

Final

Historical Radiological Assessment
(HRA)

Marine Corps Air Station, El Toro

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for

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Historical Radiological Assessment
MCAS El Toro

Signature Sheet

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1. ACRONYMS AND ABBREVIATIONS

A&R	Assembly and Repair	Co-60	Cobalt-60
Am-241	Americium-241	cpm	Counts per minute
APHO	Aerial Photograph	CTO	Contract Task Order
AOC	Area of Concern	DGMW	Down Gradient Monitoring Well
BCP	Base Realignment and Closure Cleanup Plan	DHS	California Department of Health Services
BEC	BRAC Environmental Coordinator	DOD	Department of Defense
BRAC	Base Realignment and Closure	DPDO	Defense Property Disposal Office
BuAer	Bureau of Aeronautics	dpm	Disintegrations per minute
BUMED	Bureau of Medicine and Surgery	DRMO	Defense Reutilization and Marketing Office
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980	DTSC	Department of Toxic Substances Control
CERCLIS	Comprehensive Environmental Response. Compensation and Liability Information System	EBS	Environmental Baseline Survey
CFR	Code of Federal Regulations	EIR	Environmental Impact Report
cm²	Square centimeters	EOD	Explosive Ordnance Disposal
CMC	Commandant of the Marine Corps	EPA	U.S. Environmental Protection Agency
CNO	Chief of Naval Operations	ES	Executive Summary
		FFA	Federal Facility Agreement

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FMD	Facilities Management Department	MCL	Maximum Contaminant Level
FS	Feasibility Study	MSL	Mean Sea Level
GM	Geiger-Muller	uCi	micro-Curie (millionth)
G-RAM	General Radioactive Material	NACIP	Navy Assessment and Control of Installation Pollutants
H-3	Tritium		
HRA	Historical Radiological Assessment	NARM	Natural and Accelerator-produced Radioactive Material
HRS	Hazardous Ranking System	NAVFAC	Naval Facilities Engineering Command
HSWA	Hazardous and Solid Waste Amendments	NAVSEA	Naval Sea Systems Command
IAS	Initial Assessment Study	NAVSUP	Naval Supply Systems Command
IBIS	In-flight Blade Inspection System	NBC	Nuclear, Chemical and Biological
IR	Installation Restoration	NCL	Navy Calibration Laboratory
IRP	Installation Restoration Program	NCRP	National Committee on Radiation Protection and Measurements
Kr-85	Krypton-85		
mCi	milli-Curie (thousandth)	NEESA	Naval Energy and Environmental Support Activity
MALS	Marine Air Logistics Squadron		
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual	NEHC	Navy Environmental Health Center
		NFA	No Further Action
MCAS	Marine Corps Air Station		

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NNPP	Naval Nuclear Propulsion Program	RASO	Radiological Affairs Support Office
NORM	Naturally Occurring Radioactive Material	RASP	Radiological Affairs Support Program
NPL	National Priorities List	Ra-226	Radium-226
NRC	Nuclear Regulatory Commission	RCRA	Resource Conservation and Recovery Act
NRMP	Navy Radioactive Materials Permit	RFA	RCRA Facility Assessment
NRSC	Navy Radiation Safety Committee	RFI	Ready for Issue
NWRCP	Nuclear Weapons Radiological Control Program	RI	Remedial Investigation
		RI/FS	Remedial Investigation/ Feasibility Study
O&R	Overhaul and Repair	Rn-222	Radon-222
OCWD	Orange County Water District	RPA	Radium Plaque Adaptometer
OU	Operable Unit	RSO	Radiation Safety Officer
PA	Preliminary Assessment	RWQCB	Regional Water Quality Control Board
PCB	Polychlorinated Biphenyl	SARA	Superfund Amendments and Reauthorization Act - 1986
pCi/l	pico-Curie per liter (millionth of a millionth)		
PSI	Perimeter Study Investigation	SAIC	Science Applications International Corporation
R	Roentgen	SIPOA	Site Inspection Plan of Action
RAB	Restoration Advisory Board	SSPORTS	Supervisor of Shipbuilding, Portsmouth, VA

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Sr-89/90	Strontium-89/90
SWDIV	South West Division
SWMU	Solid Waste Management Unit
Th-232	Thorium-232
USMC	U.S. Marine Corps
VOC	Volatile Organic Compound
WESTON	Roy F. Weston, Inc.

2. EXECUTIVE SUMMARY

2.1 Findings

The Base Realignment and Closure Commission (BRAC) designated Marine Corps Air Station (MCAS) El Toro to be closed in 1999, necessitating the preparation of a Historical Radiological Assessment (HRA) as part of the base closure process for the release of the Station for reuse. The HRA addresses general radioactive material (G-RAM), which includes Radiological Affairs Support Program (RASP) material and unregulated consumer products. Aircraft containing radioactive equipment and safety devices had been stationed and worked on at MCAS El Toro. The controls applied to G-RAM at MCAS El Toro had historically been consistent with Federal Regulations and with National Scientific Committee recommendations. Interviews, records review, site inspections, and limited informal surveys performed at MCAS El Toro had confirmed that G-RAM had been used in connection with the mission of the Station. These investigations had not revealed any evidence of adverse effect on the population or on the environment of the region.

2.2 Conclusions

Radiological surveys are required at MCAS El Toro and, if necessary, as the result of these surveys, sampling and/or remediation will be performed. Due to the type of work performed during past military operations at El Toro, there is a low potential for radiologically contaminated areas existing on the Station. However, based on the results of further investigations, a determination will be made as to which sites can be released for unrestricted use and which may require institutional controls.

Based on the information to date, the following sites are recommended for further investigation, including radiological surveys and, if required, sampling and/or remediation:

- 1. Original Landfill -IR Site #3**
- 2. Perimeter Road Landfill-IR Site #5 (including adjacent impoundment; APHO-46)**
- 3. Defense Reutilization and Marketing Office (DRMO) Yards #1 and #3 - IR Site #8 and AOC #264, respectively**
- 4. Hangars 295, 296 and 297 (selected areas within the hangars where radioactive materials are known or suspected to have been stored or worked)**
- 5. Buildings 242, 243, 244 - Command Air Museum (selected areas within the buildings where radioactive materials were known or suspected to have been stored or displayed)**

6. **Buildings 319 and 360 - DRMO buildings (selected areas within the buildings where radioactive materials may have been stored)**
7. **Explosive Ordnance Disposal (EOD) Range - IR Site #1**
8. **Magazine Road Landfill - IR Site #2**
9. **Communication Station Landfill - IR Site #17 (including adjacent impoundment; APHO-44)**
10. **Former Location of the Industrial Waste Treatment Plant and Drying Beds - IR Site #12 and out-fall portion of Bee Canyon Wash (IR Site #25) to the south Station boundary**
11. **Anomaly Area #3 (MSC R1) – Area located at Wherry Family Housing**
12. **Site of the former Radium Plaque Adaptometer Building**
13. **Buildings 787, 1789 and 1803 - Nuclear Biological and Chemical Group training and storage areas (including adjacent impoundment; APHO-38).**

3. PURPOSE OF THE HISTORICAL RADIOLOGICAL ASSESSMENT

3.1 Purpose

The Historical Radiological Assessment (HRA) has been prepared by Roy F. Weston, Inc. (WESTON), formerly the Supervisor of Shipbuilding and Repair, Portsmouth, VA (SSPORTS), Vallejo, CA Environmental Detachment. In September 1999, WESTON partnered with SSSPORTS and all future HRA editions will be issued by WESTON. This assessment was contracted by the Naval Facilities Engineering Command (NAVFAC), Southwest Division pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act (SARA). The purpose of the HRA is to identify potential, likely, or known sources of radioactive material and radioactive contamination based on existing or derived information and identify site(s) that need further action as opposed to those posing no threat to human health. The HRA further provides an assessment of the likelihood of contaminant migration; and, provides initial classification of the site(s) or survey unit(s) as impacted or non-impacted.

3.2 Background

A major objective in the performance of general radioactive material (G-RAM) related work is avoidance of potential releases of low-level radioactivity into the environment. Another objective is to control radiation exposure to personnel. From the beginning of such work at MCAS El Toro, radiological work has been controlled to preclude the spread of contamination and the unnecessary exposure to personnel.

There are four main Naval programs that maintain responsibility for radioactive materials, depending on their use. They are the Bureau of Medicine and Surgery (BUMED), the Nuclear Weapons Radiological Controls Program (NWRCP), the Naval Nuclear Propulsion Program (NNPP), and the Radiological Affairs Support Program (RASP). Based on the mission of MCAS El Toro, all radiological work has involved general radioactive material (G-RAM), which is the responsibility of the RASP. The G-RAM includes, but is not limited to, NRC licensed radioactive material, naturally occurring radioactive material (NORM), radiographic and instrument calibration sources, various radioactive instrumentation and radioluminescent products. Examples of G-RAM are vacuum tubes with radioactive elements thorium (Th-232), strontium (Sr-90), krypton (Kr-85), Tritium (H-3) and cobalt (Co-60), radium dials and gages (Ra-226), thoriated (Th-232) welding electrodes, strontium (Sr-90) and krypton (Kr-85) aircraft components, thoriated (Th-232) magnesium aircraft and missile parts, thoriated (Th-232) optical glass, smoke detectors containing americium (Am-241) and self luminescing exit signs containing tritium (H-3).

This HRA is organized in a format similar to the standard PA protocol used by the EPA within the CERCLA process. In addition, the California DHS Guidance for Radiological Cleanup/Remediation, dated August 11, 1995, has been used in conjunction with Chapter

3 of the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), Historical Site Assessment, dated December 1997, in the preparation of the HRA.

3.3 Requirements

The Comprehensive Environmental Response Compensation, and Liability Act (CERCLA) of 1980 established a process whereby past private sector disposal sites were evaluated for environmental contamination and remedial action initiated where warranted. Federal facilities were not included under CERCLA; however, under Executive Order 12316 of August 1981, the President directed the Department of Defense (DOD) to conduct similar evaluations of DOD installations.

As a consequence of Executive Order 12316, Initial Assessment Studies (IASs) were conducted at DOD facilities. The IAS serves as the first step in the DOD CERCLA process; it is equivalent to a Preliminary Assessment (PA). The Marine Corps Air Station (MCAS) El Toro IAS was completed in May 1986.

Beginning in 1986, DOD realigned its programs to be more consistent with those of the Environmental Protection Agency (EPA) in the private sector. IASs paralleled the Preliminary Assessment of CERCLA. Confirmation Studies paralleled the Remedial Investigation and Feasibility Studies of CERCLA.

The Superfund Amendment and Reauthorization Act (SARA) of 1986 required that Federal agencies comply in the same manner and extent as private entities and allowed Federal activities to be placed on the National Priorities List (NPL). Executive Order 12580 of January 23, 1987, provided jurisdiction to EPA for federal facilities on the NPL.

SARA also directed the EPA to revise the Hazard Ranking System (HRS) used to score sites undergoing the CERCLA process. This was completed and the revised HRS was published in the Federal Register in December 1990.

The EPA evaluated MCAS, El Toro and in June 1988, recommended listing El Toro on the NPL of the Superfund Program based on the presence of Volatile Organic Compound (VOC) contamination. The MCAS El Toro was listed on the NPL in February 1990. A Federal Facilities Agreement (FFA) among EPA, Regional Water Quality Control Board (RWQCB), California Department of Toxic Substances Control (DTSC) and the Navy (on behalf of the United States Marine Corps) was signed in September 1990. [Ref. 1]

Under agreement with U.S. Nuclear Regulatory Commission (NRC), the California Department of Health Services (DHS) has been designated as the agency responsible for administering programs to protect the citizens of California from unnecessary exposure to radioactive materials. Although the NRC has responsibility for monitoring facilities under Federal jurisdiction, DHS becomes involved when a Federal facility, such as MCAS El Toro, is undergoing closure in a plan to revert to State control. On May 26, 1998, DHS requested MCAS El Toro to provide a Historical Radiological Assessment (HRA) for all base property. The "Information Needed for the Radiological Evaluation of

Military Bases”, as indicated in the DHS guidance document dated August 11, 1995, has been addressed in this HRA.

4. PROPERTY IDENTIFICATION

4.1 Physical Characteristics

4.1.1 Name of Property

The name of the property is: Marine Corps Air Station (MCAS), El Toro. The property is owned and operated by the United States Marine Corps and the address of the Station is Santa Ana, California 92709.

4.1.2 Location

MCAS El Toro is located entirely within Orange County, California and is located about 8 miles southeast of the City of Santa Ana. It lies between 33 degrees 38 minutes and 33 degrees 41 minutes north latitude and 117 degrees 41 minutes and 117 degrees 45 minutes west longitude. Figure 4-1 is a map displaying the regional location of the site and the specific location of the site.

4.1.3 Topography

The MCAS El Toro is situated on the edge of the Tustin Plain, a gently sloping surface comprised of alluvial fan deposits derived mainly from the Santa Ana Mountains. The Tustin Plain is the southernmost extension of the Coastal Plain of Los Angeles, a structural basin located in the Peninsular Ranges Geologic Province. The Tustin Plain is bounded by the Santa Ana Mountains to the north and the San Joaquin Hills to the south.

The MCAS El Toro boundaries extend across the Tustin Plain into the Santa Ana Mountains. Elevations range from about 215 feet above mean sea level (MSL) in the southwest corner of the Station on the Tustin Plain to about 800 feet above MSL in the northeast corner in the foothills of the Santa Ana Mountains. The topographical relief across the alluvial plain portion, including the MCAS El Toro site, is nearly flat and slightly tilted with elevation ranging from about 450 feet above MSL to approximately 200 feet above MSL. Gradients on this sloping surface on the MCAS El Toro site range from 2.5 percent in the northeast to 1.5 percent in the southwest. The most severe topography occurs on the northeast part of the site where 20 percent slope is exceeded.

There are no unique or unusual topographical features on the MCAS El Toro site. The drainages on the MCAS El Toro site outside the habitat reserve, although poor, have been improved and are no longer natural channels. [Ref. 2]

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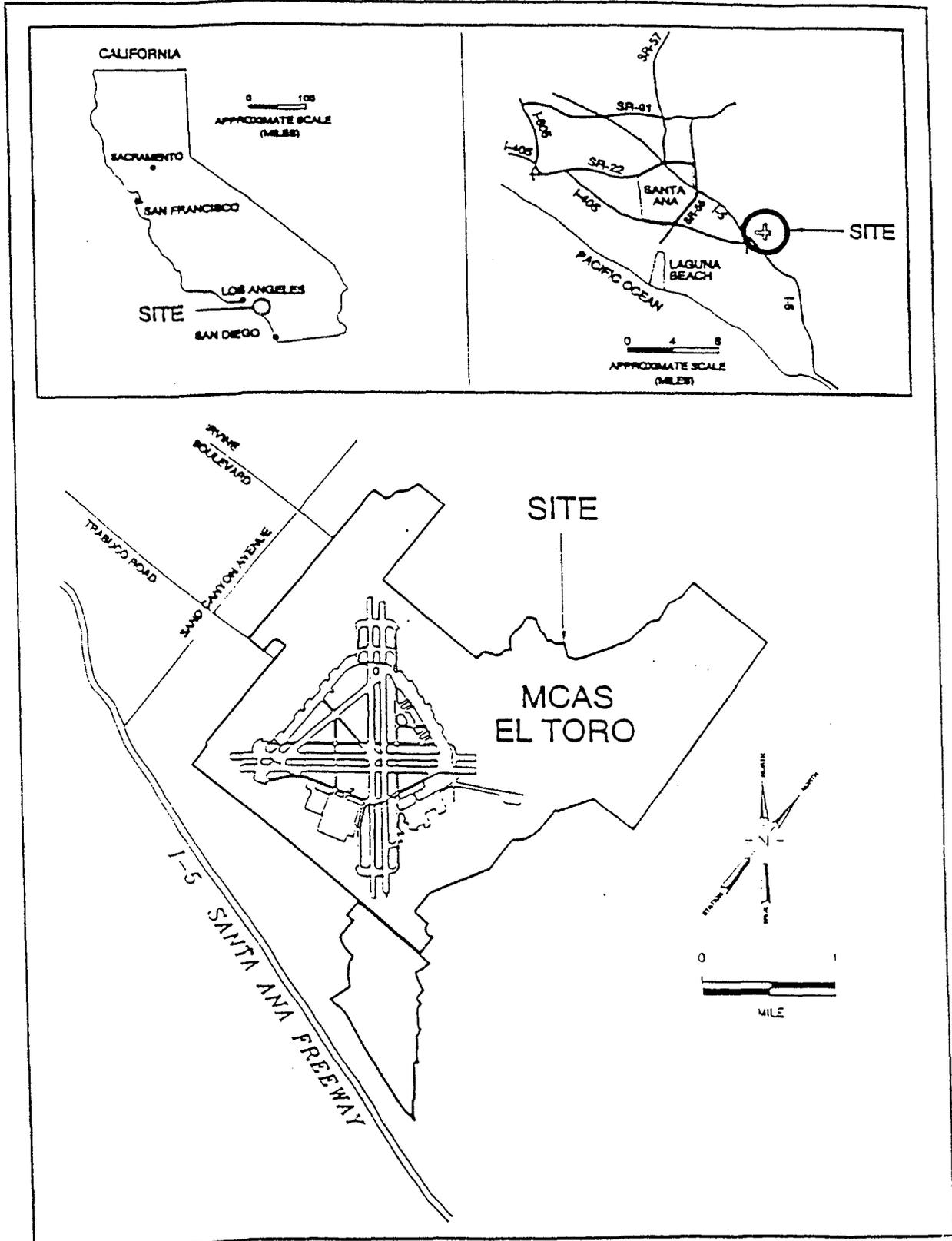


Figure 4-1
Regional and Specific Location of MCAS El Toro

4.1.4 Stratigraphy

MCAS El Toro lies on alluvial fan deposits derived mainly from the Santa Ana Mountains. These Holocene materials consist of isolated coarse-grained stream channel deposits contained within a matrix of fine-grained overbank deposits that range in thickness up to a maximum of 300 feet. The Quaternary deposits form a heterogeneous mixture of silts and clays with interbedded sands and fine gravels that range in thickness up to 500 feet in the western portion of the Tustin Plain.

The lower Pliocene Fernando Formation, considered to be the major aquifer in the Irvine area, is the base of the water-bearing units. This formation interfingers with clayey and sandy siltstones of the Capistrano and Niguel Formations west of MCAS El Toro and together range up to 1,500 feet in thickness.

Beneath the semiconsolidated rocks lies a very thick sequence of interbedded marine and nonmarine sedimentary rocks and volcanic rocks on the Monterey, Puente, Vaqueros and Sespe Formations. These units, which are deposited on a basement of crystalline metamorphic and igneous rocks, have been considered to be nonwater bearing in previous studies. [Ref. 3]

4.2 Environmental Setting

4.2.1 Geology

The soils on MCAS El Toro consist mainly of clays, sands, and loams. They are fertile and productive for agriculture use when adequate irrigation is available. Orange County has long been a notable agricultural community of state and national significance. Based on the properties of the soils on El Toro, much of the land (approximately 1,040 acres) on base has long been used for agricultural purposes. [Ref. 4]

The Holocene alluvial materials conformably overlie Pleistocene Age sediments predominantly composed of interlayered fine-grained lagoonal and near-shore marine deposits. These materials become increasingly mixed with beach sands, terrace, and stream channel deposits in the eastern portion of the Tustin Plain and along the basin margins.

The deeper Quaternary sediments may be equivalent to the lower Pleistocene San Pedro Formation, which consists of semiconsolidated silts, clays and sands with interbedded limestone. These lagoonal and shallow marine deposits are considered to be a major water-bearing unit in the region, which do not extend beneath MCAS El Toro.

The Pleistocene deposits nonconformably overlie older semiconsolidated marine sandstones, siltstones and conglomerates of late Miocene to late Pliocene age. These units comprise the Fernando, Capistrano and Niguel Formations, of which, the lower Fernando Formation is considered to be the major aquifer and the base of the water bearing units in the Irvine area. [Ref. 3]

4.2.2 Hydrogeology

MCAS El Toro is situated over the Irvine (groundwater) Subbasin adjacent to the main Orange County (groundwater) Basin. Although the aquifers beneath the Tustin Plain (Irvine Subbasin) are in hydraulic contact with the main Orange County Groundwater Basin, it is difficult to make correlation among specific aquifer zones. In the Irvine area, aquifers are much thinner and separated by thicker sequences of fine-grained materials. Aquifers tend to be composed of lenticular clayey and silty sands and fine gravels contained within a complex assemblage of sandy clays and sandy silts. Rather than identifiable aquifers that may be correlated from place to place, the groundwater may be considered to flow in a single, large-scale heterogeneous system.

