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EPA Superfund
Record of Decision:

YUMA MARINE CORPS AIR STATION
EPA ID: AZ0971590062
OU 01
YUMA, AZ
09/08/2000

REGION: 9 **FY:2001**

MARINE CORPS AIR STATION, OU 1

YUMA, AZ

ROD

FINAL
RECORD OF DECISION
OPERABLE UNIT-1

MARINE CORPS AIR STATION
YUMA, ARIZONA

JULY 2000

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ACRONYMS/ABBREVIATIONS

AAC	Arizona Administrative Code
ADEQ	Arizona Department of Environmental Quality
ADWR	Arizona Department of Water Resources
ARAR	applicable or relevant and appropriate requirement
ARS	Arizona Revised Statute
AS	air sparging
bgs	below ground surface
BLRA	baseline risk assessment
CAOC	CERCLA area of concern
CDI	chronic daily intake
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFR	*Code of Federal Regulations*
CHC	chlorinated hydrocarbon
COC	chemical of concern
COPC	chemical of potential concern
CSF	cancer slope factor
CSM	conceptual site model
2D	two dimensional
3D	three dimensional
DCA	dichloroethane
DCE	dichlorethene
ECAO	Environmental Criteria Assessment Office
ESD	explanation of significant differences
<F	degrees Fahrenheit
FFA	Federal Facilities Agreement
FS	feasibility study
ft/ft	foot per foot
GAC	granular activated carbon
HEAST	Health Effects Assessment Summary Tables
HI	hazard index
HQ	hazard quotient

ICP	institutional control plan
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
LOAEL	lowest observed-adverse-effect level
LTM	long-term monitoring
µg/L	micrograms per liter
MCAS	Marine Corps Air Station
MCL	maximum contaminant levels
MCLG	maximum contaminant level goal
mg/kg	milligram per kilogram (or parts per million)
mg/kg-day	milligrams per kilogram per day
MNA	monitored natural attenuation
NAAQS	National Ambient Air Quality Standards
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NOAEL	no observed-adverse-effect level
NPDES	National Pollutant Discharge Elimination System
O&M	operation and maintenance
OU	operable unit
PCE	tetrachloroethene
POC	point of compliance
POTW	publicly owned treatment works
PP	proposed plan
ppb	parts per billion
RA	remedial action
RAO	remedial action objective
RBC	risk-based criteria
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RI	remedial investigation
RME	reasonable maximum exposure
RNA	remediation by natural attenuation
ROD	record of decision
SDWA	Safe Drinking Water Act
STRAP	Source Treatment/Reduction Alternatives Plan
SVE	soil vapor extraction
SWDIV	Southwest Division Naval Facilities Engineering Command

TBC	to be considered,
TBD	to be determined
TCE	trichloroethene
TPH	total petroleum hydrocarbons
USBR	United States Bureau of Reclamation
U.S.C.	United States Code
U.S. EPA	United States Environmental Protection Agency
UST	underground storage tank
VOC	volatile organic compound
VR	vertical recirculation

SECTION 1

Section 1
DECLARATION

This Record of Decision (ROD) for Operable Unit (OU)-l documents the remedial action plan for groundwater contamination beneath Marine Corps Air Station (MCAS) Yuma, Arizona. The report is in accordance with the MCAS Yuma Federal Facilities Agreement (FFA) among the Department of the Navy (Navy); United States Environmental Protection Agency (U.S. EPA), Region 9; and the Arizona Department of Environmental Quality (ADEQ) (FFA 1991).

1.1 SITE NAME AND LOCATION

The site name and location are:

Marine Corps Air Station Yuma
Yuma, Arizona
Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) ID No. AZ0971590062
OU-1 (areas of contaminated groundwater underlying MCAS Yuma)

1.2 STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected and contingent remedial actions for four chlorinated hydrocarbon groundwater plumes beneath MCAS Yuma that are the result of past MCAS Yuma activities. These remedies were selected in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986, 42 United States Code (U.S.C.); and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (or National Contingency Plan [NCP]).

Documents and reports supporting the selected response actions are available at the city of Yuma's main public library and the MCAS Yuma Environmental Department for public review. The administrative record for MCAS Yuma is maintained by Southwest Division Naval Facilities Engineering Command (SWDIV) in San Diego.

The Navy, U.S. EPA, and ADEQ concur with the selected and contingent response actions.

1.3 ASSESSMENT OF THE SITE

The response actions selected in this ROD are necessary to protect the public health or welfare, or the environment, from actual or threatened releases of hazardous substances into the environment.

The remedial investigation (RI) for OU-1 assessed the impact on human health and the environment of hazardous substance releases to groundwater (JEG 1996a). The RI identified three fuels-related and four chlorinated hydrocarbon groundwater plumes at MCAS Yuma. The Navy, MCAS Yuma, US. EPA, and ADEQ agreed that the three fuels-related groundwater plumes would be handled under the state of Arizona

Underground Storage Tank (UST) Program, and the four chlorinated hydrocarbon groundwater plumes would be addressed under the Navy's Installation Restoration Program (IRP).

Based on the RI results, the four chlorinated hydrocarbon plumes in OU-1 may present a current or future threat to public health or welfare, or the environment, if not addressed by implementing the selected remedial actions described in this ROD.

1.4 DESCRIPTION OF THE SELECTED REMEDY

The U.S. EPA, ADEQ, and Navy signed an FFA in August 1991 to establish a framework and schedule for implementing environmental investigations and appropriate remedial actions. The FFA established three OUs to address specific environmental issues at MCAS Yuma.

OU-1 consists of the contaminated groundwater underlying MCAS Yuma and vadose-zone soil deeper than 10 feet below ground surface (bgs) that could potentially leach contaminants into the groundwater. This ROD addresses OU-1.

The upper 10 feet of soil at 18 CERCLA areas of concern (CAOCs) where hazardous-substance disposal or releases may have occurred make up OU-2. This OU addressed source materials at MCAS Yuma. The designated FFA parties signed the OU-2 ROD on 02 December 1997.

OU-3 had been reserved for any future contaminated sites not addressed in OUs-1 and -2. Because all sites have been addressed within either OU-1 or OU-2, OU-3 has never been needed.

This overall approach to MCAS Yuma's IRP is to address source areas and achieve significant risk reduction for on-site personnel. Assessing three fuels-related plumes under the state of Arizona UST Program combined with the IRP, provides a comprehensive strategy to address known threats to human health and the environment.

The selected remedies for the plumes in OU-1 are described in this section. The remedial approach to the groundwater contamination is to reduce the contaminant concentrations in groundwater to federal and state maximum contaminant levels (MCLs).

The OU-1 groundwater contaminant plumes are primarily characterized by tetrachloroethene (PCE) and trichloroethene (TCE) but also contain other volatile organic compounds (VOCs). This ROD sets aquifer cleanup levels for PCE, TCE, and 1,1-dichloroethene (1,1-DCE), as the more stringent of the federal and state MCLs. The major components of the selected remedies for each plume are described below.

1.4.1 Area 1 Plume

The selected remedy for the Area 1 plume consists of the following.

- C Install and operate a groundwater containment/treatment system of vertical recirculation (VR) wells (designed to contain plume migration and treat the relatively low concentration of chlorinated hydrocarbons within the groundwater plume) at the plume's leading edge on MCAS Yuma's northwest border.

- Install and operate an air sparging (AS)/soil vapor extraction (SVE) system to reduce contaminant concentrations in the plume hot spot near Building 230.

- Perform groundwater modeling in an attempt to demonstrate that VOC concentrations will reach the base boundary equal to or less than MCLs. If so demonstrated, then monitored natural attenuation (MNA) will be performed to verify VOCs are approaching MCLs.

  Note: Groundwater modeling will be performed if temporary shutdown of the containment/treatment VR system (because MCLs are reached) causes 1) VOC concentrations in monitoring wells upgradient of the MCAS Yuma boundary to rebound to levels greater than MCLs or 2) asymptotic conditions to be permanently reached at the Area 1 hot spot using the AS/SVE system.

- Monitor groundwater throughout the duration of the remedial action, estimated to take between 30 and 40 years.

- Implement institutional controls throughout the duration of the remedial action to restrict the domestic use of contaminated groundwater, which MCAS Yuma *will* implement.

In the event that the containment/treatment system VR wells are ineffective in treating the contaminant plume and preventing it from migrating off base, the selected contingent alternative to extract the contaminated groundwater and treat it with air stripping and granular activated carbon (GAC) will be implemented. The treated groundwater would either be discharged to the city of Yuma publicly owned treatment works (POTW) or recharged back into the aquifer through on-site reinjection wells. All spent GAC would be regenerated off site.

In the event the AS/SVE system is ineffective in reducing contaminant mass in the hot spot area, the selected contingent alternative to extract groundwater and treat with air stripping and GAC will be implemented.

If it is determined that pump and treat will be ineffective, the Navy will provide alternative technologies for the U.S. EPA and ADEQ to consider.

1.4.2 Areas 2, 3, and 6 Plumes

The Areas 2, 3, and 6 plumes are relatively small, stable plumes of chlorinated hydrocarbons. The major components of the selected remedy for the Areas 2, 3, and 6 plumes are as follows.

- Implement institutional controls throughout the duration of the remedial actions to restrict the domestic use of contaminated groundwater. MCAS Yuma will implement these controls.

- Conduct long-term monitoring (LTM) of groundwater to monitor plume behavior until MCLs are achieved through natural degradation/attenuation processes. It has been estimated, through fate and transport modeling of groundwater, that VOC concentrations at or below MCLs could be achieved in approximately 5 years for the Areas 2 and 6 plumes. VOC concentrations in the Area 3 plume were below MCLs in the summer of 1999.

In the event that MNA is not meeting the remedial action objectives, the selected contingent alternative to extract groundwater and treat with air stripping and GAC will be implemented. Treated groundwater would be discharged to the Yuma POTW, and spent GAC would be regenerated off site. Also selected as an alternate disposal method is discharging treated groundwater using on-site reinjection wells.

1.5 STATUTORY DETERMINATIONS

The selected remedies for the chlorinated hydrocarbon plumes in OU-1 protect human health and the environment, comply with federal and state requirements that are applicable or relevant and appropriate to the remedial action, are cost effective, and use permanent solutions and alternative treatment technologies to the maximum extent practicable. The remedies are designed to reduce chemical of concern (COC) concentrations to MCLs in each plume, as MCLs have been determined to be protective of human health and the environment. The remedies have been developed to be consistent with applicable or relevant and appropriate requirements (ARARs), and the least costly alternative that achieves remedial action objectives has been selected for each plume.

The selected remedy for Area 1 satisfies the statutory preference for treatment as a principal element of the remedy. VR and AS/SVE technologies will be used to treat the Area 1 plume.

These actions constitute the final remedy for the site; however, contingencies are included in the event that MNA or innovative treatment technologies do not perform as expected.

Because the MNA remedy results in hazardous substances remaining on site above levels that allow for unlimited use and unrestricted exposure, the Navy shall conduct a review, pursuant to CERCLA Section 121, within 5 years after commencement of the remedial action to assure that the remedy is or will be protective of human health and the environment.

1.6 RECORD OF DECISION DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this ROD. Additional information is in the administrative record file for this site.

- COCs and their respective concentrations are addressed in Section 2.7.1.1.

- The baseline risk represented by the COCs is addressed in Sections 2.7.1 through 2.7.1.4.

- Cleanup goals established for COCs and the basis for these goals are addressed in Section 2.13.1.1 and are presented on Figure 2-6.
- Source materials that constitute principal threats are addressed in Section 2.12.
- Current and reasonably anticipated future land-use assumptions, and current and potential future beneficial uses of groundwater, are addressed in Section 2.5.9.
- Potential land and groundwater use that will be available at the site as a result of the selected remedies are addressed in Section 2.15.
- Estimated capital, annual operation and maintenance (O&M) and total present-worth costs, discount rate, and the number of years over which the remedy cost estimates are projected are addressed in Sections 2.11.7, 2.13.1.6, and 2.13.2.3.
- Key factors that led to the remedy selections are addressed in Sections 2.11.10 and 2.13.

1.7 ACCEPTANCE OF REMEDY

For the United States Marine Corps, Marine Corps Air Station, Yuma:

____ ____________

Colonel M.E. Condra Date
Commanding Officer/MCAS Yuma

For the United States Environmental Protection Agency

____ ____________

Daniel Meer Date
U.S. EPA, Region 9

For the Arizona Department Of Environmental Quality

____ ____________

Jacqueline E. Schafer Date
Director, ADEQ

SECTION 2

Section 2
DECISION SUMMARY

This Decision Summary provides an overview of the OU-1 remedial actions, including site characteristics, alternatives evaluated, and the analysis of those options. It also identifies the selected remedies and explains how they fulfill statutory and regulatory requirements.

2.1 SITE LOCATION AND DESCRIPTION

MCAS Yuma, CERCLIS ID No. AZ0971590062, occupies nearly 3,000 acres southeast of the city of Yuma (Figure 2-1). The city of Yuma is on the northwest corner of Yuma Mesa, about 4 miles west of the confluence of the Gila and Colorado Rivers. Topographic relief on Yuma Mesa is generally slight, sloping down to the west at approximately 2 to 4 feet per mile. The relief on MCAS Yuma is also slight, approximately 150 feet from the lowest elevation to the highest. Local bedrock outcrops occur at higher elevations on MCAS Yuma.

The facility is owned by the federal government and operated by the U.S. Marine Corps. The Navy is the lead agency for all CERCLA actions at MCAS Yuma, providing technical leadership and fiscal support. MCAS Yuma provides services and materials to support the operations of the Marine Aircraft Wing and its subordinate units. MCAS Yuma also operates and maintains the joint military/civilian airport facility it shares with the Yuma Airport Authority.

2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

On 21 February 1928, Yuma County, Arizona, leased 640 acres of desert land near the city of Yuma from the federal government for use as an airfield. The airfield was established in the same year. Through the United States Bureau of Reclamation (USBR), Yuma County leased the acreage for 20 years with an option for an additional 20 years. In 1937, Yuma County constructed a small aircraft hangar and runway.

From 1941 to 1946, the U.S. Army Air Corps leased the facility for pilot and bomber crew training. During this period, MCAS Yuma was one of the busiest flight schools in the Army Air Corps. Flight activity ceased with the end of World War II, and the area was returned to the control of the USBR. In 1948, Yuma County obtained rights from the USBR to use the airfield, pursuant to Section 16 of the Federal Airport Act.

On 07 July 1951, the U.S. Air Force reactivated the site as a weapons proficiency center for fighter-interceptor units, and the site was declared a permanent Air Force installation in 1954. The Air Force reestablished joint use of the airfield with Yuma County in 1956.

In January 1959, the site and its associated range facilities were transferred to the U.S. Navy. MCAS Yuma was established on 10 January 1959 to maintain and operate facilities and provide services and materials to support operations of the Marine Aircraft Wing and its subordinate units.

Since 1959, major improvements have included construction of a 13,300-foot runway, development of the Instrumented Special Weapons System, and addition of a Tactical Aircrew Combat Training System.

Historical MCAS Yuma activities included management and use of various chlorinated hydrocarbon (CHC) solvents for aircraft maintenance. It is believed that CHCs have occasionally been spilled on the surface during such activities. It is also possible that tanks or drums of CHC solvents may have leaked onto the surface or into the subsurface in the past. CHCs could then have migrated into the groundwater through infiltration and percolation.

In 1985, the Navy began evaluating its installations under the IRP. Several studies were conducted at MCAS Yuma, including the Initial Assessment Study (Stearns 1985a); the former Marine Wing Weapon Unit Site Characterization (Stearns 1985b); the Confirmation Study, Verification Phase (Malcolm Pirnie 1988); and the Site Inspection (Malcolm Pirnie 1990). These early studies found chlorinated solvents in groundwater underlying MCAS Yuma, which led to its inclusion on the U.S. EPA's National Priorities List on 21 February 1990. The U.S. EPA, ADEQ, and Navy signed an FFA in August 1991 to establish a framework and schedule for implementing environmental investigations and appropriate remedial actions.

The FFA established three OUs. OU-1 consists of the contaminated groundwater underlying MCAS Yuma and soil deeper than 10 feet bgs that could potentially leach contaminants into the groundwater. OU-2 consists of soil in the upper 10 feet bgs at 18 CAOCs where hazardous substance disposal or releases may have occurred. OU-3 was reserved for future contaminated sites not previously identified in OU-2. Since no additional IRP site was identified, OU-3 was never used.

The OU-1 RI was conducted to determine areas of groundwater contamination that required either evaluation of remedial actions or no further action (JEG 1996a). Based on the results of the OU-1 RI, six areas of groundwater contamination were identified that exceeded drinking water standards (i.e., MCLs) (Figure 2-2). Four of the plume areas that were contaminated with CHCs (Areas 1, 2, 3, and 6) were investigated under the IRP. Two other areas of groundwater contamination containing, primarily, fuel constituents were investigated under the UST Program. These non-CERCLA areas are located in the Fuel Farm (Area 4) and the Motor Transportation Pool (Area 5). Subsequent to the RI, fuel constituents exceeding MCLs were identified at the Exchange Service Station (Subarea 5a), which was also investigated under the UST Program. Currently, all target compounds at the two UST sites are below MCLs, and free product has been removed. Final closure of the sites is pending.

The OU-1 Source Treatment/Reduction Alternatives Plan (STRAP) was conducted under the Navy's remedial action contract to evaluate the use of innovative *in situ* groundwater treatment technologies. In addition, the nature and extent of the primary CHC groundwater plumes were further investigated in several sampling phases (OHM Remediation Services Corp., briefing packages, 1996 and 1997). Based on the

OU-1 RI and STRAP findings, remedial alternatives were evaluated for the CHC plumes in Areas 1, 2, 3, and 6 in the OU-1 feasibility study (FS) (JEG 1998).

At OU-1, 5 VR wells, 44 air sparge points, and 15 soil vapor extraction wells have been installed as part of the remediation system at Area 1.

The OU-2 RI evaluated surface disposal and disposal units within the upper 10 feet of soil underlying MCAS Yuma, where disposal or releases of petroleum products, paints, solvents, metals, pesticides, and other process chemicals may have occurred. On the basis of the human-health and environmental risk assessments, the OU-2 RI recommended no remedial action for 12 CAOCs; remediation of asbestos-containing material at three CAOCs; and institutional controls at three CAOCs to minimize potential health risks that might be associated with land-use changes (JEG 1996b). Subsequently, an FS, proposed plan (PP), and ROD were submitted for the six CAOCs requiring further action under OU-2 (Uribe 1996a,b,c). The designated FFA parties signed the OU-2 ROD on 02 December 1997. Removal actions have been completed for the three CAOCs with asbestos-containing material with minor confirmation sampling planned during the summer of 2000.

2.3 COMMUNITY PARTICIPATION

The RI/FS Report and the PP for MCAS Yuma were made available to the public in June 1998. Because of inconsistent analytical data, Plume 2 was removed from OU-1, and a revised PP was submitted for public review in May 1999. Subsequent sampling has resolved the data inconsistencies, and Plume 2 is now again included in the scope of this ROD. These documents are in the administrative record file maintained by SWDIV in San Diego, California, and the information repositories maintained at the city of Yuma's main public library and the MCAS Yuma Environmental Department.

The Navy has implemented a progressive community-relations and involvement program for activities at MCAS. Yuma (JEG 1994). A restoration advisory board, comprising representatives from MCAS Yuma, Navy, U.S. EPA, ADEQ, and members of the general public, meets periodically to inform and involve the public in decisions regarding investigation results, proposed work, and potential remedial options.

The extent of the OU-1 contaminant plumes and the preferred remedial alternatives, as well as eight other alternatives, were described in the OU-1 PP for MCAS Yuma. The PP was prepared as a fact sheet and was distributed to all parties (approximately 200) on the community mailing list for the MCAS Yuma project. A public notice and the PP fact sheet announced that there was a 30-day period to receive public comments on the OU-1 PP. Notice of a public meeting as well as the availability of the PP was published in the Yuma *Daily Sun*.

A public meeting was held at 6:30 p.m. on 29 July 1998 to discuss the Navy's preferred and contingency alternatives. At this meeting the Navy gave a brief presentation regarding the PP, answered questions, and accepted comments from members of the public.

The 30-day public-comment period closed on 03 August 1998. The Navy received one comment. This comment and the Navy's response are summarized in Section 3.

A revised PP was published in May 1999. A public meeting was held at 6:30 p.m. on 11 May 1999. The PP was further discussed, and questions and comments from the public were addressed. The 30-day public-comment period closed on 31 May 1999. No further written comments were received.

2.4 SCOPE AND ROLE OF OPERABLE UNIT-1

As with many Superfund sites, the problems at MCAS Yuma are complex. Contaminated soils and groundwater from fuel-storage tanks and other operations using chlorinated solvents pose unacceptable risks and are being addressed in a comprehensive site-cleanup strategy.

As a result of this complexity and consistent with agreements among the Navy, U.S. EPA, and state of Arizona, the work associated with chlorinated-solvent contamination has been organized into three OUs.

- OU-1 consists of the contaminated groundwater underlying MCAS Yuma and vandose-zone soil deeper than 10 feet bgs that could potentially leach contaminants into the groundwater. This ROD addresses OU-1.

- OU-2 comprises the upper 10 feet of soil at 18 CAOCs where hazardous substance disposal or releases may have occurred. This OU addressed source materials at MCAS Yuma. The designated FFA parties signed the OU-2 ROD on 02 December 1997.

- OU-3 had been reserved for any future contaminated sites not addressed in OU-1 and -2. All sites have been addressed within either OU-1 or OU-2, so OU-3 has never been needed.

Information from the RI and STRAP was used to develop the groundwater remediation goals for OU-1. These proposed goals were based on a detailed analysis of ARARs and health risk-based criteria (RBC). Based on the state of Arizona's determination that all aquifers in the state are considered to be protected for drinking water use, federal and state MCLs were used as remediation goals. These remediation goals were used to define the areal extent of the groundwater contamination to be addressed and the cleanup levels to be achieved by remedial actions. A risk evaluation was conducted by setting cleanup goals to MCLs. The risk evaluation presented in the FS confirmed that remediation of groundwater contaminant concentrations to their respective MCLs is protective of human health.

The three fuels-related plumes have been addressed under the state of Arizona's UST Program and are not part of this decision.

2.5 SUMMARY OF OPERABLE UNIT-1 SITE CHARACTERISTCS

OU-1 addresses four groundwater plumes at MCAS Yuma. Figure 2-3 presents the conceptual site model (CSM) for groundwater on which the risk assessment and response action are based. The CSM identifies primary and secondary sources and release mechanisms, contaminant migration pathways, and exposure routes to human and ecological receptors. There is currently no complete pathway for human or ecological exposure. The only potential complete pathways would be human ingestion of groundwater from wells either on or off MCAS Yuma constructed in the future and drawing water from the plumes.

2.5.1 General Site Conditions

MCAS Yuma has supported military and civilian aircraft operations since 1928. It is primarily an industrial area, including runways, aprons, and taxiways along the flight line; landfill and disposal areas; former lagoon areas; fire-training areas; and a variety of buildings, paved roads, parking areas, and miscellaneous facilities. An on-base residential area is located upgradient of OU-1 at the southeast corner of the base. USTs have been associated with several of the facilities.

MCAS Yuma is located on the northwest corner of the Yuma Mesa, approximately 4 miles southwest of the confluence of the Gila and Colorado Rivers and approximately 60 to 70 feet above the Colorado River Valley. Topographic relief on the Yuma Mesa is generally slight, sloping down to the west at approximately 2 to 4 feet per mile. The relief on MCAS Yuma is also slight, approximately 150 feet from the lowest elevation to the highest. Local bedrock outcrops occur at higher elevations on MCAS Yuma.

The Yuma area has an arid climate with mild winters and hot summers. In winter, the average temperature is 55 degrees Fahrenheit (°F); in summer it is 87 °F. The lowest temperature on record, 19 °F, occurred in Yuma Valley on 14 January 1963, and the highest, 123 °F, occurred on 19 June 1990. Winds are usually light to moderate, with speeds from 0 to 6 miles per hour occurring 51 percent of the time and from 6 to 16 miles per hour 47 percent of the time. Average relative humidity is about 20 percent.

The Yuma area receives little annual rainfall. The total annual precipitation is approximately 4 inches. Half of this total usually falls between April and September. The heaviest 1-day rainfall was 1.95 inches on 18 September 1963. Total potential evapotranspiration in the area is over 50 inches, far exceeding the available precipitation. This, combined with the flat-lying topography and the presence of highly permeable surface soils, has produced no significant drainage feature on the Yuma Mesa. Drainage in the surrounding area is generally confined to localized depressions and subdued topographic lows.

Because of the small amount of annual precipitation, high evaporation rates created by the warm. temperatures, and relatively high permeability of the alluvium, there is no large surface-water body in the immediate vicinity of MCAS Yuma. The Colorado River is the closest major surface-water feature, located approximately 8 miles west and 4 miles north of MCAS Yuma. MCAS Yuma lies outside of the river's 100-year floodplain.

An archeological site has been identified at the south end of the runway.

2.5.2 Geology

MCAS Yuma is on the northern portion of the Yuma Mesa, which is situated approximately 60 to 70 feet above the adjacent Colorado River Valley. Yuma Mesa is separated from the Colorado River Valley by a north-trending bluff approximately 5 miles west of MCAS Yuma.

Sedimentary deposits on Yuma Mesa are predominantly fluvial (river) deposits with some eolian (windblown) deposits in the upper 180 to 200 feet. Most of the interbedded deposits consist of alluvium from Colorado River deposition that has been reworked by local ephemeral streams and sheetflow. The alluvium is highly variable and ranges in grain size from silt and fine sand up to very coarse gravel.

Locally at MCAS Yuma, silt and clay deposits form small discontinuous lenses that retard the vertical migration of groundwater. The primary stratigraphic units underlying MCAS Yuma are the "younger alluvium," which include minor windblown sand, and the "older alluvium." The bottom of the older alluvium may extend more than 2,000 feet below the surface in some areas. These alluvial units appear to directly overlie pre-Tertiary bedrock at MCAS Yuma.

Granitic bedrock outcrops occur in the Yuma area as a series of north- to northwest-trending low hills known as the "Yuma Hills." The bedrock outcrops on and adjacent to MCAS Yuma indicate that relatively shallow bedrock zones exist in this region.

According to the Yuma Soil Conservation Service (USDA 1980), the principal soil type occurring at MCAS Yuma is superstition sand. This soil is deep and somewhat excessively drained. Permeability of the superstition sand is rapid, and the available water capacity is low to moderate.

2.5.3 Hydrogeology

The principal stratigraphic units containing groundwater usable for agricultural and domestic applications are the alluvial deposits. These unconsolidated deposits are divided into 1) the upper fine-grained zone, 2) the coarse-gravel zone, and 3) the wedge zone.

The upper fine-grained zone includes the vadose zone and extends approximately 180 to more than 200 feet below the surface. This zone comprises the majority of the younger alluvium stratigraphic unit and may include the upper portion of the older alluvium. The upper fine-grained zone represents fluvial and, to a lesser degree, windblown deposits. The upper fine-grained zone consists of sand and silt with interbeds of sandy clay and sandy gravel.

Water quality in the upper zone is highly variable, probably as a result of the shallow depth to water (40 to 80 feet) and the presence of irrigated agriculture in the area. Groundwater in the upper fine-grained zone exists under unconfined conditions over much of Yuma Mesa. However, locally confined conditions associated with fine-grained lenses have been reported (Olmsted et al. 1973).

Underlying the upper, fine-grained zone is the coarse-gravel zone, which includes the basal gravel of the younger alluvium and the upper coarse gravel of the older alluvium. In addition to gravel, the coarse-gravel zone contains interbeds of sand and fine-grained lithologies. The coarse-gravel zone is the most permeable groundwater reservoir in the Yuma area and provides the primary groundwater-supply source. The top of this zone is approximately 180 to more than 200 feet below ground level, and it ranges in thickness from 0 to 100 feet. Water quality in this zone is saline (Olmsted et al. 1973).

The wedge zone underlies the coarse-gravel zone and makes up most of the older alluvium stratigraphic unit. This zone may extend to 2,000 feet below the surface. Lithologies in the wedge zone range from gravel to clay with generally coarser lithologies in the upper portion (Olmsted et al. 1973). The wedge zone contains water that is generally fresher than the water in the overlying coarse-gravel zone.

2.5.4 Groundwater-Flow Directions and Gradients

At present, groundwater flow in the vicinity of MCAS Yuma is toward the northwest. This northwesterly flow is the result of surface-water irrigation in the area south and east of MCAS Yuma. Groundwater mounding, the result of agricultural irrigation activities since 1925, has raised groundwater levels 25 to 40 feet in the vicinity of MCAS Yuma. The groundwater mound has reversed the groundwater-flow direction from southeast trending to northwest trending, toward the Colorado River. Most irrigation water for the agricultural land surrounding MCAS Yuma and the city of Yuma is from the Colorado River.

Groundwater elevation data from the fuel CHC plumes measured during October 1998 indicate the following flow directions and gradients:

- Area 1 – Flow direction northwest, gradient 0.006 foot per foot (ft/ft);
- Area 2 – Flow direction northwest, gradient 0.001 ft/ft;
- Area 3 – Flow direction northwest, gradient 0.006 ft/ft; and
- Area 6 – Flow direction slightly west of due north, gradient 0.001 ft/ft.

Nearly all the groundwater in the Yuma area is infiltrated river water. More highly mineralized water in the older rocks of the lower part of the reservoir may include some connate water that has not been completely flushed out. The MCAS Yuma area has a high geothermal gradient caused by the rifting of the Salton Trough Area. Consequently, groundwater temperatures of 80 to 85 °F are commonly recorded. The highest groundwater temperatures generally occur along faults, which apparently provide conduits for the upward movement of heated waters.

The nearest downgradient domestic wells are approximately 0.8 mile and 0.9 mile from the MCAS Yuma boundary. The first well (Arizona Department of Water Resources [ADWR] Reg. No. 55-649396) is on the north side of the Yuma Country Club, and the second well (ADWR Reg. No. 55-512296) is southeast of the intersection of 4th Avenue and 32nd Street. The nearest municipal well (ADWR Reg. No. 55-513889) is approximately 0.7 mile southeast (upgradient) of the MCAS Yuma boundary (ADWR 1991).

2.5.5 Groundwater Use

Groundwater generally occurs under unconfined conditions beneath MCAS Yuma. However, locally semiconfined or confined conditions associated with fine-grained lenses have been reported (Olmsted et al. 1973). Depth to groundwater beneath MCAS Yuma ranges from approximately 40 to 60 feet bgs with the shallower groundwater located in its south-central portion.

The primary sources of drinking water in the Yuma area are the surface-water canals that direct water from the Colorado River. In the past, MCAS Yuma had one groundwater production well, located upgradient of all the contaminant plumes. The on-site production well provided drinking water for the nearby Family Park. This well was also formerly used to supply irrigation water when the canal supplying water from the Colorado River was shut down for cleaning. The well has been capped and is not now being used. Currently, while there is no direct use or contact with groundwater contaminants, the state of Arizona considers the water beneath Yuma to be a potential source of drinking water.

2.5.6 Sampling Strategy

Field activities for the OU-1 RI were conducted in two phases. Phase I activities were conducted during February and March 1995, and Phase II activities were conducted during July through September 1995. During Phase I, 45 HydroPunch® -type groundwater samples were collected, and 13 existing groundwater monitoring wells were sampled. During Phase II, 30 HydroPunch-type groundwater samples were collected; 8 new monitoring wells were installed, developed, and sampled; 5 piezometers were installed and developed; 3 aquifer pumping tests were conducted; and 5 borings for soil sampling were installed. Samples were analyzed for metals, petroleum hydrocarbons, volatile organics, semivolatile organics, and pesticide/herbicides. The data were used to identify four distinct plumes of CHCs, as discussed further below. Additional sampling of groundwater monitoring wells for selected volatile organics has continued subsequent to development of the RI.

2.5.7 Plume Characteristics

Characteristics of each CHC plume are described in the following summaries. The CHCs detected in the plumes are associated with both carcinogenic and noncarcinogenic effects, as discussed further in Section 2.7.

2.5.7.1 AREA 1 GROUNDWATER PLUME

The Area 1 plume, which consists of TCE, PCE, and 1,1-DCE, is the largest contaminant plume at MCAS Yuma. The plume underlies an area of approximately 60 acres and extends off MCAS Yuma (Plates 1 and 2). Contaminant concentrations exceeding MCLs in the Area 1 plume have been reported extending from the vicinity of Building 230 at the eastern end of the flight-line apron to just past the northwest boundary of MCAS Yuma.

On the basis of the results of passive and active soil gas surveys and vadose-zone sampling, it is assumed that there is no remaining source of CHCs in the vadose zone in the area of Building 230. The Area 1 plume is limited to the upper portion of the unconfined aquifer; however, the plume appears to have a slight downward gradient as it crosses MCAS Yuma. Also, the area of the highest concentrations (or hot spot) of the Area 1 plume (i.e., the area of CHCs in the groundwater greater than 200 micrograms per liter [µg/L]) appears to be located northwest (downgradient) of Building 230 (i.e., toward the flight line). Based on groundwater samples collected in June 1998 after the RI, the hot spot appears to be approximately 1,000 feet long by 400 feet wide (Plates 1 and 2). The maximum concentrations of TCE and PCE appear to be decreasing, on the basis of groundwater samples collected in 1998 and 1999, subsequent to completion of the RI.

Generally, the subsurface lithology in the source area is relatively heterogeneous (i.e., it has fine to coarse sands, gravel, and silts). Lithologic logging in the vicinity of Building 230 encountered several discontinuous clay lenses of a few inches up to 5 feet thick, which begin approximately 30 feet bgs and were observed above and below the groundwater table. The presence of these clay lenses appears to have limited the vertical migration of contaminants in this area. However, the locations of these clay lenses will likely not limit the effectiveness of *in situ* remedial alternatives (OHM 1998).

Additional groundwater sampling at the leading edge of the Area 1 plume at the MCAS Yuma boundary has indicated concentrations of CHCs exceeding MCLs present at depths up to 180 feet bgs. These contaminants have migrated past the western boundary of MCAS Yuma beneath property controlled by the Yuma Airport Authority. As of September 1999, the horizontal and vertical extent of TCE- and DCE-impacted groundwater in the deep aquifer (30 to 190 feet below the groundwater table) has been fully delineated (OHM 1999a).

2.5.7.2 AREA 2 GROUNDWATER PLUME

The Area 2 plume is located northeast of the flight line along the easternmost taxiway, downgradient of the Fuel Farm Area. The plume underlies an area of approximately 4 acres and is currently located on MCAS Yuma (Plates 1 and 2). The Area 2 plume consists primarily of 1,1-DCE of unknown origin. The maximum concentration of 1,1-DCE reported in the RI was 210 µg/L at FF-MW-24. The Area 2 plume is a shallow, small plume centered on monitoring well FF-MW-24. The plume has been relatively stable for the past 3 years and does not appear to have significantly migrated horizontally. The concentrations of DCE in FF-MW-24 have decreased over the past few years to 130 µg/L in June 1998 and 26 µg/L in August 1999.

Historical groundwater VOC analytical results from monitoring wells are presented in Table 2-1.

A clay zone encountered at about 80 feet bgs (i.e., 20 feet below the groundwater table) is likely to prevent significant downward migration of contaminants. No CHC, which would indicate a source of contamination, was detected in the vadose soil in Area 2.

2.5.7.3 AREA 3 GROUNDWATER PLUME

The Area 3 plume is located north of the Combat Aircraft Loading Area near a former unlined fire training pit that was used from 1976 to 1985 to practice extinguishing various types of fires (CAOC 7). The plume underlies an area of approximately 10 acres and is currently located on MCAS Yuma (Plates 1 and 2). The Area 3 plume consists primarily of TCE and 1,1-DCE. The maximum concentrations of TCE and 1,1-DCE reported in the RI were 13 µg/L and 10.2 µg/L, respectively, at monitoring well W-5.

Historical VOC analytical results from Area 3 monitoring wells are presented in Table 2-2.

The CHC concentrations have been decreasing since the RI was prepared. On the basis of sampling conducted in August 1999, it is assumed that the concentrations of TCE and 1,1-DCE in well W-5 had fallen below the MCLs, to 2.0 µg/L and 0.5 µg/L, respectively.

2.5.7.4 AREA 6 GROUNDWATER PLUME

The Area 6 plume is located south of the Central Receiving Warehouse (Building 328), where a small plume of primarily PCE was detected in the vicinity of three former concrete tanks that stored fuel. The plume underlies an area of less than 1 acre and is currently located on MCAS Yuma (Plates 1 and 2). The maximum concentration of PCE reported in the RI was 7.1 µg/L at well 335-MW-4. The CHC plume is stable with respect to concentration and areal extent. Elevated concentrations of total petroleum hydrocarbons (TPH) as diesel (14,000 milligrams per kilogram [mg/kg]) and TPH as gasoline (770 mg/kg) were detected in the soil; however, TPH was virtually absent in the groundwater. (Only one monitoring well in five detected TPH at 0.25 milligrams per liter.)

Historical VOC analytical results from Area 6 monitoring wells are presented in Table 2-3.

On the basis of sampling conducted in April 1998, it is apparent that the concentration of PCE in well 335-MW-4 had fallen to 4.0 µg/L, while the concentration of PCE in well 317-MW-01 was 9.0 µg/L. On the basis of sampling conducted in October 1998, it is apparent that the concentration of PCE in well 335-MW-4 had fallen further to 2.0 µg/L, while the concentration of PCE in well 317-MW-01, 7.0 µg/L, remained in excess of the MCL. Sampling conducted in August 1999 showed that the concentration of PCE in well 317-MW-01 was 8.6 µg/L.

Apparently then, the Area 6 PCE concentrations have remained essentially stable over time at levels slightly in excess of the MCL but less than the 10^{-4} risk level and the noncarcinogenic RBC.

2.5.8 Known and Suspected Sources of Contamination

The Area 1 plume is located on the downgradient side of Building 230. Two USTs were removed from the vicinity of the building, and the surrounding area has been paved. However, four dry wells located within 200 feet of the building would collect and infiltrate water from the vicinity of the building. TCE was detected in soils beneath one of the USTs, which collected discharges from the floor drain of the Building 230 paint shop. Although there is no conclusive evidence regarding the source of the Area 1 CHC plume, it appears to be related to activities associated with Building 230.

The Area 2 plume is located about 200 feet downgradient of Building 303, a jet engine testing cell. The building was associated with a suspected leach field, which is a possible source of the small plume in Area 2.

The Area 3 plume is located beneath a former unlined fire pit that was used for fire training exercises between 1976 and 1985. Because the detected CHC compounds in groundwater are limited to the immediate vicinity of the former fire pit, they do not appear to be coming from an upgradient source or to be migrating significantly downgradient.

The Area 6 plume is located just south of Building 328. The area was the location of three suspected diesel-fuel USTs associated with former Building 335. The presence of PCE in groundwater in the area cannot be readily explained.

2.5.9 Current and Potential Future Land and Water Uses

Most activities or operations at MCAS Yuma are industrial/commercial in nature and/or support military activities. The downgradient area immediately off MCAS Yuma is administered by the Yuma Airport Authority to support airport operations. Currently, no industrial water is obtained from regional groundwater.

If MCAS Yuma maintains its current mission, it is anticipated that commercial/industrial uses of water will not change in the future. Consequently, there is no direct contact with groundwater (i.e., ingestion of, dermal contact with, or inhalation of volatile emissions) under the current industrial/commercial land and water use.

In addition to the airport property to the northwest, surrounding land use is primarily in support of citrus groves. Within a 1-mile radius of MCAS Yuma, all water used for irrigation is obtained exclusively from the Colorado River through a system of canals. No groundwater is used for irrigation, and it is not anticipated that this will change in the future.

Under current land-use conditions, no complete exposure pathway exists for groundwater contaminants at MCAS Yuma. In the future, it is possible that a water-supply well could be installed either on or off MCAS Yuma, especially since the shallow groundwater aquifer has been classified by the state of Arizona as protected for drinking water use.

2.6 OPERABLE UNIT-1 GROUNDWATER MODELING

During the preparation of the FS for OU-1, preliminary two-dimensional (2D) modeling was performed to gain an understanding of the migration potential of CHCs from plume Areas 1, 2, and 3. After the completion of the RI for OU-1, the Navy performed several additional phases of groundwater investigation. These investigations focused on further defining the extent of groundwater contamination in plume Area 1 and on further characterizing the geologic and hydrogeologic conditions. Several rounds of groundwater sampling were also performed in plume Areas 3 and 6. Additional three-dimensional (3D) groundwater modeling of plume Areas 1, 3, and 6 was performed to support the ROD for OU-1. This additional ROD modeling incorporated the results of the post-RI investigations and sampling data. The additional ROD modeling was described in detail in the Supplemental Groundwater Modeling Report (JEG 1999).

2.6.1 Feasibility Study Modeling

The objectives of the FS modeling were to 1) simulate and evaluate different pump and treat scenarios to support plume Area 1 FS alternatives and 2) simulate the transport and fate of contaminants under a no action (natural attenuation) alternative at plume Areas 2 and 3. Analytical and numerical 2D areal flow and transport models that incorporated dispersion, retardation, and the effects of chemical degradation were constructed for the simulations. Retardation coefficient values were calculated on the basis of published organic matter partition coefficients for the contaminants of interest, and field measurements of organic carbon content and physical characteristics of site soils. Abiotic degradation was simulated assuming linear decay using literature-based decay constants.

