FINAL

RECORD OF DECISION
SITE 17 ADMINISTRATION AREA GROUNDWATER PLUME

NASA Crows Landing Flight Facility
Crows Landing, California

November 2012

Document Control Number: TPG-9205-0000-0009
Contract No: N62473-08-C-9205

Base Realignment and Closure
Program Management Office West
1455 Frazee Road, Suite 900
San Diego, California 92108-4310

1.0 DECLARATION

1.1 SITE NAME AND LOCATION

This Record of Decision (ROD) presents the selected remedy for groundwater at the former National Aeronautics and Space Administration (NASA) Crows Landing Flight Facility (Facility) Site 17 Administration Area Groundwater Plume (Site) under Contract No. N62473-08-C-9205. The remedy was selected in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 as amended by the Superfund Amendment and Reauthorization (SARA) of 1986, Title 42 United States Code (U.S.C.) Section 9601, et seq., and in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Part 300, et seq. The remedy selection decision is based on information contained in the administrative record file for this Site. Information not specifically summarized in this ROD or its references but contained in the **administrative record**[1] for this Site has been considered and is relevant to the selection of the remedy.

1.2 STATEMENT OF BASIS AND PURPOSE

The Department of the Navy (Navy) is the lead agency responsible for this Site and is responsible for planning and implementing a clean-up action to remediate groundwater contamination that resulted from historical operations at the Facility. The Navy together with the Central Valley Regional Water Quality Control Board (CVRWQCB), and the California Department of Toxics Substances Control (DTSC) formed the BRAC Cleanup Team (BCT) to evaluate, review, and approve all major documents and activities associated with the Site. The remedy set forth in this ROD has been selected by the Navy, and concurrence is provided by DTSC and the CVRWQCB. Funding for environmental investigations, interim remedial actions, and preparation of supporting documents including the Feasibility Study (FS), this ROD, and the remedy are provided by the Navy.

1.3 ASSESSMENT OF SITE

The response action selected in this ROD is necessary to protect the public health, welfare, or the environment from actual or threatened releases of pollutants or contaminants from this Site which may present an imminent and substantial endangerment to public health or welfare.

1.3.1 Summary of Soil Conditions within the Administration Area Groundwater Plume

This section presents a summary of previous subsurface investigations and current status related to soils associated with the Administration Area Groundwater Plume, which include IRP Site 17, UST Site 117, and UST Cluster 1.

1.3.1.1 IRP Site 17

IRP Site 17 is comprised of the demolished hangar area located adjacent to the apron along the main north trending runway. Past subsurface investigations conducted at IRP Site 17 include a Site Investigation (SI) and a Remedial Investigation (RI). The SI was conducted in 1994 and the RI was conducted in 1995 and 1996. The RI report concluded that no impacts from aircraft maintenance

activities were evident aside from petroleum contamination in soils in the vicinity of the former floor drain sump. The contaminated soils was removed as part of the RI and no other soil impacts from past aircraft maintenance activities were evident. Therefore, the RI report recommended no further action for soil at IRP Site 17. The DTSC concurred with this recommendation in their comments submitted on this report.

1.3.1.2 UST Site 117

UST Site 117 is the former location of one 1,200 gallon steel gasoline UST that supplied fuel through a fuel dispenser at a former service station. In 1987, the tank failed a leak test and was removed from service. Subsequently in 1988, the tank and associated equipment were removed from the site. Soil vapor extraction (SVE) conducted over the period August 1997 through March 1998 resulted in the removal of 48,000 pounds of petroleum hydrocarbon mass from soil. Following submission of a preliminary closure report in 2005, the CVRWQCB concurred with the Navy's determination that no further action was necessary for soils at UST Site 117 but required additional groundwater monitoring at UST Site 117 in conjunction with other response actions relating to the Administration Area Groundwater Plume and enforcement of groundwater use restrictions until the completion of groundwater remediation. A final closure report for soil was issued on May 3, 2005 for UST Site 117.

1.3.1.3 UST Cluster 1

UST Cluster 1 is the former location of three 50,000 gallon concrete USTs (tanks CL-1, CL-2, and CL-3) that reportedly stored jet propulsion fuel and possibly aviation gasoline. The three tanks measured 33 feet in diameter and 9 feet deep with the top of the tanks located approximately 4 feet bgs. Tank CL-1 was removed from service in 1986 and tanks CL-2 and CL-3 were removed from service in 1990. In 1994, separate excavations were conducted to remove each tank and associated equipment to total depths ranging from 19 to 22 feet bgs. However, the tank excavations were not conducted with an objective of removing all contaminated soil.

Subsurface investigations identified three sources of petroleum contamination to soils and groundwater: (1) leaks from the seam between the tank sidewalls and tank base; (2) leaks from pipelines and pipe junction boxes; and, (3) the dry wells located on the west side of each former tank. Petroleum hydrocarbon impacts in soil were observed to extend laterally from the former tanks and dry wells and vertically to depths up to 58 feet bgs.

Long-term SVE was conducted during the periods January 2001 through August 2002 and March through December 2003 and resulted in the removal of approximately 26,819 pounds of petroleum hydrocarbon mass from soils in the vadose zone. Soil samples were collected in April 2004 from target depths of 30 feet bgs (below the former tank excavations), 40 feet bgs (between the former tank excavations and the groundwater table), and 55 feet bgs (above the groundwater table and capillary fringe) to evaluate the effectiveness of the corrective action. The highest concentrations of petroleum hydrocarbons ranged up to 13,000 mg/kg and occurred in soil samples collected at depths of 30 and 40 feet bgs. However, overall the soil analytical data suggested that SVE was effective in reducing the concentrations of TEPH to low to non-detect levels in the heaviest

impacted areas where SVE was targeted, and that the remaining elevated concentrations exist in areas where minimal to no SVE was conducted.

The soil analytical results obtained from the April 2004 soil sampling event were used to conduct SESOIL and AT123D vadose zone modeling to evaluate if vadose zone hydrocarbons at UST Cluster 1 would further contribute to existing groundwater contamination. The results of this modeling indicated that TPH-d concentrations are highest in groundwater below the center of the source area, attenuate laterally with distance away from the center of the source area, and are not expected to reach the property boundary. Based on modeling results conducted by Tetra Tech EC Inc. (TtECI), the Navy recommended that groundwater-monitoring wells continue to be monitored, sampled, and evaluated with regard to TPH-d trends. The Navy further recommended that if TPH-d concentrations in groundwater exhibited statistically significant increases at both the source zone and in downgradient monitoring wells, then additional vadose zone soil sampling should be considered to assess whether additional soil remediation is required. However, if TPH-d groundwater concentrations did not exhibit statistically significant increases at both the source zone and in downgradient monitoring wells, within a three to five year period, then a request for closure of soils at UST Cluster 1 should be submitted.

1.4 Description of Selected Remedy

The selected remedy to remediate contaminants in groundwater is Enhanced Bioremediation with Recirculation combined with Monitored Natural Attenuation (MNA) and Institutional Controls (ICs). Groundwater will be extracted via pumping from the subsurface, treated, amended with a carbon substrate, and injected back into the subsurface to recirculate the amended groundwater through the treatment area to enhance naturally occurring bioremediation of CCl4. MNA will be utilized to address other COCs in both on-site and off-site areas. Long-term monitoring of groundwater will be conducted and the ICs will remain in effect until the remedial goals for the project are achieved.

1.5 Statutory Determinations

The selected remedy meets the statutory requirements of CERCLA §121(b) for protection of human health and the environment; complies with federal and state regulations; is cost-effective; utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable, and satisfies the statutory preference for treatment as a principal element of the remedy (i.e. reduces the toxicity, mobility, and volume of hazardous substances, pollutants, or contaminants as a principal element through treatment). Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted every five years, or until remediation goals are met, after initiation of the remedial action to ensure that the remedy is protective of human health and the environment.

1.6 Data Certification Checklist

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the Administrative Record file for this Site.

- Chemicals of concern and their respective concentrations (Section 2.5)
- Human health and ecological risks represented by the chemicals of concern (Section 2.7)
- Cleanup levels established for chemicals of concern and the basis for these levels (Section 2.10)
- How source materials constituting principal threats will be addressed (Section 2.12)
- Long-term and short-term effects associated with the various remedial alternatives (Section 2.11)
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of ground water used in the risk assessment and selection of the remedy (Section 2.6)
- Potential land and groundwater use that will be available at the Site as a result of implementation of the remedy (Section 2.10)
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, and the time to implement each of the various remedial alternatives (Section 2.11)
- Key factor(s) that led to selecting the remedy (i.e., best balance of tradeoffs with respect to the balancing and modifying criteria) (Section 2.12)

1.7 AUTHORIZING SIGNATURES

This section documents the Navy's selection of the remedy in this ROD to address groundwater contamination at Site 17 Administration Area Groundwater Plume, NASA Crows Landing Flight Facility, Crows landing, California, and the concurrence of the State of California through DTSC the CVRWQCB.

Signature — Date: 7/1/13

Mr. Lawrence Lansdale
Environmental Director
By direction of the Director

Signature — Date: 6/28/13

for Ms. Pamela C. Creedon
Executive Officer
Central Valley Regional Water Quality Control Board

Signature — Date: 6/20/13

Mr. Charlie Ridenour
Clean-Up Program Branch Chief
Department of Toxic Substances Control

2.0 THE DECISION SUMMARY

2.1 SITE LOCATION AND DESCRIPTION

The NASA Crows Landing Flight Facility is located in Stanislaus County (County) in the northwestern part of the San Joaquin Valley between the towns of Patterson and Crows Landing (Figure 1). Specifically, the ROD addresses the selected plan for remediation of groundwater contamination beneath the east-central part of the Facility between Bell Road and the east side of the former aircraft parking apron. The former Facility included two decommissioned runways, each approximately 7,000 feet in length, and several support structures. A majority of the Facility including the Site and surrounding area is currently used for agricultural production of row crops and orchards.

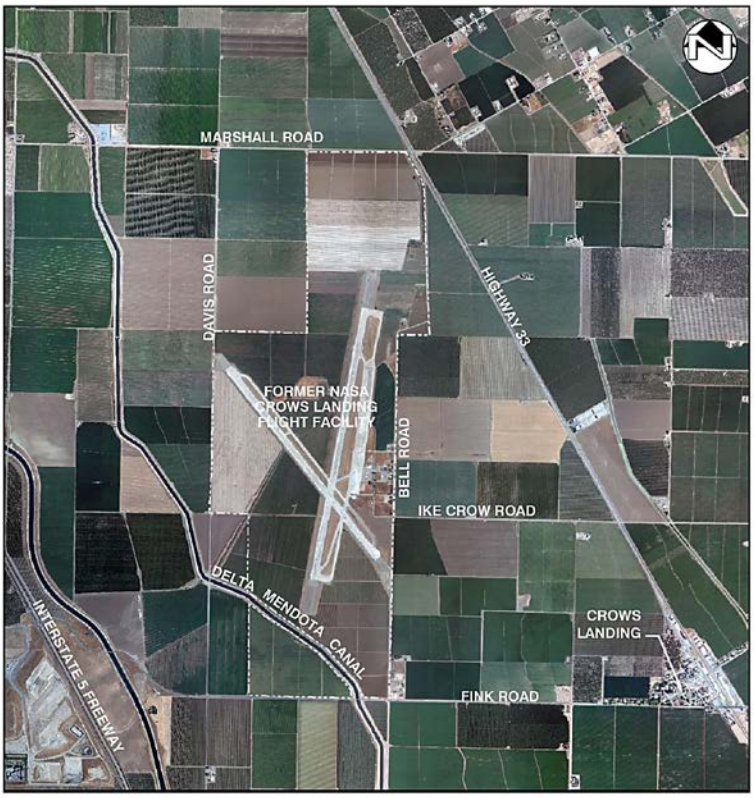


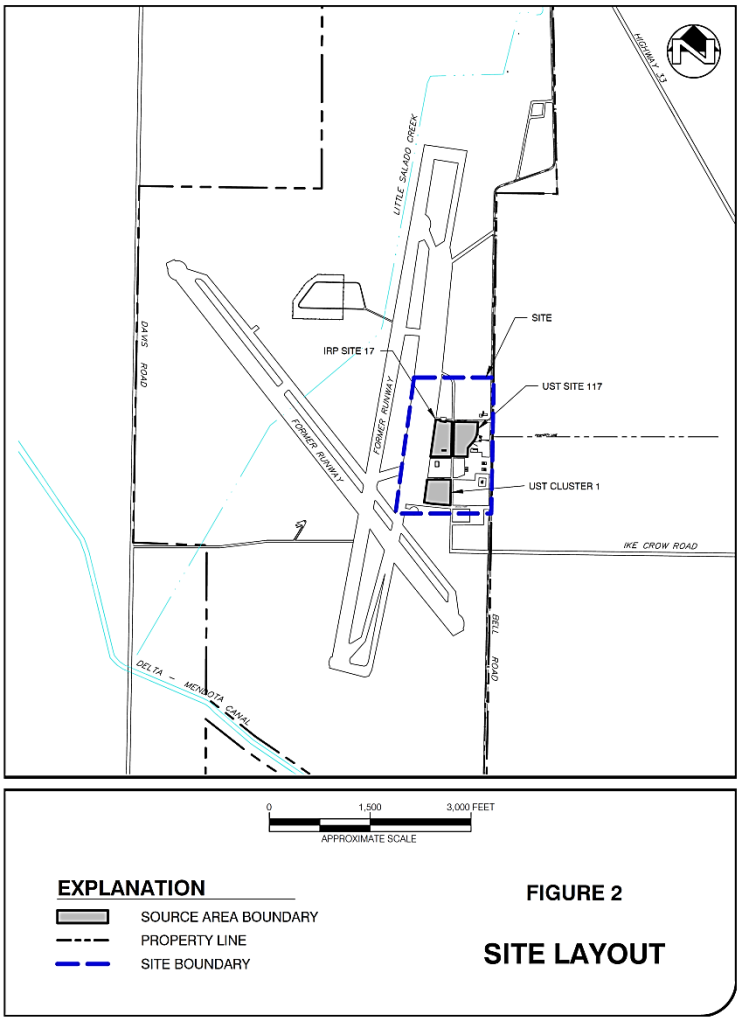
FIGURE 1

SITE LOCATION MAP

Approximately 1,200 acres of the Facility was leased for agricultural use beginning in 1950. In October 1999, the U.S. Congress passed Public Law 106-82, which directed NASA to transfer the

Facility to the County. To facilitate the transfer, NASA completed an Environmental Baseline Survey (EBS) that proposed to transfer the property in two or more phases following the completion of environmental cleanup and remediation activities. Phase 1 of the Facility transfer occurred in 2004, when NASA conveyed 1,352 acres to the County. The County anticipates that the remaining 176 acres (Phase 2) will be transferred by 2012.

The Site groundwater contamination plume is a **commingled plume**[2] originating from three source areas. The three source areas that comprise the Site include Installation Restoration Program (IRP) Site 17 (demolished hangar area), former Underground Storage Tank (UST) Cluster 1 (former jet propulsion and aviation fuel storage), and UST Site 117 (former service station) (Figure 2).



2.2 SITE HISTORY

The Facility was commissioned in 1942 and originally served as a training field during World War II. The former military facility included two decommissioned runways, each approximately 7,000 feet in length, and several support structures including a control tower, administration building, club

and exchange building, motor pool, public works shops, and storage facilities. On July 6, 1946, the Facility was decommissioned and became an Outlying Land Field (OLF) to Naval Air Station Alameda and later Moffett Field. The Facility remained active through the mid-1980s and supported various training activities performed by the Navy and Coast Guard. NASA also maintained a research and development center at the Facility through the mid-1980s. In July 1994, NASA assumed custody of the Facility from the Navy. After NASA accepted the Facility, research operations were terminated. Presently, the Facility is no longer in use and Facility features have been dismantled, with the exception of the former runways, select buildings, and former building foundations.

Various areas of the Facility have undergone separate investigations and remedial activities as a result of former Facility activities. The IRP Site 17 area is located north of the UST Cluster 1 area directly west of the UST Site 117 area (Figure 2) and, was formerly occupied by two aircraft hangars and an assembly and repair shop constructed circa 1943 and demolished and removed by the late 1950s. Groundwater contamination at the IRP Site 17 area is suspected to be migrating from the UST Cluster 1 area as no other impacts are evident from past aircraft maintenance activities. The UST Cluster 1 area is located along the southern limit of the Site (Figure 2), and was formerly occupied by three former concrete USTs that stored jet and aviation fuels. These tanks were originally installed in the 1940s, decommissioned between 1986 and 1990, and removed from the subsurface in 1994. A dry well consisting of a cobble-filled pit was located approximately 50 feet west of each tank. The dry wells were used to dispose of fuel-contaminated water that was collected in sumps below the base of each tank. The dry wells are suspected to be the main source of contamination at the UST Cluster 1 area. The UST Site 117 area is located northeast of UST Cluster 1 and is situated closest to the eastern Site property limit at Bell Road (Figure 2). This area was a former service station used for vehicle fueling and contained one 1,200 gallon steel UST that supplied gasoline through underground piping to a connected fuel dispenser in circa 1958. The UST, fuel dispenser, and associated piping were excavated and removed from the Site in 1988. Holes were observed in the tank bottom and stained soil was encountered below the tank bottom, both indicating the tank had leaked its contents into underlying groundwater. **Past operations**[3] at the three source areas have resulted in groundwater contamination including carbon tetrachloride (CCl4) and chloroform (CF) beneath IRP Site 17 and petroleum hydrocarbons, benzene, 1,2-dichloroethane (1,2-DCA), CCl4, and CF beneath UST Site 117 and UST Cluster 1 (Shaw, 2006). Recent groundwater monitoring data reveals that dissolved-phase CCl4 and 1,2-DCA have migrated off-site to the east of the Facility at Bell Road.

2.3 SITE CHARACTERISTICS

The Site consists mainly of agricultural land with some remnants from past Facility uses, such as building foundations and former runways (Figure 1). The Site is currently unoccupied and is located at approximately 135 feet above mean sea level (AMSL) with elevations sloping gently downward towards the east across the Site. Two water bodies are located at the Facility; the Delta-Mendota Canal located in the southwest corner of the Facility, and the Little Salado Creek which trends north-south along the western half of the Facility (Figure 2). The Site vicinity is mainly comprised of agricultural land.

The Facility consists of 34.5 acres of wetlands, which includes 2.2 acres of former sewage impoundments at the northeastern section of the Facility, a 6.8-acre siltation pond adjacent to Highway 33, 18.3 acres encompassing the Delta-Mendota Canal, 5 acres in the Little Salado Creek area, and a 2 acre wildlife area. The Site is located on the eastern side of the Facility near Bell Road (Figure 2) outside the wetland areas.

The majority of the Facility is situated in Flood Zone C, which is the designation for areas with minimal potential for flooding. Select areas in the vicinity of the Little Salado Creek are designated as Flood Zones A or B for flooding during either a 100 year storm or 500 year storm, respectively. The Site is located outside the three flood zones.

The Facility is located along the western edge of the San Joaquin Valley, approximately one mile east of the San Joaquin fault and the adjacent Coast Ranges. Alluvial fan deposits consisting of unconsolidated clay, silt, sand, and gravel underlie the Facility as a result of displacement on the San Joaquin fault system and continuing tectonic subsidence of the western San Joaquin Valley. Beneath the alluvial fan deposits are fine grain flood-plain and lacustrine deposits. The largest and most significant lacustrine deposit is the **Corcoran clay**[4], which are underlain with alluvial deposits consisting primarily of impermeable clay. Table 1 summarizes the geology at the Site.

TABLE 1 SITE GEOLOGY

Depth (feet bgs)	Description
0 to 75	Fine-grained alluvial fan deposits; predominantly fine-grained silt and clay.
±75 to 110	Series of relatively thin, discontinuous, and overlapping fine to coarse sand and silty sand beds.
±110 to 160	Fine-grained older alluvial fan deposits consisting mostly of silt and clay.
±160	Unconformity; old erosional surface identified by a brown to black paleosol or hard pan layer.
±160 to 200	Floodplain and lacustrine deposit composed primarily of clay.
±200 to 210	Permeable fluvial and debris flow deposits consisting of fine to coarse sand and gravel.
±210 to 220	Permeable lacustrine beach sand and reworked dune sand; predominantly poorly graded fine sand.
±220 to 300	Corcoran clay; fine-grained lacustrine deposits.
±300 to (?)	Alluvial deposits consisting primarily of impermeable clay.