Additional information on the local hydrogeologic setting, particularly within the boundaries of the Station, was gained from the Phase I Remedial Investigation field activities. A review of water level and water quality data from multiple-depth monitoring wells suggests that hydraulic communication is restricted between the uppermost sediments and the underlying main production aquifer. The interpretation of the Irvine Subbasin lithologic framework and hydrogeology is as follows: The uppermost unconsolidated sediment sequence is called the Shallow Aquifer; the lowermost unconsolidated sediment sequence is called the Principal Aquifer; and the unconsolidated sediment sequence that restricts groundwater flow between the Shallow and the Principal Aquifers is called the Intermediate Horizon. Cross-section correlation provides some geologic support of an Intermediate Horizon. The main lines of evidence are step changes in water levels and variation in the VOC water quality data with depth. [Ref. 5]

The groundwater system beneath the Tustin Plain (Irvine Subbasin) has been divided into a forebay area and a pressure area. The forebay area lies along the margin of the basin where sediments are relatively shallow and coarse-grained above consolidated rock. Groundwater generally occurs under unconfined conditions in this area. Recharge to the regional system takes place in the forebay area primarily along washes that exit the Santa Ana Mountains. The pressure area lies in the central portion of the basin, where sediments are thicker and relatively finer grained. Groundwater in this area occurs mainly in deeper zones that become increasingly confined with depth. Groundwater has historically been discharged through irrigation wells or has moved westward to the Main Orange County Basin.

In 1988, along the southwest perimeter of the Station, the depth to groundwater ranged from 82 to 122 feet below ground surface. Reduced pumping and increased water imports in the past 20 years have allowed groundwater levels to rise as much as 100 feet. Ground water within the foothills where it occurs is within 50 feet of the ground surface. Information gathered during the Phase I and Phase II Remedial Investigations (RIs) drilling shows that depth to groundwater is generally consistent with those indicated above. Ground water is most shallow in the foothills, where it lies about 45 to 60 feet beneath the washes.

According to 1989 water levels, the direction of flow along the southwest boundary of MCAS El Toro was northwest at a gradient of 0.0066 feet/foot. Regional flow has been west and northwest since the 1940s and has been controlled locally by large pumping depressions. Phase I RI data indicated that regional groundwater flow is still toward the northwest, with an average groundwater gradient of about 0.008 feet/foot. Groundwater data has been acquired during the 1995/1996 RI, Phase II RI, and sampling activities conducted throughout 1997. The average hydraulic gradient for the shallow aquifer was interpreted to be 0.008, consistent with the 1989 findings.

Phase I RI data indicated average linear groundwater flow velocities in the uppermost aquifer across the Station in the range of 0.02 to 1.9 feet per day (ft/day). Average linear groundwater flow velocities in localized areas in the deeper coarse-grained portion of the aquifer that supplies groundwater to production wells are likely to be higher than the linear groundwater velocity in the uppermost aquifer. An average linear groundwater velocity of 1.5 ft/day was calculated based on the hydraulic conductivity of 56.8 ft/day estimated from a 24-hour pumping test completed by Orange County Water District (OCWD), an average hydraulic gradient of 0.008, and a porosity of 0.3. [Ref. 3]

4.2.3 Hydrology

The MCAS El Toro is located on a flood plain which drains surface water poorly due to the fact that it is relatively level and the majority of the soils on the station are classified as silt and clay loams on nearly level alluvial fans. [Ref. 4]

Surface water drainage near MCAS El Toro generally flows southwest, following the slope of the land perpendicular to the trend of the Santa Ana Mountains. Several washes originate in the hills northeast of the Station and flow through or adjacent to the Station en route to San Diego Creek. Off-Station drainage from the hills and upgradient irrigated farmlands combines with on-Station runoff (generated from the Station's extensive paved surfaces) at the Station and flows into four main drainage channels. Three of these drainage channels are contiguous with natural washes that originate in the Santa Ana Mountains (Borrego Canyon, Agua Chinon, and Bee Canyon); the fourth channel is Marshburn Channel. All four drainages become confluent with San Diego Creek southwest of the Station. [Ref. 3]

Agua Chinon Wash and Bee Canyon Wash transect the central portion of the Station with flow contained within culverts and receive runoff mainly from storm sewers. Marshburn Channel is a lined drainage channel that runs along the northwestern boundary of MCAS El Toro and receives runoff from the western part of the Station. The Wash flows into San Diego Creek 3/4 mile northwest of Bee Canyon Wash. San Diego Creek flows from the intersection at Marshburn Channel about seven miles into the Upper Newport Bay. [Ref. 1]

4.2.4 Meteorology

The climate at MCAS El Toro is a typical Mediterranean climate, characterized by cool, moist winters and warm dry summers. Temperatures in the winter seldom drop below 37 degrees Fahrenheit. Summer temperatures rarely exceed 100 degrees Fahrenheit. Average annual precipitation is about 12 inches and occurs primarily in the winter.

Early morning light fog and low clouds are common in the late spring and early summer. Dry winds, known as the Santa Ana winds, with velocities up to 70 miles per hour, occur for short periods during the late fall and early winter. [Ref. 3]

5. HISTORICAL SITE ASSESSMENT METHODOLOGY

5.1 Approach and Rationale

Navy, MCAS El Toro, and Naval Facilities Engineering Command (NAVFAC) Southwest Division (SWDIV) correspondence, historical files, and related reports have been reviewed and utilized to ensure that all potential sources of radioactivity at the base were identified. The MCAS El Toro site descriptions were derived from Navy Installation Restoration documents.

Available records were reviewed to determine whether any inadvertent releases of radioactivity to the environment had been recorded. The review included identification of locations where radiological work may have occurred and areas in which radioactive materials may have been stored and/or disposed. It should be noted that available records were often incomplete, in that, locations might be identified in one document as being a potential radiological site and other follow-on documentation would neither confirm nor refute the radiological information. In order to supplement the data gaps from incomplete documentation records, interviews with former and current employees were conducted regarding radiological work at the base. Interview questions, based on the radiological questionnaire provided in the MARSSIM, Chapter 3, were used when interviewing current and former employees.

5.2 Boundaries of Site

The boundaries of MCAS El Toro are shown in Figure 4-1. The Base can be generally described as lying within the parcel bounded on the south by Highway Interstate 5, on the west by State Highway 133, on the north by Portola Parkway and the Foothill Transportation Corridor and on the east by Alton Parkway. The longitude and latitude coordinates are provided in paragraph 4.1.2.

5.3 Documents Reviewed

Documents reviewed, during the investigation for preparation of this HRA, included the references listed in Appendix B. Also many Station drawings were reviewed, most involving building 296. In addition, various correspondence from State and County Agencies regarding radiation issues at MCAS El Toro and various minutes from Restoration Advisory Board meetings and records from public hearings held regarding the closure and cleanup of MCAS El Toro were reviewed.

5.4 Property Inspections

5.4.1 Previous Site Investigations

The following sections briefly summarize site investigations and regulatory history at MCAS El Toro.

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- In 1972, a Cease and Desist Order from the California RWQCB resulted in the shutdown of the sewage treatment plant.
- In 1985, Brown and Caldwell commenced work on the Initial Assessment Study (IAS) to locate potentially contaminated sites on El Toro. The report was completed in 1986 and identified 17 potential sources of contamination.
- In 1985, Orange County Water District (OCWD) discovered trichloroethylene contamination in agricultural wells located down gradient of MCAS El Toro. The base was found to be the source of the contamination and investigations have been underway since the initial discovery.
- In 1988, a Site Inspection Plan of Action (SIPOA) was released and included a recommendation of 19 sites for study and amended the IAS sampling plan.
- In 1988, a Perimeter Study Investigation (PSI) was conducted and it was found that VOCs were present in the shallow groundwater, approximately 100 feet deep, near the Station boundary. This finding resulted in the installation of a pump and treatment system in 1989 capable of treating approximately 30 gallons per minute.
- In 1990, Strata Technologies, Inc. conducted field work for the four landfills on the Station. The field activities consisted of meteorological and geophysical surveys using ground penetrating radar to define landfill perimeters. Sampling was performed on landfill gas, ambient air and surface gas. Some VOC contaminants were found at concentrations above the minimum detection levels.
- In 1990, an off-Station Remedial Investigation (RI) Work Plan was completed and became the starting point for regional groundwater VOC investigation currently being conducted under the RI/Feasibility Study (FS) program. The total number of sites to be investigated increased from 19 to 22.
- In 1988, 1989 and 1990, inspections by EPA of hazardous waste management activities at MCAS indicated violations of Resource Conservation and Recovery Act (RCRA) of 1974 and Hazardous and Solid Waste Amendments (HSWA) of 1984.
- In 1993, MCAS El Toro was an Interim Status Facility under RCRA.

[Ref. 1]

5.4.2 Recent Site Inspections

The following listed site investigations have occurred since MCAS El Toro was selected for closure by the BRAC Process in 1993:

- From 1995 to 1998, Bechtel National, Inc. conducted groundwater sampling from various wells associated with landfills and analyzed the samples for radionuclides
- In 1995, Bechtel National, Inc. conducted soil sample screening at landfills (IRP Sites #3 and #5) for presence of radioactive materials above background
- In 1995, NAVFAC Southwest Division, in cooperation with Jacobs Engineering Group, International Technology Corp., and CH2M HILL developed the information for the Final Environmental Baseline Survey Report
- In 1997, JRP Historical Consulting Services performed an Inventory and Evaluation of Buildings and Structures for Historic Eligibility

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- In 1997, BRAC Cleanup Team developed the BRAC Cleanup Plan for MCAS El Toro
- In 1997, 1998 and 1999, Supervisor of Shipbuilding and Repair, Portsmouth, VA (SSPORTS) performed radiological investigation of hangars 296 and 297
- In 1998 and 1999, SSSPORTS inspected and investigated areas and sites at MCAS El Toro in preparation of the Site Historical Radiological Assessment (HRA)
- In 1999 and 2000, WESTON reinspected buildings, areas and sites in the preparation of the final HRA and the draft Radiological Survey Plan

During the Site inspections by SSSPORTS Environmental Detachment (and WESTON) in the preparation of this HRA, the following areas were visited, based on the types of operations conducted in the area during the military history of MCAS El Toro:

- Buildings 242, 243, 244 and adjacent grounds - Command Air Museum, where historic aircraft and radium painted instruments from historic aircraft were displayed. The goal of the museum was to display every aircraft ever based at MCAS El Toro. The historic aircraft and artifacts were transferred to MCAS Miramar in June 1999.
- Buildings 295, 296 and 297 - Active USMC hangars where operating aircraft utilizing radioactive equipment are located (building 296 is also the hangar in which a radium paint room was reported to have been located in the 1940's; see discussion in paragraph 5.4.2.1). The USMC Air Group removed all radioactive components and departed from these buildings in May 1999.
- Buildings 324 and 326 - Used for support work and material storage for aircraft located in buildings 295, 296 and 297.
- Buildings 317, 318 and 359 - Major supply buildings used in the receipt, storage and shipment of materials and equipment associated with operation of the Station.
- Explosive Ordnance Disposal (EOD) Range (IR Site #1) - Low-level waste reportedly (IAS dated May 1986, Section 2.2.1) was disposed of in the area at an unknown location. However, based on discussion with EOD personnel, no nuclear weapons or ammunitions containing radioactive materials were assembled, handled, stored or disposed of at this site. [Ref. 6]
- Original Landfill (IR Site #3), Perimeter Road Landfill (IR Site #5) and APHO-46 - Reportedly (IAS dated May 1986, Sections 2.2.3 and 2.2.4) received all types of on-Station waste during the years of operation (Site #3 - between 1943 and 1955; Site #5 - between 1955 and the late 1960s). Aerial Photograph (APHO-46) dated 1979 shows large impoundment adjacent to IR Site #5. [Ref 6, 41]
- Defense Reutilization and Marketing Office (DRMO) Yard #1 (IR Site #8) - Historical use as a location where scrap and excess materials and equipment were stored while awaiting disposition.

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- Buildings 319 and 360 - Long time use for inside storage of DRMO materials and equipment while awaiting disposition.
- Building 21 – Old paint shop; more recently used for miscellaneous storage.
- Building 155 – Sand blast facility, where, in the past, blasting had been accomplished inside and outside of the building.
- DRMO Yards #2 (AOC #46) and #3 (AOC #264) - Long time use as outside locations where scrap and excess materials and equipment were stored while awaiting disposition.
- Magazine Road Landfill (IR Site #2) - All solid waste from MCAS El Toro and some waste from MCAF Tustin was disposed of between the late 1960s and 1980.
- Communication Station Landfill (IR Site #17) and APHO-44 – Reportedly, any type of waste generated on the Station was disposed of between 1981 and 1983. Aerial Photograph (APHO-44) dated 1974 shows large impoundment adjacent to southern end of IR site #17. [Ref 6, 41]
- Industrial Waste Treatment Plant (IR Site #12) and out-fall portion of Bee Canyon Wash (IR Site #25) – Treated industrial waste liquids generated at the station, including discharges from building 296 (location of radium room). The plant operated between 1943 and 1972 and discharged effluent into the Bee Canyon Wash.
- Anomaly Area #3 (MSC R1) – Technical Memorandum, Aerial Photograph Anomalies of April 1999 and SWDIV Transmittals of July 1999 identified this area near Station Family Housing as a potential location where disposal of construction debris may have occurred between 1946 and 1992.
- Former Site of the Radium Plaque Adaptometer (RPA) Building - Sketch of a building footprint indicating the year 1944 shows a small building (45 ft X 51 ft) located on "C" Street, approximately two blocks north of the Trabuco Road Station Gate.
- Nuclear Biological and Chemical Buildings 787, 1789 and 1803 - Buildings and surface impoundments (APHO - 38) are located north of the intersection of East Marine Way and El Toro Boulevard.

[Refs. 1, 3, 5, 6, 17, 18, 38, 39 and 41]

While inspecting the above areas, informal questions were asked of available personnel working in the area to determine any additional information pertinent to past and present operations in that location.

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In addition, informal radiation readings were taken (see Table 5-1) using Ludlum Scaler-Ratemeter, Model 2221 (serial numbers 138346 and 148432) with a 2" X 2" sodium iodide detector (serial numbers PR 144073 or PR 119800) and/or a Ludlum Micro-R meter, Model 19 (serial numbers 142840 or 142862).

The radiation readings provided in Table 5-1 were obtained by taking a stationary measurement with the survey instrument(s) described above in contact with the surface being surveyed.

- Background readings were taken near the area being inspected i.e. they are specific to the area in question; normally at a location outside of the structure when a building was being inspected and outside of fenced areas or boundaries of areas when an outdoor sites was being inspected.
- Informal readings were taken by scanning throughout the area being inspected and when an elevated reading was observed, a stationary reading was taken and recorded.
- Since the readings were informal and were being taken to search for unusual readings, not all instruments were used at each location.

The dates of the readings, the approximate locations where the background reading were taken and where the maximum radiation levels were measured are provided in the table.

Table 5-1				
Informal Radiation Readings Recorded During Site Inspections				
<u>Location and Date Inspected</u>	<u>Approx. Back-ground (2" X 2")</u>	<u>Max. Reading (2" X 2")</u>	<u>Approx. Back-ground (micro-R)</u>	<u>Max. Reading (micro-R)</u>
Building 242 (2/17/99)	Not Taken	Not Taken	9 uR/hr (outside, adjacent to building)	12 uR/hr (aircraft display area; no aircraft surveyed)
Building 243 (2/17/99)	Not Taken	Not Taken	10 uR/hr (outside, adjacent to building)	60 uR/hr (outside surface of aircraft artifact display case)
Building 244 (2/17/99)	Not Taken	Not Taken	10 uR/hr (outside, adjacent to building)	>50 uR/hr (WW II aircraft cockpit, taken from outside)
Grounds adjacent to the museum (10/27/98)	9,000 cpm (general display area; away from aircraft)	400,000 cpm (MIG-15 jet cockpit taken from outside)	8 uR/hr (general display area; away from aircraft)	500 uR/hr (MIG-15 jet cockpit; taken from outside)
Building 295 (2/17/99)	8,000 cpm (outside, adjacent to building)	11,000 cpm (shop area of hangar)	Not Taken	Not Taken

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**Table 5-1
Informal Radiation Readings Recorded During Site Inspections**

<u>Location and Date Inspected</u>	<u>Approx. Back-ground (2" X 2")</u>	<u>Max. Reading (2" X 2")</u>	<u>Approx. Back-ground (micro-R)</u>	<u>Max. Reading (micro-R)</u>
Building 296 (3/17/98 and 5/11/99)	10,000 cpm (outside, adjacent to building)	14,600 cpm (shop areas; did not check IBIS)	10 uR/hr (outside, adjacent to building)	4,000 uR/hr (on contact with IBIS)
Building 297 (10/27/98)	8,000 cpm (outside, adjacent to building)	10,000 cpm (shop areas; did not check paradrogues)	10 uR/hr (outside, adjacent to building)	1,500 uR/hr (on contact with paradroge isolite)
Building 324 (10/27/98)	9,000 cpm (outside, adjacent to building)	10,000 cpm (inside work areas)	Not Taken	Not Taken
Building 326 (1/27/99)	12,000 cpm (outside, adjacent to building)	15,000 cpm (in work areas)	12 uR/hr (outside, adjacent to building)	14 uR/hr (in work areas)
Building 317 (1/27/99)	10,000 cpm (outside, adjacent to building)	13,000 cpm (in general warehouse area)	10.5 uR/hr (outside, adjacent to building)	13 uR/hr (in general warehouse area)
Building 318 (1/27/99)	11,000 cpm (outside, adjacent to building)	13,000 cpm (in general warehouse area)	11 uR/hr (outside, adjacent to building)	13 uR/hr (in general warehouse area)
Building 359 (1/27/99)	12,000 cpm (outside, adjacent to building)	14,500 cpm (in work areas)	13 uR/hr (outside, adjacent to building)	14.5 uR/hr (in work areas)
EOD Range – Site #1 (10/27/98 and 8/16/00)	8,000 cpm (area near entrance to range)	12,000 cpm (near access road in EOD range)	Not Taken	Not Taken
Perimeter Road Landfill - Site #5 (12/1/98 and 2/18/99)	8,000 cpm (area near golf course 5 th tee)	11,900 cpm (middle of landfill)	10 uR/hr (area near golf course 5 th tee)	13.6 uR/hr (middle of landfill)

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Table 5-1
Informal Radiation Readings Recorded During Site Inspections

<u>Location and Date Inspected</u>	<u>Approx. Back-ground (2" X 2")</u>	<u>Max. Reading (2" X 2")</u>	<u>Approx. Back-ground (micro-R)</u>	<u>Max. Reading (micro-R)</u>
Original Landfill – Site #3 (all surveys taken west of Agua Chinon Wash) (12/1/98, 2/18/99, 9/28/99 and 1/10/00)	16,000 cpm (just inside gate of construction yard; soil) 15,000 cpm (outside fence; soil on northwest side)	20,000 cpm (inside fence; crushed rock) 20,000 cpm (outside fence - northwest side; rocky soil)	18 uR/hr (just inside gate - west side; rocky surface) 16 uR/hr (outside fence - west side)	20 uR/hr (inside fence – northwest side) 20 uR/hr (outside fence northwest side – rocky soil)
DRMO Yd #1 (west side) (10/27/98, 9/28/99)	13,000 cpm (just outside gate to DRMO Yard)	17,000 cpm (inside DRMO yard near concrete)	10 uR/hr (just outside gate to DRMO Yard)	12 uR/hr (inside DRMO yard east end of fence)
DRMO Yd #1 (east side) (1/27/99)	13,000 cpm (near South Marine Way)	15,000 cpm (middle of yard; crushed rock)	Not Taken	Not Taken
Building 319 (12/2/98)	8,000 cpm (outside, adjacent to building)	10,000 cpm (inside general warehouse area)	Not taken	Not Taken
Building 360 (1/27/99)	10,000 cpm (outside, adjacent to building)	13,000 cpm (inside general warehouse area)	Not Taken	Not Taken
Building 21 (1/27/99)	13,000 cpm (outside, adjacent to building)	15,000 cpm (inside work area)	Not taken	Not Taken
Building 155 (6/14/99)	10,000 cpm (outside, adjacent to building)	12,600 cpm (inside building)	10 uR/hr (outside building)	12.5 uR/hr (inside building)
DRMO Yd #2 (2/17/99)	12,500 cpm (outside of DRMO yard near golf course)	13,200 cpm (adjacent to DRMO yard cyclone fence)	12 uR/hr (outside of DRMO yard near golf course)	15 uR/hr (adjacent to DRMO yard cyclone fence)
DRMO Yd #3 (2/17/99, 9/28/99)	12,500 cpm (outside of gate to DRMO yard)		14 uR/hr (outside of gate to DRMO yard)	15 uR/hr (inside DRMO yard near concrete)
Magazine Road	14,500 cpm (out-	19,000 cpm (in-	13 uR/hr (outside	19 uR/hr (inside