2.6.1.1 AREA 1 PLUME

For the Area 1 plume, the groundwater flow model MODFLOW (McDonald and Harbaugh 1984) and the particle-tracking model PATH3D (SSP&A 1989) were used to simulate extraction-well capture zones. The groundwater solute transport model MT3D (SSP&A 1992) was used to estimate contaminant concentrations and mass removal rates for wells designed to contain and/or clean up contaminants. 2D versions of the models were used to simulate different pump and treat scenarios to effect hydraulic containment of contaminants at the MCAS Yuma boundary and sufficient hot spot mass removal that contaminants exceeding MCLs would not reach the MCAS Yuma boundary.

Three scenarios were investigated for plume Area 1: Scenario 1, hydraulic containment and hot spot mass removal by groundwater extraction; Scenario 2, hydraulic containment by groundwater extraction without hot spot mass removal; and Scenario 3, hot spot mass removal by groundwater extraction without hydraulic containment. Basic simulations considered dispersion and retardation. Some additional simulations included chemical degradation based on decay constants from the literature.

The FS modeling indicated that Scenario 1 would achieve remediation goals within 170 years when dispersion and retardation alone were considered and within 50 years when degradation was also considered. Scenario 2, considering only dispersion and retardation, would not achieve remedial objectives because high contaminant concentrations in the hot spot area would migrate beyond the MCAS Yuma boundary after about 150 years. However, when degradation was included, the source area contamination would degrade within 60 years and not reach the MCAS Yuma boundary. Scenario 3 would achieve contaminant capture near the hot spot area comparable to that predicted for Scenario 1 considering only dispersion and retardation. However, contaminant concentrations in excess of MCLs near the MCAS Yuma boundary would migrate beyond the boundary, so remedial objectives would not be met. Considering degradation as well, contaminant concentrations at and beyond the MCAS Yuma boundary would degrade below MCLs within 10 years, and concentrations in the hot spot area would achieve remedial objectives within 50 years.

2.6.1.2 AREAS 2 AND 3 PLUMES

For the Areas 2 and 3 plumes, 2D analytical solute transport models from the PRINCE collection (Waterloo 1994) were applied. Contaminants in the Areas 2 and 3 plumes were either at sufficiently low concentrations or found over a small enough area that they would dissipate to values well below their respective MCLs before reaching the MCAS Yuma boundary. Consequently, remedial objectives for these plumes would be achieved even with no action.

2.6.1.3 AREA 6 PLUME

The Area 6 plume was not included in FS modeling activities.

2.6.2 Record of Decision Modeling

ROD modeling was as follows.

2.6.2.1 AREA 1 PLUME

The FS model for the Area 1 plume was a 2D, single-layer model that only simulated horizontal transport and horizontal dispersion. Vertical resolution of contaminant mass was not included. The model assumed a high organic carbon content, leading to more adsorption and retardation, and a small contaminant decay half-life, leading to more rapid decay of contaminants. Recharge to the shallow aquifer was not included in the model.

The ROD model for the Area 1 plume was a 3D, multiple-layer model that simulated horizontal and vertical transport. A 3D version of the MODFLOW/SURFACT groundwater flow and transport model (HydroGeoLogic 1996) was used for the simulations. Hydraulic conductivity varied in both horizontal and vertical directions, as indicated by variations in subsurface soil characteristics. Horizontal and vertical dispersion was simulated. The initial simulated contaminant plume reflected the 3D variation in contaminant concentrations across the site. The model assumed a lower organic carbon content than the FS model and a larger decay half-life. Consequently, contaminants were subject to less adsorption, retardation, and decay. A small amount of recharge to the aquifer was also simulated. In general, these changes in assumed aquifer properties and contaminant distribution reflected the results of the post-RI investigations and data collection, information not available when the FS models were constructed.

Table 2-4 provides a comparison of the two modeling approaches.

The Area 1 plume model was used to evaluate the effects of different scenarios of reduction of hot spot contaminant concentrations using AS in combination with SVE in the hot spot area near Building 230. The model was also used to evaluate the effectiveness of vertical recirculating well technology to contain and remediate contaminant concentrations at the northwest MCAS Yuma boundary.

Model results indicated that, although the TCE plume is currently disconnected when viewed at concentrations above the MCL, the northwest portion of the plume could have migrated from a source area near Building 230 by way of vertical flow paths. If recirculating wells were used at the MCAS Yuma boundary to prevent off-site plume migration but no source area contaminant reduction was attempted, TCE in the entire plume area would migrate downgradient and attenuate below the MCL in 30 to 40 years. Using AS/SVE to remediate TCE in the hot spot area to the 5 µg/L MCL would facilitate overall remediation of the plume in 10 to 20 years. Hot spot reduction to only 50 or 100 µg/L would produce remediation times of 20 to 30 years.

Recirculating wells at the MCAS Yuma boundary would effectively prevent off-site migration of the northwest portion of the plume. TCE in the northwest portion of the plume that has not already crossed the northwest MCAS Yuma boundary would fall below the MCL within 12 years.

2.6.2.2 AREA 2 PLUME

The Area 2 plume was not included in ROD modeling activities.

2.6.2.3 AREAS 3 AND 6 PLUMES

The ROD modeling for the Areas 3 and 6 plumes used 3D analytical transport models from the PRINCE collection (Waterloo 1994) rather than 2D models as in the FS modeling. The ROD models included dispersion in three dimensions, as well as less retardation and longer decay half-lives than the 2D analytical models used to support the FS. The ROD models also assumed decay in the source term, rather than constant or slug source terms as in the FS modeling. These models were an attempt to more accurately simulate future contaminant concentrations by incorporating information not available when the FS models were constructed.

The models were used to simulate the migration of TCE and PCE in groundwater from the Areas 3 and 6 plumes, respectively. The simulations included natural attenuation mechanisms of dispersion, retardation, and chemical degradation but no active remediation.

The results indicated that contaminants in these areas are at sufficiently low concentrations or found over a small enough area that they would dissipate to concentrations below their 5 µg/L MCLs before reaching downgradient MCAS Yuma boundaries. For the Area 3 plume, the concentrations greater than the MCL would migrate no more than 717 feet downgradient in 15 years and then begin to contract as the source area is depleted of TCE. The maximum TCE concentration at the MCAS Yuma boundary would be only 1.5 µg/L. For the Area 6 plume, the concentrations greater than the MCL would migrate no more than 234 feet downgradient in 3 years and then begin to contract as the source area is depleted of PCE. The maximum PCE concentration at the MCAS Yuma boundary would be only 0.5 µg/L.

2.6.3 Conclusions

The 3D modeling conducted for the ROD incorporated more accurate descriptions of site hydrogeologic conditions than did the 2D modeling for the FS because the ROD modeling included data and information acquired during the post-RI site investigations. Even though the ROD modeling used more conservative retardation and degradation parameters than did the FS modeling, the ROD modeling indicated more rapid achievement of remedial objectives. The results of the 3D ROD modeling described in the Jacobs Engineering Group, Inc., document (JEG 1999) have been used in the decision summaries for the Area 1 plume (Section 2.13.1) and the Areas 2, 3, and 6 plumes (Section 2.13.2).

2.7 SUMMARY OF SITE RISKS

The NCP requires the Navy, as the lead agency for MCAS Yuma, to develop a baseline risk assessment (BLRA) to determine whether IRP sites at MCAS Yuma pose a current or potential threat to human health and the environment in the absence of remedial action. The BLRA provides the basis to determine whether either no action or a selected remedy will be protective of human health and the environment.

2.7.1 Summary of Human-Health Risk Assessment

The BLRA estimates what risks the site poses if no action were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that must be addressed by the remedial action. This section of the ROD summarizes the results of the BLRA for MCAS Yuma.

The objective of the OU-1 BLRA was to evaluate the potential human risks and health hazards of residential use of the untreated contaminated groundwater. The BLRA incorporated the water-quality information generated during the RI and was conducted in accordance with U.S. EPA guidance documents (U.S. EPA 1988a; 1989a,b; 1991a,b).

2.7.1.1 CHEMICALS OF CONCERN AND EXPOSURE-POINT CONCENTRATIONS

Table 2-5 provides a summary of the CHCs whose maximum concentrations exceeded MCLs in each of the four OU-1 groundwater plumes. For each of the four plume areas, the table lists the frequency of detection of each CHC, the minimum and maximum detected concentrations, and the selected exposure-point concentration. The maximum detected concentration was selected as the exposure-point concentration for each plume area. However, as noted in Section 2.5.7, the maximum concentration of 1,1-DCE at the Area 2 plume had decreased to 26 µg/L by August 1999, and the concentrations of TCE and 1,1-DCE at the Area 3 plume had decreased to 2.0 µg/L and 0.5 µg/L, respectively.

2.7.1.2 EXPOSURE ASSESSMENT

The OU-1 BLRA evaluated potential carcinogenic risk and noncarcinogenic health hazards using the RBC approach. RBCs are chemical-specific concentrations in a medium (i.e., water, soil, or air) that correspond to a preestablished risk of 1×10^{-6} or a hazard index (HI) of 1.0 for a defined set of reasonable maximum exposure (RME) assumptions. A risk of 1×10^{-6} implies that there is a one in a million chance that a person would get cancer during that person's lifetime. An HI greater than 1.0 implies that there may be acute or chronic adverse noncancer health effects. Conservative RME exposure parameters include drinking 2 liters of untreated contaminated water per day, every day for 30 years. U.S. EPA-published toxicity values (U.S. EPA 1992, 1995) were used to calculate the RBCs, which include uncertainty and modifying factors from extrapolating data to human exposures.

For each detected analyte in groundwater at MCAS Yuma, the maximum reported analyte concentration was compared to its respective RBC, resulting in either a cancer ratio or noncancer ratio for that chemical. Cancer risks and health hazards were assumed to be additive, and all cancer/noncancer ratios were summed across all exposure pathways (i.e., ingestion, dermal contact, and inhalation), resulting in a total cancer or noncancer ratio for groundwater. Analytes excluded from the risk assessments included metals considered to be essential human nutrients (i.e., calcium, iron, magnesium, potassium, and sodium); nonsite-related metals within naturally occurring background (e.g., arsenic, selenium, and thallium); and trihalomethanes (e.g., chloroform), which have been historically detected in groundwater regionally throughout the Yuma area.

The primary sources of drinking water in the Yuma area are the surface-water canals that direct water from the Colorado River. In the past, MCAS Yuma had one groundwater production well, located upgradient of all the contaminant plumes. The on-site production well provided drinking water for the nearby Family Park. This well was also formerly used to supply irrigation water when the canal supplying water from the Colorado River was shut down for cleaning. The well has been capped and is not currently being used. Now, while there is no direct contact with groundwater contaminants, the state of Arizona considers the water beneath Yuma to be a potential drinking water supply. Therefore, a hypothetical future receptor of concern would be an on-site resident that may be exposed to contaminated groundwater as a residential drinking water source. Potential routes of exposure include ingestion, dermal contact during household use, and inhalation of volatile emissions during household uses (e.g., showering).

The potential for noncarcinogenic health effects was conservatively estimated by summing the HI for all analytes. A more realistic approach would have been to sum the HI by the individual target organs affected. The risk assessment also estimated the potential excess cancer risk from a hypothetical lifetime exposure to contaminated groundwater. The background probability of developing cancer from all causes is approximately 1 in 3. An excess cancer risk of 1 in a million means that a person exposed to a certain level of contamination would increase the risk of developing cancer from 333,333 in a million to 333,334 in a million as a result of the exposure. The U.S. EPA generally considers excess cancer risk greater than 100 in a million to be unacceptable.

Groundwater analyte concentrations from 192 monitoring well and direct-push technique sampling locations were compared to groundwater RBCs. Single-point estimates of carcinogenic risk and noncarcinogenic health hazards from each sampling location were then used to derive risk and hazard contours across MCAS Yuma. This approach provides a means of inferring the cumulative baseline risk and health hazard from a drinking water production well anywhere on MCAS Yuma. Areas with excess cancer risk greater than 10^{-4} or health hazard greater than 1.0 are considered to pose an unacceptable risk to human health, as defined by CERCLA. Also, areas that exceed drinking water standards (MCLs) do not meet ARARs. Therefore, the plume areas that exceeded either acceptable risk/hazard or ARARs were used to establish OU-1 plume areas.

A summary of CHC plumes exceeding acceptable human-health risk/hazard and MCLs is provided in Table 2-6. In that table, maximum concentrations are based on RI sampling results. Maximum contaminant concentrations at most plumes have decreased since the RI was prepared (Section 2.7.1.4).

2.7.1.3 TOXICITY ASSESSMENT

This section describes the process of characterizing the relationship between the exposure to a chemical and the incidence of adverse health effects in exposed populations. RBCs are based on site-specific exposure assumptions and chemical of potential concern (COPC)-specific toxicity values. The toxicity values are derived from the relationship between the dose of the COPC and the incidence and severity of known or measured adverse health effects.

Health risks from exposure to carcinogens are defined in terms of probabilities. These probabilities are expressed in terms of a cancer slope factor (CSF), which is a plausible upper-bound estimate of the probability of a response-per-unit intake of a chemical over a lifetime. The slope factor is used in risk assessments, in combination with estimated intake, to provide an estimate of the upper-bound lifetime probability that an individual will develop cancer. CSFs, published by the U.S. EPA in the Integrated Risk Information System (IRIS) database (U.S. EPA 1995) and in the Health Effects Assessment Summary Tables (HEAST) (U.S. EPA 1992), were used in the RI human-health evaluation.

Table 2-7 presents a summary of the carcinogenic toxicity data, weight-of-evidence classification, type of cancer, slope factor basis, and source of information for the three COCs identified for the groundwater plumes.

For noncarcinogenic effects, evidence is gathered regarding the potential of a substance to cause adverse effects that can include death, structural abnormality, altered growth, and functional deficiencies. The toxicant oral reference dose (RfD) is developed using no observed-adverse-effect level (NOAEL) or lowest observed-adverse-effect level (LOAEL) data derived from animal studies. The laboratory-derived NOAEL or LOAEL is converted to an equivalent human dose using uncertainty or safety factors. The RfD is defined as an estimate of daily exposure for the human population, including sensitive subpopulations, that is likely to be without appreciable risk of deleterious effects during a lifetime.

The chronic oral and inhalation reference doses/reference concentrations, as published in the IRIS and HEAST databases, were used in the RI human-health risk assessment. Table 2-8 presents a summary of the noncancer toxicity values, confidence level, critical effect, reference dose basis and source, and uncertainty and modifying factors for the three COCs identified for the groundwater plumes.

2.7.1.4 RISK CHARACTERIZATION

For carcinogens, risks are generally expressed as the incremental probability that an individual will develop cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated with the following equation.

$$\text{Risk} = CDI \times SF$$

where

risk = a unitless probability that an individual will develop cancer
CDI = chronic daily intake averaged over 70 years (milligrams per kilogram per day [mg/kg-day])
SF = slope factor $(\text{mg/kg-day})^{-1}$

These risks are probabilities that are usually expressed in scientific notation (e.g., 1×10^{-6}). An excess lifetime cancer risk of 1×10^{-6} indicates that an individual experiencing the reasonable maximum exposure estimate has a one in a million chance of developing cancer as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer an individual faces from other causes, such as smoking or too much exposure to sun. The chance that an individual will develop cancer from all other causes has been estimated to be as high as one in three (3.3×10^{-1}). U.S. EPA's generally acceptable risk range for site-related exposures is 10^{-4} to 10^{-6}.

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time (e.g., lifetime) with an RfD derived for a similar exposure period. An RfD represents a level to which an individual may be exposed that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a "hazard quotient" (HQ). An HQ less than 1 indicates that a receptor's dose of a single contaminant is less than the RfD and that toxic noncarcinogenic effects from that chemical are unlikely. The HI is generated by adding the HQs for all COCs that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may be reasonably exposed. An HI less than 1 indicates that, based on the sum of all HQs from different contaminants and exposure routes, toxic noncarcinogenic effects from all contaminants are unlikely. An HI greater than 1 indicates that site-related exposures may present a risk to human health.

The HQ is calculated as follows.

Noncancer HQ = *CDI/RfD*

where:

CDI = chronic daily intake
RfD = reference dose

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short term).

As noted in Section 2.7.1.2, risks were assessed in the RI by using derived RBC that express the COC concentration in groundwater that will be protective of human receptors based on total carcinogenic risk or noncarcinogenic hazard. For a given COC concentration in groundwater, the risk or HI can then be determined as the ratio of the exposure-point concentration to the RBC.

Table 2-9 presents a summary of derived carcinogenic risks for the maximum COPC concentrations in each of the four CHC plumes. Maximum concentrations were used since insufficient data was available to calculate the RME or 95 percent upper confidence limit. The table also includes calculations of the carcinogenic risks for COPCs at their MCLs, and for COPCs based on data from the summer of 1999.

Table 2-10 presents a summary of noncarcinogenic risks for the maximum COPC concentrations in each of the four CHC plumes. The table also includes calculations of the noncarcinogenic risks for COPCs at their MCLs and for COPCs based on data from the summer of 1999.

On the basis of August 1999 data, the maximum concentration of 1,1-DCE at the Area 2 plume decreased to 26 µg/L, which continues to exceed the MCL and the 10^{-4} risk level but gives an HI less than 1. The maximum concentrations of TCE and 1,1-DCE at the Area 3 plume had decreased to 2.0 µg/L and 0.5 µg/L, respectively; these values are less than the MCLs, and give risks less than 10^{-4} and HI less than 1. The maximum concentration of PCE at the Area 6 plume was 8.6 µg/L, slightly greater than the MCL but giving risk less than 10^{-4} and HI less than 1.

Considerable uncertainty exists regarding estimates relative to the cancer risks associated with 1,1-DCE, the largest contributor to risk for the Areas 1, 2, and 3 plumes. Specifically, evaluation of all the animal cancer bioassays suggests that 1,1-DCE is a questionable animal carcinogen. When metabolic differences between animals and humans are compared, the potential carcinogenicity of 1,1-DCE in humans is even more questionable. Therefore, the actual risk to humans may be much less than these estimates.

Based on remediating the OU-1 plumes to MCLs (including 1,1-DCE), the Areas 1, 2, and 3 plumes would slightly exceed the acceptable excess cancer risk (i.e., approximately 2 x 10^{-4}); however, excluding 1,1-DCE, the subsequent cumulative cancer risk (approximately 10^{-6}) for these areas would not be considered significant. At the MCL for PCE, cancer risk at the Area 6 plume would be well below the acceptable level of 10^{-4}. All the OU-1 plumes remediated to MCLs would be well below the HI of 1.0.

Based on RI data, the cancer risk from residential use of groundwater would be 4.7 x 10^{-3} Once COC concentrations have been reduced to MCLs, the cancer risk would be reduced to 1.9 X 10^{-4}.

2.7.2 Ecological Risk

No state or federally listed threatened or endangered species is currently known to be present at MCAS Yuma; also, no critical habitat or habitat of an endangered species is present. Given that the contaminated groundwater is about 60 feet bgs and most of the ground surface at MCAS Yuma is used for MCAS activities, no significant impact to potential ecological receptors is expected. There is no apparent mechanism for ecological receptors to be exposed to contaminated groundwater.

2.7.3 Basis for Action

The response actions selected in this ROD are necessary to protect the public health or welfare, or the environment, from actual or threatened releases of hazardous substances into the environment. As noted in Tables 2-9 and 2-10, COC concentrations in the Areas 1 and 2 plumes remain above MCLs and would result in carcinogenic risks greater than 10^{-4} and/or noncarcinogenic HI greater than 1. The PCE concentration in the Area 6 plume is above the MCL but would result in carcinogenic risk less than 10^{-4} and a noncarcinogenic HI less than 1. COC concentrations in the Area 3 plume have decreased to levels below MCLs and would result in carcinogenic risks less than 10^{-4} and noncarcinogemic HI less than 1.

2.8 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

This section discusses the ARARs for the selected remedies. CERCLA Section 121(d) states that remedial actions on CERCLA sites must attain (or the decision document justify the waiver of) any federal or more stringent state environmental standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate to chemicals, conditions, and/or actions at the site.

Identification of ARARs is a site-specific determination and involves a two-part analysis: first, determining whether a given requirement is applicable; second, if not applicable, determining whether the requirement is relevant and appropriate. A requirement is deemed applicable if the specific terms of the law or regulation directly address the COPC, the remedial action, or the place involved at the site. If the jurisdictional prerequisites of the law or regulation are not met, a legal requirement may nonetheless be relevant and appropriate if the site's circumstances are sufficiently similar to circumstances in which the law otherwise applies and if the requirement is well suited to the conditions of the site. A requirement must be substantive to constitute an ARAR for activities conducted on site. Procedural or administrative requirements, such as permits and reporting requirements, are not ARARs.

On-site CERCLA actions must comply with the substantive requirement of all ARARs. Off-site activities must comply with both substantive and administrative requirements of all applicable laws. Substantive requirements are requirements that apply directly to actions or conditions in the environment. Examples include quantitative health- or risk-based standards for contaminants. Administrative requirements are those mechanisms that assist in the implementation of the substantive requirements (such as reporting, record keeping, and permit issuance) but do not, in and of themselves, define a level of standard of control (55 Federal Register 8756). State regulations that are a component of a federally authorized or delegated state program are generally considered federal requirements and, therefore, federal ARARs.

Where ARARs do not exist, the NCP also provides agency advisories, criteria, or guidance to be considered (TBC) useful in helping to determine what is protective at the site or how to carry out certain actions or requirements (U.S. EPA 1990; 55 Federal Register 8745). The NCP preamble states, however, that provisions in the TBC category "should not be required as cleanup standards because they are, by definition, generally neither promulgated nor enforceable, so they do not have the same status under CERCLA as do ARARs." However, under appropriate circumstances, TBCs could result in performance standards in the ROD.

As the lead federal agency, the Navy has primary responsibility to identify federal ARARs at MCAS Yuma. As the lead state agency, ADEQ has primary responsibility to identify state ARARs. Pursuant to U.S. EPA guidance, ARARs and TBCs are generally divided into three categories: chemical specific, location specific, and action specific (U.S. EPA 1988b). Chemical-specific, location-specific, and action-specific ARARs driving the development of remedial action objectives (RAOs) for groundwater at MCAS Yuma are discussed in the following sections and summarized in Tables 2-11 through 2-16.

2.8.1 Chemical Specific ARARs

Chemical-specific ARARs are health- or risk-based numerical values for various environmental media, specified in state or federal statutes or regulations. These numerical values establish the acceptable amount or concentration of a chemical that may be present in a specific medium at a site or that may be discharged to the site or the ambient environment during removal-action activities.

2.8.1.1 FEDERAL DRINKING WATER STANDARDS

The U.S. EPA has promulgated MCLs under the Safe Drinking Water Act (SDWA) to protect public health from contaminants that may be in drinking water sources (40 *Code of Federal Regulations* [CFR] Part 141). Although these requirements are applicable only at the tap for water provided directly to 25 or more people or that would be supplied to 15 or more service connections, they are relevant and appropriate since the state of Arizona has designated all aquifers in the state as potential sources of drinking water (unless reclassification is obtained). Nonzero maximum contaminant level goals (MCLGs) are also relevant and appropriate to remedial actions that are required to meet drinking water standards. Federal MCLs and nonzero MCLGs are, therefore, ARARs for meeting remedial action objectives.

While none of the groundwater extraction and treatment alternatives transfer treated groundwater to a public water-supply agency, the groundwater could be considered as a potential future drinking water supply. If the treated groundwater is used as a potable water supply, it would be considered an off-site, post remedy activity and would have to comply with all legal drinking water requirements in existence at the time the water is used.

2.8.1.2 STATE DRINKING WATER STANDARDS

The state of Arizona classifies the water beneath Yuma as a potential source of drinking water. The primary sources of drinking water in the Yuma area are the surface-water canals that direct water from the Colorado River.

State MCLs are the maximum permissible levels for treated groundwater delivered to users of water systems (R18-4-205 and -211). They are applicable since the state of Arizona has designated all aquifers in the state to be potential sources of drinking water (unless reclassification is obtained) (Arizona Revised Statutes [ARSs] 49 through 224B). However, no state MCL is more stringent than the federal MCLs or nonzero MCLGs.

The Narrative and Numeric Aquifer Water Quality Standards state that a discharge shall not cause a pollutant to be present in an aquifer classified for drinking water protected use in a concentration that endangers human health, and that a discharge shall not cause a pollutant to be present in an aquifer that impairs existing or reasonably foreseeable uses of the groundwater (R18-11-405 and -406).

2.8.1.3 FEDERAL AIR QUALITY STANDARDS

The U.S. EPA has promulgated National Ambient Air Quality Standards (NAAQS) under the Clean Air Act for the following criteria pollutants: sulfur dioxide, nitrogen dioxide, carbon monoxide, particulate matter, lead, and ozone (40 CFR 50.4 through 50.12). NAAQS become enforceable standards only when they are adopted in a state implementation plan approved by the U.S. EPA. Since Yuma County has not submitted an air pollution control program to the U.S. EPA for approval, ADEQ has sole and exclusive jurisdiction over air-emission sources at MCAS Yuma.

2.8.1.4 STATE AIR QUALITY STANDARDS

Ambient air quality standards are the maximum permissible levels for a contaminant in air. They are applicable to air emissions, regardless of the source of the emission. The applicable ambient air quality standards would apply to particulate matter less than 10-micron diameter and lead (R18-2-201 and -206), which would not be an issue with the OU-1 remedial action alternatives.

2.8.2 Location-Specific ARARs

Location-specific ARARs address the areas in which the remedial action takes place. Identified regulations that are potential ARARs may require actions to preserve or protect aspects of environmental or cultural resources that may be threatened by the removal actions to be undertaken at the site.

Potential federal location-specific ARARs include the National Archeological and Historical Preservation Act and the Endangered Species Act. Potential state location-specific ARARs include two ARSs pertaining to 1) critical habitats upon which endangered species or threatened species depend; and 2) state-owned or -controlled land containing archeological, paleontological, or historical features.

2.8.3 Action-Specific ARARs

Action-specific ARARs are regulations that apply to specific activities or technologies used to remediate a site. They can include design criteria and performance standards.

2.8.3.1 FEDERAL GROUNDWATER PROTECTION STANDARDS

Portions of the Resource Conservation and Recovery Act (RCRA) groundwater protections standards contained in ARS Title 49 (Laws Relating to Environmental Quality) and Arizona Administrative Code Title 18 are considered to be relevant and or the groundwater plumes being addressed by OU-1 remedial actions appropriate because the hazardous constituents being addressed are similar or identical to those found in RCRA hazardous waste. In addition to concentration limits for groundwater, A groundwater-quality monitoring program is required to demonstrate the effectiveness of a corrective action program (40 CFR 264.100).

2.8.3.2 FEDERAL INDIRECT DISCHARGE REQUIREMENT

Discharge by industrial users to a POTW is considered an off-site activity, which requires compliance with the substantive and procedural requirements of the federal pretreatment program (40 CFR Part 403). In general, the discharges cannot cause either a violation of any requirement of the POTW's National Pollutant Discharge Elimination System (NPDES) permit or prevention of sewage sludge use or disposal.

2.8.3.3 FEDERAL GROUNDWATER INJECTION AND REINJECTION STANDARDS

The Safe Drinking Water Act (SDWA) provides federal authority over injection wells (42 U.S.C. Sec. 300f et seq.). The Federal Underground Injection Control Plan prohibits injection wells such as those that would be located at OU-1 from causing a violation of primary MCLs in the receiving waters and adversely affecting human health (40 CFR 144.12).The federal reinjection regulation states that contaminated groundwater that has been treated may be reinjected into the formation from which it was withdrawn if such reinjection is conducted pursuant to a CERCLA cleanup and is approved by the U.S. EPA (40 CFR Sec. 144.13). These regulations are applicable to any OU-1 treated groundwater that is reinjected into the aquifer.

RCRA Section 3020 is also applicable to the OU-1 remedial actions. The RCRA states that the ban that prohibits the disposal of hazardous waste into a formation that contains an underground source of drinking water does not apply to the injection of contaminated groundwater into the aquifer if 1) such injection is part of a response action under CERCLA; 2) such contaminated groundwater is treated to substantially reduce hazardous constituents before such injection; and 3) such response action would, upon completion, be sufficient to protect human health and the environment (42 U.S.C. Sec. 6939b).

2.8.3.4 STATE GROUNDWATER REINJECTION STANDARDS

Arizona's Aquifer Protection Permit Program would apply to the reinjection of treated groundwater (ARS 49-243). Under this program, MCAS Yuma must implement best available demonstrated control technology, processes, operating methods, or other alternatives and include, where practicable, a technology permitting no discharge of pollutants; and the facility must not cause or contribute to a violation of aquifer water-quality standards at the applicable point of compliance (POC), or further degrade aquifer water quality with respect to a pollutant at the POC if the quality of the aquifer already violates the applicable aquifer water-quality standard for that pollutant.

2.9 REMEDIAL ACTION OBJECTIVES

RAOs for all of the OU-1 groundwater CHC plumes include containment of all the plumes within the facility boundary and reducing groundwater contamination to meet applicable drinking water standards.

Groundwater RAOs applicable for VOCs are established to assure that any person exposed in the future will not be exposed to unsafe levels of CHCs. These RAOs are based on a detailed analysis of chemical-specific ARARs and health risk-based criteria that are consistent with the present and projected beneficial uses of the affected aquifer.

2.10 DESCRIPTION OF ALTERNATIVES

The remedial alternatives developed address a range of responses from no action to active removal of contaminants from the groundwater. The conceptual designs for all the alternatives were based on the Area 1 plume, which is the primary plume area requiring remediation. In the hot spot where the highest concentrations of VOCs have been reported (i.e., downgradient of Building 230), more aggressive alternatives to decrease the contaminant mass in the source area (in addition to plume containment) have been included to provide options that would reduce the overall time frame required to meet the remedial action objectives. To address the VOC contamination in groundwater associated with Area 1, 12 alternatives were developed, 8 of which were retained for detailed analyses in the FS for OU-1 (JEG 1998). These eight alternatives are discussed below. Only a limited number of the alternatives are applicable to the Areas 2, 3, and 6 plumes. These alternatives are identified in the following descriptions.

2.10.1 Alternative 1: No Action

The no action alternative, as required by the NCP (40 CFR 300.430[e][6]), serves as a baseline for comparison to the other alternatives. Under the no action alternative, no remedial action is undertaken to remedy the contaminated groundwater. The no action alternative excludes all activities, including monitoring and groundwater use restrictions, to reduce potential risks to human health or the environment. The no action alternative would apply to all four ROD plumes (Areas 1, 2, 3, and 6).

The only cost associated with Alternative 1 is the amount required to generate a report on site conditions every 5 years. The estimated annual cost for this report is $6,000 with a 30-year present worth of $74,000.

2.10.2 Alternative 2: Institutional Controls and Monitored Natural Attenuation

“Institutional controls” includes groundwater use restrictions, natural attenuation, and monitoring measures. No access restriction (e.g., fencing) at MCAS Yuma is necessary since no surface-soil contamination was identified. Implementation of groundwater use restrictions would include amending the MCAS Yuma Master Plan to state that groundwater from the plume areas shall not be used unless treated. The master plan is part of a comprehensive facility management program approved by the chief of Naval Operations that describes current and future asset restrictions and land-use policies and restraints. Provisions for alternate water supplies are not required since MCAS Yuma uses canal water from the Colorado River as the main water source and has an upgradient on-site well available as a backup source. Since contaminated groundwater has migrated beyond the MCAS Yuma boundaries to property controlled by the Yuma Airport Authority, enforceable groundwater use restrictions would have to be negotiated with the Airport Authority and Yuma County. Restrictions would exclude use of groundwater contaminated above MCLs as a drinking water source. Treatment of groundwater contaminated above MCLs would be required. The U.S. EPA and ADEQ will be given the opportunity to review and concur with the language of use restrictions and zoning ordinances before the Navy negotiates agreements with adjacent property owners.

MNA has been incorporated as a component of the institutional controls alternative. MNA is an *in situ* remedial action that reduces the mass, toxicity, or mobility of contaminants with distance and time caused by naturally occurring processes in the environment. These processes include physical (e.g., sorption, dispersion, diffusion, dilution, and volatilization), chemical (e.g., chemical [abiotic] reaction), and biological (biodegradation) processes. The biological degradation process of CHCs occurs because the organic contaminants are used by microorganisms for their own growth and reproduction. The three general lines of evidence to evaluate natural attenuation are (NRC 1993):

- historical trend indicating the contaminant plume is stable or shrinking,
- presence and distribution of geochemical and biological indicators, and
- direct microbiological evidence.

There are insufficient historical data to document a loss of contaminants at the OU-1 area plumes; however, existing information indicates that the Areas 2, 3, and 6 plumes appear to be stable or decreasing. Historical VOC analytical results for Areas 2, 3, and 6 monitoring wells are presented in Tables 2-1 through 2-3. Other indicators of natural attenuation can be based on changes in the groundwater chemistry or the distribution of degradation daughter products (Figure 2-4). Based on a remediation by natural attenuation (RNA) study conducted at MCAS Yuma (Parsons 1997), natural attenuation is likely to be effective and implementable for the CHC plumes at Areas 2, 3, and 6, and the Area 1 plume after CHC concentrations are reduced by the AS/SVE system..

The third line of evidence would require demonstrating that microorganisms required for contaminate biodegradation are present on site or that the indigenous microorganisms are capable of biodegrading the contaminants present under site conditions (i.e., microcosm studies). However, the third line of evidence is typically only used in limited circumstances and may not be as applicable for the evaluation of natural attenuation as the first two lines of evidence. Monitoring is required to confirm the effectiveness of natural processes in reducing and containing contaminant concentrations. Institutional controls would safeguard against groundwater use while natural attenuation is occurring.

This alternative also includes an LTM plan to monitor groundwater throughout the plume. The LTM plan will comply with the groundwater monitoring requirements set forth in Section 2.13.1.3 of this ROD.

The estimated cost for Alternative 2 includes approximately $85,000 in capital costs and $112,000 in yearly O&M costs to put institutional controls in place and implement the LTM plan, for a total 30-year present-worth cost of $1.48 million. About 90 percent of the capital cost is for the installation of four additional groundwater monitoring wells. The estimated O&M cost is based on quarterly sampling and analysis of 12 wells for the first year and then a modified monitoring program. The 30-year annual well maintenance and reports to regulatory agencies are also included. Monitoring programs are negotiated with the responsible regulatory agency. Future discussions with agency staff may result in a revised sampling/analysis frequency. Institutional controls, including monitoring, are expected to be required for a long time (e.g., 30 years or more), regardless of other remedial actions taken. Institutional controls are included in the cost of all the other alternatives discussed in the following paragraphs.

Groundwater modeling indicates that under this alternative, it would take contaminants between 30 and 40 years to naturally degrade to levels below drinking water standards., All alternatives for the Area 1 plume, except the no action alternative, include institutional controls and MNA.

2.10.3 Alternative 3: Containment by Pumping and Treatment With Discharge to Yuma POTW

Alternative 3 includes the same institutional controls as Alternative 2 and containment by on-site groundwater extraction followed by treatment of the extracted groundwater with disposal of the treated groundwater to the Yuma POTW. The conceptual design includes three extraction wells located at the leading edge of the Area 1 plume. The extracted groundwater would be pumped through an underground pipe to an aboveground treatment system located outside the airport's clear zone.

The representative treatment system for the contaminated groundwater would be a low-profile air stripper that removes VOCs. The low-profile air stripper was selected because of the proximity to the airport, which requires consideration of the height of equipment. Also, a low-profile air stripper is easier to operate and reduces potential scaling problems. The treatment system would be designed to meet the Yuma POTW pretreatment standard of 50 µg/L total toxic organics. The treated water would also meet all applicable or relevant and appropriate drinking water standards for VOCs.

The treated groundwater would be conveyed to the Yuma POTW. A vapor-phase activated-carbon unit would be used to treat the off-gas from the air stripper. Spent GAC would be removed by the vendor and regenerated off site. During the preliminary and/or final design phase, other treatment methods may be tested and selected.

The estimated cost of Alternative 3 includes $891,000 in capital costs to construct the groundwater pump and treat system and $265,000 in yearly O&M costs to operate the system, for an estimated total 30-year present-worth cost of $4.18 million, including institutional controls. The capital cost includes installing three extraction wells and one treatment system. Sewer discharge is estimated to be about $0.8 million, and O&M cost is estimated to be $153,000 per year with almost half of this cost for sewer disposal charges. Groundwater modeling indicates that this alternative would take between 20 and 30 years for the Area 1 plume to reach MCLs.

In addition to using extraction and treatment for containment of the Area 1 plume, this alternative could be considered a contingency at other area plumes (e.g., Area 2) in the event that MNA (which is part of Alternative 2) is not meeting expected remediation objectives. The actual design capacity of the extraction and treatment facilities would be determined during the remedial design phase on the basis of the latest refined groundwater information and modeling. The extraction wells would be located to most effectively intercept, extract, and remediate the contaminant plume. Groundwater monitoring wells would be installed to evaluate the effectiveness of the remedial action.

2.10.4 Alternative 3a: Containment by Pumping and Treatment With Discharge by Reinjection

Alternative 3a is the same as Alternative 3, except that the treated groundwater would be discharged to the groundwater aquifer using reinjection wells. The conceptual design estimates that a pair of reinjection wells would be aligned outside the north and south sides of the Area 1 plume near the leading edge, thereby creating two pressure ridges that would tend to funnel the contaminant plume toward the proposed extraction-well barrier. The reinjection wells would be designed to provide approximately four times more well-screen area than the extraction wells to facilitate recharge of the treated groundwater.

The estimated cost of Alternative 3a includes $1.31 million in capital costs to construct the groundwater pump and treat system and $250,000 in yearly O&M costs to operate the system, for an estimated total 30-year present-worth cost of $4.41 million.

2.10.5 Alternative 5: Containment by Vertical Recirculation Wells

Alternative 5 includes the same institutional controls as in Alternative 2 and containment using a VR-well treatment system. The in-well air-stripping system creates a vertical circulation of groundwater by injecting ambient air into the lower portion of the VR well, which is screened in the saturated and unsaturated zones and separated by an impermeable packer (Figure 2-5). Contaminated groundwater is drawn in from the saturated zone, and VOCs are stripped as the water bubbles up the VR well. The extracted vapors from the groundwater and the vadose zone are collected under negative pressure and treated at the surface, while the treated groundwater is discharged out the upper screens into the vadose zone. The extracted air vapor would pass through a liquid knockout tank to remove entrained water, be heated to reduce relative humidity (50 to 60 percent), and then be treated in a two-stage vapor-phase GAC unit. Condensed liquid from the knockout tank would be transported to MCAS Yuma's existing waste staging area for disposal. During the air-stripping process, carbon dioxide is lost, which increases the water pH and results in some minerals (such as calcium) coming out of solution and depositing as scale on interior well component surfaces. This can clog the well screens over time. To prevent this scaling, carbon dioxide would be added to the air supply injected into the wells.

Alternative 5 includes the institutional controls and groundwater LTM plan described in Alternative 2.

There are several commercially available in-well air-stripping systems. Three production wells were installed by one manufacturer (NoVOCs™ system) at the leading edge of the Area 1 plume in the beginning of 1997 under the STRAP. Results of the 5-month pilot study (OHM 1999b) indicated that the technology effectively removed CHCs from the groundwater and extracted soil gas; however, siltation problems occurred in the production wells during the last month of the pilot test, which significantly affected the operation of the system. Also, the quantity of GAC used for removing vapor-phase volatiles in the closed-loop system was significantly greater than expected because of high humidity. Since the CHC levels in the off-gas were low, ADEQ approved the release of untreated extracted vapors; however, there is no assurance that ADEQ would approve the release of untreated vapor in a full-scale system.

The Navy has also operated a modified VR-well treatment system redesigned to avoid the siltation problem (OHM 1999b). The modified variation of the VR-well alternative pumped contaminated groundwater from the bottom of the well, treated it on the surface with a liquid-phase GAC unit, and reinjected it into the VR well for discharge through the upper screens in the vadose zone. Pilot testing conducted in the latter half of 1998 indicated that the system produced significant reductions in CHC concentrations in two operating wells and in downgradient monitoring wells with substantially less downtime than the NoVOCs system (OHM 1999b).

For purposes of the ROD evaluation, the NoVOCs system was assumed; however, this alternative could use any VR-well design. The conceptual design is based on installing five NoVOCs production wells at the leading edge of the Area 1 plume. Each NoVOCs well would penetrate 75 feet below the top of the groundwater table (total 140 feet bgs) and is estimated to have a 65-foot radius of influence.

The estimated cost of Alternative 5 includes $1.65 million in capital costs to construct the VR well system, and $214,000 in yearly O&M costs to operate the system, for an estimated total 30-year present-worth cost of $4.31 million. Much of this cost is for the installation of the VR production wells and for pipelines to and from the wells to the remote treatment facility (approximately 1,500 feet) where the injection and extraction blowers would be installed. The estimated annual O&M cost is largely for sampling/analysis and O&M labor.

Groundwater modeling indicates that this alternative would require between 20 and 30 years for the Area 1 plume to reach MCLs.

2.10.6 Alternative 7: Containment Plus Hot Spot Removal by Pump and Treatment With Discharge to Yuma POTW

Alternative 7 includes the same institutional controls as Alternative 2, the same containment at the leading edge of the Area 1 plume as Alternative 5, and removal of contaminants from the hot spot of the Area 1 plume (in the vicinity of Building 230) by groundwater extraction followed by air-stripping treatment with disposal of the treated groundwater to the Yuma POTW.

The conceptual design includes three extraction wells located in the hot spot area of the Area 1 plume. The extracted groundwater would be pumped to an aboveground treatment system located near Building 230. A counter-current air stripper that removes VOCs would treat the contaminated groundwater. The treated water would meet applicable or relevant and appropriate drinking water standards for VOCs. The treated groundwater would then be conveyed to the Yuma POTW. A vapor-phase activated-carbon unit would be used to treat the off-gas from the air stripper. Spent GAC would be removed by the vendor and regenerated off site. The extraction wells would be located to optimize removal of contaminants from the source area of the contaminant plume. Groundwater monitoring wells would be installed to evaluate the effectiveness of the remedial action.