Note: Approximate depths given; actual depths vary across Site. Depth intervals are based on lithology described in Shaw (2006).

Regionally groundwater occurs in an upper water-bearing zone above the Corcoran clay and a lower water-bearing zone below the Corcoran clay. Impacts to groundwater beneath the Site occur

primarily within the upper zone in **four distinct groundwater zones**[5]. These groundwater zones include: (1) the shallow groundwater zone from 50 to 75 feet below ground surface in predominantly fine-grained sediments (bgs); (2) the mid-shallow groundwater zone from 90 to 110 feet bgs in thin discontinuous sandy beds; (3) the mid-deep groundwater zone from 160 to 180 feet bgs in a permeable sand unit locally present beneath the UST Cluster 1 source area; and, (4) the deep groundwater zone from 200 to 225 feet bgs in a permeable sand and gravel unit that is present directly above the Corcoran clay.

Site hydrogeologic data suggest that groundwater within the designated depth zones occurs in unconfined to semi-confined conditions in the shallow zone; semi-confined to confined conditions in the mid-shallow zone; and, confined conditions in the mid-deep and deep zones. A total of 72 monitoring wells (68 on-site and 4 off-site wells) are currently gauged and sampled routinely to monitor groundwater flow direction and quality at the Facility (Figure 3). The **regional groundwater flow**[6] direction at the Site is generally to the east/northeast towards Bell Road in the shallow, mid-shallow, and deep groundwater zones and to the east-southeast towards Bell Road in the mid-deep groundwater zone (Figure 3). However, these regional flow directions can be influenced locally by the pumping of agricultural wells. Calculated **hydraulic gradients**[7] indicate a hydraulic gradient of 0.0010 to 0.0011 foot per foot (ft/ft) in the mid-shallow and shallow zone respectively; 0.0034 ft/ft in the mid-deep zone; and, 0.0020 ft/ft in the deep zone. The higher gradients observed in the mid-deep and deep zones are likely a result of pumping of the off-site agricultural well (6/8-16M1) located east of the Facility and Bell Road (Figure 3).

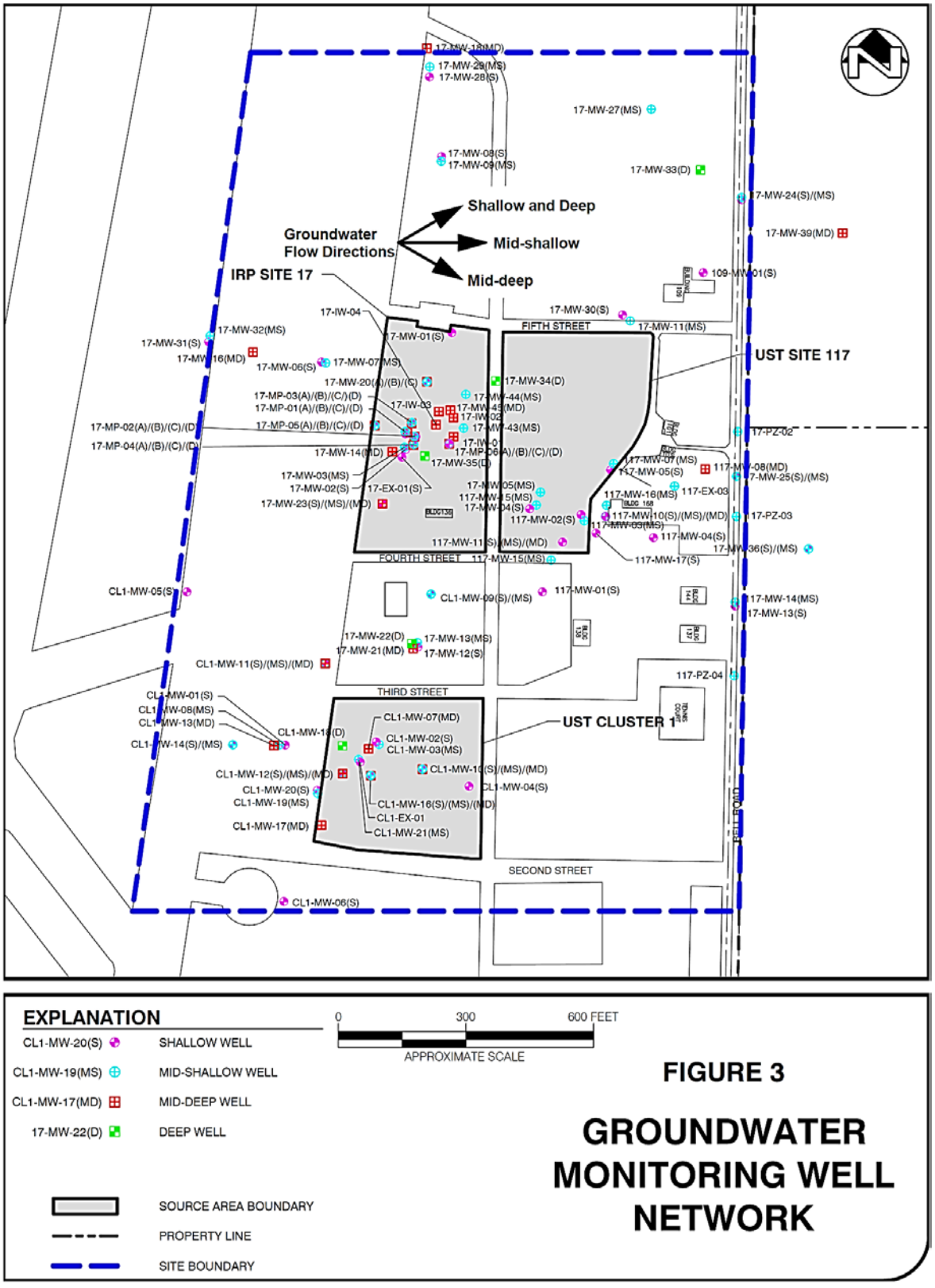


FIGURE 3

GROUNDWATER MONITORING WELL NETWORK

Ecosystems[8] that occur at the Facility consist of a 1.5 acre wildlife refuge with vegetation including salt bush (Atriplex spp.), blackberry (Rubus spp.), vetch (Vetch spp.), and willow (Salix spp). The predominant type of vegetation at the Facility is agriculturally related, with the balance consisting primarily of maintained grassland. None of the original perennial grassland habitat remains at the Facility. Irrigated crops grown on fields in the vicinity of the Site include sugar beets, peas, beans, tomatoes, spinach, grains, and melons. There are no federally-listed or candidate threatened or endangered species that inhabit the Facility. However, three protected species including the blunt nose leopard lizard, giant garter snake, and the San Joaquin kit fox have been identified in the vicinity of the Facility.

All buildings and structures at the Facility have been evaluated for listing on the National Register of Historic Places. The Navy determined that the World War II buildings and structures do not qualify for listing on the National Register because of their altered appearance and setting. NASA also determined that there are no buildings, structures, or objects at the Facility that have historical significance from the Cold War perspective.

2.4 PREVIOUS INVESTIGATIONS AND REMEDIAL ACTIONS

The Site has been characterized through numerous investigations and studies conducted between 1987 and 2010. These activities have included several phases of subsurface investigations and interim remedial actions[9] including bench and pilot scale remedial activities to evaluate the extent of impacts to soil and groundwater from past operations at the three source areas. Prior to circa 2006, the three source areas were evaluated as separate sites/operable units. Since 2006 when the commingling of the groundwater plumes was confirmed, the three source areas have been evaluated as one "Site". Table 2 provides a chronological list and brief summary of previous investigations and studies completed for each source area through 2005 as they relate to groundwater, followed by a summary of previous groundwater activities conducted since 2006 when the three source areas were evaluated as one commingled groundwater plume.

TABLE 2 PREVIOUS INVESTIGATIONS SUMMARY

Previous Study/Investigation	Date	Investigation Activities
IRP Site 17		
Site Investigation (SI)	1994	The SI included a ground penetrating radar (GPR) survey, collection and laboratory analysis of soil, soil gas, and groundwater samples, and installation of a groundwater monitoring well. CCl4, low concentrations of benzene, toluene, ethylbenzene, and total xylenes (BTEX), and CF were detected in the groundwater samples.
Remedial Investigation (RI)	1995-1996	RI activities included excavation of a floor drain sump discovered during the SI, collection of groundwater samples using a HydroPunch®, Cone Penetration Testing (CPT), two rounds of drilling and well installation, soil gas sampling, and quarterly groundwater sampling. The RI revealed the floor drain sump was not a source of CCl4 contamination to groundwater. Further, the source of CCl4 in groundwater was not identified during the RI, but elevated detections ofCCl4 in soil gas samples, as suspected, was associated with volatilization from groundwater. The RI report

TABLE 2 PREVIOUS INVESTIGATIONS SUMMARY		
Previous Study/Investigation	**Date**	**Investigation Activities**
		recommended no further action for soil at IRP Site 17. The DTSC concurred with this recommendation in their comments submitted on this report.
Air Sparging (AS) and Soil Vapor Extraction (SVE) pilot tests	1997-1999	SVE and AS pilot tests were conducted in the vicinity of groundwater monitoring well 17-MW-03. The SVE test results revealed a radius of influence of approximately 45 feet, and the AS test results revealed a radius of influence ranging from approximately 42 feet in the shallow zone; 10 feet in the mid-shallow zone; and up to 42 feet in the deep zone. Additional pilot tests conducted in 1998 showed the radius of influence for injected air exceeded 25 feet in all groundwater zones and the SVE radius of influence exceeded 47 feet.
Spray Irrigation Test	1997	A pilot test involving the extraction of CCl4-impacted groundwater and spraying through the air was conducted to evaluate the amount of contaminant reduction through volatilization at a height of three feet above the ground surface. The test revealed a reduction in CCl4 concentrations of up to 98 percent.
Groundwater Pumping and Injection Tests	1997 and 1999	Data measured and modeled from groundwater pumping tests revealed that at a pumping rate of 15 gallons per minute (gpm), the boundary of the capture zone would be approximately 100 feet after one year, 150 feet in five years, and more than 250 feet after 20 years. Groundwater injection tests revealed a sustainable flow rate of 66.1 gpm with 40 feet of displacement of the water table and a measurable response as far as 315 feet from the injection well.
Bioremediation Pilot Tests	1998-1999	Bioremediaiton pilot tests included an evaluation of air sparging and a bench-scale biotreatability study using several electron donors (molasses, methanol, and acetate) added to groundwater. The air sparge tests revealed, on average, over 64 percent reduction of CCl4 and 57 percent reduction of CF in groundwater. The biotreatability study revealed that molasses as an electron donor reduces CCl4 concentrations in groundwater, but does not result in complete degradation to CF.
Pre-design Soil Investigation	1999	Soil and soil gas sampling was conducted, which revealed CCl4 impacts are not present in the vadose zone, supporting the RI conclusion that the source of CCl4 at IRP site 17 is likely associated with groundwater.
Third Annual Groundwater Monitoring Report	2004	Semi-annual groundwater sampling revealed that the likely source of CCl4 and CF in groundwater at IRP Site 17 are likely associated with the dry wells at the UST Cluster 1 source area.
UST Site 117		
Soil and Groundwater Investigation of former tank area	1989	Soil samples were collected to evaluate the extent of impacted soil below the former UST, and groundwater monitoring wells were installed to evaluate impacts to groundwater. Groundwater results revealed a Total Petroleum Hydrocarbon as gasoline (TPH-g) concentration of 100 milligrams per liter (mg/L) in the center of the former tank excavation.
Multiple Groundwater Characterization studies(quarterly through 2004 then semi-annually)	1992 1995 1996 1998	Groundwater results from samples collected in 1992 and 1995 revealed low concentrations of BTEX. Groundwater analytical results from 1996 through 2004 identified benzene and 1,2-DCA groundwater plumes that extend from below the former tank

TABLE 2 PREVIOUS INVESTIGATIONS SUMMARY		
Previous Study/Investigation	**Date**	**Investigation Activities**
	1999 2001 2003 2004	location downgradient to the property boundary at Bell Road.
Pilot Scale SVE Study	1995	A pilot-scale SVE study was performed to evaluate the use of SVE for remediation of petroleum hydrocarbons in the vadose zone. The results of the pilot test revealed that hydrocarbon-impacted soils at UST Site 117 were well suited for remediation by SVE and that the radius of influence was up to 70 feet in both the shallow and deep zones using moderate vacuums and flow rates. This study concluded SVE and air sparging are the most viable corrective measures for remediating the UST Site 117 area
Long-term SVE Treatability Study	1997-1998	A long-term SVE study conducted over a 10-month period reduced TPH-g concentrations in soil, soil gas, and groundwater. A No Further Action (NFA) for soil was granted by the CVRWQCB based on the results of this study.
Groundwater Extraction	2001	Groundwater extraction and off-site disposal was conducted over a three month period to further reduce TPH-g concentrations in groundwater. A total mass of 0.012 pounds was removed from the subsurface, and continued decreases in TPH-g concentrations were observed. This study recommended that groundwater extraction activities be continued as a transitional remedial activity to continue the removal of contaminant mass from groundwater.
Transitional Groundwater Extraction	2002-2003	Groundwater extraction and off-site disposal was conducted between January 2002 and August 2003 as an interim remedy until a final groundwater remedy was selected. Data from the transitional groundwater extraction activities revealed concentrations of contaminants were reduced at the source area, but elevated concentrations were still present in groundwater downgradient of the source area.
In-situ Submerged Oxygen Curtain (iSOC) Demonstration Project	2003-2005	ISOC was conducted between September 2003 to July 2005 to evaluate the effect of injecting oxygen into groundwater to enhance the in-situ aerobic biodegradation of contaminants, specifically TPH-g, benzene, and 1,2-DCA. This study did not reveal that increased dissolved oxygen levels were effective at enhancing natural biodegradation processes, and it was concluded that iSOC would not be effective at reducing off-site migration of groundwater contaminants.
Final Closure Report, Underground Storage Tank Site 117		The closure report concluded that soils at UST Site 117 present a low risk to human health and the environment; current petroleum hydrocarbon concentrations in soil present a minimal risk to impacting groundwater in the future; petroleum hydrocarbon concentrations remaining in soil do not present a future risk to groundwater through leaching; and, no further action is required for soils. Subsequently, a no further action status for soils at UST Site 117 was granted in April 2005 from the CVRWQCB on the basis of the site conditions and risk assessment findings presented in the Closure report. A final closure report for soil was issued on May 3, 2005 for UST Site 117.

TABLE 2 PREVIOUS INVESTIGATIONS SUMMARY		
Previous Study/Investigation	**Date**	**Investigation Activities**
UST Cluster 1		
UST Closure Investigation	1990	A subsurface investigation of the UST Cluster 1 area was completed to evaluate the presence of soil and groundwater contamination from the three former tanks. The investigation included the installation and sampling of three groundwater monitoring wells located adjacent to the west side of each tank. The investigation revealed the presence of soil and groundwater contamination in the tank vicinity.
UST Problem Assessment Evaluation	1994-1996	This assessment was conducted to evaluate the nature and extent of subsurface impacts to soil and groundwater. Tank removal activities were observed, soil samples were collected, hydropunch groundwater sampling was conducted, and groundwater monitoring wells were installed and sampled. This assessment revealed the source of contamination to be associated with leakage from the tanks and piping, and from the dry wells. It was concluded that the groundwater concentrations occurs in the shallow and mid-shallow zone beneath contaminated soil, but does extend into the deeper groundwater zones.
AS Test	1998	Air sparging was evaluated to assess its applicability to treating petroleum-impacted soil and groundwater. The results of this test indicated air could be applied to the impacted groundwater zones, and that air moved vertically upward to the vadose zone without being trapped.
SVE/Bioventing Test	1999	A SVE and bioventing test was conducted to evaluate its feasibility for remediation of the petroleum-impacted soil. Further, biosparge respiration tests within the saturated zone were also conducted. The tests revealed a radius of influence of 30 feet, and evidence that microbial degradation was actively occurring at the time the pilot tests were conducted.
SVE Remediation System	2001-2002	An SVE remediation system was designed and operated to reduce soil and groundwater contamination in the vicinity of the former USTs. The system was operated from January 2001 to August 2002 and from March 2003 to December 2003. Approximately 26,800 pounds of volatile organics were removed from the vadose zone by the SVE system. SVE effectively reduced the concentrations of volatile organics and petroleum hydrocarbons in the subsurface, and would be effective at reducing the extent of impact.
Multiple groundwater monitoring events	1998-2004	Semi-annual groundwater data indicate the presence petroleum hydrocarbons and benzene in the shallow and mid-shallow groundwater zones. Non-chlorinated solvents, including acetone, ethylene dibromide (EDB), methyl ethyl ketone (MEK), methyl isobutyl ketone (MIBK), and 2-hexanone were also detected in groundwater beneath the UST Cluster 1 area. The highest concentrations of TPH-g, benzene, acetone, EDB, MEK, and MIBK were detected west of former tank CL-2 in the vicinity of a former dry well.
Groundwater Extraction	2001-2005	Between February 2001 and July 2005 approximately 384,000 gallons of groundwater was extracted at a rate of less than 0.5 gpm from shallow and mid-shallow groundwater monitoring wells and disposed off-site. Approximately 351 pounds of contaminant mass was removed from the subsurface.

TABLE 2 PREVIOUS INVESTIGATIONS SUMMARY		
Previous Study/Investigation	**Date**	**Investigation Activities**
Vadose Zone Modeling	2007	Soil analytical results obtained from the April 2004 soil sampling event were used to conduct SESOIL and AT123D vadose zone modeling to evaluate if vadose zone hydrocarbons at UST Cluster 1 would further contribute to existing groundwater contamination. The results of this modeling indicated that TPH-d concentrations are highest in groundwater below the center of the source area, attenuate laterally with distance away from the center of the source area, and are not expected to reach the property boundary. Based on the modeling results, TtECI recommended that groundwater-monitoring wells continue to be monitored, sampled, and evaluated with regard to TPH-d trends. If TPH-d groundwater concentrations do not exhibit statistically significant increases at both the source zone and downgradient monitoring wells within 3 to 5 years a request for closure of soils at UST cluster 1 should be submitted.
Site as Commingled Groundwater Plume		
Semi-annual Groundwater Monitoring	2004-2009	Semi-annual groundwater monitoring has been conducted since 2004 to further characterize and delineate the extent of impacts to groundwater. These monitoring events reveal the following: -Groundwater impacts in the shallow zone include benzene, 1,2-DCA, TPH-g, and TPH-d at the UST Cluster 1 and UST Site 17 areas; and, CCl4 and TPH-d at the IRP Site 17 area. Data indicate these COCs do not extend beyond the property limit at Bell Road and the plume appears to be stable -Groundwater impacts in the mid-shallow zone include benzene, 1,2-DCA, TPH-g, and TPH-d occur within the UST Cluster 1 and UST Site 117 areas, while CCl4 occurs within the IRP Site 17 area and extends to the UST Site 117 area. Data indicate CCl4 and 1,2-DCA extend off-site beyond the property limit at Bell Road, but the plume appears to be stable. -Groundwater impacts in the mid-deep zone include benzene, 1,2 DCA, TPH-g, and TPH-d occur at the UST Cluster 1 area, and CCl4 occurs at the IRP Site 17 area. CCl4 is the only contaminant that extends beyond the property limit at Bell Road. -Groundwater impacts in the deep zone include CCl4 at the IRP Site 17 area, which extends off-site beyond the property limit at Bell Road.
Natural Attenuation Evaluation	2005	A study was conducted to evaluate the extent and rate of natural attenuation of petroleum hydrocarbons and chlorinated solvents. It was concluded that biodegradation of petroleum hydrocarbons, 1,2-DCA, and CCl4 is naturally occurring in the shallow, mid-shallow, and mid-deep zones; CCl4 is degrading to CF and potentially to chloride; anaerobic conditions do not occur in the CCl4 plume to allow reductive dechlorination to occur readily; the distribution of CF and chloride suggest that the CCl4 source area may have been the same source area as the petroleum hydrocarbons at UST Cluster 1; and, overall biological destruction of constituents in groundwater is occurring to varying degrees, but the data do not conclusively indicate that MNA would reduce concentrations in groundwater to acceptable levels within a reasonable time frame based on the current plume extents and hydrogeologic conditions.

