conceptual site model
DDW	California State Water Resources Control Board, Division of Drinking Water
DO	dissolved oxygen

DQO	data quality objective
DTSC	California Department of Toxic Substances Control
EC	emerging contaminant
EPA	Environmental Protection Agency
EPC	exposure point concentrations
ERA	ecological risk assessment
ERM	Environmental Resources Management
ESV	ecological screening value
FS	feasibility study
FSP	Field Sampling Plan
ft/day	feet per day
ft/ft	foot per feet
ft/year	feet per year
ft^2/day	square feet per day
GAC	granular activated carbon
GCOU	Glendale Chromium Operable Unit
GNOU	Glendale North Operable Unit
gpm	gallon per minute
GRG	Glendale Respondents Group
GSOU	Glendale South Operable Unit
GWTP	Glendale Water Treatment Plant
$HCrO_4^-$	hydrogen chromate (bichromate) oxyanion
HHRA	human-health risk assessment
HQ	hazard quotient
HSA	hollow stem auger
IDW	investigation-derived waste
JMM	James M. Montgomery, Consulting Engineers
Kleinfelder	Kleinfelder, Inc.
LADWP	Los Angeles Department of Water and Power
LARWQCB	Regional Water Quality Control Board – Los Angeles Region

MCL	maximum contaminant level
mg/L	milligrams per liter
NAD83	North American Datum 1983
NAVD88	North American Vertical Datum 1988
NDMA	n-nitrosodimethylamine
NHOU	North Hollywood Operable Unit
NL	notification level
NPL	National Priorities List
ORP	oxidation-reduction potential
OU	operable unit
PCE	tetrachloroethylene (also known as perchloroethylene)
PHG	public health goal
PPE	personal protective equipment
PRP	potentially responsible party
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RAO	remedial action objective
RCF	reduction-coagulation-filtration
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
ROD	Record of Decision
RSL	regional screening level
SFV	San Fernando Valley
SFV RI	Remedial Investigation of Groundwater Contamination in the San Fernando Valley
SLERA	screening-level ecological risk assessment
TCA	trichloroethane
TCE	trichloroethylene
TCRA	time-critical removal action

TDS	total dissolved solids
TRV	toxicity reference value
TSD	treatment, storage, and disposal
UCL	upper confidence limit
ULARA	Upper Los Angeles River Area
U.S.	United States
USACE	U.S. Army Corps of Engineers
UTL	upper tolerance limit
VOC	volatile organic compound
WBA	weak-base anion
Work Plan	Remedial Investigation Work Plan
WY	water year

1.0 INTRODUCTION

The United States Environmental Protection Agency (EPA) has conducted a remedial investigation (RI) of chromium contamination in groundwater in the Glendale Chromium Operable Unit (GCOU) of the San Fernando Valley (SFV) Superfund Sites in Los Angeles County, California (Figure 1-1). EPA is pursuing cleanup of contaminated groundwater in the SFV under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). The study area for the GCOU RI comprises Area 2 (Glendale) and portions of Area 1 (North Hollywood and Burbank) and Area 4 (Pollock) of the SFV Superfund Sites.

Trichloroethylene (TCE), tetrachloroethylene (also known as perchloroethylene, or PCE), and other volatile organic compounds (VOCs) in groundwater underlying Area 2 are being addressed by interim pump-and-treat remedies for VOCs, which became operational in 2000. For the interim VOC remedies, extracted groundwater is treated through air stripping followed by granular activated carbon (GAC), and is then delivered to the City of Glendale for blending with water from other sources, followed by distribution for municipal use, including use as drinking water. Extraction wells associated with the pump-and-treat remedies in Area 2 serve an important plume containment function, in addition to supplying the City of Glendale with potable water.

Soon after the interim VOC remedies became operational in 2000, hexavalent chromium (Cr6) was detected at two remedy extraction wells at concentrations exceeding the California maximum contaminant level (MCL) for total chromium (sum of hexavalent and trivalent chromium) (CrT) of 50 micrograms per liter (µg/L); the state MCL for Cr6 of 10 µg/L was subsequently promulgated on July 1, 2014 (California Department of Public Health [CDPH], 2014). The interim VOC remedies in Area 2 were designed to treat VOCs, resulting in limitations on use of extraction wells affected by elevated chromium concentrations and potentially reducing the overall effectiveness of the interim VOC remedies. The interim VOC remedies are undergoing enhancements as discussed later in this report.

EXHIBIT 1-1 Key Terms Used Throughout This Report

Term	Meaning or Definition in this Report
GCOU	The operable unit (OU) established by EPA in 2007 to study and remediate chromium contamination in Area 2 groundwater, in the general vicinity of Glendale, California (EPA, 2011).
GCOU Study Area	The GCOU RI focused on Area 2, with consideration of influx of contaminated groundwater from sources in Area 1, and migration of Area 2 groundwater contamination into Area 4.
SFV	The valley floor within the Upper Los Angeles River Area (ULARA), which includes the watershed of the Los Angeles River and its tributaries upstream from the confluence of the Los Angeles River and the Arroyo Seco.
SFV Superfund Sites	The three areas of the eastern SFV currently on the National Priority List including Area 1 (North Hollywood and Burbank), Area 2 (Glendale), and Area 4 (Pollock). The areal extent of the SFV Superfund Sites is generally defined as the extent of contaminated groundwater above MCLs.
San Fernando Basin	The groundwater-bearing, alluvial basin-fill deposits underlying the majority of the SFV, excluding the smaller and hydrogeological distinct Sylmar, Verdugo, and Eagle Rock basins (discussed further in Section 2).

1.1. Purpose of Report

EPA's objectives for the GCOU RI were to determine the nature and extent of chromium in groundwater within the GCOU study area, evaluate the fate and transport of CrT and Cr6 in the GCOU study area, assess the potential threats to human health and the environment from CrT and Cr6 in groundwater in the GCOU study area, and determine if further investigation is required.

The purpose of this report is to document the methods used to conduct the GCOU RI, summarize the results of data collection and evaluation, describe the nature and extent of chromium (particularly Cr6) in groundwater, and report results of human-health and screening-level ecological risk evaluations. The RI report will be used to support a feasibility study (FS) of remedial alternatives to address chromium in GCOU groundwater.

1.2. Key Documents and Guidance

The GCOU RI was performed in accordance with the following EPA guidance:

- Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA – Interim Final (EPA/540/G-89/004) (EPA, 1988);
- Guidance for Quality Assurance Project Plans - EPA QA/G-5 (EPA/240/R-02/009) (EPA, 2002b);
- Guidance for Choosing a Sampling Design for Environmental Data Collection - for Use in Developing a Quality Assurance Project Plan (EPA QA/G-5S) (EPA, 2002c); and
- Guidance on Systematic Planning Using the Data Quality Objectives Process (EPA QA/G-4) (EPA, 2006).

EPA developed the following project-specific documents for planning and implementation of the GCOU RI activities:

- Remedial Investigation Work Plan (Work Plan), San Fernando Valley Area 2 Superfund Site, Glendale Chromium Operable Unit (EPA, 2012a);
- Field Sampling Plan(FSP), Remedial Investigation at San Fernando Valley Area 2 Superfund Site, Glendale Chromium Operable Unit (EPA, 2012b);
- Quality Assurance Project Plan (QAPP), Remedial Investigation at San Fernando Valley Area 2 Superfund Site, Glendale Chromium Operable Unit (EPA, 2012c); and
- Field Sampling Plan Addendum, Remedial Investigation at San Fernando Valley Area 2 Superfund Site, Glendale Chromium Operable Unit (EPA, 2014b).

1.3. GCOU Stakeholders

During planning of the GCOU RI, EPA solicited input from stakeholders including: the GCOU Respondents; the Glendale Respondents Group (GRG), which is leading the VOC remedial action in Area 2 of the SFV Superfund Sites; local municipalities; groundwater management agencies; government agencies; and other interested parties. The GCOU stakeholders are listed in Exhibit 1-2.

EXHIBIT 1-2 GCOU Stakeholders

Stakeholder Category	Stakeholder
Potentially Responsible Parties	GCOU Respondents Other GCOU facility[1] owners/operators
Local City Governments and Water Resource Management Entities	City of Burbank; Burbank Water and Power City of Glendale; Glendale Water & Power City of Los Angeles; Los Angeles Department of Water and Power (LADWP) ULARA Watermaster
County Governments	Los Angeles County Department of Public Health
State Government Agencies	State Water Resources Control Board, Division of Drinking Water (DDW)[2] California Environmental Protection Agency, Department of Toxic Substances Control (DTSC) Regional Water Quality Control Board – Los Angeles Region (LARWQCB)
Federal Government Agency	EPA
Other	Glendale Respondents Group (GRG)

Notes:

[1] The term "facility" refers to potential or confirmed chromium sources, such as former industrial sites.
[2] Formerly the California Department of Public Health, Drinking Water Program (until June 30, 2014).

1.4. Report Organization

This report is organized as follows:

Text Sections

Section 1—Describes the purpose of the GCOU RI and identifies the stakeholders involved in its planning and implementation.

Section 2—Summarizes the location, history and development of the SFV Superfund Sites overall, the chronology of events including EPA's decision to define a new OU, the GCOU, and an overview of the process to identify of chromium sources and impacts to groundwater in the Glendale area.

Section 3—Describes the planning, sampling, data collection, data quality and usability assessment and related activities conducted during the GCOU.

Section 4—Summarizes the physical, demographic, and ecologic characteristics of the GCOU study area that affect, or may be affected by, the occurrence of chromium in groundwater.

Section 5—Reports the results of the field investigation and data collection efforts, focusing on source identification and delineation of dissolved Cr6 and CrT in groundwater of the GCOU study area.

Section 6—Describes the fate and transport processes affecting chromium migration in groundwater, and a conceptual site model (CSM) developed to evaluate the current distribution of Cr6 and CrT in the GCOU study area.

Section 7—Summarizes human-health and screening-level ecological risk evaluations conducted in support of the GCOU RI.

Section 8—Provides a summary of the conclusions of the GCOU RI and recommendations for further investigation.

Section 9—Lists the references (works cited) used during preparation of this report.

Exhibits—In-text tables designed to provide relevant information in a summary format.

Figures—All figures referenced in this report follow Section 9.

Tables—Data summary tables referenced in this report follow the figures.

Appendices

Appendix A—Lithologic and geophysical logs, well construction diagrams, well development logs, and survey data obtained from borings and wells installed during the GCOU RI.

Appendix B—Groundwater monitoring field records generated during the GCOU RI.

Appendix C—Records for disposal of investigation-derived waste (IDW) generated during the GCOU RI.

Appendix D—Assessment of the quality and usability of data collected and used during the GCOU RI.

Appendix E—Graphs illustrating groundwater-level trends and Cr6 concentrations versus time at selected monitoring wells in the GCOU study area.

Appendix F—"Stiff diagrams" that illustrate general chemistry of groundwater at selected wells in the GCOU study area.

Appendix G—Screening-level ecological risk assessment (SLERA) addendum for chromium in groundwater of the GCOU studies area.

Appendix H—Human-health risk assessment (HHRA) addendum for chromium in groundwater of the GCOU studies area.

2.0 SITE BACKGROUND

This section describes the location, setting, and regulatory history of the GCOU and adjacent, related SFV Superfund Sites.

2.1. LOCATION AND DESCRIPTION

The SFV was defined in *Remedial Investigation of Groundwater Contamination in the San Fernando Valley* (SFV RI; James M. Montgomery, Consulting Engineers [JMM], 1992a) as the valley floor within the ULARA. This GCOU RI report retains that definition. The SFV is bounded to the northwest by the Santa Susana Mountains, to the northeast by the San Gabriel Mountains, to the east by the San Rafael Hills, to the west by the Simi Hills, and to the south by the Santa Monica Mountains (California Department of Water Resources [CDWR], 2003b). The Verdugo Mountains rise from the eastern portion of the SFV, trending southeast to northwest. The location of the SFV Superfund Sites with respect to significant physiographic features of the SFV is shown on Figure 2-1. The SFV encompasses an area of urban mixed land use; supporting industrial, light industrial, low- to high-density residential, recreational, retail, and commercial land uses.

The SFV is drained by the Los Angeles River and its various tributaries. The elevation of the Los Angeles River bed ranges from 1,100 feet above mean sea level (amsl) in the western portion of the SFV to approximately 350 feet amsl where it exits the SFV and enters the Los Angeles Coastal Plain at the outlet from the Los Angeles River Narrows.

The SFV includes four groundwater basins (Figure 2-1), consisting of the San Fernando Basin, the Verdugo Basin, the Sylmar Basin, and the Eagle Rock Basin. The SFV Superfund Sites overlie the eastern portion of the San Fernando Basin. The four groundwater basins in the SFV are a significant source of drinking water, particularly the San Fernando Basin. The San Fernando Basin is a source of groundwater for municipal supply in the Cities of Los Angeles, Glendale, and Burbank.

2.2. HISTORY AND DEVELOPMENT OF THE SAN FERNANDO VALLEY SUPERFUND SITES

In 1980, the California Department of Health Services (the agency that regulated drinking water at the time) requested all major groundwater users in the SFV to conduct tests for the presence of certain industrial chemicals in water supply wells. A groundwater monitoring program conducted from 1981 to 1987 revealed that over 50 percent of the water supply wells in the eastern portion of the SFV were contaminated. In response to the identified groundwater contamination, many water supply wells were taken out of service.

Some contaminants currently affecting groundwater in the San Fernando Basin can be traced as far back as the 1940s, when regulation of chemical waste disposal was limited (JMM, 1992a). Among the most widely distributed groundwater contaminants in the eastern SFV are VOCs, including TCE, PCE, and related compounds. TCE and PCE are chlorinated solvents that were widely used in a variety of industries in the SFV, including aerospace and defense manufacturing, machinery degreasing, metal finishing processes, and dry cleaning. Chromium (both CrT and Cr6) also was found in groundwater, collocated with VOC contamination, in some areas of the SFV Superfund Sites.

EPA has established federal MCLs for many common groundwater contaminants; an MCL is the highest level of a contaminant that is allowed in drinking water. Additionally, California has established MCLs that in some cases are more stringent than the federal MCLs. The more conservative (lower) of state and federal MCLs are generally used in this report to delineate the extent of groundwater

contamination. For chemicals without a federal or state MCL, DDW notification levels (NL) are used to define the extent of groundwater contamination. A NL is a state health-based advisory level, used to provide information to public water system operators and others about selected chemicals detected in drinking water that lack MCLs. A chemical of potential concern (COPC) is a chemical substance found at a site at concentrations that may or may not be causing risk or adverse effects to human-health or the environment. A contaminant of concern (COC) is a chemical substance that the EPA has determined poses an unacceptable risk to human health or the environment. COCs are the substances that are addressed by cleanup actions at the site.

In 1986, EPA placed four areas in the SFV on the National Priorities List (NPL) based on the location of drinking water well fields that were known to be contaminated by VOCs:

- Area 1 - North Hollywood and Burbank;
- Area 2 – Glendale (formerly referred to as Crystal Springs);
- Area 3 – Verdugo; and
- Area 4 – Pollock.

Areas 1, 2, and 4 overlie portions of the San Fernando Basin; Area 3 overlies a portion of the Verdugo Basin (Figure 2-2).

In 1987, a cooperative agreement was signed by EPA and the LADWP to perform the SFV RI in the eastern portion of the SFV, including the original four SFV Superfund Site areas listed above (JMM, 1992a). The purpose of the SFV RI was to characterize the nature and extent of the contamination on a regional scale in the groundwater basins of the SFV and to assess the potential health risks associated with contaminated groundwater. Key conclusions of the SFV RI included:

- TCE and PCE were the most prevalent contaminants detected in the eastern San Fernando Basin at concentrations exceeding MCLs for drinking water (5 µg/L for both TCE and PCE). Maximum detected concentrations of TCE and PCE in groundwater samples obtained from monitoring wells during the RI were 12,000 µg/L and 170 µg/L, respectively. Other VOCs, most notably 1,1-dichloroethylene (1,1-DCE) and carbon tetrachloride, were also detected in groundwater at concentrations exceeding their MCLs, most commonly where TCE and PCE exceeded MCLs.
- Nitrate was also detected above its MCL (10 milligrams per liter [mg/L]) as nitrogen] in groundwater underlying parts of the eastern SFV. However, nitrate is not considered a COC related to the SFV Superfund Sites, as its source is past agricultural and municipal wastewater discharges.
- CrT was also detected in two groundwater samples obtained during the SFV RI (JMM, 1992a) at concentrations exceeding its state MCL (50 µg/L at that time).
- TCE, PCE, 1,1-DCE, and carbon tetrachloride were identified as the primary contributors to elevated human-health risk, from potential exposure to contaminated groundwater in the SFV Superfund Sites.

During the SFV RI (JMM, 1992a), EPA identified two OUs within Area 1--the North Hollywood Operable Unit (NHOU) and Burbank Operable Unit (BOU)--and two in Area 2--the Glendale North Operable Unit (GNOU) and Glendale South Operable Unit (GSOU). Subsequent to the SFV RI, EPA took the following additional actions:

- Established a basinwide OU to perform RIs, groundwater monitoring, data management, and other coordinated activities throughout the four areas of the SFV Superfund Sites.
- Proposed a no-action remedy for Area 3 - Verdugo in October 2003 based on the lack of significant VOC contamination in the Verdugo Basin and the existing blending and treatment for nitrate. EPA issued a no action Record of Decision (ROD) for Area 3 in February 2004 and it was deleted from the NPL list in October 2004. SFV Area 3 is not discussed further in this report.
- Established the GCOU in 2007 to characterize chromium contamination in groundwater within Area 2 and evaluate potential remedial alternatives.

Interim groundwater remedies are currently in progress at four of the OUs in the eastern San Fernando Basin, including:

- NHOU—Groundwater extraction and treatment for VOCs commenced in 1989 and continues at present; remedial design for increased extraction and treatment of chromium and 1,4-dioxane is in progress.
- BOU—Groundwater extraction and treatment for VOCs commenced in 1996 and continues at present.
- GNOU and GSOU—Groundwater extraction from two extraction well fields and treatment for VOCs at the Glendale Water Treatment Plant (GWTP) began in 2000 and continues at present; enhancements are in progress to improve hydraulic containment of VOCs by installing a new extraction well, and adding wellhead treatment for chromium at extraction well GN-3, where chromium concentrations threatened to impact the VOC remedy.

The locations of the OU groundwater treatment plants are shown on Figure 2-3. SFV Superfund Site Areas 1, 2 and 4 are further described in the following subsections.

2.2.1. Area 1 – North Hollywood and Burbank

Area 1 (Figure 2-2) comprises approximately 7 square miles within the Cities of Los Angeles (North Hollywood neighborhood) and Burbank, and includes the NHOU and BOU. The southern boundary of Area 1 is Burbank Boulevard; the other boundaries of Area 1 are defined by the extent of groundwater contamination, and can vary over time. Area 1 is north-northwest and hydraulically upgradient of Area 2. More than 60 public drinking water supply wells are located within Area 1. The Tujunga, Rinaldi-Toluca, North Hollywood (West and East Branch), Erwin, and Whitnall well fields, comprising 56 wells, are owned and operated by the LADWP, and 11 wells are owned and operated by the City of Burbank (Figure 2-3).

EPA established the NHOU to address groundwater VOC contamination in the vicinity of LADWP's North Hollywood East Branch well field. In accordance with a ROD signed in September 1987, an interim remedy was implemented in 1989 to mitigate the observed rapid spread of groundwater contaminants in Area 1. The first interim remedy is still in operation pending implementation of a second interim remedy.

The NHOU first interim remedy consists of eight groundwater extraction wells and a treatment system consisting of an air stripper to remove VOCs from the extracted groundwater. Vapor-phase granular activated carbon (GAC) treatment is used to remove VOCs from the air-stripper off-gas. Treated water is discharged to LADWP facilities for chlorination and distribution in the City of Los Angeles municipal water supply system. The presence of Cr6 in some of the NHOU extraction wells exceeding the state

MCL was an important factor in EPA's decision to implement a Second Interim Remedy for the NHOU, documented in a September 2009 ROD. The NHOU second interim remedy is anticipated to include installation of additional extraction wells, treatment for Cr6 and 1,4-dioxane, expansion of the combined treatment system for VOCs, and either reinjection or delivery of the treated water to LADWP's municipal water supply system.

In 1987, EPA established the BOU to address VOC-contaminated groundwater affecting the City of Burbank's water-supply well fields. In June 1989, EPA finalized the ROD selecting the interim cleanup remedy for the BOU, which consists of extraction and treatment of the most highly contaminated groundwater. Operation of the Burbank water treatment plant commenced in 1996.

The contaminated water is treated using both an air-stripping process and liquid-phase GAC to remove VOCs. Vapor-phase carbon is used to remove VOCs from the air-stripper off-gas. The treated water is blended with water from other sources to reduce nitrate levels and then distributed through the City's municipal water supply system.

2.2.2. Area 2 – Glendale

Area 2 (Figure 2-2) comprises approximately 10.4 square miles in the Cities of Los Angeles, Glendale, and Burbank, and includes the GNOU and GSOU. The Crystal Springs well field, formerly operated by the LADWP, in the Cities of Los Angeles and Glendale, was shut down in the 1980s because of VOC contamination in groundwater. The VOC contamination in this well field resulted in EPA originally referring to the site as the "Crystal Springs (Area 2) Superfund Site," to address groundwater contamination in portions of the Cities of Burbank, Glendale, and Los Angeles. Groundwater quality has been affected both by sources within Area 2 and by plumes that have migrated downgradient from NHOU and BOU (Area 1). Area 2 is bounded in the north by Burbank Boulevard and in the south by Los Feliz Boulevard. Area 2 is hydraulically downgradient of Area 1 and upgradient of Area 4.

Separate (although very similar) interim RODs (EPA, 1993a and 1993b) are in place for the GNOU and GSOU (sometimes referred to together as the "GOU"). The EPA, the GRG, and the City of Glendale are parties to a Consent Decree (CD) signed in 2000 for implementation of the existing interim remedies in the GNOU and GSOU. The GRG consists of a subset of potentially responsible parties (PRPs) that have agreed to implement the interim remedies for VOC remediation in the GNOU and GSOU. A PRP is an individual or company (e.g., a past or present owner, operator, transporter, or generator of hazardous substance) with known or suspected links to contamination at a Superfund site.

The interim VOC remedies for the GNOU and GSOU began operation in 2000, and consist of:

- Groundwater extraction from four extraction wells in the GNOU and four in the GSOU;
- Treatment of contaminated groundwater in the shared 5,000 gallon per minute (gpm) GWTP located in the City of Glendale between the two extraction well fields;
- Primary removal of contaminants from the liquid phase using air stripping, followed by polishing by liquid-phase GAC;
- Treatment of the off-gas air stream by vapor-phase GAC; and
- Conveyance of the treated water to the City of Glendale for blending with water from other sources, followed by delivery to the City's municipal water-supply system.

In 2004, in response to concerns that the presence of chromium could limit municipal use of water produced by the existing BOU, GNOU, and GSOU interim remedies (none of which were designed to treat chromium), EPA conducted an evaluation of chromium trends in these OUs (CH2M HILL, 2005). At that time, concentrations of Cr6 and CrT were increasing at GNOU extraction wells GN-2 and GN-3, and at GSOU extraction well GS-3. Cr6 and CrT concentrations subsequently declined below 10 µg/L at well GN-2, and have generally remained below 10 µg/L at extraction wells GN-1, GN-4, GS-1, GS-2, and GS-4 since 2002. However, Cr6 and CrT concentrations remained elevated at wells GN-3 and GS-3 (they remain at 100 µg/L and 17 µg/L, respectively, as of April 14, 2015). In response, chromium treatment demonstration projects were added at two locations in the GNOU and GSOU:

- Reduction-coagulation-filtration (RCF) was installed in April 2010 to test treatment effectiveness of a small portion (100 gpm) of the combined influent to the treatment plant from GNOU extraction well GN-3; and
- A weak-base anion (WBA) exchange (resin) system was installed in May 2010 to test treatment effectiveness of the water extracted by GSOU extraction well GS-3.

The demonstration studies were completed in 2012; however, the WBA treatment system continued to operate until August 2015 at well GS-3 after the demonstration project ended.

2.2.3. Area 4 – Pollock

Area 4 (Figure 2-2) comprises approximately 9 square miles around the Pollock well field in the City of Los Angeles. Area 4 is hydraulically downgradient of Area 2 and extends south from Los Feliz Boulevard through the Los Angeles River Narrows where the Los Angeles River exits SFV (Figure 2-1). EPA completed an interim investigation of Area 4 in April 1994 and concluded that selecting and implementing a Superfund remedy for Area 4 was not necessary because LADWP planned to conduct wellhead treatment at the Pollock well field. In March 1999, LADWP reactivated two production wells in the Pollock well field and began operating a 3,000 gpm groundwater treatment plant. The water is treated to drinking water standards by liquid-phase GAC to remove VOCs and then blended with LADWP's municipal water supply. Recent testing at the Pollock well field by LADWP indicated relatively low concentrations of VOCs, CrT, and Cr6 (below the state MCLs for CrT and Cr6) in influent groundwater.

2.3. History and Development of the GCOU

In the late 1990s, EPA began focused investigation of chromium in groundwater in the SFV Superfund Sites through a 4-year study conducted by the LARWQCB and funded by EPA (LARWQCB, 2002a and 2002b). Chromium concentrations in groundwater were subsequently evaluated for the potential to negatively affect the existing VOC remedies in GNOU and GSOU (CH2M HILL, 2005; ERM, 2013a), as described in detail in Section 4.7.2.

EPA established the GCOU in 2007 to address data gaps regarding sources and extent of chromium (CrT and Cr6) contamination in groundwater throughout Area 2. Investigations of chromium in groundwater in Area 1 and Area 4 are being conducted separately.

EPA is working together with the DTSC and the LARWQCB to identify and remediate chromium source facilities in Areas 1, 2, and 4. DTSC and LARWQCB lead oversight of the cleanups for all known or suspected chromium sources in Area 2, with the exception of three facilities presently under EPA's oversight (discussed further in Section 5.1).

A chronology of the notable events in the GCOU study area leading up to and including planning and execution of the GCOU RI is presented in Exhibit 2-1.

EXHIBIT 2-1 Chronology of Significant Developments in the GCOU Study Area

Date	Event
1981	LADWP commenced a 2-year study to define the extent of groundwater contamination at several municipal water-supply well fields in the SFV. Results of this study indicated that 45 percent of LADWP's water-supply wells in the eastern SFV contained contaminants in excess of "state action levels" at that time.
1987 -1992	The SFV RI was conducted for VOC contamination throughout the SFV Superfund Sites, but also included sampling and risk assessment for chromium and other COPCs (JMM, 1992a). Based on the results of the SFV RI, EPA established the GNOU and GSOU.
December 1992	EPA begins routine annual sampling of SFV Basinwide RI monitoring wells for COCs and COPCs, including CrT.
1993 -1995	Site investigations and groundwater sampling were conducted under LARWQCB orders at various suspected VOC and chromium sources in the eastern SFV.
June 1996	EPA conducted supplemental sampling for chromium at selected SFV Basinwide RI and facility monitoring wells.
1998	The ULARA Watermaster notified LARWQCB and EPA that Cr6 was present in groundwater of the eastern SFV, and requested further study of the distribution and sources of chromium.
1999	EPA provided funds to the LARWQCB to investigate potential chromium sources in the SFV.
2000	Interim VOC remedies began operating in GNOU and GSOU.
November 2002	LARWQCB released the findings from its evaluation of more than 4,000 potential chromium sources, recommending further assessment of 105 sites. LARWQCB issued cleanup and abatement orders (CAOs) to 7 of the 105 sites identified in the study (LARWQCB, 2002a and 2002b).
January 2003	The ULARA Watermaster issued a report on the history and occurrence of Cr6 in groundwater of the San Fernando Basin (ULARA Watermaster, 2003).
2003 - present	LARWQCB provided regulatory oversight of field investigations at 126 industrial facilities in the eastern SFV as part of the chromium source identification efforts. Of these, 11 facilities have implemented some type of onsite remediation to address chromium. Details on the facilities where remediation is underway or has been completed are included in Section 5.
2004 – 2008	Investigations were performed by EPA at the former Drilube sites (both Wilson and Broadway facilities) to evaluate chromium and VOC contamination. Investigations focused on soil, soil vapor, and groundwater contamination. Information on Drilube sites is provided in Section 5.
June 2005	EPA conducted a Focused Chromium Trend Study to evaluate chromium concentrations in groundwater in the BOU, GNOU, and GSOU, and provided forecasts of future chromium concentrations at GNOU and GSOU interim-VOC-remedy extraction wells (CH2M HILL, 2005).
2007	EPA completed an assessment followed by an extensive time-critical removal action (TCRA) at the All Metals Processing facility (EPA, 2008a) (See Section 5 for more information).
April 2007	EPA performed an evaluation to prioritize potential locations for installing new groundwater monitoring wells for delineating chromium in the BOU, GNOU, and GSOU (CH2M HILL, 2007).
June 2007	EPA established the GCOU to characterize chromium contamination in groundwater of Area 2

Date	Event
	and adjacent areas to evaluate potential threats to human health and the environment and to evaluate potential remedial actions.
2008 - present	EPA works with the LARWQCB to identify additional facilities warranting investigation as potential sources of chromium contamination within GCOU.
March 2008	The EPA-sponsored "SFV Chromium Workshop" was held in the City of Glendale to share information about chromium in groundwater throughout the SFV. The workshop included presentations by the LARWQCB, EPA, CDPH, and DTSC.
September 2008	EPA approved a proposal by the GRG to construct chromium treatment demonstration projects at the GNOU/GSOU treatment plant (GWTP) and at extraction well GS-3 (operation of these demonstration projects began in 2010).
2009 - 2013	EPA conducted additional field investigations at and around the former Drilube sites (Wilson and Broadway facilities) to delineate soil, soil vapor, and groundwater contamination beneath and downgradient of the facilities (EPA, 2009 and 2014d).
2010	EPA performed a TCRA at the former Drilube-Wilson site to remove near surface soil containing elevated Cr6 concentrations in the former waste treatment area (EPA, 2010).
2010	EPA conducted additional soil investigation at the former All Metals Processing facility to delineate residual metals contamination in deep soil beneath the site (EPA, 2012e).
March 2011	EPA reached agreement with the GCOU Respondents on an Administrative Order on Consent (AOC), under which the GCOU Respondents agreed to conduct some of the proposed GCOU RI activities, and EPA would complete the remainder of the RI.
September 2011	EPA initiated planning for their portion of the GCOU RI as agreed under the AOC.
November 2011	The GCOU Respondents submitted the GCOU Data Compilation and Evaluation Report (ERM, 2011a), which summarized data available at that time regarding chromium in the GCOU study area.
January 2012	EPA approved the GCOU Respondents' Specified Work Plan for their portion of the GCOU RI (ERM, 2011b).
April 2012	EPA finalized the work plan for their portion of the GCOU RI (EPA, 2012a).
March 2012 – October 2012	The GCOU Respondents performed RI field work in accordance with their Specified Work Plan, including installation and sampling of 12 new groundwater monitoring wells.
August 2012 – November 2013	EPA performed the first two phases of RI fieldwork in accordance with the GCOU RI Work Plan, including installation of 15 new groundwater monitoring wells. The EPA performed quarterly sampling of new monitoring wells installed by EPA and the GCOU Respondents.
October 2012 - November 2014	EPA conducted routine (quarterly and semiannual) groundwater monitoring events in the GCOU study area.
October 2013	The GCOU Respondents submitted the Revised Final Specified Work Report (ERM, 2013e), which summarized results of the RI field work they conducted.
April – July 2014	EPA performed the third and final phase of field activities for the GCOU RI, including groundwater grab sampling from 13 borings and installation of 4 new monitoring wells.

3.0 STUDY AREA INVESTIGATION

The data collection activities conducted by EPA during the GCOU RI included preliminary data evaluation and planning, three phases of field investigation, and compilation of data from EPA's investigation and other sources. This section describes the GCOU RI data collection activities undertaken by EPA, provides a summary of the data generated during the GCOU RI as well as data from other sources that were used to supplement the data evaluations in this RI report, and summarizes an assessment of data quality and usability conducted for the GCOU RI.

3.1. PRELIMINARY DATA EVALUATION AND PLANNING

EPA maintains a groundwater database for the SFV Superfund Sites that includes groundwater quality and other hydrogeologic data generated by EPA, as well as data provided by municipalities, PRPs, and other agencies or stakeholders in the SFV. The data in the SFV database includes well location coordinates, well top-of-casing elevations, well screen depths, lithologic information, groundwater level measurements, and analytical results for groundwater samples.

The *Chromium Trend Study* (CH2M HILL, 2005) revealed that CrT and Cr6 concentrations in groundwater revealed that CrT and Cr6 concentrations in groundwater commonly exceeded the state MCL of 50 µg/L for total chromium (the only regulatory standard at the time) in some areas of the GNOU and GSOU. However, the groundwater quality data used in the *Chromium Trend Study* came from monitoring wells installed to evaluate VOC contamination, which were not all suitably located for delineating CrT and Cr6 in groundwater, resulting in significant data gaps. The *Chromium Trend Study* identified 11 areas where delineation of chromium in groundwater could be improved. Based on subsequent data collection and GCOU Respondent negotiations, these 11 areas were reduced to seven key areas (designated as data gap Areas A through G). The locations of Areas A through G are shown on Figure 3-1.

Evaluating CrT and Cr6 concentrations in the seven key areas was a primary goal of the GCOU RI. EPA provided oversight of the overall RI effort, with the GCOU Respondents installing and sampling wells in key areas along the Interstate-5 corridor in the GNOU and GSOU where chromium concentrations were known to be highest. EPA focused their investigation on data gap areas not covered by the GCOU Respondents. EPA implemented their field program using a phased approach to allow for evaluation of the Respondents data, iteratively filling data gaps, and minimizing data redundancy. Exhibit 3-1 lists the EPA and GCOU Respondents RI planning documents.

EXHIBIT 3-1 GCOU RI Planning Documents

Prepared By	Date	Document
GCOU Respondents	November 2011	Data Compilation and Evaluation Report (ERM, 2011a)
	November 2011	Specified Work Plan (ERM, 2011b)
	December 2011	Quality Assurance Project Plan (QAPP - ERM, 2011c)
	February 2012	Revised Final Field Sampling Plan (FSP - ERM, 2012a)
EPA	April 2012	Remedial Investigation Work Plan (EPA, 2012a)
	April 2012	Field Sampling Plan (EPA, 2012b)
	April 2012	Quality Assurance Project Plan (EPA, 2012c)
	April 2012	Field Sampling Plan Addendum (EPA, 2014b)

3.1.1. GCOU RI Data Quality Objectives

EPA developed data quality objectives (DQOs) for implementation of each phase of RI field activities. The DQOs were prepared in accordance with EPA *Guidance for Data Quality Objectives Process-EPA QA/G-4, Document EPA/600/R 96/055* (EPA, 2000 and 2006), and were presented in the QAPP (EPA, 2012c). The primary RI study goals were to:

- Determine the nature and extent of CrT and Cr6 in groundwater in the GCOU study area;
- Evaluate the fate and transport CrT and Cr6 in the GCOU study area; and
- Assess the potential threat to human health and the environment from CrT and Cr6 in groundwater in the GCOU study area and determine if further investigation is required.

3.1.2. GCOU RI Community Involvement Activities

As part of the planning process for the GCOU RI, EPA engaged local agencies and community members potentially affected by the planned field activities to share information and address the needs and potential concerns of the community. Community involvement activities for the GCOU included the following three main objectives:

- Planning: Identified the affected communities and key stakeholders. Established regular and open dialogue to respond to questions, concerns, and conflicts as they arose;
- Interaction: Provided opportunities for public participation that highlighted and allowed for consideration of community concerns in the GCOU; and
- Outreach: Provided to the public consistent, regular, and timely information about the investigation activities.

Community involvement for the GCOU RI followed the general approach outlined in the *Draft SFV Superfund Sites Community Involvement Plan* (EPA, 2012d). Community involvement activities completed by EPA during the GCOU RI field program are summarized in Exhibit 3-2.

EXHIBIT 3-2 Community Involvement Activities Performed by EPA during the GCOU RI

Community Involvement Activity	Description
Community interviews	Conducted interviews of stakeholders regarding the overall SFV Superfund Sites (not only the GCOU) in 2012.
Mailing list development	Maintained and updated the mailing list of contacts for distribution of SFV Superfund Sites fact sheets and meeting notices.
Information repositories	Maintained the local Superfund information repository (established in 1992) at the Glendale Library, where the community could review project documents.
Fact sheet dissemination	Prepared a fact sheet (in English and Spanish) to inform the community of the overall GCOU RI field program, and distributed to nearby residents and businesses in March 2012.
Flyer delivery	Prepared and distributed flyers (in English and Spanish) to inform residents near each well site of upcoming drilling and well installation activities prior to drilling each well.
Community Meeting/ Open House	Hosted a community open house meeting in April 2012 to share information on the well installation activities to be performed as part of the GCOU RI.

3.2. GCOU RI Field Activities

The GCOU RI phases of work (1, 2a, 2b, and 3) were established by EPA based on evaluation of incoming data, prioritization of remaining data gaps, and consideration of GCOU Respondent progress on their investigation. Following the preliminary data review and development of the DQOs and technical approach, EPA completed well installation and groundwater sampling activities during four phases:

- **Phase 1 (August – September 2012)**: EPA installed and sampled three monitoring wells (cluster monitoring well CS-C30-120/-200 and single-completion monitoring well CS-C31-102) at two locations in the northwestern part of the GCOU study area that were outside the footprint of the GCOU Respondents' portion of the field investigation. Phase 1 monitoring wells were installed to evaluate the extent of the Cr6 concentrations greater than 5 µg/L detected at EPA RI monitoring well cluster NH-C06 (Figure 3-2).
- **Phase 2a (December 2012 – January 2013)**: EPA installed and sampled two single-completion monitoring wells (CS-C32-120 and CS-C33-059) in the northwestern and southern parts of the GCOU study area , outside the footprint of the GCOU Respondents' portion of the field investigation. Well CS-C32-120 was installed as a follow on to the Phase 1 well installations to confirm the lack of laterally extensive Cr6 contamination in the northwestern part of the GCOU study area. Well CS-C39-059 was installed to evaluate the connection between the Cr6 detected at the GSOU extraction well field and the elevated Cr6 concentrations detected during GCOU RI groundwater monitoring at facility monitoring wells located approximately 3,000 feet downgradient of the GSOU wells.
- **Phase 2b (May – July 2013)**: EPA installed and sampled ten single-completion monitoring wells (CS-C34-065 through CS-C43-083) in the eastern portion of the GCOU study area. The primary focus of Phase 2b was to install the rest of the monitoring wells identified in the RI planning documents as necessary to delineate the distribution of Cr6 contamination in the GCOU study area. The planned locations were optimized to focus on data gaps in Cr6 plume delineation remaining after completion of Phases 1 and 2a and the GCOU Respondents' field investigation.
- **Phase 3 (April – July 2014)**: EPA collected groundwater grab samples at eight temporary sample points (cone penetrometer test [CPT]-1, CPT-3, CPT-6, and CPT-9 through CPT-13), and four single-completion monitoring wells (CS-C44-120 through CS-C47-053) were installed and sampled. The focus of Phase 3 was to evaluate remaining data gaps after completion of Phase 2b based on review of all previously collected RI data. One of the monitoring wells (CS-C44-120) was installed in the northern part of the study area to provide better definition of the Cr6 plume in the northeastern part of Area 2 and downgradient from Area 1. The remaining monitoring wells were installed to provide delineation of the southern and southeastern extent of the Cr6/CrT plume in Area 2 and the northern part of Area 4.

Concurrent with EPA's pre-field and Phase 1 RI activities, between March and October 2012, the GCOU Respondents installed and sampled 12 groundwater monitoring wells (PWA-1 through PWA-10, PWA-12, and PWA-13) at 11 locations, per the *Specified Work Plan* (ERM, 2011b). Well installation activities conducted by the GCOU Respondents are documented in the *Revised Final Specified Work Report* (ERM, 2013e).

The locations of the new groundwater monitoring wells installed by EPA and the GCOU Respondents for the GCOU RI, and other existing groundwater monitoring wells, are shown on Figure 3-2. The temporary

sample point locations sampled by EPA as part of the GCOU RI field program are also included on Figure 3-2.

The following tables summarize information from installation of monitoring wells during the GCOU RI:

- Table 3-1: Construction details for the new GCOU RI monitoring wells;
- Table 3-2: Construction information for the existing monitoring wells sampled by EPA during the GCOU RI ;
- Table 3-3: Variances from the FSP and FSP Addendum during groundwater monitoring well installation activities; and
- Appendix A provides lithologic logs, geophysical logs, CPT logs, and well completion diagrams for borings advanced during the GCOU RI.

3.2.1. Installation of EPA GCOU RI Monitoring Wells

A summary of EPA's GCOU RI monitoring well installation activities is provided below. The FSP (EPA, 2012b) and FSP Addendum (EPA, 2014b) describe in more detail the field methods and procedures for monitoring well installation, grab sampling, and routine groundwater monitoring.

3.2.1.1. Pre-Field Planning Activities

Before each phase of drilling and well installation, the safety and logistical feasibility of each potential drilling site was reviewed, access agreements were obtained from the jurisdictional governmental agencies, and adjacent and nearby businesses and residents notified of the scheduled field activities. Each drilling location was marked and Underground Service Alert (Dig Alert) was notified to assist in locating underground utilities. In addition, each location was checked for underground utilities by a third-party contractor using non-intrusive geophysical methods.

3.2.1.2. Well Installation – Phases 1, 2a, and 2b

Fifteen new EPA GCOU RI monitoring wells were installed (13 shallow single-completion wells and 2 wells in a shallow/deep cluster-well configuration), identified as wells CS C30-120/200 through CS-C43-083, during Phases 1, 2a, and 2b of the GCOU RI field work. The procedures used during monitoring well installation are described below.

All but two of the EPA GCOU RI monitoring wells was screened across the water table with 30-foot well screens (approximately 10 feet of well screen above the water table and 20 feet below). One deeper monitoring well (CS-C30-200) was constructed with a 20-foot screen set 100 to 120 feet below the water table (180 to 200 feet below ground surface (bgs), and well CS-C37-035 was constructed with 25 feet of screen (5 feet above and 20 feet below the water table) because shallow groundwater was encountered at this location. Variances from the FSP are detailed in Table 3-3.

Specific methods and procedures for each drilling method are described below:

- **Hollow Stem Auger (HSA) Drilling:** Boreholes for the EPA GCOU RI monitoring wells were 10 to 12 inches in diameter to their total depth, and were advanced either in a single pass or with a smaller-diameter auger to complete a pilot hole, followed by reaming to the full diameter. The HSA-drilled boreholes extended approximately 20 feet below the water table, into the saturated zone. Soil samples (for lithologic logging only) were collected during HSA drilling using a modified California split-spoon sampler approximately every 5 feet above the water table, and

continuously from the water table to total depth. Total depths of the HSA boreholes ranged from 41.5 to 123 feet bgs (Table 3-1).

- **Mud Rotary Drilling:** Mud rotary drilling was used to install cluster well CS-C30-120/CS-C30-200. A 9-7/8 inch drill bit was advanced to a depth of 225 feet bgs for the deeper well, which corresponded to approximately 120 feet below the anticipated depth of the water table. Grab soil samples were collected from the drill cuttings for lithologic logging at approximately 5-foot intervals. A suite of downhole geophysical logs—including spontaneous potential, natural gamma, short and long normal resistivity, lateral resistivity, and sonic velocity—were obtained from the initial borehole. A caliper log was also generated from the borehole and documented an approximately 10-inch diameter borehole. Screened intervals for wells CS-C30-120 and CS-C30-200 were selected based on the geophysical logs and the lithology encountered in the initial borehole, and CS-C30-200 was constructed within the initial borehole. Based on findings from the initial borehole, the boring for well CS-C30-120 was drilled to a depth of 129 feet at an adjacent location. Soil cuttings from the adjacent borehole were inspected during drilling for any significant differences in lithology between the two locations.

The general approach for well design, including casing material, screen length, slot size, and filter pack gradation, was described in the RI planning documents (Work Plan, FSP and QAPP). Polyvinyl chloride (PVC) casing was selected to eliminate the potential for biasing metals results from the monitoring wells, reduce the potential for corrosion, and because it is the most economical alternative for wells installed within the depth ranges for this RI. The screen-slot size and filter pack gradation were selected based on review of prior well installation efforts and the expectation that generally coarse-grained sediments would be screened in the study area. Use of the same slot size and filter pack gradation at all locations was selected to simplify project logistics and expedite monitoring well construction activities which were generally conducted in the public right-of-way (residential streets).

Each new monitoring well was constructed with the following materials:

- Casing: Flush-threaded 4-inch-diameter Schedule 80 PVC;
- Screen: Flush-threaded 4-inch-diameter 0.020-inch slot Schedule 80 PVC and a threaded PVC end cap;
- Filter pack: Number-3 gradation, clean, kiln-dried Monterey sand;
- Bentonite seal: Hydrated coated bentonite pellets or medium bentonite chips; and
- Cement-bentonite grout sanitary seal: Type I or II Portland cement mixed with up to 5 percent (dry weight) bentonite.

Each well was secured within a flush-to-grade, traffic-rated well vault with a locking riser extending to approximately 1-foot bgs. A summary of construction information for the new EPA GCOU RI monitoring wells is provided in Table 3-1.

Well development was performed at each new well location a minimum of 24 hours after completion of well installation. The wells were developed in accordance with CDWR's well standards (CDWR, 2003a). Development was accomplished using a combination of bailing, swabbing, and pumping until water quality parameters stabilized as outlined in the FSP (EPA, 2012b). Well development logs are included in Appendix A.

After the monitoring wells were installed, a California-licensed professional land surveyor surveyed their locations and elevations. The survey included ground surface elevation, top of well casing elevation, and monument elevation to the nearest 0.01 foot relative to mean sea level; elevations are based on North American Vertical Datum 1988 (NAVD88). The horizontal location of each monitoring well was based on North American Datum 1983 (NAD83) US Survey Feet; these data are provided in state plane coordinates (California Zone 5) to the nearest 0.1-foot. Survey data are summarized in Table 3-1 and survey reports for the new EPA GCOU RI monitoring wells are included in Appendix A.

3.2.1.3. Well Installation – Phase 3

Phase 3 field activities were performed to evaluate data gaps remaining after Phase 2b of field activities, and generally focused on data gap Areas A, F, and G (Figure 3-1). Groundwater grab samples were obtained from 8 of 13 attempted CPT borings (Figure 3-3). The groundwater grab sample data were used as screening-level data, together with other groundwater monitoring data available at that time, to identify potential locations for new monitoring wells along the longitudinal axes of plumes in Areas F and G. The lithology encountered during CPT drilling is presented in logs included in Appendix A.

The following process was implemented at each of the 13 CPT boring locations:

- A 2-inch diameter cone penetrometer was driven into the subsurface to 5 feet below the water table or to the point of equipment refusal.
- If refusal was encountered before reaching the water table, the supervising Hydrogeologist determined if it was logistically feasible to step out to another nearby location. The step-out location was cleared for utilities using an air-knife to the depth of the deepest known utility before attempting a boring at the step-out location. If refusal was encountered at the step-out location, the original and step-out CPT borings were properly abandoned and the investigation proceeded to the next planned CPT location. Total depths of CPT borings are summarized in Table 3-4.
- Where possible, groundwater samples were collected from the CPT borings using a HydroPunch™ sampling tool. The samples were submitted for laboratory analysis in accordance with the methods outlined in the FSP Addendum (EPA, 2014b). Laboratory results for Cr6 analysis of the grab groundwater samples are summarized in Table 3-4.
- All CPT borings were properly abandoned after sampling in accordance with Los Angeles County Department of Public Health Requirements for Wells Construction/Decommissioning (County of Los Angeles, 2014), California DWR Well Standards (CDWR, 2003a), and the FSP Addendum (EPA, 2014b).
- Following completion of the CPT sampling, the resultant analytical data were compiled with relevant available groundwater monitoring data to identify the optimal Phase 3 monitoring well locations.

The four Phase 3 monitoring wells (wells CS-C44-120 through CS-C47-53) were installed in accordance with the FSP and FSP addendum (EPA, 2012b and 2014b); their locations are shown on Figure 3-2. These wells were drilled using an HSA drilling rig, and were constructed with 30-foot screened intervals (approximately 10 feet above and 20 feet into the saturated zone) similar to the Phase 1, 2a, and 2b single-completion monitoring wells, with the exception of well CS-C44-120 which was installed with 40 feet of screen (Table 3-1). Well construction materials, well development, and surveying activities for Phase 3 monitoring wells were consistent with those used during Phases 1 and 2 (described above).

There were two pre-approved variances from the FSP and FSP Addendum (EPA, 2012b and 2014b) for the Phase 3 RI: 1) installation of an additional monitoring well (CS-C44-120), and 2) use of a 40-foot-long screen in this well. Per EPA's direction, monitoring well CS-C44-120 was installed to evaluate the continuity of CrT and Cr6 plumes in the northern portion of the GCOU study area. Variances from the FSP and FSP Addendum are summarized in Table 3-3.

3.2.2. Groundwater Level Measurements

Groundwater levels were measured during quarterly monitoring events for the GCOU RI and semiannual monitoring events for all of the SFV Superfund Sites. An electronic water-level sounder was used to measure groundwater levels in monitoring wells to the nearest hundredth of a foot (0.01-foot). The GCOU Respondents, the GRG, and individual SFV facilities collected additional groundwater level data during scheduled monitoring events.

3.2.3. Groundwater Sampling

EPA collected groundwater samples from 67 monitoring wells during the GCOU RI, as summarized in Exhibit 3-3. Locations for these wells are shown on Figure 3-2. The majority of the monitoring wells do not have dedicated sampling equipment; therefore, EPA sampled these wells using a portable low-flow sampling pump. The existing (older) SFV RI monitoring wells are equipped with dedicated electric submersible pumps and were sampled using conventional (three-well-volume purge) groundwater sampling procedures, per the FSP (EPA, 2012b). Field records for groundwater sampling conducted during the GCOU RI are provided in Appendix B. Tables 3-1 and 3-2 summarize well screen and total depth information, well owner or association, and analytical parameters for samples obtained during the GCOU RI.

EXHIBIT 3-3 Summary of Groundwater Monitoring Wells Sampled by EPA during the GCOU RI

Well Owner/Association	Number of Wells Sampled	Analytical Parameters Tested[a]
New GCOU RI Monitoring Wells:		
Installed by EPA	19	Cr6, CrT, Dissolved Metals, VOCs, Emerging Compounds, Anions, and General Chemistry Parameters
Installed by the GCOU Respondents	12	Cr6, CrT, and VOCs
Existing SFV Basinwide RI Monitoring Wells	2	Cr6 and CrT
Facility Monitoring Wells:		
Former All Metals Facility	2	Cr6, CrT, and VOCs
Former Drilube Facilities (Wilson and Broadway)	11	Cr6, CrT, and VOCs
Former Eemco Facility	3	Cr6, CrT, and VOCs
Former Franciscan Ceramics Facility	8	Cr6, CrT, and VOCs
Grayson Power Plant (also known as Glendale Steam Plant)	6	Cr6, CrT, and VOCs
Disney Burbank Studio	1	Cr6, CrT, and VOCs
GRG Monitoring Wells	3	Cr6, CrT, and VOCs

Notes for Exhibit 3-3:

[a]The RI QAPP (EPA, 2012c) includes a complete list of analytes for each test

- CrT – total chromium (sum of hexavalent and trivalent chromium); Cr6 – hexavalent chromium
- Dissolved Metals (filtered samples): aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium (total), cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc. Samples were field-filtered using a 0.45-micron filter before preservation and being shipped to the laboratory.
- Emerging compounds: 1,4-dioxane; n-Nitrosodimethylamine (NDMA); perchlorate; and 1,2,3-Trichloropropane (1,2,3-TCP).
- Anions: bromide, chloride, fluoride, orthophosphate, and sulfate
- General Chemistry Parameters: alkalinity (bicarbonate, carbonate, and hydroxide), ammonia, nitrate, nitrite, sulfide, total Kjeldahl nitrogen, total dissolved solids (TDS), total organic carbon

3.2.4. Laboratory Analysis of Groundwater Samples

To generate data of acceptable and known quality, EPA selects analytical methods with appropriate sensitivity and sufficient quality assurance (QA)/quality control (QC) checks. Analysis of QA/QC samples and performance evaluation samples demonstrates the precision and accuracy of the analytical methods. EPA conducted a Data Quality and Usability Assessment on the GCOU environmental data set collected through August 2014; the Data Quality and Usability Assessment are summarized in Section 3.4.

Exhibit 3-4 presents the methods used for analysis of groundwater samples obtained during the GCOU RI.

EXHIBIT 3-4 Analytical Methods of Groundwater Samples Obtained by EPA during the GCOU RI

Parameter	Method
Hexavalent chromium (Cr6)	EPA Method 218.6
Dissolved metals, including CrT	EPA 200 Series Methods
Volatile organic compounds (VOCs)	EPA Method 8260(C)
General chemistry parameters	See Exhibit 3-3 notes for list
1,4-Dioxane	EPA Method 8260 SIM or 8270 SIM
n-Nitrosodimethylamine (NDMA)	EPA Method 1625
Perchlorate	EPA Method 314
1,2,3-Trichloropropane (1,2,3-TCP)	EPA Method 524 SIM

Notes:

see Exhibit 3-3 notes

3.2.5. Investigation-Derived Waste Management

IDW produced during the GCOU RI consisted of cuttings; drilling mud; well development water and sediments; water generated from purging, sampling, and decontamination activities; and used personal protective equipment (PPE). IDW was temporarily stored in labeled roll-off bins, 275-gallon plastic totes, or United Nations (UN)-approved 55-gallon open-top drums pending waste characterization. Disposable sampling equipment and used PPE were bagged and disposed as municipal waste. Soil and liquid IDW samples were submitted to the EPA Region 9 Laboratory in Richmond, California for the following analyses as required by the disposal facility:

- VOCs (EPA Method 8260C);
- California Administrative Manual Title 22 metals, including CrT (EPA Method 6010C);

- Cr6 (water samples only) (EPA Method 218.6);
- Total petroleum hydrocarbons – diesel (8015C);
- Total petroleum hydrocarbons – gasoline (8015C); and
- pH (SM4500).

EPA reviewed and approved the generator waste profiles and disposal facilities. IDW disposal was performed as follows:

- Soil cuttings and drilling mud wastes were disposed of at the South Yuma County Landfill located in Yuma, Arizona, a CERCLA Off-Site-Rule-approved disposal facility;
- Liquid wastes generated during drilling activities were disposed of at the South Yuma County Landfill and at Crosby & Overton, which is a fully permitted Resource Conservation and Recovery Act (RCRA) Part B treatment, storage, and disposal (TSD) facility in Long Beach, California; and
- Groundwater sampling purge water was containerized and transferred to the BOU groundwater treatment plant operated by the City of Burbank.

Copies of the non-hazardous waste manifest forms for the soil and liquid wastes are included in Appendix C.

3.3. Summary of Data Used for the Remedial Investigation

The data collected during the GCOU RI include the following:

Data Collected by EPA

- Data obtained during installation and baseline sampling of 19 new EPA groundwater monitoring wells, including lithologic information, well construction details, analytical results from groundwater samples, and groundwater elevations.
- Analytical results from quarterly and semiannual groundwater samples collected by EPA between 2012 and 2014 at new groundwater monitoring wells installed by EPA and the GCOU Respondents.
- Analytical results from quarterly and semiannual groundwater samples collected by EPA between 2012 and 2014 at existing SFV Basinwide RI monitoring wells, facility monitoring wells, and select groundwater monitoring wells installed by the GRG. A list of these wells, including well completion details, is provided in Table 3-2.
- Data collected by EPA in 2013 and 2014 from four new groundwater monitoring wells (V13DRMW6 through V13DRMW9) installed as part of ongoing investigation activities at the former Drilube facilities; including lithologic information, well construction details, analytical results from groundwater samples, and groundwater elevations (EPA, 2014d).

Data Collected by Others and Incorporated into the GCOU RI

- Data obtained by the GCOU Respondents in 2012 during installation and baseline sampling of 12 new groundwater monitoring wells, including lithologic information, well construction details, analytical results from groundwater samples, and groundwater elevations.

- Data obtained by the GRG in 2011 and 2012 from 13 new groundwater monitoring wells installed and sampled during a focused feasibility study for VOC contamination in the GNOU and GSOU (ERM, 2012a), including lithologic information, well construction details, analytical results from groundwater samples, analytical results for surface water samples in the Los Angeles River, aquifer test results, and groundwater elevations.
- Analytical results from groundwater samples collected by the City of Glendale since 2000 during operation of the GNOU and GSOU interim remedies.
- Analytical results from groundwater samples collected by the GRG since 2012 from SFV RI monitoring wells located within the GCOU study area.
- Analytical results compiled from past soil and groundwater investigations and routine sampling performed at potential contaminant source facilities in the GCOU, and stored on EPA's SFV groundwater database.

3.4. Summary of Data Quality and Usability Assessment

EPA performed a Data Quality and Usability Assessment to evaluate the results of QA/QC activities associated with chromium data collected for the GCOU RI through August 2014. Results of this assessment are provided in Appendix D. The objective of the Data Quality and Usability Assessment was to ensure that the conclusions and recommendations presented for the RI are supported by data of known, acceptable, and documented quality (EPA, 2002a). Additional groundwater quality data collected from the GCOU RI Phase 3 monitoring wells during November 2014 were reviewed for usability by the contract laboratory program (CLP) laboratory that analyzed the samples. The approach for the data quality assessment is summarized below.

Data collected by EPA:

- Quantitatively assess the quality and usability of analytical data generated for the RI; and
- Qualitatively assess the quality and usability of other records and observations documented during the RI field activities.

Data collected by others:

- Qualitatively assess if the QA activities associated with the collection of data by others would result in acceptable data, in terms of the DQOs for the GCOU RI.

The Data Quality and Usability Assessment (Appendix D) shows that the analytical results used to evaluate the nature and extent of the Cr6 groundwater contamination meet the DQOs developed for the RI, and that the environmental data are of sufficient quality to support the conclusions and recommendations of this report.

4.0 PHYSICAL CHARACTERISTICS OF THE GLENDALE CHROMIUM OPERABLE UNIT

This section summarizes the physical characteristics of the GCOU study area that are relevant to development of a hydrogeologic CSM for chromium distribution, fate, transport, and potential threat to human health and ecological receptors.

4.1. SURFACE FEATURES

Surface features present in the eastern SFV, including the GCOU study area, are shown on Figure 2-1.

The surface (physiographic) features of the SFV in the GCOU study area include (JMM, 1992a):

- Los Angeles River Narrows: a topographically constricted portion of the southeastern SFV where the Los Angeles River flows southward between the Santa Monica Mountains and Elysian Hills to the southwest and west, and the San Rafael and Repetto Hills to the east. The City of Glendale and the Atwater Village neighborhood of the City of Los Angeles occupy the Los Angeles River Narrows. The Los Angeles River Narrows is the dominant physiographic feature in the southern portion of the GCOU study area, and is also the topographically lowest area of the GCOU and SFV, with land surface elevations ranging from approximately 380 feet amsl in the Los Angeles River bed in the southern part of the Los Angeles River Narrows, to 480 feet amsl at the foot of the Repetto Hills on the eastern margin of the SFV.
- Burbank Piedmont Slope: a southwest-sloping surface along the eastern margin of the SFV, formed by coalescing alluvial fan deposits at the base of the Verdugo Mountains, located in the northeast part of the GCOU study area. The Burbank Piedmont Slope ranges in elevation from approximately 480 feet amsl adjacent to the Los Angeles River near the northern approach to the Los Angeles River Narrows, to 800 feet amsl at the base of the Verdugo Mountains along the eastern margin of the SFV.
- Van Nuys Plain: a relatively flat area comprising the east-central SFV floor, drained by the Los Angeles River and several of its tributaries, present in the western part of the GCOU. Surface elevations of the Van Nuys Plain range from approximately 480 feet amsl adjacent the Los Angeles River bed near the northern approach to the Los Angeles River Narrows, to 640 feet amsl at the western margin of the GCOU study area.

4.2. METEOROLOGY

The climate in the SFV ranges from subtropical to semiarid with moderate temperatures that infrequently drop below freezing. Annual high temperatures, which can exceed 100 degrees Fahrenheit, generally occur during the months of July through September.

Precipitation in the SFV consists almost entirely of rain (snow falls very rarely on the valley floor) and occurs mostly during the winter months (December through March). Between 1980 and 2010, rainfall ranged from 5 to 40 inches per year in the eastern SFV at the City of Burbank's Valley Pumping Plant, with average rainfall of 15.88 inches reported for the period from 1940 through 2013 (ULARA Watermaster, 2014). The Valley Pumping Plant rain gauge is located approximately 0.5-mile south of the Burbank-Bob Hope Airport in the northern part of the GCOU study area.