Alternative 7 includes the institutional controls and groundwater LTM plan described in Alternative 2.

The estimated cost of Alternative 7 includes $2.79 million in capital costs to construct the VR well and the groundwater extraction and treatment systems, and $495,000 in yearly O&M costs to operate the systems, for an estimated total 30-year present-worth cost of $8.93 million.

Groundwater modeling indicates that this alternative would require between 10 and 20 years for the Area 1 plume to reach MCLs

2.10.7 Alternative 7a: Containment Plus Hot Spot Removal by Pump and Treatment With Discharge by Reinjection

Alternative 7a is the same as Alternative 7, except that the treated groundwater would be discharged to the groundwater aquifer using reinjection wells. The conceptual design estimates that seven reinjection wells would be located north of the flight-line apron. As a secondary benefit, the reinjection wells would be aligned downgradient of the Area 2 plume, thereby creating a pressure ridge that would tend to reduce downgradient migration of the Area 2 plume. The reinjection wells would be designed to provide approximately four times more well-screen area than the extraction wells to facilitate recharge of the treated groundwater.

The estimated cost of Alternative 7a includes $3.6 million in capital costs to construct the VR well, groundwater extraction and treatment, and reinjection systems, and $432,000 in yearly O&M costs to operate the systems, for an estimated total 30-year present-worth cost of $8.96 million.

2.10.8 Alternative 9: Containment Plus Hot Spot Removal by Air Sparging/Soil Vapor Extraction

Alternative 9 includes the same institutional controls as Alternative 2, the same containment at the leading edge of the Area 1 plume as Alternative 5, and removal of contaminants from the hot spot area of the Area 1 plume by *in situ* AS/SVE. Alternative 9 also includes the groundwater LTM plan described in Alternative 2. MNA may be required, depending on contaminant concentration levels, following VR and AS/SVE operation. (Section 2.13.1.4, Termination of Containment/Treatment System Operation subsection).

AS is the injection of pressurized ambient air into the saturated zone of a contaminated groundwater plume that results in volatilization of VOCs in groundwater. VOCs partition off into the sparged air and are carried by the air movement to the vadose zone where they are captured by an SVE system and treated at the surface (Figure 2-6). For purposes of comparing alternatives, a conceptual design of an AS/SVE system was prepared. The conceptual design for remediating the hot spot area involves installing a system of 39 AS wells and 19 vertical SVE wells in the hot spot area. The AS wells would penetrate down to 40 feet below the upper groundwater table (i.e., 100 feet bgs) and have a 40-foot radius of influence. The SVE wells would penetrate the vadose zone approximately 50 feet bgs (10 feet above the upper groundwater table) and have an estimated 60-foot radius of influence. The final design of the system includes 42 AS wells with a 20-foot radius of influence, and 15 dual-phase SVE wells with a 75-foot radius of influence (OHM 1999c).

The AS/SVE system is expected to volatilize contaminants in the source area and in groundwater that moves laterally across the area of influence. Off-gases from the groundwater and vadose zone would be collected from the SVE under an induced vacuum and vented to a vapor-treatment system consisting of a liquid knockout tank to remove entrained water, a heater to reduce relative humidity (50 to 60 percent), and a two-stage vapor-phase GAC unit. Spent GAC would be removed by the vendor and regenerated off site.

The estimated cost of Alternative 9 includes $3.42 million in capital costs to construct the VR well and AS/SVE systems and $370,000 in yearly O&M costs to operate the systems, for an estimated total 30-year present-worth cost of $8.01 million.

The goal is to reduce all contamination in the Area 1 plume to concentrations equal to or below MCLs; however, CHCs may be left above MCLs if remediation does not effectively reduce CHCs and modeling results indicate CHCs will not reach the facility boundary above MCLs. Groundwater modeling indicates that this alternative would require between 10 and 40 years for the Area 1 plume to reach MCLs, depending on the effectiveness of AS/SVE remediation at the hot spot (Section 2.6.2.1).

2.11 SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

Each remedial alternative was analyzed in accordance the nine evaluation criteria set forth in the NCP at 40 CFR 300.430 (e)(9)(iii). Table 2-17 provides a summary of the comparative analysis of the advantages and disadvantages of each remedial action relative to each other so that the key tradeoffs can be identified.

2.11.1 Overall Protection of Human Health and the Environment

The no action alternative (Alternative 1) does not provide adequate protection of human health or the environment if the groundwater were to be used in the future as a drinking water source. This alternative is considered the least protective because it provides no assurance that contaminated groundwater would not be brought to the surface and used in a way that would potentially threaten humans or the environment.

The institutional controls with the MNA alternative (Alternative 2) do provide protection by restricting future use. Alternative 2 provides a moderate degree of overall protection of human health and the environment because groundwater use restrictions can assure that potential receptors do not come into contact with the contaminated groundwater.

Alternatives 3, 3a, and 5 provide a higher degree of overall protection of human health and the environment by managing existing risks and minimizing potential future risks. Also, Alternatives 3, 3a, and 5 are considered more protective of human health and the environment because they manage less contaminant mass than Alternative 7, 7a, or 9. Of the alternatives that include hot spot mass removal (7, 7a, and 9), Alternative 9 provides the highest degree of overall protection because contaminated groundwater is not brought to ground surface as with Alternatives 7 or 7a.

2.11.2 Compliance With ARARs

A detailed discussion of the ARARs considered in this section is in Section 2.8.

Compliance with chemical-specific ARARs is likely to be achieved with all alternatives, although Alternatives 3, 3a, 5, 7, 7a, and 9 all involve treatment of contaminated groundwater; therefore, these alternatives are expected to achieve chemical-specific ARARs more quickly than Alternatives 1 and 2. Because Alternatives 7, 7a, and 9 remove contaminant mass from the hot spot area, they would likely be the quickest alternatives to achieve chemical-specific ARARs. Natural-attenuation processes would eventually result in contaminant concentrations meeting chemical-specific ARARs under Alternatives 1 and 2. However, implementation of Alternatives 1 and 2, alone, may not result in compliance with chemical-specific ARARs (i.e., primary drinking water standards) within a reasonable time.

Location-specific ARARs will be met by all the alternatives. These ARARs do not apply to Alternative 1 since no action is being taken. The remainder of the alternatives would meet location-specific ARARs by incorporating precautions during implementation for the protection of endangered or threatened species or any historically or archeologically significant items.

Action-specific ARARs apply to Alternatives 3, 3a, 5, 7, 7a, and 9 because they involve the actions of groundwater extraction, treatment, and disposal (Alternatives 3, 3a, 7, and 7a) and treatment of gases and other residuals management (Alternatives 3, 3a, 5, 7, 7a, and 9). Action-specific ARARs will be achieved by incorporating appropriate design criteria, performance standards, and monitoring. Alternative 1 does not trigger action-specific ARARs since no action is being taken.

2.11.3 Long-Term Effectiveness and Permanence

Restoration of the Area 1 groundwater to background conditions will be achieved eventually through natural attenuation with all eight alternatives. The natural-attenuation process might be accelerated with properly designed and operated remedial actions. If an alternative without active treatment (no action or institutional controls) is implemented, it would likely take 30 to 40 years for natural degradation and flushing to reduce contaminants in the groundwater to levels below allowable standards. Applying a containment system (Alternative 3, 3a, or 5) at the MCAS Yuma boundary would prevent migration of contaminants above MCLs from MCAS Yuma. If an additional remedial action is implemented to also remove contaminants from upgradient portions of the plume where contaminant concentrations are higher (Alternative 7, 7a, or 9), contaminants would be removed from the groundwater plume at an even more expedited rate (between 1 and 2 years). The time required for plume cleanup and the time frame that a containment system at the MCAS Yuma boundary is needed would also be reduced.

Since the majority of the Area 1 plume is within a secured military installation with restricted access, implementation of institutional controls is considered highly effective and reliable to manage untreated groundwater extraction and prevent contact with contamination. The small portion of the plume that is not on MCAS Yuma property is within the Airport Authority property. Restrictions on this property will have to be coordinated with the appropriate officials; however, appropriate restrictions are likely to be granted since they are compatible with current and likely future land use. Because Alternative 1 does not include institutional controls, it provides the least long-term effectiveness.

Risk from management of treatment residuals is low from all alternatives, consisting mainly of spent activated carbon. Residual risk is greatest from Alternatives 7 and 7a because this alternative is expected to generate the largest volume of treatment residuals. Of the other treatment alternatives, Alternatives 3, 3a, and 5 manage the lowest volume of contaminant mass and would, therefore, generate the lowest volume of residuals. Alternative 9 would generate an intermediate volume of treatment residuals.

2.11.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

The no action and institutional controls alternatives involve no treatment; therefore, other than through natural-attenuation processes, they would not reduce toxicity, mobility, or volume. Treatment would be accomplished in the other alternatives to varying degrees, as follows.

- Alternatives 3, 3a, and 5 would reduce the toxicity and mobility of contaminants by preventing migration of the plume from MCAS Yuma. These alternatives would reduce the least volume of contaminants because they treat the downgradient portion of the plume, which is least contaminated.

- Alternatives 7, 7a, and 9 would provide the greatest reduction in volume, mobility, and toxicity through treatment by removing contaminants directly from the hot spot area downgradient of Building 230 in addition to the containment actions in Alternatives 3, 3a, and 5.

2.11.5 Short-Term Effectiveness

Because of the length of the remedial action, short-term risks are the same as current risks. All alternatives, except the no action alternative, rely on institutional controls for short-term effectiveness and community protection. Such controls are more effective on MCAS Yuma. If controls cannot be maintained off MCAS Yuma, short-term effectiveness would be compromised.

The potential threat to human health and the environment from contaminated groundwater is limited to exposure to extracted groundwater contaminants in either liquid or gas form. If contaminated groundwater or gases are not extracted, there are no complete exposure pathways. Therefore, the no action and institutional controls alternatives would have the least potential immediate harmful effect on human health and the environment but would also provide less protection in the short term.

The no action alternative affords the greatest degree of protection for workers because no contaminant is brought to the surface and no drilling or construction activity is conducted. The institutional controls alternative would also be protective but to a slightly lesser degree because additional wells are drilled and routine sampling may expose workers to contaminants.

Because of the contaminant types (VOCs) to be treated and the fact that workers would constitute a more sensitive receptor than the environment, protection of workers during the implementation of active alternatives is of principal concern. These alternatives involve additional construction and management activities, creating additional potential risks.

Worker protection can be achieved by adhering to proper health and safety requirements. Worker-exposure risks posed by the alternatives are as follows:

- Alternatives 3, 3a, and 5 would pose the least additional potential risks of worker exposure because construction and O&M activities will be conducted in the most downgradient portion of the plume (at the MCAS Yuma boundary) where groundwater contaminant concentrations are low.

- Alternatives 7 and 7a would pose the greatest additional potential risk of worker exposure because construction and O&M activities will be conducted in the hot spot area where the highest contaminant concentrations were reported. Also, actions involve extracting large quantities of contaminated groundwater.

- Alternative 9 is similar to Alternatives 7 and 7a, but it appears to pose less risk to workers because only gases contaminated with VOCs would be brought to the surface. Proper system design, construction, and O&M should effectively reduce the risks of worker exposure.

The active remediation alternatives would increase the exposure risk by pumping and handling of contaminated groundwater. However, using proper worker protection and safety measures would reduce these risks to acceptable levels.

2.11.6 Implementability

The no action alternative is the easiest to implement because no actions are undertaken. Imposing institutional controls (Alternative 2) is more difficult since it will require coordination with Marine, Corps and Airport Authority personnel and installation of new groundwater monitoring wells.

The active treatment alternatives are the most difficult to implement because of construction, operation, and maintenance activities associated with treatment facilities. Alternatives 3, 3a, 7, and 7a are considered easy to construct with readily available technology. Alternatives 5 and 9, VR wells, are considered innovative. The limited previous use of this technology makes it more difficult to assess; therefore, pilot studies were conducted before a full-scale system was implemented (Section 2.10.5). Also, extra consideration is required for alternatives involving construction near active runways.

The administrative implementability of the no action alternative is also the highest because no coordination would be required. The administrative implementability of Alternatives 3 and 7 is considered the lowest because of the necessary attainment of discharge limits to the POTW and the consideration that future discharge of treated groundwater to the POTW may not be allowed. Alternatives 3a and 7a would have to meet drinking water standards in reinjection, but no permits are required for reinjection. Implementability of Alternatives 5 and 9 is considered equal because they involve the same site-use restrictions, a monitoring program and permitting for air discharge.

2.11.7 Cost

A summary of the estimated capital, O&M, and present-worth cost of each remedial alternative is in Table 2-18. All present-worth calculations were based on a uniform series, 7 percent discount rate, and 30-year project life.

Alternative 1, no action, is the least costly with a 30-year present-worth of $74,000 but is also the least protective. Alternative 2, institutional controls, is the next least costly with a present worth of $1.48 million. This alternative affords more protection to human health and the environment than Alternative 1 but is not expected to achieve groundwater cleanup goals in a reasonable time frame.

Alternatives 3 and 3a are almost the same with present worth costs of $4.18 and $4.41 million, respectively. Both alternatives provide extraction of groundwater followed by an air stripper and vapor-phase activated-carbon treatment system for removing VOCs. They only differ in the method of disposal of treated groundwater: discharge to POTW versus aquifer reinjection. The capital costs of reinjection are slightly higher, but annual O&M costs are lower than POTW discharge. In terms of cost-effectiveness, Alternatives 3 and 3a afford all the protection of Alternative 2.

Alternative 5 is also similar to Alternatives 3 and 3a in that all three are designed to intercept the plume at the leading edge. Alternative 5 provides *in situ* treatment of the groundwater plume through water recirculation and in-well stripping. Alternative 5 has an estimated present-worth cost of $4.31 million, comparable to costs for Alternatives 3 and 3a. In terms of overall benefits, Alternative 5 is more cost-effective and protective of human health and the environment than Alternatives 3 and 3a.

Alternative 5 is incorporated into Alternatives 7, 7a, and 9 as the representative containment method to prevent further plume migration off MCAS Yuma. Alternatives 7, 7a, and 9 provide the additional component of source treatment by providing groundwater treatment in the hot spot area downgradient from Building 230. Alternatives 7 and 7a provide for extraction of groundwater followed by an air stripper and vapor-phase activated-carbon treatment system for removing VOCs. Like Alternatives 3 and 3a, Alternatives 7 and 7a only differ in the method of disposal of treated groundwater: discharge to POTW versus aquifer reinjection. The present-worth costs of Alternatives 7 and 7a are almost the same, $8.93 and $8.96 million, respectively. Alternative 9 uses *in situ* AS/SVE to achieve hot spot contaminant mass removal. Alternative 9 has significantly lower annual O&M costs than Alternatives 7 and 7a, which leads to a lower present-worth cost of $8.01 million. The major difference in O&M costs among Alternatives 7, 7a, and 9 is the expense of discharging 84 million gallons per year of treated effluent to the Yuma POTW or reinjecting the effluent into the aquifer. Alternative 9, which uses an *in situ* process, avoids this cost. From a cost standpoint, Alternative 9 is clearly preferable over Alternatives 7 and 7a for contaminant mass removal in the vicinity of Building 230.

2.11.8 State Acceptance

The ADEQ and the U.S. EPA have reviewed the technical and administrative issues of the groundwater at MCAS Yuma in the OU-1 RI/FS and public comments from the PP and support the preferred alternatives and contingencies presented in this ROD.

2.11.9 Community Acceptance

This ROD considered and responded to public comments on the OU-1PP. According to the public input, there is a general consensus in the community to accept the preferred alternatives and contingencies presented herein.

2.11.10 Selected Remedy

The comparative analyses of the remedial alternatives against the nine evaluation criteria concluded that Alternative 9 (containment plus hot spot removal by AS/SVE) most fully meets the NCP criteria for the Area 1 plume. Therefore, the Navy has selected Alternative 9 as the Area 1 plume remedial action. In the event the use of the selected containment and/or hot spot removal technologies are not technically effective, the Navy has developed a decision-making process to evaluate the requirements for implementing contingency alternatives described in Section 2.13.1.

Given the limited extent and generally lower contaminant concentrations, the Navy has selected Alternative 2 (institutional controls and MINA) for the remedial action for the Areas 2, 3, and 6 plumes. Consistent with the U.S. EPA's MNA guidelines (U.S. EPA 1997), a contingency alternative is proposed in the event that natural-attenuation processes are not meeting the remedial action objectives. The Navy has developed a decision-making process to evaluate the requirements for implementing contingency alternatives described in Section 2.13.2.

Plates 1 and 2 show the general geographical boundary of plume Areas 1, 2, 3, and 6. The plates also show the location of existing groundwater monitoring wells that have been sampled during previous investigations. The Navy will prepare an LTM plan for submittal to the U.S. EPA/ADEQ for concurrence. The LTM plan will identify the set of monitoring wells (existing and proposed) for each plume area to evaluate the effectiveness of the chosen remedial alternative. The LTM plan will also define the sampling period for each monitoring well, analytical program for each groundwater sample, and proposed test methods. The Navy will use the results of the long-term sampling of the compliance monitoring wells to evaluate the effectiveness of the remedial alternatives and to determine if implementation of the contingency alternative or termination of system operation is warranted.

During the first 5 years of operation of the remedial action, analytical data from the LTM program will be periodically evaluated. These data would consist of but not be limited to the following.

- Contaminant concentrations and distribution. During the first few years of the LTM program, a database of contaminant concentrations would be developed and added to the current historical database. This database would form the first line of evidence for the evaluation of continued natural attenuation (Section 2.10.2). A decrease over time in contaminant concentrations and extent are an indication that the plume is shrinking and is the primary evidence that natural attenuation processes are continuing. Additionally, the increased presence of degradation daughter products is direct evidence that natural attenuation processes are occurring.

- Presence and distribution of biodegradation indicator parameters. Biological degradation parameters will not be monitored as part of the LTM plan since results from the RNA study indicated minimal biological degradation (Parsons 1997).

The development of a comprehensive database of the above parameters should provide a pattern of behavior for each plume that would indicate whether natural-attenuation processes (physical and chemical) are acting to reduce both contaminant mass and plume area. The Navy shall conduct a review within 5 years after commencement of the remedial action pursuant to CERCLA Section 121 to assure that the remedy is or will be protective of human health and the environment.

A detailed discussion of the major components of the selected remedies is provided in Section 2.13.

2.12 PRINCIPAL THREAT WASTES

OU-1 at MCAS Yuma consists only of residual contamination in groundwater. Non aqueous phase liquids have not been identified in the saturated zone or deeper vadose zone beneath MCAS Yuma. Source materials at the surface or in the shallow subsurface have been dealt with in the OU-2 ROD. Consequently, OU-1 does not include any source materials that would be considered principal-threat wastes under the NCP.

2.13 SELECTED REMEDIES

The selected remedies are as follows.

2.13.1 Selected Remedy for Area 1 Plume

As required by the NCP and based on CERCLA requirements, the detailed analyses of the alternatives presented above, and the public comments, the Navy has selected Alternative 9 as the Area 1 plume final remedy, which includes:

- reducing CHCs to concentrations equal to or below MCLs,
- containment and treatment of the northwest plume's leading edge at the MCAS Yuma property boundary using VR wells,
- hot spot area treatment using AS/SVE wells,
- potential MNA if VR and AS/SVE treatment does not reduce the concentrations to MCLs,
- institutional controls, and
- a contingency remedy for pump and treat with either POTW discharge or reinjection.

The conceptual design for the VR system involves installing five in-well air-stripping VR wells at the western MCAS Yuma boundary approximately perpendicular to the flow of groundwater. Each VR well would penetrate approximately 140 feet bgs and is estimated to have a 65-foot radius of influence. Extracted vapors from the groundwater would be collected under negative pressure and treated at the surface, while the treated groundwater is discharged out the upper screens of the VR wells into the vadose zone. The extracted air vapor would pass through a liquid knockout tank to remove entrained water, heated to reduce relative humidity (50 to 60 percent), and then treated in a two-stage vapor-phase GAC unit. Condensed liquid from the knockout tank would be transported to MCAS Yuma's existing Waste Staging Area for disposal. To prevent scaling, carbon dioxide would be added to the air supply injected into the wells.

The conceptual design for remediating the hot spot area involves installing a system of 42 AS wells and 15 dual-phase SVE wells in the hot spot area (OHM 1999a). The AS wells would penetrate down to 20 feet below the upper groundwater table (i.e., 80 feet bgs) and have 20-foot radius of influence. The dual-phase SVE wells would be screened from 50 to 80 feet bgs and have an estimated 75-foot radius of influence. The AS/SVE system is expected to volatilize contaminants in the source area and in groundwater that moves laterally across the area of influence. Off-gases from the groundwater and vadose zone would be collected from the SVE under an induced vacuum and vented to a vapor treatment system consisting of a liquid knockout tank to remove entrained water, a heater to reduce relative humidity (50 to 60 percent), and a two-stage vapor-phase GAC unit. Spent GAC would be removed by the vendor and regenerated off site.

The major components of the selected remedy are as follows.

- Implement a groundwater containment/treatment system at the leading edge of the Area 1 plume to prevent further off-site migration.
- Treat the groundwater Area 1 hot spot in the vicinity of Building 230 to reduce contaminant mass in this area and accelerate remediation time for the entire plume.
- Transport, regenerate, recycle, and/or dispose the spent GAC units.
- Perform groundwater modeling in an attempt to demonstrate that VOC concentrations will reach the base boundary equal to or less than MCLs. If so demonstrated, then MNA will be performed to verify VOCs are approaching MCLs (Section 2.13.1.4).
- Implement institutional controls to restrict access to contaminated groundwater. Amend the MCAS Yuma Master Plan to reflect groundwater access and use restrictions, including contamination that has moved off MCAS Yuma, and establish mechanisms to control changes that would not interfere with or adversely affect remedial actions.

- Implement an LTM plan to monitor groundwater concentrations and contaminant movement in the Areas 1, 2, 3, and 6 plumes and evaluate the results to determine the effectiveness of the selected remedies.

- Implement an institutional control plan (ICP) to facilitate training and education of personnel involved with the enforcement of the required institutional controls. The ICP will document all of the required institutional and engineering controls as well as detail the procedures for any required monitoring programs. The ICP will also document procedures for the review of digging and building permits, establish procedures for assuring regular checks and balances are in place, include provisions for annual review (and updates as necessary) of the MCAS Yuma Master Plan, and provide for inspection and enforcement measures to assure that the required institutional controls are correctly implemented and enforced. Additionally, the ICP will establish procedures that require the regulatory agencies be notified in the event any major change in land use is proposed. The LTM plan may be an attachment to the ICP.

- Remediate all contaminated groundwater to MCLs.

- Terminate system operation (Sections 2.13.1.4 and 2.13.1.5).

To assure that human health and the environment are protected in the future, institutional controls will be implemented that include access restrictions to prevent the use on MCAS Yuma of untreated groundwater as drinking water. The Navy will provide necessary information to appropriate county agencies identifying areas off MCAS Yuma that are impacted by groundwater contamination exceeding MCLs. The Navy will also support county agencies with any technical information needed for the county to implement restrictions on construction and use of wells in the affected areas. The U.S. EPA and ADEQ will be given the opportunity to review and concur with the language of use restrictions and zoning ordinances before the Navy negotiates agreements with adjacent property owners.

Written U.S. EPA and ADEQ concurrence is required before MCAS Yuma takes any action that would be inconsistent with the prohibition against use of untreated groundwater within the Area 1 plume as drinking water. If any such action is proposed, MCAS Yuma must provide the U.S. EPA and ADEQ with written notification of such proposed action. The notice shall include 1) an evaluation of the risk to human health and the environment, 2) an evaluation of the need for any additional remedial action as a result of the proposed action, and 3) a description of the changes necessary to the selected remedy for the Area 1 plume in the OU-1 ROD.

The written notice of proposed action shall be submitted to the U.S. EPA and ADEQ at least 60 days before the commencement date for the proposed action. The U.S. EPA will advise whether a ROD amendment or an explanation of significant differences (ESD) document is required. The response from the U.S. EPA and ADEQ is due within 30 days of the Navy's written notice of proposed action. The U.S. EPA and ADEQ must provide written concurrence with MCAS Yuma's evaluation of risk and proposal regarding necessary changes in the selected remedy, if required, before MCAS Yuma can commence any action.

MCAS Yuma shall 1) notify the U.S. EPA and ADEQ of any plan to lease or transfer MCAS Yuma real property to a federal or nonfederal entity, 2) notify the transferee or lessee of the prohibition on use of groundwater in the Area 1 plume as drinking water, and 3) include the restrictions in the transfer or lease. Such notification shall be provided at least 45 days in advance of the lease or transfer conveyance. MCAS Yuma shall comply with Section 120(h)(3) of CERCLA in any such transfers.

The MCAS Yuma Master Plan will be amended to incorporate the above-mentioned restrictions on access to and use of contaminated groundwater for drinking water purposes on and off MCAS Yuma. The master plan amendments will include language that 1) prohibits the use on MCAS Yuma of untreated groundwater as drinking water; 2) describes the risk to human health and the environment of contaminated groundwater use; and 3) references the OU-1 ROD. The language in the master plan amendments will also include the title and dates of the above-listed documents and their storage location. These amendments to the MCAS Yuma Master Plan will be implemented by the Navy within 15 months of signing the OU-1 ROD. The U.S. EPA and ADEQ will be given the opportunity to review and concur with the language of amendments before they are incorporated into the MCAS Yuma Master Plan.

MCAS Yuma will notify the U.S. EPA and ADEQ 30 days in advance of any amendment to the MCAS Yuma Master Plan that could affect either the substance or the language of the master plan's groundwater use-restriction amendment.

The groundwater remedy for the Area 1 plume is consistent with the requirements of Section 121 of CERCLA and the NCP. The remedy will reduce the mobility, toxicity, and volume of contaminated groundwater at the site. In addition, the remedy is protective of human health and the environment, will attain all federal and state applicable or relevant and appropriate requirements, is cost-effective, and uses permanent solutions to the maximum extent practicable. The remedy for the Area 1 plume is consistent with previous pilot studies conducted at the site. Based on the information available at this time, the selected remedy represents the best balance among the criteria used to evaluate remedies.

2.13.1.1 CLEANUP GOALS FOR GROUNDWATER

Groundwater from the aquifer shall be monitored until cleanup goals (MCLs) are achieved as agreed upon by the Navy, MCAS Yuma, U.S. EPA, and ADEQ.

2.13.1.2 GROUNDWATER DISCHARGE STANDARDS

Treated groundwater that will be reinjected into the aquifer passed through reinjection wells shall comply with federal and state groundwater reinjection standards. Federal regulations allow reinjection as long as the end result of the remediation meets ARARs. State standards also require that best available demonstrated control technology that would eliminate all pollutant discharges be used where practicable. Discharges to a POTW facility shall comply with the facility's NPDES requirements.

2.13.1.3 GROUNDWATER MONITORING

Groundwater monitoring shall be conducted for the Area 1 plume during the remedial action to verify that progress toward achieving RAOs is being made. A post-ROD groundwater LTM plan for the Area 1 plume remedial action will be prepared under the authority of this ROD and submitted to the U.S. EPA and ADEQ for concurrence. The LTM plan will establish the number and location of monitoring wells (existing and proposed) to be sampled at designated POCs and within contaminant plumes. The LTM plan will also outline the sampling and analysis methods, periods and frequency for each well and major decision points to be made during monitoring (e.g., adding or removing wells, or changing sampling frequency or analytical parameters). The criteria for assessing the effectiveness of the remedial action shall also be included in the LTM plan. The post-ROD LTM plan will be a primary FFA deliverable to be submitted to the agencies. The LTM will be designed to accomplish the following criteria from Office of Solid Waste and Emergency Response Directive 9200.4-17P.

- Demonstrate that natural attenuation is occurring according to expectations.
- Detect changes in environmental conditions (e.g., hydrogeologic, geochemical, or other changes) that may reduce the efficacy of any of the natural attenuation processes. (Detection of changes will depend on the proper siting and construction of monitoring wells/points. Although the siting of monitoring wells is a concern for any remediation technology, it is of even greater concern with MNA because of the lack of engineering controls of contaminant migration.) Microbiological conditions will not be evaluated because the RNA study indicated minimal biological degradation.
- Identify any potentially toxic and/or mobile transformation products.
- Verify that the plume(s) is not expanding (downgradient, laterally, or vertically).
- Verify that there is no unacceptable impact to downgradient receptors.
- Detect new releases of contaminants to the environment that could impact the effectiveness of the natural-attenuation remedy.
- Demonstrate the efficacy of institutional controls that were put in place to protect potential receptors.
- Verify the number of remediation objectives.

The groundwater will be monitored as specified in the LTM plan until it is demonstrated that the remedial action has effectively and permanently reduced the VOC contamination to MCLs. If monitoring indicates that MCLs have not been met in accordance with these criteria, the groundwater monitoring will continue until the MCLs are achieved. The LTM results will also be used to determine whether implementing a contingency alternative or terminating system operation is warranted. The LTM results will be evaluated every 5 years, and the duration and frequency of the groundwater monitoring will be modified as appropriate until it is determined that the remedial action has been completed.

2.13.1.4 IMPLEMENTATION OF CONTINGENCY ALTERNATIVE FOR CONTAINMENT/TREATMENT SYSTEM

In the event that operation of the chosen action indicates that containment/treatment system VR wells do not adequately contain the leading edge of the Area 1 plume, the Navy has selected Alternative 3 or 3a (extraction and treatment with discharge to Yuma POTW or reinjection) as the contingent containment response action. The conceptual design includes three extraction wells located at the leading edge of the Area 1 plume. The extracted groundwater would be pumped through an underground pipe to an aboveground treatment system located outside the airport's clear zone for the adjacent runway. The contaminated groundwater would be filtered (if necessary), treated for scale prevention, and treated by a low-profile air stripper to remove VOCs. A vapor-phase activated-carbon unit would be used to treat the off-gas from the air stripper. Spent GAC would be removed by the vendor and regenerated off site. The treated groundwater would be conveyed to the Yuma POTW or to reinjection wells.

Implementation of Contingency Pump and Treat Alternative

The LTM program results for the defined POCs and system performance data will be collected during the first year of remediation system operation. The Navy will prepare a report, subject to U.S. EPA and ADEQ concurrence, evaluating the resulting data to determine whether the system is meeting the remediation goals. The criteria for system evaluation will consist of a review of contaminant concentrations. Increasing or stable contaminant concentrations above MCLs in downgradient monitoring wells (to be determined [TBD] in the LTM plan) will require implementation of the contingency pump and treat alternative. The Navy can propose to extend system operation for an additional year if the first year's data are inconclusive.

Monitoring would also include evaluating hydraulic control if this contingency were implemented. This would include obtaining groundwater levels to determine flow directions, mounding, or a reduction in the groundwater table from pumping activities.

Termination of Containment/Treatment System Operation

Selected monitoring wells located both upgradient and downgradient of the Area 1 groundwater containment/treatment system (VR wells) will be monitored during the remedial action in accordance with the groundwater LTM plan. These wells will be identified in the LTM plan. The Navy will evaluate the results to verify that the remedial system is effectively containing and treating the plume and, in the case of AS/SVE, to verify that the system is effectively reducing contaminant mass in the hot spot area.

The groundwater containment/treatment system will be operated until one of the following conditions is reached. A decision flow diagram for operation and shutdown of the VR and AS/SVE remediation systems is shown on Figure 2-7.

- Representative groundwater concentrations measured in the designated wells upgradient and downgradient of the VR well containment/treatment system have achieved groundwater cleanup standards (MCLs).

- Remaining VOCs in groundwater will reach the base boundary at concentrations equal to or less than MCLs. (This would require groundwater modeling results indicating remaining contaminants above MCLs will reach the base boundary at concentrations equal to or less than MCLs followed by MNA to remedy the remaining VOCs.) Modeling will be performed only after CHC concentrations upgradient and downgradient of the VR system reach MCLs. After MCLs have been attained and the VR system has, therefore, temporarily shut down, if CHCs in upgradient and downgradient wells of the VR system rebound above MCLs, modeling would be performed to determine whether CHCs would reach the MCAS Yuma facility boundary above or below MCLs.

- The AS/SVE system is no longer removing mass (i.e., an asymptotic condition is permanently reached) after system optimization. Modeling of the hot spot would also be required, indicating CHCs would reach the facility boundary equal to or below MCLs to terminate operation of the VR well system.

The Navy will demonstrate the above conditions through collection of groundwater samples from the monitoring wells designated in the LTM plan. When the monitoring data show that any of the above conditions has been met, the Navy can propose a temporary shutdown of the remediation system. Shutdown will be subject to U.S. EPA and ADEQ concurrence. The groundwater LTM program will continue for a period of up to 2 years. If it is demonstrated in this period that the representative groundwater concentrations of VOCs meet the groundwater cleanup standards, the parties agree that the system operation will be shut down permanently.

If, during temporary shutdown of the containment/treatment system, monitoring wells upgradient of the MCAS Yuma boundary show a rebound in VOC concentrations to greater than MCLs, operation of the containment/treatment system will be restarted. The Navy can then attempt to demonstrate through groundwater modeling that remaining groundwater contaminants above MCLs will reach the MCAS Yuma boundary at concentrations equal to or less than MCLs. Groundwater modeling will be subject to U.S. EPA and ADEQ concurrence. If this is demonstrated, the Navy can then propose a permanent shutdown of the containment/treatment system, subject to U.S. EPA and ADEQ concurrence. MNA of the Area 1 plume would be implemented to confirm VOCs are approaching MCLs. If MNA is not progressing adequately, the remediation system will be operated as needed.

If it is determined that the first and second conditions cannot be met, the Navy will demonstrate that VOCs in groundwater have been removed to the extent technically and economically feasible as set forth in the third condition by analyzing:

- whether the total mass removil is approaching asymptotic levels after temporary shutdown periods and appropriate system optimization,
- the additional cost of continuing to operate the system at concentrations approaching asymptotic mass levels, and
- whether discontinuing the system will significantly prolong the time to attain the groundwater cleanup standard.

The Navy will submit a primary document under the FFA, providing the appropriate demonstrations. The signatory parties to this ROD will jointly make the decision that the remediation system may be shut off permanently.

2.13.1.5 IMPLEMENTATION OF CONTINGENCY ALTERNATIVE FOR HOT SPOT REDUCTION

If the first year of data does not indicate the AS/SVE system is efficiently removing CHC mass, the Navy has selected Alternative 7 or 7a (groundwater extraction and treatment with discharge to Yuma POTW or reinjection) as the contingent hot spot reduction remedial action. The conceptual design involves three extraction wells located within the hot spot area. Extracted groundwater would be pumped to an aboveground treatment system located near Building 230. A countercurrent air stripper to remove VOCs to MCLs would treat the contaminated groundwater. A vapor-phase GAC unit would be used to treat the off-gas from the air stripper, and the spent GAC would be regenerated off site, The treated groundwater would be discharged to the MCAS Yuma wastewater-collection system for conveyance to the Yuma POTW or recharged by reinjection wells.

Treated groundwater would meet ARARs for discharge to the Yuma POTW or for recharge by reinjection, and air emissions from air stripping would be controlled (if required by the ADEQ) using vapor-phase GAC to meet ARARs.

Specific design parameters, such as well locations or pumping capacities, would be determined during the remedial design phase on the basis of the results of treatability studies and the latest refined groundwater information and modeling. The final remedial design would be optimized to provide the most effective containment system at the leading edge and to effectively remove contaminants from the hot spot area of the contaminant plume. Groundwater monitoring wells would be installed to evaluate remedial action effectiveness. An LTM plan that is in concurrence with the U.S. EPA and ADEQ would be developed as established in Section 2.13.1.3.

Implementation of Contingency Pump and Treat Alternative

The LTM program results and system performance data will be collected for a minimum of four consecutive quarters for the first year after remediation system startup. Wells are TBD in the LTM plan. The Navy will evaluate the resulting data to determine whether mass removal is occurring efficiently and provide a report to the U.S. EPA and ADEQ. The criteria for system evaluation will consist of reviewing the contaminant mass extracted by the AS/SVE system. If significant mass is not removed, the contingency pump and treat alternative must be implemented. However, before implementing the pump and treat alternative, the Navy will evaluate the reasons for preferred alternative failure and determine whether pump and treat will be effective. If it is determined pump and treat will be ineffective, the Navy will provide alternative technologies for consideration by the U.S. EPA and ADEQ. Additionally, the Navy can propose extending system operation for an additional year if the first year's data are inconclusive. This is subject to U.S. EPA/ADEQ concurrence.

Termination of AS/SVE System Operation

The LTM program results and system performance data will be evaluated by the Navy and reported to the U.S. EPA and ADEQ. Wells are TBD in the LTM plan. If the remediation system is no longer efficiently removing mass (i.e., if an asymptotic condition is reached) or MCLs have been reached, the remediation system can be temporarily shut down, subject to U.S. EPA and ADEQ concurrence. An “asymptotic condition” is defined as the point where the quantity of mass removed over a period of time has been reduced to a level whereby continued remediation-system operation is considered to no longer be technologically and economically feasible.

Upon remediation system shutdown, the LTM program will continue for a period of up to 2 years, and the data will be evaluated by the Navy and reported to the U.S. EPA and ADEQ. If the LTM program results show a rebound in VOC concentrations above MCLs, remediation-system operation will be restarted. Once asymptotic conditions for mass removal are reached, the system will be temporarily shut off, and groundwater will be monitored for rebound in VOC concentrations. Once asymptotic conditions are permanently reached, active remediation will be discontinued in Area 1, subject to U.S. EPA and ADEQ concurrence. After system shutdown, the Navy will perform groundwater modeling to determine concentrations of CHCs that will reach the MCAS Yuma facility boundary.

If modeling indicates CHCs will reach the MCAS Yuma facility boundary equal to or below MCLs, the VR containment/treatment system at the boundary will be recommended for permanent shutdown, and MNA will be implemented. If modeling indicates CHCs will reach the boundary above MCLs, the VR containment/treatment system will be operated as needed until MCLs are reached.

Monitoring of the plume will continue until all portions reach MCLs.

2.13.1.6 COST ESTIMATE

A summary of capital and O&M costs for major elements of the remedy is in Table 2-19. The AS/SVE costs are based on the conceptual design for comparison of alternatives, rather than on the final design. Final design costs are not expected to be significantly different from the conceptual design costs. Present-worth calculations were based on a uniform series, 7 percent discount rate, and 30-year project life.

2.13.2 Selected Remedy for Areas 2, 3, and 6 Plumes

As required by the NCP and CERCLA, the detailed analysis of the alternatives presented above, and the public comments, the Navy has selected Alternative 2 (institutional controls and MNA) as the remedy for the Areas 2, 3, and 6 plumes. The major components of the selected remedy consists of:

- implementing institutional controls on MCAS Yuma;
- operating and maintaining an LTM plan that includes periodic monitoring of selected COCs in groundwater monitoring wells, to be specified in a post-ROD OU-1 groundwater remedial action LTM plan; and
- closure criteria.

In the event that MNA is not meeting remedial action objectives, the selected contingent alternative to extract groundwater and treat with air stripping and GAC will be implemented.

To assure that human health and the environment are protected in the future, institutional controls will be implemented that include access restrictions to prevent the use on MCAS Yuma of untreated groundwater as drinking water. Written U.S. EPA and ADEQ concurrence is required before MCAS Yuma takes any action that would be inconsistent with prohibiting the use of untreated groundwater within the Areas 2, 3, and 6 plumes as drinking water. If any such action is proposed, MCAS Yuma must provide the U.S. EPA and ADEQ with written notification of such proposed action. The notice shall 1) evaluate the risk to human health and the environment, 2) evaluate the need for additional remedial action as a result of the proposed action, and 3) describe the changes necessary to the interim selected remedy for the Areas 2, 3, and 6 plumes in the OU-1 ROD.

The written notice of proposed action shall be submitted to the U.S. EPA and ADEQ at least 60 days before the commencement date for the proposed action. The U.S. EPA will advise whether a ROD amendment or an ESD document is required. The response from the U.S. EPA and ADEQ is due within 30 days of the Navy's written notice of proposed action. The U.S. EPA and ADEQ must provide written concurrence with MCAS Yuma's evaluation of risk and proposal regarding any necessary changes in the selected remedy, if required, before MCAS Yuma may commence any action.

MCAS Yuma shall 1) notify the U.S. EPA and ADEQ of any plan to lease or transfer MCAS Yuma real property to a federal or nonfederal entity, 2) notify the transferee or lessee of the prohibition on use of groundwater in the Areas 2, 3, and 6 plumes as drinking water, and 3) include the restrictions in the transfer or lease. Such notification shall be provided at least 45 days in advance of the lease or transfer conveyance. MCAS Yuma shall comply with Section 120(h)(3) of CERCLA in any such transfers.

The MCAS Yuma Master Plan will be amended to incorporate the above-mentioned restrictions on access to and use of contaminated groundwater for drinking water purposes on MCAS Yuma. The master plan amendments will include language that 1) prohibits use of untreated groundwater from the Areas 2, 3, and 6 plumes as drinking water; 2) describes the risk to human health and the environment of using contaminated groundwater; and 3) references the OU-1 ROD. The language in the master plan amendments will also include the title and dates of the above-listed documents and their storage locations.

These amendments to the MCAS Yuma Master Plan will be implemented by the Navy within 15 months of signing the OU-1 ROD. The U.S. EPA and ADEQ will be given the opportunity to review and concur with the language of amendments before they are incorporated into the master plan.

MCAS Yuma will give the U.S. EPA and ADEQ 30-day advance notice of any amendment to the MCAS Yuma Master Plan that could affect either the substance or the language of the MCAS Yuma Master Plan groundwater use restriction amendment.