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**Table 5-1
Informal Radiation Readings Recorded During Site Inspections**

<u>Location and Date Inspected</u>	<u>Approx. Back-ground (2" X 2")</u>	<u>Max. Reading (2" X 2")</u>	<u>Approx. Back-ground (micro-R)</u>	<u>Max. Reading (micro-R)</u>
Landfill – Site #2 (8/16/99, 9/28/99)	side landfill main entrance)	side fence, near main entrance)	landfill main entrance)	fence, adjacent to main entrance)
Communication Station Landfill – Site #17 (8/16/99, 9/28/99)	16,500 cpm (northeast end) and 14,000 cpm (south end)	18,500 cpm (north end) and 16,000 cpm (south end)	14 uR/hr (north-east end of landfill)	15 uR/hr (north end)
Industrial Waste Treatment Plant -Site #12 (9/28/99)	13,000 cpm (soil east of site)	18,000 cpm (rocks in drainage ditch)	12 uR/hr (soil east of site)	16 uR/hr (middle of site)
Anomaly Area 3 – MSC R-1 (1/10/00)	Not Taken	Not Taken	13 uR/hr (parking lot near landfill)	16 uR/hr (near Agua Chinon Wash)
Former Radium Plaque Adapter Building (3/29/00)	Not Taken	Not Taken	10 uR/hr (soil outside fence around site)	12 uR/hour
Building 787 (3/29/00)	Not Taken	Not Taken	12 uR/hr (outside wall of building)	12 uR/hr
Building 1789 (3/29/00)	Not Taken	Not Taken	9 uR/hr (outside building)	10 uR/hr
Building 1803 (or 832-1) (3/29/00)	Not Taken	Not Taken	12 uR/hr (outside building)	13 uR/hr
APHO-38 (3/29/00)	Not Taken	Not Taken	9 uR/hr (ground near NBC buildings)	12 uR/hr
APHO-44 (3/29/00)	Not Taken	Not Taken	11 uR/hr (north of APHO)	13 uR/hr
APHO-46 (3/29/00)	Not Taken	Not Taken	11 uR/hr (north of APHO)	12 uR/hr

5.4.2.1 Information Leading to Investigation of Building 296 Radium Paint Room

During property inspection, radium (Ra-226) was one of the isotopes of concern, since drawings had indicated the possibility of a radium paint room in hangar 296 during the early years of MCAS El Toro. Radioluminescent dials and gages were historically in common use by the Navy and Marine Air Corps, as well as for civilian industrial applications. Ra-226 has a long half-life (~1,600 years), is a relatively high-energy-emitting radionuclide, has historically been generally available, and has not been regulated in the past.

The Draft BRAC Cleanup Report (BCP) issued in 1997 indicated the existence of a Radium Paint Room in building 296. The California Department of Toxic Substances Control (DTSC), Region 4 sent a letter dated April 21, 1997 to the MCAS El Toro BRAC Environmental Coordinator (BEC) and requested that the Department of Navy provide information regarding radiation issues at MCAS El Toro. The Orange County Division of Environmental Health also sent a letter dated May 8, 1997 to the California DTSC, Region 4, identifying concerns about the radiation issues, based on the MCAS El Toro BCP dated March 1997. The Orange County letter was responded to by the California DTSC in a letter dated June 10, 1997, wherein the DTSC agreed with Orange County's concerns. On June 10, 1997, the DTSC also sent a letter to the MCAS El Toro identifying Orange County's concerns about radiation issues that "may seriously conflict with health and safety issues, and the County's intended reuse plan."

On July 3, 1997, the United States Marine Corps (USMC) Headquarters, El Toro, sent a letter to the California DTSC, Region 4, indicating that an assessment of MCAS El Toro radiological hazards was being coordinated with Department of Navy subject-matter experts (Radiological Affairs Support Office). Consequently, on August 14, 1997, the USMC Headquarters, El Toro, sent a follow-up letter to the California DTSC stating that a contract would be issued by October 1997 for a radiological survey of buildings 296 and 297 at MCAS El Toro. In October 1997, a Project Order was provided to the SSPORTS Environmental Detachment by Naval Facilities Engineering Command (NAVFAC), Southwest Division. In November and December, 1997, the Survey Plan for buildings 296 and 297 was prepared by the SSPORTS Environmental Detachment and concurred to by the Radiological Affairs Support Office (RASO). In January 1998, SSPORTS commenced the radiological investigation of buildings 296 and 297. During the investigation, RASO visited the site to oversee the work being performed by SSPORTS. For additional information and details regarding the scope of the investigation at buildings 296 and 297 and the results, see paragraph 6.1.2.1 of this report in Section 6; History and Current Usage.

5.5 Personal Interviews

Interviews were conducted in 1991 and 1994 with 16 current and former El Toro employees regarding possible releases of hazardous materials on the base. The 1991 interview questions and answers are reported in paragraph 3.8 of the Installation

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Restoration Program Draft RCRA Facility Assessment Report, Volume III dated July 16, 1993 and contained no specific questions or answers regarding radiological releases on the base. In 1994, the interview panel was comprised of personnel from Naval Facilities Engineering Command, Southwest Division, MCAS El Toro, Bechtel National Inc., CH2M HILL, California DTSC and the RWQCB. A total of nine current and former employees [reported in Jacobs Engineering Group Inc., Project No. 01-F284-H6 dated June 27, 1994] were interviewed and the questions included queries on possible radiological material/waste dumping. The results of the radiological related information from the personnel interviews conducted in 1991 and 1994 are provided in Table 5-2. Twelve additional El Toro employee/retiree/tenant interviews were conducted during the preparation of this HRA. The results of the radiological related information from the 1998/1999 personnel interviews are reported in Table 5-3.

Throughout the 1998/1999 interviews pertaining to radioactive materials, there were no specific detailed descriptions of radiological work performed at MCAS El Toro. Most of the interviewees were asked whether they were aware of radioactive materials being disposed of anywhere on the Station; all replied in the negative. However, some interviewees did describe occurrences (e.g., aircraft parts in scrap yards, aircraft parts in landfills), that could have resulted in radioactive materials being located in areas such as the landfills and/or DRMO yards.

During inspection of the EOD Range, SSPORTS representatives questioned personnel stationed at the Range as to whether any nuclear or radioactive ordnance/materials were brought onto the site for handling and/or disposal. The EOD personnel responded in the negative, stating that the site was not authorized to handle nuclear/radiological materials.

5.5.1 Conclusions Reached from Interviews

Interview results and tours of various buildings/facilities provided no specific instances where general radioactive materials (G-RAM) were known to have been discarded at MCAS El Toro. Additionally, the interviews failed to provide any confirmation as to the exact years during which the former radium room in building 296 was actually used for work on instrumentation containing radium. However, there were several instances observed and reported where radiological materials were present at the Station. Examples include pipe, ventilation ducting, floors and walls in and adjacent to the former radium room in building 296, radioactive aircraft components in buildings 295, 296 and 297, and areas in and adjacent to the Command Air Museum located in buildings 242, 243 and 244 (See Section 6 of this HRA).

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Table 5-2

Results of Personnel Interviews Conducted in 1991

Personnel Interviewed and Date of Interview	Interviewer(s) and Radiological Related Questions Asked	Results of the Interview
<p>Total of nine employees; seven active (average length of service ~9 years) and two retired (average length of service ~42 years).</p> <p>The nine people were interviewed individually in March & April 1991.</p>	<p>Interviews were conducted by Naval Facilities Engineering Command Southwest Division Personnel with Jacobs Engineering Group, Inc. and CH2M HILL.</p> <p>1. The questions concerning Building 296 (radium paint room building) pertained only to metal plating waste operations.</p> <p>Note: NAVFAC Drawing 6314058, sheets 23 and 28 shows five industrial sewer connections from building 296 (plating facility) into the industrial sewer system. Since this system was piped separately from the sanitary sewer system, it is possible that radium paint room waste could have been disposed of into this industrial wastewater system.</p>	<p>1. It was noted that the separate, independent sewer system was installed to collect metal plating waste. The Industrial Waste Treatment Plant operated from the 1940s to 1965.</p>

Results of Personnel Interviews Conducted in 1994

Personnel Interviewed and Date of Interview	Interviewer(s) and Radiological Related Questions Asked	Results of the Interview
<p>Total of nine employees; five active (average length of service ~12 years) and four retired (average length of service ~32 years).</p> <p>Note: Two of the retirees were also interviewed in 1991.</p> <p>The nine people were interviewed as a group in May 1994.</p>	<p>Interviews were conducted by a panel comprised of Naval Facilities Engineering Command, Southwest Division, MCAS El Toro, Bechtel National Inc., CH2M HILL, California DTSC and the RWQCB.</p> <p>1. Questions were asked regarding the possibility of radioactive material/waste disposal in Landfills (RI/FS Sites 2, 3 and 5).</p> <p>2. A question was also asked regarding storage activities at the DRMO Yard (RI/FS Site 8) possibly impacting groundwater.</p>	<p>1. Although there was no direct knowledge of radioactive material disposed of into any landfills, interviewees indicated that it is possible that equipment painted with radium paint could have been disposed of into the landfills by the Marines.</p> <p>2. It was thought that Marines could have stored small quantities of radium painted parts and gauges at the DRMO Yard; since it was a regional storage yard.</p>

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Table 5-3
Results of Personnel Interviews Conducted in 1998/1999

Personnel Interviewed and Date of Interview	Interviewer(s) and Radiological Related Questions Asked	Results of the Interview
<p>MCAS El Toro active employee - John Aguilar; Pipefitter/Planner and Estimator (24 years at El Toro).</p> <p>Interviewed on October 28, 1998</p>	<p>Interviewed by three representatives from Supervisor of Shipbuilding, Portsmouth, VA (SSPORTS) Environmental Detachment; Vallejo, CA.</p> <p>1. Are you aware of any aircraft (older planes and helicopters utilized radium dials and gages) that were buried in any of the Station landfills?</p> <p>2. Have there been aircraft crashes at El Toro and where would the wreckage be disposed of?</p> <p>3. Are you aware of any place on the Station where radioactive materials might have been received or shipped?</p> <p>4. Do you believe that any radioactive materials were disposed of at the EOD Range at the north end of the Station?</p> <p>5. Who might know if radioactive material was dumped into a landfill at MCAS El Toro?</p>	<p>1. In 1965, prior to being employed at El Toro, he witnessed aircraft parts being bulldozed into the Perimeter Rd. Landfill. The remnants were from a crash of a military Boeing 707 into a hill.</p> <p>2. Yes; there have been crashes. Up until about 20 years ago, wreckage would have gone into the landfills, but now it is taken off base.</p> <p>3. No. The Preservation Building 359; was the supply building where essentially all items were received, accumulated, packaged and shipped.</p> <p>4. No. Since he started working at the Station, the EOD Range has not been used for dumping.</p> <p>5. MCAS production workers & truck drivers</p>
<p>MCAS El Toro active employee - Jan Ferguson; Facilities Management Department (FMD) (34 years at El Toro).</p> <p>Interviewed on December 1, 1998</p>	<p>Two representatives from SSSPORTS Environmental Detachment, Vallejo, CA</p> <p>1. Do you know if there are any records that might give the date when the building 296 radium paint room was decommissioned?</p>	<p>1. If the work was done after 1962 by MCAS FMD or a contractor, there would be a work order card in the files. Since there is no card, the work was either performed before 1962 or by the USMC.</p>

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Table 5-3
Results of Personnel Interviews Conducted in 1998/1999
(Continued)

Personnel Interviewed and Date of Interview	Interviewer(s) and Radiological Related Questions Asked	Results of the Interview
<p>MCAS El Toro retirees - Jake Kormos and Bob Aguilar (46 years and 25 years at El Toro respectively).</p> <p>Interviewed on December 1, 1998</p>	<p>Interviewed by two representatives from SSPORTS Environmental Detachment; Vallejo, CA.</p> <ol style="list-style-type: none"> 1. Were you aware of the radium paint room in building 296 at El Toro? 2. Do you know when the radium paint room in building 296 was decommissioned? 3. How would the scrap from the decommissioning of the radium paint room have been disposed of? 4. Were there any other radium paint facilities or licensed radiological work facilities that you were aware of at El Toro? 5. Were you aware of radioactive materials being disposed of in any landfills; Magazine Rd. (Site 2) Original Landfill (Site 3) or Perimeter Rd.(Site 5)? 6. Do you know if the landfills were limited as to what could be disposed of in them? 7. Are you aware of any radiography work for non-destructive testing performed at the Station, utilizing licensed radioactive sources, such as iridium-192 or cobalt-60? 8. As Station employees, did you get involved with the receipt, maintenance or disposal of radioactive components associated with aircraft; such as, In-flight Blade Inspection Systems (IBISs), ice detector units or paradrogues? 	<ol style="list-style-type: none"> 1. Yes; also aware of Public Works construction work performed on the room. 2. No; it may have been done by Marines occupying the building. 3. Debris may have been loaded on a MCAS garbage truck and taken to an active landfill on Station. 4. Not aware of any other radiological paint or work facilities. 5. No; however, aircraft parts were disposed of in Sites 3 and 5. 6. No. Kormos recalled the excavation at Original Landfill. When the Flight Simulator building was being built, excavation was deep (about 20 feet). He saw metal scrap and at least one vehicle pulled out of the pit. 7. No; however, x-ray work was performed for non-destructive testing (no radiological license required). 8. No; those were apparently always handled by the Marines.

Table 5-3
Results of Personnel Interviews Conducted in 1998/1999
(Continued)

Personnel Interviewed and Date of Interview	Interviewer(s) and Radiological Related Questions Asked	Results of the Interview
<p>MCAS El Toro active employee - Lee Amador; Pipefitter/Planner and Estimator (26 years at El Toro)</p> <p>Interviewed on January 26, 1999</p>	<p>Interviewed by one representative from SSPORTS Environmental Detachment, Vallejo, CA</p> <ol style="list-style-type: none"> 1. Do you know about the Radium paint Room in building 296 at El Toro? 2. Are you aware of an instrument calibration facility (radioactive instruments may have been worked at such a facility)? 3. Are you aware of a radiography facility where non-destructive testing may have been performed? 4. Do you recall any aircraft accidents on Station? 5. Did El Toro disassemble aircraft as part of its mission? Were aircraft parts dumped in landfills? 6. Were civilian workers involved with radioactive components (IBIS, paratrogues, etc.) on aircraft? 	<ol style="list-style-type: none"> 1. Only since the recent rad removal work was performed. 2. Not at El Toro. The Navy Calibration Lab at Tustin was used for calibration; not aware of radioactive work. 3. No. 4. No; only a helicopter accident at Tustin in the 1980s (Discuss with Tom Leary) 5. No disassembly. Not to my knowledge. 6. Not to my knowledge.
<p>MCAS El Toro active employees - Joe Saenz; Plumber/Planner and Estimator (26 years at El Toro) & Doug Campbell; Electrician/Planner and Estimator (26 years at El Toro)</p> <p>Interviewed together on January 26, 1999</p>	<ol style="list-style-type: none"> 1. Were you aware of the radium Paint Room in Building 296? 2. Do you know of any other radiological work performed at MCAS El Toro? 3. Do you know of any aircraft accidents at MCAS El Toro? 4. Where was scrap from the aircraft accidents taken for disposal? 	<ol style="list-style-type: none"> 1. Only recently, by word of mouth. 2. No. 3. Yes. An F-4 (see Note 5.1) flipped over after landing about 1973. An A-4 (see Note 5.2) crashed about 1974, sending debris onto Perimeter Road. 4. They believe that scrap was saved for investigation, then shipped off Station for disposal.

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Table 5-3
Results of Personnel Interviews Conducted in 1998/1999
(Continued)

Personnel Interviewed and Date of Interview	Interviewer(s) and Radiological Related Questions Asked	Results of the Interview
<p>MCAS El Toro active employee - Tom Leary; Laborer/Waste Management (has worked at both El Toro and Tustin for a total of 26 years)</p> <p>Interviewed on January 27, 1999</p>	<p>Interviewed by one representative from SSPORTS Environmental Detachment, Vallejo, CA</p> <p>1. Do you recall aircraft accidents at Tustin and/or El Toro?</p> <p>2. Do you know what happened to the scrap metal from the wreckage after the aircraft crashes?</p>	<p>1. Mr. Leary was personally involved in the rescue effort after a helicopter crash at Tustin in 1985. He believes that the aircraft was a Sikorsky CH-46 (first built in early 1960s). He is aware of other aircraft crashes at El Toro, but doesn't have details because he was not directly involved.</p> <p>2. There is scrap metal (aircraft wreckage) currently located at DRMO Yard #3 at El Toro. He believes that there is scrap metal from more than one aircraft in the yard and he believes that some of the wreckage has been there for several years.</p>
<p>MCAS El Toro active employee (military) - Major Jeff Matthews, USMC; Environmental Engineering Officer; assigned to the El Toro/Tustin Complex for past 12 years.</p> <p>Interviewed on February 17, 1999</p>	<p>1. Are the U.S. Marine Corps and civilian tenants of MCAS El Toro required to provide certification to the Environmental Engineering Office that no hazardous materials remain in their vacated building upon departure?</p> <p>2. From your experience at MCAF Tustin, do you know why radioactive ice detectors and instruments were left by departing Marine Air Logistic Squadron (MALS)?</p> <p>3. If similar radioactive material is proposed to be left at El Toro by departing Marine Air Groups, will the Station accept them?</p>	<p>1. No. The process of closing buildings at El Toro should preclude the tenant from leaving hazardous materials.</p> <p>2. I believe that the Tustin environmental group agreed to dispose of the items for the USMC.</p> <p>3. No. The departing activity will be required to remove the items.</p>

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Table 5-3
Results of Personnel Interviews Conducted in 1998/1999
(Continued)

Personnel Interviewed and Date of Interview	Interviewer(s) and Radiological Related Questions Asked	Results of the Interview
<p>MCAS El Toro active employee (military) - Lieutenant Colonel Roberts, USMC; Officer-in-Charge, Facilities Coordination (FACO) (has worked off-and-on at Tustin and El Toro since 1988).</p> <p>Interviewed on February 17 and 18, 1999</p>	<p>Interviewed by two representatives from SSPORTS Environmental Detachment; Vallejo, CA</p> <ol style="list-style-type: none"> 1. Do the tenants at MCAS El Toro provide the Facilities Management Department with certification, upon departure, that their vacated building is free of hazardous materials? 2. What is the process to turnover the facilities with assurance that hazardous materials are not present? 3. Who ensures that any hazardous materials are removed from the facility? 4. Does the inspection team which completes the Layaway Inspection Sheet ever include a representative responsible to check for evidence of radioactive materials (e.g., radiation signs, radioactive material tri-foil markers, etc)? 5. Are you aware that buildings 243, 295, 296 and 297, either in the past, or currently are known to contain radioactive material and therefore, need to be inspected for such material during turnover and surveyed when vacated, to ensure that no radioactive material remains? 	<ol style="list-style-type: none"> 1. No. The process for turnover of the facilities is designed to check for hazardous materials. 2. The Facility Closure Standard Operating Procedure uses a Layaway Inspection sheet which includes Environmental Inspection. 3. The tenant; however, if something is missed, the Station is responsible to dispose of the material. 4. No. Currently, the only specialized group, outside of the eleven "attendees" listed on the Layaway Inspection Sheet, is the Explosive Ordnance Disposal Unit, which attends when invited. 5. No. Who will do the inspection and surveys? (Note: Inspections and surveys can be accomplished by any qualified entity as determined by RASO/EFA SWDiv. A release report will be issued for the affected buildings when complete)

