Proposed Plan

Orange County Water District
South Basin Groundwater Protection Project, Operable Unit 2
Interim Remedial Action Plan

Orange County Water District Announces Proposed Plan

This Proposed Interim Remedial Action Plan (Proposed Plan) identifies the Preferred Alternative for Interim Remedial Measures (IRMs) to address contaminated groundwater in Operable Unit 2 (OU2) in the south-central portion (the South Basin) of the Orange County Groundwater Basin (the Basin) in Orange County, California as part of the South Basin Groundwater Protection Project (SBGPP) and provides the rationale for the selection of the Preferred Alternative.

In addition, this Proposed Plan summarizes six alternatives that were evaluated for the IRMs, including No Action. This document is issued by the Orange County Water District (OCWD or District), the lead agency for the SBGPP, in consultation with the Santa Ana Regional Water Quality Control Board (RWQCB) and California Department of Toxic Substances Control (DTSC), the State agencies, who reviewed this Proposed Plan and the SBGPP remedial investigation and feasibility study reports and provided comments. OCWD, in consultation with the State agencies, will select one of the alternatives as the IRMs, or No Action, after reviewing and considering all information submitted during the 45-day public comment period. OCWD, in consultation with the State agencies, may modify the Preferred Alternative or select another alternative presented in this Proposed Plan as the IRMs based on available information or public comments. The public is encouraged to review and comment on all the alternatives presented in this Proposed Plan.

OCWD issues this Proposed Plan pursuant to the provisions of Sections 300.430(f)(2) and 300.430(f)(3) of the National Oil and Hazardous Substances Pollution

MARK YOUR CALENDAR!!!

PUBLIC COMMENT PERIOD:

December 13, 2024 – January 27, 2025

OCWD will accept written comments on the Proposed Plan during the public comment period. Written comments can be delivered to OCWD staff at the Public Meeting, by mail, or by email to bleever@ocwd.com.

PUBLIC MEETING:

January 16, 2024

OCWD will hold a public meeting to explain the Proposed Plan and the alternatives presented in the Feasibility Study. Oral and written comments will also be accepted at the meeting. The meeting will be held at Delhi Center, 505 E. Central Ave., Santa Ana, CA 92707, at 6:00 p.m.

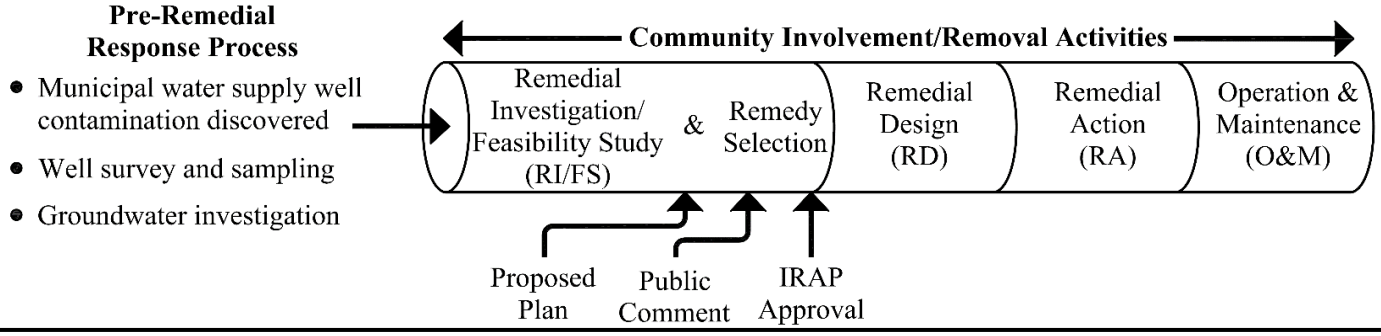
For more information, the RI/FS and Proposed Plan are at the following locations:

- Delhi Center - 505 E. Central Ave., Santa Ana, CA 92707 (714) 481-9600
- Santa Ana Library – 122 N Newhope St, Santa Ana, CA 92703 (714) 647-6992
- Irvine Heritage Park Library - 14361 Yale Ave, Irvine, CA 92604 (949) 936-4040
- Tustin Library - 345 E Main St, Tustin, CA 92780 (714) 544-7725
- State Water Resources Control Board GeoTracker website - https://geotracker.waterboards.ca.gov/profile_report?global_id=T10000009588

The Administrative Record is on OCWD's website - https://www.ocwd.com/what-we-do/water-quality/groundwater-cleanup/south-basin/

Operable Unit 2 (OU2) is defined as groundwater contamination in the Shallow Aquifer System off-property of numerous groundwater contamination source sites located within the SBGPP Study Area where groundwater contaminant plumes emanating from individual source sites have migrated and commingled.

Remedial Response Process Pipeline



Contingency Plan (NCP or National Contingency Plan). This Proposed Plan summarizes information found in greater detail in the Preliminary and Supplemental Remedial Investigation (RI) reports[1,2], the Feasibility Study (FS) report [3] (collectively, RI/FS), and other documents contained in the Administrative Record for the SBGPP.

OCWD and the State agencies encourage the public to review these documents to gain a more comprehensive understanding of the SBGPP, provide feedback on the alternatives, including the Preferred Alternative, and participate in the selection of the IRMs, or No Action, for the SBGPP OU2.

The Study Area

The SBGPP Study Area (Study Area) is an approximate five square mile area located in the south-central part of the roughly 300 square mile Basin in Orange County, California. The Study Area is within the southeastern portion of the city of Santa Ana, the western portion of the city of Irvine, and the southwestern portion of the city of Tustin.

After the repeated detection of chemical contaminants in groundwater from public water supply well IRWD-3, OCWD established the SBGPP to better characterize local hydrogeologic conditions in the vicinity of that well and to investigate the sources and the extent of the groundwater contamination. A review of records maintained by the DTSC, the RWQCB, and the Orange County Health Care Agency (OCHCA) resulted in the identification of multiple industrial source sites in the area surrounding IRWD-3 where chemical releases impacting soil and groundwater had been investigated as early as the mid-1980s. Additionally, many other potential source sites were identified where no soil or groundwater investigation appeared to have been conducted. Following this initial investigation, OCWD identified the Study Area as the geographic area encompassing the majority of these source sites.