TABLE 2 PREVIOUS INVESTIGATIONS SUMMARY		
Previous Study/Investigation	**Date**	**Investigation Activities**
Off-site Groundwater Conditions Verification Sampling	2006	In 2005 an off-site downgradient investigation[10] east of Bell road was completed to evaluate off-site groundwater conditions. This investigation concluded that groundwater downgradient and off-site to the east of the Site property limit at Bell Road is impacted with CF in the shallow zone; benzene 1, 2-DCA, CF, and CCl4 in the mid-shallow zone; and, CCl4 in the mid-deep and deep zones. However, only the extent of benzene and 1,2-DCA were defined in all groundwater intervals laterally east of the Site.
Enhanced in-situ Bioremediation (EISB) Pilot Tests	2008-2010	During the period 2008 through 2010 three phases of EISB were conducted at the three source areas to evaluate the effectiveness of biosparging via injection of air at UST Cluster 1; to evaluate the effectiveness of oxygen releasing compounds at enhancing aerobic biodegradation processes at UST Site 117; and, to evaluate the effectiveness of different organic substrates at enhancing anaerobic processes of contaminant degradation at IRP Site 17 to remove residual source mass, significantly reduce groundwater concentrations in the source zone that will in time achieve long-term reduced groundwater concentrations at levels below established California EPA MCLs for drinking water at the property limit. This test revealed the following at the three source areas: -IRP Site 17: EISB pilot tests concluded that the injection of a carbon source (electron donor) consisting of substrates 3DME or EOS was effective at increasing anaerobic biodegradation rates, which resulted in the rapid dechlorination of CCl4 as evidenced by decreasing concentrations of CCl4 coupled with increasing concentrations of CF. -UST Site 117: EISB pilot tests concluded that the injection of oxygen releasing compound (ORC) does enhance biodegradation rates, which resulted in the reduction of the 1,2-DCA and benzene plumes. -UST Cluster 1: EISB pilot tests concluded that biosparging with injected air appears to be very effective in reducing benzene concentrations to levels below MCLs in the shallow and mid-shallow zones, and enhancing naturally occurring biodegradation rates. Further, overall decreasing concentrations of benzene, TPH-g, and TPH-d revealed that biosparge is effective at reducing residual benzene and petroleum hydrocarbon mass in the saturated zone, capillary fringe, and vadose zone.
Feasibility Study	2011	The results of the evaluation conducted in the Final FS report concluded that select volatile organic compounds (VOCs) including benzene, 1,2-DCA, CCl4 and petroleum hydrocarbons including TPH-d and TPH-g occur in groundwater at concentrations that exceed the water quality objectives (WQOs) outlined in the CVRWQCB Basin Plan (Basin Plan). Remedial alternatives were evaluated to reduce groundwater concentrations to meet the WQOs outlined in the Basin Plan. The selected alternative was alternative 4 (Enhanced Bioremediation with Recirculation), which utilizes groundwater extraction, ex situ treatment, carbon amendment, and injection along with MNA and ICs.

2.5 NATURE AND EXTENT OF GROUNDWATER CONTAMINATION

The **nature and extent of groundwater contamination**[12] was estimated using the **February 2009 semiannual groundwater monitoring results**[13] and the **Enhanced in-situ Bioremediation Treatability Study groundwater sampling results**[14]. The **groundwater chemicals of concern**[15] (COCs) detected in groundwater are the **key compounds of interest**[16] that have been consistently detected at concentrations that exceed the recommended taste and odor thresholds outlined in the Basin Plan or the California MCLs and include CCl4, benzene, 1,2-DCA, TPH-g, and TPH-d. The nature and extent of groundwater contamination for the COCs is depicted in Figures 4, 5, 6, and 7 and, is described below for each of the four groundwater zones.

Shallow Zone

COCs in the shallow groundwater zone (approximately 50 to 75 feet bgs) include benzene, 1,2-DCA, TPH-g, TPH-d, and CCl4 (Figure 4).

Benzene is most prevalent in the shallow zone at the UST Cluster 1 area, extending northeast in the direction of groundwater flow a distance of approximately 350 feet from the west side of the former USTs, but has also been detected in the shallow zone at UST Site 117 just downgradient of the former tank (Figure 4). Benzene impacts in both areas remain within the Site property boundary and appear to be stable or decreasing.

The 1,2-DCA plume in the shallow zone at UST Cluster 1 forms a relatively small plume extending approximately 400 feet northeast toward UST Site 117. A slightly smaller, separate plume exists at UST Site 117 (Figure 4).

In general, the CCl4 plume occurs primarily at IRP Site 17 although the plume boundary extends from IRP Site 17 to UST Site 117 and UST Cluster 1 (Figure 4). The CCl4 plume appears to be stable and does not appear to be increasing downgradient of the IRP Site 17.

TPH-g and TPH-d contamination in the shallow zone is primarily located within the source area at UST Cluster 1. During Phase 1 of the bioremediation treatability study at UST Cluster 1 in July 2008, free-phase product was observed in wells CL1-EX-01(S), CL1-MW-12(S), and CL1-MW-02(S). In the following month, approximately 15 gallons of product was removed from these wells. In subsequent progress monitoring events associated with the bioremediation treatability study, free-phase product was not encountered. However, a sheen was observed on the purge water removed from the aforementioned groundwater monitoring wells where free-phase product was previously observed. At UST Site 117, although sporadic localized detections of TPH compounds have been historically observed, TPH-g and TPH-d were not detected during the February 2009 sampling event or during the final bioremediation treatability study progress sampling event in July 2009.

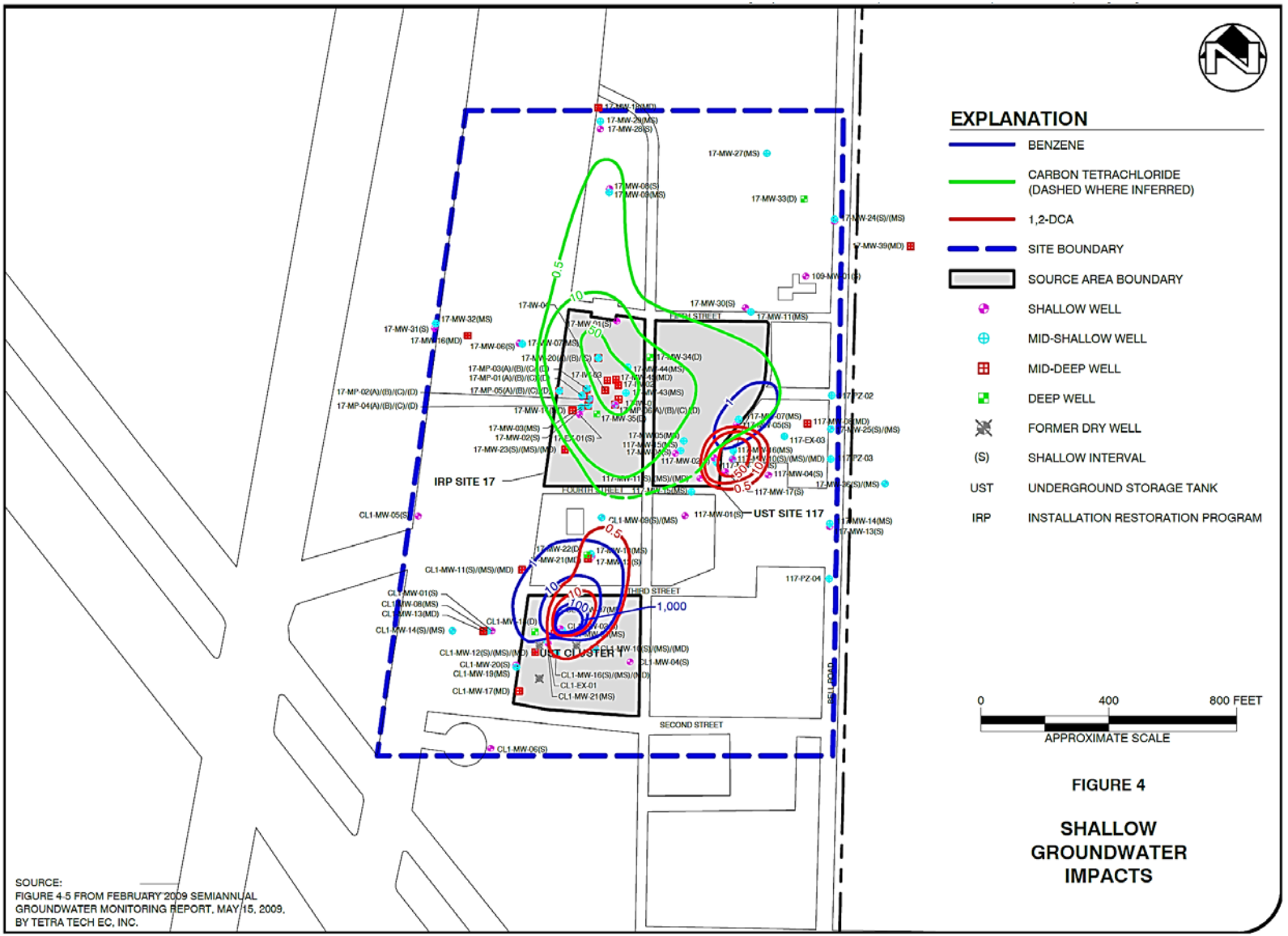


FIGURE 4

SHALLOW GROUNDWATER IMPACTS

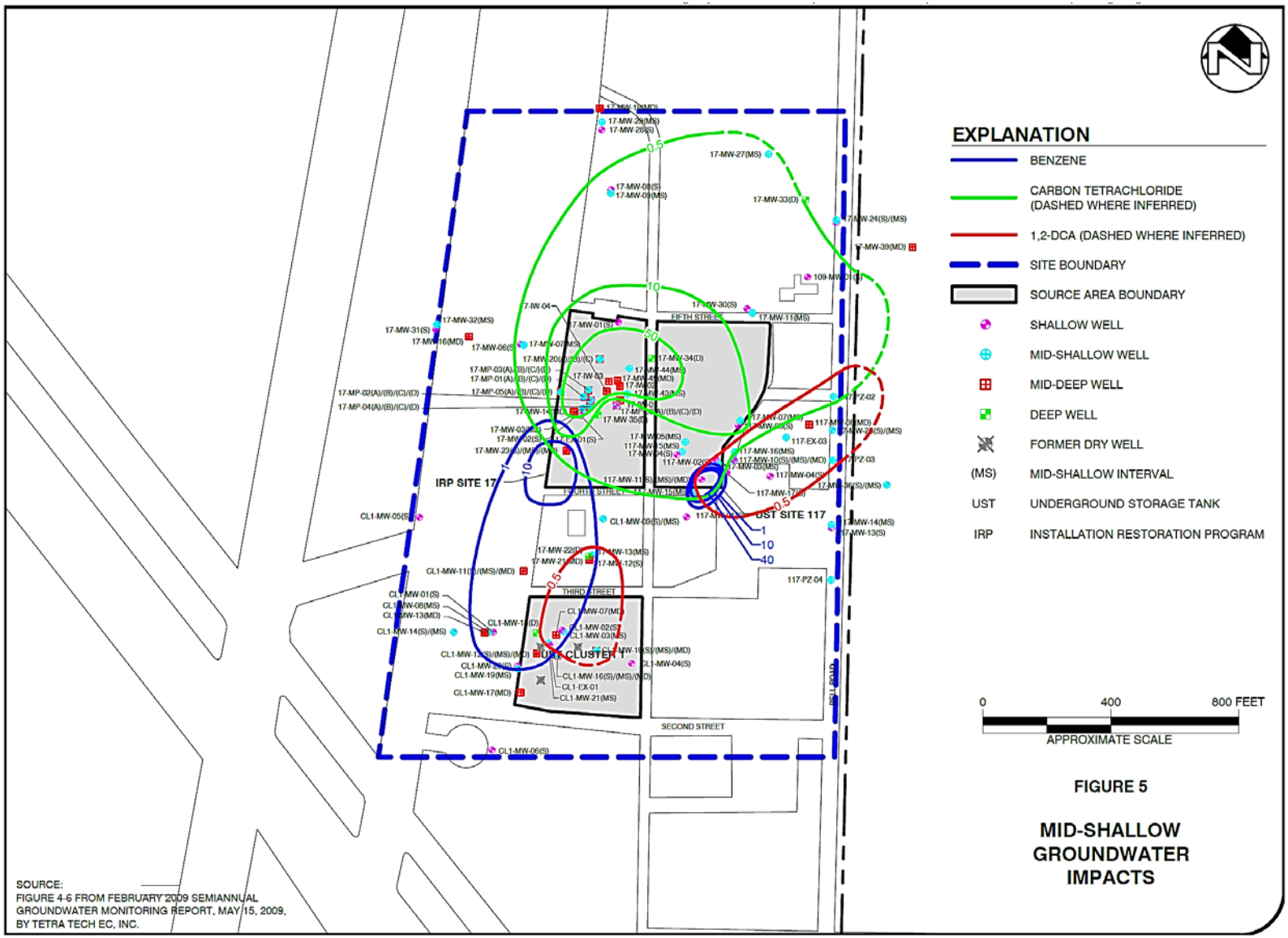


FIGURE 5

MID-SHALLOW GROUNDWATER IMPACTS

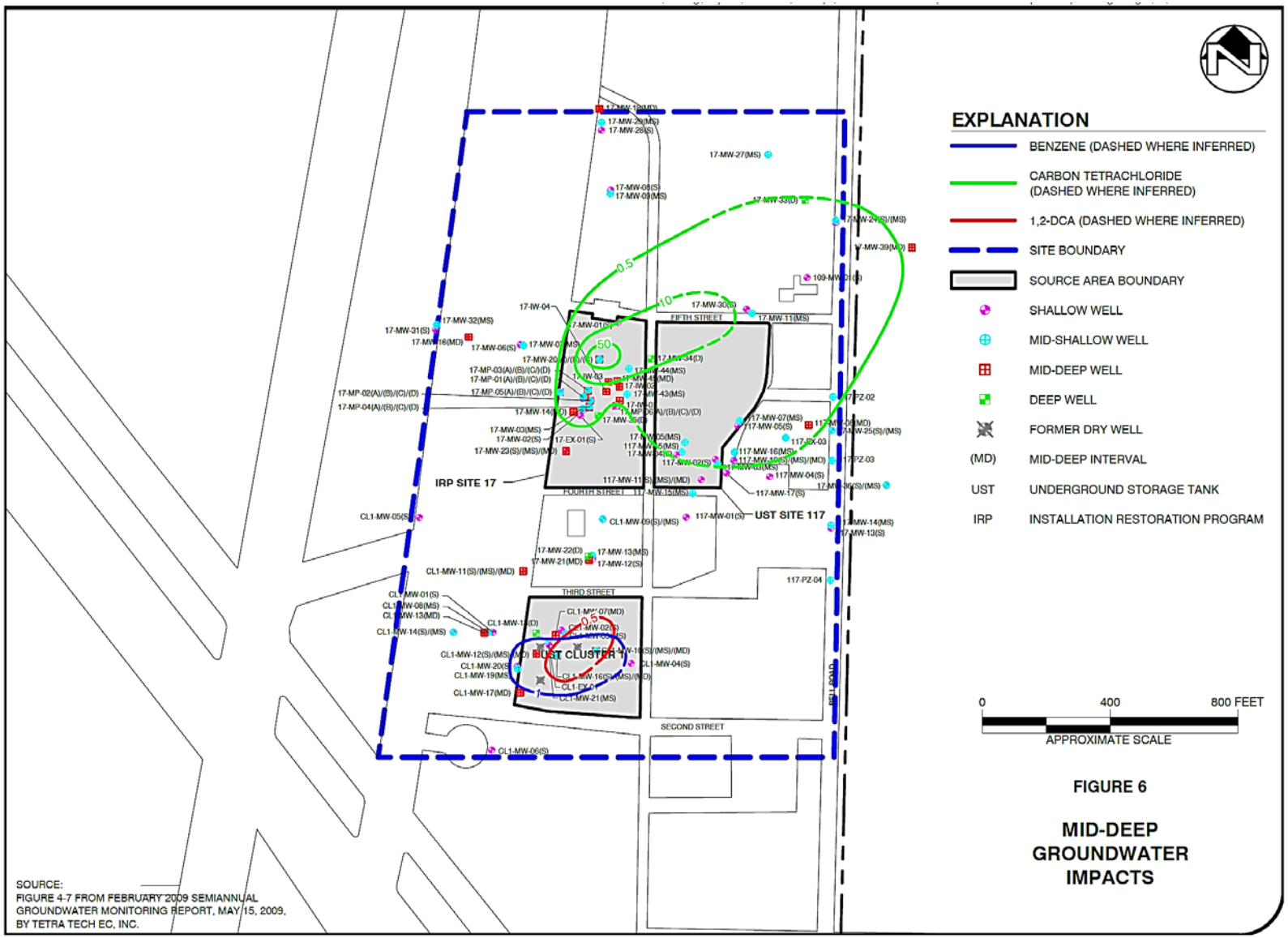


FIGURE 6

MID-DEEP GROUNDWATER IMPACTS

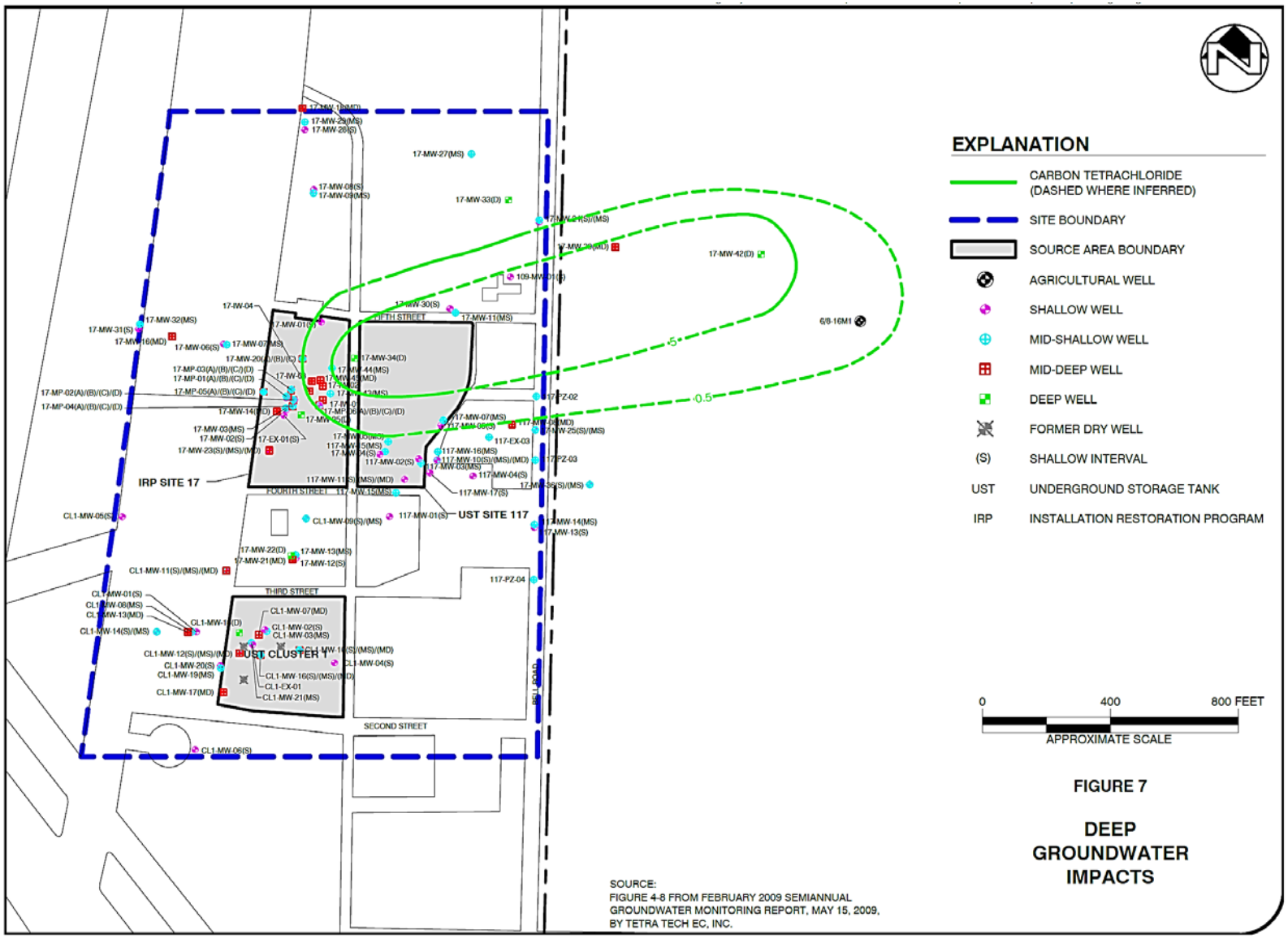


FIGURE 7

DEEP GROUNDWATER IMPACTS

Mid-Shallow Zone

The mid-shallow plume (approximately 90 to 110 feet bgs) consists of several smaller co-mingled plumes similar to the shallow zone, although the extent of contamination in the mid-shallow zone is greater than in the shallow zone (Figure 5). COCs in the mid-shallow zone include benzene, 1,2-DCA, TPH-g, TPH-d, and CCl4.