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Table 5-3
Results of Personnel Interviews conducted in 1998/1999
(Continued)

Personnel Interviewed and Date of Interview	Interviewer(s) and Radiological Related Questions asked	Results of the Interview
<p>MCAS El Toro current tenant (military) - Warrant Officer McGowen, USMC; Marine Air Group-46 Reserve Unit (first assigned to MCAS El Toro in the early 1960s and has served off-and-on at El Toro since that time).</p> <p>Interviewed on February 17, 1999</p>	<p>Interviewed by two representatives from SSPORTS Environmental Detachment, Vallejo, CA</p> <p>1. Aside from the aircraft equipped with radioactive components, which underwent repair in hangar 295, are you aware any other radiological work being performed?</p> <p>2. Why was this procedure used on these radioactive components?</p>	<p>1. Yes. In the 1960s, magnetron electronic tubes, containing various radioisotopes, were physically destroyed by crushing; after which, the debris was swept up and deposited into a dumpster (see Note 5.3).</p> <p>2. This was the approved method of disposing of magnetron electron tubes.</p>
<p>MCAS El Toro current tenant (retired military) - Retired Colonel O'Hara, USMC; Chairman of the El Toro Historical Foundation.</p> <p>Interviewed on February 17 and 18, 1999</p>	<p>1. Many historic aircraft contain radioactive instrumentation and markers. When will all of the historic aircraft be transferred off site and where will they go?</p> <p>2. Will the radioactive components (gages and dials) located in the display cases in building 243 be transferred with the historic aircraft?</p> <p>3. Who will disassemble the aircraft, transport the parts and reassemble the aircraft at MCAS Miramar?</p> <p>4. Does the museum own the historic aircraft and aircraft artifacts?</p> <p>5. There are two inactive F-4 jet fighters and one helicopter located outside of the museum property at El Toro (at MAG-16 Ordnance, near building 1803 and at building 435 on South 9th St.). Will these historic aircraft also be taken to Miramar?</p>	<p>1. All will be moved by July 2, 1999 to MCAS Miramar.</p> <p>2. Yes. All artifacts will be taken to the new museum at Miramar.</p> <p>3. A contractor (same as moved the Spruce Goose from Long Beach to Washington). One aircraft was already relocated without disassembly.</p> <p>4. No. All USMC historic aircraft belong to the USMC Quantico, VA and all US Navy aircraft belong to NAS Pensacola, FL.</p> <p>5. Yes. They are not officially part of the museum, but are on the list of historic aircraft that will be moved.</p>

Notes (Table 5-3):

- 5.1 The F-4 is a fixed wing aircraft, which contains the following radioactive parts and/or equipment:
Thoriated (Th-232)-magnesium engine parts and rain removal nozzle
Tritium (H-3) in the standby compass
Cesium (Cs-137) in the engine exciter.
Depleted uranium (DU) in counterweights
- 5.2 The A-4 is a fixed wing aircraft which contains the following radioactive parts and/or equipment:
Depleted uranium (DU) in the forward and aft bobweights
Krypton (Kr-85) in the drogue refueling tank light
Tritium (H-3) in the standby compass
- 5.3 Area where magnetron electronic tubes were crushed was known to be located just outside the south wall of the building. It is suspected that similar work may have been accomplished inside of the building in the first floor shops located along the south wall (i.e., metal shop, hydraulics room and avionics).

6. HISTORY AND CURRENT USAGE

6.1 History

6.1.1 Type of Facility

In July 1942, construction of a U.S. Marine Corps (USMC) pilots' fleet operational training facility began on approximately 2,320 acres in Orange County, California. On March 17, 1943, that facility was commissioned as MCAS El Toro. In 1950, MCAS El Toro was selected for development as a master jet air station and permanent center for Marine aviation on the West coast to support the operations and combat readiness of Fleet Marine Forces, Pacific.

6.1.2 Description of Operations

Between 1944 and 1988, land was acquired to bring MCAS El Toro to its present size of approximately 4,740 acres. The following is a listing of land acquisitions for MCAS El Toro:

- 1942 - 2,319 acres acquired under the authority of an Act of Congress
- 1945 - 22 acres acquired under the authority of an Act of Congress
- 1952 - 161 acres acquired by a Grant Deed from the El Toro Development Co., Inc.
- 1953 - 1403 acres acquired pursuant to a Declaration of Taking filed in the U.S. District Court for the Southern District of California
- 1972 - 87 acres acquired by exchange from the Irvine Company
- 1976 - 729 acres acquired by exchange from the Irvine Company
- 1986 - 18 acres acquired by purchase from the Irvine Company

The Station was in operation for 56 years. According to the MCAS El Toro Organizational Manual, the mission of MCAS El Toro was "to maintain and operate facilities and provide services and materials to support the operation of aviation activities and units of the operating forces of the Marine Corps, Navy, and other activities as designated by the Commandant of the Marine Corps (CMC), in coordination with the Chief of Naval Operations (CNO)". Generation of hazardous waste has resulted from operations at the following locations:

- Aircraft maintenance hangars and support buildings
- Maintenance shops
- Auto repair station and steam cleaning facilities
- Hazardous and chemical materials storage
- Aircraft fueling stations, dispensing systems and fuel farms

Previous operations, no longer in existence at MCAS El Toro, but that were significant in past waste generation and disposal include the following:

- Work was performed on instruments containing radium in building 296 and metal plating was performed in building 296 and 297.
- Sewage treatment plant (IR Site #12) received waste water (1943 to 1972) from metal plating operations
- Incinerator operated between 1943 and 1955 to reduce waste volume; ash was disposed in the Original landfill (IR Site #3) which was located on a 20 acre tract. The incinerator was located at the north west corner of the landfill. Any type of waste generated (metals, paint, etc.) at El Toro during this time was disposed at this landfill (approximately 12 acres and 243,000 cubic yards maximum volume). This landfill was identified by former employees as having received aircraft parts.
- The Perimeter Road landfill (IR Site #5) was used for many types of waste generated (scrap metal, paint residue, etc.) at El Toro from 1955 to the late 1960s (approximately 1.8 acres and 60,000 cubic yards maximum volume). This landfill was identified by former employees as having received aircraft parts.
- The Magazine Road landfill (IR Site #2) received the solid wastes generated (metals, paint, etc.) at El Toro from late 1960s to 1980 and some waste from MCAF Tustin (approximately 27 acres; estimated volume of 800,000 to one million cubic yards).
- The Explosive Ordnance Disposal (EOD) Range (IR Site #1) contained two 100 feet diameter pits used in 1982 for acid barrel disposal. There is an unsubstantiated report that low level radioactive waste may have been disposed of in the EOD Range.[Ref. 6]
- The Communications landfill (IR Site #17) received waste from the Base from 1981 to 1983.
- The Defense Reutilization and Marketing Office (DRMO) Storage Yard (IR Site #8), since early years of El Toro, served as storage area for mechanical and electrical components and containerized liquids.
- The DRMO Storage Yards #2 (SWMU #46) and #3 (SWMU #264) were in operation since the 1950s.
- Anomaly Area #3 (MSC R1) is located near Wherry Housing north of Irvine Boulevard. The first ground disturbances were observed at the site in 1946.

[Refs. 1, 3, 5, 6, 17, 18, 38 and 39]

Figure 6-1 is a map of MCAS El Toro showing the locations of the EOD Range (Site #1), landfills (Sites #2, #3, #5 and #17), DRMO Yard #1 (Site #8), and the location of the former Industrial Waste Treatment Plant (Site #12); each of which is included in the Installation Restoration Program for the Station. Also, the approximate locations of Anomaly Area #3 and Surface Impoundments (APHO - 38, 44 and 46) are shown in Figure 6-1.

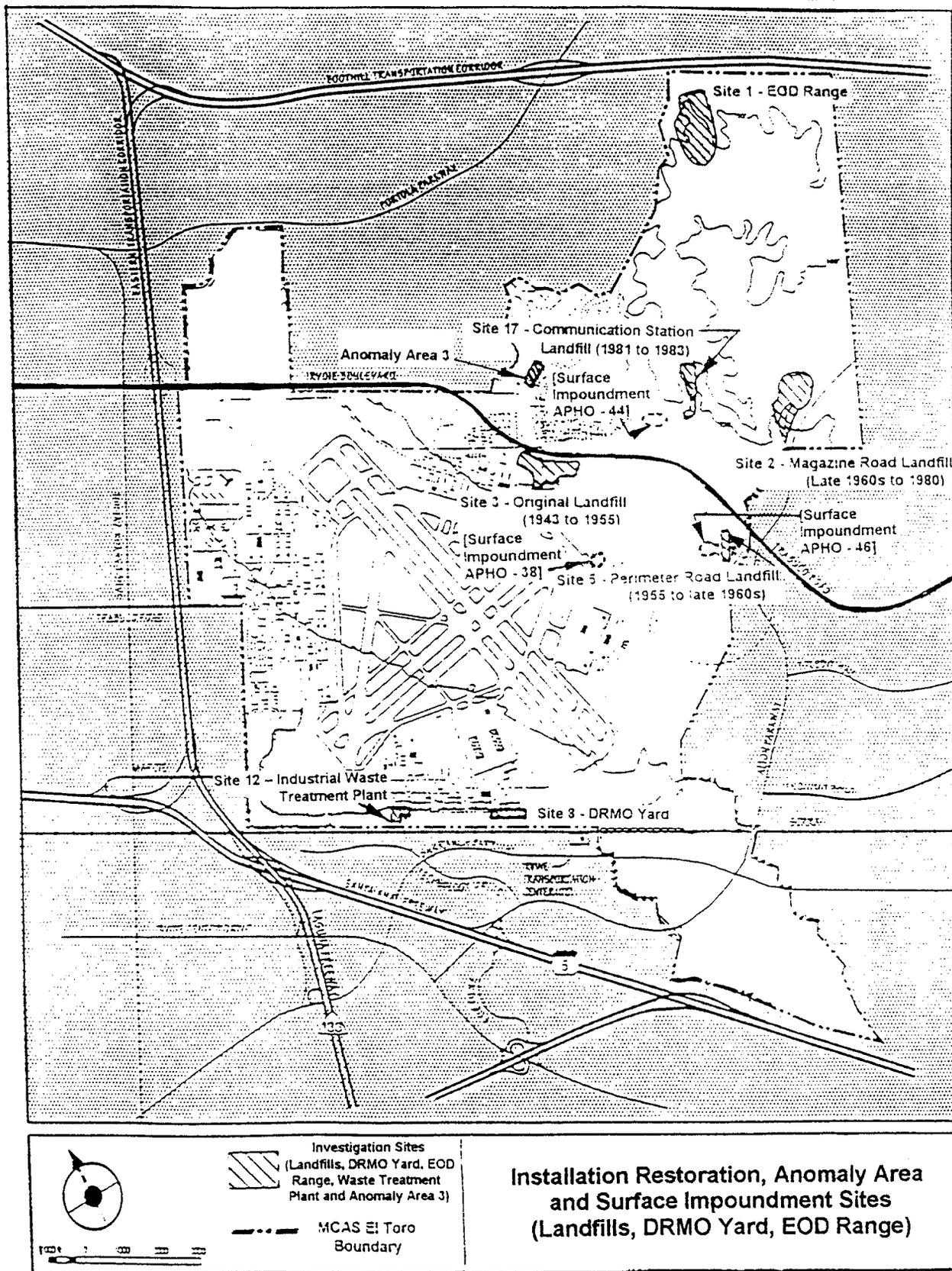
Figure 6-2 shows the locations of DRMO Yards #2 (SWMU #46) and #3 (SWMU #264) which are not in the IR program.

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Landfills have been used for disposal of a variety of waste materials on the Station until the early 1990s and the DRMO yards have been used for handling and storage of various materials since the early years of the Station. In June 1999, DRMO Yards #1, #2 and #3 were clear of all materials.

The potentially impacted areas, described in paragraph 7.2, are shown on detailed maps in Appendix A. Landfills (Sites #2, #3, #5 and #17), DRMO Yards #1 and #3, and EOD Range (Site #1) are also shown in historical aerial photographs in Appendix C.

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**Figure 6-1
Installation Restoration, Anomaly Area and Surface Impoundment Sites**

6.1.2.1 Aircraft Work Involving Radium Paint (Beginning in mid-1940s)

According to a Station drawing (Y. & D. Drawing No. 311465, sheet 10) dated 30 May 1944, a radium paint room was under construction on the mezzanine floor in the northeast corner of building 296 when it was being built in 1944. Aircraft refurbishing operations in building 296 commenced in April 1949 and ended in October 1950. There has been no documentation or comments indicating dial refurbishment in building 297. Historical records indicate that building 296 was put into operation for routine maintenance in June 1945. [Ref. 16]

A Bureau of Aeronautics (BuAer) document dated June 7, 1945, requested MCAS El Toro to procure quotations for radium paint shop equipment installation. However, in late 1946, the Assembly and Repair (A&R) Department in building 296, which would perform this type of work, was closed altogether. The Navy Department BuAer Technical Order No. 7-48, dated 15 March 1948, designated the Naval and Marine Air Stations authorized to handle radioactive luminous compounds, and it did not include MCAS El Toro. [Refs. 20 and 21]

Commanding Officer (CO) 11th Naval District correspondence of August 11, 1948 discussed reactivation of the Overhaul and Repair (O&R) Department at MCAS El Toro. A letter from the CO to the Chief of BuAer dated September 3, 1948 requested an increase in allotment to support this reactivation. Correspondence between October 1948 and March 1949 discussed equipment and funding required for the new O&R Department. This included MCAS El Toro Public Works Drawing No. WO 3160, dated 12 January 1949, which provided details for the construction of "Radium Room Exhaust Ducts" connecting from an overhead mounted exhaust fan into work stations in the radium room, located in the Instrument Shop of building 296. On March 21, 1949 a letter was sent from the CO, MCAS El Toro to Chief BuAer listing 82 items of material required for the Instrument Shop in building 296, which specified that an item listed as "fluorescent paint, O.P." was "cancelled, returned for review for standard stock". [Refs. 22 through 29]

The MCAS El Toro "Organization Manual of the Overhaul and Repair Department", dated April 18, 1949, indicated that the Graphic Arts Shop had the responsibility for operating equipment necessary to refinish luminous dials. However, the extent of work conducted by the shop was limited to that authorized by the BuAer. The Manual also designated the Instrument Shop (same Branch as the Graphic Arts Shop) as responsible to disassemble, clean, repair, overhaul, modify, calibrate and test aircraft instruments. [Ref. 30]

Correspondence sent to the Chief BuAer in May and June 1949 discussed funding and installation of alterations for the Master Gauge Room and Graphics Arts Shop in building 296. A historical summary for the period from January 1 to June 30, 1949 indicated that the O&R Department was a major department on the station for the overhaul, repair, modification, salvage and test of aircraft accessories and other related naval aeronautical equipment as directed by the Bureau of Aeronautics. [Refs. 31, 32 and 33]

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Correspondence dated September 14, 1949 from the Secretary of Navy to United States Senator McCarran discussed the inactivation of the O&R Department at MCAS El Toro. A letter dated September 22, 1949 from Chief BuAer to Commanding Officer MCAS El Toro indicated; "In view of scheduled deactivation of the Overhaul and Repair Department by December 31, 1949, no action on the request (installation of Master Gauge Room and Graphic Arts Shop in the building 296) will be taken by BuAer." [Refs. 34, 35]

On February 24, 1950, a BuAer message was issued requiring; "Discontinue immediately application of radioactive paint on all air craft instrument dials." The message also indicated that "Instrument is suitable for use until depletion of present RFI stocks of instruments having radioactive graduations." On October 6, 1950, a report issued by MCAS El Toro indicated that all O&R activities in building 296 had been secured. [Refs. 36, 37]

In 1998, very low levels of Ra-226 were found in the piping, ventilation and surfaces of the radium room in building 296. Based on these findings, it may be concluded that, during the short periods of time in the 1940s when A&R and O&R work was performed, rather than equipment being painted in the room, the facility was used only for cleaning and refurbishment of equipment which had previously been painted using Ra-226 paint. During the cleaning and refurbishment process, utilizing solvents, small amounts of Ra-226 paint could have been removed, resulting in the low levels of contamination found compared to the higher levels expected if Ra-226 paint were used in liquid form.

In late 1998, a search was made of the MCAS El Toro Facility Maintenance Department Public Works records (drawings and work orders) for building 296, with particular emphasis on records from the 1950s and 1960s. No records could be found regarding the decommissioning of the hangar 296 radium facility. Parts of the ducting shown on the 1949 Public Works drawings were removed by SSPORTS radiological personnel in 1998 during the radiological investigation described in paragraph 6.1.2.1.1 below.

The Navy initiated actions in the early 1960s to discontinue the use of radium paint for luminescence on military equipment altogether. A 1967 drawing for building 296 shows the radium room area being utilized as a computer center, which would indicate that the room was decommissioned and dismantled prior to the mid-1960s. During performance of remediation work in 1998 (see paragraph 6.1.2.1.1), SSPORTS radiological personnel noted evidence of previous dismantlement of the radium facility, including partially removed ventilation ducting and sewage piping, as well as areas on the walls and floors where ducting and piping had been removed.

As stated above, further evidence of the existence of a former active radium facility at MCAS El Toro, was obtained during the remediation performed in early 1998. Small quantities of radioisotope Ra-226, with levels slightly higher than the release limits were found and removed from the concrete floor in the south wall of the radium room, as well as, in the remaining ventilation ducting located above the radium room and in the sewage piping located below the floor of the radium room. The contaminated ducting and piping, along with flooring materials, were removed and disposed of as radioactive waste.

The disposal method and disposal site for the dismantled radium room equipment, removed ventilation ducting, sewage piping and wall and floor debris from the original radium room decommissioning is unknown. However, from 1943 to 1955, Landfill Site #3 (Original Landfill) was in operation and, from 1955 to the late 1960s, Landfill Site #5 (Perimeter Road) was in operation at the Station. The LAS dated May 1986 indicates that almost any type of waste generated on the station during that time may have been disposed of in these landfills; including scrap metals, solid waste, paint residue and other materials. Although there are no official records or direct knowledge of radioactive materials being dumped at Landfills #3 or #5, during employee interviews conducted in 1994, some interviewees indicated that; "Since the landfills were not under 24 hour surveillance, it is possible that equipment painted with radium paint could have been disposed of into the landfills by the Marines." [Ref. 6]

6.1.2.1.1 Investigation of Buildings 296 Performed in 1998

SSPORTS radiological personnel performed the following in accordance with the Radiological Survey Plan – Hangar 296 and 297, MCAS El Toro, dated April 1998:

1. A visual inspection of the radium room complex and adjacent areas was made and compared to the 1944 MCAS El Toro Public Works drawing number 311465, sheet 10 and 1949 Public Works drawing number WO 3160. Most of the complex rooms and portions of remaining ventilation ducts and sewer piping (plumbing) were located as shown on the Public Works drawings. This provided confirmation that the complex containing the radium room was built and existed at some time in the past.
2. The floors of the radium room complex and six feet up on the walls were grid marked. Gamma radiation surveys were conducted using 3"X 3" sodium iodide detectors and a micro-R meter on the floors and 2"X 2" sodium iodide detectors on the walls. All radiation levels in the areas surveyed were within the normal background variation, except for a portion of the floor and a lower area of the south wall, where the maximum gamma reading exceeded twice the background levels. This area was marked, remediated and the debris was disposed of as radioactive waste.
3. Alpha and beta radiation surveys were performed in the gridded areas described in 2 above using an alpha-beta scintillation counter. All alpha levels were within the requirements of the Nuclear Regulatory Guide 1.86 fixed limit for Ra-226 of 300 dpm/100 cm², except for a portion of the floor in the south wall where a maximum level of 454 dpm/100 cm² was found. This area was marked, remediated and the debris was disposed of as radioactive waste. All beta levels were within the investigation criteria established for hangar 296.
4. Gamma radiation surveys were performed, using 2"X 2" sodium iodide detectors, on the outside of the plumbing system piping connected to the radium room complex. Several areas on the outside of the piping contained gamma levels that were three times the background levels. These areas were marked, the pipe was removed and disposed of as radioactive waste.

5. Alpha radiation surveys inside the ventilation system ducting exiting the radium room, indicated several areas slightly above the Nuclear Regulatory Guide 1.86 removable limit of 20 dpm/100 cm². The ventilation was marked, removed and disposed of as radioactive waste.