2.13.2.1 PERFORMANCE STANDARDS FOR GROUNDWATER

Groundwater from the aquifer shall be monitored until cleanup goals (MCLs) are achieved as agreed upon by the Navy, MCAS Yuma, U.S. EPA, and ADEQ.

2.13.2.2 GROUNDWATER MONITORING

Groundwater monitoring shall be conducted for the Areas 2, 3, and 6 plumes during the remedial action to verify that it is effectively achieving RAOs. A post-ROD groundwater LTM plan for the Areas 2, 3, and 6 plumes remedial action will be prepared under the authority of this ROD and submitted to the U.S. EPA and ADEQ for concurrence. The LTM plan will establish the number and location of monitoring wells (existing and proposed) to be sampled at designated POCs and within contaminant plumes. The LTM plan will also outline the sampling and analysis methods, periods and frequency for each well, and major decisions (e.g., adding or removing wells, or changing sampling frequency or analytical parameters) to be made during monitoring. The criteria for assessing the effectiveness of the remedial action shall also be included in the groundwater LTM plan. The post-ROD LTM plan will be a primary FFA deliverable to be submitted to the agencies.

The LTM will be designed to accomplish the following criteria from OSWER Directive 9200.4-17P.

- Demonstrate that natural attenuation is occurring according to expectations.

- Detect changes in environmental conditions (e.g., hydrogeologic, geochemical, or other changes) that may reduce the efficacy of the natural attenuation processes. (Detection of changes will depend on the proper siting and construction of monitoring wells/points. Although the siting of monitoring wells is a concern for any remediation technology, it is of even greater concern with MNA because of the lack of engineering controls of contaminant migration.)

- Identify potentially toxic and/or mobile transformation products.

- Verify that the plume(s) is not expanding (downgradient, laterally, or vertically).
- Verify that there is no unacceptable impact to downgradient receptors.
- Detect new releases of contaminants to the environment that could impact the effectiveness of the natural-attenuation remedy.
- Demonstrate the efficacy of institutional controls that were put in place to protect potential receptors.
- Verify the number of remediation objectives.

The Navy will monitor the groundwater as specified in the LTM plan until it is demonstrated that the remedial action has effectively and permanently reduced the VOC contamination to cleanup standards (i.e., MCLs) set forth in Table 2-6. If monitoring indicates that MCLs have not been met in accordance with these criteria, the groundwater monitoring will continue until the MCLs are achieved. When monitoring indicates that VOC concentrations have decreased to MCLs, the LTM program will continue for a minium of 2 additional years. If there is no significant rebound in VOC concentrations above MCLs, the Navy can propose that the LTM program be terminated. Closure of LTM requires U.S. EPA and ADEQ approval. The LTM results will also be used by the Navy to determine whether implementation of an active remedy is warranted.

Because the MNA remedy results in remaining hazardous substances on site that are above allowable levels for unlimited use and unrestricted exposure, the Navy shall conduct a review pursuant to CERCLA Section 121 within 5 years after commencement of the remedial action to assure that the remedy is or will be protective of human health and the environment.

2.13.2.3 COST ESTIMATE

A summary of capital and O&M costs for major elements of the remedy is provided in Table 2-19. Present-worth calculations were based on a uniform series, 7 percent discount rate, and 30-year project life.

2.14 STATUTORY DETERMINATIONS

Statutory determinations are as follows.

2.14.1 Statutory Determinations for Area 1 Selected Remedy

As required under CERCLA Section 121, the selected and contingency remedial actions are protective of human health and the environment. These actions also comply with federal and state requirements that are legally applicable or relevant and appropriate to the remedial actions, and they are cost-effective. The selected and contingency remedies use permanent solutions and alternative treatment technologies to the maximum extent practicable and satisfy the statutory preference for remedies that employ treatment to reduce, toxicity, mobility, and volume as a principal element.

2.14.1.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The selected and contingent remedial actions protect human health and the environment by removing CHC contaminant mass from the aquifer and inhibiting further migration of contaminated groundwater downgradient. Based on RI data, the cancer risk from residential use of groundwater would be 4.7×10^{-3}. Once COC concentrations have been reduced to MCLs, the cancer risk would be reduced to 1.9×10^{-4}.

2.14.1.2 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The *in situ* and *ex situ* treatment of contaminated groundwater would be able to meet drinking water standards (MCLs). VOCs from either the VR or the SVE wells would be controlled to meet air-quality regulations. If the contingent extraction and treatment is used, the treated groundwater discharge to the Yuma POTW or recharge to reinjection wells would comply with discharge requirements.

2.14.1.3 COST EFFECTIVENESS

The selected Area 1 plume remedy is cost effective. This remedy for institutional controls and containment has an estimated capital cost of about $1.65 million (1997 dollars), which is about half the cost of hot spot area removal, containment, and institutional controls. However, if the contaminant mass removal at the hot spot is not cost effective, the overall remediation time would be extended. The O&M cost for the selected *in situ* containment process is less than the extraction and treatment alternative since there is no *ex situ* treatment and discharge of treated groundwater.

2.14.1.4 USE OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

Use of VR wells is an innovative *in situ* treatment technology that permanently remove VOCs from groundwater. The selected and/or contingent remedies (AS/SVE and groundwater pump and treat) are proven methods for permanently removing VOCs from groundwater.

2.14.1.5 IMPLEMENTABILITY

The selected and/or contingent remedies can be implemented at MCAS Yuma. Additional on-site pilot testing of innovative *in situ* treatment processes will be necessary to confirm their effectiveness and design parameters. The remedy can be implemented with readily available equipment, materials, and labor. Construction activities will have to be carefully scheduled and coordinated around runways, parking aprons, and other MCAS Yuma flight activity areas, which may cause some construction delays and additional costs.

2.14.1.6 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

The selected and contingent remedies would significantly reduce the toxicity, mobility, and volume of hazardous substances in the aquifer.

2.14.2 Statutory Determinations for Areas 2, 3, and 6 Selected Remedy

LTM for physical degradation of the CHCs is the selected remedy. As required under CERCLA Section 121, the selected remedy is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial actions, and is cost-effective. The selected remedy does not use treatment technologies. The remedy is preferred because the groundwater plumes are relatively small, stable plumes of CHCs.

2.14.2.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedial actions are protective of human health and the environment because groundwater use restrictions would effectively assure that potential receptors do not come into contact with the contaminated groundwater. Furthermore, groundwater use restrictions would remain in place until VOC contaminant concentrations are reduced to MCLs. Because the plumes are small, contain low COC concentrations, and are totally contained on MCAS Yuma, the effectiveness of groundwater use restrictions is enhanced. Based on RI data, the cancer risk from residential use of groundwater in Area 2 would be 4.6×10^{-3}, in Area 3 would be 2.7×10^{-4}, and in Area 6 would be 1.0×10^{-5}. Once COC concentrations have been reduced to MCLs, the cancer risk would be reduced to 1.8×10^{-4} at Area 2, 1.8×10^{-4} at Area 3, and 6.0×10^{-6} at Area 6.

2.14.2.2 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Groundwater samples will be collected and analyzed to determine whether physical degradation of CHCs is occurring. The effectiveness of the remedy will be evaluated within 5 years to determine whether contaminant concentrations are approaching drinking water standards (MCLs).

2.14.2.3 COST EFFECTIVENESS

Institutional controls with MNA is the most cost-effective means of assuring that these small, low-concentration, isolated contaminant plumes are remediated in a reasonable time. Active remedial actions involving groundwater pump and treat would cost more without significantly increasing protection of human health and the environment.

2.14.2.4 USE OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

The combination of institutional controls and MNA is not new or innovative, but it offers an alternative treatment option. The selected remedy would permanently treat the contaminant plume by natural physical, chemical, and biological processes.

2.14.2.5 IMPLEMENTABILITY

The selected remedy can be easily implemented since it involves installing conventional monitoring wells, and its administrative controls can be effectively enforced. The remedy can be implemented with readily available equipment, materials, and labor.

Drilling and well installation activities will have to be carefully scheduled and coordinated around runways, parking aprons, and other MCAS Yuma flight activity areas, which may cause some delays in field work and additional costs.

2.14.2.6 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

Although the selected remedy for Areas 2, 3, and 6 does not use active treatment, the groundwater plumes are relatively small and appear to be stable. On the balance, the overall selected remedy that includes Areas 1, 2, 3, and 6 satisfies statutory preferences for treatment because degradation of chlorinated solvents in the plumes will be monitored to evaluate the effectiveness of MNA as a remedy. The selected contingent alternative to extract groundwater and treat with air stripping and GAC will be implemented if MNA does not reduce contamination.

2.14.3 Five-Year Review

Because the MNA remedy results in remaining hazardous substances on site that are above allowable levels for unlimited use and unrestricted exposure, the Navy shall conduct a review pursuant to CERCLA Section 121 within 5 years after commencement of the remedial action to assure that the remedy is or will be protective of human health and the environment. Five-year reviews will be required until cleanup standards (MCLs) are reached.

2.15 LAND AND GROUNDWATER USE AFTER IMPLEMENTATION OF SELECTED REMEDY

Most activities or operations at MCAS Yuma are industrial/commercial in nature and/or support military activities. The downgradient area immediately off MCAS Yuma is administered by the Yuma Airport Authority to support airport operations. Currently, no industrial water is obtained from regional groundwater. If MCAS Yuma maintains its current mission, it is anticipated that commercial/industrial uses of water will not change in the future. Consequently, there is no direct contact with groundwater (i.e., ingestion, or dermal contact with or inhalation of volatile emissions) under the current industrial/commercial land and wafer use. The situation will remain unchanged during and after implementation of the selected remedy.

In addition to the airport property to the northwest, surrounding land use primarily supports citrus groves. Within a 1-mile radius of MCAS Yuma, all water used for irrigation purposes is obtained exclusively from the Colorado River through a system of canals. No groundwater is used for irrigation, and it is not anticipated that this will change in the future. The selected remedy will not affect this situation.

Under current land-use conditions, no complete exposure pathway exists for groundwater contaminants at MCAS Yuma. In the future, it is possible that a water-supply well could be installed either on or off MCAS Yuma, especially since the shallow groundwater aquifer has been classified by the state of Arizona as a drinking-water-quality aquifer. Once the selected remedy has been completed, groundwater will meet drinking water MCLs.

To assure that human health and the environment are protected in the future, institutional controls will be implemented that include access restrictions to prevent the use on MCAS Yuma of untreated groundwater as drinking water. The Navy will provide necessary information to appropriate county agencies identifying areas off MCAS Yuma impacted by groundwater contamination exceeding MCLs. The Navy will also support county agencies with any technical information needed for the county to implement restrictions on construction and use of wells in the affected areas.

MCAS Yuma shall 1) notify the U.S. EPA and ADEQ of any plan to lease or transfer MCAS Yuma real property to a federal or nonfederal entity, 2) notify the transferee or lessee of the prohibition on use of groundwater in the Area 1 plume as drinking water, and 3) include the restrictions in the transfer or lease. Such notification shall be provided at least 45 days in advance of the lease or transfer conveyance. MCAS Yuma shall comply with Section 120(h)(3) of CERCLA in any such transfers.

The MCAS Yuma Master Plan will be amended to incorporate the above-mentioned restrictions on access to and use of contaminated groundwater for drinking water purposes on MCAS Yuma until MCLs are reached. The master plan amendments will include language that 1) prohibits the use on MCAS Yuma of untreated groundwater as drinking water, 2) describes the risk to human health and the environment of contaminated groundwater use, and 3) references the OU-1 ROD. The language in the master plan amendments will also include the title and dates of the above-listed documents and their storage location.

2.16 SIGNIFICANT CHANGES FROM PREFERRED ALTERNATIVE IN PROPOSED PLAN

The PP for OU-1 at MCAS Yuma was released for public comment in May 1999. The PP identified the following preferred alternatives for the Areas 1, 3, and 6 plumes.

- For the Area 1 plume, Alternative 9, incorporating Alternatives 2 and 5, is preferred. This alternative involves institutional controls with LTM, containment of the leading edge of the plume with vertical recirculation wells, and treatment of the hot spot area with air sparging and soil vapor extraction.

- Because of data inconsistencies, the Area 2 plume had been proposed for transfer to OU-3 for further study.

- For the Areas 3 and 6 plumes, Alternative 2 is preferred. This alternative involves the institutional controls with LTM.

The PP incorporated comments from the U.S. EPA and ADEQ in the draft ROD for OU-1.

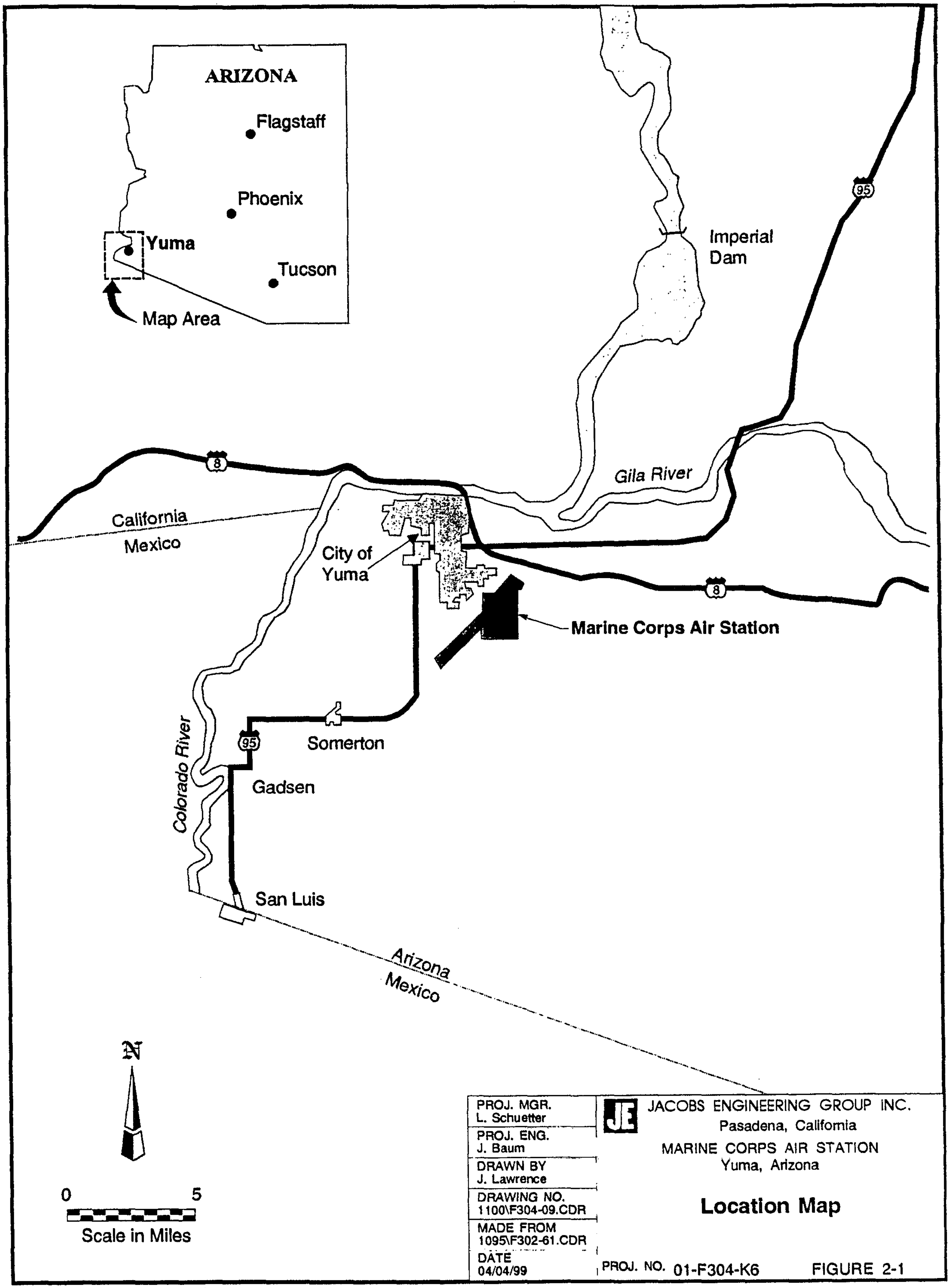
During development of the draft ROD and the PP, and development of the current revision to the ROD, additional groundwater monitoring data have been collected from each of the OU-1 plumes. These data have documented stable or decreasing VOC concentrations and plume sizes. Based on these data, which are documented in the administrative record for OU-1, the changes made to the preferred alternatives documented in the PP are:

- Area 1 plume, no significant changes;

- Area 2 plume, Alternative 2, institutional controls with MNA; and

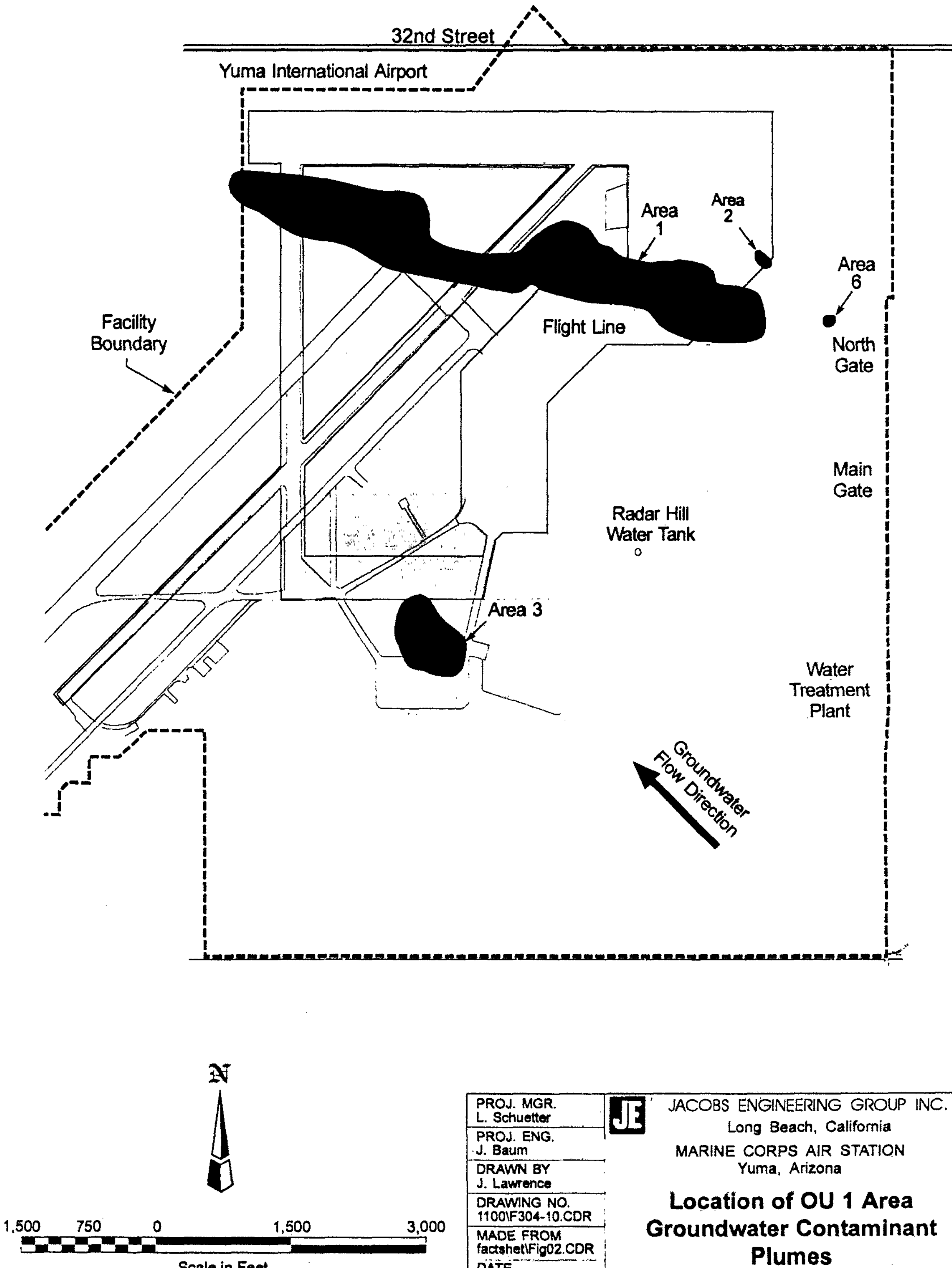
- Areas 3 and 6 plumes, no significant changes.

Each of these alternatives was described in the PP. New data for the Area 1 plume indicate that VOC concentrations have declined and the plume size has decreased. But VOC concentrations remain in excess of MCLs, so the selected alternative from the PP remains appropriate. New data for the Areas 2 and 6 plumes indicate that VOC concentrations have decreased but remain in excess of MCLs. However, groundwater modeling indicates that the plumes will not migrate off MCAS Yuma and will continue to decrease in concentration and size, and concentrations will decrease to MCLs in a reasonable time by natural attenuation. New data for the Area 3 plume indicate that VOC concentrations have decreased to levels that are below MCLs and risk-based concentrations. However, MNA will continue until the criteria of Section 2.13.2.2 have been met.



PROJ. MGR. L. Schuetter	JACOBS ENGINEERING GROUP INC. Pasadena, California
PROJ. ENG. J. Baum	MARINE CORPS AIR STATION Yuma, Arizona
DRAWN BY J. Lawrence	
DRAWING NO. 1100\F304-09.CDR	**Location Map**
MADE FROM 1095\F302-61.CDR	
DATE 04/04/99	PROJ. NO. 01-F304-K6 FIGURE 2-1

I:navclean/01k304k6/common/f304-09rev.cdr revised 10/21/99 DEN



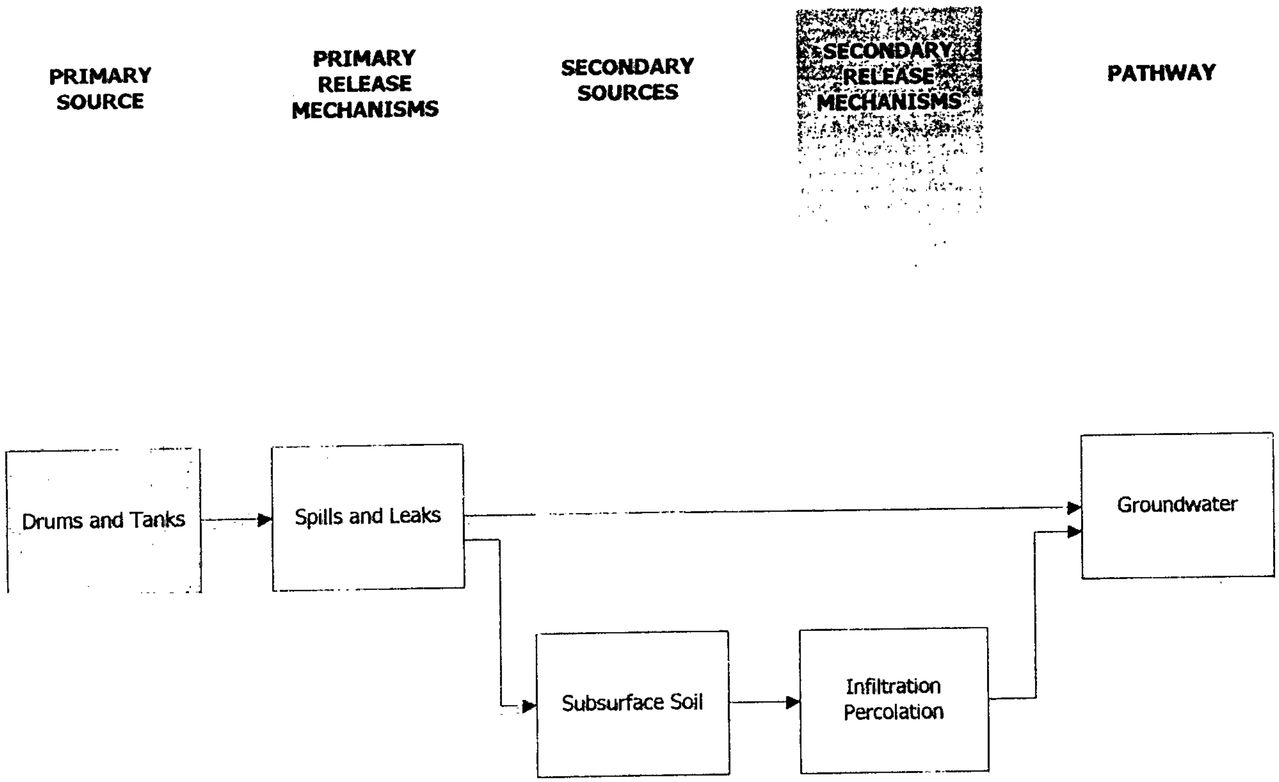
PROJ. MGR. L. Schuetter	JACOBS ENGINEERING GROUP INC. Long Beach, California
PROJ. ENG. J. Baum	MARINE CORPS AIR STATION Yuma, Arizona
DRAWN BY J. Lawrence	
DRAWING NO. 1100\F304-10.CDR	
MADE FROM factshet\Fig02.CDR	
DATE 03/11/99	PROJ. NO. 01-F304-K6

Location of OU 1 Area Groundwater Contaminant Plumes

Figure 2-2

I:navclean/01k304k6/common/f304-10rev.cdr revised 10/21/99 DEN

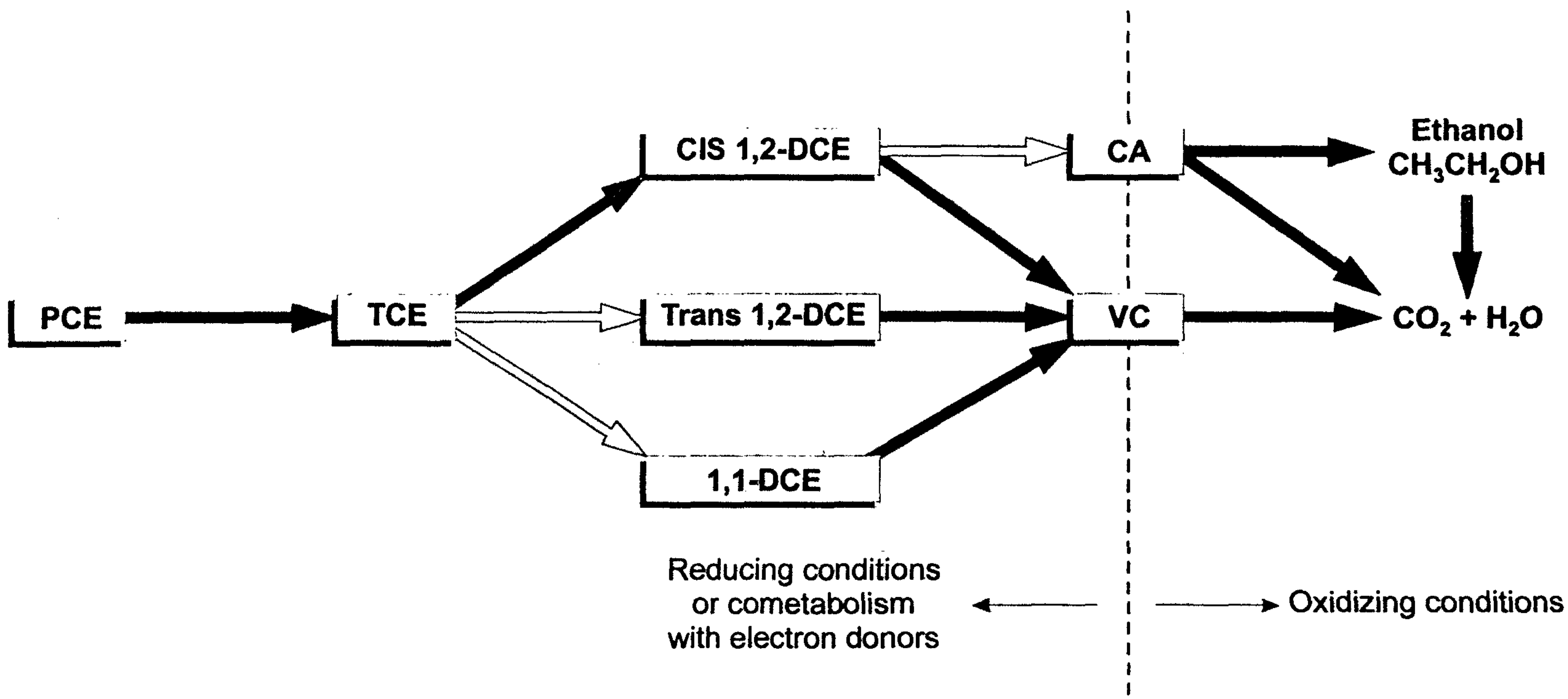
Figure 2-3. Conceptual Site Model for Solvent Contamination of Groundwater
Marine Corps Air Station, Yuma, Arizona



RECEPTOR

	Human		Biota	
Exposure Route	Site Resident	Area Resident	Terrestrial	Aquatic
Ingestion	✔	✔		
Dermal Contact	✔	✔		
Inhalation	✔	✔		

I:navyclean/01f304k6/common/solventcsm.



NOTES:

1. CIS-1,2-DCE generated at approximately 30 times the concentration of Trans 1,2-DCE (3) and approximately 25 times the concentration of 1,1-DCE.
2. Biodegradation is the principal breakdown mechanism along all pathways except from PCA to TCE, which proceeds abiotically.

SOURCE: Olsen R. and A. Davis 1990.

LEGEND

PCA	Tetrachloroethane	**CA**	Chloroethane	**1,1-DCE**	1,1-Dichloroethene
1,1,1-TCA	1,1,1-Trichloroethane	**PCE**	Tetrachloroethene	**VC**	Vinyl Chloride
1,1-DCA	1,1-Dichloroethane	**TCE**	Trichloroethene	(solid arrow)	Major Pathway
CIS 1,2-DCE	CIS 1,2-Dichloroethene	**Trans 1,2-DCE**	Trans 1,2-Dichloroethene	(open arrow)	Minor Pathway

PROJ. MGR.
L. Schuetter
PROJ. ENG.
J. Baum
DRAWN BY
J. Lawrence
DRAWING NO.
1100\F304-14.CDR
MADE FROM
1168\G464-498.CDR
DATE
03/12/99

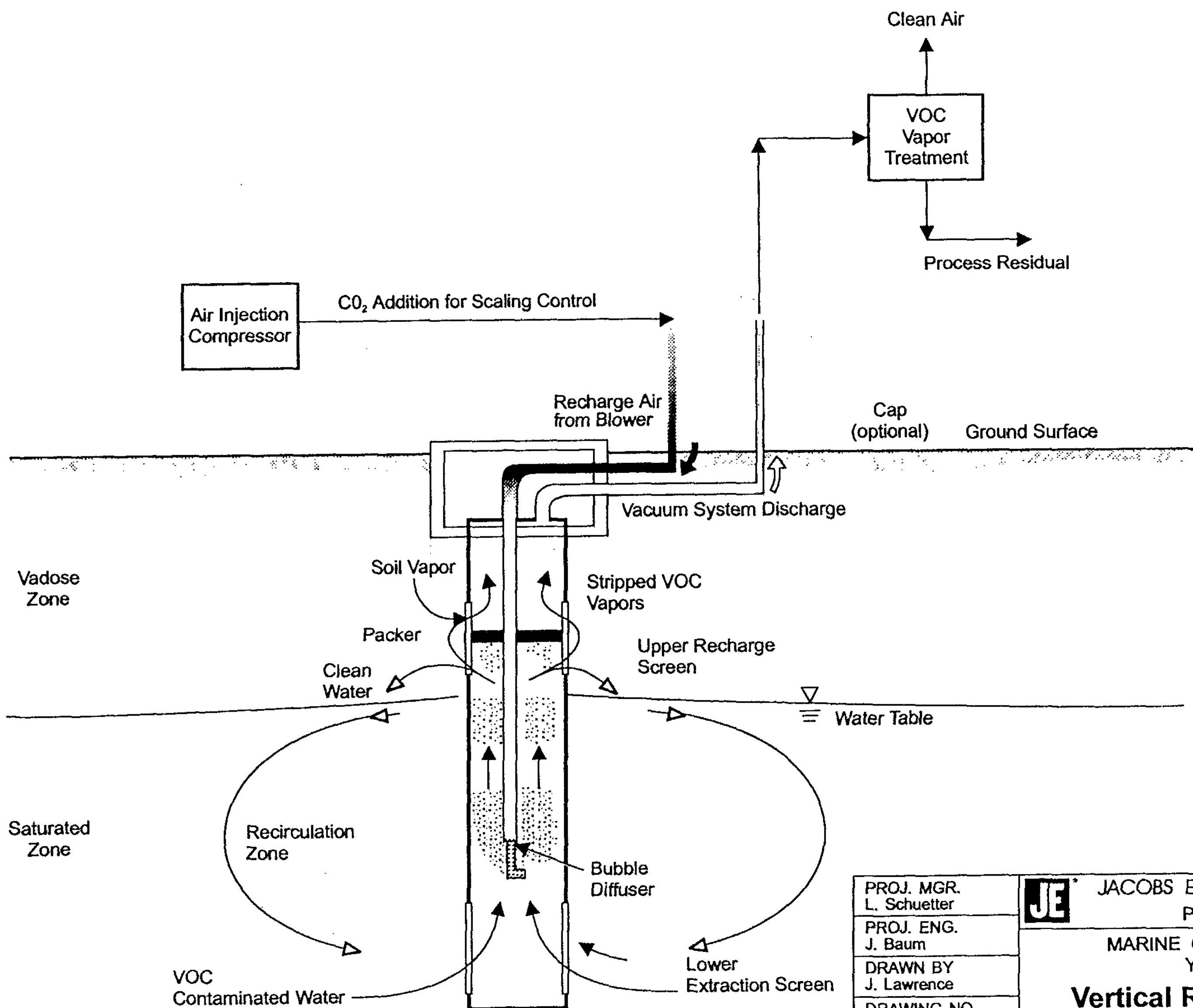
JACOBS ENGINEERING GROUP INC.
Pasadena, California

MARINE CORPS AIR STATION
Yuma, Arizona

Chlorinated Hydrocarbon Degradation Pathways and Breakdown Products

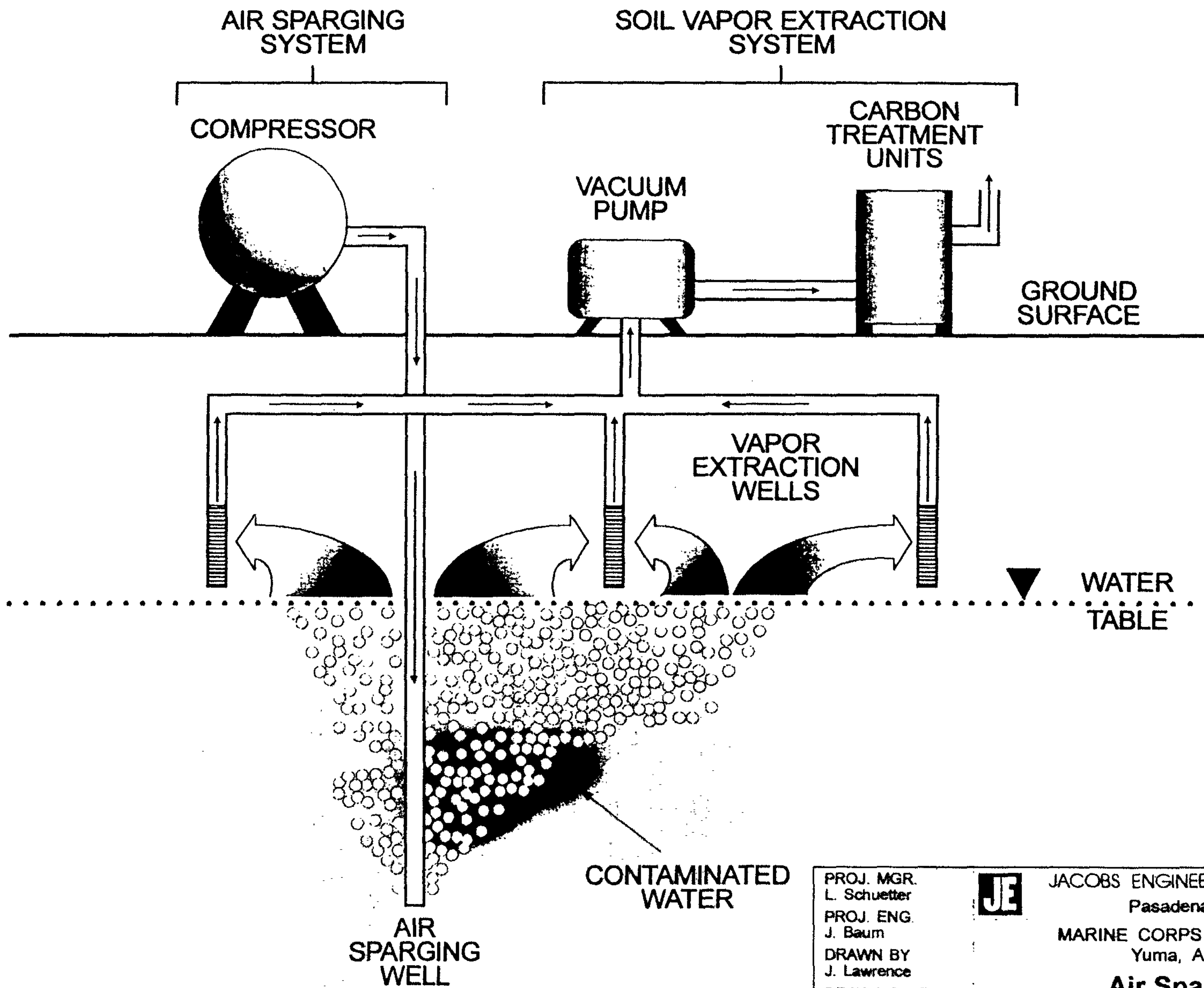
PROJ. NO. 01-F304-K6 Figure 2-4

I:navclean/01k304k6/common/f304-14rev.cdr revised 10/21/99 DEN



PROJ. MGR. L. Schuetter	JACOBS ENGINEERING GROUP INC. Pasadena, California
PROJ. ENG. J. Baum	MARINE CORPS AIR STATION Yuma, Arizona
DRAWN BY J. Lawrence	**Vertical Recirculation Well Conceptual Flow Diagram**
DRAWING NO. 1100\F304-13.CDR	
MADE FROM 1062\F302-48.CDR	
DATE 03/12/99	PROJ. NO. 01-F304-K6 — Figure 2-5

l:navclean/01k304k6/common/f304-13rev.cdr revised 10/21/99 DEN



PROJ. MGR. L. Schuetter	JACOBS ENGINEERING GROUP INC. Pasadena, California
PROJ. ENG. J. Baum	MARINE CORPS AIR STATION Yuma, Arizona
DRAWN BY J. Lawrence	**Air Sparging/ Soil Vapor Extraction Conceptual Flow Diagram**
DRAWING NO. 1100\F304-12.CDR	
MADE FROM	
DATE 03/12/99	PROJ. NO. 01-F304-K6 — Figure 2-6

I:navclean/01[illegible]4k6/common/f304-12rev.cdr revised 10/21/99 DEN

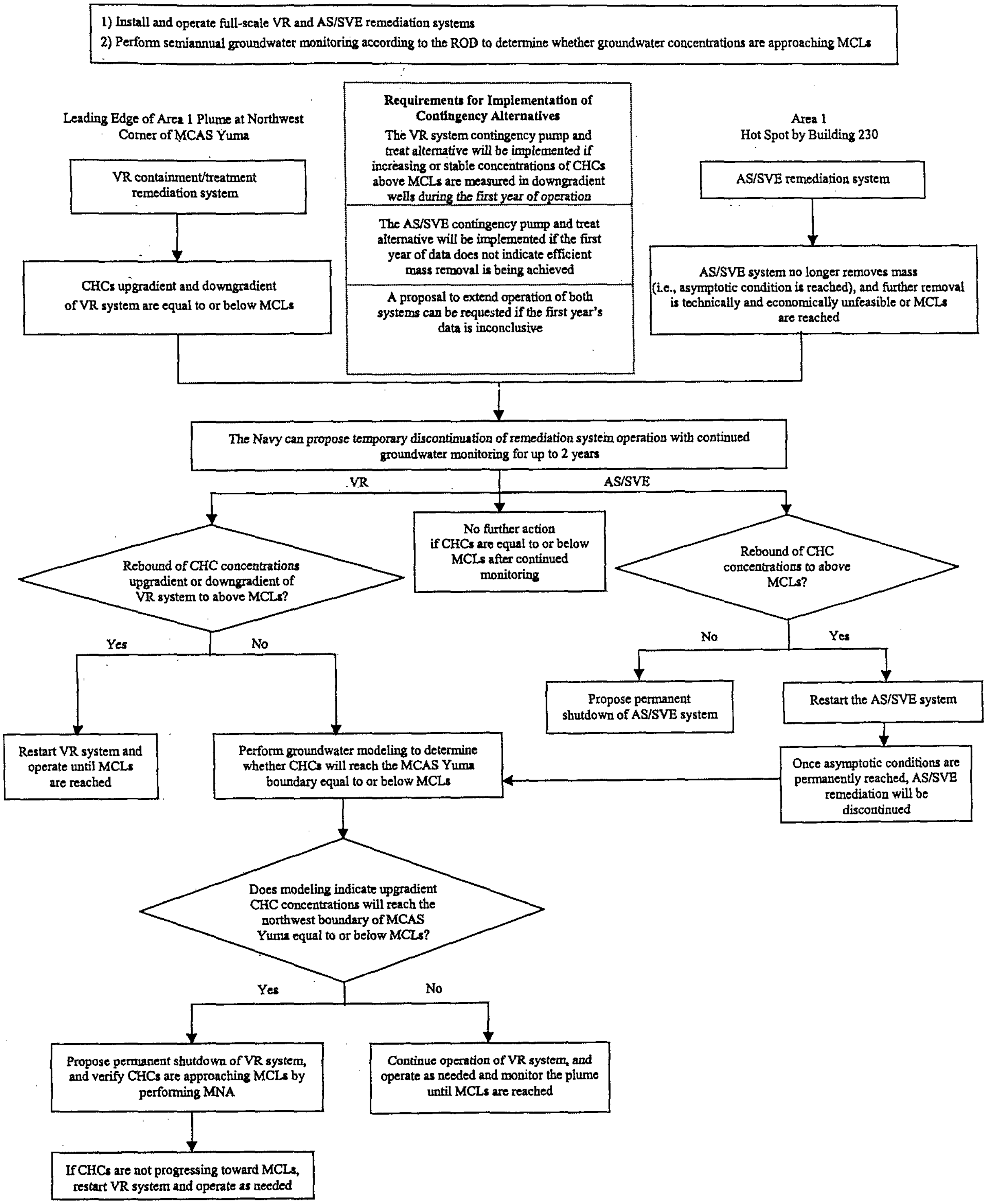


Figure 2-7
Decision Flow Diagram for Operation at Shutdown of VR and AS/SVE Remediation Systems, Area 1