4.3. SURFACE WATER HYDROLOGY

The Los Angeles River is the primary surface water body in the San Fernando Basin. The principal tributaries to the Los Angeles River in the eastern SFV are shown on Figure 2-1 and include:

- Pacoima and Tujunga Washes, both of which drain part of the western San Gabriel Mountains and the eastern SFV. Surface flows in the Pacoima Wash are diverted to the Tujunga Wash via the Pacoima Diversion Channel in the north-central SFV. The Tujunga Wash discharges to the Los Angeles River approximately 2 miles west (upstream) from the GCOU study area, in Studio City, California.
- Verdugo Wash, which drains portions of the Verdugo Hills and the La Crescenta Valley in Area 3, then flows westward through Glendale to its confluence with the Los Angeles River within the GCOU study area.
- The Arroyo Seco, which drains part of the west-central San Gabriel Mountains and the eastern margin of the SFV in the Eagle Rock sub-basin vicinity.
- Burbank Western Channel (also known as Burbank Wash), which drains the downtown Burbank area and discharges to the Los Angeles River just upstream from where the Los Angeles River turns southward in the GCOU study area.

The Los Angeles River is an effluent-dominated water body, particularly in the GCOU study area. Approximately 70 percent of its flow derives from Tillman Water Reclamation Plant, which discharges treated effluent to the Los Angeles River in the western SFV. Within the GCOU study area, the Burbank Western Channel, which receives discharge from the Burbank Water Reclamation Plant and other urban runoff/discharges, and the Verdugo wash, are the main tributaries of the Los Angeles River. Additionally, the Los Angeles-Glendale Water Reclamation Plant discharges treated effluent to the Los Angeles River about 0.25-mile north of the GSOU extraction wells (USACE, 2013a).

Much of the Los Angeles River is lined with concrete, but there are several reaches within the GCOU study area that are unlined, allowing potential surface-water/groundwater interaction. Of note are the unlined portions of the river through the Los Angeles River Narrows adjacent to the GNOU and GSOU extraction wells (Figure 2-1).

The SFV RI Report (JMM, 1992a) noted that the amount and occurrence of groundwater discharge to the Los Angeles River (referred to as “rising groundwater”) depends on the elevation of the water table relative to the elevation of the bottom of the river channel. Higher groundwater elevations, which can result from increased groundwater recharge or a decrease in pumping from nearby wells, increase the discharge to the river. The ULARA Watermaster estimated discharges to the Los Angeles River consisting of rising groundwater during the period from 2001 through 2012 to be 3,257 acre-feet per year (AF/yr) at a stream gauge located where the Los Angeles River exits the SFV (ULARA Watermaster, 2014).

EPA performed a preliminary evaluation to assess the potential for groundwater discharge to the Los Angeles River within Area 2 considering recent groundwater levels (CH2M HILL, 2014). The evaluation compared measured values of groundwater elevations to the elevation of the Los Angeles River bottom (invert), and concluded that groundwater elevations are potentially higher than invert elevations in the vicinity of and downgradient of the GSOU extraction wells. Samples of surface water obtained from the Los Angeles River in the vicinity of GS-1 in December 2011 by the GRG indicated the presence of low concentrations of PCE (0.54 – 1.3 µg/L) and CrT (1.0J to 1.1J µg/L); TCE and Cr6 were not detected (ERM, 2012c). Depth-discrete groundwater samples from GS-1 (non-pumping) collected during the same

time period indicated the presence of PCE and TCE at concentrations up to 6.9 and 110 µg/L, respectively; Cr6 and CrT were not detected (ERM, 2012b).

Although access to the Los Angeles River by the public is generally restricted along most of its length, kayak tours are currently allowed on a limited, controlled basis, and trespassing in the Los Angeles River bed occurs, especially in the unlined reaches within the GCOU study area. According to the Los Angeles River Revitalization Master Plan (City of Los Angeles, 2007), the reach of the Los Angeles River near its confluence with Verdugo Wash in the GCOU study area is considered an "opportunity area" where modifications to the channel and floodplain are under consideration for improved habitat and recreational opportunities. Modifications may include:

- Realignment of the river;
- Creation of a greenbelt;
- Creation of wetlands;
- Creation of river access for people;
- Creation of parkland; and
- Creation of trails.

Several of these modifications, if implemented, have the potential to increase direct contact with the Los Angeles River by the public and by wildlife.

4.4. GEOLOGY

4.4.1. Regional Geology

Details of the stratigraphy and structural geology of the San Fernando Basin, including the GCOU study area, are described in the Basinwide RI Report (JMM, 1992a) and are not repeated here; key points include:

- The tectonic events that formed the Transverse Ranges and began filling the intervening valleys with sediment in the Los Angeles area, including the San Fernando Basin, began about 3.5 million years ago and continue today;
- The mountains surrounding the SFV consist of folded sedimentary rocks (i.e. Santa Monica and Santa Susana Mountains, Simi Hills) and uplifted basement-complex rocks in fault blocks (i.e. San Gabriel and Verdugo Mountains). The basement complex consists of Cretaceous and older igneous-intrusive and metamorphic crystalline rocks; and
- Erosion of the surrounding mountains has filled the San Fernando Basin with sediments to a thickness up to 2,000 feet. The sediments along the margins of the SFV have been deposited as alluvial fans, wash deposits, and reworked river sediments of varying size and gradient. Small alluvial fans and relatively fine-grained deposits occur in the western SFV as a result of the gentler topography and the types of sedimentary rocks present in the western Santa Monica and Santa Susana Mountains. The high elevations and erosion of basement-complex rocks in the San Gabriel and Verdugo Mountains have resulted in deposition of coarser-grained alluvial deposits in the eastern SFV.

The basin-fill deposits comprising the primary aquifer in the eastern SFV and, in particular, the GCOU study area, consists chiefly of alluvial sediments eroded from the Verdugo Mountains, the western San Gabriel Mountains, and, to a lesser degree, the eastern Santa Monica Mountains and San Rafael Hills (JMM, 1992a). The basement complex in the San Gabriel and Verdugo Mountains and the San Rafael Hills include gneissic diorite and granitic rocks of undetermined age (Mesozoic or older), with some ultramafic rocks (gabbro) and anorthosite in the westernmost San Gabriel Mountains.

The eastern Santa Monica Mountains (adjacent to the GCOU) consist of:

- Mesozoic or older granitic rocks with small outcrops of metamorphic rocks;
- Jurassic black slate of the Santa Monica Formation;
- Miocene basaltic rocks; and
- Miocene to Pleistocene marine sedimentary rocks, including shale, sandstone, and conglomerate.

4.4.2. GCOU Study Area Geology

The geology of the GCOU study area described in this section is based on review of prior reports and geologic interpretations from the RI boring logs, municipal well logs, facility investigation boring logs, and oil well geologic and geophysical logs made available by the ULARA Watermaster. The GCOU RI boring lithologic logs are provided in Appendix A; the other logs used in the GCOU geologic interpretations were included in previous reports.

The basin-fill deposits in the GCOU study area consist of poorly consolidated sands and gravels with local and discontinuous intervals of fine-grained material (silt and clay). The thickness of the basin-fill deposits in the GCOU study area generally is greatest in the east-central portion of the San Fernando Basin, thinning toward the margins and in the Los Angeles River Narrows. The estimated thickness of the alluvium is 800 feet in the western part of the GCOU study area and approximately 200 feet in the Los Angeles River Narrows (JMM, 1992a). Investigations currently being conducted by the ULARA Watermaster suggest that some of the basin-fill deposits described as older alluvium in the SFV Basinwide RI report (JMM, 1992a) may instead comprise poorly consolidated sandstone and conglomerate of the Saugus Formation or its stratigraphic equivalent (ULARA Watermaster, 2014). Offset along the Benedict Canyon Fault causes a notable thinning of the basin-fill deposits from north to south in the area where the Los Angeles River turns southward into the Los Angeles River Narrows (JMM, 1992a). The Los Angeles River Narrows is generally defined as beginning south of the Verdugo Wash where the basin thins between the Repetto Hills (to the east) and the Elysian Hills (to the west), while the lower reach of the ULARA watershed is near the junction of the Los Angeles River and Arroyo Seco (ULARA Watermaster, 2014).

Lithologic and geophysical data obtained from most wells drilled during the GCOU RI are limited to depths ranging from 35 to 120 feet bgs (to 200 feet bgs at one well). The lithology encountered at these depths was primarily poorly graded sand, well graded sand, and silty sand with generally thinner interbeds of gravel, silt, and clay, likely consisting of the younger and older alluvium units described in the SFV Basinwide RI report (JMM, 1992a). Based on field observations recorded during installation of the GCOU RI groundwater monitoring wells, sediments tend to coarsen in the southern portion of the GCOU study area toward the Los Angeles River Narrows.

Cross-sections were developed to assist in evaluation of the GCOU study area geology, which has been interpreted to the extent practicable, given the relatively large distance between available geologic logs outside the core plume area. Cross-sections were developed along longitudinal and lateral lines (generally parallel to and perpendicular to the groundwater flow direction), as indexed on Figure 4-3, and are provided on Figures 4-4 through 4-8. The intent of the cross-sections is to provide a general conceptual model of the types and distribution of sediments in the study area. These cross-sections also include the Cr6 concentrations in groundwater to support the nature and extent evaluation, as further described in Section 5.3.

4.5. HYDROGEOLOGY

The aquifer underlying the GCOU study area is part of the San Fernando Basin aquifer system; therefore, hydrogeologic conditions in the GCOU study area are affected directly by groundwater occurrence and flow in the San Fernando Basin. This section describes regional hydrogeologic conditions in the San Fernando Basin first, followed by discussion of hydrogeologic conditions specific to the GCOU study area.

4.5.1. Regional Hydrogeologic Setting

Groundwater in the eastern San Fernando Basin occurs primarily in the Quaternary basin-fill (alluvial) deposits. As noted by the ULARA Watermaster (2014), "A groundwater basin could be considered to typically represent an area underlain by permeable sediments capable of storing and yielding a substantial supply of groundwater to water-supply wells… For the four ULARA groundwater basins (San Fernando, Sylmar, Verdugo, and Eagle Rock Basins), the potentially water-bearing sediments are comprised by various young and old alluvial fan-type deposits." The hydrogeologic properties of the bedrock surrounding the basin were described by the ULARA Watermaster (2014) as follows:

> "Exposed at ground surface in all of the topographically-elevated hill and mountain watershed areas of ULARA, and also known to directly underlie all potentially water-bearing sediments beneath the four ULARA groundwater basins, are geologically older sedimentary rocks (i.e., sedimentary bedrock) and even older crystalline, metamorphic and igneous rocks (i.e., crystalline basement rock). These geologically older rocks are either well-lithified, cemented and/or crystalline in nature, and as such, they are considered to display only secondary porosity; their permeability is low to very low. Because of their lithified and/or cemented and/or crystalline character, these rocks do not contain water in the interstices between the individual sand or gravel grains (as occurs in the potentially water-bearing deposits), but rather the groundwater is contained solely within fractures, joints, and/or along bedding planes in the rocks. Hence, the groundwater storage capacity of these rocks is low and their long-term sustained yield is unpredictable; as a result, only limited quantities of water can be yielded to wells. For these reasons, these rocks are classified as nonwater-bearing for municipal-supply purposes in ULARA, and none of these older sedimentary or crystalline rocks are considered to be part of the four groundwater basins within ULARA."

Water-bearing formations in the eastern San Fernando Basin as described in the SFV Basinwide RI report (JMM, 1992a), from youngest to oldest, include:

- **Younger alluvium**—Unconsolidated sand, gravel, and clay of Holocene age, up to 250 feet thick;

- **Older alluvium**—Unconsolidated to poorly consolidated gravel, sand, silt and clay of late Pleistocene age, up to 2,000 feet thick (but generally less than 500 feet thick in the eastern San Fernando Basin); and
- **Saugus Formation**—poorly consolidated conglomerate, sand, silt, and clay of early Pleistocene age, up to 6,400 feet thick. This unit, or its stratigraphic equivalent, underlies older alluvium in the northeastern SFV and possibly extends southward into the GCOU study area. Due to its degree of consolidation and depth, it is thought to produce limited quantities of groundwater to wells in the eastern San Fernando Basin, and is of marginal significance for understanding chromium transport in the GCOU study area.

The younger alluvium in the eastern San Fernando Basin is likely the most permeable of the basin-fill deposits within the basin, created by coalescing alluvial fans at the base of the San Gabriel and Verdugo Mountains (which are composed of crystalline basement-complex rocks), and consisting of boulders, coarse gravels, sand, and relatively smaller amounts of silt and clay (JMM, 1992a). The basin-fill deposits in the western San Fernando Basin are derived primarily from sedimentary rocks of the Santa Monica Mountains, Santa Susana Mountains, and Simi Hills and contain 75 percent clay, whereas the alluvial basin-fill deposits in the east contain approximately 20 percent clay (State Water Rights Board Referee, 1962) and, therefore, are typically more permeable.

The Basinwide RI Report (JMM, 1992a) included a description of the alluvial basin-fill deposits of the eastern San Fernando Basin developed from the electric and geologic logs of 15 deep cluster well test holes. The 1992 RI report described four distinct lithologic/aquifer zones as follows:

- The Upper Zone, which occurs between the present ground surface and 200 to 250 feet bgs, is 200 to 350 feet in thickness and is composed of variable alluvium;
- The Middle Zone, which occurs between 200 to 250 feet bgs, averages 50 feet thick and is characterized by relatively abundant fine-grained sand and silt;
- The Lower Zone, which occurs between approximately 250 and 550 feet bgs is approximately 250 to 300 feet in thickness and is characterized by coarse sand and gravel horizons; and
- The Deep Zone, which occurs to a depth of at least 1,200 feet bgs with an unknown thickness and is composed of fine to coarse alluvium, some of which may be correlative with the Saugus Formation.

A recent review by EPA of over 100 electric and geologic logs across the eastern SFV basin found limited evidence to support the existence of a continuous “middle zone” as described in the 1992 RI report. Most significantly, there does not appear to be evidence for extensive and continuous fine-grained layers that would significantly impede vertical migration of contaminants (low-permeability layers of limited extent have been identified at two sites within the GCOU, as described in Section 4.5.2.1). Additionally, 1992 RI zone descriptions are not applicable to the Los Angeles River Narrows area, which consists of relatively thin, generally coarse reworked alluvium overlying bedrock which occurs at 200 to 300 feet bgs.

Three faults or fault zones have been identified as potentially affecting groundwater flow patterns in the eastern San Fernando Basin, including in or near the GCOU study area. In the alluvial-fill deposits of the San Fernando Basin, these faults, including the Verdugo, the Benedict Canyon, and the Raymond faults (Figure 2-1) tend to create zones of lower permeability or contrasting permeability that impede

groundwater flow. Increases in hydraulic gradient and drawdown at extraction or pumping wells are the usual indicators of impediments to groundwater flow observed near these faults, where present.

Depths to groundwater measured recently (2013 and 2014) at monitoring wells in the eastern San Fernando Basin range from approximately 15 feet bgs to over 300 feet bgs, with typical depths at about 120 feet bgs and increasingly shallow towards and in the Los Angeles River Narrows (Table 4-1) . As further described in Section 4.5.2.3, groundwater levels at SFV RI monitoring wells have declined by approximately 30 feet since the mid-1990s as a result of several factors, including (ULARA, 2014):

- Large-scale groundwater withdrawals;
- Below-average precipitation during the past decade; and
- A significant reduction in the amount of groundwater recharged through spreading facilities.

Groundwater elevation contours for the SFV Superfund Sites, estimated using 2014 water level measurements and the locations of active production wells and extraction wells, are shown on Figure 4-1. Groundwater flow in the San Fernando Basin is generally from northwest to southeast toward the Los Angeles River Narrows, where essentially all groundwater and surface water outflow from the San Fernando Basin occurs. Localized deviations to this pattern occur near pumping wells at several locations in the GCOU study area, and a large cone of depression occurs around the BOU extraction well field (Figure 4-1). Horizontal hydraulic gradients are generally highest in the northeast along the base of the Verdugo Mountains.

The following is a summary of aquifer properties developed from pumping tests performed in Areas 1 and 2 of the SFV:

- According to aquifer tests conducted during the SFV RI in Areas 1 and 2, hydraulic conductivities in the Upper Zone range from about 30 to 360 feet per day (ft/day) or 1.1x10-2 to 12.9x10-2 centimeters per second (cm/sec) (JMM, 1992a);
- Hydraulic conductivities below 300 feet have been estimated to range from 130 to 900 ft/day. Most of the groundwater pumped from existing and former municipal water-supply production wells in the eastern SFV (mostly Area 1) is or was pumped from the highly productive coarse-grained deposits below 300 depths bgs; and
- The ULARA Watermaster estimates groundwater flow velocities in the eastern San Fernando Basin to range from approximately 300 to 1,300 feet per year (ft/year), depending on location, and generally are highest in the Los Angeles River Narrows area (ULARA Watermaster, 2014).

Based on historical groundwater data (JMM, 1992a), the natural pattern of vertical hydraulic gradients in the San Fernando Basin is:

- Downward along the northern and eastward margins of the SFV (base of Santa Susana, San Gabriel, and Verdugo mountains), where most of the natural recharge to the basin occurs;
- Upward in the southeast portion of the SFV approaching the Los Angeles River Narrows, where most of the natural discharge from the basin occurs; and
- Neutral (no appreciable upward or downward gradient) through the Los Angeles River Narrows.

Vertical hydraulic gradients have increased in some areas of the San Fernando Basin, and decreased in others, as a result of large-scale groundwater-supply pumping and artificial recharge in the northeastern and east-central portions of the San Fernando Basin (north of the GCOU study area). Recharge from irrigation return flows from lawns, parks, golf courses, and other irrigated land uses, as well as leaks from water and sewer lines, likely also has modified the vertical hydraulic gradients in the basin. Finally, fluctuations in groundwater levels resulting from periods of intensive groundwater withdrawals during multi-year droughts, followed by "wet" years with abundant natural and artificial recharge, can have a significant effect on vertical gradients in the basin, again mostly in the northeastern and east-central portions of the San Fernando Basin.

4.5.2. Hydrogeologic Conditions in the GCOU Study Area

Hydrogeologic conditions that affect fate and transport of chromium in groundwater of the GCOU study area include hydrostratigraphy, hydraulic gradients and flow velocities, and general groundwater chemistry. The following figures and tables provide supporting information and data for the discussion that follows:

- Figure 2-1 shows the location of selected physical features of the SFV and San Fernando Basin, including faults and mountain ranges;
- Figure 3-2 shows the location of the GCOU RI monitoring wells and other wells in the GCOU study area;
- Figure 4-1 shows groundwater elevation contours for the eastern San Fernando Basin in April 2014.
- Figure 4-2 shows groundwater contours for the GCOU study area in April 2014;
- Figure 4-3 shows the locations for hydrogeologic cross sections provided on Figures 4-4 through 4-8, which illustrate subsurface conditions and Cr6 concentrations in the GCOU study area;
- Table 4-1 summarizes the groundwater levels measured during the GCOU RI;
- Table 4-2 summarizes the general chemistry analytical results reported for groundwater samples obtained during the GCOU RI; and
- Table 4-3 provides the field parameters measured for groundwater samples obtained during the GCOU RI.

Appendix E provides groundwater-level and chemical hydrographs for selected monitoring wells in the GCOU study areas that have extensive historical data. Appendix F includes Stiff diagrams used to evaluate groundwater quality at the EPA GCOU RI monitoring wells.

4.5.2.1. Hydrostratigraphy

Consistent with the remainder of the San Fernando Basin, groundwater in the GCOU study area occurs in alluvial basin-fill deposits consisting chiefly of poorly to unconsolidated sands and gravels with local and discontinuous intervals of silt and clay. As is discussed in more detail in Section 5, nearly all of the detections of CrT and Cr6 in groundwater exceeding the state MCL in the GCOU study area occur within the upper 100 feet of the saturated zone; therefore, the GCOU RI data collection and evaluation efforts focused on this depth interval. Figure 4-3 shows the locations for hydrogeologic cross sections provided on Figures 4-4 through 4-8, which illustrate the general subsurface conditions in the GCOU study area.

The cross sections illustrate the lithology encountered in the upper 200 feet of the saturated zone during drilling of monitoring and extraction wells. The alluvial deposits in the vicinity of the GNOU and GSOU extraction wells consist primarily of sand or a mixture of sand, silt, and clay. Coarser-grained deposits containing gravel, and finer-grained deposits consisting primarily of silt and clay, were also encountered, but appear to be discontinuous over distances greater than a few hundred feet. The gravel deposits observed in the vicinity of the extraction wells tend to be thicker (typically 20-40 feet) than the fine-grained layers (typically 10 to 20 feet).

In most of the eastern San Fernando Basin, including the GCOU study area, continuous fine-grained layers that impede vertical flow of groundwater have not been reported by investigators. However, locally along the eastern margin of the basin, near the boundary of the Cities of Burbank and Glendale, a laterally continuous fine-grained unit occurs above the regional water table, creating a perched water bearing zone below two chromium source facilities:

- At the former Menasco Aerospace facility, the perched zone appears to be continuous, has a saturated thickness of 5 to 15 feet, and consists primarily of silty to clayey sand with low hydraulic conductivity (Amec Foster Wheeler Environment & Infrastructure, Inc. [Amec], 2014).
- At the former ITT Aerospace Controls facility, the fine-grained unit that creates the perched groundwater condition is 5 to 20 feet thick and occurs at a depth of 45 to 55 feet bgs, creating a perched zone with saturated thickness ranging from 0 to 15 feet (Geosyntec, 2012).

Groundwater data from known perched zones were not used in the development of contaminant distribution maps in this report because the current hydraulic connection with the regional groundwater was not assessed as part this RI. For the purposes of differentiating groundwater elevations and the distribution of contaminants with respect to depth in the GCOU study area, EPA designated wells screened within 50 feet of the water table as “Shallow Zone” wells, and wells screened deeper than 50 feet below the water table as “Deep Zone” or “Deeper Zone” wells. These informal well-depth designations should not be confused with the 1992 RI designations of the Upper, Middle, Lower, and Deep Zones.

4.5.2.2. Groundwater Flow Directions and Gradients

Groundwater level measurements recorded during the GCOU RI are provided in Table 4-1. April 2014 groundwater elevation contours for the GCOU are shown on Figure 4-2. Groundwater level data obtained by EPA and other parties were considered when preparing Figure 4-2. The measured elevations represent the uppermost saturated interval (excluding perched-zone wells) in the San Fernando Basin.

Groundwater generally flows southeastward north of the GNOU well field, then southward through the Los Angeles River Narrows area. Observations based on review of the groundwater elevation contour map (Figure 4-2) include:

- Horizontal hydraulic gradients range from approximately 0.001-foot per feet (ft/ft) in the northeast to 0.006 ft/ft in the east-central part of the GCOU study area. The average gradient throughout the GCOU study area is approximately 0.003 ft/ft.
- Slight decreases in the horizontal hydraulic gradient, as indicated by increased spacing between groundwater elevation contours, occur downgradient of the GNOU and GSOU extraction wells. This flattening of the gradient is largely due to groundwater extractions from these wells.

- The flattening of the hydraulic gradient in the northeast portion of the GCOU study area is largely caused by operation of the BOU extraction wells to the north.
- Except near water-supply and extraction wells, vertical hydraulic gradients in the GCOU study area are generally much smaller than horizontal hydraulic gradients. Consequently, upward or downward migration of dissolved Cr6 and CrT appears to be minor compared to horizontal transport.

4.5.2.3. Groundwater Level Trends

Hydrographs were generated for five existing SFV RI Basinwide cluster monitoring wells (closely spaced wells that monitor different depth intervals at a single location) with groundwater level records dating back to the early 1990s (Appendix E). These cluster wells (NH-C06, NH-VPB-14/NH-C04, CS-VPB-04/ CS-C04, CS-VPB-06/CS-C06, and PO-VPB-02/PO-C01) are distributed spatially to cover much of the GCOU study area; locations for these wells are shown on Figure 3-2. A comparison of the hydrographs in Appendix E (Figures E-1 through E-5) shows that groundwater elevations historically have fluctuated up to 30 feet at a given well since the early 1990s, and water level fluctuations are variable across the GCOU. Observations based on review of the hydrographs are provided below:

- Larger groundwater level fluctuations are observed in the north and west portions of the GCOU study area compared to the south and east. The larger fluctuations to the north and west are likely the result of higher groundwater production in Area 1.
- Hydrographs for wells NH-C04-375 and NH-C04-560 (Figure E-2) show significant pumping influence on groundwater levels from approximately 1992 through 2000. Data presented by the ULARA Watermaster (2014) indicates that both pumping from the LADWP well fields and artificial recharge at their spreading grounds in the SFV have a significant influence on groundwater levels in eastern part of the San Fernando Basin.
- During periods of limited groundwater withdrawals, individual wells at a given well cluster do not show substantial differences in groundwater elevation, suggesting an absence of strong vertical hydraulic gradients. Since 2010, most of the cluster wells show a slight upward vertical hydraulic gradient, on average; however, the NH-C06 well cluster has generally exhibited a downward vertical gradient in recent years (Figure E-1).

4.5.2.4. Hydraulic Properties and Groundwater Flow Velocity

The ability of an unconfined (water-table) aquifer, as occurs in the GCOU study area, to store and transmit groundwater is determined chiefly by its specific yield or storativity, saturated thickness, and hydraulic conductivity (often referred to informally as permeability). The product of aquifer thickness and hydraulic conductivity, referred to as transmissivity, can be estimated using pumping tests and is a common measure of the ability of an aquifer to yield groundwater to wells. The average velocity of groundwater flow is generally assumed to be the product of hydraulic conductivity and hydraulic gradient, divided by the effective porosity.

Exhibit 4-1 summarizes the hydraulic properties for the aquifer underlying the GCOU study area based on pumping tests performed at the GNOU and GSOU extraction wells in 2012 (ERM, 2012b). Transmissivity is estimated to range from 19,430 to 89,270 square feet per day (ft^2/day) at the GNOU extraction wells, and 29,180 to 48,000 ft^2/day at the GSOU extraction wells. Based on the transmissivity and assuming the interval between the water table and the bottom of the pumping well screen as the saturated thickness, the average hydraulic conductivity near the GSOU extraction wells is approximately

305 ft/day (0.12 cm/sec). Hydraulic conductivity estimates near the GNOU extraction wells are slightly more variable and average 370 ft/day (0.13 cm/sec).

The vertical hydraulic conductivity of the aquifer in the GCOU study area was not evaluated as part of the GCOU RI. The ratio of horizontal to vertical hydraulic conductivity, also referred to as the anisotropy ratio, usually falls between 2 and 10 for alluvial deposits, but values up to 100 or more can occur where fine-grained layers are present (Todd, 1980).

Using hydraulic properties estimated from the 2012 pumping tests, hydraulic gradients estimated from the groundwater levels measured during the GCOU RI, and assuming effective porosity of 15 percent, groundwater flow velocity is estimated to range from 680 to 2,920 ft/year near the GNOU extraction well field, and 1,460 to 2,250 ft/year near the GNOU/GSOU extraction well field.

EXHIBIT 4-1 Summary of Hydraulic Properties Estimated From 2012 Pumping Tests for Glendale North and South Extraction Wells

Extraction Well	Screen Interval (feet bgs)	Saturated Thickness[1] (feet)	Transmissivity[2] (ft^2/day)	Hydraulic Conductivity[3] (ft/day)	Storativity[2]	Specific Yield[2]
GN-1	80 – 136 146 – 185	150	65,120 – 89,270	430 – 600	$1.41x10^{-3}$ - $2.57x10^{-3}$	0.167 – 0.214
GN-3	75 – 175	140	19,430 – 83,270	140 – 590	$8.86x10^{-4}$ - $8.86x10^{-2}$	0.116 – 0.184
GS-1	51 – 146	120	29,180 – 39,160	240 – 330	$7x10^{-4}$ – $6x10^{-3}$	0.18
GS-3	84 – 174	130	39,400 – 48,000	300 – 370	$2x10^{-4}$ – $9x10^{-3}$	0.18

Notes:

Data in this table obtained from ERM, 2012a.

ft^2/day – square feet per day

[1] "Saturated thickness" was defined by ERM (2012b) as the interval between the water table and the total depth of the well screen, for the purpose of estimating hydraulic properties.

[2] Transmissivity, storativity, and specific yield ranges as reported in Tables 10 and 11 of the Final Site Characterization Technical Memorandum (ERM, 2012b) are estimated from pumping tests performed in 2012.

[3] Hydraulic conductivity is calculated by dividing transmissivity by the saturated thickness. The hydraulic conductivity values reported in Exhibit 4-1 differ from those presented in Tables 10 and 11 of the Final Site Characterization Technical Memorandum (ERM, 2012b) due to differing methods for estimating the saturated thickness.

4.5.2.5. General Groundwater Chemistry

Groundwater samples collected by EPA during the RI field work were analyzed for metals, common anions, and routine field-measured groundwater quality parameters (field parameters) to evaluate the general groundwater chemistry in the GCOU study area. The occurrence of nitrate, which is included in the list of general chemistry parameters below, is discussed in more detail in Section 5.

The general chemistry may be useful in evaluating potential groundwater treatment remedies and chromium migration in the future, and to provide data for evaluating overall groundwater quality. Table 4-2 summarizes the general chemistry of groundwater samples obtained from monitoring wells in the GCOU study area during the GCOU RI. Table 4-2 includes EPA and California primary and secondary MCLs for the general chemistry analytes. Except for CrT and nitrate, no exceedances of primary MCLs were detected in these samples. Sample results from some of the new monitoring wells exceeded secondary MCLs for iron, manganese, sulfate, and TDS. Secondary MCLs are not risk-based standards

and are generally in place to protect the aesthetics of drinking water, including taste, odor, and appearance.

Field parameters measured during groundwater sample collection can be used to characterize general groundwater quality. Table 4-3 provides a summary of the field parameters measured during collection of groundwater samples. General observations based on the field parameters are listed below:

- Groundwater samples obtained during the GCOU RI exhibit a neutral pH with an average pH of 7.1;
- Dissolved oxygen (DO) measurements averaged 4.9 mg/L, indicating a slightly oxidizing environment; and
- Oxidation-reduction potential (ORP) averaged 85.1 millivolts, which is consistent with a slightly oxidizing environment.

Stiff diagrams were prepared for selected Area 2 monitoring wells to evaluate potential differences in general chemistry across the GCOU. Stiff diagrams are plots of the concentrations (expressed in milli-equivalents per liter) of the major anions and cations in groundwater, and can be used to visually assess differences in the major-ion chemistry of groundwater samples. The relative width of the Stiff diagram graph along its horizontal axis is proportional to the TDS content of the sample; higher TDS contents result in wider plots. Stiff diagrams are presented in Appendix F. Observations based on review of the Stiff diagrams are provided below:

- Calcium is the dominant cation in all groundwater samples; groundwater at the majority of monitoring wells is of the calcium bicarbonate water type; and
- Groundwater sample results from new monitoring well CS-C38-051 contained twice the TDS levels compared to most other wells (note the increased scale on the Stiff diagram for CS-C38-051). This monitoring well exhibits calcium-sulfate groundwater, rather than the more typical calcium-bicarbonate type. Well CS-C38-051 is located approximately 150 feet west of the Los Angeles River and is screened across the water table; therefore, the sample from this well may have been influenced by the chemistry of surface water in the Los Angeles River, which is dominated by treated wastewater.

Nearly all of the new GCOU RI monitoring wells (29 of 31) installed by EPA and the GCOU Respondents are screened across the water table; therefore, limited data were collected during the GCOU RI to provide insight into vertical differences in groundwater quality. Review of the Stiff diagrams suggests there is no significant differences in general groundwater chemistry in shallow groundwater across most of the GCOU.

4.6. Population and Land Use

The GCOU study area includes the southern part of the City of Burbank, the western part of the City of Glendale, and the Atwater Village neighborhood of the City of Los Angeles. Municipal boundaries within the study area are shown on Figure 2-2. The demographic data for the portions of Burbank, Glendale, and Atwater Village that are located in the SFV are summarized in Exhibit 4-2.

EXHIBIT 4-2 Demographics Summary for GCOU Study Area

City	Population[1]	Population Density[1] (people per square mile)
Burbank[2]	103,340	6,622
Glendale[2]	191,417	6,781
Atwater Village neighborhood of Los Angeles[3]	15,455	8,379

Notes:

[1] Statistics provided are for the portions of these Cities in the SFV (all of Burbank, and portions of Glendale and Los Angeles).
[2] Data from 2010 United States (U.S.) Census, available online.
[3] Data from 2008 "Mapping L.A." information, provided online by the Los Angeles Times (http://maps.latimes.com/neighborhoods/neighborhood/atwater-village/).

Land uses in the GCOU include:

- Industrial;
- Residential;
- Open space and recreational (primarily Griffith Park);
- Education;
- Transportation;
- Mixed use; and
- Commercial land use.

Inspection of Figure 4-9 indicates that commercial, industrial, residential, and mixed land uses occupy most of the GCOU study area, with commercial, industrial, and mixed land uses dominant in a corridor that aligns with Interstate 5 and rail lines at the base of the Verdugo Mountains and south through the Los Angeles River Narrows.

4.7. Groundwater Use

The San Fernando Basin is a significant source of drinking water, with an estimated capacity to store 2.85 million AF of groundwater within the alluvial fill of the basin (Superior Court of the State of California for the County of Los Angeles, 1979). The Cities of Glendale, Burbank, and Los Angeles use groundwater as a source of drinking water. Historically, groundwater pumped from the San Fernando Basin aquifer has accounted for 15 to 50 percent of the local water needs. According to the ULARA Watermaster (2014), "Los Angeles, under its Pueblo Water Right, has an exclusive right to extract and utilize the entire native safe yield of the San Fernando Basin of 43,660 AF/yr." Furthermore, the Cities of Los Angeles, Burbank, and Glendale each have a right to extract the following amounts of groundwater derived from return flow of imported water from the San Fernando Basin:

- **Los Angeles:** 20.8 percent of all delivered water, including recycled water, to valley-fill lands of the San Fernando Basin (85,822 AF of annual extraction rights, including 43,660 AF of native safe yield credit, in water year [WY] 2013/2014; a water year begins on October 1 and ends September 30 the following year);

- **Burbank:** 20.0 percent of all delivered water, including recycled water, to the San Fernando Basin and its tributary hill and mountain areas (4,096 AF of annual extraction rights in WY 2013/2014); and
- **Glendale:** 20.0 percent of all delivered water, including recycled water, to the San Fernando Basin and its tributary hill and mountain areas (5,074 AF of annual extraction rights in WY 2013/2014).

Several additional smaller, private parties are granted a limited entitlement to extract groundwater chargeable to the rights of others upon payment of specified charges. Based on the ULARA Watermaster 2012-2103 water year report (2014), the only smaller, private party water users within the defined chromium plume boundaries are Home Depot (ITT Aerospace Controls) and B.F. Goodrich (Menasco/Coltec). Groundwater extraction at these sites is limited to site-specific groundwater cleanup activities at relatively low levels of pumping.

Los Angeles, Burbank, and Glendale also have a right to store groundwater in San Fernando Basin by artificial spreading or by in-lieu activities, and to extract equivalent amounts (ULARA Watermaster, 2014). Exhibit 4-3 provides a summary of long-term-average and most recent available (WY 2012/2013) groundwater operation statistics for the San Fernando Basin as reported by the ULARA Watermaster (2014).

EXHIBIT 4-3 San Fernando Basin Groundwater Operations Summary

Operation	Long-Term Average	WY 2012/2013
Spreading (recharge)	32,078 AF/yr[1]	10,782 AF
Groundwater Extractions	85,071 AF/yr[1]	73,710 AF
Net Imported Water	NR	296,847 AF[2]
Change in Groundwater Storage in Aquifer	NA	Decrease of 12,157 AF

Notes:
NR = Not reported
NA = Not applicable
[1] 1968-2013
[2] Includes all of ULARA (San Fernando, Sylmar, Verdugo, and Eagle Rock Basins)

Groundwater accounted for approximately 20 percent of the net water used in the San Fernando Basin in WY 2012/2013 (and 30 percent of the long-term average), with the remainder consisting of imported surface water from sources outside the San Fernando Basin. Disruption of imported surface water supplies, due to extended drought in the southwestern U.S. or earthquake damage to aqueducts, for example, could lead to increased use of groundwater supplies in the San Fernando Basin in the future. The imported surface water comes from the following sources:

- Los Angeles Aqueduct (eastern Sierra Nevada Mountains);
- State Water Project (western Sierra Nevada Mountains); and
- Colorado River Aqueduct (Colorado River).

The Los Angeles Aqueduct is owned and operated by LADWP. Surface water imported via the State Water Project and Colorado River Aqueduct is purchased by the Cities of Los Angeles, Glendale, and Burbank (ULARA Watermaster, 2014).

4.7.1. Glendale Area

Groundwater extractions and surface water imports within the GCOU study area by the Cities of Los Angeles, Burbank and Glendale are summarized in Exhibit 4-4 (ULARA Watermaster, 2013 and 2014). The Cities of Los Angeles and Burbank extract a relatively small quantity of groundwater from wells in the GCOU study area compared to their extractions from the remainder of the SFV or their net imports of water to the SFV. The City of Glendale, however, uses a significantly higher proportion (approximately one-fourth) of groundwater extracted from the GCOU study area for their water supply needs relative to surface water imports. Pumping from the GNOU and GSOU extraction wells comprises essentially all of the groundwater used by the City of Glendale for municipal supply, as summarized in Exhibit 4-5. Therefore, the City of Glendale is the most susceptible to potential water-quality degradation and limitations to its water supply as a result of the presence and migration of chromium in groundwater. Pumping rates from extraction wells GN-3 and GS-3 have been reduced in the past in response to rising chromium concentrations; these reductions in groundwater extraction rates may have also limited the effectiveness of containment of VOCs achieved by the GNOU and GSOU extraction well fields.

EXHIBIT 4-4 Groundwater Withdrawals in the GCOU Study Area and Surface Water Imports by the Cities of Los Angeles, Burbank, and Glendale

	Long-Term Average[1] (AF/yr)		WY 2012/2013 (AF)	
City	Groundwater Extractions from GCOU Study Area	Surface Water Imports	Groundwater Extractions from GCOU Study Area	Surface Water Imports
City of Los Angeles[2]	2,025	192,328	889	238,699
City of Burbank[3]	16	11,920	0	7,507[4]
City of Glendale	7,665	18,230	7,141	19,783[5]

Notes:

Data compiled from ULARA Watermaster Annual Reports from WY 2001/2002 through WY 2012/2013.
[1] 10-year average for WY 2001/2002 through 2011/2012.
[2] Includes groundwater extraction at Verdugo well field only, compared to net surface water imports for the entire SFV.
[3] Includes groundwater withdrawals at City of Burbank wells only (excludes BOU wells), compared to net surface water imports for the entire SFV.
[4] Excludes imported water that is recharged to groundwater at the Pacoima Spreading Grounds.
[5] Combined total of 19,195 AF of MWD imported water and 588 AF of groundwater from the Verdugo Basin.

Groundwater extraction (pumping from wells) and spreading (artificial recharge in basins) have the potential to affect the rate and direction of contaminated groundwater movement in the GCOU study area. Alternatively, extraction rates can be subject to limitations because of the presence of chromium or other contaminants. Exhibit 4-5 summarizes the recharge and pumping rates at spreading grounds (recharge basins) and water-supply well fields, respectively, within the GCOU study area, as reported by the ULARA Watermaster (2014). Other water-supply well fields in the GCOU that have been used historically, but are no longer in use, include LADWP's Headworks and Crystal Springs well fields, and the City of Glendale's Grandview well field (Figure 2-3). Although these well fields have not been used

extensively in more than two decades, past pumping from them likely influenced historical migration and capture of chromium-impacted groundwater within the GCOU study area.

EXHIBIT 4-5 Spreading Grounds and Water-Supply Well Fields in the GCOU Study Area

Spreading Ground or Well Field	Long-Term Average Recharge/Pumping Rate[1] (AF/yr)	WY 2012/2013 Recharge/Pumping Rate (AF)
Headworks Spreading Grounds (recharge)	Mostly unused since 1983, except for recharge of 396 AF (total) from 1990 through 1993	0
Verdugo Well Field (pumping)	2,025	889
City of Burbank Wells (pumping)	Mostly unused since 2001, except for pumping of 148 AF in WY 2008/2009, and pumping of 4 to 5 AF/yr in 2009-2012	0
Glendale (Grayson) Steam Plant Supply Wells (pumping)	221	35.37
GNOU Extraction Wells (pumping)	4,853	4,486
GSOU Extraction Wells (pumping)	2,587	2,655

Notes:
Data compiled from ULARA Watermaster Annual Reports from WY 2001/2002 through WY 2012/2013.
[1] 10-year average for WY 2001/2002 through 2011/2012, unless otherwise noted.

Of the well fields and spreading grounds listed in Exhibit 4-5, the GNOU and GSOU extraction well fields (installed specifically to contain and remove contaminated groundwater, as discussed in Section 4.7.2) would be expected to have the greatest potential influence on chromium migration in the GCOU study area since 2000, owing to their relatively large pumping rates and their locations within areas of elevated chromium concentrations, as discussed further in Section 5. The other well fields and spreading grounds in the GCOU study area would be expected to have a minor effect on chromium migration in the GCOU study area at present due to their small pumping rates, inactivity (in the case of the Headworks Spreading Ground), or location (relatively large distance from areas of elevated chromium concentration in groundwater). Historically, the Glendale-Grandview and City of Burbank well fields may have had a stronger influence on migration of both VOCs and chromium in groundwater, owing to their locations along the eastern margin of the GCOU study area in the high-concentration areas of the VOC and chromium plumes, as discussed in Section 5.

4.7.2. Operation of GNOU and GSOU Extraction Well Fields and Treatment System

Construction of the existing interim GNOU and GSOU remedies occurred from 1997 to 2000 and included installation of eight extraction wells (four wells each in the north and south well fields, GN-1 through GN-4 and GS-1 through GS-4), capable of producing a total of 5,000 gpm (8,070 AF/yr). Seven of the extraction wells were completed to a depth of approximately 200 feet, and one well (GN-4) was completed to a depth of approximately 400 feet (U.S. Army Corps of Engineers [USACE], 2013b). Wellhead facilities for each extraction well consist of a pump and appurtenances to discharge to the GWTP. The groundwater treatment facility consists of two single-stage packed air strippers, eight liquid-phase GAC units operated in parallel, and six vapor-phase GAC vessels (two trains of three vapor-phase GAC units operated in parallel; one train per air stripper). Groundwater from the water transmission pipelines flows directly into two single-stage packed air strippers for VOC removal. The water is collected

at the bottom of each air stripper and pumped into liquid-phase GAC vessels where residual VOCs are adsorbed. The water pumped through the liquid phase GAC units is disinfected and conveyed to the Grandview Reservoir. The off-gases from the air strippers are treated by passing them through the vapor-phase GAC vessels. As the off-gases pass through the vapor-phase GAC vessels, VOCs are adsorbed onto the GAC, and the treated air is released through discharge stacks. The interim VOC remedies began initial operation in August 2000, and all extraction wells were operational by 2002. The interim VOC remedies are operated by CDM-Smith, who is funded by the GRG and working on behalf of the City of Glendale. As noted in Section 2.2.2 of this report, the GRG, City of Glendale, and EPA are parties to a CD (and subsequent stipulated agreement) for operation of the GNOU and GSOU interim remedies through November 30, 2018.

Difficulties in addressing Cr6 have been a challenge throughout the operational history of GNOU and GSOU extraction wells and treatment system (EPA, 2008b). Although the levels of total chromium in the GWTP influent remained below the historical state MCL of 50 µg/L for CrT (prior to promulgation of a state MCL for Cr6 of 10 µg/L in July 2014), the City of Glendale operated under a “voluntary” limit of 5 µg/L on the concentration of Cr6 that it was willing to allow in drinking water served to the public (City of Glendale, 2002). The City of Glendale was able to achieve that target without interruption of operations by blending the treated water from the GWTP with water from other facilities before distribution. The GWTP operated in this mode until mid-2007, producing an effluent that averaged 10 µg/L of Cr6 before blending. In April 2007, LARWQCB changed the effluent standards for the maintenance and emergency discharges of treated water to the Los Angeles River to 8 µg/L of Cr6. In order to maintain the GWTP effluent below 8 µg/L the City began alternating pumping of wells GS-3 and GN-3, which are the two extraction wells with the highest concentrations of Cr6. Each well was alternately pumped for a 24-hour period. EPA approved the alternate pumping scheme temporarily with the condition that alternatives to modify the GWTP to meet the 8 µg/L discharge limit be developed that allow the plant to return to design pumping rates.

In response to the chromium concentrations detected at extraction wells GN-3 and GS-3, testing of two demonstration-scale Cr6-removal treatment systems occurred between 2010 and 2012 (USACE, 2013b). Details on the systems are provided in Section 2.2.2 of this report.

The demonstration studies were completed in 2012; however, operation of the WBA treatment system continued to operate at an influent rate of 425 gallons per minute (gpm) at well GS-3 until it was shut down in August 2015.

As part of a Focused Feasibility Study, the GRG conducted an assessment of emerging contaminants, including Cr6, and potential effects of these contaminants on the performance of the interim remedies performance (ERM, 2013a); the report concluded with an increasing concentration trend identified in groundwater sampled from GN-3, Cr6 will likely continue to impact GWTP operations. In late 2014, Cr6 concentrations in raw groundwater from well GS-3 stabilized at approximately 20 µg/L, while Cr6 concentrations at well GN-3 have increased over the past several years, and are currently at approximately 100 µg/L (CDM Smith, 2014).

The GRG also conducted a hydraulic containment study resulting in a Final Hydraulic Containment Technical Memorandum (ERM, 2013b) to evaluate the effectiveness of the extraction wells at intercepting groundwater contaminants in Area 2. The GRG subsequently completed a remedial design for the enhancements and submitted a Final Remedial Design Work Plan (MWH, 2014), which was approved by the EPA on November 19, 2014. The remedial design plans specify the WBA chromium-

treatment system, previously operating at GS-3, will be relocated to treat chromium in water extracted by well GN-3, so the existing remedies may continue to operate. The WBA system will be modified to accept the 600 gpm design discharge rate from well GN-3 and the forecasted Cr6 concentration. To further inhibit migration of VOCs in groundwater from the GNOU and GSOU, the enhanced remedy includes the following:

- A new extraction well (GS-5) will be added to the GSOU well array and pumped at 600 gpm;
- The pumping rate for well GS-1 will be maintained at 400 gpm, while pumping rates at well GS-2 and well GS-3 will be increased to 600 gpm;
- Pumping from well GS-4 will be reduced, because it is not considered necessary for hydraulic containment of the VOC plume in the GSOU;
- The pumping rate at well GN-3 will be increased to 600 gpm, while pumping at GS-4 will be curtailed; and
- The pumping rate in well GN-4 will be decreased, if necessary, to optimize hydraulic containment in the GNOU, while limiting total flow to the GWTP to 5,000 gpm or less.

As of the date of this report, the enhanced remedy remedial design is being implemented by the GRG under EPA oversight.

4.8. ECOLOGY

Land use in the GCOU study area is mostly residential, commercial, and industrial. Because the area is extensively developed, there are few areas with natural vegetation and habitat. However, USACE (2013a) found that the unlined areas of the Los Angeles River, including those in the GCOU study area, support degraded riparian habitat.

EPA conducted an ecological field survey for three areas of the Los Angeles River in the GCOU study area on September 24, 2014, as part of the GCOU RI field investigation. The purpose of this study was to identify, if present, potential habitat and receptors that could be exposed to Cr6 from groundwater should it discharge to the Los Angeles River. The findings are included in the SLERA in Appendix G. The area surrounding the Los Angeles River was estimated to be 10 percent urban (including roads), 55 percent residential, 10 percent light industrial, and 25 percent recreational (including Griffith Park and golf courses). All three areas of the Los Angeles River surveyed during the GCOU RI have been channelized and have concrete banks with a combination of concrete-lined and unlined bottom sections. The concrete-lined portions of the river provide minimal habitat. The earthen, unlined portions support riparian vegetation, including native and non-native mature trees; non-native species dominated the survey areas.

Vegetation observed at the survey locations included eucalyptus (*Eucalyptus* sp.), sycamore (*Platanus* sp.), giant reed (*Arundo donax*), castor bean (*Ricinus* sp.), Mexican fan palm (*Washingtonia robusta*), willow (*Salix* sp.), mule fat (*Baccharis salicifolia*), and ash (*Fraxinus* sp.). Wildlife species observed at the first survey location included: great blue heron (*Ardea herodias*), black phoebe (*Sayornis nigricans*), snowy egret (*Egretta thula*), rock dove (*Columba livia*), and mallard (*Anas platyrhynchos*). At the second survey location, mallard, black-necked stilt (*Himantopus mexicanus*), Anna's hummingbird (*Calypte anna*), and Canada goose (*Branta canadensis*) were observed. Canada goose, rock dove, great blue heron, and egrets were also recorded at the third

location. Mallard was the most common species observed, with groups ranging from 4 to 21 individuals at each location.

None of the special-status avian species that have been documented within 1 mile of the river (Appendix G) has a high probability of being present in the GCOU study area due to either a lack of suitable habitat or limited suitable habitat. However, the Los Angeles River does support a variety of species protected under the Migratory Bird Treaty Act and birds protected under California Department of Fish and Wildlife (CDFW) code. Several special-status bat species also have been recorded within 1-mile of the river; based on current species distribution information, the western yellow bat (*Lasiurus xanthinus*) and the hoary bat (*Lasiurus cinereus*) have the potential to occur in the GCOU study area. Neither of these bats is federally threatened or endangered, but the western hoary bat is listed as a species of special concern in California.

USACE (2013a) recommended restoration of areas along the Los Angeles River within the GCOU; however, this restoration is to focus on habitat improvements to recreational areas that are adjacent to the channel, with minimal effort to alter the current condition of the channel itself. This restoration is expected to increase use of the river corridor and may increase the number of potential ecological receptors at the site.

5.0 CONTAMINANT NATURE AND EXTENT

This section presents the sources, nature, and extent of Cr6 and CrT in groundwater within the GCOU study area. Additionally, the distribution and occurrence of other key COPCs for the SFV Superfund Sites are discussed in relation to chromium.

5.1. IDENTIFICATION OF POTENTIAL CHROMIUM SOURCES

As noted in Section 2.3, Exhibit 2-1, in 1999 EPA began coordinating with LARWQCB to identify potential sources of chromium contamination in SFV groundwater. LARWQCB continues to lead most of the contaminant source investigations and facility-specific remediation efforts in the SFV. In the GCOU, DTSC led the site investigation at one facility, former Dynamic Plating, Inc. In addition, EPA has assumed responsibility as the lead agency for investigation and remediation at the former All Metals Processing, Drilube Wilson, and Drilube Broadway facilities.

The general approach that EPA and LARWQCB have used to investigate chromium sources for the GCOU is discussed below. A summary of specific chromium source investigations conducted at facilities in support of the GCOU is provided in Section 5.2.1.

EPA's search for potential sources of chromium has focused on collecting data to establish whether releases (or threats of releases) of Cr6 have occurred to groundwater underlying the GCOU. Tasks performed to identify and locate sources of chromium contamination have included the following:

- Reviewing files and collecting records;
- Reviewing information on current and historical groundwater flow directions;
- Reviewing records of land use that identify areas of historical industrial or commercial activity;
- Reviewing lists of potential chromium source facilities generated by the LARWQCB with EPA support;
- Reviewing field data collected during the RI;
- Issuing information request letters; and
- Performing title searches.

In seeking to identify potential sources of contamination, the LARWQCB's investigation process initially targeted a wide range of facilities for screening to ensure the search captured all likely candidates for evaluation. The majority of facilities initially identified by the LARWQCB ultimately were determined to require no further investigation.

Contaminant source investigations overseen by the LARWQCB typically involve operating businesses or properties with identified owners or operators. LARWQCB evaluates the possibility that past or present facility operations have released COPCs. LARWQCB assesses the operations of each facility based on the practices listed below:

- Types and quantities of chemicals used;
- Types and conditions of chemical storage areas and equipment used;

- Chemical conveyance methods used; and
- Onsite waste storage, treatment, and disposal practices used.

LARWQCB investigates locations of potential chromium (or other contaminant) releases based on review of agency files and industry directories, information provided by facility owners or operators, and findings from facility inspections/interviews. LARWQCB initiates the following activities if an inspection determines that subsurface investigation is warranted.

- **Investigation of Shallow Soil Contamination**—Facility directed to complete a shallow subsurface investigation that includes sampling, analyzing soil for Cr6, and evaluating the results.
- **Investigation of Deep Soil Contamination**—Facility directed to conduct an enhanced subsurface investigation that involves sampling and analyzing Cr6 in soil at depth. The presence of Cr6 at concentrations that exceed evaluation criteria triggers further investigation, remediation, or both.
- **Investigation of Groundwater Contamination**—Facility directed to install a groundwater monitoring well (or wells) and conduct a groundwater investigation. Because many of the GCOU facilities being investigated as potential sources of chromium have already been investigated for VOCs, groundwater monitoring wells are often already present, minimizing the need for additional well installation.
- **Contaminant Source Remediation**— the facility is directed to characterize the nature and extent of the Cr6 source and evaluate the necessity and feasibility of remediating the contaminant source. The LARWQCB reviews the proposed cleanup plan and oversees the remedial activities conducted by the facility, if needed.

The LARWQCB's process to identify potential chromium source facilities began in 1998 with a broad, general review of over 4,000 case files from LARWQCB archives for sites originally evaluated as part of the VOC source identification efforts in the 1990s. The LARWQCB efforts have focused on potential chromium dischargers, based primarily on potential chromium plating and anodizing operations (and associated processes), aircraft manufacturing, and aerospace manufacturing.

The LARWQCB has overseen field investigations at nearly 130 industrial facilities within the GCOU study area as part of the chromium source identification efforts. Of these:

- Six facilities have either completed on-site Cr6 remediation or remediation is ongoing. This includes five facilities where in situ soil or groundwater remediation efforts have been used to address elevated chromium concentrations; and
- Two facilities have investigations underway or pending (as of the date of this RI report) that will help determine the likelihood that the facility contributed to Cr6 contamination in the groundwater.

5.2. Potential Sources of Chromium Contamination

Historic uses of chromium in the San Fernando Basin reportedly included:

- Corrosion control in cooling towers operated by aerospace and other manufacturers; and

- Metal finishing, pickling, anodizing, and plating operations.

These activities resulted in the release of chromium via spills, leaks, injection via "return wells," and discharges to storm drains and other surface-water bodies (ULARA Watermaster, 2003). EPA and the State of California continue to actively pursue and investigate industrial facilities as potential sources of chromium in groundwater of the SFV Superfund Sites.

Both point and non-point sources of chromium in groundwater were considered during the GCOU RI, with the primary focus on point sources. Point sources include specific facilities where releases of chromium have reached groundwater. Examples include facilities that used, stored, or discharged chromium. Non-point sources include broader areas where chromium has reached the aquifer via:

- Infiltration of contaminated surface water to groundwater along a reach of stream channel, storm drain, or sewage line, and
- Inflow of groundwater affected by upgradient chromium sources.

5.2.1. Point Sources

The EPA and LARWQCB investigations of chromium point sources have focused on industrial and commercial facilities currently and historically in operation in the GCOU study area. Facilities where metals finishing, electroplating, anodizing, and manufacturing and testing of specialty metal components occurred are the most likely point sources of Cr6 contamination and, therefore, are the primary focus of these investigative efforts. These facilities represent either potential or confirmed point sources of Cr6 contamination to GCOU groundwater. EPA and the LARWQCB continue to evaluate other potential sources of chromium contamination in the GCOU study area.

The State has led most of the investigations of suspected chromium-point-source facilities in the SFV following the approach described in Section 5.1. LARWQCB, with technical and financial support from EPA, is the state agency that provides the majority of regulatory oversight of potential chromium source facilities in the SFV. EPA has issued General Notice letters to 21 entities representing at least 14 facilities where chromium releases to groundwater are documented or under investigation (EPA, 2015). General Notice letters provide the following information:

- Informs recipient they are identified as a PRP at a Superfund site;
- Informs recipient they may be liable for cleanup costs at the site; and
- Explains the process for negotiating the cleanup with EPA.

Figure 5-1 shows the locations of 13 sites that have received General Notice Letters from EPA. The former Weber Aircraft site is within the GCOU study area; however, this site is not within the area shown on Figure 5-1.

The following is a brief description of 14 sites that have received General Notice Letters from the EPA (more details are provided on Table 5-1).

1. Former Lockheed Plant B-1 — Lockheed Martin Corporation (Lockheed) conducted parts fabrication and subassembly activities at the former Plant B-1 site between 1928 and 1991 , including tooling, parts shaping and machining, plating, deburring, cleaning, and painting (Tetra Tech, 2014b). Chemicals and materials used at the former Plant B-1 included fuels, oils, solvents, paints, acids, caustic solutions, chromic acid, boiler blowdown, and metal shavings

(Tetra Tech, 2014b). Lockheed has previously conducted soil remediation (excavation and disposal) at Plant B-1, and is currently conducting follow-up investigations to determine the potential threat to groundwater posed by remaining chromium in soil at the facility.

2. Dynamic Plating, Inc. (Dynamic Plating) — Metal plating activities were conducted at the site between 1971 and 1990, using chromium compounds, acids, bases, cyanide and VOCs. Results of a 1989 soil investigation indicated elevated concentrations of VOCs and metals. The site operations were shut down by the County due to waste stream violations in 1990. EPA conducted a TCRA in 1990-1991 with an additional removal action in 1992, primarily focusing on above-ground facilities and residual wastes. DTSC issued a limited No Further Action letter for soil that is only applicable for commercial/industrial use of the property. Additional soil cleanup may be required for any other land use.

3. J&M Anodizing Inc. (J&M Anodizing) — Metal finishing work at the site began in 1957; the facility operated continuously until 2007 and chromate compounds were likely used during operations. A series of soil investigations and remedial activities were directed by LARWQCB between 2004 and 2009, and shallow soil has been remediated. Deep soil and groundwater contamination remain (CCI, 2009).

4. Former Menasco Aerospace (Menasco) — Menasco and its successors manufactured, designed, and overhauled aircraft landing gear at the site from the 1940s until the site was closed in 1994 (LARWQCB, 2011a). Manufacturing activities included use of various coolants, lubricants, solvents, and alkaline and metal plating solutions (LARWQCB, 2011a). Past remedial activities include operation of a soil vapor extraction system, soil excavation, and groundwater extraction from the thin perched zone. Current remedial activities consist of in-situ treatment of VOCs and Cr6 via quarterly to semiannual molasses injections through multiple wells in the perched groundwater zone and one injection well completed in the regional aquifer and quarterly groundwater monitoring (Amec, 2015a and 2015b).

5. Former Technibilt Corporation (Technibilt) — Activities began at the site in 1968 and primarily consisted of manufacturing shopping carts. Processes included metal fabricating, metal finishing/plating, and assembly. Operations were discontinued in 1987 when the property was sold. A soil investigation was conducted for the property transfer and an additional soil investigation was performed in 1988 with excavation of contaminated soil. An investigation of chromium in soil was directed by LARWQCB in 2012 and has been completed.

6. Former ITT Facility (ITT) — ITT and its predecessor, General Controls, operated at the site from 1940 until 1994. Operations at the Former ITT Facility included manufacturing thermostats, pressure control instruments, valves, actuators, and switches for commercial, aerospace, and military applications (LARWQCB, 2014). Manufacturing operations at the Former ITT Facility included machining, plating, heat treating, and degreasing (Geosyntec, 2013). Home Depot purchased the property in 2004 and agreed to share responsibility with ITT for the cleanup down to approximately 55 feet bgs. Chromium remediation work involved: (i) construction of a slurry wall around the Former ITT Facility, (ii) excavation of approximately 23,000 tons of soil, and (iii) in-situ treatment of Cr6 using calcium polysulfide in soil and groundwater in the shallow

zone. A Petition for No Further Action for the remedy in the shallow zone at the Former ITT Facility is under review by the LARWQCB.

7. Former All Metals Processing (All Metals) — The former All Metals Processing facility (All Metals) operated as a metal plating facility from 1976 to 2007, specializing in cadmium, copper, nickel, zinc, black oxide, and gold plating (EPA, 2012e). EPA performed a TCRA at the site in 2007, which included demolition of the building and soil removal to depths up to 16 feet bgs (EPA, 2012e).

8. Automation Plating (Automation Plating) — Automation plating has been operating since 1952, using significant quantities of chromium, cadmium, cyanide, and zinc. Soil investigations were performed in 2005 and 2007 under LARWQCB. No cleanup activities have been conducted to date.

9. Loral Librascope, Inc. (Librascope) - Librascope, an independent principal supplier of weapons and combat control systems for tactical shipboard applications, tactical communications terminals, and equipment for army field communications, operated from 1949 to 1997. Manufacturing at Librascope involved the production of printed circuit boards, metal fabrication, and metal finishing. Soil and groundwater investigations and a soil removal action have been conducted at this site (Tetra Tech, 2010, 2014a, 2014b).

10. PRC DeSoto International/ Former Courtaulds Aerospace (PRC-DeSoto) — PRC-DeSoto manufactured metal products, gaskets, and sealants for the aerospace industry at the site from 1946 to 2008 Manufacturing activities included use of lead curing compounds (lead dioxide) and chromic acid (Stantec, 2013). Cr6 remediation at the site is complete, and included a combination of excavation, capping, and in situ chemical treatments (Stantec, 2013).

11,12. Former Drilube Company (Wilson and Broadway Facilities) — The former Drilube Company conducted aerospace and aircraft plating, anodizing, painting, and metal finishing at two facilities at the site:

    11. The Drilube Wilson facility operated from 1959 until approximately 2004 (OTIE, 2014). EPA performed a TCRA at the Wilson location to remove the upper 5 feet of the dirt floor in the waste treatment area of the former processing facility (OTIE, 2014).