6. The above areas were remediated to within gamma background variation levels and to below the Nuclear Regulatory Guide 1.86 removable limit for radium. Portions of the south floor and wall, more than 100 linear feet of sewer piping and approximately 40 feet of ventilation ducting was removed. Approximately 10 square feet total (wall and flooring) was removed. After completion of remediation, results of all surveys of the remaining areas were within the gamma background variations and less than the Nuclear Regulatory Guide 1.86 removable limit for Ra-226.

7. The surrounding areas adjacent to the radium room complex were gridded. Gamma and alpha radiation surveys were performed in these areas. Surveys included the elevator and stairway leading down from the mezzanine. All gamma levels were within background variations. No alpha levels above the Nuclear Regulatory Guide 1.86 removable limits for Ra-226 were detected.

8. A walkthrough gamma survey of the remainder of the building covering each open space, shop area, and office space in the building. All gamma levels were within the background variations.

6.1.2.1.2 Investigation of Building 297 Performed in 1998

SSPORTS radiological personnel performed the following:

1. A walk-through gamma survey, utilizing 3"X 3" sodium iodide and micro-R meter, of the entire building including each open space, shop area and office space, resulted in gamma levels equivalent to background.

6.1.2.2 Station Operations Requiring Photodosimetry Program (Mid-1950s)

In 1953, a letter was written from the Medical Officer, MCAS El Toro providing the Annual Photodosimetry Report for seven personnel to the Chief, Bureau of Medicine and Surgery (BUMED). This letter, Serial 204-75, dated 9 January 1953, provides evidence that operations requiring monitoring of radiation exposure of personnel were conducted at El Toro in the early to mid-1950s. A search of Station records and discussion with MCAS employees revealed that the personnel involved in these operations were all in the military medical corps and would have been involved with medical x-rays. Each of the seven individuals in the program received less than 10 milliroentgens for the year 1952.

MCAS El Toro has had dental/medical offices that used x-ray machines. In the early years of the Station, these facilities were located in building 64 (dispensary), which has been demolished. In 1959, building 439, which also had x-ray machines, was built to house the medical/dental clinic.

6.1.2.3 Radium Plaque Adaptometer Building

6.1.2.3 Radium Plaque Adaptometer Building

Records from 1944 show that a Radium Plaque Adaptometer (RPA) building may have existed, as part of the dispensary. This building would have been used for testing the night vision of USMC personnel. The only radioactive equipment used in a RPA facility was a metal disc approximately 8 inches in diameter, coated with a radium/phosphor compound encapsulated in transparent plastic. During night vision testing, the disc was rotated, while being viewed by the examinee, as a check for the person's ability to see at night. Available information indicates that this type of night vision testing was discontinued in 1951.

It cannot be determined whether the RPA building was actually constructed at El Toro, since there was no building number assigned, no construction drawings and no evidence of a building (foundation, disturbed soil, etc.) in the location where an unnumbered sketch shows the footprint of such a building.

However, since records do show a facility footprint, it is recommended that radiation surveys be performed at the footprint of the site to ensure that no residual radioactivity remains.

6.1.2.4 Nuclear, Biological and Chemical Training Buildings

A Nuclear Biological and Chemical Defense (NBCD) group existed on the Station since the 1950s. As the name implies, this group was likely tasked with training station personnel to be prepared in the event of nuclear, biological and/or chemical weapons attack. About 1959, building 1789 was constructed containing a small (4' X 6' area) concrete structure inside, reportedly for the storage of non-licensed, radioactive sources. The concrete structure has now been demolished, but building 1789 is intact. It is not known which type(s) of radioactive sources were stored inside the concrete structure, however, former NBCD personnel stated that one instrument, known to have been used in the area is an AN/PDR-27, which measures gamma radiation. Recent informal readings utilizing gamma, alpha and beta measuring equipment did not reveal any elevated levels of radioactivity.

Located to the northwest of building 1789, there are several surface impoundments (APHO-38). There are no formal records that indicate whether these impoundments were associated with the NBCD training operations.

In addition to building 1789, after the 1950s, buildings 787 and 1803 were constructed to support the NBC effort on the Station. These buildings housed the NBCD training facilities. Based upon the available records, these buildings were utilized as offices, training/instruction areas, and training group storage areas.

Based on the above information, the NBCD buildings and surface impoundments adjacent to the buildings are recommended to be surveyed for radioactivity. [Ref. 42]

6.1.3 Regulatory Involvement

6.1.3.1 Regulatory Oversight

The Navy's Radiological Affairs Support Program (RASP) is the vehicle used by the Commander Naval Sea Systems Command (NAVSEA) to discharge the responsibility for radiological controls at MCAS El Toro. Technical support, to include radiological assistance, program review, coordination of Navy Radioactive Materials Permits, radiation safety training, and inspection of radiation safety programs, is provided by the Naval Sea Systems Command Detachment, Radiological Affairs Support Office (NAVSEADET RASO), Yorktown, VA. This oversight provides assurance that G-RAM devices are satisfactorily dispositioned when the Station is closed.

6.1.3.2 Naval Radiation Safety Committee (NRSC)

The NRSC, acting for the Chief of Naval Operations, manages the Navy's Master Materials License. The Navy has been delegated by the Nuclear Regulatory Commission (NRC), through the issuance of a Master Material License, regulatory authority for the receipt, possession, distribution, use, transportation, transfer and of licensed radioactive material at Navy and Marine Corps activities. The NRSC has been established to provide administrative control of all radioactive material used in the Navy and Marine Corps, except for nuclear propulsion reactors and associated radioactivity, nuclear weapons, and certain components of weapon's delivery systems. Navy Radioactive Material Permits (NRMPs, described in paragraph 6.1.4 below) are used to maintain this control. The Radiological Affairs Support Office (RASO) and the Navy Environmental Health Center (NEHC) are the designated technical support centers for the NRSC.

6.1.3.3 Navy Environmental Health Center (NEHC)

The NEHC provides technical support on behalf of the Bureau of Medicine and Surgery (BUMED) to the NRSC, to include radiological assistance, program review, coordination of NRMPs, radiation safety training, and inspection of radiation safety programs.

6.1.3.4 Radiological Affairs Support Program (RASP)

The RASP is the vehicle used by the NAVSEA to discharge its responsibility for radiological controls for applicable sources of ionizing radiation. These include NRC-licensed radioactive material, (non-NRC-licensed) naturally-occurring radioactive material (NORM), natural and accelerator-produced radioactive material (NARM), radioactive waste, and machine sources such as x-ray machines, particle accelerators, electron microscopes, laboratory analytical devices, and all other equipment capable of producing ionizing radiation. Excluded are radioactive sources used for medical treatment or diagnosis, radioactivity associated with the Navy Nuclear Propulsion Program (NNPP), and radioactivity associated with nuclear weapons.

6.1.3.5 Naval Sea Systems Command (NAVSEA)

NAVSEA provides a member to the Navy Radiation Safety Committee and serves as the central point of contact for the RASP matters within the Department of the Navy.

6.1.3.6 Radiological Affairs Support Office (RASO)

Naval Sea Systems Command has designated RASO as their technical support center within the remediation process. Services available through NAVSEADET RASO include consultation, assessment of remediation plans, document review, environmental risk communication, public dialogue support, and radioactive waste disposal.

6.1.3.7 Naval Facilities Engineering Command (NAVFAC)

NAVFAC is responsible for negotiating FFAs with EPA regional offices and for coordinating Naval and Marine Corps Base Closures.

6.1.4 Nuclear Regulatory Commission/Agreement State Licenses (NRC) and Naval Radioactive Material Permits (NRMPs)

Under the provisions of 10 CFR, the Nuclear Regulatory Commission (NRC) has issued a Master Materials License to the Department of the Navy, to control the receipt, acquisition, possession, use, transfer and disposal of NRC licensed radioactive material. The Naval Radiation Safety Committee (NRSC) exercises regulatory authority over individual users, whose former NRC licenses were replaced with Naval Radioactive Materials Permits (NRMPs) in 1987. The NRC retains oversight of the Naval Radiation Safety Committee management of the master license.

6.1.4.1 Licensed Radiological Materials at MCAS El Toro

According to records and information obtained from MCAS El Toro and RASO, during its history, MCAS El Toro has not had any licenses or permits for the handling of radioactive materials. Handling of instruments with radium dials did not require a license. The types and quantities of radiological materials handled by the USMC Air Wings at MCAS El Toro are licensed by the supplier or permitted by the Naval logistics system and do not require permitting by the user. Examples of supplier permits for the types of radiological materials present during the 1990s at MCAS El Toro, and listed in paragraph 6.2.1.2.1, are provided below:

- In-flight Blade Inspection System (IBIS) indicators (500 uCi Sr-90), are received and used under the manufacturer's (General Nucleonics) general license issued by the state of California. Precautions and controls are specified in the general license and Technical Manual A1-H53CE-150-000. Shipping of the indicator(s) is done in accordance with Department of Transportation regulations.

- Ice Detector Units (50 uCi Sr-90), are received and used under the manufacturer's (Sundstrand Data Control) general license issued by the state of Washington. Precautions and controls are specified by the general license and Technical Manuals A1-H53CE-400-000 and A1-H53CE-400-100. Shipping of the ice detector units is done in accordance with Department of Transportation regulations.
- Refueling Paradrogue isolites (25 mCi Kr-85 or 500 mCi H-3), are received and used under NRMP No. 37-00023-T2NP issued to Commander Naval Supply Systems Command. Precautions and controls are specified in the NRMP and Technical Manual NA 03-100C-6/TO 6A8-3-1. Shipping of the isolites is in accordance with Department of Transportation regulations.

6.1.5 Waste Handling Procedures

6.1.5.1 Historical G-RAM Controls

Requirements for the control of G-RAM at MCAS El Toro have been consistent with pertinent federal regulations. The Navy's radiological safety regulations at the time when El Toro commenced operations consisted of the National Bureau of Standards Handbooks for specific radioactive material hazards, including: National Committee on Radiation Protection and Measurements (NCRP) Report No. 4, Radium Protection, 1938 and NCRP Report No. 5, Safe Handling of Radioactive Luminous Compounds, 1941. In 1949, two additional NCRP Reports were issued for radiation protection: Report No. 6, Medical X-Ray Protection Up to Two Million Volts and Report No. 7, Safe Handling of Radioactive Isotopes.

Navy requirements have continued to be updated in accordance with updates to national scientific committee recommendations and Federal regulations (e.g., Code of Federal Regulations, Title 10 (10 CFR), created pursuant to the 1954 Atomic Energy Act). In 1963, the Navy began a series of programs to remove all non-mission-essential equipment containing radioluminescent (e.g., radium) material, and replace all such mission-essential equipment with equipment containing non-radioluminescent or lower energy radioluminescent substitutes where possible.

Historical records at MCAS El Toro documenting handling of G-RAM are sparse. From the time that Station operations commenced in 1942, there are no specific G-RAM disposal records for MCAS El Toro. Due to the lack of such records, it is not possible to determine where the waste and debris from the radium room remodeling was disposed. Based on interviews with MCAS El Toro employees, equipment painted with radium paint could have been disposed of into the landfills (see Table 5-2 [1994]).

6.2 Current Usage of G-RAM

6.2.1 Type of Facility and Description of Operations

The USMC, in order to carry out its mission (described in section 6.1.2 above), handled radioactive materials (paragraph 6.1.4.1 above) under a manufacturer/supplier G-RAM license. The Marines utilized radiological controls and precautions specified in

applicable maintenance procedures during the handling and disposition of G-RAM components used on aircraft for which they were responsible. Available records for radioactive components requiring periodic leak test indicate that no leaks have been reported from El Toro.

Not all G-RAM material requires manufacturer/supplier controls. Examples of items which contain non-permitted exempt quantities are; thoriated welding rods, aluminum oxide sand blast grit, certain electron tubes, smoke detectors and luminescent devices such as "exit" signs. These items were identified and disposed of at a licensed disposal facility in accordance with approved Navy procedures.

6.2.1.1 Recent Station Operations at DRMO/Supply

Recent activities at MCAS El Toro dictate the need for the Supply Department to receive, store, and ship equipment/components that may have contained radioactive materials, as specified in paragraph 6.2.1 above. However, the Defense Reutilization and Marketing Office (DRMO) was restricted from receiving and/or storing equipment/components containing radioactive material. There were no official records or direct knowledge of radiological materials being handled by the El Toro Supply Department or DRMO. However, during the 1994 employee interviews, one employee stated; "The Marines could have stored small quantities of radium painted parts and gauges at the storage yard (DRMO Yard #1), since it is a regional storage yard."

6.2.1.2 Probable Sources (Types and Sizes) of Radioactive Materials

6.2.1.2.1 Recent G-RAM Associated with Active Aircraft

There are at least three recent (1999) usages of radioactive materials at MCAS El Toro associated with hangars 296 and 297 and aircraft assigned to the Station. These materials were utilized in aircraft operational equipment, were controlled, and were removed from the Station prior to closure. Examples of these radioactive devices are listed below:

- In hangar 296, In-flight Blade Inspection Systems (IBIS) for H-53 helicopters were being utilized. Each helicopter blade has one IBIS unit installed which contains 500 microcuries (uCi) of Strontium-90 (Sr-90) in a sealed unit. Spare IBIS units were controlled by the Air Wing for replacement when required and were stored in the building. During an inspection performed by SSPORTS in 1998, six spare IBIS units were observed in building 296. IBIS components were removed by the USMC when the USMC Air Wings departed by May 1999.
- The H-53 helicopters located in hangar 296 were each equipped with an Ice Detector Unit installed on the fuselage. The Ice Detector Units each contain a sealed source of 50 uCi of Sr-90. Although spares were reported to be on hand, an inventory of the spare units was not performed. The Ice Detector Units were removed by the USMC when the USMC Air Wings departed by May 1999.
- In hangar 297, fourteen metal basket-like devices ("paradrogues"), each containing six sealed radioactive isolites, were stored for use on C-130 aircraft for in-flight refueling operations. Each sealed isolite contains a maximum of 25 millicuries

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(mCi) of Krypton-85 (Kr-85) for a total of 150 mCi per paragrouge. USMC Maintenance personnel indicated that there were an additional 13 spare isolites available in hangar 297 for replacement of damaged isolites on the paragrouge units. The "paragrouge assemblies" and spare isolites were removed by the USMC when the USMC Air Wing departed by May 1999.

6.2.1.2.2 Recent G-RAM Associated with Historic Aircraft

The MCAS El Toro Historical Center and Command Museum, located near the intersection of West Marine Way and South 8th Street, utilizing buildings 242, 243 and 244, had been in operation since 1991. There were also five historic aircraft located at the Station along Trabuco Road northwest of the Main Gate which were part of the museum. Although the museum did not officially open until 1991, collection of historic aircraft and aircraft artifacts had been in progress since at least the early 1980s. Two fixed wing historic aircraft and one inactive helicopter, located on the Station in areas outside of the museum exhibit areas, were also indicated as belonging to the museum. The museum had a goal of displaying every type of aircraft ever based at MCAS El Toro, as well as some foreign aircraft. In late 1998, there were a total of 35 airplanes and helicopters available at the museum for viewing. Many of the aircraft were built in the 1940s through the mid-1960s, prior to the Department of Defense (Navy) program for deleting all radium dials and gages from military vehicles (aircraft, ships, etc.).

A significant number of the aircraft on display at El Toro contained levels of Ra-226 (and possibly other radioluminescent and heat resistant materials, such as Sr-90, Kr-85 and Th-232) which required dispositioning when the Base closed. During SSPTS personnel investigation for the preparation of this HRA, radioactive dials (meters and gages) displayed in showcases in building 243 were observed and confirmed with radiation detection equipment. An interview with a Museum official (see Table 5-3), indicated that all of the historic aircraft, including aircraft parts (artifacts), at El Toro were planned to be transferred to MCAS Miramar near San Diego for display at the museum to be constructed at that site. In June 1999, the aircraft and artifacts were transferred.

6.2.2 Spills, Releases, Waste Manifests and Emergency or Removal Actions

6.2.2.1 Policies and Records Related to Release of Radioactivity

The policy of the Navy is to minimize the amount of radioactivity released to the environment. This policy is consistent with applicable recommendations issued by the Federal Radiation Council (incorporated into the Environmental Protection Agency in 1970), U.S. Nuclear Regulatory Commission, National Council on Radiation Protection and Measurements, International Commission on Radiological Protection, International Atomic Energy Agency, and National Academy of Science-National Research Council. The Navy, Naval Sea Systems Command (NAVSEA), has additionally issued standard instructions defining procedures to be used in controlling non-licensed G-RAM, which is

not regulated by specific Naval Radioactive Materials Permits (NRMPs). Current and historical G-RAM controls are described in paragraph 6.1 above.

6.2.2.2 Potential Low-Level Non-Regulated Solid Radioactive Waste Disposal

Solid G-RAM items located at MCAS El Toro include items such as radium painted dials and gages on older aircraft, thoriated welding electrodes, tritium exit signs and americium smoke detectors. A search of available records was conducted for potential releases (on-site disposal) of G-RAM to the environment.

Some reports have indicated the potential for non-regulated G-RAM being present or disposed of at various locations at MCAS El Toro. These reports are summarized in Appendix D; Tables 7-1, 7-2 and 7-3 as follows:

- Table 7-1: Potential for Non-regulated G-RAM being Disposed of in the EOD Range (Site #1)
- Table 7-2: Potential for Non-regulated G-RAM being Present in the Station DRMO Yards (#1 [Site #8], #2 [AOC 46], and #3 [AOC 264])
- Table 7-3: Potential for Non-regulated G-RAM being disposed of in the Station Landfills (Sites #2, #3, #5 and #17)

Personnel interviews and some of the documents referenced in Appendix D; Tables 7-1, 7-2 and 7-3 indicate that there may have been some low-level radioactive materials at several locations on the Station. However, specific types of materials and dates during which radioactive materials were allegedly disposed of or stored in these areas are not provided.

The ongoing Installation Restoration (IR) Program sampling (soil and/or groundwater), performed in several of these areas, provides a method of checking for radioactive materials at the above mentioned IR sites.

There are groundwater sampling wells located at the EOD Range (five total at Site #1 as of early 1999 and four wells added in late 1999), at each of the landfills (14 at Site #2, seven at Site #3/#4, five at Site #5 and two at Site #17), at DRMO Yard 1 (two at Site #8) and at the former Industrial Waste Treatment Plant (two at Site #12). Groundwater samples from wells located at Sites #1, #2, #3/#4 and #5 have been analyzed for radioactivity (gross alpha and gross beta) starting in 1992. Groundwater wells located at Sites #8, #12 and #17 were sampled commencing in 1995/96, however, during this period, only Site #17 water samples were analyzed for gross alpha and gross beta.

In October 1998, 20 groundwater samples from Sites #2, #3/#4 and #5 were analyzed for radionuclides. Nine of these samples contained elevated (greater than drinking water MCL of 15 pCi/l) gross alpha activity; none contained elevated gross beta activity. Each of the 20 samples was analyzed for natural occurring uranium and radium (226 and 228). All analyses showed that natural uranium was the isotope, which corresponded with the gross alpha levels. The total radium (226 and 228) in each sample was within the

USEPA drinking water limits of 5 pCi/l and the Ra-226 was within USEPA limits of 3 pCi/l. It should be noted that it may not be appropriate to apply drinking water standards to non-potable groundwater, particularly in areas where levels of naturally occurring uranium deposits are likely found.

Summaries of the results of the analyses for radionuclides in the groundwater samples taken at the EOD Range (IR Site #1), DRMO Yards #1 (IR Site #8), #2 and #3 and landfills (IR Sites #2, #3/4, #5 and #17) are provided in Appendix D; Tables 7-1, 7-2 and 7-3 respectively.

The Site #12 groundwater monitoring wells radionuclide samples have been analyzed only for Radon (Rn)-222 and Strontium (Sr)-89/90. Maximum Rn-222 sample level was 410 pCi/l. There is currently no promulgated USEPA drinking water standard for Rn-222, however concentrations in groundwater typically range from 100 pCi/l to 3,000 pCi/l (although levels as high as 10,000 pCi/l have been reported in groundwater in the United States). All Sr-89/90 sample results were less than detection limits.

No documents have been shown to date to indicate the deliberate disposal of radioactive material on MCAS El Toro property, nor have any documents been shown to indicate where radioactive materials from MCAS El Toro actually went.