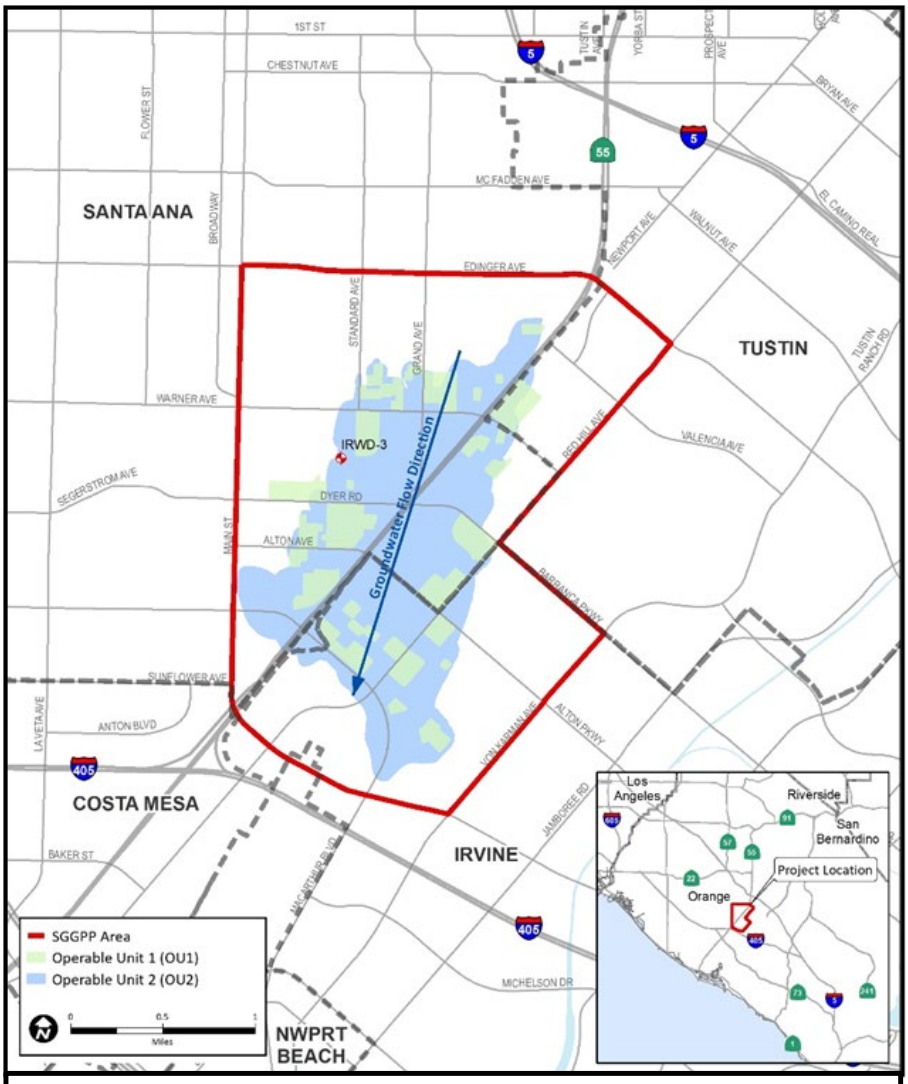


Figure 1. Study Area

The Study Area has a decades-long history of industrial operations at multiple individual source sites (some dating back to the 1950s) from which the release of chemicals has contaminated soil and groundwater beneath and downgradient of the source sites. Groundwater contamination from chemical releases at individual source sites within the Study Area has migrated away from the source sites and in many cases has mixed, or commingled, with chemical releases from other source sites to form a broad plume of groundwater contamination in the Study Area. This commingled plume extends laterally downgradient in the general direction of groundwater flow from north to south, over an area approximately 3 miles in length and 1.5 miles in width from east to west.

[1] Aquilogic, Inc. 2015. *Preliminary Remedial Investigation Report, South Basin Groundwater Protection Project (SBGPP).* Prepared for Orange County Water District

[2] Hargis + Associates, Inc. 2020. *Supplemental Remedial Investigation Report, South Basin Groundwater Protection Project, Operable Unit 2*. Prepared for Orange County Water District

[3] Engineering Analytics. 2023. *Feasibility Study, South Basin Groundwater Protection Project, Operable Unit 2*. Prepared for Orange County Water District

Study Area Characteristics

This section of the Proposed Plan summarizes the Study Area characteristics, including the magnitude and extent of chemicals of concern (COCs), that were evaluated in the RI/FS. For a more detailed description of the Study Area characteristics, OCWD directs you to the RI/FS, which is publicly available as part of the Administrative Record at the locations listed on page 1 of this Proposed Plan.

In 2023, OCWD completed a years-long and comprehensive RI/FS with the participation of the State agencies through a technical advisory committee that was established to guide the RI/FS. From 2018 to 2023, the technical advisory committee met regularly to discuss project progress, draft RI/FS document review comments, and resolve issues that arose either during document review or committee meetings. A summary of the technical advisory committee meetings is provided in the FS (pages 1 through 3) and in the FS appendices G through V. The finalized RI/FS reports reflect the resolution of technical advisory committee comments on these documents.

The RI/FS identified the magnitude and extent of contaminants and evaluated ways to address the contamination. The Preliminary and Supplemental RI reports indicated that:

- Large portions of the Study Area have been used for industrial land use purposes for several decades, and operations at a substantial number of these facilities

WHAT IS AN INTERIM REMEDIAL MEASURE (IRM)?

One of the U.S. Environmental Protection Agency's (USEPA) primary goals for any corrective action is to expedite risk reduction through implementation of interim measures to control or minimize ongoing or potential threats to human health or the environment. In many state and federal remedial programs, interim measures address risks to human health or the environment in advance of final remedy selection. The USEPA-recommended IRM Performance Standard includes:

> *Control, minimize, or eliminate releases(s) or potential release(s) that pose actual or potential threats to human health and the environment and, to the extent practicable, be consistent with remedies that meet the remedy performance standard.*

Consistent with the USEPA guidance, OCWD intends to implement IRMs, or No Action, that will be consistent with any final remedy, if required. Under the Preferred Alternative, IRMs would be applied to OU2, and long-term groundwater monitoring would be performed as part of these actions. Five-year remedy reviews would be performed to track the progress and effectiveness of the interim remedy. The five-year remedy reviews also would evaluate the progress and effectiveness of the source site remedial efforts as they pertain to preventing off-property migration of chemicals of concern (COCs). Evaluation of the combined effectiveness of both the OU2 IRMs and source site remedial efforts by responsible parties, would provide a basis for determining if changes to the IRMs are warranted. A final remedy may incorporate final restoration of the groundwater targeted by the IRMs to the designated beneficial uses following the implementation of the IRMs.