Benzene is present in the mid-shallow zone at UST Cluster 1 and UST Site 117, but remains within the Site property boundary, and appears to be stable or decreasing (Figure 5). The benzene plume associated with UST Cluster 1 extends for approximately 750 feet from the western side of UST Cluster 1 towards IRP Site 17 (Figure 5). At UST Site 117, the observed benzene plume is present near the source area where the former UST was located and is approximately 150 feet in length (Figure 5).

1,2-DCA occurs in the mid-shallow zone at both UST Cluster 1 and UST Site 117 (Figure 5). At UST Cluster 1, the 1,2-DCA plume extends approximately 350 feet to the north from the source area, while at UST Site 117 the 1,2-DCA plume extends from the source area approximately 650 feet downgradient and off-site across Bell Road (Figure 5). The 1,2-DCA plumes have not changed significantly in recent monitoring events and appear to be stable.

The CCl4 plume is approximately 1,100 feet long and approximately 1,100 feet wide. In recent years, the highest CCl4 concentrations were observed at IRP Site 17. Sampling associated with the recent bioremediation treatability study indicates CCl4 concentrations are generally stable or decreasing.

TPH-g and TPH-d contamination in the mid-shallow zone is generally located within the source area at UST Site 117 and within, and west of, the source area at UST Cluster 1. TPH-g and TPH-d contamination does not extend off-site beyond the Site boundary at Bell Road. Recent groundwater data from the February 2009 sampling event and the bioremediation treatability study indicate TPH concentrations are generally decreasing at the Site.

Mid-Deep Zone

The groundwater plumes for COCs in the mid-deep zone (approximately 160 to 180 feet bgs) are much less commingled than in the shallow and mid-shallow groundwater zones (Figure 6). COCs including benzene, 1,2 DCA, TPH-g, and TPH-d are present at UST Cluster 1, and CCl4 is present primarily at IRP Site 17.

Benzene and 1,2-DCA are co-located at UST Cluster 1, and do not extend beyond UST cluster 1 to other areas of the Site (Figure 6). Both the benzene and 1,2-DCA plumes appear to be stable or decreasing in the mid-deep zone.

At IRP Site 17, the CCl4 plume is approximately 1,200 feet long and 800 feet wide and extends from IRP Site 17 downgradient in the direction of groundwater flow to UST Site 117 and off-site across Bell Road (Figure 6). Recent groundwater results measured in February 2009 compared with the

May 2010 bioremediation treatability study progress sampling show an increase in CCl4 concentrations. The bioremediation treatability study report indicated the increase may be indicative of source material in the aquifer matrix.

TPH-g and TPH-d contamination in the mid-deep groundwater zone is generally located within the source area at UST-Cluster 1 and at one isolated location at IRP Site 17. In February 2009, the highest detected concentrations of TPH-g and TPH-d occurred in the vicinity of UST Cluster 1 in the source area west of the former tanks. TPH does not extend off-site beyond the Site boundary at Bell Road.

Deep Zone

CCl4 is the only COC present in the deep groundwater zone (approximately 200 to 225 feet bgs) at the Site. The CCl4 plume is primarily located at IRP Site 17 and extends downgradient in the direction of groundwater flow approximately 1,900 feet across Bell Road, off-site to the Escobar agricultural well (6/8-16M1) (Figure 7). In February 2009, the highest concentration of CCl4 (18 µg/L) was detected in off-site monitoring well 17-MW-42D, located approximately 700 feet downgradient from the property line at Bell Road and west and upgradient of the Escobar agricultural well (Figure 7).

2.5.1 Fate and Transport Modeling

A **groundwater flow and solute transport model**[17] for the Site was developed to evaluate the fate and transport of selected COCs in groundwater and to use as a tool to evaluate the relative effectiveness of potential remedial alternative developed for the Site in the **Feasibility Study**[18]. A three-dimensional groundwater flow model (MODFLOW2000) and a three-dimensional transport model (MT3DMS) were used to develop the fate and transport model for the Site. Model simulations were conducted to evaluate the fate and transport of dissolved CCl4, 1,2-DCA, and benzene at the Site. The model was developed based on the available data and assumed that a continuing source of contaminants is not present at the Site. Under existing Site groundwater conditions the model simulations revealed the following:

- There is potential for continued off-site migration of CCl4 in the shallow, mid-shallow, mid-deep, and deep groundwater zones for approximately 14 to 16.5 years before concentrations at the property line (Bell Road) decrease to below CA MCLs. On-site the model results show that the simulated CCl4 concentrations would remain above CA MCLs for approximately 24 years before the on-site concentrations would degrade to levels below the CA MCLs.
- 1,2-DCA concentrations at the property line (Bell Road) in the mid-shallow zone would be reduced to below CA MCLs in approximately four years due to natural attenuation processes and would be reduced on-site to below CA MCLs in approximately five years. The model results did not show 1,2-DCA extending offsite at concentrations above the CA MCLs in any other groundwater zones.

- The model results show that benzene would not exceed the CA MCL at the property line (Bell Road). On-site the model shows that benzene would degrade to concentrations below the CA MCLs in less than five years unless a continuing source of benzene were present.

2.6 CURRENT AND POTENTIAL FUTURE LAND AND GROUNDWATER USE

Groundwater is currently used in the vicinity of the Site for agricultural or domestic water supply. The majority of the Facility and surrounding area is used for **agricultural production**[19] of row crops and orchards. There are approximately 40 agricultural or domestic **water supply wells**[20] located within a one-mile radius of the Facility, with multiple water supply wells located on fields adjacent to the eastern boundary of the Facility. According to the Department of Water Resources (DWR) records, older water supply wells (installed during the 1970s and earlier) are screened in both the upper and lower water-bearing zones (above and below the Corcoran clay), whereas newer water supply wells are screened in the upper water-bearing zone, which is equivalent to the Site deep groundwater zone (200 to 225 feet bgs).

The closest water supply well to the Site is the Escobar agricultural well (ID 6/8-16M1), which is reportedly used intermittently over a period of 26 weeks of the year between March and September to irrigate an almond orchard located 1,600 feet north of the well. During the 26-week irrigation period, extracted groundwater is pumped northward to the almond orchard three days per week and is applied via irrigation sprinklers that are evenly spaced between the almond trees in each row. CCl4 has been detected in this well during recent groundwater sampling and is likely associated with the deep groundwater zone (200 to 225 feet bgs).

There is one on-site water supply well (ID NASA-SW-03) located at the south end of the Facility approximately 1,000 feet south of the UST Site 117 area. This well is currently used only for emergency fire suppression in accordance with an existing land-use covenant (**LUC**[21]). The existing LUC includes a 2,000-foot buffer zone around the on-site portion of the Site within which groundwater use and the installation of new water supply wells is currently restricted. The LUC does not apply to off-site areas.

As outlined in the LUC, the following uses or activities are prohibited within the Restricted Area without the express written permission of the CVRWQCB:

(a) Construction of groundwater wells for injection or extraction and utilization or consumption of any groundwater within the boundary of the Restricted Area as defined in the LUC.
(b) Use (including pumping) of existing supply wells or the drilling of any new wells within the Restricted Area except as expressly stated in the LUC.
(c) Any other activity on the Restricted Area that would interfere with or adversely affect any groundwater remediation system or cause the contamination to migrate

or spread from on the Restricted Area or result in the creation of a groundwater recharge area (e.g., unlined surface impoundments or disposal trenches). Normal landscaping and irrigation activities within the Restricted Area including routine irrigation practices are not prohibited activities.

(d) Notwithstanding the above, the above prohibited activities shall not apply to: (i) the use of Well #6/8-17R(NASA) when used for emergency or fire suppression purposes only (ii) uses of groundwater approved by the CVRWQCB (iii) uses of groundwater *after* the LUC is terminated.

The County of Stanislaus, or any other owner of the Restricted Area or any portion thereof may apply to CVRWQCB for a termination of the Restrictions as they apply to all or any portion of the Restricted Area occupied by the applicant. CVRWQCB's consent thereto shall not be unreasonably withheld. The LUC shall continue in effect until the underground contaminants adjacent to the Restricted Area have been remediated.

Stanislaus County currently owns 1,352 acres of the 1,528-acre Facility. The County has been in the process of developing a **future reuse plan for the Facility**[22], which includes reuse of the former Facility airfield as a general aviation airport in the short-term, and development of an air and ground distribution center in the long-term with proposed land uses including:

- Aviation/Aviation Industrial
- Office/Business Park
- Commercial/Retail
- Industrial (light and heavy)
- Agricultural Industrial
- Open Space
- Public Facilities and Infrastructure
- Rail/Inland Port
- Research and Development
- Warehouse Distribution

The preliminary plan specifies that no residential uses are proposed for the Facility, with the exception of incidental uses, such as sleeping quarters associated with public facilities (e.g. fire station). The CVRWQCB Basin Plan considers all groundwater in the Central Valley Region as suitable or potentially suitable for municipal and domestic water supply, agricultural water supply, industrial service supply, and industrial process supply. In accordance with the Basin Plan, groundwater beneath the Site must meet the beneficial use of municipal water supply in the future.

2.7 SUMMARY OF SITE RISKS

A **human health risk assessment**[23] (HHRA) was conducted in 2008 to evaluate the potential risks associated with exposure to CCl4 in groundwater migrating from the Site into the deep groundwater zone, which is pumped and used to irrigate an almond orchard located across Bell Road and immediately east of the Site. In 1997 and later in 2008 **ecological risk assessments (ERAs)**[24] were completed to evaluate the threat to terrestrial habitats and biota whom have potential to be exposed to COCs in groundwater. The results of the HHRA and ERAs are summarized below and support the selected remedy that will prevent exposure of off-site receptors to COCs, specifically CCl4, in groundwater.

2.7.1 Human Health Risk Summary

The HHRA was conducted to evaluate the potential human health risks associated with exposure to CCl4 in extracted groundwater that is used to irrigate an almond orchard located across Bell Road northeast of the Site. The almond orchard is irrigated with groundwater pumped from the Escobar agricultural well (ID 6/8-16M1) that is screened through the deep groundwater zone defined at the Site (200 to 225 feet bgs). The potential human health risks were quantified for the exposure pathways that were considered potentially significant. The HHRA considered three exposure media: (1) ambient air via volatilization of CCl4 released from groundwater; (2) irrigation water via incidental ingestion and dermal absorption resulting from direct contact with irrigation water; and (3) soil via incidental ingestion, inhalation of particulates and dermal absorption of CCl4 adsorbed to the soil or direct ingestion of CCl4 in almonds as a result of uptake from the soil. The primary receptors considered in the risk assessment included orchard workers and off-site consumers (adult or child) that may ingest the almonds. The complete exposure pathways selected for quantitative risk evaluation relative to the orchard worker were incidental ingestion and dermal absorption of CCl4 from groundwater, and inhalation of CCl4 released into ambient air. For the market consumers, the consumption of almonds with potential uptake of CCl4 from soil was evaluated.

The **site conceptual model**[11] is shown in Figure 8. The site conceptual model identifies potentially complete transport and exposure pathways relevant to the Site including: 1) upward migration of groundwater contaminant vapors to the surface where inhalation in buildings or outdoors could occur; 2) ingestion of groundwater via pumping of impacted groundwater from water supply wells; and, 3) inhalation and/or dermal contact with impacted groundwater during irrigation activities on adjacent agricultural lands. Future land-use scenarios may include agricultural, industrial, and/or commercial uses. The identified potentially complete exposure pathways address the possible future land-uses. Groundwater occurs at greater than 44 feet bgs and does not discharge into any nearby surface water body. Potential receptors identified in the conceptual site model included off-site agricultural workers, off-site residents, and possible future occupants who may work or conduct business at the Site.

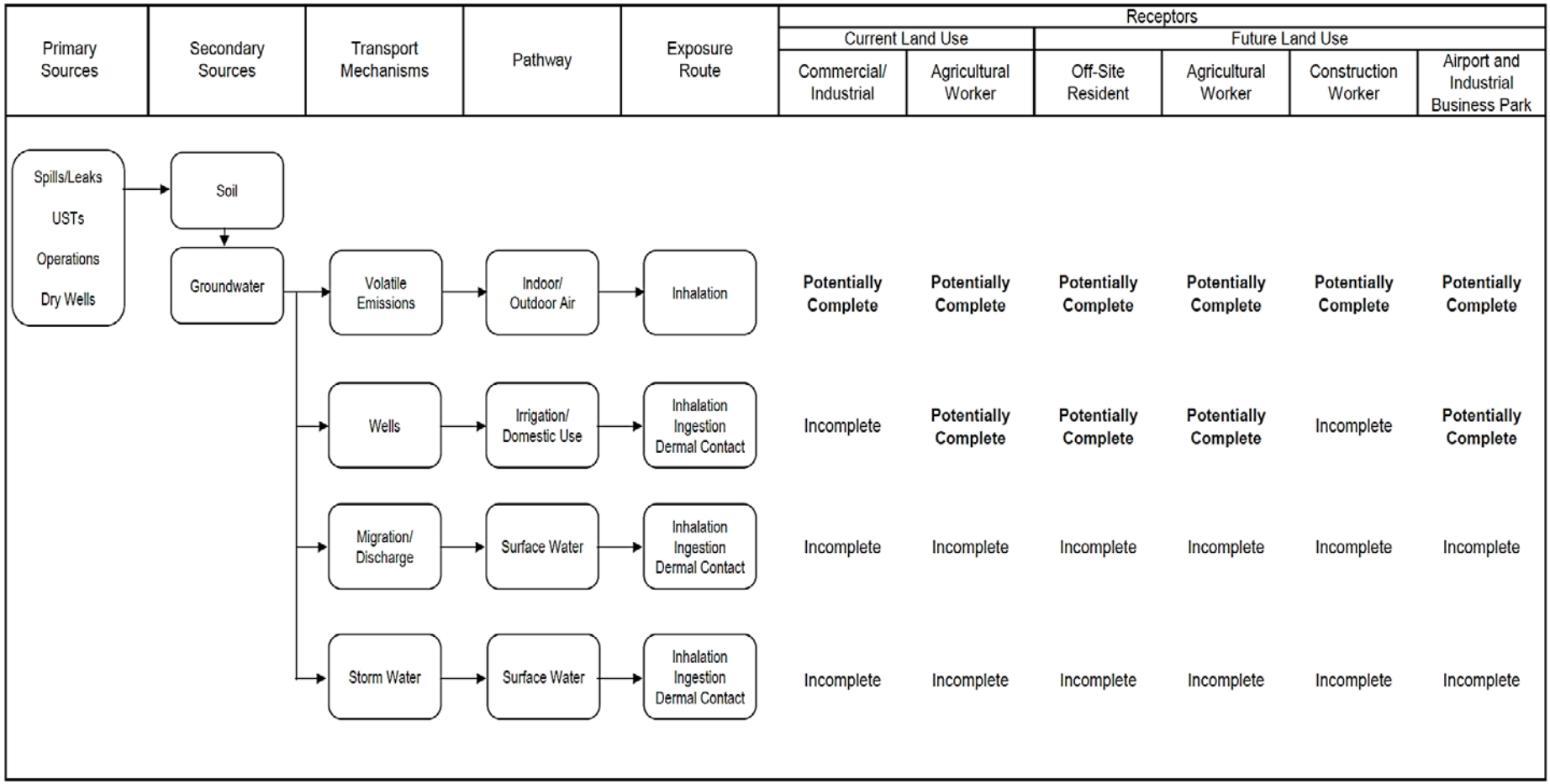


FIGURE 8 SITE CONCEPTUAL MODEL

The CCl4 concentrations used in the risk assessment included the maximum detected CCl4 concentration at the off-site Escobar agricultural well of 1.8 µg/L (September 2008) and at the off-site groundwater monitoring well 17-MW-42D of 19 µg/L (February 2008). Because CCl4 has not been measured in surface soil, irrigation water, ambient air or almonds, environmental transport models were used to estimate the maximum CCl4 concentration based on the measured levels at the off-site wells.

A qualitative screening level assessment was conducted to identify the exposure media that would be carried through the quantitative HHRA analysis. The qualitative screening level assessment including a comparison of the modeled estimated CCl4 concentrations and the measured CCl4 concentrations in groundwater at the off-site wells against the **EPA Region 9 Regional Screening Levels (RSLs)**[25]. The results of this screening evaluation indicated that the maximum detected CCl4 concentration in the off-site groundwater monitoring well and the Escobar agricultural well exceed the EPA RSL for CCl4 for tap water. However, the modeled estimated concentration of CCl4 in surface soil and ambient air did not exceed the EPA RSL value for CCl4 for industrial exposure, and were therefore not evaluated further in the HHRA. The inhalation exposure pathway was also retained for evaluation in the qualitative HHRA because this pathway could contribute to the overall cumulative risk level for orchard worker relative to exposures to irrigation water.

The **potential cancer and non-cancer risk levels**[26] were calculated for the orchard worker, market consumer adult, and market consumer child as a sum of the total calculated risk associated with incidental ingestion, dermal absorption, inhalation of vapors, and ingestion of almonds. The calculated risk levels were compared to the DTSC and Office of Environmental Health Hazard Assessment (OEHHA) cancer risk threshold of $1x10^{-6}$ and non-cancer hazard index threshold of 1. The calculated cancer risk and non-cancer hazards are below the DTSC and OEHHA cancer risk threshold of $1x10^{-6}$ and non-cancer hazard index threshold of 1. Therefore, the conclusions of the HHRA were significant health risks to the orchard worker or market consumer resulting from exposure to CCl4 in groundwater are unlikely.

2.7.2 Ecological Risk Assessment

An Ecological Risk Assessment (ERA) was performed in 1997 to evaluate the threat to terrestrial habitats and biota with potential to be exposed to COCs present at the IRP Site 17 area. Based on habitat coverage, spatial characteristics of the potential exposure area, low frequencies of detection and low chemical concentrations, the results indicated that the likelihood is low that ecological receptors will be exposed to COCs.

In 2008 an ERA was completed to evaluate the potential risks associated with exposure to CCl4 in groundwater migrating from the Site in the deep groundwater zone which is pumped and used to irrigate an almond orchard located across Bell Road northeast of the Site. The ERA evaluated the risk to wildlife and plants that may come into direct or indirect contact with CCl4 during irrigation activities. The identified receptors included plants, soil invertebrates, and wildlife such as honeybees associated with pollination activities in the almond orchard. Five exposure pathways were evaluated

in the ERA including: ambient air, groundwater used for irrigation, surface soil, plants, and soil invertebrates.

