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NAVAL AIR WEAPONS STATION CHINA LAKE

REMEDIAL INVESTIGATION
PHASE II WORK PLAN ADDENDUM
FOR SITES 12 AND 22

Draft
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ACRONYMS AND ABBREVIATIONS

1,1,1-TCA	1,1,1-Trichloroethane
2,4-D	2,4-dichlorophenoxyacetic acid
∘ F	degree Fahrenheit
µg	micrograms
µmhos	micromhos
ANSI	American National Safety Institute
ARAR	Applicable or Relevant and Appropriate Requirements
ASQE	Activity-specific QAPjP element
ASTM	American Standards for Testing and Materials
bgs	below ground surface
BLM	Bureau of Land Management
BOA	Basic Order Agreement
BTEX	benzene, ethylbenzene, toluene and xylene
CAL	California Action Level
CAD	computer-aided design
CDCA	California Desert Conservation Area
CDFG	California Department of Fish and Game
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
CLPL	China Lake Propulsion Laboratory
cm	centimeter
COC	chain-of-custody
CRP	Community Relations Plan
CSM	Conceptual Site Model
CTO	Contract Task Order
DCE	Dichloroethene
DDE	dichlorodiphenyldicholoroehtylene
DDT	dichlorodiphenyltricholoroethane
DHS	Department of Health Services (California)
DNAPL	dense non-aqueous phased liquid
DOD	Department of Defense
DOT	Department of Transportation
DQO	Data Quality Objective
DTSC	Department of Toxic Substance Control
EIC	Engineer-In-Charge
EM	electromagnetic profiling
EPA	Environmental Protection Agency
FSP	Field Sampling Plan
FTL	Field Team Leader
GPR	ground-penetrating radar

ACRONYMS AND ABBREVIATIONS (Continued)

HSP	Health and Safety Plan
IAS	Initial Assessment Study
IDW	investigation-derived waste
IRP	Installation Restoration Program
IT	International Technology, Corporation
IWVWD	Indian Wells Valley Water District
JMM	James M. Montgomery, Consulting Engineers, Inc.
kg	kilograms
l	liter
LCS	laboratory control sample
LOE	level of effort
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
mg	milligrams
MK	Morrison Knudsen Corporation
ml	milliliter
mph	miles per hour
MPN	most probable number
mR/hr	millirem per hour
MSL	Mean Sea Level
MW	Montgomery Watson, Inc.
NAPL	non-aqueous phased liquid
NAWS	Naval Air Weapons Station
NACIP	Navy Assessment and Control of Installation Pollutants
nCi	nanocuries
NCP	National Contingency Plan
NEESA	Naval Energy and Environmental Support Activity
NIOSH	National Institute for Occupational Safety and Health
NOTS	Naval Ordnance Test Station
NPL	National Priority List
NTP	Notice to proceed
NWC	Naval Weapons Center
OCP	Organochlorine Pesticide
OSHA	Occupational Safety and Health Administration
PAO	Public Affairs Office
PCB	polychlorinated biphenyl
pCi	picocuries
PID	photo-ionization detector
POTW	Publicly Owned Treatment Works
PPE	Personal Protective Equipment
PRC	PRC Environmental Management, Inc.

ACRONYMS AND ABBREVIATIONS (Continued)

PRG	Preliminary Remediation Goal
PVC	polyvinyl chloride
QA	Quality Assurance
QAPjP	Quality Assurance Project Plan
QC	Quality Control
RAB	Restoration Advisory Board
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
RPM	Remedial Project Manager
RT	round-trip
RWQCB	Regional Water Quality Control Board
SACM	Superfund Accelerated Cleanup Model
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SMCL	Secondary Maximum Contaminant Level
SNORT	Supersonic Naval Ordinance Research Track
SOP	Standard Operation Procedures
SVOC	semivolatile organic compound
SWAT	Solid Waste Assessment Test
TCA	trichloroethane
TCE	trichloroethene
TDS	total dissolved solids
TM	Technical Memorandum
TM-3	Technical Memorandum No. 3
TOC	total organic carbon
TPH-D	Total Petroleum Hydrocarbons as Diesel
TSDF	Treatment, Storage, and Disposal Facility
USA	Underground Service Alert
USEPA	United States Environmental Protection Agency
USGS	United States Geologic Services
UXO	unexploded ordinance
VOC	volatile organic compound
WESTDIV	U.S. Navy Western Division Naval Facilities Engineering Command
WPA II	Work Plan Addendum, Phase II

EXECUTIVE SUMMARY

This Phase II Remedial Investigation/Feasibility Study (RI/FS) Work Plan Addendum Phase II (WPA II) has been developed for the U.S. Navy Western Division Naval Facilities Engineering Command (WESTDIV) and the Naval Air Weapons Station (NAWS), China Lake, California. The WPA II presents the second phase of work to be performed for Site 12, the Supersonic Naval Ordinance Research Track Road Landfill and Site 22, the Pilot Plant Road Landfill located at NAWS. The WPA II is a supplement to the original work plan (dated January 1991) and has been prepared to provide a general explanation of the reasons for the additional RI/FS and the expected results and goals of the investigation. This work is performed as part of the Navy's Comprehensive Long-Term Environmental Action Navy II Installation Restoration Program. The first phase of the RI/FS was conducted under CLEAN I.

This WPA II has been prepared to meet the requirements of a work plan under the EPA Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) program. Furthermore, a Sampling Analysis Plan, which serves as both the Field Sampling Plan and Quality Assurance Project Plan, has been provided as an addendum to the base-wide Draft Quality Assurance Project Plan (June 21, 1996). An addendum to the Draft Base-Wide Health and Safety Plan (July 30, 1996) has also been provided for use by project personnel.

Results from the 1992 Phase I RI/FS field activities, presented in the Technical Memorandum-3 (TM-3) (PRC and JMM, 1993) and validated data from the May 1996 groundwater sampling event, have been incorporated into this document. The RI/FS activities proposed in the WPA II are in direct response to the results of these previous investigations. In brief, previous investigations have indicated chemical and radiological contamination in groundwater at both sites, although concentrations are generally below California Action Levels. The site specific objectives of the WPA II are:

Site 12

- Assess the potential impact on human health and the environment from contaminants detected in the surface soils at the site.
- Further assess the groundwater flow regime of the Water Table Aquifer and the first water-bearing zone of the semiconfining layer (Semiconfining Layer Aquifer). This includes the evaluation of the vertical gradient between the two aquifers.

- Assess the nature and extent of potential groundwater contamination in both the Water Table Aquifer and the first water-bearing zone of the semiconfining layer (Semiconfining Layer Aquifer).

- Confirm the existence and significance of a fault beneath the SNORT Road Landfill that is believed to be part of the western branch of the Little Lake fault zone.

- Characterize soil for contamination at the location of the former asphalt batch plant to evaluate the need for removal action.

- Assess what hydrogeologic interaction may exist between the Water Table Aquifer and the first water-bearing zone of the semiconfining layer (Semiconfining Layer Aquifer) resulting from nearby production wells screened in the deep aquifer.

Site 22

- Assess the potential impact on human health and the environment from any contaminants detected in the surface soils at the site.

- Assess the nature and extent of potential groundwater contamination in the Water Table Aquifer.

- Characterize the Water Table Aquifer for the potential presence of Non-Aqueous Phase Liquids.

Phase II RI/FS field activities will include surface soil sampling, soil samples collected from borings, and groundwater sampling. The Phase II RI/FS field activities will be completed in two steps. These steps are described below.

STEP ONE:

(1) Information on pumping patterns and wells will be collected from NAWS, the IWVWD and the City of Ridgecrest to assess the relationship between the seasonal variations in water levels, and the pumping of groundwater in the Intermediate and Ridgecrest Well Fields

(2) Fifteen (15) and twenty-two (22) surface soils samples at Sites 12 and 22, respectively, will be collected by hand auger and analyzed for Volatile Organic Compounds, Semivolatile Organic Compounds, Total Petroleum Hydrocarbons - diesel range, metals, pesticides, and polychlorinated biphenyls.

(3) Four (4) shallow soil borings will be drilled and sampled at the location of the former asphalt plant at Site 12. The samples will be analyzed for Volatile Organic Compounds, Semivolatile Organic Compounds, Total Petroleum Hydrocarbons - diesel range, metals, pesticides, and polychlorinated biphenyls.

(4) Two (2) exploratory borings will be drilled at Site 12 for geologic and geophysical logging.

(5) Six (6) monitoring wells will be installed at Site 12. Three wells will be screened in the Water Table Aquifer and three wells will be screened in the Semiconfining Layer Aquifer. In the three deep wells, geotechnical samples will be collected from the semiconfining layer to evaluate the competency of the layer as an aquitard.

(6) Five (5) monitoring wells will be drilled and installed at Site 22. During the drilling of the boreholes for the monitoring wells, groundwater samples will be collected using a hydropunch sampling tool from both the top and bottom of the Water Table Aquifer and will be analyzed for the presence of Non Aqueous Phase Liquids and Volatile Organic Compounds.

STEP TWO:

(1) All existing and new monitoring wells at Sites 12 and 22 will be sampled and analyzed for Volatile Organic Compounds, Semivolatile Organic Compounds, Total Petroleum Hydrocarbons - diesel range, metals, pesticides, and polychlorinated biphenyls, pesticides, inorganics, metals, radionuclides, and landfill parameters. This sampling event will also be the first quarterly sampling event for the long-term groundwater monitoring plan at NAWS.

At the conclusion of the Phase II RI/FS, a Technical Memorandum, including the results of field activities, a risk assessment for soils at both sites, a treatability study, conclusions and recommendations will be submitted.

1.0 INTRODUCTION

PRC Environmental Management, Inc. (PRC) received Contract Task Order (CTO) 0050 (dated October 3, 1995) from the Department of the Navy, Engineering Field Activity West, Naval Facilities Engineering Command, under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract No. N62474-94-D-7609 (CLEAN II). Under this CTO, PRC has been tasked to conduct a phased Remedial Investigation/Feasibility Study (RI/FS) at 13 sites at the Naval Air Weapons Station (NAWS)[1] China Lake. As part of the phased RI/FS, Morrison Knudsen Corporation (MK) was authorized to conduct the Phase II remedial investigations and initiate the feasibility studies for Site 12 (Supersonic Naval Ordinance Research Track [SNORT] Road Landfill) and Site 22 (Pilot Plant Road Landfill).

Under the CTO, MK will conduct a RI/FS, including a removal action evaluation for soils related to the landfill. These RI/FS activities include screening surveys and field sampling to (1) evaluate the potential risk or hazard posed to human health and the ecology; (2) establish the nature and extent of groundwater contamination; (3) assess what hydrogeologic interaction may exist between shallow aquifers beneath the two sites and nearby production wells screened in the deep aquifer; and (4) determine if future removal actions will mitigate risks presented by the sites.

This document presents the work plan addendum (WPA II) for conducting the Phase II RI/FS activities at Sites 12 and 22. The WPA II (1) states the RI/FS objectives, (2) describes the environmental settings of the sites, (3) summarizes the results of previous site investigations, (4) identifies remaining data needs, (5) describes field sampling activities necessary to address the remaining data needs, and (6) describes an approach to addressing human health and ecological risk assessment requirements. Additional investigations may be necessary to complete the RI/FS beyond those described in the WPA II. However, this document is intended to be as comprehensive as possible to minimize the need for subsequent field work.

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[1] As a result of reorganization in 1993, NAWS represents the facility portion of the previously named Naval Weapons Center (NWC).

1.1 RI/FS OBJECTIVES

The specific RI/FS objectives for Site 12 and Site 22 are presented below.

Site 12

- Assess the potential impact on human health and the environment from any contaminants detected in the surface soils at the site.
- Further assess the groundwater flow regime of the Water Table Aquifer and the Semiconfining Layer Aquifer.
- Assess the nature and extent of potential groundwater contamination in both the Water Table Aquifer and the Semiconfining Layer Aquifer.
- Confirm the existence of a fault beneath the SNORT Road Landfill that has been interpreted as the result of faulting on a western branch of the Little Lake fault zone.
- Characterize soil for contamination at the location of the former asphalt batch plant to evaluate the need for a removal action at the location.
- Assess what hydrogeologic interaction may exist between the Water Table Aquifer and the Semiconfining Layer Aquifer as each relates to the nearby production wells screened in a separate deeper aquifer.

Site 22

- Assess the potential impact on human health and the environment from any contaminants detected in the surface soils at the site.
- Assess the nature and extent of potential groundwater contamination in the Water Table Aquifer.
- Characterize the water table aquifer for the potential presence of non-aqueous phase liquids (NAPLs).

The data gathered during the RI/FS field work will be used to (1) characterize the site, (2) define the site dynamics, (3) collect data sufficient to define the risks, and (4) develop the response action whether it is removal, remediation, or no action. WPA II was prepared with these objectives in mind, and is based on interim final guidance issued by the United States Environmental Protection Agency (EPA, 1988a), and on the revised National Contingency Plan (NCP) (55 Federal Register 8666, 1990).

1.2 WORK PLAN ADDENDUM II ORGANIZATION

This document has been prepared to meet the requirements of a work plan following EPA guidance. Since this WPA II contains much information repeated from previous documents already approved by the regulatory agencies, relevant sections have been extracted and referenced from these documents to expedite the regulatory review process.

The WPA II is divided into eight sections, as described below. For convenience, tables and figures are located at the end of each section.

- Section One. Introduction presents the objectives of the RI/FS program and describes the contents of the project plan.
- Section Two. NAWS Installation Background and Setting provides a history of NAWS, as well as a physical description of NAWS. Site-specific information is included for Sites 12 and 22.
- Section Three. Initial Evaluation of Sites 12 and 22 presents the types and volumes of waste, potential exposure routes, and identifies preliminary remedial and removal objectives.
- Section Four. WPA II describes the development of conceptual models of site contamination, defines the Data Quality Objectives (DQOs) of the RI/FS, and outlines the overall WPA II approach.
- Section Five. RI/FS Tasks enumerates the various tasks that will be undertaken during the conduct of the RI/FS. This chapter provides an overall framework for the RI/FS process, describing the tasks that will be taken including the following: field activities, community relations, data evaluation, fate and transport analyses, risk assessment, removal action assessment, remedial action assessment, quality assurance/quality control (QA/QC), project management, and report preparation.
- Section Six. RI/FS Project Management presents the project management approach for the RI/FS and includes a schedule for executing of the RI/FS.
- Section Seven. Costs and Key Assumptions presents key assumptions associated with the RI/FS.
- Section Eight. References lists the references used to generate this WPA II.

1.3 PROJECT APPROACH

All activities will be conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and related guidance, including the NCP.

To conduct the RI/FS, MK will first assemble a project staff based on the technical needs of the project. Characterization activities will be conducted as outlined in Section Five. The resulting data will be used to establish the following:

- Adequately characterize the site.
- Define site dynamics.
- Provide information for risk based associated exposure models with each site.
- Identification of the need for removal actions, if determined as being necessary to minimize a release or threat of a release.
- Identification of the need for other remedial actions necessary to mitigate risks posed by each site.

Finally, a Technical Memorandum presenting the results of the above will be prepared. Other associated tasks as outlined in Section Five will be conducted during the project duration.

2.0 NAWS INSTALLATION BACKGROUND AND SETTING

The following sections provide a description and an operational history of the NAWS and its surroundings. Sections 2.1 through 2.5 are reprinted from Section 2 of the Draft Final RI/FS Work Plan (PRC and JMM, 1991a), which has been approved by the regulatory agencies. Section 2.6 is extracted from the approved Technical Memorandum-3 (TM-3) (PRC and JMM, 1993).

2.1 HISTORY AND MISSION

NAWS China Lake is located in the southeastern California desert, approximately 150 miles northeast of Los Angeles (Figure 2-1). Two major areas comprise NAWS China Lake, the China Lake Complex and the Randsburg Wash/Mojave B Complex. The 950-square mile China Lake Complex, located in Inyo, San Bernardino, and Kern counties, contains the majority of the range and test facilities, as well as NAWS China Lake headquarters and the China Lake community. Sites 12 and 22, that are the subject of this investigation, lie within the 950-square-mile China Lake Complex and are shown on Figure 2-2.

The installation began with the establishment of the Naval Ordnance Test Station (NOTS) at China Lake in 1943, and has since expanded in support of the Department of Defense and Navy Research, Development, Test, and Evaluation mission for air warfare systems. The initial function of the installation was three-fold: (1) to support the rocket development work then being conducted at the California Institute of Technology for the World War II Office of Scientific Research and Development; (2) to test air-launched rocket weapons; and (3) to furnish primary training in the use of those weapons.

The existing airstrip at Inyokern initially was used as a temporary base for NOTS test and training operations. The installation rapidly expanded during the war years, and by early 1945 approximately 1,000 buildings and facilities had been constructed. The new facilities included the China Lake Pilot Plant, Armitage Airfield, the Salt Wells Pilot Plant, and Michelson Laboratory. Within a few years, several large test ranges, research laboratories, and small, highly specialized production plants were added. Residential facilities were also constructed in the form of a self-sufficient community for military and civilian personnel stationed at NOTS.

NAWS was created in 1967, by merging NOTS with the Naval Ordnance Laboratory in Corona, California, as part of a reorganization of Navy Laboratories. Prior to the merger, Corona was responsible for research and development for missile fuses, guidance systems, and countermeasures; and telemetry and development work on the standard anti-radiation missile. These functions and the majority of the associated personnel were transferred to China Lake by 1971.

According to NAWS China Lake public relations material, the present mission of one station is to be (1) the principal Navy research, development, test, and evaluation center for air warfare systems and missile weapons systems except antisubmarine warfare systems; and (2) the national range for parachute test and evaluation. NAWS China Lake manages and conducts the complete weapon development process, from concept formulation through the entire lifetime of a weapon system, including fleet and production support. As of December 1993, NAWS China Lake had approximately 4,800 civilian employees and 460 military personnel, excluding non-naval and tenant activity personnel, according to NAWS China Lake Public Affairs Office (PRC and JMM, 1993).

2.2 REGIONAL SETTING

The following sections describe the location and surrounding land use, climate, topographic setting, and geology, hydrogeology and surface water hydrology of the NAWS and the Indian Wells Valley. Local water supply sources are also identified. A brief overview of the local flora and fauna is provided with a listing of endangered and threatened species.

2.2.1 Location and Surrounding Land Use

The NAWS is located in the upper Mojave Desert of California and consists of over one million acres of desert land with restricted airspace several times that size extending over the surrounding area. The NAWS major land areas are surrounded predominantly by undeveloped public lands (Westec, 1984).

Most of the unincorporated land in the vicinity of the NAWS is federally owned, administered, and managed by the Bureau of Land Management (BLM) under the California Desert Conservation Area (CDCA) Plan. Surrounding land uses in the Indian Wells Valley include the urban residential communities of Ridgecrest and Inyokern along the southern boundary of the China Lake Complex.

Three towns, Pearsonville, Little Lake, and Olancha, are located on U.S. Highway 395, paralleling the western boundary of NAWS. Other small communities are located along US 395, and to the southeast (Argus and West End) and north (Darwin) of NAWS (Figure 2-1). The Inyokern Airport is located between Inyokern and U.S 395. Commercial areas are small and generally close to residential areas. Approximately 1,200 to 1,500 acres of irrigated alfalfa fields and many small 5 to 15-acre fruit tree ranches are located along Brown Road towards Little Lake. Almost a third of the total water production in the Indian Wells Valley is pumped along the western boundary of NAWS.

The west boundary of Death Valley National Monument is located approximately 15 miles north of the northeastern corner of the China Lake Complex. Portions of the Sequoia National Forest are 12 miles west of Inyokern (Westec, 1984).

2.2.2 Climate

NAWS is located in a desert, with a correspondingly arid climate. Average annual precipitation is from 3 to 6 inches in the Indian Wells Valley to approximately 10 inches in the Argus Range. The majority of the precipitation occurs between the months of October and March, with December being the wettest month. Desert thunderstorms usually occur in the late summer. Precipitation falls in the form of rain with the exception of occasional snow at the higher elevations.

Temperatures in the Indian Wells Valley range from a low of 0°F in winter to a high of 118°F in the summer. The mean temperature for NAWS is 63.7°F. Prevailing winds in the valley are from the southwest, and wind speeds in excess of 25 miles per hour (mph) have been recorded throughout the year. Between October and June, wind speeds in excess of 50 mph are common. The yearly average wind speed is 6.6 mph (Westec, 1984).

2.2.3 Topography

NAWS is located in the Indian Wells Valley in the southwestern corner of the Great Basin section of the Basin and Range Physiographic Province. The province is typically characterized by isolated, north-south trending mountain ranges separated by parallel desert basins. The valley is bordered on the west by the southern Sierra Nevada, on the east by the Argus Range, and on the south by the east-west

trending El Paso Mountains and the Spangler Hills. On the north, the valley is separated from the Coso Basin by a low ridge and a lower narrow divide. The Coso Range lies north of the Coso Basin (Figure 2-3). Salt Wells Valley lies southeast of the China Lake Complex, and is topographically lower than Indian Wells Valley. Low ridges separate the two valleys.

Elevations in the Indian Wells Valley vary from approximately 3,000 feet above mean sea level (MSL) at the margins of the valley, decreasing to approximately 2,150 feet MSL at China Lake Playa in the southeastern corner of the China Lake Complex. Elevations of the Sierra Nevada peaks to the west exceed 9,000 feet MSL, while those of the Coso Range average 6,500 feet MSL with a maximum elevation of 8,156 feet MSL at Coso Peak. The highest point in the Argus Range is Maturango Peak, at 8,839 feet MSL.

Broad alluvial fans extend into the valley from Sierra Nevada canyons, forming bajadas several miles wide. The bajadas slope eastward into the east-central portion of the valley where several low playas are located. Smaller alluvial fans extend into the basin from the south and southeast. The largest and lowest of the playas is China Lake, which is an active discharge area for seasonal precipitation. Other playas in the valley include Airport Lake, Mirror Lake and Satellite Lake, all presently dry. Depths to groundwater at Mirror Lake and Satellite Lake are in excess of 50 feet (Stollar, 1988; Westec, 1984).

2.3 REGIONAL GEOLOGY, HYDROGEOLOGY, AND SURFACE WATER

The geology of the Indian Wells Valley is the subject of debate, due to its complexity. One school of thought holds that the valley is a closed basin, recharged only by precipitation and runoff within its borders, while the other school believes the valley is an open basin. Both of these viewpoints are presented in the following discussion.

2.3.1 Regional Geology

The geology of the Indian Wells Valley was described in detail by Kunkel and Chase (1969). The following discussion of the valley's stratigraphy and geologic structure is summarized from that study. Further information on geologic terms discussed herein is presented in Appendix C of the Draft Final RI/FS Work Plan (PRC and JMM, 1991a).

2.3.1.1 Stratigraphy

The Indian Wells Valley is underlain by Paleozoic to late Mesozoic crystalline basement rocks of granitic and metamorphic origin. The basement complex is overlain by 4,000 to 6,000 feet of Tertiary continental deposits. These deposits are indurated fluvial and lacustrine sediments and intrusive and extrusive volcanic rocks with thicknesses ranging from 300 to over 1,000 feet. Late Tertiary to middle Pleistocene older alluvium unconformably overlies both the basement complex and the continental deposits. The older alluvium, ranging up to 800 feet in thickness, is characterized by lenticular deposits of semi-indurated silt, sand, gravel, and boulders. Older lacustrine deposits interfinger with and overlie the older alluvium. These deposits are typically silt and silty clay interbedded locally with thin beds of impure limestone, calcareous sandstone, conglomerate, and nonindurated sand. The thickness of these units is unknown but is interpreted to be greater than 500 feet. Test borings in some areas have penetrated several hundred feet of blue clay, thought to be part of the older lacustrine deposits. Unnamed volcanic rocks are found at the north end of Indian Wells Valley and overlie older lacustrine deposits, basement complex, and probably older alluvium. These volcanics consist of several hundred feet of basalt interbedded in a few places with scoria, pumice, obsidian, and andesite.

Younger alluvium overlies most of the present valley proper and consists primarily of lenticular beds of unconsolidated clay, silt, sand, and gravel derived mainly from the Sierra Nevada, with minor contributions from the other mountains surrounding the central Indian Wells Valley area. The younger alluvium is estimated to range in age from middle Pleistocene to Holocene. Alluvial fan deposits correlative with the younger alluvium are found mainly on the west side of the valley. These deposits consist primarily of unconsolidated clay, silt, sand, gravel, and boulders. Interbedded with the younger alluvium and possibly with the alluvial fan deposits are younger lacustrine deposits comprised chiefly of lenticular deposits of silt and silty clay with occasional beds of sand and sandy silt. These deposits crop out in Salt Wells Valley where they contain conspicuous castle-like calcereous deposits of tufa. The younger lacustrine deposits are also found at shallow depths in wells in the central portion of Indian Wells Valley beneath much of the surface mapped as windblown sand and interdune playas. These deposits are presumed to be associated with Lake Searles and Lake China of late Pleistocene age.

Playa deposits overlie the younger alluvium and younger lacustrine deposits in the areas of the active playa formation in the Indian Wells Valley. These deposits are composed of gray silt, thin layers of

yellow, green, and blue plastic clay and occasional sand lenses. The playa deposits interfinger with alluvial deposits along their margins. In the area surrounding China Lake and the North Playa, windblown sands are deposited as dunes transverse to the direction of the prevailing winds. Hundreds of interdune playas form in the troughs between the dunes and are depicted as small, closed depressions on large-scale topographic maps. The dunes range from one to ten feet in height. About ten percent of the total area of these dunes contain playas.

The youngest and most active deposit in Indian Wells Valley is windblown sand. Prevailing westerly winds transport sand, silt, and clay from west to east and deposit it in dunes transverse to the direction of the wind. The sand usually is deposited as a veneer on underlying deposits, while much of the finer material is blown out of the basin. The thickness of these dune deposits may range up to 25 feet.

2.3.1.2 Structural Geology

Indian Wells Valley and parts of Salt Wells Valley are viewed by those who follow the closed basin theory as a down-dropped fault block formed by three or possibly four major fault zones. These major fault zones are the Sierra Nevada on the west, the Argus on the east, the Garlock on the south, and probably the Wilson Canyon on the northeast. All of these fault zones, except the Argus Fault Zone, are shown on Figure 2-4.

The Sierra Nevada Fault Zone lies along the west side of Indian Wells Valley and along the east side of the Sierra Nevada. As mentioned above, closed-basin proponents believe the vertical movement on this fault zone has uplifted the Sierra Nevada and downdropped the Indian Wells Valley relative to one another. The trace of this zone, though largely concealed beneath alluvial fans, extends northward beyond Indian Wells Valley (Kunkel and Chase, 1969). The open-basin theorists, on the other hand, feel the Sierra Nevada mountains are thrust faulted by older thrusts and are a complex compressional feature (Austin, 1988). The East Kern County Resource Conservation District conducted studies in 1989 to determine whether the Sierra Nevada mountains are an eastward-moving overthrust which, over geologic time, have been thrusted over part of the Indian Wells Valley (Innis-Tennebaum, 1989). The results of this study are not known.

The postulated Argus Fault Zone lies along the west side of the Argus Range. The location of this fault zone is poorly defined and therefore is not identified on the geologic map (Figure 2-4). The followers of the closed basin theory believe that the vertical movement on this fault zone uplifted the Argus Range and downdropped Indian Wells Valley relative to one another. According to Kunkel and Chase (1969), the north end of the fault zone seems to be terminated or offset by the Wilson Canyon Fault Zone (Figure 2-4). The Argus Fault probably extends north between the Coso and Argus Range. The southern extent of the Argus Fault Zone is not known, but the zone seems to split; one fault, exposed at the divide between Indian Wells Valley and Salt Wells Valley, extends to the southeast and is concealed beneath the alluvium of Salt Wells Valley, while the other seems to trend southerly across the outcrop of older lacustrine deposits. The trace of this fault in the El Paso Mountains to the south cannot be determined. Considerable faulting occurs along the north side of the El Paso Mountains, potentially related to the Argus Fault Zone and/or the Garlock Fault Zone (Kunkel and Chase, 1969).

In addition to the main basin forming fault zones, numerous faults were identified within Indian Wells Valley from a combination of geologic, hydrologic, and geophysical data (Figure 2-4). Information on these faults indicate displacements of the basement complex, the continental deposits and the overlying alluvium (Dutcher and Moyle, 1973). Where the alluvium is offset, movement of groundwater between recharge areas on the west and discharge areas on the east may be restricted. Specific data on the amount of offset and the actual effect of these faults on the local groundwater are not available.

2.3.2 Regional Hydrogeology

All groundwater users in the area surrounding NAWS draw their water from unconsolidated alluvial deposits which comprise the major water-bearing formation in the Indian Wells Valley. The occurrence, movement, and storage of groundwater in the unconsolidated deposits have been discussed in detail over the past 60 years. Like the geology, there are currently two schools of thought with regard to groundwater flow in the Indian Wells Valley: (1) the closed basin theory; and (2) the open basin theory. Both theories are presented in this section.

2.3.2.1 Closed Basin Theory

The closed basin theory presents a classic picture of a fault-bounded valley. This theory identifies the Indian Wells Valley as a downdropped block of land separated by faults from the surrounding hills. The bedrock and surrounding hills are hard, impervious granite, granodiorite, and other igneous rocks, all of which are faulted, crushed, and fractured. The impervious rock boundaries around the Indian Wells Valley (Figure 2-5) creates a near-watertight container, conducting minimal water into the valley. Some of the rainfall falling on the ranges surrounding the valley collects and flows into the alluvial slopes, where it flows underground through the canyons and into the Indian Wells Valley groundwater supply. However, the amount of water that actually reaches the water table is much smaller than the total amount of precipitation (Saint-Amand, 1986).

The closed basin theory and associated bedrock geology limits the groundwater recharge to the valley. Likewise, groundwater discharge through evapotranspiration or artificial withdrawal is also limited. The majority of evaporation from the groundwater system occurs at the China Lake playa, on the eastern side of the valley. If no valley water is withdrawn for consumption, the closed-basin theorists reason that the amount of natural discharge would, at some point, equal the amount of recharge. Because total discharge rates increase when consumption is considered, this approach identifies impending problems with overdraft conditions where discharge exceeds recharge.

2.3.2.2 Open Basin Theory

The open basin approach agrees with the closed basin concept that the Indian Wells Valley is underlain and surrounded by bedrock. However, the open basin theory goes on to assume that the bedrock is leaky and permits the movement of water into or out of the valley. Additionally, the alluvial fill within the valley is assumed to be hydraulically connected to similar formations outside of the valley that are sufficiently permeable to transmit groundwater. Thus, the Indian Wells Valley becomes a local basin within a larger, regional flow system that includes all the adjacent areas. Surface and subsurface recharge from these adjacent areas is an integral part of the open basin model.

The recharge of groundwater into and the discharge of groundwater out of the Indian Wells Valley form the basis of the open basin theory. In addition to groundwater movement from other nearby basins

(Rose, Owens, and Coso), recharge also occurs from the mountain ranges surrounding the Indian Wells Valley, including the Sierra, Argus, and El Paso (Figure 2-6). Recharge due to runoff or leakage from the Los Angeles Department of Water and Power pipelines, as well as thermal upwellings from active geothermal systems, are other sources of groundwater recharge to the valley. The theory does not state that all waters are exceptionally good; rather, the water chemistry is quite varied throughout the valley. However, no overdraft condition exists in this scenario.

According to the open basin theory, the largest recharge zone to enter the Indian Wells Valley is runoff from the Sierra Nevada mountain range. Certain geologic features of the Sierran bedrock (fractured granitics, marine sediments and metamorphic roof pendant) provide pathways for water movement into the valley. These pathways include not only the large, scattered fractures in the granite, but also the micro-fractures. However, the majority of flow potential is assumed to occur within the larger fractures (Austin, 1988). These flow pathways, coupled with the hydraulic gradients present in the Sierra and adjacent to the Indian Wells Valley, are some of the supporting elements of this theory.

In addition to abundant recharge sources, the theory accounts for discharge from the Indian Wells Valley by means other than withdrawal for consumption or evaporation from the playa. As presented in Figure 2-6, additional discharge points include overflow to the Salt Wells Valley, exports, and subsurface leakage to Searles Valley, Koehn Lake and Cantil (Fremont) Valley. In summary, the open basin theory represents a groundwater flow system that integrates the Indian Wells Valley into a larger, more regional system of recharge, storage and discharge.

2.3.2.3 Groundwater Flow Regime

A complex flow system exists beneath the valley floor. Previous investigations describe a single groundwater body within alluvial deposits, where permeability is greater in the horizontal than in the vertical direction. This difference in permeabilities is caused by the presence of discontinuous silt and clay lenses and beds within the sand matrix. An increasing concentration of clay lenses has been identified in the eastern half of the valley. Some believe these clay lenses result in effective semiconfined conditions. Dutcher and Moyle (1973) generalized these conditions for use in their mathematical model. By simplifying the valley into a two-layer system, the process for modeling

groundwater flow was made easier. However, this generalization is too simplified and will not be assumed in this or further studies.

Groundwater flow through the major portion of the valley is horizontal towards China Lake playa. However, groundwater in the southwest and south-center portions of the valley flows to the south-southwest, toward two major water supply well fields operated by the Indian Wells Valley Water District (IWVWD) for the City of Ridgecrest. Localized groundwater depressions have been created in the area as a result of the operation of the Intermediate and Ridgecrest Well Fields (Stollar, 1988). While the Intermediate Well Field is still active, operations at the Ridgecrest Well Field decreased significantly in 1983 due to high concentrations of dissolved solids. The effects of this partial shutdown on the configuration of the water table and groundwater flow direction is not known at this time.

The groundwater divide between flow to the playa and flow to the well fields has frequently been attributed to a poorly defined area termed the China Lake Barrier. The barrier has been described as a geologic fault by some investigators (Dutcher and Moyle, 1973; Kunkel and Chase, 1969). These investigators also reported that some groundwater flow in the lower section of the aquifer may be inhibited by the presence of the barrier.

2.3.2.4 Surface Water Hydrology

As previously mentioned, the Indian Wells Valley drainage basin receives recharge through surface water runoff from the surrounding mountain ranges. Numerous springs occur in the Argus Range between Argus and Maturango Peaks. Additionally, a few fresh water springs are located along the western edge of the Coso Range, the majority of which are above the 6,000-foot level. On the valley floor, there are no naturally occurring perennial streams or lakes on NAWS property. However, a total of 49 springs or seeps were identified within the China Lake Complex (Westec, 1984). Two of these seeps, the Lark Seep and G-1 Seep, are environmentally sensitive as they, and a ditch connecting them, support the Mohave tui chub, an endangered fish. Recharge from the City of Ridgecrest sewage treatment ponds provides a major portion of the water supplied to these seeps and the surrounding drainage area. The locations of these seeps are shown on Figure 2-2.

2.3.2.5 Water Supply

Groundwater is the sole source of water in the Indian Wells Valley and is used by NAWS, public water districts, and private, industrial, and agricultural users. Prior to 1944, irrigation was the main use of groundwater. In 1912, only eight wells existed, pumping a total volume of approximately 2,000 acre-feet per year. Since 1944, groundwater has been mainly used by NAWS or for public supply (Dutcher and Moyle, 1973). By 1979, the estimated annual volume of pumped water had increased to about 26,500 acre-feet (Westec, 1984).

Historically, the IWVWD operated two water supply well fields. The locations of these well fields are shown in Figure 2-2. A third well field, Inyokern Well Field, is located approximately 5 miles west of the Intermediate Well Field, near the Inyokern Airport. This well field provides the major portion of NAWS's water supply, although NAWS also operates wells in the Intermediate Well Field.

As previously mentioned, the Ridgecrest Well Field was an active potable water supply for the IWVWD until 1983. Since 1983, Kerr-McKee has continued to operate a well, blending its production water with water from the western side of the valley. The blended water is supplied to Trona via pipeline. The City of Ridgecrest installed a new well at the well field in 1989 to provide landscape irrigation water for city property. Water from this new well is not used for agricultural or potable water supply.

Localized groundwater depressions caused by pumpage of the Ridgecrest Well Field were evident during the evaluation of water levels conducted in 1976 (Stollar, 1988). The Intermediate Well Field, the second field operated by the IWVWD, is still actively producing water.

In addition to these large well fields, groundwater is drawn from private supply wells. Beyond the city limits, many residents operate private wells for their water supply. This includes the area west of the City of Ridgecrest and just south of the NAWS boundary. Water supply wells also exist on NAWS property. While the NAWS supply wells are currently inactive, the wells are capable of production should the need arise. Supply wells 7A and 22A are located near Armitage Airfield (Sites 1, 2, 44, and 45) and the C-1 East Disposal Area (Site 29), respectively (Figure 2-2). Although these wells are located up-gradient of the aforementioned sites, their return to production could create a reversal in groundwater gradients, potentially resulting in the migration of contaminants towards the wells.

2.4 REGIONAL BIOLOGICAL RESOURCES

Information on the biological resources at NAWS was compiled as part of the NAWS China Lake Master Plan (Master Plan), prepared by Innis-Tennebaum Architects, Inc. in 1989. A brief summary of the local vegetation and wildlife is provided below along with an identification of endangered or threatened species, as presented in the Master Plan and other NAWS documents (Kohfield and others, 1985). Care must be taken that activities proposed on the habitat of any of these species will be conducted in a manner that will minimize or eliminate the potential impacts.

2.4.1 Vegetation

The vegetation communities found at NAWS are transitional between the Mojave and the Great Basin Deserts. Over 60 vascular plants have been identified on NAWS. Twelve plant communities are found on the China Lake complex of NAWS:

- Sagebrush Scrub
- Pinyon-Juniper Woodland
- Blackbrush Scrub
- Mixed Desert Scrub
- Joshua Tree Woodland
- Creosote Bush Scrub
- Saltbush Scrub
- Alkali Sink Scrub
- Sandy Desert Wash
- Desert Riparian
- Freshwater Marsh
- Desert Sand Dunes

Table 2-1 provides a listing of the sensitive (rare, endangered, threatened, endemic or otherwise restricted) plant species in the NAWS environs. These species are known to exist or to have potential habitat on NAWS property.

2.4.2 Wildlife

A great diversity of wildlife is found in the Mojave Desert habitats in southern California. The NAWS is located on the edge of the Pacific flyway. The occurrence of over 235 species of birds, as well as over 80 species of mammals and 30 species of reptiles and a few amphibians, have been recorded at the Center. Many of these animals are unique in their specific habitat and requirements and are not found elsewhere. Six of these species are non-native and one of these six, the Mohave tui chub *(Gila bicolor mohavensis)*, is a federally listed endangered species native to the Mohave River Drainage. The chub was introduced into a groundwater seep (Lark Seep) on the installation in 1971 by the California Department of Fish and Game (CDFG) as a conservation measure and have since prospered in their new surroundings. The chub have an estimated current population of 18,500.

As of 1989, 96 sensitive animal species were identified as being present or potentially present on NAWS lands (Innis-Tennebaum, 1989). Lists of endangered, threatened, or otherwise protected wildlife species are included in Tables 2-2, 2-3, and 2-4.

2.5 HISTORY OF THE INSTALLATION RESTORATION PROGRAM

As a result of increasing public and government concern over the potential impacts of past hazardous waste disposal methods, the Department of Defense (DOD) has initiated a program to identify and investigate potential hazardous waste sites at military installations. This program was begun on a pilot scale in 1975, and was subsequently expanded to full scale in 1980, under the Installation Restoration Program (IRP).

The Navy has instituted its own program for implementing the IRP at Navy facilities in response to the IRP. The program is called the Navy Assessment and Control of Installation Pollutants (NACIP) Program, and is conducted in three phases:

- Initial Assessment Study (IAS) - Identify potential disposal sites or contaminated areas, and evaluate these sites with respect to their potential threat to human health and the environment.

- Confirmation Study - Verify and characterize the extent of contamination and define potential migration pathways.

- Remedial Action - Design and implement the required corrective measures to mitigate or eliminate confirmed problems.

Concurrently with the formation of the IRP, the U.S. Congress directed the EPA to develop a comprehensive national program to manage past disposal sites. The basis for this program is the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), passed by Congress in December of 1980. Since the passage of CERCLA, EPA has further defined the program in the form of numerous regulations and guidance. In 1986, Congress passed the Superfund Amendments and Reauthorization Act (SARA) which extended and amended CERCLA and associated regulations and guidance.

Initial investigations at the NAWS were performed under the NACIP Program. These investigations included:

- Initial investigations at the NAWS air support facility, Armitage Field (Ertec Western, 1982; Leedshill-Herkenhoff, 1983)

- Confirmation Study, Verification and Characterization Phases, Armitage Field (International Technology [IT] 1986, 1987 and 1988)

- Initial Assessment Study (Westec, 1984)

- Confirmation Study, Verification Phase (Stollar, 1988)

During the preparation of the 1988 Confirmation Study, the Navy chose to adopt the EPAs terminology for the investigation and remediation of past hazardous waste disposal sites. Therefore, the 15 sites identified as requiring additional work after the previous investigations were slated for an RI/FS as defined in the NCP (55 FR 8666, 1990) and related EPA guidance documents.