GRAPHIC SCALE

0 200 400 800

(IN FEET)

RACT_ NAME

OHM Remediation Services Corp.
A Subsidiary of OHM Corporation
SAN DIEGO, CA

DATE
ADIAN 05/24/99
DATE

DATE

DATE

DISTRIBUTION AND EXTENT OF PETROLEUM AND/OR CHLORINATED HYDROCARBON–IMPACTED GROUNDWATER DECEMBER 1998

MARINE CORPS AIR STATION YUMA, ARIZONA

	SHEET	OF	DOCUMENT CONTROL No.	OHM PROJECT No.	DRAWING No.
C'	1	1	SW6569	20440	PLATE 1

GRAPHIC SCALE

0 200 400 800

(IN FEET)

SWDIV

OHM Remediation Services Corp.
A Subsidiary of OHM Corporation
SAN DIEGO, CA

Z	DATE 10/26/99	DISTRIBUTION AND EXTENT OF PETROLEUM AND/OR CHLORINATED HYDROCARBON-IMPACTED GROUNDWATER DECEMBER 1998 THROUGH AUGUST 1999
	DATE	
	DATE	
	DATE	MARINE CORPS AIR STATION YUMA, ARIZONA
:.DWG		

	SHEET	OF	DOCUMENT CONTROL No.	OHM PROJECT No.	DRAWING No.
,	1	1	SWXXXX	20440	PLATE 2

Table 2-1
Summary of Laboratory Analytical Results (Selected VOCs) in Groundwater Monitoring Wells, Area 2
(results reported in micrograms per liter)

Well Number	Total Depth (feet bgs)	Screen Interval (feet bgs)	Date Sampled	Sample Number	PCE (5 µg/L)[a]	TCE (5µg/L)[a]	1,1-DCE (7 µg/L)[a]	cis-1,2-DCE (70 µg/L)[a]	1,1-DCA NE	1,2-DCA (5 µg/L)[a]	Vinyl Chloride (2 µg/L)[a]
A2-MW-01	78	54 ! 74	09/17/96	18734-169	10 U	10 U	**39**[b]	10 U	9.0 J	10 U	10 U
			09/17/96	18734-170	10 U	10 U	**42**	10 U	10 J	10 U	10 U
			10/08/97	18734-1023	0.10 J	2.0 U	**19**	2.0 U	4.0	2.0 U	2.0 U
			04/27/98	20440-168	0.10 J	2.0 U	**18**	2.0 U	6.0	2.0 U	2.0 U
			10/29/98	20440-926	0.20 J	0.30 J	**17**	2.0 U	5.0	2.0 U	2.0 U
			08/16/99	20440-1352	0.20 J	2.0 U	3.0	2.0 U	2.0 J	2.0 U	2.0 U
			03/15/00	4304390-0052	2.0 U	2.0 U	2.0 U	2.0 U	0.50 J	2.0 U	2.0 U
			04/12/00	4304390-0145	2.0 U	2.0 U	2.0 J	2.0 U	0.70 J	2.0 U	2.0 U
			05/16/00	4304390-0318	0.1 J	2.0 U	1.0 J	2.0 U	0.40 J	2.0 U	2.0 U
			05/16/00	4304390-0319 (dup)	0.1 J	2.0 U	1.0 J	2.0 U	0.40 J	2.0 U	2.0 U
A2-MW-02	80	55 ! 75	09/17/96	18734-168	2.0 U	0.50 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			10/07/97	18734-1019	2.0 U	0.50 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/23/98	20440-162	2.0 U	0.50 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			10/29/98	20440-924	2.0 U	0.70 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			08/16/99	20440-1354	2.0 U	0.50 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			03/15/00	4304390-0049	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/12/00	4304390-0144	2.0 U	0.40 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			05/16/00	4304390-0317	2.0 U	0.40 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U

(table continues)

Table 2-1 (continued)

Well Number	Total Depth (feet bgs)	Screen Interval (feet bgs)	Date Sampled	Sample Number	PCE (5 µg/L)[a]	TCE (5 µg/L)[a]	1,1-DCE (7 µg/L)[a]	cis-1,2-DCE (70 µg/L)[a]	1,1-DCA NE	1,2-DCA (5 µg/L)[a]	Vinyl Chloride (2 µg/L)[a]
A2-MW-03	75	48 ! 73	09/17/96	18734-172	0.30 J	0.40 J	5.0	2.0 U	23	**6.0**	2.0 U
			10/06/96	18734-1009	0.20 J	0.40 J	5.0	2.0 U	27	3.0	0.90 J
			04/27/97	20440-164	0.20 J	0.40 J	6.0	2.0 U	24	**5.0**	2.0 U
			10/29/98	20440-925	0.30 J	0.60 J	**15**	2.0 U	35	**9.0**	2.0 U
			08/16/99	20440-1355	0.30 J	0.50 J	**11**	2.0 U	29	**8.0**	2.0 U
			03/16/00	4304390-0056	2.0 U	2.0 U	5.0	2.0 U	20	**5.0**	2.0 U
			04/12/00	4304390-0147	0.20 J	2.0 U	6.0	2.0 U	20	**6.0**	2.0 U
			05/16/00	4304390	0.20 J	2.0 U	4.0	2.0 U	16	**5.0**	2.0 U
A2-MW-04	77	50 ! 75	09/17/96	18734-167	10 U	10 U	**35**	1.0 U	4.0 J	10 U	10 U
			10/08/97	18734-1022	0.30 J	0.20 J	**68 J**	2.0 U	5.0	2.0 U	0.60 J
			04/27/98	20440-167	0.40 J	4.0 U	**58**	4.0 U	7.0	4.0 U	4.0 U
			10/29/98	20440-927	20 U	20 U	**78**	20 U	9.0 J	20 U	20 U
			08/17/99	20440-1358	0.20 J	2.0 U	**9.0**	2.0 U	1.0 J	2.0 U	2.0 U
			03/15/00	4304390-0053	0.20 J	2.0 U	**8.0**	2.0 U	1.0 J	2.0 U	2.0 U
			04/12/00	4304390-0148	0.40 J	2.0 U	**31.0**	2.0 U	5.0	2.0 U	2.0 U
			05/16/00	4304390-0321	0.30 J	0.10 J	**11.0**	2.0 U	2.0 J	2.0 U	2.0 U
FF-MW -24[c]	*72*	*50 ! 70*	*10/95*	*NA*	*10 U*	*10 U*	***180***	*NA*	*71*	*10 U*	*NA*
			02/96	*NA*	*5 U*	*5U*	***200***	*NA*	*100*	*5 U*	*NA*
			11/20/96	18734-274	10 U	10 U	**150**	10 U	69	10 U	10 U
			12/11/96	18734-394	50 U	50 U	**160**	50 U	89	50 U	50 U
			05/27/97	18734-780	10 U	10 U	**150**	10 U	92	2.0 J	10 U
			10/08/97	18734-1026	20 U	20 U	**170 J**	20 U	110	20 U	20 U
			10/08/97	18734-1027	20 U	20 U	**160 J**	20 U	110	20 U	20 U

(table continues)

Table 2-1 (continued)

Acronyms/Abbreviations:

- bgs – below ground surface
- DCA – dichloroethane
- DCE – dichloroethene
- dup – duplicate analysis
- J – estimated
- µg/L – micrograms per liter
- NA – data is not available
- NE – no established clean-up criteria
- PCE – tetrachloroethene
- TCE – trichloroethene
- U – not detected at or above the stated reporting limit
- VOC – volatile organic compound

Table 2-1 (continued)

Well Number	Total Depth (feet bgs)	Screen Interval (feet bgs)	Date Sampled	Sample Number	PCE (5 µg/L)[a]	TCE (5 µg/L)[a]	1,1-DCE (7 µg/L)[a]	cis-1,2-DCE (70 µg/L)[a]	1,1-DCA NE	1,2-DCA (5 µg/L)[a]	Vinyl Chloride (2 µg/L)[a]
FF-MW-24	72	50 – 70	04/27/98	20440-166	10 U	10 U	**130**	10 U	86	10 U	10 U
(continued)			10/29/98	20440-928	20 U	20 U	**100**	20 U	64	20 U	20 U
			03/10/99	20886-027	20 U	20 U	**110**	20 U	62	20 U	20 U
			03/11/99	20886-028	20 U	20 U	**110**	20 U	64	20 U	20 U
			03/11/99	20886-029	20 U	20 U	**110**	20 U	59	20 U	20 U
			03/12/99	20886-030	20 U	20 U	**89**	20 U	50	20 U	20 U
			03/13/99	20886-031	20 U	20 U	**89**	20 U	49	20 U	20 U
			03/15/99	20886-032	20 U	20 U	**79**	20 U	51	20 U	20 U
			03/16/99	20886-033	20 U	20 U	**110**	20 U	79	20 U	20 U
		From 10 March 1999 through 16 March 1999, approximately 30,000 gallons of water was pumped from FF-MW-24									
			07/14/99	20440-1346	10 U	0.80 J	**34**	10 U	28	10 U	10 U
			08/17/99	20440-1359	0.30 J	0.30 J	**26**	2.0 U	16	2.0 U	2.0 U
			11/01/99	779377-024	0.40 J	2.0 U	**30**	2.0 U	19	2.0 U	2.0 U
			03/16/00	4304390-0058	0.30 J	2.0 U	**18**	2.0 U	13	2.0 U	2.0 U
		From 30 March 2000 through 06 April 2000, approximately 43,000 gallons of water was pumped from FF-MW-24									
			04/12/00	4304390-0149	0.30 J	0.20 J	**24**	2.0 U	16	2.0 U	2.0 U
		From 14 April 2000 through 12 May 2000, approximately 196,000 gallons of water was pumped from FF-MW-24									
			05/16/00	4304390-0323	0.30 J	0.20 J	**30**	2.0 U	21	0.60 J	2.0 U

Notes:

[a] cleanup concentration for contaminant of concern

[b] bold type indicates a concentration equal to or above cleanup concentration for contaminant of concern

[c] shaded and italicized data are from Jacobs Engineering Group, Inc., prior to 1996 (complete data is not available)

(table continues)

Table 2-2
Summary of Laboratory Analytical Results (Selected VOCs) in Groundwater Monitoring Wells, Area 3
(results reported in micrograms per liter)

Well Number	Total Depth (feet bgs)	Screen Interval (feet bgs)	Date Sampled	Sample Number	PCE (5 µg/L)[a]	TCE (5 µg/L)[a]	1,1-DCE (7 µg/L)[a]	cis-1,2-DCE (70 µg/L)[a]	1,1-DCA NE	1,2-DCA (5 µg/L)[a]	Vinyl Chloride (2 µg/L)[a]
7-MW-01	69	37 – 67	04/21/98	20440-142	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			10/21/98	20440-900	2.0 U	2.0 U	2.0 UJ	2.0 U	2.0 U	2.0 U	2.0 U
			03/08/00	4304390-0033	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/14/00	4304390-0162	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			05/18/00	4304390-0341	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
7-PZ-01	68	37 – 67	04/21/98	20440-143	2.0 U	0.10 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			10/28/98	20440-919	2.0 U	0.20 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			03/08/00	4304390-0032	2.0 U	0.20 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/14/00	4304390-0164	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			05/18/00	4304390-0344	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
A3-MW-01	56	30 – 55	12/19/96	18734-434	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/22/98	20440-152	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/22/98	20440-153	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			10/20/98	20440-890	0.20 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			03/09/00	4304390-0041	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/14/00	4304390-0160	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			05/18/00	4304390-0339	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
A3-MW-02	56	31 – 46	12/18/96	18734-429	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/21/98	20440-141	0.50 J	0.20 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			10/21/98	20440-901	2.0 U	2.0 U	2.0 UJ	2.0 U	2.0 U	2.0 U	2.0 U
			03/09/00	4304390-0042	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	0.70 J	2.0 U
			04/14/00	4304390-0159	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			05/18/00	4304390-0338	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U

(table continues)

Table 2-2 (continued)

Well Number	Total Depth (feet bgs)	Screen Interval (feet bgs)	Date Sampled	Sample Number	PCE (5 µg/L)[a]	TCE (5 µg/L)[a]	1,1-DCE (7 µg/L)[a]	cis-1,2-DCE (70 µg/L)[a]	1,1-DCA NE	1,2-DCA (5 µg/L)[a]	Vinyl Chloride (2 µg/L)[a]
W-1[b]	*56.5*	*44 – 54*	*12/84*	*NA*	*ND (?)*	*ND (?)*	*ND (?)*	*NA*	*ND (?)*	*ND (?)*	*NA*
			02/95	*NA*	*ND (?)*	*ND (?)*	*ND (?)*	*NA*	*ND (?)*	*ND (?)*	*NA*
			12/18/96	18734-425	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/22/98	20440-151	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			08/19/98	20440-647	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
			10/20/98	20440-891	0.20 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			03/09/00	4304390-0038	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/14/00	4304390-0154	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/14/00	4304390-0155 (dup)	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			05/18/00	4304390-0334	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
W-2	65	44 – 54	01/06/97	18734-440	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			03/09/00	4304390-0036	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			01/06/97	18734-441	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/22/98	20440-150	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			10/20/98	20440-889	0.30 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/14/00	4304390-0157	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			05/18/00	4304390-0336	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			05/18//00	4304390-0337 (dup)	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
W-3	*59.5*	*45 – 57*	*12/84*	*NA*	*ND (?)*	*ND (?)*	*ND (?)*	*NA*	*ND (?)*	*ND (?)*	*NA*
			02/95	*NA*	*ND (?)*	*ND (?)*	*ND (?)*	*NA*	*ND (?)*	*ND (?)*	*NA*
			01/06/97	18734-443	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/23/98	20440-155	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			10/20/98	20440-892	0.20 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			03/08/00	4304390-0035	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/11/00	4304390-0150	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			05/18/00	4304390-0333	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U

(table continues)

Table 2-2 (continued)

Well Number	Total Depth (feet bgs)	Screen Interval (feet bgs)	Date Sampled	Sample Number	PCE (5 µg/L)[a]	TCE (5 µg/L)[a]	1,1-DCE (7 µg/L)[a]	cis-1,2-DCE (70 µg/L)[a]	1,1-DCA NE	1,2-DCA (5 µg/L)[a]	Vinyl Chloride (2 µg/L)[a]
W-4	60	45 – 60	04/22/98	20440-149	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			10/20/98	20440-888	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			03/09/00	4304390-0039	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/14/00	4304390-0161	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			05/18/00	4304390-0340	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
W-5	*55*	*40 – 55*	*02/87*	*NA*	*ND (?)*	*1.7*	*4.4*	*NA*	*ND (?)*	*ND (?)*	*NA*
			02/95	*NA*	*ND (?)*	***12.8***[c]	***10.2***	*NA*	*8.2*	*ND (?)*	*NA*
			01/06/97	18734-439	2.0 U	**13**	7.0	2.0 U	8.0	2.0 U	2.0 U
			04/23/98	20440-158	2.0 U	**17**	4.0	2.0 U	11	2.0 U	2.0 U
			10/28/98	20440-920	2.0 U	**24**	7.0	2.0 U	13	2.0 U	2.0 U
			07/14/99	20440-1348	2.0 U	1.0 J	0.40 J	2.0 U	0.80 J	2.0 U	2.0 U
			08/18/99	20440-1368	2.0 U	2.0	0.50 J	2.0 U	1.0 J	2.0 U	2.0 U
			11/01/99	779377-026	2.0 U	**9.0**	2.0 J	2.0 U	5.0	2.0 U	2.0 U
			During January 2000, approximately 4,000 gallons of water was pumped from W-5								
			01/10/00	779377-039	2.0 U	0.48 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			4/00	NS	NA	NA	NA	NA	NA	NA	NA
			05/29/00				Well destroyed				
W-5A[d]	62	40 – 60	03/00	4304390-0048	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
		During February, March, and April 2000, approximately 300,000 gallons of water was pumped from W-5A									
			04/14/00	4304390-0165	2.0 U	2.0 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			05/18/00	4304390-0346	2.0 U	3.0	0.20 J	2.0 U	2.0 U	2.0 U	2.0 U
W-6	65	50 – 65	04/23/98	20440-157	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			10/21/00	20440-899	2.0 U	2.0 U	2.0 UJ	2.0 U	2.0 U	2.0 U	2.0 U
			03/07/00	4304390-0029	0.10 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U

(table continues)

Table 2-2 (continued)

Well Number	Total Depth (feet bgs)	Screen Interval (feet bgs)	Date Sampled	Sample Number	PCE (5 µg/L)[a]	TCE (5 µg/L)[a]	1,1-DCE (7 µg/L)[a]	cis-1,2-DCE (70 µg/L)[a]	1,1-DCA NE	1,2-DCA (5 µg/L)[a]	Vinyl Chloride (2 µg/L)[a]
W-6 (continued)	65	50 – 65	03/08/00	4304390-0030 (duplicate)	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/14/00	4304390-0158	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			05/18/00	4304390-0345	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
W-7	70	54 – 69	04/22/98	20440-147	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			10/21/98	20440-896	0.10 J	2.0 U	2.0 UJ	2.0 U	2.0 U	2.0 U	2.0 U
			10/21/98	20440-897	0.20 J	0.20 J	2.0 UJ	2.0 U	2.0 U	2.0 U	2.0 U
			03/08/00	4304390-0034	0.10 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/14/00	4304390-0163	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			05/18/00	4304390-0342	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U

Notes:

[a] cleanup concentration for contaminant of concern
[b] shaded and italicized data are from Jacobs Engineering Group, Inc., prior to 1996 (complete data is not available)
[c] bold type indicates a concentration equal to or above cleanup concentration for contaminant of concern
[d] new 6-inch well installed March 2000

Acronyms/Abbreviations:

bgs – below ground surface
DCA – dichloroethane
DCE – dichloroethene
dup – duplicate analysis
J – estimated
µg/L – micrograms per liter
NA – data is not available
ND (?) – detection limit not available
NE – no established clean-up criteria
PCE – tetrachloroethene
TCE – trichloroethene
U – not detected at or above the stated reporting limit
UJ – estimated reporting limit
VOC – volatile organic compound

Table 2-3
Summary of Laboratory Analytical Results (Selected VOCs) in Groundwater Monitoring Wells, Area 6
(results reported in micrograms per liter)

Well Number	Total Depth (feet bgs)	Screen Interval (feet bgs)	Date Sampled	Sample Number	PCE (5 µg/L)[a]	TCE (5 µg/L)[a]	1,1-DCE (7 µg/L)[a]	cis-1,2-DCE (70 µg/L)[a]	1,1-DCA NE	1,2-DCA (5 µg/L)[a]	Vinyl Chloride (2 µg/L)[a]
317-MW-01	70	50 – 70	12/19/96	18734-433	**5.0**[b]	0.20 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/21/98	20440-140	**9.0**	0.30 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			10/20/98	20440-886	**7.0**	0.30 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			07/13/99	20440-1344	**5.0**	0.90 J	0.40 J	2.0 U	2.0 U	2.0 U	2.0 U
			08/17/99	20440-1360	**9.0**	0.20 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			03/07/00	4304390-0028	**9.0**	0.10 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
		From 10 March to 10 April 2000, approximately 22,000 gallons of water was pumped from 317-MW-01									
			04/14/00	4304390-0172	**7.0**	0.20 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
		From 16 April to 15 May 2000, approximately 35,000 gallons of water was pumped from 317-MW-01									
			05/17/00	4304390-0331	**6.0**	0.10 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
335-MW-01	70	57 – 67	04/20/98	20440-131	1.0 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			10/19/98	20440-882	0.70 J	0.20 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			03/07/00	4304390-0026	0.80 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/14/00	4304390-0171	1.0 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			05/17/00	4304390-0330	0.7 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
335-MW-02	70	50 – 70	12/16/96	18734-418	0.80 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
335-MW-02[c]	*70*	*50 – 70*	*10/95*	*NA*	*0.85*	*0.5 U*	*0.5 U*	*NA*	*0.5 U*	*0.5 U*	*NA*
			2/96	*NA*	*0.82*	*0.5 U*	*0.5 U*	*NA*	*0.5 U*	*0.5 U*	*NA*
			04/20/98	20440-133	0.60 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/20/98	20440-134	0.60 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			10/19/98	20440-887	0.30 J	0.30 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			03/07/00	4304390-0025	0.40 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/14/00	4304390-0169	0.60 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			05/17/00	4304390-0326	0.40 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			05/17/00	4304390-0327 (dup)	0.40 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U

(table continues)

Table 2-3 (continued)

Well Number	Total Depth (feet bgs)	Screen Interval (feet bgs)	Date Sampled	Sample Number	PCE (5 µg/L)[a]	TCE (5 µg/L)[a]	1,1-DCE (7 µg/L)[a]	cis-1,2-DCE (70 µg/L)[a]	1,1-DCA NE	1,2-DCA (5 µg/L)[a]	Vinyl Chloride (2 µg/L)[a]
335-MW-03	*70*	*50 – 70*	*10/95*	*NA*	*1.1*	*0.5 U*	*0.5 U*	*NA*	*0.5 U*	*0.5 U*	*NA*
			2/96	*NA*	*0.91*	*0.5 U*	*0.5 U*	*NA*	*0.5 U*	*0.5 U*	*NA*
			12/18/96	18734-431	1.0 J	0.20 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/20/98	20440-135	0.70 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			10/19/98	20440-879	0.40 J	0.20 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			10/19/98	20440-880	0.40 J	0.20 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			03/07/00	4304390-0022	0.40 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			03/07/00	4304390-0023 (dup)	0.70 J	0.20 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/14/00	4304390-0166	0.50 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/14/00	4304390–0167 (dup)	0.4 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			05/17/00	4304390-0325	0.40 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
335-MW-04	*85*	*58 – 74*	*10/95*	*NA*	*7.3*	*0.5 U*	*0.5 U*	*NA*	*0.5 U*	*0.5 U*	*NA*
			2/96	*NA*	*8.1*	*0.5 U*	*0.5 U*	*NA*	*0.5 U*	*0.5 U*	*NA*
			12/18/96	18734-436	6.0	0.20 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			12/18/96	18734-437	6.0	0.20 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/21/98	20440-138	4.0	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			10/19/98	20440-884	2.0	0.20 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
335-MW-05	*70*	*50 – 70*	*10/95*	*NA*	*1.3*	*0.5 U*	*0.5 U*	*NA*	*0.5 U*	*0.5 U*	*NA*
			2/96	*NA*	*1.8*	*0.5 U*	*0.5 U*	*NA*	*0.5 U*	*0.5 U*	*NA*
			12/19/96	18734-432	2.0 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/20/98	20440-136	1.0 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			10/19/98	20440-881	0.50 J	0.20 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			03/07/00	4304390-0027	0.50 J	0.30 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			04/14/00	4304390-0170	0.60 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
			05/17/00	4304390-0329	0.60 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U

(table continues)

Table 2-3 (continued)

Notes:

[a] cleanup concentration for contaminant of concern
[b] bold type indicates a concentration equal to or above cleanup concentration for contaminant of concern
[c] shaded and italicized data are from Jacobs Engineering Group, Inc., prior to 1996 (complete data is not available)

Acronyms/Abbreviations:

bgs – below ground surface
DCA – dichloroethane
DCE – dichloroethene
dup – duplicate analysis
J – estimated
µg/L – micrograms per liter
NA – data is not available
NE – no established clean-up criteria
PCE – tetrachloroethene
TCE – trichloroethene
U – not detected at or above the stated reporting limit
VOC – volatile organic compound

Table 2-4
Comparison Between FS and ROD Groundwater Modeling

Features	FS Model	ROD Model
Dimensions	2D, horizontal gradients	3D, horizontal and vertical gradients
Hydraulic Conductivity	Uniform horizontal	Variable horizontal and vertical
Dispersion	No vertical dispersion	Included vertical dispersion
Decay half-life	9 years	50 years
Organic carbon content	2.1 percent	0.03 percent
Plume representation	Uniform 20 feet thick	Variable thickness, deeper in northwest
Recharge	None	Low recharge included

Acronyms/Abbreviations:
2D – two dimensional
3D – three dimensional
FS – feasibility study
ROD – Record of Decision

Table 2-5
Summary of Chemicals of Concern and Exposure Point Concentrations

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	Chemical of Concern	Concentration Detected		Units	Frequency of Detection *	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure
		Min	Max					
Area 1 Groundwater, on-site and off-site	1,1-Dichloroethene (1,1-DCE)	0.4	170	µg/L	22/46	170	µg/L	MAX
	Trichloroethene (TCE)	0.2	450	µg/L	31/45	450	µg/L	MAX
	Tetrachloroethene (PCE)	0.3	16	µg/L	17/45	16	µg/L	MAX
Area 2 Groundwater, on-site	1,1-Dichloroethene (1,1-DCE)	180	180	µg/L	1/3	180	µg/L	MAX
Area 3 Groundwater, on-site	Trichloroethene (TCE)	12.8	12.8	µg/L	1/26	12.8	µg/L	MAX
	1,1-Dichloroethene (1,1-DCE)	10.2	10.2	µg/L	1/25	10.2	µg/L	MAX
Area 6 Groundwater, on-site	Tetrachloroethene (PCE)	0.5	7.1	µg/L	4/6	7.1	µg/L	MAX

Key:
µg/L – micrograms per liter
MAX – maximum detected concentration
* – estimated based on RI maps

Table 2-6
Contaminants Exceeding MCLs and Major Risk Contributors
(Based on Maximum RI Data)

Specific Contaminant	Maximum Reported Concentration (µg/L)[a]	Federal National Primary Drinking Water Standards (MCLs) (µg/L)	Federal Maximum Contaminant Level Goals (MCLGs) (µg/L)	State of Arizona MCLs for Organic Chemicals (µg/L)	State of Arizona Numeric Aquifer Water Quality Standards (µg/L)	Required Cleanup Concentration (µg/L)	Exceeds Cleanup Concentration	Major Risk or Hazard Contributor Human Health	
								Risk [b]	Hazard[c]
Area 1									
1,1-Dichloroethene (1,1-DCE)	170	7	7	7	7	7	Yes	x	x
Trichloroethene (TCE)	450	5	0	5	5	5	Yes	x	x
Tetrachloroethene (PCE)	16	5	0	5	5	5	Yes		
Area 2									
1,1-Dichoroethene (1,1-DCE)	180	7	7	7	7	7	Yes	x	x
Area 3									
1,1-Dichloroethene (1,1-DCE)	10.2	7	7	7	7	7	Yes	x	
Trichloroethene (TCE)	12.8	5	0	5	5	5	Yes		
Area 6									
Tetrachloroethene (PCE)	7.1	5	0	5	5	5	Yes		

Notes:
[a] some higher concentrations were detected during the STRAP investigation
[b] exceeds 10^{-4} excess cancer risk (Section 2.7.1.4)
[c] exceeds 1.0 noncancer Hazard index (Section 2.7.1.4)

Table 2-7
Toxicity Values for COCs: Potential Carcinogenic Effects

Compound	Slope Factor, CSF $(mg/kg\text{-}day)^{-1}$	Weight of Evidence Classification*	Type of Cancer	CSF Basis/ CSF Source
Oral Route				
1,1-Dichloroethene (1,1-DCE)	0.6	C	Adrenal pheochromo-cytomas	Drinking water/IRIS
Trichloroethene (TCE	0.011			ECAO
Tetrachloroethene (PCE)	0.052	C-B2		ECAO
Inhalation Route				
1,1-Dichloroethene (1,1-DCE)				
Trichloroethene (TCE)	0.006			ECAO
Tetrachloroethene (PCE)	0.002	C-B2		ECAO

Note:
* Weight of Evidence Classification:
B2 = probable human carcinogen -- sufficient evidence in animals and inadequate or no evidence in humans
C = possible human carcinogen

Acronyms/Abbreviations:
COC – chemical of concern
CSF – cancer slope factor
ECAO – Environmental Criteria Assessment Office
IRIS – Integrated Risk Information System
mg/kg – milligrams per kilogram

Table 2-8
Toxicity Values for COCs: Potential Noncarcinogenic Effects

Compound	Chronic Reference Dose, RfD (mg/kg-day)	Confidence Level	Critical Effect	RfD Basis/ RfD Source	Uncertainty Factors (UF) and Modifying Factors (MF)
Oral Route					
1,1-Dichloroethene (1,1-DCE)	0.009	Medium	Hepatic lesions	2-yr rat chronic bioassay/ IRIS	UF = 1000[a] H, A[b] MF = 1
Trichloroethene (TCE)	0.006			ECAO	
Tetrachloroethene (PCE)	0.01	Medium	Hepato-toxicity in mice, weight gain in rats	6-wk mouse gavage study/IRIS	UF = 1000[a] H, A, S[c] MF = 1
Inhalation Route					
1,1-Dichloroethene (1,1-DCE)	0.009	Medium	Hepatic lesions	Route-to-route extrapolation/ IRIS	UF = 1000[a] H, A MF = 1
Trichloroethene (TCE)	0.006			Route-to-route extrapolation/ ECAO	
Tetrachloroethene (PCE)	0.01	Medium	Hepato-toxicity in mice, weight gain in rats	Route-to-route extrapolation/ IRIS	UF = 1000[a] H, A, S MF = 1

Note:

[a] H – variation in human sensitivity
A – animal to human extrapolation
S – extrapolation from subchronic to chronic NOAEL

Acronyms/Abbrevations:

COC – chemical of concern
ECAO – Environmental Criteria Assessment Office
HEAST – Health Effects Assessment Summary Tables
IRIS – Integrated Risk Information System
RfD - reference dose

Table 2-9
Risk Characterization Summary - Carcinogens

Scenario Timeframe: Future Receptor Population: Resident						
Area 1 Plume						
Medium	Exposure Medium	Exposure Point	Chemical of Concern	Exposure Point Concentration (µg/L)*	RBC (µg/L)	Risk at Exposure Point Concentration
Groundwater	Groundwater	Tap Water	1,1-DCE	170	0.039	4.4×10^{-3}
Groundwater	Groundwater	Tap Water	TCE	450	1.5	3.0×10^{-4}
Groundwater	Groundwater	Tap Water	PCE	16	0.83	1.9×10^{-5}
Area 2 Plume						
Medium	Exposure Medium	Exposure Point	Chemical of Concern	Exposure Point Concentration (µg/L)*	RBC (µg/L)	Risk at Exposure Point Concentration
Groundwater	Groundwater	Tap Water	1,1-DCE	180	0.039	4.6×10^{-3}
Area 3 Plume						
Medium	Exposure Medium	Exposure Point	Chemical of Concern	Exposure Point Concentration (µg/L)*	RBC (µg/L)	Risk at Exposure Point Concentration
Groundwater	Groundwater	Tap Water	1,1-DCE	10.2	0.039	2.6×10^{-4}
Groundwater	Groundwater	Tap Water	TCE	12.8	1.5	8.5×10^{-6}
Area 6 Plume						
Medium	Exposure Medium	Exposure Point	Chemical of Concern	Exposure Point Concentration (µg/L)*	RBC (µg/L)	Risk at Exposure Point Concentration
Groundwater	Groundwater	Tap Water	PCE	7.1	0.83	8.6×10^{-6}
Area 1, 2, 3, 6 Plumes						
Medium	Exposure Medium	Exposure Point	Chemical of Concern	MCL (µg/L)	RBC (µg/L)	Risk at MCL
Groundwater	Groundwater	Tap Water	1,1-DCE	7	0.039	1.8×10^{-4}
Groundwater	Groundwater	Tap Water	TCE	5	1.5	3.3×10^{-6}
Groundwater	Groundwater	Tap Water	PCE	5	0.83	6.0×10^{-6}

(table continues)

Table 2-9 (continues)

Scenario Timeframe: Future Receptor Population: Resident						
Area 1 Plume						
Medium	Exposure Medium	Exposure Point	Chemical of Concern	July-August 1999 Concentration (µg/L)	RBC (µg/L)	Risk at July-August 1999 Concentration
Groundwater	Groundwater	Tap Water	1,1-DCE	61	0.039	1.6×10^{-3}
Groundwater	Groundwater	Tap Water	TCE	220	1.5	1.5×10^{-4}
Area 2 Plume						
Medium	Exposure Medium	Exposure Point	Chemical of Concern	August 1999 Concentration (µg/L)	RBC (µg/L)	Risk at August 1999 Concentration
Groundwater	Groundwater	Tap Water	1,1-DCE	26	0.039	6.7×10^{-4}
Area 3 Plume						
Medium	Exposure Medium	Exposure Point	Chemical of Concern	August 1999 Concentration (µg/L)	RBC (µg/L)	Risk at August 1999 Concentration
Groundwater	Groundwater	Tap Water	1,1-DCE	0.5	0.039	1.3×10^{-5}
Groundwater	Groundwater	Tap Water	TCE	2.0	1.5	1.3×10^{-6}
Area 6 Plume						
Medium	Exposure Medium	Exposure Point	Chemical of Concern	August 1999 Concentration (µg/L)	RBC (µg/L)	Risk at August 1999 Concentration
Groundwater	Groundwater	Tap Water	PCE	8.6	0.83	1.0×10^{-5}

Notes:
* Exposure point concentration = maximum detected

Acronyms/Abbreviations:
RBC = risk-based concentration for 1×10^{-6} risk
µg/L – micrograms per liter
TCE – trichloroethene
PCE – tetrachloroethene
DCE – dichloroethene
MCL – maximum contaminant level

Table 2-10
Risk Characterization Summary - Noncarcinogens

Scenario Timeframe: Future Receptor Population: Resident						
Area 1 Plume						
Medium	Exposure Medium	Exposure Point	Chemical of Concern	Exposure Point Concentration (µg/L)*	RBC (µg/L)	HI at Exposure Point Concentration
Groundwater	Groundwater	Tap Water	1,1-DCE	170	55	3.1
Groundwater	Groundwater	Tap Water	TCE	450	36	12.5
Groundwater	Groundwater	Tap Water	PCE	16	61	0.3
Area 2 Plume						
Medium	Exposure Medium	Exposure Point	Chemical of Concern	Exposure Point Concentration (µg/L)*	RBC (µg/L)	HI at Exposure Point Concentration
Groundwater	Groundwater	Tap Water	1,1-DCE	180	55	3.3
Area 3 Plume						
Medium	Exposure Medium	Exposure Point	Chemical of Concern	Exposure Point Concentration (µg/L)*	RBC (µg/L)	HI at Exposure Point Concentration
Groundwater	Groundwater	Tap Water	1,1-DCE	10.2	55	0.2
Groundwater	Groundwater	Tap Water	TCE	12.8	36	0.4
Area 6 Plume						
Medium	Exposure Medium	Exposure Point	Chemical of Concern	Exposure Point Concentration (µg/L)*	RBC (µg/L)	HI at Exposure Point Concentration
Groundwater	Groundwater	Tap Water	PCE	7.1	61	0.1
Area 1, 2, 3, 6 Plumes						
Medium	Exposure Medium	Exposure Point	Chemical of Concern	MCL (µg/L)	RBC (µg/L)	HI at MCL
Groundwater	Groundwater	Tap Water	1,1-DCE	7	55	0.1
Groundwater	Groundwater	Tap Water	TCE	5	36	0.1
Groundwater	Groundwater	Tap Water	PCE	5	61	0.08

(table continues)

Table 2-10 (Continued)

Scenario Timeframe: Future Receptor Population: Resident						
Area 1 Plume						
Medium	Exposure Medium	Exposure Point	Chemical of Concern	July - August 1999 Concentration (µg/L)*	RBC (µg/L)	HI at July - August 1999 Concentration
Groundwater	Groundwater	Tap Water	1,1-DCE	61	55	1.1
Groundwater	Groundwater	Tap Water	TCE	220	36	6.1
Area 2 Plume						
Medium	Exposure Medium	Exposure Point	Chemical of Concern	August 1999 Concentration (µg/L)*	RBC (µg/L)	HI at August 1999 Point Concentration
Groundwater	Groundwater	Tap Water	1,1-DCE	26	55	0.5
Area 3 Plume						
Medium	Exposure Medium	Exposure Point	Chemical of Concern	August 1999 Concentration (µg/L)*	RBC (µg/L)	HI at August 1999 Point Concentration
Groundwater	Groundwater	Tap Water	1,1-DCE	0.5	55	0.01
Groundwater	Groundwater	Tap Water	TCE	2.0	36	0.06
Area 6 Plume						
Medium	Exposure Medium	Exposure Point	Chemical of Concern	August 1999 Concentration (µg/L)*	RBC (µg/L)	HI at August 1999 Point Concentration
Groundwater	Groundwater	Tap Water	PCE	8.6	61	0.1

Note:
* Exposure point concentration = maximum detected

Acronyms/Abbreviations:
RBC – risk-based concentration for HI = 1
HI – hazard index
MCL = maximum contaminant level

Table 2-11
Federal Chemical-Specific ARARs for MCAS Yuma

Medium	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Safe Drinking Water Act (SDWA), 42 United States Code (U.S.C.) 300 *et seq.*					
Groundwater	National Primary Drinking Water Standards (MCLs) are health-based standards for public water systems.	Community and nontransient noncommunity water systems	40 CFR 141.11-141.15, 141.23 - 141.25, 141.61, 141.62, and 141.80	Relevant and Appropriate	The NCP states that MCLs are cleanup standards for groundwater determined to be a current or potential source of drinking water if they are relevant and appropriate. The State of Arizona has designated all aquifers in the state as protected for drinking water use unless reclassification is obtained. Pursuant to 40 CFR 142.10, the state is the primary enforcing agency for drinking water regulation, with jurisdiction over water systems within the state. See state regulations R18-4-242, 243, and 245 on Table 2-12. See Table 2-6 for a comparison of numeric standards for each chemical in water.
Groundwater	MCLGs	Community and nontransient noncommunity water systems	40 CFR 141.50 and 141.51	Relevant and Appropriate	MCLGs that have nonzero values are cleanup standards for groundwater determined to be a current or potential source of drinking water (CERCLA Section 300.430[e][2][i][B] through [D]) if they are relevant and appropriate. The State of Arizona has designated all aquifers in the state as protected for drinking water use unless reclassification is obtained. Pursuant to 40 CFR 142.10,

(table continues)

Table 2-11 (continued)

Medium	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Groundwater *Cont'd*					the state is the primary enforcing agency for drinking water regulation, with jurisdiction over water systems within the state. See state regulations R18-4-242, 243, and 245 on Table 2-12. See Table 2-6 for a comparison of numeric standards for each chemical in water.

Acronyms/Abbreviations:

ARAR – applicable or relevant and appropriate requirement
CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act
CFR – *Code of Federal Regulations*
DCE – dichloroethene
MCAS – Marine Corps Air Station
MCL – maximum contaminant level
MCLG – maximum contaminant level goal
NCP – National Oil and Hazardous Substances Pollution Contingency Plan
PCE – tetrachloroethene
TCE – trichloroethene

Table 2-12
State Chemical-Specific ARARs for MCAS Yuma

Medium	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Arizona Drinking Water and Certification Regulations, Arizona Administrative Rules and Regulations, Title 18 – Environmental Quality; Chapter 4 - Drinking Water and Certification, Article 2					
Groundwater	State Maximum Contaminant Levels (MCLs) for inorganic chemicals	Community and nontransient noncommunity water systems, and transient noncommunity, private agricultural and semi-public water systems	R18-4-205	Applicable	State MCLs are the maximum permissible level for a contaminant in water that is delivered to any user of a water system. They are applicable for groundwater which is delivered to any user of a water system when they are more stringent than federal MCLs and/or Maximum Contaminant Level Goals (MCLGs) that are greater than zero. The State of Arizona has designated all aquifers in the state as protected for drinking water use unless reclassification is obtained. Pursuant to 40 CFR 142.10, the state is the primary enforcing agency for drinking water regulation with jurisdiction over water systems within the state. See Table 2-6 for a comparison of numeric standards for each chemical in water
	State MCLs for organic chemicals	Community and nontransient noncommunity water systems, and transient noncommunity, private agricultural and semi-public water systems	R18-4-211 1,1-DCE – 7 ppb TCE – 5 ppb PCE – 5 ppb	Applicable	State MCLs are the maximum permissible level for a contaminant in water that is delivered to any user of a water system. They are applicable for groundwater that is delivered to any user of a water system when they are more stringent than federal MCLs and/or MCLGs that are greater than zero. In addition, the State of Arizona has designated all aquifers in the state as protected for drinking water use unless reclassification is obtained.