The maximum CCl4 concentrations detected in groundwater at the agricultural pumping well (1.8 µg/L), and groundwater monitoring well 17-MW-42D (19 µg/L), were compared to identified screening concentrations that have been established for protection of wildlife. Similar to the HHRA, because CCl4 has not been measured in surface soil, irrigation water, ambient air or almonds, environmental transport models were used to estimate the maximum CCl4 concentration that were then used in the ERA. The maximum detected or modeled concentrations of CCl4 in groundwater, soil, and air were compared to the available risk-based screening levels for the Site relevant ecological receptors (i.e., plants, soil invertebrates, and wildlife potentially associated with the orchard). The comparisons showed that none of the maximum or modeled CCl4 concentrations for all exposure pathways exceeded the available screening levels summarized above. The ERA concluded that significant risks to wildlife or other ecological receptors as a result of exposure to CCl4 in groundwater at the almond orchard are unlikely.

2.8 BASIS OF RESPONSE ACTION

The former NASA Crows Landing Flight Facility is a federal facility that contains several contaminated sites and potential sources of contamination, which have been identified and addressed through various environmental assessments and investigations over the last 20 or more years. The lead agency for these activities is the Navy, with regulatory oversight by the DTSC and the CVRWQCB. The primary objective of this ROD is to address contaminants in groundwater and meet CVRWQCB Basin Plan WQOs which require the COCs at minimum meet the CA MCLs for drinking water or taste and odor thresholds where a CA MCL for drinking water is not available. The COCs in groundwater at the Site include TPH, benzene, 1,2-DCA, and CCl4 which are associated with previous releases from IRP Site 17, UST Site 117, and UST Cluster 1 areas at the Facility. The selected remedy described in this ROD will reduce risks associated with off-site exposure to contaminated groundwater in areas where LUCs will not be in place to restrict groundwater use. Following implementation of the selected remedy, concentrations in groundwater, both on-site and off-site, will be reduced to levels that meet the beneficial uses of the Basin Plan and comply with the CA MCLs, which will ultimately allow for removal of any LUCs that restrict groundwater usage.

The FS and selection of the remedy focused on the February 2009 groundwater analytical results associated with the three source areas (IRP Site 17, UST Site 117, and UST Cluster 1), the 2008 to 2010 enhanced in situ bioremediation groundwater sampling results, and associated investigations and assessments completed to further evaluate the extent of groundwater contamination. The selected remedy does not include remediation of soils at the Site. Selection of the remedy for the Site is consistent with the overall findings of the environmental investigation and FS activities completed at the Site.

2.9 PRINCIPAL THREAT WASTES

Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur. There are no known drummed wastes, free product, high concentrations of mobile chemicals, or highly toxic source materials at the Site. The contaminants at the Site in groundwater are considered a low-level non-principal threat waste because the contaminants can be reliably contained and present a low risk to off-site receptors at current levels.

2.10 GROUNDWATER REMEDIAL ACTION GOALS

The remedial action objectives (RAOs) for the Site have been established to comply with the CVRWQCV Basin Plan WQOs which require the COCs meet the drinking water MCLs or taste and odor thresholds where a drinking water MCL is not available.

To meet the RAOs established for the Site, numerical remedial goals (RGs) have been established. The RGs for the Site are summarized in Table 3.

TABLE 3
REMEDIAL GOALS FOR GROUNDWATER

COCs	µg/L
Benzene	1.0
1,2-DCA	0.5
CCl4	0.5
TPH-g	100
TPH-d	490

Notes:
(µg/L) = micrograms per liter
COCs = chemicals of concern

Table 4 summarizes the COCs that occur at concentrations that exceed the RGs for each groundwater zone, and the impacted areas of the Site that require remediation.

TABLE 4
SUMMARY OF AREAS REQUIRING REMEDIATION

Groundwater Zone	Approximate Depth (feet bgs)	Impacted Area - Elevated COCs
Shallow	50 - 75	**UST Cluster 1, UST Site 117** - Benzene, 1,2-DCA, TPH-d, and TPH-g **IRP Site 17** - CCl4 and TPH-d
Mid-Shallow	90 - 110	**UST Cluster 1, UST Site 117** - Benzene, 1,2-DCA, TPH-d, and TPH-g **IRP Site 17** - CCl4 **Off-site** - CCl4, 1,2-DCA
Mid-Deep	160 - 180	**UST Cluster 1** - Benzene, 1,2-DCA, TPH-d, and TPH-g **IRP Site 17** - CCl4 **Off-site** - CCl4
Deep	200 -225	**IRP Site 17** - CCl4 **Off-site** - CCl4

Notes:
bgs = below ground surface
COCs = chemicals of concern

2.11 DESCRIPTION AND COMPARATIVE ANALYSES OF GROUNDWATER REMEDIAL ALTERNATIVES

To address identified groundwater impacts at the Site, **general response actions**[27] were identified and evaluated to determine their applicability to treat impacted groundwater at the Site. For each retained general response action, remedial technologies were identified and an **initial screening of remedial technologies**[28] was completed to evaluate its technical implementability as part of the FS to refine the remedy selection process. A **final screening of retained remedial technologies**[29] based on an evaluation of the remedial technology's effectiveness, implementability, and cost was completed. Identified applicable remedial technologies retained after the final screening evaluation were assembled into four groundwater remedial alternatives for **detailed analysis**[30], which included the evaluation of each alternative against the **nine evaluation criteria**[31] as required by the national contingency plan (NCP).

2.11.1 Description of Remedial Alternatives

The four remedial alternatives identified for groundwater at the Site are summarized in Table 5 below.

TABLE 5

DESCRIPTION OF GROUNDWATER REMEDIAL ALTERNATIVES EVALUATED

Remedial Alternative	Description	Time (Years)*	Cost
Alternative 1 No Action	- The no action alternative is required by CERCLA as a baseline for comparison with other alternatives. -No further action of any type would be conducted at the Site. This alternative would not involve engineered remediation measures, administrative controls, or monitoring of contaminated groundwater. -This alternative would not include measures to prevent contact with or ingestion of Site groundwater containing chemicals at concentrations above remediation goals. - COCs dissolved in groundwater would continue to migrate off-site above the RGs for approximately 16.5 years, under anticipated future conditions.	24	$0
Alternative 2 MNA with ICs	-This alternative relies on natural processes to remediate the groundwater at the Site. -MNA would be used to monitor the concentration of COCs in groundwater, the groundwater plume stability, and confirm the continued natural degradation of TPH, benzene, 1,2-DCA, and CCl4 in groundwater. -The ICs under this alternative include an on-site LUC restricting groundwater use to remain in-place for approximately 24 years. - COCs dissolved in groundwater would continue to migrate off-site above the RGs for approximately 16.5 years, under anticipated future conditions.	24	Total Cost: $3,310,000

TABLE 5

DESCRIPTION OF GROUNDWATER REMEDIAL ALTERNATIVES EVALUATED

Remedial Alternative	Description	Time (Years)*	Cost
Alternative 3 EISB, MNA and ICs	-This alternative includes the injection of a substrate into the groundwater in a single treatment to increase the rate of naturally occurring degradation processes to treat the shallow, mid-shallow, and mid-deep groundwater zones impacted with CCl4. -Injection point wells would be installed on-site within the CCl4 plume at 498 locations in the shallow groundwater zone, 639 locations in the mid-shallow zone, and 107 injection locations in the mid-deep groundwater zone. -MNA would be used to monitor the concentration of COCs in groundwater, the groundwater plume stability, and confirm the continued natural degradation of TPH, benzene, 1,2-DCA, and CCl4 in groundwater. -The ICs under this alternative include an on-site LUC restricting groundwater use to remain in-place for approximately 20 years.	20	Total Cost: $8,940,000
Alternative 4 Enhanced Bioremediation with Recirculation, MNA, and ICs	-This alternative includes groundwater extraction from 14 new extraction wells**,** treatment of extracted groundwater, addition of a carbon amendment to the treated groundwater to enhance naturally occurring bioremediation processes, and subsequent injection of the amended groundwater back into the subsurface at 17 new injection wells. -Groundwater extraction and injection activities will hydraulically contain the on-site groundwater plume and significantly reduce off-site migration of COCs dissolved in groundwater, reducing the risk that potential off-site receptors could be exposed to contaminated groundwater. -COCs in groundwater migrating off-site would be reduced to levels below the RGs in all groundwater zones in approximately 4.5 years. After approximately 8 years of system operation, groundwater concentrations on-site would be reduced to levels less than the RGs. -MNA would be used to monitor the concentration of COCs in groundwater, the groundwater plume stability, and confirm the continued natural degradation of TPH, benzene, 1,2-DCA, and CCl4 in groundwater. -The ICs under this alternative include an on-site LUC restricting	8	Total Cost: $5,560,000

TABLE 5

DESCRIPTION OF GROUNDWATER REMEDIAL ALTERNATIVES EVALUATED

Remedial Alternative	Description	Time (Years)*	Cost
	groundwater use to remain in-place for approximately 8 years.		

Notes:
***** Time shown is years to meet RGs on-site based on the fate and transport model simulated timeframe, and the assumption that a continuing source of contamination to groundwater is not present. A detailed description of the Fate and Transport model simulations and results are presented in the Final Feasibility Study Report.
MNA = monitored natural attenuation
IC = institutional controls
EISB = enhanced in situ bioremediation

2.11.2 Comparative Analysis of Remedial Alternatives

A **comparative analysis**[32] of the four remedial alternatives with respect to the nine evaluation criteria was completed and is presented in the FS report. The results of the comparative analysis are summarized in Table 6.

TABLE 6

COMPARATIVE ANALYSIS OF GROUNDWATER REMEDIAL ALTERNATIVES

Criteria	Alternative			
	Alternative 1 No Action	Alternative 2 MNA and ICs	Alternative 3 EISB, MNA, ICs	Alternative 4 Enhanced Bioremediation with Recirculation, MNA, ICs
Threshold Criteria				
Protection of Human Health and the Environment	○	◎	◉	●
Compliance with ARARs	○	●	●	●
Primary Balancing Criteria				
Long-term Effectiveness and Permanence	○	◎	◉	●

TABLE 6

COMPARATIVE ANALYSIS OF GROUNDWATER REMEDIAL ALTERNATIVES

Criteria	Alternative			
	Alternative 1 No Action	Alternative 2 MNA and ICs	Alternative 3 EISB, MNA, ICs	Alternative 4 Enhanced Bioremediation with Recirculation, MNA, ICs
Reduction of Toxicity, Mobility, or Volume Through Treatment	○	○	◎	●
Short-Term Effectiveness	○	◎	◎	●
Implementability	●	●	◎	◎
Cost	$0	$3.3M	$8.9M	$5.6M
Modifying Criteria				
State Acceptance	○	○	○	●
Community Acceptance	NC	NC	NC	NC

Notes:
○ = Low, ◎ = Low-Medium ◎ = Medium ◎ = Medium-High ● = High

* = Cost evaluation is based on net present value (NPV)
NA = not applicable, there are no ARARs applicable to Alternative 1.
MNA = monitored natural attenuation
ICs = institutional controls
EISB = enhanced in situ bioremediation
NR = not rated
NC = no comments received on proposed plan or during the public meeting or public comment period

2.11.2.1 Threshold Criteria

Overall Protection of Human Health and the Environment: Alterative 1 is not protective of human health or the environment because it leaves contaminants in-place, does not verify the stability of the groundwater plume, and ICs would not be in effect to prevent exposure to impacted groundwater. Alternatives 2, 3 and 4 are all protective of human health and the environment. Alternative 2 is less protective of human health and the environment than Alternative 3 because Alternative 3 actively reduces contaminant mass at the source and the time to achieve the RGs is less than for Alternative 2. Alternative 4 is the most protective of human health and the environment because it would prevent further off-site migration of CCl4 through mass reduction and hydraulic control.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs): The **ARARs**[33] include Federal and State standards, requirements, criteria, and/or limitations that are determined to be legally applicable or relevant and appropriate to a CERCLA site response action.

The ARARs for the Site were evaluated in the FS, and are summarized in Appendix A of this ROD. Alternatives 2 through 4 would comply with ARARs. ARARs are not applicable to Alternative 1.

2.11.2.2 Primary Balancing Criteria

Long-term Effectiveness and Permanence: Alternative 4 scored high in long-term effectiveness and permanence on the basis that in situ treatment would reduce the long-term management of contaminants. Alternative 3 was scored as medium-high because it would reduce the long-term management of contaminants, but would require significantly longer than Alternative 3 to achieve similar results. Alternative 2 was given a rating of low-medium in long-term effectiveness and permanence because even though attenuation through natural processes has been demonstrated, the time to achieve RAOs would be longer than for the other active remedial alternatives. Alternative 1 was given a low rating because the effectiveness of natural attenuation processes would not be verified and plume migration would not be monitored to demonstrate protectiveness.

Reduction of Toxicity, Mobility, and Volume through Treatment: Alternative 4 received the highest rating for reduction of toxicity, mobility, and volume through active treatment. Alternative 4 would be expected to reduce toxicity, mobility, and volume by actively extracting, treating and amending, and injecting water into the subsurface to provide hydraulic capture, enhance gradients, and distribute a carbon substrate through the aquifers to be treated. Alternative 3 would be expected to enhance natural degradation, as has been demonstrated in the ongoing bioremediation treatability study, and reduce the concentration of CCl4 in the source area to below the MCL in a relatively short time. However, Alternative 3 was scored as medium because it is less aggressive than Alternative 4 and it would require significantly longer to achieve RAOs for CCl4. Alternatives 1 and 2 were rated low because they do not involve active treatment.

Short-term Effectiveness: Alternative 4 was rated high for short-term effectiveness. There is some risk to workers during installation of the treatment system and from the handling of contaminated groundwater during the system operation. There are also risks to workers from the drilling and installation of new extraction and injection wells, but these risks are low as long as safe work practices are followed. Risks to the environment from leaks and spills and from off-gassing of VOC-impacted groundwater would be minimized through the proper use of engineering controls. Alternative 3 risks to workers from the drilling of new injection points would be similar to Alternative 4, and implementation of EISB poses little additional risk to the environment. However, Alternative 3 was rated medium because it would take significantly longer to reach the RGs than Alternative 4. Alternative 2 would not result in additional risks to the environment compared to Alternatives 3 and 4, and similar to Alternatives 3 and 4 it would pose little risk to workers as long as safe work practices are followed during monitoring. However, Alternative 2 will take a longer timeframe to achieve the RGs than Alternatives 3 and 4, which resulted in the medium rating. Alternative 1 received a low rating for short-term effectiveness. Although there are no significant risks to workers or additional risks to the environment under Alternative 1, there would be no means to monitor the time to achieve the RGs.

Implementability: Alternatives 1 and 2 can be easily implemented and were given a high rating. Alternative 3 was rated medium to high for implementability because injection of bioenhancing

substrates is easily accomplished with a direct-push drilling technology or via other drilling methods, and implementation of this alternative has been demonstrated in the recent EISB study. Alternative 4 was rated medium for implementability. Although extraction, treatment, amendment, and injection under Alternative 4 can be easily implemented, this alternative will also require construction, operation, and maintenance of a treatment system, and there are regulatory compliance requirements related to treatment and injection of treated water that are not required for implementation of the other alternatives.

Cost: No costs are associated with Alternative 1, while Alternative 2 ($3.3M) and Alternative 4 ($5.6M) have similar total costs, and Alternative 3 has the highest total cost ($8.9M). While Alternative 2 requires less up front capital expenditures then Alternative 4, Alternative 4 requires higher O&M costs due to the operation of a treatment system and ongoing groundwater monitoring with implementation of ICs until the RGs are achieved. Due to the depth of contamination and the relatively large area that would require treatment under Alternative 3, the high drilling and injection costs result in a significantly higher cost for Alternative 3 as compared to the other alternatives.

2.11.2.3 Modifying Criteria

State Acceptance: State involvement through regulatory agencies has been solicited throughout the CERCLA process. The State of California DTSC and the CVRWQCB concur with the selected remedy.

Community Acceptance: The proposed plan was released to the public for review and comment for a 30-day period between January 20 to February 21, 2012, and was discussed at a public meeting on February 9, 2012, where representatives from the Navy, DTSC, and the CVRWQCB presented the proposed plan to the public, and answered questions associated with the selected remedy for the Site. The questions raised at the meeting were general inquiries for information purposes. No comments or concerns requiring amendment to the proposed plan were received from the public during the meeting, or public comment period.

2.12 SELECTED REMEDY

Alternative 4, enhanced bioremediation with recirculation, MNA, and ICs, is the selected remedy to address groundwater impacts at the Site.

2.12.1 Rationale for Selected Remedy

All of the Alternatives would, over time, meet the RGs. Alternatives 2, 3, and 4 would be in full compliance with ARARs and would be easily implementable. They would all provide long-term effectiveness and permanence in that they all reduce the level of contaminants in groundwater at the Site. However, Alternative 4 addresses off-site migration by implementing hydraulic controls so that the RGs along the property line at Bell Road would be achieved within a relatively short time. In terms of overall time to closure, Alternative 4 is expected to achieve the Site-wide RGs in less than half the time required for Alternatives 2 and 3.

2.12.2 Detailed Description of Selected Remedy

The selected remedy utilizes extraction of contaminated groundwater by pumping from multiple extraction wells, ex situ treatment of the pumped groundwater, addition of a carbon amendment to the treated groundwater, and injection of treated groundwater back into the subsurface through multiple injection wells. MNA with ICs will be implemented until COCs meet the RGs on-site and off-site. Groundwater extraction and injection will hydraulically control the flow of groundwater and limit further off-site migration of CCl4 beyond the property boundary at Bell Road, while also reducing CCl4 concentrations within the on-site source area in the shallow, mid-shallow, mid-deep, and deep groundwater zones.

Ex situ treatment of groundwater may be accomplished using either air stripping, granular activated carbon (GAC), or a similar technology that will be effective at treating the extracted groundwater. For cost estimating purposes in the FS, it was assumed that GAC would be utilized. The treated groundwater will be amended with a carbon source and injected into the subsurface using a network of injection wells completed in the shallow, mid-shallow, mid-deep, and deep zones. The approximate number of injection wells and their generalized locations in each of these groundwater zones is shown in Figures 9 through 11. The rate of injection into each of the groundwater zones at the Site will be conducted such that the net extraction from each groundwater zone is approximately equivalent to the net injection within that zone.

The estimated time frames for achieving RGs for the selected remedy are based on model simulations conducted as part of the FS with injection and extraction well locations shown in Figures 9 through 11. The simulations were based on the data available at the time the model was constructed and assume that no continuing sources of contaminants are present and that all of the contaminant mass is present in the dissolved and adsorbed phases only. Additionally, the model simulations were designed to demonstrate the feasibility of the selected remedy based on the available data, and to compare remedial alternatives presented in the FS. It is likely that the selected remedy could be optimized, based on additional modeling and data collection to further enhance the performance of the selected remedy. During the design phase for the selected remedy, additional data should be collected and used to optimize the number and location of extraction and injection wells, the proposed extraction and injection rates, and ultimately re-evaluate the predicted performance and duration of the selected remedy. Significant variability has been observed in the subsurface conditions across the Site in each of the depth zones evaluated. Extraction and injection test wells should be drilled at selected locations to confirm subsurface conditions and aquifer testing should be conducted to verify the hydraulic properties in each of the zones. The data obtained from these wells can be used to update the site model and refine the selected remedy based on the new data. Additional, or fewer, extraction/ injection wells may be required to achieve the overall performance predicted in the FS model simulations. Alternately, the selected remedy may be optimized by modifying the extraction/ injection well locations based on the new information.

Treatability testing should also be conducted to evaluate the type and concentration of carbon amendment to use in the selected remedy. Recent biotreatability testing conducted at the Site can be used as an initial guide to selecting carbon amendments to test.