2.5.1 Initial Assessment Study

In 1984, an IAS was conducted for 42 sites at the NAWS (Westec, 1984). A list of these sites is provided in Table 2-5. Information on all sites was collected from a variety of sources, including government records, personnel interviews, and aerial photographs. Each site was then evaluated with respect to its potential hazard to human health and the environment. Fourteen of the 42 sites were evaluated as posing such a hazard, and were recommended for a confirmation study (Table 2-5). These sites were selected on the basis of their potential to contaminate the public water supply or adversely affect an endangered fish species (Mohave tui chub) located in the area of groundwater seeps in or near China Lake playa.

2.5.2 1988 Confirmation Study

The verification step of the Confirmation Study was conducted by R.L. Stollar and Associates, Inc. in 1987. A total of 15 sites was investigated to verify the presence of soil and groundwater contamination (Table 2-5). All but one of the sites were recommended by the IAS; the fifteenth was added by NAWS personnel on the basis of information received after completion of the IAS. Nine of the 15 Confirmation Study sites contained contaminants present in concentrations considered potentially hazardous to human health and the environment and were recommended for further investigation in an RI/FS.

The present RI/FS addresses the nine recommended sites, the four Armitage Field sites, and two additional sites in the Salt Wells/China Lake Propulsion Laboratory (CLPL) Area (Sites 8 and 18). The latter two sites were added at the request of NAWS personnel. The locations of these 15 sites are shown in Figure 2-2.

2.5.3 1992 Remedial Investigations and Feasibility Studies

The nine sites recommended by Stollar (1988) for further investigation in an RI/FS were Sites 7, 12, 13, 15, 22, 29, 31, 32, and 43. The RI/FS was conducted as a phased investigation. In addition to the recommended nine sites, the RI/FS Phase I also focused on an additional four sites from the confirmation studies at Armitage Field (Sites 1, 2, 44, and 45) (IT 1986; 1987; 1988). The results of

the RI/FS Phase I site-specific investigations and a regional hydrogeologic assessment were presented in TM-3 (PRC and MW, 1993). TM-1 (PRC and JMM, 1992) was prepared prior to TM-3 and presented preliminary results of the site-specific investigations. The 13 RI/FS sites were prioritized into three categories with respect to the need for additional investigation in Phase II:

- High priority for additional investigation - This category includes those sites where (1) floating product and associated groundwater contamination are known to be present, and/or (2) the presence of known groundwater contamination poses a potential threat to human and/or ecological receptors. Sites 1, 15, 43, and 44 are included in this category.

- Moderate priority for additional investigation - This category includes those sites where (1) the presence of groundwater contamination has been confirmed, but the likelihood of human or ecological exposure is low, or (2) low or negligible levels of contamination has been noted, but potential receptors are located nearby. Sites 2, 7, and 45 are included in this category under the first condition; Site 12 is included under the second.

- Low priority for additional investigation - This category includes those sites where (1) there is little or no evidence of significant contamination, and (2) there are no nearby potential receptors. Sites 22 and 29 are included in this category.

The remaining three sites, Sites 13, 31, and 32, were recommended for remediation. The recommendations at these three sites focused on source definition and remediation of wastes and soil in conjunction with confirmation sampling of soil and continued groundwater monitoring. In all cases, it should be noted that the ranking of high, moderate, and low, as listed above is relative, not absolute.

Therefore, the assignment of “high” for a given site with respect to the need for additional investigation should not be inferred to mean that the site presents a high risk to human health and/or the environment.

Additional water level measurements, aquifer testing, background groundwater sampling, and surface water and sediment sampling in the G-1 Channel were also recommended for Phase II. The draft TM-3 has been reviewed by the Lahontan Regional Water Quality Control Board (RWQCB) and California Department of Toxic Substance Control (DTSC). Based on recommendations made as a result of the Phase I RI/FS, a Phase II groundwater investigation was initiated at Sites 1, 2, 7 and 47 in October, 1995. However, the Phase II groundwater investigation has not yet occurred.

2.6 SITE SPECIFIC INVESTIGATION HISTORY

The follow sections present the history of previous investigations for Sites 12 and 22, the sites of interest for this WPA II and are extracted from TM-3 (PRC and MW, 1993).

2.6.1 SITE 12 - SNORT Road Landfill

Site 12 is a former active landfill within the confines of an abandoned gravel quarry located approximately 1.5 miles west of the NAWS main gate along the southern boundary of the China Lake Complex (Figure 2-2). Water supply wells in the Intermediate Well Field 8,500 feet to the south and west are operated by the IWVWD and NAWS. Several homes, located several thousand feet south-southwest of the landfill, are outside of the IWVWD distribution system and obtain water from private wells.

2.6.1.1 Site History

From 1952 to 1979, the SNORT Road Landfill (Figure 2-7) received approximately 100 tons per year of solid waste from the NAWS. These wastes included tree trimmings, construction debris, cans and barrels, small electrical parts, plastics, and rags. Household garbage was not disposed of in the landfill. It is likely that solvents, waste oils, miscellaneous unspecified chemicals, and polychlorinated biphenyls (PCBs) were also disposed of at the site, although this is not verified and volumes of such wastes cannot be estimated (Westec, 1984). An asphalt batch processing plant was located just southwest of the landfill and a black tar-like residue was found on the ground surface (Stollar, 1988).

2.6.1.2 Geology

Site 12 is underlain by Quaternary alluvium and possibly lacustrine deposits. The alluvium consists of sand, silty sand, and minor amounts of gravel. The possible lacustrine deposits consist of silt and clay, and range in depth from 110 feet to 135 feet below ground surface (bgs) (Stollar, 1988). The vadose zone generally includes sandy silt to silty sand (with some gravel) from approximately 0 to 30 feet. The remainder of the vadose zone generally consists of fine- to medium-grained sand to approximately 120 feet. If groundwater is encountered deeper than this depth, then the remainder of the vadose zone

consists of clayey sand (with some silty sand and sandy silt) from approximately 120 feet to groundwater (PRC and MW 1993).

Five soil samples were collected from JMM12-MW09 and analyzed for selected geotechnical characteristics to provide preliminary data necessary for the assessment of contaminant migration. Samples were collected at 0.5, 10, 25, 120 and 130 feet bgs mostly from the vadose zone. The results of the soil analyses are summarized in Table 2-6. The median grain size ranged from fine to medium sand. The porosity ranged from 33 to 54 percent, and the vertical permeability ranged from 6.5×10^{-5} to 2.0 ft/day. These values provided the first estimates of permeability at Site 12. However, vertical permeability is typically considered lower than horizontal permeability due to stratification (Driscoll, 1986).

2.6.1.3 Hydrogeology

Two distinct shallow water-bearing zones have been identified beneath Site 12 (Stollar 1988; PRC and JMM 1993). The shallower zone is tentatively considered correlative with the Water Table Aquifer at Armitage Field, based on its stratigraphic position above the low-permeability and possibly lacustrine, silts and clays. The lower water-bearing zone is overlain by these low-permeability horizons, and is therefore considered part of the Semiconfining Layer. The water-bearing zone has been termed the 150-foot zone (TM-3) based on its approximate depth beneath Site 12. However, for this WPA II, this layer will only be referred to as the Semiconfining Layer Aquifer.

The Water Table Aquifer was referred to as a semiperched zone by Stollar (1988). The depth to groundwater in the Water Table Aquifer varies from approximately 100 feet bgs to 120 feet bgs, and the apparent groundwater flow direction is to the southeast at a moderate gradient of about 12 ft/mile (0.0023 ft/ft) (PRC and JMM 1993). There is some uncertainty in the groundwater flow direction and gradient at this site. One of the site monitoring wells is located northeast of an inferred fault that may be a western branch of the Little Lake Fault. Furthermore, observed drops in water levels in wells completed in the Water Table Aquifer may reflect drawdown due to pumping in the Intermediate Area located 1.5 miles to the southwest, and/or in the Ridgecrest Area.

The groundwater flow direction in the Semiconfining Layer Aquifer beneath Site 12 is not well-defined as three of the six monitoring wells are in nearly a straight line. Water level measurements, however, indicate a general westward flow direction with a gradient of approximately 16 to 24 ft/mile (0.0030 to 0.0045 ft/ft) in the fall of 1991 to 33 ft/mile (0.0062 ft/ft) in the spring of 1992 (PRC and JMM 1993). This relatively steep westward flow direction may be related to pumping in an unconfined deep aquifer south and/or west of Site 12 where the Semiconfining Layer is absent.

The Navy obtains the majority of its water supply for NAWS China Lake from deep wells screened in the unconfined aquifer, three of which are located approximately 1 to 3 miles west of Site 12 near the start of the Trona aqueduct. In addition, the IWVWD operates three water supply at the Intermediate Well Field located approximately 1.5 miles southwest of Site 12.

Deeper permeable zones below approximately 250 feet bgs are also apparent on geophysical logs conducted during the RI Phase I. No wells have been completed in these deeper zones at Site 12. The top of the deeper water-bearing zones at Site 12 is similar in depth to the postulated base of the lacustrine horizons that form the regional semiconfining layer is some parts of the east-central Indian Wells Valley. The effectiveness of the silty zones in separating the Semiconfining Layer Aquifer from the Water Table Aquifer or deeper water-bearing zones is not known at this time. Water level measurements at Site 12 document a very strong downward vertical gradient of approximately -0.50 ft/ft (PRC and JMM 1993).

2.6.1.4 Surface Topography and Hydrology

Surface topography in the vicinity of Site 12 slopes gently to the northeast with surface elevations ranging from 2295 feet near the southwest corner of the site to 2285 feet near the northeast corner of the site. Based on the 1973 USGS 7.5 Minute Quadrangle for the area containing the site (Ridgecrest North Quadrangle), the elevation at the bottom of the quarry containing the SNORT Road Landfill is approximately 2250 feet. The quarry is elongated in a southwest-northeast direction for a distance of approximately 1400 feet.

Stollar (1988) noted that the quarry acts as a recharge zone to the water table due to surface water drainage flowing into the abandoned quarry.

2.6.1.5 Previous Investigations

Previous investigations conducted at Site 12 include the collection of soil and groundwater samples by Stollar (1988), and the RI Phase I, reported in TM-3 (PRC and JMM 1993). RI Phase I activities included a geophysical survey, drilling and geophysical logging of exploratory borings, and sampling and analysis of four new and five existing monitoring wells and three exploratory borings. A complete description of the results of the RI/FS are presented in the RI/FS Phase I TM-3 by PRC and JMM (1993).

In May 1996, MK performed the sampling and analysis of the nine existing monitoring wells at Site 12. This activity was performed to further evaluate groundwater quality and analyze for the possible presence of groundwater contamination beneath the site.

2.6.1.6 Nature and Extent of Contamination

The following subsections describe the nature and extent of contamination based on previous investigations that have been completed at Site 12.

2.6.1.6.1 Soil

In 1988 Stollar drilled one soil boring at the location of the former asphalt batch plant where tar-like residue had been identified. Two samples were collected. One sample was collected from the 0- to 5-foot and another sample was collected from the 5- to 10-foot interval. High concentrations of oil and grease (75,000 mg/kg) were found in the shallow sample; the deeper sample was not analyzed for oil and grease. Tests for volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) were negative for both samples. Soil analyses results for Site 12 are presented in Table 2-6.

2.6.1.6.2 Groundwater

Results for 1987

In 1987 Stollar installed, developed and sampled five monitoring wells, RLS12-MW01 through RLS12-MW05 (Stollar, 1988). Volatile organics were detected in groundwater at all five wells. The highest

concentrations were detected in well RLS12-MW02 located southwest of the site. Acetone and 1,1, l-TCA were detected in the greatest concentrations, up to 14 and 54 μg/L, respectively. Acetone was detected in all wells except well RLS12-MW05. However, according to EPAs 1994 Functional Guidelines for Organic Data Review, acetone is considered as a "common laboratory contaminant" and is discounted at concentrations below 100 μg/l. Organic compounds l,l,l-TCA (2.5 to 14 μg/L), ethylbenzene (0.20 to 1.4 μg/L), m- and p-xylenes (0.20 to 2.5 μg/L), and 1,1,2-TCA (0.3 to 1.0 μ/L) were detected in all wells. Radionuclides (gross alpha, gross beta, and radium) were also detected in all wells, in concentrations up to 4.7, 16, and 11 pCi/L, respectively. Groundwater analyses results from the Stollar investigation are presented in Table 2-7.

Results for 1992

In 1992, PRC and JMM sampled five existing wells RLS12-MW01 through RLS12-MW05 and four newly installed wells (JMM12-MW06 through JMM12-MW09) during Phase I of the RI/FS (Figure 2-7). In addition, groundwater samples were collected during drilling at or slightly below the semiconfining layer (150-foot depth) in each of exploratory borings JMM12-SB01 through JMM12-SB03. A groundwater sample was also collected from about 295 feet bgs in exploratory borings JMM12-SB01 and JMM12-SB02. All groundwater samples were analyzed for VOCs, SVOCs, total petroleum hydrocarbons (TPH), PCBs, general inorganic parameters (excluding cyanide for the monitoring well samples), and landfill parameters. Groundwater analyses results for monitoring well samples and exploratory boring samples are presented in Tables 2-7 and 2-8, respectively. A complete list of chemical results is included in TM-3 (PRC and JMM 1993). Elevated concentrations of VOCs detected during the previous investigation of the site by Stollar (1988) were not encountered during the 1992 Phase I RI/FS field investigation. However, the detection limits for several compounds obtained for the 1992 investigation are higher than the concentrations detected previously by Stollar. Specifically, benzene, l,l-DCE, ethylbenzene, 1,1,2-TCA, and xylenes were detected by Stollar at concentrations below the 0.50 μg/L detection limit obtained for the 1992 study. Therefore, the sampling results by Stollar for some compounds are suspect or were not detected due to elevated method detection limits.

Due to the qualitative nature of the groundwater samples from the exploratory borings, inorganic results for boring samples cannot be effectively compared to the upgradient well results. The elevated

radionuclide results in the water sample from the exploratory boring may be related to the high turbidity of the sample.

Results for 1996

In May 1996, MK redeveloped and sampled all nine existing wells at Site 12. All groundwater samples were analyzed for VOCs, SVOCs, total petroleum hydrocarbons-diesel (TPH-D), organochlorine pesticides (OCPs), organophosphorous pesticides (OPPs), PCBs, general inorganic parameters (excluding cyanide for the monitoring well samples), and landfill parameters. Monitoring well RLS12-MW01 was additionally analyzed for isotopic uranium, isotopic radium, and gamma spectrometry. Groundwater analyses results for the monitoring well samples are presented in Table 2-7. In addition, Stiff diagrams were generated to assess water-composition differences and similarities between the Water Table Aquifer and the Semiconfining Layer Aquifer and between monitoring wells upgradient and downgradient of the SNORT Road Landfill. The Stiff diagrams are shown in Figure 2-8. The salient results of the 1996 groundwater sampling event are:

- Toluene was the only organic compound detected at Site 12. Toluene was detected in monitoring wells RLS12-MW01 and RLS12-MW03 at concentrations of 4 μg/l and 1 μg/l, respectively. The Maximum Contaminant Level (MCL) for toluene is 100 μg/l (State of California, Department of Health Services Action Level).

- Iron (unfiltered concentration) was the only metal detected above its corresponding MCL. Iron, which has a secondary drinking water standard, exceeded the MCL in three wells RLS12-MW01, JMM12-MW06, and JMM12-MW08 at concentrations of 1,100 μg/l, 1,170 μg/l, and 474 μg/l, respectively. The MCL for iron is 300 μg/l.

- Gross alpha concentrations exceeded the MCL in the Water Table Aquifer monitoring well JMM12-MW09. The MCL for gross alpha is 15 pCi/l.

- Stiff diagrams generated from the major anion and cation concentrations, indicate that the groundwater in both the Water Table Aquifer and the Semiconfining Layer Aquifer are the same in nature and are probably hydrogeologically interconnected. The Water Table Aquifer monitoring well JMM12-MW09, located to the south of the landfill, does have a different signature and is probably being influenced from major anions and cations coming out of the SNORT Road Landfill.

Overall, the results of elevated concentrations of VOCs detected during the Stollar investigation (1988) and that of PRC and JMM (1992) were not reproduced during the 1996 sampling event. However, the detection limits for several compounds obtained for the 1996 investigation are higher than the concentrations detected previously by Stollar. Specifically, benzene, l,l-DCE, ethylbenzene,

1,1,2-TCA, and xylenes were detected by Stollar at concentrations below the 0.50 μg/L detection limit obtained for the 1992 study. Therefore the sampling results obtained for these compounds by Stollar are suspect or were not detected due to the elevated method detection limits.

2.6.1.6.3 Site Surveys

Phase I activities at Site 12 included a review of aerial photographs to identify site features, geophysical surveys, and inspection of infrared photography, as well as water level measurements and a topographic survey.

Site Features. A 1952 aerial photograph shows the asphalt batch plant. A dark area, possibly representative of discolored soil, is present at the eastern end of the plant. The photograph also shows a trench excavated between the main railroad line and the siding. A 1979 aerial photograph shows structures remaining in only the western portion of this batch plant area.

Geophysical Surveys. Geophysical surveys at Site 12 included a unexploded ordinance (UXO) clearance and an electromagnetic/ground penetration radar (EM/GPR) survey. The purpose of the surveys was to locate the presence of unexploded ordnance and to define the landfill boundaries. The EM/GPR data are included in TM-3 (PRC and JMM, 1993).

UXO clearance was performed for vehicle access routes, geophysical transects, five existing monitoring well locations, and four proposed exploratory boring locations. UXO clearance was not considered necessary at the four proposed monitoring well locations along the north side of Inyokern Road, due to their distance from the former landfill boundary. No UXO was encountered during any of the clearance operations. Items exposed at the surface of the landfill included kitchen appliances, metal parts, and rebar.

An estimate of the possible limits of shallow landfill material at Site 12 was based primarily on the identification of anomalous EM responses compared to established background levels. High-amplitude, in-phase EM responses typical of metallic material were recorded. The identification of anomalous GPR reflection patterns provided secondary confirmation of the anomalies within the limits of the possible shallow landfill area. A large, triangular area of anomalous EM and GPR responses, measuring

approximately 600 feet north to south by 1,100 feet east to west, is interpreted to represent the area containing significant quantities of metal in the upper 20 feet or less of soil (Figure 2-7).

Infrared Photography. Infrared photography of Site 12 at a scale of 1 inch equals 100 feet was reviewed to assist in the delineation of the landfill boundaries. Areas of no vegetation generally appear within the berm surrounding the site, along access roads, and within gullies. Areas of low vegetation densities appear near the east side of the site where the topography slopes gently towards the center of the landfill. Areas of moderate vegetation densities appear primarily around the perimeter of the site and are interpreted to be native (undisturbed) areas. Areas of high vegetation densities appear in the central, southern, and western portions of the site and are topographic lows, interpreted to be areas where rainfall runoff accumulates.

An asphalt patch, an area of black pavement, and a pit containing asphalt are present in the southwest corner of the site. These features appear to be related to the batch plant formerly located at the approximate southwest corner of the site (Stollar, 1988).

2.6.2 SITE 22 - Pilot Plant Road Landfill

The Pilot Plant Road Landfill is located in the southeastern portion of the China Lake Complex, just 1 mile west of the CLPL entrance (Figure 2-2) and just north of Pilot Plant Road (Figure 2-9). The southern boundary of NAWS is located 0.75 miles to the south of the landfill.

2.6.2.1 Site History

From 1944 to 1965, the majority of wastes generated by on-base housing (household wastes) and the NAWS Public Works Department were disposed of in several large trenches at the Pilot Plant Road Landfill. Other wastes disposed of in the landfill consisted of small amounts of industrial and hazardous wastes (e.g. pesticides, oils, solvents, paint, and paint thinners). It is estimated that approximately 110,000 cubic yards of waste were disposed of during the landfill's 21 years of operation (Westec, 1984; Stollar, 1988). Three distinct areas of trenching activity, as noted from historical aerial photographs, are shown in Figure 2-9 and are interpreted to correspond to the landfill areas.

2.6.2.2 Geology

Previous investigations have indicated that Site 22 is underlain by Quaternary alluvium. The upper 20 to 30 feet of this alluvium consist of light, yellowish brown to light, brownish gray, silty sands with some fine to coarse sands, as described from IRP borings south of the landfill. In general, relatively clean, fine to coarse, unconsolidated sands were found below the silty sands. Discontinuous lenses of sandy silts and silty clays were encountered in borings east and southwest of the landfill. Approximately 34 feet of clayey sand were logged from 20 to 54 feet bgs, in a boring (RLS22-MW03) adjacent to the center of the landfill's southern boundary (Stollar, 1988).

2.6.2.3 Hydrogeology

Site 22 is located near the identified southeast edge of the regional semiconfining layer in the east-central Indian Well Valley. The depth to groundwater at the site has been observed to vary from approximately 45 feet bgs at the northern edge of the landfill (RLS22-MW08) and 61 to 70 feet at the eastern and southern edges (PRC and JMM 1993). There is limited seasonal effect on the water table, apparently due to the fact that groundwater is relatively deep, and the vadose zone consists of low permeability lenses that may prevent rapid infiltration from the playas.

The groundwater flow direction varies from southeast across most of the site to due south at the southeast corner of Site 22. The horizontal gradient ranges from 3.4 to 6.9 ft/mile (0.00064 to 0.0012 ft/ft). A downward vertical gradient of approximately -0.049 ft/ft exists between the Water Table Aquifer monitoring wells and an unsurveyed well in a deeper aquifer, 26S40E35H02. Although the RI Phase I provided no evidence that the Water Table Aquifer is influenced by groundwater extraction in the Ridgecrest or Intermediate areas to the west (PRC and JMM 1993), the USGS modeling suggests westward flow in the deep aquifer.

2.6.2.4 Surface Topography and Hydrology

Surface topography in the vicinity of Site 22 slopes gently to the north with surface elevations ranging from 2245 feet near the southwest corner of the site to 2240 feet near the northeast corner of the site (Ridgecrest North Quadrangle, 7.5 Minute Quadrangle, 1973).

Based on the USGS topographic map, surface water flows away from the Pilot Plant Road Landfill towards Mirror Lake. Mirror Lake is located approximately 2,000 feet to the north of the Pilot Plant Road Landfill.

2.6.2.5 Previous Investigations

Previous investigations conducted at Site 22 include the installation and sampling of eight groundwater monitoring wells in 1987 (Stollar 1988), the RI Phase I (PRC and JMM 1993), and redevelopment and sampling of the groundwater monitoring wells in May 1996 by MK. RI Phase I activities included only the measurement of water table elevations, a review of aerial photographs, and the installation of a barbed-wire fence around the site to limit unauthorized access.

The May 1996 groundwater sampling activity by MK was performed to further evaluate groundwater quality and analyze for the possible presence of groundwater contamination beneath the site.

2.6.2.6 Nature and Extent of Contamination

The following subsections describe the nature and extent of contamination based on previous investigations that have been completed at Site 22.

2.6.2.6.1 Soil

Soil investigations at Site 22 have been limited to lithologic classification during the installation of monitoring wells. No soil samples have been submitted for chemical analysis.

2.6.2.6.2 Groundwater

<u>Investigative Results for 1987</u>

Eight groundwater monitoring wells (RLS22-MW01 through RLS22-MW08) were installed and sampled in 1987 at Site 22 (Stollar, 1988). Groundwater analyses results are presented in Table 2-9. Soil

samples were not collected during well installation. Water levels obtained by Stollar (1988) indicated that the groundwater flow direction was to the southeast.

Groundwater samples collected from all eight wells contained several VOCs. Well RLS22-MW05 had the greatest variety of VOCs, including 8.1 µg/L of 1,1,1-TCA. The United States Environmental Protection Agency (EPA) and California maximum contaminant limit (MCL) for 1,1,1-TCA is 200 µg/L. Monitoring well RLS22-MW02 had the highest concentration of 1,1,1-TCA (24 µg/L), and well RLS22-MW07, downgradient at the time of sampling, had the second highest 1,1,1-TCA concentration (11 µg/L). Two additional VOCs, 2-butanone and tetrahydrofuran, were detected in the three monitoring wells located at the southeastern corner of the landfill in concentrations of up to 11 µg/L. MCLs have not been established for these two compounds. However, according to EPA's 1994 Functional Guidelines for Organic Data Review, 2-butanone is considered as a "common laboratory contaminant" and is discounted at concentrations below 100 µg/l.

Radionuclides (gross alpha, gross beta, and radium) were consistently detected in all wells at Site 22 in concentrations up to 26, 31, and 1.6 pCi/L, respectively. The gross alpha concentrations in three wells exceeded the EPA and California MCL of 15 pCi/L; gross beta and radium concentrations were below EPA and California MCLs. Metals concentrations were also below EPA and California MCLs.

Investigative Results for May 1996

All eight monitoring wells were redeveloped and sampled in May 1996. All groundwater samples were analyzed for VOCs, SVOCs, total petroleum hydrocarbons-diesel (TPH-D), OCPs, OPPs, PCBs, general inorganic parameters (excluding cyanide for the monitoring well samples), and landfill parameters. Monitoring wells RLS22-MW05, RLS22-MW07, and RLS22-MW08 were additionally analyzed for isotopic uranium, isotopic radium, and gamma spectometry. Groundwater analyses results for the monitoring well samples are presented in Table 2-9. In addition, Stiff diagrams were generated to assess water-composition differences and similarities between monitoring well upgradient and downgradient of the Pilot Plant Road Landfill. The Stiff diagrams are shown in Figure 2-10. The salient results of the May 1996 groundwater sampling event are:

- Several organic compounds were detected including toluene (RLS22-MW01), 1,1,2,2-tetrachloroethane (RLS22-MW06), and tetrahydrofuran (RLS22-MW06). Only 1,1,2,2-

tetrachloroethane was at or above its corresponding MCL. 1,1,2,2-tetrachloroethane was detected at 1 μg/l in monitoring well RLS22-MW06. The MCL for this compound is 1 μg/l. Toluene has a MCL of 100 μg/l and tetrahydrofuran is currently unregulated.

- Iron (unfiltered concentration) was the only metal detected above its corresponding MCL. Iron, which has a secondary drinking water standard, exceeded MCLs in six wells RLS22-MW01, RLS22-MW04, RLS22-MW05, RLS22-MW06, RLS22-MW07, and RLS22-MW08 at concentrations of 536 μg/l, 1,410 μg/l, and 26,600 μg/l, 496 μg/l, 21,900 μg/l, and 2,070 μg/l respectively. The MCL for iron is 300 μg/l.

- Arsenic concentrations exceed corresponding MCLs in three monitoring wells RLS22-MW01, RLS22-MW03, and RLS22-MW08. However, the highest concentrations were detected in the upgradient wells RLS22-MW01 and RLS22-MW08 and indicates that it is not a result of operations at the landfill. The MCL for arsenic is 50 μg/l.

- Manganese, which has a secondary drinking water standard, exceeded MCLs in three downgradient monitoring wells RLS22-MW04, RLS22-MW05, and RLS22-MW07. The MCL for manganese is 50 μg/l.

- Selenium was detected at a concentration equal to the MCL of 10 μg/l in monitoring well RLS22-MW06. The MCL for selenium is 10 μg/l.

- Gross alpha concentrations above MCLs in upgradient and downgradient monitoring wells were indication that elevated gross alpha concentrations are representative of background conditions. The MCL for gross alpha is 15 pCi/l.

- Stiff diagrams suggest that there are two types of groundwater present at the site. One type of groundwater is represented in monitoring wells RLS22-MW01, RLS22-MW08 and RLS22-MW03. Monitoring wells RLS22-MW01 and RLS22-MW08 are located upgradient of the northern and eastern landfill areas. Monitoring well RLS22-MW03 is located downgradient of the northern and eastern landfill areas. Monitoring wells RLS22-MW04, RLS22-MW05, and RLS22-MW07 are also located downgradient of the northern and eastern landfill areas. The groundwater chemistry in these downgradient wells is similar to the upgradient wells and downgradient well RLS22-MW03 but tend to have elevated calcium, magnesium and chloride concentrations. This suggests that some anion and cations are leaching out of this area of the landfill and is entering the groundwater.

- The second type of groundwater is evident in monitoring wells RLS22-MW02 and RLS22-MW06. These monitoring wells are located in the western portion of the Pilot Plant Road Landfill.

2.6.2.7 Site Surveys

In addition to water level measurements and the topographic survey, the Phase I RI included an historic aerial photographic review. A 1948 photograph shows trenching only in the northern area. A 1952 photograph shows an increase in the extent of trenching in the northern area.

A 1961 photograph shows a greatly increased total landfill area. Individual trenches in the northern portion cannot be discerned. There is widespread soil disturbance in this area, but clumps of vegetation have appeared. The eastern area of trenching activity is visible (located south and east of the northern trenches). Elongated mounds of earth are visible in the eastern area.

A 1965 photograph shows site features similar to those evident in 1961, except that the eastern trenching area has expanded further east. The western trenching area appearing in a 1979 photograph extends very close to the current location of well RLS22-MW02. This well is an upgradient monitoring well that was found to contain low levels of VOCs (Stollar, 1988). The review of the aerial photographs indicates that the individual trenches cannot be discerned. The present RI/FS maps (Figure 2-9) therefore portray only the outline of each area of trenching activity.

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TABLE 2-1

SENSITIVE PLANT SPECIES
NAWS CHINA LAKE, CALIFORNIA

Proper Name	Common Name
Astragalus atratus var-menanus	Darwin Mesa milk-vetch[d,f]
Atriplex hymenelytra	Desert holly[b]
Cordylanthus eremicus ssp.-eremicus	Panamint bird's-beak[a,d,f]
Fendlerella utahensis	Little fendlerbrush[d,e]
Hulsea vestita ssp. inyoensis	Inyo hulsea[d,e]
Lupinus magnificus var. glarecola	Coso Mountains lupine[d,f]
Dudley saxosa ssp. saxosa	Panamint live-forever[a,b,d,f]
Phacelia mustelina	Weasel phacelia[d,e]
Phacelia nashiana	Charlotte phacelia[d]
Prosopis glandulosa	Mesquite[b]
Psorothamnus arborescens var. arborescens	Mohave indigo bush[d,f]
Sclerocactus polyancistrus	Mohave fishhook cactus[c,d,f]
Yucca brevifolia	Joshua tree[b]

Source: Innis - Tennebaum, 1989; Kohfield et al, 1985 (annotated 1990)

[a] Federal Candidate Species, Category 2
[b] California Protected Species
[c] U.S. Forest Service and U.S. Bureau of Land Management Sensitive Species
[d] CDFG, California Natural Diversity Database - Special Plant or Animal
[e] California Native Plant Society: Rare and Endangered in California but more common elsewhere
[f] California Native Plant Society: Plants of Limited Distribution

Other species not included in these designations are also of special management concern. For more detail see the references above.

TABLE 2-2

PROTECTED BIRD SPECIES
NAWS CHINA LAKE, CALIFORNIA
PAGE 1 OF 2

Common and Proper Names	Federal Endangered or Threatened	Under Consideration for Federal Endangered or Threatened Status	Protected by the State of California
Fulvous Whistling-duck (Dendrocygna bicolor)		(a)	(d)
Swainson's hawk (Buteo swainsoni)		(a)	(e)
Ferruginous hawk (Buteo regalis)		(a)	
Long-billed curlew (Numenous americanus)		(a)	(d)
Tricolored blackbird (Agelaius tricolor)		(a)	(d)
Inyo brown towhee (Pipilofuscus eremophilus)	(f)		(c)
Golden eagle (Aquila chrysaetos)			(d)
Black-shouldered kite (Elanus caeruleus (leucurus))			(d)
Bald eagle (Halaetus leucocephalus)	(b)		(c,d)
Peregrine falcon (Falco peregrinus anatum)	(b)		(c,d)
Brown pelican (Pelicanus occidentalis californicus)	(b)		(c,d)
White-faced ibis (Plegadus chihi)		(a)	(d)
Snowy plover (Charadrius alexandrinus civosus)		(a)	(d)
Least Bell's vireo (vireo bellii busillus)	(b)		(c)
Common loon (Gavia immer)			(d)
American white pelican (Pelicanus erythrorynchos)			(d)
Double-crested cormorant (Phalacrocorax auritus)			(d)
Osprey (Pandion halieaetus)			(d)
Northern harrier (Circus cyaneus)			(d)
Sharp-shinned hawk (accipiter striatus)			(d)
Cooper's hawk (Accipiter cooperii			(d)
Northern goshawk (Accipiter gentilis)			(d)
Prairie falcon (Falco mexicanus)			(d)
California gull (Larus californicus)			(d)
Burrowing owl (Tyto alba)			(d)
Long-eared owl (Asio otus)			(d)

TABLE 2-2

PROTECTED BIRD SPECIES
NAWS CHINA LAKE, CALIFORNIA
PAGE 2 OF 2

Common and Proper Name	Federal Endangered or Threatened	Under Consideration for Federal Endangered or Threatened Status	Protected by the State of California
Short-eared owl (Asio flammeous)			(d)
Willow flycatcher (Empidonax trailii)			(d)
Vermilion flycatcher (Pyrocephalus rubinus)			(d)
Purple martin (Progne subis)			(d)
Bank swallow (Riparia riparia)			(d)
Crissal thrasher (Toxostama dorsale)			(d)
Le Conte's thrasher (Toxostoma lecontei)			(d)
Gray vireo (Vireo vicinior)			
Virginia's warbler (Vermivora virginiae)			(d)
Yellow-breasted chat (Icteria virens)			(d)
Heptatic tanager (Piranga flava)			(d)
Summer tanager (Piranga rubra)			(d)
Black tern (Chlidonias niger)			(d)

Source: Innis - Tennebaum, 1989; Kohfield et al, 1985 (annotated 1990)

Notes:
(a) Federal Candidate Species, Category 2
(b) Federal Endangered Species
(c) California Endangered Species
(d) California Protected Species
(e) California Threatened Species
(f) Federal Threatened Species

Other species not included in these designations are also of special management concern; for more detail, see the references above.

TABLE 2-3

PROTECTED FISH AND REPTILE SPECIES
NAWS CHINA LAKE, CALIFORNIA

Common and Proper Name	Federal Endangered or Threatened	Under Consideration for Federal Endangered or Threatened Status	Protected by the State of California
Panamint alligator lizard (Gerrhonotus (Elgaria) panamintus)		(a)	(d)
Desert tortoise (Gopherus (xerobates) agassizi)		(a)	(c)
Mohave tui chub (Gila bicolor mohavensis)	(b)		(c,d)

Source: Innis - Tennebaum, 1989; Kohfield et al, 1985 (annotated 1990)

Notes:

(a) Federal Candidate Species, Category 2
(b) Federal Endangered Species
(c) California Endangered Species
(d) California Protected Species
(e) California Threatened Species
(f) Federal Threatened Species

Other species not included in these designations are also of special management concern. For more detail, see the references above.

TABLE 2-4

PROTECTED MAMMAL SPECIES
NAWS CHINA LAKE, CALIFORNIA

Common and Proper Name	Federal Endangered or Threatened	Under Consideration for Federal Endangered or Threatened Status	Protected by the State of California
Nelson's bighorn sheep (Ovis canadensis nelsonii)			(d)
Mohave ground squirrel (Spermophilus mohavensis)		(a)	(e)
Spotted bat (Euderma maculata)		(a)	(d)
Western mastiff bat (Eumops perotis californicus)		(a)	(d)
Ringtail (Bassariscus astutus)			(d)
Mountain lion (Felis concolor)			(d)
Townsend's big-eared bat (Plecotus townsendii pallescens)			(d)
Badger (Taxidea taxus)			(d)
California myotis (Myotis californicus)			(d)
Little pocket mouse (Perognathus longimembris)			(d)

Source: Innis - Tennebaum, 1989; Kohfield et al, 1985 (annotated 1990)

Notes:

(a) Federal Candidate Species, Category 2
(b) Federal Endangered Species
(c) California Endangered Species
(d) California Protected Species
(e) California Threatened Species
(f) Federal Threatened Species

Other species not included in these designations are also of special management concern; for more detail, see the references above.

TABLE 2-5

SITES PREVIOUSLY INVESTIGATED
NAWS CHINA LAKE, CALIFORNIA
PAGE 1 OF 3

		Initial Assessment Study (Westec, 1984)		Confirmation Study (Stollar, 1988)		Phase I RI/FS (PRC & JMM, 1993)	
	Sites	**Investigated**	**Recommended for Further Study**	**Investigated**	**Recommended for RI/FS**	**Investigated**	**Recommened for Further RI/FS**
Site 1	**Armitage Field Dry Wells (a)**	X	(b)			X	
Site 2	**Aircraft Washdown Drainage Ditches**	X	(b)			X	
Site 3	Armitage Field Leach Pond	X	X	X			
Site 4	Beryllium Contaminated Equipment Disposal Area	X					
Site 5	Burro Canyon		X				
Site 6	T-Range Disposal Area	X					
Site 7	**Michelson Lab Drainage Ditches**	X	X	X	X	X	
Site 8	Salt Wells Drainage Channels	X				X	
Site 9	Salt Wells Asbestos Trenches	X					
Site 10	Salt Wells Disposal Trenches	X					
Site 11	China Lake Propulsion Lab Evaporation	X					
Site 12	**SNORT Road Landfill**	X	X	X	X	X	X
Site 13	**Oily Waste Disposal Area**	X	X	X	X	X	X
Site 14	ER Range Septic System	X	X	X			
Site 15	**R-Range Leach Field**	X	X	X	X	X	
Site 16	G-1 Range Septic System	X	X	X			
Site 17	G-2 Range Septic System	X	X	X			
Site 18	China Lake Propulsion Laboratory Leach Fields	X				X	
Site 19	Baker Range Waste Trenches	X					

TABLE 2-5

SITES PREVIOUSLY INVESTIGATED
NAWS CHINA LAKE, CALIFORNIA
PAGE 2 OF 3

		Initial Assessment Study (Westec, 1984)		Confirmation Study (Stollar, 1988)		Phase I RI/FS (PRC & JMM, 1993)	
	Sites	**Investigated**	**Recommended for Further Study**	**Investigated**	**Recommended for RI/FS**	**Investigated**	**Recommened for Further RI/FS**
Site 20	Division 36 Ordinance Waste Area	X					
Site 21	CT-4 Disposal Area	X					
Site 22	**Pilot Plant Road Landfill**	X	X	X	X	X	X
Site 23	K-2 South Disposal Area	X					
Site 24	K-2 North Disposal Area	X					
Site 25	G-2 Range Disposal Area	X					
Site 26	G Range Ordnance Waste Area	X					
Site 27	NAF Disposal Site	X	X	X			
Site 28	Old DPDO Storage Yard	X					
Site 29	**C-1 East Disposal Area**	X	X	X	X	X	
Site 30	C-1 Range West Disposal Area	X					
Site 31	**Public Works Pesticide Rinse Area**	X	X	X	X	X	
Site 32	**Golf Course Pesticide Rinse Area**	X	X	X	X	X	
Site 33	Michelson Lab Dry Wells	X					
Site 34	Lauritsen Road Landfill	X	X	X	(c)		
Site 35	SNORT Track Accident	X					
Site 36	SNORT Track Storage Sheds	X					
Site 37	Golf Course Landfill	X					
Site 38	Cactus Flat Disposal Trenches	X					

TABLE 2-5

SITES PREVIOUSLY INVESTIGATED
NAWS CHINA LAKE, CALIFORNIA
PAGE 3 OF 3

		Initial Assessment Study (Westec, 1984)		Confirmation Study (Stollar, 1988)		Phase I RI/FS (PRC & JMM, 1993)	
	Sites	**Investigated**	**Recommended for Further Study**	**Investigated**	**Recommended for RI/FS**	**Investigated**	**Recommened for Further RI/FS**
Site 39	CGEH-1 Geothermal Waste	X					
Site 40	Randsburg Wash #1	X					
Site 41	Randsburg Wash #2	X					
Site 42	Randsburg Wash #3	X					
Site 43	**Minideck**			X	X	X	
Site 44	**Armitage Field Fire Fighting Training Facility**					X	
Site 45	**NAF Maintenance Area**					X	

Sources: Westec, 1984
Stollar, 1988
PRC & JMM, 1993

Notes:

(a) Sites in bold type are present RI/FS sites.
(b) Investigation of these sites was being conducted as a separate activity under different funding (IT, 1986, 1987, 1988), and therefore were not recommened for further study under the IR program.
(c) Contamination in groundwater at this site was attributed to Site 7.