    12. The Drilube Broadway facility operated from the 1945 until 2002, when a fire burned down the structure housing the facility. Remedial activities for VOCs are pending at this facility.

13. Former Excello Plating Company, Inc. (Excello) — Plating facilities operated by multiple entities at various locations on the property from at least 1946 until 2004 when the former Excello Plating Company abandoned the property (Kleinfelder, 2015). The property was purchased by the Kroger Company and Ralphs Grocery Company in 2012, and a Remedial Action Plan was negotiated with LARWQCB. Remediation of Cr6 in soil beneath the property was completed in 2014 (Kleinfelder, 2014).

14. Weber Aircraft - Starting in the early 1950's, the Weber Aircraft facility was part of an industrialized complex northeast of what is now the Burbank Airport. Weber Aircraft manufactured aircraft parts, galley assemblies, and ejection seats for military aircraft until 1989.

Manufacturing operations included: machining, metal degreasing, plating, metal finishing, and assembly. Subsurface investigation work at the site began in 1988. The facility was demolished in 1992.

5.2.2. Potential Non-point Sources

The following subsections summarize potential non-point sources of chromium to groundwater in the GCOU study area.

5.2.2.1. Groundwater Inflow from the North (Area 1)

Area 1 includes both the NHOU (to the west/northwest) and the BOU (to the north), which are hydraulically upgradient from Area 2 (Figure 2-2). Elevated concentrations of chromium, VOCs, nitrate, and emerging contaminants have been detected in groundwater in the NHOU and the BOU. As part of the GCOU RI, several additional groundwater monitoring wells were installed in Data Gap Area A (Figure 3-1) to further evaluate concentrations of Cr6 and CrT near the northern boundary of Area 2, where influx of chromium-contaminated groundwater would be expected. New EPA RI well CS-C44-120 and new GCOU RI wells PWA-1, PWA-2, PWA-3, PWA-4, PWA-5, and PWA-13 were installed in the northern portion of Area 2 (Figure 3-2).

The laboratory results indicated that chromium concentrations were below the MCLs in all samples collected from these new RI wells, with the exception of Cr6 in samples from wells PWA-1 and PWA-4 (Table 5-2). The Cr6 concentrations in PWA-1 and PWA-4 were only slightly above the state MCL, and the concentrations are bounded by wells with Cr6 concentrations below the MCL to the west (well PWA-5) and to the east (wells PWA-2, PWA-3, and CS-C44-120). The slightly elevated Cr6 concentrations may be the result of releases from the nearby Dynamic Plating, Inc. facility, identified as a potential point source (Section 5.2.1). Although migration of groundwater with higher concentrations of chromium from the NHOU and BOU may have occurred in the past and could occur in the future (e.g., if operations cease or are changed at the NHOU and BOU extraction wells), the recent data suggest that significant levels of Cr6 above the MCL are not currently entering the GCOU study area from Area 1.

5.2.2.2. Groundwater Inflow from the West/Northwest (Area 1)

As part of the GCOU RI, additional groundwater monitoring wells were also installed in Data Gap Area B located in the western portion of the GCOU (Figure 3-1), to further evaluate concentrations of Cr6 and CrT potentially migrating into the GCOU from the NHOU portion of Area 1 located to the west/northwest. New EPA RI wells CS-30-120, CS-30-200, CS-31-107, and CS-32-120 were installed in the western portion of Area 2 (Figure 3-2).

The laboratory results indicated that chromium concentrations were below the MCLs in all samples collected from the new RI wells in the west/northwest study area (concentration range of 0.548 µg/L to 5.92 µg/L in all samples to date) (Table 5-2). Although historical monitoring data indicate that migration of groundwater with higher concentrations of chromium from the west/northwest may have occurred in the past, the recent data suggest that levels of Cr6 above the MCL are not currently entering the main GCOU study area from this area.

5.2.2.3. Storm Drains and Surface Water Bodies

As described by the ULARA Watermaster (2003), historical releases of Cr6 from industrial facilities to drains and surface water bodies in the eastern SFV may have occurred, and are briefly described in this section.

In the referenced report (ULARA Watermaster, 2003), declarations were included from several former engineers, chemists, and other employees of LADWP, the Los Angeles Bureau of Sanitation, and the Los Angeles County Flood Control District that solutions containing elevated concentrations (up to 80,000 µg/L) of dissolved hexavalent chromium were likely discharged to surface water bodies within and upstream of the GCOU study area during the 1950s through the 1980s. The Burbank Western Wash, former Glendale Central Air Terminal (alternatively named "Grand Central Air Terminal") Drain, and Los Angeles River near its confluence with the Burbank Western Wash were specifically mentioned in these declarations. Also noted in the declarations were known and suspected discharges of Cr6-containing solutions to storm drains, sanitary sewers, and land surface in the eastern SFV, including the GCOU study area.

As noted above, there are also two lesser components of recharge with the potential to increase the levels of Cr6 and CrT in the basin aquifers. One is rainfall infiltration, and the second occurs in areas that are artificially watered, such as: lawns, recreational areas, golf-courses, landscaped areas, parks and green spaces. In many locations, this water percolates down through surface soils that were transported, filled, graded, and amended. This recharge water can dissolve trace-levels of contaminants, including Cr6 and CrT, as it infiltrates down to the aquifer. The net contribution of these scattered sources is very difficult to quantify, or control.

Based on the current distribution of Cr6 in groundwater (Figure 5-2), it appears that point sources (i.e., facilities) are the primary sources of the chromium impacted groundwater plume in the GCOU. However, the possibility remains that the non-point source releases, such as those described above, may be contributing low levels of chromium to the GCOU study area.

5.3. Extent of Chromium in Groundwater in the GCOU

The extent of the Cr6 and CrT plumes is discussed in this section, with plume extents illustrated on the following figures:

- Figures 4-4 through 4-8 present cross sections through the GCOU study area and show the vertical distribution of Cr6. Figure 4-3 shows the locations of the cross sections;
- Figures 5-2 and 5-3 show respectively the overall extent of Cr6 and CrT, respectively; and
- Figure 5-4 shows is an expanded view of the extent of Cr6 in the central GCOU area.

Note that the Cr6 isoconcentration contour plume maps shown on Figures 5-2 and 5-4 includes the 5 µg/L contour interval because the City of Glendale manages their use of the groundwater resource to 5 µg/L (City of Glendale, 2002).

Isoconcentration contours shown on Figure 5-2 through 5-4 were based on the most recent analytical results available to the U.S. EPA as of October 31, 2014 from groundwater samples collected between January 1, 2010 and September 30, 2014. Other analytical data that were not available at the time of map production could significantly change the shape of the contaminated area. Ongoing remediation at individual sites may significantly change the shape of the contaminated area over time. The maximum contaminant concentration at any well or group of adjacent wells, regardless of depth, was used for contouring with the exception of concentrations from previously identified perched groundwater zones where the current relationship between the regional groundwater and perched zone has not been fully assessed. Due to the possible vertical zonation of contamination, a well within an identified area of contamination may produce water with concentrations different than that indicted on this map. Where

a U.S. EPA 2010 basinwide plume map showed significant impacts and no current data are available, the 2010 plume concentrations were used as a guide for contouring, or historic analytical data were used. All groundwater samples collected during the GCOU RI were analyzed for Cr6 and CrT. The Cr6 and CrT results for all groundwater samples collected during the RI are summarized on Table 5-2. In nearly all groundwater samples, results for CrT and Cr6 from individual wells were approximately equal; indicating that nearly all dissolved CrT (trivalent chromium [Cr3] plus Cr6) in the GCOU study area groundwater consists of Cr6, rather than Cr3. The predominance of Cr6 is expected in GCOU groundwater, based on geochemical conditions in the aquifer (discussed further in Section 6.3.1).

Because Cr6 is the predominant dissolved chromium ion in GCOU study area groundwater, and because of its lower MCL (10 µg/L) compared to the MCL for CrT (50 µg/L), the discussion of chromium in this section focuses on Cr6. The distribution of Cr6 in the GCOU study area that exceeds the MCL encompasses an area of approximately 1.1 square miles, and mostly occurs in an elongated plume underlying the heavily industrial and commercial area that trends parallel to Interstate 5 and the rail lines transecting the Cities of Burbank, Glendale, and Los Angeles (referred to in this report as the "Interstate 5 corridor"). The following subsections discuss the distribution Cr6 in the GCOU study area, focusing on the following areas:

- Western and northern GCOU study areas, where the Cr6 (and CrT) concentrations are generally near or below the MCL; and
- Eastern and southern GCOU study areas, where a long, distinct plume of chromium groundwater contamination (likely comprised of multiple commingled plumes resulting from multiple source areas) occurs along the Interstate 5 corridor.

5.3.1. Chromium Distribution in Western and Northern Study Areas

The northern and western portions of the GCOU study area are characterized by large areas of relatively low-level Cr6 concentrations. The majority of monitoring wells in these areas exhibit concentrations of Cr6 below the 10 µg/L of MCL, with samples from only a few wells containing concentrations between 10 µg/L and 50 µg/L (Figure 5-2).

The Cr6 hot-spot (marked by concentrations greater than 100 µg/L on Figure 5-2) in the northern portion of the GCOU study area is interpreted based on older groundwater monitoring results from the former Dynamic Plating, Inc., facility. No additional groundwater investigation is pending at the Dynamic Plating facility, which is presently under DTSC jurisdiction.

As discussed in Section 5.2.2.2, Cr6 is detected through much of the western part of the GCOU study area, but concentrations are generally less than the Cr6 MCL. The source(s) of the persistent low-level Cr6 detected throughout the western area are not known, but may include migration of diffuse plumes emanating from upgradient sources in Area 1.

5.3.2. Chromium Distribution in Eastern and Southern Study Areas

A long, distinct chromium plume is present in the eastern part of the GCOU study area along the Interstate 5 corridor (Figures 5-2 and 5-3). A smaller plume, associated with the All Metals Processing site, is located west of the main plume. Sufficient data have not been collected to determine if the plume is discrete or comingled with the main plume. Concentrations of chromium in these plumes exceed the MCLs for Cr6 and CrT by an order of magnitude or more at some monitoring wells.

The northern portion of the main plume appears to originate primarily from sources upgradient of the GNOU extraction wells and extends downgradient of the GNOU extraction wells; the southern portion of the main plume appears to be primarily impacted from sources upgradient of the GSOU extraction wells and extends downgradient to just beyond the Area 2/Area 4 boundary. The following subsections provide further detail on the distribution of chromium in the main plume.

5.3.2.1. Northern Portion of Main Plume

The northern portion of the main plume is the largest verified contiguous area in the eastern SFV with Cr6 and CrT concentrations in groundwater exceeding their respective MCLs. Based on the distribution of Cr6 contamination shown on Figure 5-2, the northern portion of the main plume is more than 2 miles long and 0.25-mile wide, with an area of approximately 0.5 square miles, and extending along the Interstate 5 corridor from the City of Burbank to approximately 1 mile southeast (downgradient) of the GNOU extraction wells. This portion of the main plume appears to consist of comingled smaller plumes from several chromium source facilities in the industrial area along Interstate 5 and the railroad lines through this area.

To date, cleanup activities to address Cr6 and CrT contamination sources within the footprint of the northern portion of the main plume sources have been initiated at the former J&M Anodizing, ITT, and Menasco facilities. Remedial activities at the former ITT and Menasco facilities are ongoing and focus on remediation of perched groundwater, where the highest chromium concentrations occur. J&M Anodizing completed remediation of shallow soil on-site, but deep soil remediation has not occurred. Other facilities (e.g., Technibilt and Automation Plating) within or near the northern portion of the main plume that have been the subject of General Notice letters from EPA for chromium contamination have performed investigations under LARWQCB direction, but to date, they have not been directed to perform remediation of chromium in soil or groundwater.

The vertical distribution of Cr6 in the northern portion of the main plume is shown on Figure 4-4 (Cross Section A-A') and Figure 4-5 (Cross Section B-B'). Cross Section A-A' is a longitudinal (northwest-southeast) transect along the direction of groundwater flow, extending to downgradient of the GNOU extraction wells. Data from monitoring wells located upgradient and immediately downgradient of the GNOU extraction wells show Cr6 impacts extending downward to 75 to 100 feet below the water table. The Cr6 concentrations detected in deep monitoring wells CS-C06-185 and CS-C06-278 at the southeastern end of Cross Section A-A' indicate that high chromium concentrations do not extend deeper into the aquifer in this area.

A southwest-northeast transect through the GNOU extraction wells and nearby monitoring wells is shown on Cross Section B-B' (Figure 4-5), perpendicular to the general direction of groundwater flow. As shown on Figures 4-5 and 5-2, the width of the higher-concentration portions of the Cr6 plume (greater than 50 µg/L) near the GNOU extraction wells is relatively small (less than 500 feet) and centered around extraction well GN-3.

The distribution of Cr6 contamination in the area where the northern portion of the main plume extends from the GNOU into the GSOU is shown on Figure 5-4 and Cross Section E-E' (Figure 4-8). There is some uncertainty in the Cr6 distribution in this area and the commingling of the northern and southern portions of the main plume. As shown on Figure 5-4, there is an area between the railroad tracks and the Los Angeles River with very few data points. This potential data gap is also apparent across the middle portion of Cross Section E-E' (Figure 4-8)

5.3.2.2. Southern Portion of Main Plume

The current data show the southern portion of the main plume consists of a continuous area in the GSOU where Cr6 concentrations exceed the MCL. This portion of the main plume is approximately 1.5 miles long and up to 1,000 feet wide, elongated in the north/south direction, with an area of approximately 0.3-square mile (Figure 5-2). The southern portion of the main plume extends from the two former Drilube Company facilities downgradient through the area of the former Excello facility and the GSOU extraction well field to approximately 500 feet beyond the southern boundary of Area 2. Soil and groundwater investigations have confirmed chromium impacts at the former Drilube and Excello facilities, as discussed in Section 5.2.1.

The lateral and vertical distributions of Cr6 in the southern portion of the main plume are shown on Figure 4-6 (Cross Section C-C') and Figure 4-7 (Cross Section D-D'). Cross Section C-C' is a longitudinal (north-south) transect through the southern portion of the main plume along the direction of groundwater flow, extending from north of the former Drilube facilities, downgradient through the former Excello facility and the GSOU extraction wells, and past the southern boundary of Area 2 into Area 4. Although Cross Section C-C' shows an apparent gap in elevated Cr6 concentrations between former Drilube facility monitoring wells and GCOU RI monitoring well CS-C43-083, as shown on Figures 4-6 and 5-4, the elevated Cr6 contamination is interpreted to be located just east of Cross Section C-C'. Based on analytical data from collocated monitoring wells PWA-6/PWA-12, CS-C30-073/-P2, and CS-C33-059/GS-P5, elevated concentrations of dissolved Cr6 and CrT in groundwater in this area are generally limited to the upper 50 feet of the saturated zone.

Phase 3 of EPA's GCOU RI field activities included efforts to help delineate the downgradient extent of the southern portion of the main Cr6 plume. Several CPT borings were installed and HydroPunch™ groundwater samples were collected at five locations downgradient of the GSOU extraction wells (in the vicinity of the Area 2/Area 4 boundary) to evaluate the southern extent of Cr6 contamination in this area. Following review of the HydroPunch™ groundwater sample data, EPA installed three monitoring wells (CS-C45-054, CS-C46-045, and CS-C47-053) to monitor the leading edge of the Cr6 plume in GSOU. Figure 3-3 shows the Phase 3 CPT and monitoring well locations. Figure 4-6 (Cross Section C-C') and Figure 5-2 show that the leading edge of the Cr6 plume appears to be laterally and vertically delineated.

A west-east transect through the GSOU extraction wells and nearby monitoring wells is shown on Cross Section D-D' (Figure 4-7), perpendicular to the direction of groundwater flow. As shown on Figures 4-7 and 5-2, the width of the elevated Cr6 plume (above 50 µg/L) near the GSOU extraction wells is approximately 700 feet and is centered at or near extraction well GS-3. Analytical data from monitoring wells surrounding the GSOU extraction wells confirm that the Cr6 contamination migrating downgradient beyond the extraction wells is generally limited to the portion of the aquifer near the water table.

5.4. Other Related Contaminants in Groundwater

The purpose of this section is to provide an overview of the key collocated contaminants within the defined main chromium plume in the GCOU study area. The presence of other contaminants collocated with chromium will be an important consideration in the FS and for general use and management of the SFV groundwater resource. As presented in Table 5-3, the key collocated contaminants in groundwater include TCE, PCE, 1,4-dioxane, NDMA, perchlorate, 1,2,3-TCP, and nitrate. Overall, NDMA, perchlorate, 1,2,3-TCP, and nitrate were not widely analyzed as part of the GCOU RI and, where analyzed, concentrations have been relatively low and without anomalously high readings. This section focuses

primarily on PCE, TCE, and 1,4-dioxane, which have been detected above MCLs (in the case of PCE and TCE) or the NL (in the case of 1,4-dioxane) in the GCOU RI study area. As described in Section 4.7.2, the existing GWTP is only designed for VOC removal.

Prior to 2000, PCE, TCE, and related VOCs were the identified COCs in groundwater within the SFV Superfund Sites, and therefore were the primary focus of characterization efforts and remedial activities. PCE and TCE were detected at high concentrations (greater than ten times their MCLs) in relatively large areas compared to other COCs and COPCs.

Solvents, including PCE and TCE, were typically used to clean metal surfaces prior to plating and anodizing, so chromium and solvent discharges often were collocated, resulting in coincidental plumes in groundwater. The distribution of TCE and PCE in groundwater in the vicinity of Area 2 is shown on Figures 5-5 and 5-6, respectively. The footprints of TCE and PCE plumes are similar, with TCE concentrations generally higher than PCE concentrations at a given location. TCE concentrations exceed the MCL over a slightly larger area than PCE, therefore the below comparison of VOC and Cr6 plumes focuses on the distribution of TCE (Figure 5-5).

In general, wells in the GCOU study area with high levels of Cr6 also exhibit high concentrations of TCE, indicating collocated solvent and chromium sources. Conversely, there are monitoring wells in the GCOU study area that contain high concentrations of TCE and relatively low concentrations of chromium, indicative of upgradient solvent sources without corresponding chromium sources, exemplified by the following:

- Groundwater in much of the western and northern GCOU study area, upgradient from the GNOU extraction wells and northwest of the northern portion of the main Cr6 plume, contains TCE at concentrations that exceed the MCL of 5 µg/L; however, Cr6 concentrations in this area are below the MCL and do not appear to be related to a specific point source.
- Shallow groundwater south of the GNOU extraction wells on the southwestern side of the bend in the Los Angeles River contains TCE at concentrations that exceed the MCL, but Cr6 concentrations are generally below the MCL.
- A high-concentration TCE plume is present along the Los Angeles River near the GSOU extraction wells, but Cr6 concentrations in this area are consistently below the MCL.
- In the southern part of the GCOU study area, near the Area 2/Area 4 boundary, the TCE plume extends slightly farther south (Figure 5-5) than the Cr6 plume (Figure 5-2).
- The TCE plumes in the GCOU study area extend laterally and vertically beyond the limits of the northern and southern portion of the main Cr6 plume. Nearly all of the GNOU and GSOU extraction wells (with the exception of GN-4, which is screened much deeper and used for blending purposes) yield TCE concentrations above the MCL, whereas only GNOU extraction well GN-3 and GSOU extraction well GS-3 consistently yield Cr6 detections above the MCL at present.
- Based on review of cross sections prepared for the GRG's focused feasibility study, TCE contamination in excess of the MCL is generally much deeper, extending approximately 100 feet deeper than Cr6 contamination in the vicinity of GNOU and GSOU extraction wells (ERM, 2012b).

The presence of 1,4-dioxane, NDMA, perchlorate, 1,2,3-TCP, nitrate and Cr6 in groundwater in Area 2 was evaluated by the GRG in a Technical Memorandum submitted to EPA in 2013 addressing emergent chemicals in the GOU (ERM 2013a; the "Emerging Compound Technical Memorandum" or "EC Memo"). The EC Memo evaluated the distribution of ECs in Area 2 groundwater, conducted a detailed screening evaluation of the ECs, and evaluated potential impact of the ECs on the performance of the GOU remedy. The EC Memo concluded that only Cr6 had a significant likelihood of impacting the GOU remedy. As a result, the EC Memo recommended moving the WBA chromium treatment system from GS-3 to GN-3 and increasing the treatment capacity of the WBA system (see Section 4.7.2 above.)

The chemical 1,4-dioxane is used as a stabilizer of the solvent 1,1,1-trichloroethane (TCA), which is commonly used in vapor degreaser operations among numerous other uses. The distribution of 1,4-dioxane in the GCOU study area is shown on Figure 5-7. The largest area of 1,4-dioxane in groundwater exceeding the DDW's NL of 1 µg/L is collocated with the main Cr6 and VOC plume upgradient of the GNOU extraction wells. There is also an area of slightly elevated 1,4-dioxane contamination in groundwater collocated with the main chromium plume upgradient from the GSOU extraction wells, and a smaller area along the Los Angeles River where 1,4-dioxane is detected above the NL (Figure 5-7).

5.5. Nature and Extent Summary

Throughout the GCOU study area, the dominant dissolved species of chromium in GCOU groundwater is Cr6, in the form of the chromate oxyanion ($CrO4^{-2}$). Known and suspected point sources of dissolved chromium in groundwater of the GCOU study area include former and current aerospace and industrial facilities located mostly along the Interstate 5 corridor. Soil and groundwater investigations have confirmed releases of Cr6 at several chromium source facilities in the GCOU study area, as discussed in Section 5.1 and summarized in Table 5-1. Identified sources (Figure 5-1) are located north of and within the GCOU study area. Additional point sources of chromium in groundwater may exist. EPA has issued General Notice letters to identified Cr6 source facilities in the GCOU study area listed in Table 5-1, and LARWQCB continues to investigate other potential sources of chromium in the SFV.

The Cr6 plume in the GCOU has been largely delineated by the GCOU RI, although some uncertainties remain, as discussed in this section. The Cr6 plume above MCLs consists of a long, narrow high-concentration plume or comingled plumes originating from various point and possibly non-point sources. Cr6 and CrT plumes are collocated, with the above-MCL CrT plume completely within the footprint of the above-MCL Cr6 plume (see Section 6 for further discussion). The following is a summary of the RI delineation of the horizontal extent, followed by a discussion of uncertainties:

- The northern and western portions of the GCOU study area are characterized by relatively low-level Cr6 concentrations, below the MCL. These areas of contaminated groundwater appear to be due to non-point sources possibly including migration of chromium from upgradient (Area 1) sources. However, a plume associated with former Dynamic Plating, Inc. has been identified (Source 2 on Figures 5-2 and 5-3).
- A long, distinct chromium plume has developed from multiple sources present in the eastern part of the GCOU study area along the heavily-industrialized Interstate 5 corridor. Concentrations of chromium in the plume exceed the MCLs for Cr6 and CrT by an order of magnitude or more at some locations (Figures 5-2 and 5-3). Furthermore, based on groundwater data, Cr6 concentrations greater than 5 µg/L are continuous from the Area 1/Area 2 boundary to the southernmost plume extent in Area 4, as shown on Figure 5-2.

- The northern portion of the chromium plume appears to originate primarily from sources upgradient of the GNOU extraction wells; this portion of the plume is more than 2 miles long and 0.25 mile wide, with an area of approximately 0.5 square miles. The northern portion of the chromium plume extends from the City of Burbank to approximately 1 mile southeast (downgradient) of the GNOU extraction wells, migrating consistent with the general groundwater flow path.
- The southern portion of the main plume appears to originate primarily from sources upgradient of the GSOU extraction wells, and extends downgradient just past the Area 2/Area 4 boundary.
- A smaller plume is centered at the former All Metals Processing facility, immediately west of the northern portion of the main chromium plume (Source 7 on Figures 5-2 and 5-3).

There is uncertainty in the continuity of the chromium plume in three areas: between the Dynamic Plating and J&M Anodizing facilities in the north (Figure 5-2), between the central portion of the plume and the former All Metals facility to the west (Figure 5-2), and between monitoring wells CS-C06-185, CS-VPB-06, and V13PRW39 and the two Drilube facilities near the southern portion of the plume (Figure 5-4). Further investigation would be required to fill the data gap area illustrated on Cross Section E-E' (Figure 4-8). Additionally, there is uncertainty about other potential source(s) contributing to the Cr6 plume south of the Drilube facilities (Figure 5-4).

Monitoring wells screened near the water table exhibit the highest Cr6 concentrations. However, Cr6 is present at greater depths (up to 100 feet below the water table) in the northern portion of the main plume upgradient and immediately downgradient of the GNOU extraction wells. The presence of elevated concentrations of chromium downgradient from the GNOU and GSOU extraction wells suggests that the extraction wells have not historically, and may not currently, capture contamination present below the upper portion of the water table.

In several areas of the GCOU study area, dissolved Cr6 in groundwater is comingled with TCE, PCE, and 1,4-dioxane plumes, indicating the likely contribution from common sources for all of these contaminants. However, the lateral and vertical extent of the TCE and PCE plumes exceeding the MCL is significantly larger than the extent of the Cr6 and CrT plumes exceeding the respective MCLs. Conversely, the lateral extent of 1,4-dioxane at concentrations above the NL is considerably smaller than the extent of the chromium plumes exceeding the MCL. The understanding of the collocation of chromium with VOCs and other contaminants is critical to the FS as well as management and use of the groundwater resource.

6.0 CHROMIUM FATE AND TRANSPORT

This section describes fate and transport mechanisms that affect the persistence and mobility of CrT and Cr6 present in groundwater in the regional aquifer underlying the GCOU study area. The persistence and mobility of CrT and Cr6 in groundwater determine when and how they can migrate to locations, such as water-supply wells or surface-water bodies, and where exposure pathways could potentially be complete, resulting in human-health or ecological risks.

This section concludes with a description of the CSM for the distribution, fate, and transport of CrT and Cr6 in groundwater in the GCOU. The CSM is a useful tool for evaluating present and potential future human and environmental exposure pathways and risks, and to aid in developing protective mitigation (remediation) strategies, if needed.

6.1. POTENTIAL ROUTES OF MIGRATION

As noted in Section 1, the GCOU RI focused primarily on chromium occurrence and migration within the regional aquifer in Area 2 of the San Fernando Basin, where groundwater occurs at depths ranging from 35 to over 100 feet bgs. Transport of dissolved CrT and Cr6 in groundwater in the study area occurs under the influence of the southeasterly to southerly regional hydraulic gradients. Discharge of chromium from groundwater to water-supply wells or to the Los Angeles River could potentially result in exposure of human or ecological receptors to chromium via ingestion or direct contact, as discussed in Section 7.

As discussed in Section 5, known and suspected chromium point sources in the SFV include multiple industrial facilities, primarily concentrated along the Interstate 5 corridor in the eastern part of the GCOU study area and through the Los Angeles River Narrows (Figures 5-1 through 5-4). Additional sources, such as infiltration from surface-water bodies in the GCOU study area, and diffuse chromium plumes migrating from the NHOU and BOU (Area 1), may also contribute to chromium concentrations in groundwater within the GCOU study area, but were not the primary focus of this RI.

Investigation of CrT and Cr6 in soil and local perched aquifers below some known and suspected source facilities, with cleanup if warranted, are being conducted under the direction of the State, as noted in Section 5. Therefore, potential routes of migration for elevated chromium concentrations present in soil (e.g., transport of particles via wind or runoff) are not discussed further in this report.

6.2. PERSISTENCE

Chromium is a metallic element and therefore will persist in either the immobile solid, mobile dissolved, or suspended particulate phase until extracted by wells, discharged to surface water, or transported via groundwater flow out of the SFV Basin.

Considering the relatively low concentrations of chromium detected in groundwater pumped from most of the GNOU and GSOU extraction wells and in surface water flows in the Los Angeles River, compared to the large mass of chromium present in dissolved, sorbed, and solid phases (including chromium-containing minerals) in the regional aquifer within the GCOU study area, the rate of removal of chromium from the subsurface via groundwater extraction, surface water discharge, and groundwater migration is very slow. In addition, groundwater flowing into the GCOU study area from upgradient areas of the San Fernando Basin also contains low concentrations of dissolved chromium (see Section 5), which results in a continuous influx of chromium to the GCOU study area that partly balances the flux out of the GCOU study area downgradient. Because of these factors, the subsurface mass of chromium

currently in the GCOU study area that is already dissolved, or has the potential to dissolve, in groundwater, where it might achieve a complete exposure pathway to human and ecological receptors is not expected to naturally decay, dissipate, or exit the basin to a significant degree in the foreseeable future.

6.3. MIGRATION IN GROUNDWATER

The present distribution of dissolved CrT and, more importantly (because of its greater solubility and toxicity), Cr6 in groundwater of the GCOU is a result of a complex interaction of geochemical and hydraulic influences. The general chemistry of the groundwater and mineralogy of the aquifer matrix are the controlling factors for the solubility and mobility of chromium, while hydraulic gradients and physical characteristics of the aquifer (primarily hydraulic conductivity and vertical flow directions) determine where and how fast dissolved chromium will migrate. Unanticipated changes in groundwater flow patterns and geochemistry in the San Fernando Basin could significantly influence how chromium interacts with and is transported by groundwater in the future.

6.3.1. Geochemical Factors Influencing Chromium Solubility and Mobility

The solubility and mobility of chromium in groundwater is highly dependent on valence state (Cr3 or Cr6), which is ultimately controlled by geochemistry of the groundwater and the aquifer matrix. Geochemical factors influencing chromium solubility and mobility in groundwater are summarized below.

6.3.1.1. Oxidation and Reduction

Under typical geochemical conditions in groundwater, chromium can occur in two valence states: Cr3 and Cr6. In oxic (containing dissolved oxygen) and neutral to alkaline (pH greater than 6) groundwater, as occurs in the eastern SFV (including the GCOU study area), Cr6 is the dominant valence state, and the CrO_4^{2-} oxyanion (chromate) is the dominant dissolved Cr6-containing species (EPA, 2007). Chromate forms few insoluble precipitates and is only weakly adsorbed to mineral surfaces; therefore, it (and the Cr6 it contains) is relatively mobile in groundwater. Under more acidic conditions (below pH 6—not typically seen in the SFV or GCOU), the hydrogen chromate (bichromate) oxyanion ($HCrO_4^-$) is the dominant form of dissolved Cr6.

As discussed in Section 4.5.2.5, field parameters measured in shallow groundwater samples indicate oxidizing groundwater conditions, including a positive ORP and presence of DO and nitrate. These conditions support the persistence of Cr6 (as chromate or bichromate). Cr3 is generally insoluble under these conditions unless the pH of the solution is below 5 (acidic), which has not been observed to date in the eastern San Fernando Basin (field parameters measured during GCOU RI groundwater monitoring consistently show pH above 6). Chromium is removed from groundwater under more reducing conditions by the precipitation of chromium hydroxide. In a small number of groundwater samples from monitoring wells located near known sources of chromium, Cr3 is the dominant species. For samples in which CrT concentrations significantly exceed Cr6 concentrations, the likely cause is the presence of colloidal Cr3 (i.e., Cr3 entrained on suspended solids or extremely fine particulates), as discussed further below.

6.3.1.2. Adsorption and Desorption

Adsorption and desorption of dissolved chromium species to mineral surfaces in the aquifer matrix can cause decreases or increases, respectively, of chromium concentrations in groundwater. Adsorption rates for Cr6 (as chromate, the dominant Cr6 species) are affected by pH and the concentration of other

anions in solution (EPA, 2007). Cr6 binds to mineral adsorption sites with intermediate intensity; therefore, other common anions, such as sulfate, carbonate, silicate, and phosphate, compete with chromate for adsorption sites, resulting in a complex dependency of chromate adsorption on pH and concentrations of other solutes in groundwater (EPA, 2007). For this reason, adsorption and desorption rates for Cr6 in groundwater of the San Fernando Basin, which is intensively managed for water supply and is recharged with multiple sources of water (with significantly varying chemistry), can be expected to vary over time at any given location. Typically, adsorption of Cr6 to mineral surfaces is weak, reflected by published soil-water partition coefficients among the lowest assigned to trace metals (EPA, 2007).

In contrast to Cr6, Cr3 readily adsorbs to mineral surfaces because it exists as a free trivalent cation (Cr^{3+}) in solution with no attached oxygen atoms. Common adsorbent minerals (e.g., clays, iron oxides) adsorb free cations effectively in the pH range observed in the GCOU groundwater, and the bond between Cr3 and the mineral surfaces is stronger and less easily reversible than that of Cr6.

6.3.1.3. Other Geochemical Processes

Other geochemical processes that may affect chromium migration to a limited degree in the GCOU include:

- **Colloidal transport:** Chromium transport associated with suspended solids (mobile colloidal solids), which typically consist of organic macromolecules, iron oxyhydroxides, clay minerals, or sulfide minerals, may occur in natural groundwater and surface water systems (EPA, 2007). Cr3, in particular, may be subject to colloidal transport due to its strong adsorption to particle surfaces (EPA, 2007).
- **Coprecipitation with calcite:** Research suggests that Cr6 may be attenuated by coprecipitation with calcium carbonate (calcite) or by substitution of chromate into the structure of existing carbonate crystals (Tang et al., 2007; Hua et al., 2007). This geochemical process may play a significant role in areas where calcite is actively precipitating, but these areas are not expected to be widespread in the GCOU study area. The degree to which the interaction of Cr6 and calcite plays a role in fate and transport on a field scale has not yet been specifically reported in the literature, so the influence of calcite on Cr6 mobility is not well known at present.

6.3.2. Advection and Related Transport Processes

Transport (migration) of dissolved constituents in groundwater occurs primarily via the processes of advection, dispersion, and diffusion. Advection is the primary transport mechanism by which dissolved chromium moves with groundwater in the direction of the horizontal hydraulic gradient, which is generally to the southeast and south in the GCOU study area. The current distribution of chromium and other contaminants shown on Figures 5-2 through 5-7 are largely a result of their advective transport with groundwater in the GCOU study area.

Dispersion results in gradually increasing dilution of the solute front as it migrates downgradient from the source area. Dispersion occurs because of differences in groundwater velocity resulting from matrix heterogeneities on micro and macro scales. Dispersion does not slow down the average rate of migration of the solute front during transport.

Molecular diffusion is the process whereby solutes migrate from zones of high concentration to zones of lower concentration (known as chemical concentration gradients, as opposed to hydraulic gradients). A significant effect of molecular diffusion is the potential for gradual migration of dissolved contaminants

out of relatively permeable aquifer zones (such as sands and gravels), where contaminants are most likely to occur initially after introduction to groundwater, and into low permeability zones (such as silt and clay layers), from which the contaminants may slowly diffuse back into the more permeable aquifer zones years to decades later (Parker, et al., 2008). These twin processes, commonly referred to as "matrix diffusion" and "back diffusion," respectively, can yield low to moderate concentrations of contaminants near source areas and downgradient along groundwater flow paths for a longer period than would be forecast based solely on evaluation of advection and dispersion rates. Back diffusion is an important process to consider in the selection and design of cleanup activities, as it can lengthen cleanup time.

As discussed in Section 4.5.2.2, horizontal hydraulic gradients in the eastern SFV, including the GCOU study area, are generally southeast toward the Los Angeles River Narrows, and then south out of the San Fernando Basin and into the Los Angeles Central Basin. Localized deviations from this pattern occur around the large cone of depression resulting from groundwater withdrawals in the BOU extraction well field and in the vicinity of the GNOU and GSOU extraction well fields. The BOU extraction well field causes a flat to northward hydraulic gradient along the northern margin of the GCOU study area. Groundwater flow velocities in the eastern SFV were estimated by the Watermaster to range from approximately 300 to 1,300 ft/year, depending on location (ULARA Watermaster, 2002). Average groundwater velocities in the northern and western parts of the GCOU study area were estimated to be approximately 300 to 400 ft/year. In the Los Angeles River Narrows area (southeastern part of the GCOU study area), average velocities were estimated to be 1,000 to 1,300 ft/year. More recent hydraulic conductivity data (ERM, 2012b), presented in Section 4.5.2.4, indicate groundwater flow velocities ranging from 680 to 2,920 ft/year and 1,460 to 2,250 ft/year near the GNOU and GSOU extraction wells, respectively.

The dissolved CrT and Cr6 transported via advection through the GCOU study area (and not removed from solution by the geochemical processes described in Section 6.3.1) eventually are:

- Withdrawn by the GNOU and GSOU extraction wells;
- Potentially discharged to the Los Angeles River in the Los Angeles River Narrows area; or
- Continue migrating with groundwater to Area 4 (Pollock).

As discussed in Section 4.7.2, the GRG recently conducted a hydraulic containment study to evaluate the effectiveness of the GNOU and GSOU extraction wells at intercepting COCs in groundwater (ERM, 2013b). The hydraulic containment study evaluated GNOU and GSOU remedy performance using multiple techniques including water level and water quality evaluations and analytical and numerical modeling of the extraction well field capture zones. The study concluded that the GNOU and GSOU interim VOC remedies achieved the remedial action objective (RAOs) for inhibiting vertical and lateral migration of VOC contamination, but that uncertainty remains regarding the effectiveness of hydraulic containment between GNOU extraction wells GN-2 and GN-3, and between GSOU extraction wells GS-2 and GS-3. The GRG is planning for the installation of an additional extraction well (GS-5) in the GSOU between GS-2 and GS-3 to enhance containment in this area. Figure 6-1 shows the estimated capture zone widths of existing extraction wells in the GNOU and GSOU as calculated for the GRG's hydraulic containment study, superimposed on the map of Cr6 in groundwater in the GCOU study area. The highest Cr6 concentrations in the vicinity of the GNOU and GSOU extraction wells are observed near the water table, above the extraction well screens. Based on the present distribution of Cr6 in groundwater

(extending past each extraction well field), the extraction wells do not appear to be preventing all downgradient migration of shallow contamination.

EPA conducted an initial assessment of the potential for discharge of COCs into the Los Angeles River (CH2M HILL, 2014), and concluded that some groundwater in the southern portion of the Los Angeles River Narrows area could potentially discharge to surface water where groundwater elevations are higher than the bottom of the unlined river channel or under high groundwater conditions. Determination of the potential rates of groundwater discharge and COC mass flux to the Los Angeles River was beyond the scope of the initial assessment, however, EPA is planning to have the assessment completed in the future. An evaluation of basin discharge through the Los Angeles River Narrows area demonstrated in 1990 that, on average, approximately 2,000 AFY of groundwater were rising into the unlined portion of the Los Angeles River and leaving the basin (ULARA Watermaster, 2014).

The volume of groundwater flowing downgradient through the Los Angeles River Narrows into the Central Basin is relatively small, estimated to be 391 AF in WY 2012/13 by the ULARA Watermaster (2014). Cr6 concentrations at monitoring well CS-C46-045, near the downgradient (southern) margin of the GCOU study area increased from 2.2 to 11 µg/L between July and October 2014 (Table 5-2), suggesting that transport of Cr6 out of the GCOU is occurring. There may also be additional sources of Cr6 present south of the GCOU. As stated in Section 2.2.3, recent testing at the Pollock well field by LADWP indicated relatively low concentrations of VOCs, CrT, and Cr6 (below the state MCLs for CrT and Cr6) in influent groundwater.

6.4. Chromium Distribution, Fate, and Transport in Groundwater

This CSM qualitatively describes how chromium has migrated from source areas, influenced by geochemical and hydrogeological conditions in the San Fernando Basin, resulting in the current distribution of chromium in groundwater. The CSM also provides a framework and starting point for forecasting future migration of chromium in groundwater in the GCOU study area and evaluating the potential for completion of human and ecologic exposure pathways.

6.4.1. Historical Migration from Source Areas

As discussed in Section 5.2, known and potential point sources of chromium in the SFV include metals manufacturing and finishing facilities; most of these facilities also discharged chlorinated solvents (primarily TCE and PCE), resulting in VOC contamination being collocated with chromium in groundwater.

The known chromium source facilities are concentrated along the Interstate 5 corridor and through the Los Angeles River Narrows. Past intentional or unintentional releases of dissolved chromium in aqueous solutions from facilities resulted in migration of Cr3 (if the solutions were acidic) or Cr6 downward through the vadose zone to the water table where groundwater would have been initially affected. Residual chromium in the vadose zone at source facilities likely continued to percolate downward, particularly when mobilized by infiltrating precipitation, providing an ongoing source of chromium to groundwater.

In addition to the known or suspected industrial facilities, the Burbank Wash and potentially other surface water drainages reportedly received industrial discharges containing chromium wastes, as observed in the 1950s through 1970s (ULARA Watermaster, 2003). Vertical migration of chromium from affected surface water drainages may have also impacted groundwater.

Chromium and VOC use occurred in the GCOU study area primarily from the 1950s through the 1980s, and it is assumed that most discharges that reached groundwater occurred during this period. Migration of chromium through the vadose zone at each source facility would have varied in terms of timing, mass-flux rate, migration pathways and processes, and co-contaminants. However, long-term degradation of groundwater at each of the identified source facilities exhibits a similar pattern, with dissolved Cr6 concentrations typically remaining at one to two orders of magnitude or more above the State MCL for Cr6 until remediation of the source is completed.

Once the dissolved contaminants reach the regional aquifer, hydraulic gradients control the direction of contaminant migration, and geochemical processes affect their persistence, rate of movement, and attenuation. Under the geochemical conditions typical of groundwater in the GCOU study area, chromate is the dominant dissolved Cr6 species.

As described in Section 5.2.2.1, upgradient (Area 1) sources have likely contributed to the mass of dissolved Cr6 present in the aquifer in the northern and western portions of the GCOU study area. Currently, concentrations of Cr6 and CrT in these diffuse zones are below MCLs.

In the aquifer, dissolved Cr6 was transported via advection under the dominant (southeast) horizontal hydraulic gradient, and then southward into the Los Angeles River Narrows area. Localized deviations from these flow patterns likely occurred in the vicinity of water-supply well fields that operated historically, including the City of Burbank wells, LADWP's Verdugo, Headworks, and Crystal Springs well fields, the Glendale Grandview well field, and the Glendale (Grayson) Steam Plant supply wells (JMM, 1992a). In 1996, the BOU extraction well field began operation, followed by the GNOU and GSOU extraction well fields in 2000. These extraction well fields (with associated treatment systems) became new sources of groundwater for the Cities of Burbank and Glendale, respectively, and use of the older water-supply well fields was curtailed or eliminated. Similarly, groundwater extractions by LADWP from the GCOU study area diminished in the 1990s, with only minor production from the Verdugo well field during the past decade.

Estimates of groundwater flow velocities range from 300 feet per year in the northern part of the GCOU study area to more than 2,000 feet per year in the Los Angeles River Narrows (see Section 6.3.2). Based on an estimated average groundwater flow velocity at the low end of this range (300 feet per year), groundwater entering the northern margin of the GCOU study area in 1965 would have reached the southern margin of the GCOU study area in approximately 50 years. Therefore, the groundwater "residence time" in the GCOU from 1965 to 2015 is contemporaneous with wide-spread industrial use of solvents and chromium, as well as documented observations of chromium in surface water bodies in the Glendale and Burbank areas (ULARA, 2003).

Vertical hydraulic gradients in the eastern SFV generally are much smaller than horizontal gradients, and are strongly influenced by groundwater withdrawals near production well fields (JMM, 1992a). Most of the interim remedy extraction wells in Area 2 are screened in the upper portions of the regional aquifer where the highest chromium concentrations were observed. Upward gradients are assumed to occur near these well fields, although the well fields do not appear to provide for complete capture of chromium, as described below in Section 6.4.2.

The rate of transport of dissolved chromium (and other contaminants), in groundwater of the GCOU study area would likely have been affected by the following attenuation mechanisms and processes:

- Dilution and spreading of dissolved plumes laterally, vertically, and parallel to the direction of flow due to dispersion and chemical diffusion;
- Retardation (slowing) of dissolved constituents relative to the average groundwater velocity because of adsorption and of molecular diffusion into finer-grained hydrostratigraphic units; and
- Decreasing solute concentrations along the flow path as a result of other attenuation mechanisms/processes, including chemical reduction of Cr6 to Cr3, followed by precipitation or adsorption of Cr3 on mineral surfaces.

6.4.2. Current Distribution

Dissolved CrT and Cr6 are present in groundwater at detectable concentrations across much of the GCOU study area, as described in Section 5.3. Low-level (below MCLs) chromium in the western and northern GCOU study area is believed to originate from upgradient sources Area 1. As shown on Figure 5-2, releases from the Dynamic Plating, Inc. facility at the northern portion of the GCOU study area have resulted in a plume with Cr6 concentrations above the MCL of 10 µg/L. The sources of the significantly higher Cr6 concentrations (greater than the MCL of 10 µg/L) in groundwater in the southern and eastern part of the GCOU study area along the Interstate 5 corridor are primarily point-source releases from multiple facilities (Figure 5-1). The plumes emanating from these facilities have commingled, resulting in an elongated plume with Cr6 and CrT concentrations ranging from 10 to more than 1,000 µg/L (Figures 5-2 and 5-3). There is uncertainty regarding whether the smaller plumes near the former Dynamic Plating, Inc. facility or former All Metals Processing facility are discrete or comingled with the main plume. Exhibit 6-1 summarizes the distribution of chromium in the GCOU study area relative to the existing GNOU and GSOU remedy extraction wells.

EXHIBIT 6-1 Distribution of Chromium Contamination in GCOU Study Area

Geographic Area	Comments on Distribution of Chromium in Area
Western and Northern GCOU – upgradient and cross-gradient from GNOU extraction wells	• Characterized by areas of relatively low dissolved chromium concentrations (below the MCLs for Cr6 and CrT) in both shallow and deep groundwater. • The source of most of the chromium detections in groundwater in this area is likely Area 1 to the north/northwest.
GNOU upgradient area – upgradient of GNOU extraction wells	• Largest area where Cr6 and CrT concentrations in groundwater exceed the MCLs. • A continuous Cr6/CrT plume extends along the Interstate-5 corridor from the City of Burbank toward the GNOU extraction wells. • Several point sources (facilities) have been identified in this portion of the GCOU study area, as shown on Figure 5-1.
GSOU upgradient area – upgradient of GSOU extraction wells	• The Cr6/CrT plume extends south from the GNOU extraction wells, receives contributions from various sources and extends to the GSOU extraction wells. • Uncertainty remains in the Cr6 distribution south of monitoring wells CS-C06-185, CS-VPB-06, and V13PRW39 and in the vicinity (particularly immediately downgradient) of the Drilube facilities (Figure 5-4). • Monitoring well data upgradient and surrounding the GSOU extraction wells suggest that Cr6 and CrT concentrations exceeding the MCLs are mostly limited to shallow groundwater.

Geographic Area	Comments on Distribution of Chromium in Area
GSOU downgradient area – downgradient of GSOU extraction wells	• Cr6 concentrations above the MCL occur in groundwater downgradient (south) from the GSOU extraction wells. Groundwater in this area historically received contributions from the former Excello facility and extended approximately 1-mile downgradient with the leading edge apparently located several hundred feet south of the Area 4 (Pollock) boundary. • Several point sources (facilities) have been identified in this portion of the GCOU study area, as shown on Figure 5-1.

6.4.3. Concentration Trends

Although the exact timing for discharges of chromium at point and non-point sources in the GCOU study area is uncertain in most cases, the discharges likely occurred from the 1950s through the 1980s, or approximately 25 to 60 years ago. Therefore, the Cr6 and CrT plumes in the GCOU study area are "mature" in that sufficient time has passed for chemical equilibrium to be reached between chromium, other dissolved metals, and major anions in the vicinity of (and thousands of feet downgradient from) the source areas. Sudden expansion or contraction of the chromium plumes would not be expected to result from ongoing geochemical reactions with groundwater or the aquifer matrix at this time. However, continued southward migration of dissolved Cr6 in groundwater may be occurring, as discussed below. Cr6 concentration trends over time at select SFV RI and facility monitoring wells are presented in Figures E-6 through E-11 in Appendix E. The Cr6 and CrT plumes in most of the GCOU study area appear to be in equilibrium, as indicated by the trends summarized below.

EXHIBIT 6-2 Trends in Chromium Contamination in GCOU Study Area

Geographic Area	Comments on Concentration Trends
Western and Northern GCOU – upgradient and cross-gradient from GNOU extraction wells	• The Cr6 time series charts for the NH-VPB-14/NH-C04 cluster wells (Appendix E, Figure E-6) and the NH-C06 cluster wells (Appendix E, Figure E-7) show that chromium concentrations have been relatively low in the western and northern GCOU study area since the late 1990s. • The chromium concentrations appear to be declining at well NH-VPB-14 while they remain relatively stable at well NH-C06-160. Chromium has been detected in deep SFV RI monitoring well NH-C06-285 for approximately the last 10 years. Prior to approximately 2004, chromium was only detected in the shallow well (NH-C06-160) at this location. Concentrations are generally stable in the deeper NH-C04 cluster wells.
GNOU upgradient area – upgradient of GNOU extraction wells	• Based on the Cr6 concentration trend at SFV RI monitoring well CS-VPB-04/CS-C04 well cluster (Appendix E, Figure E-8), chromium concentrations in the northern plume upgradient of the GNOU extraction wells have been relatively stable since the late 1990s.
GSOU upgradient area – upgradient of GSOU extraction wells	• Based on the Cr6 concentration trend at well CS-VPB-06 (Appendix E, Figure E-11), the Cr6 concentrations have significantly increased during the last 2 years, suggesting Cr6-contaminated groundwater is migrating into the GSOU. • The Cr6 time series chart for facility monitoring wells at the former Drilube facility (Appendix E, Figure E-9) indicates the chromium concentrations in groundwater at this source area have shown some fluctuations but overall have remained relatively constant since approximately 1995; and

Geographic Area	Comments on Concentration Trends
	• Based on the Cr6 concentration trend at SFV RI monitoring well PO-VPB-02/PO-C01 well cluster (Appendix E, Figure E-10), chromium concentrations in the core of the southern plume, near the former Excello facility, have been relatively stable since the late 1990s. A spike in the Cr6 concentration at well PO-VPB-02 occurred in 2013, likely in response to remediation activities for chromium-impacted soil at the former Excello facility; however, Cr6 concentrations have subsequently declined to levels below those observed prior to soil remediation.
GSOU downgradient area – downgradient of GSOU extraction wells	• The southern plume (south of the GSOU extraction wells) appears to be entering Area 4 (Pollock OU). Chromium was found in Area 4 in GCOU RI monitoring wells approximately 750 feet south of the boundary between Areas 2 and 4. Those results suggest that there is not complete hydraulic containment at the GSOU wells and/or that groundwater migrated before the GSOU extraction wells went into operation in 2000, and/or there is a source(s) for Cr6 south of the GSOU extraction wells.

Despite the apparent stability of chromium concentrations in wells in some portions of the GCOU study area, mobilization of chromium from high-concentration residual mass remaining in source areas is likely to continue in response to future recharge events or rapid rises in the water table. Migration of Cr6 in groundwater continues via advection even though groundwater monitoring data trends may give the appearance of plume stability. Downgradient expansion of the Cr6 and CrT plumes in some areas of the GCOU study area is also likely occurring, including at the location of well CS-VPB-06 and into Area 4.

6.4.4. Effects of Source Cleanups on Fate and Transport

As described in Section 5 of this report, investigations and cleanup activities are ongoing or have been completed at several identified potential chromium source facilities in the GCOU study area. To date, various cleanup activities to address chromium in the vadose zone have been conducted at 12 of the 14 Cr6 sources identified in Table 5-1:

- Lockheed Plant B1 – focused soil excavation;
- Dynamic Plating – focused excavation of upper 2 feet of soil (deeper contamination not addressed);
- J&M Anodizing – shallow soil excavation (deeper contamination not addressed);
- Menasco – in-situ treatment of soil, perched groundwater and regional aquifer;
- Technibilt – shallow soil excavation;
- ITT Aerospace – in-situ treatment of soil and perched groundwater;
- All Metals Processing – excavation of soil up to 16 feet deep (deeper contamination not addressed);
- Loral Librascope – soil excavation (limited information available);
- PRC-Desoto – in-situ treatment of soil and groundwater;
- Drilube – Wilson- focused excavation of upper 5 feet of soil in source area (deeper contamination not addressed);

- Excello- in-situ treatment of soil and groundwater; and
- Weber Aircraft – in-situ treatment of vadose and saturate zones at the site.

Removal of chromium from near-surface soils can be expected to eventually result in a permanent decrease in the concentration of chromium in underlying groundwater; this could take many years, even decades. At the sites where active in-situ groundwater remediation has occurred or is occurring, a more rapid decrease in groundwater chromium concentrations would be expected as Cr6 is reduced to the generally immobile Cr3 ion. Such decreases in groundwater chromium concentrations have been observed at the Excello, PRC-Desoto, ITT Aerospace, and Menasco sites (discussion of specific results are beyond the scope of this RI, but should be considered during the FS). Site-specific cleanup reports and long-term monitoring data for facilities undergoing cleanup activities are available from the LARWQCB for the above-listed sites, except Drilube-Wilson which is under EPA oversight, and Dynamic Plating which is under DTSC oversight.

7.0 RISK ASSESSMENT UPDATES

An HHRA addendum and SLERA addendum have been prepared in support of the GCOU RI. The complete HHRA addendum is included as Appendix H, and the complete SLERA addendum is included as Appendix G.

7.1. HUMAN HEALTH RISK ASSESSMENT ADDENDUM

The HHRA addendum has been prepared to evaluate potential risks to human health from Cr6 contamination in groundwater of the GCOU. A baseline HHRA was previously conducted for Area 2, as documented in the RI Report for the Glendale Study Area (JMM, 1992b). The current HHRA addendum prepared for the GCOU RI includes screening-level evaluations focused solely on the potential risks posed by Cr6 in groundwater; these risks were not explicitly evaluated in the baseline HHRAs. Other contaminants that are also present in the groundwater, primarily VOCs, were evaluated in the baseline HHRA and are not considered in this HHRA addendum.

As discussed in Section 2.2.2, the interim pump-and-treat remedies in the GNOU and GSOU were designed to address only VOC contamination in groundwater. Currently, the eight GNOU and GSOU extraction wells (four in each OU) pump water to a single VOC treatment plant. The treated groundwater is blended with water from other sources and incorporated into the City of Glendale's water supply system. Concentrations of all monitored contaminants, including Cr6, in the treated and blended water are below state and federal MCLs before leaving the treatment plant. The treated water is closely monitored to verify compliance. As described in Section 4.7.2, implementation of remedy enhancements is in progress to improve hydraulic containment of contaminated groundwater and to relocate wellhead treatment for Cr6.

The HHRA addendum evaluates whether the Cr6 contamination poses a significant risk to human health if human receptors (for example, local residents) were exposed to untreated groundwater. For this HHRA addendum, drinking water MCLs was used to evaluate potential risks. Because federal and state drinking water regulations make it unlikely that residential consumers would actually be exposed to contaminated groundwater, this health risk evaluation is considered conservative and likely overestimates the actual exposures and risks.

7.1.1. Exposure Assessment

Groundwater data collected between January 2010 and August 2014 for Cr6 are used in the HHRA addendum screening evaluation. The data were collected by EPA, the GCOU Respondents and GRG (working under EPA direction), the City of Glendale, and individual facilities doing work under LARWQCB direction.

Receptors that could potentially be exposed to untreated, contaminated groundwater include current and future residents that theoretically could receive drinking water from groundwater wells located in Cr6 contaminated areas. Exposure could occur through ingestion, dermal contact, or inhalation of the Cr6 present in the groundwater. In accordance with EPA guidance for a baseline HHRA (EPA, 1989), federal and state drinking water regulations that prohibit the use of contaminated water (which would eliminate this exposure pathway) are not considered in this risk assessment ; instead, it is assumed that contaminated groundwater is potentially available for consumptive use.

Another exposure pathway considered but eliminated was potential exposure to Cr6 in Los Angeles River surface water that could theoretically be impacted by groundwater discharges. However, this

potential exposure pathway is not considered in this screening-level HHRA addendum for three main reasons:

- The volume of groundwater discharge, if any occurs, is expected to be small compared to the volume of surface water already flowing in the river channel;
- There is currently no routine recreational use of the river channel in this area, eliminating the potential for recurring exposure; and
- The quality of the surface water at the location of any potential groundwater discharges is unknown and there is considerable uncertainty in the fate of Cr6 in the small volume of groundwater discharges.

For this evaluation, groundwater data have been grouped into six exposure areas or well groups based primarily on geographic distribution, well depth, and proximity to known sources of Cr6 contamination. The designation of well groups is useful in evaluating potential exposure because of the varying Cr6 concentrations in groundwater based on location (source areas, or upgradient/downgradient of source areas) and screened interval (shallow or deep) of the well.

- **Well Group 1** (shallow wells) ("shallow" refers to wells screened in the upper 50 feet of the water table): Western part of GCOU; widely distributed Cr6 that is generally at low concentrations below the state MCL of 10 µg/L for Cr6.
- **Well Group 2** (shallow wells): Wells located in and near the primary source areas upgradient of the GNOU remedy extraction wells.
- **Well Group 3** (shallow wells): Wells located in and near the primary source areas upgradient of the GSOU remedy extraction wells (and downgradient of the GNOU extraction wells).
- **Well Group 4** (shallow wells): Wells located downgradient of the GSOU extraction wells and beyond the influence of the interim VOC remedy hydraulic containment zone.
- **Well Group 5a** (deep wells) ("deep" refers to wells screened more than 50 feet below the water table): Deep wells located throughout the GCOU study area, except for those located at two facilities (see Well Group 5b); overall, Cr6 concentrations are typically very low in these deep-zone wells.
- **Well Group 5b** (deep wells): Deep wells associated with two Cr6 source facilities (ITT and Menasco) located in the primary source area upgradient of the GNOU remedy extraction wells.

Exposure point concentrations (EPCs) were calculated for Cr6 in groundwater from each of the assumed well groups using ProUCL Version 5.0 (EPA, 2013). Additional details on the development of EPCs for each well group are provided in Appendix H.

It should be noted that most of the data points included in the well groups described above are from monitoring wells installed specifically to characterize potential releases from contaminant sources and associated downgradient migration. Sampling results from these types of monitoring wells are often quite different from the data generated from deeper extraction wells that pump large volumes of water from screens covering significant vertical intervals in the aquifer. These deeper extraction wells in the GNOU and GSOU are the wells that produce water to be treated and distributed to the City of Glendale's water distribution system for use as drinking water. The GNOU and GSOU extraction wells are included with other deep monitoring wells in Well Group 5a (EPC of 20 µg/L). Monitoring wells located in the

immediate vicinity of contaminant sources are included in Well Groups 2, 3, and 5b (EPCs ranging from 242 µg/L to 14,681 µg/L). Monitoring wells located in the western part of the GCOU are in Well Group 1 (EPC of 3.7 µg/L), while monitoring wells at the southern extent of the GCOU, downgradient of the GSOU extraction wells are in Well Group 4 (EPC of 66 µg/L).

The effluent water that enters the City of Glendale's water distribution system following treatment and blending has Cr6 concentrations in the 3 to 5 µg/L range, which is consistent with Cr6 levels found in drinking water systems throughout the State of California. Based on data compiled by the DDW, 86 percent of the drinking water sources tested between 2000 and 2012 had peak Cr6 concentrations between 1 µg/L and 10 µg/L (DDW, 2014b).

7.1.2. Toxicity Assessment and Risk Characterization

Hexavalent chromium is considered by regulatory agencies to be a carcinogen via inhalation and oral routes of exposure. Hypothetical future exposure to Cr6 in GCOU groundwater is assumed to occur through potential ingestion, dermal contact, and inhalation (for example, while showering).

EPA has developed a Cr6 regional screening level (RSL) for tap water of 0.035 µg/L (EPA, 2014a) and the State of California public health goal (PHG) for Cr6 is 0.02 µg/L (Cal-EPA, 2011). It should be noted that ongoing evaluations are being conducted by both EPA and the State of California that could ultimately result in changes to the EPA RSL and the California PHG. EPA's Integrated Risk Information System program is actively reviewing potential risks associated with Cr6.

EPA, under the Superfund program, generally considers action to be warranted when the multi-chemical aggregate cancer risk for all exposure routes within a specific exposure scenario exceeds 1×10^{-4}. Remedial action is not explicitly required for risks falling between 1×10^{-6} and 1×10^{-4} (often called the risk management range); however, this is judged on a case-by-case basis (EPA, 1991). Considering the potential for future changes to the federal and state screening levels (RSL and PHG) that currently represent the lower end (1×10^{-6}) of EPA's risk management range, EPA decided not to develop numeric estimates of risks associated with theoretical exposure to Cr6 in GCOU groundwater. Instead, the EPCs are compared to the State of California MCL for Cr6 of 10 µg/L (DDW, 2014a) and the EPA MCL for CrT of 100 µg/L (EPA, 2014c).

Exhibit 7-1 presents the MCL exceedance ratio for each Well Group's EPC compared to the State of California MCL for Cr6 and the EPA MCL for CrT. The California Cr6 MCL exceedance ratio is less than 1 for Well Group 1 and above 1 for the other well groups. This means that only Well Group 1 has an EPC less than the California Cr6 MCL. The EPA total chromium MCL exceedance ratio is less than 1 for Well Groups 1, 4, and 5a, and above 1 for Well Groups 2, 3, and 5b.