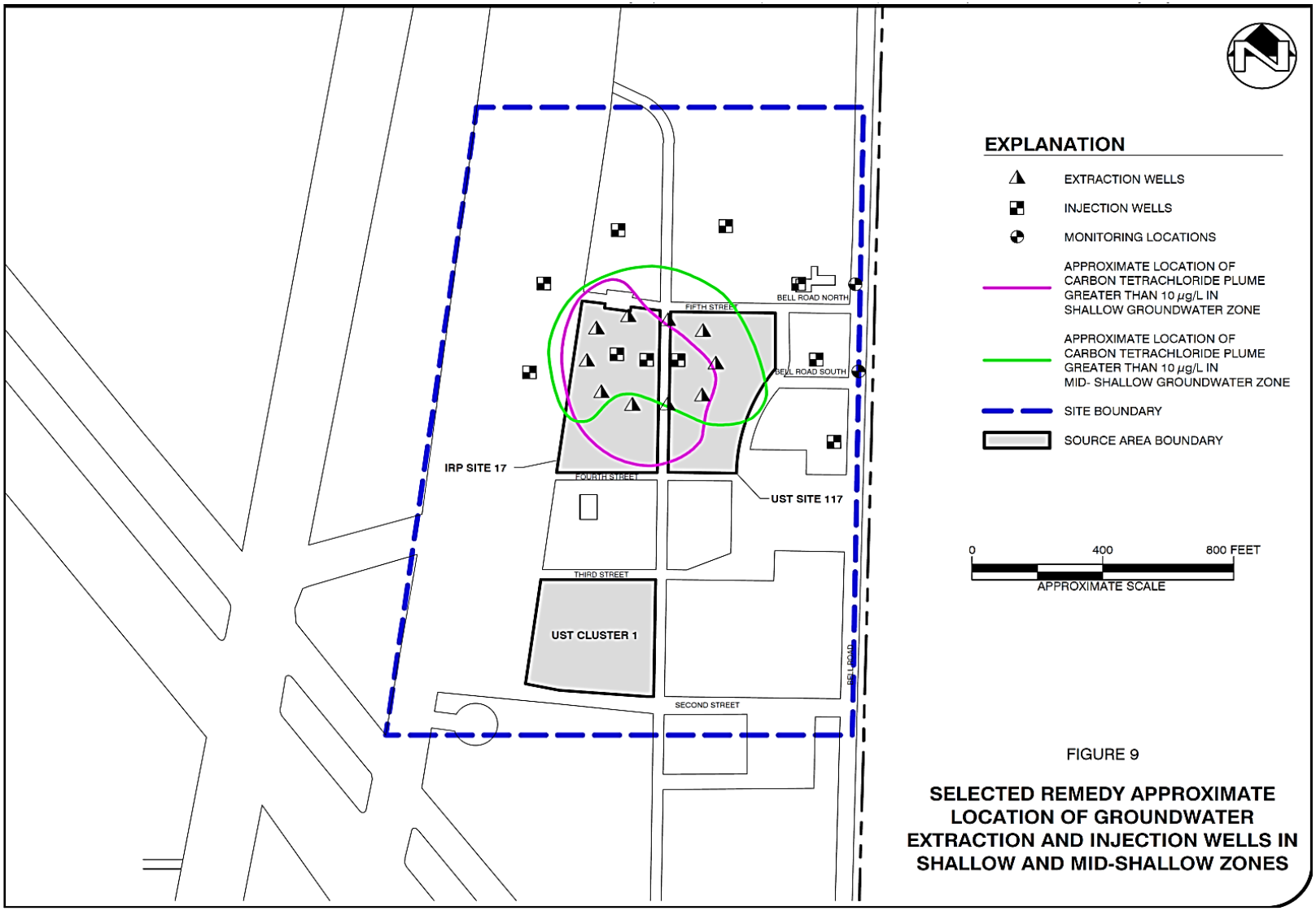


FIGURE 9

SELECTED REMEDY APPROXIMATE LOCATION OF GROUNDWATER EXTRACTION AND INJECTION WELLS IN SHALLOW AND MID-SHALLOW ZONES

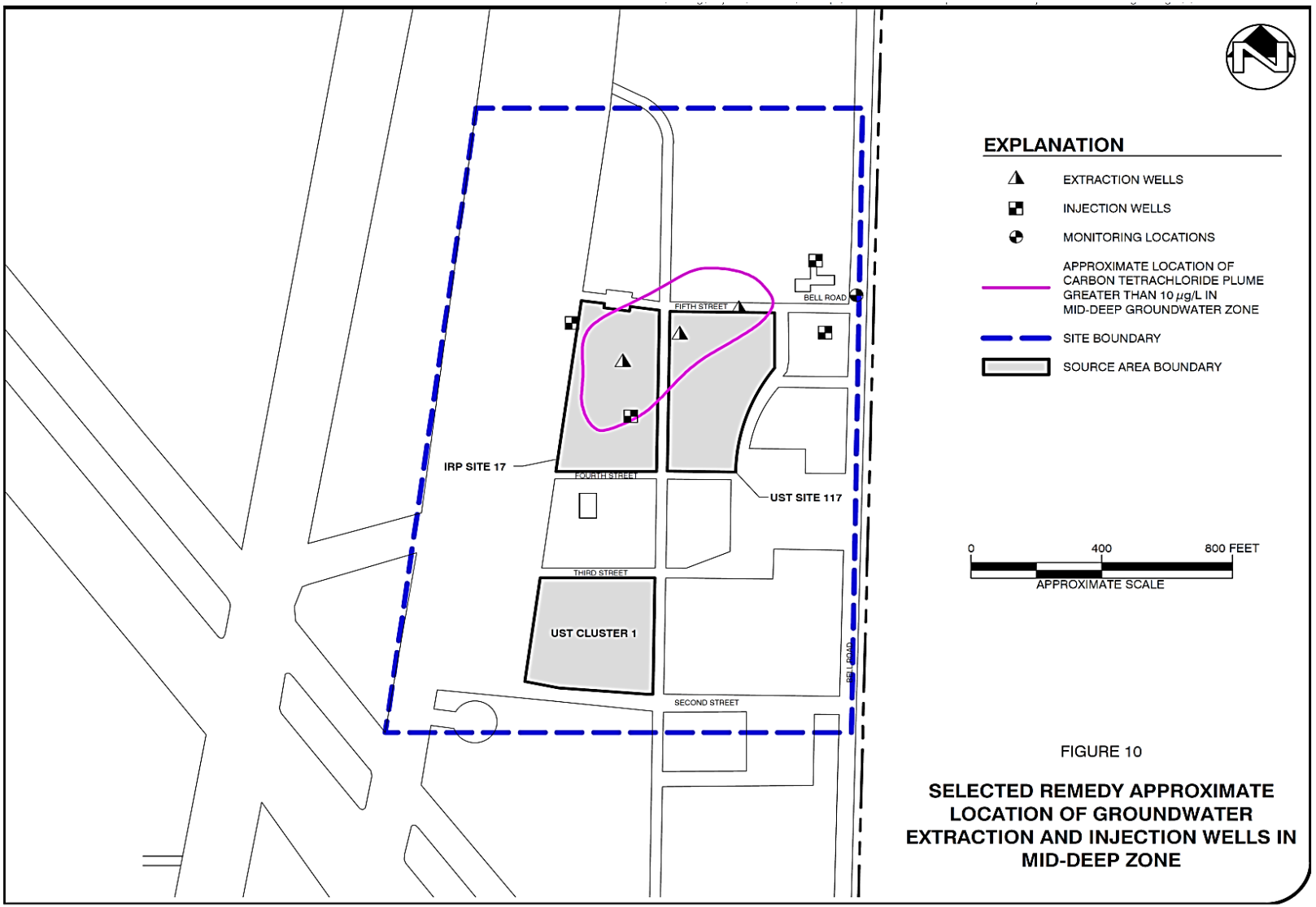


FIGURE 10

SELECTED REMEDY APPROXIMATE LOCATION OF GROUNDWATER EXTRACTION AND INJECTION WELLS IN MID-DEEP ZONE

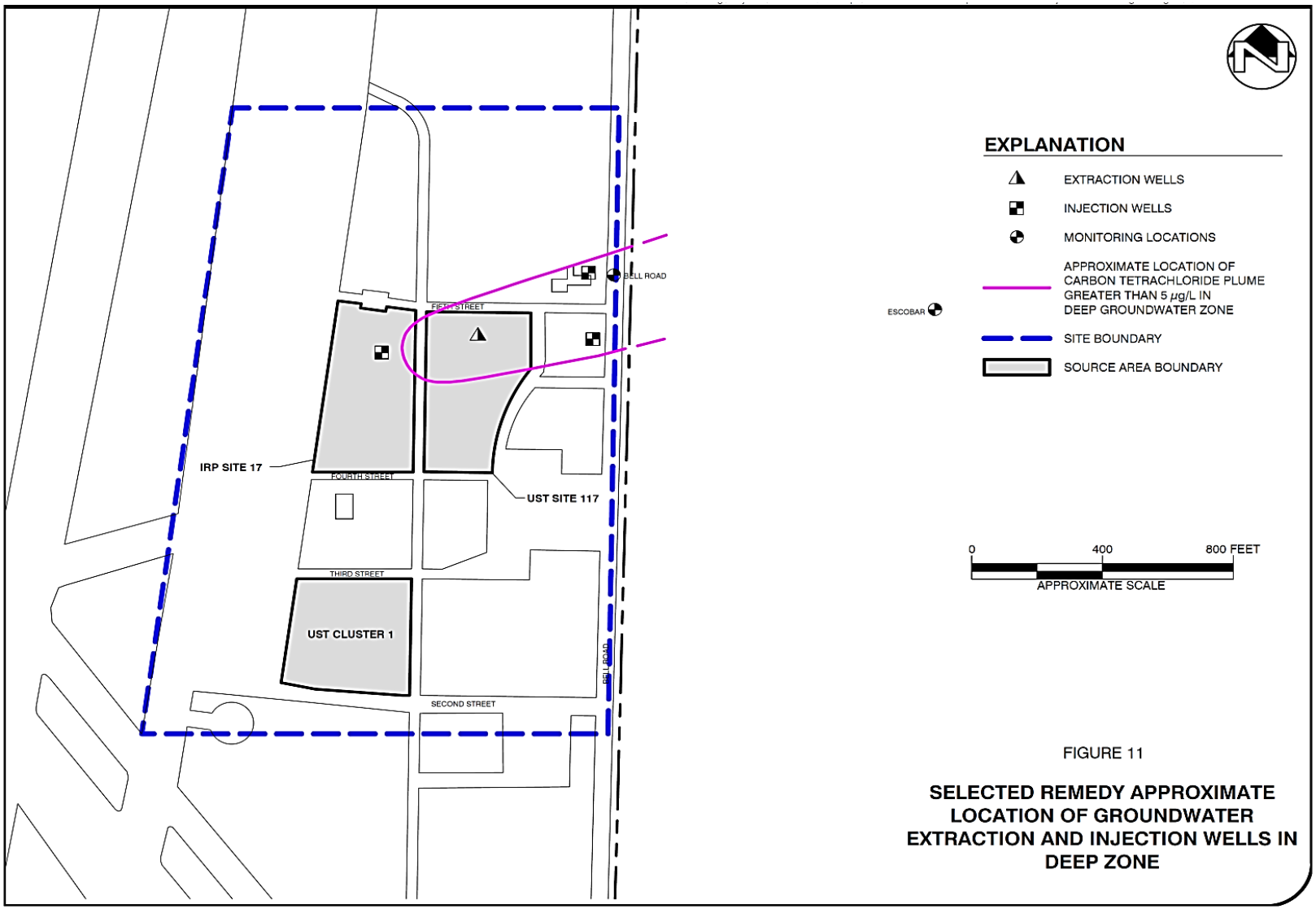


FIGURE 11

SELECTED REMEDY APPROXIMATE LOCATION OF GROUNDWATER EXTRACTION AND INJECTION WELLS IN DEEP ZONE

ICs to protect sensitive receptors from exposure to impacted on-site groundwater will be implemented until the RGs are achieved on-site. The ICs under the selected remedy involve placing a LUC on the property to restrict on-site groundwater use. The LUC will be similar in concept to the existing LUC, however, the new LUC will be implemented based on an agreement between NASA and the NAVY. The existing LUC prohibits the following:

- Use of existing supply wells or the drilling of any new wells within the Restricted Area except as noted in the LUC;
- Construction of groundwater wells for injection or extraction and utilization or consumption of any groundwater within the boundary of the Restricted Area except as expressly stated in the LUC; and,
- Any activity on the Restricted Area that will interfere with or adversely affect any groundwater remediation system or cause the contamination to migrate or spread from the Restricted Area or result in the creation of a groundwater recharge area (e.g., unlined surface impoundments or disposal trenches).

The above prohibited activities would not apply to the use of on-site water supply well 6/8-17R (NASA) for emergency fire suppression purposes only or uses of groundwater approved by the CVRWQCB. The term "Restricted Area" refers to a "2,000-foot pumping exclusion boundary" around the Site Plume as shown on Exhibit A of the Covenant to Restrict Use of Property-Water Use Restriction dated October 26, 2004 by and between the County of Stanislaus and the CVRWQCB.

2.12.3 Expected Outcomes of Selected Remedy

Future land-uses at the Facility are expected to include use as a general aviation airport in the short-term, and development of an air and ground distribution center in the long-term, with potential future land-uses including office/ business park, public facilities, warehouse distribution, research and development and similar. However, preliminary future redevelopment plans do not include residential reuse of the Facility. The RGs for impacted groundwater at the Site have been established to comply with the CVRWQCB Basin Plan, which requires groundwater meet the beneficial use of municipal water supply, which would also meet the potential Facility redevelopment uses. Off-site migration of COCs in groundwater during implementation of the selected remedy will be limited by hydraulic controls and treatment of groundwater, while on-site exposures will be controlled through ICs in the form of an LUC which will be established for the Site based on an agreement between NASA and the Navy.

The active treatment system installed at the Site will be operated until one of the following conditions is met:

- The RGs for CCl4 within the treatment area are achieved;

- The mass recovery of the system has reached asymptotic levels with no monitoring wells exhibiting concentrations of CCl4 greater than four times the RG, at which time operation of the system will cease and MNA will be utilized to address residual CCl4 concentrations; or,

- The system has operated for eight years.

Active treatment in individual groundwater zones, or areas, may be terminated if RGs for CCl4 are achieved within that zone. MNA will be implemented to address all COCs outside of the treatment area and will remain in place until RGs for the contaminants have been met. A LUC will be utilized to protect sensitive receptors from exposure to impacted on-site groundwater and will remain in effect until RGs are achieved on-site. A groundwater monitoring network will be established to monitor groundwater conditions in each of the groundwater zones and groundwater monitoring will be conducted periodically until RGs are met. System effectiveness will also be evaluated annually by reviewing mass removal rates and comparing concentrations in the monitoring well network to pre-treatment concentrations.

2.13 STATUTORY DETERMINATION

In accordance with the NCP, remedial actions must meet the statutory requirements of Section 121 of CERCLA and thereby achieve adequate protection of human health and the environment, comply with ARARs of both federal and state laws and regulations, be cost-effective, and use, to the maximum extent practicable, permanent solutions and alternative treatment or resource recovery technologies. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, and/or mobility of hazardous waste as the principal element. The following discussion summarizes the statutory requirements that are met by the Selected Remedy.

- **Protection of Human Health and the Environment** — The selected remedy is needed to protect human health and the environment due to the presence of contaminated groundwater that is considered a potential drinking water source. A remedial action is required to restore the groundwater to meet drinking water standards (i.e., CA MCLs or CVRWQB WQOs). Although there is no risk based on current land use and off-site COC concentrations in groundwater, the selected remedy will protect human health and the environment by reducing site risks through groundwater containment and treatment and the implementation of LUCs to limit the use of groundwater until groundwater is restored to drinking water standards.

- **Compliance with ARARs —** The ARARs include any federal or state standard, requirement, criteria, or limitations that are determined to be legally applicable or relevant and appropriate to a CERCLA site or response action. CERCLA Section 121(d), as amended, specifies that remedial actions for cleanup of hazardous substances must comply with ARARs that are relevant to the hazardous substances or particular circumstances at a site or a waiver must be obtained from the regulatory

agency. In addition to ARARs, the lead and support agencies may, as appropriate, identify other advisories, criteria, or guidance to be considered for a particular response action. These are known as to be-considered (TBC) criteria.

The State (CVRWQCB and DTSC) has identified State Water Resources Control Board Resolutions 68-16, 88-63, and 92-49 as proposed ARARs that are not recognized as applicable by the Department of the Navy.

The State maintains that SWRCB Resolution No. 68-16 is a promulgated standard applicable to discharges of waste to ground or surface water which should be identified as an ARAR for the selected remedy. SWRCB Resolution 68-16 requires use of best practical treatment or control to achieve a level between background and the water quality standard. The State's position is that SWRCB Resolution 68-16 applies to treatment via injection of treatment media, noting that such injection can result in unintended consequences that can increase concentrations of constituents or for new compounds. The Navy has determined that migration of COCs in groundwater is not a discharge governed by the language in SWRCB Resolution 68-16. However, the Navy acknowledges that injection of treated groundwater to the groundwater aquifer as required by the selected remedy will comply with the resolution by removing/treating COCs to obtain levels at the reporting limit prior to injection and thus comply with the requirement of maintaining acceptable levels of contaminants in groundwater, which for the Site are the California MCLs and recommended taste and odor thresholds as prescribed by the Basin Plan. Injected groundwater will comply with the requirements of the Basin Plan and project-specific standards and limits determined at the time of implementation.

The State also maintains that SWRCB Resolution No. 88-63 should be identified as an applicable requirement for the selected remedy. The beneficial uses of the groundwater as identified in the Basin Plan form the basis for identifying water quality standards. According to the State, the determination of the beneficial uses of waters of the state is a promulgated standard and therefore an ARAR. The Navy acknowledges that the Basin Plan requires that groundwater meet drinking water MCLs and has identified this resolution as a relevant and appropriate requirement, but the Navy has determined that the drinking water MCLs identified under the California SDWA as a chemical-specific ARAR is the more stringent standard that will be enforced.

State Board Resolution No. 92-49 has been identified by the State as an applicable requirement for the selected remedy. The Navy acknowledges that SWRCB Resolution 92-49 establishes requirements for investigation, cleanup, and abatement of discharges and that the RWQCB may decide on cleanup and abatement goals and objectives for the protection of water quality and beneficial uses of water within each region. However, the Navy has determined that this resolution is not a chemical specific ARAR because it is a state requirement that is not more stringent than the federal ARAR provisions of CCR Title 22 § 66264.94. The State agrees that the selected remedy is in the best interests of the people of the State and the criteria are

intended to result in cleanup to the lowest level that is economically and technically feasible and will protect the beneficial uses of the waters of the State.

Whereas the Navy and the State of California have not agreed on whether SWRCB resolutions 68-16, 88-63, and 92-49 are applicable requirements for the selected remedy, this ROD documents each of the parties' positions on the resolutions but does not attempt to resolve the issue.

Appendix A of this ROD summarizes the ARARs and TBCs considered for the Site. As summarized above, ARARs and TBCs for the selected remedy have been identified and will be met during implementation of the selected remedy.

- **Cost-Effectiveness** — The selected remedy is cost-effective and represents a reasonable value for the money to be spent. The total cost of the selected remedy is proportional to the overall effectiveness by achieving long-term effectiveness and permanence within a reasonable timeframe. This analysis was accomplished by evaluating the overall effectiveness of those alternatives that satisfied the threshold criteria. The following definition was used to determine cost-effectiveness, as defined by the NCP, "a remedy shall be cost effective if its costs are proportional to its overall effectiveness (NCP Section 300.430(f)(1)(ii)(D)."
- **Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable** — The selected remedy provides a high degree of long-term effectiveness and permanence by hydraulically containing groundwater, treating the impacted groundwater, and thus reducing the toxicity and volume of COCs in groundwater. Because long-term effectiveness and permanence along with reduced toxicity and volume are achieved in the shortest timeframe, the selected remedy provides the best balance of tradeoffs in terms of the balancing criteria, while also considering the statutory preference for treatment as a principal element and considering State and community acceptance.
- **Preference for Treatment as a Principal Element** — The selected remedy uses treatment as a principal element, and therefore satisfies the statutory preference for treatment.
- **Five-Year Review Requirements** — This remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure for an estimated period of eight years based on the model simulated results; therefore in accordance with CERCLA Section 121(c) and the NCP 40 CFR300.430 (f)(4)(ii) a statutory review will be conducted by the Navy within five years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment. If the remedy is determined not to be protective of human health and the environment because, for example, concentrations of COCs are not decreasing, then additional remedial actions would be evaluated and the Navy may be required to undertake additional remedial action.