TABLE 2-6

SOIL ANALYSES RESULTS AT SITE 12
NAWS CHINA LAKE, CALIFORNIA

		RLS12-SBB2		JMM12-MW09				
		Jun-87		Feb-92				
Compounds/Parameters	**Units**	**0-5 ft**	**5-10 ft**	**1 ft**	**10 ft**	**25 ft**	**120 ft**	**130 ft**
Volatile Organic Compounds (a)	mg/kg	ND	ND					
Base/Neutral/Acids Extractables (b)	mg/kg	ND	ND					
Metals								
Chromium	mg/kg	2.9	4.1					
Copper	mg/kg	12	12					
Nickel	mg/kg	2.2	3.8					
Zinc	mg/kg	22	23					
Miscellaneous								
Oil and Grease	mg/kg	75,000	NA					
Geotechnical Parameters								
Water Content	%			6.3	4.8	3.6	18.9	22.6
Porosity	%			54.4	33.1	41.4	39.7	41.0
Dry Density	pcf			75.7	112.2	98.4	101.5	99.3
Bulk Density	pcf			80.4	117.6	101.9	120.6	121.7
Permeability	cm/s			1.7E-04	2.3E-07	9.6E-04	7.0E-03	5.5E-07
Permeability (c)	ft/day			4.8E-01	6.5E-04	2.7E-00	2.0	1.6E-03
Median Grain Size	mn			0.3	0.5	0.1	0.6	0.5
(50th Percentile, mm)				(fine sand)	(medium sand)	(fine sand)	(medium sand)	(medium sand)
TOC	mg/kg			460	20	36	53	20
Grain Size Distribution (d)								
Gravel	%			0.5	11	0	0	0
Sand	%			74	69	54	93.5	91
Silt	%			16	5	42	6	4
Clay	%			9.5	15	4	0.5	5

Source: Stollar, 1988; PRC, 1993 (TM-3)

Notes:
(a) EPA Method 8240
(b) EPA Method 8270
(c) Permeability converted from cm/s value reported by laboratory
(d) Estimated from Particle Diameter Graph

Abbreviations:
NA - Not Analyzed
pcf - pounds per cubic foot
mm - millimeter
ND - Not Detected
cm/s - centimeters per second
TOC - Total Organic Carbon
ft/day - feet per day

TABLE 2-7

GROUNDWATER ANALYSES RESULTS AT SITE 12
NAWS CHINA LAKE, CALIFORNIA
PAGE 1 of 6

		Well Location														
		RLS12-MW01			RLS12-MW02			RLS12-MW03			RLS12-MW04			RLS12-MW05		
Compound/Parameters	**Units**	**Aug-87**	**Feb-92**	**May-96**	**Aug-87**	**Feb-92**	**May-96**	**Aug-87**	**Feb-92**	**May-96**	**Aug-87**	**Feb-92**	**May-96**	**Aug-87**	**Feb-92**	**May-96**
Volatile Organics Compounds (a)																
Carbon Disulfide	µg/l		< 10 U (b)	< 10 U		1.0	< 10 U		3.0	< 10 U		< 5 U	< 10 U		2.0 J	< 10 U
Benzene	µg/l	< 0.1		< 10 U	0.1		< 10 U	< 0.1		< 10 U	< 0.1		< 10 U	0.1		< 10 U
1,1-Dichloroethene	µg/l	< 0.1		< 10 U	0.1		< 10 U	< 0.1		< 10 U	0.3		< 10 U	0.1		< 10 U
Ethylbenzene	µg/l	0.3		< 10 U	1.0		< 10 U	0.2		< 10 U	1.4		< 10 U	0.5		< 10 U
Toluene	µg/l	< 0.5		4.0 J	1.0		< 10 U	< 0.5		1.0 J	1.0		< 10 U	1.0		< 10 U
1,1,1-Trichloroethane	µg/l	2.5		< 10 U	8.2		< 10 U	1.3		< 10 U	14.0		< 10 U	3.3		< 10 U
1,1,2-Trichloroethane	µg/l	0.4		< 10 U	1.2		< 10 U	0.3		< 10 U	0.7		< 10 U	1.0		< 10 U
Trichlorofluoromethane	µg/l	< 1			< 1			< 1			1.8			2.0		
Acetone	µg/l	14.0		< 10 U	54.0		< 10 U	23.0		< 10 U	15.0		< 10 U	< 10		< 10 U
m,p-Xylenes	µg/l	0.7		< 10 U	0.2		< 10 U	0.5		< 10 U	2.5		< 10 U	1.0		< 10 U
o-Xylene	µg/l	< 0.1		< 10 U	< 0.1		< 10 U	0.1		< 10 U	0.3		< 10 U	0.2		< 10 U
Semi-Volatile																
Pyrene	µg/l		< 10 U	< 10 U		< 10 U	< 10 U		10.0	< 10 U		< 10 U	< 10 U		< 10 U	< 10 U
Hydrocarbons																
Other HC as Diesel	µg/l		< 50 U			< 50 U			58.0			< 50 U			< 50 U	
Fuel Oil # 2	µg/l			< 100 U			< 100 U			< 100 U			< 100 U			< 100 U
JP 5 Range Organics	µg/l			< 100 U			< 100 U			< 100 U			< 100 U			< 100 U
Motor Oil Range Organics	µg/l			< 100 U			< 100 U			< 100 U			< 100 U			< 100 U

Source: Stollar, 1988
TM3, 1993

Notes: (a) EPA Method 624
(b) Data Qualifiers: U = Material was analyzed, but not detected. The numerical value is the sample quantitation limit. J = The numerical value is an estimated quantity.
(c) Converted from mg/l.
(d) Isotope not reported.

Abbreviations:

NA - Not Analyzed	µmhos/cm - micromhos per centimeter
µg/l - micrograms per liter	MPN - Most Probable Number per 100 milliliters
pCi/l - picoCuries per liter	mg/l - milligrams per liter

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NAWS CHINA LAKE, CALIFORNIA
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GROUNDWATER ANALYSES RESULTS AT SITE 12
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		Well Location														
		RLS12-MW01			RLS12-MW02			RLS12-MW03			RLS12-MW04			RLS12-MW05		
Compound/Parameters	**Units**	**Aug-87**	**Feb-92**	**May-96**	**Aug-87**	**Feb-92**	**May-96**	**Aug-87**	**Feb-92**	**May-96**	**Aug-87**	**Feb-92**	**May-96**	**Aug-87**	**Feb-92**	**May-96**
Metals																
Arsenic	µg/l	< 10 (c)	< 5 U	2.8 B	30.0 (c)	30.2 J	37.0	15.0 (c)	17.1 J	18.9	13.0 (c)	11.8 J	10.6	4.0 (c)	9.8	11.0
Barium	µg/l	24.0 (c)	38.1	41.3 B	< 12	< 2 U J	6.3 B	< 12 (c)	< 4.1 U J	6.7 B	30.0 (c)	< 35.1 U J	25.6 B	120.0 (c)	21.3	10.0 B
Calcium	µg/l		33,300 J	34,800		28,600	33,000		24,300	29,300		37,900	40,500		27,000 J	33,400
Copper	µg/l		< 10 U	18.7 B		< 3.1 U J	22.7 B		< 4.3 U J	33.7		< 2 U	15.5 B		< 10 U	13.5 B
Iron	µg/l		11.3 J	1,100.0		< 7.1 U J	237.0		< 18.8 U J	179.0		< 5 U	73.2 B		61.0 J	57.7 B
Magnesium	µg/l		5,160 J	5,830		7,500	8,910		6,940	8,060		11,500	12,400		6,580 J	10,300
Manganese	µg/l		< 15 U	24.0		11.9	19.7		< 6.5 U J	8.3 B		< 1 U J	2.4 B		< 15 U	11.6 B
Molybdenum	µg/l		< 10 U	< 9.1 U		18.8	14.4 B		14.8	17.4 B		13.4	22.1 B		< 10 U	14.2 B
Potassium	µg/l		12,200 J	12,100		9,800	10,300		11,200	9,970		4,960	3,050 B		7,660 J	6,570
Silver	µg/l	18.0 (c)		< 5.9 U	< 500 (c)		< 5.9 U	< 500 (c)		< 5.9 U	< 500 (c)		< 5.9 U	14.0 (c)		< 5.9 U
Sodium	µg/l		42,100 J	44,700		31,500	33,000		32,600	33,600		32,800	32,500		29,300 J	31,600
Vanadium	µg/l		< 10 U	9.9 B		< 4 U	< 5.7 U		< 4 U	6.6 B		15.0	22.2 B		24.2	17.9 B
Zinc	µg/l		43.2 J	88.4		< 13.2 U J	26.5		< 13.2 U	54.4		< 21.4 U J	14.5 B		21.2 J	72.2
Radionuclides																
Gross Alpha Activity	pCi/l	4.7	680 ± 200	0.9	3.9	11.33 ± 9.05	4.8	0.8	24.72 ± 6.12	1.2	4.5	7.41 ± 3.63	8.3	1.5	4.7 ± 4.0	1.8
Gross Beta Activity	pCi/l	16.0	420 ± 90	7.7	10.0	6.19 ± 2.71	21.0	9.4	12.82 ± 2.77	8.1	7.1	3.49 ± 2.94	4.0	-	9.1 ± 3.5	8.4
Radium 226	pCi/l	0.5 (d)	NA	0.5	11.0 (d)	NA		2.4 (d)	NA		0.2 (d)	NA		0.9	NA	
Radium 228	pCi/l		NA	0.5		NA			NA			NA			NA	
Uranium 235	pCi/l		NA			NA			NA			NA			NA	
Uranium 238	pCi/l		NA			NA			NA			NA			NA	
Cesium 137	pCi/l			14.0												

Source: Stollar, 1988
TM3, 1993

Notes: (a) EPA Method 624
(b) Data Qualifiers: U = Material was analyzed, but not detected. The numerical vlaue is the sample quantitation limit. J = The numerical value is an estimated quantity.
(c) Converted from mg/l.
(d) Isotope not reported.

Abbreviations:
NA - Not Analyzed
µg/l - micrograms per liter
pCi/l - picoCuries per liter
µmhos/cm - micromhos per centimeter
MPN - Most Probable Number per 100 milliliters
mg/l - milligrams per liter

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GROUNDWATER ANALYSES RESULTS AT SITE 12
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		Well Location														
		RLS12-MW01			RLS12-MW02			RLS12-MW03			RLS12-MW04			RLS12-MW05		
Compound/Paramete	**Units**	**Aug-87**	**Feb-92**	**May-96**	**Aug-87**	**Feb-92**	**May-96**	**Aug-87**	**Feb-92**	**May-96**	**Aug-87**	**Feb-92**	**May-96**	**Aug-87**	**Feb-92**	**May-96**
General Chemistry																
Alkalinity	µg/l		150,000	121,000		114,000	96,500		106,000	99,500		111,000	112,000		91,000	98,100
Ammonia as N	µg/l		< 100 U	< 50 U		< 50 U	< 50 U		53.0	50.6		< 50 U	< 50 U		< 100 U	< 50 U
Bicarbonate	µg/l		150,000	121,000		114,000	96,500		106,000	99,500		111,000	112,000		73,000	98,100
Carbonate	µg/l		< 1000 U	< 5,000 U		< 1000 U	< 5,000 U		1,000.0	< 5,000 U		< 1000 U	< 5,000 U		12,000.0	< 5,000 U
Chloride	µg/l		27,000	33,600		27,400	36,400		23,900	27,600		35,000	39,300		23,000	31,300
Fluoride	µg/l	590	620	580	610 (c)	680	490	620 (c)	740	560	690 (c)	700	530	620 (c)	980	560
Nitrate as N	µg/l	< 40	< 100 U		< 40 (c)	< 40 U		< 40 (c)	40.0		810.0 (c)	830.0		< 40 (c)	< 100 U	
Nitrite as N	µg/l		< 100 U			< 40 U			40.0			< 40 U			< 100 U	
Nitrate/Nitrite as N	µg/l			68.5			< 50 U			< 50 U			1,220			< 50 U
Orthophosphate	µg/l		170	< 500 U		450	< 500 U		290	< 500 U		490	< 500 U		< 100 U	< 500 U
Sulfate	µg/l		36,000	39,900		51,200	57,300		41,400	39,200		35,800	55,100		53,000	114,000
TKN	µg/l		< 100 U	56.9		NA	< 50 U		-	139.0		NA	< 50 U		< 100 U	< 50 U
TOC	µg/l		< 500 U	< 1,000 U		< 1000 U	< 1,000 U		1,000	1,130		< 1000 U	< 1,000 U		< 500 U	< 1,000 U
TDS	µg/l		320,000	285,000		313,000	303,000		256,000	287,000		395,000	331,000		280,000	302,000
Total Phosphorus	µg/l		160.0			50.0			230.0			< 50 U			260.0	
Biological																
Total Coliform	MPN/100 ml	< 2.2	< 2.2 U		2.2	< 2.2 U		2.2	< 2.2 U		16.0	< 2.2 U		< 2.2	< 2.2 U	
Miscellaneous																
pH		9.18			8.00			7.99			8.02			10.36		
Specific Conductance	µmhos	319			397			369			442			425		

Source: Stollar, 1988
TM3, 1993

Notes: (a) EPA Method 624
(b) Data Qualifiers: U = Material was analyzed, but not detected. The numerical vlaue is the sample quantitation limit. J = The numerical value is an estimated quantity.
(c) Converted from mg/l.
(d) Isotope not reported.

Abbreviations:
NA - Not Analyzed
µg/l - micrograms per liter
pCi/l - picoCuries per liter
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MPN - Most Probable Number per 100 milliliters
mg/l - milligrams per liter

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GROUNDWATER ANALYSES RESULTS AT SITE 12
NAWS CHINA LAKE, CALIFORNIA
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		Well Location								
		JMM12-MW06		JMM12-MW07		JMM12-MW08		JMM12-MW09		JMM12-MW09 (Dup)
Compound/Parameters	**Units**	**Apr-92**	**May-96**	**Apr-92**	**May-96**	**Apr-92**	**May-96**	**Apr-92**	**May-96**	**Apr-92**
Volatile Organics Compounds (a)										
Carbon Disulfide	µg/l	1.0	< 10 U	< 0.5 U	< 10 U	< 0.5 U	< 10 U	3.0	< 10 U	< 0.5 U
Benzene	µg/l		< 10 U		< 10 U		< 10 U		< 10 U	
1,1-Dichloroethene	µg/l		< 10 U		< 10 U		< 10 U		< 10 U	
Ethylbenzene	µg/l		< 10 U		< 10 U		< 10 U		< 10 U	
Toluene	µg/l		< 10 U		< 10 U		< 10 U		< 10 U	
1,1,1-Trichloroethane	µg/l		< 10 U		< 10 U		< 10 U		< 10 U	
1,1,2-Trichloroethane	µg/l		< 10 U		< 10 U		< 10 U		< 10 U	
Trichlorofluoromethane	µg/l									
Acetone	µg/l		< 10 U		< 10 U		< 10 U		< 10 U	
m,p-Xylenes	µg/l		< 10 U		< 10 U		< 10 U		< 10 U	
o-Xylene	µg/l		< 10 U		< 10 U		< 10 U		< 10 U	
Semi-Volatile										
Pyrene	µg/l	< 10 U	< 10 U	< 10 U	< 10 U	1.0 J	< 10 U	< 10 U	< 10 U	NA
Hydrocarbons										
Other HC as Diesel	µg/l	< 50 U		< 50 U		< 50 U		< 50 U		NA
Fuel Oil # 2	µg/l		< 100 U		< 100 U		< 100 U		< 100 U	
JP 5 Range Organics	µg/l		< 100 U		< 100 U		< 100 U		< 100 U	
Motor Oil Range Organics	µg/l		< 100 U		< 100 U		< 100 U		< 100 U	

Source: Stollar, 1988
TM3, 1993

Notes: (a) EPA Method 624
(b) Data Qualifiers: U = Material was analyzed, but not detected. The numerical vlaue is the sample quantitation limit. J = The numerical value is an estimated quantity.
(c) Converted from mg/l.
(d) Isotope not reported.

Abbreviations:
NA - Not Analyzed
µg/l - micrograms per liter
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MPN - Most Probable Number per 100 milliliters
mg/l - milligrams per liter

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NAWS CHINA LAKE, CALIFORNIA
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GROUNDWATER ANALYSES RESULTS AT SITE 12
NAWS CHINA LAKE, CALIFORNIA
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		JMM12-MW06			JMM12-MW07			JMM12-MW08			JMM12-MW09			JMM12-MW09 (Dup)
Compound/Parameters	**Units**	**Apr-92**	**May-96**		**Apr-92**	**May-96**		**Apr-92**	**May-96**		**Apr-92**	**May-96**		**Apr-92**
Metals														
Arsenic	µg/l	9.8	6.9	B	5.9	6.6	B	27.0	27.5		26.2	17.0		NA
Barium	µg/l	27.0	45.7	B	< 10 U	7.2	B	< 10 U	24.9	B	10.9	90.0	B	NA
Calcium	µg/l	22,400 J	37,300		30,400 J	36,100		34,000 J	40,300		33,400 J	143,000		NA
Copper	µg/l	14.0	14.1	B	< 10 U	14.5	B	< 10 U	10.8	B	< 10 U	24.0	B	NA
Iron	µg/l	45.0 J	1,170		11.6 J	118		< 10 U J	474		16.9 J	293.0		NA
Magnesium	µg/l	6,870 J	11,300		8,130 J	10,200		10,100 J	13,000		9,910 J	46,800		NA
Manganese	µg/l	< 15 U	31.5		< 15 U	4.9	B	< 15 U	9	B	< 15 U	5.7	B	NA
Molybdenum	µg/l	< 10 U	15.2	B	< 10 U	14.4	B	< 10 U	17.4	B	< 10 U	12.4	B	NA
Potassium	µg/l	19,200 J	9,970		9,860 J	8,470		< 7320 U J	7,580		8,000 J	12,200		NA
Silver	µg/l		< 5.9	U		< 5.9	U		< 5.9	U		< 5.9	U	
Sodium	µg/l	45,100 J	40,100		31,800 J	35,900		31,900 J	35,200		34,900 J	70,000		NA
Vanadium	µg/l	19.4	31.1	B	13.0	24.5	B	< 10 U	18.2	B	< 10 U	16.8	B	NA
Zinc	µg/l	20.5 J	34.2		18.1 J	17.8	B	< 10 U J	14.5	B	19.1 J	29.2		NA
Radionuclides														
Gross Alpha Activity	pCi/l	35 ± 9.2	2.0		35 ± 9.2	1.9		21 ± 8.0	10.1		33 ± 12	27.4		2.12 ± 6.36
Gross Beta Activity	pCi/l	38 ± 4.7	4.9		38 ± 4.7	5.5		13 ± 4.3	5.6		33 ± 6.0	14.1		8.97 ± 3.15
Radium 226	pCi/l	3.5 ± 0.1			NA			2.6 ± 0.1			1.9 ± 0.1 / 1.3 ± 0.1			NA
Radium 228	pCi/l	4.1 ± 2.3			NA			4.8 ± 2.2			3.7 / 3.5 U			NA
Uranium 235	pCi/l	).12 ± 0.11			NA			< 0.24 U			NA			NA
Uranium 238	pCi/l	2.16 ± 0.54			NA			7.37 ± 1.83			NA			NA

Source: Stollar, 1988
TM3, 1993

Notes: (a) EPA Method 624
(b) Data Qualifiers: U = Material was analyzed, but not detected. The numerical vlaue is the sample quantitation limit. J = The numerical value is an estimated quantity.
(c) Converted from mg/l.
(d) Isotope not reported.

Abbreviations:
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MPN - Most Probable Number per 100 milliliters
mg/l - milligrams per liter

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GROUNDWATER ANALYSES RESULTS AT SITE 12
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Compound/Parameters	Units	JMM12-MW06 Apr-92	JMM12-MW06 May-96	JMM12-MW07 Apr-92	JMM12-MW07 May-96	JMM12-MW08 Apr-92	JMM12-MW08 May-96	JMM12-MW09 Apr-92	JMM12-MW09 May-96	JMM12-MW09 (Dup) Apr-92
General Chemistry										
Alkalinity	µg/l	140,000	109,000	100,000	94,900	110,000	64,300	12,000	118,000	NA
Ammonia as N	µg/l	690.0	< 50 U	< 100 U	< 50 U	420.0	< 50 U	280.0	< 50 U	NA
Bicarbonate	µg/l	140,000	109,000	100,000	94,900	< 110000 U	64,300	120,000	118,000	NA
Carbonate	µg/l	< 1000 U	< 5,000 U	< 1000 U	< 5,000 U	< 1000 U	< 5,000 U	< 1000 U	< 5,000 U	NA
Chloride	µg/l	30,000	32,200	26,000	30,700	27,000	38,300	25,000	239,000	NA
Fluoride	µg/l	620	470	560	460	320	620	680	370.0	NA
Nitrate as N	µg/l	1,600.0		710.0		1,200.0		740.0		NA
Nitrite as N	µg/l	< 100 U		< 100 U		< 100 U		< 100 U		NA
Nitrate/Nitrite as N	µg/l		1,440		674		1,550		17,800	
Orthophosphate	µg/l	750	< 500 U	< 100 U	< 500 U	410	< 500 U	240	< 500 U	NA
Sulfate	µg/l	59,000	77,900	57,000	63,900	60,000	170,000	55,000	221,000	NA
TKN	µg/l	< 100 U	< 50 U	< 100 U	< 50 U	< 100 U	< 50 U	< 100 U	97.1	NA
TOC	µg/l	< 500 U	< 1,000 U	500	< 1,000 U	< 500 U	< 1,000 U	< 500 U	< 1,000 U	NA
TDS	µg/l	330,000	277,000	300,000	279,000	310,000	299,000	310,000	1,090,000	NA
Total Phosphorus	µg/l	< 100 U		190.0		340.0		260.0		NA
Biological										
Total Coliform	MPN/100 ml	< 2.2 U		< 2.2 U		< 2.2 U		> 16		NA
Miscellaneous										
pH										
Specific Conductance	µmhos/cm									

Source: Stollar, 1988
TM3, 1993

Notes: (a) EPA Method 624
(b) Data Qualifiers: U = Material was analyzed, but not detected. The numerical vlaue is the sample quantitation limit. J = The numerical value is an estimated quantity.
(c) Converted from mg/l.
(d) Isotope not reported.

Abbreviations:
NA - Not Analyzed
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MPN - Most Probable Number per 100 milliliters
mg/l - milligrams per liter

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GROUNDWATER ANALYSES RESULTS AT SITE 12
NAWS CHINA LAKE, CALIFORNIA
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TABLE 2-8

GROUNDWATER ANALYSES RESULTS FOR EXPLORATORY BORINGS AT SITE 12
NAWS CHINA LAKE, CALIFORNIA

		FEBRUARY, 1992				
		JMM12-SB01		JMM12-SB02		JMM12-SB03
Compounds/Parameters	**Units**	**215 ft**	**295 ft**	**197 ft**	**296 ft**	**197 ft**
Volative Organics Compounds						
Carbon Sulfide	µg/l	< 5 U	1 J	< 5 U	< 5 U	< 5 U
1,1,1-Trichloroethane	µg/l	< 5 U	< 5 U	2 J	< 5 U	< 5 U
General Chemistry						
Alkalinity	µg/l	220000	410000	120000	360000	140000
Ammonia as N	µg/l	1300	5200	270	3200	3000
Bicarbonate	µg/l	210000	280000	120000	290000	140000
Carbonate	µg/l	10000	130000	< 1000 U	67000	< 1000 U
Chloride	µg/l	15000	14000	20000	9700	18000
Fluoride	µg/l	3600	5800	920	360	1900
Nitrate as N	µg/l	< 100 U	950	< 100 U	< 100 U	< 100 U
Phosphate	µg/l	4100	4700	320	3200	1800
Sulfate	µg/l	4000	8100	22000	2000	2100
TKN	µg/l	2200	4000	330	3900	2500
TOC	µg/l	4700	5400	1000	3900	1800
Total Dissolved Solids	µg/l	300000	570000	220000	370000	200000
Total Phosphorous	µg/l	4100	5600	420	3100	1900
Radionuclides						
Gross Alpha	pCi/l	680 ± 200	1100 ± 410	140 ± 42	1800 ± 310	430 ± 120
Gross Beta	pCi/l	420 ± 90	1500 ± 240	110 ± 20	720 ± 120	300 ± 51
Radium 226	pCi/l	NA	NA	NA	149 ± 1	NA
Radium 228	pCi/l	NA	NA	NA	57.3 ± 9.5	NA
Uranium 235	pCi/l	NA	NA	NA	1.24 ± 0.36 / 1.49 ± 0.42	NA
Uranium 238	pCi/l	NA	NA	NA	36.26 ± 5.14 / 37.12 ± 5.36	NA
Biological						
Coliform	MPN/100 ml	5.1	< 2.2 U	NA	NA	< 2.2 U
Metals						
Arsenic	µ/l	27.9	27	< 5 U	24.2	11.1
Calcium	µ/l	3180 J	680 J	15200 J	1040 J	6140 J
Copper	µ/l	14.4	20.2	< 10 U	< 10 U	< 10 U
Magnesium	µ/l	568 J	< 200 U	3810 J	< 200 U J	1050 J
Potassium	µ/l	9600 J	6450 J	13400 J	6940 J	10000 J
Sodium	µ/l	92100 J	221000 J	45400 J	131000 J	63900 J

Source: PRC, 1993 (TM-3)

Note: (a) Data Qualifiers: U = Material was analyzed, but not detected. The numerical value is the sample quantitation limit.
J = The numerical value is an estimated quantity.

Abbreviation: NA - Not Analyzed
MPN - Most Probable Number
µg/l - micrograms per liter
pCi/l - picoCuries per liter

TABLE 2-9

GROUNDWATER ANALYSES RESULTS AT SITE 22
NAWS CHINA LAKE, CALIFORNIA
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		Well Location								
		RLS22-MW01		RLS22-MW02		RLS22-MW03		RLS22-MW04		RLS22-MW02(Dup)
Compound/Parameters	**Units**	**Aug-87**	**May-96**	**Aug-87**	**May-96**	**Aug-87**	**May-96**	**Aug-87**	**May-96**	**May-96**
Volatile Organic Compounds (a)										
Benzene	µg/l	< 0.1	< 10 U	< 0.1	< 10 U	0.10	< 10 U	0.30	< 10 U	< 10 U
Chloroform	µg/l	0.3	< 10 U	0.30	< 10 U	0.30	< 10 U	0.10	< 10 U	< 10 U
Dichlorobromomethane	µg/l	< 0.1		< 0.1		0.10		< 0.1		
1,1-Dichloroethane	µg/l	< 0.1	< 10 U	< 0.1	< 10 U	< 0.1	< 10 U	0.10	< 10 U	< 10 U
1,1-Dichloroethene	µg/l	< 0.1	< 10 U	0.30	< 10 U	< 0.1	< 10 U	< 0.1	< 10 U	< 10 U
1,1-Dichloropropane	µg/l	< 0.1		< 0.1		< 0.1		0.10		
Ethylbenzene	µg/l	0.2	< 10 U	2.20	< 10 U	0.10	< 10 U	0.10	< 10 U	< 10 U
Tetrachloroethene	µg/l	< 0.1	< 10 U	< 0.1	< 10 U	< 0.1	< 10 U	0.20	< 10 U	< 10 U
Toluene	µg/l	< 0.5	1.0 J	2.00	< 10 U	< 0.5	< 10 U	< 0.5	< 10 U	< 10 U
1,1,1-Trichloroethane	µg/l	1.0	< 10 U	24.00	< 10 U	1.00	< 10 U	1.00	< 10 U	< 10 U
1,1,2-Trichloroethane	µg/l	< 0.1	< 10 U	1.10	< 10 U	< 0.1	< 10 U	< 0.1	< 10 U	< 10 U
Trichloroethene	µg/l	< 0.1	< 10 U	< 0.1	< 10 U	0.10	< 10 U	0.10	< 10 U	< 10 U
Trichlorofluoromethane	µg/l	< 0.1		< 1		< 5		< 5		
Acetone	µg/l	< 10	3.0 J	< 1	< 10 U	7.00	< 10 U	< 1	3.0 J	< 10 U
Methylethylketone	µg/l	< 1		< 1		5.10		< 1		
Tetrahydrofuran	µg/l	< 1	< 100 U	< 1	< 100 U	11.00	< 100 U	< 1	< 100 U	< 100 U
m,p-Xylenes	µg/l	0.5	< 10 U	0.20	< 10 U	0.20	< 10 U	0.20	< 10 U	< 10 U
o-Xylene	µg/l	0.2	< 10 U	< 0.1	< 10 U	< 0.1	< 10 U	< 0.1	< 10 U	< 10 U
Metals										
Arsenic	µg/l	35.0		13.0	12.5	20.0	79.6	NA	24.9	12.7
Barium	µg/l	39.0		54.0	59.2 B	35.0	35.7 B	NA	67.1 B	55.4 B
Selenium	µg/l	2.0		< 1	6.3	< 1	4.1 B	NA	< 1.5 U	4.1 B
Silver	µg/l	25.0		< 5	< 5.9 U	< 5	< 5.9 U	NA	< 5.9 U	< 5.9 U
Radionuclides										
Gross Alpha activity	pCi/l	15.0	40.9	11	21.3	11	22.6	11	17.7	22.1
Gross Beta Activity	pCi/l	13.0	9.1	19	9.9	15	5.0	14	10.2	10.0
Radium	pCi/l	0.1		0.50		0.00		0.10		
Miscellaneous										
pH		7.5		7.92		7.43		6.88		
Specific Conductance	µmhos/cm	NA		1200		1350		1890		
Total Coliforms	MPN/100 ml	< 2.2		< 2.2		< 2.2		< 2.2		
Fluoride	mg/l	0.7	2.020	0.53	0.460	0.57	0.990	0.38	0.550	0.440
Nitrate	mg/l	1.4		0.05		1.20		< 0.2		
Nitrate/Nitrite as N	µg/l		651		2,570		1,940		95.9	2,720

Source: Stollar, 1988

Notes: (a) EPA Method 624
(b) Data Qualifiers: U = Material was analyzed, but not detected. The numerical vlaue is the sample quantitation limit. J = The numerical value is an estimated quantity.
(c) Converted from mg/l.
(d) Isotope not reported.

Abbreviations:
NA - Not Analyzed
µg/l - micrograms per liter
pCi/l - picoCuries per liter
µmhos/cm - micromhos per centimeter
MPN - Most Probable Number per 100 milliliters
mg/l - milligrams per liter

TABLE 2-9

GROUNDWATER ANALYSES RESULTS AT SITE 22
NAWS CHINA LAKE, CALIFORNIA
PAGE 1 OF 2

TABLE 2-9

GROUNDWATER ANALYSES RESULTS AT SITE 22
NAWS CHINA LAKE, CALIFORNIA
PAGE 2 OF 2

		Well Location											
		RLS22-MW05			RLS22-MW06			RLS22-MW07			RLS22-MW08		
Compound/Parameters	**Units**	**Aug-87**	**May-96**		**Apr-92**	**May-96**		**Apr-92**	**May-96**		**Apr-92**	**May-96**	
Volatile Organic Compounds (a)													
Benzene	µg/l	0.10	< 10	U	0.10	< 10	U	0.10	< 10	U	0.20	< 10	U
Chloroform	µg/l	0.30	< 10	U	0.10	< 10	U	0.20	< 10	U	0.30	< 10	U
Dichlorobromomethane	µg/l	< 0.1			< 0.1			< 0.1			< 0.1		
1,1-Dichloroethane	µg/l	0.50	< 10	U	< 0.1	< 10	U	< 0.1	< 10	U	< 0.1	< 10	U
1,1-Dichloroethene	µg/l	0.10	< 10	U	< 0.1	< 10	U	0.20	< 10	U	< 0.1	< 10	U
1,1-Dichloropropane	µg/l	0.10			< 0.1			< 0.1			< 0.1		
Ethylbenzene	µg/l	0.70	< 10	U	0.10	< 10	U	1.30	< 10	U	0.30	< 10	U
Tetrachloroethene	µg/l	0.40	< 10	U	< 0.1	< 10	U	< 0.1	< 10	U	< 0.1	< 10	U
Toluene	µg/l	1.00	< 10	U	< 0.5	< 10	U	1.00	< 10	U	2.00	< 10	U
1,1,1-Trichloroethane	µg/l	8.10	< 10	U	1.00	< 10	U	11.00	< 10	U	0.30	< 10	U
1,1,2-Trichloroethane	µg/l	1.00	< 10	U	< 0.1	< 10	U	< 0.1	< 10	U	< 0.1	< 10	U
Trichloroethene	µg/l	0.40	< 10	U	< 0.1	< 10	U	< 0.1	< 10	U	< 0.1	< 10	U
Trichlorofluoromethane	µg/l	< 5			1.00			< 1			< 1		
Acetone	µg/l	< 1	< 10	U	< 1	< 10	U	< 1	< 10	U	< 10	< 10	U
Methylethylketone	µg/l	5.00			< 1			3.10			< 1		
Tetrahydrofuran	µg/l	2.00	< 100	U	< 1	14	J	< 1	< 100	U	< 1	< 100	U
m,p-Xylenes	µg/l	1.30	< 10	U	0.20	< 10	U	2.40	< 10	U	1.20	< 10	U
o-Xylene	µg/l	0.20	< 10	U	0.10	< 10	U	0.30	< 10	U	1.00	< 10	U
Metals													
Arsenic	µg/l	NA	22.9		12.0	11.5		NA	24.9		130.0	156.0	
Barium	µg/l	NA	206.0		140.0	71.8	B	NA	183.0	B	21.0	45.6	B
Selenium	µg/l	NA	4.7	B	2.0	10.0		NA	5.8		< 1	2.1	B
Silver	µg/l	NA	< 5.9	U	< 5	< 5.9	U	NA	< 5.9	U	17.0	< 5.9	U
Radionuclides													
Gross Alpha activity	pCi/l	17	59.2		10	20.0		19	55.0		26	49.3	
Gross Beta Activity	pCi/l	23	22.8		13	9.3		31	23.9		24	8.0	
Radium	pCi/l	0.00			1.40			0.10			1.60		
Radium 226	pCi/l		3.1						3.8			0.5	
Radium 228	pCi/l		2.9						2.7			2.8	
Uranium 238	pCi/l											16.6	
Uranium 235/236	pCi/l											4.0	
Uranium 234	pCi/l											23.0	
Cesium 137	pCi/l		11.8						12.8			11.7	
Miscellaneous													
pH		7.59			7.52			7.26			7.54		
Specific Conductance	µmhos/cm	1520			1200			1580			1490		
Total Coliforms	MPN/100	2.2			9.2			< 2.2			< 2.2		
Fluoride	mg/l	0.48	0.360		0.53	0.400		0.40	0.390		2.60	1.750	
Nitrate	mg/l	1.00			1.60			1.70			1.20		
Nitrate/Nitrite as N	µg/l		650			1,200			1,630			708	

Source: Stollar, 1988

Notes: (a) EPA Method 624
(b) Data Qualifiers: U = Material was analyzed, but not detected. The numerical vlaue is the sample quantitation limit. J = The numerical value is an estimated quantity.
(c) Converted from mg/l.
(d) Isotope not reported.

Abbreviations:
NA - Not Analyzed
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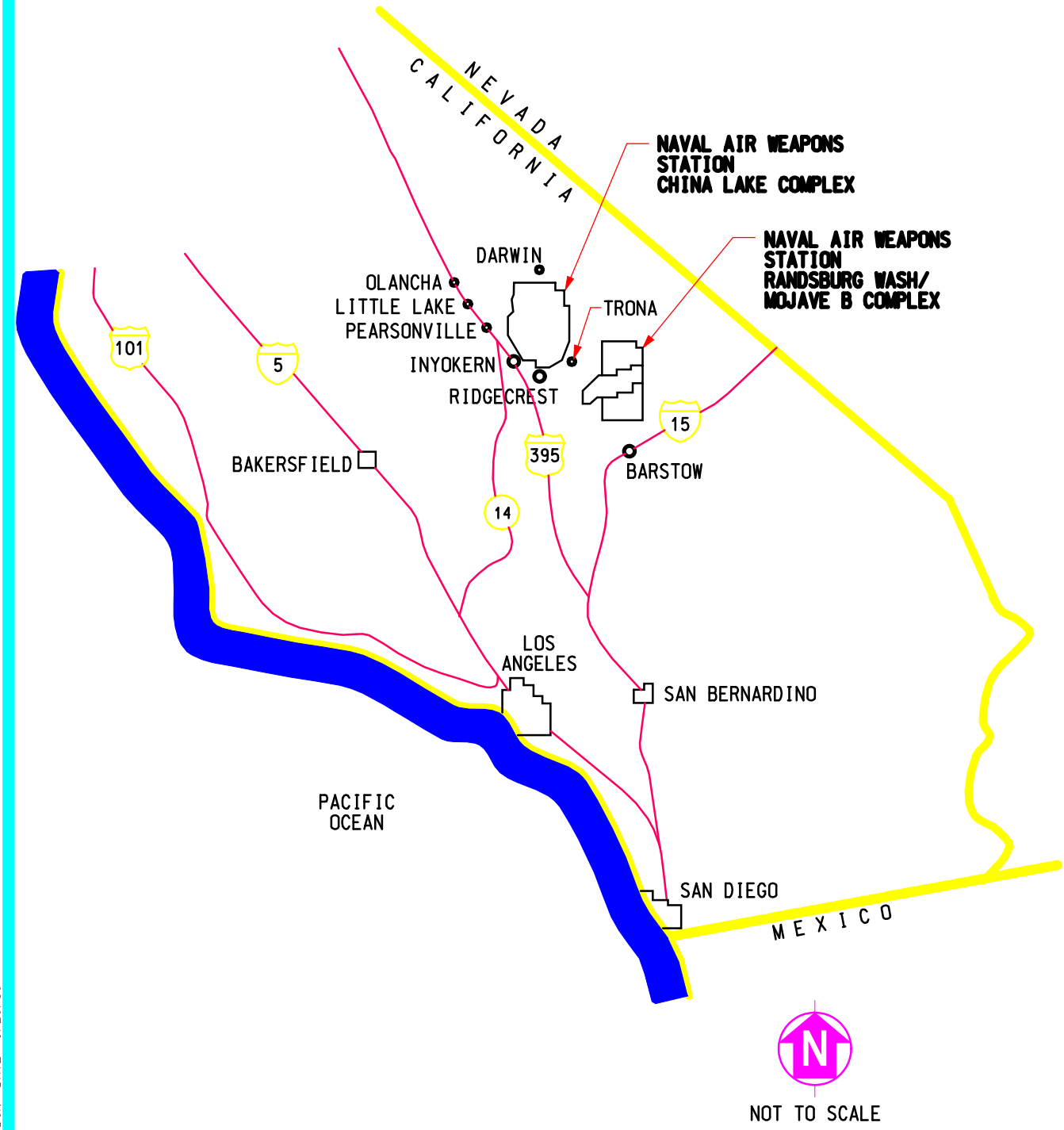
pCi/l - picoCuries per liter
µmhos/cm - micromhos per centimeter
MPN - Most Probable Number per 100 milliliters
mg/l - milligrams per liter

TABLE 2-9

GROUNDWATER ANALYSES RESULTS AT SITE 22
NAWS CHINA LAKE, CALIFORNIA
PAGE 2 OF 2



SOURCE: PRC AND MW, 1993

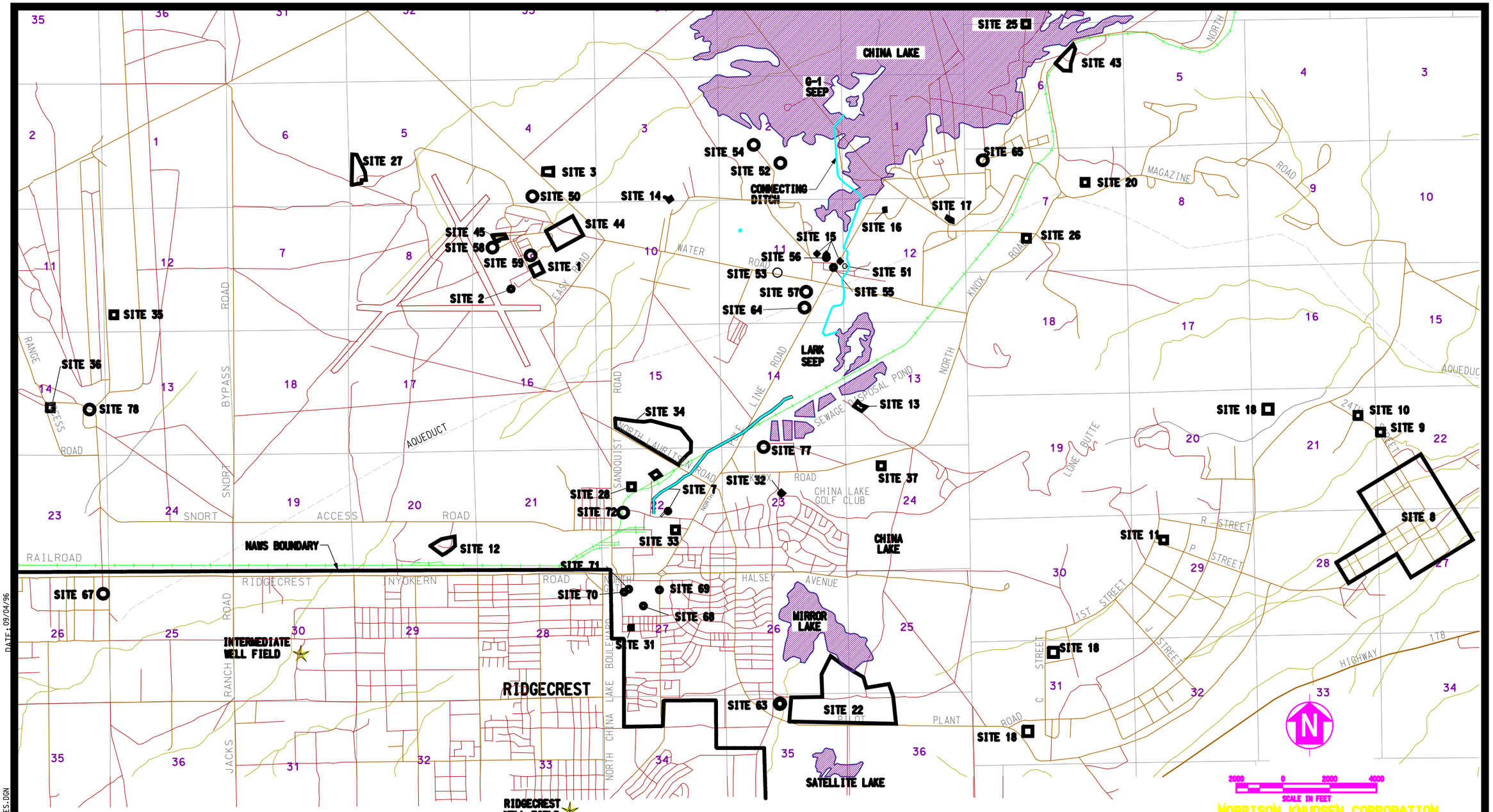
MORRISON KNUDSEN CORPORATION
NAWS CHINA LAKE, CALIFORNIA

FIGURE 2-1

LOCATION MAP

PROJECT NO.:	ORIGINATOR:	CHECKER:	DATE:
4545-0050	CFF	-	9/96

FILENAME: P:/4545CL/0050/4545LMAP.DGN DATE: 8/26/96



LEGEND

- PLAYA LAKE AND/OR WATER
- IRP SITE LOCATION
- MUNICIPAL WATER SUPPLY WELL FIELD
- ROAD
- RAILROAD TRACK
- CONNECTION DITCH
- NAWS BOUNDARY

DRAFT

SOURCE: PRC (DENVER). GIS DEPARTMENT. AUGUST 1996.