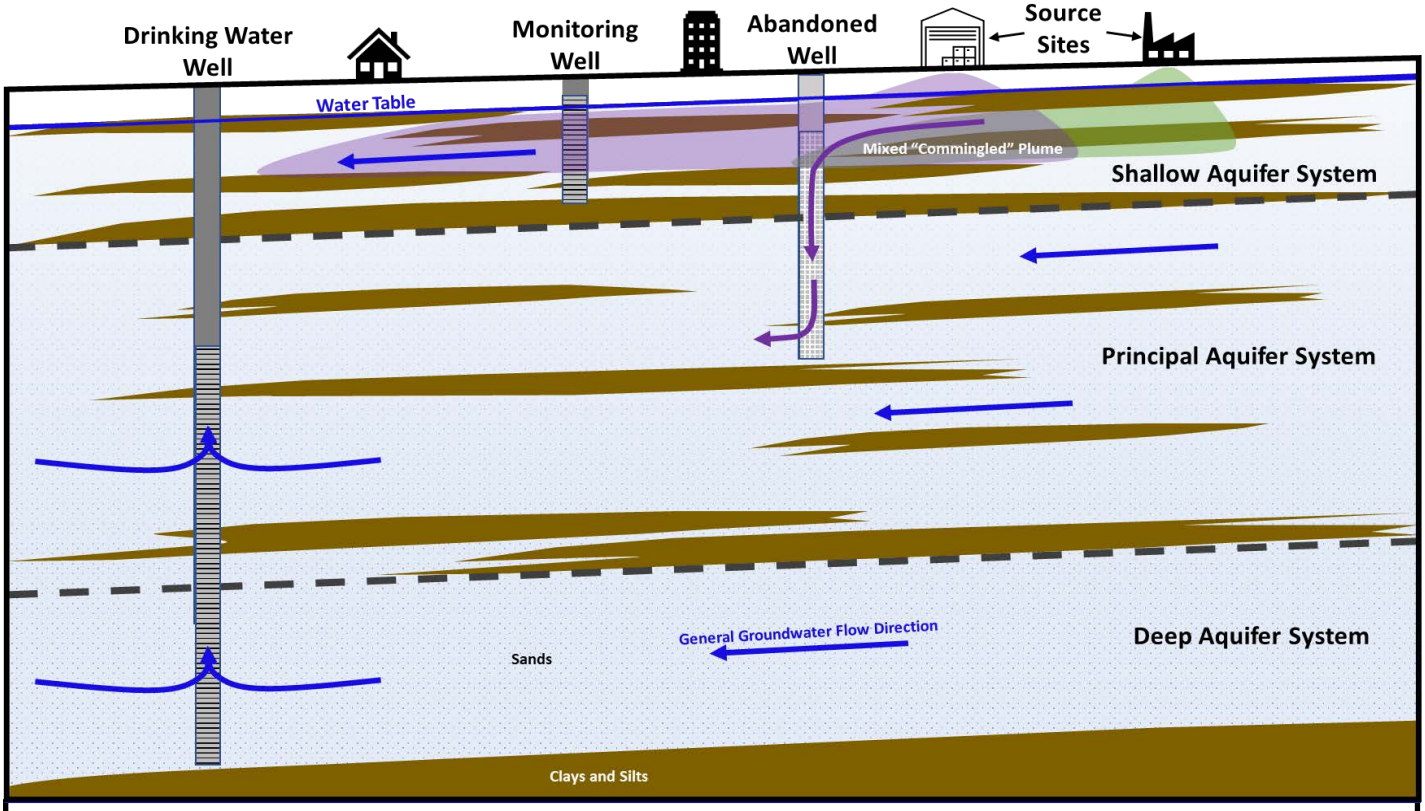


Figure 2. Schematic of Shallow Aquifer System and Contaminants

have released a broad range of contaminants to soil and groundwater.

- COCs that occur in groundwater include, among others, trichloroethylene (TCE), tetrachloroethylene (PCE), 1,1-dichloroethylene (1,1-DCE), and 1,4-dioxane.
- From shallow to deep, the three aquifer systems in the Study Area are the Shallow Aquifer System, the Principal Aquifer System, and the Deep Aquifer System.
- The Shallow Aquifer System in the Study Area is generally less than 200 feet below ground surface and is where the groundwater contamination found in the RI primarily occurs. The Shallow Aquifer System is characterized by lenses, layers, and interbeds of interfingered fine and coarse-grained material, and is subdivided into the following four layers:
  - Layer 1: an uppermost clay/silt zone at and below the water table;
  - Layer 2: a generally laterally continuous predominantly coarse sand zone;
  - Layer 3: a mixed zone of sands and clays/silts; and
  - Layer 4: a laterally continuous and relatively coarse-grained basal sand.
- Contaminants have been detected in active and inactive water supply wells within and near the Study Area. Former abandoned and likely improperly destroyed water supply wells (referred to as "legacy supply wells") in the Study Area may act as conduits for the transport of contaminants from the surface through the Shallow Aquifer System downward into the underlying Principal Aquifer System, from which most groundwater production occurs.
- Although no drinking water wells are known to currently pump groundwater from the Shallow Aquifer System within the Study Area, if unrestricted use of the contaminated groundwater were to occur, it could result in ingestion, dermal, and inhalation exposure that threatens human health. Further migration of COCs to the Principal Aquifer System, including through potentially improperly abandoned former wells, could also result in additional contaminant pathways to human exposures.
- The COCs in Shallow Aquifer System groundwater constitute a threat to human health and the environment because, among other considerations, they are found at concentrations that pose a significant risk to human health and ecological receptors.

WHAT ARE THE "CHEMICALS OF CONCERN"?

OCWD has identified 11 Chemicals of Concern (COCs) in OU2, based on the risk they pose to humans or surface water receptors. COCs that pose great risk to human health and the environment and are widespread in OU2 include trichloroethylene (TCE), tetrachloroethylene (PCE), 1,1-dichloroethylene (1,1-DCE), and 1,4-dioxane.

Trichloroethylene (TCE): TCE, detected in groundwater at concentrations over 100 times the drinking water standard, is an organic compound historically used as a solvent and degreaser in many industries. Exposure to this compound has been associated with deleterious health effects in humans, including anemia, skin rashes, diabetes, liver conditions, and urinary tract disorders. Based on laboratory studies, TCE is considered a probable human carcinogen.

Tetrachloroethylene (PCE): PCE, detected in groundwater at concentrations over 100 times the drinking water standard, is an organic compound historically used as a solvent and degreaser in many industries, and has commonly been used in the dry-cleaning industry. Exposure to this compound has been associated with deleterious health effects in humans, including liver and kidney damage. Animal studies have also shown that offspring of pregnant animals exposed to excessive levels of PCE can develop behavior problems. Based on laboratory studies, PCE is considered a probable human carcinogen.

1,1-Dichloroethylene (1,1-DCE): 1,1-DCE, detected in groundwater at concentrations over 100 times the drinking water standard, is an organic compound historically used to make other chemicals and to make fire retardant fibers and polyethylene food wraps. 1,1-DCE is also a breakdown product of 1,1,1-Trichloroethane, which is a halogenated organic compound historically used as a solvent and degreaser in many industries. Exposure to 1,1-DCE has been associated with central nervous system disorders including depression and symptoms of inebriation, convulsions, spasms, and unconsciousness at high concentrations. Low-level, chronic (long-term) inhalation exposure in humans may affect the liver. Animal studies indicate that chronic exposure to 1,1-DCE can affect the liver, kidneys, central nervous system, and lungs.

1,4-dioxane: 1,4-dioxane, detected in groundwater at concentrations over 100 times the drinking water notification level, is an organic compound historically used as a stabilizer in certain chlorinated solvents, paint strippers, greases, and waxes. Exposure to this compound has been associated with eye, nose and throat irritation, and kidney and liver damage. 1,4-dioxane is a likely human carcinogen.

Scope and Role of the Proposed Plan

This Proposed Plan identifies the Preferred Alternative for IRMs that are intended to prevent current and future exposure to contaminated groundwater by implementing a combination of containment and treatment of contaminated groundwater within OU2. This Proposed Plan also summarizes five other alternatives evaluated for the IRMs, including No Action.

The Preferred Alternative IRMs would permanently reduce the toxicity, mobility, and volume of COCs that constitute the principal threat to human health and the environment (see the next section, "Summary of Site Risks"). The COCs include TCE, PCE, 1,1-DCE, and 1,4-dioxane.

OCWD, in consultation with the State agencies, will choose the final IRMs after considering all available information, including information submitted during the 45-day public comment period for this Proposed Plan.