(table continues)

Table 2-12 (continued)

Medium	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Groundwater *Cont'd*					Pursuant to 40 CFR 142.10, the state is the primary enforcement agency with jurisdiction over water systems in the state.
Arizona Water Quality Standards, Arizona Administrative Rules and Regulations, Title 18 – Environmental Quality; Chapter 11- Water Quality Boundaries and Standards, Article 2					
Groundwater	Narrative Aquifer Water Quality Standards are qualitative standards for pollutants in aquifers.	Aquifers designated for drinking water protected use, which are all aquifers in the state, unless reclassification is applied for and granted	R18-11-405	Applicable	The Narrative Aquifer Water Quality Standards state that a discharge shall not cause a pollutant to be present in an aquifer classified for drinking water protected use in a concentration that endangers human health, and that a discharge shall not cause a pollutant to be present in an aquifer that impairs existing or reasonably foreseeable uses of water in an aquifer.
	Numeric Aquifer Water Quality Standards	Aquifers designated for drinking water protected use, which are all aquifers in the state, unless reclassification is applied for and granted	R18-11-406 1,1-DCE – 7 ppb TCE – 5 ppb PCE – 5 ppb	Applicable	The Numeric Aquifer Water Quality Standards are the maximum permissible levels for a contaminant in an aquifer classified for drinking water protected use.. They are applicable to aquifers that are classified for drinking water protected use when they are more stringent than state and federal MCLs and/or MCLGs that are greater than zero. The State of Arizona has designated all aquifers in the state as protected for drinking water use unless reclassification is obtained. See Table 2-6 for a comparison of numeric standards for each chemical in aquifers.

(table continues)

Table 2-12 (continued)

Acronyms/Abbreviations:
- ARAR – applicable or relevant and appropriate requirement
- CFR – *Code of Federal Regulation*
- MCAS – Marine Corps Air Station
- MCL – maximum contaminant level
- MCLG – maximum contaminant level goal
- ppb – parts per billion

Table 2-13
Federal Location-Specific ARARs for MCAS Yuma

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comments
FEDERAL					
National Archeological and Historical Preservation Act, 16 U.S.C. Section 469					
Within area where action may cause irreparable harm, loss, or destruction of significant artifacts	Action to recover and preserve artifacts	Alteration of terrain that threatens significant scientific, prehistoric, historic, or archaeologic data	36 CFR Part 65	Applicable	Scientific, prehistoric, historic, or archaeological artifacts may be present at MCAS Yuma. More stringent than state of Arizona Revised Statute, Title 41 (Table 2-14).
Endangered Species Act, 16 U.S.C. 1531 *et seq*; and Fish and Wildlife Coordination Act, 16 U.S.C. 661 *et seq*.					
Critical habitat upon which endangered species or threatened species depend	Action to conserve endangered species or threatened species, including consultation with the Department of the Interior	Determination of effect upon endangered or threatened species or its habitat	50 CFR Part 200, 50 CFR Part 402, and 33 CFR Parts 320 - 330	Applicable	Federal threatened and endangered species have been recorded as being potentially present on MCAS Yuma. More stringent then state of Arizona Statute, Title 17 (Table 2-14).

Acronyms/Abbreviations:
- ARAR – applicable or relevant and appropriate requirement
- MCAS – Marine Corps Air Station
- CFR – *Code of Federal Regulation*

Table 2-14
State Location-Specific ARARs for MCAS Yuma

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Arizona Revised Statutes, Title 17 - Game and Fish					
Critical habitat upon which endangered species or threatened species depend	Action to conserve threatened native species, including consultation with the Game and Fish Department	Determination of effect upon threatened species or its habitat	AAC R12-4-401	Relevant and Appropriate	Arizona threatened species have been recorded as being potentially present on MCAS Yuma. Less stringent than Endangered Species Act (Table 2-13).
Arizona Revised Statutes, Title 41 - State Government; Chapter 4.1 – History, Archaeology and State Emblems; Article 4 - Archaeological Discoveries					
Within state-owned or controlled land containing archaeological, paleontological, or historical feature	Prohibits excavating in or upon, defacing, or altering any archaeological, paleontological, or historical site or object; and requires notification upon discovery of any such site or object	Existence of any archaeological, paleontological, or historical site or object at least 50 years old	State-owned land ARS 41-841-847 Nonstate land ARS 41-861-866	Relevant and Appropriate	Archaeological, paleontological, or historical features may be discovered at MCAS Yuma during the course of any surveys, excavations, or construction that occur during a remedial action. Less stringent than National Archaeological and Historic Preservation Act (Table 2-13).

Acronyms/Abbreviations:

AAC Arizona Administrative Code
ARAR – applicable or relevant and appropriate requirement
ARS – Arizona Revised Statutes
MCAS – Marine Corps Air Station

Table 2-15
Federal Action-Specific ARARs for MCAS Yuma

<u>Alternatives</u>: 1 – No Action; 2 – Institutional Controls and Monitored Natural Attenuation; 3 – Containment by P/T by Air Stripping with Discharge to Yuma POTW; 3a – Containment by P/T by Air Stripping with Discharge by Reinjection; 5 – Containment by Vertical Recirculation Wells; 7 – Containment plus "Hot Spot" Removed by P/T by Air Stripping with Discharge to Yuma POTW; 7a – Containment plus "Hot Spot" Removal by by P/T by Air Stripping with Discharge by Reinjection; 9 – Containment plus "Hot Spot" Removal by Air Sparging/SVE.

Action	Requirement	Prerequisites	Citation	ARAR Determination			Comments
				A	RA	TBC	
Resource Conservation and Recovery Act (RCRA) 42 USC 6901 et seq.* (as incorporated by ARS Title 49 and AAC Title 18)							
Groundwater Monitoring	Owners and operators of hazardous waste management facility must, as part of corrective action, implement a groundwater monitoring program.	Hazardous waste release from solid waste management unit.	40 CFR Subpart F - sections 264.90 through 264.101		2,5,7,9		Applicable for any releases of hazardous waste. The extracted groundwater is not a listed or characteristic RCRA hazardous waste, however, portions of the groundwater extracted on-site may exceed TCLP limits. The determination of whether wastes generated during remedial activities such as soil cutting from well installation and treatment residues, are hazardous will be made at the time the wastes are generated. Monitoring requirements are subject to these determinations.
Secondary Containment	Owners and operators of hazardous waste tank systems must provide secondary containment that prevents the release of hazardous waste or hazardous constituents to the environment.	Management of hazardous waste with a tank system.	40 CFR 264.193		5,7,9		Applicable for any operations where hazardous waste is managed in a tank system. The extracted groundwater is not a listed or characteristic RCRA hazardous waste, however, portions of the groundwater extracted on-site may exceed TCLP limits. The determination of whether wastes generated during remedial activities such as soil cutting from well installation and treatment residues, are hazardous will be made at the time the wastes are generated. If the treatment technology involves the components of a tank system, and contaminants are similar to or identical to hazardous wastes, these requirements are relevant and appropriate.
Air Strippers	RCRA standards for control of emissions of volatile organics,	RCRA hazardous waste.	40 CFR 264.1030 et seq.		5,7		The standard requires reduction from production accumulator vessels and leak detection and repair programs. Product accumulator vessels include air strippers. If hazardous wastes are treated, these requirements will be ARARs,

(table continues)

Alternatives: **1 – No Action; 2 – Institutional Controls and Monitored Natural Attenuation; 3 – Containment by P/T by Air Stripping with Discharge to Yuma POTW; 3a – Containment by P/T by Air Stripping with Discharge by Reinjection; 5 – Containment by Vertical Recirculation Wells; 7 – Containment plus "Hot Spot" Removed by P/T by Air Stripping with Discharge to Yuma POTW; 7a – Containment plus "Hot Spot" Removal by by P/T by Air Stripping with Discharge by Reinjection; 9 – Containment plus "Hot Spot" Removal by Air Sparging/SVE.**

Action	Requirement	Prerequisites	Citation	ARAR Determination			Comments
				A	RA	TBC	
On-site waste generation	Person who generates waste shall determine if that waste is a hazardous waste.	Generator of hazardous waste in Arizona.	40 CFR 262.10(a), 262.11,	2,5,7,9			Applicable for any operation where waste is generated. The extracted groundwater is not a listed or characteristic RCRA hazardous waste, however, portions of the groundwater extracted on-site may exceed TCLP limits. The determination of whether wastes generated during remedial activities such as soil cutting from well installation and treatment residues, are hazardous will be made at the time the waste are generated.
Hazardous waste accumulation	Generator may accumulate waste on-site for 90 days or less or must comply with requirements for operating a storage facility.	Accumulate hazardous waste.	40 CFR 262.34				No storage of hazardous waste is planned. Accumulation of hazardous wastes onsite for longer than 90 days would be subject to RCRA requirements for storage facilities.
Recordkeeping	Generator must keep records.	Generate hazardous waste.	40 CFR 262.40				Applicability of this requirement is contingent upon generation and management of hazardous waste during remedial activities.
Container storage	Containers of RCRA hazardous waste must be: - Maintained in good condition - Compatible with hazardous waste to be stored. - Closed during storage except to add or remove waste.	Storage of RCRA hazardous waste not meeting small quantity generator criteria held for a temporary period greater than 90 days before treatment, disposal or storage elsewhere, in a container.	40 CFR 264.171, 172, 173				See comment above.
	Inspect container storage areas weekly for deterioration.		40 CFR 264.174				See comment above.
	Place containers on a sloped, crack-free base, and protect from contact with accumulated liquid. Provide contain-ment system with a capacity of 10 percent of the volume of containers of free liquids. Remove spilled or leaked waste in a timely manner to prevent overflow of the containment system.		40 CFR 264.175(a) and (b)				See comment above.

(table continues)

Table 2-15 (continued)

Action	Requirement	Prerequisites	Citation	ARAR Determination A	RA	TBC	Comments
Container storage Con't	Keep containers of ignitable or reactive waste at least 50 feet from the facility property line.		40 CFR 264.176				See comment above.
	Keep incompatible materials separate. Separate incompatible materials stored near each other by a dike or other barrier.		40 CFR 264.177				See comment above.
	At closure, remove all hazardous waste and residues from the containment system, and decontaminate or remove all containers, liners.		40 CFR 264.178				See comment above.
Clean closure	Removal or decontamination of all waste residues, contaminated containment system components, contaminated subsoils, and structures and equipment contaminated with waste and leachate, and management of them as hazardous waste.	Surface impoundments, container or tank liners and hazardous waste residues, or contaminated soil (including soil from dredging or soil disturbed in the course of drilling or excavation) returned to land.	40 CFR 264.111 and 264.228 (a, b, e through k, m, o, p, q), except as it cross-references procedural requirements such as closure plans and annual reports.	2,5,7, 9			To be determined. Potentially relevant and appropriate for treatment system contaminated with hazardous waste.
Use of equipment that contacts hazardous waste with organic concentrations greater than 10% by weight.	Air emission standards for process vents or equipment leaks,	Equipment that contains or contracts hazardous waste with organic concentrations of a least 10% by weight or process vents associated with specified operations that manage hazardous wastes with organic concentrations of at least 10 ppmw.	40 CFR 264.1030 through 1034 (excluding 1030(c), 1033(j), 1034(c)(2), 1034(d)(2)); 40 CFR 264.1050 through 1063 (excluding 1050(c), 1050(d), 1057(g)(2), 1061(d), 1063(d)(3)				May be applicable for portions of the extraction and treatment system.

Table header note: **Alternatives:** **1 – No Action; 2 – Institutional Controls and Monitored Natural Attenuation; 3 – Containment by P/T by Air Stripping with Discharge to Yuma POTW; 3a – Containment by P/T by Air Stripping with Discharge by Reinjection; 5 – Containment by Vertical Recirculation Wells; 7 – Containment plus "Hot Spot" Removed by P/T by Air Stripping with Discharge to Yuma POTW; 7a – Containment plus "Hot Spot" Removal by by P/T by Air Stripping with Discharge by Reinjection; 9 – Containment plus "Hot Spot" Removal by Air Sparging/SVE.**

(table continues)

Table 2-15 (continued)

Action	Requirement	Prerequisites	Citation	ARAR Determination A	RA	TBC	Comments
Alternatives: 1 – No Action; 2 – Institutional Controls and Monitored Natural Attenuation; 3 – Containment by P/T by Air Stripping with Discharge to Yuma POTW; 3a – Containment by P/T by Air Stripping with Discharge by Reinjection; 5 – Containment by Vertical Recirculation Wells; 7 – Containment plus "Hot Spot" Removed by P/T by Air Stripping with Discharge to Yuma POTW; 7a – Containment plus "Hot Spot" Removal by by P/T by Air Stripping with Discharge by Reinjection; 9 – Containment plus "Hot Spot" Removal by Air Sparging/SVE.							
Discharge to groundwater from regulated unit	Groundwater Protection Standards: Owners/operators of RCRA treatment, storage, or disposal facilities must comply with conditions in this section that are designed to ensure that hazardous constituents entering the ground-water from a regulated unit do not exceed the concentration limits for contaminants of concern set forth under Section 264.94 in the uppermost aquifer underlying the waste management area beyond the point of compliance.	Uppermost aquifer underlying a waste management unit beyond the point of compliance; RCRA hazardous waste, treatment, storage, or disposal.	40 CFR 264.94(a)(1), (a)(3), (c), (d), and (e)		2,5,7,9		Standards require consideration of cleanup to background.
Clean Water Act (CWA), 33 U.S.C. 1251 -1387							
Underground injection of wastes and treated groundwater	The underground injection control (UIC) program prohibits injection activities that allow movement of contaminants into underground sources of drinking water which may result in violations of or adversely affect health.	An approved UIC program is required in states listed under Safe Drinking Water Act (SDWA) Section 1422. Class I wells and Class IV wells are the relevant classifications for CERCLA sites. Class I wells are used to inject hazardous waste beneath the lowermost formation within 1/4 mile that contains an underground source of drinking water (USDW). Class IV wells are used to inject hazardous or radioactive waste into or above a formation that contains an USDW within 1/4 mile of the well.	40 CFR 144.12, excluding the reporting requirements in 144.12(b) and 144.12(c)(1)				May be applicable because groundwater injection is a potential alternative for disposal of treated groundwater for the Contingency Pump and Treat alternative.

<u>Alternatives:</u> 1 – No Action; 2 – Institutional Controls and Monitored Natural Attenuation; 3 – Containment by P/T by Air Stripping with Discharge to Yuma POTW; 3a – Containment by P/T by Air Stripping with Discharge by Reinjection; 5 – Containment by Vertical Recirculation Wells; 7 – Containment plus "Hot Spot" Removal by P/T by Air Stripping with Discharge to Yuma POTW; 7a – Containment plus "Hot Spot" Removal by by P/T by Air Stripping with Discharge by Reinjection; 9 – Containment plus "Hot Spot" Removal by Air Sparging/SVE.

Action	Requirement	Prerequisites	Citation	ARAR Determination A	RA	TBC	Comments
Safe Drinking Water Act (SDWA), 42 USC 30							
Underground injection of wastes and treated groundwater *Con'd*	The UIC program regulates construction of new Class IV wells and operation and maintenance of existing wells.		40 CFR 144.13				See comment above
	Class IV wells are banned except for reinjection of treated groundwater into the same formation from which it was withdrawn, as part of a CERCLA cleanup or RCRA corrective action.		40 CFR 144.13(c)				See comment above.
	The director of the UIC program in a state may lessen the stringency of 40 CFR 144.52 construction, operation, and manifesting requirements, for a well if injection does not occur into, through, or above a USDW or if the radius of endangering influence in less than or equal to the radius of the well.		40 CFR 144.16				See comment above.
	Prepare, maintain, and comply with plugging and abandonment plan.	Class I wells.	40 CFR 144.28(c) 40 CFR 144.51(e)				See comment above.
	Monitor Class I wells by: ! Frequent analysis of injection fluid ! Continuous monitoring of injection pressure, flow rate, and volume ! Installation and monitoring of groundwater monitoring wells.	Class I wells are used to inject hazardous waste beneath the lowermost formation within 1/4 mile that contains an USDW.	40 CFR 144.28(g)				See comment above.

(table continues)

Table 2-15 (continued)

Alternatives: 1 – No Action; 2 – Institutional Controls and Monitored Natural Attenuation; 3 – Containment by P/T by Air Stripping with Discharge to Yuma POTW; 3a – Containment by P/T by Air Stripping with Discharge by Reinjection; 5 – Containment by Vertical Recirculation Wells; 7 – Containment plus "Hot Spot" Removal by P/T by Air Stripping with Discharge to Yuma POTW; 7a – Containment plus "Hot Spot" Removal by by P/T by Air Stripping with Discharge by Reinjection; 9 – Containment plus "Hot Spot" Removal by Air Sparging/SVE.

Action	Requirement	Prerequisites	Citation	ARAR Determination A	RA	TBC	Comments
Underground injection of wastes and treated groundwater *Con't*	Applicants for Class I permits must: C Identify all injection wells within the area of review C Take action as necessary to ensure that such wells are properly sealed, completed, or abandoned to prevent contamination of USDW.		40 CFR 144.55 (144.55[b][4] is applicable only for Class III wells)				See comment above
	Criteria for determining whether an aquifer may be determined to be an exempted aquifer include current and future use, yield, and water quality characteristics.		40 CFR 146.4				See comment above
	Case and cement all Class I wells to prevent movement of fluids into USDW, taking into consideration well depth, injection pressure, hole size, composition of injected waste, and other factors.		40 CFR 144.28(e)				See comment above
	Conduct appropriate geologic drilling logs and other tests during construction.		40 CFR 146.12(d), excluding the reporting requirements				See comment above
	Injection pressure may not exceed a maximum level designed to ensure that injection does not initiate new fractures or propagate existing ones and causes the movement of fluids into a USDW. Continuous monitoring of injection pressure, flow rate, and volume, and annual pressure, if required. Demonstration of mechanical integrity is required every 5 years.		40 CFR 146.13(a, b,d)				See comment above

(table continues)

Table 2-15 (continued)

<u>Alternatives</u>: 1 – No Action; 2 – Institutional Controls and Monitored Natural Attenuation; 3 – Containment by P/T by Air Stripping with Discharge to Yuma POTW; 3a – Containment by P/T by Air Stripping with Discharge by Reinjection; 5 – Containment by Vertical Recirculation Wells; 7 – Containment plus "Hot Spot" Removal by P/T by Air Stripping with Discharge to Yuma POTW; 7a – Containment plus "Hot Spot" Removal by by P/T by Air Stripping with Discharge by Reinjection; 9 – Containment plus "Hot Spot" Removal by Air Sparging/SVE.

Action	Requirement	Prerequisites	Citation	ARAR Determination			Comments
				A	RA	TBC	
Underground injection of wastes and treated groundwater *Con't*	Groundwater monitoring may also be required.						
	Comply with State underground injection requirements.		40 CFR 147				See comment above.
	Hazardous waste to be injected is subject to land ban regulations. Treated groundwater that meets the definition of hazardous waste and is to be injected also is subject to land ban regulations.		40 CFR 268.2				See comment above.
Clean Air Act (CAA) 40 USC 7401 et seq.*							
Discharge to air	Provisions of State Implementation Plan (SIP) approved by U.S. EPA under Section 110 of CAA.	Major sources of air pollutants	40 USC Section 7410; portions of 40 CFR Section 52.123				Specific pertinent rules are listed below.
	National Primary and Secondary Ambient Air Quality Standards (NAAQS) - Standards for ambient air quality to protect public health and welfare (including standards for particulate matter and lead).	Contamination of air affecting public health and welfare	40 CFR Sections 50.4 - 50.12 (AAC R18-2-201-206)				Not an ARAR; Federal NAAQS are nonenforceable standards.
Discharge of particulate matter	Particulate matter from any source may not be discharged to the atmosphere in excess of amounts calculated by the formulas provided.	Discharge of particulate matter into atmosphere	AAC R18-2-530	5,7,9			Applicable to treatment units. However, emissions are not expected to exceed criteria.

(table continues)

Table 2-15 (continued)

Alternatives: 1 – No Action; 2 – Institutional Controls and Monitored Natural Attenuation; 3 – Containment by P/T by Air Stripping with Discharge to Yuma POTW; 3a – Containment by P/T by Air Stripping with Discharge by Reinjection; 5 – Containment by Vertical Recirculation Wells; 7 – Containment plus "Hot Spot" Removal by P/T by Air Stripping with Discharge to Yuma POTW; 7a – Containment plus "Hot Spot" Removal by by P/T by Air Stripping with Discharge by Reinjection; 9 – Containment plus "Hot Spot" Removal by Air Sparging/SVE.

Action	Requirement	Prerequisites	Citation	ARAR Determination			Comments
				A	RA	TBC	
New source of discharge to air	Meet standards of performance for new sources and emission standards for hazardous air pollutants.	Stationary source constructed or modified after effective date of requirement. Specified stationary sources of specific hazardous air pollutant(s).	40 CFR Part 60 (AAC R18-2-801)	5,7,9			Applicable to treatment units. However, emissions are not expected to exceed criteria.
	Performance testing is required not later than 180 days after start-up.	Facility which emits or may emit any air pollutant.	40 CFR 63.7(a)(2)(ii)	5,7,9			See comment above.
	National Emission Standards for Hazardous Air Pollutants (NESHAPS)	Any stationary source for which a standard is prescribed under this regulation.	40 CFR Part 63	5,7,9			See comment above.
Discharge to Atmosphere	Applicability, definitions, calculations, offsets, exemptions, and other requirements of Article 4.	Authority to construct required and demonstrated potential compliance with all other applicable air pollution rule and regulations.	R18-2-402,406	5,7,9			See comment above.
	The lowest achievable emission rate (LAER) for nonattainment pollutants and best available control technology (BACT) are required.	Source requires authority to construct; actually emits 25 tons per year or more of particulate matter, 40 tons per year of other listed compounds, or 100 tonx per year of carbon monoxide; and calculated daily emissions increase is at or greater than listed amounts.	R18-2-403	5,7,9			See comment above.
	Demonstrate by modeling, that the emission increase would not violate or interfere with attainment of any NAAQS or cause violation of any air-quality increment.	Source requires authority to construct and the daily emissions increase, is at or greater than listed amounts.	R18-2-406	5,7,9			See comment above.

(table continues)

Table 2-15 (continued)

Action	Requirement	Prerequisites	Citation	ARAR Determination			Comments
				A	RA	TBC	
Discharge to Atmosphere *Con't*	Analysis of impairment to visibility, soils, and vegetation using U.S. EPA methods required. Must provide analysis of ambient air quality if located in attainment or unclassifiable area and other information required for analysis.	Source requires authority to construct, and the daily emissions increase, is at or greater than listed amounts for pollutants in designated attainment or unclassified area.	R18-2-407	5,7,9			See comment above.
	Must not exceed or contribute to an exceeded NAAQS.	New major source of organic compounds or any air contaminant.	R18-2-402	5,7,9			See comment above.
	Applicant must certify that all major stationary sources owned or operated by such person in the State are in compliance, carry out the SIP for applicable pollutant, make the new source comply with LAER, conduct air quality analysis in accordance with R18-2-407, and show that attainment of NAAQS is not interfered with.	Any source for which an NAAQS is exceeded.	R18-2-403	5,7,9			See comment above.
U.S. Department of Transportation, 49 USC 1802, et seq.*							
Hazardous Materials Transportation	No person shall represent that a container or package is safe unless it meets the requirements of 49 USC 1802, et seq. or represent that a hazardous material is present in a package or motor vehicle if it is not.	Interstate carriers transporting hazardous waste and substance by motor vehicle. Transportation of hazardous material under contract with any department of the executive branch of the Federal government.	49 CFR 171.2(f)	2,5,7,9			Substantive portions of these requirements would be ARARs for transport of hazardous materials onsite. Offsite transport must comply with both substantive and administrative requirements.
Hazardous Materials Marking, Labeling, and Placarding	Each person who offers hazardous material for transportation or each carrier that transports it shall mark each package, container, and vehicle in the manner required.	Person who offers hazardous material for transportation; carries hazardous material; or packages, labels, or placards hazardous material.	49 CFR 172.300	2,5,7,9			See comment above.

<u>Alternatives</u>: 1 – No Action; 2 – Institutional Controls and Monitored Natural Attenuation; 3 – Containment by P/T by Air Stripping with Discharge to Yuma POTW; 3a – Containment by P/T by Air Stripping with Discharge by Reinjection; 5 – Containment by Vertical Recirculation Wells; 7 – Containment plus "Hot Spot" Removal by P/T by Air Stripping with Discharge to Yuma POTW; 7a – Containment plus "Hot Spot" Removal by by P/T by Air Stripping with Discharge by Reinjection; 9 – Containment plus "Hot Spot" Removal by Air Sparging/SVE.

(table continues)

Table 2-15 (continued)

<u>Alternatives</u>: 1 – No Action; 2 – Institutional Controls and Monitored Natural Attenuation; 3 – Containment by P/T by Air Stripping with Discharge to Yuma POTW; 3a – Containment by P/T by Air Stripping with Discharge by Reinjection; 5 – Containment by Vertical Recirculation Wells; 7 – Containment plus "Hot Spot" Removal by P/T by Air Stripping with Discharge to Yuma POTW; 7a – Containment plus "Hot Spot" Removal by by P/T by Air Stripping with Discharge by Reinjection; 9 – Containment plus "Hot Spot" Removal by Air Sparging/SVE.

Action	Requirement	Prerequisites	Citation	ARAR Determination			Comments
				A	**RA**	**TBC**	
Hazardous Materials Marking, Labeling, and Placarding *Con't*	Each person offering nonbulk hazardous materials for transportation shall mark the proper shipping name and identification number (technical name) and consignee's name and address.		49 CFR 172.301	2,5,7,9			See comment above.
	Hazardous materials for transportation in bulk packages must be labelled with proper identification (ID) number, specified in 49 CFR 172.101 table, with required size of print. Packages must remain marked until cleaned or refilled with material requiring other marking.		49 CFR 172.302	2,5,7,9			See comment above.
	No package marked with a proper shipping name or ID number may be offered for transport of transported unless the package contains the identified hazardous material or its residue.		49 CFR 172.303	2,5,7,9			See comment above.
	The markings must be durable, in English, in contrasting colors, unobscured, and away from other markings.		49 CFR 172.304	2,5,7,9			See comment above.
	Labeling of hazardous material packages shall be as specified in the list.		49 CFR 172.400	2,5,7,9			See comment above.
	Nonbulk combination packages containing liquid hazardous materials must be packed with closures upward, and marked with arrows pointing upward.		49 CFR 172.312	2,5,7,9			See comment above.

(table continues)

Table 2-15 (continued)

<u>Alternatives</u>: 1 – No Action; 2 – Institutional Controls and Monitored Natural Attenuation; 3 – Containment by P/T by Air Stripping with Discharge to Yuma POTW; 3a – Containment by P/T by Air Stripping with Discharge by Reinjection; 5 – Containment by Vertical Recirculation Wells; 7 – Containment plus "Hot Spot" Removal by P/T by Air Stripping with Discharge to Yuma POTW; 7a – Containment plus "Hot Spot" Removal by by P/T by Air Stripping with Discharge by Reinjection; 9 – Containment plus "Hot Spot" Removal by Air Sparging/SVE.

Action	Requirement	Prerequisites	Citation	ARAR Determination			Comments
				A	RA	TBC	
Hazardous Materials Marking, Labeling, and Placarding *Con't*	Each Bulk packaging or transport vehicle containing any quantity of hazardous material must be placarded on each side and each end with the type of placards listed in Tables 1 and 2 of 49 CFR 172.504.	Each person who offers for transport or transports any hazardous materials shall comply requirements.	49 CFR 172.504	2,5,7,9			See comment above.
Criteria for Classification of Solid Waste Facilities and Practices, 40 CFR Part 257*							
Solid Waste Disposal	A facility or practice shall not contaminate an underground drinking water source beyond the solid waste boundary or a court- or State-established alternative.	Solid waste disposal facility and practices except agricultural wastes, overburden resulting from mining orerations, land application of domestic sewage, location and operations of septic tanks, solid of dissolved materials in irrigation return flows, industrial discharges that are point sources subject to permits under CWA, source special nuclear or by-product material as defined by the Atomic Energy Act, hazardous waste disposal facilities that are subject to regulation under RCRA subtitle C, disposal of soilid waste by underground will injection, and municipal solid waste landfill units.	49 CFR 257.3-4 and Appendix I				Not an ARAR; this remedial action for groundwater does not involve solid waste disposal facilities.
	A facility shall not cause a discharge of pollutants into waters of the U.S. that is in violation of the <u>substantive</u> requirements of the NPDES under CWA Section 402, as amended.		49 CFR 257.3-3(a)				Not an ARAR; this remedial action for groundwater does not involve solid waste disposal facilities.

(table continues)

Table 2-15 (continued)

<u>Alternatives</u>: 1 – No Action; 2 – Institutional Controls and Monitored Natural Attenuation; 3 – Containment by P/T by Air Stripping with Discharge to Yuma POTW; 3a – Containment by P/T by Air Stripping with Discharge by Reinjection; 5 – Containment by Vertical Recirculation Wells; 7 – Containment plus "Hot Spot" Removal by P/T by Air Stripping with Discharge to Yuma POTW; 7a – Containment plus "Hot Spot" Removal by by P/T by Air Stripping with Discharge by Reinjection; 9 – Containment plus "Hot Spot" Removal by Air Sparging/SVE.

Action	Requirement	Prerequisites	Citation	ARAR Determination			Comments
				A	RA	TBC	
Solid Waste Disposal *Con't*	A facility shall not cause a discharge of dredged material or fill material to waters of the U.S. that is in violation of the <u>substantive</u> requirements of CWA Section 404.		49 CFR 257.3-3				Not an ARAR. No discharge of dredged or fill material is planned.
	A facility or practice shall not cause nonpoint source pollution of waters of the U.S. that violates applicable legal <u>substantive</u> requirements implementing an areawide or Statewide water quality management plan approved by the Administrator under CWA Section 208, as amended.		49 CFR 257.3- 3 (a)				Not an ARAR. This remedial action is not expected to increase nopoint sources of water pollution.
	The facility of practice shall not engage in open burning of residential, commercial, institutional, or industrial solid waste.	Not applicable to infrequent burning of agricultrual wastes in the field, silvicultural wastes for forest management purposes, landclearing debris from emergency cleanup operations, and ordnance.	49 CFR 257.3- 7 (a)				Not an ARAR. No open burning is planned as part of this remedial action.
	The facility shall not violate applicable requirements developed under a State implementation plan approved or promulgated by the Administrator pursuant to CAA Section 110, as amended.		49 CFR 257.3- 7 (b)				Not an ARAR.

(table continues)

Table 2-15 (continued)

C	Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs. Specific potential ARARs are addressed in the table below each general heading.

A – Applicable.
AAC – Arizona Administrative code
ACLS – Alternate concentration limits.
ADEQ – Arizona Department of Environmental Quality
ARAR – Applicable or relevant and appropriate requirement.
ARS – Arizona Revised Statutes
BACT – Best available control technology.
BDAT – Best demonstrated available technologies.
CAA – Clean Air Act.
CAMU – Correction action management unit.
AAC – Arizona Administrative Code.
CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act.
CFR – *Code of Federal Regulations.*
CWA – Clean Water Act.
DOT – U.S. Department of Transportation.
LAER – Lowest achievable emission rate.
MCLs – Maximum contaminant levels.
MCLGs – Maximum contaminant level goals.
NAAQS – National Ambient Air Quality Standards (primary and secondary).
NCP – National Contingency Plan
NESHAPS – National emission standards for hazardous air pollutants.
NPDES – National Pollutant discharge elimination system.
ppm – Parts per million.
ppmw – Parts per million by weight.
RA – Relevant and appropriate.
RCRA – Resource Conservation and Recovery Act.
SDWA – Safe Drinking Water Act.
SIP – State Implementation Plan.
SMCLs – Secondary maximum contaminant levels.
TBC – To be considered.
UIC – Underground injection control.
USC – United States Code.
USDW – Underground source of drinking water.
U.S. EPA – United States Environmental Protection Agency.

Table 2-16
State Action-Specific ARARs for MCAS Yuma

<u>Alternatives</u>: 1 – No Action; 2 - Institutional Controls and Monitored Natural Attenuation; 3 – Containment by P/T by Air Stripping with Discharge to Yuma POTW; 3a – Containment by P/T by Air Stripping with Discharge by Reinjection; 5 – Containment by Vertical Recirculation Wells; 7 – Containment plus "Hot Spot" Removal by P/T by Air Stripping with Discharge to Yuma POTW; 7a – Containment plus "Hot Spot" Removal by by P/T by Air Stripping with Discharge by Reinjection; 9 – Containment plus "Hot Spot" Removal by Air Sparging/SVE.

Action	Requirement	Prerequisites	Citation	ARAR Determination			Comments
				A	RA	TBC	
Solid Waste Management Statute (SWMS) ARS 49-701 et seq.							
Groundwater Monitoring	Owners and operators of solid waste management facility must install a system of detection groundwater monitoring wells if there is a reasonable probability that the facility will impact groundwater.	Solid waste landfill probable to affect groundwater.	AACR18-2-112				Applicable for any impact on groundwater from solid waste landfill related activities. Not an ARAR for remediation of already contaminated groundwater.
Environmental Quality Act of f1986 (EQA) ARS 49-101 et seq.							
Discharges of treated groundwater to POTW	A user may not introduce into a POTW any pollutant(s) which violates a municipal ordinance.	Discharge of pollutants to POTW.	Municipal Code – City of Yuma			7,9	Discharge of pollutants to the POTW must be approved by the POTW and will be conditioned on compliance with relevant municipal ordinances, if any. This is considered an off-site activity and both substantive and kprocedural compliance is required.
Aquifer Protection Permit Program	Requires implementation of (1) best available demonstrated control technology, processes, operating methods, of other alternatives, including, where practicable, a technology permitting no discharge of pollutants, and (2) the facility must not cause or contribute to a violation of aquifer water qualitystandards at the applicable point of compliance (POC), or (3) further degrade aquifer water with respect to a pollutant at the POC if the quality of the aquifer already violates the applicable aquifer water quality standard for that pollutant.	Discharges of pollutants to groundwater.	ARS 49-241 et seq.	2,5,7,9 3, 3a			Site remediation will affect groundwater quality and the aquifer protection permit substantive requirements will be ARARs. This will likely be the mechanism by which Arizona controls the remedial activities for MCAS Yuma.
Groundwater Code ARS 45-101 et seq.							
Wells	All well construction, replacement, deepening, and abandonment operations pursuant to CERCLA remedial actions shall comply with state rules and be conducted by a licensed well driller.	A person may not construct, replace, or deepen a well in Arizona without complying with state rules.	45 ARS 454.01, 45-594, 45-595, 45-596, and 45-600	2,5,7,9			Although some new well construction activities are exempt from certain state requirements when conducted pursuant to a CERCLA remedial action, Substantive requirements of these cited rules are ARARs for all activities involving well drilling.
Discharge of treated groundwater	If withdrawn groundwater is not reinjected into the aquifer, the groundwater shall be put to reasonable and beneficial use.	Groundwater withdrawal, treatment,and non-reinjection discharge.	45 ARS 454.01	3,7			Applies to the discharge of all groundwater.

(table continues)

Table 2-16 (continued)

Alternatives: 1 – No Action; 2 – Institutional Controls and Monitored Natural Attenuation; 3 – Containment by P/T by Air Stripping with Discharge to Yuma POTW; 3a – Containment by P/T by Air Stripping with Discharge by Reinjection; 5 – Containment by Vertical Recirculation Wells; 7 – Containment plus "Hot Spot" Removal by P/T by Air Stripping with Discharge to Yuma POTW; 7a – Containment plus "Hot Spot" Removal by by P/T by Air Stripping with Discharge by Reinjection; 9 – Containment plus "Hot Spot" Removal by Air Sparging/SVE.

Action	Requirement	Prerequisites	Citation	ARAR Determination			Comments
				A	RA	TBC	
Arizona Water Quality Control ARS 49-201 et seq.							
Aquifer Quality	Since all aquifers in the state are classified as drinking water aquifers, the goal of remediation is to restore affected aquifer to drinking water quality.	Contamination of aquifer.	ARS §49-224B	2,3,5,7,9 3a,7a			Unless aquifer can be reclassified as non-drinking water, this requirement is more stringent than federal standards and is an ARAR.
Remedial Action	Remedial actions must (a) assure the protection of public health and welfare and the environment (b) to the extent practicable, provide for the control and management of clean-up of the hazardous substance so as to allow the maximum beneficial use of the water of the state; and (c) be cost effective over the period of potential exposure to such hazardous substance.	Release of hazardous substance.	ARS §49-282		2,3,5,7,9		Provides general guidelines for remedial actions in the contest of the state water quality assurance revolving fund.
Groundwater Code ARS 45-101 et seq.							
Use of groundwater	Specifics how groundwater may be withdrawn, used and transported outside active management areas.	"Use" of groundwater outside active management area.	ARS §45-453	2,3,3a,5, 7,7a,9			If groundwater is withdrawn as part of a remedial action this section is applicable.

* Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs. Specific potential ARARs are addressed in the table below each general heading.

A – Applicable.
AAC – Arizona Administrative Code
ACLS – Alternate concentration limits
ADEQ – Arizona Department of Environmental Quality
ARAR – Applicable or relevant and appropriate requirement.
ARS – Arizona Revised Statutes
BACT – Best available control technology.
BDAT – Best demonstrated available technologies.
CAA – Clean Air Act.
CAMU – Correction action management unit.
AAC – Arizona Administrative Code.
CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act.
CFR – Code of Federal Regulations.
CWA – Clean Water Act.
DOT – U.S. Department of Transportation.
EPA – U.S. Environmental Protection Agency.
LAER – Lowest achievable emission rate.
MCLs – Maximum contaminant levels.
MCLGs – Maximum contaminant level goals.
NAAQS – National Ambient Air Quality Standards (primary and secondary).
NCP – National Contingency Plan
NESHAPS – National emission standards for hazardous air pollutants.
NPDES – National Pollutant discharge elimination system.
ppm – Parts per million.
ppmw – Parts per million by weight.
RA – Relevant and appropriate.
RCRA – Resource Conservation and Recovery Act.
SDWA – Safe Drinking Water Act.
SIP – State Implementation Plan.
SMCLs – Secondary maximum contaminant levels.
TBC – To be considered.
UIC – Underground injection control.
USC – United States Code.
USDW – Underground source of drinking water.

Table 2-17
Detailed Analyses of Alternatives Summary

	Alternative 1 No Action	Alternative 2 Institutional Controls and Monitored Natural Attenuation	Alternative 3 Containment by Pump and Treatment by Air Stripping with Disposal to Yuma POTW, and Institutional Controls	Alternative 3a Containment by Pump and Treatment by Air Stripping with Disposal by Reinjection, and Institutional Controls	Alternative 5 Containment by Vertical Recirculation Wells, and Institutional Controls	Alternative 7 Containment, Hot Spot Removal by Pump and Treatment by Air Stripping with Discharge to Yuma POTW, and Institutional Controls	Alternative 7a Containment, Hot Spot Removal by Pump and Treatment by Air Stripping with Discharge by Reinjection, and Institutional Controls	Alternative 9 Containment, Hot Spot Removal by AS/SVE, and Institutional Controls
Overall Protectiveness								
Human Health	Does not prevent future contaminated groundwater use, and therefore does not increase the protectiveness of human health. Does not monitor changes in groundwater quality. May fail in future to protect human health.	Prevents current and future groundwater use, increasing the protectiveness of human health. Does not involve bringing contaminated groundwater or gases to the surface. Monitoring would provide data to evaluate natural attenuation processes,.	See Alternative 2. Aboveground handling of contaminated groundwater creates minor potential risk to operating personnel, which can be managed by proper health and safety procedures. Installation of an extraction well barrier at the leading edge of the plume will prevent or minimize future contaminant migration off Station.	See Alternative 2. This Alternative is the same as Alternative 3, except treated effluent is discharged by reinjection back into aquifer. Creates possibility that inadequately treated effluent could be reinjected and contaminate previously clean groundwater, however, can be avoided with careful monitoring. Also, reinjection could adversely change local hydrology.	See Alternative 2. Extraction and treatment of organic-laden off-gases creates minor potential risks to operating personnel. These can be managed by proper health and safety procedures. *In situ* treatment of contaminated groundwater at leading edge of plume will prevent or minimize future contaminant migration off Station.	See Alternatives 2 and 5. Mitigation measures will be incorporated into extraction and treatment plant design to minimize potential risks associated with operations. Increase in overall protection of human health is gained by reduction in overall time required for remediation by mass removal.	See Alternative 2. This Alternative is the same as Alternative 7, except treated effluent is discharged by reinjection back into aquifer. Creates possibility that inadequately treated effluent could be reinjected and contaminate previously clean groundwater, however, can be avoided with careful monitoring. Also, reinjection could adversely change local hydrology.	See Alternatives 2 and 5. Mitigation measures will be incorporated into above ground facility to treat extracted soil vapors to protect workers and the environment from exposure to contaminants in soil gas. Increase in overall protection of human health is gained by reduction in overall time required for remediation by mass removal.
Environment	Although existing conditions are protective of the environment, future use of groundwater may not be protective of the environment.	Existing conditions are protective of the environment and monitoring would ensure they remain so under this alternative. No known endangered species on Station.	See Alternative 2. See comments above.	See Alternative 2. See comments above.	See Alternative 2. See comments above.	See Alternative 2. See comments above.	See Alternative 2. See comments above.	See Alternative 2. See comments above.
Compliance with ARARs								
Chemical-Specific	Because no remedial actions are being taken, existing conditions where ARARs are exceeded would continue until natural attenuation processes reduced contaminant concentrations below ARARs.	See Alternative 1. Natural attenuation processes would reduce contaminant concentrations and eventually result in compliance with ARARs.	Contaminant plume containment would intercept migration of contaminants off Station. Natural attenuation in the remainder of the Area 1 plume would eventually result in compliance with ARARs.	See Alternatives 2 and 3.	See Alternative 2 and 3.	Contaminant plume containment would intercept migration of contaminants off Station. Removal of mass in the source area and natural attenuation would result in compliance with ARARs more quickly than Alternatives 1, 2 and 5.	See Alternative 7.	See Alternative 7.