MORRISON KNUDSEN CORPORATION

NAWS CHINA LAKE, CALIFORNIA

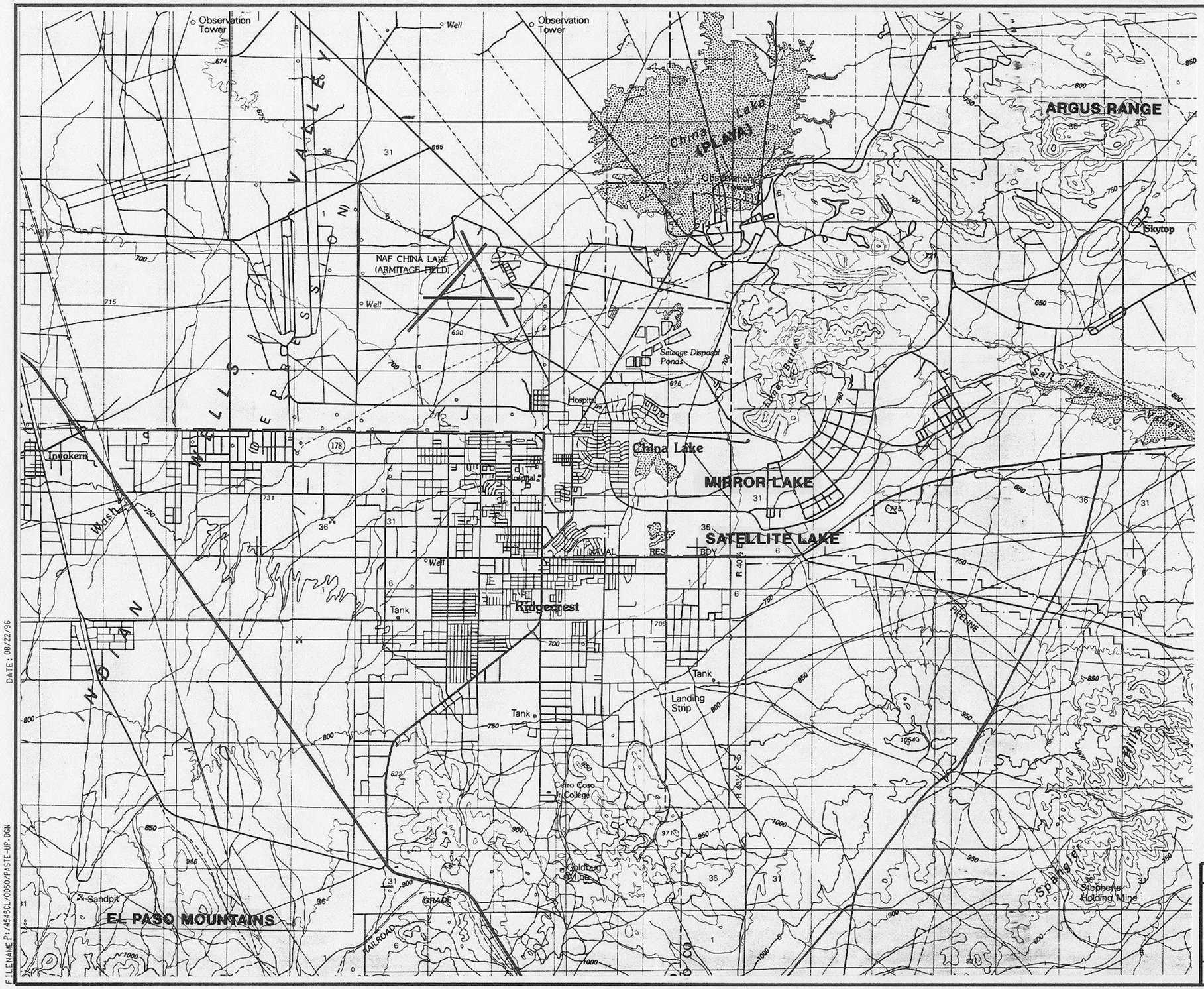
FIGURE 2-2

LOCATIONS OF RI SITES AND MUNICIPAL SUPPLY WELL FIELDS

PROJECT NO.:	ORIGINATOR:	CHECKER:	DATE:
4545-0050	RKT	–	9/96

DATE: 09/04/96

FILENAME: P:/4545CL/0050/RISITES.DGN



SOURCE: USGS 30 x 60 MINUTE TOPOGRAPHIC MAP No.35117-E1-TM100, RIDGECREST, CA, 1993.

DRAFT

N

1 0 1 2

SCALE IN MILES

MORRISON KNUDSEN CORPORATION

NAWS CHINA LAKE, CALIFORNIA

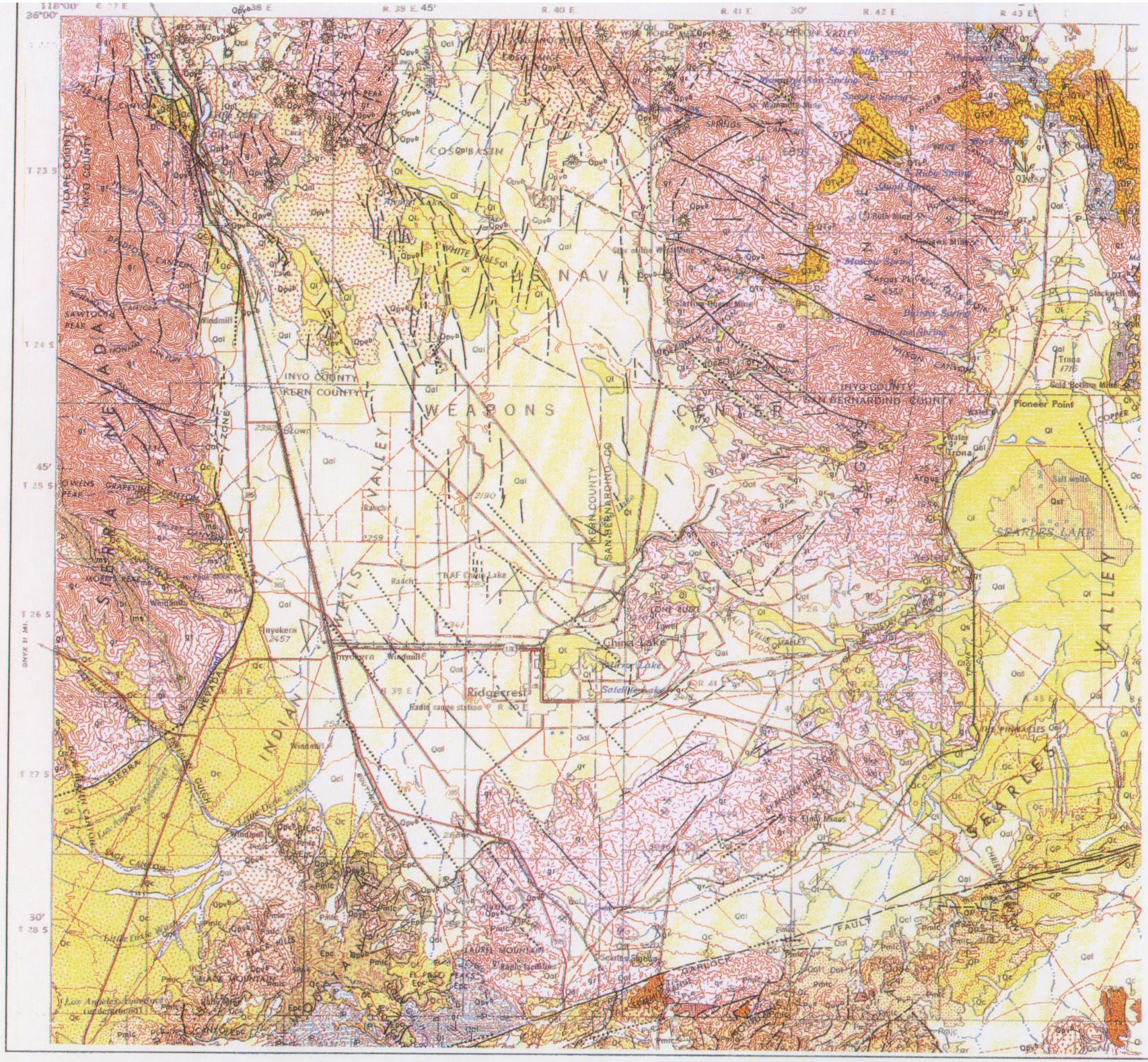
FIGURE 2-3

TOPOGRAPHIC MAP, INDIAN WELLS VALLEY AND SURROUNDING AREAS

PROJECT NO.:	ORIGINATOR:	CHECKER:	DATE:
4545-0050	CFF	-	9/96

FILENAME P:/4545CL/0050/PASTE-UP.DGN

DATE: 08/22/96



LEGEND

Quaternary

- Qal — Alluvium
- Qsf — Salt deposits
- Ql — Quaternary lake deposits
- Qc — Pleistocene nonmarine
- Qpv — Pleistocene volcanic
- QP — Plio-Pleistocene nonmarine
- QTv — Cenozoic volcanic

Tertiary

- Pmic — Middle and/or lower Pliocene
- Pv — Pliocene volcanic
- Epc — Paleocene nonmarine
- Ti — Tertiary intrusive (hypabyssal)
- Tv — Tertiary volcanic

Pre-Tertiary

- gr — Mesozoic granitic rocks
- ms — Pre-Cretaceous metasedimentary rocks
- ls — Paleozoic marine (ls=limestone or dolomite)

Contact (dashed where approximately located)

Contact (dashed where approximately located; dotted where inferred)

Source:
Modified from Geologic Map of California, Trona Sheet (California Division of Mines and Geology, 1982).

N

0 2 4
SCALE IN MILES

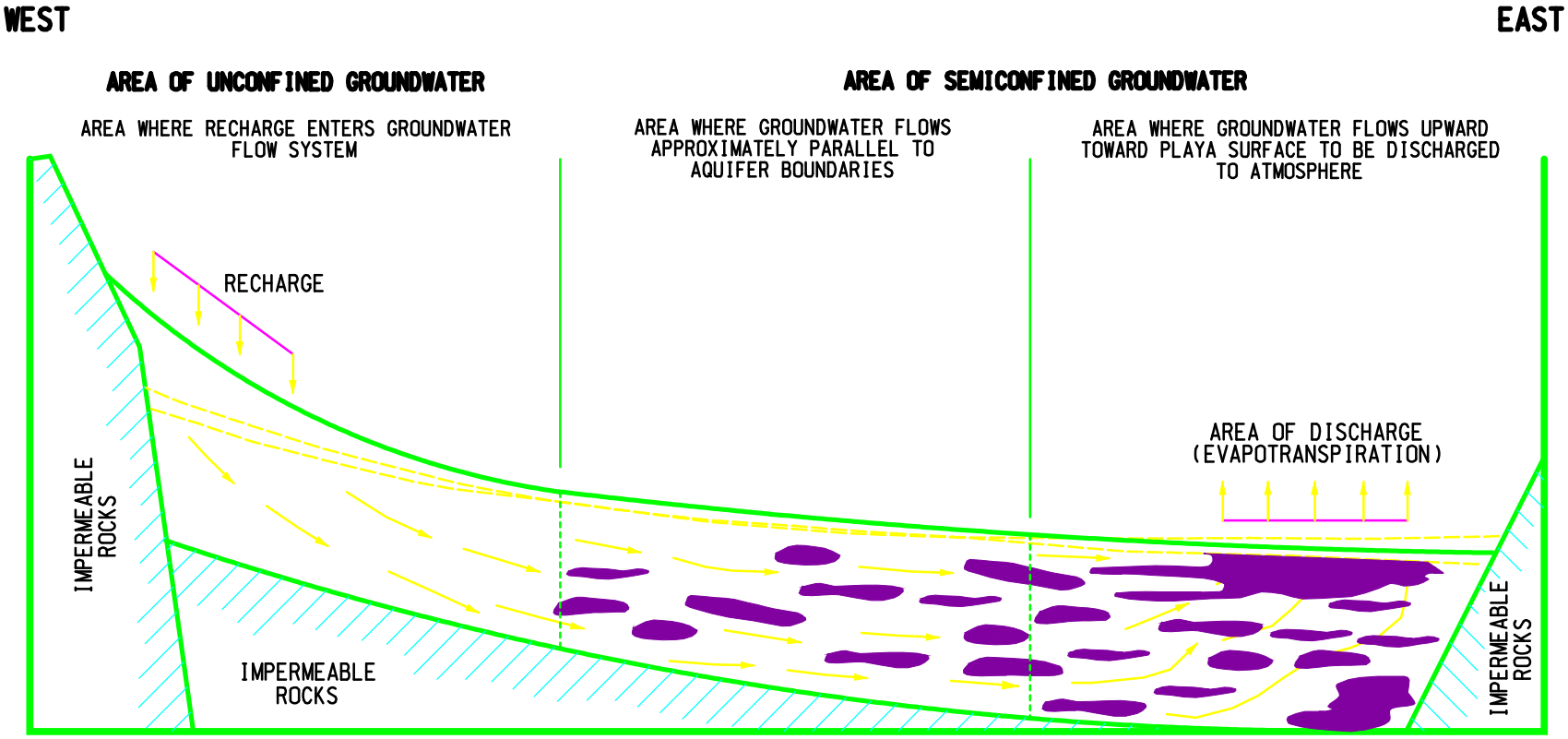
NAWS CHINA LAKE, CALIFORNIA

FIGURE 2-4

REGIONAL GEOLOGIC MAP

PROJECT NO.:	ORIGINATOR:	CHECKER:	DATE:
4545-0050		–	9/96

FILENAME: P:/4545CL/0050/4545GWCL.DGN DATE: 8/27/96



NOT TO SCALE

LEGEND

SILT OR CLAY

GROUNDWATER FLOW LINE

SOURCE: MODIFIED FROM DUTCHER AND MOYLE, 1973

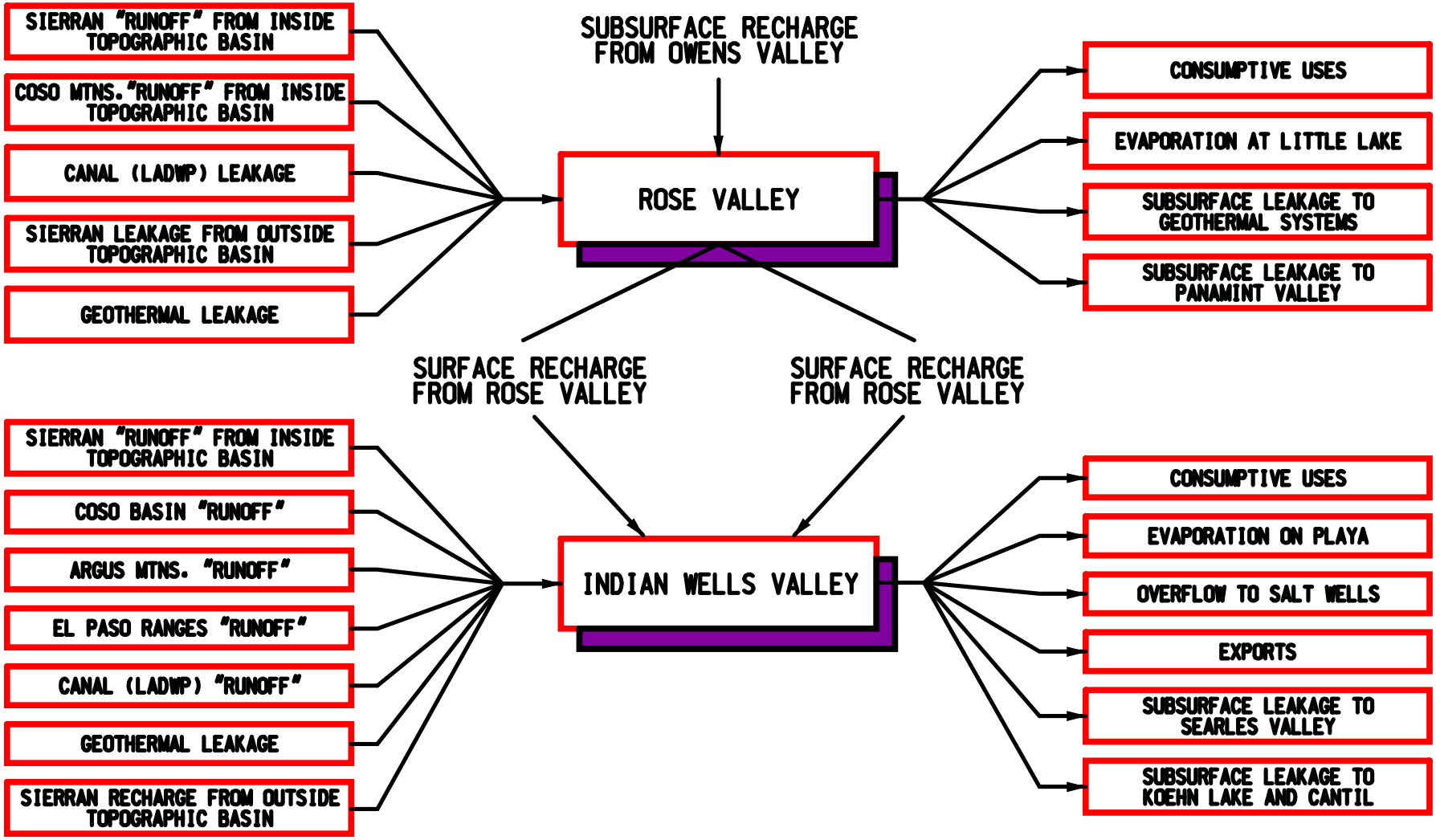
MORRISON KNUDSEN CORPORATION
NAWS CHINA LAKE, CALIFORNIA

FIGURE 2-5

GROUNDWATER FLOW SYSTEM CLOSED BASIN

PROJECT NO.:	ORIGINATOR:	CHECKER:	DATE:
4545-0050	CFF	-	9/96

FILENAME: P:/4545CL/0050/4545LGWFS.DGN DATE: 8/27/96



SOURCE: AUSTIN, 1988

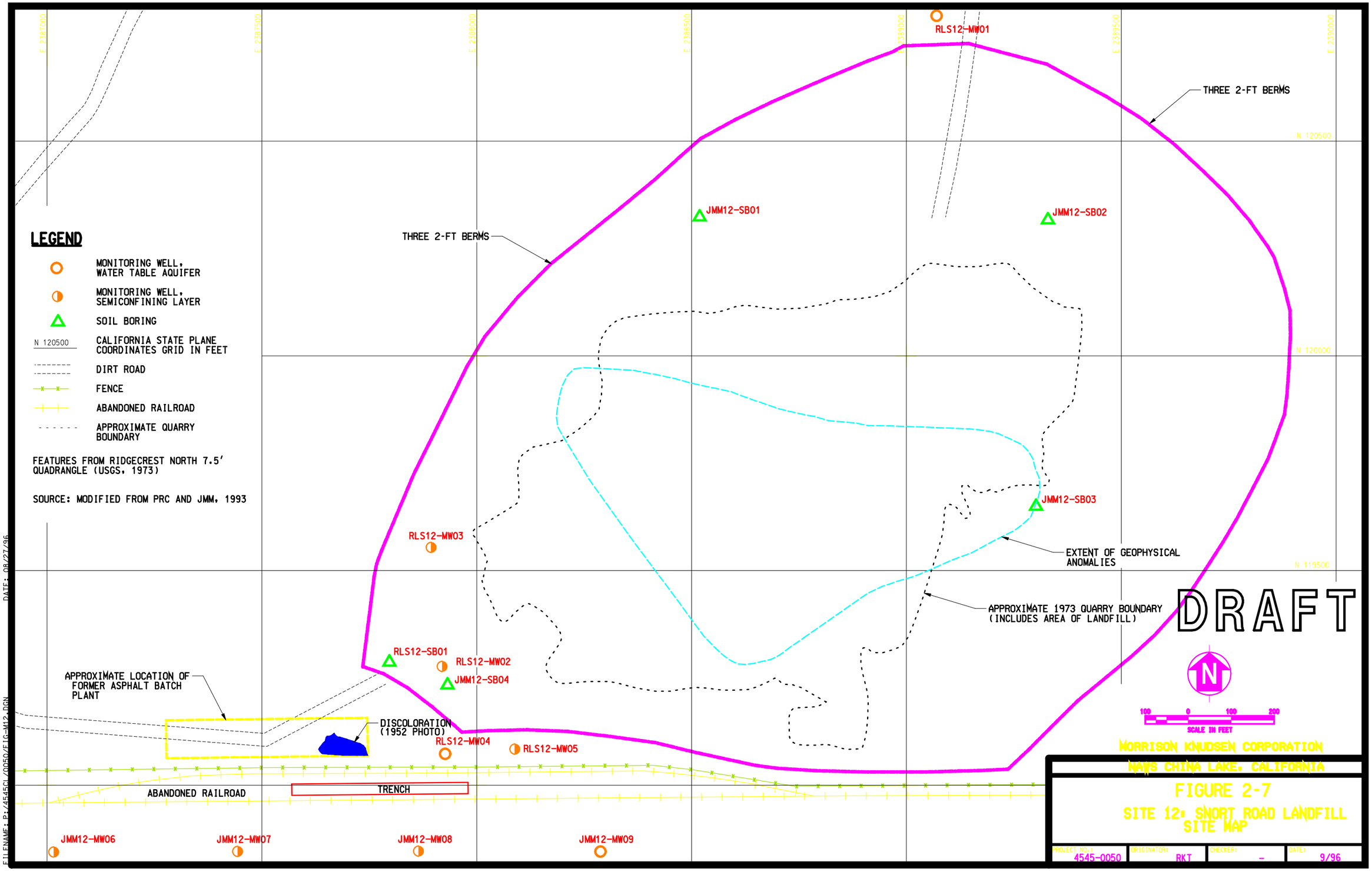
MORRISON KNUDSEN CORPORATION

NAWS CHINA LAKE, CALIFORNIA

FIGURE 2-6

GROUNDWATER FLOW SYSTEM OPEN BASIN

PROJECT NO.:	ORIGINATOR:	CHECKER:	DATE:
4545-0050	CFF	-	9/96



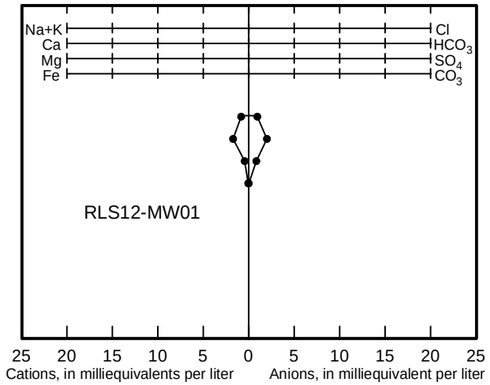
MORRISON KNUDSEN CORPORATION

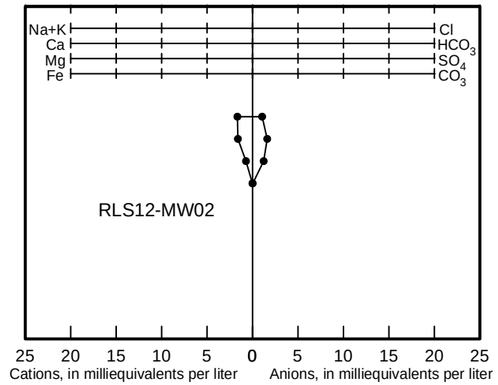
NAVS CHINA LAKE, CALIFORNIA

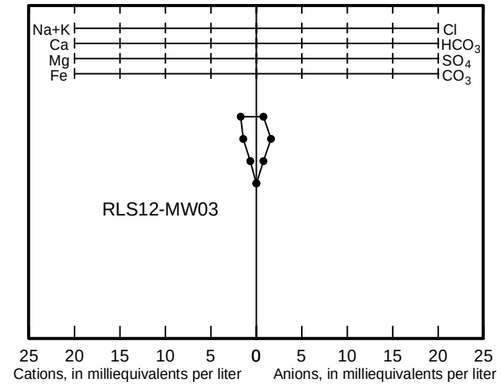
FIGURE 2-7

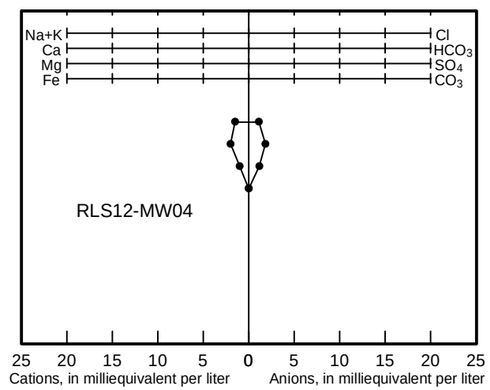
SITE 12: SNORT ROAD LANDFILL SITE MAP

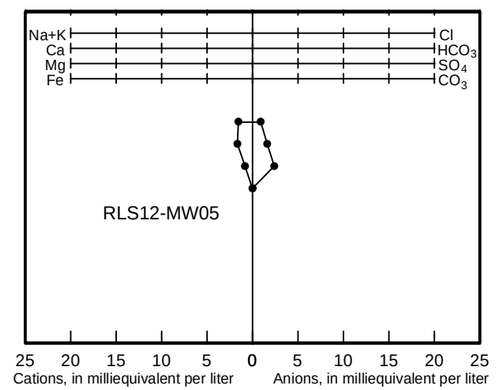
PROJECT NO.:	ORIGINATOR:	CHECKER:	DATE:
4545-0050	RKT	-	9/96

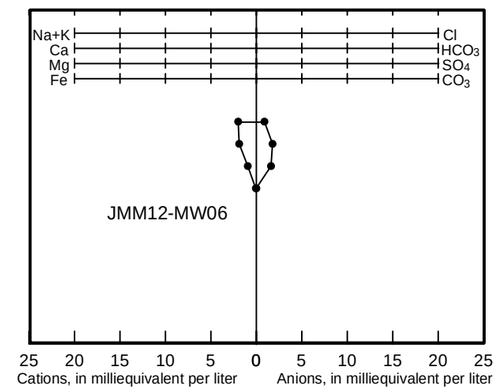


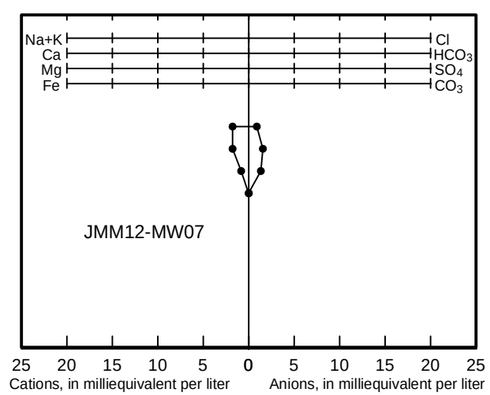


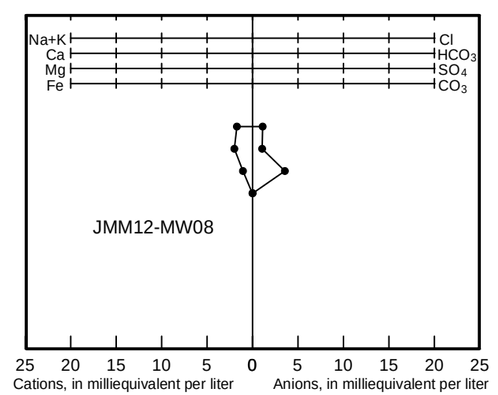


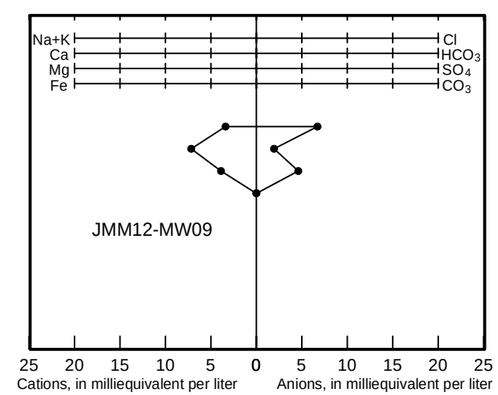












NOTES

1) Stiff diagrams generated from analytical data associated with the May 1996 groundwater sampling event.

2) Water table aquifer monitoring wells are
   - RLS12-MW01
   - RLS12-MW04
   - JMM12-MW09

3) Semiconfining Layer monitoring wells are
   - RLS12-MW02
   - RLS12-MW03
   - RLS12-MW05
   - JMM12-MW06
   - JMM12-MW07
   - JMM12-MW08

MORRISON KNUDSEN CORPORATION

NAWS CHINA LAKE, CALIFORNIA

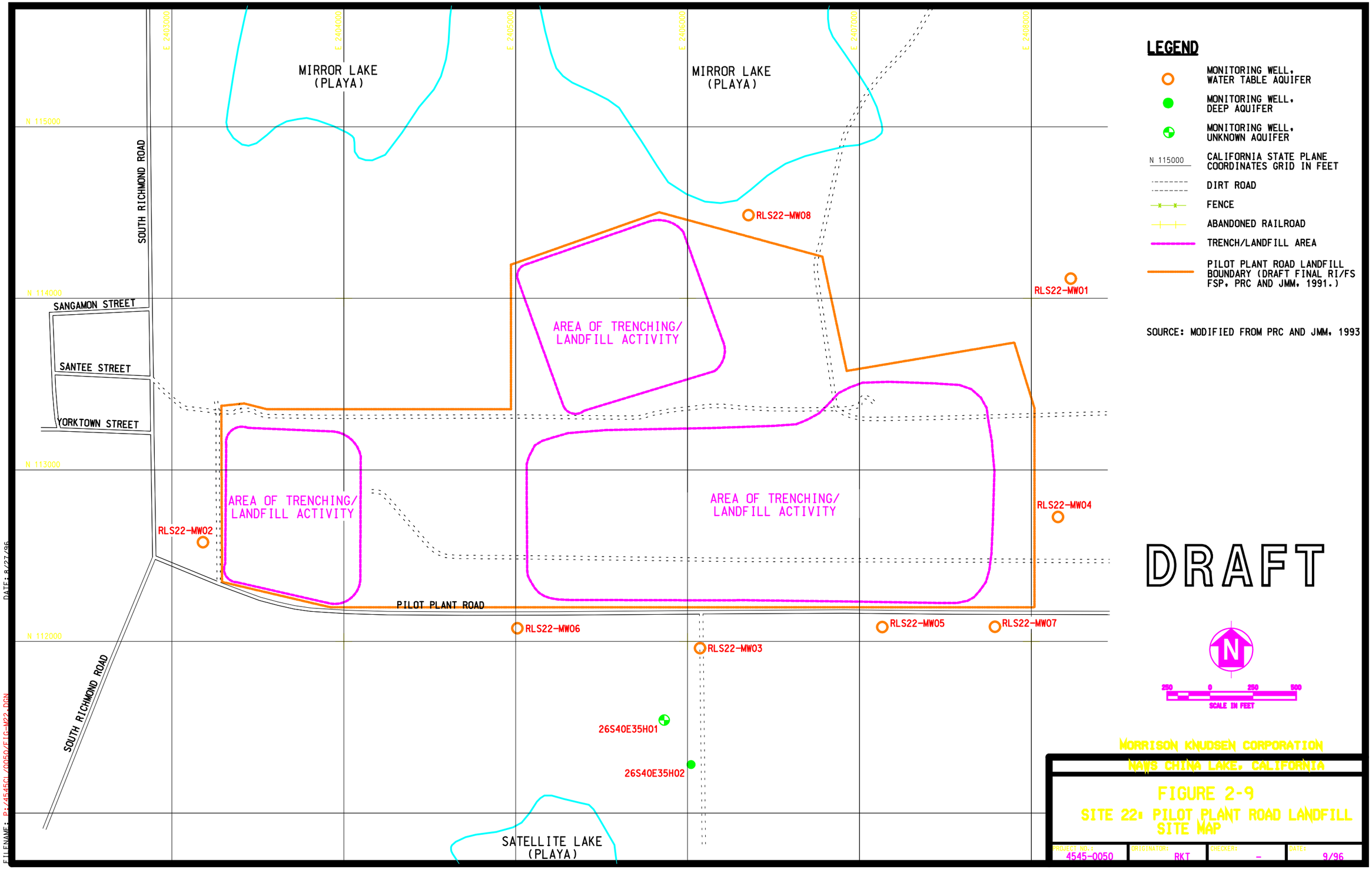
FIGURE 2-8

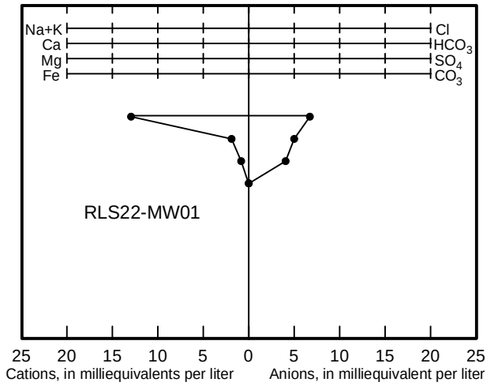
SITE 12: SNORT ROAD LANDFILL GROUNDWATER STIFF DIAGRAM

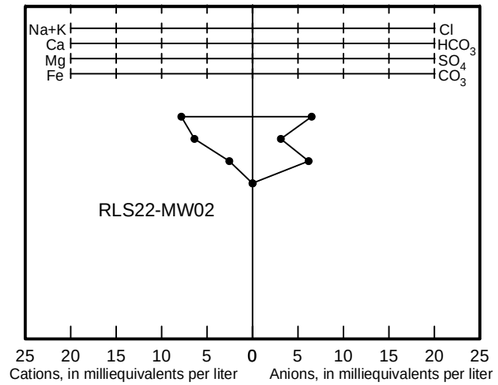
PROJECT NO. :	ORIGINATOR:	CHECKER:	DATE:
4545-0050	RKT	-	9/96

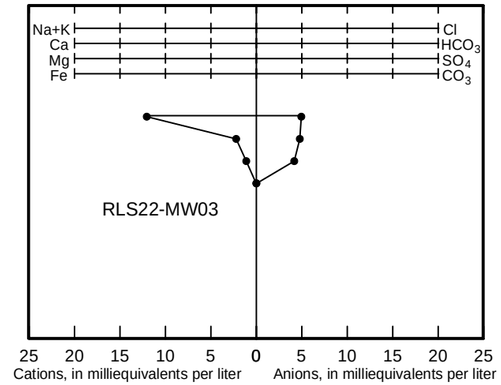
J:\CLEAN2\CTO\0050\WORKPLAN\REV\B\FIGURES\TIFF\12A.GRF

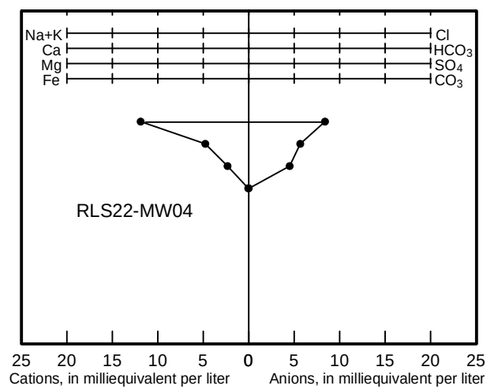
9/5/96

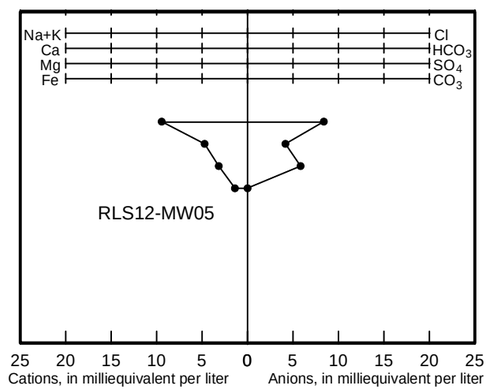

MIRROR LAKE (PLAYA)
MIRROR LAKE (PLAYA)
SOUTH RICHMOND ROAD
SANGAMON STREET
SANTEE STREET
YORKTOWN STREET
N 115000
N 114000
N 113000
N 112000
E 2403000
E 2404000
E 2405000
E 2406000
E 2407000
E 2408000
RLS22-MW08
RLS22-MW01
RLS22-MW04
RLS22-MW02
RLS22-MW06
RLS22-MW05
RLS22-MW07
RLS22-MW03
AREA OF TRENCHING/ LANDFILL ACTIVITY
AREA OF TRENCHING/ LANDFILL ACTIVITY
AREA OF TRENCHING/ LANDFILL ACTIVITY
PILOT PLANT ROAD
26S40E35H01
26S40E35H02
SATELLITE LAKE (PLAYA)
LEGEND
MONITORING WELL, WATER TABLE AQUIFER
MONITORING WELL, DEEP AQUIFER
MONITORING WELL, UNKNOWN AQUIFER
N 115000 CALIFORNIA STATE PLANE COORDINATES GRID IN FEET
DIRT ROAD
FENCE
ABANDONED RAILROAD
TRENCH/LANDFILL AREA
PILOT PLANT ROAD LANDFILL BOUNDARY (DRAFT FINAL RI/FS FSP, PRC AND JMM, 1991.)
SOURCE: MODIFIED FROM PRC AND JMM, 1993
DRAFT
N
250 0 250 500
SCALE IN FEET
MORRISON KNUDSEN CORPORATION
NAWS CHINA LAKE, CALIFORNIA
FIGURE 2-9
SITE 22: PILOT PLANT ROAD LANDFILL SITE MAP
PROJECT NO.: 4545-0050
ORIGINATOR: RKT
CHECKER: -
DATE: 9/96
FILENAME: P:/4545CL/0050/FIG-M22.DGN
DATE: 8/27/96

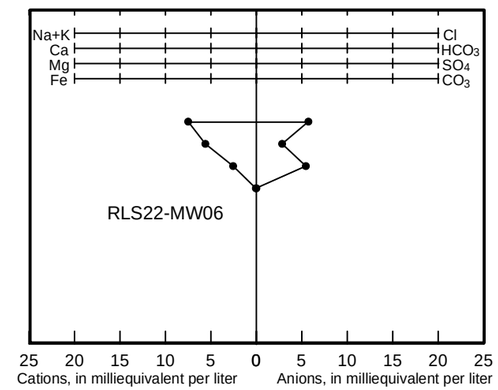


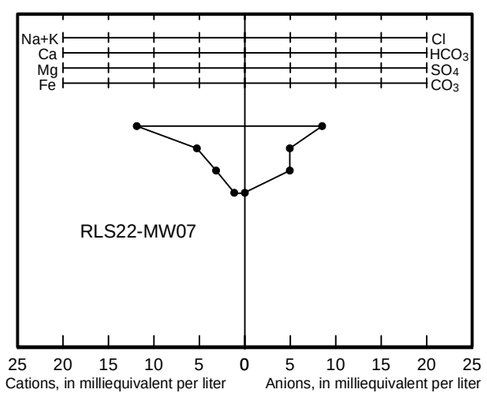


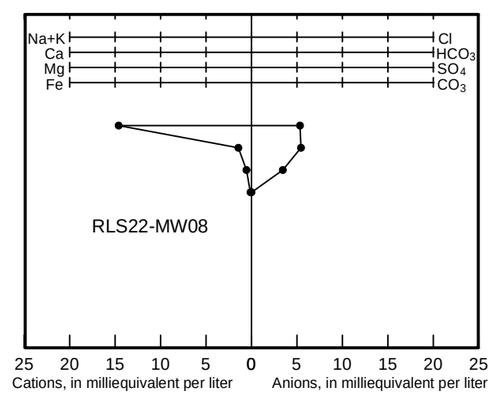












NOTES

1) Stiff diagrams generated from analytical data associated with the May 1996 groundwater sampling event.