Although the exceedance ratios in Exhibit 7-1 can be used to assess the impacts of hypothetical future residential exposure to untreated groundwater in various portions of the GCOU study area, it should be recognized that these ratios are not likely indicative of actual health outcomes and only provide a general frame of reference for risk management decision-making. Any actual impacts could be expected to be much lower, considering existing state and federal regulations that prohibit municipal use of water containing contaminant concentrations that exceed an MCL. In addition, as described in Appendix H, there are a number of other important uncertainties to consider in the evaluation of risks associated with potential exposure to Cr6 in GCOU groundwater.

EXHIBIT 7-1 MCL Exceedance Ratios for Total and Hexavalent Chromium

Exposure Area	Reasonable Maximum Exposure	MCL (µg/L)		MCL Exceedance Ratio	
	EPC (µg/L)	EPA (Total Chromium)	Cal-EPA (Cr6)	EPA (Total Chromium)	Cal-EPA (Cr6)
Well Group 1	3.7	100	10	0.0	0.4
Well Group 2	6,371	100	10	64	637
Well Group 3	242	100	10	2.4	24
Well Group 4	66	100	10	0.7	6.6
Well Group 5a	20	100	10	0.2	2.0
Well Group 5b	14,681	100	10	147	1,468

Notes:

MCL – maximum contaminant level
EPC – exposure point concentration
EPA – U.S. Environmental Protection Agency
Cal-EPA – California Environmental Protection Agency

7.2. Screening-Level Ecological Risk Assessment Addendum

The SLERA addendum was prepared to address potential ecological exposure to Cr6 and CrT in groundwater, including an updated evaluation of potential habitat and receptors in the GCOU area.

7.2.1. Background, Approach and Problem Formation

An ecological assessment was conducted for exposure to VOCs in Area 2 during the initial RI for the Glendale Study Area (JMM, 1992b). However, a complete ecological risk assessment (ERA) was not performed at that time because Area 2 was considered highly developed for commercial, industrial, and residential use; urbanization had reduced habitat quality, and significant wildlife populations and natural vegetative cover were not present. In addition, although some potential ecological receptors were identified in and near the Los Angeles River, it was concluded that groundwater discharges to the Los Angeles River, if any occurred, would be infrequent, seasonal, and localized. However, a recent focused evaluation of the potential for discharge from groundwater to the Los Angeles River was completed by EPA, and indicated groundwater could potentially discharge to surface water in both GNOU and GSOU depending on regional groundwater conditions (CH2M HILL, 2014). Therefore, as part of the GCOU RI, an ecological assessment addendum was prepared to address potential ecological exposure to Cr6 in groundwater, including an updated evaluation of potential habitat and receptors in the GCOU area, particularly along the Los Angeles River in the GCOU. This SLERA was completed using EPA guidance for conducting ecological risk assessment (EPA, 1997 and 1998).

7.2.1.1. Environmental Setting

An ecological field survey of the GCOU study area was conducted on September 24, 2014. The purpose of this survey was to identify habitat and receptors that could potentially be exposed to Cr6 in groundwater should discharge occur to the Los Angeles River. The earthen, unlined portions of the river support riparian vegetation, including native and non-native mature trees, but a majority of the locations contained non-native species. The vegetation and wildlife species observed during the field survey are listed in Appendix G.

7.2.1.2. Special-Status Plants and Animals

The potential for special-status species was assessed based on the field survey and a search of the CDFW California Natural Diversity Database (CDFW, 2015a, 2015b, and 2015c). Three special-status avian species have been documented within 1-mile of the Los Angeles River; however, none of these species has a high probability of being present at the site because of the limited suitable habitat. A variety of species protected under the Migratory Bird Treaty Act and birds protected under CDFW code are present along the river.

7.2.1.3. Ecological Conceptual Site Model

The ecological CSM described in Appendix G illustrates exposure pathways evaluated in the SLERA and provides other key information such as chemical sources, release and transport mechanisms, and the relative importance of exposure pathways to specific receptor groups.

The SLERA is limited to an evaluation of chromium (primarily Cr6). Other contaminants of potential ecological concern, primarily VOCs, are also present in groundwater at elevated concentrations. However, this SLERA was prepared in support of the GCOU RI and does not consider VOCs. Data from groundwater wells closest to the Los Angeles River were evaluated for use in the SLERA. These wells are clustered into subgroups within HHRA Well Groups 2, 3, and 4 and are named Ecological Well Groups 2a, 3a, 3b, 3c, 3d, 3e, and 4a (Appendix G, Figure 1).

Considering the potential for groundwater discharge to the unlined portions of the Los Angeles River, there are potentially complete exposure pathways from groundwater to sediment pore water and surface water in the river. Specifically, there are potential exposure pathways from surface water to aquatic organisms (aquatic plants, water-column invertebrates, amphibians, and fish), aquatic reptiles, aquatic birds, and mammals. Additionally, aquatic invertebrates and rooted aquatic/riparian plants may be exposed to groundwater via sediment pore water; deep-rooting plants such as riparian trees and shrubs may have a direct exposure pathway to groundwater, which is less than 10 feet below the river bottom along the unlined portions of the river.

Potentially complete/significant exposure pathways to ecological receptors that are evaluated in the SLERA include the following:

- Direct contact and ingestion of chromium in surface water by aquatic organisms (aquatic plants, water-column invertebrates, amphibians, and fish);
- Direct contact/root uptake of chromium from pore water or groundwater by plants; and
- Ingestion of chromium in surface water and food-chain transfer of chromium in surface water through ingestion of contaminated aquatic plants, aquatic invertebrates, and/or fish by higher trophic-level wildlife (reptiles, birds, and mammals).

For the purposes of the SLERA, the following assessment endpoint entities and representative bird and mammal receptors were evaluated:

- Aquatic organisms – aquatic plants, water-column invertebrates, amphibians, and fish potentially present in the Los Angeles River;
- Riparian plants – present in the unlined portions of the Los Angeles River;
- Aquatic reptiles (for example, turtles) – potentially present in the Los Angeles River;

- Mallard (omnivorous bird) – observed at all three field survey locations; evaluated in this SLERA as an herbivore (100 percent plant diet) and an insectivore (100 percent aquatic invertebrate diet);
- Great blue heron (piscivorous bird) – observed at two field survey locations;
- Little brown bat (insectivorous mammal) – surrogate for bat species that may forage in the riparian areas of the Los Angeles River; and
- Raccoon (omnivorous mammal) – may forage in the Los Angeles River; evaluated as a piscivore (100 percent fish diet).

7.2.2. Risk Characterization

The Risk Characterization includes the following three main components: Risk Estimation, Risk Description, and Uncertainty Analysis. These three components were used together to identify and evaluate the potential risks and make recommendations for the site.

7.2.2.1. Risk Estimation

The results of the Risk Estimation are presented as hazard quotients (HQs). For the SLERA, HQs were calculated by direct comparisons of measured concentrations in groundwater with the ecological screening values (ESVs) for aquatic organisms, rooted aquatic plants and riparian plants, and aquatic birds and mammals.

Exposure and effects information for reptiles were limited or lacking, precluding development of appropriate benchmarks for aquatic reptiles. Therefore, risk analyses for birds were identified as a surrogate for aquatic reptiles.

All initial evaluations were completed using the maximum detected concentration within each well group and screening-level benchmarks (aquatic organisms, and rooted aquatic/riparian plants) or low toxicity reference value (TRV) benchmarks (no observed adverse effects level based) (birds and mammals). HQs equal to or exceeding 1 indicates the potential for unacceptable risk because the constituent concentration (exposure) exceeds the screening value (effect). HQs less than 1 indicate that unacceptable risks are unlikely. Additional qualitative evaluation in the risk description is provided for exposure/receptor combinations with HQs greater than 1.

Maximum, undiluted Cr6 and/or total Cr concentrations in Ecological Well Group 4a exceeded one or more of the aquatic organism and rooted aquatic plant/riparian plant benchmarks. Additionally, one or more low TRV-based benchmarks for multiple bird and mammal receptors were exceeded in each Ecological Well Group (Appendix G).

Refined risks are discussed by receptor below.

Aquatic Organisms. There were no exceedances of the criterion-continuous concentration (CCC; chronic) benchmarks for aquatic organisms in Ecological Well Groups 2a, 3d, or 3e; therefore, there are no unacceptable risks to aquatic organisms in the areas of the river adjacent to these well groups. The maximum undiluted concentration of total Cr in Ecological Well Group 4a exceeded the CCC; however, the 95 UCL undiluted concentration did not exceed the CCC. Therefore, no unacceptable risks are predicted. Exposure is also reduced when the dilution factor of 10 is applied, which adds support to this risk conclusion.

The overall conclusion is that there are no unacceptable risks to aquatic organisms (aquatic plants, water-column invertebrates, amphibians, and fish) from groundwater discharge to the Los Angeles River.

Rooted Aquatic Plants and Riparian Plants. Rooted-aquatic plants may be exposed via groundwater discharge to sediment pore water, whereas deep-rooted riparian plants (such as trees and shrubs) may be directly exposed to groundwater at the site depending on the depth to groundwater.

- Rooted aquatic plants – As with aquatic organisms, no unacceptable risks to rooted aquatic plants were predicted for Ecological Well Groups 2a, 3d, or 3e. No unacceptable risks were predicted in Ecological Well Group 4a when the ESV for plants was compared to the 95UCL. Application of the dilution factor further reduces potential exposure and risk.
- Deep-rooted riparian plants – No unacceptable risks to deep-rooted riparian plants for Ecological Well Groups 2a, 3d, or 3e were predicted. No unacceptable risks were predicted in Ecological Well Group 4a when the ESV for plants was compared to the 95 UCL. During the site field survey, no obvious signs of stressed vegetation were observed in this portion of the river. This provides further support for the risk conclusion.

The overall conclusion is that there are no unacceptable risks to rooted aquatic plants or deep-rooted riparian plants from groundwater or groundwater discharge to sediment pore water in the Los Angeles River.

Birds and Mammals. Results of the initial screening indicate that there are no unacceptable risks to piscivorous birds and mammals as represented by the great blue heron or raccoon. For the remaining receptors, there were exceedances of either the low TRV-based benchmark, the high TRV-based benchmark, or both at Ecological Well Groups 2a, 3d, 3e, and 4a for total Cr, and at Ecological Well Group 2a for Cr6. Therefore, risks to these receptors were refined by:

- The 95 UCL concentrations for these Ecological Well Groups were used for EPCs;
- 95 UCL concentrations of total Cr and Cr6 were diluted to more accurately represent discharge to surface water by using a dilution factor of 10 as recommended in Buchman (1999); and
- Low and high TRV-based benchmarks for the little brown bat that were calculated using a water-to-emergent aquatic insect bioconcentration factor of 600 were used.

When these refinements were applied to risk estimation, the diluted 95 UCL for Cr6 was less than the low TRV-based benchmarks for the herbivorous and insectivorous mallard, as well as for the little brown bat (see Appendix G, Table 9). The diluted 95 UCL for total Cr at Ecological Well Groups 2a, 3d, and 3e was less than the low TRV-based benchmarks for the herbivorous mallard, insectivorous mallard, and little brown bat. Therefore, no unacceptable risks to these receptors are predicted for Ecological Well Groups 2a, 3d, and 3e.

For Ecological Well Group 4a, the diluted 95 UCL for total Cr was less than the low TRV-based benchmarks for the insectivorous mallard and little brown bat. The low TRV-based benchmark for herbivorous mallard was slightly exceeded (HQ = 1.004), but the high TRV-based benchmark was not exceeded (HQ = 0.17). Because the mallard is not a special-status species and special-status avian species are not likely to be present at the site, unacceptable risks to avian populations are not predicted. It also should be noted that the Group 4a wells are about 1,000 feet to the east of the river and may not represent concentrations of groundwater under or near the river. Well data from locations closer to the

river in Ecological Well Group 3e (immediately to the north) suggest that chromium concentrations decrease as the distance from the groundwater well to the river decreases. Therefore, total Cr concentrations in Ecological Well Group 4a are likely overestimated, and thus exposure and risks to receptors in the river are likely overestimated.

The overall conclusion is that there are no unacceptable risks to aquatic birds and mammals from groundwater discharge to surface water in the Los Angeles River.

Aquatic Reptiles. Risk analyses for birds were identified as a surrogate for aquatic reptiles because of limited or lacking exposure and effects information for reptiles. Based on the results for avian receptors, risks to aquatic reptiles from exposure to Cr6 are not predicted for any Ecological Well Group, and risks to aquatic reptiles from exposure to total Cr are not predicted for Ecological Well Groups 2a, 3d, or 3e. Potential risk to individual aquatic reptiles may exist for Ecological Well Group 4a (exceedance of the low TRV-based benchmark observed for herbivorous mallard); however, as with birds, there were no special-status reptiles identified at the site and risks to populations are not predicted (that is, the high TRV-based benchmark for herbivorous mallard was not exceeded).

7.2.2.2. Uncertainties

Uncertainties are inherent in all aspects of a SLERA. The nature and magnitude of uncertainties depend on the amount and quality of the data available, the degree of knowledge concerning site conditions, and the assumptions made to perform the risk assessment. A qualitative evaluation of the major uncertainties associated with this assessment is presented in Appendix G.

As described in Section 7.1.2.3, the SLERA addendum only evaluated potential Cr6 risk, and does not evaluate total risk from potential exposure to all contaminants in groundwater at the site. A baseline HHRA was conducted for exposure to VOCs and metals in groundwater (JMM, 1992b); however, those results are not incorporated into this SLERA addendum. The contributions from other chemicals known to be present in GCOU groundwater would result in higher total risks and hazards than the estimates provided herein.

8.0 SUMMARY AND CONCLUSIONS

This section summarizes key findings and conclusions from the GCOU RI, and presents recommendations for future work in support of the forthcoming FS.

8.1. PROJECT OBJECTIVES

EPA's primary objectives for the GCOU RI were to evaluate the following within the GCOU study area:

- The nature and extent of chromium in groundwater;
- The fate and transport of chromium in groundwater;
- The potential threat to human health and the environment from chromium in groundwater; and
- Determine if further investigation is needed.

This report was prepared to document the methods used to conduct the GCOU RI and to summarize and present the results of data collection and risk evaluation efforts. The findings presented in this RI Report will be used to develop an FS to evaluate a range of remedial alternatives to address chromium contamination in GCOU groundwater.

8.2. SCOPE OF WORK OVERVIEW

The GCOU RI included a comprehensive assessment of groundwater conditions from multiple locations throughout the study area. The data collection activities conducted by EPA during the GCOU RI included preliminary data evaluation and work planning, three phases of field investigation and data evaluation, groundwater sampling and water level measurements, and compilation of data from EPA's investigation and other sources.

Nineteen groundwater monitoring wells were installed by EPA at 18 different locations. A phased approach was used to review incoming data, and iteratively fill data gaps and optimize well locations as the fieldwork for the GCOU RI progressed. In support of the GCOU RI, the GCOU Respondents installed 12 groundwater monitoring wells at 11 locations.

EPA also collected groundwater samples from 67 new and existing monitoring wells during the GCOU RI, and measured groundwater levels during quarterly GCOU and semiannual SFV basinwide monitoring events. The GCOU Respondents, the GRG, and individual SFV facilities collected additional groundwater levels and groundwater samples during scheduled monitoring events.

8.3. FINDINGS

The following sections present the key findings of the GCOU RI.

8.3.1. Primary Sources

Historic uses of chromium in the San Fernando Valley reportedly included corrosion control in cooling towers, metal finishing, pickling, anodizing, and plating operations by various manufacturers. These activities sometimes resulted in the release of chromium. EPA and the State continue to actively pursue and investigate industrial facilities as potential sources of chromium. Based on the results of these source identification activities, at least 14 facilities were identified (Table 5-1) where chromium impacts to groundwater are documented or under investigation within the GCOU study area.

Investigations and cleanup activities are ongoing or have been completed at several of the known and suspected chromium source facilities in the GCOU study area. To date, various cleanup activities to

address chromium in the vadose zone have been conducted at identified chromium sources, as summarized in Table 5-1.

8.3.2. Nature and Extent of Contamination

Dissolved chromium is present in groundwater at detectable concentrations across much of the GCOU study area. The sources of low concentrations (generally below State and Federal MCLs) of Cr6 and CrT in the western and northern GCOU study area are not known, but may include historical migration of diffuse plumes from upgradient sources in SFV Area 1 (BOU and NHOU). The Cr6 concentrations in the western part of the GCOU study area are generally within the range of the state MCLs.

In nearly all groundwater samples collected during the GCOU RI, results for CrT and Cr6 from individual wells were approximately equal, indicating that nearly all dissolved CrT (comprised of Cr3 plus Cr6 concentrations) in the GCOU study area groundwater consists of Cr6, rather than Cr3. Because Cr6 is the predominant dissolved chromium ion, and because of its lower MCL (10 µg/L) compared to the MCL for CrT (50 µg/L), the primary focus of the GCOU RI is on Cr6.

Based on data collected to date, the sources of elevated chromium concentrations (greater than the MCLs) in groundwater in the eastern part of the GCOU study area are likely associated with point source (facility) releases. The main, elongated plume likely results from commingling of several, smaller plumes emanating from individual facilities and is characterized by Cr6 and CrT concentrations ranging from 10 µg/L to more than 1,000 µg/L (Figures 5-2 through 5-4), depending on proximity to the source facilities. Two possibly distinct plumes exist in the eastern GCOU study area: one at the former Dynamic Plating facility and the other emanating from the former All Metals Processing facility.

There is uncertainty in the continuity of the chromium plume south of monitoring wells CS-C06-185, CS-VPB-06, and V13PRW39 and north of the two Drilube facilities (Figure 5-4). Additionally, there is uncertainty about other potential source(s) contributing to the Cr6 plume to the south of the Drilube facilities (Figure 5-4).

8.3.3. Fate and Transport

Residual chromium in the vadose zone at source facilities likely continues to percolate downward, particularly when mobilized by infiltrating water during and after periods of heavy rainfall, providing an ongoing source of chromium to groundwater. However, investigation and remediation of source facilities is continuing under State and EPA oversight and significant remediation of Cr6 has occurred or is ongoing at nearly all of the identified chromium source facilities (as summarized in Table 5-1).

Transport of dissolved chromium in groundwater from point and non-point sources in the GCOU study area occurs under the influence of the southeasterly to southerly regional hydraulic gradient, to potential discharge points. Discharge of chromium-contaminated groundwater to water-supply wells or to the Los Angeles River could theoretically result in exposure of human or ecological receptors to chromium via ingestion, inhalation, or dermal contact.

The chromium transported via advection through the GCOU study area may:

- be withdrawn by the GNOU and GSOU extraction wells;
- potentially discharge to the Los Angeles River in the Los Angeles River Narrows (to be further investigated), or
- continue to migrate with groundwater into SFV Area 4 (Pollock OU).

The GRG conducted a hydraulic containment study to evaluate the effectiveness of the GNOU and GSOU extraction wells at intercepting COCs in groundwater (ERM, 2013b). The study found that the GNOU and GSOU extraction wells inhibited vertical and horizontal migration of VOCs in groundwater, but that the effectiveness of hydraulic containment was uncertain and could be improved. The GRG is currently in the planning stages for installation of an additional extraction well in the GSOU to enhance containment in this area. Based on the distribution of Cr6 in groundwater (extending past each extraction well field), the extraction wells do not appear to be preventing all downgradient migration of shallow Cr6 contamination at present, particularly near the water table.

An evaluation of the potential for discharge of contaminants into the Los Angeles River (CH2M HILL, 2014) concluded that groundwater in the southern portion of the Los Angeles River Narrows area could discharge to the Los Angeles River where groundwater elevations are higher than the bottom of the unlined river channel or during high groundwater conditions. Determination of the rates of groundwater discharge and contaminant mass flux to the Los Angeles River was beyond the scope of the initial evaluation; however, EPA intends to have the assessment completed in the future.

Increasing Cr6 concentrations were detected in the shallow zone at cluster well CS-VPB-06, located approximately one mile south of the GNOU extraction well field, suggesting that Cr6 contaminated groundwater is migrating into the GSOU. In addition, chromium contamination detected south of the GSOU extraction wells appears to be entering the Area 4 (Pollock OU). The EPA will conduct investigations to delineate the nature and extent of chromium contamination in Area 4.

8.3.4. Risk Assessment

Results of the HHRA addendum indicate that the Cr6 EPC is less than the California MCL for Well Group 1 (referred to as an “exceedance ratio” of less than 1 in the HHRA addendum) but greater than the MCL for all the other well groups (referred to as an “exceedance ratio” greater than 1). Although these exceedance ratios can be used to assess the potential impacts of hypothetical future residential exposure to untreated groundwater, it should be recognized that these ratios are not likely indicative of actual health outcomes and only provide a general frame of reference for risk management decision making. Any actual impacts are expected to be much lower, considering existing state and federal regulations that prohibit municipal use of water containing contaminant concentrations that exceed an MCL.

Results of the SLERA indicate that there are no unacceptable risks to aquatic organisms, aquatic bird populations or mammals from potential groundwater discharge to the Los Angeles River. Based on the results for aquatic birds, unacceptable risks to aquatic reptiles are also unlikely. Additionally, there are no unacceptable risks to rooted aquatic plants or deep-rooted riparian plants (such as trees and shrubs) from groundwater discharge to sediment pore water or to deep-rooted riparian plants from direct contact with groundwater.

8.4. Overall Conclusions

The GCOU RI achieved the objectives of evaluating the nature and extent, fate and transport, and potential risk associated with chromium in groundwater. The primary conclusions of the GCOU RI are as follows:

1. **Groundwater impacts are primarily the result of point source facilities within the GCOU Study Area**. Prior and ongoing investigations have identified chromium releases from several facilities

throughout the study area, which have contributed to an elongated main plume through the eastern GCOU study area, and smaller individual plumes to the northwest and southeast.

2. **Nearly all chromium impacts consist of hexavalent chromium, and are within the footprint of larger VOC impacts**. In general, Cr6 concentrations are nearly equal to CrT concentrations. In most areas of the GCOU study area, dissolved Cr6 in groundwater is comingled with TCE and PCE plumes, indicating the likely contribution from common sources for all of these contaminants. However, the lateral and vertical extent of the TCE and PCE plumes exceeding the MCL is significantly larger than the extent of the Cr6 and CrT plume exceeding the MCL.

3. **The lateral and vertical extents of the main plume have been largely delineated.** The lateral extent of the main plume extends from the northern portion of Area 2 to approximately 750 feet south of the Area 2/Area 4 boundary, and is up to 1,500 feet wide. The vertical extent of the main plume is limited to the upper 100 feet of the aquifer, with some shallow perched water bearing zone impacts particularly in the northern portion of the GCOU study area. Uncertainties on continuity of groundwater contamination between the northern and southern portions of the main Cr6 plume remain.

4. **The GNOU/GSOU extraction system may not provide complete capture of the chromium plume.** Elevated and increasing chromium concentrations are observed in the area between the GNOU and GSOU extraction well fields. In addition, the RI data indicate it is likely that contaminated groundwater has migrated into Area 4 where it could potentially represent a threat to down-gradient well fields.

8.5. Data Limitations and Recommendations for Future Work

Evaluation of the nature and extent of chromium impacts to groundwater is complex and challenging because of the large size of the GCOU study area and the large number of known and suspected chromium-source facilities. Detailed investigation and remediation of several source facilities is being conducted under state and EPA oversight on a site-specific basis. Furthermore, the results presented in this report are based on field investigations and groundwater sampling conducted over a limited amount of time relative to the time scale of the initial releases and subsequent migration of chromium in groundwater. Data are available from previous investigations conducted within the GCOU study area; where applicable and of suitable quality, these data were incorporated into this RI.

Specific data gaps that could be addressed as part of the planned FS include:

- A data gap exists between the northern and southern portions of the Cr6 plume, as illustrated on Cross Section E-E' (Figure 4-8). The increasing concentration trends observed at monitoring well CS-VPB-06 may indicate further plume migration into the data gap area.
- Additional unidentified sources may be contributing to the chromium plume south of the two Drilube facilities.
- The continuity of the Dynamic Plating and All Metals plumes with the main chromium plume is uncertain.
- Chromium concentration trends at the southern limit of the GCOU study area and into Area 4, particularly along the western margin of the southern plume between the GSOU extraction well field and Los Feliz and Glendale Boulevards have not been evaluated.

- Investigate whether Cr6 and CrT are migrating south or southwest toward the Los Angeles River, where groundwater may discharge to surface water.
- Evaluate the effectiveness of the existing GSOU/GNOU remedy to capture the Cr6/CrT plume.

In addition, EPA will consider future recommendations by the GCOU Respondents regarding additional data collection needed to support the FS.

9.0 REFERENCES

Amec. 2014. Request for Decommissioning the Perched Zone Groundwater Treatment Extraction and System – Former Menasco Aerospace Facility – 100 East Cedar Avenue, Burbank, California – File No. 109.0842, Site ID: 1843900. August 27.

_____. 2015a. Fourth Quarter 2014 Groundwater Monitoring Report, October through December 2014 – Waste Discharge Permit – In Situ Treatment of Hexavalent Chromium and Volatile Organic Compounds in Perched Groundwater – Former Menasco Aerospace Facility – 100 East Cedar Avenue, Burbank, California – File No. 109.0842, Order No. R4-2007-0019, Series No. 024, CI-9293 – Global ID WDR100001639. January 14.

_____. 2015b. Perched Zone Groundwater Extraction and Treatment System Decommissioning Report – Former Menasco Aerospace Facility – 100 East Cedar Avenue, Burbank, California – File No. 109.0842, Cleanup and Abatement Order No. R4-2002-0078, File No. 109.0842, Site ID: 1843900. January 14.

Buchman, M.F. 1999. NOAA screening quick reference tables. NOAA HAZMAT Report 99-1, Seattle, WA. 12 pp.

California Department of Fish and Wildlife (CDFW). 2015a. Natural Diversity Database. Special Animals List. Periodic publication. 51 pp. March.

_____. 2015b. Natural Diversity Database. Special Vascular Plants, Bryophytes, and Lichens List. Quarterly publication. 125 pp. April 2015.

_____. 2015c. State and Federally Listed Endangered, Threatened, and Rare Plants of California, updated October 2015 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=109390&inline=1

California Department of Water Resources (CDWR). 2003a. California Laws for Water Wells, Monitoring Wells, Cathodic Protection Wells, Geothermal Heat Exchange Wells. March.

_____. 2003b. California's Groundwater Bulletin 118. Update 2003. October.

_____. 2014. Groundwater Information Sheet – Hexavalent Chromium. May.

California Department of Public Health (CDPH). 2014. California Regulations Related to Drinking Water, July 1, 2014 (Revisions effective on 7/1/14). July.

California Environmental Protection Agency (Cal-EPA). 2011. Public Health Goal for Hexavalent Chromium (Cr VI) in Drinking Water. Pesticide and Environmental Toxicology Branch, Office of Environmental Health Hazard Assessment. July. http://oehha.ca.gov/water/phg/pdf/Cr6PHG072911.pdf

California State Water Resources Control Board, Division of Drinking Water (DDW). 2014a. Comparison of MCLs and PHGs for Regulated Contaminants in Drinking Water. Last updated June 1. http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/MCLsandPHGs.shtml

_____. 2014b. Chromium-6 in Drinking Water Sources: Sampling Results. Last updated July 11. http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Chromium6sampling.shtml.

CCI. 2009. Groundwater Monitoring Well Installation and Sampling Report, J&M Anodizing, 525 South Flower Street, Burbank, CA 91520. RWQCB File No. 109.0588. December 18.

CDM Smith. 2014. WBA Relocation Conceptual Design Technical Memorandum, City of Glendale, California. December.

CH2M HILL. 2005. Burbank and Glendale Operable Units, Focused Chromium Trend Study, Final Technical Memorandum. June.

_____. 2007. Priority Ranking of Potential Well Sites for Chromium Monitoring, Burbank and Glendale Operable Units, Draft Technical Memorandum. April 10.

_____. 2014. *Technical Memorandum – Preliminary Evaluation of Potential Discharge of Ground Water to the Los Angeles River in Glendale North and Glendale South Operable Units*. Prepared for U.S. Environmental Protection Agency, Region 9. August 13.

City of Glendale. 2002. Motion adopting 5 ppb goal for chromium 6 by the Glendale City Council at its regular meeting held on Tuesday, January 29, 2002.

City of Los Angeles. 2007. Los Angeles River Revitalization Master Plan. April

County of Los Angeles. 2014. Los Angeles County Department of Public Health Requirements for Wells Construction/Decommissioning http://publichealth.lacounty.gov/eh/docs/ep_dw_decommission_req.pdf

ENVIRON International Corporation (ENVIRON). 2015. *2014 Semi-Annual Sampling and Analysis Report (November 2014 Sampling Event) – Former ITT Flower Street Site, 1200 Flower Street, Burbank/Glendale, California*. January 31.

Environmental Resources Management (ERM). 2011a. Data Compilation & Evaluation Report, Glendale Chromium Operable Unit, San Fernando Valley Superfund Site – Area 2. November.

_____. 2011b. Specified Work Plan, Glendale Chromium Operable Unit, San Fernando Valley Superfund Site – Area 2. November.

_____. 2011c. Quality Assurance Project Plan (QAPP), Glendale Chromium Operable Unit, San Fernando Valley Superfund Site – Area 2. November.

_____. 2012a. Focused Feasibility Study Revised Final Field Sampling Plan, San Fernando Valley Superfund Sites Area 2 – Crystal Springs, Glendale North and Glendale South Operable Units. February.

_____. 2012b. Final Site Characterization Technical Memorandum, San Fernando Valley Superfund Sites, Area 2- Crystal Springs, Glendale North and Glendale South Operable Units. October.

_____. 2013a. Final Emerging Compounds Evaluation Technical Memorandum, San Fernando Valley Superfund Sites Area 2 – Crystal Springs, Glendale North and Glendale South Operable Units. March 4.

_____. 2013b. Final Hydraulic Containment Evaluation Technical Memorandum, San Fernando Valley Superfund Sites Area 2 – Crystal Springs, Glendale North and Glendale South Operable Units. March 8.

_____. 2013c. Final Extraction Well GS-1 Evaluation Technical Memorandum, San Fernando Valley Superfund Sites Area 2 – Crystal Springs, Glendale North and Glendale South Operable Units. April.

_____. 2013d. Spring 2013 Remedial Investigation Well Sampling Report, San Fernando Valley Superfund Sites, Area 2- Crystal Springs, Glendale North and Glendale South Operable Units. Prepared for the Glendale Respondents Group. June.

_____. 2013e. Revised Final Specified Work Report, Glendale Chromium Operable Unit, San Fernando Valley Superfund Site – Area 2. Prepared for the Glendale Chromium Operable Unit Respondents Group. October 21.

_____. 2014. Fall 2013 Remedial Investigation Well Sampling Report, San Fernando Valley Superfund Sites, Area 2- Crystal Springs, Glendale North and Glendale South Operable Units. Prepared for Glendale Respondents Group. January.

Geosyntec Consultants (Geosyntec). 2012. Comprehensive Data Analyses Report – Home Depot Development, 1200 Flower Street, Burbank/Glendale, California. July 23.

_____. 2013. Remedial Action Plan for Residual Hexavalent Chromium (RAP Amendment) – Home Depot Development, 1200 Flower Street, Burbank/Glendale, California. June 26.

_____. 2015. Treatment Status and Monitoring Report, Fourth Quarter 2014 – Home Depot Development, 1200 Flower Street, Burbank/Glendale, California. January 7.

James M. Montgomery, Consulting Engineers, Inc. (JMM). 1992a. Remedial Investigation of Groundwater Contamination in the San Fernando Valley, Remedial Investigation Report. December.

_____. 1992b. Remedial Investigation Report for the Glendale Study Area. Submitted to Department of Water and Power, City of Los Angeles, California. January.

Kleinfelder, Inc. (Kleinfelder). 2014. Excello Remediation Progress Report – Completion of Hexavalent Chromium Remediation Work Pursuant to Excello Parcel Prospective Purchaser Agreements – Former Excello Plating Co., Inc. Facility – 4057 and 4059 Goodwin Avenue, City of Los Angeles, County of Los Angeles, California. September 4.

_____. 2015. Soil Vapor Extraction Remediation Progress Report – Former Excello Plating Co., Inc. Facility – 4057 and 4059 Goodwin Avenue, Los Angeles, California – File No. 113.5243, Site No. 2040209. January 15.

Los Angeles Regional Water Quality Control Board (LARWQCB). 2002a. *Final Chromium VI Investigation Report, San Fernando Valley, California*. August.

_____. 2002b. Results of Chromium VI Investigation – Phase I, San Fernando Valley, California. November.

_____. 2011a. Approval of Feasibility Study/Remediation Action Plan Pursuant to California Water Code Section 13304 Under Cleanup and Abatement Order No. R4-2002-0078 at Goodrich Corporation (Former Menasco Aerospace), 100 East Cedar Avenue and Providencia Avenue, Burbank, California (Site ID No. 1843900; WIP File No. 109.0842). May 9.

_____. 2011b. Prospective Purchaser Agreement and Covenant Not to Sue. Former Excello Plating Co., Inc. Site – 4057 and 4059 Goodwin Avenue, Los Angeles, CA 90039 – APN: 5593-020-020. September.

_____. 2014. Approval for Decommissioning Soil Vapor Extraction System Components for Home Depot Facility, 1200 Flower Street, Burbank, California 91502 –RWQCB File No. 109.0582; Site ID No. 2040154. May 29.

MWH. 2014. Final Remedial Design Work Plan, Glendale North and South Operable Units Enhancement to the Interim Remedy, prepared on behalf of the Glendale Respondents Group. October 24.

National Climatic Data Center. 2014. 1981-2010 Station Normal of Temperature, Precipitation, and Heating and Cooling Degree Days—Station: BURBANK GLENDALE PASADENA AIRPORT, CA US. Download from National Climatic Data Center database (www.ncdc.noaa.gov).

Oneida Total Integrated Enterprises (OTIE). 2014. *Supplemental Investigation – Former Drilube Facility – Technical Memorandum – San Fernando Valley Superfund Sites, Glendale Chromium Operable Unit*. May 12.

Parker, B.L., S.W. Chapman, and M.A Guilbeault. 2008. Plume persistence caused by back diffusion from thin clay layers in a sand aquifer following TCE source-zone hydraulic isolation. *Journal of Contaminant Hydrology*. 102 (1-2): 86-104. November.

Stantec Consulting Corporation (Stantec). 2013. Chromium Remediation Confirmation Sampling and RAP Addendum No. 5 Investigation Report – PRC-DeSoto International, Inc. – 5430 San Fernando Road, Glendale, California 91209 – CAO No. R4-2002-0085, (Site ID No. 2030129, File No. 113.5886). February 20.

State Water Rights Board Referee. 1962. The City of Los Angeles, Plaintiff, vs City of San Fernando, et al., Defendants—No. 650079: Report of Referee. July.

Superior Court of the State of California for the County of Los Angeles. 1979. The City of Los Angeles, Plaintiff, vs City of San Fernando, et al., Defendants—No. 650079: Findings of Fact and Conclusions of Law. January 26.

Tang, Y., E.J. Elzinga, Y.J. Lee, and R.J. Reeder (Tang et al). 2007. Coprecipitation of chromate with calcite: Batch experiments and X-ray absorption spectroscopy. *Geochim. Cosmochim. Acta* 71: 1480-93.

Tetra Tech, 2010. Dynamic Soil Investigation at the Former Librascope-Glendale Facility Glendale, California. Volume I of II. April.

_____. 2014a. *Annual Groundwater Monitoring Report – Second Quarter 2014 – Burbank Operable Unit, Burbank, California*. July.

_____. 2014b. Additional Site Investigation Report – Former Lockheed Martin Plants A-1 North, B-1, B-6, and C-1, Burbank, California. December.

Todd, David Keith (Todd). 1980. *Groundwater Hydrology*. 2nd Edition. John Wiley & Sons, New York.

U.S. Army Corps of Engineers (USACE). 2013a. Los Angeles River Ecosystem Restoration Integrated Feasibility Report. Feasibility Study and Environmental Impact Statement/Environmental Impact

Report, Los Angeles County, California. Draft. Prepared by U.S. Army Corps of Engineers, Los Angeles District. September.

_____. 2013b. Second Five-Year Review Report for San Fernando Valley – Area 2 Superfund Site, Glendale, Los Angeles County, California. *September*.

U.S. Environmental Protection Agency (EPA). 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA – Interim Final (EPA/540/G-89/004). October.

_____. 1989. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Part A. EPA/540/1-89/002. December.

_____. 1991. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part B, Development of Risk Based Preliminary Remediation Goals), Interim Final (RAGS). EPA/540/R-92/003. December.

_____. 1993a. *Record of Decision (ROD) and Responsiveness Summary for Glendale South Operable Unit (GSOU)*. June 18.

_____. 1993b. *Record of Decision (ROD) and Responsiveness Summary for Glendale North Operable Unit (GNOU)*. June 18.

_____. 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final. Office of Solid Waste and Emergency Response. EPA 540-R-97-006. June.

_____. 1998. Final Guidelines for Ecological Risk Assessment, Risk Assessment Forum. U.S. EPA, Washington, D.C., EPA/630/R-95/002F. April. http://rais.ornl.gov/documents/ECOTXTBX.PDF.

_____. 2000. Guidance for the Data Quality Objectives Process - QA/G-4 (EPA/600/R-96/055). August.

_____. 2002a. Guidance on Environmental Data Verification and Data Validation (EPA QA/G-8). November (reissued in January 2008).

_____. 2002b. Guidance for Quality Assurance Project Plans - EPA QA/G-5 (EPA/240/R-02/009). December

_____. 2002c. Guidance for Choosing a Sampling Design for Environmental Data Collection – for Use in Developing a Quality Assurance Project Plan (EPA QA/G-5S). December.

_____. 2006. Guidance on Systematic Planning Using the Data Quality Objectives Process - QA/G-4 (EPA/240/B-06/001). February.

_____. 2007. *Monitored Natural Attenuation of Inorganic Contaminants in Ground Water: Volume 2, Assessment for Non-Radionuclides Including Arsenic, Cadmium, Chromium, Copper, Lead, Nickel, Nitrate, Perchlorate, and Selenium (EPA/600/R-07/140)*. Office of Research and Development. October.

_____. 2008a. *Letter Report Re: All Metals Processing Burbank, California Contract No.: EP-S9-06-01 TDD No.: T01-09-07-06-0002*. May 19.

_____. 2008b. *First Five-Year Review Report for San Fernando Valley – Area 2 Superfund Site, Los Angeles County, California*. September.

_____. 2009. *Final Report, Site Investigation, Former Drilube Facility, 716 and 718 W. Wilson Avenue, Glendale, California*. Prepared by CH2M HILL. October 30.

_____. 2010. *Letter Report San Fernando Valley, Area 2, OU4, Drilube-Mazmanian Site Removal Letter Report, 716 and 718 W. Wilson Avenue, Glendale, Los Angeles County, California*. Prepared by Ecology and Environment, Inc. October 30.

_____. 2011. *Administrative Settlement Agreement and Order on Consent for Specified Work in Support of a Remedial Investigation*. April.

_____. 2012a. *Remedial Investigation Work Plan, San Fernando Valley Area 2 Superfund Site, Glendale Chromium Operable Unit*. April.

_____. 2012b. *Field Sampling Plan, Remedial Investigation at San Fernando Valley Area 2 Superfund Site, Glendale Chromium Operable Unit*. April.

_____. 2012c. *Quality Assurance Project Plan, Remedial Investigation at San Fernando Valley Area 2 Superfund Site, Glendale Chromium Operable Unit*. April.

_____. 2012d. *Draft San Fernando Valley Superfund Sites Community Involvement Plan*. September.

_____. 2012e. *Final Report, Deep Soil Investigation, Former All Metals Processing Facility, 264 W. Spazier Avenue, Burbank, California*. Prepared by CH2M HILL. March.

_____. 2013. Statistical Software ProUCL 5.0.00 for Environmental Applications for Data Sets with and without Nondetect Observations. http://www2.epa.gov/land-research/proucl-software

_____. 2014a. Regional Screening Levels. http://www.epa.gov/region9/superfund/prg/

_____. 2014b. *Field Sampling Plan Addendum, Remedial Investigation at San Fernando Valley Area 2 Superfund Site, Glendale Chromium Operable Unit*. 5 May 2014.

_____. 2014c. "Chromium in Drinking Water" information downloaded from: http://water.epa.gov/drink/info/chromium/index.cfm

_____. 2014d. *Technical Memorandum, Supplemental Investigation, Former Drilube Facility, San Fernando Valley Superfund Sites, Glendale Chromium Operable Unit.* Prepared by OTIE with CH2M HILL. May 12.

_____. 2015. San Fernando Valley (All Areas) Superfund Site, General Notice Letter – Special Notice Letter Recipients. List available on EPA's website at http://yosemite.epa.gov/r9/sfund/r9sfdocw.nsf/webdisplay/oid-91548cdb0dca97bb88256e2b007b9d56?OpenDocument. Downloaded March.

Upper Los Angeles River Area Watermaster (ULARA Watermaster). 2002. Watermaster Service in the Upper Los Angeles River Area, Los Angeles County: 2000-2001 Water Year. May.

_____. 2003. Watermaster Special Report Concerning the History and Occurrence of Hexavalent Chromium Contamination in the San Fernando Basin and Watermaster Conclusions and Recommendations. January.

_____. 2013. Annual Report - 2011-2012 Water Year. May2003. Watermaster Special Report Concerning the History and Occurrence of Hexavalent Chromium Contamination in the San Fernando Basin and Related Watermaster Conclusions and Recommendations. January.

_____. 2014. *Annual Report - 2012-2013*. Watermaster Service in the Upper Los Angeles River Area, Los Angeles County: 2012-2013 Water Year: October 1, 2012 – September 30, 2013. December.

_____. 2015. Personal communication with Richard Slade (ULARA Watermaster) during a meeting with EPA and contractor staff. April 22.

FIGURES

Aerial Basemap Source: ESRI/CNES/Airbus DS

N

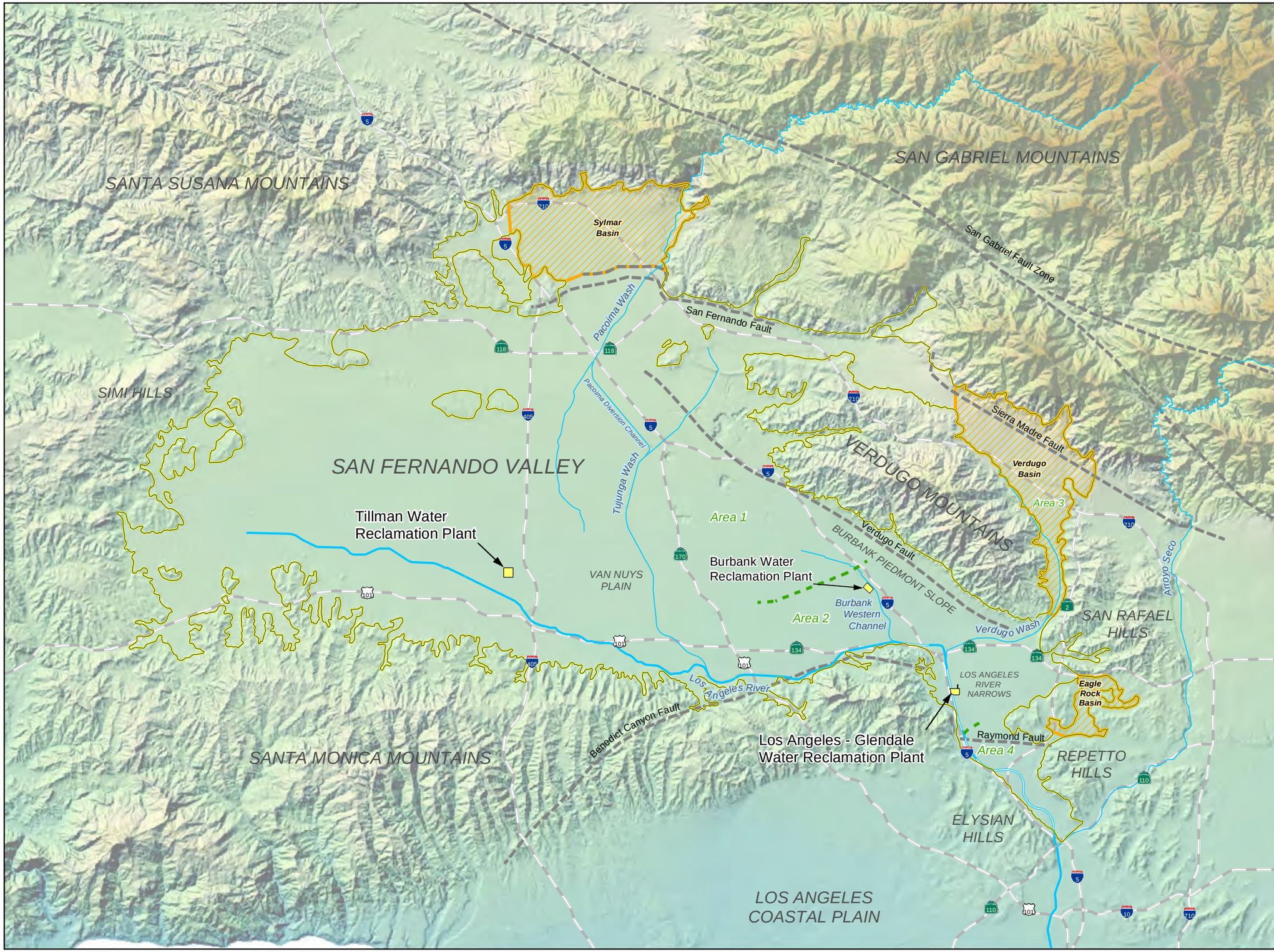
0 4 8 16 Miles

Figure 1-1
San Fernando Valley
Location Map

Glendale Chromium Operable Unit
San Fernando Valley Superfund Sites

OTIE
Oneida Total Integrated Enterprises

SCO \\CHERON\PROJECTS\EPA\386243GLENDALECHOU\GIS\MAPFILES\2015\RI_REPORT\LOCATION_MAP_150224.MXD BLECHLER 4/13/2015 8:50:06 PM



LEGEND

- San Fernando Basin
- Other Groundwater Basin in San Fernando Valley
- Water Reclamation Plant
- Approximate Boundaries of Investigation Areas for San Fernando Valley Superfund Sites
- Fault
- Freeway
- Los Angeles River
- Unlined Section of Los Angeles River
- Tributary of Los Angeles River

N

0 1.25 2.5 5 Miles

Figure 2-1
San Fernando Valley
Physical Features

Glendale Chromium Operable Unit
San Fernando Valley Superfund Sites

OTIE
Oneida Total Integrated Enterprises

SCO \\CHERON\PROJECTS\EPA\386243GLENDALECHOU\GIS\MAPFILES\2015\RI_REPORT\REVISEDDRAFT\GCOU_PHYSICAL_SETTING_REV.MXD BLECHLER 7/13/2015 4:25:00 PM

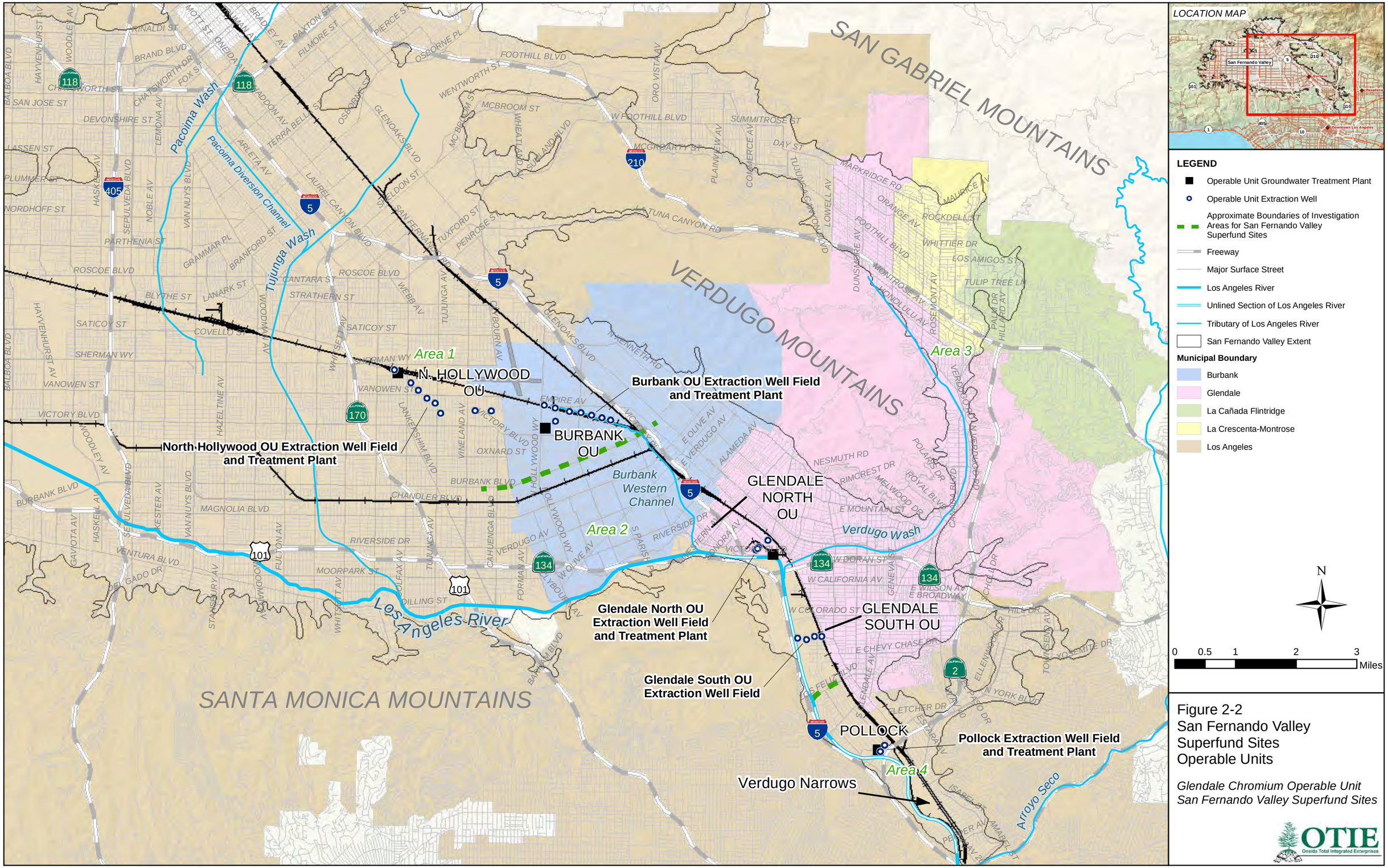
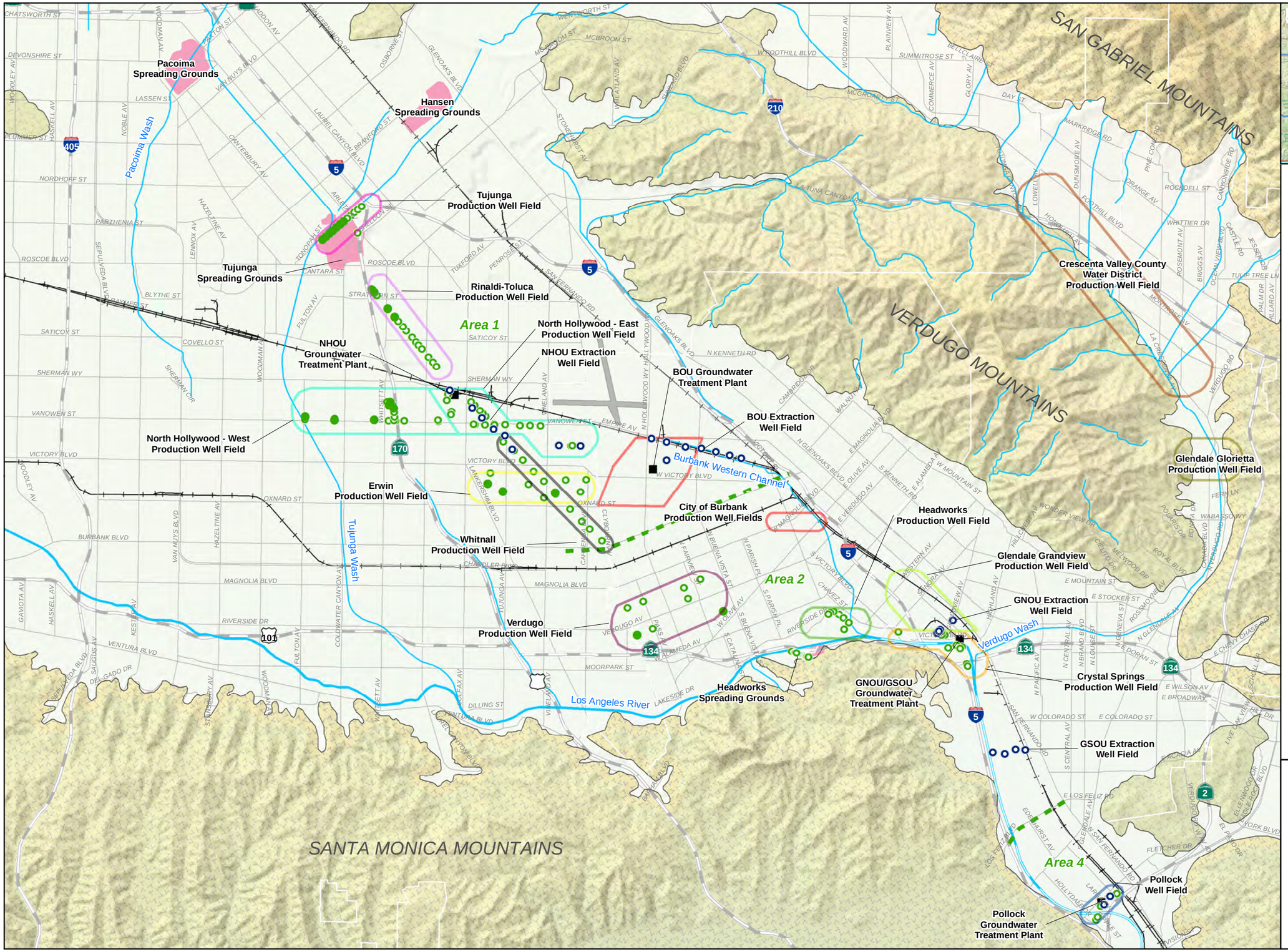


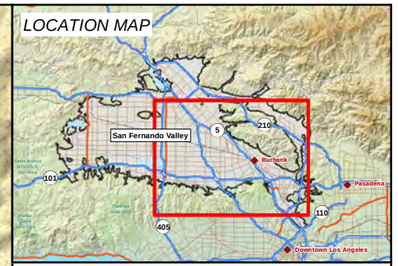
Figure 2-2
San Fernando Valley
Superfund Sites
Operable Units

Glendale Chromium Operable Unit
San Fernando Valley Superfund Sites

OTIE
Oneida Total Integrated Enterprises

SCO \\CHERON\PROJECTS\EPA\386243GLENDALECHOU\GIS\MAPFILES\2015\RI_REPORT\REVISEDDRAFT\OU_BOUNDARIES.MXD BLECHLER 7/13/2015 4:28:23 PM





LEGEND

- LADWP Production Well (pumping)
- LADWP Production Well (not pumping)
- Operable Unit Extraction Well
- Operable Unit Groundwater Treatment Plant
- Approximate Boundaries of Investigation Areas for San Fernando Valley Superfund Sites
- Freeway
- Major Surface Street
- Railroads
- Los Angeles River
- Unlined Section of Los Angeles River
- Stream
- Spreading Grounds

Pumping production wells are defined as greater than 100 acre-feet per year as reported during the 2011-2012 water year.