Summary of Risks of Contamination in the Study Area

As part of the Supplemental RI to support the FS, a Human Health and Ecological Risk Assessment (HHERA) was performed to determine the potential effects of contaminants in groundwater on human health and the environment using baseline risk assumptions described in the inset box. The Preferred Alternative identified in this Proposed Plan, or one of the other alternatives evaluated that incorporate active remedial measures, is necessary to protect human health and the environment from actual and threatened contamination caused by releases of hazardous substances into the environment. The HHERA quantified potential risks associated with residential and ecological exposure to contaminants in groundwater. Specifically, the people, animals, and plants evaluated included a residential child, residential adult, freshwater and saltwater aquatic plants, aquatic invertebrates, and fish. The HHERA was conducted as a "baseline risk assessment" that evaluated potential current risks in the absence of an IRM to address the contaminated groundwater in OU2.

Human Health Risk

Human health incremental lifetime cancer risk and noncancer hazard index values were developed as explained in the HHERA and are based on exposure to COCs by inhalation, dermal contact while showering, and ingestion. An incremental lifetime cancer risk of 10^{-4} corresponds to the upper end of USEPA's generally acceptable risk range of 10^{-6} to 10^{-4} as discussed in the NCP, 40 CFR 300.430(e)(2)(i). For human health, the incremental lifetime cancer risk and hazard index values are 0.44 and 3,100, respectively. Both values exceed the upper bound benchmark human health risk management levels of 10^{-4} and 1, respectively, which are commonly applied by local, state, and federal regulatory agencies to evaluate human health risk.

Ecological Hazard

To assess environmental risks, ecological hazard ratios were calculated for freshwater and saltwater habitats. The ecological hazard ratio values calculated for freshwater and saltwater are 790 and 480, respectively. Both values exceed the target benchmark ecological risk management level of 1 commonly applied by local, state, and federal regulatory agencies to evaluate environmental risk.[4]

WHAT IS RISK AND HOW IS IT CALCULATED?

A human health risk assessment estimates the "baseline risk." This is an estimate of the likelihood of health problems occurring if no IRM were taken at a site. To estimate the baseline risk there is a multi-step process, that can be generalized as follows.

In Step 1, the concentrations of contaminants found at a site as well as past scientific studies on the effects these contaminants have had on people (or animals, when human studies are unavailable) are reviewed. Comparisons between site-specific concentrations and concentrations reported in past studies helps to determine which contaminants are most likely to pose the greatest threat to human health.

In Step 2, the different ways that people might be exposed to the contaminants identified in Step 1, the concentrations that people might be exposed to, and the potential frequency and duration of exposure are evaluated. Using this information, a "reasonable maximum exposure" (RME) scenario is considered, which defined by the USEPA, is the "highest exposure that is reasonably expected to occur." The RME approach of assessing exposure relies upon conservative assumptions for the exposure parameters to ensure that the calculated risks are not underestimated. For the groundwater risk assessment in the HHERA, the following pathways were quantified:

- Inhalation of COCs during domestic water use;
- Dermal contact with COPCs during showering; and
- Ingestion of COCs in water.

The HHERA also conservatively assumed that groundwater from the Shallow Aquifer System is used for residential supply and that residents will be exposed to the COCs 24 hours per day, 350 days per year for 26 years.

In Step 3, the information from Step 2 combined with information on the toxicity of each chemical to assess potential health risks is determined. Two types of risk are evaluated: cancer risk and non-cancer risk. The likelihood of any kind of cancer resulting from contamination is generally expressed as an upper bound probability; for example, a "1 in 10,000 chance." In other words, for every 10,000 people that could be exposed, one extra cancer may occur as a result of exposure to site contaminants. An extra cancer case means that one more person could get cancer than would normally be expected to from all other causes. For non-cancer health effects, a "hazard index" is calculated. The key concept here is that a "threshold level" (measured usually as a hazard index of less than 1) exists below which non-cancer health effects are no longer predicted.

In Step 4, it is determined whether site risks are great enough to cause actual or potential health problems for people at or near the site. The results of the three previous steps are combined, evaluated, and summarized and the potential risks to human health and the environment are determined.

[4] Hargis + Associates, Inc. 2020. *Supplemental Remedial Investigation Report, South Basin Groundwater Protection Project, Operable Unit 2, Appendix K – Human Health and Ecological Risk Assessment*. Prepared for Orange County Water District

Remedial Action Objectives

The Remedial Action Objectives (RAOs) for the OU2 IRMs evaluated in the RI/FS are to:

1. Protect groundwater resources from further degradation by preventing lateral and vertical migration of high concentration COCs into zones with lower concentrations of COCs within OU2, to the extent practicable;
2. Protect groundwater resources by preventing the potential for vertical migration of high concentration COCs from the upper/middle portions of the Shallow Aquifer System to the Principal Aquifer System through legacy water supply wells, to the extent practicable;
3. Protect groundwater resources from further degradation by preventing the spread of COCs exceeding drinking water maximum contaminant levels (MCLs) in the leading-edge areas of the plume, to the extent practicable;
4. Implement a reliable interim groundwater remedy (or remedies) that is (or are) compatible with ongoing and planned remediation at source sites and associated off-property locations, where applicable;
5. Prevent discharge of COCs exceeding ecological risk-based concentrations from the Shallow Aquifer System to surface water channels; and
6. Prevent human exposure to contaminated groundwater with COC concentrations exceeding MCLs or other Applicable or Relevant and Appropriate Requirements (ARARs).

The Preferred Alternative IRMs in the Proposed Plan will reduce the excess human health and ecological risks associated with exposure to contaminated groundwater.

Summary of Remedial Alternatives

This section of the Proposed Plan summarizes the alternative IRMs for OU2 groundwater that have been evaluated in the FS. For a more detailed description, evaluation, and comparison of the alternatives, OCWD directs you to the FS, which is publicly available as part of the Administrative Record at the locations listed on page 1 of this Proposed Plan.

The IRMs for OU2 groundwater, with the exception of the No Action alternative, were developed and evaluated in the FS Report using a combination of general response actions and associated remedial technologies that have the potential to achieve the RAOs. The alternatives are presented below and are numbered to correspond with the alternative numbers presented in the FS.

In addition to containment and treatment of contaminated groundwater, all IRMs except No Action incorporate institutional controls, monitoring, and sealing legacy supply wells until each alternative achieves the RAOs. Institutional controls are actions such as administrative and legal controls that help minimize the potential for human exposure to contamination and/or protect the integrity of the remedy. Consistent with USEPA regulations, none of the alternatives rely exclusively on institutional controls to protect human health and the environment. For all alternatives except No Action, monitoring groundwater levels and quality would be conducted to monitor and evaluate performance of the IRMs and to adjust as warranted, based on the data, to improve remedy effectiveness. Sealing of legacy water supply wells would mitigate vertical migration of contaminants from the Shallow Aquifer System to deeper aquifers to the extent that legacy water supply wells are discovered and accessed during the IRMs.