(table continues)

Table 2-17 (continued)

	Alternative 1 No Action	Alternative 2 Institutional Controls and Monitored Natural Attenuation	Alternative 3 Containment by Pump and Treatment by Air Stripping with Disposal to Yuma POTW, and Institutional Controls	Alternative 3a Containment by Pump and Treatment by Air Stripping with Disposal by Reinjection, and Institutional Controls	Alternative 5 Containment by Vertical Recirculation Wells, and Institutional Controls	Alternative 7 Containment, Hot Spot Removal by Pump and Treatment by Air Stripping with Discharge to Yuma POTW, and Institutional Controls	Alternative 7a Containment, Hot Spot Removal by Pump and Treatment by Air Stripping with Discharge by Reinjection, and Institutional Controls	Alternative 9 Containment, Hot Spot Removal by AS/SVE, and Institutional Controls
Location-Specific	No actions will be taken; therefore no location-specific ARARs apply.	Precautions can be taken during implementation for the protection of endangered or threatened species, or any historical or archeologically significant items.	See Alternative 2.	See Alternative 2.	See Alternative 2.	See Alternatives 2.	See Alternative 2.	See Alternatives 2.
Action-Specific	No actions will be taken; therefore no action-specific ARARs apply.	No actions will be taken involving action-specific ARARs.	Off-gas treatment system will be designed to meet state air pollution standards.	See Alternative 3. Reinjection system will be designed to meet federal and state standards.	Off-gas treatment system will be designed to meet all state air pollution control standards.	See Alternative 5.	See Alternative 7.	See Alternative 5.
Long-Term Effectiveness								
Magnitude of Residual Risk	Potential of residual risk from exposure to untreated groundwater exists because institutional controls are not implemented to prevent usage.	Residual risk from untreated groundwater is low, because institutional controls are implemented to prevent use of contaminated groundwater.	See Alternative 2. Residual risks exist as a result of treatment of extracted off-gases. Residual risk can be addressed by proper handling of spent carbon and other wastes.	See Alternative 2. See Alternative 3.	See Alternative 2.	See Alternative 2. See Alternative 3. Residual risks also exist as a result of treatment of extracted groundwater. Residual risk can be addressed by proper handling of spent carbon and other wastes.	See Alternative 2. See Alternative 7.	See Alternative 2. See Alternative 3.
Adequacy and Reliability of Controls	No controls will be implemented.	Reliability of institutional controls is adequate. Would require long-term commitment from Base and Airport Authority officials.	See Alternative 2. Spent carbon would be regenerated off Station by permitted facility to destroy contaminants.	See Alternative 2. See Alternative 3.	See Alternative 2.	See Alternative 2. See Alternative 5.	See Alternative 2. See Alternative 7.	See Alternative 2. See Alternative 3.
Reduction of Toxicity, Mobility, or Volume								
Treatment Process Used	No treatment process is used.	See Alternative 1.	Organics in groundwater are transferred to gaseous phase. GAC system would remove nearly 100 percent of volatiles in extracted off-gas.	See Alternative 3.	See Alternative 3.	See Alternative 3.	See Alternative 3.	See Alternative 3.
Amount Destroyed or Treated	Natural processes are used to reduce the amount of contamination present.	See Alternative 1.	VOCs - 3.0 pounds/year	VOCs - 3.0 pounds/year	VOCs = 3.0 pounds/year	VOCs = 182 pounds/year	VOCs - 182 pounds/year	VOCs = 182 pounds/year
Expected Reduction in Toxicity, Mobility, or Volume	No treatment process is used. Natural processes are used to reduce the amount of contamination present.	See Alternative 1.	Small overall reduction of volume and mobility because dissolved contaminant concentrations are very low at containment area.	See Alternative 3.	See Alternative 3.	Greater reduction in volume through mass removal. Reduction in mobility of contaminants that otherwise would have migrated to Station boundary.	See Alternative 7.	See Alternative 7.

(table continues)

Table 2-17 (continued)

	Alternative 1 No Action	Alternative 2 Institutional Controls and Monitored Natural Attenuation	Alternative 3 Containment by Pump and Treatment by Air Stripping with Disposal to Yuma POTW, and Institutional Controls	Alternative 3a Containment by Pump and Treatment by Air Stripping with Disposal by Reinjection, and Institutional Controls	Alternative 5 Containment by Vertical Recirculation Wells, and Institutional Controls	Alternative 7 Containment, Hot Spot Removal by Pump and Treatment by Air Stripping with Discharge to Yuma POTW, and Institutional Controls	Alternative 7a Containment, Hot Spot Removal by Pump and Treatment by Air Stripping with Discharge by Reinjection, and Institutional Controls	Alternative 9 Containment, Hot Spot Removal by AS/SVE, and Institutional Controls
Degree to which Treatment Is Irreversible	No treatment process is used.	See Alternative 1.	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Types and Quantities of Residuals	No treatment process is used.	See Alternative 1.	GAC - 1,800 pounds/year	GAC = 1,800 pounds/year	GAC = 1,800 pounds/year	GAC = 18,000 pounds/year	GAC = 18,000 pounds/year	GAC = 18,000 pounds/year
Short-Term Effectiveness								
Community Protection	No risks posed to the community since no action is taken.	Protection through institutional controls. Potential releases during quarterly sampling will be minimized by properly trained workers.	Protection through institutional controls. Extraction and treatment of off-gases may cause accidental releases that may affect the community. Disturbance from construction activities would be minimal due to location away from main Station area.	See Alternative 3.	See Alternative 3.	See Alternative 3. Disturbance to Station community due to construction of treatment system would be greater since source area removal system is located in main Station area.	See Alternative 7.	See Alternative 7.
Worker Protection	No protection required for no action.	Protection through proper health and safety requirements during installation of wells and sampling activities. Potential releases during quarterly sampling will be minimized by properly trained workers.	Protection through proper health and safety requirements during installation of system. Extraction and treatment of groundwater off-gases may cause releases affecting workers. Potential impacts will be addressed by complying with proper procedures.	See Alternative 3.	See Alternative 3.	See Alternative 3.	See Alternative 3.	See Alternative 3.
Environmental Impacts	No additional impacts from no action.	Protection through institutional controls. Potential releases occurring during quarterly sampling will be minimized by properly trained workers.	Protection through institutional controls. Extraction and treatment of contaminated groundwater off-gases may release contaminants to the local environment.	See Alternative 3.	See Alternative 3.	See Alternative 3.	See Alternative 3.	See Alternative 3.
Time to reach remedial action objectives	Natural processes control the time required for restoration.	See Alternative 1.	Objectives would be reached in a short time for portion of the plume passing Station boundary. Natural processes would dictate time for remainder of plume exceeding MCLs to reach containment system at Station boundary.	See Alternative 3.	See Alternative 3.	Objectives would be reached in a short period of time at Station boundary. Objectives would be reached in approximately 50 to 60 years in the area around Bldg. 230 with source area removal (Appendix M)	See Alternative 7.	Objectives would be reached in a short period of time at Station boundary. Objectives would be reached in approximately 17 years under ideal conditions in the area around Bldg. 230 with source area removal. Field results may vary (Appendix O).

(table continues)

Table 2-17 (continued)

	Alternative 1 No Action	Alternative 2 Institutional Controls and Monitored Natural Attenuation	Alternative 3 Containment by Pump and Treatment by Air Stripping with Disposal to Yuma POTW, and Institutional Controls	Alternative 3a Containment by Pump and Treatment by Air Stripping with Disposal by Reinjection, and Institutional Controls	Alternative 5 Containment by Vertical Recirculation Wells, and Institutional Controls	Alternative 7 Containment, Hot Spot Removal by Pump and Treatment by Air Stripping with Discharge to Yuma POTW, and Institutional Controls	Alternative 7a Containment, Hot Spot Removal by Pump and Treatment by Air Stripping with Discharge by Reinjection, and Institutional Controls	Alternative 9 Containment, Hot Spot Removal by AS/SVE, and Institutional Controls
Implementability								
Ability to Construct and Operate	No construction or operation is involved.	Some monitoring wells already Installed. Additional wells are recom-mended. Installation of wells and sampling and monitoring easy to implement. Ground water use restrictions on Base and on Airport Authority property are easy to implement.	Conventional construction of wells and pipelines will need to coordinate with Station for construction in Flight Line areas. May be potential concern with discharge of treated water to POTW in future and permanent removal of groundwater from aquifer.	Conventional construction of wells are pipelines will need to coordinate with Station for construction in Flight Line areas. Reinjection wells require frequent maintenance. Groundwater hydrology will require monitoring	Construction and operation of the treatment system is implementable. Treatment is innovative. Pilot test is underway to assess performance of system. Initial results indicate operational problems, but design changes being initiated to correct.	Readily implementable. Technologies are well known. Will need to coordinate with Station for plot space for treatment facility and construction in the Flight Line. May be potential concerns with discharge of treated water to POTW in future and with permanent removal of groundwater from the aquifer.	Readily implementable. Technologies are well known. Will need to coordinate with Station for plot space for treatment facility and construction in Flight Line area. Reinjection wells require frequent maintenance. Groundwater hydrology will require monitoring	Readily implementable. Technologies are well known. Will need to coordinate with Station for plot space for treatment facility and construction in the Flight Line.
Reliability	No action is taken.	Highly reliable.	Pump and treatment extraction well barrier shown reliable elsewhere to intercept plumes	See Alternative 3. Reinjection well system would require diligent operation to maintain reliability.	Reliability difficult to assess. Pilot test is underway to assess performance of system.	Expected to be reliable. Potential concern in the future for continuing discharge of treated groundwater to POTW.	Expected to be reliable. Reinjection well system would require diligent operation to maintain reliability	Expected to be reliable. Pilot test is necessary to confirm performance.
Ease of Additional Remediation.	No action is taken, and no additional actions would be taken.	Additional institutional controls could easily be added.	Easy to add additional wells and/or treatment capacity.	See Alternative 3.	System could be converted to a pump-and-treat extraction system or more vertical recirculation wells added.	Easy to add additional wells and/or treatment capacity.	See Alternative 7.	More air sparging and/or vapor extraction wells could be added.
Ability to Monitor Effectiveness	No actions will be taken, so nothing will be monitored.	Monitoring institutional controls is easy because the site is a secured Marine Corps base. Monitoring of controls off Station on Airport Authority land would require coordination.	See Alternative 2. Groundwater quality monitoring is easy. Monitoring of treatment system efficiency and effluent quantity also easy.	See Alternative 3. Monitoring of reinjection well efficiency and groundwater hydrology is easy.	See Alternative 2. Monitoring of vertical recirculation well effectiveness in subsurface aquifer is difficult. Monitoring of off-gas system is considered easy.	See Alternative 3.	See Alternative 3a.	See Alternative 5. Monitoring of air sparging effectiveness in subsurface aquifer is difficult.
Ability to Obtain Approvals and Coordinate with Other Agencies	No actions will be taken, so no approvals or coordination will be required.	Easy to coordinate with agencies for approval of a monitoring program.	See Alternative 2. Air emissions permit and waste residual management expected to be routine. Sewer discharge permit may become difficult in future.	See Alternative2. Air emissions permit and waste residual manage-ment expected to be routine. Reinjection well approvals may be more difficult.	See Alternative 2. Coordination for location-specific ARARs, air emissions permit, and waste residual management not expected to be a problem.	See Alternative 2 See Alternative 53	See Alternative 2. See Alternative 3a.	See Alternative 2. See Alternative 5.
Availability of off-site TSDFs.	No actions will be taken, so no off-site TSDF will be required.	Institutional controls will not require an off-site TSDF.	Off-site TSDFs are accessible in the area for waste management.	See Alternative 3.	See Alternative 3.	See Alternative 3.	See Alternative 3.	See Alternative 3.
Availability of Equipment and Specialists.	No actions will be taken, so no equip-ment or specialists will be required	Institutional controls will not require any unusual equipment or specialists.	Specially trained personnel to install systems are available.	See Alternative 3.	See Alternative 3.	See Alternative 3.	See Alternative 3.	See Alternative 3.

(table continues)

Table 2-17 (continued)

	Alternative 1 No Action	Alternative 2 Institutional Controls and Monitored Natural Attenuation	Alternative 3 Containment by Pump and Treatment by Air Stripping with Disposal to Yuma POTW, and Institutional Controls	Alternative 3a Containment by Pump and Treatment by Air Stripping with Disposal by Reinjection, and Institutional Controls	Alternative 5 Containment by Vertical Recirculation Wells, and Institutional Controls	Alternative 7 Containment, Hot Spot Removal by Pump and Treatment by Air Stripping with Discharge to Yuma POTW, and Institutional Controls	Alternative 7a Containment, Hot Spot Removal by Pump and Treatment by Air Stripping with Discharge by Reinjection, and Institutional Controls	Alternative 9 Containment, Hot Spot Removal by AS/SVE, and Institutional Controls
Availability of Technologies	No actions will be taken, so no technologies will be required.	Institutional controls will not require any unusual technologies.	Readily available.	Readily available.	Vertical recirculation wells area an innovative technology however vendors are available. Off-gas treatment system readily available.	Readily available.	Readily available.	Readily available.
Cost								
Capital	$0	$85,000	$891,000	$1,306,000	$1,653,000	$2,791,000	$3,600,000	$3,4210,000
Annual O&M	$6,000	$112,200	$265,000	$250,000	$214,060	$495,000	$432,000	$370,000
Present Cost (7%, 30 yrs)	$92,000	$1,475,000	$4,179,000	$4,408,000	$4,308,000	$8,933,000	$8,961,000	$8,012,000

Table 2-18
Summary of Alternative Cost
(x $1,000)

	Alternative							
Remedial Action	**1**	**2**	**3**	**3a**	**5**	**7**	**7a**	**9**
No Action	X							
Institutional Control		X	X	X	X	X	X	X
Containment by Pump & Treatment			X	X				
Containment/Discharge to POTW			X					
Containment/Discharge by Reinjection				X				
Containment by Vertical Recirculation Well					X	X	X	X
Hot Spot Removal by Pump & Treatment						X	X	
Hot Spot Removal Discharge to POTW						X		
Hot Spot Removal Discharge by Reinjection							X	
Hot Spot Removal by AS/SVE								X
Total Capital	$0	$85	$891	$1,306	$1,653	$2,791	$3,600	$3,421
Total Annual O&M	$6	$112	$265	$250	$214	$495	$432	$370
Total Present Worth*	$74	$1,475	$4,179	$4,408	$4,308	$8,933	$8,961	$8,012

Note:
* based on uniform series, 7 percent discount rate, 30-year project life

Table 2-19
Cost Estimates for the Selected Remedies

Area 1 Plume		
Remedy Element	**Capital Cost**	**Annual O&M Cost**
Institutional Controls with Monitored Natural Attenuation	$85,000	$112,000
Containment by Vertical Recirculation Wells	$1,568,000	$102,000
"Hot Spot" Treatment by AS/SVE	$1,768,000	$156,000
TOTALS	$3,421,000	$370,000
Total Present Worth	$8,012,000	
Areas 2, 3, and 6 Plumes		
Remedy Element	**Capital Cost**	**Annual O&M Cost**
Institutional Controls with Monitored Natural Attenuation	$85,000*	$112,000*
TOTALS	$85,000*	$112,000*
Total Present Worth	$1,475,000*	

Note:
* costs included in those for Area 1 plume but broken out here for comparative purposes
total present worth based on uniform series, 7 percent discount rate, 30-year project life

Acronyms/Abbreviations:
AS/SVE – air sparging with soil vapor extraction
O&M – operations and maintenance

SECTION 3

Section 3
RESPONSIVENESS SUMMARY

3.1 WRITTEN COMMENTS

One written comment was received from Mr. R. Hartley, dated 31 July 1998. This comment is included as Appendix A and is reproduced below.

Comment: Mr. Hartley

Dear Sirs: Your paper of June 98 on Marine Corps Air Station PP for Operable Unit 1 [is] well detailed and prepared.

My thoughts are that this cleanup of soil and ground H_2O be of a *LTM* of said plumes. This would involve FY funding for upcoming years as the Yuma Marine Corps is a[n] asset to the training and location is a key.

We also must look into passing of data & [sic] world wide and exchange same where as other nations are going through what we have here.

Would also see alternate forms of energy used in cleanup and for monitoring and info exchanges as we must look beyond the present but for the future.

And last [but] not least, if any ground H_2O is to be discharged onto the surface native grasses to be utilized and an area set aside for possible future use, would suggest an 9 [sic] area Pilot Study Area.

Response:

The MCAS Yuma team concurs that the PP for Operable Unit-1 is well detailed and prepared. The team has expended a great amount of resources during its development. The comment is appreciated.

A long-term monitoring plan will be developed and implemented as part of the environmental response. Institutional controls with LTM are chosen for one of the four plumes and for a portion of a second plume. The information that is gathered during the Operable Unit-1 remedial action (RA) will be available to the public in both the repositories and administration record. In addition, information about successful projects is commonly provided in Department of Defense publications. The remedial design will evaluate potential options for the implementation of the selected RA. Additional forms of energy to operate the remedial systems will be evaluated.

At this time, discharge of treated groundwater to the surface is not anticipated. If surface discharge is deemed appropriate in the future, this area will be considered.

3.2 COMMENTS FROM PUBLIC MEETINGS

Several verbal questions were received from the public at the public meetings held on 29 July 1998 and 11 May 1999 concerning the proposed actions for OU-1. These questions are included in the public meeting transcripts provided in Appendix B.

3.3 COMMENTS FROM ADEQ AND U.S. EPA ON DRAFT ROD

The ADEQ and U.S. EPA provided comments regarding the draft ROD prepared by Jacobs Engineering Group, Inc. (December 1999 Rev. 0). Responses to these comments are included in Appendix C and incorporated in this document. Responses to comments that were included in the draft ROD are also included in Appendix C. This includes responses to ADEQ comments, dated 15 June 1999, and responses to U.S. EPA comments, dated 11 June 1999.

Section 4

Section 4
REFERENCES

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APPENDIX A

PUBLIC COMMENTS ON PROPOSED PLAN FOR OPERABLE UNIT-1

Use this space to write your comments

Your input on the proposed remedies for Operable Unit 1 is important to MCAS Yuma. Comments provided by the public are valuable in helping select a final remedy for remediating contaminated groundwater.

You may use the space below to write your comments, then fold and mail. Comments must be postmarked by August 3, 1998.

FRIDAY JULY 31ST, 1998

DEAR SIRS,

YOUR PAPER OF JUNE 98 ON MARINE CORPS AIR STATION PROPOSED PLAN FOR OPERABLE UNIT 1 WELL DETAILED & PREPARED.

MY THOUGHTS ARE THAT THIS CLEAN-UP OF SOIL & GROUND H_2O BE OF A LONG TERM MONITORING OF SAID PLUMES. THIS WOULD INVOLVE FY FUNDING FOR UPCOMING YEARS AS THE YUMA MARINE CORPS IS A ASSET TO THE TRAINING & LOCATION IS A KEY.

WE ALSO MUST LOOK INTO PASSING OF DATA & WORLD WIDE & EXCHANGE SAME WHERE AS OTHER NATIONS ARE GOING THRU WHAT WE HAVE HERE

WOULD ALSO SEE ALTERNATE FORMS OF ENERGY USED IN CLEAN-UP & FOR MONITORING & INFO EXCHANGE AS WE MUST LOOK BEYOND THE PRESENT BUT FOR THE FUTURE

AND LAST NOT LEAST IF ANY GROUND H_2O IS TO BE DISCHARGED ONTO THE SURFACE NATIVE GRASSES TO BE UTILIZED & AN AREA SET ASIDE FOR POSSIBLE FUTURE USE, WOULD SUPPORT AN 9 AREA PILOT STUDY [illegible]

Additional comments on a separate piece of paper may be included.

Name R R HARTLEY [illegible]
Address 11844 [illegible]
City YUMA
State ARIZONA Zip 85362

Public Comment Period

The 30-day public comment period runs from July 3, 1998 through August 3, 1998. You may send written comments to:

Commanding Officer
(Attn: JPAO)
MCAS Yuma
Box 99113
Yuma, Az 85369-9113

After the public comment period is concluded, MCAS Yuma will review and consider the submitted comments when making its final decision on the remedies. The final actions chosen may therefore, be different than the preferred alternative in the Proposed Plan.

MCAS Yuma will respond to comments in a document called a Responsiveness Summary. The Responsiveness Summary will be available to the public as part of the Record of Decision (ROD) for the site. You are encouraged to review the Proposed Plan, Feasibility Study Report, and other documents related to the site, which are available in the Information Repositories.

Fold on dashed lines, staple, stamp and mail

Name R.R. [illegible]

Address 11844 [illegible]

City Yuma

State AZ Zip 85367

Commanding Officer
(Attn: JPAO)
MCAS Yuma
Box 99113
Yuma, Az 85369-9113

MARINE CORPS AIR STATION
YUMA ARIZONA

APPENDIX B

PUBLIC MEETING TRANSCRIPTS

PUBLIC HEARING

PROPOSED PLAN

REGARDING OPERABLE UNIT 1

MARINE CORPS AIR STATION

YUMA, ARIZONA,

MAY 11, 1999

YUMA COUNTY MAIN LIBRARY

350 SOUTH THIRD AVENUE

6:30 P.M.

PREPARED FOR:

BORT COURT REPORTING SERVICE
REGISTERED PROFESSIONAL REPORTERS
220 South Second Avenue
Yuma, Arizona 85364
Phone: (520) 782-7591

BY:

APPEARANCES

MR. GARY KIGER, CLEM PROJECT MANAGER, JACOBS ENGINEERING, 1111 S. ARROYO PARKWAY, PASADENA, CALIFORNIA 91105

MR. LARRY LEAKE, IR PROGRAM MANAGER, MCAS YUMA, BUILDING 228, YUMA, ARIZONA.

MICHAEL GONZALES, REMEDIAL PROJECT MANAGER, SOUTHWEST DIVISION NAVAL FACILITIES ENGINEERING COMMAND, 1220 PACIFIC HIGHWAY, SAN DIEGO, CALIFORNIA 92132-5818.

MARTIN HAUSLADEN, REMEDIAL PROJECT MANAGER, U.S. ENVIRONMENTAL PROTECTION AGENCY, REGION IX, 75 HAWTHORNE STREET, SAN FRANCISCO, CALIFORNIA 95105-3901.

NANCY LOU MINKLER, REMEDIAL PROJECT MANAGER, ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY, 3033 NORTH CENTRAL AVENUE, PHOENIX, ARIZONA 85012.

MR. KIGER: OKAY. IF EVERYBODY COULD BE SEATED, PLEASE. THIS IS THE PUBLIC MEETING FOR THE PROPOSED PLAN FOR THE GROUNDWATER OPERABLE UNIT 1 AT MARINE CORPS AIR STATION, YUMA, AND JUST A COUPLE OF ANNOUNCEMENTS BEFORE WE GET GOING.

THERE'S MORE COPIES OF THE PROPOSED PLAN OVER ON THE TABLE IF YOU'D LIKE ONE. WE'D LIKE TO HAVE EVERYBODY SIGN IN ON THE SIGN-IN SHEET BEFORE THEY LEAVE SO WE CAN HAVE A RECORD OF WHO ATTENDED THIS MEETING.

IF ANYONE WOULD LIKE TO PRESENT OR ASK A QUESTION AT THE END OF THE MEETING, PLEASE STATE THEIR NAME AND SPEAK CLEARLY. WE HAVE A COURT REPORTER HERE WHO IS REPORTING THE MEETING, THE MINUTES OF THE MEETING. WE WOULD APPRECIATE THAT.

IF YOU DO NOT WISH TO SUBMIT OR PROVIDE A QUESTION TODAY AT THE END OF THIS MEETING BUT WOULD LIKE TO SUBMIT ONE IN WRITING, THERE IS A FORM INSIDE THE PROPOSED PLAN WHERE YOU CAN SUBMIT YOUR QUESTION IN WRITING AND IT WILL BE MAILED TO THE STATION AND HOPEFULLY MAKE ITS WAY TO LARRY LEAKE.

SO AT THIS TIME MIKE GONZALES WITH THE NAVY WILL GO AHEAD AND MAKE THE PRESENTATION.

MR. GONZALES: ALL YOU

LATECOMERS, GO AHEAD AND SIGN THE FORM TO MAKE SURE YOU GET REPORTED IN.

GOOD EVENING EVERYONE. MY NAME IS MIKE GONZALES, I'M THE REMEDIAL PROJECT MANAGER, OR ONE OF THEM, FOR THE MARINE CORPS AIR STATION YUMA TEAM.

WE ARE HERE THIS EVENING TO DISCUSS THE ENVIRONMENTAL REMEDIES FOR GROUNDWATER CONTAMINATION UNDERNEATH THE MARINE BASE HERE IN YUMA.

WHAT WE DEVELOPED IS A PROPOSED PLAN IN ACCORDANCE WITH THE CERCLA GUIDELINES THAT GOES THROUGH THE DIFFERENT ALTERNATIVES THAT WE CAME UP WITH, WE SCREENED, EVALUATED AND PUT TOGETHER OUR PREFERRED ALTERNATIVES.

AND ONE OF THE STEPS IS TO MAKE SURE THAT WE GET COMMUNITY INPUT, PUBLIC INPUT, TO SEE IF THOSE PREFERRED ALTERNATIVES ARE ACCEPTABLE.

THE PUBLIC MEETING IS SCHEDULED FOR AN HOUR. WE HAVE REPRESENTATIVES HERE FROM THE MARINE BASE, THE E.P.A. AND A.D.E.Q., AND WE WILL STICK AROUND AND ANSWER QUESTIONS, AND IF YOU WANT TO TALK TO US AFTERWARDS, FEEL MORE THAN WELCOME TO DO SO.

I'M GOING TO BASICALLY GO THROUGH A BRIEF PRESENTATION OF THE PROPOSED PLAN THAT

WE PUT TOGETHER SO IT KIND OF MAKES IT EASY TO FOLLOW ALONG. LIKE GARY KIGER SAID, THAT WE'LL BE ACCEPTING COMMENTS ON THE PROPOSED PLAN FROM -- I GUESS THE PUBLIC COMMENT PERIOD STARTED MAY 1ST AND ENDS MAY 31ST, SO SIMILAR TO TAXES, IF YOU SEND A WRITTEN RESPONSE IN AND HAVE IT POSTMARKED BY THE 31ST, THEN WE WILL GET IT AND WE WILL EVALUATE THE COMMENT, RESPOND TO IT AND ATTACH IT AS AN OFFICIAL RESPONSE TO THE RECORD OF DECISION FOR OPERABLE UNIT 1.

AND I GUESS IT'S IMPORTANT TO POINT OUT THAT WE WILL NOT MAKE THE FINAL DETERMINATION ON THE ENVIRONMENTAL REMEDY UNTIL WE GET PUBLIC INPUT.

THE FIRST SECTION OF THE PROPOSED PLANNING GOES THROUGH SIGNIFICANT CHANGES. WE PUT TOGETHER A PROPOSED PLAN FOR THE GROUNDWATER CONTAMINATION IN YUMA IN JUNE OF '98. WE ISSUED IT AND WE HAD A MEETING THE FOLLOWING MONTH IN JULY, AND THE SIGNIFICANT CHANGES ARE: WE HAVE REMOVED MONITORED NATURAL ATTENUATION AS A REMEDIAL ALTERNATIVE UNDER CONSIDERATION.

IN OUR EFFORTS TO DELINEATE AND GATHER MORE INFORMATION ABOUT THE GROUNDWATER CONTAMINATION, WE TOOK SAMPLES ON THE FIELD CHEMICAL CONSTITUENTS IN THE GROUNDWATER, LOOKED AT

THEM UPSTREAM, IN THE MIDDLE OF THE PLUMES, AND DOWNSTREAM, AND CAME TO THE CONCLUSION THAT NATURAL ATTENUATION WASN'T HAPPENING.

SO, WE TOOK THAT INFORMATION, HAD A MEETING WITH THE E.P.A., R.P.M. AND HIS STAFF, AND BASICALLY COULDN'T SUPPORT THE MONITORED NATURAL ATTENUATION, AND WE TOOK IT OUT FROM ALL OF OUR PREFERRED ALTERNATIVES.

THE SECOND CHANGE WAS -- WE HAVE FIGURE 2. IF YOU LOOK AT THE PLUMES THAT WE'RE COVERING, THE AREA 2 PLUME, WHICH IS THE SMALLER PLUME ON THE NORTHEAST SIDE OF THE BASE, THAT WAS REMOVED FROM OPERABLE UNIT 1.

SO, THIS PROPOSED PLAN IS FOR PLUME AREAS 1, 3 AND 6. SO THOSE ARE THE TWO SIGNIFICANT CHANGES THAT WE TOOK OUT: MONITORED NATURAL ATTENUATION AND REMOVED ONE OF THE PLUME AREAS.

ON THE YELLOW PORTION OF THE FRONT SHEET, IT ACTUALLY DETAILS WHAT THE PREFERRED ALTERNATIVES ARE, AND FOR THE ACTIVE REMEDIATION FOR PLUME AREA 1, WHICH IS THE LARGE PLUME THAT STARTS IN THE MIDDLE OF THE APRON AREA AND PROCEEDS TO THE NORTHWEST CORNER, WE HAVE THE SAME AIR SPARGING/SOIL VAPOR EXTRACTION FOR THE HOTSPOTS. CONCENTRATIONS ARE

IN THE HUNDREDS OF PARTS PER BILLION DISSOLVE PHASE.

THE MIDDLE OF THE PLUME BETWEEN THE HOTSPOT AND THE LEADING EDGE, WE HAVE LONG-TERM MONITORING, SO WE'RE GOING TO MONITOR THAT AND LET THE PHYSICAL PROCESSES REDUCE THE CONTAMINATION IN THE GROUNDWATER DOWN TO ACCEPTABLE DRINKING WATER STANDARDS, AND AT THE LEADING EDGE WE ARE GOING TO PROPOSE VERTICAL RECIRCULATION, WHERE WE ARE ACTUALLY -- AT THE CONTAINMENT TREATMENT SYSTEM, WHERE WE'RE GOING TO PULL THE CONTAMINATED GROUNDWATER UP TO THE SURFACE, TREAT IT AND THEN REINJECT IT INTO THE VADOSE ZONE, OR SOMEWHAT AROUND THE VADOSE ZONE. THOSE ARE THE REMEDIES FOR THE AREA 1 PLUME.

FOR THE AREA 3 AND 6 PLUMES, THOSE ARE SMALLER IN SIZE, RELATIVE STABLE, LOW CONCENTRATION PLUMES, AND WE'RE GOING TO PROPOSE LONG-TERM MONITORING WITH INSTITUTIONAL CONTROLS.

OUR CONTRACTOR PERFORMED SOME DETAILED MODELING FOR US AND CAME BACK AND THE MODELING SHOWS THAT ANY CONTAMINATION THAT GOT TO THE FACILITY BOUNDARY WOULD BE WELL BELOW DRINKING WATER STANDARDS, AND THAT IN FACT THE CONTAMINATION LEVELS WOULD HIT DRINKING WATER STANDARDS WITHIN THREE YEARS FOR AREA 6 AND 15 YEARS FOR AREA 3.

THE PROPOSED PLAN GOES

INTO A LITTLE HISTORY OF THE MARINE BASE, HOW YUMA COUNTY -- PURCHASED THE LAND? LEASED THE LAND, CREATED AN AIR FIELD, AND THROUGH THE YEARS IT STAYED AN AIR FIELD BUT IT'S GONE INTO THE DEPARTMENT OF THE ARMY, SWITCHED OVER TO THE DEPARTMENT OF THE AIR FORCE AND THEN BACK TO THE DEPARTMENT OF THE NAVY IN 1959.

WE STARTED OUR ENVIRONMENTAL INVESTIGATIONS IN 1985, TAKING SAMPLES OF THE GROUNDWATER AND CONTAMINATED SOIL SITES. WE WENT THROUGH THE CERCLA PROCESS, WE DID A PRELIMINARY ASSESSMENT SITE INSPECTION, REMEDIAL INVESTIGATION, AND FEASIBILITY STUDY IN ORDER TO COME UP WITH THIS PROPOSED PLAN.

THE SUMMARY OF RISKS IN THERE GOES THROUGH AND BASICALLY GIVES THE CRITERIA OF WHY WE'RE TAKING THESE ACTIONS; THAT THE THEORETICAL RISKS ARE UNACCEPTABLE RIGHT NOW, BUT THEY ARE THEORETICAL, AND WE HAVE A NOTE IN THERE TO SAY ABOUT HOW CONSERVATIVE WE WERE AND DOESN'T REALLY REFLECT WHAT THE ACTUAL SITUATIONS ARE.

THE ALTERNATIVES THAT WE WENT THROUGH, STARTING ON PAGE 5, IT BEGINS WITH THE NO ACTION ALTERNATIVE, AND THAT BASICALLY GIVES YOU A BASELINE TO START WITH AND COMPARES THE OTHER ALTERNATIVES WITH, AND THEN THE SECOND ONE DOWN WE HAVE

INSTITUTIONAL CONTROLS AND LONG-TERM MONITORING. THOSE ARE THE TWO INACTIVE REMEDIES.

THE NEXT THREE REMEDIES ARE ACTIVE REMEDIES FOR CONTAINMENT AT THE LEADING EDGE, AND THEY HAVE PUMP AND TREAT WITH DIFFERENT TYPES OF DISCHARGE, PUMP AND TREAT WITH DISCHARGE TO THE SEWER, PUMP AND TREAT WITH DISCHARGE BY REINJECTION, AND THE PREFERRED ALTERNATIVE FOR THE CONTAINMENT IS VERTICAL RECIRCULATION, AND IF YOU LOOK AT FIGURE 3 ON PAGE 5, THAT GRAPHICALLY DEPICTS WHAT THE RECIRCULATION CONCEPT IS.

AND OUR REMEDIAL ACTION CONTRACTOR HAS PUT IN A PIPE SYSTEM, AND HE'S RUN IT -- OR THEY'VE RUN IT FOR A YEAR, AND WE ARE CONFIDENT THAT IT WILL WORK, AND WE ARE WRITING UP A SUMMARY DOCUMENT OF THE PILOT STUDY AND THAT WILL BE INCLUDED IN OUR ADMIN RECORD HERE AT THE LIBRARY.

BASICALLY, I THINK WE HAVE KNOCKED DOWN ABOUT 15 PERCENT OF THE CONTAMINATION IN A YEAR, WHICH IS ONE -- TWO WELLS NESTED TOGETHER, SO IT WORKS FAIRLY WELL.

THE NEXT THREE ALTERNATIVES ARE FOR THE HOTSPOT REDUCTION. ONCE AGAIN, WE GO THROUGH THE PUMP AND TREAT ALTERNATIVES. PUMP AND TREAT WITH THE DISCHARGE TO THE SEWER, PUMP

AND TREAT WITH THE DISCHARGE BY REINJECTION, AND THEN THE AIR SPARGE AND SOIL VAPOR EXTRACTION.

AS WE BUILT THE ALTERNATIVES WE NESTED THEM TOGETHER SO THE CONTAINMENT ALTERNATIVES INCLUDED THE INSTITUTIONAL CONTROLS AND LONG-TERM MONITORING OF ALTERNATIVE 2, AND THEN AS WE WENT THROUGH THE HOTSPOT REDUCTION ALTERNATIVES FOR 7, 7A, AND 9, WE INCLUDED ALTERNATIVE 5 FOR THE RECIRCULATION, SO WHEN WE GO THROUGH AND WE SAY WE'RE GOING TO DO AIR SPARGE, IT'S AIR SPARGING PLUS THE VERTICAL RECIRCULATION AT THE BOUNDARY, AND LONG-TERM MONITORING, AND THAT'S FOR PLUME AREA 1.

FOR PLUME AREAS 3 AND 6, THE SMALLER ONES, WE LOOKED AT NO ACTION AND LONG-TERM MONITORING AND WE HAVE SELECTED LONG-TERM MONITORING.

THE WAY WE EVALUATE -- THERE'S NINE CRITERIA IN THE NATIONAL CONTINGENCY PLAN TO EVALUATE YOUR ALTERNATIVES AGAINST: OVERHAUL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT. THE NO ACTION ALTERNATIVES DON'T MEET THAT CRITERIA, SO THAT WAS THROWN OUT.

THE LONG-TERM MONITORING FOR THE ENTIRE PLUME AREA 1, 3 AND 6, OR FOR THE PLUME AREA 1, MET IT BUT NOT IN AN ACCEPTABLE TIME FRAME TO ANY OF THE REGULATORS, BUT THE OTHER ACTIVE ONES DO

MEET IT AND THEY ARE PROTECTIVE OF HUMAN HEALTH AND THE ENVIRONMENT.

COMPLIANCE WITH ARAR'S. ALL EXCEPT THE FIRST NO ACTION ONES WILL COMPLY WITH ARAR'S.

LONG-TERM EFFECTIVENESS AND PERFORMANCE AND REDUCTION, SHORT-TERM EFFECTIVENESS, THEY'RE ALL ACCEPTABLE FOR ALL OUR DIFFERENT ALTERNATIVES. ALL OF THEM WILL MEET IMPLEMENTABILITY. ALL OF THE ACTIONS THAT WE HAVE PROPOSED ARE READILY IMPLEMENTABLE.

WHEN WE LOOK AT COSTS, THE COSTS FOR THE CONTAINMENT TREATMENT AT THE BOUNDARY IS CURRENTLY ESTIMATED ABOUT FIVE MILLION DOLLARS. THERE'S A LITTLE BIT OF SKEW BACK AND FORTH BETWEEN -- LIKE FOUR POINT NINE MILLION AND FIVE POINT ONE AND FOUR POINT NINE THREE.

THERE'S A TABLE -- TABLE 1 HAS THE COSTS OF EACH ONE OF THE ALTERNATIVES DOWN AT THE BOTTOM, BUT THEN IF YOU LOOK AT IT, IT ALSO HAS THE RANGE OF IMPLEMENTABILITY FOR 30 TO 40 YEARS, 30 TO 40 YEARS, SO THE COST FOR THE CONTAINMENT, INCLUDING THE MASS REDUCTION AT THE HOTSPOT, IS APPROXIMATELY TEN MILLION DOLLARS, AND THAT'S WHAT WE HAVE CHOSEN AND IT DROPS OUR REMEDIAL TIME FRAME DOWN TO 10 TO 20 YEARS.

SO IT LOOKS LIKE AS A TEAM WE HAVE DECIDED TO SPEND A LITTLE BIT MORE OF THE MONEY NOW AND REDUCE THE OVERALL TIME FRAME OF REMEDIATION, AND THOSE ARE MORE COMPARATIVE COSTS THAN ANYTHING ELSE. THEY HAVEN'T BEEN NEGOTIATED OR AWARDED TO A CONTRACTOR, BUT THAT'S WHAT WE'RE USING JUST TO KEEP THE ALTERNATIVES FAIRLY EQUALLY COMPARED.

THE STATE ACCEPTANCE CRITERIA, WE HAVE BEEN WORKING WITH THE STATE THROUGHOUT THIS PROCESS AND FEEDING THEM INFORMATION AND THEN SENDING CORRESPONDENCE BACK ON WHAT ALTERNATIVES AND ASKING FOR THEIR INPUT, AND IT SEEMS LIKE THEY BUY INTO WHAT WE'RE DOING, AND WE'RE GETTING PUBLIC ACCEPTANCE NOW. WE'RE EVALUATING PUBLIC ACCEPTANCE NOW.

OUR COMMUNITY RELATIONS PROGRAM, WE HAVE A RAB ESTABLISHED, WE PUT OUT NOTICES IN THE PAPER, SO WE'RE WILLING TO PRESENT TO ANY GROUPS THAT HAVE INTEREST IN WHAT WE'RE DOING, SO WE WOULD LIKE TO COME OUT, AND THROUGH THOSE EFFORTS WE'D LIKE TO GET SOME KIND OF FEEDBACK INTO WHAT WE THINK ABOUT THE PREFERRED ALTERNATIVES.

JUST AS A RECAP, WE'RE DOING AIR SPARGING WITH SOIL VAPOR EXTRACTIONS. THERE'S ANOTHER CONCEPTUAL DRAWING THERE. IT'S PAGE 6,

FIGURE 4, AND WE'LL BE DOING THAT OVER A 600 FOOT BY 2,000 FOOT AREA, PLUS OR MINUS, UNDER THE APRON ON BASE, SO WE'LL BE BUBBLING -- WE PROPOSE TO BE BUBBLING AIR INTO THE GROUNDWATER, TRANSPORTING THE CONTAMINANTS UP INTO THE VADOSE ZONE AND CAPTURING THEM WITH A VACUUM. LIKE AN EXTRACTION WELL. THAT'S WHAT I HAVE.

I WOULD LIKE TO OFFER THE E.P.A. AND R.P.M. A CHANCE TO MAKE A COMMENT IF YOU WISH IT.

MR. HAUSLADEN: WE ARE STILL UNDERGOING REVIEW OF THE RECORD OF THE DECISION, BUT WE FEEL THAT THE NAVY, THE MARINES, HAVE PROBABLY CHOSEN THE BEST ALTERNATIVES TO SUIT THE NEEDS OF THIS PROJECT.