N

0 0.5 1 2 Miles

Figure 2-3
Production Well Fields and Recharge Basins in the Eastern San Fernando Basin

Glendale Chromium Operable Unit
San Fernando Valley Superfund Sites

OTIE
Oneida Total Integrated Enterprises

SCO P:\EPA 8ARAC\2013152 GLEND CR OU\F-FIGS_MAPS\RI REPORT\2-3 GCOUR INFILTRATION-EXTRACTION.MXD BAKTER 7/14/2015 7:37:11 AM

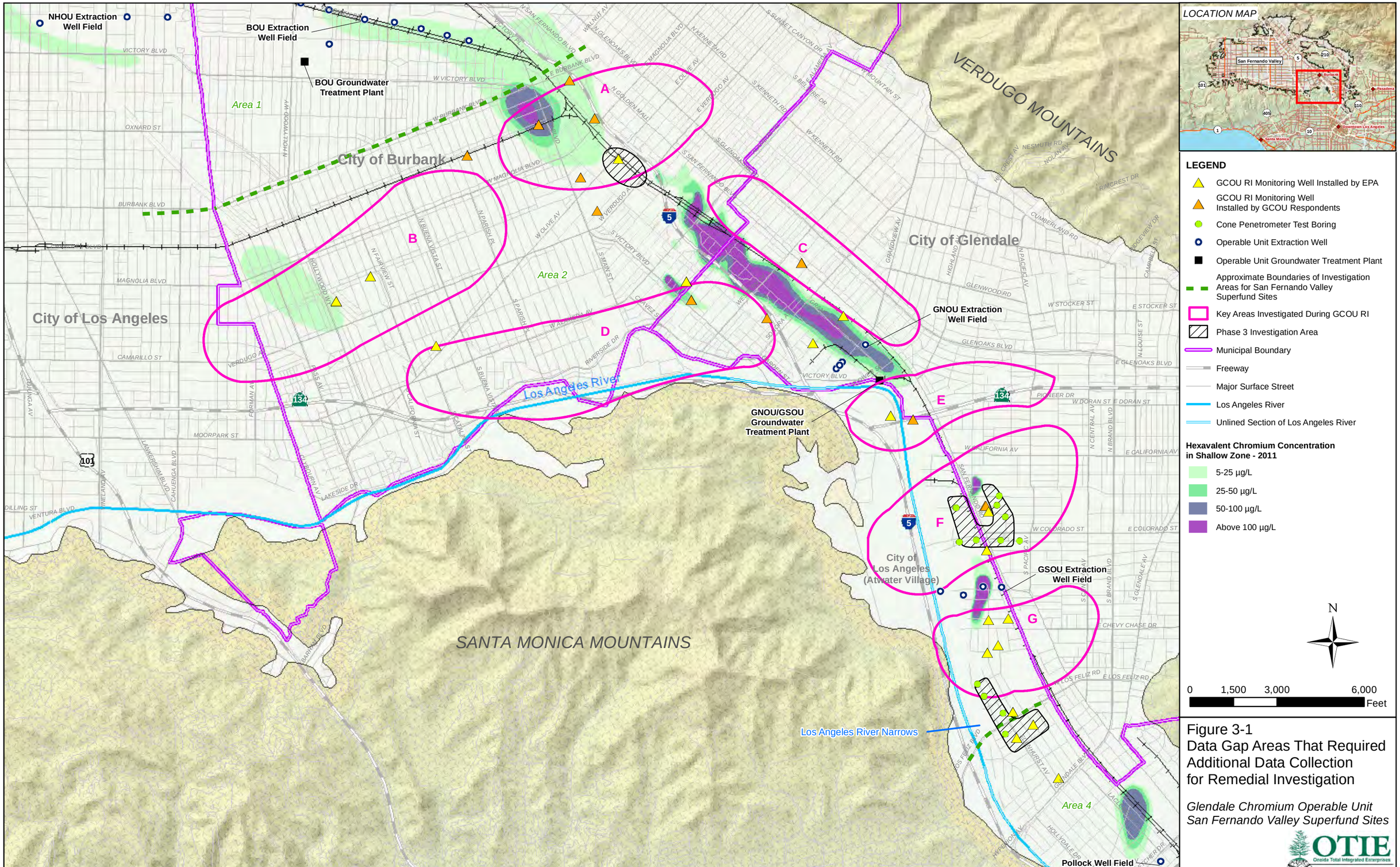


Figure 3-1
Data Gap Areas That Required Additional Data Collection for Remedial Investigation

Glendale Chromium Operable Unit
San Fernando Valley Superfund Sites

SCO \\CHERON\PROJECTS\EPA\386243GLENDALECHOU\GIS\MAPFILES\2015\RI_REPORT\REVISEDDRAFT\GCOU_STUDY_AREA.MXD BLECHLER 7/13/2015 4:44:27 PM

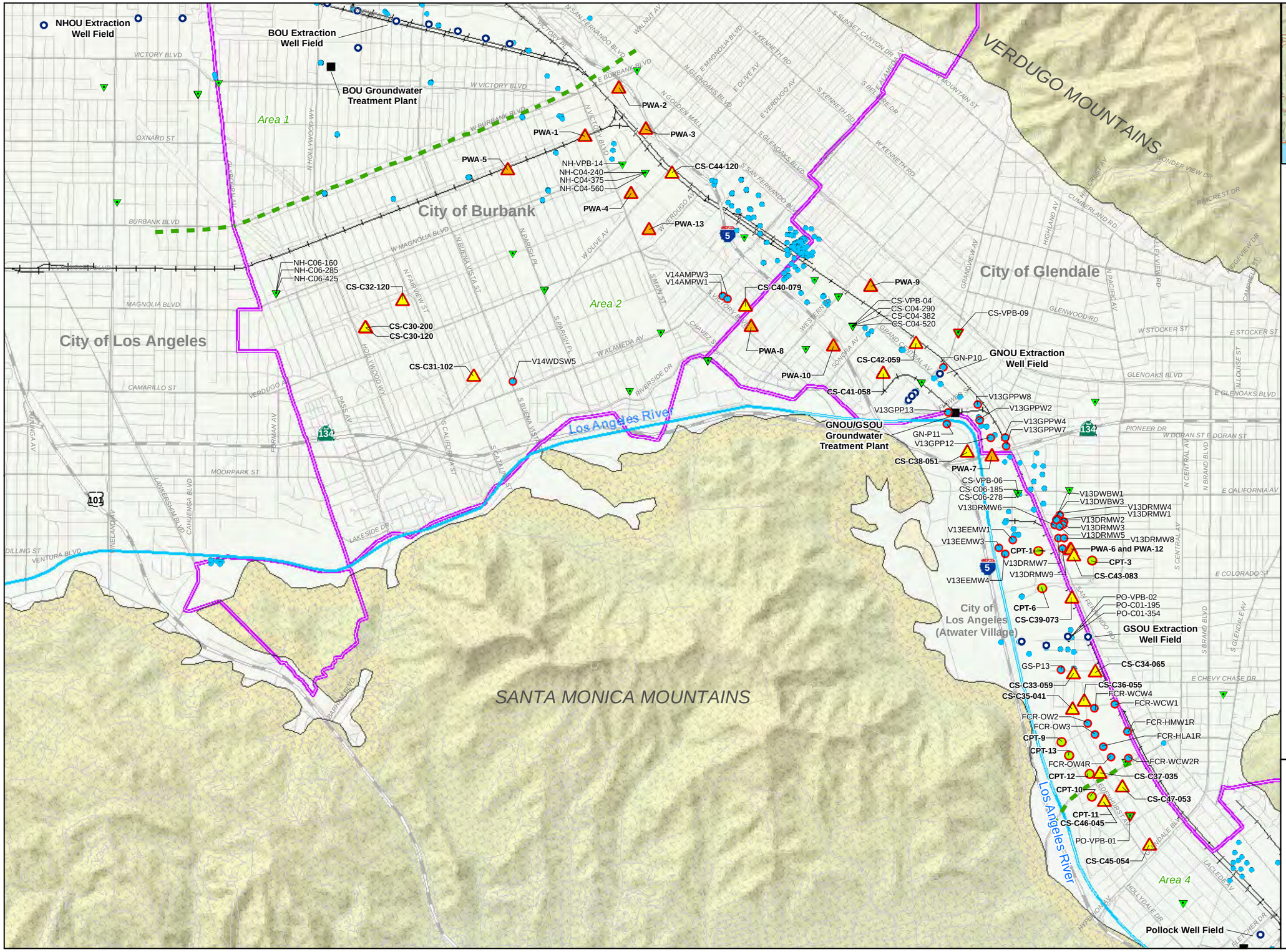
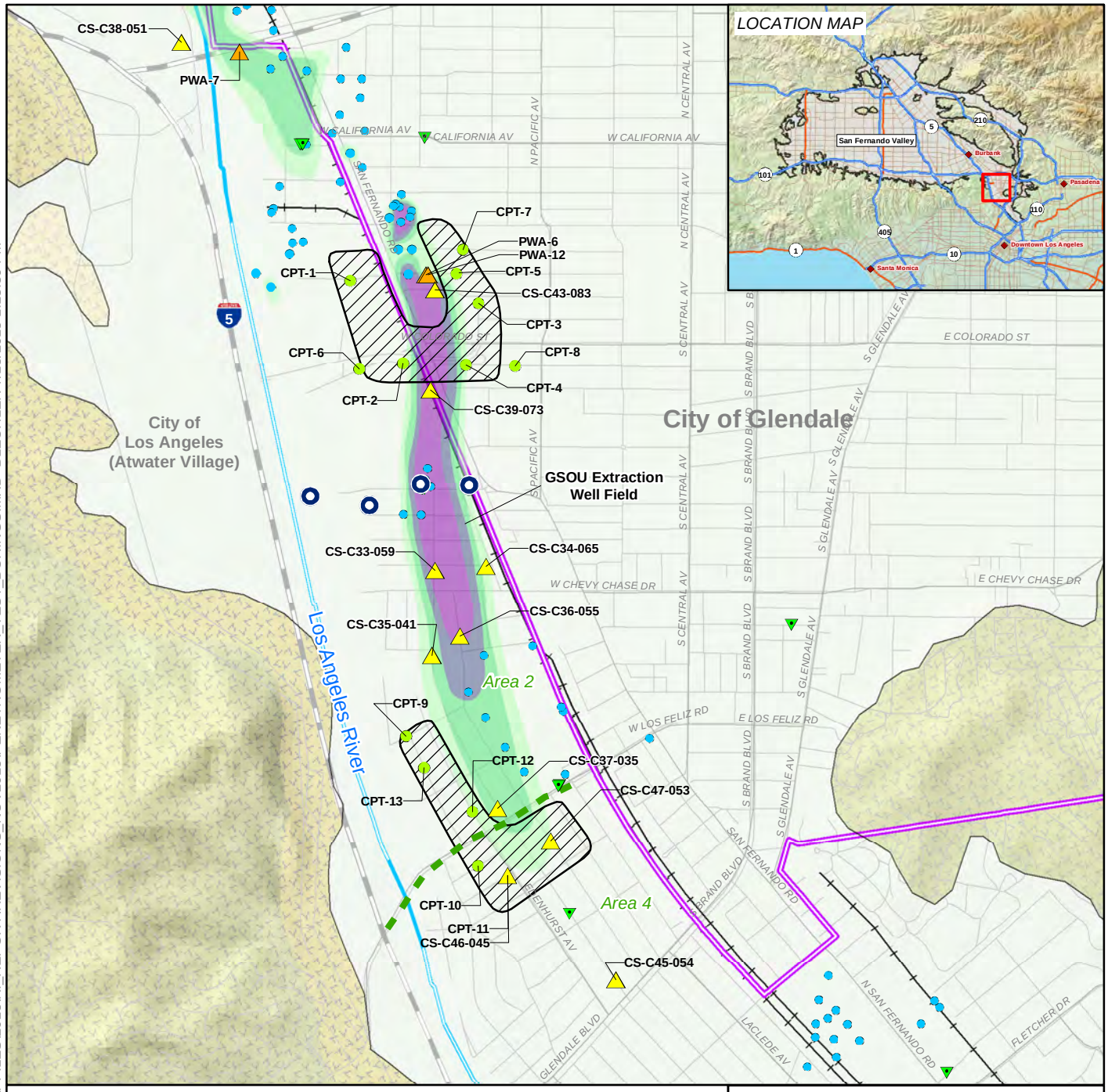


Figure 3-2
Remedial Investigation Groundwater Sampling Locations

Glendale Chromium Operable Unit
San Fernando Valley Superfund Sites

OTIE
Oneida Total Integrated Enterprises

SCO \\CHERON\PROJECTS\EPA\386243GLENDALECHOU\GIS\MAPFILES\2015\RI_REPORT\REVISEDDRAFT\GCOU_WELLS_AND_SAMPLING_LOCS_REV.MXD BLECHLER 6/30/2015 10:18:48 AM



LEGEND

- GCOU RI Phase 3 CPT/Hydropunch
- GCOU RI Monitoring Well Installed by EPA
- GCOU RI Monitoring Well Installed by GCOU Respondents
- SFV Basinwide RI Monitoring Well or Well Cluster
- Facility Monitoring Well
- Operable Unit Extraction Well
- Municipal Boundary
- Los Angeles River
- Unlined Section of Los Angeles River
- Approximate Boundaries of Investigation Areas for San Fernando Valley Superfund Sites
- Phase 3 Investigation Area

Hexavalent Chromium Concentration*

- 5-10 µg/L
- 10-50 µg/L
- 50-100 µg/L
- Above 100 µg/L

*Hexavalent chromium distribution based on GCOU RI data collected Mar 2012 - Aug 2013

N

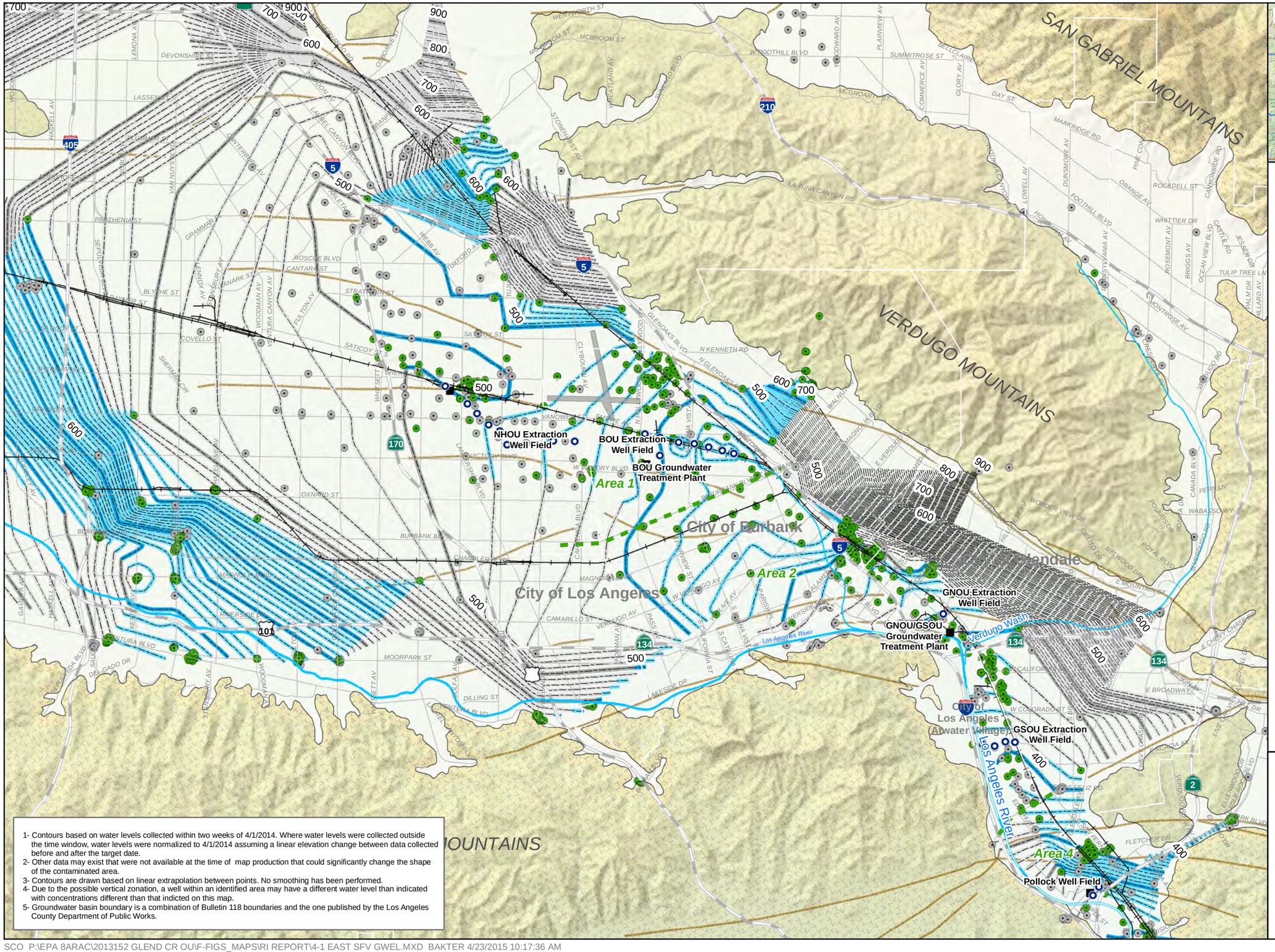
0 1,000 2,000
Feet

Figure 3-3
Remedial Investigation
Phase 3 Cone Penetrometer Test Borings and Grab Sample Locations

Glendale Chromium Operable Unit
San Fernando Valley Superfund Sites

OTIE
Oneida Total Integrated Enterprises

SCO \\CHERON\PROJ\EPA\38243GLENDALECHOU\GIS\MAPFILES\2015\RI_REPORT\REVISIONS_NOV2015\PENETROMETER_TEST_BORINGS.MXD BLECHLER 7/15/2015 1:13:39 PM



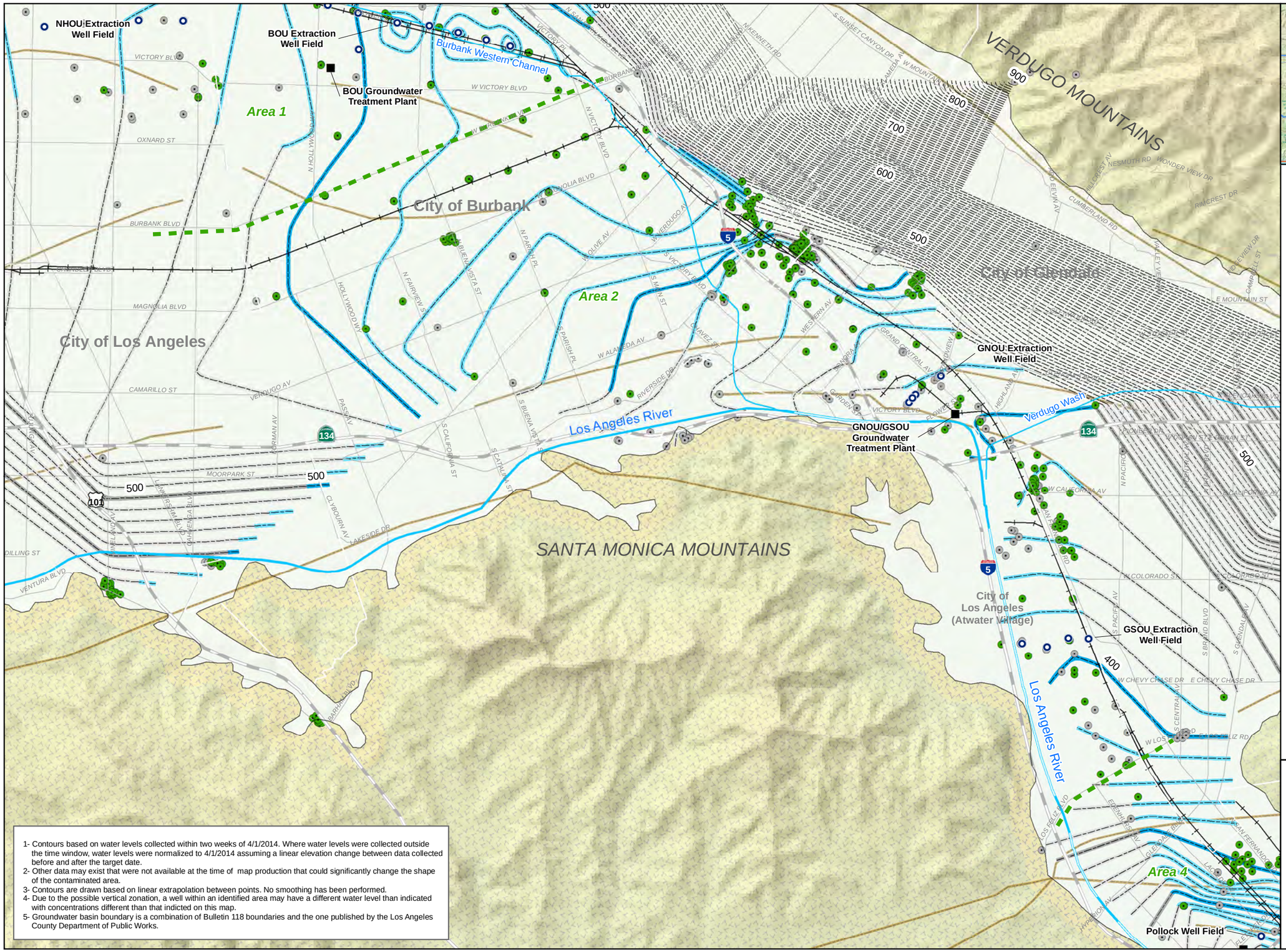
1- Contours based on water levels collected within two weeks of 4/1/2014. Where water levels were collected outside the time window, water levels were normalized to 4/1/2014 assuming a linear elevation change between data collected before and after the target date.
2- Other data may exist that were not available at the time of map production that could significantly change the shape of the contaminated area.
3- Contours are drawn based on linear extrapolation between points. No smoothing has been performed.
4- Due to the possible vertical zonation, a well within an identified area may have a different water level than indicated with concentrations different than that indicted on this map.
5- Groundwater basin boundary is a combination of Bulletin 118 boundaries and the one published by the Los Angeles County Department of Public Works.

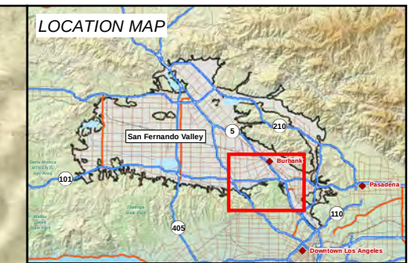
Figure 4-1
Groundwater Elevations in Eastern San Fernando Basin
April 2014

Glendale Chromium Operable Unit
San Fernando Valley Superfund Sites

OTIE
Oneida Total Integrated Enterprises

SCO P:\EPA 8ARAC\2013152 GLEND CR OU\F-FIGS_MAPS\RI REPORT\4-1 EAST SFV GWEL.MXD BAKTER 4/23/2015 10:17:36 AM





LEGEND

- Operable Unit Extraction Well
- Operable Unit Groundwater Treatment Plant
- Municipal Boundary
- Approximate Boundaries of Investigation Areas for San Fernando Valley Superfund Sites
- Freeway
- Major Surface Street
- Railroads
- Los Angeles River
- Unlined Section of Los Angeles River
- Stream
- Faults

Groundwater Elevation

- 25 ft contour
- Estimated 25 ft contour
- 5 ft contour
- Estimated 5 ft contour
- Conjecture 5 ft contour
- Water Level Data With in Range
- Water Level Data Out of Range

N

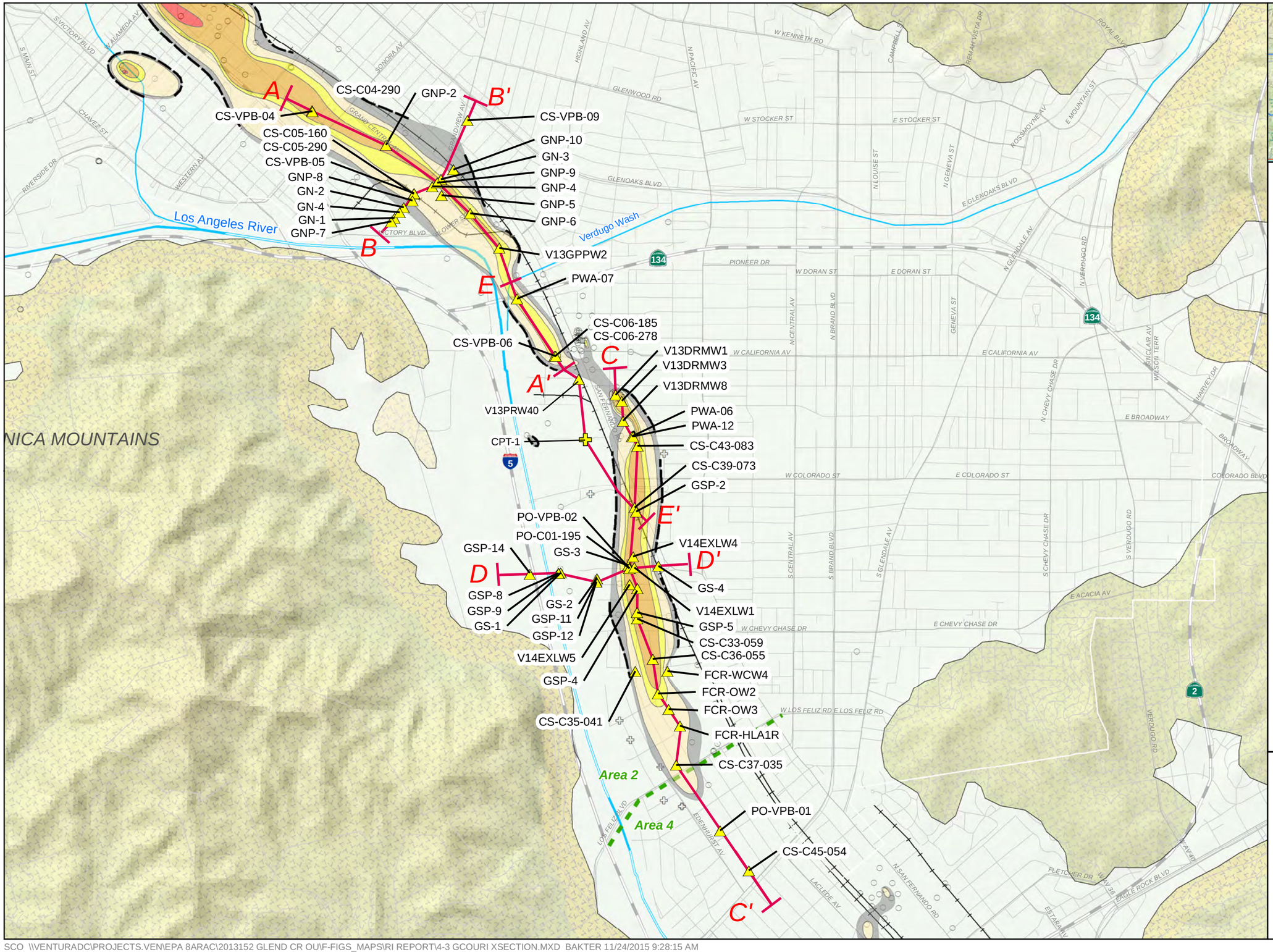
0 1,500 3,000 6,000 Feet

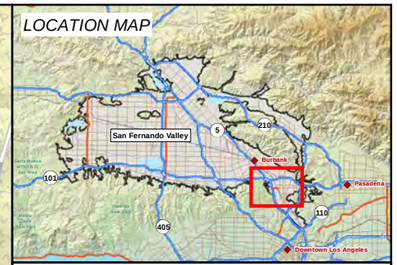
Figure 4-2
Groundwater Elevations in GCOU Study Area
April 2014

Glendale Chromium Operable Unit
San Fernando Valley Superfund Sites

OTIE
Oneida Total Integrated Enterprises

SCO P:\EPA 8ARAC\2013152 GLEND CR OU\F-FIGS_MAPS\RI REPORT\4-2 GCOURI 2014 GWEL STUDY AREA.MXD BAKTER 7/14/2015 8:02:41 AM





LEGEND

- Well on Section Line
- CPT Boring on Section Line
- Approximate Boundaries of Investigation Areas for San Fernando Valley Superfund Sites
- Freeway
- Major Surface Street
- Railroads
- Los Angeles River
- Unlined Section of Los Angeles River
- Stream
- Cross Section Lines

Cr6 Concentration

(Jan 2014 - Aug 2014)

- >1,000 µg/L
- 100-1,000 µg/L
- 50-100 µg/L
- 10-50 µg/L
- 5-10 µg/L
- Wells with Cr6 Data
- Cr6 Data Prior to 2010
- Hydropunch Sample

N

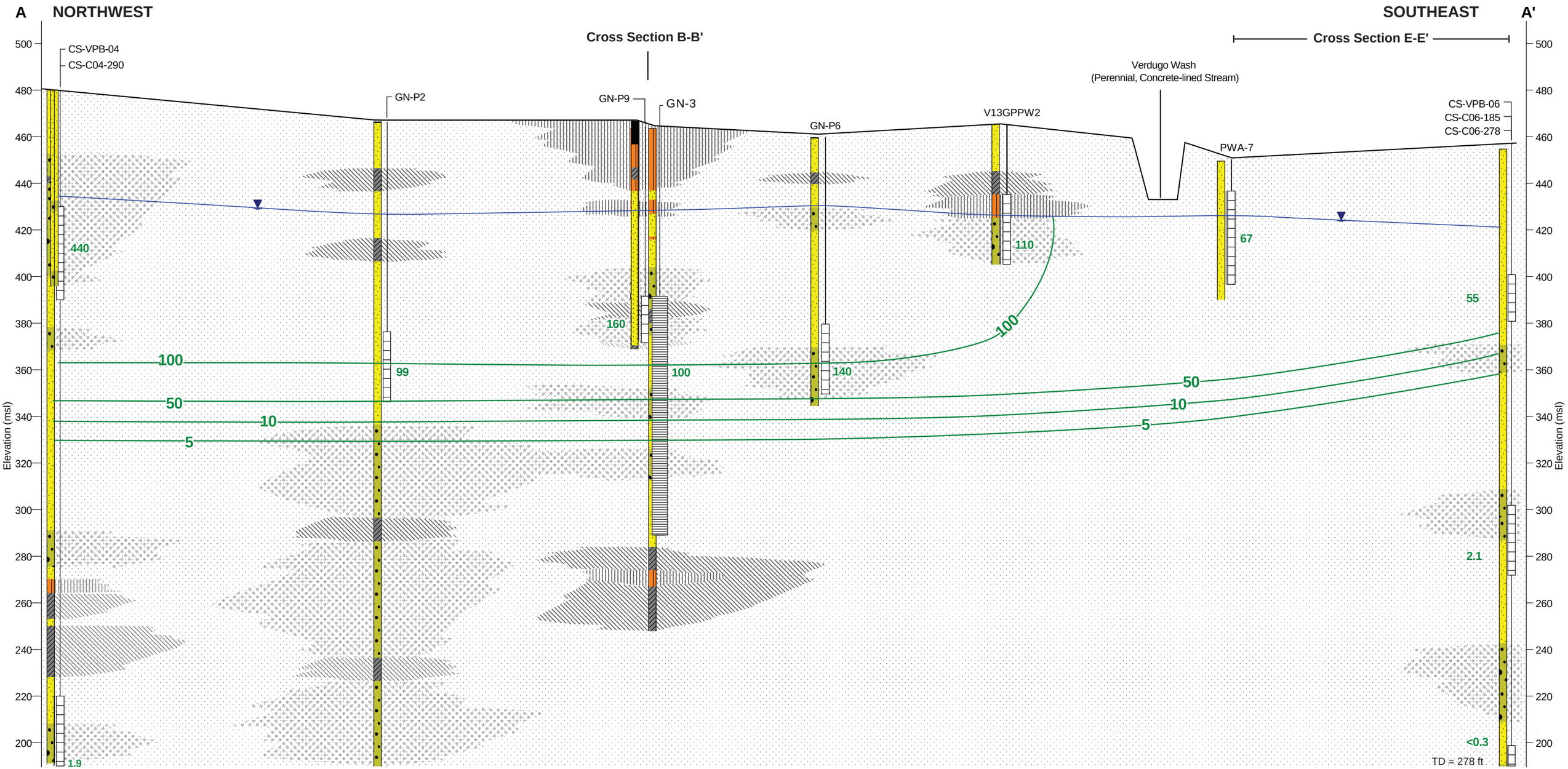
0 750 1,500 3,000 Feet

Figure 4-3
Locations for
Cross Sections

Glendale Chromium Operable Unit
San Fernando Valley Superfund Sites

OTIE
Oneida Total Integrated Enterprises

SCO \\VENTURADC\PROJECTS.VEN\EPA 8ARAC\2013152 GLEND CR OU\F-FIGS_MAPS\RI REPORT\4-3 GCOURI XSECTION.MXD BAKTER 11/24/2015 9:28:15 AM



SECTION DESCRIPTION:

0 250 500
(IN FEET)
Horizontal Scale 1 inch = 500 ft
Vertical Scale: 1 inch = 40 ft

Interpolated Groundwater Elevations for 04/01/2014

Monitoring Well Screen

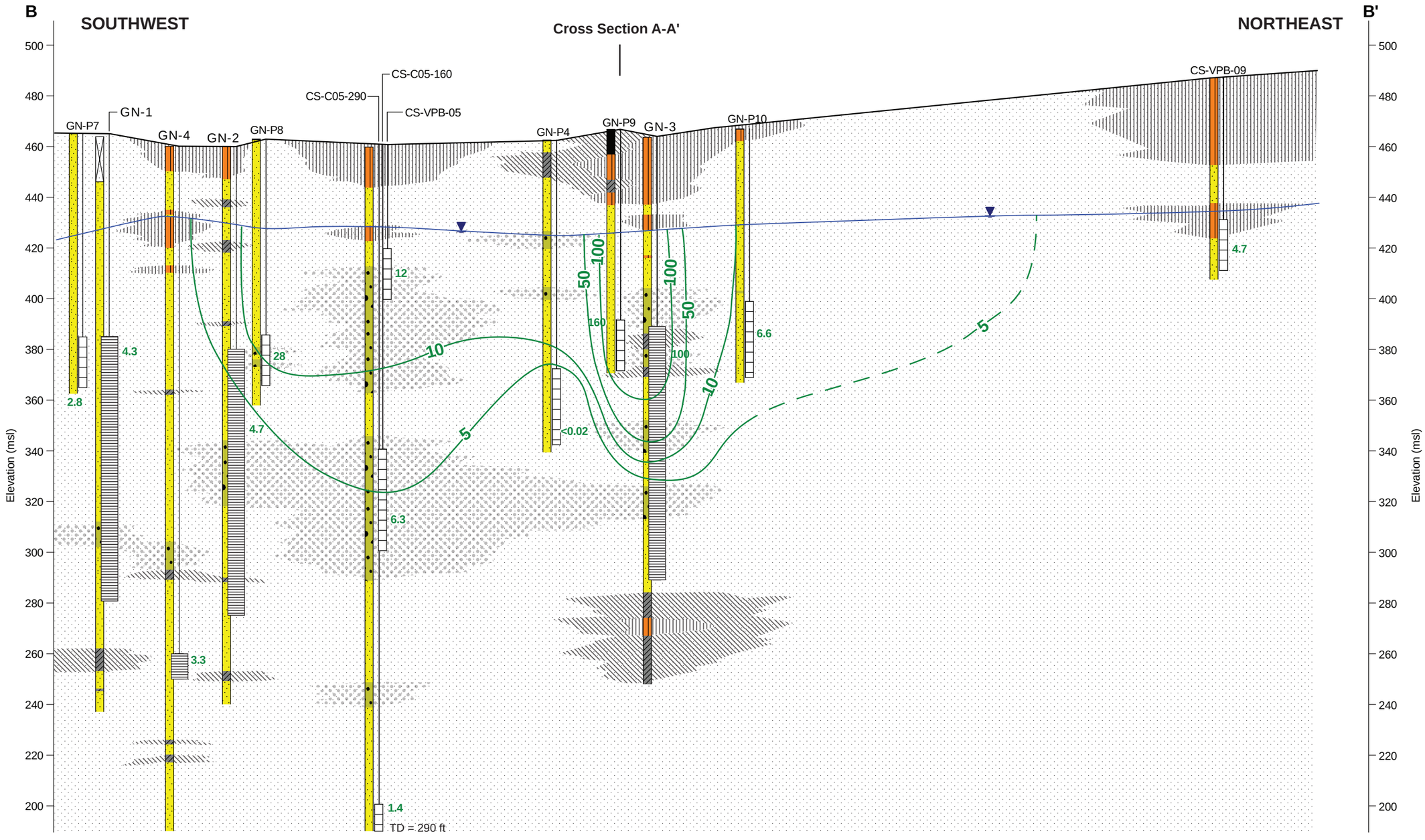
Extraction Well Screen

Asphalt, Fill
Sand, Sand with Silt/Clay, Silty/Clayey Sand
Gravel, Gravel with Silt/Clay, Silty/Clayey Gravel
Silt
Clay

110 Most recent hexavalent chromium result available to the EPA from groundwater samples collected between 1/1/2010 and 9/30/2014

Hexavalent chromium isoconcentration contour (µg/L)

FIGURE 4-4
Cross Section A-A'
Glendale Chromium Operable Unit
San Fernando Valley Superfund Sites



SECTION DESCRIPTION:

0 125 250
(IN FEET)
Horizontal Scale 1 inch = 250 ft
Vertical Scale: 1 inch = 40 ft

Interpolated Groundwater Elevations for 04/01/2014

Monitoring Well Screen

Extraction Well Screen

Asphalt, Fill

Sand, Sand with Silt/Clay, Silty/Clayey Sand

Gravel, Gravel with Silt/Clay, Silty/Clayey Gravel

Silt

Clay

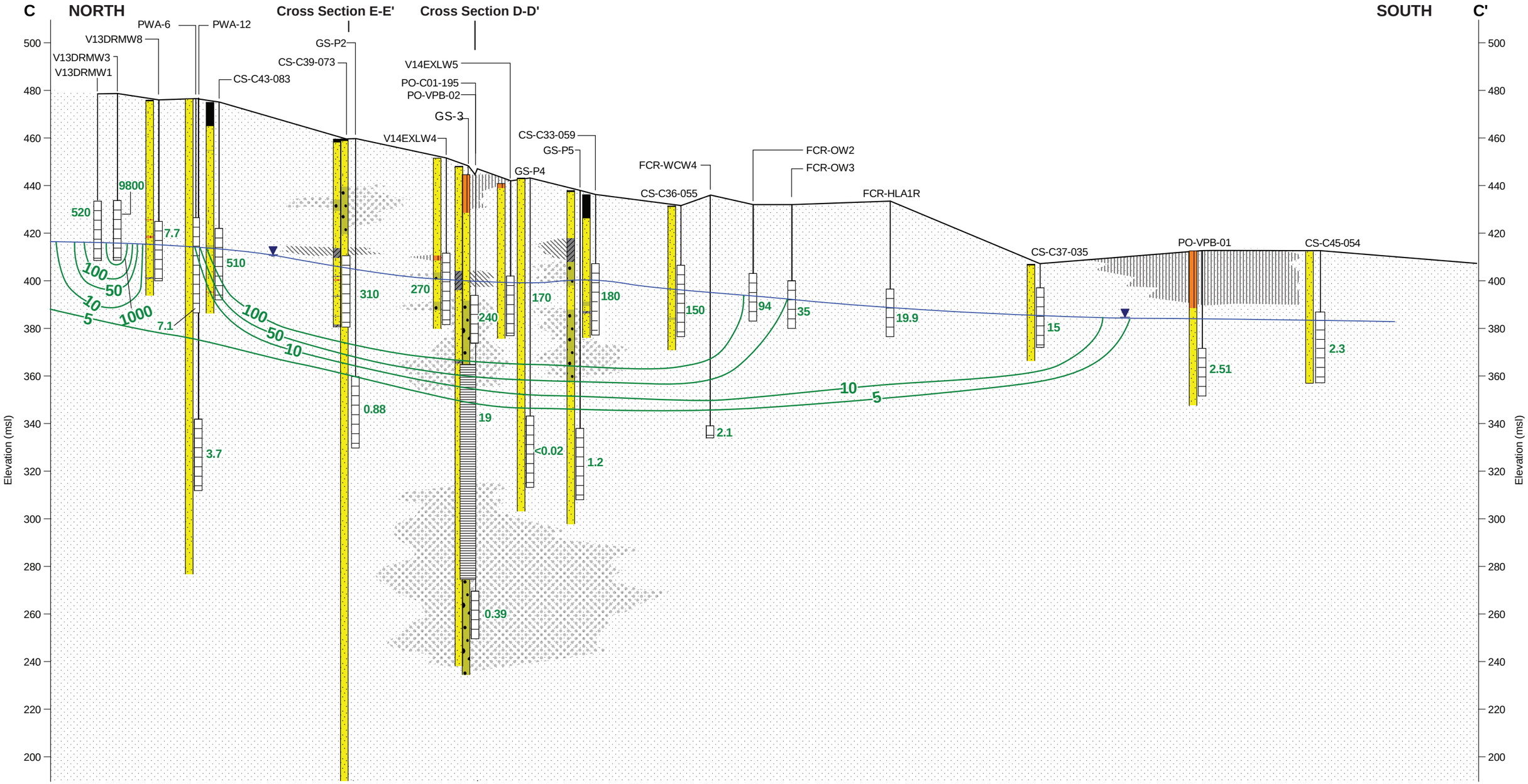
No Recovery

110 Most recent hexavalent chromium result available to the EPA from groundwater samples collected between 1/1/2010 and 9/30/2014

Hexavalent chromium isoconcentration contour (µg/L)

FIGURE 4-5
Cross Section B-B'
Glendale Chromium Operable Unit
San Fernando Valley Superfund Sites

ES020112203616SCO GCOU_cross_b-b'_GEOPAT_v6.ai 7/15



SECTION DESCRIPTION:

0 500 1000
(IN FEET)
Horizontal Scale 1 inch = 1000 ft
Vertical Scale: 1 inch = 40 ft

Interpolated Groundwater Elevations for 04/01/2014

Monitoring Well Screen

Extraction Well Screen

Asphalt, Fill

Sand, Sand with Silt/Clay, Silty/Clayey Sand

Gravel, Gravel with Silt/Clay, Silty/Clayey Gravel

Silt

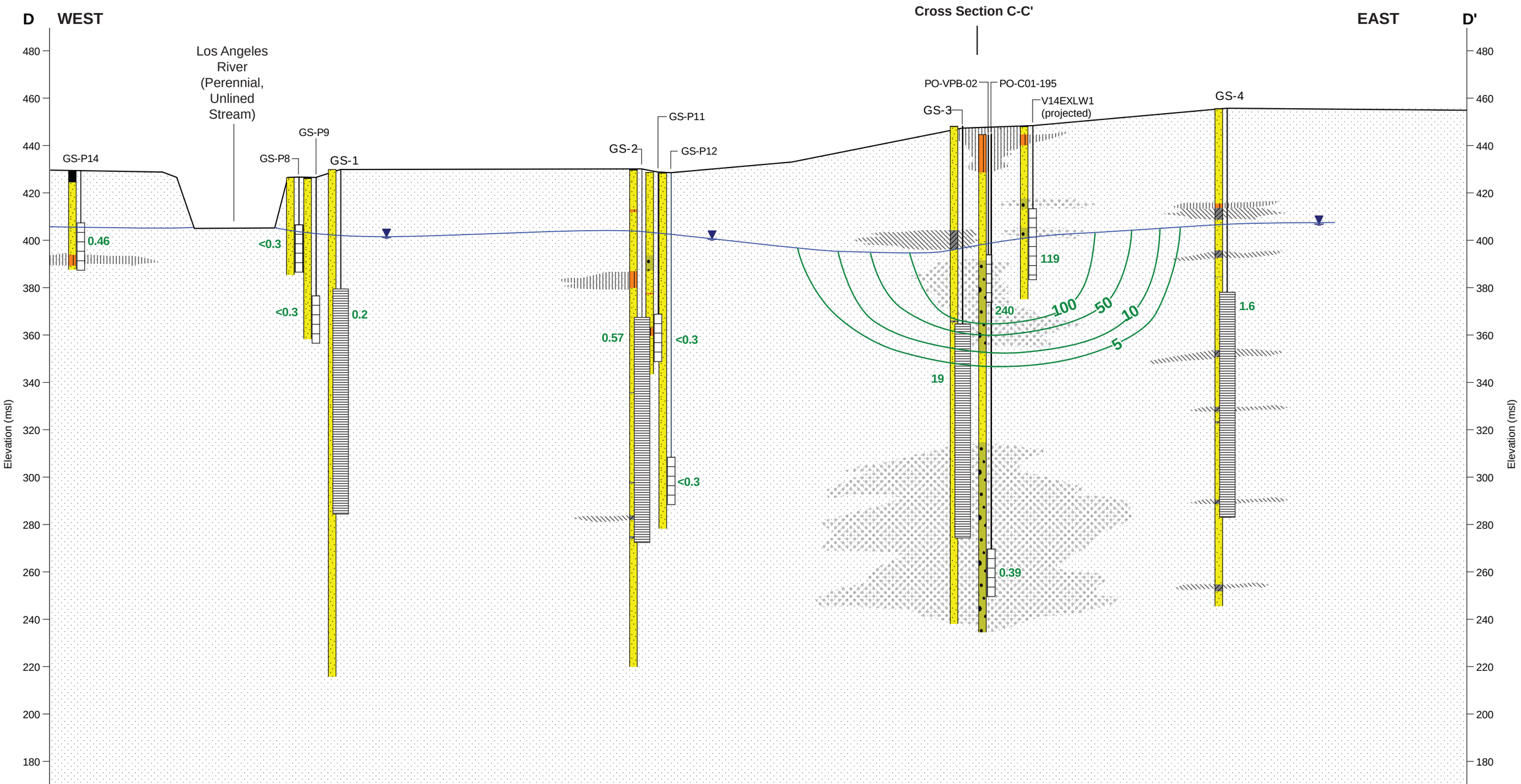
Clay

110 Most recent hexavalent chromium result available to the EPA from groundwater samples collected between 1/1/2010 and 9/30/2014

Hexavalent chromium isoconcentration contour (µg/L)

FIGURE 4-6
Cross Section C-C'
Glendale Chromium Operable Unit
San Fernando Valley Superfund Sites

ES020112203616SCO GCOU_cross_c-c'_GEOPAT_v7.ai 7/15



SECTION DESCRIPTION:

0 125 250
(IN FEET)
Horizontal Scale 1 inch = 250 ft
Vertical Scale: 1 inch = 40 ft

Interpolated Groundwater Elevations for 04/01/2014

Monitoring Well Screen

Extraction Well Screen

Asphalt, Fill

Sand, Sand with Silt/Clay, Silty/Clayey Sand

Gravel, Gravel with Silt/Clay, Silty/Clayey Gravel

Silt

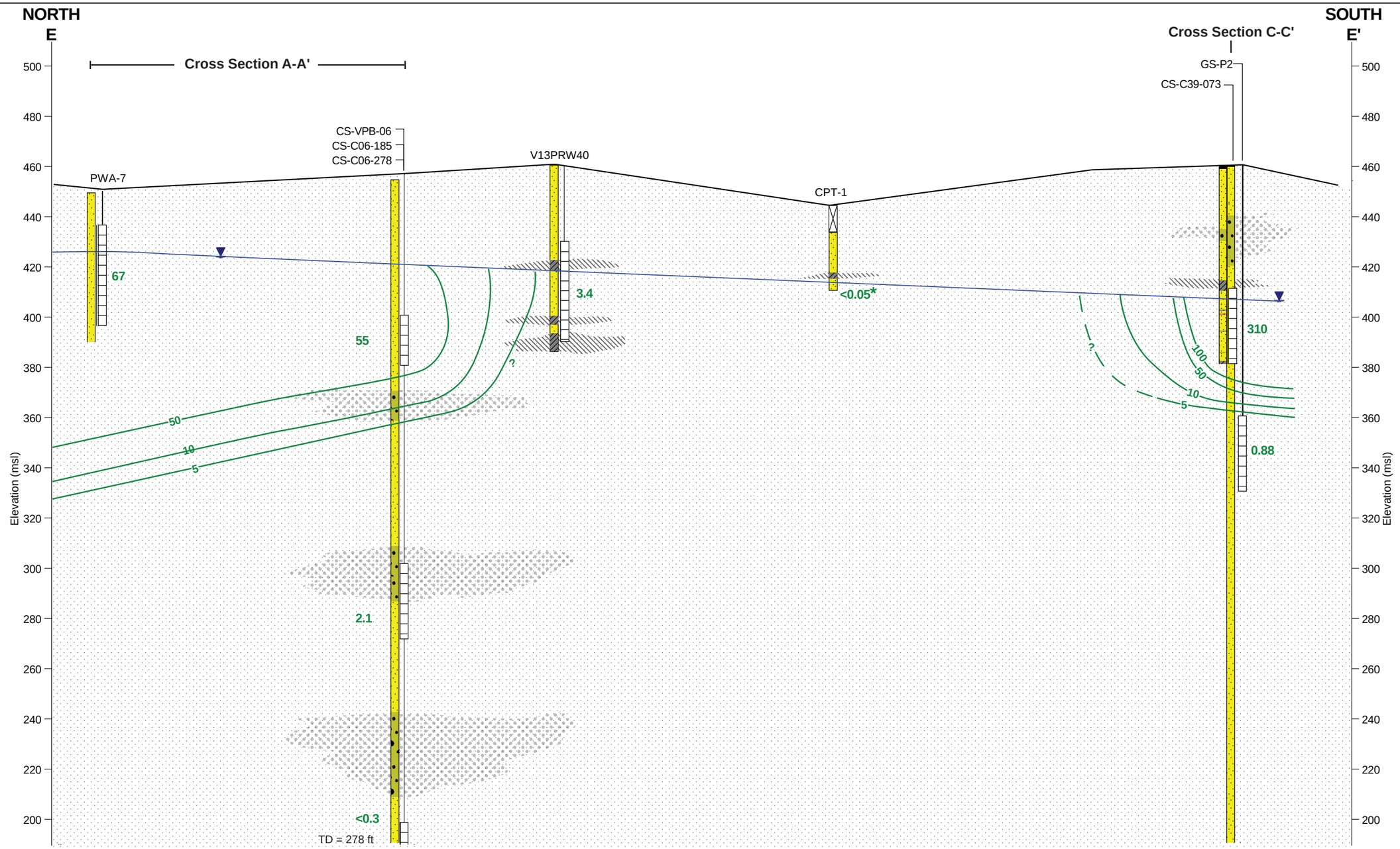
Clay

110 Most recent hexavalent chromium result available to the EPA from groundwater samples collected between 1/1/2010 and 9/30/2014

Hexavalent chromium isoconcentration contour (µg/L)

FIGURE 4-7
Cross Section D-D'
Glendale Chromium Operable Unit
San Fernando Valley Superfund Sites

ES020112203616SCO GCOU_cross_d-d'_GEOPAT_v6.ai 7/15



SECTION DESCRIPTION:

0 250 500
(IN FEET)
Horizontal Scale 1 inch = 500 ft
Vertical Scale: 1 inch = 40 ft

Interpolated Groundwater Elevations for 04/01/2014

Monitoring Well Screen

Extraction Well Screen

Asphalt, Fill
Sand, Sand with Silt/Clay, Silty/Clayey Sand
Gravel, Gravel with Silt/Clay, Silty/Clayey Gravel
Silt
Clay
No Recovery

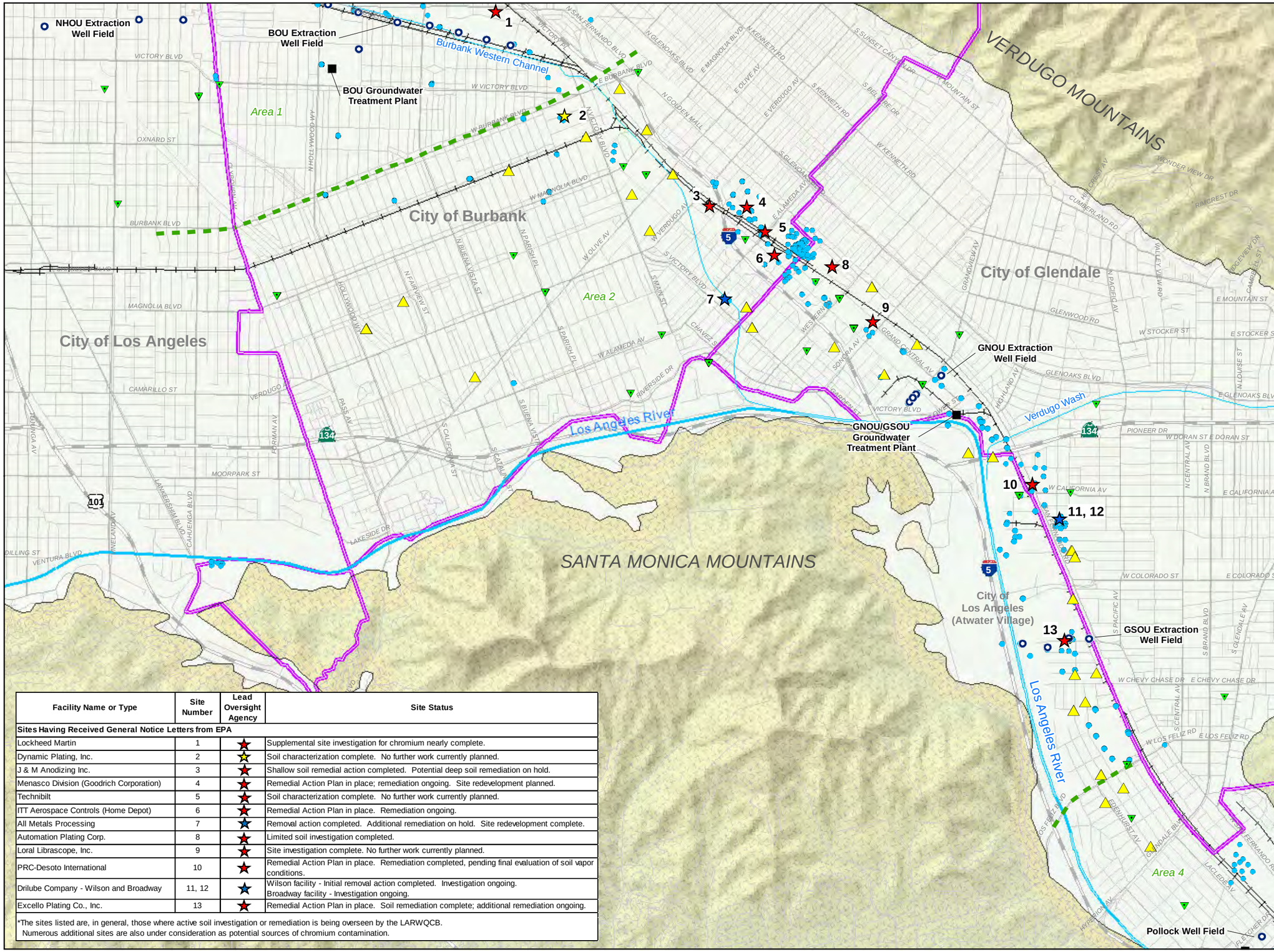
110 Most recent hexavalent chromium result available to the EPA from groundwater samples collected between 1/1/2010 and 9/30/2014

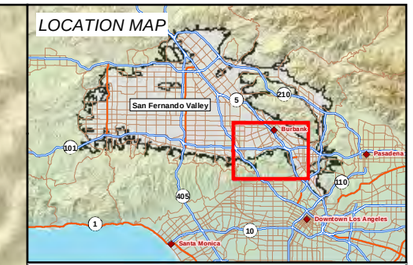
Hexavalent chromium isoconcentration contour (µg/L)

* Hydropunch grab sample. Should be considered a qualitative result.

FIGURE 4-8
Cross Section E-E'
Glendale Chromium Operable Unit
San Fernando Valley Superfund Sites

ES020112203616SCO GCOU_cross_e-e'_GEOPAT_ACTIVE_v5.ai 7/15





LEGEND

- GCOU RI Monitoring Well
- SFV Basinwide RI Monitoring Well or Well Cluster
- Facility Monitoring Well
- Operable Unit Extraction Well
- Operable Unit Groundwater Treatment Plant

Potential Source Facility Lead Oversight Agency

- EPA
- DTSC
- LARWQCB
- Approximate Boundaries of Investigation Areas for San Fernando Valley Superfund Sites
- Municipal Boundary
- Freeway
- Major Surface Street
- Los Angeles River
- Unlined Section of Los Angeles River
- Stream

N

0 1,500 3,000 6,000 Feet

Facility Name or Type	Site Number	Lead Oversight Agency	Site Status
Sites Having Received General Notice Letters from EPA			
Lockheed Martin	1	LARWQCB	Supplemental site investigation for chromium nearly complete.
Dynamic Plating, Inc.	2	DTSC	Soil characterization complete. No further work currently planned.
J & M Anodizing Inc.	3	LARWQCB	Shallow soil remedial action completed. Potential deep soil remediation on hold.
Menasco Division (Goodrich Corporation)	4	LARWQCB	Remedial Action Plan in place; remediation ongoing. Site redevelopment planned.
Technibilt	5	LARWQCB	Soil characterization complete. No further work currently planned.
ITT Aerospace Controls (Home Depot)	6	LARWQCB	Remedial Action Plan in place. Remediation ongoing.
All Metals Processing	7	EPA	Removal action completed. Additional remediation on hold. Site redevelopment complete.
Automation Plating Corp.	8	LARWQCB	Limited soil investigation completed.
Loral Librascope, Inc.	9	LARWQCB	Site investigation complete. No further work currently planned.
PRC-Desoto International	10	LARWQCB	Remedial Action Plan in place. Remediation completed, pending final evaluation of soil vapor conditions.
Drilube Company - Wilson and Broadway	11, 12	EPA	Wilson facility - Initial removal action completed. Investigation ongoing. Broadway facility - Investigation ongoing.
Excello Plating Co., Inc.	13	LARWQCB	Remedial Action Plan in place. Soil remediation complete; additional remediation ongoing.

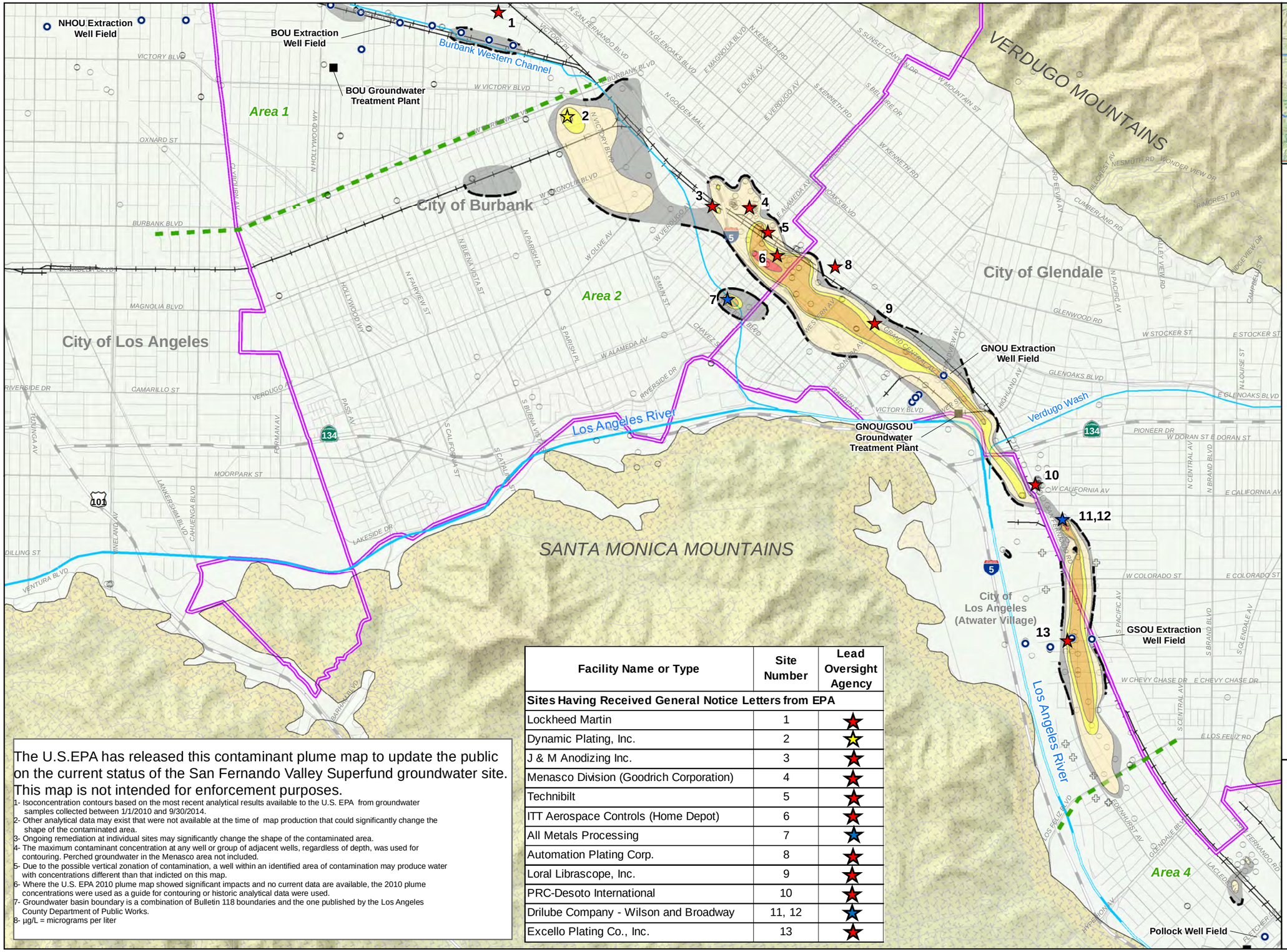
*The sites listed are, in general, those where active soil investigation or remediation is being overseen by the LARWQCB.
Numerous additional sites are also under consideration as potential sources of chromium contamination.

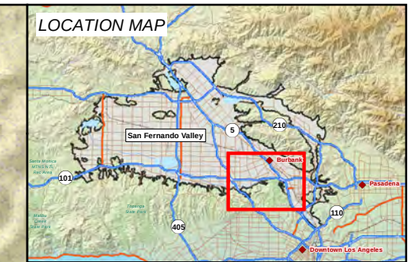
Figure 5-1
Facilities Under Investigation as Potential or Confirmed Sources of Chromium

Glendale Chromium Operable Unit
San Fernando Valley Superfund Sites

OTIE Oneida Total Integrated Enterprises

SCO \\CHERON\PROJECTS\EPA\386243GLENDALECHOU\GIS\MAPFILES\2015\RI_REPORT\REVISEDDRAFT\CHROMIUM_FACILITIES_REV5.MXD BLECHLER 8/18/2015 11:39:30 AM





LEGEND

- Operable Unit Extraction Well

Potential Source Facility Lead Oversight Agency

- EPA
- DTSC
- LARWQCB
- Operable Unit Groundwater Treatment Plant
- Municipal Boundary
- Approximate Boundaries of Investigation Areas for San Fernando Valley Superfund Sites
- Freeway
- Major Surface Street
- Railroads
- Los Angeles River
- Unlined Section of Los Angeles River
- Stream

Most Recent Cr6 Concentration

(Jan 2010 - Aug 2014)

- >1,000 µg/L
- 100-1,000 µg/L
- 50-100 µg/L
- 10-50 µg/L
- 5-10 µg/L
- Dashed where uncertain
- Wells with Cr6 Data
- Cr6 Data Prior to 2010
- Hydropunch Sample

N

0 1,500 3,000 6,000 Feet

Facility Name or Type	Site Number	Lead Oversight Agency
Sites Having Received General Notice Letters from EPA		
Lockheed Martin	1	EPA
Dynamic Plating, Inc.	2	DTSC
J & M Anodizing Inc.	3	LARWQCB
Menasco Division (Goodrich Corporation)	4	LARWQCB
Technibilt	5	LARWQCB
ITT Aerospace Controls (Home Depot)	6	LARWQCB
All Metals Processing	7	EPA
Automation Plating Corp.	8	LARWQCB
Loral Librascope, Inc.	9	LARWQCB
PRC-Desoto International	10	LARWQCB
Drilube Company - Wilson and Broadway	11, 12	EPA
Excello Plating Co., Inc.	13	LARWQCB

The U.S.EPA has released this contaminant plume map to update the public on the current status of the San Fernando Valley Superfund groundwater site. This map is not intended for enforcement purposes.