6.2.3 Radionuclide Inventories

The G-RAM Location and Uses at MCAS El Toro, as of early 1999, is provided in Table 6-1.

General Radioactive Material (G-RAM)

Location and Use

Table 6-1

<u>G-RAM Description</u>	<u>Location</u>	<u>Radionuclide and Permit</u>	<u>Approximate Quantity</u>	<u>Years Utilized</u>	<u>Disposition</u>
Radium Room remnants (from final removal work completed(1998)	Building 296; North Mezz.	Radium-226 Permit not required	Approx. 0.5 uCi (recorded on radioactive material shipping manifest)	Starting in late 1940s; estimated to end in early 1950s	Remnants (pipe, ducting, wall debris) stored in building 296 were disposed of as radioactive waste by Navy in June 1999.
El Toro Historical Center and Command Museum	Building 242, 243, 244 and adjacent areas and located at main gate on Trabuco Road.	Radium-226 and possibly strontium-90, krypton-85 and thorium-232. Permit not required	Estimated to be less than 100 mCi in a total of approximately 25 aircraft and aircraft parts	1991 to 1999	The aircraft located at the museum were to be transferred to another military base (e.g., MCAS Miramar) This transfer was accomplished by private contractor in June 1999
In-flight Blade Inspection System (IBIS)	CH-53E Helicopters in and adjacent to Hangars 295 and 296	Strontium-90 Permitted under general license	Maximum of 500 uCi per IBIS; one per helicopter blade; seven blades total (plus spares)	1960s to 1999	When USMC Air Wings departed, the IBIS components located on the aircraft and those stored as spare parts were removed by the USMC.
Ice Detector Units	CH-53E Helicopters in and adjacent to Hangars 295 and 296	Strontium-90 Permitted under general license	Maximum of 50 uCi per Ice Detector Unit; one per helicopter (plus spares)	1960s to 1999	When USMC Air Wing departed, the Ice Detector Units located on the aircraft and those stored as spare parts were removed by the USMC.

General Radioactive Material (GRAM)

Location and Use

Table 6-1
(continued)

<u>G-RAM Description</u>	<u>Location</u>	<u>Radionuclide and Permit</u>	<u>Approximate Quantity</u>	<u>Years Utilized</u>	<u>Disposition</u>
Paradrogues with isolites	Hangar 297, stored in locker; for use in refueling C-130 aircraft	Krypton-85 Permitted under Navy Radioactive Material Permit NR 37-00023-T2NP1	Maximum of 25 mCi per isolite; six per paratroque basket. 14 paratrogues (total of 84 isolites) and 13 spare isolites were stored in the locker in October 1998.	1960s to 1999	When USMC Air Wings departed, the paratrogues and spare isolites were removed by the USMC.

6.3 Adjacent Land Usage

Historically, the land use around MCAS El Toro has been largely agricultural. To the north, south, and east, the majority of the land immediately adjacent to the station has been used to raise oranges and other agricultural crops. Recently, the land to the south, southeast, and southwest has been developed as commercial, light industrial, and some residential usage. The commercial and light industrial usage is directly adjacent to the southeast and southwest borders of the Station. Nearby off-Station residences are located about 3/4 mile from the Station. [Ref. 3]

7. FINDINGS

7.1 Potential Contaminants

7.1.2 General Radioactive Material (G-RAM)

The MCAS El Toro has had a mission to maintain and operate facilities and to provide services and material to support the operation of aviation activities and the units of the operating forces of the USMC and to provide support for other activities designated by the Commandant of the Marine Corps, in coordination with the Chief of Naval Operations. Potential contaminants resulting from carrying out this mission include:

- Radium (Ra)-226 painted instruments were cleaned and refurbished in a room located in the north east corner of the mezzanine of building 296, resulting in radium residues (see paragraph 6.1.2.1).
- Ra-226 and strontium (Sr)-90 dials, gages and other instruments associated with historic aircraft (paragraph 6.2.1.2.2 describes aircraft containing Ra-226 and/or Sr-90 instruments and individual aircraft instruments on display at and adjacent to buildings 242, 243 and 244)
- Radioactive equipment and components utilized on CH-53 helicopters, such as the In-flight Blade Inspection System (IBIS) and Ice Detector Units which contain Sr-90 (paragraph 6.2.1.2.1 describes aircraft equipped with radioactive IBIS and Ice Detector Units, and spare components located in building 296)
- Radioactive in-flight luminescent (Kr-85) “baskets” (Paradrogues) used by C-130s in refueling operations with other aircraft (paragraph 6.2.1.2.1 describes radioactive paradrogues and spare parts located in building 297)

In addition to radium and strontium, other examples of G-RAM sources, some of which may have been used at MCAS El Toro, include:

- Magnetron electronic tubes containing various radioactive materials, such as cobalt (Co)-60, thorium (Th)-232, strontium (Sr)-90, tritium (H)-3 and krypton (Kr)-85 [The activities of the isotopes contained in the tubes range from 0.1 uCi to 30 to 50 uCi depending on the exempt quantity of the particular radionuclide]. [Ref. 43]
- Sealed or contained sources in various industrial and consumer products, such as self-luminous “exit” signs containing tritium (H)-3 and smoke detectors containing americium (Am)-241

7.2 Potential Contaminated Areas

Review of documents, interviews with personnel, and inspections at MCAS El Toro have provided information concerning the potential for non-regulated G-RAM being present in various areas within the Station.

Information pertaining to IR Sites #1, #2, #3, #5, #8, and #17 and AOCs #46 and #264 is summarized in Tables 7-1, 7-2 and 7-3 (See Appendix D).

In addition, the former Waste Treatment Plant and Sludge Drying Beds (IR Site #12) were located downstream of building 296 (radium room location). Based on the possibility that, in the past, waste from the radium room could have been treated at the plant, Site #12 may be considered to be a potentially contaminated area.

Also, in 1999, Anomaly Area #3 located near Wherry Family Housing was determined to have received construction debris. This area may have received construction debris as early as 1946 and surface soils and materials from IR Site #3 in approximately 1991. Based on these determinations, Anomaly Area #3 may be considered to be a potentially contaminated area.

[Refs 38 and 39]

7.2.1 Impacted Areas - Known and Potential

7.2.1.1 Known Impacted Areas

7.2.1.1.1 Building 296 (radium room and adjacent equipment)

The radium room and associated equipment located on the second floor in the north east corner of building 296 is a known impacted area (MARSSIM Class 1).

7.2.1.2 Potential Impacted Areas

Potentially impacted areas are the facilities and properties where radioactive materials were used and/or stored (MARSSIM Class 3). Potentially impacted areas at MCAS El Toro include landfills where radioactive materials have been reported as being disposed and yards/areas where such materials may have been handled. There are buildings in which radioactive materials were known to have been located. In some instances, areas around the locations (potentially impacted areas) are included, because of the potential for inadvertent spread of contamination. [Ref. 10]

7.2.1.2.1 Original Landfill (IR Site #3)

The U.S. Navy/U.S. Marine Corps policies and practices, during the time, 1943 to 1955, when the landfill was in operation, are such that it is unlikely that licensed general radioactive material (G-RAM) was intentionally disposed in the landfills on the station. There has, however, been non-licensed G-RAM (mainly radium) present at the station. Employee interviews conducted in 1994, 1998 and 1999 resulted in no interviewee having direct knowledge of the disposal of the radioactive material in any of the Station's landfills. Yet, comments from MCAS El Toro employees indicate that G-RAM may have been inadvertently disposed in the landfills on the station.

7.2.1.2.2 Perimeter Road Landfill (IR Site #5)

The Perimeter Landfill was in operation from 1955 to the late 1960s. Adjacent to IR Site #5 is a large impoundment, APHO-46 (from an aerial photograph dated 1979). To date, no evidence has been found indicating the disposal of components containing radioactive material. However, comments from MCAS El Toro employees indicate that G-RAM may have been inadvertently disposed in the landfill. APHO-46 is considered potentially impacted, based on its close proximity to IR Site #5.

7.2.1.2.3 Magazine Road Landfill (IR Site #2)

The Magazine Road Landfill operated between the late 1960s and 1980. Employee statements indicate that G-RAM may have been inadvertently disposed in the Station landfills and, in July 1999, a gauge with a radium painted dial was reported to have been found in the vicinity of Landfill Site #2.

7.2.1.2.4 Communication Station Landfill (IR Site #17)

The Communication Station Landfill operated between 1981 and 1983. Adjacent to the southern end of IR Site #17 is a large impoundment, APHO-44 (from an aerial photograph dated 1974). To date, no evidence has been found indicating the disposal of components containing radioactive material. However, comments from MCAS employees indicate that G-RAM may have been inadvertently disposed in the landfills. APHO-44 is considered potentially impacted, based on its close proximity to IR Site #17.

7.2.1.2.5 Defense Reutilization and Marketing Office (DRMO) Yards #1 and #3 (IR Site #8 and AOC #264)

The DRMO yards #1 and #3 were in operation since the early years of the Station and after the 1950's were restricted from receiving and/or storing equipment/components containing radioactive material. There were no official records or direct knowledge of radiological materials being handled by the El Toro DRMO. However, during the 1994 employee interviews, one employee stated; "Marines could have stored small quantities of radium painted parts and gauges at the storage yard, since it is a regional storage yard."

7.2.1.2.6 DRMO Buildings (319 and 360)

Buildings 319 (partial) and 360 were operated as DRMO buildings since the early years of the Station and were restricted from receiving and/or storing equipment/components containing radioactive material. There were no official records or direct knowledge of radiological materials being handled by the El Toro DRMO. However, since the DRMO function may utilize buildings, in addition to yards (#1 and #3) for storage, these DRMO buildings could have stored small quantities of G-RAM.

7.2.1.2.7 Explosive Ordnance Disposal (EOD) Range (IR Site #1)

The EOD Range operated since 1952 and EOD personnel indicated that the Range was not permitted to receive or handle radioactive or nuclear ordnance and/or ammunition. There are no official records or direct knowledge of radioactive materials being handled at the EOD Range. Although Site #1 was not authorized or utilized as a Station dump, there was an unsubstantiated report of low-level radioactive waste disposal in the EOD Range.

7.2.1.2.8 Former Industrial Waste Treatment Plant and Sludge Drying Beds (IR Site #12)

The former Industrial Waste Treatment Plant and Sludge Drying Beds (IR Site #12), were located downstream of building 296 (location of the radium room), and processed effluent from the Station buildings which were connected to the industrial waste sewer system. Based on this information, Site #12 and the out-fall to the Bee Canyon Wash (IR #25) are considered as potentially impacted.

7.2.1.2.9 Buildings 295, 296 (other than radium room) and 297

These facilities are known to have contained aircraft (CH-46 and H-53 helicopters and/or C-130 cargo planes, etc.) which utilized radioactive materials (components). Radioactive materials (IBISs, paradrogues and/or ice detector units) are known to have been stored in hangars 296 and 297. The aircraft and associated equipment have been removed, however, based on the above information, these buildings are potentially impacted.

7.2.1.2.10 Buildings 242, 243 and 244

The Command Museum, building 243, displayed individual aircraft instruments containing radium paint. Historic aircraft containing radium painted instruments were located in hangars 242 and 244 and the adjacent grounds. The aircraft and associated equipment have been removed, however, based on the above information, these buildings are potentially impacted.

7.2.1.2.11 Anomaly Area #3 (MSC R1)

Anomaly Area #3 is located near Wherry Family Housing which was determined to have received construction debris as early as 1946. The area was also utilized in 1991 for the disposal of surface soils and materials from IR Site #3 created during the grading in support of the construction of the central environmental field facility. There are no official records of radioactive materials being disposed in the Anomaly Area. However, based on available information, this site is potentially impacted.

7.2.1.2.12 Radium Plaque Adaptometer (RPA) Building

The RPA building (currently not existing) was reportedly located on "C" Street, approximately two blocks north of the Trabuco Road entrance to the Station. The facility would have been in operation approximately between 1944 and 1951 and would have utilized a radium/phosphor-coated disc, encapsulated in plastic, for checking USMC personnel night vision. There are no official records indicating when the building was constructed or demolished. Based on available information, the site of the former RPA building is potentially impacted.

7.2.1.2.13 Nuclear, Biological and Chemical (NBC) Buildings 787, 1789 and 1803

The NBC buildings are located on East Marine Way just north of the intersection with El Toro Boulevard. One building (1789) contained a concrete structure, reported by a former El Toro NBC marine to have been used to store unlicensed radioactive test source(s). The other buildings (787 and 1803) were NBC training buildings. There are no official records, which indicate that radioactive materials were used or stored in the building(s). However, based on available information, the NBC buildings are potentially impacted.

7.2.2 Non-Impacted Areas

Structures: Administrative, medical, residential, commercial, recreational, and most storage/warehouses and work facilities (except for those listed in paragraph 7.2.1.2) are considered non-impacted radiologically. DRMO building 326 has been used principally for the storage of hazardous (non-radioactive) materials while awaiting disposition, and is not likely to have had radioactive materials stored therein. Supply buildings 317, 318 and 359 were used for receipt, short term storage and ship out of items associated with Station operations and building 324 was used for administrative and technical support of work in buildings (hangars) 295, 296 and 297. Based on their usage, none of these buildings are considered to have contained radioactive materials in the past.

Land: Agricultural areas, golf course, runways, taxi-ways, washes and surrounding land areas (except for the areas listed in section 7.2.1.2) are considered non-impacted radiologically. Based on DRMO Yard #2 (AOC #46) being used primarily for vehicle storage, it is unlikely that radioactive materials were ever present in the yard.

Due to the wide-spread use of consumer products, with radioactive sources, such as smoke detectors, exit signs and watches, many facilities at MCAS El Toro are likely to have contained minor exempt quantities of radioactive materials. Most such devices contain either highly purified naturally-occurring radioactivity, or very small amounts of radioactive material of low energy and/or short half-life. Such consumer products are not considered to be a source of G-RAM concern, and do not, of themselves, cause facilities

(e.g., housing, clubs, recreation areas, etc.) to be classified as G-RAM areas in need of eventual release surveys when they are decommissioned.

7.3 Potential Contaminated Media

The media of concern at the Station includes soils (surface, subsurface and sediment), surface water, groundwater, air, buildings, and asphalt and concrete (DRMO Yards). An evaluation has been made in each of these areas and is provided in paragraphs 7.3.1 through 7.3.6.

7.3.1 Soil Exposure

The soil exposure pathway considers potential exposure threats to people on or near the site, who may come into contact with a hazardous substance via whole body radiation exposure, dermal exposure, soil ingestion, or plant uptake into the human food chain.

A description of the soil and its use at MCAS El Toro is provided in paragraph 4.2.1. Approximately 20 per cent of the base is currently being used for agricultural purposes. None of the agricultural areas are located on the Installation Restoration (IR) Sites of potential radiological concern, including the EOD Range (Site #1), Station landfills (Sites #2, #3, #5 and #17), former Industrial Waste Treatment Plant (Site #12), DRMO Yards (Site #8 and AOC #264) or Anomaly Area #3 (MSC R1).

Soil samples were taken from borings at Sites #3 (65 soil samples) and #5 (69 soil samples) and were screened for radioactivity using a thin window pancake Geiger-Muller (GM) detector with the following results:

- At Site #3, 29 (10 up-gradient and 19 down-gradient) samples were screened from the landfill (unit 1) and 36 soil samples were screened from the former incinerator location (unit 4). The average background levels at unit 1 is 50 cpm and the radioactive screening results for unit 1 indicated four (all up-gradient) highest readings of 80 cpm. The average background levels at unit 4 is approximately 50 cpm and the radioactive screening results for unit 4 indicated one high reading of 80 cpm and 12 next highest readings at 60 cpm.
- At Site #5, 19 soil samples were screened from the landfill trench (unit 1) and 50 soil samples were screened down-gradient of the landfill. The average background for the landfill is ~60 cpm and for down-gradient is ~50 cpm. The screening results at unit 1 indicated a single high reading of 80 cpm. Screening results down-gradient of unit 1 indicated two high readings of 80 cpm.

Radioactivity in soil does have a potential pathway for exposure threats to plants and therefore, to animals and people. The most likely on-site G-RAM, if present, however, is not expected to migrate far from the area in which it was placed. Since the most probable locations for G-RAM would be in one of the above mentioned IR Sites, it is unlikely that

the soil pathway will be a viable concern, so long as the IR Sites are not released for agricultural use. Soil samples alone will not provide the necessary information required to determine whether radioactive material was disposed of in the landfills. However, the results of the soil samples screened for radioactivity at Sites #3 and #5 indicate that there has not been a significant, if any, release of radioactivity to the soil from those two landfills. Radioactive material is less likely to have been disposed of in landfill Sites #2 and #17, due to the official time period in which they operated (late 1960s to 1982). However, based on the possibility of unauthorized dumping as early as the 1950s (Site #2) and the 1970s (Site #17), these landfills, as well as Sites #3 and #5, are recommended for further investigation.

DRMO Yard #2 (AOC #46) was historically used primarily for vehicle storage and, as such, would be unlikely to have had radioactive material stored therein. Various materials have been stored within DRMO Yards #1 (IR Site #8) and #3 (AOC #264) since the early years of the base and, although not confirmed by available records, there is a possibility that radioactive material was stored in the yards; therefore these areas will be investigated.

The EOD Range (IR Site #1) was not authorized to receive nuclear or radioactive ordnance and there are no confirmed reports or evidence of radioactive materials being present at the site. However, it is concluded that, based on concerns regarding the unsubstantiated comments that radioactive waste may have been disposed of at Site #1, the EOD Range should be investigated further.

The former Industrial Waste Treatment Plant and Sludge Drying Beds (IR Site #12) was located downstream of building 296 (location of the radium room), and therefore, should be investigated further.

The Anomaly Area 3; MSC R1, located near Wherry Family Housing, was determined to have received construction materials as early as 1946, as well as surface soils and materials from IR Site #3 (Original Landfill) in approximately 1991 from grading for the construction of the central environmental field facility and therefore should be investigated further. [Refs 38 and 39]

7.3.2 Surface Water Pathway

The surface water pathway considers potential exposure threats to drinking water supplies, to human food chain organisms and to sensitive environments.

Surface water sources and flow in the immediate vicinity of MCAS El Toro are identified in Section 4.2.3. The majority of the Station is poorly drained, however, the drainage generally flows southwest via channels and washes en route to San Diego Creek. From

the intersection with Marshburn Channel, San Diego Creek carries the surface water about seven miles until it flows into Upper Newport Bay (Pacific Ocean).

The surface water and storm sewer sources to San Diego Creek make the creek unsuitable for drinking water intakes as it is carried to the Upper Newport Bay. The dynamics of transport of particulate G-RAM, if any were present, are such that it is unlikely that any significant amount of radioactivity would ever leave the Station with surface water flow. However, because the former Industrial Waste Treatment Plant (IR Site #12) is being investigated (see paragraph 7.3.1 above) the portion of Bee Canyon Wash (IR Site #25) from Site #12 to the Station boundary will also be radiologically investigated.

Surface water and seep water analyses performed in 1998 indicated that samples taken in the vicinity of the Magazine Road Landfill (IR Site #2) contained gross alpha (estimated) and gross beta in excess of the MCL for drinking water. No analyses were performed to determine the radionuclide(s) present in the surface water and seep water samples. Radionuclide analyses should be performed when elevated levels are found. When such analyses were performed on area groundwater samples exhibiting elevated gross alpha levels, it was determined that natural uranium was the cause. A program is now in place to monitor surface water and seep water. If elevated gross alpha levels are detected, the samples will be analyzed for specific radionuclides.

7.3.3 Groundwater Pathway

The groundwater pathway considers potential exposure threats to drinking water supplies migration to and within aquifers.

As discussed in paragraph 4.2.2, the groundwater distance below the ground surface is 50 feet or more and the hydraulic communication is restricted between the uppermost sediments and the underlying main production aquifer. The physical characteristics of Ra-226 (one of the most likely radioisotopes to be present in G-RAM at MCAS El Toro), are such that the radionuclide is dense and does not dissolve, therefore, it is not readily carried by water percolating through soil. Based on the dynamics of transport for particulate G-RAM, the ability for radioactivity to infiltrate the main production aquifer is remote.