Summary of Remedial Alternatives for OU2 IRMs

Alternative	Proposed Plan Designation	Description
1	No Action	No Action
2	Monitored Natural Attenuation	Monitored Natural Attenuation (MNA) includes physical processes; chemical processes; and reactions resulting from biological processes to reduce contaminant concentrations to an acceptable level without active intervention
3	Groundwater Extraction and Treatment with Sewer Discharge	Containment and treatment of relatively high concentration and leading-edge areas using groundwater extraction and treatment with discharge of treated groundwater to an Orange County Sanitation District wastewater treatment plant (WWTP) and the OCWD Groundwater Replenishment System Advanced Wastewater Purification Facility (GWRS)
4	Groundwater Extraction and Treatment with Reinjection	Containment and treatment of relatively high concentration and leading-edge areas using groundwater extraction and treatment with injection of treated groundwater in the Basal Sand
5	In-Situ Treatment Using Chemical Oxidation	In-Situ treatment of relatively high concentration and leading-edge areas using chemical oxidation
6	Combination of Groundwater Extraction and Treatment with Sewer Discharge and In-Situ Treatment using Chemical Oxidation	Containment and in-situ treatment of relatively high concentration and leading-edge areas using chemical oxidation combined with groundwater extraction and treatment with discharge of treated groundwater to the WWTP and GWRS

The estimated capital costs for each alternative shown below include the design, construction, and equipping of each IRM over the first three years of the implementation period for each IRM. The estimated operation, maintenance, and monitoring (OMM) costs over the remainder of the implementation period for each IRM, and the net present value of the cost of each alternative, assume a 27-year operating period for each IRM.

As explained in the FS, the net present value of each IRM is based on a 2.5% discount rate, which is the typical current discount rate OCWD uses to assess long-term projects.

Alternative 1 – No Action

The No Action alternative (FS page 61) is the baseline to which all other alternatives are compared. In the No Action alternative, there is no groundwater monitoring, no compliance with ARARs, and no protection of human health or the environment.

- Estimated Capital Cost: $0
- Estimated OMM Cost: $0
- Estimated Net Present Value: $0

Alternative 2 - Monitored Natural Attenuation

Alternative 2 (FS page 62) would include installation of monitor wells within OU2, followed by long-term monitoring of natural attenuation of the contaminants. Monitored natural attenuation (MNA) would be used to track the rate at which natural destructive and nondestructive processes are reducing COCs in OU2 groundwater. This alternative would include institutional controls for maintaining a prohibition on the use of groundwater for potable purposes within OU2, and with appropriate notification and planning, would be protective of human health by minimizing the risk of exposure to OU2 COCs in groundwater. However, Alternative 2 would not effectively prevent migration or promote further degradation of COCs in OU2 groundwater and would not prevent COCs exceeding ecological thresholds from potentially discharging into surface waters. Alternative 2 would simply monitor the concentration changes that would occur through natural attenuation of COCs, therefore, despite institutional controls, would not fully protect human health and the environment. This alternative would not comply with applicable ARARs, including state and federal MCLs for groundwater COCs, in a reasonable timeframe.

- Estimated Capital Cost: $5,200,000
- Estimated OMM Cost: $26,400,000
- Estimated Net Present Value: $24,600,000

Alternative 3 - Groundwater Extraction and Treatment with Sewer Discharge

Alternative 3 (FS page 66) would include installation of groundwater extraction wells and conveyance piping, filtration to reduce sediment load, liquid-phase granular activated carbon to remove COCs, and discharge of treated groundwater to the sewer for further treatment at an Orange County Sanitation District wastewater treatment plant (WWTP) and OCWD's Groundwater Replenishment System (GWRS). The WWTP provides primary and secondary treatment (including screening, clarification, activated sludge process, trickling filters, clarifiers, biological treatment to break down organic matter, and settling tanks). From the WWTP, the extracted water would flow to the GWRS for treatment using a three-step advanced process (microfiltration, reverse osmosis, and ultraviolet light with hydrogen peroxide), producing high quality purified water that would meet or exceed all state and federal MCLs. The purified GWRS water is returned to the Basin by percolation and injection at OCWD's spreading basins and injection wells.

Alternative 3 is protective of human health and the environment because it would reduce the mass of COCs that would migrate within and beyond OU2, thereby reducing potential human health and environmental exposures. In addition, maintaining a prohibition on the use of groundwater for potable purposes within OU2, with appropriate notification and planning, would be protective of human health by minimizing the risk of exposure to OU2 COCs in groundwater. This alternative would meet ARARs. For example, extracted groundwater would be treated to meet sewer discharge requirements. In the context of transitioning the IRM to final remedy, this alternative also would meet ARARs associated with the state and federal MCLs for groundwater COCs by removing these COCs from groundwater.

- Estimated Capital Cost: $14,600,000
- Estimated OMM Cost: $31,200,000
- Estimated Net Present Value: $35,800,000

Alternative 4 - Groundwater Extraction and Treatment with Reinjection

Alternative 4 (FS page 71) would include installation of groundwater extraction wells and conveyance piping, treatment using filtration, advanced oxidation, liquid-phase granular activated carbon, and reverse osmosis membrane technologies to remove COCs, and reinjection of treated groundwater into the Shallow Aquifer System through injection wells. These treatment technologies together would produce water that meets or exceeds state and federal MCLs.

Alternative 4 is protective of human health and the environment because it would reduce the mass of COCs that would migrate within and beyond OU2, thereby reducing potential human health and environmental exposures. In addition, maintaining a prohibition on the use of groundwater for potable purposes within OU2, with appropriate notification and planning, would be protective of human health by minimizing the risk of exposure to

COCs in groundwater. This alternative would meet ARARs. For example, extracted groundwater would be treated to meet COC MCLs/notification levels prior to reinjection. In the context of transitioning the IRM to final remedy, this alternative also would meet ARARs associated with the state and federal MCLs for groundwater COCs by removing these COCs from groundwater.

- Estimated Capital Cost: $34,900,000
- Estimated OMM Cost: $43,600,000
- Estimated Net Present Value: $64,000,000

Alternative 5 - In-Situ Treatment Using Chemical Oxidation

Alternative 5 (FS page 76) would include in-situ chemical oxidation using activated persulfate (a chemical oxidant) delivered to groundwater through injection wells. Chemical oxidants are intended to destroy COCs, and some oxidants are generally accepted as being effective in oxidizing organic chemicals in groundwater. Injection wells would be installed along alignments that are oriented perpendicular to the contaminant plumes and the direction of groundwater flow.

Alternative 5 may be protective of human health and the environment, since it would likely reduce the mass of COCs that would migrate within and beyond OU2, thereby reducing potential human health and environmental exposures. However, potential generation of byproducts, such as hexavalent chromium, could threaten the environment if the byproduct is persistent in groundwater. This possibility presents particular challenges in the southern portion of the Study Area where in-situ injection occurs near the Armstrong Channel, into which groundwater in the uppermost portion of the Shallow Aquifer System flows. This alternative may meet ARARs if the application of in-situ chemical oxidation does not create persistent undesirable byproducts, for example hexavalent chromium, and repeated persulfate injection does not exceed the water quality objectives (WQO) in the RWQCB Basin Plan or otherwise threaten water quality, neither of which is assured. In the context of transitioning the IRMs to a final remedy, Alternative 5 could meet ARARs, including state and federal MCLs, by removing these COCs from groundwater. However, the potential for persistent undesirable byproducts and/or threats to water quality remains a concern.

- Estimated Capital Cost: $58,000,000
- Estimated OMM Cost: $424,600,000
- Estimated Net Present Value: $348,600,000

Alternative 6 - Combination of Groundwater Extraction and Treatment with Sewer Discharge and In-Situ Treatment using Chemical Oxidation

Alternative 6 (FS page 83) would include in-situ chemical oxidation in a portion of the Study Area using activated persulfate delivered to groundwater through injection wells (similar to Alternative 5), combined with groundwater extraction and treatment in other portions of the Study Area (similar to Alternative 3).