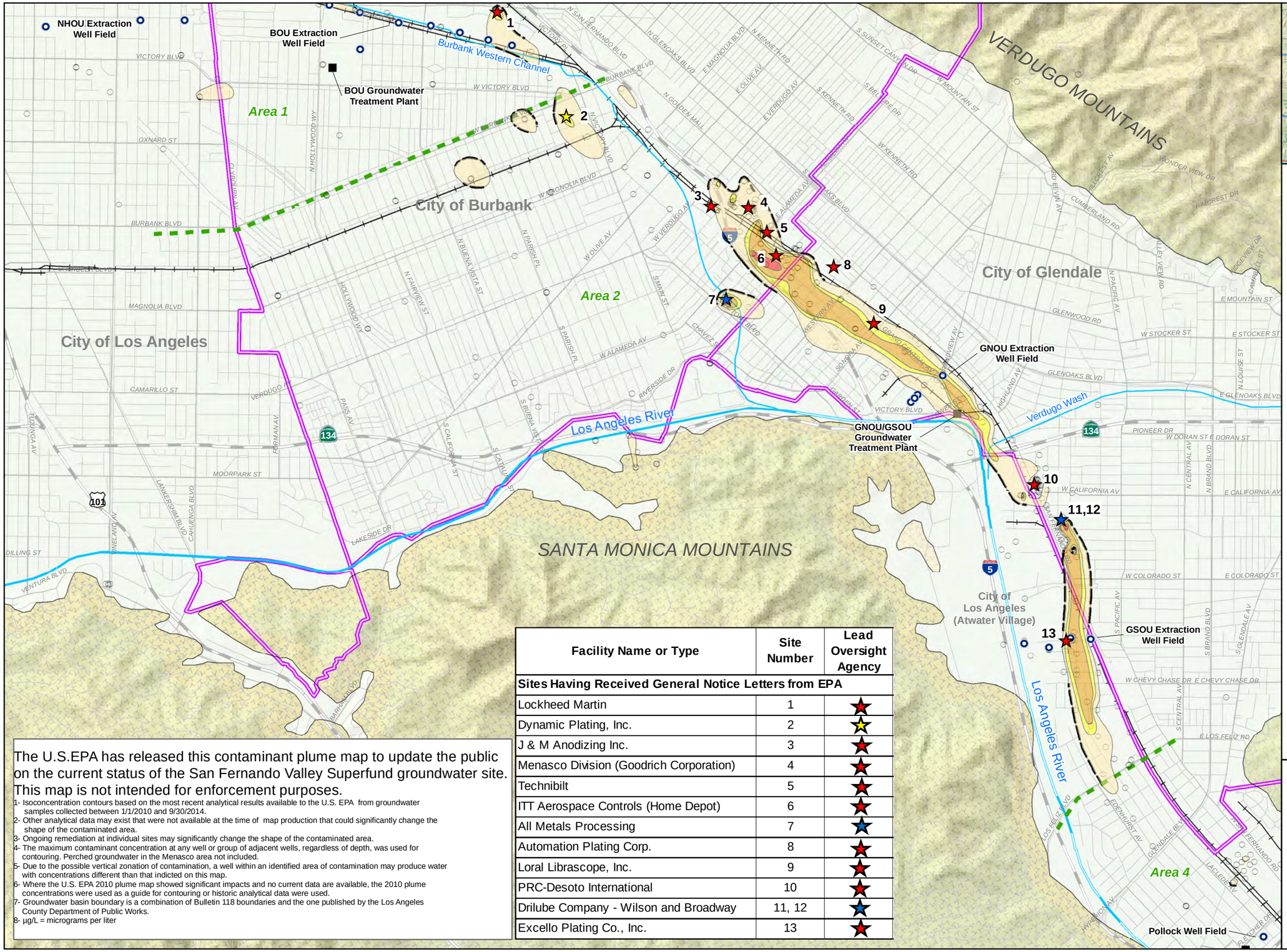
1- Isoconcentration contours based on the most recent analytical results available to the U.S. EPA from groundwater samples collected between 1/1/2010 and 9/30/2014.
2- Other analytical data may exist that were not available at the time of map production that could significantly change the shape of the contaminated area.
3- Ongoing remediation at individual sites may significantly change the shape of the contaminated area.
4- The maximum contaminant concentration at any well or group of adjacent wells, regardless of depth, was used for contouring. Perched groundwater in the Menasco area not included.
5- Due to the possible vertical zonation of contamination, a well within an identified area of contamination may produce water with concentrations different than that indicted on this map.
6- Where the U.S. EPA 2010 plume map showed significant impacts and no current data are available, the 2010 plume concentrations were used as a guide for contouring or historic analytical data were used.
7- Groundwater basin boundary is a combination of Bulletin 118 boundaries and the one published by the Los Angeles County Department of Public Works.
8- µg/L = micrograms per liter

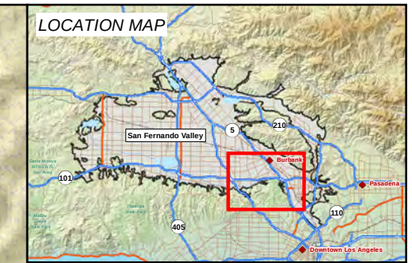
Figure 5-2
Hexavalent Chromium (Cr6) in Groundwater, GCOU Area (Jan 2010-Aug 2014)

Glendale Chromium Operable Unit
San Fernando Valley Superfund Sites

OTIE Oneida Total Integrated Enterprises

SCO P:\EPA 8ARAC\2013152 GLEND CR OU\F-FIGS_MAPS\RI REPORT\5-2 GCOURI 2014 CR6 PLUMES 11X17.MXD BAKTER 11/13/2015 10:22:50 AM





LEGEND

- Operable Unit Extraction Well

Potential Source Facility Lead Oversight Agency

- EPA
- DTSC
- LARWQCB
- Operable Unit Groundwater Treatment Plant
- Municipal Boundary
- Approximate Boundaries of Investigation Areas for San Fernando Valley Superfund Sites
- Freeway
- Major Surface Street
- Railroads
- Los Angeles River
- Unlined Section of Los Angeles River
- Stream

Most Recent CrT Concentration
(Jan 2010 - Aug 2014)

- >1,000 µg/L
- 100-1,000 µg/L
- 50-100 µg/L
- 10-50 µg/L
- Dashed where uncertain
- Wells with CrT Data
- Data Prior to 2010

N

0 1,500 3,000 6,000 Feet

Facility Name or Type	Site Number	Lead Oversight Agency
Sites Having Received General Notice Letters from EPA		
Lockheed Martin	1	EPA
Dynamic Plating, Inc.	2	DTSC
J & M Anodizing Inc.	3	LARWQCB
Menasco Division (Goodrich Corporation)	4	LARWQCB
Technibilt	5	LARWQCB
ITT Aerospace Controls (Home Depot)	6	LARWQCB
All Metals Processing	7	EPA
Automation Plating Corp.	8	LARWQCB
Loral Librascope, Inc.	9	LARWQCB
PRC-Desoto International	10	LARWQCB
Drilube Company - Wilson and Broadway	11, 12	EPA
Excello Plating Co., Inc.	13	LARWQCB

The U.S.EPA has released this contaminant plume map to update the public on the current status of the San Fernando Valley Superfund groundwater site. This map is not intended for enforcement purposes.

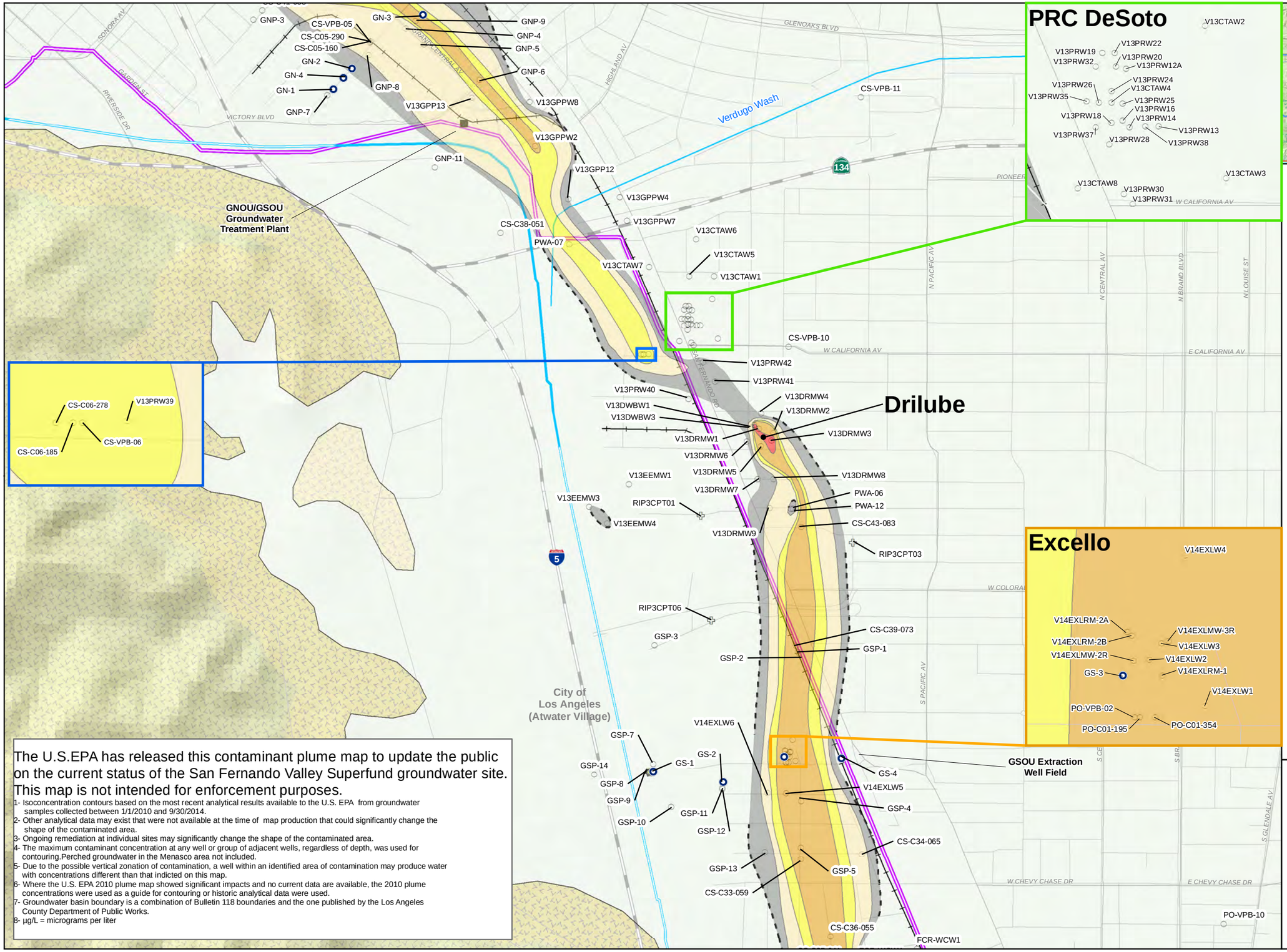
1- Isoconcentration contours based on the most recent analytical results available to the U.S. EPA from groundwater samples collected between 1/1/2010 and 9/30/2014.
2- Other analytical data may exist that were not available at the time of map production that could significantly change the shape of the contaminated area.
3- Ongoing remediation at individual sites may significantly change the shape of the contaminated area.
4- The maximum contaminant concentration at any well or group of adjacent wells, regardless of depth, was used for contouring. Perched groundwater in the Menasco area not included.
5- Due to the possible vertical zonation of contamination, a well within an identified area of contamination may produce water with concentrations different than that indicted on this map.
6- Where the U.S. EPA 2010 plume map showed significant impacts and no current data are available, the 2010 plume concentrations were used as a guide for contouring or historic analytical data were used.
7- Groundwater basin boundary is a combination of Bulletin 118 boundaries and the one published by the Los Angeles County Department of Public Works.
8- µg/L = micrograms per liter

Figure 5-3
Total Chromium (CrT) in Groundwater, GCOU Area (Jan 2010-Aug 2014)

Glendale Chromium Operable Unit
San Fernando Valley Superfund Sites

OTIE Oneida Total Integrated Enterprises

SCO P:\EPA 8ARAC\2013152 GLEND CR OU\F-FIGS_MAPS\RI REPORT\5-3 GCOURI 2014 CRT PLUMES 11X17.MXD BAKTER 11/13/2015 10:24:40 AM



The U.S.EPA has released this contaminant plume map to update the public on the current status of the San Fernando Valley Superfund groundwater site. This map is not intended for enforcement purposes.

1- Isoconcentration contours based on the most recent analytical results available to the U.S. EPA from groundwater samples collected between 1/1/2010 and 9/30/2014.
2- Other analytical data may exist that were not available at the time of map production that could significantly change the shape of the contaminated area.
3- Ongoing remediation at individual sites may significantly change the shape of the contaminated area.
4- The maximum contaminant concentration at any well or group of adjacent wells, regardless of depth, was used for contouring.Perched groundwater in the Menasco area not included.
5- Due to the possible vertical zonation of contamination, a well within an identified area of contamination may produce water with concentrations different than that indicted on this map.
6- Where the U.S. EPA 2010 plume map showed significant impacts and no current data are available, the 2010 plume concentrations were used as a guide for contouring or historic analytical data were used.
7- Groundwater basin boundary is a combination of Bulletin 118 boundaries and the one published by the Los Angeles County Department of Public Works.
8- µg/L = micrograms per liter

LEGEND

- Operable Unit Extraction Well
- Operable Unit Groundwater Treatment Plant
- Municipal Boundary
- Freeway
- Major Surface Street
- Railroads
- Los Angeles River
- Unlined Section of Los Angeles River
- Stream

Most Recent Cr6 Concentration
(Jan 2010 - Aug 2014)

- >1,000 µg/L
- 100-1,000 µg/L
- 50-100 µg/L
- 10-50 µg/L
- 5-10 µg/L
- Dashed where uncertain
- Wells with Cr6 Data
- Cr6 Data Prior to 2010
- Hydropunch Sample

N

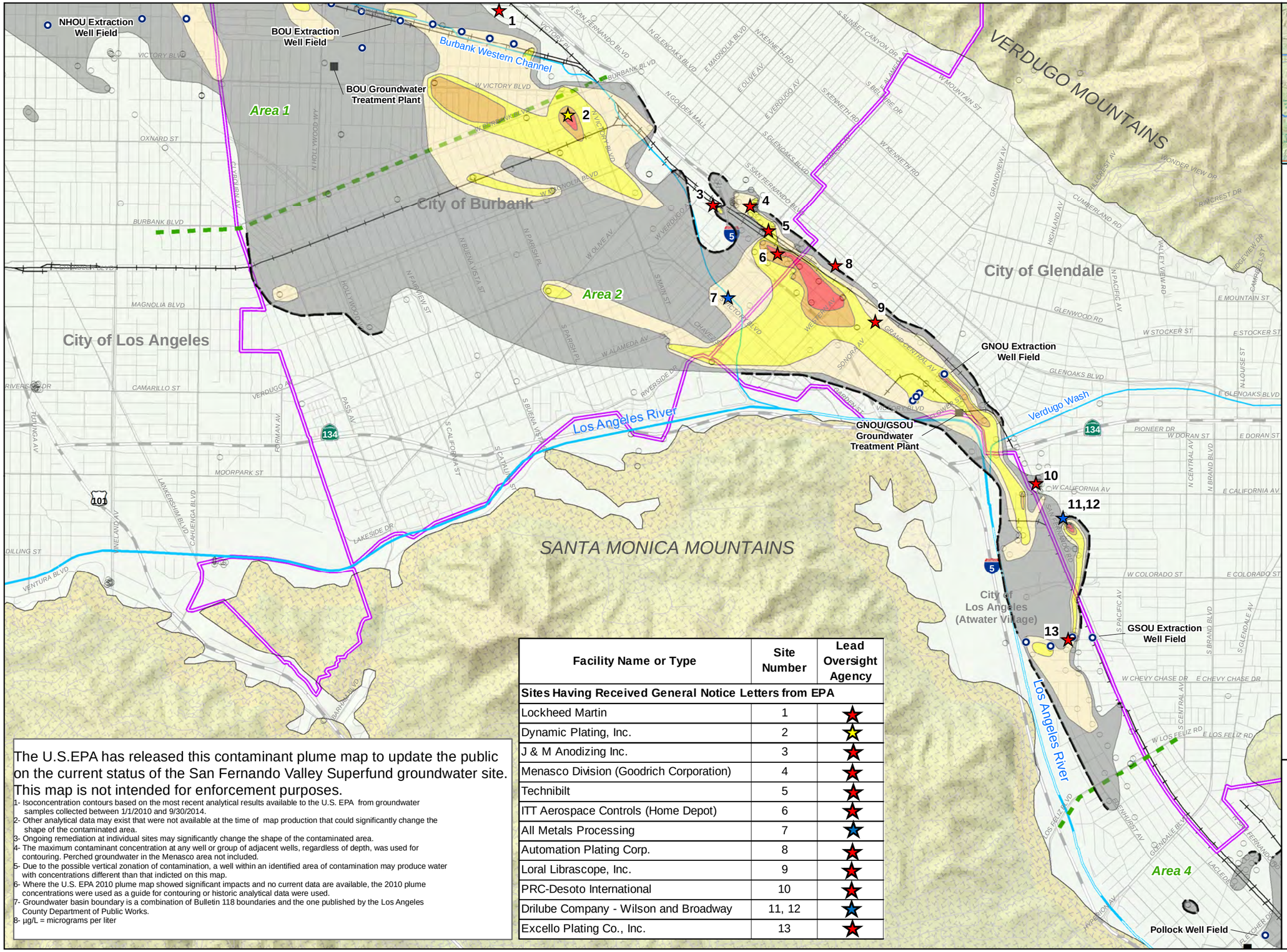
0 250 500 1,000 Feet

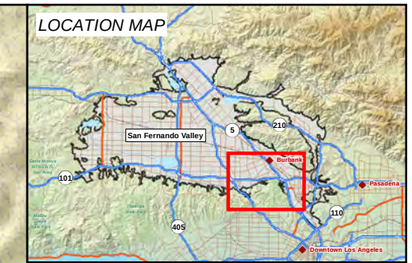
Figure 5-4
Hexavalent Chromium (Cr6) in Groundwater, Central GCOU Expanded View
(Jan 2010-Aug 2014)

Glendale Chromium Operable Unit
San Fernando Valley Superfund Sites

OTIE Oneida Total Integrated Enterprises

SCO P:\EPA 8ARAC\2013152 GLEND CR OU\F-FIGS_MAPS\RI REPORT\5-4 GCOURI 2014 CR6 PLUMES 11X17 SGCOU.MXD BAKTER 11/13/2015 10:28:05 AM





LEGEND

- Operable Unit Extraction Well

Potential Source Facility Lead Oversight Agency

- EPA
- DTSC
- LARWQCB
- Operable Unit Groundwater Treatment Plant
- Municipal Boundary
- Approximate Boundaries of Investigation Areas for San Fernando Valley Superfund Sites
- Freeway
- Major Surface Street
- Railroads
- Los Angeles River
- Unlined Section of Los Angeles River
- Stream

Most Recent TCE Concentration

(Jan 2010 - Aug 2014)

- >1,000 µg/L
- 500-1,000 µg/L
- 100-500 µg/L
- 50-100 µg/L
- 5-50 µg/L
- Dashed where uncertain
- Wells with TCE Data
- TCE Data Prior to 2010

N

0 1,500 3,000 6,000 Feet

Facility Name or Type	Site Number	Lead Oversight Agency
Sites Having Received General Notice Letters from EPA		
Lockheed Martin	1	EPA
Dynamic Plating, Inc.	2	DTSC
J & M Anodizing Inc.	3	LARWQCB
Menasco Division (Goodrich Corporation)	4	LARWQCB
Technibilt	5	LARWQCB
ITT Aerospace Controls (Home Depot)	6	LARWQCB
All Metals Processing	7	EPA
Automation Plating Corp.	8	LARWQCB
Loral Librascope, Inc.	9	LARWQCB
PRC-Desoto International	10	LARWQCB
Drilube Company - Wilson and Broadway	11, 12	EPA
Excello Plating Co., Inc.	13	LARWQCB

The U.S.EPA has released this contaminant plume map to update the public on the current status of the San Fernando Valley Superfund groundwater site. This map is not intended for enforcement purposes.

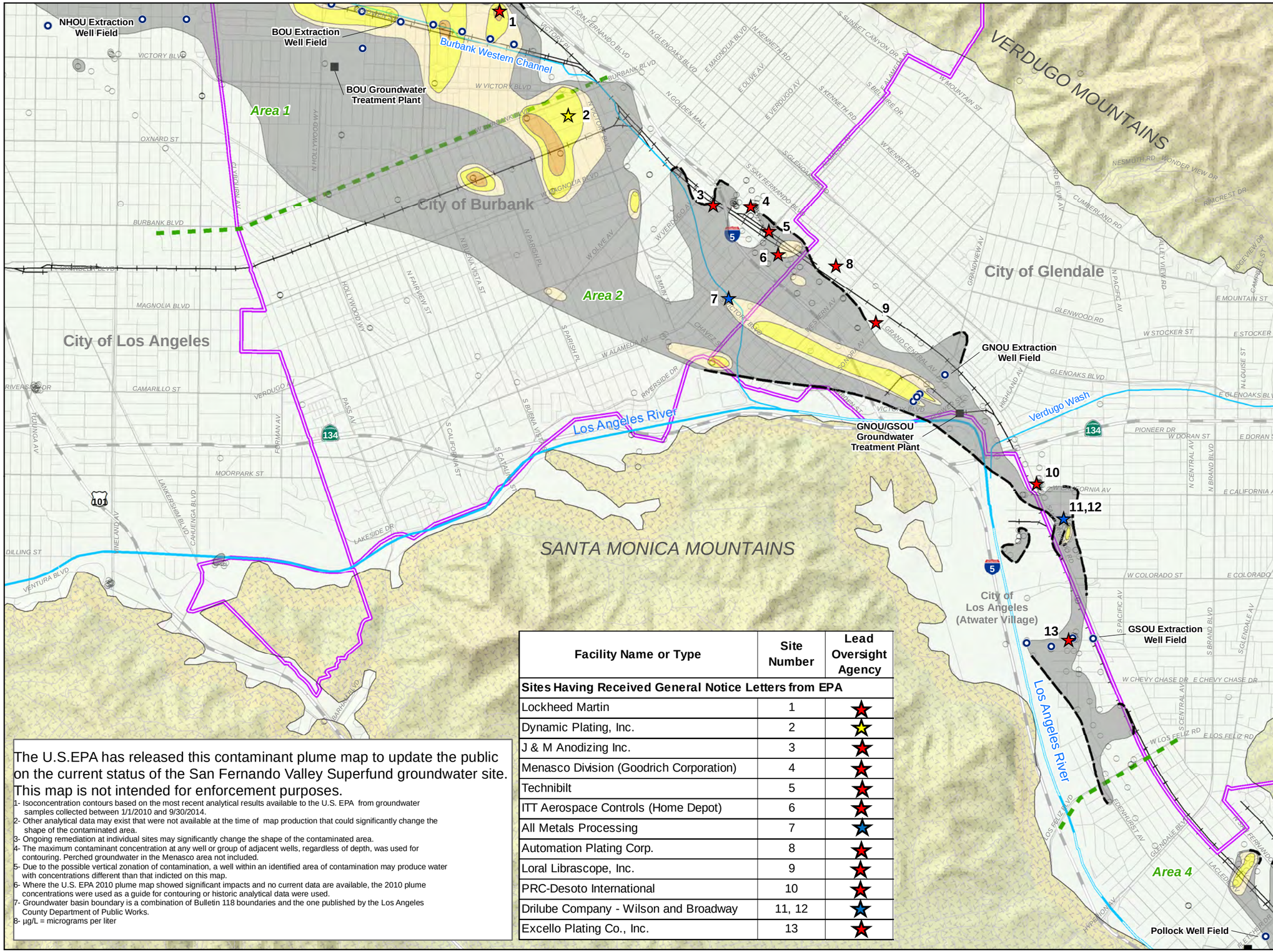
1- Isoconcentration contours based on the most recent analytical results available to the U.S. EPA from groundwater samples collected between 1/1/2010 and 9/30/2014.
2- Other analytical data may exist that were not available at the time of map production that could significantly change the shape of the contaminated area.
3- Ongoing remediation at individual sites may significantly change the shape of the contaminated area.
4- The maximum contaminant concentration at any well or group of adjacent wells, regardless of depth, was used for contouring. Perched groundwater in the Menasco area not included.
5- Due to the possible vertical zonation of contamination, a well within an identified area of contamination may produce water with concentrations different than that indicted on this map.
6- Where the U.S. EPA 2010 plume map showed significant impacts and no current data are available, the 2010 plume concentrations were used as a guide for contouring or historic analytical data were used.
7- Groundwater basin boundary is a combination of Bulletin 118 boundaries and the one published by the Los Angeles County Department of Public Works.
8- µg/L = micrograms per liter

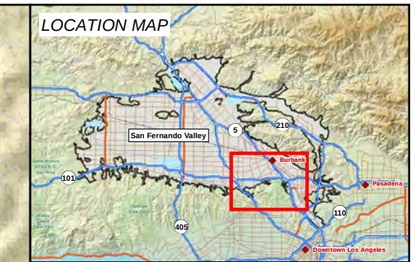
Figure 5-5
TCE in Groundwater
GCOU Area
(Jan 2010-Aug 2014)

Glendale Chromium Operable Unit
San Fernando Valley Superfund Sites

OTIE
Oneida Total Integrated Enterprises

SCO P:\EPA 8ARAC\2013152 GLEND CR OU\F-FIGS_MAPS\RI REPORT\5-5 GCOURI 2014 TCE PLUMES 11X17.MXD BAKTER 11/13/2015 10:30:46 AM





LEGEND

- Operable Unit Extraction Well

Potential Source Facility Lead Oversight Agency

- EPA
- DTSC
- LARWQCB
- Operable Unit Groundwater Treatment Plant
- Municipal Boundary
- Approximate Boundaries of Investigation Areas for San Fernando Valley Superfund Sites
- Freeway
- Major Surface Street
- Railroads
- Los Angeles River
- Unlined Section of Los Angeles River
- Stream

Most Recent PCE Concentration (Jan 2010 - Aug 2014)

- >1,000 µg/L
- 500-1,000 µg/L
- 100-500 µg/L
- 50-100 µg/L
- 5-50 µg/L
- Dashed where uncertain
- Wells with PCE Data
- PCE Data Prior to 2010

N

0 1,500 3,000 6,000 Feet

Facility Name or Type	Site Number	Lead Oversight Agency
Sites Having Received General Notice Letters from EPA		
Lockheed Martin	1	EPA
Dynamic Plating, Inc.	2	DTSC
J & M Anodizing Inc.	3	LARWQCB
Menasco Division (Goodrich Corporation)	4	LARWQCB
Technibilt	5	LARWQCB
ITT Aerospace Controls (Home Depot)	6	LARWQCB
All Metals Processing	7	EPA
Automation Plating Corp.	8	LARWQCB
Loral Librascope, Inc.	9	LARWQCB
PRC-Desoto International	10	LARWQCB
Drilube Company - Wilson and Broadway	11, 12	EPA
Excello Plating Co., Inc.	13	LARWQCB

The U.S.EPA has released this contaminant plume map to update the public on the current status of the San Fernando Valley Superfund groundwater site. This map is not intended for enforcement purposes.

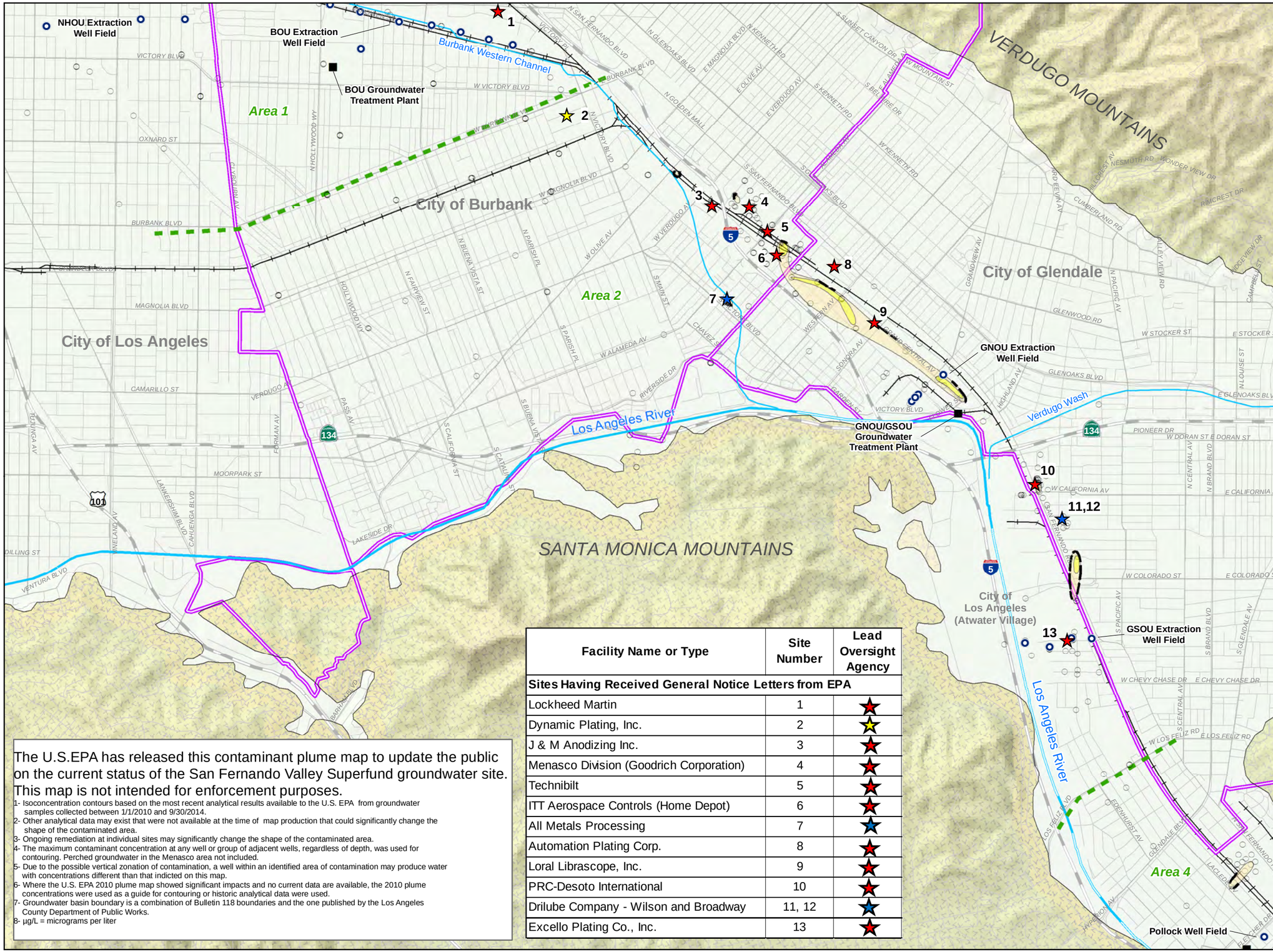
1- Isoconcentration contours based on the most recent analytical results available to the U.S. EPA from groundwater samples collected between 1/1/2010 and 9/30/2014.
2- Other analytical data may exist that were not available at the time of map production that could significantly change the shape of the contaminated area.
3- Ongoing remediation at individual sites may significantly change the shape of the contaminated area.
4- The maximum contaminant concentration at any well or group of adjacent wells, regardless of depth, was used for contouring. Perched groundwater in the Menasco area not included.
5- Due to the possible vertical zonation of contamination, a well within an identified area of contamination may produce water with concentrations different than that indicted on this map.
6- Where the U.S. EPA 2010 plume map showed significant impacts and no current data are available, the 2010 plume concentrations were used as a guide for contouring or historic analytical data were used.
7- Groundwater basin boundary is a combination of Bulletin 118 boundaries and the one published by the Los Angeles County Department of Public Works.
8- µg/L = micrograms per liter

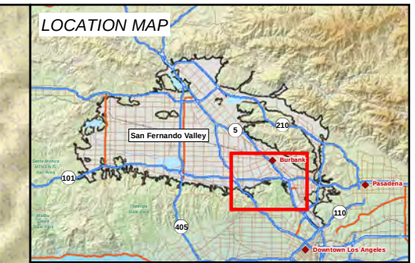
Figure 5-6
PCE in Groundwater
GCOU Area
(Jan 2010-Aug 2014)

Glendale Chromium Operable Unit
San Fernando Valley Superfund Sites

OTIE Oneida Total Integrated Enterprises

SCO P:\EPA 8ARAC\2013152 GLEND CR OU\F-FIGS_MAPS\RI REPORT\5-6 GCOURI 2014 PCE PLUMES 11X17.MXD BAKTER 11/13/2015 10:32:25 AM





LEGEND

- Operable Unit Extraction Well

Potential Source Facility Lead Oversight Agency

- EPA
- DTSC
- LARWQCB
- Operable Unit Groundwater Treatment Plant
- Municipal Boundary
- Approximate Boundaries of Investigation Areas for San Fernando Valley Superfund Sites
- Freeway
- Major Surface Street
- Railroads
- Los Angeles River
- Unlined Section of Los Angeles River
- Stream

Most Recent 1,4-Dioxane Concentration (Jan 2010 - Aug 2014)

- >100 µg/L
- 50-100 µg/L
- 10-50 µg/L
- 3-10 µg/L
- Dashed where Uncertain
- Wells with 1,4-Dioxane Data
- 1,4-Dioxane Data Prior to 2010

N

0 1,500 3,000 6,000 Feet

Facility Name or Type	Site Number	Lead Oversight Agency
Sites Having Received General Notice Letters from EPA		
Lockheed Martin	1	EPA
Dynamic Plating, Inc.	2	DTSC
J & M Anodizing Inc.	3	LARWQCB
Menasco Division (Goodrich Corporation)	4	LARWQCB
Technibilt	5	LARWQCB
ITT Aerospace Controls (Home Depot)	6	LARWQCB
All Metals Processing	7	EPA
Automation Plating Corp.	8	LARWQCB
Loral Librascope, Inc.	9	LARWQCB
PRC-Desoto International	10	LARWQCB
Drilube Company - Wilson and Broadway	11, 12	EPA
Excello Plating Co., Inc.	13	LARWQCB

The U.S.EPA has released this contaminant plume map to update the public on the current status of the San Fernando Valley Superfund groundwater site. This map is not intended for enforcement purposes.

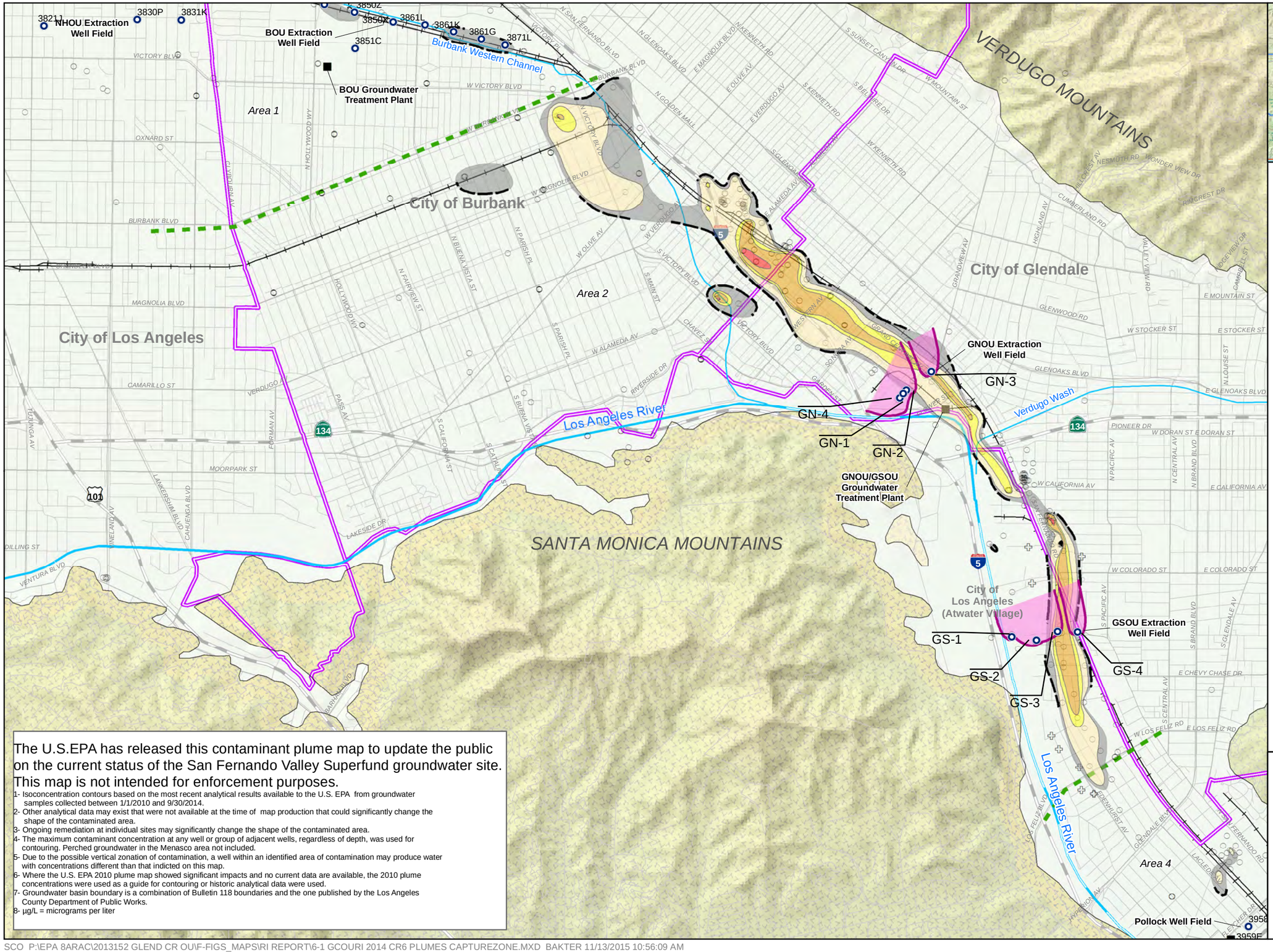
1- Isoconcentration contours based on the most recent analytical results available to the U.S. EPA from groundwater samples collected between 1/1/2010 and 9/30/2014.
2- Other analytical data may exist that were not available at the time of map production that could significantly change the shape of the contaminated area.
3- Ongoing remediation at individual sites may significantly change the shape of the contaminated area.
4- The maximum contaminant concentration at any well or group of adjacent wells, regardless of depth, was used for contouring. Perched groundwater in the Menasco area not included.
5- Due to the possible vertical zonation of contamination, a well within an identified area of contamination may produce water with concentrations different than that indicted on this map.
6- Where the U.S. EPA 2010 plume map showed significant impacts and no current data are available, the 2010 plume concentrations were used as a guide for contouring or historic analytical data were used.
7- Groundwater basin boundary is a combination of Bulletin 118 boundaries and the one published by the Los Angeles County Department of Public Works.
8- µg/L = micrograms per liter

Figure 5-7
1,4-Dioxane in Groundwater
GCOU Area
(Jan 2010-Aug 2014)

Glendale Chromium Operable Unit
San Fernando Valley Superfund Sites

OTIE
Oneida Total Integrated Enterprises

SCO P:\EPA 8ARAC\2013152 GLEND CR OU\F-FIGS_MAPS\RI REPORT\5-7 GCOURI 2014 DIOXANE PLUMES 11X17.MXD BAKTER 11/13/2015 10:47:55 AM



The U.S.EPA has released this contaminant plume map to update the public on the current status of the San Fernando Valley Superfund groundwater site. This map is not intended for enforcement purposes.

1- Isoconcentration contours based on the most recent analytical results available to the U.S. EPA from groundwater samples collected between 1/1/2010 and 9/30/2014.
2- Other analytical data may exist that were not available at the time of map production that could significantly change the shape of the contaminated area.
3- Ongoing remediation at individual sites may significantly change the shape of the contaminated area.
4- The maximum contaminant concentration at any well or group of adjacent wells, regardless of depth, was used for contouring. Perched groundwater in the Menasco area not included.
5- Due to the possible vertical zonation of contamination, a well within an identified area of contamination may produce water with concentrations different than that indicted on this map.
6- Where the U.S. EPA 2010 plume map showed significant impacts and no current data are available, the 2010 plume concentrations were used as a guide for contouring or historic analytical data were used.
7- Groundwater basin boundary is a combination of Bulletin 118 boundaries and the one published by the Los Angeles County Department of Public Works.
8- µg/L = micrograms per liter

Figure 6-1
Modeled Capture Zones for GNOU and GSOU Extraction Wells

Glendale Chromium Operable Unit
San Fernando Valley Superfund Sites

OTIE
Oneida Total Integrated Enterprises

SCO P:\EPA 8ARAC\2013152 GLEND CR OU\F-FIGS_MAPS\RI REPORT\6-1 GCOURI 2014 CR6 PLUMES CAPTUREZONE.MXD BAKTER 11/13/2015 10:56:09 AM

TABLES

TABLE 3-1
Construction Details and Survey Data for Monitoring Wells Installed During GCOU Remedial Investigation
Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Well ID	Borehole Diameter (inches)	Total Borehole Depth (ft bgs)	Well Zone Designation	Date Completed	Coordinates[1] Northing (feet)	Coordinates[1] Easting (feet)	Ground Surface Elevation[2] (ft msl)	Top of Casing Elevation[2] (ft msl)	Total Cased Depth[3] (ft bgs)	Well Material (PVC)	Screened Interval[4] (ft bgs)	Filter Pack Interval[5] (ft bgs)	Seal Interval[6] (ft bgs)
EPA GCOU RI Wells													
CS-C30-120	10	129	Shallow	08/08/12	1882052.0	6457705.3	564.38	563.93	122.5	Sch 80	90 - 120	85 - 129	80 - 85
CS-C30-200	10	225	Deep	08/10/12	1882066.5	6457688.6	564.50	563.96	202.5	Sch 80	180 - 200	175 - 220	170 - 175
CS-C31-102	10	103	Shallow	08/16/12	1880562.4	6461145.3	539.30	538.86	102.5	Sch 80	72 - 102	67 - 103	62 - 67
CS-C32-120	10	123	Shallow	12/12/12	1882933.7	6458859.2	567.78	567.31	120.5	Sch 80	90 - 120	85 - 123	80 - 85
CS-C33-059	10	62	Shallow	12/14/12	1871305.7	6480270.9	436.24	435.91	59.5	Sch 80	29 - 59	24 - 62	19 - 24
CS-C34-065	12	67.5	Shallow	05/08/13	1871368.7	6480953.3	442.68	442.30	65.5	Sch 80	35 - 65	30 - 67.5	25 - 30
CS-C35-041	12	45	Shallow	05/10/13	1870174.2	6480242.3	414.81	414.38	41.5	Sch 80	11 - 41	9 - 45	6 - 9
CS-C36-055	12	60	Shallow	05/13/13	1870440.7	6480612.2	431.55	431.01	55.5	Sch 80	25 - 55	20 - 60	15 - 20
CS-C37-035	12	41.5	Shallow	05/13/13	1868151.9	6481139.5	407.00	406.79	35.5	Sch 80	10 - 35	9 - 41.5	4 - 9
CS-C38-051	12	54	Shallow	05/20/13	1878304.7	6476829.2	456.40	456.15	51.5	Sch 80	21 - 51	16 - 54	11 - 16
CS-C39-073	12	79	Shallow	05/24/13	1873705.4	6480189.4	459.58	459.20	73.5	Sch 80	43 - 73	38 - 79	33 - 38
CS-C40-079	12	81.5	Shallow	06/07/13	1882860.7	6469742.2	501.97	501.67	79.5	Sch 80	49 - 79	44 - 81.5	39 - 44
CS-C41-058	12	63	Shallow	06/11/13	1880777.6	6474132.2	469.85	469.47	58.5	Sch 80	28 - 58	23 - 63	18 - 23
CS-C42-059	12	61.5	Shallow	06/12/13	1881735.1	6475163.9	471.18	470.93	59.5	Sch 80	29 - 59	24 - 61.5	19 - 24
CS-C43-083	12	88	Shallow	06/13/13	1875040.1	6480236.6	475.05	474.87	83.5	Sch 80	53 - 83	48 - 88	43 - 48
CS-C44-120	10	120.5	Shallow	05/28/14	1887060.8	6467366.5	555.75	555.47	120.5	Sch 80	80 - 120	74 - 120.5	67 - 74
CS-C45-54	10	54	Shallow	05/29/14	1865886.3	6482732.3	412.48	412.06	54.0	Sch 80	23.5 - 53.5	19 - 54	14 - 19
CS-C46-45	10	46	Shallow	05/30/14	1867258.9	6481281.0	411.95	411.49	45.5	Sch 80	15 - 45	10 - 46	2 - 10
CS-C47-53	10	54	Shallow	06/04/14	1867723.7	6481847.0	418.34	417.99	53.5	Sch 80	23 - 53	18 - 54	2 - 18
GCOU Respondents RI Wells													
PWA-1	8	160	Shallow	09/27/12	1888206.4	6464601.8	576.9	576.51	150	Sch 40	110 - 150	108 - 160	103 - 108
PWA-2	8	163	Shallow	09/18/12	1889748.7	6465656.0	593.0	592.6	150	Sch 40	110 - 150	108 - 156	103 - 108
PWA-3	8	148	Shallow	09/21/12	1888447.8	6466527.4	574.3	573.92	135	Sch 40	95 - 135	93 - 140	90 - 93
PWA-4	8	127	Shallow	10/02/12	1886408.6	6466075.9	556.3	555.85	120	Sch 40	80 - 120	77 - 127	70 - 77
PWA-5	8	168	Shallow	10/05/12	1887118.7	6462154.7	578.56	578.06	145	Sch 40	105 - 145	102 - 152	92 - 102
PWA-6	8	115	Shallow	04/24/12	1875238.0	6480118.7	476.5	476.18	90	Sch 40	50 - 90	45 - 95	42 - 45
PWA-7	8	60	Shallow	03/12/12	1878185.2	6477606.2	450.1	449.62	53.5	Sch 40	13.5 - 53.5	10.5 - 60	7 - 10.5
PWA-8	8	95	Shallow	05/15/12	1882223.7	6469928.6	499.1	498.7	85	Sch 40	45 - 85	40 - 90	37 - 40
PWA-9	8	110	Shallow	06/14/12	1883532.9	6473710.3	508.3	507.94	95	Sch 40	55 - 95	50 - 100	47 - 50
PWA-10	8	100	Shallow	10/15/12	1881625.2	6472544.6	483.1	482.47	80	Sch 40	40 - 80	38 - 85	33 - 38
PWA-12	8	200	Deep	04/19/12	1875238.3	6480145.2	476.8	476.39	165	Sch 40	135 - 165	130 - 170	127 - 130
PWA-13	8	117	Shallow	10/10/12	1885263.4	6466654.5	538.8	538.4	105	Sch 40	65 - 105	63 - 117	58 - 63

Notes:

ft bgs = feet below ground surface
ft msl = feet (elevation relative to) mean sea level
ID = Identification
PVC = polyvinyl chloride
(1) State Plane Coordinates, CA Zone 5, NAD 83.
(2) Surveyed to NAVD 88 datum.
(3) All casings are 4-inch-diameter PVC
(4) Screens are 0.02-inch slot.
(5) Filter pack material is No. 3 Monterey sand.
(6) Seal composed of medium bentonite chips; cement-bentonite grout from the top of the seal to ground surface.

TABLE 3-2

Construction Information for Existing Monitoring Wells Sampled During GCOU Remedial Investigation

Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Well ID	Well Zone Designation	Date Completed	Reference Point Elevation (ft msl)	Total Cased Depth (ft bgs)	Screened Interval (ft bgs)
Existing EPA Monitoring Well					
CS-VPB-09	Shallow	08/18/89	485.44	76.5	56 - 76
PO-VPB-01	Shallow	10/25/89	411.33	61.5	41 - 61
Glendale Respondents Group Wells					
GN-P10	Shallow	04/06/12	466.54	98	68 - 98
GN-P11	Shallow	01/31/12	454.78	45	25 - 45
GS-P13	Shallow	11/30/12	432.40	50	30 - 50
Disney Burbank Studio Facility					
V14WDSW5	Shallow	06/11/93	524.90	93	58 - 88
Former All Metals Processing Facility					
V14AMPW1	Shallow	09/01/95	503.45	75	45 - 75
V14AMPW3	Shallow	06/08/09	503.85	75	55 - 75
V14AMPW3R	Shallow	--	--	--	--
Former Drilube Facility					
V13DRMW1	Shallow	06/09/94	477.9	75	45 - 70
V13DRMW2	Shallow	07/28/94	479.43	79	50 - 75
V13DRMW3	Shallow	08/17/94	477.96	75	45 - 70
V13DRMW4	Shallow	-	478.61	-	46 - 71(1)
V13DRMW5	Shallow	-	476.21	-	44 - 69(1)
V13DRMW6	Shallow	06/14/13	473.61	71.5	46 - 71
V13DRMW7	Shallow	06/18/13	472.95	73.5	48 - 73
V13DRMW8	Shallow	06/17/13	475.64	76.5	51 - 76
V13DRMW9	Shallow	06/19/13	473.90	77.5	47 - 72
V13DWBW1	Shallow	12/21/93	476.84	80	45 - 75
V13DWBW3	Shallow	12/22/93	476.47	76	46 - 76
Former Eemco Facility					
V13EEMW1	Shallow	03/11/93	435.84	35	10 - 35
V13EEMW3	Shallow	03/11/93	433.85	35	10 - 35
V13EEMW4	Shallow	03/17/93	430.88	35	10 - 35
Former Franciscan Ceramics Facility					
FCR-HLA1R	Shallow	03/01/97	433.27	57.5(2)	37 - 57(1)
FCR-HMW1R	Shallow	03/01/97	438.82	57.9(2)	37 - 57(1)
FCR-OW2	Shallow	03/01/84	431.96	49	29 - 49
FCR-OW3	Shallow	03/01/84	431.47	52	32 - 52
FCR-OW4R	Shallow	03/01/97	424.93	48.1(2)	28 - 48(1)
FCR-WCW-1	Shallow	06/01/87	440.13	57	42 - 57
FCR-WCW2R	Shallow	03/01/97	438.20	57.3(2)	37 - 57(1)
FCR-WCW4	Deep	06/01/87	435.21	102	97 - 102

TABLE 3-2

Construction Information for Existing Monitoring Wells Sampled During GCOU Remedial Investigation

Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Well ID	Well Zone Designation	Date Completed	Reference Point Elevation (ft msl)	Total Cased Depth (ft bgs)	Screened Interval (ft bgs)
Grayson Power Plant					
V13GPPW2	Shallow	06/11/05	463.36	60	30 - 60
V13GPPW4	Shallow	06/11/05	459.58	60	30 - 60
V13GPPW7	Shallow	06/12/05	-	59	29 - 59
V13GPPW8	Shallow	06/15/05	461.06	51.5	30 - 50
V13GPP12	Shallow	06/15/05	465.66	56.5	34 - 54
V13GPP13	Shallow	06/16/05	459.83	46.0	25 - 45

Notes:

ID = Identification

ft bgs = feet below ground surface

ft msl = feet (elevation relative to) mean sea level

(1) Well screen interval is approximate and estimated based on the total depth measured during sampling and construction of existing wells at the site.

(2) Total depth as recorded in field data sheets from November 29, 2006, during biennial groundwater monitoring (reported in *Groundwater Monitoring Report for November 2006, Former Franciscan Ceramics Facility 2901 Los Feliz Boulevard, Los Angeles, California,* prepared by Envirosolve, April 9, 2007).

TABLE 3-3

Variances from the Field Sampling Plans During Installation of EPA's GCOU Remedial Investigation Monitoring Wells

Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Variance from Field Sampling Plan	Rationale for Variance
EPA used mud rotary drilling methods to install the CS-C30 cluster monitoring well, which includes one Shallow Zone (CS-C30-120) and one Deep Zone (CS-C30-200) monitoring well. The FSP specified hollow-stem auger (HSA) and air rotary drilling methods for Shallow Zone and Deep Zone monitoring wells, respectively.	Mud rotary drilling was used in place of air rotary for Deep Zone monitoring well CS-C30-200, in part, due to the space constraints and the smaller footprint of the work area for mud rotary drilling.
	Mud rotary drilling was used to install Shallow Zone monitoring well CS-C30-120 due to difficult (hard) drilling conditions encountered while advancing the borehole for Deep Zone monitoring well CS-C30-200. Mud rotary drilling methods are better suited for drilling through hard geologic formations than HSA methods.
EPA performed geophysical logging in the borehole for CS-C30-200. Geophysical logging was not specified in the FSP.	EPA performed geophysical logging in the deeper of the two boreholes at cluster well CS-C30 to provide additional information for locating the water table and selecting screened intervals for other monitoring wells in the vicinity.
	It is standard industry practice to perform geophysical logging in boreholes advanced using mud rotary drilling. Geophysical logging was not initially planned because the selected drilling methods (HSA and air rotary) do not provide a fluid-filled borehole which is required for logging.
EPA completed Shallow Zone monitoring well CS-C37-035 with a 25-foot screened interval. The FSP specified 30-foot screened intervals, 10 feet above and 20 feet below the water table, for Shallow Zone monitoring wells.	Groundwater was encountered at approximately 15 feet below ground surface in the borehole for CS-C37-035. The length of well screen placed above the water table was shortened to 5 feet to allow enough space to place an adequate seal between the ground surface and the well screen.
EPA decreased the thickness of the filter pack or bentonite seal interval at Shallow Zone monitoring wells CS-C35-041 and CS-37-035. A filter pack that extends 5 feet above the top of the well screen and a 5-foot-thick bentonite seal above the filter pack are specified in the FSP.	At CS-C35-041, 2 feet of filter pack and a 3-foot-thick bentonite seal were placed above the well screen. At well CS-C37-035, 1 foot of filter pack was placed above the well screen. The thickness of the filter placed (both wells) and bentonite seal (CS-C35-041 only) were each reduced to allow a few feet of cement-bentonite grout to be placed between the ground surface and the top of the bentonite seal.
EPA completed Shallow Zone monitoring well CS-C44-120 in the City of Burbank with a 40-foot screened interval. The RI Phase 3 was intended to focus on remaining data gaps in the in the three areas identified at the end of Phase 2 RI activities. The FSP specified 30-foot screened intervals, 10 feet above and 20 feet below the water table, for Shallow Zone monitoring wells.	Well placement for monitoring well CS-C44-120 was selected to evaluate if the Cr6 contamination migrating from the Burbank OU is connected to the main Cr6 plume in the GCOU parallel to San Fernando Road.
	Groundwater was encountered at approximately 90 feet below ground surface in the borehole for CS-C44-120. The length of well screen placed below the water table was lengthened to 30 feet to increase the future usability of the well due to the increased rate of declining groundwater levels in the region.
EPA completed Shallow Zone monitoring well CS-C45-54 south of the GCOU study area into the Pollock OU . The RI Phase 3 was intended to focus on remaining data gaps in the three areas identified at the end of Phase 1 and 2 RI activities.	Well placement for monitoring well CS-C45-54 was selected to assess the extent of Cr6 migration continuing to the south into the Pollock OU.

