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8. Remedial Investigation Summary and Next Steps for the Area 3 RI/FS

The collection and evaluation of ***environmental data*** based on the ***data quality objectives*** (DQOs) presented in Table 2-1 have enabled the United States Environmental Protection Agency (EPA) to complete the ***remedial investigation*** (RI) of regional ***groundwater contamination*** at the San Gabriel Valley Area 3 ***Superfund*** Site (Area 3). The results of the RI indicate that, due to the presence of ***contaminants of potential concern (COPCs***), groundwater in many parts of Area 3 is unsuitable as a source of tap water for domestic use. The overall conclusion of the RI is that action needs to be taken to protect human health in Area 3 by addressing groundwater contamination.
This report examines key physical characteristics of Area 3, including the ***hydrogeology*** and the sources and distribution of ***volatile organic compound*** (VOC) contamination in groundwater. The report fulfills the main objective of the RI by evaluating the potential risk to human health and the environment from regional groundwater contamination in Area 3.

Each section of this report provides a discussion of the subject, followed by any tables or figures cited in the text. In addition, exhibits and text boxes noted in the margins present key concepts, tables, and figures.

*The glossary explains words presented in **bold, italicized** text.*

The following sections discuss the results of the evaluations completed for each subtask.

8.1 Hydrogeologic Conceptual Site Model

The hydrogeologic conceptual site model developed for Area 3 provides the foundation for most of the assessments performed for the RI. The model incorporates surface water recharge data, groundwater discharge data, ***aquifer*** properties, groundwater levels, groundwater flow data, and geochemistry data. Figure 8-1 presents a schematic diagram of the hydrogeologic conceptual site model for Area 3.

The RI identifies three aquifers in Area 3: the western ***bedrock*** aquifer; the western ***alluvial*** aquifer; and the eastern alluvial aquifer, which is divided into the shallow, intermediate, and deep groundwater zones. A geologic ***structural bedrock discontinuity*** appears to separate the ***hydrostratigraphy*** and groundwater conditions between the western and eastern portions of Area 3, and to affect groundwater flow, as shown in Figure 8-1.

Figure 8-1 presents the hydrogeologic conceptual site model for Area 3.

The three distinct shallow, middle, and deep groundwater zones occur in the eastern alluvial aquifer in Area 3 and generally dip to the southeast, similar to the slope of the topography and the dip of the intervening fine-grained sediments that separate the groundwater zones. Groundwater in the shallow zone generally flows to the southwest. The shallow groundwater zone occurs as the first-encountered groundwater in northeastern (NE) Area 3.

Currently, groundwater in the intermediate zone generally flows to pumping centers, including the Alhambra Pumping Hole and to Production Well 01901679 located in northwestern (NW) Area 3. Groundwater in the deep zone, similar to groundwater in the intermediate zone, flows toward the active production wells. Local groundwater flow directions in the intermediate and deep zones are strongly influenced by the effects of production well pumping, and have varied over time in response to changes in production well pumping patterns.

Historically, the western and eastern alluvial aquifers were in direct hydraulic communication; groundwater occurred in the eastern alluvial aquifer at elevations higher than the base of the western ***alluvium*** (top of bedrock). Increased pumping in the San Gabriel Valley Groundwater ***Basin*** (San Gabriel Basin) caused groundwater elevations in the eastern alluvial aquifer to decline significantly to below the western bedrock elevation, and created hydraulic separation between the western and eastern alluvial aquifers.

8.2 Contaminant Source Identification

Exhibit 8-1 presents the Key COPCs and the occurrence in groundwater underlying Area 3.

Concentrations in groundwater of seven Key COPCs, listed in Exhibit 8-1, exceed the ***evaluation criteria*** (***maximum contaminant levels*** [MCLs] or ***notification levels*** [NLs]) multiple times at production wells in Area 3. Exhibit 8-1 also highlights general observations about the occurrence of the Key COPCs in groundwater. Section 4.2.1 describes the approach and the criteria used to evaluate the concentrations of COPCs.