Alternative 6 may be protective of human health and the environment; however, it still retains the potential generation of byproducts associated with in-situ chemical oxidation, such as hexavalent chromium, present in Alternative 5. For the groundwater extraction and treatment portion of Alternative 6, ARARs would be met. For example, extracted groundwater would be treated to meet sewer discharge requirements. In the context of transitioning the groundwater extraction and treatment portion of Alternative 6 to final remedy, this also would meet ARARs associated with the state and federal MCLs for groundwater COCs by removing these COCs from groundwater.

- Estimated Capital Cost: $28,800,000
- Estimated OMM Cost: $109,200,000
- Estimated Net Present Value: $103,400,000

Evaluation of Alternatives

This section of the Proposed Plan summarizes the FS evaluation of alternative IRMs for OU2 groundwater. For a more detailed description, evaluation, and comparison of the alternatives, OCWD directs you to the FS (pages 101-104), which is publicly available as part of the Administrative Record at the locations listed on page 1 of this Proposed Plan.

The nine evaluation criteria specified in the National Contingency Plan (40CFR300.430(e)(9)(iii)) are identified in the table below and have been used by OCWD and the State agencies to evaluate the alternatives individually and in comparison to each other to select the Preferred Alternative. The analysis of alternatives in the FS reflects the scope and complexity of the Study Area and OU2 groundwater contamination and considers the factors in each criterion.

This section of the Proposed Plan also summarizes the relative performance of each alternative under the Threshold Criteria and Balancing Criteria, noting how each alternative compares to the other alternatives. The last two criteria, referred to as Modifying Criteria in the NCP, will be evaluated after State agency and public comments on this Proposed Plan are received, including those received at the public meeting. The evaluation of the alternatives under the first seven criteria (excluding the Modifying Criteria) is summarized below.

Threshold Criteria

Applying the Threshold Criteria to each alternative, Alternatives 3 and 4 rank highest, Alternative 6 ranks moderately high, Alternative 5 has a moderate ranking, Alternative 2 has a relatively low ranking, and Alternative 1 is lowest in rank.

Alternative 1 (No Action) does not meet the primary Threshold Criterion of protectiveness of human health or the environment. With excess risk present and unaddressed, Alternative 1 was not retained for consideration as a preferred alternative because of its inability to meet the most basic Threshold Criterion of protectiveness.

Alternative 2 (Monitored Natural Attenuation) also does not meet the primary Threshold Criterion of protectiveness of human health or the environment, except for prevention of human exposure to contaminated groundwater through institutional controls. Regarding monitored natural attenuation in OU2, the RWQCB stated: "Please be advised that we do not consider natural attenuation a 'cleanup action,' because it is a passive remedy," and thus the RWQCB does not approve of monitored natural attenuation as a stand-alone remedy for OU2 groundwater. Monitored natural attenuation was nonetheless evaluated as a potential stand-alone remedial measure in the FS for purposes of completeness and consistency with the NCP. Because no active remedial measure (e.g., groundwater extraction or in situ treatment) is being implemented, there are no ARARs identified for Alternative 2; however, in context of transitioning an IRM to a final remedy, this alternative would not comply with the ARARs associated with the state and federal MCLs for groundwater COCs in a reasonable timeframe.

Alternative 3 (Groundwater Extraction and Treatment with Sewer Discharge) and **Alternative 4** (Groundwater Extraction and Treatment with Reinjection) meet the primary Threshold Criterion of protectiveness of human health and the environment, and compliance with ARARs, through containment, removal, and treatment of contaminated groundwater, and the application of institutional controls.

Alternative 5 (In-Situ Chemical Oxidation) might meet the Threshold Criterion for protectiveness of human health and the environment. However, the potential for generation of persistent undesirable byproducts,

Nine NCP Evaluation Criteria for Remedial Alternatives (40 CFR 300.430)(e)(9)(iii)		
Threshold Criteria	1.	***Overall Protectiveness of Human Health and the Environment*** determines whether an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.
	2.	***Compliance with ARARs*** evaluates whether the alternative meets Federal and State environmental statutes, regulations, and other requirements that pertain to the site, or whether a waiver is justified.
Balancing Criteria	3.	***Long-term Effectiveness and Permanence*** considers the ability of an alternative to maintain protection of human health and the environment over time.
	4.	***Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment*** evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.
	5.	***Short-term Effectiveness*** considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation.
	6.	***Implementability*** considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services.
	7.	***Cost*** includes estimated capital and annual operations and maintenance costs, as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.
Modifying Criteria	8.	***State/Support Agency Acceptance*** considers whether the State agrees with OCWD's analyses and recommendations, as described in the RI/FS and Proposed Plan.
	9.	***Community Acceptance*** considers whether the local community agrees with OCWD's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance.

particularly near some source sites and near the surface water channels, including the Armstrong Channel, in the southern portion of the Study Area, are of concern. The potential for generation of persistent undesirable byproducts along with potential for not complying with the RWQCB Basin Plan water quality objectives due to repeated application of relatively large volumes of amendments to groundwater and generation of persistent byproducts (i.e., different contaminants) are also of concern when evaluating compliance with ARARs.

Alternative 6 (Combination of Groundwater Extraction and Treatment with Sewer Discharge and In-Situ Chemical Oxidation) combines aspects of Alternatives 3 and 5, with a smaller application area for in-situ chemical oxidation, thereby reducing, but not eliminating (e.g., potential generation of undesirable byproducts), protectiveness of human health and the environment and ARARs.

Balancing Criteria

Applying the Balancing Criteria to each alternative, Alternative 3 ranks highest followed closely by Alternative 4, Alternatives 5 and 6 rank moderately high, Alternative 2 has a relatively low ranking, and Alternative 1 is lowest in rank.

Alternative 1 (No Action) ranks low in long-term effectiveness, reduction of toxicity, mobility, and volume, and short-term effectiveness, and high in implementability. Alternative 1 has no associated cost and therefore was not ranked in cost.

Alternative 2 (Monitored Natural Attenuation) ranks low in long-term effectiveness, reduction of toxicity, mobility, and volume, and short-term effectiveness, and high in implementability and cost.

Alternative 3 (Groundwater Extraction and Treatment with Sewer Discharge) ranks high in long-term effectiveness, reduction of toxicity, mobility, and volume, and short-term effectiveness, and moderate to high in implementability and cost.

Alternative 4 (Groundwater Extraction and Treatment with Reinjection) ranks high in long-term effectiveness, reduction of toxicity, mobility, and volume, and short-term effectiveness, and moderate in implementability and cost.

Alternative 5 (In-Situ Chemical Oxidation) ranks moderate in long-term effectiveness, reduction of toxicity, mobility, and volume, short-term effectiveness, and implementability and low in cost.

Alternative 6 (Combination of Groundwater Extraction and Treatment with Sewer Discharge and In-Situ Chemical Oxidation) ranks moderate to high in long-term effectiveness, reduction of toxicity, mobility, and volume, short-term effectiveness, and implementability, and low to moderate in cost.