TABLE 3-4

Sampling Details for Cone Penetrometer Test Borings, Phase 3 of GCOU Remedial Investigation

Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Sample ID	Sample Date	Location	Total CPT Depth (feet bgs)	Hydropunch Sample Depth (feet bgs)	Hexavalent Chromium (mg/L)
CPT #1	04/14/14	4520 Electronics	35.43	31-35	< 0.05
CPT #2	04/14/14	4520 Colorado Blvd	47.52*	no sample	no sample
CPT #3	04/15/14	Harvard & Kenilworth intersection	68.57	70-74	< 0.05
CPT #4	04/15/14	610 Elk Ave	24.1*	no sample	no sample
CPT #5	04/15/14	633 Hawthorne St	52.66*	48.5-52.5 (attempted)	no sample
CPT #6	04/16/14	4552 Colorado Blvd	35.6	31-35	< 0.05
CPT #7	04/16/14	628 Ivy St	18.87*	no sample	no sample
CPT #8	04/16/14	525 W. Elk Ave	25.59*	no sample	no sample
CPT #9	04/16/14	4001 Rigali Ave	35.1	31-35	< 0.05
CPT #10	04/17/14	3845 Hollypark Place	34.12	30-34	**0.496**
CPT #11	04/17/14	3930 Edenhurt & Dover Pl.	30.02	26.8-30.8	**0.249**
CPT #12	04/17/14	4030 Edenhurst	28.05	24.2-28.2	< 0.05
CPT #13	04/17/14	4134 Garden Ave.	33.14	29.1-33.1	< 0.05
CPT #14 (DUP of CPT#13)	04/17/14				< 0.05

Notes:

CPT = cone penetrometer test

bgs = below ground surface

ID = Identification

mg/L = micrograms per liter

Samples analyzed at AETL, Burbank, CA, using EPA Method 218.6

TABLE 4-1
Groundwater Level Measurements Obtained During GCOU Remedial Investigation
Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Well ID	Well Designation	Reference Point Elevation (ft msl)	Screened Interval (ft bgs)	Date	Depth to Groundwater (ft btoc)	Groundwater Elevation (ft msl)
GCOU Remedial Investigation Wells						
CS-C30-120	Shallow	563.93	90 - 120	09/06/12	95.41	468.52
				10/19/12	95.20	468.73
				01/23/13	94.55	469.38
				04/30/13	93.65	470.28
				07/25/13	93.57	470.36
				11/20/13	93.90	470.03
				04/15/14	93.95	469.98
CS-C30-200	Deep	563.96	180 - 200	09/06/12	95.79	468.17
				10/19/12	94.50	469.46
				01/23/13	93.43	470.53
				04/30/13	92.42	471.54
				07/25/13	93.97	469.99
				11/20/13	93.95	470.01
				04/15/14	94.52	469.44
CS-C31-102	Shallow	538.86	72 - 102	09/06/12	80.92	457.94
				10/19/12	79.48	459.38
				01/23/13	78.27	460.59
				04/30/13	77.29	461.57
				07/25/13	78.65	460.21
				11/19/13	78.85	460.01
				04/16/14	78.90	459.96
CS-C32-120	Shallow	567.31	90 - 120	01/22/13	99.88	467.43
				04/30/13	98.86	468.45
				07/25/13	99.58	467.73
				11/19/13	99.60	467.71
				04/16/14	99.88	467.43
CS-C33-059	Shallow	435.91	29 - 59	01/22/13	37.01	398.90
				04/30/13	36.11	399.80
				07/29/13	37.02	398.89
				11/20/13	37.08	398.83
				04/25/14	29.59	406.32
CS-C34-065	Shallow	442.30	35 - 65	06/19/13	43.62	398.68
				08/02/13	43.67	398.63
				11/13/13	43.72	398.58
				04/23/14	43.48	398.82
CS-C35-041	Shallow	414.38	11 - 41	06/19/13	18.04	396.34
				08/02/13	18.09	396.29
				11/15/13	18.13	396.25
				04/23/14	17.84	396.54

TABLE 4-1
Groundwater Level Measurements Obtained During GCOU Remedial Investigation
Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Well ID	Well Designation	Reference Point Elevation (ft msl)	Screened Interval (ft bgs)	Date	Depth to Groundwater (ft btoc)	Groundwater Elevation (ft msl)
CS-C36-055	Shallow	431.01	25 - 55	06/20/13	34.15	396.86
				08/02/13	34.18	396.83
				11/15/13	34.18	396.83
				04/10/14	33.94	397.07
				04/25/14	33.91	397.10
CS-C37-035	Shallow	406.79	10 - 35	06/19/13	15.25	391.54
				08/02/13	15.45	391.34
				11/15/13	15.25	391.54
				04/25/14	14.94	391.85
CS-C38-051	Shallow	456.15	21 - 51	06/25/13	29.60	426.55
				07/31/13	29.97	426.18
				11/14/13	31.40	424.75
				04/23/14	30.40	425.75
CS-C39-073	Shallow	459.20	43 - 73	06/21/13	52.49	406.71
				08/07/13	52.43	406.77
				11/20/13	52.71	406.49
				04/10/14	52.61	406.59
CS-C40-079	Shallow	501.67	49 - 79	06/20/13	58.35	443.32
				07/30/13	58.65	443.02
				11/17/13	60.15	441.52
				04/17/14	59.78	441.89
CS-C41-058	Shallow	469.47	28 - 58	06/20/13	36.94	432.53
				07/31/13	37.35	432.12
				11/14/13	39.15	430.32
				04/10/14	38.36	431.11
				04/25/14	37.89	431.58
CS-C42-059	Shallow	470.93	29 - 59	06/21/13	36.57	434.36
				07/31/13	36.75	434.18
				11/15/13	38.54	432.39
				04/17/14	37.55	433.38
CS-C43-083	Shallow	474.87	53 - 83	06/25/13	61.81	413.06
				07/16/13	61.79	413.08
				08/07/13	61.90	412.97
				11/20/13	62.40	412.47
				04/15/14	62.28	412.59
CS-C44-120	Shallow	555.75	80 - 120	07/17/14	88.85	466.90
				10/29/14	89.35	466.40
CS-C45-054	Shallow	412.48	23.5 - 53.5	07/17/14	28.32	384.16
				10/29/14	28.38	384.10
CS-C46-045	Shallow	411.95	15 - 45	07/17/14	22.45	389.50
				10/29/14	22.65	389.30
CS-C47-053	Shallow	418.34	23.5 - 53.5	07/17/14	28.05	390.29
				10/28/14	22.21	396.13

TABLE 4-1
Groundwater Level Measurements Obtained During GCOU Remedial Investigation
Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Well ID	Well Designation	Reference Point Elevation (ft msl)	Screened Interval (ft bgs)	Date	Depth to Groundwater (ft btoc)	Groundwater Elevation (ft msl)
GCOU Respondents RI Monitoring Wells						
PWA-1	Shallow	576.51	110 - 150	01/28/13	109.10	467.41
				05/02/13	108.60	467.91
				07/23/13	108.60	467.91
				11/11/13	109.15	467.36
				04/16/14	108.02	468.49
PWA-2	Shallow	592.6	110 - 150	01/31/13	123.34	469.26
				05/01/13	122.40	470.20
				07/22/13	121.95	470.65
				11/11/13	122.20	470.40
PWA-3	Shallow	573.92	95 - 135	01/31/13	105.84	468.08
				05/01/13	105.29	468.63
				07/22/13	105.50	468.42
				11/11/13	105.68	468.24
				04/16/14	104.90	469.02
PWA-4	Shallow	555.85	80 - 120	01/28/13	89.06	466.79
				05/03/13	88.25	467.60
				07/24/13	88.41	467.44
				11/12/13	88.88	466.97
				04/16/14	88.34	467.51
PWA-5	Shallow	578.06	105 - 145	01/28/13	109.83	468.23
				05/02/13	109.24	468.82
				07/23/13	109.55	468.51
				11/11/13	110.25	467.81
				04/16/14	109.05	469.01
PWA-6	Shallow	476.18	50 - 90	01/21/13	62.70	413.48
				05/01/13	61.77	414.41
				07/24/13	61.91	414.27
				11/14/13	62.65	413.53
				04/17/14	62.45	413.73
PWA-7	Shallow	449.62	13.5 - 53.5	01/21/13	25.96	423.66
				05/01/13	24.58	425.04
				07/30/13	24.49	425.13
				11/19/13	25.90	423.72
				04/22/14	25.00	424.62
PWA-8	Shallow	498.7	45 - 85	01/23/13	57.63	441.07
				05/02/13	56.33	442.37
				07/29/13	56.03	442.67
				11/11/13	57.54	441.16
				04/17/14	57.10	441.60

TABLE 4-1
Groundwater Level Measurements Obtained During GCOU Remedial Investigation
Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Well ID	Well Designation	Reference Point Elevation (ft msl)	Screened Interval (ft bgs)	Date	Depth to Groundwater (ft btoc)	Groundwater Elevation (ft msl)
PWA-9	Shallow	507.94	55 - 95	01/28/13	53.28	454.66
				05/03/13	53.25	454.69
				07/30/13	53.57	454.37
				11/19/13	53.90	454.04
				04/17/14	54.50	453.44
PWA-10	Shallow	482.47	40 - 80	01/28/13	46.71	435.76
				05/02/13	43.09	439.38
				07/29/13	44.62	437.85
				11/12/13	46.60	435.87
				04/17/14	45.82	436.65
PWA-12	Deep	476.39	135 - 165	01/21/13	62.76	413.63
				05/01/13	61.90	414.49
				07/24/13	61.92	414.47
				11/14/13	62.70	413.69
				04/17/14	62.52	413.87
PWA-13	Shallow	538.4	65 - 105	01/28/13	72.58	465.82
				05/03/13	71.85	466.55
				07/23/13	71.86	466.54
				11/13/13	72.00	466.40
				04/16/14	71.85	466.55
Existing EPA Monitoring Well						
CS-VPB-09	Shallow	485.44	56 - 76	10/22/12	51.70	433.74
				04/10/14	50.80	434.64
PO-VPB-01	Shallow	411.33	41 - 61	08/08/13	26.35	384.98
New Glendale Respondents Group Wells						
GN-P10	Shallow	466.54	68 - 98	10/18/12	39.54	427.00
				11/18/13	38.45	428.09
				04/22/14	36.88	429.66
GN-P11	Shallow	454.78	25 - 45	10/18/12	28.80	425.98
				11/19/13	28.00	426.78
				04/10/14	27.23	427.55
GS-P13	Shallow	432.40	30 - 50	10/19/12	33.33	399.07
				11/20/13	33.28	399.12
				04/23/14	32.83	399.57
Disney Burbank Studio Facility						
V14WDSW5	Shallow	524.90	58 - 88	01/31/13	67.99	456.91
Former All Metals Processing Facility						
V14AMPW1	Shallow	503.45	45 - 75	10/16/12	61.97	441.48
				05/07/13	59.87	443.58
				07/22/13	59.41	444.04
				04/17/14	60.55	442.90

TABLE 4-1
Groundwater Level Measurements Obtained During GCOU Remedial Investigation
Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Well ID	Well Designation	Reference Point Elevation (ft msl)	Screened Interval (ft bgs)	Date	Depth to Groundwater (ft btoc)	Groundwater Elevation (ft msl)
V14AMPW3	Shallow	503.85	55 - 75	10/16/12	62.55	441.30
				05/07/13	60.46	443.39
				07/22/13	59.93	443.92
V14AMPW3R	Shallow	--	--	04/22/14	59.62	NC
				07/16/14	59.82	NC
				10/30/14	60.75	NC
Former Drilube Facility						
V13DRMW1	Shallow	477.9	45 - 70	10/17/12	61.20	416.70
				05/08/13	60.19	417.71
				08/06/13	60.23	417.67
				04/21/14	60.75	417.15
V13DRMW2	Shallow	479.43	50 - 75	10/17/12	62.85	416.58
				05/08/13	61.78	417.65
				08/05/13	61.83	417.60
				04/22/14	62.40	417.03
V13DRMW3	Shallow	477.96	45 - 70	10/17/12	62.17	415.79
				05/08/13	61.17	416.79
				08/05/13	61.24	416.72
				04/22/14	61.72	416.24
V13DRMW4	Shallow	478.61	46 - 71[(1)]	10/17/12	61.52	417.09
				05/08/13	60.50	418.11
				08/06/13	60.52	418.09
				04/22/14	61.04	417.57
V13DRMW5	Shallow	476.21	44 - 69[(1)]	10/17/12	60.19	416.02
				05/07/13	59.18	417.03
				08/05/13	59.22	416.99
				04/22/14	59.70	416.51
V13DRMW6	Shallow	473.61	46 - 71	06/24/13	56.15	417.46
				08/05/13	56.23	417.38
				11/12/13	57.00	416.61
				04/22/14	56.70	416.91
V13DRMW7	Shallow	472.95	48 - 73	06/24/13	57.20	415.75
				08/07/13	57.33	415.62
				11/12/13	58.00	414.95
				04/15/14	57.78	415.17
V13DRMW8	Shallow	475.64	51 - 76	06/24/13	61.01	414.63
				08/07/13	60.28	415.36
				11/12/13	60.76	414.88
				04/15/14	60.60	415.04
V13DRMW9	Shallow	473.9	47 - 72	06/25/13	59.60	414.30
				08/08/13	59.75	414.15
				11/14/13	60.30	413.60
				04/17/14	60.12	413.78

TABLE 4-1
Groundwater Level Measurements Obtained During GCOU Remedial Investigation
Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Well ID	Well Designation	Reference Point Elevation (ft msl)	Screened Interval (ft bgs)	Date	Depth to Groundwater (ft btoc)	Groundwater Elevation (ft msl)
V13DWBW1	Shallow	476.84	45 - 75	10/17/12	59.95	416.89
				05/07/13	58.89	417.95
				08/06/13	58.95	417.89
				04/21/14	59.45	417.39
V13DWBW3	Shallow	476.47	46 - 76	10/17/12	59.65	416.82
				05/07/13	58.60	417.87
				08/06/13	58.65	417.82
				04/21/14	59.15	417.32
Former Eemco Facility						
V13EEMW1	Shallow	435.84	10 - 35	06/17/13	18.80	417.04
				11/13/13	19.85	415.99
V13EEMW3	Shallow	433.85	10 - 35	06/17/13	20.16	413.69
				11/13/13	20.60	413.25
V13EEMW4	Shallow	430.88	10 - 35	06/17/13	18.04	412.84
				11/13/13	18.83	412.05
Former Franciscan Ceramics Facility						
FCR-HLA1R	Shallow	433.27	37 - 57[1]	01/29/13	42.75	390.52
				07/26/13	42.24	391.03
				10/28/14	42.31	390.96
FCR-HMW1R	Shallow	438.82	37 - 57[1]	01/29/13	45.96	392.86
				07/26/13	46.46	392.36
				10/28/14	46.80	392.02
FCR-OW2	Shallow	431.96	29 - 49	11/01/12	39.16	392.80
				01/29/13	38.79	393.17
				11/18/13	39.08	392.88
FCR-OW3	Shallow	431.47	32 - 52	11/01/12	39.45	392.02
				01/29/13	39.11	392.36
				11/18/13	39.45	392.02
FCR-OW4R	Shallow	424.93	28 - 48[1]	01/31/13	34.48	390.45
				07/26/13	35.12	389.81
				10/28/14	35.23	389.70
FCR-WCW-1	Shallow	440.13	42 - 57	11/01/12	46.21	393.92
				01/29/13	45.88	394.25
				11/18/13	46.20	393.93
FCR-WCW2R	Shallow	438.20	37 - 57[1]	01/31/13	45.02	393.18
				07/30/13	46.02	392.18
				10/28/14	46.00	392.20
FCR-WCW4	Deep	435.21	97 - 102	11/01/12	41.39	393.82
				01/29/13	41.00	394.21
				11/18/13	41.32	393.89
				04/21/14	41.06	394.15

TABLE 4-1

Groundwater Level Measurements Obtained During GCOU Remedial Investigation

Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Well ID	Well Designation	Reference Point Elevation (ft msl)	Screened Interval (ft bgs)	Date	Depth to Groundwater (ft btoc)	Groundwater Elevation (ft msl)
Grayson Power Plant						
V13GPPW2	Shallow	463.36	30 - 60	01/30/13	40.46	422.90
				08/01/13	38.79	424.57
				11/18/13	40.07	423.29
				04/21/14	39.20	424.16
V13GPPW4	Shallow	459.58	30 - 60	01/30/13	38.19	421.39
				08/08/13	38.27	421.31
V13GPPW7	Shallow	NA	29 - 59	01/30/13	36.93	NA
				08/08/13	37.61	NA
V13GPPW8	Shallow	461.06	30 - 50	01/30/13	37.35	423.71
				08/01/13	35.54	425.52
V13GPP12	Shallow	465.66	34 - 54	01/30/13	43.59	422.07
				08/01/13	42.10	423.56
V13GPP13	Shallow	459.83	25 - 45	01/30/13	33.59	426.24
				08/01/13	37.25	422.58
				11/18/13	33.35	426.48

Notes:

ft bgs = feet below ground surface

ft msl = feet (elevation relative to) mean sea level

ft btoc = feet below top of casing

NA - reference elevation not available; ground water elevation cannot be calculated

(1) Well screen interval is approximate and estimated based on the total depth measured during sampling and construction of existing wells at the site.

TABLE 4-2
Analytical Results for Major Cations, Anions, Metals, and General Chemistry Parameters in Groundwater Samples Obtained During GCOU Remedial Investigation
Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

	Regulatory Action Levels				CS-C30-120		CS-C30-200		CS-C31-102			CS-C32-120	CS-C33-059		CS-C34-065	CS-C35-041	CS-C36-055	CS-C37-035	CS-C38-051		CS-C39-073
	CA Primary MCL	EPA Primary MCL	CA Secondary MCL	EPA Secondary MCL	09/06/12	01/23/13	09/06/12	01/23/13	09/06/12	09/06/12	01/23/13	01/22/13	01/22/13	01/22/13	06/19/13	06/19/13	06/20/13	06/19/13	06/25/13	06/25/13	06/21/13
					N	N	N	N	N	FD	N	N	N	FD	N	N	N	N	N	FD	N
Parameter					CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M
Major Cations (mg/L)																					
Aluminum	1,000		200	50 to 200	15.9 J	< 200	13.9 J	< 200	24.7	24.5	< 200	< 200	< 200	< 200	< 20	< 20	< 20	< 20	12.8 J	20.5	< 20
Antimony	6	6			< 2	< 60	< 2	< 60	< 2	< 2	< 60	< 60	< 60	< 60	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Arsenic					1.5	< 10	1.5	< 10	1.5	1.5	< 10	< 10	< 10	< 10	< 1	< 1	< 1	1.3	< 1	< 1	1.2
Barium	1,000	2,000			72 J	< 200	186 J	< 200	77.3 J	76 J	< 200	< 200	< 200	< 200	99.3	61.2	101	54.5	20.1	22	140
Beryllium	4	4			< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Cadmium	5	5			< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Calcium					92,800	169,000	172,000	89,600	174,000	166,000	175,000	187,000	114,000	114,000	113,000	100,000	99,400	96,700	214,000	225,000	95,900
Chromium (total) (unfiltered)	50	100			7.7 J	33	5.6 J	< 10	7.8 J	2.4 J	14.3	19.6	134	130	14	29	135	19.2	3.2	2.7	219
Chromium (total) (filtered)	50	100			6	< 10	3.6	< 10	< 10	2.4	< 10	< 10	123	120	14.8 J	29.5 J	133 J	20.4 J	1.1 J	1.7 J	199 J
Cobalt					< 1	< 50	< 1	< 50	0.35 J	0.36 J	< 50	< 0.2	< 0.2	< 0.2	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Copper			1,000	1,000	< 25	< 25	< 25	< 25	< 25	< 25	< 25	0.58 J	< 25	< 25	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Iron			300	300	542	< 100	571	< 100	465	541	< 100	< 100	< 100	< 100	437	384	363	360	786	851	403
Lead			15	15	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 1	< 1	< 1	< 1	1.2	< 1	< 1
Magnesium					17,900	32,800	33,400	18,100	35,600	33,200	37,300	41,000	38,100	37,900	38,500	34,300	33,300	31,600	84,400	90,100	33,900
Manganese			50	50	12 J	< 15	4.9 J	< 15	109	109	< 15	15.3	15.9	16.4	414	57.8	54.6	122	178	198	4.8
Nickel	100				< 40	6.5 J	< 40	1.3 J	< 40	< 40	3.2 J	4.6 J	3.4 J	2.8 J	6.4 J	2.9 J	2.9 J	5.2 J	5	5.7	3.5 J
Potassium					5,010	5,420	7,590	< 5,000	8,150	7,680	6,420	6,330	< 5000	< 5000	5,430	3,000	2,670	3,730	6,090	6,530	2,410
Selenium	50	50			< 35	< 35	< 35	< 35	< 35	< 35	< 35	1.8 J	< 35	< 35	2.4 J	3.2 J	2.5 J	1.9 J	8.5	8	1.8 J
Silver			100	100	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	0.5 J	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Sodium					33,400	38,600	54,200	29,900	91,800	86,600	52,800	41,900	47,000	46,800	48,300	43,200	40,500	40,200	62,400	66,600	41,700
Thallium	2	2			< 1	< 25	< 1	< 25	< 1	< 1	< 25	< 25	< 25	< 25	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Vanadium					< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 5	< 5	< 5	< 5	2.2 J	2.3 J	< 5
Zinc			5,000	5,000	17.4 J	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	32.1	4.2	2.5	7.8	9.0	25.1	11.6
Anions and Other Parameters (mg/L)																					
Bicarbonate Alkalinity (as CaCO3)					200	NA	320	NA	350	360	NA	350	230	230	230	240	210	200	280	270	200
Bicarbonate					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbonate Alkalinity (as CaCO3)					< 10	NA	< 10	NA	< 10	< 10	NA	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Carbonate					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hydroxide Alkalinity (as CaCO3)					< 10	NA	< 10	NA	< 10	< 10	NA	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Total Alkalinity (as CaCO3)					200	NA	320	NA	350	360	NA	350	230	230	230	240	210	200	280	270	200
Lime (as CaCO3)					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromide					0.13	NA	0.28	NA	0.25	0.22	NA	0.35	0.41	0.35	NA	NA	NA	NA	NA	NA	NA
Chloride			250 to 500	250	31	NA	110	NA	120	110	NA	120	84	84	81	72	87	72	93	93	88
Fluoride	2	4		2	0.42	NA	0.29	NA	0.3	0.33	NA	0.35	0.3	0.26	0.32	0.32	0.3	0.36	0.44	0.42	0.32
Nitrate (as NO3)					40.05	NA	28.035	NA	28.035	28.035	NA	30.705	43.61	43.165	NA	NA	NA	NA	NA	NA	NA
Nitrate-N	10	10			9.0	NA	6.3	NA	6.3	6.3	NA	6.9	9.7	9.8	10	7.8	10 J	8.0	11 J	11 J	9.7
Nitrite	1	1			0.1	NA	< 0.5	NA	< 0.5	< 0.5	NA	< 0.1	< 0.5	< 0.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Nitrite-N					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ammonia (as N)					0.045 J	NA	< 0.05	NA	< 0.05	< 0.05	NA	< 0.05	< 0.05	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
Total Kjeldal Nitrogen (TKN)					NA	NA	NA	NA	NA	NA	NA	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Orthophosphate-P					< 1	NA	< 1	NA	< 1	< 1	NA	< 1	< 1	< 1	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Sulfate			250 to 500	250	95	NA	160	NA	200	200	NA	190	140	140	150	120	160	130	740	740	160
Sulfide					< 0.5	NA	< 0.5	NA	< 0.5	< 0.5	NA	< 0.5	< 0.5	< 0.5	< 0.93	< 0.93	< 0.91	< 0.94	< 0.97	< 0.95	< 0.93
Total Dissolved Solids			500 to 1,000	500	460	NA	800	NA	900	900	NA	820	640	640	730	630	700	600	1,600	1,600	710
Total Dissolved Solids (residue, filterable)					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon					0.69	NA	0.85	NA	0.89	1.3	NA	0.76	0.64	0.73	0.77	0.51 J	0.61	0.49 J	1.2	1.3 J	0.6

TABLE 4-2
Analytical Results for Major Cations, Anions, Metals, and General Chemistry Parameters in Groundwater Samples Obtained During GCOU Remedial Investigation
Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

	CS-C40-079		CS-C41-058	CS-C42-059	CS-C43-083	CS-C44-120	CS-C45-054	CS-C46-045	CS-C47-053	CS-VPB-09		FCR-HLA1R	FCR-HMW1R	FCR-OW2	FCR-OW3	FCR-OW4R	FCR-WCW1	FCR-WCW2R	FCR-WCW4	GSP-13		
	06/20/13	06/20/13	06/20/13	06/21/13	06/26/13	07/17/14	07/17/14	07/16/14	07/17/14	04/13/12	04/10/13	01/29/13	01/29/13	01/29/13	01/29/13	01/31/13	01/29/13	01/31/13	01/29/13	02/08/12	02/08/12	04/24/12
	N	FD	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	FD	N
Parameter	CH2M	CH2M	CH2M	CH2M	CH2M	OTIE	OTIE	OTIE	OTIE	CH2M	ERM	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M
Major Cations (mg/L)																						
Aluminum	< 20	< 20	< 20	< 20	432	380	120	520	280	NA	NA	< 200	< 200	< 200	< 200	< 200	< 200	< 200 U	< 200	< 10 U	< 10 U	NA
Antimony	< 2	< 2	< 2	< 2	< 2	< 0.25	< 0.25	< 0.25	< 0.25	NA	NA	< 60	< 60	< 60	< 60	< 60	< 60	< 60 U	< 60	0.62 J	0.72 J	NA
Arsenic	1.7	< 1	< 1	1.3	< 1	1.7	0.69	1.1	0.82	NA	NA	< 10	< 10	< 10	< 10	< 10	< 10	< 10 U	< 10	< 1 U	< 1 U	NA
Barium	79.3	75.5	49.1	153	123	140	61	50	66	NA	NA	59.7 J	138 J	64.3 J	66.6 J	< 200	74.8 J	< 200 U	60.2 J	60	59	NA
Beryllium	< 1	< 1	< 1	< 1	< 1	< 0.25	< 0.25	< 0.25	< 0.25	NA	NA	< 5	< 5	< 5	< 5	< 5	< 5	< 5 U	< 5	< 0.5 U	< 0.5 U	NA
Cadmium	< 1	< 1	< 1	< 1	< 1	< 0.20	< 0.20	< 0.20	< 0.20	NA	NA	< 5	< 5	< 5	< 5	< 5	1 J	< 5 U	< 5	0.15 J	0.14 J	NA
Calcium	146,000	139,000	151,000	136,000	92,800	150,000	100,000	96,000	110,000	270,000	290,000	106,000	108,000	114,000	108,000	111,000	54,700	109,000	94,700	110,000 J	110,000 J	110,000
Chromium (total) (unfiltered)	30.3	31.7	5.1	27.9	370	6.0	2.7	3.0	4.3	NA	NA	29.2	10.6	118	37.2	< 10	< 10	26.2 J	< 10	NA	NA	NA
Chromium (total) (filtered)	40 J	37.6 J	4.8 J	21.1 J	402	NA	NA	NA	NA	5.8	3.83	15.6	< 10	106	35.5	9.7 J	< 10	< 10 U	< 10	< 2 U	< 2 U	< 2 U
Cobalt	2.3	2.1	< 1	< 1	< 1	0.44	0.53	0.78	0.35	NA	NA	< 50	< 50	< 50	< 50	< 50	0.22 J	< 50 U	< 50	0.93 J	0.92 J	NA
Copper	< 2	< 2	< 2	< 2	< 2	1.5 J	< 1.0	1.2 J	< 1.0	NA	NA	< 25	0.71 J	< 25	< 25	< 25	1.7 J	< 25 U	< 25	< 2 U	< 2 U	NA
Iron	616	561	582	574	932	430	130	420	300	2,600 J	4730	< 100	< 100	< 100	< 100	< 100	< 100	< 100 U	< 100	5800	5900	620
Lead	< 1	< 1	< 1	< 1	< 1	< 0.50	< 0.50	< 0.50	< 0.50	NA	NA	< 10	< 10	< 10	< 10	< 10	< 10	< 10 U	< 10	< 1 U	< 1 U	NA
Magnesium	36,900	35,600	45,700	48,400	34,000	42,000	34,000	31,000	36,000	95,000	106,000	35,000	36,100	37,800	36,100	36,500	17,000	37,000	31,000	39,000	40,000	42,000
Manganese	352	340	245	126	223	37	24	250	43	NA	NA	< 15	< 15	< 15	< 15	< 15	258	< 15 U	< 15	NA	NA	NA
Nickel	7.5 J	7.1 J	3.9 J	3.3 J	3.5	4.9	3.2	3.3	3.3	NA	NA	< 40	< 40	< 40	< 40	< 40	< 40	< 40 U	< 40	1.9 J	1.7 J	NA
Potassium	7,200	6,920	7,620	2,920	3,170	8,200	3,400	5,200	3,500	2,300	2,290	< 5,000 J	< 5,000 J	< 5000 J	< 5,000 J	< 5,000	< 5,000 J	< 5000 U	< 5,000 J	7,500	7,300	6,900
Selenium	5.6	4.2 J	4.5 J	3.5 J	1.4 J	2.8	1.5	1.4	1.3	NA	NA	2.1 J	3.8 J	< 35	< 35	< 35	< 35	< 35 U	2.2 J	1.8 J	2	NA
Silver	< 1	< 1	< 1	< 1	< 1	< 0.13	< 0.13	< 0.13	< 0.13	NA	NA	< 10	< 10	< 10	< 10	< 10	< 10	< 10 U	< 10	< 1 U	< 1 U	NA
Sodium	62,900	60,300	71,500	57,900	43,000	61,000	52,000	51,000	48,000	63,000	73,100	42,100	49,200	42,900	41,000	46,300	24,900	94,600	37,500	77,000	80,000	66,000
Thallium	< 1	< 1	< 1	< 1	< 1	< 0.50	< 0.50	< 0.50	< 0.50	NA	NA	< 25	< 25	< 25	< 25	< 25	< 25	< 25 U	< 25	< 1 U	< 1 U	NA
Vanadium	< 5	< 5	< 5	5.2 J	7.2	5.8	4.7	4.1	4.8	NA	NA	4.6 J	4.5 J	5 J	4.9 J	< 50	3.4 J	< 50 U	4.9 J	2.9	2.4	NA
Zinc	32.8	35.4	34	18.6	10.7	12	5.1	7.0	2.8 J	NA	NA	< 60	< 60	< 60	< 60	< 60	< 60	< 60 U	< 60	< 20 U	< 20 U	NA
Anions and Other Parameters (mg/L)																						
Bicarbonate Alkalinity (as CaCO3)	280	290	300	380	200	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	310	330	340
Bicarbonate	NA	NA	NA	NA	NA	310	190	210	190	NA	570	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbonate Alkalinity (as CaCO3)	< 10	< 10	< 10	< 10	< 10	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	< 2.4	< 2.4	< 2.4
Carbonate	NA	NA	NA	NA	NA	< 5.0	< 5.0	< 5.0	< 5.0	NA	< 1.0	NA	NA	NA	NA	NA	NA	NA	NA	< 2.4	< 2.4	< 2.4
Hydroxide Alkalinity (as CaCO3)	< 10	< 10	< 10	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Alkalinity (as CaCO3)	280	290	300	380	200	310	190	210	190	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	260	270	280
Lime (as CaCO3)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	570	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloride	93	95	110	95	88	120	90	76	89	87	230	NA	NA	NA	NA	NA	NA	NA	NA	91	88	86
Fluoride	0.45	0.44	0.37	0.24	0.46	NA	NA	NA	NA	0.25	0.3	NA	NA	NA	NA	NA	NA	NA	NA	0.3	0.34	NA
Nitrate (as NO3)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.9	7.9	6.0
Nitrate-N	8.4 J	8.5 J	8.1 J	15	9.7	10	9.2	8.0	9.0	8.2	7.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrite	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	< 3	< 3	< 0.15
Nitrite-N	NA	NA	NA	NA	NA	< 0.25	< 0.25	< 0.25	< 0.25	< 0.10	< 0.10	NA	NA	NA	NA	NA	NA	NA	NA	< 2.2	< 2.2	< 0.11
Ammonia (as N)	0.044 J	0.047 J	0.037 J	< 0.025	0.031 J	0.027	< 0.025	0.036	< 0.025	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.29 J
Total Kjeldal Nitrogen (TKN)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.12	< 0.05	< 0.05	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Orthophosphate-P	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate	180	180	250	160	170	170	170	140	170	160	320	NA	NA	NA	NA	NA	NA	NA	NA	130	130	140
Sulfide	< 0.92	< 0.93	<0.90	<0.90	< 0.95	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Dissolved Solids	810	820	940	940	740	NA	NA	NA	NA	790	1380	NA	NA	NA	NA	NA	NA	NA	NA	750	750	NA
Total Dissolved Solids (residue, filterable)	NA	NA	NA	NA	NA	870	650	630	680	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon	0.66	0.56	0.68	0.77	0.82	0.61	0.5	0.46	0.52	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.9	< 1	NA

TABLE 4-2
Analytical Results for Major Cations, Anions, Metals, and General Chemistry Parameters in Groundwater Samples Obtained During GCOU Remedial Investigation
Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

	PO-VPB-01	PWA-01		PWA-02		PWA-03		PWA-04		PWA-05		PWA-06		PWA-07		PWA-12		PWA-13	
	04/19/12	10/31/12	01/28/13	10/31/12	01/31/13	10/30/12	01/31/13	10/31/12	01/28/13	10/31/12	01/28/13	10/29/12	01/14/13	10/29/12	01/21/13	10/29/12	01/21/13	10/30/12	01/28/13
	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Parameter	CH2M	ERM	CH2M	ERM	CH2M	ERM	CH2M	ERM	CH2M	ERM	CH2M	ERM	CH2M	ERM	CH2M	ERM	CH2M	ERM	CH2M
Major Cations (mg/L)																			
Aluminum	< 20 U	< 10	< 200	< 10	< 200	< 10	< 200	< 10	< 200	< 10	< 200	< 10	< 200	< 10	< 200	< 10	< 200	< 10	< 200
Antimony	< 2 U	< 2.0	< 60	< 2.0	< 60	< 2.0	< 60	0.49 J	< 60	< 2.0	< 60	< 2.0	< 60	< 2.0	< 60	< 2.0	< 60	< 2.0	< 60
Arsenic	2.7	1.1	< 10	< 1.0	< 10	0.99 J	< 10	0.98 J	< 10	< 1.0	< 10	< 1.0	< 10	< 1.0	< 10	< 1.0	< 10	< 1.0	< 10
Barium	70.9	72	99.1 J	140	< 200	210	< 200	64	81.9 J	130	122 J	160	< 200	56	< 200	180	< 200	92	98.1 J
Beryllium	< 1 U	< 0.50	< 5	< 0.50	< 5	< 0.50	< 5	< 0.50	< 5	< 0.50	< 5	< 0.50	< 5	< 0.50	< 5	< 0.50	< 5	< 0.50	< 5
Cadmium	< 1 U	< 1.0	< 5	< 1.0	< 5	< 1.0	< 5	< 1.0	< 5	< 1.0	< 5	< 1.0	< 5	< 1.0	< 5	< 1.0	< 5	0.10 J	< 5
Calcium	115,000 J	96,000	115,000	100,000	113,000	100,000	97,200	82,000	92,200	150,000	136,000	120,000	129,000	130,000	159,000	110,000	119,000	190,000	209,000
Chromium (total) (unfiltered)	NA	NA	36.5	NA	< 10	NA	59 J	NA	< 10	NA	< 10	NA	26.7	NA	63.9	NA	3.7 J	NA	< 10
Chromium (total) (filtered)	3.9	14	18.8	8.2	8.1 J	1.2 J	< 10	6.8	10 J	5.0	9.1 J	13	23.6	66	51.4	5.8	< 10	2.2	4.8 J
Cobalt	< 1 U	0.37 J	< 50	< 1.0	< 50	< 1.0	< 50	0.15 J	< 50	0.12 J	< 50	0.15 J	< 50	0.55 J	< 50	0.10 J	< 50	0.19 J	< 50
Copper	2.9	0.54 J	< 25	0.53 J	< 25	< 2.0	< 25	0.60 J	< 25	1.0 J	< 25	2.8	< 25	0.91 J	< 25	0.62 J	< 25	0.69 J	< 25
Iron	< 200 U	< 40	< 100	< 40	< 100	< 40	< 100	< 40	< 100	< 40	< 100	27 J	< 100	< 40	< 100	< 40	< 100	< 40	< 100
Lead	< 1 U	< 1.0	< 10	< 1.0	< 10	< 1.0	< 10	< 1.0	< 10	< 1.0	< 10	< 1.0	< 10	< 1.0	< 10	< 1.0	< 10	< 1.0	< 10
Magnesium	40,800 J	26,000	29,100	27,000	28,900	32,000	26,900	22,000	23,100	39,000	32,800	43,000	42,800	41,000	40,200	40,000	40,000	53,000	50,000
Manganese	1.1	< 20	< 15	< 20	< 15	< 20	< 15	< 20	< 15	< 20	< 15	7.7 J	< 15	< 20	< 15	< 20	21.3	< 20	< 15
Nickel	13.3	1.1 J	< 40	< 2.0	< 40	< 2.0	< 40	1.5 J	< 40	0.67 J	< 40	5.5	1.3 J	2.6	2.2 J	3.5	6 J	0.87 J	< 40
Potassium	3230 J	5,200	5,370 J	4,300	< 5,000	5,100	< 5,000	4,600	< 5,000 J	6,100	5,430 J	2,800	< 5,000	3,700	< 5,000	4,400	< 5,000	7,100	6,410 J
Selenium	2.1 J	1.8 J	1.9 J	2.2	< 35	< 2.0	< 35	1.3 J	1.7 J	3.1	2.4 J	0.67 J	< 35	2.8	4.3 J	< 2.0	< 35	2.1	2.8 J
Silver	< 1 U	< 1.0	< 10	< 1.0	< 10	< 1.0	< 10	< 1.0	< 10	< 1.0	< 10	< 1.0	< 10	< 1.0	< 10	< 1.0	< 10	0.10 J	< 10
Sodium	48,900 J	41,000	37,700	39,000	36,300	41,000	40,700	34,000	29,200	40,000	33,200	46,000	44,100	59,000	91,500	45,000	46,300	48,000	41,500
Thallium	< 1 U	< 1.0	< 25	< 1.0	< 25	< 1.0	< 25	< 1.0	< 25	< 1.0	< 25	< 1.0	< 25	< 1.0	< 25	< 1.0	< 25	< 1.0	< 25
Vanadium	4.3 J	3.3	3.3 J	5.7	< 50	8.4	< 50	2.8	2.9 J	3.1	2.7 J	5.4	< 50	5.3	< 50	5.4	< 50	3.9	3.5 J
Zinc	1.3 J	< 20	< 60	< 20	< 60	< 20	< 60	< 20	< 60	< 20	< 60	4.1 J	< 60	< 20	< 60	16 J	< 60	< 20	< 60
Anions and Other Parameters (mg/L)																			
Bicarbonate Alkalinity (as CaCO3)	NA	220	NA	240	NA	150	NA	210	NA	340	NA	230	NA	290	NA	230	NA	380	NA
Bicarbonate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbonate Alkalinity (as CaCO3)	NA	< 4.0	NA	< 4.0	NA	< 4.0	NA	< 4.0	NA	< 4.0	NA	< 4.0	NA	< 4.0	NA	< 4.0	NA	< 4.0	NA
Carbonate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hydroxide Alkalinity (as CaCO3)	NA	< 4.0	NA	< 4.0	NA	< 4.0	NA	< 4.0	NA	< 4.0	NA	< 4.0	NA	< 4.0	NA	< 4.0	NA	< 4.0	NA
Total Alkalinity (as CaCO3)	NA	220	NA	240	NA	150	NA	210	NA	340	NA	230	NA	290	NA	230	NA	380	NA
Lime (as CaCO3)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromide	NA	< 0.50	NA	0.50	NA	0.38 J	NA	0.43 J	NA	< 0.50	NA	0.61	NA	0.47 J	NA	0.55	NA	0.77	NA
Chloride	NA	56	NA	52	NA	120	NA	44	NA	84	NA	81	NA	67	NA	79	NA	84	NA
Fluoride	NA	0.47 J	NA	0.49 J	NA	< 0.50	NA	0.51	NA	0.43 J	NA	0.38 J	NA	0.42 J	NA	0.41 J	NA	0.41 J	NA
Nitrate (as NO3)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate-N	NA	11	NA	9.3	NA	1.7	NA	6.0	NA	12	NA	11	NA	11	NA	9.3	NA	1.0	NA
Nitrite	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrite-N	NA	< 0.15	NA	< 0.15	NA	< 0.15	NA	0.23	NA	< 0.15	NA	< 0.15	NA	< 0.15	NA	< 0.15	NA	< 0.15	NA
Ammonia (as N)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Kjeldal Nitrogen (TKN)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Orthophosphate-P	NA	< 0.16	NA	< 0.16	NA	< 0.16	NA	< 0.16	NA	< 0.16	NA	< 0.16	NA	< 0.16	NA	< 0.16	NA	< 0.16	NA
Sulfate	NA	110	NA	100	NA	110	NA	100	NA	150	NA	140	NA	150	NA	120	NA	250	NA
Sulfide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Dissolved Solids	NA	610	NA	590	NA	600	NA	550	NA	830	NA	680	NA	730	NA	660	NA	950	NA
Total Dissolved Solids (residue, filterable)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 4-2
Analytical Results for Major Cations, Anions, Metals, and General Chemistry Parameters in Groundwater Samples Obtained During GCOU Remedial Investigation
Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

	V13DRMW6	V13DRMW7	V13DRMW8	V13DRMW9	V13EEMW1			V13EEMW3	V13EEMW4	V13GPP12	V13GPP13		V13GPPW2	V13GPPW4	V13GPPW7	V13GPPW8	V14WDSW5
	06/24/13	06/24/13	06/24/13	06/25/13	10/29/12	10/29/12	06/17/13	06/17/13	06/17/13	01/30/13	01/30/13	01/30/13	01/30/13	01/30/13	01/30/13	01/30/13	01/31/13
	N	N	N	N	N	FD	N	N	N	N	N	FD	N	N	N	N	N
Parameter	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M
Major Cations (mg/L)																	
Aluminum	54.3	2.5 J	2.7 J	6.9 J	< 10	< 10	< 20.0 U	< 20.0 U	< 20.0 U	< 200 U	< 200 U	< 200 U	< 200	< 200 U	< 200 U	< 200 U	< 200 U
Antimony	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0 U	< 2.0 U	< 2.0 U	< 60 U	< 60 U	< 60 U	< 60	< 60 U	< 60 U	< 60 U	< 60 U
Arsenic	1.4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0 U	< 1.0 U	< 1.0 U	< 10 U	< 10 U	< 10 U	< 10	< 10 U	< 10 U	< 10 U	< 10 U
Barium	104	111	104	67.9	91	97	101	85.2	60.9	< 200 U	< 200 U	< 200 U	< 200	< 200 U	< 200 U	< 200 U	< 200 U
Beryllium	< 1.0	< 1.0	< 1.0	< 1.0	< 0.50	< 0.50	< 1.0 U	< 1.0 U	< 1.0 U	< 5 U	< 5 U	< 5 U	< 5	< 5 U	< 5 U	< 5 U	< 5 U
Cadmium	< 1.0	< 1.0	< 1.0	< 1.0	0.11 J	< 1.0	< 1.0 U	< 1.0 U	< 1.0 U	< 5 U	< 5 U	< 5 U	< 5	< 5 U	< 5 U	< 5 U	< 5 U
Calcium	106,000	103,000	99,200	60,100	110,000	110,000	101,000	117,000	105,000	274,000	224,000	220,000	150,000	101,000	124,000	170,000	174,000
Chromium (total) (unfiltered)	35.2	5.7	33.4	60.4	NA	NA	9.1	175	284	NA	71.8 JE	77 JE	74 J	< 10 UJE	20.1 JE	13.4 JE	551 JE
Chromium (total) (filtered)	3.6	2.2	29.9	61	< 2.0	< 2.0	3.7 J	8.0 J	13.9 J	< 10 U	67	65.4	75.2	< 10 U	< 10 U	< 10 U	< 10 U
Cobalt	< 1.0	< 1.0	< 1.0	< 1.0	0.96 J	0.98 J	< 1.0 U	< 1.0 U	< 1.0 U	< 50 U	< 50 U	< 50 U	< 50	< 50 U	< 50 U	< 50 U	< 50 U
Copper	< 2.0	< 2.0	< 2.0	< 2.0	0.81 J	1.2 J	< 2.0 U	< 2.0 U	< 2.0 U	< 25 U	< 25 U	< 25 U	< 25	< 25 U	< 25 U	< 25 U	< 25 U
Iron	478	398	362	198	160	160	871	467	419	< 100 U	< 100 U	< 100 U	< 100	< 100 U	< 100 U	< 100 U	< 100 U
Lead	< 1.0	< 1.0	< 1.0	2.7	0.20 J	0.21 J	< 1.0 UJ	< 1.0 UJ	< 1.0 UJ	< 10 U	< 10 U	< 10 U	< 10	< 10 U	< 10 U	< 10 U	< 10 U
Magnesium	40,100	40,700	37,900	22,600	36,000	37,000	31,900	31,400	28,400	82,100	48,500	47,600	42,300	33,300	40,500	56,000	38,100
Manganese	255	384	184	96.2	840	840	714	< 1 U	1.6	< 15 U	< 15 U	< 15 U	< 15	< 15 U	45.1	< 15 U	23.9
Nickel	4.5	4.1	3.7	4.4	1.9 J	1.7 J	3.3 J	2.9 J	19.8 J	< 40 U	< 40 U	< 40 U	< 40	< 40 U	< 40 U	< 40 U	< 40 U
Potassium	3,150	3,370	3,290	2,390	5,200	5,200	4,780	5,530	5,800	< 5000 U	15,900	15,700	< 5000	< 5000 U	< 5000 U	< 5000 U	6,000
Selenium	2.0 J	1.4 J	2.1 J	0.88 J	1.8 J	1.3 J	1.6 J	5.2	3.5 J	< 35 U	< 35 U	< 35 U	< 35	< 35 U	< 35 U	< 35 U	< 35 U
Silver	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0 U	< 1.0 U	< 1.0 U	< 10 U	< 10 U	< 10 U	< 10	< 10 U	< 10 U	< 10 U	< 10 U
Sodium	47,100	45,600	40,500	30,800	66,000	67,000	61,300	59,300	51,900	131,000	72,300	70,900	68,700	80,900	75,300	87,000	50,600
Thallium	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0 U	< 1.0 U	< 1.0 U	< 25 U	< 25 U	< 25 U	< 25	< 25 U	< 25 U	< 25 U	< 25 U
Vanadium	5.5	3.2 J	3.0 J	3.7 J	< 2.0	< 2.0	< 5.0 UJ	< 5.0 UJ	< 5.0 UJ	< 50 U	< 50 U	< 50 U	< 50	< 50 U	< 50 U	< 50 U	< 50 U
Zinc	5.6	31.4	8.6	9.3	< 20	< 20	4.7	< 2.0 U	3.6	< 60 U	< 60 U	< 60 U	< 60	< 60 U	< 60 U	< 60 U	< 60 U
Anions and Other Parameters (mg/L)																	
Bicarbonate Alkalinity (as CaCO3)	NA	< 10	NA	NA	360	350	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bicarbonate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbonate Alkalinity (as CaCO3)	NA	< 10	NA	NA	< 4.0	< 4.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbonate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hydroxide Alkalinity (as CaCO3)	NA	< 10	NA	NA	< 4.0	< 4.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Alkalinity (as CaCO3)	NA	< 10	NA	NA	360	350	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lime (as CaCO3)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromide	NA	NA	NA	NA	0.54	0.56	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloride	NA	< 1.0	NA	NA	56	55	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoride	NA	< 0.10	NA	NA	0.43 J	0.40 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate (as NO3)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate-N	NA	NA	NA	NA	4.6	4.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrite	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrite-N	NA	NA	NA	NA	0.47	0.48	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ammonia (as N)	NA	< 0.050	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Kjeldal Nitrogen (TKN)	NA	0.06 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Orthophosphate-P	NA	NA	NA	NA	0.21	< 0.16	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate	NA	< 0.50	NA	NA	91	92	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sulfide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Dissolved Solids	NA	NA	NA	NA	620	640	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Dissolved Solids (residue, filterable)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon	NA	< 0.50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

µg/L - micrograms per liter
mg/L - milligrams per liter
N - primary sample; FD - field duplicate sample
J - the reported concentration should be considered an estimated value
NA - not analyzed

CH2M - CH2M HILL
ERM - Environmental Resources Management
OTIE - Oneida Total Integrated Enterprises

TABLE 4-3

Results for Routine Field Parameter Measurements in Groundwater Samples Obtained During GCOU Remedial Investigation

Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Well	Sample Date	Sampling Company	Temperature (deg C)	Specific Conductivity (mS/cm)	Dissolved Oxygen (mg/L)	pH (-)	Oxidation Reduction Potential (mV)	Turbidity (NTU)
New EPA Monitoring Wells								
CS-C30-120	09/06/12	CH2M	23.35	2.880	8.47	7.19	165	NM
	10/19/12	CH2M	22.23	1.298	4.92	7.39	51.1	42.5
	01/23/13	CH2M	22.72	1.249	4.27	7.30	7.4	54.9
	04/30/13	CH2M	21.59	1.129	5.24	7.33	42.9	38.5
	07/25/13	CH2M	21.68	1.175	NM	7.27	NM	7.02
	11/20/13	OTIE	20.53	1.210	6.54	7.39	120	1.70
	04/16/14	OTIE	NM	NM	NM	NM	NM	NM
CS-C30-200	09/06/12	CH2M	21.23	1.700	9.23	7.49	208	NM
	10/19/12	CH2M	21.13	0.716	4.58	7.56	51.1	0.84
	01/23/13	CH2M	21.33	0.717	6.73	7.30	2.29	1.80
	04/30/13	CH2M	20.31	0.678	5.51	7.49	70.4	0.40
	07/25/13	CH2M	22.15	0.699	NM	7.47	NM	0.32
	11/20/13	OTIE	21.10	0.690	6.10	7.61	148	NM
	04/15/14	OTIE	21.59	0.662	7.08	7.49	605	1.34
CS-C31-102	09/06/12	CH2M	23.06	3.230	7.08	7.16	111	NM
	10/19/12	CH2M	22.40	1.327	4.99	7.17	64.7	21.8
	01/23/13	CH2M	22.53	1.396	6.38	7.31	18.4	2.19
	04/30/13	CH2M	21.76	1.286	6.99	7.11	52.8	1.93
	07/25/13	CH2M	22.02	1.357	NM	7.16	NM	7.50
	11/19/13	OTIE	20.45	1.300	5.50	7.25	94	1.40
	04/16/14	OTIE	20.39	1.269	7.17	7.16	434	2.99
CS-C32-120	01/22/13	CH2M	21.86	1.451	6.43	7.55	37.7	32.1
	04/30/13	CH2M	21.15	1.328	6.68	7.14	82.8	7.11
	07/25/13	CH2M	22.21	1.256	NM	7.20	NM	10.6
	11/19/13	OTIE	20.75	1.220	5.56	7.28	87	26.6
	04/16/14	OTIE	20.77	1.184	7.53	7.22	479.4	15.8
CS-C33-059	01/22/13	CDM	22.42	1.112	5.37	7.18	17.8	58.8
	04/30/13	CDM	22.76	1.043	5.35	6.87	66.7	33.3
	07/29/13	CH2M	23.32	1.066	NM	7.08	NM	19.3
	11/20/13	OTIE	21.06	1.070	5.20	7.04	155	NM
	04/25/14	OTIE/ERM	ERM COLLECTED FIELD PARAMETERS AND SAMPLES WERE SPLIT					
CS-C34-065	06/19/13	CH2M	22.89	1.117	5.60	6.84	115	67.9
	08/02/13	CH2M	23.03	1.143	NM	7.00	NM	70.1
	11/13/13	OTIE	22.60	1.120	6.15	6.92	163	1.10
	04/23/14	OTIE	21.95	1.096	6.21	6.82	549	10.4
CS-C35-041	06/19/13	CH2M	21.65	0.976	4.44	6.87	130.4	26.5
	08/02/13	CH2M	21.53	1.006	NM	7.12	NM	15.7
	11/15/13	OTIE	20.51	1.000	3.13	7.02	225	NM
	04/23/14	OTIE	21.06	0.961	3.87	6.97	545.1	4.25
CS-C36-055	06/20/13	CH2M	21.38	1.040	8.66	6.40	199.7	6.73
	08/02/13	CH2M	21.78	1.066	NM	7.10	NM	3.46
	11/15/13	OTIE	21.03	1.080	6.00	7.00	243	6.90
	04/25/14	OTIE/ERM	ERM COLLECTED FIELD PARAMETERS AND SAMPLES WERE SPLIT					
CS-C37-035	06/19/13	CH2M	21.79	0.908	7.32	6.92	135	32.1
	08/02/13	CH2M	21.70	0.944	NM	7.15	NM	13.4
	11/15/13	OTIE	20.65	0.930	5.70	7.04	254.0	9.1
	04/25/14	OTIE/ERM	ERM COLLECTED FIELD PARAMETERS AND SAMPLES WERE SPLIT					
CS-C38-051	06/25/13	CH2M	21.97	2.005	0.48	6.20	150.9	65.3
	07/31/13	CH2M	21.62	1.973	NM	5.61	NM	11.6
	11/14/13	OTIE	21.34	1.410	2.30	6.48	186	10.1
	04/23/14	OTIE	22.45	1.542	1.26	6.42	610.8	61.4

TABLE 4-3

Results for Routine Field Parameter Measurements in Groundwater Samples Obtained During GCOU Remedial Investigation

Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Well	Sample Date	Sampling Company	Temperature (deg C)	Specific Conductivity (mS/cm)	Dissolved Oxygen (mg/L)	pH (-)	Oxidation Reduction Potential (mV)	Turbidity (NTU)
CS-C39-073	06/21/13	CH2M	21.60	1.055	8.36	6.93	140.4	22.8
	08/07/13	CH2M	22.25	1.105	NM	7.18	NM	6.38
	11/20/13	OTIE	20.98	1.070	6.12	7.03	154	4.80
	06/03/14	OTIE/ERM	ERM COLLECTED FIELD PARAMETERS AND SAMPLES WERE SPLIT					
CS-C40-079	06/20/13	CH2M	22.76	1.211	3.70	6.99	118.4	27.4
	07/30/13	CH2M	22.69	1.195	NM	7.01	NM	1.01
	11/14/13	OTIE	20.25	1.140	3.32	7.10	229	2.40
	04/17/14	OTIE	20.25	1.115	4.18	7.03	382	10.1
CS-C41-058	06/20/13	CH2M	21.47	1.426	2.11	6.90	126.3	8.58
	07/31/13	CH2M	21.36	1.732	NM	6.09	NM	4.46
	11/14/13	OTIE	21.62	1.270	3.90	7.07	172	56.4
	04/25/14	OTIE/ERM	ERM COLLECTED FIELD PARAMETERS AND SAMPLES WERE SPLIT					
CS-C42-059	06/21/13	CH2M	25.43	1.382	5.57	7.10	86.8	16.9
	07/31/13	CH2M	23.70	1.353	NM	6.52	NM	19.4
	11/15/13	OTIE	22.40	1.290	4.91	7.10	4.91	5.70
	04/17/14	OTIE	22.69	1.277	5.11	7.06	352.5	12.7
CS-C43-083	06/26/13	CH2M	22.67	1.092	7.73	7.12	123.1	410
	07/16/13	CH2M	22.01	1.029	6.08	6.42	NM	20.7
	08/07/13	CH2M	22.06	1.125	NM	7.21	NM	24.4
	11/20/13	OTIE	20.98	1.090	5.63	7.10	130	27.4
	04/15/14	OTIE	23.38	1.058	5.98	7.01	459.4	60.0
CS-C44-120	07/17/14	OTIE	22.12	1.176	4.98	7.43	150.7	18.4
	10/29/14	OTIE	22.29	1.212	4.90	6.83	196.3	8.17
CS-C45-054	07/17/14	OTIE	23.08	0.933	7.57	6.92	218	1.7
	10/29/14	OTIE	22.86	0.969	6.41	6.6	197.3	9.62
CS-C46-045	07/16/14	OTIE	25.08	0.922	3.90	6.98	215.6	6.1
	10/29/14	OTIE	21.50	0.864	5.08	5.77	196.1	6.12
CS-C47-053	07/17/14	OTIE	23.03	0.946	7.41	6.93	178.8	3.8
	10/28/14	OTIE	21.63	0.946	5.40	6.68	189.7	5.55
GCOU Respondents Wells								
PWA-1	10/31/12	ERM	NR	NR	NR	NR	NR	NR
	01/28/13	CH2M	22.87	0.996	7.74	7.60	4.1	38.3
	05/02/13	CH2M	22.31	0.929	6.03	7.60	69.4	3.7
	07/23/13	CH2M	22.47	0.963	NM	7.90	NM	8.2
	11/19/13	OTIE	22.04	0.920	5.84	7.50	175	0.7
	04/16/14	OTIE	22.65	0.855	7.42	7.38	561.3	4.96
PWA-2	10/31/12	ERM	NR	NR	NR	NR	NR	NR
	01/31/13	CH2M	24.17	0.964	6.65	7.59	10.3	9.16
	05/01/13	CH2M	23.76	0.947	6.61	7.46	44	NM
	07/22/13	CH2M	24.58	1.006	NM	7.67	NM	13.9
	11/14/13	OTIE	22.97	0.960	5.69	7.64	96	35.2
PWA-3	10/30/12	ERM	NR	NR	NR	NR	NR	NR
	01/31/13	CH2M	24.58	0.973	0.69	7.80	-12.2	82.6
	05/01/13	CH2M	24.02	0.870	2.37	7.60	22.0	3.29
	07/22/13	CH2M	24.57	0.901	NM	7.81	NM	2.64
	11/14/13	OTIE	24.11	0.930	1.64	7.76	98.0	15.3
	04/16/14	OTIE	24.53	0.913	1.30	7.54	604.1	2.31
PWA-4	10/31/12	ERM	NR	NR	NR	NR	NR	NR
	01/28/13	CH2M	21.22	0.773	6.37	7.66	2.2	84.0
	05/03/13	CH2M	21.92	0.750	6.36	7.22	10.5	7.61
	07/24/13	CH2M	21.72	0.830	NM	7.32	NM	4.1
	11/19/13	OTIE	20.10	0.900	4.68	7.40	224	12.9
	04/16/14	OTIE	25.22	0.819	4.79	7.29	501.7	5.31
PWA-5	10/31/12	ERM	NR	NR	NR	NR	NR	NR
	01/28/13	CH2M	21.51	1.061	7.89	7.44	16.4	12.9
	05/02/13	CH2M	21.71	1.141	7.36	7.48	47.6	13.3
	07/23/13	CH2M	21.42	1.313	NM	7.37	NM	6.82
	11/19/13	OTIE	20.82	1.310	7.01	7.4	210	22.8
	04/16/14	OTIE	20.04	1.247	8.60	7.27	437.1	3.95

TABLE 4-3
Results for Routine Field Parameter Measurements in Groundwater Samples Obtained During GCOU Remedial Investigation
Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Well	Sample Date	Sampling Company	Temperature (deg C)	Specific Conductivity (mS/cm)	Dissolved Oxygen (mg/L)	pH (-)	Oxidation Reduction Potential (mV)	Turbidity (NTU)
PWA-6	10/29/12	ERM/CH2M	NR	NR	NR	NR	NR	NR
	01/14/13	CDM	NR	NR	NR	NR	NR	NR
	01/21/13	CH2M	20.59	1.251	8.43	7.19	35.7	24.1
	05/01/13	CH2M	21.25	1.071	7.21	7.05	79.5	4.36
	07/24/13	CH2M	21.66	1.141	NM	6.99	NM	0.91
	11/14/13	OTIE	20.67	1.120	6.27	7.11	180	0.10
	04/17/14	OTIE	22.75	1.114	6.32	7.09	454.3	3.39
PWA-7	10/29/12	ERM/CH2M	NR	NR	NR	NR	NR	NR
	01/21/13	CH2M	21.81	1.565	3.04	7.19	15.1	36.0
	05/01/13	CH2M	21.74	1.210	1.58	7.03	58.7	8.79
	07/30/13	CH2M	21.77	1.241	NM	6.85	NM	10.4
	11/19/13	OTIE	21.17	1.260	1.63	7.04	56	2.10
	04/22/14	OTIE	24.36	1.213	1.47	7.02	516.3	3.06
PWA-8	10/30/12	ERM/CH2M	NR	NR	NR	NR	NR	NR
	01/23/13	CH2M	22.63	1.150	5.05	6.80	20.8	12.9
	05/02/13	CH2M	22.30	1.079	4.67	7.20	12.1	16.0
	07/29/13	CH2M	21.79	1.085	NM	7.27	NM	8.96
	11/14/13	OTIE	22.80	1.080	3.70	7.28	183	46.2
	04/17/14	OTIE	23.61	1.075	4.49	7.15	464.7	11.8
PWA-9	10/30/12	ERM/CH2M	NR	NR	NR	NR	NR	NR
	01/28/13	CH2M	22.85	1.240	0.710	7.22	-79.3	13.5
	05/03/13	CH2M	22.81	1.219	0.280	7.11	-259	5.47
	07/30/13	CH2M	24.24	1.246	NM	6.85	NM	5.54
	11/19/13	OTIE	22.50	1.300	0.210	6.92	-191	13.0
	04/17/14	OTIE	21.87	1.353	0.130	7.10	139.8	17.8
PWA-10	10/30/12	ERM/CH2M	NR	NR	NR	NR	NR	NR
	01/28/13	CH2M	20.86	1.193	5.13	7.19	15.8	21.3
	05/02/13	CH2M	21.87	1.162	4.00	7.29	22.6	34.0
	07/29/13	CH2M	22.35	1.178	NM	7.27	NM	16.3
	11/20/13	OTIE	20.74	1.170	3.73	7.25	183	14.7
	04/17/14	OTIE	25.28	1.156	3.77	7.08	465.8	2.61
PWA-12	10/29/12	ERM/CH2M	NR	NR	NR	NR	NR	NR
	01/21/13	CH2M	19.87	1.199	7.25	7.19	30.1	31.5
	05/01/13	CH2M	20.06	1.041	7.26	6.88	73.7	NM
	07/24/13	CH2M	21.30	1.084	NM	7.06	NM	2.68
	11/14/13	OTIE	20.27	1.070	4.32	7.14	170	1.50
	04/17/14	OTIE	22.08	1.049	7.36	7.04	514.9	3.04
PWA-13	10/30/12	ERM/CH2M	NR	NR	NR	NR	NR	NR
	01/28/13	CH2M	22.02	1.507	4.21	7.49	0.3	28.0
	05/03/13	CH2M	22.79	1.497	3.08	7.37	-20.4	24.4
	07/23/13	CH2M	22.07	1.527	NM	7.3	NM	10.37
	11/13/13	OTIE	20.84	1.490	3.69	7.26	186	1.70
	04/16/14	OTIE	22.92	1.472	3.42	7.14	537.2	7.68
Former Eemco Facility								
V13EEMW1	10/29/12	ERM/CH2M	NR	NR	NR	NR	NR	NR
	06/17/13	CH2M	22.08	1.153	0.16	7.01	-205.5	6.75
	11/13/13	OTIE	21.78	1.000	0.12	7.20	-236	NM
V13EEMW3	06/17/13	CH2M	21.17	1.246	4.94	6.86	69.8	6.16
	11/13/13	OTIE	22.23	1.090	3.52	7.03	121	29.7
V13EEMW4	06/17/13	CH2M	21.60	1.173	4.38	6.90	72.2	5.67
	11/13/13	OTIE	24.53	1.020	5.32	7.08	136	NM
New GRG Monitoring Wells								
GN-P10	04/27/12	CH2M	NR	NR	NR	NR	NR	NR
	10/18/12	CH2M	22.51	1.156	3.97	7.17	84.2	3.85
	11/18/13	OTIE	22.05	1.060	3.60	7.44	207	NM
	04/22/14	OTIE	27.43	1.059	3.82	7.36	570.7	12.5

TABLE 4-3
Results for Routine Field Parameter Measurements in Groundwater Samples Obtained During GCOU Remedial Investigation
Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Well	Sample Date	Sampling Company	Temperature (deg C)	Specific Conductivity (mS/cm)	Dissolved Oxygen (mg/L)	pH (-)	Oxidation Reduction Potential (mV)	Turbidity (NTU)
GN-P11	02/08/12	CH2M	NR	NR	NR	NR	NR	NR
	10/18/12	CH2M	21.80	1.355	3.86	6.70	99.2	42.8
	11/19/13	OTIE	20.77	1.340	4.33	6.88	135	4.4
	04/24/14	OTIE/ERM	ERM COLLECTED FIELD PARAMETERS AND SAMPLES WERE SPLIT					
GS-P13	02/08/12	CH2M	NR	NR	NR	NR	NR	NR
	04/24/12	CH2M	NR	NR	NR	NR	NR	NR
	10/19/12	CH2M	23.81	1.115	8.90	7.20	46.6	67.1
	11/20/13	OTIE	21.57	1.090	1.75	7.14	144	4.6
	04/23/14	OTIE	22.80	1.053	2.67	7.08	574.3	11.4
Former Franciscan Ceramics Facility								
FCR-HLA1R	01/29/13	CH2M	22.15	1.012	7.21	7.44	20.5	51.6
	07/26/13	CH2M	22.65	1.006	NM	6.99	NM	0.44
	10/28/14	OTIE	20.96	0.991	6.81	6.70	222.22	3.27
FCR-HMW1R	01/29/13	CH2M	23.45	1.044	5.59	7.41	8.8	6.63
	07/26/13	CH2M	24.26	1.042	NM	6.96	NM	3.63
	10/28/14	OTIE	20.78	1.038	6.10	6.61	237.9	9.02
FCR-OW2	11/01/12	CH2M	21.91	1.114	5.80	7.06	107.4	2.53
	01/29/13	CH2M	21.88	1.026	6.41	7.41	17.3	3.05
	11/18/13	OTIE	20.84	1.030	4.84	7.03	210	NM
FCR-OW3	11/01/12	CH2M	22.08	1.111	6.65	7.12	104.5	0.89
	01/29/13	CH2M	21.77	1.017	7.84	7.38	22.8	1.12
	11/18/13	OTIE	21.38	1.02	5.16	7.01	224	1.10
FCR-OW4R	01/31/13	CH2M	22.83	1.061	6.28	6.98	29.7	34.1
	07/26/13	CH2M	24.26	1.035	NM	6.97	NM	11.6
	10/28/14	OTIE	22.76	0.971	5.10	6.62	206.1	5.70
FCR-WCW1	11/01/12	CH2M	22.19	1.074	5.17	6.91	111.2	694
	01/29/13	CH2M	Grab sample collected with a bailer; field parameters not recorded					
	11/18/13	OTIE	22.07	0.960	4.91	6.91	190.0	56.4
FCR-WCW2R	01/31/13	CH2M	17.87	1.237	5.40	6.5	55.1	51.2
	07/30/13	CH2M	24.77	1.131	NM	6.57	NM	30.1
	10/28/14	OTIE	18.34	0.976	5.66	6.51	218.7	6.87
FCR-WCW4	11/01/12	OTIE	21.18	0.994	6.15	6.91	120.3	NM
	01/29/13	CH2M	20.69	0.916	6.32	7.44	16.6	1.68
	11/18/13	CH2M	20.91	0.890	6.11	7.11	241	NM
	04/21/14	OTIE	21.77	0.878	7.30	7.04	616.7	1.84
Grayson Power Plant								
V13GPPW2	01/30/13	CH2M	23.61	1.276	2.31	7.12	20.3	6.66
	08/01/13	CH2M	23.04	1.311	NM	7.06	NM	0.037
	11/18/13	OTIE	22.41	1.340	1.53	7.07	220	NM
	04/21/14	OTIE	22.35	1.295	2.14	6.95	471.3	2.34
V13GPPW4	01/30/13	CH2M	21.30	1.082	1.53	6.39	31.8	9.6
	08/08/13	CH2M	22.49	1.143	NM	6.74	NM	0.43
V13GPPW7	01/30/13	CH2M	21.68	1.243	1.31	7.00	-0.1	31.1
	08/08/13	CH2M	22.51	1.318	NM	6.40	NM	1.91
V13GPPW8	01/30/13	CH2M	23.24	1.507	2.55	7.06	18.8	44.5
	08/01/13	CH2M	23.11	1.441	NM	6.90	NM	2.03
V13GPP12	01/30/13	CH2M	23.44	2.351	2.48	6.84	19.0	6.24
	08/01/13	CH2M	24.60	2.455	NM	6.96	NM	5.07
V13GPP13	01/30/13	CH2M	22.40	1.748	2.70	7.07	23.2	112.0
	08/01/13	CH2M	22.51	1.640	NM	6.93	NM	2.72
	11/18/13	OTIE	22.03	2.000	2.56	6.97	102	12.7
	04/21/14	OTIE	22.76	1.801	2.55	6.88	536.6	286.0
Disney Burbank Studio Facility								
V14WDSW5	01/31/13	CH2M	20.73	1.398	7.04	7.15	34.6	67.1
Former All Metals Processing Facility								
V14AMPW1	10/16/12	CH2M	23.62	1.311	3.74	6.99	89.8	1.82
	05/07/13	CH2M	22.88	1.319	3.86	7.1	72.0	51.8
	07/22/13	CH2M	24.21	1.403	NM	7.19	NM	122.0