2) All monitoring wells are screened within the Water Table Aquifer.

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FIGURE 2-10

SITE 22: PILOT PLANT ROAD LANDFILL GROUNDWATER STIFF DIAGRAM

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3.0 INITIAL EVALUATION OF SITES 12 AND 22

This section presents an initial evaluation of Sites 12 and 22 based on previously reported data and provides preliminary conceptual site models (CSMs) of each site. The preliminary CSM identifies potential contamination sources, associated migration pathways, and receptors. This section also summarizes information on waste sources at Sites 12 and 22. Potential remedial action objectives are identified, with a range of remedial alternatives and technologies discussed. Potentially applicable or relevant and appropriate requirements (ARARs) are identified in Section 3.5.

With the exception of Section 3.3, which is based on the Human Health and Ecological Risk Assessment Work Plan currently being produced by PRC, the following sections are modifications of Section 3 from the Draft Final RI/FS Work Plan (PRC and JMM, 1991a).

3.1 TYPES / VOLUMES OF WASTE

The types and volumes of waste that have been placed within Sites 12 and 22 are discussed in this sub-section. This information is based on previous investigation results (Westec, 1984; Stollar, 1988; PRC and JMM, 1993).

3.1.1 Site 12

As discussed in Section 2.0, from 1952 to 1979, the SNORT Road Landfill received approximately 100 tons per year of solid waste from the NAWS. These wastes included tree trimmings, construction debris, cans and barrels, small electrical parts, plastics and rags. Household garbage was not disposed of in the landfill. It is also likely that solvents, waste oils, miscellaneous unspecified chemicals and PCBs were also disposed of at the site, although this has not been verified and volumes of such wastes cannot be estimated (Westec, 1984). An asphalt processing batch plant was located just southwest of the landfill and a black tar-like residue was found on the ground surface in this area (Stollar, 1988). This plant is visible in historical aerial photographs.

Oil and grease are the only verified contaminants in shallow soil near the abandoned asphalt batch plant area at Site 12. Groundwater contaminants at Site 12 are primarily VOC's. The 1992 RI/FS (PRC and JMM) confirmed the presence of carbon disulfide and 1,1,1-TCA.

3.1.2 Site 22

As discussed in Section 2.0, from 1944 to 1965, the majority of wastes generated by on-base housing and the NAWS Public Works Department were disposed of in 12 large trenches at the Pilot Plant Road site. Other wastes disposed of in the landfill consisted of small amounts of industrial and hazardous wastes. It is estimated that approximately 110,000 cubic yards of waste were disposed of during the landfill's 21 years of operation. The landfill is irregularly shaped with a length of 4,600 feet and maximum width of 2,850 feet. The dimensions of the trenches are approximately 200 feet long by 30 feet wide by 15 feet deep (Westec, 1984 and Stollar, 1988). Groundwater chemical contaminants at Site 22 are currently identified as low levels of VOCs.

3.2 CONCEPTUAL SITE MODELS

To aid in formulating an approach to the RI/FS process at each site, a CSM of contamination is being developed that incorporates information on known and potential contaminant sources, migration pathways, and potentially exposed human and environmental populations. Once the model has been defined, it can be used to identify the types of data needed to assess the resulting impact of the observed contamination on human health and the environment.

Sites 12 and 22 are non-active landfills located on an active military base. As landfills, no residential housing will be allowed at either location (EPA 1993b). In addition, the landfills have been capped with dirt and are located in a dry desert climate. Access to the landfills is also strictly controlled by the Navy. The preliminary CSM for each location, one for human receptors and one for ecological receptors, assumes an industrial setting which is representative of the current status for each site and reasonable maximum exposure for future land use. The models limit direct receptors of soil contamination to onsite workers and ecological receptors.

3.3 POTENTIAL EXPOSURE ROUTES AND IMPACTS ON HUMAN HEALTH AND THE ENVIRONMENT

A risk assessment will be prepared as part of the RI/FS to further identify and quantify the potential risks posed by contaminants in the soil. The risk assessment is further discussed in Section 5.0. The following sections discuss the CSMs for each site and are based on information provided in the PRC documents, Human Health and Ecological Risk Assessment Work Plans, (PRC 1996c). (Final versions of these documents have not been submitted by PRC to the regulatory agencies and are still being revised).

3.3.1 Site 12

Presented in Figures 3-1 and 3-2 are the CSMs for human and ecological receptors at Site 12, respectively. These CSMs were developed from data collected during previous investigations. The models identify potential sources of contamination, release mechanisms, migration pathways, and receptors.

Wastes disposed of in the SNORT Road Landfill or associated with the former asphalt batch plant could have resulted in surface and subsurface soil contamination. As illustrated in Figure 3-1, the potential existence of VOC soil contamination could reach current and possible future onsite human receptors through volatilization, wind suspension, and direct contact. Contaminants that do not bind to soil particles, such as organic solvents, have migrated to groundwater beneath the site. The groundwater beneath the site maybe part of an aquifer that has been identified by the Regional Water Quality Control Board as suitable for municipal, residential, agricultural, and industrial uses (California RWQCB, Water Quality Control Plan For Lahontan Region), but groundwater is not drawn from the site.

As presented in Figure 3-2, terrestrial animal receptors may be exposed to site soils via (1) ingestion with foodstuffs, (2) during burrowing or grooming activities, and (3) inhalation of windblown dust. Plants may be exposed through root uptake.

There are no complete exposure pathways for the surface water contaminants at Site 12.

3.3.2 Site 22

Presented in Figures 3-3 and 3-4 are the CSMs for human and ecological receptors at Site 22, respectively. These CSMs were developed from data collected during previous investigations. The model identifies potential sources of contamination, release mechanisms, migration pathways, and receptors.

Wastes disposed of in the Pilot Plant Road landfill could have resulted in surface and subsurface soil contamination. As illustrated in Figure 3-3, the potential existence of VOC soil contamination could reach current and possible future onsite human receptors through volatilization, wind suspension, and direct contact. Contaminants that do not completely bind to soil particles, such as organic solvents, have migrated to groundwater beneath the site. The groundwater beneath the site may be part of an aquifer that has been identified by the Regional Water Quality Control Board as suitable for municipal, residential, agricultural, and industrial uses (California RWQCB, Water Quality Control Plan For Lahontan Region), but groundwater is not drawn from the site.

As presented in Figure 3-4, terrestrial animal receptors may be exposed to site soils via ingestion with foodstuffs or during burrowing or grooming activities and inhalation of windblown dust. Plants may be exposed through root uptake. Surface water is seasonally available in the nearby Mirror Lake playa just to the north of and adjacent to the site. The Satellite Lake playa lies approximately 1,000 feet to the south across Pilot Plant Road (PRC and JMM 1993). Both of these playas may provide seasonal habitat for migrating birds. Seasonal aquatic receptors may also occur in both of these playa lakes.

The Mohave tui chubs would not be affected by contamination at Site 22 since the site is located over a mile south of their permanent aquatic habitat and groundwater flow beneath Site 22 is to the south-southeast.

3.4 PRELIMINARY IDENTIFICATION OF OPERABLE UNITS

No operable units have been identified for either Site 12 or Site 22. Operable units may be identified as information becomes available throughout the course of the RI/FS. Identification of operable units for each site will facilitate understanding of the sources and media of contamination, and the feasibility of any proposed remedial actions for these contaminated areas

3.5 PRELIMINARY REMEDIAL ACTION OBJECTIVES AND REMEDIAL ACTION ALTERNATIVES

The purpose of this section is to provide cursory identification of potential remedial action objectives and alternatives for Sites 12 and 22. These objectives are based on the preliminary assessment of contamination and the conceptual models introduced in Section 3.2. It must be noted that this scoping phase is too early in the RI/FS process to permit detailed investigation of alternatives. Instead, the identification of preliminary remedial objectives and potential remedial technologies at this stage is required to help ensure that the data needed for the ultimate remedial evaluation will be collected in the field investigation effort.

The methodology consists of identification of potential remedial action objectives for each contaminated medium, followed by the selection of a preliminary range of broadly defined remedial action alternatives and associated technologies. This process can only begin once a CSM has been developed. The preliminary identification of remedial action alternatives during the RI/FS scoping phase helps the initial identification of relevant ARARs that would apply to site remediation activities and also helps to focus planning efforts on subsequent data gathering requirements, if needed.

As part of these functions, presumptive remedies to accelerate potential future cleanup at Sites 12 and 22 will be considered. The presumptive remedy approach will follow guidelines in the Superfund Accelerated Cleanup Model (EPA, 1993b). The objective of the presumptive remedies approach is to use the EPA's past experience to evaluate implementation of the remedies to accelerate the selection of cleanup actions, if required.

3.5.1 Preliminary Remedial Action Objectives

As defined by the EPA (1988a), remedial action objectives are "medium-specific goals (i.e., goals for soil, groundwater, surface water, and other relevant media) or operable-unit-specific goals for protecting human health and environment" from negative impacts associated with exposure to hazardous substances, pollutants or contaminants. These objectives must be developed based on knowledge of the nature and extent of contamination, contaminated media, potential receptors, exposure pathways, risk and ARARs specific to the site. These objectives can be expressed in terms of exposure routes, as well as levels of contamination, because protection can be achieved by reducing exposure as well as by reducing contaminant levels.

The preliminary remedial action objectives for potentially contaminated media, which consists of soil and groundwater at Sites 12 and 22 are listed below.

3.5.1.1 Soil

Preliminary soil remedial action objectives for soils at Sites 12 and 22 are:

- Prevent direct contact with soils that contain site-related carcinogenic chemicals that pose an unacceptable human health risk and/or ecological risk.
- Prevent direct contact with soils that contain site-related noncarcinogenic chemicals that pose an unacceptable human health hazard and/or ecological hazard.
- Prevent inhalation of dusts that contain site-related carcinogenic and noncarcinogenic chemicals that pose an unacceptable human health risk and/or ecological risk.
- Prevent inhalation of volatilized chemicals that pose an unacceptable human health risk and/or ecological risk.

3.5.1.2 Surface Water

Based on CSMs for each site, preliminary remedial action objectives for surface water are only relevant for Site 22 and only from an ecological perspective. As illustrated in Figures 3-1 and 3-2, no complete human or ecological exposure pathway for surface water exists at Site 12.

Preliminary surface water remedial action objectives for surface water at Site 22 are:

- Prevent the potential for ingestion of surface water containing site-related chemicals that pose an unacceptable ecological risk.
- Prevent the potential for site-related chemicals to enter surface water and exceed chemical-specific ARARs.

3.5.1.3 Groundwater

Preliminary groundwater remedial action objectives for Sites 12 and 22 are:

- If groundwater is migrating off-site, is potable, or is in connection with a deeper aquifer, prevent exceeding the Maximum Contaminant Level Goals (MCLG), Maximum Contaminant Level (MCL), or acceptable human health risk-based concentrations when MCLs are not available.
- Potential dermal and inhalation exposure may also be of concern; the risks and acceptable exposure levels related to these routes will be evaluated on the basis of risk assessment considerations if pathways are potentially complete.

3.5.2 Potential Remedial Action Alternatives

The potential remedial action alternatives for Sites 12 and 22 have been reproduced from the Draft Final RI/FS Work Plan (PRC and JMM, 1991a).

The potential remedial alternatives to be ultimately selected for Sites 12 and 22 cannot be determined until the nature and extent of contamination are more fully defined. However, information developed to date, along with the conceptual site models discussed, allows identification of a preliminary list of remedial action alternatives and associated technologies. Preliminary remedial action alternatives for groundwater, surface water and soil are discussed in general terms below.

3.5.2.1 Soil

Five general remedial action alternatives were identified for potentially contaminated soils:

- **No Action.** The "no action" alternative leaves soils in their existing condition. Because contaminated soils may act as continuing sources of groundwater contamination, groundwater monitoring is a component of the no action alternative for soils.

- **Containment and Source Infiltration Controls.** Potential soil containment measures include installation of a cap or subsurface barrier to prevent precipitation infiltration, groundwater flowthrough or leachate migration. Contaminated soils could also be processed in-situ to immobilize, reduce, or remove the contaminants of concern. Potential in-situ processes include vitrification and microbial degradation.

- **Institutional Controls to Supplement Source Controls.** Institutional controls such as deed restrictions, access restrictions, and fences would be used to limit exposure to the contaminated soils.

- **Excavation and Disposal.** This alternative would involve the excavation of contaminated soils and disposal at an offsite facility, under applicable regulations and institutional controls. After excavation and prior to disposal, contaminated soils may be thermally treated and/or stabilized to allow all or portions of the soils to be disposed of onsite, under applicable regulations and institutional controls.

- **Presumptive Remedy.** This alternative would include one or more of the following five components, as needed: (1) landfill cap consisting of either a multilayered cap or an engineered alternative cap, (2) source area groundwater control to contain the plume, (3) leachate collection and treatment, (4) landfill gas collection and treatment, and (5) institutional controls to supplement engineering controls.

3.5.2.2 Surface Water

Two general remedial action alternatives were identified for potentially contaminated surface water:

- **Institutional Controls.** Institutional controls for surface water remediation could include establishment of a monitoring program. Surface water samples can be collected from gully flow runoff associated with the landfill at Site 22 during storm events to track contaminant migration and to evaluate whether further remedial actions are necessary.

- **Source Control.** The type of control measures that may be considered for surface water include grading, vegetation, diversion, and collection systems. These surface water control measures are designed to minimize contamination of surface waters and sediments, prevent surface water infiltration through contaminated soils, and prevent offsite transport of contaminated surface water and sediments.

3.5.2.3 Groundwater

Four general remedial action alternatives for groundwater are identified:

- **No Action.** The "no action" alternative leaves groundwater in its existing condition. Groundwater monitoring is a component of the no action alternative.

- **Limited Action.** This alternative includes imposing institutional controls such as deed restrictions and providing an alternative water supply.

- **Groundwater Controls and Containment.** Potential groundwater control and containment alternatives include: (1) capping (clay and/or synthetic material), to minimize generation of contaminated leachate; (2) vertical barriers, such as slurry walls, grout curtains or sheet piling, to retard the lateral migration of contaminants; (3) horizontal barriers, using liners or grout injection, to seal off the bottom of a site to minimize downward transport of leachate; and (4) injection/extraction wells, to control the hydraulic gradient and minimize the downgradient migration of contaminants.

- **Groundwater Collection and Treatment.** Collection, treatment and discharge alternatives involve extraction of contaminated groundwater, treatment of the groundwater in an on- or offsite treatment unit, and discharge of the treated groundwater to receiving waters or a Publicly Owned Treatment Works (POTW). Potential treatment technologies include a variety of physical/chemical and biological processes. Commonly used processes include air stripping, carbon adsorption, precipitation, ion exchange, biological degradation and oxidation/reduction. In-situ applications of some of these technologies are available or under development.

3.6 PRELIMINARY IDENTIFICATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The identification of ARARs involves determining whether a given requirement is applicable, and if it is not applicable, determining whether it is nevertheless both relevant and appropriate. Applicable requirements are those standards of cleanup or control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a site. Relevant and appropriate requirements are those standards, criteria, or limitations promulgated under federal or state law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or circumstance at a site, address problems or situations sufficiently similar to those encountered at the site that the requirement's use is well suited to that particular site.

DTSC is responsible for initiating and coordinating the involvement of its respective program offices and other agencies in developing information on ARARs.

During the RI/FS, ARARs will be considered for contaminants, locations, and actions of concern. As the RI/FS progresses, potential ARARs will be evaluated in accordance with "CERCLA Compliance with Other Laws Manual" (EPA, 1988b) to establish whether they are applicable or relevant and appropriate to Sites 12 and 22. Requirements will be identified and refined as a better understanding is developed of site conditions, contaminants, and remedial action alternatives. This includes the completion of a risk assessment to determine cleanup goals for soil and potentially for groundwater. It should be noted that the cleanup goals for hazardous substances, pollutants, or contaminants may differ from PRGs for soils or MCLs for groundwater based on the results of the risk assessment. A risk assessment will be completed for groundwater if it is determined during the RI/FS that a complete exposure pathway exists between shallow groundwater at the site and domestic supply wells.

A preliminary list of potential federal and state ARARs for Sites 12 and 22 is presented in Table 3-1.

TABLE 3-1

LIST OF POTENTIAL FEDERAL
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, CRITERIA, OR LIMITATIONS
NAWS CHINA LAKE, CALIFORNIA

Statute or Regulation	Citation	Description	Comment
Safe Drinking Water Act	42 U.S.C. § 300f et seq. Pub. L. 93-523	Goal of the Act is to protect human health by protecting the quality of drinking water. The Act authorizes the establishment of drinking water standards.	Applies to CERCLA site discharges to public drinking water sources, including underground drinking water sources. May be relevant and appropriate to cleanup of water that may be used for drinking.
National Primary Drinking Water Standards	40 CFR Part 141	Establishes primary maximum contaminant levels (MCLs) that are health-based standards for public water systems.	MCLs are relevant and appropriate for any water that is considered to be a source or potential source of drinking water. MCLs are applicable at the tap when the water is directly provided to 25 or more people or 15 or more service connections. Otherwise, MCLs are relevant and appropriate.
National Secondary Drinking Water Standards	40 CFR Part 143	Establishes secondary MCLs that are welfare-based standards for public water systems. Standard to control chemicals in drinking water that primarily affects the aesthetic qualities relating to public acceptance of drinking water.	Secondary MCLs are not federally enforceable standards, but intended as guidelines for the States. SMCLs are not ARARs unless promulgated by States.
Maximum Contaminant Levels Goals (MCLGs)	40 CFR Part 141, Subpart F	Establishes drinking water quality goals set at levels of no known or anticipated adverse health effects, with an adequate margin of safety. MCLGs do not take cost or feasibility into account.	MCLGs are not federally enforceable drinking water standards, but CERCLA §121(d) has raised MCLGs and water quality criteria (see below) to the level of potentially relevant and appropriate.
Clean Water Act	33 U.S.C. § 1251-1376	Provides for the restoration and maintenance of the chemical, physical, and biological integrity of the nation's waters.	MCLGs may be considered when a CERCLA cleanup may require more stringent standards than the MCLs.

TABLE 3-1

LIST OF POTENTIAL FEDERAL
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, CRITERIA, OR LIMITATIONS
NAWS CHINA LAKE, CALIFORNIA

Statute or Regulation	Citation	Description	Comment
Water Quality Criteria	40 CFR Part 131 Quality Criteria for Water, 1976, 1980, 1986	Federal water quality criteria are guidelines from which States determine their water quality standards. Criteria are developed for the protection of human health and aquatic life.	Applicable to direct discharges to surface waters. An indirect discharge to a POTW may be considered an off-site activity even though the conveyance system is located onsite. A POTW may require a CERCLA wastewater to meet "pretreatment" standards to acceptance. If a water quality standard is available for a contaminant, the standard should be used rather than the criteria.
Water Quality Standards	40 CFR Part 131	Nonenforceable criteria for water quality to protect human health and aquatic life. From the water quality criteria, states adopt water quality standards that protect a designated use. A water quality standard defines the water quality goals of a water body through use of designations and criteria to protect the designated uses.	CERCLA requires that the remedy selected must require a level or standard of control which at least attains water quality criteria established under Section 303 or 304` of the Clean Water Act. CERCLA also states "in determining whether or not any water quality criteria…is relevant and appropriate…the President shall consider the designated or potential use of the surface or ground water, the environmental media affected, the purposes for which the criteria were developed, and the latest information available."
Guidelines Establishing Test Procedures for the Analysis of Pollutants	40 CFR Part 136	Identifies EPA-approved analytical methodologies for analyzing water and wastewater.	

TABLE 3-1

LIST OF POTENTIAL FEDERAL
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, CRITERIA, OR LIMITATIONS
NAWS CHINA LAKE, CALIFORNIA

Statute or Regulation	Citation	Description	Comment
National Pretreatment Standards	40 CFR Part 403	Sets standards to control pollutants which pass through or interfere with treatment processes in publicly-owned treatment works (POTW) or which may contaminate sewage sludge. Standards are set by the POTW.	
Resource Conservation and Recovery Act	42 U.S.C. §§ 6901-6987		
Criteria for Classification of Solid Waste Disposal Facilities and Practices	40 CFR Part 257	Establishes criteria for use in determining which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on health or the environment and thereby constitute prohibited open dumps.	The current focus of RCRA Subtitle D is primarily on municipal landfills.
Hazardous Waste Management Systems General	40 CFR Part 260	Provides definitions of hazardous waste terms, procedures for rule-making petitions, and procedures for delisting a waste.	May be applicable if variances or delisting are required.
Identification and Listing of Hazardous Waste	40 CFR Part 261	Defines those solid wastes which are subject to regulation as hazardous wastes under 40 CFR Parts 261-265 and Parts 124, 270, 271.	
Standards Applicable to Generators of Hazardous Waste	40 CFR Part 262	Establishes standards for generators of hazardous waste.	Applicable if the selected remedial alternative involves generation and offsite transport of hazardous wastes.

TABLE 3-1

LIST OF POTENTIAL FEDERAL
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, CRITERIA, OR LIMITATIONS
NAWS CHINA LAKE, CALIFORNIA

Statute or Regulation	Citation	Description	Comment
Standards Applicable to Transporters of Hazardous Waste	40 CFR Part 263	Establishes standards which apply to persons transporting hazardous waste within the U.S. or if the transportation requires a manifest under 40 CFR Part 262.	Applicable if the selected remedial alternative involves offsite transportation of hazardous waste.
Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities	40 CFR Part 264	Establishes minimum national standards which define the acceptable management of hazardous waste for owners and operators of facilities which treat, store, or dispose of hazardous waste.	Generally applicable for any remedy that involves current treatment, storage or disposal. If the action does not involve current treatment, storage or disposal, it may be relevant and appropriate.
• General Facility Standards	40 CFR Part 264.10, Subpart B		
• Preparedness and Prevention	40 CFR Part 264.30, Subpart C		
• Contingency Plan and Emergency Procedures	40 CFR Part 264.50, Subpart D		
• Manifest System, Recordkeeping and Reporting	40 CFR Part 264.70, Subpart E		
• Release from Solid Waste Management Units	40 CFR Part 264.90, Subpart F		
• Closure and Post-Closure	40 CFR Part 264.110, Subpart G		

TABLE 3-1

LIST OF POTENTIAL FEDERAL
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, CRITERIA, OR LIMITATIONS
NAWS CHINA LAKE, CALIFORNIA

Statute or Regulation	Citation	Description	Comment
• Financial Requirements Subpart H	40 CFR Part 264.140		
• Use and Management of Containers	40 CFR Part 264.170, Subpart I		
• Tank Systems	40 CFR Part 264.190, Subpart J		
• Surface Impoundments	40 CFR Part 264.220, Subpart K		
• Waste Piles	40 CFR Part 264.250, Subpart L		
• Land Treatment	40 CFR Part 264.270, Subpart M		
• Landfills	40 CFR Part 264.300, Subpart N		
Release from Solid Waste Management Units	40 CFR Part 264, Subpart F	Establishes maximum contaminant concentrations for groundwater protection. Concentration limits apply to the uppermost aquifer underlying the site.	The maximum contaminant concentrations that can be released from hazardous waste units are identical to the MCLs.
Interim Status TSD Facility Standards - Closure and Post-Closure	40 CFR Part 265, Subpart G	Establishes closure performance standards and post-closure care requirements.	

TABLE 3-1

LIST OF POTENTIAL FEDERAL
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, CRITERIA, OR LIMITATIONS
NAWS CHINA LAKE, CALIFORNIA

Statute or Regulation	Citation	Description	Comment
Land Disposal Restrictions	40 CFR Part 268	Restricts the land disposal of hazardous waste and specifies treatment standards that must be met before these wastes can be land disposed.	Applicable if the selected remedial alternative involves placement of waste from outside the area of contamination; if waste is removed, treated and redeposited in the same or another unit. A treatability variance may also be applicable.
Occupational Safety and Health Act	29 U.S.C. §§ 651-678	Regulates worker health and safety.	Applies to all response activities under the NCP.
Hazardous Material Transportation Act	49 U.S.C. §§ 1801-1813		
Hazardous Materials Transportation Regulations	49 CFR Parts 107, 171-177	Regulates transportation of hazardous materials.	Applicable if waste is shipped offsite.

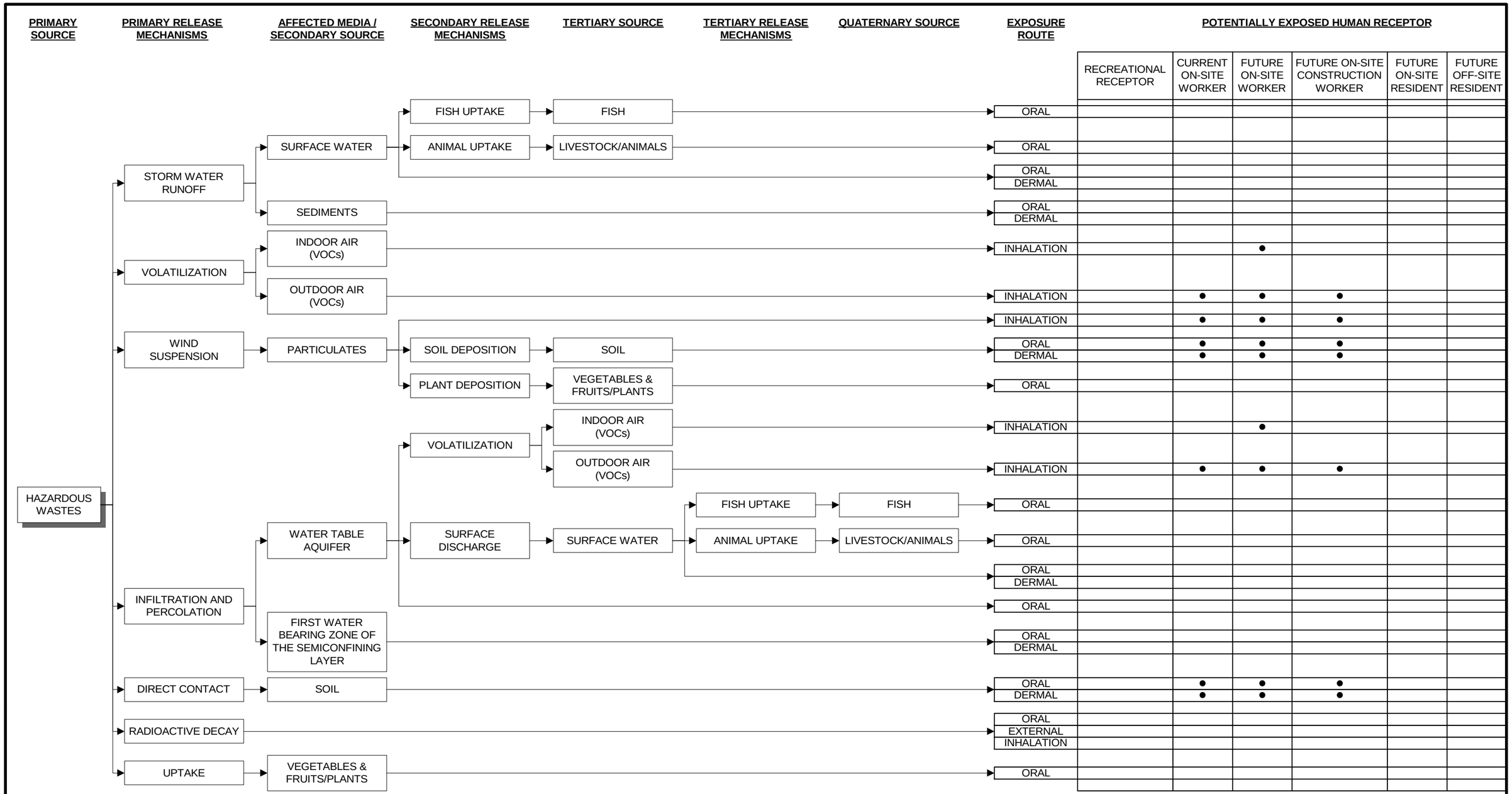
TABLE 3-1

LIST OF POTENTIAL FEDERAL
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, CRITERIA, OR LIMITATIONS
NAWS CHINA LAKE, CALIFORNIA

Statute or Regulation	Citation	Description	Comment
Endangered Species Act	16 U.S.C. § 1531-1536 50 CFR Part 402	Requires action to conserve endangered species within critical habitats upon which endangered species depend; includes consultation with Department of Interior.	
Media Cleanup Standards (MCSs)	Proposed 55 CFR pp 30798	MCSs are established at concentrations that ensure protection of human health and the environment. Standards are set for each medium during the remedy selection process.	The regulations are proposed and therefore only to be considered as potential ARARs. When promulgated, the standards are potential ARARs. 40 CFR Part 264 § 264.525.

ABBREVIATIONS:

U.S.C.	United State Code
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Registry
MCL	Maximum contaminant level
SMCL	Secondary maximum contaminant level
MCLG	Maximum contaminant level goal
POTW	Publicly-owned treatment works
EPA	Environmental protection agency
RCRA	Resource Conservation and Recovery Act
MCS	Media cleanup standards
NCP	National Contingency Plan



SOURCE: DRAFT HUMAN HEALTH & ECOLOGICAL RISK ASSESSMENT WORK PLANS (PRC, 1996c)

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NAWS CHINA LAKE, CALIFORNIA

FIGURE 3-1

SITE 12: SNORT ROAD LANDFILL PRELIMINARY CONCEPTUAL SITE MODEL FOR HUMAN RISK ASSESSMENT

PROJECT NO.:	ORIGINATOR:	CHECKER:	DATE:
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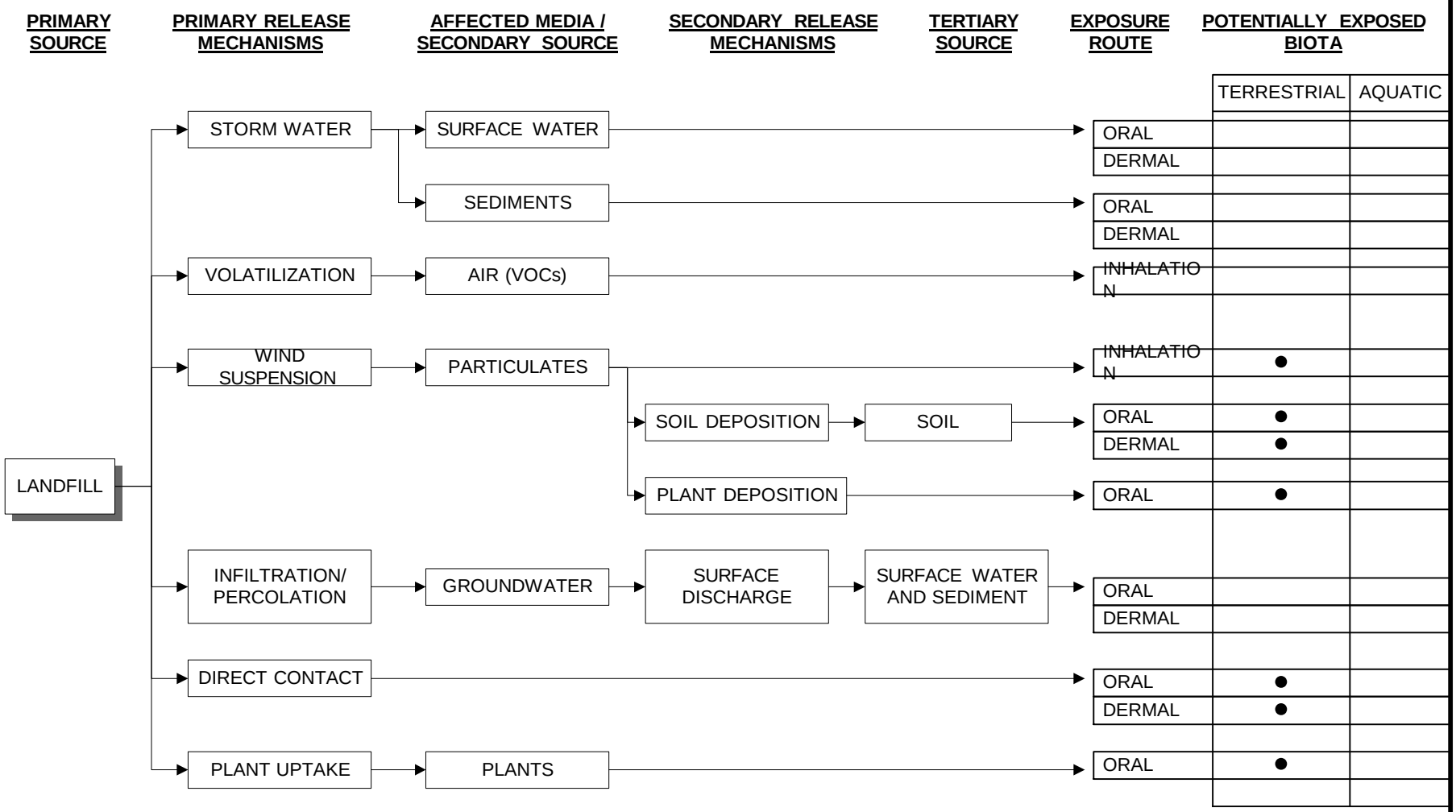

SOURCE: DRAFT HUMAN HEALTH & ECOLOGICAL RISK ASSESSMENT WORK PLANS (PRC, 1996c)

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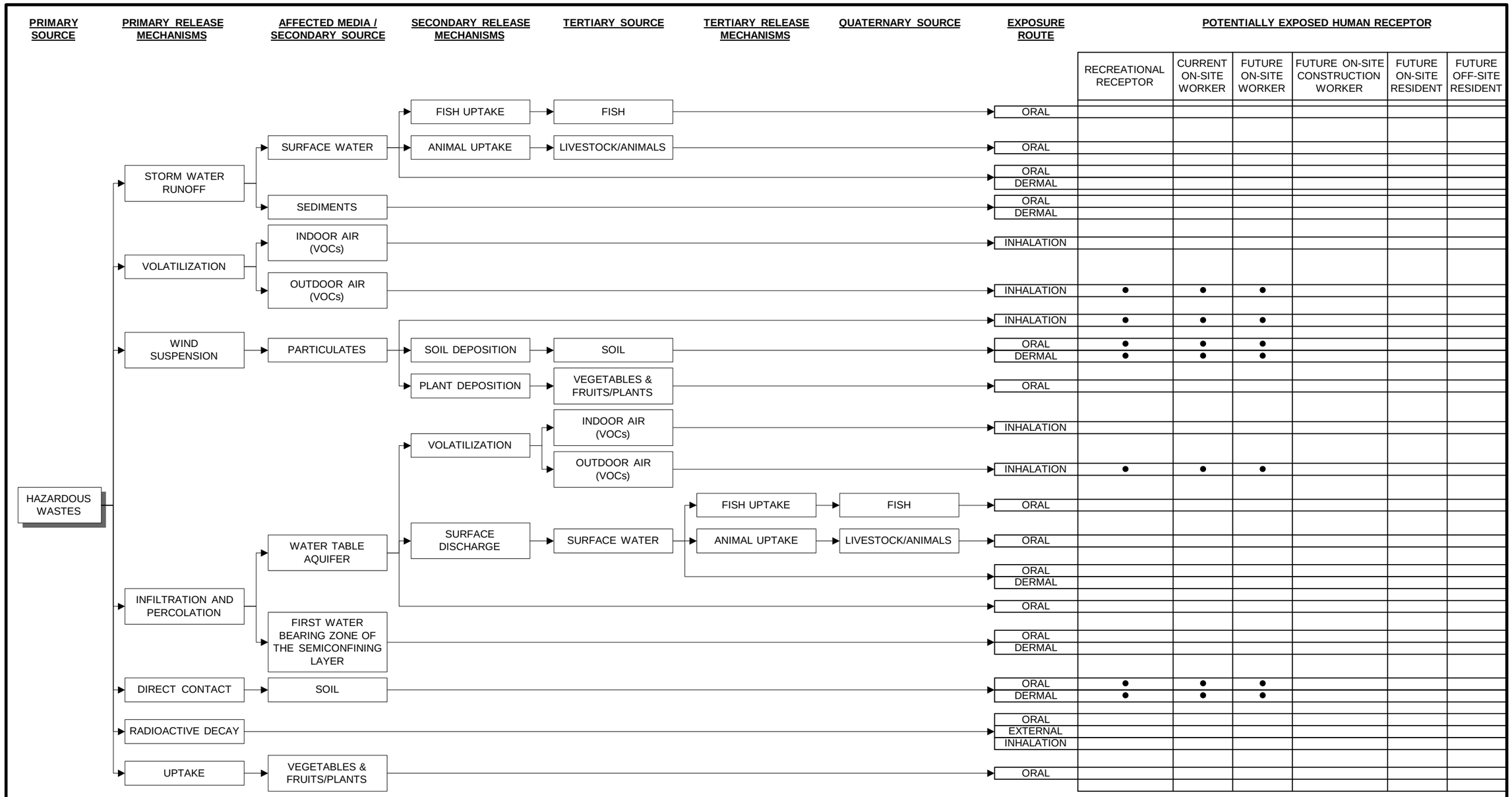
MORRISON KNUDSEN CORPORATION

NAWS CHINA LAKE, CALIFORNIA

FIGURE 3-2

SITE 12: SNORT ROAD LANDFILL
PRELIMINARY CONCEPTUAL SITE MODEL
FOR ECOLOGICAL RISK ASSESSMENT

PROJECT NO.:	ORIGINATOR:	CHECKER:	DATE:
4545-0050	BYW	-	9/96



SOURCE: DRAFT HUMAN HEALTH & ECOLOGICAL RISK ASSESSMENT WORK PLANS (PRC, 1996c)

MORRISON KNUDSEN CORPORATION

NAWS CHINA LAKE, CALIFORNIA

FIGURE 3-3

SITE 22: PILOT PLANT ROAD LANDFILL PRELIMINARY CONCEPTUAL SITE MODEL FOR HUMAN RISK ASSESSMENT

PROJECT NO.:	ORIGINATOR:	CHECKER:	DATE:
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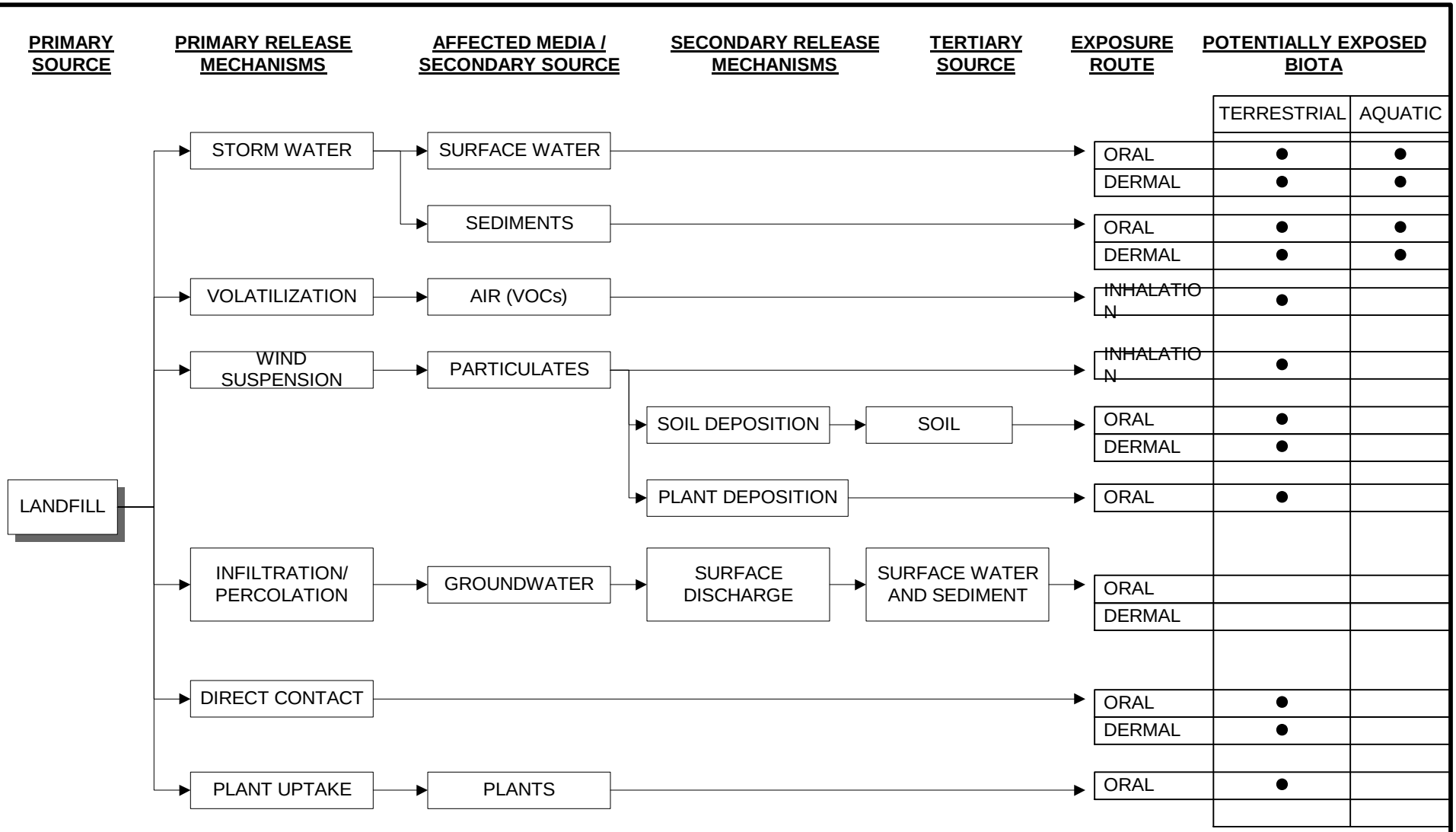

SOURCE: DRAFT HUMAN HEALTH & ECOLOGICAL RISK ASSESSMENT WORK PLANS (PRC, 1996c)

MORRISON KNUDSEN CORPORATION

NAWS CHINA LAKE, CALIFORNIA

FIGURE 3-4

SITE 22: PILOT PLANT ROAD LANDFILL PRELIMINARY CONCEPTUAL SITE MODEL FOR ECOLOGICAL RISK ASSESSEMENT

PROJECT NO.:	ORIGINATOR:	CHECKER:	DATE:
4545-0050	BYW	-	9/96

9/5/96

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4.0 WORK PLAN ADDENDUM RATIONALE

The following sections have been reproduced from Section 4.0 of the Draft Final RI/FS Work Plan (PRC and JMM, 1991a). The RI/FS objectives, data needs and DQOs, and the WPA II RI/FS tasks including rationale are presented and discussed within this section.