Balancing Criteria								
	Alternative	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume	Short-Term Effectiveness	Implement-ability	Cost Ranking	Cost ($, million) (Design, Capital and OMM)	
							Total	Net Present Value
1	No Action	Low	Low	Low	High	Not Applicable	$0	$0
2	Monitored Natural Attenuation	Low	Low	Low	High	High	$31.6	$24.6
3	Groundwater Extraction and Treatment with Sewer Discharge	High	High	High	Moderate to High	Moderate to High	$45.7	$35.8
4	Groundwater Extraction and Treatment with Reinjection	High	High	High	Moderate	Moderate	$78.5	$64.0
5	In-Situ Treatment Using Chemical Oxidation	Moderate	Moderate	Moderate	Moderate	Low	$482.6	$348.6
6	Combination of Groundwater Extraction and Treatment with Sewer Discharge and In-Situ Treatment using Chemical Oxidation	Moderate to High	Moderate to High	Moderate to High	Moderate to High	Low to Moderate	$138.1	$103.4

Other Considerations

The sustainability of each of the remedial alternatives was evaluated and ranked using the SiteWise Tool for Green and Sustainable Remediation.[5] Comparing the overall sustainability of each alternative, Alternative 2 ranked highest closely followed by Alternative 3, Alternative 4 has modest ranking, Alternative 6 has a relatively low ranking, and Alternative 5 has a low ranking.

The alternatives were also evaluated relative to one another based on compatibility with source site remediation and the potential for discharge of groundwater containing undesirable byproducts (e.g., hexavalent chromium) to surface water in Armstrong Channel. Alternatives 1 and 2 are compatible with source remediation systems and with Armstrong Channel. Alternative 5 is slightly more compatible with source site remediation systems when compared to Alternatives 3, 4 and 6; however, this alternative is not compatible with Armstrong Channel. Alternatives 3 and 4 are compatible with source site remediation and with Armstrong Channel, given the operational flexibility (e.g., balancing extraction rates and extraction well locations) of these IRMs.

Summary of Preferred Alternative

The Preferred Alternative is Alternative 3 – Groundwater Extraction and Treatment with Discharge to the WWTP and GWRS. Alternative 3 is preferred because it would be protective of human health and the environment by removing COCs through a safe, reliable, and effective technology that is cost-effective and compatible with source site remedial efforts. Alternative 3 reduces risk more effectively and at lower cost than the other alternatives. The RWQCB and DTSC support the selection of Alternative 3 as the Preferred Alternative.

Based on information currently available, the Preferred Alternative would meet the Threshold Criteria and provide the best balance of tradeoffs among the alternatives under the Balancing Criteria and Modifying Criteria. The Preferred Alternative permanently and significantly reduces the volume, toxicity, and mobility of the COCs, and best meets the statutory goals of CERCLA §121(b) because it (1) is protective of human health and the environment, (2) is cost effective, and (3) utilizes permanent solutions to reduce the threat to human health and the environment by reducing the COCs in OU2.

Alternative 3 would include approximately eight extraction alignments with approximately 75 extraction wells in total. The extraction wells pump contaminated groundwater from three zones within the Shallow Aquifer System and have a maximum depth of approximately 80 feet below ground surface. Approximately nine local treatment systems will treat the pumped groundwater (approximately 340 gallons per minute total) to remove COCs. The treated groundwater will be discharged to the sewer system where it will flow to the WWTP and GWRS, from which it be percolated back into the Basin. To measure the effectiveness of Alternative 3 at removing COCs and protecting human health and the environment, a network of monitoring wells will be constructed to a maximum depth of approximately 130 feet.

Prior to construction of the Preferred Alternative, the District will perform a preliminary design investigation from which OCWD will determine the final number, location, depth, and flow rates of the extraction wells, monitoring wells, conveyance pipes, and treatment systems. Upon completion of the preliminary design investigation, the final remedy design will be prepared and the system construction will be constructed and operated until the RAOs are met.

OCWD, as the Lead Agency, will implement and operate the remedy. The RWQCB and DTSC will advise OCWD durin the design and implementation of the remedy.

Community Participation

OCWD provides information regarding the SBGPP to the public through the implementation of the Community Involvement Plan, local community meetings, the Administrative Record, fact sheets, mailings, the District's website, webinars, social media, and meetings of the District's Board of Directors. OCWD and the State agencies encourage the public to use this information to gain a comprehensive understanding of the Study Area, the SBGPP, and the Preferred Alternative. The dates for the public comment period, the date, location, and time of the public meeting regarding this Proposed Plan, and the locations of the Administrative Record files, are provided on page 1 of this Proposed Plan.

[5] Naval Facilities Engineering Command (NAVFAC), Engineering and Expeditionary Warfare Center, (2018). *SiteWise™ Version 3.2 User Guide (UG-0000-ENV)*. Prepared in collaboration with Army Corps of Engineers, US Army, NAVFAC and Battelle