2.14 COMMUNITY PARTICIPATION

The Navy, DTSC, and the CVRWQCB provide information regarding investigations, assessment, and cleanup response actions at the Site to the public through the community relations program, which includes the Administrative Record File for the Site, public notices and announcements published in local newspapers, mailings to the community, and an information repository to access technical documents for the Site.

In accordance with Sections 113 and 117 of CERCLA, the Navy provided a public comment period from January 20, 2012 through February 21, 2012 for the Proposed Plan for the Site. A public meeting to present the Proposed Plan to the community was held on February 9, 2012 at the Best Western Villa Del Lago in Patterson, California. Public notice of the community meeting and availability of the Proposed Plan was published in the *Patterson Irrigator* on January 19, 2012.

The Proposed Plan was released for public comment on January 20, 2012. The proposed plan identified Alternative 4, enhanced bioremediation with recirculation, MNA, and ICs, as the preferred alternative for groundwater remediation.

Information on documents and relevant information relied upon in the remedy selection process, including the Proposed Plan, FS, and other technical reports are available to the public at the following information repositories:

Stanislaus County Library
Patterson Branch
46 N. Salado Ave
Patterson, CA
(209) 892-6473

Administrative Record File
Contact: Ms. Diane Silva
Command Records Manager
Naval Facilities Engineering Command, Southwest
Naval Base San Diego
2965 Mole Road, Building 3519
San Diego, California 92136
Telephone: (619) 556-1280
diane.silva@navy.mil

2.15 DOCUMENTATION OF SIGNIFICANT CHANGES

The proposed plan for the site was released for public comment on January 20, 2012. No comments were received during the public meeting or comment period. It was determined that no significant changes to the remedy, as originally identified in the proposed plan, were necessary.

3.0 RESPONSIVENESS SUMMARY

A public meeting was held on February 9, 2012 to discuss the proposed plan for the Site. The participants at the Public Meeting included representatives of the Navy, DTSC, and RWQCB. Nine community members attended the meeting. Questions received during the public meeting were general inquiries and are described in the public meeting minutes in the Administrative Record. There were no comments received at the public meeting that required amendments to the proposed plan, and no additional written comments, concerns, or questions were received from community members during the public comment period.

4.0 REFERENCES

Reference Number	Reference Phrase in ROD	Location in ROD	Identification of Referenced Document Available in the Administrative Record
1	Administrative Record	Section 1.1	Administrative Record File Index for Crows Landing
2	commingled groundwater plume	Section 2.1	Final Feasibility Study, Site 17 Administration Area Groundwater Plume, NASA Crows Landing Flight Facility, Crows Landing, California. Terra Pacific Group. February 18, 2011. Section 4.1
3	past operations	Section 2.2	Final Work Plan, Bioremediation Treatability Study, Site 17 Administration Area, NASA Crows Landing Flight Facility, Crows Landing, California. TN & Associates, Inc. April 17, 2008. Sections 2.3, 2.4, 2.5
4	Corcoran clay	Section 2.3	Final Investigation Summary Report, Extent of Groundwater Impact Verification, Installation Restoration Program Site 17, NASA Crows Landing Flight Facility, Crows Landing, California. Shaw Environmental, Inc. May 5, 2006. Section 1.4
5	four distinct groundwater zones	Section 2.3	Final Interim Remedial Action Technologies Evaluation. Tetra Tech EC, Inc. March 27, 2007. Section 2.2
6	regional groundwater flow	Section 2.3	Final February 2009 Semiannual Groundwater Monitoring Report. Tetra Tech EC, Inc. May 15, 2009. Section 2.2
7	hydraulic gradients	Section 2.3	Final February 2009 Semiannual Groundwater Monitoring Report. Tetra Tech EC, Inc. May 15, 2009. Section 4.1
8	ecosystems	Section 2.3	Action Memorandum for Time-Critical Removal Actions at the NASA Crows Landing Flight Facility, Administration Area Plume, 1,2-Dichloroethane (1,2-DCA) and Carbon Tetrachloride Source Areas at IRP Site 17. Department of the Navy. Section II.A.2
9	subsurface investigations and interim remedial actions	Section 2.4	Final Feasibility Study, Site 17 Administration Area Groundwater Plume, NASA Crows Landing Flight Facility, Crows Landing, California. Terra Pacific Group. February 18, 2011. Section 3.1
10	off-site downgradient	Section 2.4	Final Investigation Summary Report,

Reference Number	Reference Phrase in ROD	Location in ROD	Identification of Referenced Document Available in the Administrative Record
	investigation		Extent of Groundwater Impact Verification Installation Restoration Program Site 17, NASA Crows Landing Flight Facility, Crows Landing, California. Shaw Environmental, Inc. May 5, 2006. Section 2
11	Site Conceptual Site Model	Section 2.7.1	Final Feasibility Study, Site 17 Administration Area Groundwater Plume, NASA Crows Landing Flight Facility, Crows Landing, California. Terra Pacific Group. February 18, 2011. Figure 5.1
12	nature and extent of groundwater contamination	Section 2.5	Final Feasibility Study, Site 17 Administration Area Groundwater Plume, NASA Crows Landing Flight Facility, Crows Landing, California. Terra Pacific Group. February 18, 2011. Section 4
13	February 2009 semiannual groundwater monitoring results	Section 2.5	Final February 2009 Semiannual Groundwater Monitoring Report. Tetra Tech EC, Inc. May 15, 2009. Sections 4 and 5
14	Enhanced in-situ bioremediation treatability study groundwater sampling results	Section 2.5	Final Feasibility Study, Site 17 Administration Area Groundwater Plume, NASA Crows Landing Flight Facility, Crows Landing, California. Terra Pacific Group. February 18, 2011. Sections 3.2.3.6 and 3.3.3.6
15	groundwater chemicals of concern	Section 2.5	Final Feasibility Study, Site 17 Administration Area Groundwater Plume, NASA Crows Landing Flight Facility, Crows Landing, California. Terra Pacific Group. February 18, 2011. Section 4.2.2
16	key compounds of interest	Section 2.5	Final Feasibility Study, Site 17 Administration Area Groundwater Plume, NASA Crows Landing Flight Facility, Crows Landing, California. Terra Pacific Group. February 18, 2011. Section 4.2.1
17	groundwater flow and solute transport model	Section 2.5.1	Final Feasibility Study, Site 17 Administration Area Groundwater Plume, NASA Crows Landing Flight Facility, Crows Landing, California. Terra Pacific Group. February 18, 2011. Section 4.3
18	Feasibility Study	Section 2.5.1	Final Feasibility Study, Site 17 Administration Area Groundwater Plume, NASA Crows Landing Flight Facility, Crows

Reference Number	Reference Phrase in ROD	Location in ROD	Identification of Referenced Document Available in the Administrative Record
			Landing, California. Terra Pacific Group. February 18, 2011
19	agricultural production	Section 2.6	Final Interim Remedial Action Technologies Evaluation. Tetra Tech EC, Inc. March 27, 2007. Section 2.3
20	Water supply wells	Section 2.6	Final Remedial Investigation Report, Installation Restoration Program, Sites 10, 11, 12, 13, 14, 15, 16, 17, and 18. PRC Environmental Management, Inc. July 31, 1997. Section 3.3
21	LUC	Section 2.6	Final Closure Report, Underground Storage Tank Site 117 NASA Crows Landing Facility, Crows Landing, California. Shaw Environmental, Inc. May 3, 2005. Section 2.2
22	future reuse plan for the Facility	Section 2.6	Revised Preliminary Redevelopment Plan. Stanislaus County Redevelopment Agency. February 2009. Pages 9-11
23	human health risk assessment	Section 2.7	Draft Human Health and Ecological Risk Assessment for Groundwater Associated with an Off-site Agricultural Supply Well. Tetra Tech EC, Inc. November 17, 2008. Section 3
24	ecological risk assessments (ERAs)	Section 2.7	Draft Human Health and Ecological Risk Assessment for Groundwater Associated with an Off-site Agricultural Supply Well. Tetra Tech EC, Inc. November 17, 2008. Section 4
25	EPA Region 9 Regional Screening Levels	Section 2.7.1	Draft Human Health and Ecological Risk Assessment for Groundwater Associated with an Off-site Agricultural Supply Well. Tetra Tech EC, Inc. November 17, 2008. Section 3.3
26	potential cancer and non-cancer hazard risk levels	Section 2.7.1	Draft Human Health and Ecological Risk Assessment for Groundwater Associated with an Off-site Agricultural Supply Well. Tetra Tech EC, Inc. November 17, 2008. Section 3.7
27	general response actions	Section 2.11	Final Feasibility Study, Site 17 Administration Area Groundwater Plume, NASA Crows Landing Flight Facility, Crows Landing, California. Terra Pacific Group. February 18, 2011. Section 6.1
28	initial screening of	Section 2.11	Final Feasibility Study, Site 17

Reference Number	Reference Phrase in ROD	Location in ROD	Identification of Referenced Document Available in the Administrative Record
	remedial technologies		Administration Area Groundwater Plume, NASA Crows Landing Flight Facility, Crows Landing, California. Terra Pacific Group. February 18, 2011. Section 6.2
29	final screening of retained remedial technologies	Section 2.11	Final Feasibility Study, Site 17 Administration Area Groundwater Plume, NASA Crows Landing Flight Facility, Crows Landing, California. Terra Pacific Group. February 18, 2011. Section 6.3
30	detailed analysis	Section 2.11	Final Feasibility Study, Site 17 Administration Area Groundwater Plume, NASA Crows Landing Flight Facility, Crows Landing, California. Terra Pacific Group. February 18, 2011. Sections 8.2 – 8.5
31	nine evaluation criteria	Section 2.11	Final Feasibility Study, Site 17 Administration Area Groundwater Plume, NASA Crows Landing Flight Facility, Crows Landing, California. Terra Pacific Group. February 18, 2011. Section 8.1
32	comparative analysis	Section 2.11.2	Final Feasibility Study, Site 17 Administration Area Groundwater Plume, NASA Crows Landing Flight Facility, Crows Landing, California. Terra Pacific Group. February 18, 2011. Section 9
33	ARARs	Section 2.11.2.1	Appendix A of this Record of Decision

Appendix A

ARARs and TBCs

Table A-1
Potentially Applicable or Relevant and Appropriate Requirements (ARARs) Related to Groundwater
Former Crows Landing Flight Facility
Crows Landing, California

Standard, Requirement, Criteria, Limitation	Citation	Description	Type of ARARs	ARAR Determination
Federal				
RCRA – Land Disposal Restrictions (LDRs)	40 CFR Parts 148 and 268 RCRA §§ 3020(a) and (b) RCRA § 3004(f), (g), (m) http://www.clu-in.net/products/regs/9234106.htm	RCRA LDRs prohibit land disposal and/or reinjection of restricted hazardous waste that does not meet treatment standards achieved using the Best Available Technology (BDAT). However RCRA 3020(b) makes groundwater reinjection as part of a CERCLA response exempt from this LDR provided the reinjected water is treated to substantially reduce concentrations and its protective human health and the environment. These regulations do not apply to the injection of nutrients/ adjuvants and/or chemical reagents as part of in situ bioremediation because these commercial products are not considered hazardous.	Chemical/ Action	Applicable
RCRA - Hazardous Waste Identification/Characterization	40 CFR 261.24 (last updated July 14, 2006)	Establishes criteria to determine whether solid waste exhibits hazard characteristics of toxicity based on the measured TCLP concentration.	Chemical	Relevant and Appropriate
Clean Water Act (CWA) – National Recommended Water Quality Criteria (NRWQC)	CWA § 304(a)(1) 33 U.S.C, Chapter 26, §§ 1251–1387 33 U.S.C. § 1314(a) 42 U.S.C.§ 9621(d)(2) 64 Fed. Reg. 19781 (CWA last updated April 22, 1999; NRWQC last updated by USEPA in 2009)	CWA establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. The CWA made it unlawful to discharge any pollutant from a point source into navigable waters, unless a permit was obtained. http://www.epa.gov/lawsregs/laws/cwa.html http://www.epa.gov/waterscience/criteria/wqctable/nrwqc-2009.pdf	Chemical	Relevant and Appropriate

Table A-1
Potentially Applicable or Relevant and Appropriate Requirements (ARARs) Related to Groundwater
Former Crows Landing Flight Facility
Crows Landing, California

Standard, Requirement, Criteria, Limitation	Citation	Description	Type of ARARs	ARAR Determination
Federal				
Safe Drinking Water Act- USEPA Maximum Contaminant Levels (Drinking Water Standards)	40 CFR § 141.11, excluding § 141.11(d)(3);141.61(a) and (c); and 141.62(b) (1996) (last updated January 26, 2010) 40 CFR § 131.36 (b) and 131.36 33 U.S.C. § Chapter 26 1311(b)(2) CWA § 301(b) 55 Fed. Reg. 8666, 8753,[1990]	SDWA authorizes USEPA to set national health-based standards for drinking water to protect against both naturally-occurring and man-made contaminants that may be found in drinking water. USEPA, states, and water systems then work together to make sure that these standards are met. Establishes maximum contaminant levels for organic and inorganic contaminants at the tap. However, for CERCLA sites, MCLs shall be obtained throughout the contaminated plume for potential sources of drinking water. http://www.epa.gov/safewater/contaminants/index.html	Chemical	Relevant and Appropriate
Clean Air Act (CAA)- National Ambient Air Quality Standards	40 CFR § 50.4-50.12	The Clean Air Act is the law that defines EPA's responsibilities for protecting and improving the nation's air quality and the stratospheric ozone layer. The last major change in the law, the Clean Air Act Amendments of 1990, was enacted by Congress in 1990. Legislation passed since then has made several minor changes. NAAQS are not enforceable in and of themselves; they are translated into source-specific emission limitations by the state. http://www.epa.gov/air/caa/	Chemical	Relevant and Appropriate
CERCLA Alternative Concentration Limits	CERCLA §121(d)(2)(B)(ii) 42 U.S.C. § 9621[d][2][B][ii]	Alternate Concentration Limits (ACLs) are risk-based concentration limits that can be used to establish alternate groundwater protection standards.	Chemical/ To be considered	Relevant and Appropriate

Table A-1
Potentially Applicable or Relevant and Appropriate Requirements (ARARs) Related to Groundwater
Former Crows Landing Flight Facility
Crows Landing, California

Standard, Requirement, Criteria, Limitation	Citation	Description	Type of ARARs	ARAR Determination
Federal				
USEPA Region 9 Remediation Screening Level (RSL)	www.epa.gov/region09/superfund/prg/ (last updated December 20, 2009)	RSLs, formerly known as the preliminary remediation goals (PRGs), are risk-based concentration levels that can be used to screen and evaluate contaminant concentrations for contaminated sites and streamline and standardize all stages of the risk decision-making process. These levels combine current human health toxicity values with standard exposure factors to estimate acceptable contaminant concentrations in environmental media (soil, air, and water) that are considered by the Agency to be protective of human exposures (including sensitive groups) over a lifetime.	Chemical/ To be considered	Relevant and Appropriate
CERCLA NCP	55 Fed. Reg. 8753 (March 8, 1990)	The CERCLA NCP preamble provides that compliance with groundwater cleanup standards should be attained throughout the affected area of the aquifer. This statute states there may be certain circumstances where a plume of groundwater contamination is caused by releases from several distinct sources that are in close geographical proximity. The NCP preamble provides that, in such cases, the most cost-effective groundwater cleanup strategy may be to address the problem as a whole rather than on a source-by-source basis.	Chemical/ To Be considered	Relevant and Appropriate
CWA – Wetlands	§ 404 of CWA 33 U.S.C. § 1344	The CWA prohibits the discharge of dredged or fill material into wetlands without permit and regulates actions to minimize the destruction, loss, or degradation of wetlands.	Location/ To be considered	Not an ARAR; Wetlands are not located within the Site.

Table A-1
Potentially Applicable or Relevant and Appropriate Requirements (ARARs) Related to Groundwater
Former Crows Landing Flight Facility
Crows Landing, California

Standard, Requirement, Criteria, Limitation	Citation	Description	Type of ARARs	ARAR Determination
Federal				
Protection of Wetlands	Executive Order Number 11990 § 7 40 CFR § 6.302(a)	This order has been established to minimize the destruction, loss, or degradation of wetlands.	Location/ To be considered	Not an ARAR; Wetlands are not located within the Site boundary.
RCRA – Within 100-year floodplain	42 U.S.C. §§ 6901-6991 (i)	USEPA requires facilities related to RCRA hazardous waste treatment, storage, or disposal be designed, constructed, and operated to avoid washout.	Location/ To be considered	Not a ARAR; Site located in Flood Zone C (minimal potential for flooding)
Floodplain Management	40 CFR § 6.302 (b)	Requires actions that will occur within floodplains, lowlands, and flat areas adjoining inland waters, coastal waters, and other flood prone areas avoid adverse effects, minimize potential harm, and restore and preserve natural and beneficial values.	Location/ To be considered	Not an ARAR; Site and majority of Facility located in Flood Zone C for minimal potential for flooding.

Table A-1

Potentially Applicable or Relevant and Appropriate Requirements (ARARs) Related to Groundwater

Former Crows Landing Flight Facility

Crows Landing, California

Standard, Requirement, Criteria, Limitation	Citation	Description	Type of ARARs	ARAR Determination
Federal				
Historical Sites, Buildings and Antiquities Act of 1935	16 U.S.C. §§ 461-467	Protection of designated historic places by prohibiting undesirable impacts on landmarks.	Location/ To be considered	Not an ARAR; there are no designated historical buildings or places at the Site.
National Historic Preservation Act of 1966	16 U.S.C. §§ 470-470x-6	Designates or list eligibility of properties or places on the National Register of Historic Places and prohibits actions to prevent harm and maintain these resources.	Location/ To be considered	Not an ARAR; Facility is not a designated or eligible Historic Place.
Archaeological and Historic Preservation Act	16 U.S.C.§ 469-469c-1 40 CFR § 6.301 (c)	This statute regulates the alternation of terrain caused a result of a federal construction project or federally licensed activity or program where action may cause irreversible harm, loss, or destruction of significant artifacts. Requires an archaeological survey be completed prior to construction.	Location/ To be considered	Not an ARAR; archaeological or historical data have not been previously identified.
Archaeological Resources Protection Act of 1979	16 U.S.C. § 470aa-470mm	This statute prohibits unauthorized excavation, removal, damage, alteration, or defacement of archaeological resources located on public lands unless such actions are conducted pursuant to a permit.	Location/ To be considered	Not an ARAR; archaeological resources have not been previously identified.