Multiple sources of contaminants contribute to groundwater contamination observed in Area 3 and some additional sources likely exist. Subsurface investigations revealed the presence of chlorinated VOCs at manufacturing and chemical storage facilities, located primarily in SW Area 3, and dry cleaning facilities, located throughout Area 3. Twelve facilities reported detections of chlorinated VOCs in groundwater at concentrations that exceed the evaluation criteria.

Other evaluations yield inconclusive results on potential point sources of groundwater contamination in Area 3, including formerly active landfills, fuel storage and handling facilities, redevelopment sites, and the former Alhambra Airport.

Potential ***non-point sources*** of contamination include historical application of agricultural chemicals within Area 3; inflow of contamination from upgradient sources outside Area 3, including the Raymond Basin, El Monte ***Operable Unit*** (OU) and South El Monte OU; and imported water for groundwater recharge. Groundwater monitoring will continue during the feasibility study and the collected data will be evaluated to determine the impact of point and non-point sources to the contamination in Area 3. Water purveyors implement safeguards to ensure that all tap water meets drinking water standards through well shutdowns, wellhead treatment, and blending.

EXHIBIT 8-1
Distribution of Key COPCS In Area 3

Key COPC	Occurrence in Groundwater	Potential Sources
PCE	Maximum concentration occurs in NE Area 3; contamination generally occurs throughout Area 3.	SW Area 3 – At least three discrete sources NW Area 3 – Unknown[a] Central Area 3 – At least one discrete source NE Area 3 – At least three discrete sources SE Area 3 – Unknown[a]
TCE and cis-1,2-DCE	Maximum concentrations occur in SW Area 3; contamination generally occurs throughout Area 3.	SW Area 3 – At least four discrete sources for TCE; cis-1,2-DCE likely occurs as a biological degradation product of TCE NW Area 3 – Unknown[a] Central Area 3 – At least two discrete sources NE Area 3 – Unknown[a]; TCE may occur as a biological degradation product of PCE SE Area 3 – Unknown[a]
Carbon tetrachloride	Occurs at locations with TCE contamination in SW and central Area 3.	Unknown[a]
1,2,3-TCP	Maximum concentration occurs in central Area 3.	Unknown[a]
Perchlorate	Based on limited data, low level contamination appears to occur throughout Area 3.	Unknown[a]
Nitrate	Based on limited data, low level contamination appears to occur throughout Area 3.	Unknown[a]

Notes:
[a]Point or non-point sources likely exist. Contaminant source activities will continue during the feasibility study.
cis-1,2-DCE – cis-1,2-dichloroethene
Key COPC – ***Key contaminant of potential concern***
NE – northeastern
NW – northwestern
PCE – ***tetrachloroethene***
SE – southeastern
SW – southwestern
TCE– ***trichloroethene***
1,2,3-TCP – 1,2,3-trichloropropane

8.3 Contamination Migration Conceptual Site Model

As discussed in Section 5, contamination from the Key COPCs impacts the bedrock aquifer; western alluvial aquifer; and the shallow, intermediate, and deep zones of the eastern alluvial aquifer. The transport of dissolved contaminants by groundwater flow (advection) likely controls the migration of Key COPCs in Area 3. Chemicals that are by-products of ***biological degradation*** also occur in Area 3, as discussed in Technical Appendix 5. However, the impact of biological degradation on the migration of contaminants in Area 3 likely is limited. Figure 8-2 illustrates key aspects of the hydrogeology and the distribution of ***tetrachloroethene*** (PCE) in Area 3. Figure 8-3 illustrates key aspects of the hydrogeology and the distribution of ***trichloroethene*** (TCE) in Area 3.

Figure 8-2 illustrates key aspects of the hydrogeology and the distribution of PCE in Area 3.

Figure 8-3 illustrates key aspects of the hydrogeology and the distribution of PCE in Area 3.

8.4 Human Health Risk Assessment

Exhibit 8-2 summarizes results of the HHRA for Area 3.