TABLE 4-3
Results for Routine Field Parameter Measurements in Groundwater Samples Obtained During GCOU Remedial Investigation
Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Well	Sample Date	Sampling Company	Temperature (deg C)	Specific Conductivity (mS/cm)	Dissolved Oxygen (mg/L)	pH (-)	Oxidation Reduction Potential (mV)	Turbidity (NTU)
	04/17/14	OTIE	22.71	1.332	3.77	7.04	465.4	26.5
V14AMPW3	10/16/12	CH2M	22.94	1.651	4.77	7.08	106.6	1.00
	05/07/13	CH2M	23.03	2.481	5.82	7.31	21.3	11.5
	07/22/13	CH2M	23.51	2.275	NM	7.37	NM	3.9
V14AMPW3R	04/22/14	OTIE	22.22	1.343	3.68	7.04	528.3	NM
	07/16/14	OTIE	23.06	1.273	4.37	7.01	196.7	40.2
	10/30/14	OTIE	21.40	1.417	4.39	6.74	204.7	25
Former Drilube Facility								
V13DRMW1	10/17/12	CH2M	22.88	1.309	4.29	6.94	44.1	10.96
	05/08/13	CH2M	22.47	1.328	5.57	6.76	80.2	4.33
	08/06/13	CH2M	22.68	1.309	NM	7.06	NM	3.96
	04/21/14	OTIE	23.79	1.229	5.15	6.95	721.7	60.9
V13DRMW2	10/17/12	CH2M	24.14	1.138	2.28	6.77	90.5	4.21
	05/08/13	CH2M	22.98	1.230	3.62	6.84	87.3	1.39
	08/05/13	CH2M	22.68	1.138	NM	6.70	NM	0.94
V13DRMW3	10/17/12	CH2M	23.26	1.184	3.75	6.88	109.2	7.80
	05/08/13	CH2M	21.84	1.563	5.77	6.99	109.6	2.33
	08/05/13	CH2M	22.16	1.177	NM	6.93	NM	1.20
	04/22/14	OTIE	21.41	1.739	2.58	6.99	486.7	17.6
V13DRMW4	10/17/12	CH2M	22.32	1.207	4.82	6.87	82.1	12.20
	05/08/13	CH2M	22.23	1.207	5.59	7.09	110.7	2.54
	08/06/13	CH2M	22.54	1.232	NM	7.16	NM	5.77
	04/22/14	OTIE	21.72	1.146	4.60	7.14	380.5	365
V13DRMW5	10/17/12	CH2M	22.96	1.266	5.06	6.87	122.2	0.54
	05/07/13	CH2M	23.94	1.289	5.39	6.93	45.5	1.25
	08/05/13	CH2M	22.82	1.304	NM	7.00	NM	1.38
	04/22/14	OTIE	21.03	1.230	5.60	6.96	427.2	16.3
V13DRMW6	06/24/13	CH2M	23.72	1.088	5.45	7.13	106	666
	08/05/13	CH2M	22.77	1.180	NM	7.20	NM	48.1
	11/21/13	OTIE	22.37	1.200	3.79	7.22	211	273
	04/22/14	OTIE	NM	NM	NM	NM	NM	NM
V13DRMW7	06/24/13	CH2M	23.75	1.157	3.78	7.07	86.1	36.2
	08/07/13	CH2M	23.92	1.198	NM	7.36	NM	7.15
	11/21/13	OTIE	22.16	1.160	3.73	7.19	157	10.5
	04/15/14	OTIE	22.13	1.126	5.24	7.07	498.8	2.11
V13DRMW8	06/24/13	CH2M	22.49	1.167	6.93	7.03	113.3	24.1
	08/07/13	CH2M	22.31	1.198	NM	7.30	NM	11.1
	11/21/13	OTIE	21.65	1.160	6.09	7.17	177	5.9
	04/15/14	OTIE	21.95	1.117	6.49	7.05	543.3	21.8
V13DRMW9	06/25/13	CH2M	22.56	0.700	8.56	6.61	116.1	45.7
	08/08/13	CH2M	22.84	0.804	NM	6.33	NM	8.29
	11/14/13	OTIE	21.31	0.740	5.01	6.87	165	0.1
	04/17/14	OTIE	22.26	0.562	6.62	6.72	437.8	21.6
V13DWBW1	10/17/12	CH2M	22.97	1.242	4.44	6.83	53.9	13.7
	05/07/13	CH2M	22.26	1.223	6.07	6.68	176.6	9.18
	08/06/13	CH2M	23.27	1.236	NM	7.08	NM	10.9
	04/21/14	OTIE	23.07	1.168	5.62	6.90	676.4	51.4
V13DWBW3	10/17/12	CH2M	Grab sample collected with a bailer; field parameters not recorded					
	05/07/13	CH2M	Grab sample collected with a bailer; field parameters not recorded					
	08/06/13	CH2M	Grab sample collected with a bailer; field parameters not recorded					
	04/21/14	OTIE	Grab sample collected with a bailer; field parameters not recorded					

TABLE 4-3

Results for Routine Field Parameter Measurements in Groundwater Samples Obtained During GCOU Remedial Investigation

Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Well	Sample Date	Sampling Company	Temperature (deg C)	Specific Conductivity (mS/cm)	Dissolved Oxygen (mg/L)	pH (-)	Oxidation Reduction Potential (mV)	Turbidity (NTU)
Existing EPA Monitoring Well								
CS-VPB-09	04/13/12	CH2M	NR	NR	NR	NR	NR	NR
	10/22/12	CH2M	20.20	2.160	6.91	6.97	131.6	27.1
	04/10/13	ERM	NR	NR	NR	NR	NR	NR
	04/16/14	ERM	NR	NR	NR	NR	NR	NR
PO-VPB-01	04/19/12	CH2M	NR	NR	NR	NR	NR	NR
	08/08/13	CH2M	21.45	1.018	NM	6.54	NM	9.14

Notes:

NM - not measured
NR - not reported
deg C - degrees Celsius
mg/L - milligrams per liter
mS/cm - milliSiemens per centimeter
mV - millivolts
NTU - nephelometric turbidity units
CDM - CDM-Smith
CH2M - CH2M HILL
ERM - Environmental Resources Management
OTIE - Oneida Total Integrated Enterprises

TABLE 4-4

Analyte List for Groundwater Samples Obtained During GCOU Remedial Investigation

Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Metals	**Volatile Organic Compounds**	**Volatile Organic Compounds**
Aluminum	Acetone	Toluene
Antimony	Benzene	trans-1,3-Dichloropropene
Arsenic	Bromochloromethane	1,1,2-Trichloro-1,2,2-trifluoroethane
Barium	Bromodichloromethane	1,2,3-Trichlorobenzene
Beryllium	Bromoform	1,2,4-Trichlorobenzene
Cadmium	Bromomethane	1,1,1-Trichloroethane
Calcium	Carbon disulfide	1,1,2-Trichloroethane
Chromium	Carbon tetrachloride	Trichloroethylene (TCE)
Chromium(VI)	Chlorobenzene	Trichlorofluoromethane
Cobalt	Chloroethane	Vinyl chloride
Copper	Chloroform	
Iron	Chloromethane	**Emerging Compounds**
Lead	Cyclohexane	1,4-dioxane
Magnesium	Dibromochloromethane	n-Nitrosodimethylamine (NDMA)
Manganese	1,2-Dibromo-3-chloropropane	Perchlorate
Nickel	1,2-Dibromoethane	1,2,3-Trichloropropane (1,2,3-TCP)
Selenium	1,2-Dichlorobenzene	
Silver	1,3-Dichlorobenzene	
Sodium	1,4-Dichlorobenzene	
Thallium	Dichlorodifluoromethane	
Vanadium	1,1-Dichloroethane	
Zinc	1,2-Dichloroethane	
	1,1-Dichloroethylene	
Anions and General	cis-1,2-Dichloroethylene	
Water Quality Parameters	trans-1,2-Dichloroethylene	
Ammonia (Nitrogen)	1,2-Dichloropropane	
Bromide	cis-1,3-Dichloropropene	
Chloride	Ethylbenzene	
Fluoride	2-Hexanone	
Nitrate (as Nitrogen)	Isopropylbenzene	
Nitrite (as Nitrogen)	m,p-Xylene	
Orthophosphate	Methyl acetate	
Potassium	Methyl cyclohexane	
Sulfate	Methyl ethyl ketone	
Sulfide	Methyl isobutyl ketone	
Total alkalinity	Methyl tert-butyl ether (MTBE)	
Carbonate alkalinity	Methylene chloride	
Bicarbonate alkalinity	o-Xylene	
Hydroxide alkalinity	Styrene	
Total Dissolved Solids (TDS)	1,1,2,2-Tetrachloroethane	
Total Organic Carbon (TOC)	Tetrachloroethylene (PCE)	

TABLE 5-1
History, Remedial Progress and Current Status of Facilities Investigated for Chromium Discharges to Groundwater
Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Facility Name	Address	Regulatory Lead	Facility History	Summary of Chromium Remediation Activities	Status
Lockheed Martin Corporation (Lockheed) Former Plant B-1	Former Plant B-1 1705 Victory Pl. Burbank, CA 91504 (Site 1 on Figure 5-1)	LARWQCB	• Former Lockheed parts-fabrication and subassembly Plant B-1 covered approximately 100 acres southeast of the current Burbank Airport (Tetra Tech, 2014b). • Lockheed operated at the former Plant B-1 site between 1928 and 1991, with activities including tooling, parts shaping and machining, plating, deburring, cleaning, and painting (Tetra Tech, 2014b). • Chemicals and materials used at former Plant B-1 included fuels, oils, solvents, paints, acids, caustic solutions, chromic acid, boiler blowdown, and metal shavings (Tetra Tech, 2014b).	• Lockheed conducted limited excavation of chromium contamination from several former "dry wells" on the former Plant B-1 site.	Investigation ongoing. Remediation activities in progress.
Dynamic Plating	1102 W. Isabel St. Burbank, CA 91506 (Site 2 on Figure 5-1)	DTSC	• In 1971, Dynamic Plating, Incorporated (Dynamic) purchased the property at 1102 West Isabel Street and maintained a plating until 1990. Chemical use included chromium compounds, acids, bases, cyanide and VOCs. • In 1990, Los Angeles County shut down operations because of multiple waste stream violations.	• In 1990-1991, EPA conducted a time-critical removal action (TCRA) and removed drums, containers, tanks, vats, and hazardous materials. In 1992, EPA conducted an additional removal action including demolishing onsite buildings and a wastewater treatment system, debris removal, and excavating 936 cubic yards of shallow soils (down to 2 feet) contaminated with chromium and other metals. • In 2009, the DTSC commissioned a site soil characterization and HHRA to assess potential human health risks. Based on that study, the DTSC issued a No Further Action letter for soils in 2011 limited to commercial/industrial land uses. DTSC determined the risk is unacceptable for sensitive land uses including residential and schools.	Soil cleanup complete for commercial/industrial uses. Additional work may be necessary for any other land use.
J&M Anodizing	525 S. Flower St. Burbank, CA 91502 (Site 3 on Figure 5-1)	LARWQCB	• Metal finishing work at the site began in 1957 and operated continuously until 2007. Chromate compounds were likely in use at the site throughout the 50-year operational history.	• Excavation of Cr6 contaminated soil was completed in 2009. • An infiltration gallery and conveyance piping were installed to facilitate future in-situ remediation efforts to address the deeper Cr6 contamination.	Shallow soil remedial action complete. Deep soil remediation on hold.
Menasco Aerospace Division (Menasco)	100 E. Cedar Ave. Burbank, CA 91502 (Site 4 on Figure 5-1)	LARWQCB	• Menasco developed the site in the 1940s for manufacturing, design, and overhauling of aircraft landing gear. Manufacturing activities included use of various coolants, lubricants, solvents, and alkaline and metal plating solutions (LARWQCB, 2011a). • In 1977, Menasco was purchased by Coltec, which operated until 1992 at the facility when manufacturing and overhauling operations were shutdown. The facility was completely closed in 1994 (LARWQCB, 2011a). • Goodrich Aerospace (Goodrich) acquired Coltec in 1999 and sold the property (LARWQCB, 2011a). • United Technologies Corporation purchased Goodrich in 2012.	• A perched zone groundwater extraction and treatment system began operating at the facility in 2000 to mitigate downward movement of Cr6 and VOC contamination in perched groundwater (Amec Foster Wheeler, 2015a). Following LARWQCB approval, in late 2014/early 2015, the perched zone groundwater extraction and treatment system was decommissioned (Amec Foster Wheeler, 2015b). • A pilot study was performed in 2007 for in-situ treatment of Cr6 in perched groundwater beneath the site. Implementation of full-scale perched groundwater remediation commenced in September 2012. The in-situ remediation consists of quarterly to semiannual molasses injections and quarterly groundwater monitoring (AMEC Foster Wheeler, 2015a).	Remediation activities in progress.

TABLE 5-1
History, Remedial Progress and Current Status of Facilities Investigated for Chromium Discharges to Groundwater
Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Facility Name	Address	Regulatory Lead	Facility History	Summary of Chromium Remediation Activities	Status
Technibilt	1 W. Alameda Ave. Burbank, CA 91502 (Site 5 on Figure 5-1)	LARWQCB	• Technibilt began activities at the site in 1968, primarily the manufacturing of shopping carts. Processes included metal fabricating, metal finishing/plating, and assembly. • In approximately 1980-81, Technibilt merged with Gleason Corporation and then was subsequently purchased by Whittaker Corporation. • Operations ceased in 1987. • The site has been used for office and storage space since redevelopment.	• In 1988, approximately 500 cubic yards of chromium- and nickel-contaminated soil and concrete were removed from the site.	Soil investigation complete.
ITT Aerospace Controls (ITT)/Home Depot	1200 Flower St. Glendale, CA 91201 (Site 6 on Figure 5-1)	LARWQCB	• The site was developed in the 1940s to be used for manufacture of thermostats, pressure control instruments, valves, actuators, and switches for commercial, military, and aerospace applications. • From 1940 to 1963, General Controls conducted operations at the facility (LARWQCB, 2004 • ITT purchased General Controls in 1963 and operated the facility until 1994 (LARWQCB, 2004). • Manufacturing operations included machining, plating, heat-treating, and degreasing. Most manufacturing operations ceased in 1986, and all operations ceased in 1994 (Geosyntec, 2013). • ITT used PCBs, VOCs – including PCE and TCE – and heavy metals – including hexavalent chromium – as part of manufacturing and metal plating operations. (Geosyntec, 2013). • Home Depot purchased the property from ITT in June 2004. ITT and Home Depot agreed to share responsibility for the cleanup of the vadose zone and shallow perched groundwater down to approximately 55 ft bgs.	• Investigation primarily addressing VOCs began in the 1980s. • Beginning in 2004, a subsurface slurry wall surrounding the site was installed, designed to extend to the top of a fine-grained layer in the underlying alluvium to hydraulically contain COCs, including Cr6, in a perched aquifer beneath the site (ENVIRON, 2015). • Approximately 23,000 tons of soil impacted by COCs, including Cr6, were excavated from the site (ENVIRON, 2015). • In situ treatment of Cr6 in the vadose zone and perched groundwater began in 2014 at the facility. Treatment consisted of injections of calcium polysulfide (Geosyntec, 2015). • A petition for No Further Action for the vadose zone and perched groundwater at the facility has been submitted to LARWQCB • A need for source reduction of VOCs and Cr6 in the regional aquifer beneath the site has been identified.	Vadose Zone and perched groundwater remedial action nearly complete, pending LARWQCB approval. Source reduction in the regional aquifer pending.
All Metals Processing (AMP)	264 W. Spazier Ave. Burbank, CA 91502 (Site 7 on Figure 5-1)	EPA	• Prior to 1976, the site was reportedly occupied by Carbon Black Company, which manufactured products for photocopying (EPA, 2008). • The site was occupied by the AMP facility from approximately 1976 to 2007. AMP conducted metal plating operations at the site from 1976 to 2007 and specialized in cadmium, copper, nickel, zinc, black oxide, and gold plating (CH2M HILL, 2012). • The AMP Facility included a 7,000 square foot building that was divided into a plating area, wastewater treatment area, and drum storage area (CH2M HILL, 2012). • A developer purchased the property in 2012 and redevelopment was completed in 2014 with construction of a building intended for commercial or light industrial use.	• A TCRA was conducted at the Site in 2007 to mitigate the imminent and substantial threat it posed. Cr6 and other heavy metals were the primary focus of EPA's TCRA. Removal activities included demolition of the building, surface soil removal along the east embankment adjacent to the site, and soil removal to depths ranging from 1 to 16 feet bgs (CH2M HILL, 2012).	Removal action complete. Possible future deep soil remediation.
Automation Plating	927 Thompson Ave. Burbank, CA 91201 (Site 8 on Figure 5-1)	LARWQCB	• Operations have been continuous since 1952 at the site. The facility uses significant quantities of chromium, cadmium, cyanide, and zinc. Degreasing operations are likely, however, have not been confirmed.	• No activities for chromium.	Partial soil investigation completed. Active site

TABLE 5-1
History, Remedial Progress and Current Status of Facilities Investigated for Chromium Discharges to Groundwater
Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Facility Name	Address	Regulatory Lead	Facility History	Summary of Chromium Remediation Activities	Status
Loral Librascope Inc.	Librascope 811 Sonora Ave. Glendale, CA 91201 (Site 9 on Figure 5-1)	LARWQCB	• The Site was used by Librascope, an independent principal supplier of weapons and combat control systems for tactical shipboard applications, tactical communications terminals, and equipment for army field communications, from 1949 until operations ceased in 1997. Manufacturing at Librascope involved the production of printed circuit boards, metal fabrication, and metal finishing. (TetraTech, 2010) • Lockheed Martin purchased Loral Librascope, Inc. in 1996.	• Soil remediation performed in 1992 (Bldg. 18).	Site investigation complete. No work currently planned.
PRC-DeSoto/Courtaulds Aerospace	5430 San Fernando Rd. Glendale, CA 91203 (Site 10 on Figure 5-1)	LARWQCB	• PRC-DeSoto initiated operations in 1946, manufacturing metal products, gaskets, and sealants for the aerospace industry using lead oxide curing technology (non-aqueous). These manufacturing activities included use of lead curing compounds (lead dioxide) and chromic acid (Cr6). Later operations included plastic injection and electronics packaging. (Stantec, 2013). • Manufacturing of aerospace sealants was terminated in the late 1990s, and plastic injection and electronics packaging was terminated in 2006. PRC-DeSoto completely terminated operations at the facility in December 2008 (Stantec, 2013).	• In-situ vadose zone and groundwater remediation of Cr6 (using ferrous sulfate) occurred between 1996 and 2003 in portions of the facility (Stantec, 2013). • A RAP was submitted in January 2008, in part to document the plan to remediate remaining Cr6 contamination. Cr6 contamination was mitigated using a combination of excavation, capping, and in-situ injections of CaSx and carbon substrate, including emulsified vegetable oil and fructose (Stantec, 2013). • PRC-DeSoto continues investigating to evaluate whether Cr6 and VOCs have been remediated to levels that warrant site closure.	Remediation activities in progress.
Drilube Company – Wilson facility (Drilube – Wilson)	716 and 718 W. Wilson Ave. Glendale, CA 91203 (Site 11 on Figure 5-1)	EPA	• The Drilube Company conducted aerospace and aircraft plating, anodizing, painting, and metal finishing at the Wilson facility from 1959 until approximately 2004 (OTIE, 2014). • At the Wilson facility, there were 13 fixed treatment units, including five treatment pit units, two pretreatment container units, one settling unit, three container treatment units, one vacuum filter process unit, one filter press, and one elementary neutralization unit. (OTIE, 2014) • Chemicals used at the Drilube facilities during the period of operation included chromic acid, muriatic acid, nickel compounds, sodium hydroxide, ammonium hydroxide, caustic potash, ammonium nitrate, silver cyanide, copper cyanide, nitric acid, sodium dichromate, sulfuric acid, manganese phosphate, zinc phosphate, and various alkaline cleaners (OTIE, 2014).	• EPA performed a TCRA at the Wilson location to remove the upper 5 feet of the dirt floor in the waste treatment area of the former processing facility (OTIE, 2014).	Investigation ongoing, initial removal action completed.
Drilube Company – Broadway facility (Drilube – Broadway)	711 W. Broadway Glendale, CA 91204 (Site 12 on Figure 5-1)	EPA	• The Drilube Company conducted degreasing, anodizing, painting, and finishing of metal components for the aerospace industry at the Broadway facility from the 1970s until 2002, when a fire burned down the Broadway structure (OTIE, 2014). • At the Broadway facility, there was an underground storage tank (UST), clarifier, two degreasers, and a laboratory (OTIE, 2014). • Chemicals used at the Drilube facilities during the period of operation included chromic acid, muriatic acid, nickel compounds, sodium hydroxide, ammonium hydroxide, caustic potash, ammonium nitrate, silver cyanide, copper cyanide, nitric acid, sodium dichromate, sulfuric acid, manganese phosphate, zinc phosphate, and various alkaline cleaners (OTIE, 2014).	• No activities for chromium.	Investigation ongoing.

TABLE 5-1
History, Remedial Progress and Current Status of Facilities Investigated for Chromium Discharges to Groundwater
Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Facility Name	Address	Regulatory Lead	Facility History	Summary of Chromium Remediation Activities	Status
Excello Plating Co., Inc. (Excello)	4057 and 4059 Goodwin Ave. Los Angeles, CA 90039 (Site 13 on Figure 5-1)	LARWQCB	• A plating facility operated by Plating Engineering Company, Inc. operated on the northern portion of the property (4059 Goodwin Ave.) from at least 1946 until 1955 when the facility was destroyed by a fire (Kleinfelder, 2014). • A new plating facility was constructed in 1956 on the southern portion of the property (4057 Goodwin Ave.), which Excello began operating (Kleinfelder, 2014). • There were three main process areas at the facility, including a decorative chrome plating department, an anodized plating process area, and a hard chrome process area (ERM, 2011). • Excello ceased operations in 2004 and abandoned the property (Kleinfelder, 2014).	• A RAP for the facility was prepared in 2010, with chemical reduction/cement stabilization selected to treat Cr6 in soil and soil vapor extraction (SVE) was selected to remove TCE and PCE from soil beneath the property. • Remediation of Cr6 in soil beneath the property via in-situ chemical reduction through application of CaSx and Portland cement and CaSx injections was completed in 2014 (Kleinfelder, 2014).	Remediation activities in progress.
Weber Aircraft	2820 N. Ontario St. Burbank, CA 91504 (not shown on Figure 5-1)	LARWQCB	• Starting in the early 1950's, the Weber Aircraft facility was part of an industrialized complex northeast of what is now the Burbank Airport. Weber Aircraft manufactured aircraft parts, galley assemblies, and ejection seats for military aircraft until 1989. Manufacturing operations included: machining, metal degreasing, plating, metal finishing, and assembly. • Subsurface investigation work at the site began in 1988. The facility was demolished in 1992.	• The Source Group completed the pilot test field program, injection of CaSx into the vadose zone and underlying groundwater in the identified source area at the site in July 2015.	Remediation activities in progress.

TABLE 5-2

Analytical Results for Total and Hexavalent Chromium in Groundwater Samples Obtained During GCOU Remedial Investigation

Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Well	Sample Date	Sampling Company	Hexavalent Chromium (µg/L)	Total Chromium (Dissolved/Filtered) (µg/L)	Total Chromium (Total/Unfiltered) (µg/L)
New EPA Monitoring Wells					
CS-C30-120	09/06/12	CH2M	3.16	NA	7.7 J
	09/06/12	CH2M	3.30	5.8	NA
	10/19/12	CH2M	3.19	< 10	6.9 J
	01/23/13	CH2M	0.95	< 10	33.1
	04/30/13	CH2M	1.79	3.0	6.5
	07/25/13	CH2M	2.53	3.1	2.9 J
	11/20/13	OTIE	2.20	2.1 J	4.1
	04/15/14	OTIE	2.1 J	NA	NA
CS-C30-200	09/06/12	CH2M	2.06	NA	5.6 J
	09/06/12	CH2M	1.12	3.6	NA
	10/19/12	CH2M	5.92	4.4 J	< 10
	01/23/13	CH2M	2.79	< 10	< 10
	04/30/13	CH2M	4.15	7.9	5.9 J
	07/25/13	CH2M	4.48	5.6	5.5 J
	11/20/13	OTIE	4.40/4.50	4.4 J/4.4 J	5.7/5.9
	04/15/14	OTIE	4.70	NA	NA
CS-C31-102	09/06/12	CH2M	0.548/0.588	NA	7.8 J/2.4 J
	09/06/12	CH2M	0.601/0.594	< 10/2.4	NA
	10/19/12	CH2M	2.2/2.3	< 10/< 10	20.4/14.6
	01/23/13	CH2M	0.97	< 10	14.3
	04/30/13	CH2M	1.54	3.9	9.0
	07/25/13	CH2M	1.06	< 2	5.9 J
	11/19/13	OTIE	1.6 J	2.3	4.1
	04/16/14	OTIE	1.8 J	NA	NA
CS-C32-120	01/22/13	CH2M	0.921	< 10	19.6
	04/30/13	CH2M	1.43	2.8	9.2
	07/25/13	CH2M	1.78	3.7	6.2 J
	11/19/13	OTIE	1.5	2.1	6.5
	04/16/14	OTIE	1.7 J	NA	NA
CS-C33-059	01/22/13	CDM	90.2/97.2	123/120	134/130
	04/30/13	CDM	99.4	100	113
	07/29/13	CH2M	107 J	109	122
	11/20/13	OTIE	150	162	158
	04/25/14	OTIE/ERM	170 J/180	NA	183
CS-C34-065	06/19/13	CH2M	3.6	14.8 J	14
	08/02/13	CH2M	8.53/8.59	12.2/14.9	13.5/14.9
	11/13/13	OTIE	10	8.9	9.4
	04/23/14	OTIE	18 J	NA	NA
CS-C35-041	06/19/13	CH2M	24.2	29.5 J	29
	08/02/13	CH2M	25.4	26.8	29.6
	11/15/13	OTIE	23.0	21.6	21.9
	04/23/14	OTIE	22 J	NA	NA
CS-C36-055	06/20/13	CH2M	136	133 J	135
	08/02/13	CH2M	125	144	144
	11/15/13	OTIE	130	123	122
	04/25/14	OTIE/ERM	140/150	NA	161
CS-C37-035	06/19/13	CH2M	14.0	20.4 J	19.2
	08/02/13	CH2M	15.7/14.0	16.4/93.8	17.1/21.6
	11/15/13	OTIE	16.0	15.2	15
	04/25/14	OTIE/ERM	15.0/15.0	NA	15.9

TABLE 5-2
Analytical Results for Total and Hexavalent Chromium in Groundwater Samples Obtained During GCOU Remedial Investigation
Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Well	Sample Date	Sampling Company	Hexavalent Chromium (µg/L)	Total Chromium (Dissolved/Filtered) (µg/L)	Total Chromium (Total/Unfiltered) (µg/L)
CS-C38-051	06/25/13	CH2M	0.25/0.272	1.1 J/1.7 J	3.2/2.7
	07/31/13	CH2M	0.161	3.7	4.4
	11/14/13	OTIE	2.4	2.6	3.1
	04/23/14	OTIE	0.87 J/0.9 J	NA	NA
CS-C39-073	06/21/13	CH2M	192	199 J	219
	08/07/13	CH2M	247	218	224
	11/20/13	OTIE	220/230	239/201 J	245/242
	06/03/14	OTIE/ERM	280 J/310	NA	299
CS-C40-079	06/20/13	CH2M	20.9/26.4	40.0 J/37.6 J	30.3/31.7
	07/30/13	CH2M	37.3	43.3	45.5
	11/12/13	OTIE	26	27.2	27.5
	04/17/14	OTIE	16 J	NA	NA
CS-C41-058	06/20/13	CH2M	0.891	4.8 J	5.1
	07/31/13	CH2M	1.23	3.3	5.8
	11/14/13	OTIE	3.20	3.4	8.4
	04/25/14	OTIE/ERM	3.30J/3.40	NA	3.8
CS-C42-059	06/21/13	CH2M	19.7	21.1 J	27.9
	07/31/13	CH2M	16.7	21.8	26.2
	11/15/13	OTIE	8.1	13.7	8.0
	04/17/14	OTIE	8.1 J	NA	NA
CS-C43-083	06/26/13	CH2M	400	402	370
	07/16/13	CH2M	557	NA	NA
	08/07/13	CH2M	508	524	534
	11/20/13	OTIE	460	482	526
	04/15/14	OTIE	510 J	NA	NA
CS-C44-120	07/17/14	OTIE	4.6	NA	6.0
	10/29/14	OTIE	6.2	NA	NA
CS-C45-054	07/17/14	OTIE	2.3	NA	2.7
	10/29/14	OTIE	2.9 J/2.9 J	NA	NA
CS-C46-045	07/16/14	OTIE	2.2	NA	3.0
	10/29/14	OTIE	11 J	NA	NA
CS-C47-053	07/17/14	OTIE	3.7	NA	4.3
	10/29/14	OTIE	4.3	NA	NA
GCOU Respondents Wells					
PWA-1	10/31/12	ERM	14	NA	14
	01/28/13	CH2M	11.6	18.8	36.5
	05/02/13	CH2M	11.8/12.4	19.0 J/19.5 J	32.4/31.5
	07/23/13	CH2M	17.0	16.6	25 J
	11/11/13	OTIE	17/NA	14.7/14.3	22.8/20.5
	04/16/14	OTIE	18 J	NA	NA
PWA-2	10/31/12	ERM	8.3	NA	8.2
	01/31/13	CH2M	3.62	8.1 J	< 10
	05/01/13	CH2M	8.74	8.1	13.9 J
	07/22/13	CH2M	8.58	10.7	17.8 J
	11/14/13	OTIE	8.8	10.9	245
PWA-3	10/30/12	ERM	1.6	NA	1.2 J
	01/31/13	CH2M	0.459	< 10	59 J
	05/01/13	CH2M	3.22	4.3	5.1 J
	07/22/13	CH2M	3.58	7.0	11.6 J
	11/14/13	OTIE	1.5	2.2	9.4
	04/16/14	OTIE	1.5	NA	NA

TABLE 5-2

Analytical Results for Total and Hexavalent Chromium in Groundwater Samples Obtained During GCOU Remedial Investigation

Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Well	Sample Date	Sampling Company	Hexavalent Chromium (µg/L)	Total Chromium (Dissolved/Filtered) (µg/L)	Total Chromium (Total/Unfiltered) (µg/L)
PWA-4	10/31/12	ERM	7.3	NA	6.8
	01/28/13	CH2M	5.41	10.0 J	< 10
	05/03/13	CH2M	9.65	14.2 J	21.2
	07/24/13	CH2M	10.6	11.7	14.9 J
	11/19/13	OTIE	9.7	9.9	11.5
	04/16/14	OTIE	12 J	NA	NA
PWA-5	10/31/12	ERM	5.4	NA	5.0
	01/28/13	CH2M	5.61	9.1 J	< 10
	05/02/13	CH2M	5.84	11.8 J	16.3
	07/23/13	CH2M	5.92	6.7	8.0 J
	11/19/13	OTIE	5.0	5.6	10.2
	04/16/14	OTIE	5.1 J	NA	NA
PWA-6	10/29/12	ERM/CH2M	6.8/7.17	NA	13/NA
	01/14/13	CDM	NA	23.6	NA
	01/21/13	CH2M	14.5	23.6	26.7
	05/01/13	CH2M	9.55	11.3	13.6
	07/24/13	CH2M	18.8/16.6	19.4/37.6	22.3 J/22.4 J
	11/14/13	OTIE	12	10.6	12.1
	04/17/14	OTIE	7.1 J	NA	NA
PWA-7	10/29/12	ERM/CH2M	61/64.7	NA	66/NA
	01/21/13	CH2M	34	51.4	63.9
	05/01/13	CH2M	82.7	77.8	73.8 J
	07/30/13	CH2M	45.4	51	49.8
	11/19/13	OTIE	81	88.4	89.1
	04/22/14	OTIE	72 J/67 J	NA	NA
PWA-8	10/30/12	ERM/CH2M	2.4/1.62	NA	2.2/NA
	01/23/13	CH2M	1.96	4.3 J	< 10
	05/02/13	CH2M	3.19	8.5	10.9
	07/29/13	CH2M	3.24 J	5.2	7.2
	11/14/13	OTIE	3.4	3.3	28.9
	04/17/14	OTIE	3.4 J	NA	NA
PWA-9	10/30/12	ERM/CH2M	< 1.0/< 0.05 J	NA	< 2.0/NA
	01/28/13	CH2M	< 0.05 J	< 10	< 10
	05/03/13	CH2M	< 0.05	10.2	12.7
	07/30/13	CH2M	< 0.05	2.7	4.5
	11/19/13	OTIE	< 0.2	< 2	6.4
	04/17/14	OTIE	< 0.01 J	NA	NA
PWA-10	10/30/12	ERM/CH2M	8.1/7.92	NA	8.6/NA
	01/28/13	CH2M	8.54/10.4	14.5/15.3	18.0/18.3
	05/02/13	CH2M	13	24 J	21.2
	07/29/13	CH2M	12.6 J/17.6 J	16.7/18.0	16.4/16.1
	11/20/13	OTIE	14	14.2	48.6
	04/17/14	OTIE	16 J	NA	NA
PWA-12	10/29/12	ERM/CH2M	3.2/3.1	NA	5.8/NA
	01/21/13	CH2M	1.56	< 10	3.7 J
	05/01/13	CH2M	2.36	4.0	24.7 J
	07/24/13	CH2M	2.47	9.5	5.0 J
	11/14/13	OTIE	3.20	3.3	3.4
	04/17/14	OTIE	3.7 J	NA	NA

TABLE 5-2

Analytical Results for Total and Hexavalent Chromium in Groundwater Samples Obtained During GCOU Remedial Investigation

Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Well	Sample Date	Sampling Company	Hexavalent Chromium (µg/L)	Total Chromium (Dissolved/Filtered) (µg/L)	Total Chromium (Total/Unfiltered) (µg/L)
PWA-13	10/30/12	ERM/CH2M	2.4/1.34 J	NA	2.2
	01/28/13	CH2M	1.4	4.8 J	< 10
	05/03/13	CH2M	2.02	8.7 J	20.4
	07/23/13	CH2M	3.16	6.3	6.0 J
	11/13/13	OTIE	2.8	2.9	4.4
	04/16/14	OTIE	2.7 J	NA	NA
Former Eemco Facility					
V13EEMW1	10/29/12	ERM/CH2M	< 1.0/< 1.0/<0.05 J	NA	< 2.0/< 2.0/NA
	06/17/13	CH2M	< 0.02	3.7 J	9.1
	11/13/13	OTIE	< 0.02/ < 0.02	< 2/< 2	< 2/< 2
V13EEMW3	06/17/13	CH2M	3.49	8 J	175
	11/13/13	OTIE	5.00	6.4	2,070
V13EEMW4	06/17/13	CH2M	7.79	13.9 J	284
	11/13/13	OTIE	7.50	7.7	47.3
New GRG Monitoring Wells					
GN-P10	04/27/12	CH2M	6.8	NA	NA
	10/18/12	CH2M	6.67	< 10	< 10
	11/18/13	OTIE	7.6	8.3	10.3
	04/22/14	OTIE	6.6 J	NA	NA
GN-P11	02/08/12	CH2M	1.5	NA	NA
	10/18/12	CH2M	2.56	3.6	6.2
	11/19/13	OTIE	2.4	3.0	4.5
	04/24/14	OTIE/ERM	3.0 J/2.7	NA	3.08
GS-P13	02/08/12	CH2M	1.4/1.4	< 2/< 2	NA
	04/24/12	CH2M	0.3	< 2	NA
	10/19/12	CH2M	1.08	< 10	11
	11/20/13	OTIE	5.7	5.6 J	9.4
	04/23/14	OTIE	8.2 J	NA	NA
Former Franciscan Ceramics Facility					
FCR-HLA1R	01/29/13	CH2M	8.69	15.6	29.2
	07/26/13	CH2M	19.9	19.3	19.8
	10/28/14	OTIE	16 J	NA	NA
FCR-HMW1R	01/29/13	CH2M	2.07	< 10	10.6
	07/26/13	CH2M	3.44	4.1	4.8
	10/28/14	OTIE	2.5 J	NA	NA
FCR-OW2	11/01/12	CH2M	98.9	104	104
	01/29/13	CH2M	73.7	106	118
	11/18/13	OTIE	94.0	99.9	101
FCR-OW3	11/01/12	CH2M	33.9/33.6	34.3/36.0	35.2/34.2
	01/29/13	CH2M	26.1	35.5	37.2
	11/18/13	OTIE	35.0	37.2	37.9
FCR-OW4R	01/31/13	CH2M	4.16	9.7 J	< 10
	07/26/13	CH2M	8.89	9.4	9.8
	10/28/14	OTIE	8.40 J	NA	NA
FCR-WCW1	11/01/12	CH2M	0.76	1 J	< 10
	01/29/13	CH2M	< 0.02	< 10	< 10
	11/18/13	OTIE	1.4	< 2	26.1

TABLE 5-2

Analytical Results for Total and Hexavalent Chromium in Groundwater Samples Obtained During GCOU Remedial Investigation

Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Well	Sample Date	Sampling Company	Hexavalent Chromium (µg/L)	Total Chromium (Dissolved/Filtered) (µg/L)	Total Chromium (Total/Unfiltered) (µg/L)
FCR-WCW4	11/01/12	CH2M	2.03	< 10	< 10
	01/29/13	CH2M	1.53	< 10	< 10
	11/18/13	OTIE	2.1	2.5	2.9
	04/21/14	OTIE	2.1 J	NA	NA
FCR-WCW2R	01/31/13	CH2M	0.443	1.8 J	< 10
	07/30/13	CH2M	0.704	< 2	11.4
	10/28/14	OTIE	0.700 J	NA	NA
Grayson Power Plant					
V13GPPW2 (MW-2)	01/30/13	CH2M	33.3	75.2	74 J
	08/01/13	CH2M	72.5	82.1	83.7
	11/18/13	OTIE	87.0	91.3	94.3
	04/21/14	OTIE	110 J	NA	NA
V13GPPW4 (MW-4)	01/30/13	CH2M	0.268	< 10	< 10
	08/08/13	CH2M	0.314	< 2	4.1
V13GPPW7 (MW-7)	01/30/13	CH2M	< 0.02	< 10	20.1 J
	08/08/13	CH2M	0.333	2 J	3.2
V13GPPW8 (MW-8)	01/30/13	CH2M	2.13	< 10	13.4 J
	08/01/13	CH2M	4.35	6.5	6.5
V13GPP12 (MW-12)	01/30/13	CH2M	2.1	< 10	22.2 J
	08/01/13	CH2M	4.92	8.2	7.4
V13GPP13 (MW-13)	01/30/13	CH2M	28.7/28.9	67.0 J/65.4	71.8 J/77
	08/01/13	CH2M	44	45	47.8
	11/18/13	OTIE	28	34.5	162
	04/21/14	OTIE	23 J	NA	NA
Disney Burbank Studio Facility					
V14WDSW5 (MW-5)	01/31/13	CH2M	0.987	< 10	551 J
Former All Metals Processing Facility					
V14AMPW1	10/16/12	CH2M	544	537	556
	05/07/13	CH2M	173	170 J	1,290
	07/22/13	CH2M	615	872	2,300 J
	04/17/14	OTIE	120	NA	NA
V14AMPW3	10/16/12	CH2M	1,230	1,250	1,220
	05/07/13	CH2M	1,030	948 J	924
	07/22/13	CH2M	1,060	1100	947 J
V14AMPW3R	04/22/14	OTIE	330 J	NA	NA
	07/16/14	OTIE	250/250	NA	NA
	10/30/14	OTIE	220 J	NA	NA
Former Drilube Facility					
V13DRMW1	10/17/12	CH2M	934	958	1,170
	05/08/13	CH2M	555/552	529 J/< 2	648 J/621 J
	08/06/13	CH2M	627	551	706
	04/21/14	OTIE	520 J/520 J	NA	NA
V13DRMW2	10/17/12	CH2M	229/243	1,030/243	300/317
	05/08/13	CH2M	952	851	855 J
	08/05/13	CH2M	764	814	666
V13DRMW3	10/17/12	CH2M	2,720	12.2	4,360
	05/08/13	CH2M	2,360	< 50	2,060
	08/05/13	CH2M	1,370	1,110	1,280
	04/22/14	OTIE	10,000 J/9,800 J	NA	NA

TABLE 5-2

Analytical Results for Total and Hexavalent Chromium in Groundwater Samples Obtained During GCOU Remedial Investigation

Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Well	Sample Date	Sampling Company	Hexavalent Chromium (µg/L)	Total Chromium (Dissolved/Filtered) (µg/L)	Total Chromium (Total/Unfiltered) (µg/L)
V13DRMW4	10/17/12	CH2M	2.31	2,780	159
	05/08/13	CH2M	4.45/4.43	18.1 J/1.8 J	31.1/32.6
	08/06/13	CH2M	1.84	8.2	61.1
	04/22/14	OTIE	3.1 J	NA	NA
V13DRMW5	10/17/12	CH2M	1,020	262	1,030
	05/07/13	CH2M	782	540 J	656
	08/05/13	CH2M	875/907	826/802	847/873
	04/22/14	OTIE	240 J	NA	NA
V13DRMW6	06/24/13	CH2M	1.54	3.6	35.2
	08/05/13	CH2M	5.9	7.0	8.7
	11/21/13	OTIE	7.9/7.6	8.1	22.5
	04/22/14	OTIE	4.7 J	NA	NA
V13DRMW7	06/24/13	CH2M	1.1	2.2	5.7
	08/07/13	CH2M	4.66	5.5	6.1
	11/21/13	OTIE	3.6	4.0	17.9
	04/15/14	OTIE	4.5 J	NA	NA
V13DRMW8	06/24/13	CH2M	24.1	29.9	33.4
	08/07/13	CH2M	5.87/6.21	8.4/8.5	10.7/9.0
	11/21/13	OTIE	6.4	7.9	13.3
	04/15/14	OTIE	7.7 J	NA	NA
V13DRMW9	06/25/13	CH2M	51.2	61	60.4
	08/08/13	CH2M	108	132	129
	11/14/13	OTIE	180	172	163
	04/17/14	OTIE	15 J	NA	NA
V13DWBW1	10/17/12	CH2M	1,610	1,640	1,970
	05/07/13	CH2M	6,710	6,490 J	6,230
	08/06/13	CH2M	9,440	8,360	7,510
	04/21/14	OTIE	2400 J	NA	NA
V13DWBW3	10/17/12	CH2M	37.6	38.8	6,700
	05/07/13	CH2M	4.49 J	10.2 J	1,130 J
	08/06/13	CH2M	4.25	9.0	1,270
	04/21/14	OTIE	13 J	NA	NA
Existing EPA Monitoring Well					
CS-VPB-09	04/13/12	CH2M	5.3	5.8	NA
	10/22/12	CH2M	4.8	< 10	< 10
	04/10/13	ERM	2.2	3.83	NA
	04/16/14	ERM	4.7	NA	255
PO-VPB-01	04/19/12	CH2M	2.5 J	NA	NA
	08/08/13	CH2M	2.5	4.8	12.3

Notes:

µg/L - micrograms per liter
N - primary sample; FD - field duplicate sample
J - the reported concentration should be considered an estimated value
NA - not analyzed
Results separated by a "/" indicate normal, field duplicate, and/or split sample results
CDM - CDM-Smith
CH2M - CH2M HILL
ERM - Environmental Resources Management
OTIE - Oneida Total Integrated Enterprises

For dissolved/filtered metals analysis, samples were field-filtered using a 0.45-micron filter before preservation and shipment to the laboratory

TABLE 5-3

Analytical Results for Volatile Organic Compounds, Nitrate, and Emerging Contaminants in Groundwater Samples Obtained During GCOU Remedial Investigation

Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Well	Sample Date	Sampling Company	Sample Type	PCE (µg/L)	TCE (µg/L)	1,4-dioxane (µg/L)	NDMA (µg/L)	perchlorate (µg/L)	1,2,3-TCP (µg/L)	Nitrate (mg/L)
		Regulatory Action Levels[1]		**5**	**5**	**1**	**0.01**	**6**	**0.005**	**10**
New EPA Monitoring Wells										
CS-C30-120	09/06/12	CH2M	N	2.3	72	0.13 J	< 0.002	< 2	0.014 J	9.0
	11/20/13	OTIE	N	< 0.5	< 0.5	NA	NA	NA	NA	NA
CS-C30-200	09/06/12	CH2M	N	< 0.5	< 0.5	< 0.5	< 0.002	1.2 J	< 0.005	6.3
	11/20/13	OTIE	N	0.67 J	17	NA	NA	NA	NA	NA
	11/20/13	OTIE	FD	0.71 J	18	NA	NA	NA	NA	NA
CS-C31-102	09/06/12	CH2M	N	< 0.5	0.32 J	< 0.5	< 0.002	1.2 J	< 0.005	6.3
	09/06/12	CH2M	FD	< 0.5	0.30 J	< 0.5	< 0.002	1.5 J	< 0.005	6.3
	11/19/13	OTIE	N	< 0.5	0.52	NA	NA	NA	NA	NA
CS-C32-120	01/22/13	CH2M	N	2.0	0.5 J	< 0.5	0.0006 J	2.3	< 0.005	6.9
	11/19/13	OTIE	N	2.9 J	1.4	NA	NA	NA	NA	NA
CS-C33-059	01/22/13	CDM-G	N	25	62	1.5	< 0.002	3.3	< 0.005	9.7
	01/22/13	CDM-G	FD	27	63	1.9	< 0.002	3.4	< 0.005	9.8
	11/20/13	OTIE	N	26 J	70 J	NA	NA	NA	NA	NA
	04/25/14	ERM	N	22	79	1.7	NA	NA	< 0.005	NA
CS-C34-065	06/19/13	CH2M	N	0.3 J	< 0.5	0.097 J	< 0.002	3.4 J	0.0036 J	10
CS-C35-041	06/19/13	CH2M	N	9.2	140	1.0	< 0.002	3.2	0.0052	7.8
CS-C36-055	06/20/13	CH2M	N	27	76	2.0	< 0.002	4.2	< 0.005	10
	04/25/14	ERM	N	22	73	2.0	NA	NA	< 0.005	NA
CS-C37-035	06/19/13	CH2M	N	5.2	14	0.39 J	< 0.002	3.4	< 0.005	8.0
	04/25/14	ERM	N	3.5	13	< 0.96	NA	NA	NA	NA
CS-C38-051	06/25/13	CH2M	N	15	20	0.14 J	< 0.002	1.8 J	0.020	11
	06/25/13	CH2M	FD	15	20	0.15 J	< 0.002	1.7 J	0.021	11
CS-C39-073	06/21/13	CH2M	N	31	140	4.4	< 0.002	3.3	< 0.005	9.7
	06/03/14	CH2M	N	25	160	6.3	NA	NA	< 0.005	NA
CS-C40-079	06/20/13	CH2M	N	60	78	0.63	0.0038 J	1.9 J	0.032	8.4
	06/20/13	CH2M	FD	56	73	0.76	0.0074 J	2.5	0.03	8.5
CS-C41-058	06/20/13	CH2M	N	150	93	0.21 J	0.001 J	1.6 J	0.059	8.1
	04/25/14	ERM	N	130	110	< 0.96	NA	NA	0.059	NA
CS-C42-059	06/21/13	CH2M	N	2.5	66	0.16 J	< 0.002	3.8	< 0.005	15
CS-C43-083	06/26/13	CH2M	N	29	200	13	NA	3.1 J	< 0.005	9.7
	08/07/13	CH2M	N	NA	NA	NA	< 0.002	NA	NA	NA
CS-C44-120	07/17/14	OTIE	N	22	28	3.0	NA	1.5	< 0.0025	10
CS-C45-054	07/17/14	OTIE	N	1.4	0.9	< 0.5	NA	3.3	< 0.0025	9.2
CS-C46-045	07/16/14	OTIE	N	5.5	14 J	0.5 J	NA	2.7 J	< 0.0025	8.0
CS-C47-053	07/17/14	OTIE	N	1.1	1.5	< 0.5	NA	3.2	< 0.0025	9.0
GCOU Respondents Wells										
PWA-1	10/31/12	ERM	N	150	170	NA	NA	NA	< 20	11
	11/11/13	OTIE	N	70	180	NA	NA	NA	NA	NA
	11/11/13	OTIE	FD	61	200	NA	NA	NA	NA	NA
PWA-2	10/31/12	ERM	N	3.2	11	NA	NA	NA	< 10	9.3
	01/31/13	CH2M	N	4.8	10	NA	NA	NA	NA	NA
	11/14/13	OTIE	N	9.7	17	NA	NA	NA	NA	NA
PWA-3	10/30/12	ERM	N	0.50 J	82	NA	NA	NA	< 10	1.7
	01/31/13	CH2M	N	0.42 J	71	NA	NA	NA	NA	NA
	11/11/13	OTIE	N	3.6	87	NA	NA	NA	NA	NA
PWA-4	10/31/12	ERM	N	16	83	NA	NA	NA	< 10	6.0
	11/12/13	OTIE	N	130	150	NA	NA	NA	NA	NA
PWA-5	10/31/12	ERM	N	9.0	4.9	NA	NA	NA	< 10	12
	11/11/13	OTIE	N	11	4.6	NA	NA	NA	NA	NA
PWA-6	10/29/12	ERM	N	15	9.8	NA	NA	NA	< 10	11
	11/13/13	OTIE	N	19	23	NA	NA	NA	NA	NA
PWA-7	11/19/13	ERM	N	25	690	NA	NA	NA	< 50	11
	11/19/13	OTIE	N	25 J	420	NA	NA	NA	NA	NA
PWA-8	10/30/12	ERM	N	150	100	NA	NA	NA	< 10	8.9
	11/11/13	OTIE	N	340	190	NA	NA	NA	NA	NA
PWA-9	10/30/12	ERM	N	< 20	4.1 J	NA	NA	NA	< 100	1.7
	11/19/13	OTIE	N	< 50	< 50	NA	NA	NA	NA	NA
PWA-10	10/30/12	ERM	N	44	73	NA	NA	NA	< 10	8.4
	11/12/13	OTIE	N	89	91	NA	NA	NA	NA	NA

TABLE 5-3

Analytical Results for Volatile Organic Compounds, Nitrate, and Emerging Contaminants in Groundwater Samples Obtained During GCOU Remedial Investigation

Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Well	Sample Date	Sampling Company	Sample Type	PCE (µg/L)	TCE (µg/L)	1,4-dioxane (µg/L)	NDMA (µg/L)	perchlorate (µg/L)	1,2,3-TCP (µg/L)	Nitrate (mg/L)
		Regulatory Action Levels[1]		**5**	**5**	**1**	**0.01**	**6**	**0.005**	**10**
PWA-12	10/29/12	ERM	N	3.1	1.0 J	NA	NA	NA	< 10	9.3
	11/13/13	OTIE	N	2.9	1.2	NA	NA	NA	NA	NA
PWA-13	10/30/12	ERM	N	0.59	3.4	NA	NA	NA	< 10	1.0
	11/13/13	OTIE	N	0.53	9.6	NA	NA	NA	NA	NA
Former Eemco Facility										
V13EEMW1	10/29/12	ERM	N	3.1	96	NA	NA	NA	< 10	4.6
	10/29/12	ERM	FD	3.3	100	NA	NA	NA	< 10	4.7
	06/17/13	CH2M	N	3.4 J	96	NA	NA	NA	NA	NA
	11/13/13	OTIE	N	3.1	59	NA	NA	NA	NA	NA
	11/13/13	OTIE	FD	3.4 J	56	NA	NA	NA	NA	NA
V13EEMW3	06/17/13	CH2M	N	31	63	NA	NA	NA	NA	NA
	11/13/13	OTIE	N	33	56	NA	NA	NA	NA	NA
V13EEMW4	06/17/13	CH2M	N	30	99	NA	NA	NA	NA	NA
	11/13/13	OTIE	N	28	72	NA	NA	NA	NA	NA
New GRG Monitoring Wells										
GN-P10	04/27/12	CH2M	N	20	2.6	< 0.97	NA	2.9	< 0.005	NA
	11/18/13	OTIE	N	8.1 J	18	NA	NA	NA	NA	NA
GN-P11	02/08/12	CH2M	N	19	34	< 0.49	NA	2.0	0.034	NA
	11/19/13	OTIE	N	20 J	34 J	NA	NA	NA	NA	NA
	04/24/14	ERM	N	19	50	0.36 J	NA	NA	0.025	NA
GS-P13	02/08/12	CH2M	N	4.4	88	0.71	< 0.002	3.4	< 0.005	7.9
	02/08/12	CH2M	FD	5.0	98	0.55	< 0.002	2.1	< 0.005	7.9
	04/24/12	CH2M	N	5.1	81	0.76	< 0.0019	< 4	0.0065	6.0
	11/20/13	OTIE	N	7.3 J	61 J	NA	NA	NA	NA	NA
Former Franciscan Ceramics Facility										
FCR-HLA1R	01/29/13	CH2M	N	4.5	12	NA	NA	NA	NA	NA
	10/28/14	OTIE	N	5.7	14	NA	NA	NA	NA	NA
FCR-HMW1R	01/29/13	CH2M	N	5.8	1.7	NA	NA	NA	NA	NA
	10/28/14	OTIE	N	5.0	1.5	NA	NA	NA	NA	NA
FCR-OW2	11/01/12	CH2M	N	18	59	NA	NA	NA	NA	NA
	11/18/13	OTIE	N	26 J	64	NA	NA	NA	NA	NA
FCR-OW3	11/01/12	CH2M	N	7.7	26	NA	NA	NA	NA	NA
	11/01/12	CH2M	FD	9.7	26	NA	NA	NA	NA	NA
	11/18/13	OTIE	N	11 J	30	NA	NA	NA	NA	NA
FCR-OW4R	01/31/13	CH2M	N	2.0	3.7	NA	NA	NA	NA	NA
	10/28/14	OTIE	N	2.1	5.3	NA	NA	NA	NA	NA
FCR-WCW1	11/01/12	CH2M	N	4.9	2.8	NA	NA	NA	NA	NA
	11/18/13	OTIE	N	8.3	5.0	NA	NA	NA	NA	NA
FCR-WCW2R	01/31/13	CH2M	N	< 0.5	< 0.5	NA	NA	NA	NA	NA
	10/28/14	OTIE	N	< 0.5	< 0.5	NA	NA	NA	NA	NA
FCR-WCW4	11/01/12	CH2M	N	1.2	0.98	NA	NA	NA	NA	NA
	11/18/13	OTIE	N	1.7 J	1.5	NA	NA	NA	NA	NA
Grayson Power Plant										
V13GPPW2	01/30/13	CH2M	N	22	910	NA	NA	NA	NA	NA
	11/18/13	OTIE	N	26 J	900	NA	NA	NA	NA	NA
V13GPPW4	01/30/13	CH2M	N	0.12 J	< 0.5	NA	NA	NA	NA	NA
V13GPPW7	01/30/13	CH2M	N	0.11 J	0.13 J	NA	NA	NA	NA	NA
V13GPPW8	01/30/13	CH2M	N	1.6	8.7	NA	NA	NA	NA	NA
V13GPP12	01/30/13	CH2M	N	5.6	200	NA	NA	NA	NA	NA
V13GPP13	01/30/13	CH2M	N	24	300	NA	NA	NA	NA	NA
	01/30/13	CH2M	FD	21	250	NA	NA	NA	NA	NA
	11/18/13	OTIE	N	18 J	140	NA	NA	NA	NA	NA
Disney Burbank Studio Facility										
V14WDSW5	01/31/13	CH2M	N	0.3 J	1.0	NA	NA	NA	NA	NA
Former All Metals Processing Facility										
V14AMPW1	07/22/13	CH2M	N	34 J	63 J	NA	NA	NA	NA	NA
	04/17/14	OTIE	N	40 J	64 J	NA	NA	NA	NA	NA
V14AMPW3	07/22/13	CH2M	N	31 J	57 J	NA	NA	NA	NA	NA

TABLE 5-3

Analytical Results for Volatile Organic Compounds, Nitrate, and Emerging Contaminants in Groundwater Samples Obtained During GCOU Remedial Investigation

Glendale Chromium Operable Unit, San Fernando Valley Superfund Sites

Well	Sample Date	Sampling Company	Sample Type	PCE (µg/L)	TCE (µg/L)	1,4-dioxane (µg/L)	NDMA (µg/L)	perchlorate (µg/L)	1,2,3-TCP (µg/L)	Nitrate (mg/L)
		Regulatory Action Levels[1]		**5**	**5**	**1**	**0.01**	**6**	**0.005**	**10**
V14AMPW3R	04/22/14	OTIE	N	40	64	NA	NA	NA	NA	NA
	07/16/14	OTIE	N	58	82	NA	NA	NA	< 0.2	NA
	10/30/14	OTIE	N	45	80	NA	NA	NA	NA	NA
Former Drilube Facility										
V13DRMW1	05/08/13	CH2M	N	28	89	NA	NA	NA	NA	NA
	05/08/13	CH2M	FD	34	120	NA	NA	NA	NA	NA
	08/06/13	CH2M	N	19	80	NA	NA	NA	NA	NA
	04/21/14	OTIE	N	20 J	82 J	NA	NA	NA	NA	NA
	04/21/14	OTIE	FD	18 J	73 J	NA	NA	NA	NA	NA
V13DRMW2	05/08/13	CH2M	N	97	140	NA	NA	NA	NA	NA
	08/05/13	CH2M	N	38	59	NA	NA	NA	NA	NA
V13DRMW3	05/08/13	CH2M	N	230	3,500	NA	NA	NA	NA	NA
	08/05/13	CH2M	N	260	2,700	NA	NA	NA	NA	NA
	04/22/14	OTIE	N	930 J	30,000	NA	NA	NA	NA	NA
	04/22/14	OTIE	FD	880 J	29,000	NA	NA	NA	NA	NA
V13DRMW4	05/08/13	CH2M	N	10	2.4	NA	NA	NA	NA	NA
	05/08/13	CH2M	FD	9.6	2.4	NA	NA	NA	NA	NA
	08/06/13	CH2M	N	12	4.0	NA	NA	NA	NA	NA
	04/22/14	OTIE	N	11	3.3	NA	NA	NA	NA	NA
V13DRMW5	05/07/13	CH2M	N	73	28	NA	NA	NA	NA	NA
	08/05/13	CH2M	N	46	50	NA	NA	NA	NA	NA
	08/05/13	CH2M	FD	61	73	NA	NA	NA	NA	NA
	04/22/14	OTIE	N	29	120	NA	NA	NA	NA	NA
V13DRMW6	06/24/13	CH2M	N	12	43	NA	NA	NA	NA	NA
	08/05/13	CH2M	N	15	28	NA	NA	NA	NA	NA
	04/22/14	OTIE	N	13	28	NA	NA	NA	NA	NA
V13DRMW7	06/24/13	CH2M	N	24	5.0	NA	NA	NA	NA	NA
	08/07/13	CH2M	N	35	5.5	NA	NA	NA	NA	NA
	04/15/14	OTIE	N	98 J	12 J	NA	NA	NA	NA	NA
V13DRMW8	06/24/13	CH2M	N	27	47	NA	NA	NA	NA	NA
	08/07/13	CH2M	N	62	55	NA	NA	NA	NA	NA
	08/07/13	CH2M	FD	58	50	NA	NA	NA	NA	NA
	04/15/14	OTIE	N	100 J	55 J	NA	NA	NA	NA	NA
V13DRMW9	06/25/13	CH2M	N	20	20	NA	NA	NA	NA	NA
	08/08/13	CH2M	N	29	31	NA	NA	NA	NA	NA
	04/17/14	OTIE	N	9.7 J	9.2 J	NA	NA	NA	NA	NA
V13DWBW1	05/07/13	CH2M	N	110	20 J	NA	NA	NA	NA	NA
	08/06/13	CH2M	N	100	33	NA	NA	NA	NA	NA
	04/21/14	OTIE	N	120 J	22 J	NA	NA	NA	NA	NA
V13DWBW3	05/07/13	CH2M	N	310	2.9	NA	NA	NA	NA	NA
	08/06/13	CH2M	N	200	3.1	NA	NA	NA	NA	NA
	04/21/14	OTIE	N	42 J	25 J	NA	NA	NA	NA	NA

Notes:

(1) Action levels for PCE, TCE, perchlorate, and nitrate are California maximum contaminant levels (MCLs).
Action levels for 1,4-dioxane, NDMA, and 1,2,3-TCP are California Department of Public Health (CDPH) notification levels (NLs).

µg/L - micrograms per liter
mg/L - milligrams per liter
N - primary sample; FD - field duplicate sample
J - the reported concentration should be considered an estimated value
NA - not analyzed

NDMA - n-nitrosodimethylamine
1,2,3-TCP - 1,2,3-trichloropropane
PCE - tetrachloroethylene
TCE - trichloroethylene
CDM - CDM-Smith
CH2M - CH2M HILL
ERM - Environmental Resources Management
OTIE - Oneida Total Integrated Enterprises