4.1 RI/FS OBJECTIVES

The approach for the remedial investigation stage of the project focuses on (1) identifying and confirming the onsite sources of contamination, (2) defining the extent of the onsite soil and groundwater contamination, (3) characterizing the potential contaminant migration pathways, and (4) identifying potential groundwater releases from the sites.

Specific RI/FS objectives include collection of data sufficient to:

- Characterize the geology and hydrogeology of the sites and identify potential contaminant pathways.
- Assess the nature and extent of potential groundwater and soil contamination and associated migration rates of contaminants.
- Support a limited baseline human health risk assessment.
- Provide a basis for the identification and screening of potential remediation technologies and alternatives, if required, of site contaminants and contaminated media.

A treatability study may be needed to augment the characterization and risk assessment presented in the RI/FS. If needed, the treatability study will be used to develop and identify preliminary recommendations for addressing any impacted media at Sites 12 and 22. Any required treatability study will be based upon an initial screening of technologies suitable for remediation at the two sites. Presumptive remedies for CERCLA municipal landfill sites will be reviewed to potentially streamline the investigations at the two sites and to speed up the selection of cleanup actions that may be required.

Data developed during the RI/FS will also be used to assess the risk to remedial personnel during the implementation of the selected remedial action alternative, and to define any subsequent long-term

monitoring program. Additionally, the data will be used to evaluate the risk to onsite workers during future maintenance or construction activities.

4.2 DATA NEEDS

Data needs to meet the RI/FS objectives have been identified based on an evaluation of existing data and the CSM presented in Section 3.2. These data needs are required to confirm and expand the CSM. In particular, data are needed (1) to assess whether the potential sources of contamination exist and are releasing contaminants to identified pathways, (2) to assess the magnitude and extent of contamination through these pathways, (3) to assess the potential for future migration through these pathways, and (4) to identify potentially affected receptors. A summary of the data types required to evaluate potential sources, release mechanisms, and migration pathways is presented in Table 4-1. Data needed to aid in the remedial technology screening and selection identified in Section 3.5.2 are presented in Table 4-2.

Implementation of the RI/FS tasks described in Section 5.0 are designed to meet the data needs identified in Tables 4-1 and 4-2. For regional groundwater hydrology, a broad based study will be used to evaluate existing stratigraphy and hydrogeology of groundwater supply source areas. This includes:

- Evaluation of the Intermediate Well Field source area.
- Evaluation of the Ridgecrest Well Field source area.
- Assessment of seasonal groundwater level fluctuations and pumping patterns.

Characterization of surface soils and subsurface soils at the former asphalt batch plant is required to:

- Evaluate potential sources of contamination as identified in the CSMs.
- Evaluate the extent of, or potential for, migration of contamination from Site 12.

Characterization of borrow materials is required to:

- Identify soils suitable for grading and capping to meet the presumptive remedy alternatives for landfills.
- Evaluate significant cost factors related to use of borrow materials.

- Avoid problem materials such as highly plastic clays, elastic silts, and highly heterogeneous materials.

To examine contaminant migration through the groundwater, data are needed to:

- Further assess geologic and hydrogeologic conditions, including delineation of lateral extent and depths of specific geologic units (i.e. Water Table Aquifer and the Semiconfining Layer).
- Further assess the extent of contamination.
- Evaluate the extent of and interrelationships between the Water Table Aquifer and the Semiconfining Layer Aquifer.
- Further assess the occurrence and movement of groundwater.
- Further assess groundwater quality upgradient of potential sources of contamination.
- Further assess groundwater quality downgradient of potential sources of contamination.
- Monitor seasonal groundwater level fluctuations in monitoring wells at Site 12.
- Evaluate the effect production well pumping in the Intermediate Well Field and the Ridgecrest Well Field might have on the two aquifers at Site 12.

Some of the field activities that are required to satisfy data needs may result in the disturbance of sensitive plant or animal species. The utmost care will be taken in all field activities to minimize the impact on plant and animal life present in the investigation areas.

4.3 DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) are qualitative and quantitative statements produced from the DQO identification process to assure that the data user will obtain results of appropriate quality for defensible decision making. The DQO identification process for developing DQOs, as described in "Data Quality Objectives Process For Superfund" (EPA, 1993a) consists of:

- Stating the objectives of the project.
- Specifying the data type needed to meet project objectives.
- Specifying and describing the appropriate methods needed to collect data that will be acceptable qualitatively and quantitatively to support decision making.

The first two steps of the DQO process are described in Sections 4.1 and 4.2. The third step, which consists of data quality needs and data quantity needs, is described in detail in the SAP and is briefly described below.

4.3.1 Data Quality Needs

Data quality is comprised of three elements. These are:

- Identification of contaminants or classes of contaminants of concern
- Definition of appropriate analytical levels for decision making
- Identification of applicable or relevant and appropriate requirements (ARAR) or soil preliminary remediation goals (PRG).

4.3.1.1 Identification of Site Contaminants - Soil

Contaminants of concern in soils at Sites 12 and 22 are relatively unknown. Contaminants of concern in soil verified at Site 12 consist of oil and grease. At Site 22 no contaminants of concern have been verified. Based on historical disposal practices at Site 22, the types of contaminants that might be expected would be those associated with household waste (Section 2.6.2.1). In addition, some pesticide, oil, solvent, and paint residues may be present at both sites. Surface soil contamination will be investigated further at both sites during the RI/FS. The chemical parameters that will be analyzed include:

- Volatile organic compounds (VOCs)
- Semi-volatile organic compounds (SVOCs)
- Organochlorine pesticides (OCPs) and PCBs
- Organophosphorus pesticides (OPPs)
- Total petroleum hydrocarbons as diesel (TPH-D)
- Metals
- Gross alpha and gross beta

4.3.1.2 Identification of Site Containments - Groundwater

Contaminants of concern confirmed in groundwater at Site 12 consist primarily of VOCs. The VOCs confirmed in Phase I of the RI/FS are carbon disulfide and 1,1,1-TCA. At Site 22, contaminants of concern confirmed in groundwater are low levels of VOCs: acetone, benzene, 2-butanone, chloroform, dichlorobromomethane, 1,1-DCA, 1,1-DCE, 1,2-dichloropropane, ethylbenzene, 1,1,1-TCA, 1,1,2-TCA, tetrachloroethene, tetrahydrofuran, toluene, trichloroethene, m-, o-, and p-xylenes; and radionuclides as gross alpha. Groundwater contamination will be investigated further at both sites during the RI/FS. The chemical parameters that will be analyzed include:

- VOCs
- SVOCs
- OCPs and PCBs
- OPPs
- TPH-D
- Metals
- General inorganic parameters (cations, anions, total dissolved solids)
- Landfill Parameters: ammonia, nitrite, nitrate, total Kjeldahl nitrogen, and total nitrogen, orthophosphate and total phosphorous, chloride, fluoride, sulfate, total organic carbon, and total coliform bacteria.
- Gross alpha and gross beta

4.3.1.3 Definition of Analytical Levels

The highest analytical level for this project was identified by the Navy EIC as Level D. This level, equivalent to EPA Level IV, was selected by the Navy EIC because the NAWS may be placed on the EPA National Priority List (NPL) in the near future. The selected laboratory must be certified by the California Department of Health Services (DHS) to perform hazardous waste testing. As part of the Navy Level D program, the analytical laboratory must successfully analyze a performance evaluation sample, undergo an audit by the Navy, correct deficiencies found during the audit, and provide monthly progress reports on QA. These activities will be administered by the Navy contract representative

currently, Martin Marietta Energy System, Inc. This audit and the analysis of performance samples will be in addition to those required by the EPA Contract Laboratory Program (CLP). In addition, the selected laboratory will be experienced in CLP procedures and will be able to generate CLP deliverables.

CLP routine analytical services procedures (EPA, 1994a, 1994b) will be used for the analysis and reporting of VOCs, SVOCs, OCPs, PCBs, and metals in soil and groundwater. Non-CLP routine analytical services procedures, as defined in the CLP statement of work, will be used for the analysis and reporting OPPs, TPH-D, hexavalent chromium, and various inorganic parameters. The analytical level identified for these non-CLP methods will be equivalent to EPA Level III.

Level I data quality will be provided by (1) the field sampling team collecting health and safety monitoring data, (2) the field sampling team providing NAPL screening results, and (3) an off-site laboratory providing soil physical parameter testing results. Health and safety monitoring will include use of a hand-held PID to monitor boreholes and soil samples for volatile organics. NAPL screening will be performed using the addition of a hydrophobic dye to the water samples. Soil physical parameter testing will include total organic carbon, bulk density, porosity, moisture content, grain size, and permeability. Health and safety monitoring equipment and NAPL screening solutions will be utilized according to manufacturers' recommendations. The soil physical parameter testing will follow guidelines established in the American Society for Testing Materials (ASTM) and U.S. Corps of Engineers Methods.

4.3.1.4 Levels of Concern and Analytical Detection Limits

The physical and chemical analytical parameters proposed for the analyses of soil and groundwater samples are listed in Table 4-3.

4.3.2 Data Quantity Needs

The estimated number of soil samples is 60. The estimated number of groundwater samples during the RI/FS is 18. A minimum of 10 percent these will also be sent to the Navy CLEAN basic order agreement (BOA) laboratory for definitive confirmation analysis.

4.3.3 Data Quality Indicators

Critical indicators of project data quality are precision, accuracy, representativeness, completeness, and comparability. Objectives for these indicators were developed for this project based on past experience and on the objectives of this RI/FS. Field procedures, analytical methods, and the project QA program were selected and developed to meet these objectives. Field procedures, analytical methods and the project QA program are identified in the site specific SAP.

4.4 WORK PLAN ADDENDUM RATIONALE

The purpose of the RI/FS is to provide a detailed characterization of Sites 12 and 22 to allow for the preliminary screening of remedial action alternatives during the treatability studies. This section provides a summary of the overall approach, the RI/FS rationale, and the major field tasks required to complete the site characterization and a description of the rationale for performing each task.

The two sites will be investigated in a stepped approach to aid in defining and targeting subsequent field activities. The collection of field data will be conducted in accordance with the procedures presented in Section 5.0. Specific sampling locations were selected based on the results of previous investigations.

Using the data generated during the stepped RI/FS, the preliminary screening of remedial action alternatives during the treatability studies will be completed following the streamlined presumptive remedy approach within the SACM.

4.4.1 Step One of RI/FS

Step One of the RI/FS will involve the collection of information on pumping patterns and wells from NAWS, the IWVWD and the City of Ridgecrest to assess the relationship between seasonal variations in water levels and pumping in the Intermediate and Ridgecrest Well Fields. Also, Step One site characterization activities will include surface soil sampling, shallow soil borings, exploratory borings, the installation of groundwater elevation data loggers at Site 12, surface soil sampling at Site 22, and the installation of monitoring wells at Site 12 and Site 22. The data collected from surface soil samples and shallow soil borings will be used to:

- Evaluate the potential sources of contamination in surface soils at both sites and shallow soils at the former asphalt batch plant at Site 12.

- Evaluate the extent of, or potential for, migration of contamination from the sites.

Data from the groundwater monitoring well data loggers (Site 12), the exploratory borings (Site 12), and the monitoring wells installed at Site 12 and Site 22 will be used to:

- Further assess geologic and hydrogeologic conditions, including delineation of lateral extent and depths of specific geologic units (Water Table Aquifer and the Semiconfining Layer).

- Evaluate the extent of and the interrelationships between the Water Table Aquifer and the Semiconfining Layer Aquifer (Site 12).

- Further assess the occurrence and movement of groundwater.

- Further assess groundwater quality upgradient of potential sources of contamination.

- Further assess groundwater quality downgradient of potential sources of contamination.

- Assess seasonal groundwater level fluctuations in monitoring wells at Site 12 using data loggers.

- Evaluate the effect production well pumping in the Intermediate and Ridgecrest groundwater supply source areas may have on the two aquifers at Site 12 using data loggers.

- Assess the nature and extent of potential groundwater contamination at both sites.

- Evaluate the vertical gradient between the Water Table Aquifer and the Semiconfining Aquifer at Site 12.

- Evaluate for the presence of NAPLs within the Water Table Aquifer at Site 22.

The proposed monitoring well locations have been provided in Section 5.0 and in the site specific SAP.

The data collected from surface soil samples will be used to complete a risk assessment that will begin following Step One of the RI/FS. The validation and evaluation of the data collected will occur following the completion of Step One RI/FS field activities.

4.4.2 Step Two of RI/FS

Step Two of the RI/FS will consist of the sampling of all new and existing wells at Sites 12 and 22. This sampling event will also be considered as the First Quarterly Groundwater Sampling Event for each site. Past groundwater sampling has been sporadic and performed on an inconsistent schedule. All past data will be utilized and incorporated in the new groundwater monitoring program.

The First Quarterly Groundwater Sampling Event will follow procedures identified in the Draft Long-Term Groundwater Monitoring Program Plan, NAWS China Lake, California, June 1995 (PRC and JMM, 1995).

The general objectives of the long-term groundwater monitoring program as defined in this guidance document are to:

- Develop a program which documents QA/QC and define procedures for sample collection, analysis, and well maintenance.
- Specify a method and frequency for collecting groundwater level measurements to assess flow directions, gradients, and potential seasonal variations in the hydraulic system.
- Identify the lateral and vertical extent of groundwater contamination.
- Track the rate and direction of both horizontal and vertical plume movement to evaluate the impact on potential beneficial uses and the threat to nearby receptors.
- Provide a long-term groundwater monitoring strategy that includes the constituents of concern, monitoring locations, frequency, and analytical methods.
- Improve the understanding of the site hydrogeology conceptual model.
- Validate and optimize the effectiveness of groundwater remedial measures.
- Establish when remedial objectives have been met.
- Ensure groundwater sampling is performed in a cost effective manner.
- Provide a system for effective data management.

The applicability of these objectives will vary over time for the individual sites as they progress through the RI/FS process. Early-stage objectives at a given site will include identifying the extent of contamination and tracking plume movement. Later-stage objectives, if a site proceeds to remediation, will include validation and optimizing remedial measures and determining when remedial objectives have been met. The final objective of the initiating regular groundwater monitoring will be to use the data for the preliminary screening of remedial action alternatives during the treatability studies. The preliminary screening will be completed following the streamlined presumptive remedy approach within the SACM.

Groundwater sampling procedures, decontamination procedures, and sample handling and documentation procedures are presented in the site specific SAP. The validation and evaluation of the data collected generated during Step Two of the RI/FS will occur following the completion of Step Two field activities.

TABLE 4-1

POTENTIAL IMPACTS ON HUMAN HEALTH AND THE ENVIRONMENT
NAWS CHINA LAKE, CALIFORNIA

	Human Health										Environment		
	Groundwater			Surface Water			Soil				Mojave tui chub		
Sites	**Ingestion**	**Dermal Absorption**	**Inhalation**	**Ingestion**	**Dermal Absorption**	**Inhalation**	**Ingestion**	**Dermal Absorption**	**Inhalation**	**Other**	**Surface Water Discharge**	**Groundwater Discharge**	**Other**
Site 12, SNORT Road Landfill	Yes (e)	Yes (e)	Yes (e)	No	No	No	Yes (f)	Yes (f)	Yes (f)	--	No	No	--
Site 22, Pilot Plant Road Landfill	Yes (h)	Yes (h)	Yes (h)	No	No	No	Yes	Yes	Yes	--	No	No	--

Notes:

(a) Intermediate Well Field is located approximately 1 mile of the site and individual private wells are located within 0.5 mile of the site.
(b) In the area of the former batch asphalt plant.
(c) Ridgecrest Well Field located within 2 1/2 miles of site. If pumping resumes, gradient may revert to southwest, towards the well field. Groundwater may also flow to Intermediate Well Field.

TABLE 4-2

DATA NEEDS FOR REMEDIAL INVESTIGATION/FEASIBILITY STUDY
NAWS CHINA LAKE, CALIFORNIA

		Geology and Hydrogeology				Presence/Extent of Contamination			Potential Exposure Points			
									Water Supply Wells			
Site No.	**Site Name**	**Subsurface Geology**	**Groundwater Elevations**	**Aquifer Parameters**	**Vadose Zone Characteristics**	**Groundwater**	**Surface Water & Sediments**	**Soil**	**Public**	**Private**	**Navy**	**Chub**
12.	SNORT Road Landfill	x	x	x	x	x	---	x	x	x	---	---
22.	Pilot Plant Road Landfill	x	x	x	x	x	---	x	x	x	---	---

TABLE 4-3

PROPOSED ANALYTICAL PARAMETERS
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
NAWS CHINA LAKE, CALIFORNIA

Parameter	Groundwater	Surface Water	Soil	Sediments	Product
General Organic Analyses					
Fuel characterization	---	---	---	---	x
PCBs	x	x	x	x	x
Semivolatile compounds	x	x	x	x	---
Total fuel hydrocarbons	x	x	x	x	---
Volatile Organic Compounds					
Halogenated hydrocarbons	x	x	x	x	---
Non-halogenated hydrocarbons	x	x	x	x	---
Agricultural Chemicals					
Organochlorine pesticides	x	x	x	x	---
Organophosphorus pesticides	x	x	x	x	---
Landfill Parameters					
Alkalinity	x	x	---	---	---
Ammonia as nitrogen	x	x	---	---	---
Anion scan	x	x	---	---	---
Coliforms	x	x	---	---	---
Fluoride	x	x	---	---	---
Orthophosphate	x	x	---	---	---
Total Kjeldahl nitrogen	x	x	---	---	---
Total phosphorus	x	x	---	---	---
Geotechnical Parameters					
Total oganic carbon	x	---	x	---	---
Soil bulk density	---	---	x	---	---
Soil porosity	---	---	x	---	---
Specific Gravity					
Moisture content (by weight)	---	---	x	---	---
Grain size analysis	---	---	x	---	---
Permeability (falling head)	---	---	x	---	---
Inorganic/Physical Parameters					
Cyanide	x	x	x	x	---
Gross alpha/beta[a]	x	---	x	---	---
Metals[c]	x	x	x	x	x[b]
Total dissolved solids (TDS)	x	x	---	---	---
Total solids	---	---	x	---	---

[a] Additional analyses for Radium 226, Radium 228, Uranium, Strontium and Tritium may be performed if gross alpha/beta are above drinking water standards.

[b] Lead only.

[c] Metals include: aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chronium, hexavalent chronium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, potassium, selenium, silver, sodium, thallium, vanadium, zinc.

5.0 RI/FS TASKS FOR SITES 12 AND 22

The following section describes in detail the tasks necessary to successfully complete the remedial investigation and the removal evaluation at the sites. The WPA II presents the technical approach, including task descriptions, general and task-specific assumptions, and deliverables. It also outlines the anticipated schedule, management, staffing, and performance protocols (including health and safety, sampling and analysis, and quality assurance) required to complete the work at these sites.

The RI/FS will encompass the following tasks:

- Task 1 - Project Scoping
- Task 2 - Community Relations
- Task 3 - Site Characterization
- Task 4 - Sample Analysis and Validation
- Task 5 - Data Evaluation
- Task 6 - Quality Assurance Program
- Task 7 - Risk Assessment
- Task 8 - Treatability Study
- Task 9 - Technical Memorandum

The deliverables and schedule associated with each of these tasks are presented in Section 6.2.

5.1 TASK 1 - PROJECT SCOPING

Scoping is the initial planning phase of the RI/FS process. Project planning decisions and special concerns associated with the site are discussed in this phase. The preliminary identification of ARARs, data quality objectives, operable units if available, and preliminary remedial actions lead to the development of sampling strategies, analytical support plans, and health and safety protocols.

Scoping activities comprise the first steps in the initial evaluation of the site. The initial strategy to be used to perform the RI/FS was determined during the scoping process and is presented in the WPA II. A Sampling and Analysis Plan (SAP), which includes the FSP and the QAPjP, outlines the data collection program to be implemented during the execution of the WPA II.

Scoping is currently ongoing. Existing information on potential sources of contamination, pathways, and receptors has been collected and reviewed to identify data gaps for completeness. New information collected during the RI/FS will be used to fill in these data gaps. Regional, historical, and site-specific literature will be reviewed and evaluated during Step One of the RI/FS. Scoping activities will continue as site conditions and possible remedial alternatives are better defined. Task 1 deliverables include this document, which includes the WPA II, and the SAP, and HSP.

Presented within the following subsections is a detailed discussion of the elements included within Task 1.

5.1.1 Project Kickoff

The project kickoff entailed the preparation of a work plan approach document and a cost estimate for the Department of the Navy, Naval Facilities Engineering Command, Engineering Field Activity West under the CTO 0050. The proposed WPA II RI/FS activities include various screening surveys to evaluate the approximate extent of possible soil and groundwater contamination, initial sampling to establish if future removal actions will mitigate risks that may be presented by each site, and general support tasks such as site map production and data management.

MK and PRC have met with the Naval Remedial Project Manager (RPM) to scope the effort necessary to complete this WPA II RI/FS. MK staff, with the assistance of PRC, will review existing plans, previous studies, and other data relevant to this plan. Existing relevant data have been included in Section 2.0 of this document and have been used to identify the data gaps presented in Section 3.0.

5.1.2 Site Visit

MK and PRC met with the Naval RPM on April 10, 1996 and conducted site visits of Sites 12 and 22. Project logistic activities, including the review of existing information on the sites, the preliminary identification and scheduling of required activities, and sampling strategies, were discussed.

5.1.3 Subcontractor Selection / Coordination

To complete the tasks within this plan MK will engage the services of several subcontractors. A Navy CLEAN II team subcontractor laboratory will be used to do the chemical analysis of the environmental samples collected for formal laboratory analysis.

Several non-team subcontractors will also be used to complete this RI/FS. MK has a government approved procurement system, based on the Federal Acquisition Regulations, that will be used to retain the best qualified subcontractors at the most reasonable competitive costs.

Subcontractor services that will be required include:

- unexploded ordnance clearance
- underground utility clearance
- drilling and well development
- downhole geophysical survey
- geotechnical laboratory
- surveying
- waste disposal

5.1.4 Environmental Review of Proposed Activities

The review of all activities in this RI/FS will be conducted by a wide variety of interested parties. The overall control of activities will be at the direction of Department of the Navy, Engineering Field Activity West, Naval Facilities Engineering Command. Oversight review of the plans and activities will

be supplied by State of California, California Environmental Protection Agency, Department of Toxic Substances Control, and the California Regional Water Quality Control Board, along with the NAWS China Lake Restoration Advisory Board.

NAWS and PRC biological experts will conduct an environmental review of the proposed field activity at each site, and will identify any potential adverse impacts on local plant or wildlife species. Environmental Assessments, Findings of No Significant Impact, and other relevant documents will be prepared as appropriate.

5.1.5 Premobilization

Premobilization activities will begin with a premobilization meeting at the NAWS facility approximately two months prior to commencement of the field investigation. Experienced MK field operations managers will take over the investigation. Coordination with the facility, the subcontractors, and the MK field staff will be a major part of the premobilization. The field equipment will be assembled, including field analytical screening instruments, health and safety monitoring instruments, sample containers, sampling tools, and miscellaneous sampling supplies.

This task will also include:

- Setting up and organizing the existing field office at 1520-B Richmond Avenue (located in NAWS China Lake complex) in preparation for the new field investigation.
- Identifying utilities in the investigation areas and obtaining the necessary clearance from Navy and public utility personnel prior to probing or drilling activities.
- Obtaining all drilling and digging permits as required by Navy, state, and local regulatory personnel.

5.1.6 Utility and Unexploded Ordnance Clearance

All proposed field investigation activities, except for the drilling and installation of wells south of Site 12, will be conducted on Navy property. Underground utility clearance on site will be done by Navy personnel. Existing engineering plans, drawings, diagrams and other information showing underground utilities will be reviewed prior to locating proposed soil borings or well locations in the field. Each

sampling location will be checked by the various utility departments prior to any subsurface sampling activities. The MK field team manager will meet with the utility clearance personnel and discuss the proposed sampling and the location of any utilities. The field sampling will be coordinated with the appropriate facility maintenance department and NAWS will issue a digging permit after the review of the location by NAWS personnel.

For the proposed well locations south of Site 12 and outside of Navy property, a commercial underground utility clearance company will be procured to identify and locate any subsurface features prior to drilling.

At Site 12, several sampling locations are in an area where there is an unexploded ordnance (UXO) concern. These locations will be cleared by a commercial UXO surveying company prior to and during drilling activities.

5.1.7 Permitting

All required State of California and county permits for drilling of soil borings and wells will be obtained from the appropriate agencies. Records of drilling and grouting activities will be submitted to the agencies in compliance with regulations.

5.1.8 Data Management System Design

The data management system will be based on the one that is currently being used at Moffett Federal Airfield and at NAWS China Lake. The sample results and locations will be recorded in digital form and processed through the Global Positioning System set up for the facility. Data management is discussed in further detail in Section 5.4.4.

5.2 TASK 2 - COMMUNITY RELATIONS

Community relations efforts are an ongoing activity at NAWS. Specific community relations for this work will begin prior to any field activities. The plans for this project, including this one, will be reviewed by the NAWS China Lake Restoration Advisory Board (RAB) which includes representatives

from the community. The RAB will aid in the dissemination of information and may have an impact on overall activities at the sites.

The goal of the community relations activities includes the following:

- Identify concerns and information needs of the communities surrounding NAWS.
- Establish two-way communication system with the public to be used throughout the RI/FS.
- Provide up-to-date information to the community regarding the activities, progress, and results of the RI/FS.

The development of a successful community relations program requires a coordinated effort between NAWS personnel, regulatory agencies, and consultants. The section below briefly describes some of the activities involved in the preparation and performance of the community relations program at NAWS. The facility-wide CRP describes in detail these and other activities planned during the RI/FS. The facility-wide CRP is currently being revised to update these and other actions being undertaken at the facility (PRC and JMM, 1991d).

5.2.1 Coordination

Each phase of community relations activities will be conducted by NAWS in cooperation with federal, state, and local regulatory agencies who will provide technical assistance and oversight to the program. Community activities such as interviews, public meetings or news conferences will be coordinated between all interested parties. Contractors may be used to provide support services for some program activities. These activities may range from assisting in daily or on-going site work, conducting community interviews, and/or preparing community relations plans. All final documents will be prepared in accordance with “Community Relations in Superfund: A Handbook” (EPA, 1988c) and “Community Relations for Site Mitigation” (California DTSC, 1989).

Any community concerns or feedback on activities conducted during the RI/FS will be directed to the Public Affairs Office (PAO). The PAO will provide information about site activities and respond to community inquiries and concerns, either answering directly or referring questions to the people most knowledgeable about the subject.

5.2.2 Completion of Pre-plan Development Tasks

Concurrent with the development of the WPA II, several activities were conducted to initiate communication with the surrounding communities and to identify concerns and information needs of the public. These pre-plan development activities included the following tasks:

- Development and printing of a fact sheet announcing the RI/FS.
- Conducting interviews with local and state officials, public and citizen interest groups, and concerned residents.
- Establishing information repositories at NAWS and in surrounding communities.
- Developing a mailing list of interested parties.

5.2.3 Plan Development

Using the information gathered from the pre-plan development tasks, the CRP was prepared. The plan describes actions that have been, and will be taken, to keep the public informed about all aspects of the investigation. It also describes how and when information will be disseminated, identifies the groups that have requested information, and discusses the areas of public concern.

The following topics are included in the CRP:

- Introduction, including site description.
- Site background.
- Historical community involvements.
- Current community concerns and key issues.
- CRP objectives.
- Activities schedule.
- List of contacts.
- Information repository details.

The implementation of the CRP will be conducted by NAWS and assisted as necessary by contractors and/or regulatory agency personnel. The selected techniques and approaches will reflect community needs. These may include, but is not limited to, the following methods:

- Public meetings.
- Information repositories.
- News conferences.
- News releases.
- Facts sheets.
- NAWS contact person.
- Public notices.
- Comment periods.
- Responsiveness summaries.
- Small group meetings.
- Community contacts.

It is anticipated that the CRP may require revisions in the future. The plan is intended to be a working document, and will be updated to reflect changes in the project or the changing needs of the community as those needs become apparent.

5.3 TASK 3 - SITE CHARACTERIZATION

Site characterization activities are intended to define the nature and extent of contamination and to assess the potential for migration. The contaminant distribution will be assessed by a program of drilling, data logger installation and monitoring, hydropunch sampling, monitoring well installation, and the sampling and analysis of various environmental media. Migration potential will be assessed by collection and evaluation of subsurface data, including stratigraphy, physical properties of soils, and aquifer characteristics. Site characterization and the scope of work are described in greater detail in the site specific SAP.

The following subtasks will be performed during site characterization:

- Preparation for field investigation.
- Performance of field investigation.
- Analysis, evaluation, and validation of data.

5.3.1 Preparation For Field Investigation

This subtask will include preparation of bid specifications for the selection of qualified UXO clearance, geophysical surveying, surveying, and drilling firms as described in this WPA II. Procurement of all field supplies and equipment required for the investigation will be included. Permits will be obtained for all proposed drilling and sampling activities, as required by state and local agencies. UXO and underground utility clearance surveys will be required before any intrusive activities begin. Arrangements for the storage, transport and disposal of investigation derived waste (IDW) will also be made.

5.3.2 Field Investigations

The field investigations conducted as part of the site characterization will be executed using the following plans:

- Draft RI/FS Field Sampling Plan (PRC and JMM, 1991b) plus the site specific SAP.
- Draft Quality Assurance Project Plan (PRC, 1996a) plus the site specific QAPjP.
- Base-Wide Health and Safety Plan, NAWS China Lake (PRC, July 1996b) plus the site specific HSP.
- Draft Final RI/FS Community Relations Plan (PRC and JMM, 1991d).
- Draft Long-Term Groundwater Monitoring Program Plan (PRC and JMM, 1995).

Each of these plans describes procedures which will be followed during field investigations and/or the rationale for selection of sample types, locations, and analytical parameters.

A summary of site-specific field activities has been provided in Section 4.4. Detailed description of field activities are provided in the site specific SAP. A general description of the subtasks associated with the field activities is presented below.

The objectives of the field investigations for Site 12 and Site 22 are to (1) characterize the stratigraphy and hydrogeology at the sites; (2) collect sufficient samples to conduct risk assessments of the sites; (3) identify areas of soil contamination; (4) further define the extent of any previously identified soil contamination; and (5) further assess the nature and extent of potential groundwater contamination in both the Water Table Aquifer and the Semiconfining Layer Aquifer.

Planned activities include the following: (1) an investigation of local wells and groundwater pumping patterns; (2) a surface soil sampling investigation at both Site 12 and Site 22; (3) a shallow soil boring investigation of the asphalt plant area at Plant 12; (4) an exploratory soil boring investigation at Site 12 to characterize site stratigraphy and hydrogeology; (5) a groundwater sampling investigation at Site 12 and Site 22; (6) the installation of additional monitoring wells at Site 12 and Site 22 with the installation of monitoring wells at Site 22 to include hydropunch sampling to screen for NAPLs; and (7) a comprehensive groundwater well sampling event at Site 12 and Site 22. These field investigation activities are described in the following sections and summarized on Table 5-1.

5.3.2.1 Local Groundwater and Well Investigation

The first activity will be the collection of information on the wells and pumping patterns from NAWS, the IWVWD, and the City of Ridgecrest to assess the relationship between the seasonal variations in water levels, and the pumping of groundwater in the Intermediate and Ridgecrest Well Fields. Lithologic and electric (downhole geophysical) logs will be obtained from the United States Geological Survey and IWVWD for wells located near Site 12 and Site 22. The logs will be used to assess the stratigraphy and hydrogeology in the Intermediate and Ridgecrest Well Fields.

5.3.2.2 Surface Soil Investigation

This investigation is being performed as part of the CSM for human health and ecological evaluation. The surface soil sampling program will provide data which will be used in the risk assessment.

The surface soil sampling program will:

- Assist in establishing background levels of metals in surface soils.
- Establish current levels of chemicals over a broad area at each site.
- Identify trends, if any, in surface soil concentrations related to surface drainage and distance from the disposal area at each site.
- Establish allowable exposure levels for human and ecological receptors.
- Identify preliminary remedial alternatives, if required, for each site.

A total of 15 surface soil samples will be collected at Site 12, the SNORT Road Landfill. Twelve of the samples will be collected on the surface of the landfill, and three background samples will be collected in areas adjacent to the landfill. The surface soil sampling locations for Site 12 are shown on Figure 5-1. Prior to the collection of the surface soil samples from within the bermed area, a UXO survey will be performed.

A total of 21 surface soil samples will be collected at Site 22, the Pilot Plant Road Landfill. Fifteen of the samples will be collected on the surface of the landfill, three background samples will be collected adjacent to the landfill, and three ecological samples will be collected. The ecological sampling will be conducted to assess contaminants in surface soils of drainage swales leading from the landfill to nearby Mirror Lake playa, and to assess contaminants in the Mirror Lake playa sediments. The surface soil sampling locations for Site 22 are shown on Figure 5-2. Surface samples from Sites 12 and 22 will be analyzed for the compounds identified in Table 5-2. The surface soil sampling equipment and procedures to be used are described in detail in the site specific SAP.

5.3.2.3 Shallow Soil Borings Investigation

Results from previous soil boring RLS12-SB01, located near the former asphalt batch processing plant at Site 12, indicated the presence of oil and grease. Surface soil staining has also been identified at the location. Accordingly, four shallow (25 ft.) soil borings will be drilled at the locations illustrated in Figure 5-3 using hollow-stem augering techniques. The objective of sampling is to further assess the vertical and horizontal extent of elevated oil and grease concentrations in soil at the location. Hollow-stem augering techniques are described in the site specific SAP. Soil samples will be collected at depths

of 0.5, 5, 10, 15, 20, and 25 feet, and will be analyzed according to the soil sampling and analyses methods summary given in Table 5-2.

5.3.2.4 Exploratory Soil Boring Investigation

At Site 12, two exploratory borings will be drilled to a depth of approximately 300 feet and the logged information used to:

- Assess the effectiveness of the low permeability soil zones for preventing any downward movement of contaminants through the soil column;
- Assist in the correlation and mapping of distinct water-bearing zones;
- Verify the existence and, if verified, the orientation of the fault previously identified beneath the site (PRC and JMM,1993); and
- Evaluate for the presence of additional faulting beneath the site.

The exploratory borings will be continuously cored using dual tube rotary drilling techniques, described in the site specific SAP. Lithologic logging of the boreholes will be accomplished both by direct observation of drill cuttings during drilling, and by down-hole geophysical logging (resistivity, gamma, and spontaneous potential) after drilling is completed. Geophysical logging techniques are defined in the site specific SAP. Once these activities are completed, each boring will be destroyed by grouting the boring back to surface to prevent hydraulic interconnection between water-bearing zones.

5.3.2.5 Groundwater Investigation

The groundwater investigation will provide information to:

- Further assess geologic and hydrogeologic conditions, including delineation of lateral extent and depths of specific geologic units (Water Table Aquifer and the semiconfining layer).
- Evaluate the extent of and the interrelationships between the Water Table Aquifer and the Semiconfining Layer Aquifer (Site 12).
- Further assess the occurrence and movement of groundwater.
- Further assess groundwater quality upgradient of potential sources of contamination.

- Further assess groundwater quality downgradient of potential sources of contamination.
- Assess seasonal groundwater level fluctuations in monitoring wells at Site 12 using data loggers.
- Evaluate the effect production well pumping in the Intermediate and Ridgecrest groundwater supply source areas may have on the two aquifers at Site 12 using data loggers.
- Assess the nature and extent of potential groundwater contamination at both sites.
- Evaluate the vertical gradient between the Water Table Aquifer and the Semiconfining Aquifer at Site 12.
- Evaluate for the presence of NAPLs within the Water Table Aquifer at Site 22.

Investigation work activities related to the groundwater beneath Site 12 include:

- Installation of data loggers in selected existing monitoring wells to monitor water level fluctuation related to seasonal variations and the possible influence from IWVWD, City of Ridgecrest, and private groundwater production wells in close proximity to Site 12.
- Installation of groundwater monitoring wells.
- Groundwater sampling and analyses.

Investigation work activities related to the groundwater beneath Site 22 include:

- Installation of groundwater monitoring wells including hydropunch sampling to screen for the presence of NAPLs within the Water Table Aquifer.
- Groundwater sampling and analyses.

The groundwater investigation will be implemented as part of Step One and Step Two of the WPA II RI/FS. During Step One of the RI/FS, all groundwater investigation activities for Site 12 and Site 22 will be completed except for sampling all existing and new monitoring wells. Step Two of the RI/FS will involve the sampling and analyses of all existing and new monitoring wells. Step Two of the RI/FS as it relates to the groundwater investigation will also be considered as the first round of quarterly groundwater monitoring for both sites.

Presented below is a general description of each activity associated with the groundwater investigation. A detailed description is provided in the SAP.

5.3.2.5.1 Monitoring Well Installation

A total of eleven new monitoring wells will be installed during the RI/FS. Six new monitoring wells will be installed at Site 12 and five new monitoring wells will be installed at Site 22. The shallow Water Table Aquifer monitoring wells will be installed at both Site 12 and Site 22 using hollow-stem auger drilling techniques. Deeper monitoring wells penetrating the Semiconfining Layer Aquifer will be installed at Site 12 using sonic drilling techniques.

At Site 12, three wells will be installed in the Water Table Aquifer and are estimated to be 120 feet deep. Three wells will also be installed in the Semiconfining Layer Aquifer. Each deeper well has an estimated depth of 150 feet.

Continuous soil coring techniques will be employed at the four proposed new well locations MK12-MW10, MK12-MW12, MK12-MW14, and MK12-MW15 to assess lithology and hydrogeologic conditions beneath Site 12. Soil samples from the top of the semiconfining layer will be analyzed to assess geotechnical characteristics such as bulk density, porosity, grain size analysis, and permeability. The remaining two monitoring well locations MK12-MW11 and MK12-MW13, will be sampled at 5-foot intervals during drilling. Soil samples other than the samples collected for geotechnical testing, will be used solely for geologic logging purposes. No soil samples will be submitted for chemical analyses. The proposed and existing monitoring well locations at Site 12 are shown on Figure 5-3.

At Site 22, five new wells will be installed in the Water Table Aquifer at depths ranging from approximately 45 to 70 feet. The new wells will be drilled using hollow-stem auger drilling techniques. Continuous soil coring techniques will be employed at all five new well locations to assess lithology and hydrogeologic conditions beneath Site 22. Soil samples from the top of the semiconfining layer will be analyzed to assess geotechnical characteristics such as bulk density, porosity, grain size analysis, and permeability. No soil samples will be submitted for chemical analysis.

During the installation of the five new monitoring wells at Site 22, groundwater samples will be collected using hydropunch sampling technology from the top and bottom of the Water Table Aquifer. All hydropunch samples will be prescreened in the field for non-aqueous phased liquid (NAPL) compounds by adding a hydrophobic dye (Sudan IV). The NAPL screening procedure is defined in

Section 3.2.6.4 of the SAP. The locations of the existing wells and the five new monitoring wells at Site 22 are shown on Figure 5-4.