Samples of groundwater, to date, at wells associated with the EOD Range (Site #1), have disclosed no gross alpha (Ra-226 is an alpha emitter) or gross beta levels above the State and Federal drinking water maximum contaminant level (MCL). Recognizing that drinking water MCLs are the most restrictive and may not always be applicable for these samples, there were several (51 of 129) groundwater samples, taken between 1992 and 1997, at wells associated with landfills (Sites #2, #3 and #5) which had gross alpha levels greater than the drinking water MCL of 15 pCi/l. Only three of the samples (Site #2) exceeded two times the MCL (see Table 7-3). One sample, taken in 1992 at Site #5, exceeded the gross beta particle MCL of 50 pCi/l with an activity of 53 pCi/l. The highest gross beta level of four samples taken from the same well since 1992 was 19

pCi/l, indicating that the gross beta results from 1992 may have been an anomaly. [Ref. 7]

In 1998 and 1999, groundwater samples from Sites #2, #3 and #5, in addition to being analyzed for gross alpha and gross beta radiation, were analyzed for radionuclides. It was determined from the analyses of these groundwater samples that the gross alpha in the groundwater at these landfills is the result of naturally occurring uranium rather than contamination from radium. In each sample analyzed, total radium (Ra-226 and Ra-228) was determined to be less than 2 pCi/l (MCL for total radium in drinking water is 5 pCi/l). The gross alpha in these water samples, therefore is not the result of disposed radium-painted equipment. Although it is possible that the landfills may contribute to the gross alpha/beta concentrations, this activity can also be due to natural sources.

There have been groundwater gross alpha activities two to three times the drinking water MCL (30 to 44.7 pCi/l) found in samples taken in areas, located away from MCAS El Toro, in the Raymond Basin, Central Los Angeles Basin (Tustin Plain is southernmost extension), and the South Coast Hydrologic Basin. These radioactivity levels are comparable to those found in granite sources and indicate that there is relatively high background gross alpha activity in the region surrounding MCAS El Toro. Also, water samples, of themselves, do not confirm the presence or absence of radionuclides in the landfills or other sites adjacent to the monitoring wells. Future monitoring of the affected groundwater sampling wells will provide additional information regarding the potential for radioactivity in the groundwater pathway. Based on the sampling performed to date, and in particular the report of the October and November 1999 sampling: detected uranium is naturally occurring, gross alpha activity is primarily due to the presence of natural uranium, and no man-made radionuclides were detected at concentrations indicative of a release. [Ref. 44]

7.3.4 Air Pathway

The air pathway considers potential exposure threats to people and to sensitive environments via migration through the air.

The radiological work described in sections 6.1 and 6.2, conducted at MCAS El Toro involved essentially no operations that would have resulted in filtered exhaust ventilation from a work facility since the time when the radium room in building 296 was decommissioned (sometime prior to the mid-1960s). Airborne contamination from the radium room operations, which are believed to have commenced in the 1940s and may have continued until the early 1950s, is considered to be minimal. Other possible sources of airborne radioactivity are: spills of radioactive liquids, smoke from fires in facilities or aircraft where radioactive materials are used or stored, or breaches of sealed radioactive components. Such occurrences have not been documented or otherwise reported at MCAS El Toro.

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The target population under the air pathway consists of people who reside, work or go to school within the four mile target distance limit around the site. Targets are evaluated on the basis of their distance from the site. Those persons closest to the site are most likely to be affected and are evaluated as primary targets. The nearest individuals would be the on-site workers. Like the other migration pathways, a release must be suspected in order to score primary targets for the air pathway. Releases to the air pathway, however, are fundamentally different from releases to other migration pathways. Depending on the wind, air releases may disperse in any direction. Therefore, when a release is suspected, all populations and sensitive environments out to and including the 1/4 mile distance category are evaluated and scored as primary targets. Because air releases are quickly diluted in the atmosphere, targets beyond 1/4 mile distance are evaluated as secondary targets.

As with other migration pathways, when a release is not suspected, all residential, student and worker population within the entire four mile target distance limit is evaluated as the secondary target population.

Searches of historical records and interviews revealed no occurrences or practices which could have released significant quantities of G-RAM from MCAS El Toro into the air. Therefore, it is concluded that the potential threat to targets via migration of G-RAM through air at MCAS El Toro is insignificant.

7.3.5 Buildings

Buildings 295, 296 and 297 are known to have contained aircraft which were equipped with radioactive equipment. During interviews a USMC representative indicated that, at building 295, magnetron electronic tubes containing various radioisotopes (typically Sr-90, Kr-85, Co-60, and Th-232) were physically destroyed (crushed) and swept up and deposited into a dumpster. SSPORTS personnel performing HRA investigations in buildings 296 and 297 and survey/remediation work in building 296, have confirmed that there were small amounts of residual radium in the floor, wall, plumbing and ventilation ducting associated with the radium paint room on the mezzanine of building 296 (See paragraph 6.1.2.1.1 for preliminary results of the surveys/remediation performed in 1998 by SSPORTS). Also it was determined that certain radioactive materials associated with active aircraft were stored in both buildings 296 and 297 by the USMC.

Buildings 242 and 244 and adjacent taxiways were determined, during the SSPORTS investigation work associated with preparation of this HRA, to contain historical aircraft equipped with instruments painted with radium paint and other components containing various radioisotopes. Building 243 had displays of individual aircraft artifacts (dials, gages and other instruments) which also contained radium.

Building 1789, used by NBC personnel, may have been used to store unlicensed radioactive source(s). The storage structure has been demolished and there is currently no

evidence that there was a spread of radioactivity, which would have contaminated the building.

Based on the types of operations performed in the other areas of the buildings listed above, and due to the absence of reports of spills and/or airborne releases as discussed in paragraph 7.3.4, it is not likely that any buildings or structures on MCAS El Toro have been radiologically contaminated.

7.3.6 Asphalt and Concrete

The DRMO Yards #1 (Site #8) and #3 (AOC #264) contain areas which are paved with asphalt (and possibly concrete). During investigation performed by SSPORTS Environmental Detachment, information from interviews (see Table 5-3) and various reports indicated that radioactive materials may have been stored in DRMO Yards and recommendations were previously made to perform radiation monitoring on soil and suspect objects uncovered during intrusive work (see Table 7-2).

Based on the lack of records indicating that radioactive materials were handled at the DRMO Yards at MCAS El Toro, it is not considered that significant quantities, if any, radioactive materials were present in the yards over the years. Therefore, it is not likely that asphalt and/or concrete in the DRMO Yards has been radiologically contaminated, although these media will be further investigated during surveys recommended to be accomplished in DRMO yards #1 and #3.

7.4 Related Environmental Concerns

The "Guidance for Performing Preliminary Assessments under CERCLA", lists four pathways of possible environmental transport, each evaluated by three elements. These pathways include groundwater, surface water, soil and air. The three elements are; (1) the likelihood of release (including the likelihood of a substance migrating through a specific pathway), (2) the waste characteristics, and (3) the targets. Based on the discussion of each of the four pathways in paragraph 7.3 above, it is concluded that there are no confirmed radiological environmental concerns at MCAS El Toro.

8. CONCLUSIONS

Because of the type of work undertaken at MCAS El Toro, there is a low potential for radiologically contaminated areas on the Station. Based on the information obtained to date, input from the BRAC Closure Team and Restoration Advisory Board (RAB) and to public concern, the following areas are classified as potentially impacted and further radiological investigation is needed before a decision regarding final disposition can be made:

1. Original Landfill - IR Site #3
2. Perimeter Road Landfill - IR Site #5 (including impoundment APHO-46)
3. Magazine Road Landfill - IR Site #2
4. Communication Station Landfill - IR Site #17 (including impoundment APHO-44)
5. Defense Reutilization and Marketing Office (DRMO) Yards #1 and #3 - IR Site #8 and AOC #264, respectively.
6. Building 319 and 360 - DRMO buildings (selected areas within the buildings where radioactive materials were known or suspected to have been stored)
7. Hangars 295, 296 and 297 (selected areas within the hangars where radioactive materials are known or suspected to have been stored or worked)
8. Buildings 242, 243, 244 - Command Air Museum (selected areas with the buildings where radioactive materials were known or suspected to have been stored or displayed)
9. Explosive Ordnance Disposal (EOD) Range - IR Site #1
10. Former Location of the Industrial Waste Treatment Plant and Drying Beds - IR Site #12 and portion of Bee Canyon Wash (IR Site #25) from southwest corner of Site #12 to the south Station boundary.
11. Anomaly Area #3 (MSC R1) located near Wherry Family Housing bounded by Pusan Way, Connor Avenue, Agua Chinon Wash and building 722.
12. Site of the former Radium Plaque Adaptometer Building ("C" Street approximately two blocks north of the Trabuco Road Station Gate).
13. Buildings 787, 1789 and 1803 - Nuclear, Biological and Chemical (NBC) buildings and adjacent impoundment (APHO-38).

9. REFERENCES

The references used throughout this HRA are listed in Appendix B.

10. APPENDICES

A. Site Diagrams

Site Diagrams for impacted and potentially impacted areas at MCAS El Toro are shown in Appendix A. These diagrams include maps of APHO -38 (Diagram A-11), APHO -46 (Diagram A-4), and Anomaly Area 3 (Diagram A-9).

B. List of Documents

The list of documents used for research in the preparation of this HRA are provided in Appendix B

C. Photo Documentation

Aerial Photographs - A series of historical aerial photographs of the Original Landfill (Site #3), Perimeter Road Landfill (Site #5), Magazine Road Landfill (Site #2), Communication Station Landfill (Site #17), EOD Range (Site #1), DRMO Yards #1 and #3 at MCAS El Toro are provided in Appendix C.

D. Potential for Non-Regulated Radioactive Materials Being Disposed of at MCAS El Toro

Table 7-1: Potential for Non-regulated General Radioactive Materials Being Disposed of in the Explosive Ordnance Disposal Range (Site 1) at MCAS El Toro

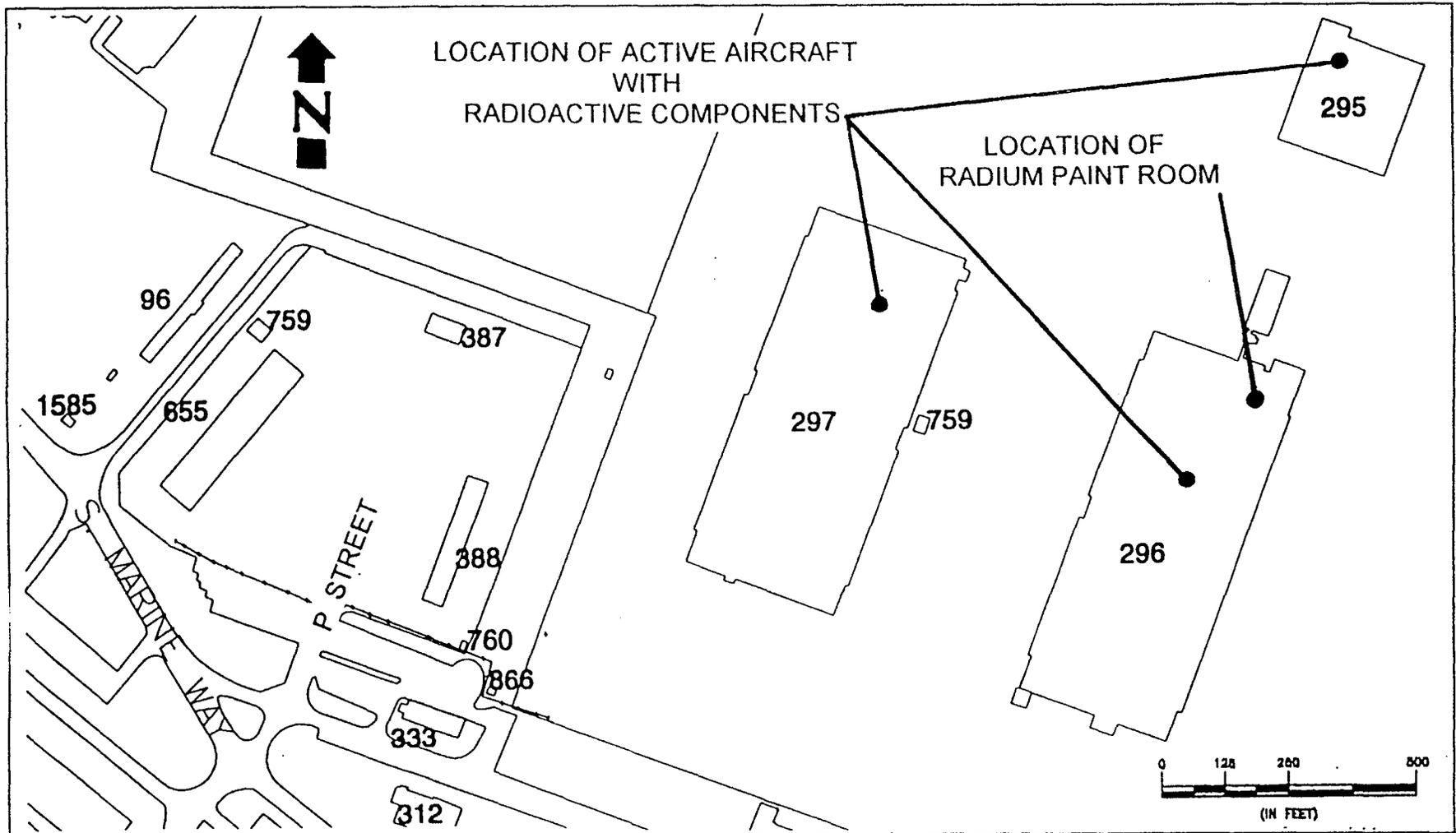
Table 7-2: Potential for Non-regulated General Radioactive Materials Being Present in the Station Defense Reutilization and Marketing Office (DRMO) Yards at MCAS El Toro

Table 7-3: Potential for Non-regulated General Radioactive Materials Being Disposed of in the Station Landfills (Sites 2, 3, 5 and 17) at MCAS El Toro

Appendix A

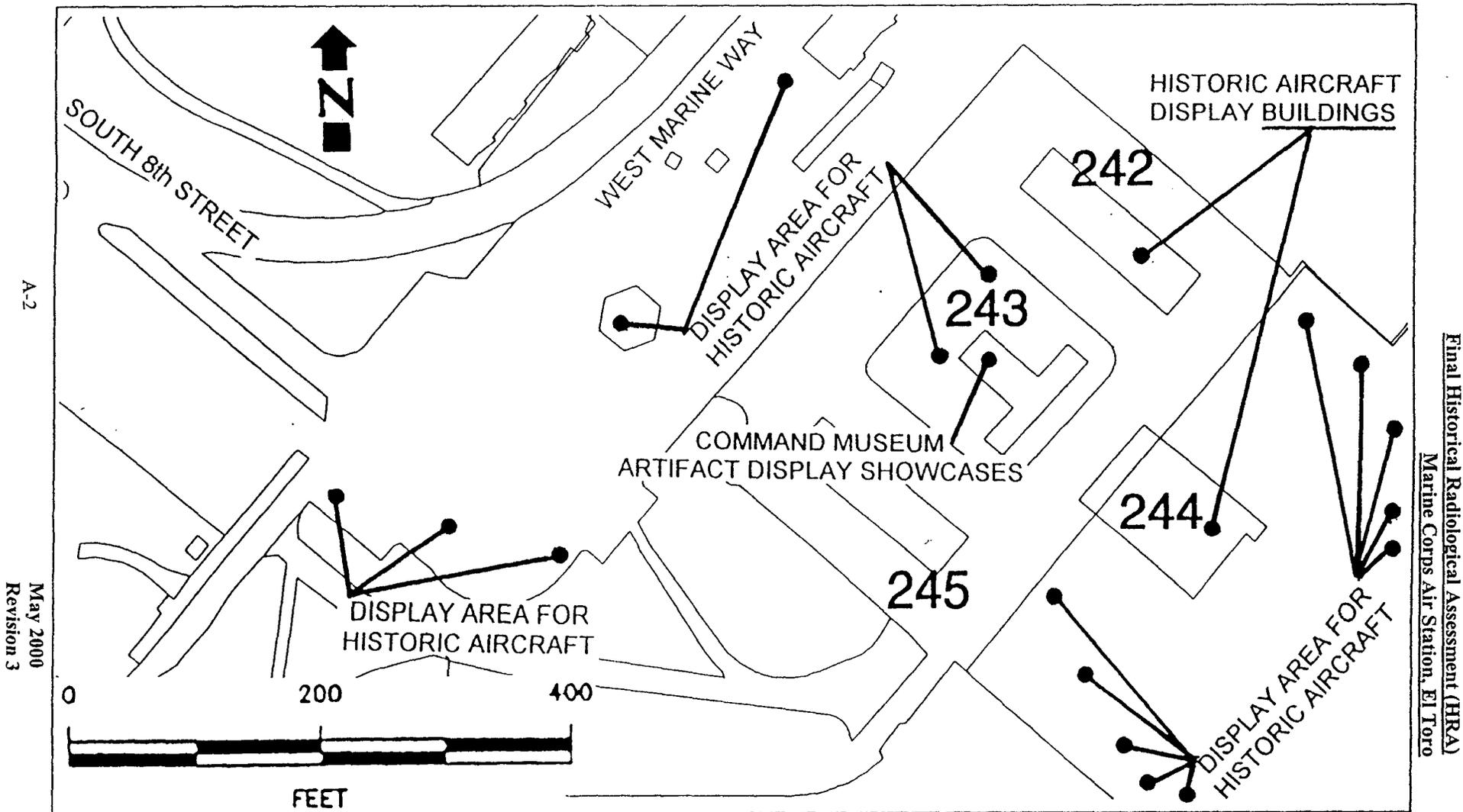
Site Diagrams

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Figure A-1
Building 295, 296, 297 Hangar Complex



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Figure A-2
Building 242, 243, 244 Command Museum Complex