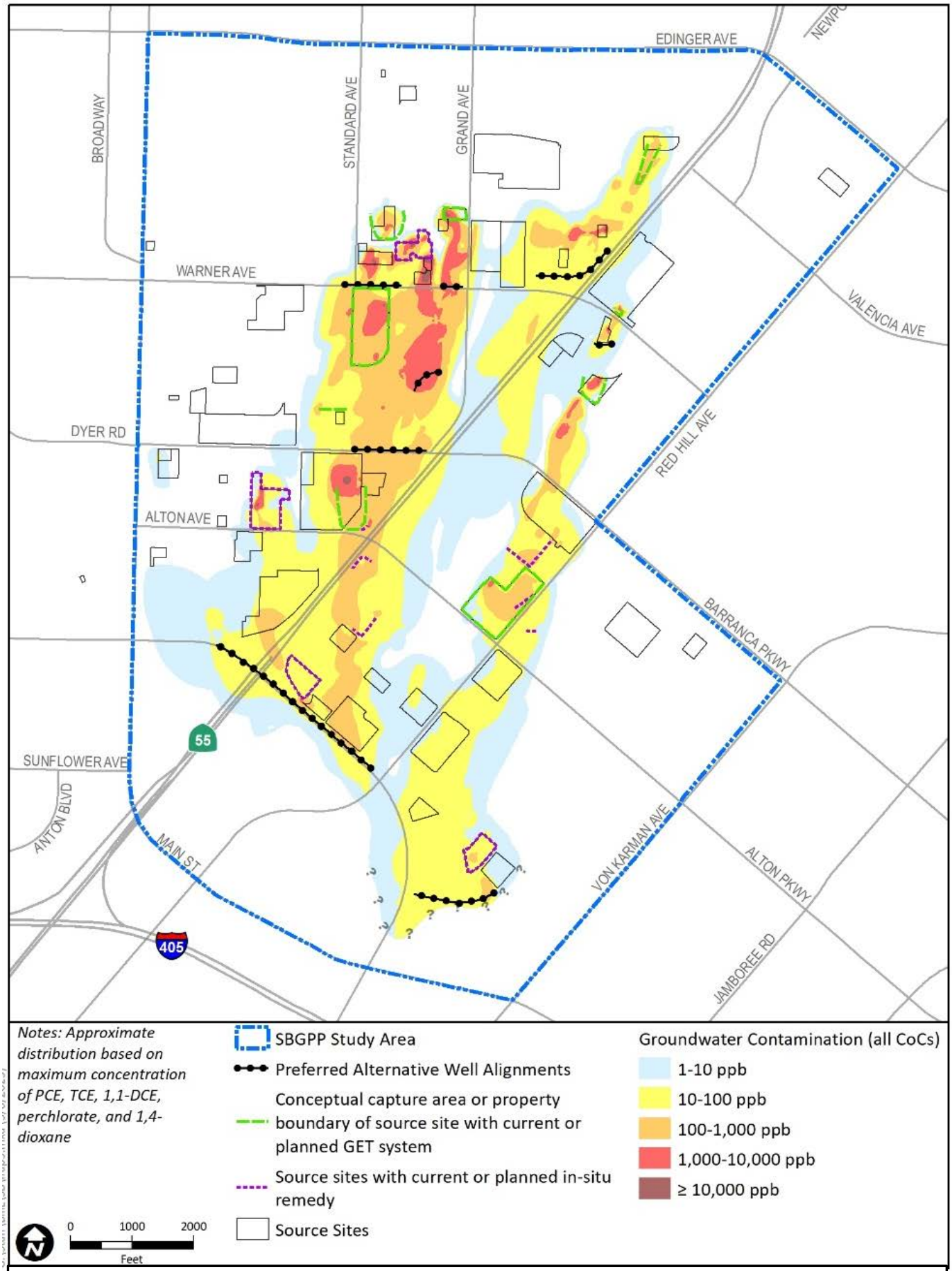


Figure 3. Preferred Alternative: Groundwater Extraction and Treatment with Discharge to the WWTP and GWRS

For more information on the SBGPP and this Proposed Plan, please contact:

Bill Leever, PG, CHg
Project Manager and Principal Hydrogeologist

Orange County Water District
18700 Ward Street
Fountain Valley, California 92708

bleever@ocwd.com | (714) 378-3200

https://www.ocwd.com/what-we-do/water-quality/groundwater-cleanup/south-basin/

Glossary of Terms

Applicable or Relevant and Appropriate Requirements (ARARs): Federal and State environmental laws that a selected remedy will meet. These requirements may vary among sites and alternatives.

Administrative Record: The supporting documents that regulatory agencies consider or rely upon on to select a remedial action.

Aquifer: An underground geological formation, or group of formations, containing water. This is a source of groundwater for wells and springs.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): A federal law first passed in 1980, and subsequently amended, that created a trust fund, known as Superfund, to investigate and clean up abandoned or uncontrolled hazardous waste sites.

Chemicals of Concern (COCs): Site-specific chemicals that exceed regulatory levels or pose a potentially significant risk to human health and the environment.

Environmental Protection Agency (EPA): The U.S. Environmental Protection Agency (EPA) is the federal agency responsible for the protection of human health and the environment.

Extraction Well: A discharge well used to remove groundwater or air.

Feasibility Study (FS): A study that develops, screens, and evaluates alternative actions to clean up environmental contamination.

Groundwater: Water found below the ground surface, usually in aquifers.

Human Health and Ecological Risk Assessment (HHERA): The qualitative and quantitative evaluation of the risk posed to human health and the environment by the specific pollutants found at the Site.

Information Repository: A location accessible to community members (such as a local library) that houses documents, reports and other site-related information, general information about the project, newspaper notices, and the Administrative Record for the site. OCWD also maintains an on-line information repository available to the public.

Interim Remedial Action Plan (IRAP): A document also referred to as the Proposed Plan that summarizes the cleanup alternatives evaluated as part of the Feasibility Study process and identifies the preferred cleanup alternative.

Interim Remedial Measure (IRM): Interim measures are used to address risks to human health or the environment in advance of final remedy selection. The recommended IRM Performance Standard includes: 1) Control, minimize, or eliminate releases(s) or potential release(s) that pose actual or potential threats to human health and the environment and, 2) To the extent practicable, be consistent with remedies that meet the remedy performance standard.

In-Situ Chemical Oxidation (ISCO): a cleanup process where amendments are applied to subsurface contaminated soil and/or groundwater to destroy contaminants in these media.

Institutional Controls: Land use restrictions and other non-engineering controls that prevent or limit exposure to contamination.

Lead Agency: The agency that provides the on-scene coordinator (OSC)/remedial project manager to plan and implement response actions under the NCP. EPA, the USCG, another federal agency, or a state (or political subdivision of a state) operating pursuant to a contract or cooperative agreement executed pursuant to section 104(d)(1) of CERCLA or designated pursuant to a Superfund Memorandum of Agreement entered into pursuant to subpart F of the NCP or other agreements may be the lead agency for a response action, if one exists, throughout the response process.

Legacy Supply Well: Water supply well installed in the late 1800s to early 1900s within the Study Area but with limited to no records on the proper destruction of the well.

Liquid Granular Activated Carbon (LGAC) Treatment: A filtering system often used in small water systems and individual homes to remove organic contaminants in water. Also used by municipal water treatment plants.

Monitoring: The ongoing collection of information about the environment that helps gauge the effectiveness of a clean-up action. Monitoring wells drilled at different depths within the Study Area would be used to detect sources of groundwater contamination, to monitor contamination concentration trends, and to monitor the effectiveness of the IRMs.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP): Provides the organizational structure and procedures for preparing for and responding to discharges of oil and releases of hazardous substances. The NCP is the primary federal regulation governing the investigation and cleanup of contaminant release sites.

Net Present Value: a method of evaluating expenditures that occur over different time periods. By discounting all costs to a primarily common base year, the costs for different

remedial action alternatives can be compared based on a single cost value for each alternative.

Operable Unit 1 (OU1): OU1 comprises the vadose zone and Shallow Aquifer System groundwater contamination beneath source properties.

Operable Unit 2 (OU2): OU2 is groundwater contamination in the Shallow Aquifer System off-property of numerous groundwater contamination source sites located within the SBGPP Study Area where groundwater contaminant plumes emanating from individual source sites have migrated and commingled.

Operation, Maintenance and Monitoring (OMM): All activities that occur following the design and construction of the remedy, including the operation and maintenance of the remedy and the monitoring of the remedy's effectiveness, which may include the collection of groundwater quality data, groundwater levels, discharge monitoring, and reporting.

Potentially Responsible Parties (PRPs): Possible historic polluters who may eventually be held liable under CERCLA or other statutes for the contamination or misuse of a particular property or resource.

Preferred Alternative: The alternative identified by the lead agency that best meets the threshold criteria and provides the best balance of tradeoffs among the balancing and modifying criteria.

Proposed Plan: The document also referred to as the Interim Remedial Action Plan that briefly summarizes the alternatives studied in the detailed analysis phase of the RI/FS, highlighting the key factors that led to identifying the Preferred Alternative.

Public Water Supply Well: A well that is used to supply a public drinking water system.

Remedial Action Objectives (RAOs): The cleanup goals established by regulatory or other agencies when implementing a remedial action.

Remedial Investigation (RI): The process of determining the nature and extent of contamination at a site.

South Basin Groundwater Protection Project (SBGPP) Study Area: The SBGPP Study Area is an approximate five square mile area located in the south-central part of the roughly 300 square mile Orange County Groundwater Basin located in Orange County, California. The SBGPP Study Area is located within the southeastern portion of the city of Santa Ana, the western portion of the city of Irvine, and the southwestern portion of the city of Tustin.

Superfund: The common name for the process established by CERCLA to investigate and clean up abandoned or uncontrolled hazardous waste sites.

Maximum Contaminant Level (MCL): The maximum permissible level of a contaminant in water that is delivered to any user of a public water system.

Vadose Zone: The zone between land surface and the water table where the soil is not saturated.

Volatile Organic Compounds (VOCs): Carbon-containing chemical compounds that evaporate readily at room temperature and can pose a risk to human health or the environment.