The new monitoring wells at Site 12 and Site 22 will be constructed of 4-inch diameter Schedule 40 PVC casing and screen. Screen intervals are expected to be 10 feet but may change based on the results of the NAPL screening and the thickness of the aquifer at the proposed location. Well installation and well development is discussed in detail in Section 3.2.6.1 of the SAP.

Table 5-1 summarizes the drilling, sampling, and well installation activities to be completed at Site 12 and Site 22. Prior to commencement of drilling activities, NAWS facility personnel and Underground Service Alert will be contacted and asked to mark locations of known utilities or obstructions near proposed drilling locations.

For the proposed well locations south of Site 12 and off Navy property, a commercial geophysical survey company will be used to clear each location of any underground utility or obstruction.

All new boring locations and monitoring wells will be surveyed (northing, easting, and elevation) after their completion by a state-licensed land surveyor.

5.3.2.5.2 First Quarterly Groundwater Sampling Event

The second stage of the groundwater investigation will consist of comprehensive groundwater sampling of all existing and new monitoring wells at Site 12 and Site 22. This activity will be also be considered as the first quarterly groundwater sampling event for each site. A summary of the first quarterly groundwater sampling event analytical program for Site 12 and Site 22 is given in Table 5-3.

As part of this activity, each well will be inspected following the procedures presented in the Long-term Groundwater Monitoring Program Plan (PRC and JMM, 1995). Based on observations and measurements, it will be determined by referencing the Long-term Groundwater Monitoring Program Plan whether the well is suitable for sampling. All inspection observations and measurements will be noted in the field note books.

5.3.3 Investigation Derived Waste Disposal Plan

Field investigations performed under this WPA II will generate investigation derived waste (IDW) consisting of decontamination solutions, monitoring well purge and development water, soil cuttings, drilling mud, and personal protective equipment (PPE). IDW generated from this investigation will be stored either in the areas of contamination where the waste is generated, or in a centrally located storage area. Drilling mud and soil cuttings storage areas will be located at the each investigation site. A centrally located storage area for liquids has been identified near Site 7, as shown in Figure 5-5. Also identified in Figure 5-5 are the areas within NAWS China Lake where no IDW will be stored or disposed of. MK anticipates disposing of most IDW by discharging aqueous wastes to the sanitary sewer (after onsite treatment), spreading uncontaminated soil cuttings over the investigation areas, and disposing of PPE in the municipal landfill.

5.3.3.1 Disposal of Liquid Investigation-Derived Waste

Water generated during the RI/FS will be temporarily held in a 6,500-gallon Baker tank, or equivalent aboveground storage tank, in the centrally located storage area designated for IDW. At the completion of the field work the IDW water will be passed through an on-site flocculation and activated carbon treatment system maintained at the centrally located storage area. The treated water will be stored in a second 6,500-gallon Baker tank. Once all the water has been treated, the water stored in the Baker tank will be sampled. Analytical data provided from the analysis of the IDW water sample will be reviewed by MK and NAWS water treatment plant personnel to determine if the treated water can be discharged into the NAWS sanitary sewer system for final disposal. If the water cannot be discharged into the NAWS sanitary sewer, it will be disposed of according to the appropriate state and federal laws by a licensed waste handler under subcontract to MK. Water generated during the RI/FS will include well development water from the new wells, purge water generated from well sampling, and water generated during the decontamination of equipment.

The analyte list for which the samples will be analyzed will be contingent on the laboratory analytical results from the RI/FS and on specific POTW requirements.

5.3.3.2 Disposal of Soil Investigation-Derived Waste

Soil IDW will consist of soil cuttings generated from the borehole drilling and sampling, soil from monitoring well installations, and drilling mud from mud rotary drilling. Soil cuttings will be segregated at the point of generation. Soil cuttings from monitoring well, soil boring, and from the exploratory boring locations will be placed in closed top DOT-approved roll-off bins. A representative sample will be collected from each roll-off bin containing soil cuttings from the monitoring well and soil boring locations. One representative sample will be collected from mud cuttings associated with each exploratory boring. All samples will be analyzed by a Navy and State of California DTSC-approved analytical laboratory. The analyses will be the same as those conducted on soil samples from the borehole. If the analytical data indicates that the levels of contaminants are below California Action Levels (CAL), the soil will be removed from the soil bin and spread out on the ground in an isolated area of the site. If the analytical data exhibits concentrations above CALs then the soil will be left in the soil bin and a sample will be submitted to the Treatment Storage and Disposal Facility (TSDF) for profiling. The TSDF identified for NAWS is Chemical Waste Management.

5.3.3.3 Disposal of PPE Investigation-Derived Waste

PPE known to be contaminated, based on analytical results of soil and groundwater samples, will be segregated by site, drummed, and disposed of in a Class I or II landfill, or will be incinerated, depending on the contaminant type and concentration. Uncontaminated PPE will be double-bagged and disposed of in a municipal landfill.

5.3.3.4 Disposal Record of Investigation-Derived Waste

Records will be maintained of the type, source, and date of all IDW generated as part of this investigation. Records of IDW sampling procedures and disposal will also be maintained. All containers will be labeled listing the location, date, and contents with a paint marker. The containers will be marked listing the sample identification number corresponding to the samples taken at that location. This will ensure proper identification of the waste characteristics of each container.

5.3.4 Data Completeness

Once the data generated by the sampling and analysis described above are received and reviewed, a site-specific assessment will be made as to whether additional data are needed before proceeding to the next phase of the RI/FS. If no additional work is needed for these sites at the completion of RI/FS field activities presented in this WPA II, work will proceed on the risk assessment and the treatability studies.

5.4 Task 4 - Sample Analysis and Validation

This section addresses the analysis and validation of the samples and measurements obtained during the field investigation. The procedures for sample analysis and data validation are described in Section 3.4 (Analytical Methods Requirements) and Section 5.0 (Data Validation and Useability) of the site specific SAP. Sample analysis and validation is the responsibility of PRC.

5.4.1 CLP Laboratory Procurement

The selected laboratory must be capable of (1) conducting the analytical procedures specified in the SAP; (2) meeting Navy Level IV QC requirements; and (3) being certified by the following entities:

- California Department of Toxic Substance Control, for all analyses.
- U.S. Navy, for all analyses.

To satisfy Level IV requirements, the selected laboratory must (1) have passed the performance evaluation sample conducted by the EPA CLP (or be exempt from this condition, based on Navy approval); (2) perform CLP methods, as appropriate; and (3) generate CLP deliverables. Qualified laboratories will be selected through a competitive bidding process on the basis of their ability to meet project DQOs.

5.4.2 Management and Oversight of Laboratory Activities

The immediate, day-to-day responsibility for oversight of laboratory activities is assigned to the PRC Analytical Coordinator, whose responsibilities include:

- Ensuring that the requirements of the SAP are implemented by the laboratory.
- Coordinating with the contract laboratory on QA/QC matters.
- Reviewing laboratory data prior to release.
- Coordinating data validation activities.

The Analytical Coordinator will report to the PRC Project Manager.

5.4.3 Quality Control

Internal quality control checks are performed to assess the accuracy and precision during field sampling and measurement as well as laboratory analysis. For the WPA II RI/FS, field checks will be conducted on a regularly scheduled basis. Laboratory checks will be conducted according to EPA and CLP protocols for the CLP laboratory.

Field quality control samples will be collected for laboratory analysis to check sampling and analytical accuracy and precision. The field QC samples proposed for the WPA II RI/FS are consistent with guidelines established by the U.S. Navy (NEESA, 1988), and meet or exceed guidelines established by EPA Region 9 (EPA, Region 9, January 1990). The frequency of the field QC samples to be collected is described in the SAP.

Laboratory control samples (LCS) will be analyzed at the frequency specified in the current CLP statement of work for CLP routine analytical services analyses and/or in the EPA-approved method for the remaining analyses. LCSs will also be analyzed at the frequency specified in the appropriate PRC Standard Operating Procedures for field screening analyses. The following QC samples will be analyzed as appropriate:

- Method blanks.
- Surrogate Compounds.
- Matrix spike/matrix spike duplicates.
- LCSs.
- Initial and continuing calibration checks.

- Performance evaluation sample.

5.4.4 Sample and Data Management

A system to manage data collected during the implementation of the WPA II RI/FS will be designed as part of the project planning and premobilization activities. Included within this overall project data management system will be a program for the management of samples and analytical data. The sample management program will begin with the systematic naming of samples in the field, as described in the SAP, and will conclude with confirmation that the appropriate samples were collected during the field program and were analyzed according to the designated methods. The analytical data management system will be initiated in the laboratory and will conclude with the final reporting of the data. The transfer of the analytical data from the laboratory to the MK and PRC WPA II RI/FS team will be performed via electronic transfer.

There will be a PRC team member who will be designated as the sample custodian and data manager. That person's responsibility will be to confirm that the appropriate samples were collected during the field program, analyzed according to the designated methods, and all appropriate analyses were performed by the CLP laboratory.

5.4.5 Data Validation and Reporting

Data validation is performed based on the following QC criteria, where the data is subsequently accepted, rejected, or qualified:

- Initial and continuing calibration of analyses.
- Sample holding times.
- Results of blank samples.
- Results of other QC samples.

Data values that are significantly different from the population are referred to as “outliers” and a systematic effort will be made to identify outliers and/or errors in field or laboratory procedures prior to reporting the data. Analytical data will be validated following CLP protocols and EPA functional

guidelines for inorganic and organic constituents. Full CLP packages will be prepared for 100 percent of the data required for human health and ecological risk assessment and for Level IV (definitive) confirming analysis. Full validation will only be performed on 10 percent of all CLP samples. Cursory validation will be performed on all CLP samples. Field screening results (Level I) will be cursorily validated based on QC criteria.

Field screening data recorded during the sampling activities will be reduced to tables or matrices for review and verification. Once verified, the data will be compiled and reported in a summary table. Data files will then be transferred electronically to a project database. Correct codes and/or units will be provided to accurately reflect the field conditions.

5.5 TASK 5 - DATA EVALUATION

Analytical data collected during the RI/FS will be evaluated to assess the nature and extent of potential sources, migration potential of contaminants from these sources, and potential receptors of any contamination detected in surface soils, subsurface soils, and groundwater. Following validation by PRC, this data will be used to complete the risk assessment and eventually used for the treatability study.

The site characterization and risk assessment data will be reduced and evaluated as to their significance according to accepted statistical procedures. Further evaluation of the data and the resulting impacts on interpretation of site contamination will be conducted using analytical or numerical modeling techniques, as appropriate.

Lithologic and hydrogeologic data generated during the WPA II RI/FS will be used to further develop the geologic and hydrogeologic model for Site 12 and Site 22. This will include at a minimum geologic cross sections and groundwater contour maps for each respective site.

5.6 TASK 6 - QUALITY ASSURANCE PROGRAM

The overall QA program will be implemented to assure that data of the quality necessary to meet RI/FS objectives are obtained. The details of the QA program for the NAWS WPA II RI/FS are presented in

the SAP. Throughout the duration of the RI/FS, the status of the QA program will be documented in several different types of reports:

- Daily Field Progress Reports summarizing the daily field activities, including work performed, QA/QC activities, problems encountered, and corrective actions taken.
- Laboratory Monthly Progress Reports, to include control sample results, control charts, out-of-control events, corrective actions, and any significant changes in the laboratory QA plan.
- Contractor Monthly Progress Reports, summarizing the status of the project, the status of objectives defined in previous reports, activities planned for the following month, and any problems encountered during the reporting month.
- Final QC report, to include the full CLP reporting package for up to 100 percent of each of the soil samples.
- QA audit reports, to assess and document the performance of technical operations of both field and laboratory activities.

The combination of these five types of reports will provide comprehensive documentation of the status of the QA program and associated field investigation; sample analyses; and data validation, evaluation and reporting activities.

5.7 TASK 7 - RISK ASSESSMENT

PRC will complete a risk assessment following the RI/FS field activities and before the treatability studies are initiated. The risk assessment will satisfy the public health and ecological requirements of the CERCLA process. Results of the risk assessment will be provided to MK and will be used for site characterization, the treatability studies, and final site analyses, and will be incorporated in the RI/FS Technical Memorandum.

The purpose of the risk assessment is to evaluate quantitatively the potential risks posed by the site to human health and the environment. The information gathered in the performance of the risk assessment will serve to accomplish the following objectives:

- Determine for the necessity of additional response or removal action(s).
- Support a “no action” remedial alternative, as appropriate.

5.7.1 Development of Site-Specific Exposure Scenarios

An exposure scenario is made up of three major elements:

- Potential on- and off-site receptors, including sensitive subpopulations such as children or senior citizens.
- Potential transport pathways (such as groundwater or wind)
- Potential exposure routes into the body (such as inhalation, ingestion, dermal).

Site specific exposure scenarios will be developed as the specific information is compiled. The exposure scenarios will be consistent with current and future land use considered as primarily industrial. The magnitude, duration and multiplicity of exposures will also be included in the site-specific scenario development.

5.7.2 Identification of Contaminants of Concern and the Selection of Indicator Chemicals

An initial list of contaminants of concern at each site will be prepared on the basis of previous site investigations. This list will be updated as more information from the Phase II RI/FS becomes available. Indicator chemicals will be identified as appropriate to keep the number of selected chemicals to a manageable size.

Factors that will be considered in the preparation of these lists include the toxicity of the particular chemical and its physical and chemical properties as they relate to persistence and mobility in the environment. Comparison of site data with existing guidelines or standards and any existing background data for the general site region will be used to establish representative values and provide a site-specific perspective on the chemical data collected. Consideration of these and related issues will result in the determination of indicator chemicals for inclusion in subsequent quantitative risk assessment, and the rationale for the exclusion of other chemicals.

5.7.3 Development of Exposure Modules

The exposure scenarios identified in Section 5.7.1 will be further developed as "exposure modules" through the definition of exposure factors, behavioral patterns, and any accompanying assumptions. Specific components of an exposure module include:

- Identification and description of the scenario.
- Age group exposed (e.g. adults and children).
- Activity during which exposure occurs (e.g. work, recreation).
- Number of people potentially exposed.
- Frequency and duration of exposure, as well as total period over which exposure occurs.
- Rationale for estimate of "representative" chemical concentrations to be considered (e.g. mean, upper limits, interpretation of "not detected" values, etc.).
- Exposure point concentrations, the pathways and compounds modeled, migration models used, source of input data, and key assumptions (e.g. rate of chemical uptake).

The exposure modules developed in this task will be reviewed with Navy personnel prior to their use in the risk assessment.

5.7.4 Risk Characterization

The exposure scenarios defined for each site will be translated into mathematical expressions for input in a spreadsheet format and the subsequent calculation of potential risk. The risks for each exposed population will be combined across sites as appropriate, and an estimate of total risk prepared. The results of the risk assessment will be presented in a TM and submitted to the Navy for information and review.

5.8 TASK 8 - TREATABILITY STUDY

MK will develop a preliminary recommendation for treatability studies of impacted media at Sites 12 and 22. The recommendation will be based on an initial screening of technologies suitable for

remediation at the sites. The recommendations will be limited to consideration of proven and commonly used approaches to treatment.

This task will be completed by performing a limited review of existing data from the original RI/FS, complemented by the results to be obtained through the WPA II RI/FS, results of the risk assessment, followed by a screening of appropriate technologies suitable for the media, each remedial technology's effectiveness, implementability, relative cost, the regulatory requirements, and safety of workers.

This task will be documented as an appendix in the TM report. Information to be provided will be a brief characterization of the site; the rationale for conducting each recommended treatability study; a limited description of the testing procedures; equipment to be used; sampling procedures including analytical requirements; and a discussion of the anticipated results. The treatability study will be preliminary in scope and will not include work plans or budgetary estimates for implementation.

5.9 REMEDIAL INVESTIGATION REPORT

This task covers all efforts related to the preparation of the findings of the RI/FS. The RI/FS report will be presented as a technical memorandum and will summarize the information gathered and recommend remedial options. The following elements will be included in the technical memorandum:

- Site background.
- Field activities conducted at the sites, including description of methods and techniques.
- Nature and extent of soil contamination at each site, and identification of any additional data needs.
- Identification of contaminants of concern and/or indicator chemicals for each site, and potential human and environmental receptors.
- Results of the exposure assessment for the identified chemicals and receptors, including the results of any migration estimation or modeling exercises for chemical transport in the vadose zone or groundwater.
- Results of the limited risk assessment and recommendations, as appropriate.
- Results of the treatability study and recommendations

Overall, this document will serve as supporting documentation for the removal assessment and will provide the basis for the identification and evaluation of potential removal alternatives, if required, for each site.

TABLE 5-1

FIELD INVESTIGATION ACTIVITIES FOR SITE 12 AND SITE 22
NAWS CHINA LAKE, CALIFORNIA

Site/Activity	No. of Locations	Depth (ft. bgs)	Drilling & Sampling Method	Soil Sample Interval (ft. bgs)	Soil Analyses	Groundwater Analyses
STEP ONE OF RI FIELD ACTIVITIES						
Site 12						
Surface Soil Samples	15	3	Hand auger composite	0 - 3	VOCs, SVOCs, TPH-D, TPH-G, Metals, OPPs, OCPs, PCBs	--
Soil Borings	4	25	Hollow stem auger at 5 ft. intervals	0.5, 5, 10, 15, 20, 25	VOCs, SVOCs, TPH-D, TPH-G, Metals, OPPs, OCPs, PCBs, TRPH	--
Exploratory Borings	2	300	Dual tube rotary	--	Lithologic Logging	--
Monitoring Well Installation	3	130	Hollow stem auger 1 continuous core 2 bores at 5 ft. intervals	--	Lithologic Logging	--
Monitoring Well Installation	3	160	Sonic continuous core	Top of Semiconfining Layer	Geotechnical Parameters	--
Site 22						
Surface Soil Samples	21	3	Hand auger composite	0 - 3	VOCs, SVOCs, TPH-D, TPH-G, Metals, OPPs, OCPs, PCBs	--
Monitoring Well Installation	5	90	Hollow stem auger W/Hydropunch 3 Bore Continuous Core 2 Bores at 5 ft. intervals	Top of Semiconfining Layer	Geotechnical Parameters	NAPL Screening,
STEP TWO OF RI FIELD ACTIVITIES						
Site 12						
Monitoring Well Sampling Event	15	--	--	--	--	VOCs, SVOCs, TPH-D, TPH-G, PCBs, OCPs, OPPs, I/P, Landfill
Site 22						
Monitoring Well Sampling Event	13	--	--	--	--	VOCs, SVOCs, TPH-D, TPH-G, PCBs, OCPs, OPPs, I/P, Landfill

Abbreviations:

bgs - below ground surface
ft- feet
I/P - Inorganic/Physical analyse
Landfill - Landfill parameters
NAPL - Non-aqueous phase liquid
OCPs - Organochlorine Pesticide
OPPs - Organophosphorous Pesticide
PCBs - Polychlorinated biphenyls
SVOCs - Semivolatile Organic Compounds
TPH-D - Total Petroleum Hydrocarbons as diesel
TPH-G - Total Petroleum Hydrocarbons as gasoline
TRPH - Total recoverable Petroleum Hydrocarbon
VOC - Volatile Organic Compounds

TABLE 5-2

SOIL SAMPLING AND ANALYSES FOR SITE 12 AND SITE 22
NAWS CHINA LAKE, CALIFORNIA
PAGE 1 OF 2

Media/Parameter	Analytical Method	Field Samples	Quality Control Samples: Duplicates (at 10%)	MS/MSD (at 10%)	Rinsates (1/day)	Trip Blanks	Total Samples
Site 12 Surface Soil Samples							
VOCs Including TICs	EPA CLP Organic SOW	15	2	2	2	4	25
TPH-D	SW-846 Mod. 8015/LUFT	15	2	2	--	--	19
TPH-G	SW 846 Mod. 8015/LUFT	15	2	2	--	--	19
SVOCs Including TICs	EPA CLP Organic SOW	15	2	2	--	--	19
Metals (b)	EPA Inorganic CLP SOW	15	2	2	--	--	19
Hexavalent Chromium	SW-846 Method 7196A	21	2	2	--	--	25
OC Pesticides/PCBs	EPA CLP Organic SOW	15	2	2	--	--	19
OP Pesticides	SW-846 Method 8140	15	2	2	--	--	19
Site 22 Surface Soil Samples							0
VOCs Including TICs	EPA CLP Organic SOW	21	2	2	2	2	29
TPH-D	SW-846 Mod. 8015/LUFT	21	2	2	--	--	25
TPH-G	SW 846 Mod. 8015/LUFT	15	2	2	--	--	19
SVOCs Including TICs	EPA CLP Organic SOW	21	2	2	--	--	25
Metals (b)	EPA Inorganic CLP SOW	21	2	2	--	--	25
Hexavalent Chromium	SW-846 Method 7196A	21	2	2	--	--	25
OC Pesticides/PCBs	EPA CLP Organic SOW	21	2	2	--	--	25
OP Pesticides	SW-846 8140	21	2	2	--	--	25
Site 12 Shallow Boring Samples							
VOCs Including TICs	EPA CLP Organic SOW	24	2	2	2	2	32
TPH-D	SW-846 Mod. 8015/LUFT	24	2	2	--	--	28
TPH-G	SW 846 Mod. 8015/LUFT	15	2	2	--	--	19
SVOCs Including TICs	EPA CLP Organic SOW	24	2	2	--	--	28
Metals (b)	EPA Inorganic CLP SOW	24	2	2	--	--	28
Hexavalent Chromium	EPA Water 7196A	21	2	2	--	--	25
OC Pesticides/PCBs	EPA CLP Organic SOW	24	2	2	--	--	28
OP Pesticides	SW-846 8140	24	2	2	--	--	28
TRPH	SW-486 418.1	24	2	2	--	--	28

Notes:

(A) Analysis for metals includes Molybdenum, based on EPA SW-846 6010A (EPA 1994a)

ASTM	=	American Society for Testing and Materials	PCBs	=	Polychlorinated Biphenyls
CLP	=	Contract Laboratory Program	SOW	=	Statement of Work
COE	=	U. S. Army Corp of Engineers	SVOCs	=	Semivolatile Organic Compounds
EPA	=	U.S. Environmental Protection Agency	TICs	=	Tentatively Identified Compounds
TPH-G	-	Total Petroleum Hydrocarbons as gasoline	SW-816	-	Eoa Sikud Waste (Nanyak) - 846
EPA Water	=	EPA Drinking Water Standards	TPH-D	=	Total Petroleum Hydrocarbons as Diesel
LUFT	=	Leaking Underground Fuel Tank	TRPH	=	Total Recoverable Petroleum Hydrocarbons
MS/MSD	=	Matrix Spike/Matrix Spike Duplicate	VOCs	=	Volatile Organic Compounds
OC Pesticides	=	Organochlorine Pesticides			
OP Pesticides	=	Organophosphorous Pesticides			

TABLE 5-2

SOIL SAMPLING AND ANALYSES FOR SITE 12 AND SITE 22
NAWS CHINA LAKE, CALIFORNIA

Media/Parameter	Analytical Method (a)	Field Samples	Quality Control Samples: Duplicates (at 10%)	MS/MSD (at 10%)	Rinsates (1/day)	Trip Blanks	Total Samples
Site 12 Monitoring Well Boring Samples							
G eotechnical Parameters							
Total Organic Carbon	ASTM D 2974	3	--	--	--	--	3
Soil Bulk Density	COE EM 1110-2-1906	3	--	--	--	--	3
Soil Porosity	COE EM 1110-2-1906	3	--	--	--	--	3
Specific Gravity	ASTM D 854	3	--	--	--	--	3
Moisture Content (by weight)	AST M D 2216	3	--	--	--	--	3
Grain Size Analysis	ASTM D 422	3	--	--	--	--	3
Permeability (falling head)	ASTM D 5084	3	--	--	--	--	3
Site 22 Monitoring Well Boring Samples							
Geotechnical Parameters							
Total Organic Carbon	ASTM D 2974	5	--	--	--	--	5
Soil Bulk Density	COE EM 1110-2-1906	5	--	--	--	--	5
Soil Porosity	COE EM 1110-2-1906	5	--	--	--	--	5
Specific Gravity	ASTM D 854	5	--	--	--	--	5
Moisture Content (by weight)	AST M D 2216	5	--	--	--	--	5
Grain Size Analysis	ASTM D 422	5	--	--	--	--	5
Permeability (falling head)	ASTM D 5084	5	--	--	--	--	5

Notes:
(a) For more detailed information on specific parameters and analytical methods, refer to the Sampling and Analysis Plan.
(b) Analysis for metals includes Molybdenum, based on EPA SW-846 6010A (EPA 1994a)

ASTM	=	American Society for Testing and Materials
CLP	=	Contract Laboratory Program
COE	=	U. S. Army Corp of Engineers
EPA	=	U.S. Environmental Protection Agency
EPA Water	=	EPA Drinking Water Standards
LUFT	=	Leaking Underground Fuel Tank
MS/MSD	=	Matrix Spike/Matrix Spike Duplicate
OC Pesticides	=	Organochlorine Pesticides
OP Pesticides	=	Organophosphorous Pesticides
PCB	=	Polychlorinated Biphenyl
SOW	=	Statement of Work
SVOC	=	Semivolatile Organic Compound
TIC	=	Tentatively Identified Compounds
TPH-D	=	Total Petroleum Hydrocarbons as Diesel
TRPH	=	Total Recoverable Petroleum Hydrocarbons
VOC	=	Volatile Organic Compounds

TABLE 5-3

QUARTERLY GROUNDWATER SAMPLING ANALYTICAL PARAMETERS FOR SITE 12 AND SITE 22
NAWS CHINA LAKE, CALIFORNIA
Page 1 of 2

			Quality Control Samples				
Event/Parameter	**Analytical Method (a)**	**Field Samples**	**Duplicates (at 10%)**	**MS/MSD (at 10%)**	**Rinsates (c) (one/day)**	**Trip Blanks (one/cooler)**	**Total Analyses**
Site 12							
Quarterly Groundwater Sampling Event							
VOCs, Including TICs	EPA CLP Organic SOW	15	2	2	--	10	29
SVOCs, Including TICs	EPA CLP Organic SOW	15	2	2	--	--	19
TPH-D	EPA SW-846 Mod. 8015/LUFT	15	2	2	--	--	19
TPH-G	EPA SW-846 Mod. 8015/LUFT	15	2	2	--	--	19
OC Pesticides/PCBs	EPA CLP Organic SOW	15	2	2	--	--	19
OP Pesticides	EPA SW-846 8140	15	2	2	--	--	19
Inorganic/Physical Analyses (ex. Cyanide)							
Metals (b)	EPA Inorganic CLP SOW	15	2	2	5	--	24
Hexavalent Chromium	EPA SW-846 7196A	15	2	2	5	--	24
Anions	EPA 300.0	15	2	2	--	--	19
Total Dissolved Solids	EPA Method 160.1	15	2	2	--	--	19
pH	CLP or EPA SW-846 9040B	15	2	2	--	--	19
Bicaronate, Carbonate & Alkalinity	EPA Method 403	15	2	2	--	--	19
Conductivity	EPA SW-846 9050	15	2	2	--	--	19
Total Organic Carbon (TOC)	EPA Method 415.1	15	2	2	--	--	19
Gross alpha/beta Activity	EPA Method 9310	15	2	2	--	--	19
Landfill Parameters							
Ammonia as Nitrogen	EPA Method 350.3	15	2	2	--	--	19
Chloride, Fluoride, Sulfate, Nitrate, Nitrite, Total Phosphorus	EPA Method 300.0	15	2	2	--	--	19
Total Coliform	EPA SW-846 9131	15	2	2	--	--	19
Orthophosphate	EPA Method 365.1	15	2	2	--	--	19
Total Organic Carbon (TOC)	EPA Method 415.1	15	2	2	--	--	19

Notes
(a) Analysis for metals includes Molybdenum, based on EPA SW-846 6010A (EPA, 1994a)
(b) It is assumed that an average of three wells will be sampled per day

CLP = Contract Laboratory Program
EPA = U.S. Environmental Protection Agency
LUFT = California Leaking Underground Fuel Tank Manual
MS/MSD = Matrix Spike/Matrix Spike Duplicate
OC Pesticides = Organochlorine Pesticides
OP Pesticides = Organophosphorous Pesticides
PCB = Polychlorinated Biphenyl
SOW = Statement of Work
SVOC = Semivolatile Compound
TIC = Tentatively Identified Compounds
TPH-D = Total Petroleum Hydrocarbons as Diesel
TPH-G = Total Petroleum Hydrocarbons as Gasoline
VOC = Volatile Organic Compounds

TABLE 5-3

QUARTERLY GROUNDWATER SAMPLING ANALYTICAL PARAMETERS FOR SITE 12 AND SITE 22
NAWS CHINA LAKE, CALIFORNIA

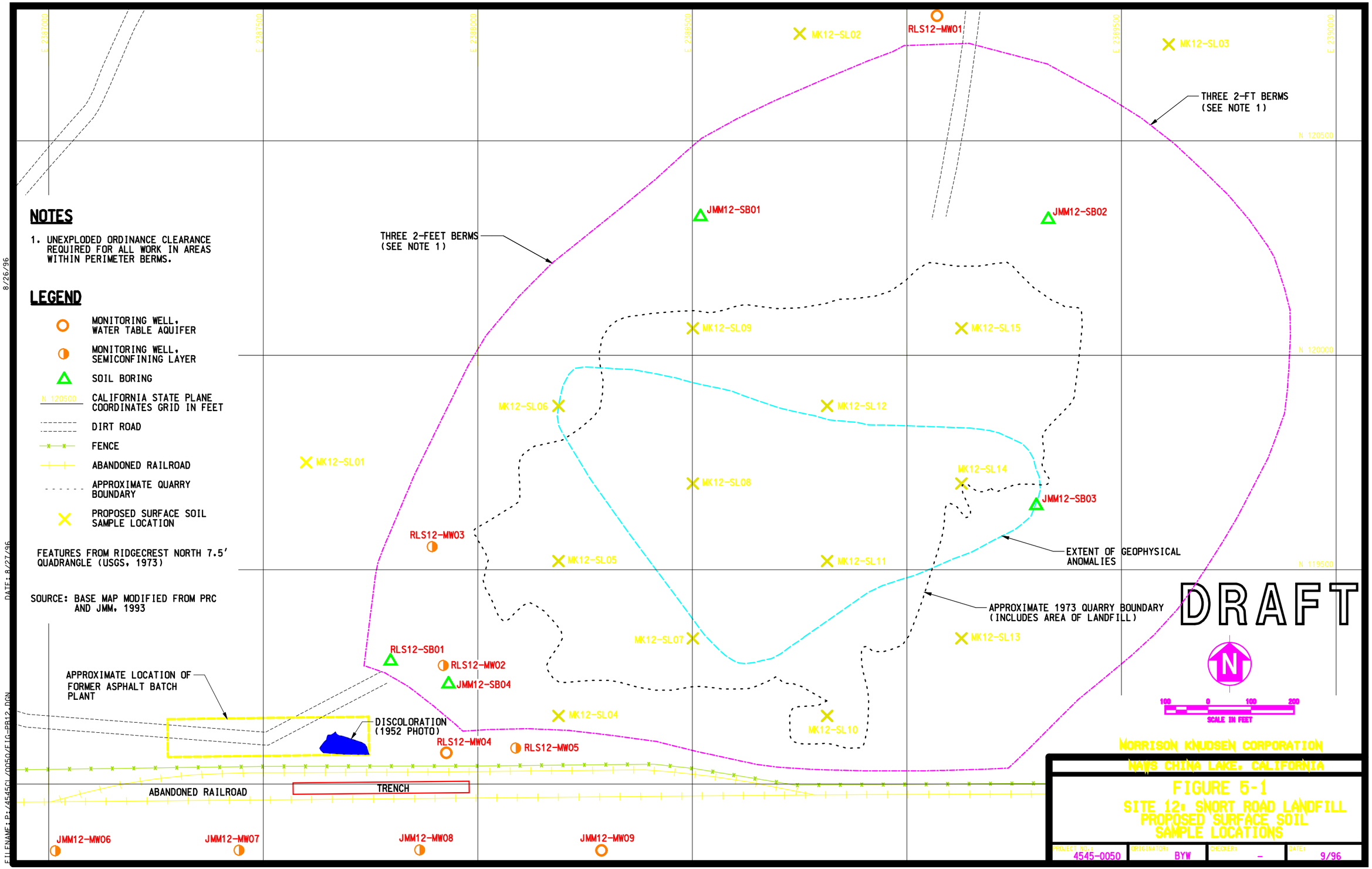
Event/Parameter	Analytical Method (a)	Field Samples	Quality Control Samples: Duplicates (at 10%)	MS/MSD (at 10%)	Rinsates (b) (one/day)	Trip Blanks (one/cooler)	Total Analyses
Site 22							
Quarterly Groundwater Sampling Event							
VOCs, Including TICs	EPA CLP Organic SOW	13	1	1	--	12	27
SVOCs Including TICs	EPA CLP Organic SOW	13	1	1	--	--	15
TPH- diesel	EPA SW-846 Mod. 8015/LUFT	13	1	1	--	--	15
TPH-G	EPA SW-846 Mod. 8015/LUFT	13	1	1	--	--	15
OC Pesticides/PCBs	EPA CLP Organic SOW	13	1	1	--	--	15
OP Pesticides	EPA SW-846 8140	13	1	1	--	--	15
Inorganic/Physical Analyses (ex. Cyanide)							
Metals (a)	EPA Inorganic CLP SOW	13	1	1	5	--	20
Hexavalent Chromium	EPA SW-846 7196A	13	1	1	5	--	20
Nitrate/Nitrite	EPA Method 353.1	13	1	1	--	--	15
Anions	EPA 300.0	13	1	1	--	--	15
Total Dissolved Solids	EPA Method 160.1	13	1	1	--	--	15
pH	CLP or EPA SW-846 9040B	13	1	1	--	--	15
Bicaronate, Carbonate & Alkalinity	EPA Method 403	13	1	1	--	--	15
Conductivity	EPA SW-846 9050	13	1	1	--	--	15
Total Organic Carbon (TOC)	EPA Method 415.1	13	1	1	--	--	15
Landfill Parameters							
Ammonia as Nitrogen	EPA Method 350.3	13	1	1	--	--	15
Chloride, Fluoride, Sulfate, Nitrate, Nitrite, Total Phosphorus	EPA Method 300.0	13	1	1	--	--	15
Total Coliform	EPA SW-846 9131	13	1	1	--	--	15
Orthophosphate	EPA Method 365.1	13	1	1	--	--	15
Total Organic Carbon	EPA Method 415.1	13	1	1	--	--	15
Total Kjeldahl Nitrogen	EPA Method 351.2	13	1	1	--	--	15

Notes:

(a) Analysis for metals includes Molybdenum, based on EPA SW-846 6010A (EPA 1994a)

(b) It is assumed that an average of three wells will be sampled per day.

CLP = Contract Laboratory Program
EPA = U.S. Environmental Protection Agency
LUFT = Leaking Underground Fuel Tank
MS/MSD = Matrix Spike/Matrix Spike Duplicate
OC Pesticides = Organochlorine Pesticides
OP Pesticides = Organophosphorous Pesticides
PCB = Polychlorinated Biphenyl
SOW = Statement of Work
SVOC = Semivolatile Compound
TIC = Tentatively Identified Compounds
TPH-D = Total Petroleum Hydrocarbons as Diesel
TPH-G = Total Petroleum Hydrocarvons as Gasoline
VOC = Volatile Organic Compounds



NOTES

1. UNEXPLODED ORDINANCE CLEARANCE REQUIRED FOR ALL WORK IN AREAS WITHIN PERIMETER BERMS.

LEGEND

- MONITORING WELL, WATER TABLE AQUIFER
- MONITORING WELL, SEMICONFINING LAYER
- SOIL BORING
- CALIFORNIA STATE PLANE COORDINATES GRID IN FEET
- DIRT ROAD
- FENCE
- ABANDONED RAILROAD
- APPROXIMATE QUARRY BOUNDARY
- PROPOSED SURFACE SOIL SAMPLE LOCATION

FEATURES FROM RIDGECREST NORTH 7.5' QUADRANGLE (USGS, 1973)

SOURCE: BASE MAP MODIFIED FROM PRC AND JMM, 1993

8/26/96

DATE: 8/27/96

FILENAME: P:\4545GL\0050\FIG-PB12.DGN

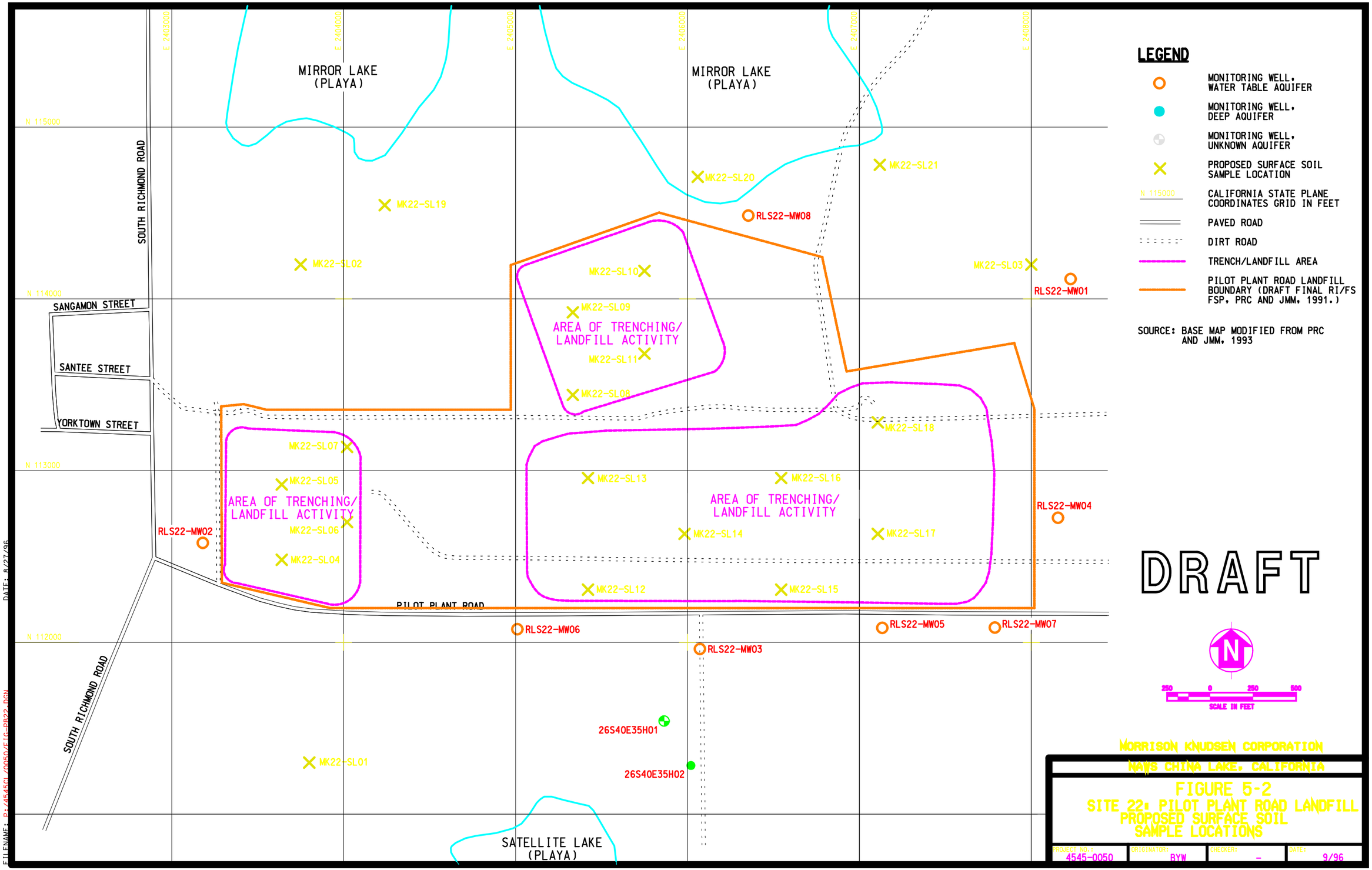
MORRISON KNUDSEN CORPORATION

NAVS CHINA LAKE, CALIFORNIA

FIGURE 5-1

SITE 12: SNORT ROAD LANDFILL
PROPOSED SURFACE SOIL
SAMPLE LOCATIONS

PROJECT NO.:	ORIGINATOR:	CHECKER:	DATE:
4545-0050	BYW	-	9/96


MIRROR LAKE (PLAYA)
MIRROR LAKE (PLAYA)
SATELLITE LAKE (PLAYA)
SOUTH RICHMOND ROAD
SANGAMON STREET
SANTEE STREET
YORKTOWN STREET
PILOT PLANT ROAD
AREA OF TRENCHING/ LANDFILL ACTIVITY
AREA OF TRENCHING/ LANDFILL ACTIVITY
N 115000
N 114000
N 113000
N 112000
E 2403000
E 2404000
E 2405000
E 2406000
E 2407000
E 2408000
MK22-SL01
MK22-SL02
MK22-SL03
MK22-SL04
MK22-SL05
MK22-SL06
MK22-SL07
MK22-SL08
MK22-SL09
MK22-SL10
MK22-SL11
MK22-SL12
MK22-SL13
MK22-SL14
MK22-SL15
MK22-SL16
MK22-SL17
MK22-SL18
MK22-SL19
MK22-SL20
MK22-SL21
RLS22-MW01
RLS22-MW02
RLS22-MW03
RLS22-MW04
RLS22-MW05
RLS22-MW06
RLS22-MW07
RLS22-MW08
26S40E35H01
26S40E35H02
LEGEND
MONITORING WELL, WATER TABLE AQUIFER
MONITORING WELL, DEEP AQUIFER
MONITORING WELL, UNKNOWN AQUIFER
PROPOSED SURFACE SOIL SAMPLE LOCATION
CALIFORNIA STATE PLANE COORDINATES GRID IN FEET
PAVED ROAD
DIRT ROAD
TRENCH/LANDFILL AREA
PILOT PLANT ROAD LANDFILL BOUNDARY (DRAFT FINAL RI/FS FSP, PRC AND JMM, 1991.)
SOURCE: BASE MAP MODIFIED FROM PRC AND JMM, 1993
DRAFT
N
250 0 250 500
SCALE IN FEET
MORRISON KNUDSEN CORPORATION
NAWS CHINA LAKE, CALIFORNIA
FIGURE 5-2
SITE 22: PILOT PLANT ROAD LANDFILL
PROPOSED SURFACE SOIL
SAMPLE LOCATIONS
PROJECT NO.: 4545-0050
ORIGINATOR: BYW
CHECKER: -
DATE: 9/96
DATE: 8/27/96
FILENAME: P:\4545GL\0050\FIG-PR22.DGN