I NOTICED A FEW EYES ROLLING AT THE COST VERSUS MAYBE THE RELATIVE COST TO SOME OF THE OTHER REMEDIES THAT ARE IN THIS. THE THING TO REMEMBER IS THAT IF WE CAN GET MONITORING TERMINATED WITHIN 15 TO 20 YEARS, IN THE LONG TERM THAT'S A WHOLE LOT CHEAPER THAN MONITORING FOR THE NEXT HUNDRED YEARS, TAKING SAMPLES FOUR TIMES A YEAR, AND YOU HAVE TO LOOK AT NET WORTH OF WHAT A DOLLAR IS WORTH TODAY VERSUS WHAT IT'S GOING TO BE WORTH IN THE YEAR 2075, AND WHAT IT'S GOING TO COST TO GET PEOPLE OUT HERE TO TAKE THESE SAMPLES.

THAT'S WHY WE FEEL THAT THE MARINES ARE TAKING THE RIGHT STEPS IN GOING FOR A MORE AGGRESSIVE, MORE ACTIVE REMEDIATION PROGRAM.

MR. GONZALES: AND LOU MINKLER?

MS. MINKLER: I'M FROM A.D.E.Q. THE STATE HAS BEEN WORKING VERY CLOSELY WITH THE NAVY SOUTHWEST DIVISION AND THE MARINE CORPS AIR STATION, AND WE'RE PLEASED AT THE RESPONSE AND THE COOPERATION THAT THEY HAVE GIVEN US AND HOW WE'VE WORKED TOGETHER ON REMEDIATING THESE CONTAMINATION PROBLEMS.

THAT'S ABOUT ALL I HAVE TO SAY.

MR. GONZALES: IF WE DO GET ANY COMMENTS, EITHER ORALLY OR WRITTEN, WE WILL RESPOND TO THEM OFFICIALLY IN THE ROD, AND WE WILL NOT MAKE OUR SELECTIONS UNTIL THE END OF THIS PUBLIC COMMENT PERIOD.

JUST SO EVERYBODY KNOWS, THERE IS AN INFORMATION REPOSITORY HERE AT THE LIBRARY WHERE WE KEEP ALL OUR DOCUMENTS, SO AS WE DO OUR INVESTIGATIONS AND STUDIES AND PUT TOGETHER SUMMARY DOCUMENTS AND REACH CONCLUSIONS AND RECOMMENDATIONS, WE DO FILE THEM HERE AT THE LIBRARY. THEY'RE AT THE BASE

AND THEY'RE AT MY OFFICE IN SAN DIEGO.

AND THE TECHNICAL INFORMATION CONTACTS ARE ON THE BACK SHEET, SO IT'S GOT MY, NAME AND NUMBER, MARTIN'S, NANCY LOU MINKLER AND LARRY LEAKE, SO WE WILL BE AVAILABLE TO ANSWER ANY QUESTIONS OR TALK TO YOU ABOUT ANY OF THE ACTIONS THAT WE'RE PROPOSING.

MR. COLVIN: ARE ANY OF THIS INFORMATION AND DATA ON THE WEB, OR DO YOU HAVE A WEB SITE ANYWHERE?

MR. GONZALES: WE HAVE AN INTERNAL NAVY WEB SITE, AND IT HAS SERVICES THAT MY OFFICE PROVIDES, BUT NOT SPECIFICALLY TO WHAT WE'RE DOING HERE, UNFORTUNATELY.

I THINK THAT ONE OF THE TASKS THAT YOU ALWAYS HAVE PROJECT MANAGERS TALK ABOUT -- I GUESS IT WAS ABOUT SIX OR SEVEN MONTHS AFTER I STARTED THE PROGRAM, IT WAS LAST YEAR SOMETIME, THEY WERE GOING TO CREATE A WEB SITE SO WE COULD PUT DOCUMENTS AND RESPONSES AND THINGS BACK AND FORTH FOR COMMENTS AND GIVE ACCESS TO TEAM MEMBERS AND RAB MEMBERS SO THEY COULD LOG ON, HAVE A PASSWORD AND REVIEW THE DOCUMENTS. THAT WAS AN IDEA THAT WAS KICKED AROUND BUT NEVER REALLY IMPLEMENTED.

THE E.P.A. HAS A NUMBER

OF WEB SITES. THEY HAVE TECHNICAL GUIDANCE AND THEIR LATEST UPCOMING EVENTS, AND THEY HAVE TECHNICAL PAPERS POSTED ON THEIR WEB SITES.

MS. MINKLER: A.D.E.Q. ALSO HAS A WEB SITE AND IT IS UPDATED QUARTERLY AS TO THE MOST RECENT ACTIVITIES FOR ALL THE SITES IN THE STATE.

MR. GONZALES: I GUESS NOT SPECIFICALLY FOR US, BUT THERE IS INFORMATION OUT THERE.

MR. COLVIN: IS THIS THE ADDRESS THAT'S ON HERE? IT'S YOUR E-MAIL ADDRESS. IS THAT HOW YOU ACCESS THE SITE?

MR. GONZALES: THIS E-MAIL ADDRESS? NO, THAT WOULD ACTUALLY SEND E-MAIL TO ME.

MS. MINKLER: I MIGHT HAVE A CARD THAT HAS THE WEB SITE ADDRESS ON IT. LET ME LOOK. IF NOT, IF I DON'T HAVE IT WITH ME, YOU CAN GIVE ME A CALL AT MY OFFICE AND I'LL BE GLAD TO GIVE THE ADDRESS TO YOU.

IS THIS THE AGENCY'S NUMBER? THE 800 NUMBER, IF YOU'RE CALLING FROM OUT OF TOWN -- ARE YOU READY WITH A PEN AND PAPER? IT'S 800-234-5677, AND THEN MY EXTENSION AS GIVEN HERE, 4187.

SO IT WILL BE TOLL-FREE WITHIN THE STATE OF ARIZONA. I'LL LOOK FOR THAT CARD THAT HAS THE WEB SITE ON IT. I MIGHT HAVE IT WITH ME. MAYBE.

MR. LEAKE: IF SHE DOESN'T, I HAVE IT ON MY COMPUTER AT THE OFFICE AND I'LL GIVE YOU A CALL TOMORROW AND GIVE IT TO YOU.

MR. COLVIN: THANK YOU. APPRECIATE IT.

MR. GONZALES: ANYTHING ELSE?

MS. GEORGE: IS ALL OF THE COST GOING TO BE COVERED UNDER CERCLA, ALL TEN MILLION, OR IS THERE ANYTHING THAT'S SUPPOSED TO BE MATCHED BY THE STATE OR BY THE LOCAL COMMUNITY?

MR. LEAKE: IT'S ALL FUNDED BY THE ENVIRONMENTAL RESTORATION NAVY ACCOUNT.

MS. GEORGE: IT IS ALL --

MR. HAUSLADEN: THERE IS NO CERCLA MONEY PER SE.

MS. GEORGE: BUT IT'S FEDERAL --

MR. HAUSLADEN: IT'S FEDERAL MONEY --

MS. GEORGE: FEDERAL MONEY --

MR. HAUSLADEN: -- UNDER THE AUSPICES OF SOUTHWEST --

MS. GEORGE: OKAY.

MR. LEAKE: THERE'S NO MATCHING FUNDS THAT THE CITY OR THE COUNTY HAVE TO USE, IT'S ALL PROVIDED FROM THE DEPARTMENT OF DEFENSE.

MR. GONZALES: I GUESS ONE IMPORTANT POINT IS, WE ARE ACTUALLY EVALUATING THE SYSTEMS RIGHT NOW THAT WE HAVE SELECTED AS OUR PREFERRED ALTERNATIVES, AND WE HAVE A CONTRACT WITH OUR RAC ONE CONTRACTOR, THE I.C. GROUP, AND WE HAVE AWARDED THEM TWO POINT ONE MILLION DOLLARS BECAUSE WE WANT TO MAKE SURE THIS SYSTEM WILL WORK.

I DON'T THINK WE'LL EVER GET 10 MILLION DOLLARS IN ONE WHACK, BUT WHAT THEY WILL DO IS, THEY WILL FUND US TO KEEP US GOING WORKING TOWARDS OUR GOAL.

MR. REYNOSO: ALEX REYNOSO. DID I HEAR YOU SAY THAT YOU HAVE A CONTRACTOR SELECTED FOR THE REMEDIAL PART OF THIS, OR ARE YOU STILL LOOKING FOR REMEDIAL GROUPS TO ADDRESS THE PROBLEM?

MR. GONZALES: IN OUR

COMMAND IT'S NAVAL FACILITIES ENGINEERING COMMAND, SOUTHWEST DIVISION, AND WE'RE LOCATED IN SAN DIEGO, AND WE HAVE GONE THROUGH PROCESSES TO ESTABLISH LONG-TERM CONTRACTORS THAT ARE AVAILABLE TO OUR COMMAND, SO WE WENT THROUGH AND WE ADVERTISED -- WE PUT IN TWO HUNDRED AND FIFTY MILLION DOLLARS WORTH OF CONTRACT CAPACITY. A GREAT NUMBER OF THE CONSTRUCTION -- DEPARTMENT OF CONSTRUCTION CONTRACTORS BID ON IT, AND WHAT WE DID IS, WE WENT THROUGH A SOURCE SELECTION PROCESS AND PICKED THE CONTRACTORS THAT WE THOUGHT BEST FOR THE JOB, WHICH WAS THE O.H.M. REMEDIATION SERVICES, INCORPORATED, SO THEY WERE OUR -- THEY HAVE BEEN OUR EXISTING REMEDIAL ACTION CONTRACTOR OVER THE PAST FIVE OR SIX YEARS, AND WE JUST WENT THROUGH ANOTHER SELECTION PROCESS LAST SUMMER AND SELECTED FOSTER WHEELER.

I'M NOT EXACTLY SURE IF THAT'S THE CORRECT COMPANY NAME, BUT FOSTER WHEELER IS ON BOARD CONTRACTUALLY WITH US RIGHT NOW.

SO FAR AT THE MARINE BASE HERE IN YUMA WE HAVE USED JACOBS ENGINEERING GROUP AS OUR STEADY CONTRACTOR SO FAR, AND WE HAVE USED THE I.C. GROUP, FORMERLY O.H.M., AS OUR REMEDIAL ACTION CONTRACTORS, SO THOSE HAVE BEEN THE TWO MAIN CONTRACTORS WE HAVE HAD ON THE SITE.

MR. REYNOSO: WAS ANY

FORM OF BIOREMEDIATION CONSIDERED FOR ANY OF THESE SITES? WAS THAT NOT VIABLE OR –-

MR. GONZALES: WHEN WE WENT THROUGH OUR -- WE ACTUALLY -- PART OF OUR MONITORED NATURAL ATTENUATION, WE DID A -- HELP ME OUT HERE. WHAT DOES "STRA" STAND FOR?

MR. LEAKE: SOURCE TREATMENT/REDUCTION, ALTERNATIVES PLAN.

MR. GONZALES: WE PUT TOGETHER THE SOURCE TREATMENT REDUCTION ANALYSIS PLAN FOR THE CONTAMINANTS ON BASE, AND THE TEAM SAT DOWN, IT WAS THE REGULATORY TEAM AND THE NAVY MARINE CORPS TEAM, SAT DOWN AND WE BROUGHT IN A NUMBER OF DIFFERENT VENDORS, AND THE VENDORS SHOWED US WHAT THEY COULD PROVIDE FOR US, AND WHAT WE DID WITH THE AVAILABLE FUNDING WE HAD, WE SELECTED A COUPLE OF THEM, AND ONE OF THE THINGS THAT WE SELECTED WAS A NATURAL ATTENUATION-TYPE STUDY THAT PARSON'S ENGINEERING -- I'M NOT EXACTLY SURE -- WE REFERRED TO THEM AS PARSON'S. THEY CAME OUT AND THEY DID A STUDY AND SAID THAT NATURAL ATTENUATION MAY WORK ON OUR SITE, BUT WE NEEDED FURTHER INVESTIGATION, AND WE WENT THROUGH AND WE LOOKED AT BIOLOGICAL ENHANCEMENT OF OUR SOLVENT PLUMES, ESPECIALLY IN THE HOTSPOT AREA, AND WHAT WE DID IS, IN ORDER TO GET THE BIOLOGICAL MECHANISMS IN PLACE AND

CONTACT WITH THE GROUNDWATER, WHAT WE DID IS, WE PROPOSED TO PUT EXTRACTION WELLS DOWNGRADE IN, PULL THEM UP, DO THE MIXING AND INJECT THEM UPGRADIENT (UPGRADING IT???), AND IT ACTUALLY CAME OUT MORE EXPENSIVE THAN THE AIR SPARGING/SOIL VAPOR EXTRACTION.

AND OUTSIDE OF THE CERCLA WORLD WE ARE USING A LOT OF THE AIR SPARGING TECHNIQUES FOR BIOLOGICAL REDUCTION OF T.P.H. SITES, SO I THINK RIGHT NOW ON THE T.P.H. SITES WE'RE RUNNING ABOUT HALF MECHANICAL REMOVAL, OR DESTRUCTION OF THE T.P.H. AND THEN HALF WOULD BE BIOLOGICAL.

MR. REYNOSO: ONE LAST QUESTION. IS IT TOO LATE TO ENTERTAIN A FORM OF BIOREMEDIATION USING A DIFFERENT TECHNOLOGY?

MR. GONZALES: NO. THE MARINE CORPS TEAM IS ALWAYS OPEN TO INNOVATIVE AND COST SAVING MEASURES, SO EVEN AS WE SIGN OUR DECISION DOCUMENTS AND EVERYBODY AGREES, PART OF THIS DECISION DOCUMENTS ALWAYS HAS A CLAUSE IN THERE, IF THERE'S SOMETHING SMARTER OR BETTER THAT IS AVAILABLE, WE CAN CONSIDER THAT.

MR. LEAKE: AND ALSO, AFTER WE SIGN THERE'S A FIVE-YEAR REVIEW, AND WE GO THROUGH AND WE REVIEW THE -- WE ANALYZE THE SYSTEM TO SEE HOW WELL IT'S PERFORMING IN CLEANING UP, AND IF

IT'S NOT PERFORMING VERY WELL, WE WILL GO INTO OUR ALTERNATIVES, WHICH IS PUMP AND TREAT, OR WE MIGHT BE ABLE TO FIND SOMETHING BETTER AND CHEAPER AND WHICH COULD BE A BETTER BIOREMEDIATION SYSTEM.

MR. GONZALES: WE DEFINITELY TRY TO GET THE POWERS TO BE TOGETHER TO DO THE SMART THING.

ANYTHING ELSE? I WOULD LIKE TO THANK EVERYBODY FOR ATTENDING. I APPRECIATE ALL THE FEEDBACK THAT WE GET, IT'S IMPORTANT FOR THE TEAM, AND WE DO GO OUT OF OUR WAY SO WE CAN GET COMMUNITY INPUT ACCEPTANCE, SO THANK YOU FOR COMING AND THIS CONCLUDES OUR MEETING.

AND LIKE I SAID, WE'LL ALL MILL AROUND HERE FOR A LITTLE WHILE AFTER IF YOU WANT TO ASK US SOME QUESTIONS ON THE SIDE. THANK YOU.

I WILLARD J. BORT, DO HEREBY CERTIFY THAT THE FOREGOING 22 PAGES ARE A TRUE AND CORRECT TRANSCRIPT OF THE PROCEEDINGS HAD IN THE ABOVE MATTER, ALL DONE TO THE BEST OF MY SKILL AND ABILITY.

DATED THIS 25TH DAY OF MAY, 1999.

____

WILLARD J. BORT

MY COMMISSION EXPIRES:

9-11-2002

APPENDIX C

RESPONSE TO COMMENTS

RESPONSE TO COMMENTS ON THE DRAFT RECORD OF DECISION OPERABLE UNIT 1, MARINE CORPS AIR STATION YUMA, ARIZONA, DATED DECEMBER 1999, JEG CTO 304, REVISION 0
CTO-206

Written on 14 February 2000

Herbert Levine
Hydrogeologist
U.S. Environmental Protection Agency

GENERAL COMMENTS	RESPONSE
Comment 1: Per your request, I have reviewed the draft Record of Decision for OU 1 at MCAS Yuma. In general I found the document to be well written and conceived. There are a few discrepancies from EPA policy and guidance, mostly related to MNA and long term monitoring which I must point out. I recommend that the Navy incorporate the guidance found in the following EPA publications: *Methods for Evaluating the Attainment of Cleanup Standards, Vol. 2 Ground Water*, EPA 230-R-014, July 1992, *Methods for Monitoring Pump-and-Treat Performance,* EPA/600/R-94/123, June 1994, and *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Sites,* Final, April 21, 1999. I am not now convinced that the Navy has sufficient data to select natural attenuation as a remedy.	**Response 1**: See Responses 1, 5, 6, 7, and 8 regarding incorporation of guidance from *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Sites.* See Response 9 regarding incorporation of guidance from *Methods for Monitoring Pump-and-Treat Performance.* The *Methods for Evaluating the Attainment of Cleanup Standards, Vol. 2 Ground Water* guidance discusses sampling and analysis methods for evaluating whether groundwater remediation has met preestablished cleanup standards. Sufficient numbers of monitoring wells are present or will be monitored to evaluate the extent of the various plumes. Statistical analysis of samples will be addressed in the Long-Term Monitoring Plan. It is recommended that trend evaluations be determined on the basis of the Mann-Kendall Test. As agreed upon during the 23 February Federal Facility Agreement project managers meeting, the concern regarding a lack of data to select natural attenuation are to be addressed by adding a table to the ROD summarizing VOC concentrations over time. Additionally, monthly groundwater samples are to be collected and analyzed for VOCs over a 3-month period from Areas 2, 3, and 6 beginning March 2000 as part of current remediation activities at OU1. Data from these sampling events will be included in the Final ROD. This comment is also discussed in the response to Specific Comment 5.

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SPECIFIC COMMENTS	RESPONSE
Comment 1: Section 1.4, Description of the Selected Remedy, Areas 2, 3, and 6 Plumes, page 1-4	**Response 1:**
The EPA policy on MNA (OSWER Directive 9200.4-17P, *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites*, April 21, 1999) requires that a contingency remedy be specified in the ROD, which the Navy has done. However, the OSWER Directive goes on to require implementation if monitoring results trigger the contingency and presents such trigger data. The Navy has suggested here that a contingency will be evaluated and only implemented if technically and economically appropriate. This must be re-written to conform with the EPA policy that if triggered, a contingency will be implemented. If there is a need to evaluate the effectiveness of a contingency it should be done prior to signing the ROD.	The text has been modified to state that if monitoring results trigger the contingency remedy (extracting groundwater), then that remedy will be implemented.
Comment 2: Section 1.4, Description of the Selected Remedy, Areas 2, 3, and 6 Plumes, page 1-4	**Response 2:**
The Navy is making the claim here (second bullet) that the Area 2 and Area 6 plumes will meet MCLs within five years through natural attenuation. This time-frame is acceptable and should be included in the LTM plan as a target to he monitored against.	The text states that MCLs could (rather than "will") be reached within 5 years for Areas 2 and 6. Contaminant concentrations in Area 3 were measured below MCLs during the summer of 1999. A review of MNA will be performed within 5 years after commencement of the remedial action pursuant to CERCLA Section 121. (See Section 1.5 of the Declaration.) The LTM will also include an evaluation of MNA within 5 years after commencement of the remedial action.

RESPONSE TO COMMENTS ON THE DRAFT RECORD OF DECISION OPERABLE UNIT 1, MARINE CORPS AIR STATION YUMA, ARIZONA, DATED DECEMBER 1999, JEG CTO 304, REVISION 0 CTO-206

Comment 3: Section 2.9.3, Criteria for Termination of Groundwater Containment/Treatment System, page 2-37 The Navy is implying with condition #2 that natural attenuation through dilution may be relied upon to futher control the plume. If this is the case then the Navy should re-write this criteria to state that natural attenuation will be used to remedy the remaining VOCs and that this remedy will be monitored.	**Response 3:** The selected remedies to be monitored in Area 1 include containment/treatment followed by potential monitored natural attenuation. Condition No. 2 has been rewritten as follows. "Remaining VOCs in groundwater will reach the base boundary at concentrations equal to or less than MCLs (this would require groundwater modeling results indicating remaining contaminants above MCLs will reach the base boundary at concentrations equal to or less than MCLs followed by MNA to remedy the remaining VOCs)." Section 2.9.3 has been modified to clarify that monitored natural attenuation (MNA) is used in Area 1 as part of the selected remedy and as the selected remedy for Areas 2, 3, and 6.

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Comment 4: Section 2.9.3, Criteria for Termination of Groundwater Containment/Treatment System, page 2-37 The Navy should replace condition #3 with system optimization and renumber condition 3 as 4. As written, the end point for this process is not clear. Will the Navy rely on natural attenuation to remove the remaining contamination, as suggested in condition 2, or apply for a technical impracticability waiver (of ARARs)? Since the Navy is making the claim that natural attenuation is practical at some sites it is logical to conclude that it would be used as a contingency if a containment/treatment system were unable to achieve the cleanup standard.	**Response 4:** The three conditions are described to provide criterion for shutdown of the containment/treatment system for Area 1. System optimization would be included as part of the operation of a remediation system in Area 1. This would be part of the activities used to remove VOCs from the groundwater to the extent technically and economically feasible. System optimization is mentioned at the bottom of page 2-37. System optimization has been added to the third condition. It is possible that monitored natural attenuation may be a part of the remedy for Area 1 if modeling results indicate any remaining VOCs remaining in the eastern Area 1 plume will reach the base boundary equal to or below MCLs. The ROD is not suggesting any technical impracticability waiver of ARARs. Also, see Response 3. There are also selected contingencies for Area 1 if the previously described remedies are not effective. The contingencies are Alternative 7 or 7a (groundwater extraction and treatment with discharge to the Yuma POTW or reinjection). This is documented on page 2-63 of the ROD.
Comment 5: Section 2.10.2, Alternative 2: Institutional Controls and Monitored Natural Attenuation, page 2-40 The Navy states that “There are insufficient historical data to document a loss of contaminants at the OU 1 plumes; however, existing information indicates that the Areas 2, 3, and 6 plumes appear to be stable or decreasing.” This is counter to the requirement set forth in the OSWER Directive (page 16, item 1) that: “Historical groundwater and/or soil chemistry data that demonstrates a clear and meaningful trend of decreasing contaminant mass and/or concentration over time at appropriate monitoring or sampling points.” The OSWER Directive goes on to state that “sites where contaminant plumes are no longer increasing, or are shrinking, would be the most appropriate candidates” (OSWER Directive, page 18). If the Navy has this information it should be presented here in the ROD, if not then the Navy is not now ready to select natural attenuation as a remedy.	**Response 5:** Historical VOC analytical data for Areas 2, 3, and 6 showing that the plumes are stable and have decreasing VOC concentrations as measured at groundwater monitoring wells will be included in the draft final and final versions of the ROD.

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Comment 6: Section 2.10.2 Alternative 2: Institutional Controls and Monitored Natural Attenuation, page 2-40	**Response 6:**
The Navy states that requirements for the LTM are found in section 2.9.3, however I could not find them. The OSWER Directive 9200.4-17P, *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Sites,* April 21, 1999 provides specific criteria and requirements for a LTM program. These should be listed here in this ROD. The Navy should also present the degradation rates which will be monitored against (item number 2, page 16, of the OSWER Directive). The Navy also states that 4 additional wells are needed to monitor this remedy. This is OK for a guess for cost comparison, however the EPA will not now agree to the number of monitoring wells. EPA awaits the LTM plan which will propose the number of wells to monitor, among many other things.	The reference to Section 2.9.3, requirements for the LTM, is incorrect and will be revised to state that Section 2.13.1.3 discusses requirements for the LTM plan. A list of criteria that all monitoring programs should be designed to accomplish from OSWER Directive 9200.4-17P has been added to Section 2.13.1.3 and 2.13.2.2. It should be noted that bullet two of the OSWER directive will not be fully monitored since a previous evaluation of natural attenuation indicated minimal biological activity is occurring and future monitoring of biological activity is not planned. Degradation rates are not presented on page 16, section (2), of OSWER Directive 9200.4-17P. Chlorinated hydrocarbons will be monitored to determine if concentrations at individual monitoring wells decrease and degradation products are present. It should be noted that only physical parameters are to be monitored since a previous study has indicated that biological degradation processes at MCAS Yuma are minimal.
Comment 7: Section 2.11.10 Selected Remedy, page 2-56. Page 2-55	**Response 7:**
The OSWER Directive requires that a historical database be available at the time of the remedy selection. The Navy should provide this information before the selected remedy is selected and a ROD signed.	See response to Comment 5. This section has been modified, indicating physical natural attenuation is currently occurring.
Comment 8: Section 2.13.1.3 Groundwater Monitoring, page 2-61	**Response 8:**
I suggest removing reference to POCs (~~at designated POCs~~) since points of compliance will not necessarily be the sole monitoring locations. There are 8 objectives for the performance monitoring of natural attenuation which are specified in the OSWER Directive. The Navy should state that those will be incorporated in the LTM plan.	POCs are not the only monitoring locations. Groundwater monitoring wells located within the plumes will also be monitored. The text has been modified to describe sampling of POC wells and monitoring wells located within the plumes. The LTM plan will be designed to evaluate the criteria in the referenced OSWER directive.

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Comment 9: Section 2.13.1.4 Implementation of Contingency Alternative for Containment, page 2-62	**Response 9:**
Criteria and methods for monitoring containment can be found in Methods for Monitoring Pump-and-Treat Performance, EPA 600/R-94/123, June 1994. The Navy is only proposing monitoring containment concentrations. They should monitor hydraulic control as well to demonstrate containment.	Monitoring would also include evaluating hydraulic control. Groundwater elevations would be measured if this contingency were implemented to evaluate groundwater flow directions and mounding or reduction in the groundwater table that results from pumping activities. This section has been modified to clarify that pumping influences on the groundwater table will also be evaluated.
Comment 10: Section 2.13.1.4 Implementation of Contingency Alternative for Containment, page 2-63	**Response 10:**
The Navy seems to suggest that if MCLs are not met and modeling shows that contamination beyond MCLs will not occur at the base boundary then the system could be shut down permanently. Since the ROAs (sic:should be RAO) as would not be met the Navy should identify natural attenuation here as a contingency.	See Response 3. MNA is a part of the selected remedy for Area 1.
Comment 11: Section 2.13.2.2 Groundwater Monitoring, page 2-68	**Response 11:**
Comment number 8 above applies here as well.	This will be changed per Comment 8

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CTO-206

Written on 06 March 2000

Nancy Lou Minkler
Project Manager
ADEQ Federal Projects Unit, Waste Programs Division

GENERAL COMMENTS	RESPONSE
Comment 1:	**Response 1:**
This Record of Decision (ROD) is well written and well organized. The level of detail appears to be appropriate. The selected remedy for Areas 2, 3, and 6 are Institutional Controls (ICs) and Monitored Natural Attenuation (MNA). When ICs are selected as a remedy ADEQ requires that an Institutional Control Plan (ICP) be developed. ICs are a new remedy, and like other remedies, documentation is necessary to show how the remedy will be implemented. The purpose of an ICP is to document the steps that will be taken to insure that groundwater use and digging permit restrictions will be enforced and protected. The ICP should contain a description of applicable ADWR statutes (especially in the event that groundwater contamination should migrate off site), and an excerpt from the relevant change in language in the Station Master Plan. The ICP will become a required step in the training of the permitting process. The ICP will be a living document, that will be reviewed annually and updated as necessary. Since this is a new process, the ADEQ Project Manager will gladly assist the Marine Corps Air Station, Yuma (YMCAS) in the development of the ICP document. Numerous typographical errors which should be corrected were noted throughout the document.	Agreed; an ICP will be prepared as discussed during the project managers' meeting held on 23 February 2000. The ICP will be reviewed annually and updated as necessary. Text describing the ICP has been added to Section 2.9.2. The document has been edited, and typographical errors were corrected.
SPECIFIC COMMENTS	**RESPONSE**
Comment 1: Page 2-7, 2.5.1 General Site Conditions	**Response 1:**
The first paragraph of this section should note the existence and general locations of residential areas at YMCAS	A sentence has been added to this section describing residential housing at MCAS Yuma as being located at the southeast corner of the base.

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Comment 2: Page 2-12, 2.5.7.1 Area Plume	**Response 2:**
"The footprint of the plume covers about 60 acres and extends off-Station (see Plates 1 and 2)." It may be more appropriate to use wording such as "the plume underlies an area of approximately 60 acres . . . ."	The text has been modified as described in the comment
Comment 3: Page 2-13, 2.5.7.2 Area 2 Plume	**Response 3:**
"The footprint of the plume covers about 4 acres and is confined on-station (see Plates 1 and 2)." See comment #2. Also, the reference to the plume being "confined" to a geographic area (on-Station) is misleading. "Confined" implies some kind of limiting conditions imposed on the plume. Describing the "current location of the plume" as being on-Station would be acceptable. This comment also applies to sections 2.5.7.3 Area 3 Plume and 2.5.7.4 Area 6 Plume and numerous other locations throughout the document. [Also, not that this is the only place noticed in this document where "station" is not capatalized.]	Agree will all comments. Changes to text have been made as recommended.
Comment 4: Page 2-17, 2.6.1.1 Area 1 Plume	**Response 4:**
The word "cleanup" is a noun. "Clean up" (two words) better describes the action modeled.	The text was modified as described in the comment.
Comment 5: Page 2-36, 2.9.2 Remedial Approach to OU 1 Groundwater Cleanup	**Response 5:**
The acronym "LTM" is used in the fourth bullet without being defined. Has it been defined previously in the document, other than in the acronym lists?	The acronym, "LTM," was not previously defined in the text of the document. It is now spelled out at the subject location.
Comment 6: Page 2-51, 2.11.5 Short-term Effectiveness	**Response 6:**
"Therefore, the No Action and Institutional Control alternatives would have the least immediate harmful effect on human health and the environment, but would also provide less protection in the short term." It would be more appropriate to insert the word "potential" in front of " immediate harmful effect".	The text has been modified as described in the comment.

**RESPONSE TO COMMENTS ON THE DRAFT RECORD OF DECISION OPERABLE UNIT 1,
MARINE CORPS AIR STATION YUMA, ARIZONA, DATED DECEMBER 1999, JEG CTO 304, REVISION 0
CTO-206**

Written on 14 February 2000

U.S. Environmental Protection Agency Legal Department

SPECIFIC COMMENTS	RESPONSE
Comment 1: Section 1.5 Statutory Determinations	**Response 1:**
The text states that "[t]hese remedies satisfy the preference for treatment as a principal element of the remedy." Since the remedies for Areas 2, 3, and 6 do not involve active treatment, this statement appears to be correct only for Area 1.	The text has been modified to state that Area 1 treatment satisfies the preference for treatment as a principal element of the remedy.
Comment 2: Section 2.9.2 Remedial Approach to OU 1 Groundwater Cleanup	**Response 2:**
The third bullet summarizing institutional controls involving the Station Master Plan should also mention institutional controls that will restrict access to contaminated groundwater that has moved offbase (see page 2-39).	The text has been modified to "Amend the MCAS Yuma Master Plan to reflect groundwater access and use restrictions, including groundwater that has moved off MCAS Yuma, and establish mechanisms to control changes that would not interfere with or adversely affect remedial actions."

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Comment 3: Section 2.10.2 Alternative 2: Institutional Controls and Monitored Natural Attenuation The ROD states that contaminated groundwater has migrated beyond the Station's boundaries to property controlled by the Yuma Airport Authority, and that "enforceable groundwater use restrictions would need to be negotiated with the Airport Authority." The ROD should describe the intended use restrictions, and the legal mechanism for accomplishing them, in more detail. Any such restrictions should be enforceable against subsequent owners or lessees of the affected property. The May 1999 Proposed Plan for OU 1 states at page 5 that off-Station groundwater use restrictions "would include but not be limited to zoning ordinances implemented by county agencies that restrict use of groundwater in these areas." As with the amendments to the Station Master Plan discussed below, EPA requests that, if the language of the zoning ordinances can not be agreed upon before the ROD is finalized, the ROD should state that the EPA and the State will be given the opportunity to review and approve the language of an ordinance before the Navy agrees to it with the County. In addition, the ROD should describe any other types of institutional controls that will be used off-Station, such as restrictive covenants.	**Response 3:** The following text has been added to Section 2.10.2: "Restrictions would exclude use of groundwater contaminated above MCLs as a drinking water source. Treatment of groundwater contaminated above MCLs would be required. The U. S. EPA and ADEQ will be given the opportunity to review and concur with the language of use restrictions and zoning ordinances before the Navy negotiates agreements with adjacent property owners."

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Comment 4: Section 2.13.1 Selected Remedy for Area 1 Plume

(1) The text on page 2-59 states:

The Navy will provide necessary information to appropriate county agencies identifying off Station areas impacted by groundwater contamination exceeding MCLs. The Navy will also support county agencies with any technical information needed for the county to implement restrictions on construction and use of wells in the affected areas.

This, and the language quoted above from Section 2.10.2 stating that the Navy will negotiate enforceable groundwater use restrictions with the Yuma Airport Authority, appear to be the only detail provided in the ROD regarding off-Station groundwater use restrictions. As currently drafted, Section 2.13.1 appears to indicate that the Navy's role in establishing off-Station groundwater use restrictions will be limited to providing notice of and technical information about the contamination. In order to avoid the apparent inconsistency with Section 2.10.2, text should be added to Section 2.13.1 reiterating that the Navy will negotiate appropriate groundwater use restrictions with affected adjacent landowners.

(2) The text on page 2-60 states the EPA and ADEQ will be provided with a draft copy of the proposed amendments to the Station Master Plan "for review and comment." EPA had requested that, if the language of the amendments could not be agreed upon before the ROD is finalized, the ROD should state that the EPA and the State will be given the opportunity to review and approve the language of the amendment before it is added to the Master Plan. EPA continues to believe that is should have concurrence authority for the amendments to the Station Master Plan, since they are a significant element of the remedy being approved in the Record of Decision.

Response 4:

The following text was added to Section 2.13.1:

(1) "The U.S. EPA and ADEQ will be given the opportunity to review and concur with the language of use restrictions and zoning ordinances before the Navy negotiates agreements with adjacent property owners."

(2) Text was added to this section stating the ADEQ and U.S. EPA will be given the opportunity to review and concur with the language of amendments before it is incorporated into the MCAS Yuma Master Plan.

Also, the first bullet after the third paragraph in Section 2.3.1 reads: "implementing institutional controls on and off MCAS Yuma (with the Navy negotiating appropriate groundwater use restrictions with affected adjacent land owners);"

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Comment	Response
Comment 5: Section 2.13.2 Selected Remedy for Area 2, 3, and 6 Plumes The text on page 2-67 states that EPA and ADEQ "will be provided with a draft copy of the amendments to the Station Master Plan reflecting the groundwater access and water supply well design restrictions on the station for review and comment." EPA had requested that, if the language of the amendments could not be agreed upon before the ROD is finalized, the ROD should state that the EPA and the State will be given the opportunity to review and approve the language of the amendment before it is added to the Master Plan. EPA continues to believe that it should have concurrence authority for the amendments to the Station Master Plan, since they are a significant element of the remedy being approved in the Record of Decision.	**Response 5:** See Response 4. The referenced sentence has been deleted and replace with: "The U.S. EPA and ADEQ will be given the opportunity to review and concur with the language of amendments before they are incorporated into the master plan."
Comment 6: Section 2.14.2 Statutory Determinations for Areas 2, 3, and 6 Selected Remedy The text states that the selected remedy "satisfies the statutory preference for remedies that employ treatment to reduce toxicity, mobility, and volume as a principal element." Since the remedies for Areas 2, 3, and 6 do not involve active treatment, this statement appears to be incorrect. The text should explain why on balance the remedies are nevertheless to be preferred.	**Response 6:** The referenced was removed from the text. The following text was added: "The selected remedy does not use treatment technologies. The remedy is preferred because the groundwater plumes are relatively small, stable plumes of CHCs, and long-term monitoring for physical degradation of the CHCs is the selected remedy."
Comment 7: Section 2.14.2.2 Compliance with Applicable or Relevant and Appropriate Requirements The text states that the selected remedy "complies with ARARs in that it would reduce VOC contaminant concentration in groundwater." The rationale for this statement is unclear, since concentrations could be reduced, but still not achieve ARARs.	**Response 7:** This section was rewritten as follows: "Groundwater samples will be collected and analyzed to determine whether physical degradation of CHCs is occurring. The effectiveness of the remedy will be evaluated within 5 years to determine whether contaminant concentrations are approaching drinking water standards (MCLs)."

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Comment 8: Section 2.14.2.6 Preference for Treatment as a Principal Element

The text states that the selected remedy "would significantly reduce the toxicity, mobility and volume of hazardous substances in the aquifer." Although this statement may be correct with respect to the expected effect of monitored natural attenuation on contaminants in the groundwater at these sites, since the remedies for Areas 2, 3, and 6 do not involve active treatment, if would appear that the selected remedies do not satisfy the statutory preference for treatment. The text should explain why on balance the remedies are nevertheless to be preferred.

Response 8:

The section was rewritten as follows.

"Although the selected remedy for Areas 2, 3, and 6 does not use active treatment, the groundwater plumes are relatively small and appear to be stable. On the balance, the overall selected remedy that includes Areas 1, 2, 3, and 6 satisfies statutory preferences for treatment because degradation of chlorinated solvents in the plumes will be monitored to evaluate the effectiveness of MNA as a remedy. The selected contingent alternative to extract groundwater and treat with air stripping and GAC will be implemented if MNA does not reduce VOC contamination."

Comment 9: Table 2-3 Contaminants Exceeding MCLs and Major Risk Contributors

The ARARs Tables refer to Table 2-3 as showing "a comparison of numeric standards for each chemical in aquifers." However, the table only appears to show whether the detected concentrations of each contaminant exceed MCLs. The ROD should include a separate table showing for each contaminant the numeric values for the federal MCL, state MCL, MCLG, and any other similar ARAR or risk-based cleanup standard, with a summary column showing which numeric value is the required cleanup value.

Response 9:

Table 2-3 was modified to include applicable, and relevant and appropriate cleanup standards from Tables 2-8 and 2-9. A summary column was added showing which numeric value is the cleanup value.

Comment 10: Table 2-8 Federal Chemical-Specific ARARs for MCAS Yuma

(1) The references to Table 2-3 are confusing, since it does not contain a "comparison on numeric standards for each chemical in water." See the comment on Table 2-3, above.

(2) National Secondary Drinking Water Standards (SMCLs) and Proposed MCLs are categorized in the "ARAR Determination" column as "To-Be-Considered Guidance." The "Comments" column should state whether particular SMCLs and Proposed MCLs will be used to set performance standards at OU 1. (Generally, it is not necessary to list TBCs in the ROD unless they are being used to set performance standards for the cleanup. If all TBCs are to be listed in the ARARs table, the table should therefore indicate which TBCs are being used to set performance standards for the cleanup and which are not.)

Response 10:

(1) See Response 9.

(2) TBC guidance was removed from Table 2-8 since the guidance will not be used to set performance standards at OU-1. National Secondary Drinking Water Standards and proposed MCLs have also been removed from Table 2-8.

**RESPONSE TO COMMENTS ON THE DRAFT RECORD OF DECISION OPERABLE UNIT 1, MARINE CORPS AIR STATION YUMA, ARIZONA, DATED DECEMBER 1999, JEG CTO 304, REVISION 0
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Comment	Response
Comment 11: Table 2-9 State Chemical-Specific ARARs for MCAS Yuma (1) The entries for State maximum contaminant levels (MCLs) for inorganic chemicals and for organic chemicals characterize them as "Applicable" in the ARAR Determination column, but appear to characterize them as "relevant" and appropriate" in the Comments column. The text should be edited for consistency. (State MCLs would be "applicable" to water that is delivered to a user of a regulated water system.) (2) See the comment above regarding references to Table 2-3. (3) Health-Based Guidance Levels (HBGLs) for remediation of a contaminant in an aquifer are categorized in the "ARAR Determination" column as "To-Be-Considered Guidance." The "Comments" column states that some HBGLs are more stringent than federal MCLs and have been identified by the State of Arizona as the standard for cleanup at OU 1. The table should indicate which HBGLs are being used to set performance standards for the cleanup.	**Response 11:** (1) The text in the comments column for state MCLs was changed from "They are relevant and appropriate..." to "They are applicable..." (2) Reference to Table 2-3 were removed for state MCLs for inorganic chemicals and Narrative Aquifer Water Quality Standards. Inorganic chemicals are not major risk contributors and will not be included in Table 2-3. Narrative Aquifer Water Quality Standards do not have numeric standards. (3) HBGLs have been removed from Table 2-9 since they are TBC and are not being used to set performance cleanup standards.
Comment 12: Table 2-10 Federal Location-Specific ARARs for MCAS Yuma and Table 2-11 State Location-Specific ARARs for MCAS Yuma The two tables appear inconsistent in categorizing the federal ARARs as "Applicable" and the state ARARs as "Relevant and Appropriate." The tables should be edited for consistency of the difference should be explained in the Comments column.	**Response 12:** Federal ARARs are more stringent than state of Arizona regulations and have been determined to be applicable. The comments section will be updated.

RESPONSE TO COMMENTS ON THE DRAFT RECORD OF DECISION OPERABLE UNIT 1, MARINE CORPS AIR STATION YUMA, ARIZONA, DATED DECEMBER 1999, JEG CTO 304, REVISION 0 CTO-206

Comment 13: Table 2-12 Federal Action-Specific ARARs for MCAS Yuma The Clean Air Act policy for control of emissions from air stripper operations at CERCLA sites is categorized in the "ARAR Determination" column as "TBC" for alternatives 5 and 7. The "Comment" column should state whether the policy will be used to set performance standards at OU 1. (Generally, it is not necessary to list TBCs in the ROD unless they are being used to set performance standards for the cleanup. If all TBCs are to be listed in the ARARs table, the table should therefore indicate which TBCs are being used to set performance standards for the cleanup and which are not.)	**Response 13:** This TBC policy is not to be used as a performance standard for cleanup and has been removed from the table.