As shown in Exhibit 8-2, the results of the ***human health risk assessment*** (HHRA) indicate that due to the presence of COPCs, groundwater in many parts of Area 3 is unsuitable as a source of tap water for domestic use. The HHRA indicates that action needs to be taken to protect human health in Area 3. Section 6 provides a summary of the HHRA; Appendix F presents the complete HHRA.

EXHIBIT 8-2
Summary of Estimated Human Health Risks and Hazards Based on Detected Current Maximum Concentrations of Key COPCS in Groundwater Underlying Area 3

Key COPC	Current Maximum Concentration Detected (µg/L)	Evaluation Criterion[a] (µg/L)	Estimated Cancer Risk Based on Current Maximum Concentration (Risks greater than 1E-06)	Estimated Hazard Index Based on Current Maximum Concentration (Hazards greater than 1)
PCE	640	5	6E-03	10.5
TCE	1,700	5	1E-03	**
cis-1,2-DCE	17	6	--	0.05
1,2,3-TCP	0.23	0.005	2E-05	0.001
Carbon tetrachloride	1.2	0.5	6E-06	0.05
Perchlorate	6.8	6	--	0.3
Nitrate as N[b]	18.5 [b]	10 [b]	--	0.74

Notes:
[a]Evaluation criterion, the most protective standard or lowest allowable concentration is either the maximum contaminant level (MCL) or notification level (NL).
[b]Nitrate concentration measured in milligrams per liter (mg/L) as nitrogen (N).
Other COPCs that also contribute to estimated risks in Area 3 include arsenic, naphthalene, n-nitrosodimethylamine (NDMA), dibromochloropropane, 1,2,4-trimethylbenzene, benzene, and atrazine. These COPCs will also be addressed during the feasibility study.
** = Key COPC occurs only at concentrations that present no potential hazard to human health.
-- = Key COPC occurs only at concentrations that present no potential risk to human health.
cis-1,2-DCE – cis-1,2-dichloroethene
COPC – contaminant of potential concern
µg/L- micrograms per liter
PCE – tetrachloroethene
TCE – trichloroethene
1,2,3-TCP – 1,2,3-trichloropropane

The RI identifies the ***contaminants of concern*** to be addressed during the ***feasibility study*** as part of the next steps for Area 3. The potential risk contributors include Key COPCs and the following COPCs: arsenic, naphthalene, n-nitrosodimethylamine (NDMA), dibromochloropropane, 1,2,4-trimethylbenzene, benzene, and atrazine. Groundwater monitoring will continue during the feasibility study; the additional data will be evaluated to determine the impact of these contaminants in groundwater underlying Area 3.

8.5 Ecological Risk Assessment

The RI also includes an ***ecological risk assessment*** to evaluate the likelihood of harmful effects to plants and animals resulting from contact with contaminated groundwater used for irrigation and stored in ponds. The ecological risk assessment identifies no risks to ecological ***receptors*** from potential exposure to groundwater contamination in Area 3.

8.6 Next Steps

The collection and evaluation of data have enabled EPA to complete the investigation of regional groundwater contamination in Area 3. The results of the RI indicate that, due to the presence of COPC contamination, groundwater in many parts of Area 3 is unsuitable as a source of tap water for domestic use. The overall conclusion of the RI is that action needs to be taken to protect human health in Area 3 by addressing groundwater contamination. Table 8-1 identifies the next steps for Area 3 (RI Subtask 6) based on the outputs of RI Subtasks 1 through 5.

Table 8-1 identifies the next steps for Area 3.

EPA will use the contamination migration ***conceptual site model*** as a basis for the feasibility study, which will evaluate technologies, costs, and challenges for cleaning up contaminated groundwater in Area 3. The feasibility study will consider the data needs identified during the RI. The current schedule envisions completion of a draft feasibility study report in 2010.

The feasibility study will accomplish the following.