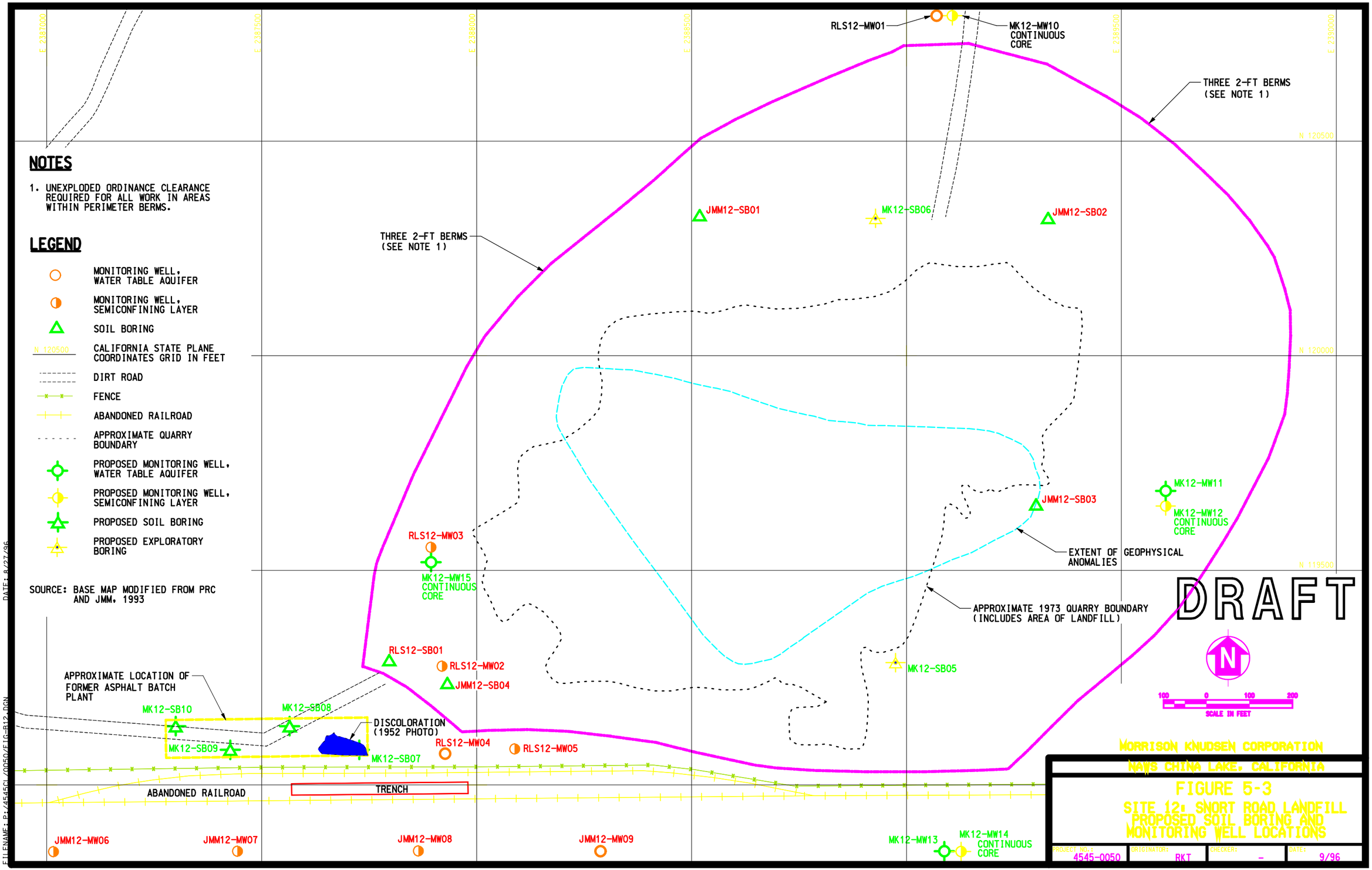
NOTES

1. UNEXPLODED ORDINANCE CLEARANCE REQUIRED FOR ALL WORK IN AREAS WITHIN PERIMETER BERMS.

LEGEND

- MONITORING WELL, WATER TABLE AQUIFER
- MONITORING WELL, SEMICONFINING LAYER
- SOIL BORING
- CALIFORNIA STATE PLANE COORDINATES GRID IN FEET
- DIRT ROAD
- FENCE
- ABANDONED RAILROAD
- APPROXIMATE QUARRY BOUNDARY
- PROPOSED MONITORING WELL, WATER TABLE AQUIFER
- PROPOSED MONITORING WELL, SEMICONFINING LAYER
- PROPOSED SOIL BORING
- PROPOSED EXPLORATORY BORING

SOURCE: BASE MAP MODIFIED FROM PRC AND JMM, 1993

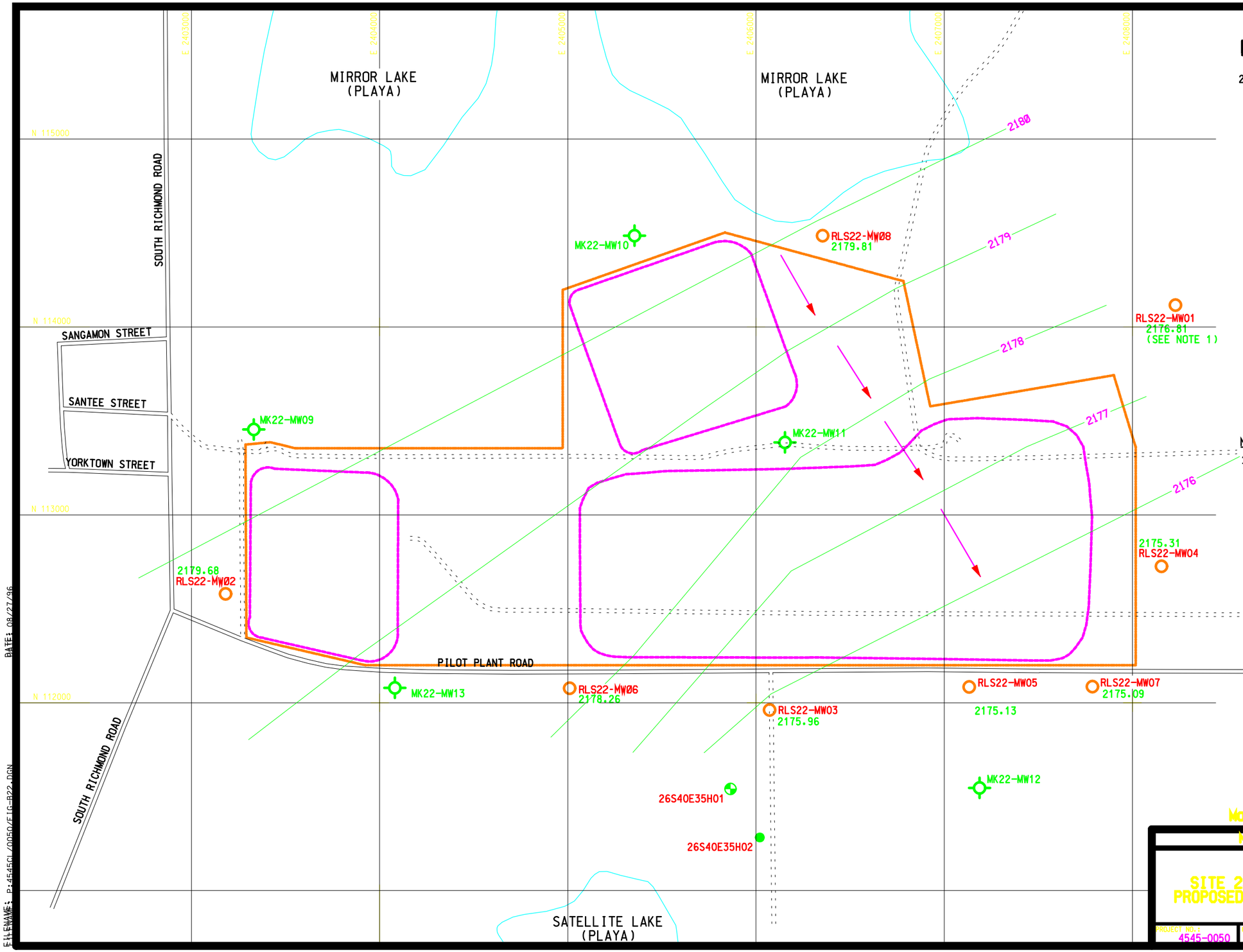


MORRISON KNUDSEN CORPORATION
NAWS CHINA LAKE, CALIFORNIA

FIGURE 5-3
SITE 12: SNORT ROAD LANDFILL
PROPOSED SOIL BORING AND MONITORING WELL LOCATIONS

PROJECT NO.:	ORIGINATOR:	CHECKER:	DATE:
4545-0050	RKT	-	9/96

FILENAME: P:\4545\GL\0050\FIG-B12.DGN
DATE: 8/27/96



LEGEND

2175.09	MONITORING WELL, WATER TABLE AQUIFER WATER TABLE ELEVATION 2175.09 FEET MSL (MAY 8, 1996)
	MONITORING WELL, DEEP AQUIFER
	MONITORING WELL, UNKNOWN AQUIFER
N 115000	CALIFORNIA STATE PLANE COORDINATE GRID IN FEET
	PAVED ROAD
	DIRT ROAD
	TRENCH/LANDFILL AREA
	PILOT PLANT ROAD LANDFILL BOUNDARY (DRAFT FINAL RI/FS, PRC AND JMM, 1991.)
2175	GROUNDWATER GRADIENT CONTOUR AT ELEVATION 2175 FEET MSL ARROW SHOWING FLOW DIRECTION (MAY 8, 1996)
	PROPOSED HYDROPUNCH AND MONITORING WELL, WATER TABLE AQUIFER

NOTES

1. ELEVATION NOT USED FOR ASSESSMENT OF GROUNDWATER GRADIENT MAP.

SOURCE: BASE MAP MODIFIED FROM PRC AND JMM, 1993.

DRAFT

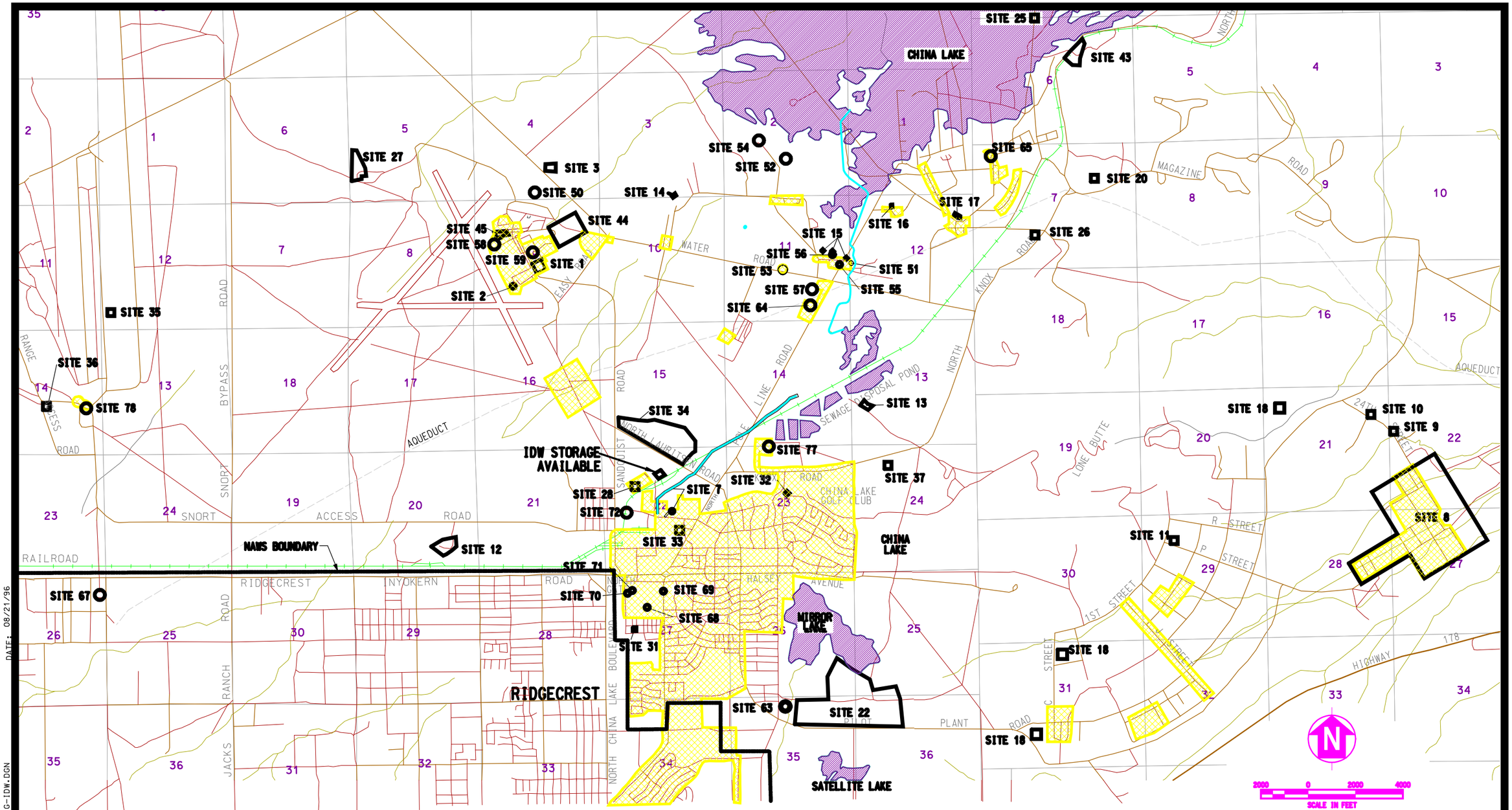
250 0 250 500
SCALE IN FEET

MORRISON KNUDSEN CORPORATION
NAWS CHINA LAKE, CALIFORNIA

FIGURE 5-4
SITE 22: PILOT PLANT ROAD LANDFILL
PROPOSED HYDROPUNCH AND MONITORING WELL LOCATIONS

PROJECT NO.:	ORIGINATOR:	CHECKER:	DATE:
4545-0050	RKT	-	6/96

FILENAME: P:\4545\0050\FIG-B22.DGN
DATE: 08/27/96



LEGEND

- PLAYA LAKE AND/OR WATER
- NO IDW STORAGE OR DISPOSAL IN POPULATED AREAS
- IRP SITE LOCATION
- ROAD
- RAILROAD TRACK
- CONNECTION DITCH
- NAWS BOUNDARY

DRAFT

SOURCE: PRC (DENVER). GIS DEPARTMENT. AUGUST 1996.

MORRISON KNUDSEN CORPORATION

NAWS CHINA LAKE, CALIFORNIA

FIGURE 5-5

AREAS PROHIBITED FOR IDW STORAGE AND DISPOSAL

PROJECT NO.:	ORIGINATOR:	CHECKER:	DATE:
4545-0050	RKT	–	9/96

FILENAME: P:/4545CL/0050/FIG-IDW.DGN DATE: 08/21/96

6.0 RI/FS PROJECT MANAGEMENT

The following section is intended to define the relationships and responsibilities for selected tasks and project management items.

The objectives of project management during the RI/FS are to:

- Ensure the necessary quantity and quality of project staff to keep the project running smoothly.
- Coordinate closely with the Navy to ensure the smooth functioning of all field activities.
- Ensure project costs remain within budget for the item scoped.
- Ensure that RI/FS activities remain on schedule.
- Monitor the costs and performance of subcontractors.
- Ensure the overall high quality of the work and work products.

6.1 PROJECT ORGANIZATION AND RESPONSIBILITIES

A well organized and experienced project team will assure consistent progress and quality of work throughout the RI/FS. This section describes the key members and their responsibilities within the project team organization. Actual personnel will be assigned based on their background experience, and availability basis. Personnel may substituted if conflicts exist with other projects.

The project team involved with this RI/FS activity for Site 12 and Site 22 consists of the following:

- Navy Lead Engineer-in-Charge - James McDonald- (619) 927-1508
- PRC Facility Program Manager - Robert Couch - (505) 246-9192
- MK Facility Program Manager - John Romie - (415) 442-7526
- MK China Lake Project Manager - Rob Tweidt - (415) 442-7370
- PRC Program QA Manager - Ron Reising - (312) 856-8722
- PRC Program Health and Safety Manager - Conrad Sherman - (415) 222-8377
- MK Project Health and Safety Coordinator - Don Beeler - (415) 442-7472
- PRC Facility Community Relations Coordinator - Stacey Lupton - (415) 222-8245

- MK Field Team Leader - Belinda Wong - (415) 442-7744
- PRC Analytical Coordinator - Candace Friday - (713) 364-7173
- MK Treatability Study Engineer - Frank Guros - (415) 442-7535

Figure 6-1 presents an organization chart for this project. MK will submit resumes of all project team members upon request. The specific responsibilities of the team members are shown in Figure 6-1 and are described below.

Navy Lead Engineer-in-Charge. The engineer-in-charge (EIC) is responsible for the following:

- Providing site information and history.
- Providing logistical assistance.
- Specifying sites requiring investigation.
- Reviewing all results and recommendations and providing management and technical oversight on behalf of the Navy.
- Ensuring proper review and distribution of all documents.
- Communicating comments from technical reviewers to contractors.
- Ensuring that contractors address all comments and take appropriate corrective actions.

PRC Facility Program Manager. The PRC facility program manager is responsible for the following activities:

- Ensuring that contract requirements are met.
- Providing necessary resources to the PRC project team to allow adequate response to requirements of the investigation.
- Maintaining consistency in procedures and work products with other task orders.
- Establishing and maintaining communication between the EIC, program QA manager, program health and safety manager, and project manager.
- Providing technical oversight and reviewing the final project report(s).
- Giving guidance to the project management team as needed.

MK Navy Clean Facility Program Manager. The MK Navy Clean program manager is responsible for the following activities:

- Ensuring that contract requirements are met.
- Providing necessary resources to the MK project team to allow adequate response to requirements of the investigation.
- Maintaining consistency in procedures and work products with all other task orders.
- Establishing and maintaining communication between the EIC, program QA manager, program health and safety manager, and project manager.
- Providing technical oversight and reviewing the final project report(s).
- Giving guidance to the MK project manager as needed.

MK China Lake Project Manager. The MK China Lake project manager is ultimately responsible for the timely completion of the project in accordance with the WPA II, SAP, and HSP. The responsibilities of the project manager include the following:

- Ensuring the completion of quality control (QC) requirements by team members.
- Supervising the document control process.
- Approving deliverables and associated documents prior to transmittal.
- Establishing and maintaining communication between technical staff, program manager, QA coordinator, health and safety coordinator, and regulatory agencies.
- Implementing programs and protocols related to the project.

PRC Program QA Manager. The program QA manager is responsible for ensuring that the RI/FS at NAWS has appropriate overall QA. The program QA manager reviews laboratory QA plans, work plans, and audit reports, as well as data from the site. Other responsibilities include the following:

- Communicating regularly with the program manager and project manager.
- Developing and revising the QA program, as required.
- Supervising the QA responsibilities of the project QA coordinator.

- Identifying nonconformance situations to management, as required.
- Providing guidance in the correction of nonconformances.
- Ensuring that deliverables meet the requirements of the CLEAN QA/QC program.
- Making recommendations to the program manager and project manager regarding corrective action.

PRC Program Health and Safety Manager. The program health and safety manager is responsible for the following:

- Reviewing and approving a site-specific health and safety plan (HSP).
- Ensuring that the health and safety plan meets the requirements of the CLEAN Health and Safety Program.
- Providing assistance and guidance to the project health and safety manager as needed.
- Maintaining communication with the program manager, project manager, and project health and safety manager.
- Other responsibilities as included in the NAWS site-specific HSP.

MK Project Health and Safety Coordinator. The responsibilities of the project health and safety coordinator include the following:

- Preparing a site-specific HSP.
- Establishing and maintaining communication between the onsite safety officer, the project manager, and the program health and safety manager.
- Verifying that site personnel adhere to the site safety requirements.
- Providing guidance on appropriate corrective action procedures to the project manager and support personnel.
- Other responsibilities as specified in the site-specific HSP.

PRC Facility Community Relations Coordinator. The community relations coordinator ensures that all requirements of the Community Relations Plan are implemented within the scheduled time frame. The coordinator also ensures that updates to the plan are made, as appropriate, to reflect changes in community needs. The coordinator will work closely with

NAWS personnel and regulatory agencies, providing updates to the project manager as necessary.

MK Field Team Leader. The Field Team Leader (FTL) is responsible for the RI/FS field program. The FTL will direct all onsite activities, including those of subcontractors, and will ensure that all procedures described in the HSP are adhered to in the field. The Field Team Leader will also be the liaison for PRC with NAWS personnel during the course of the field work.

PRC Analytical Coordinator. Responsibilities of the analytical coordinator include, at a minimum:

- Review the activity-specific QAPjP elements (ASQE) contained in the MK prepared SAP.
- Ensuring that the laboratory implements the requirements of the SAP.
- Coordinating with the contract laboratory on QA/QC matters.
- Reviewing laboratory data prior to release.
- Coordinating data validation activities.
- Providing updates to the project manager with regard to QA/QC data.

MK Treatability Study Engineer. The responsibilities of the MK treatability study engineer are as follows:

- Giving guidance to the treatability study team as needed.
- Coordinating staff efforts related to the treatability study activities.
- Establishing and maintaining communication between the project manager and the treatability study team.
- Providing updates to the project manager as necessary.
- Reviewing all treatability study deliverables and associated documents prior to transmittal.

6.1.1 Staffing

The project will be staffed by the MK San Francisco office. If unanticipated site problems cannot be adequately covered by the managing office, additional technical resources will be obtained from other offices, as appropriate. The MK China Lake Project Manager (PM), Rob Tweidt, is from the San Francisco office. He will manage all aspects of the project, from planning through completion of the RI/FS. The MK Field Team Leader, Belinda Wong, will provide technical oversight and quality assurance for the field work. It is expected that the continuity provided by these long-term assignments will result in overall efficiency of the project. The PM will work directly with the Navy EIC, PRC, and the MK Field Team Leader. The PM will have primary responsibility for executing all work necessary at the site.

6.1.2 Coordination with the Navy

The MK PM will have the primary responsibility for coordinating all aspects of work with the Navy EIC. The status of the project will be reviewed thoroughly on a monthly or more frequent basis, as warranted. The EIC, with the assistance of PRC, will provide the MK PM with overall program guidance issued by the Navy, and will consult with the MK PM in conjunction with PRC, on key technical and policy issues. Direct oversight of the project will ensure that the MK PM is aware of current and developing policies, relevant guidance, and the latest technical information applicable at the site.

6.2 Scheduling

The WPA II for the RI/FS includes a schedule (Figure 6-2) for completing the project and a list of associated expected deliverables, expressed in terms of months from notice to proceed (NTP). The schedule presented in Figure 6-2 assumes that all work is conducted in two steps. The installation and monitoring of the data loggers in monitoring wells at Site 12 is identified as a Step One RI/FS field activity. However, this task will begin prior to the initiation of the other Step One RI/FS activities and will continue for a period of 12 consecutive months. This task will also be ongoing after completion of Step Two of the RI/FS field activities.

As the project progresses, the MK PM will continually monitor actual progress against the schedule and deliverable due dates. The PM will be responsible for maintaining and, if necessary, updating, the project schedule.

The PM will keep the EIC informed of any known or anticipated delay or acceleration of project activities. If slippage does occur or is anticipated, the PM will develop and outline available methods to maintain the overall project schedule.

6.3 Costs and Cost Tracking

An overall cost for the performance of the activities described in this WPA II and supporting documents is provided in the Cost Estimate. Costs were estimated based on anticipated field conditions and necessary level-of-effort. If the encountered field conditions are significantly different than anticipated, the MK PM will inform the Navy EIC and the PRC PM immediately and will revise the cost estimate accordingly.

An important element of cost control for remedial planning projects is proper scoping and budgeting of the RI/FS. The cost monitoring system for this project will provide the MK PM with a monthly report of current and total site costs at the activity level. This monitoring system will be used to track budget versus actual expenditures on individual site activities and will give the PM a clear indication of any deviations in project delivery costs.

When site activities involve extensive unit price or time and material subcontract activities, onsite personnel will monitor costs on a daily basis and will advise the PM of actual expenditures, approve and authorize all travel costs, and ensure that the site team maximizes use of government contractor discounts. Subcontractor invoices will be thoroughly checked for reasonableness and compliance with the terms of the contract.

6.4 Quality Control

QC procedures will be implemented throughout the project in accordance with the SAP and the Navy CLEAN Quality Control Management Plan (PRC 1989). Internal QC checks will consist of:

- Internal deliverable review.
- Files and office audits.
- Corrective action.
- Data validation.
- Data quality assessment.

Through these activities, information will be received and reviewed by QA/QC personnel throughout the project, ensuring that the final work products are of the highest possible quality.

6.5 Progress Meetings and Deliverables

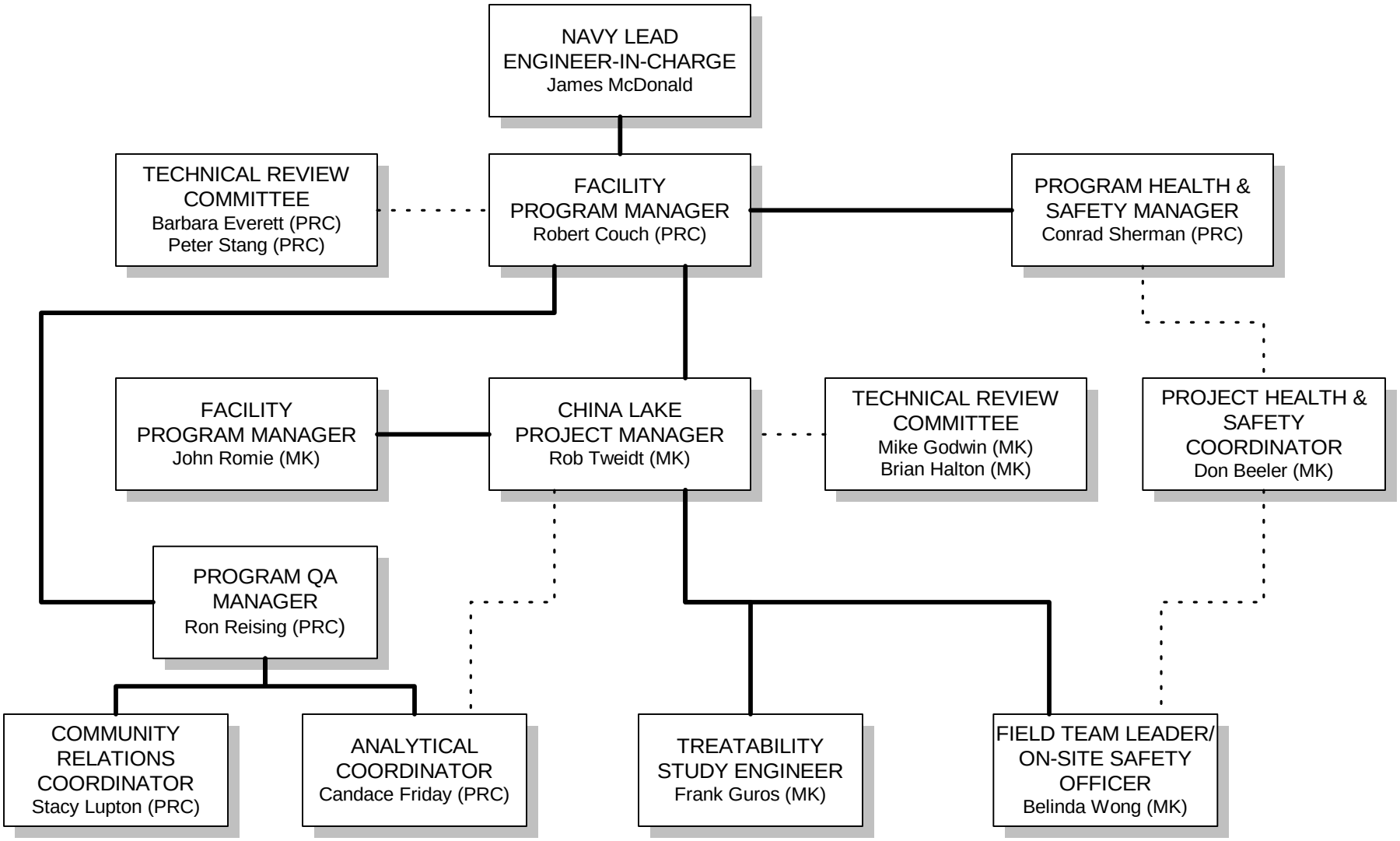
Progress meetings will be held monthly during the RI/FS. Specific topics that will be discussed at the meetings have been identified to include:

- Project kickoff
- Development and presentation of a proposed data management system.
- Presentation of treatability study results, as appropriate.
- Presentation of proposed exposure scenarios for risk assessment.
- Presentation of results of initial site characterization, and identification of sites ready for risk assessment and alternative evaluation. Recommendations for any additional site characterization activities will be made at this time.
- Review of draft Technical Memorandum.

The Technical Memorandum will be prepared to provide an informal vehicle for the presentation of interim data to the Navy. The following TMs are anticipated:

- Presentation of location of borings and/or wells for Sites 12 and 22.
- Presentation of recommendations following review of site characterization data generated by the field sampling program and literature review.
- Presentation of treatability study results.

- Presentation of proposed exposure scenarios (in coordination with PRC).
- Presentation of draft risk assessment (in coordination with PRC).
- Presentation of additional RI/FS site characterization data, if any.



KEY

LINES OF AUTHORITY

LINES OF COMMUNICATION

MORRISON KNUDSEN CORPORATION

NAWS CHINA LAKE, CALIFORNIA

FIGURE 6-1

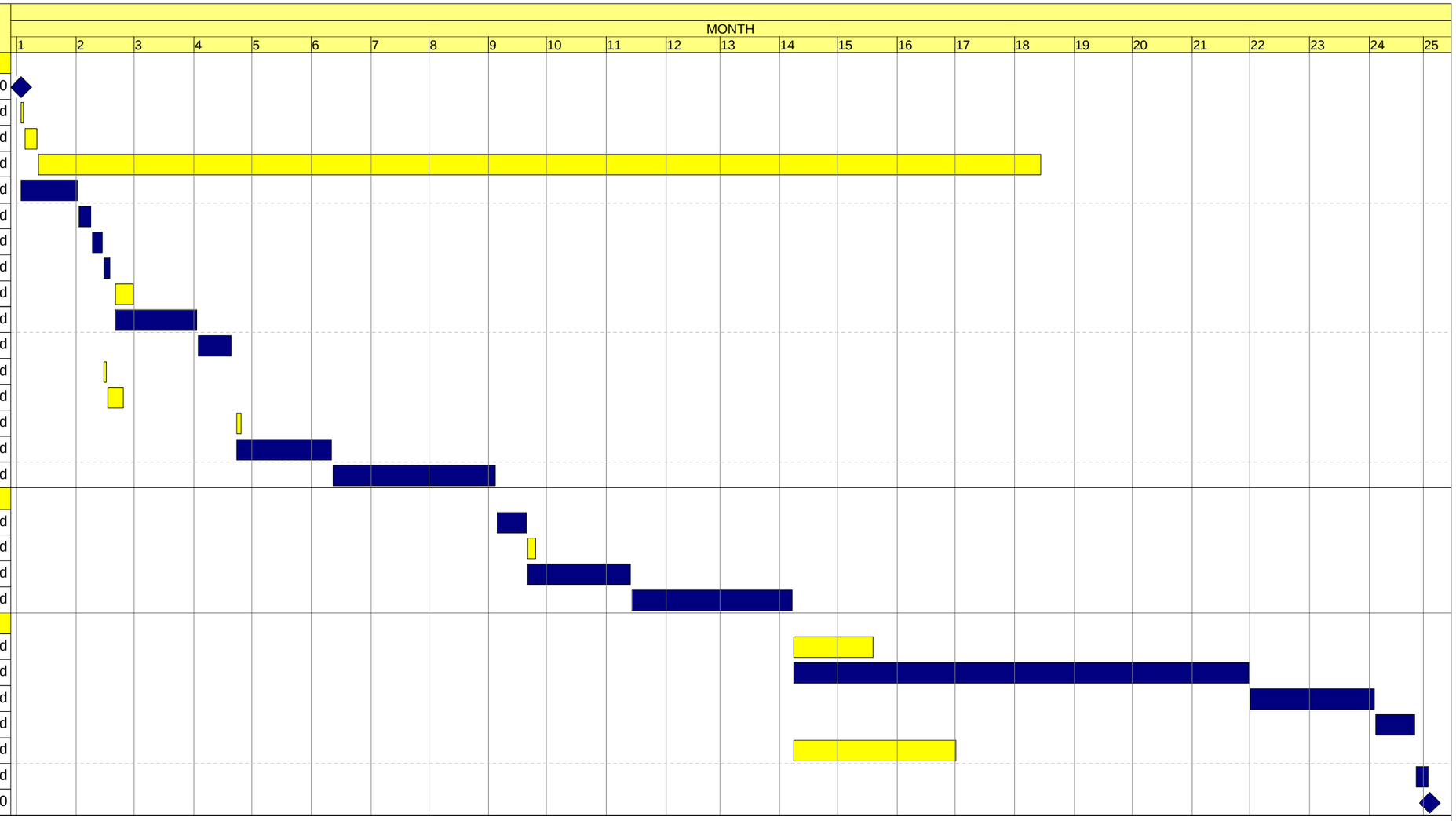
ORGANIZATION CHART

PROJECT NO.:	ORIGINATOR:	CHECKER:	DATE:
4545-0050	BYW	-	9/96

9/5/96

J:\CLEAN2\CTO\0050\WORKPLAN\REV00\FIGURES\ORGCHT.VSD

Description	Orig Dur
STEP ONE RI FIELD ACTIVITIES	
Work Plan Approval	0
Mobilize Data Logger Installation	2d
Install Data Loggers	5d
Collect Data Logger Data	365d
Procure Drilling/Geophysical Contractors	22d
Mobilize for Step One RI Field Activities	5d
Utility/UXO Surveys	4d
Drill/Sample Shallow Borings - Site 12	4d
Drill/Sample Exploratory Borings - Site 12	8d
Drill Monitoring Wells - Site 12 and Site 22	30d
Develop Monitoring Wells - Site 12 and Site 22	14d
Mark Surface Sample Locations - Sites 12 & 22	2d
Collect Surface Sample Locations - Sites 12 & 22	7d
Clean-up/Demobilize	3d
Laboratory Analytical	35d
Lab Data Validation	60d
STEP TWO RI FIELD ACTIVITIES	
Sample All Wells - Site 12 and 22	12d
Clean-up/Demobilize	3d
Laboratory Analytical	35d
Lab Data Validation	60d
REPORT GENERATIONS	
Treatability Study	30d
Prepare Technical Memorandum (TM) - Draft	165d
Agency Review TM - Draft	45d
Prepare Technical Memorandum Report - Final	15d
Prepare 1st Quarterly G.W. Monitoring Report	60d
Close Out Activities	5d
End of Phase II RI/FS at Sites 12 & 22	0



Early bar

Critical bar

Start milestone point

Finish milestone point

MORRISON KNUDSEN ORPORATION
NAWS CHINA LAKE, CALIFORNIA

FIGURE 6 - 2
PROJECT SCHEDULE

7.0 COSTS AND KEY ASSUMPTIONS

The RI/FS costs will vary greatly depending on the size and complexity of the site and the availability and adequacy of the existing data. MK made several key assumptions discussed below in estimating the costs for the RI/FS.

7.1 COSTS

Because this is not a federal-lead site, there will not be any associated cost recovery activities.

MK's cost monitoring system will provide the PM with a monthly report of current and total site costs at each activity level. This monitoring system will be used to track budget versus actual expenditures on individual site activities and will give the PM a clear indication of any deviations in project delivery costs. All cost related information will be provided to the EIC verbally on a need-to-know basis and in a written detailed monthly financial summary report that will be submitted by PRC. The financial summary report will be itemized by task level. The MK PM will notify PRC and the EIC in writing when 75 percent of the budget has been expended.

7.2 KEY ASSUMPTIONS

The following key assumptions have been made in the preparation of this budget estimate:

1. The CTO is assumed to be performed over a 23 month period.
2. Ten-hour days are assumed for all field activities.
3. All activities will be conducted in Level D PPE. MK will be equipped to elevate to Level C PPE if necessary.
4. Telephone, facsimile, and modem costs are based on average historical costs. The average cost was determined to be approximately 1 call per every 10 level-of-effort (LOE) hours based on the individual task.
5. Computer charges, exclusive of computer aided design (CAD), are based on average historical computer costs. The charge is based on a calculation of all clerical hours, technical LOE hours, and 10 percent of the professional LOE hours for each task. CAD hours were determined by adding all technical drafting hours and adding corresponding hours for the CAD computer.

6. Travel costs are based on the lowest-cost refundable 14-day advance purchase ticket price at the date of the cost estimate. Ten hours will be charged for each one-way airline trip between San Francisco and the site.

7. The WPA II and cost estimate are based on the assumption that no radioactive contaminants are present in the soils at these sites.

8. An MK field team leader will be on site at all times during field activities. The field team leader will assist in the coordination and oversight of multiple activities, including oversight of the drilling subcontractor and other field tasks, including coordination with Navy personnel.

9. The Navy will provide a field office. No costs are included for a trailer or for electricity in the field laboratory. MK will maintain a telephone, facsimile machine, and refrigerator in the field office. MK will also have a cellular phone to support the field activities with onsite communications.

10. Personnel will arrive up to 5 working days before each field activity. This will be to inventory all field supplies, coordinate operations with the Navy, obtain utility clearances for boring locations, and interface with the surveyor.

11. Drilling and well installation activities will be conducted during daylight hours.

12. One visit or audit by the MK corporate health and safety officer will take place during field activities.

13. Two primary field efforts will be required to complete site characterization activities:

    - The first field effort will be conducted following completion and acceptance of the WPA II. This field effort will involve the following for Sites 12 and 22:

      <u>Site 12</u>

      - Collection of 15 surface soil samples
      - Soil sampling of four shallow 25-foot borings
      - Completion of two 300-foot exploratory borings
      - Installation and development of six groundwater monitoring wells

      <u>Site 22</u>

      - Collection of 21 surface soil samples
      - Installation and development of five groundwater monitoring wells including the collection of groundwater samples using hydropunch technology that will be used to screen for the presence of NAPLs

    - The second field effort will be conducted on the completion of the first field effort. The second field effort will involve the purging and sampling of all existing and new

groundwater monitoring wells at Sites 12 and 22. This sampling event will also be considered as the First Quarterly Groundwater Monitoring Event for both sites.

14. Forty-five round-trip (RT) airline trips are assumed for the completion of the RI/FS activities presented in this WPA II.

15. For the purposes of estimating costs, it is assumed that nonaqueous IDW generated during the Phase II RI/FS will require transportation, storage, and disposal at a Class II landfill located in California. The IDW will be stored onsite in bins and will be disposed of at the end of field activities by Chem Waste under the supervision of MK personnel.

16. It is assumed that each RPM meeting will be 1 day in duration and will require 1 day of preparation. Costs per attendee for each RPM meeting includes 20 hours for combined mobilization and demobilization, 10 hours on site and a one-night stay.

17. RPM meetings will be attended by the MK project manager, and either one technical or QA/QC professional. During onsite field operations, the field team leader will also attend these meetings.

18. There will no need for bench or pilot scale studies.

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