Table A-1

Potentially Applicable or Relevant and Appropriate Requirements (ARARs) Related to Groundwater

Former Crows Landing Flight Facility

Crows Landing, California

Standard, Requirement, Criteria, Limitation	Citation	Description	Type of ARARs	ARAR Determination
Federal				
Endangered Species Act of 1973	16 U.S.C. §§ 1531-1543	This statute protects endangered species and their habitat from adverse modifications and allows for reasonable mitigation and enhancement measures be implemented if an exemption is granted to disturb these areas due to a necessary CERCLA corrective action.	Location/ To be considered	Not an ARAR; protected species and habitat not previously identified.
Migratory Bird Treaty Act of 1972	16 U.S.C. §§ 703-712	Statute protects most species of native migratory birds in the US from poisoning related to hazardous waste sites.	Location/ To be considered	Not an ARAR; migratory birds have not been previously observed at the Facility.
National Wildlife Refuge System Administration Act of 1966	16 U.S.C. § 668dd-668ee	Statute designates areas protected for wildlife and prohibits any person from removing any animal or plant from a designated area. Statute also prohibits dumping of wastes into protected areas.	Location/ To be considered	Not an ARAR; protected wildlife areas not previously identified at the Site or Facility

Table A-1

Potentially Applicable or Relevant and Appropriate Requirements (ARARs) Related to Groundwater

Former Crows Landing Flight Facility

Crows Landing, California

Standard, Requirement, Criteria, Limitation	Citation	Description	Type of ARARs	ARAR Determination
State and Local				
RCRA Program - Hazardous waste characterization, transport, and disposal as well as discharges to land	California Code of Regulations (CCR) Title 22 (22 CCR) § 66261.24, 66261.22(a)(1), 66261.23, 66261.24(a)(1), 66261.100 23 CCR, Division 23, Chapter 15 23 CCR, Article 1, § 2511	Regulates handling, transport, and disposal of waste meeting the requirements of a California Hazardous waste defined by chemical levels that do not exceed the federal TCLP limit, but do exceed the state STLC limit. CCR Title 23 states that discharge of waste to wells by injection under the Safe Drinking Water Act are exempt from these provisions.	Chemical	Relevant and Appropriate
RCRA Program - Groundwater Protection Standards	22 CCR §§ 66264.94(a)(1), (a)(3), (c), (d), (e)	Provides regulations for the protection of groundwater at RCRA-regulated waste management units. Requires groundwater concentrations be equal to or below background levels if technologically or economically feasible and/or groundwater concentrations do not exceed other regulated levels such as the MCLs.	Chemical	Relevant and Appropriate
Determination of Characteristic Wastes	22 CCR § 66261.24 (last updated 2005)	Establishes criteria for identifying characteristic wastes.	Chemical/ To be considered	Relevant and Appropriate
Determination of Hazardous Waste	22 CCR 66260.1 et seq. (2004)	Establishes criteria for determining waste classification for the purposes of transportation and disposal of wastes.	Chemical/ Action	Relevant and Appropriate
Hazardous Waste Control	California Health and Safety Code (H&SC) Chapter 6.5, §§ 25100-25250.26 (2008)	Establishes hazardous waste control measures.	Action/ To be considered	Relevant and Appropriate
Hazardous Waste Generator Requirements	22 CCR § 66262.11 et seq. (2003)	Establishes standards applicable to generators of hazardous waste.	Action/ To be	Relevant and Appropriate

Table A-1
Potentially Applicable or Relevant and Appropriate Requirements (ARARs) Related to Groundwater
Former Crows Landing Flight Facility
Crows Landing, California

Standard, Requirement, Criteria, Limitation	Citation	Description	Type of ARARs	ARAR Determination
State and Local				
			considered	
Transportation of Hazardous Waste	22 CCR Chapter 13 (1997)	Governs transportation of hazardous materials.	Action/ To be considered	Relevant and Appropriate
Hazardous Substances Account Act	H&SC, Chapter 6.8, §§ 25300-25395.15 (1999)	Establishes site mitigation and cost recovery programs.	Action/ To be Considered	Relevant and Appropriate
Department of Toxic Substances Control (DTSC) Site Mitigation Program Policies and Procedures	California EPA (CAL EPA) DTSC	Applicable policies, procedures, management memos and related guidance documents.	Action/ To be considered	Relevant and Appropriate
Toxics Pits Cleanup Act	H&SC, § 25208 (1984)	Authorizes the Regional Water Quality Control Board to regulate surface impoundments containing hazardous waste.	Action/ To be considered	Not an ARAR; surface impoundments not proposed at Site
Land Disposal Restrictions	22 CCR Chapter 18 (2004)	Identifies hazardous waste restricted from land disposal unless specific treatment standards are met.	Chemical/ Action	Relevant and Appropriate

Table A-1
Potentially Applicable or Relevant and Appropriate Requirements (ARARs) Related to Groundwater
Former Crows Landing Flight Facility
Crows Landing, California

Standard, Requirement, Criteria, Limitation	Citation	Description	Type of ARARs	ARAR Determination
State and Local				
Standards for Discharge of Waste to Land	27 CCR section 20080 et seq.; 23 CCR section 2510 et seq.; 22 CCR section 66250 et seq.	Establishes waste and siting classification systems and minimum waste management standards for discharge of waste to land for treatment, storage, and disposal. Engineered alternatives that are consistent with Title 27/Title 23 performance goals may be considered. Establishes corrective action requirements for responding to discharges to land, including spills and leaks and other unauthorized discharges. The application of specific sections of Title 27/Title 23 is noted below. Provisions of Title 23 apply to hazardous waste and provisions of Title 27 apply to nonhazardous solid waste.	Action	Applicable
	Title 27, CCR section 20090(d); Title 23, CCR, section 2511(d)	Actions taken by public agencies to clean up unauthorized releases are generally exempt from Title 27/Title 23. One exception is that wastes contained or left in place must comply with Title 27 or Title 23 to the extent feasible.	Action	Relevant and Appropriate (State believes this is an applicable requirement)
	27 CCR section 20400, 23 CCR section 2550.4	Concentration limits must be established for groundwater, surface water, and the unsaturated zone. Must be based on background, equal to background, or for corrective actions, may be greater than background, not to exceed the lower of the applicable water quality objective or the concentration technologically or economically achievable. Specific factors must be considered in setting cleanup standards above background levels.	Action	Applicable

Table A-1
Potentially Applicable or Relevant and Appropriate Requirements (ARARs) Related to Groundwater
Former Crows Landing Flight Facility
Crows Landing, California

Standard, Requirement, Criteria, Limitation	Citation	Description	Type of ARARs	ARAR Determination
State and Local				
	27 CCR section 20410; 23 CCR section 2550.6	Requires monitoring for compliance with remedial action objectives for three years from the date of achieving cleanup standards.	Action	Applicable
	27 CCR section 20415; 23 CCR section 2550.7	Requires general soil, surface water, and groundwater monitoring. Applies to all areas at which waste has been discharged to land.	Action	Applicable
	27 CCR section 20430; 23 CCR section 2550.10	Requires implementation of corrective action measures that ensure that cleanup levels are achieved throughout the zone affected by the release by removing the waste constituents or treating them in place. Source control may be required. Also requires monitoring to determine the effectiveness of the corrective actions.	Action	Applicable
Porter-Cologne Water Quality Control Act (California Water Code)	California Water Code 13240, 13241, 13243, 13263(a), 13243, 13269, 13360	Establishes the State Water Resources Control Board (SWRCB) and each Regional Water Quality Control Board as the primary State of California agency responsible for the coordination and control of water quality. Enables legislation, as implemented through the beneficial uses, WQOs, waste discharge requirements, and promulgated policies of the Basin Plan.	Chemical	Relevant and Appropriate
California Safe Drinking Water Act Maximum Contaminant Levels (Drinking Water Standards)	22 CCR Chapter 15 Article 4 §§ 64431 and 64444	This act is applicable for an aquifer and associated distribution and pre-treatment system that is defined as "public water system". The CA SDWA authorizes the State Department of health to protect the public from contaminants in drinking water by establishing MCLs that are at least as stringent as those established by the USEPA. Establishes Maximum contaminant levels for	Chemical	Applicable

Table A-1
Potentially Applicable or Relevant and Appropriate Requirements (ARARs) Related to Groundwater
Former Crows Landing Flight Facility
Crows Landing, California

Standard, Requirement, Criteria, Limitation	Citation	Description	Type of ARARs	ARAR Determination
State and Local				
		organics and inorganics in drinking water.		
Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basin	California Water Code §§ 13240-13243	The Basin Plan is enforced by the Central Valley Regional Water Quality Control Board (CVRWCB) and identifies beneficial uses for all waters within the basin. Groundwater within the basin is considered suitable or potentially suitable, at minimum, for municipal and domestic water supply (MUN), agricultural water supply (AGR), industrial service supply (IND), and industrial process supply (PRO). The Basin Plan indicates that all groundwater must meet or exceed background conditions and comply with the contaminant levels outlined in 22 CCR.	Chemical	Applicable
State Water Resources Control Board Resolution No. 2009-0011	California Water Code section 13140	Policy establishing criteria promoting use of recycled water and applies, among other activities, to actions that result in discharge of treated water.	Action	State determination: Relevant and Appropriate Navy determination: TBC. The remedy will treat extracted groundwater to lowest concentrations technically and economically feasible prior to

Table A-1
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Crows Landing, California

Standard, Requirement, Criteria, Limitation	Citation	Description	Type of ARARs	ARAR Determination
State and Local				
				injection into the aquifers.
SWRCB Resolution No. 68-16 (High Quality water, Anitdegradation Policy)	California Water Code §§ 13000, 13140, 13263, 13304 (October 1968)	Requires maintenance of high quality waters to maintain status unless a change is consistent with the maximum benefit to the people of the state, will not unreasonably affect the beneficial uses of the water, and will not result in adverse water quality less than that prescribed in the adopted policies. Also requires discharges to high quality water meet waste disposal requirements.	Action/ To be considered	Relevant and Appropriate (State believes this is an applicable requirement)
SWRCB Resolution No. 88-63 (California Source of Drinking Water Policy)	California Water Code §§ 13000, 13140, 13240 (February 2006)	This resolution specifies that all groundwater and surface water must have the beneficial use of municipal or domestic water supply and identifies the specific criteria for those cases where water may not be considered a potential drinking water source.	Action/ To be considered	Relevant and Appropriate (State believes this is an applicable requirement)
SWRCB Resolution No. 92-49 (Policies and Procedures for Investigation and Cleanup and Abatement of Discharges)	California Water Code § 13304 (October 1996)	Establishes requirements for investigations and cleanup and abatement of discharges. Requires dischargers cleanup and abate the effects of discharge in a manner that promotes the attainment of background water quality, or the best water quality that is reasonably obtainable if background levels cannot be met.	Action/ To be considered	Relevant and Appropriate (State believes this is an applicable requirement)
Staff Report of the Central Valley Water Board	"A Compilation of Water Quality Goals"	Provides guidance on selecting numerical values to implement narrative water quality objectives contained in		To Be Considered

Table A-1
Potentially Applicable or Relevant and Appropriate Requirements (ARARs) Related to Groundwater
Former Crows Landing Flight Facility
Crows Landing, California

Standard, Requirement, Criteria, Limitation	Citation	Description	Type of ARARs	ARAR Determination
State and Local				
		the Basin Plan.		
State of California Air Resources Board	H&SC §41700	The State of California has established the Air Resources Board to oversee regional air management districts to ensure emissions of the State meet the CAA NAAQS at minimum. In many cases, State emission guidelines are more stringent than those identified by USEPA in the CAA. The Air Management Districts regulate and enforce standards for emissions of chemical vapors and dust. The Site is located within the San Joaquin Valley Air Pollution Control District (SJVAPCD). SJVAPCD issues permits to comply with allowable contaminant emission levels. Emission limits may be established by the SJVAPCD for selected remedial ex situ treatment technologies.	Chemical/ To be considered	Relevant and Appropriate
SFRWQCB Environmental Screening Levels (ESLs)	Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater (last updated May 2008) http://www.swrcb.ca.gov/rwqcb2/esl.shtml)	This document is a technical report prepared by staff of the California Regional Water Quality Board, San Francisco Bay Region. The ESLs represent an expansion of the USEPA Region 9 RSLs and have been established for chemicals commonly found in soil and groundwater at sites where releases of hazardous chemicals have occurred. ESL goals for groundwater include: protection of drinking water resources; protection of aquatic habitats; protection against vapor intrusion into buildings; and, protection against adverse nuisance conditions.	Chemical/ To be considered	Relevant and Appropriate

Table A-1
Potentially Applicable or Relevant and Appropriate Requirements (ARARs) Related to Groundwater
Former Crows Landing Flight Facility
Crows Landing, California

Standard, Requirement, Criteria, Limitation	Citation	Description	Type of ARARs	ARAR Determination
State and Local				
California Human Health Screening Levels (CHHSLs)	H&SC § 57008 CAL EPA, 2005, Use of California Human Health Screening Levels (CHHSLs) in Evaluation of Contaminated Properties, January.	CAL EPA Office of Environmental Health Hazard Assessment (OEHHA) published the CHHSLs as a tool to assist in the evaluation of contaminated site for potential adverse threats to human health. The CHHSLs are essentially identical to the corresponding soil and soil gas screening levels incorporated into the ESLs.. CHHSLs were not developed for groundwater or surface water, but are used to understand human health exposures related to vapor emissions from the subsurface.	Chemical/ To be considered	Relevant and Appropriate
California Endangered Species Act – Endangered species habitat	California Department of Fish and Game (CDFG) Code, § 2080	Statute protects endangered or threatened species listed on or before January 1, 1985, or a candidate species with proper notification from import, export, or sale.	Location/ To be considered	Not an ARAR; protected species and habitat not previously identified.
California Endangered Species Act – Discharge to water	CDFG Code § 5650 (a) and (f)	Prohibits the discharge or release of any enumerated substance or deleterious material to fish, plant life, or birds into waters of the State.	Location/ To be considered	Relevant and Appropriate
Occupational Health and Safety	8 CCR §§ 1500, 2300, and 3200 et seq. (1984)	Establishes standards for working conditions and employees matter; and notification requirements.	Action/ To be considered	Relevant and Appropriate

Table A-1
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Former Crows Landing Flight Facility
Crows Landing, California

Standard, Requirement, Criteria, Limitation	Citation	Description	Type of ARARs	ARAR Determination
State and Local				
Land Use Covenants	22 CCR Chapter 39, Division 4.5, § 67391.1 CA Civil Code §1471 H&SC §§ 2520.5, 25222.1, 25233(c), 25234, 25355	Specifies that a land use covenant imposing appropriate limitations on land use shall be executed and recorded when hazardous materials, hazardous wastes or constituents, or hazardous substances will remain at the property at levels which are not suitable for unrestricted use of the land. Land use covenants involve layered implementation in the form of a land-use restriction, land-use covenant, and/or deed notice.	Action/ To be considered	Applicable
Groundwater Quality Monitoring	22 CCR § 66264.100	Regulation requires a water quality program be implemented to demonstrate the effectiveness of a corrective action program.	Action/ To be considered	Applicable

Table A-1

Potentially Applicable or Relevant and Appropriate Requirements (ARARs) Related to Groundwater

Former Crows Landing Flight Facility

Crows Landing, California

Notes:

ACLs = Alternate Concentration Limits
AGR = Agricultural
ARAR = Applicable or Relevant and Appropriate Requirements
BDAT = Best Available Technology
CA = California
CA SDWA = California Safe Drinking Water Act
CAA = Clean Air Act
CAL EPA = California Environmental Protection Agency
CCR = California Code of Regulations
CDFG = California Department of Fish and Game
CERCLA = Comprehensive Environmental Response Recovery Act
CFR = Code of Federal Regulations
CHHSL = California Human Health Screening Level
CVRWQCB = Central Valley Regional Water Quality Control Board
CWA = Clean Water Act
DTSC = Department of Toxic Substances Control
EPA = Environmental Protection Agency
ESL = Environmental Screening Levels
Fed. Reg. = Federal Regulation
H&SC = Health and Safety Code
IND = Industrial
LDR = Land Disposal Restrictions
MCL = Maximum Contaminant Level
MUN = Municipal
NAAQS = National Ambient Air Quality Standards
NCP = National Contingency Plan
NPDES = National Pollution Discharge Elimination System
NRWC = National Recommended Water Quality Criteria
OEHHA = Office of Environmental Health Hazard Assessment
PRG = preliminary remediation goal
PRO = Industrial Process Supply

Notes (continued):
RCRA = Resource Conservation Recovery Act
RSL = Remediation Screening Level
SDWA = Safe Drinking Water Act
SJVAPCD = San Joaquin Valley Air Pollution Control District
STLC = Soluble Threshold Limit Concentration
SWRCB = State Water Resources Control Board
TCLP = Toxicity Characteristic Leachate Procedure
U.S.C. = United States Code
USEPA = United States Environmental Protection Agency
WQOs = Water Quality Objectives

Appendix B

Acronyms and Abbreviations

LIST OF ABBREVIATIONS AND ACRONYMS

1,2-DCA	1,2-dichloroethane
AMSL	above mean sea level
ARAR	applicable or relevant and appropriate requirement
AS	air sparging
Basin Plan	Water Quality Control Plan for the Sacramento River and San Joaquin River Basin
BDAT	best demonstrated available technology
bgs	below ground surface
BCT	BRAC Cleanup Team
BTEX	benzene, toluene, ethylbenzene, and xylenes
CCl4	carbon tetrachloride
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CF	chloroform
CFR	Code of Federal Regulations
COCs	chemicals of concern
County	Stanislaus County
CCl4	carbon tetrachloride
CVRWQCB	Central Valley Regional Water Quality Control Board
CWA	Clean Water Act
DTSC	Department of Toxic Substances Control
DWR	Department of Water Resources
EBS	environmental baseline survey
EDB	ethylene dibromide
EISB	enhanced in situ bioremediation
ERA	ecological risk assessment
Fed. Reg.	Federal Register
FS	Feasibility Study
gpm	gallons per minute
GAC	granular activated carbon
GPR	Ground Penetrating Radar

HHRA	human health risk assessment
ICs	institutional controls
IRP	Installation Restoration Program
iSOC	in situ submerged oxygen curtain
LUC	land-use covenant
MCLs	maximum contaminant levels
MEK	Methyl ethyl ketone
MIBK	methyl isobutyl ketone
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MNA	monitored natural attenuation
NASA	National Aeronautics and Space Administration
Navy	Department of the Navy
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
O&M	operation and maintenance
OEHHA	Office of Environmental Health Hazard Assessment
OLF	outlying land field
ORC	oxygen releasing compound
RAO	remedial action objective
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RGs	Remedial Goals
RI	remedial investigation
ROD	record of decision
RWQCB	Regional Water Quality Control Board
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
Shaw	Shaw Environmental, Incorporated
SI	site investigation
SVE	soil vapor extraction
TBC	to be considered

LIST OF ABBREVIATIONS AND ACRONYMS (continued)

TEPH	total extractable petroleum hydrocarbons
TPH-d	diesel range petroleum hydrocarbons
TPH-g	gasoline range petroleum hydrocarbons
U.S.C.	United States Code
USEPA	United States Environmental Protection Agency
UST	underground storage tank
VOCs	volatile organic compounds
WQOs	water quality objectives

Appendix C

Response to Regulatory Comments

Response to Regulatory Comments: Draft ROD, Site 17 Administration Area Groundwater Plume, NASA Crows Landing Flight Facility, Crows Landing, Stanislaus County, dated August 29, 2012, and prepared by Terra Pacific Group, Inc.

Comment No.	Section, Figure, Table	Comments	Response
Draft ROD, August 29 2012			
Comments from Central Valley Regional Water Quality Control Board, dated September 25, 2012.			
1	Section 2.12.2	The third paragraph in this section discussed the permitting that will be required to inject the treated and amended groundwater back into the aquifer. The draft ROD states a "waiver of waste discharge" will be obtained. The permit that will be needed for the cleanup remedy is General Order No. R5-2008-0149: *Waste Discharge Requirements for in-situ Groundwater Remediation at Sites with Volatile Organic Compounds, Nitrogen Compounds, Perchlorate, Pesticides, Semi-Volatile Compounds, Hexavalent Chromium and/or Petroleum Hydrocarbons.* A notice of applicability for this general order will need to be obtained before injection of the treated/amended groundwater can occur.	CERCLA response actions that are conducted on site do not require federal, state or local permits to engage in the remediation activity (CERCLA Section 121(e), as codified in 42 USC Section 9621(e) [2001]). CERCLA Section 121(e) waives the requirement to obtain permits and exempts the Navy from the associated administrative and procedural requirements of permits. Accordingly, the Navy will not be obtaining a permit for the onsite discharge of treated and amended water into the subsurface. However, the substantive provisions of permitting regulations that would otherwise be required for a non-CERCLA action will be adhered to during the project through compliance with the identified ARARs. The paragraph of Section 2.12.2 that discussed the requirement for a permit has been deleted.
Comments from the Department of Toxic Substances Control, dated October 1, 2012			
1	Page 1-3 Statutory Determinations.	Please state a statutory review will be conducted every 5 years or until remediation goals are met.	The text has been modified to state "Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted every five years, or until remediation goals are met, after initiation of the remedial action to ensure that the remedy is protective of human health and the environment"
2	Page 1-5 Authorizing Signatures	Please include Mr. Charlie Ridenour, Clean-Up Program Branch Chief, in the block of authorizing signatures	Mr. Charlie Ridenour has been added to the authorizing signatures.