- Develop, screen, and evaluate potential remedial alternatives.
- Assess adequacy of the data set for the evaluations of remedial alternatives.
- Assess the potential performance and cost of remedial alternatives.

Figure 8-4 presents the general progression of activities and milestones in the Superfund process for Area 3.

Figure 8-4 presents the activities and milestones in the Superfund process for Area 3.

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Glossary

Glossary

1.0E-06 Risk: A screening criterion and estimate of risk that indicates for every 1 million people exposed to carcinogens throughout their lifetimes, the average incidence of cancer might increase by one case of cancer.

alluvial: Relating to alluvium.

alluvium: Sediment deposited by flowing water, as in a riverbed, flood plain, or delta.

aquifer: A saturated geologic unit, often of sand or gravel, which contains and transmits significant quantities of water under normal conditions.

basin: A large geologic depression in the bedrock filled with unconsolidated sediments.

bedrock: Solid rock that underlies loose material, such as soil, sand, clay, or gravel.

biological degradation: The process by which organic substances are broken down by the enzymes produced by living organisms.

conceptual site model: A planning tool that provides the framework from which the study design is structured. It is frequently created as a site map that organizes information that already is known about a site.

contaminant: A substance not naturally present in the environment or present in unnatural concentrations that can, in sufficient concentration, adversely alter an environment.

contaminants of concern: The contaminants which have been shown through a risk assessment to be those that are likely to be causing risk to receptors at a site.

contaminants of potential concern: Contaminants that potentially pose a risk to human health or the environment.

contamination: The presence of hazardous substances in the environment.

data quality objectives: Performance and acceptance criteria that clarify study objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions.

ecological risk assessment: A process for systematically evaluating the likelihood that adverse ecological effects may occur as a result of exposure to one or more contaminants.

environmental data: Any measurements or information that describe environmental processes, location, or conditions; ecological or health effects and consequences; or the performance of environmental technology.

evaluation criterion: A standard or reference point on which a decision will be assessed.

feasibility study: The mechanism for the development, screening, and detailed evaluation of remedial action alternatives.

groundwater: Water occurring underground, in the zone of saturation in an aquifer.

human health risk assessment: Qualitative and quantitative evaluation of the risk posed to human health by the actual or potential presence of specific contaminants.

hydrogeology: The study of the occurrence and movement of water beneath the surface of the earth.

hydrostratigraphy: The body of soil or rock having considerable lateral extent that also exhibits reasonably distinct groundwater conditions.

Key contaminants of potential concern: The contaminants detected multiple times in groundwater at production wells within Area 3 at concentrations that exceed evaluation criteria. Key COPCs identify regional contamination within Area 3.

maximum contaminant levels: The maximum permissible level of a contaminant in water that is delivered to any user of a public water system.

non-point sources: Sources of contamination that originate from multiple areas or locations rather than from a discrete site.

notification level: Health-based advisory levels (formerly referred to as Action Levels) established by the California Department of Public Health for certain chemicals for which no established drinking water standards exist.

operable unit: A subunit of a Superfund site, defined based on a geographical area or on another parameter, where a number of separate activities are undertaken as part of site cleanup.

remedial investigation: Actions undertaken to characterize the full nature and extent of contamination, including characterization of hazardous substances, identification of contaminant sources, and assessment of human health and ecological risk.

structural bedrock discontinuity: In structural geology, a subsurface bedrock zone or surface separating two unrelated groups of rocks across which an abrupt geologic change occurs, e.g., a fault.

Superfund: The program operated under the legislative authority of CERCLA and the Superfund Amendments and Reauthorization Act that funds and carries out EPA solid waste emergency and long-term response actions, including conducting or supervising cleanup actions.

tetrachloroethene: A volatile organic compound primarily used for dry cleaning clothing and in manufacturing processes as a solvent and metal degreaser.

trichloroethene: A volatile organic compound primarily used in manufacturing processes as a solvent, metal degreaser, and textile degreaser.

volatile organic compound: An organic (carbon-containing) compound that evaporates readily at room temperature.

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Tables

Figures