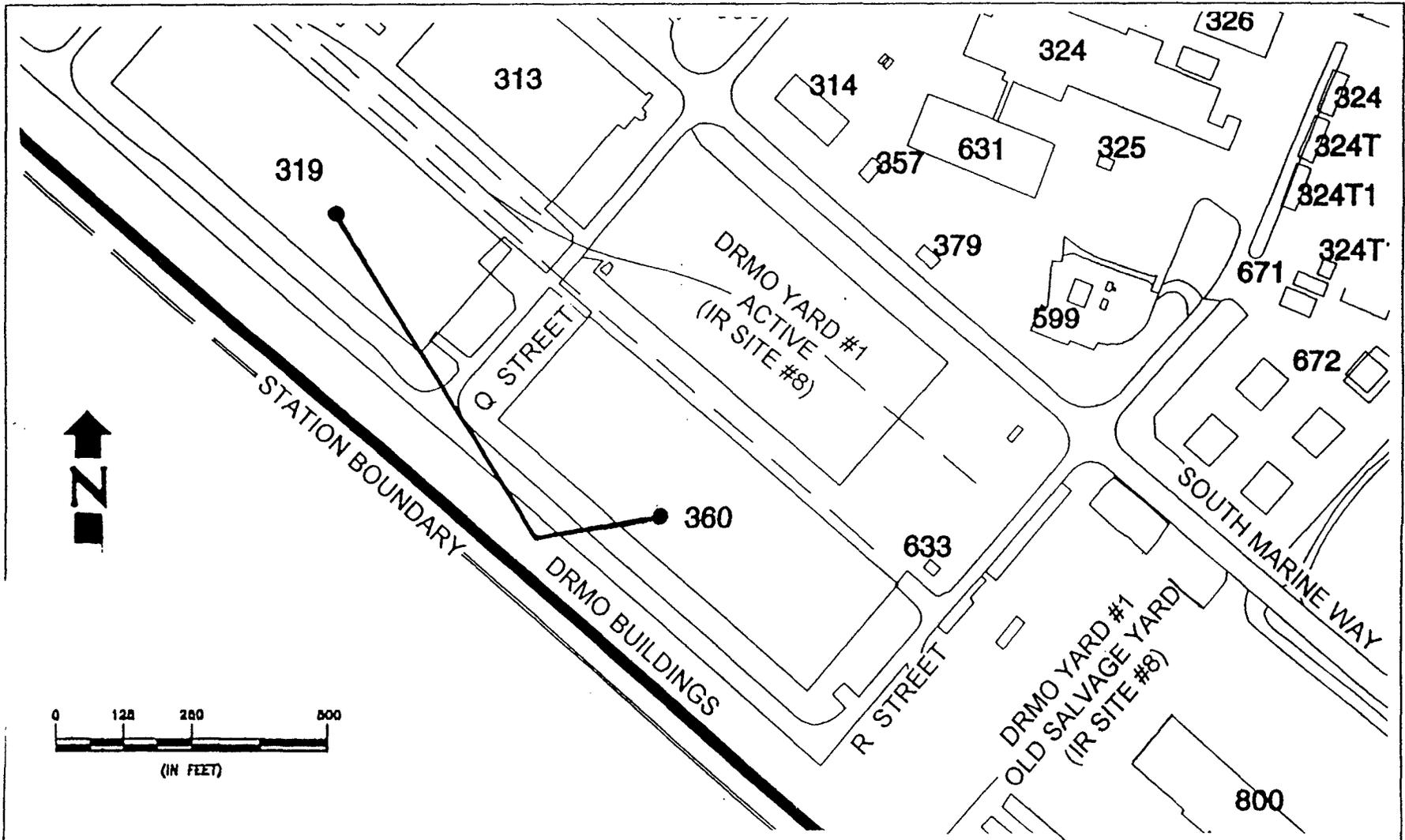
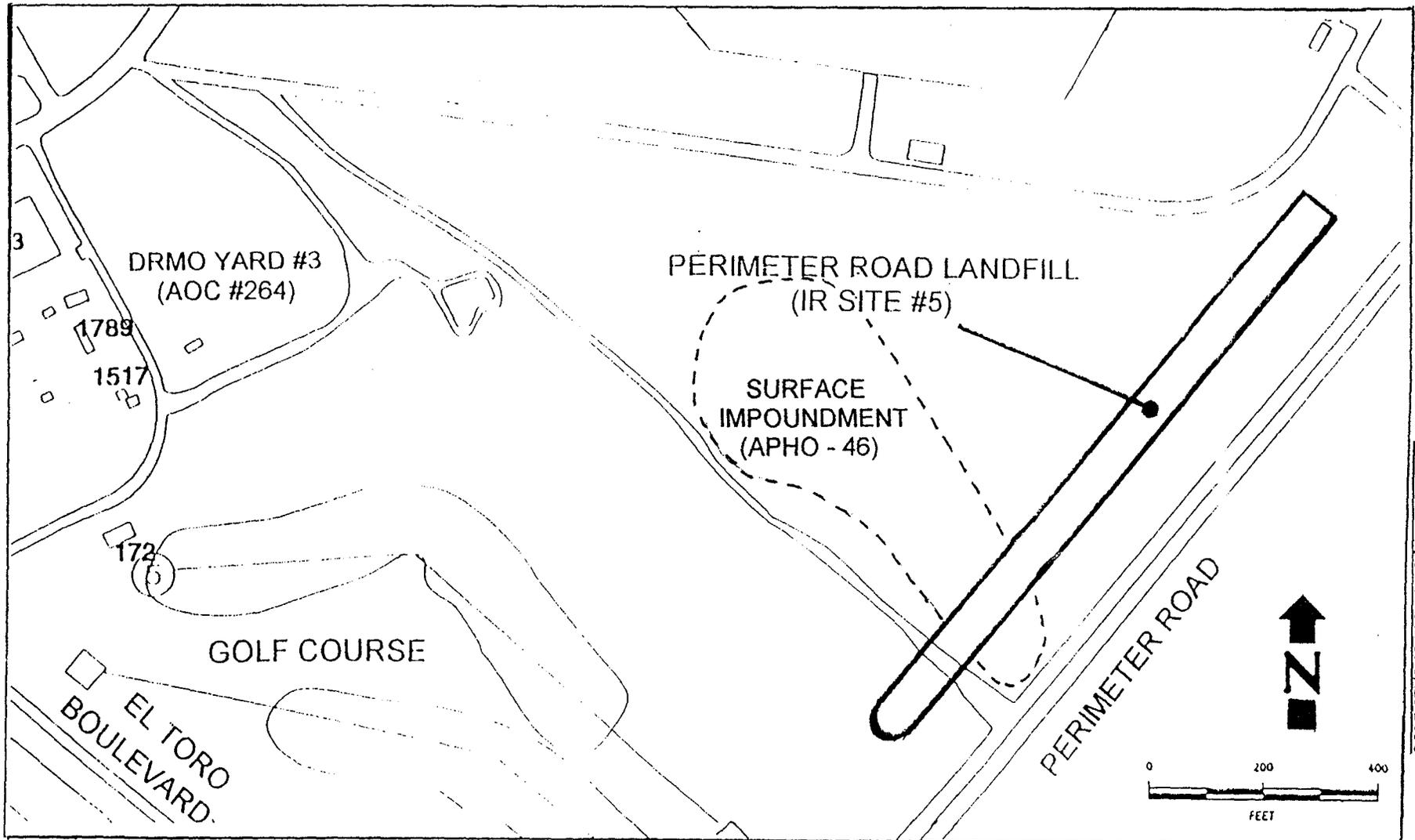


Figure A-3

DRMO Buildings 319 and 360 and DRMO Yard #1 (IR Site #8)

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Figure A-4

DRMO Yard #3 (AOC #264) and Perimeter Road Landfill (IR Site #5) Including Surface Impoundment (APHO-46)

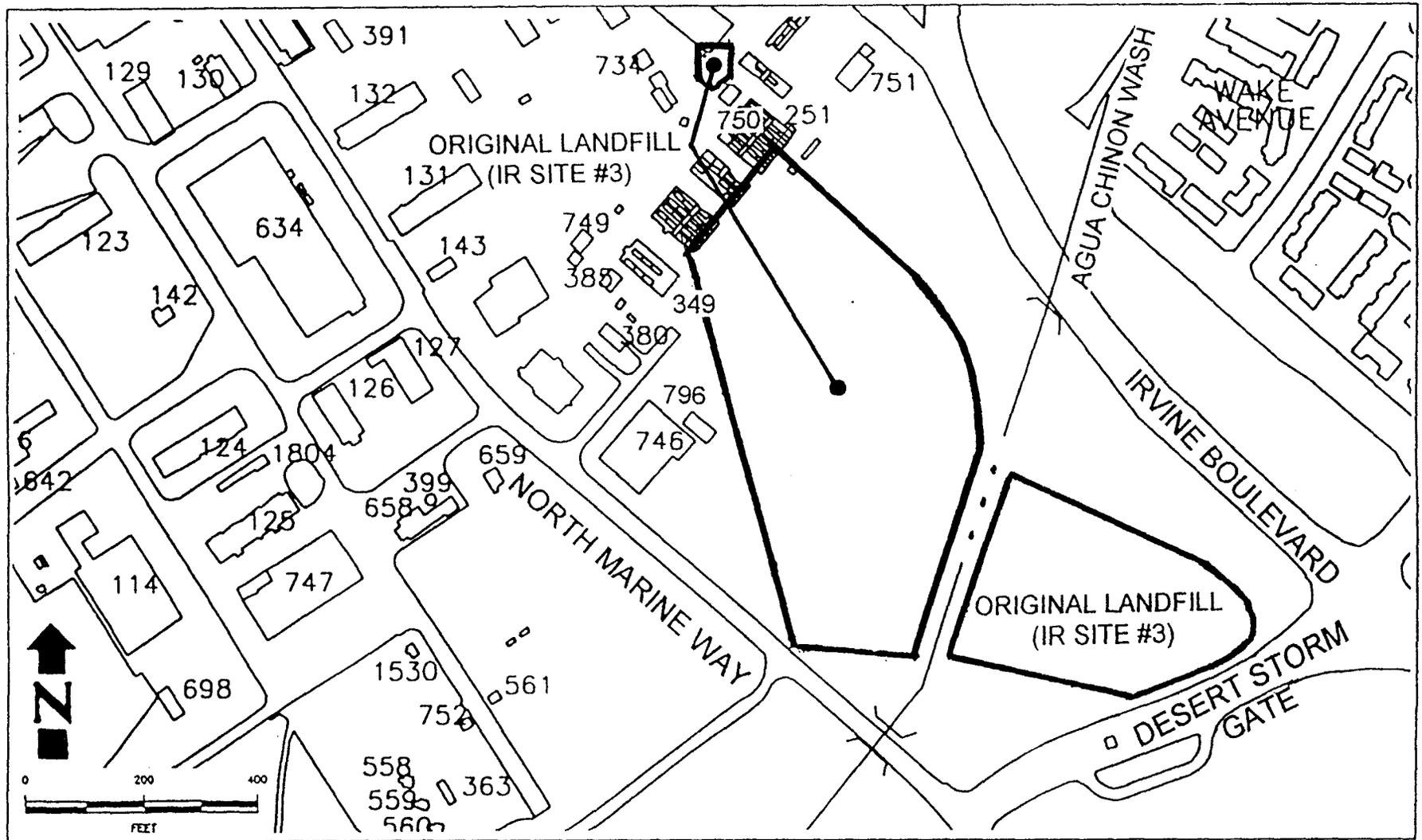
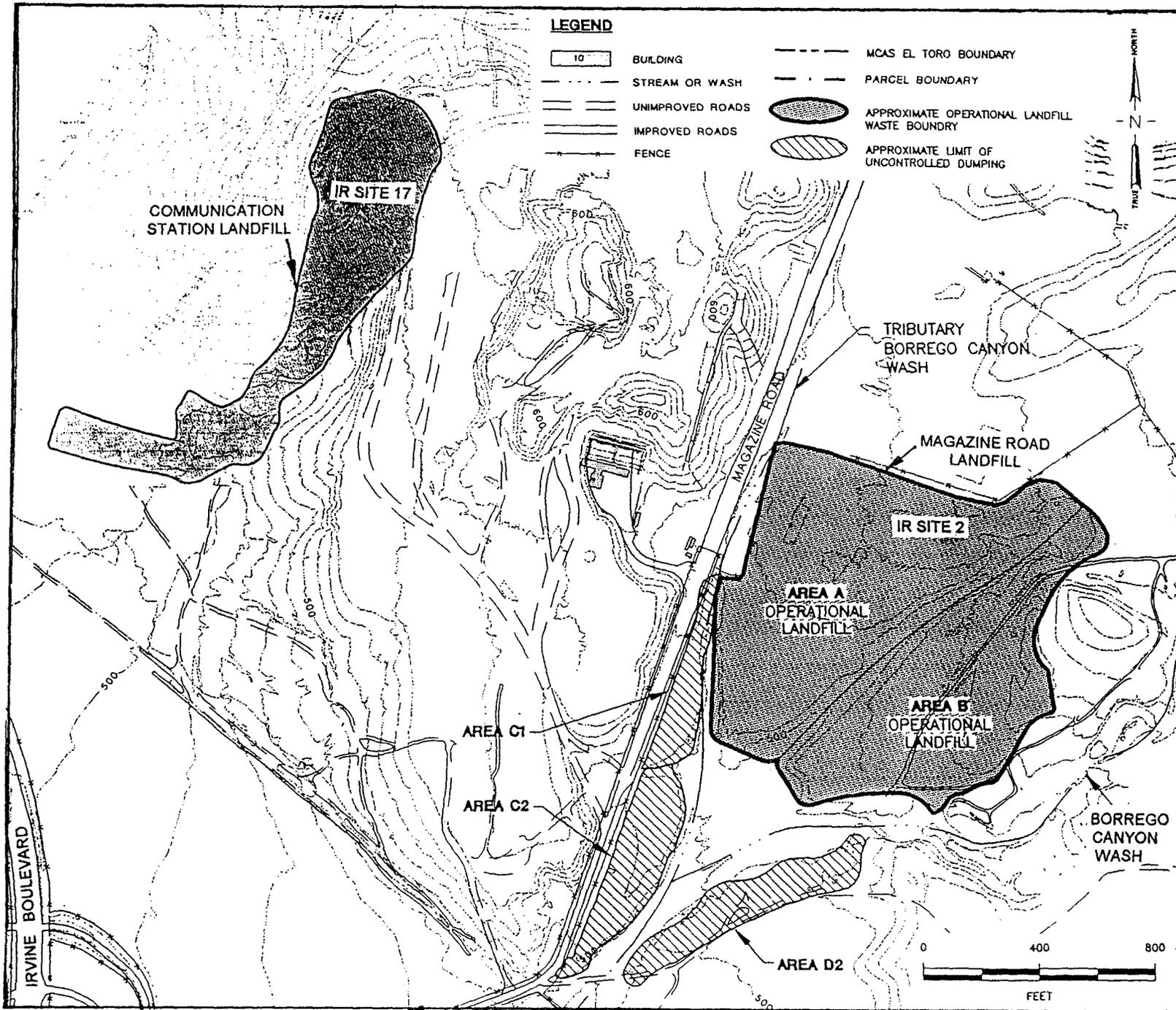


Figure A-5
Original Landfill (IR Site #3)

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Figure A-6
Magazine Road (IR Site #2) and Communication Station (IR Site #17) Landfills

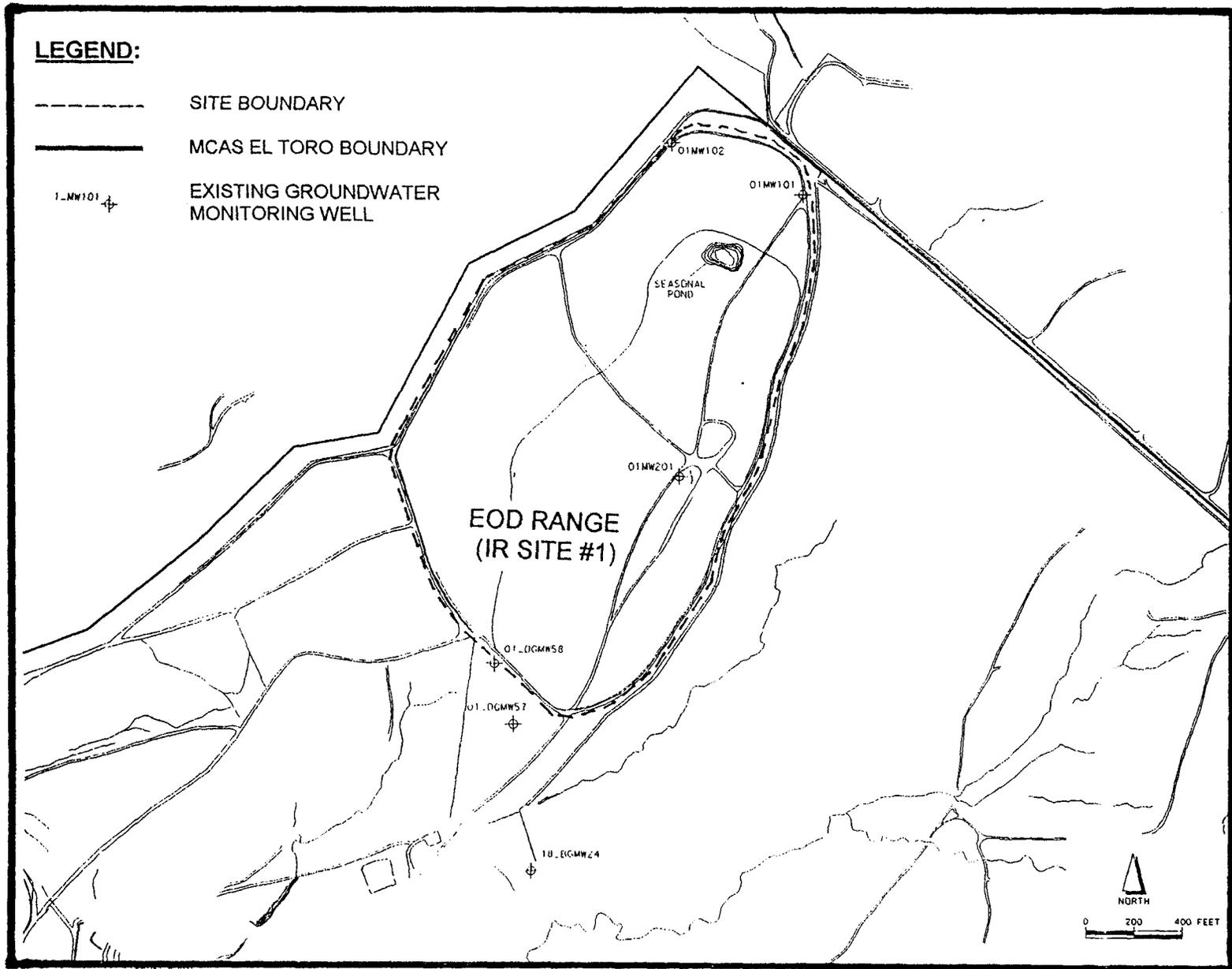


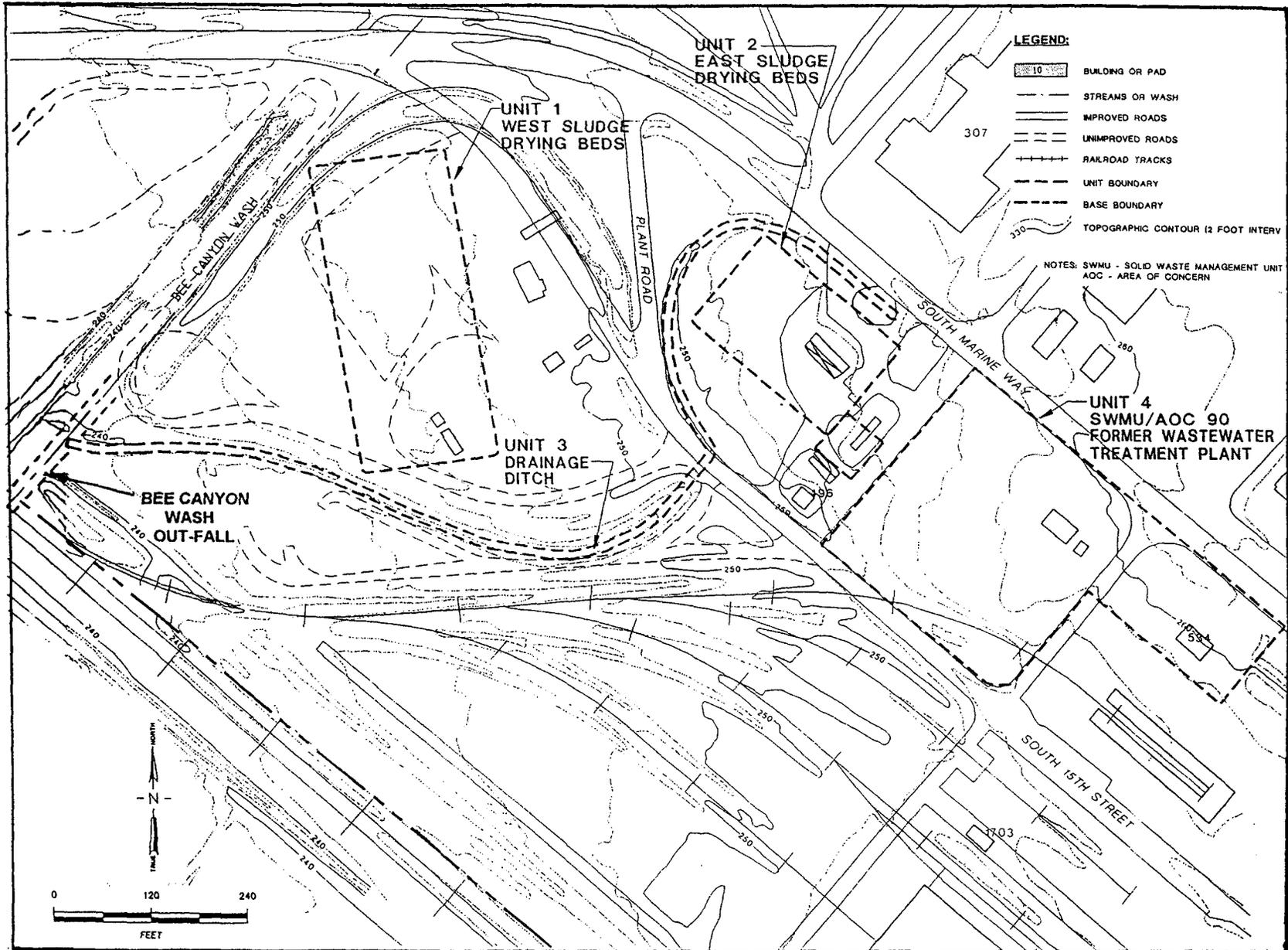
Figure A-7
Explosive Ordnance Disposal (EOD) Range (IR Site #1)

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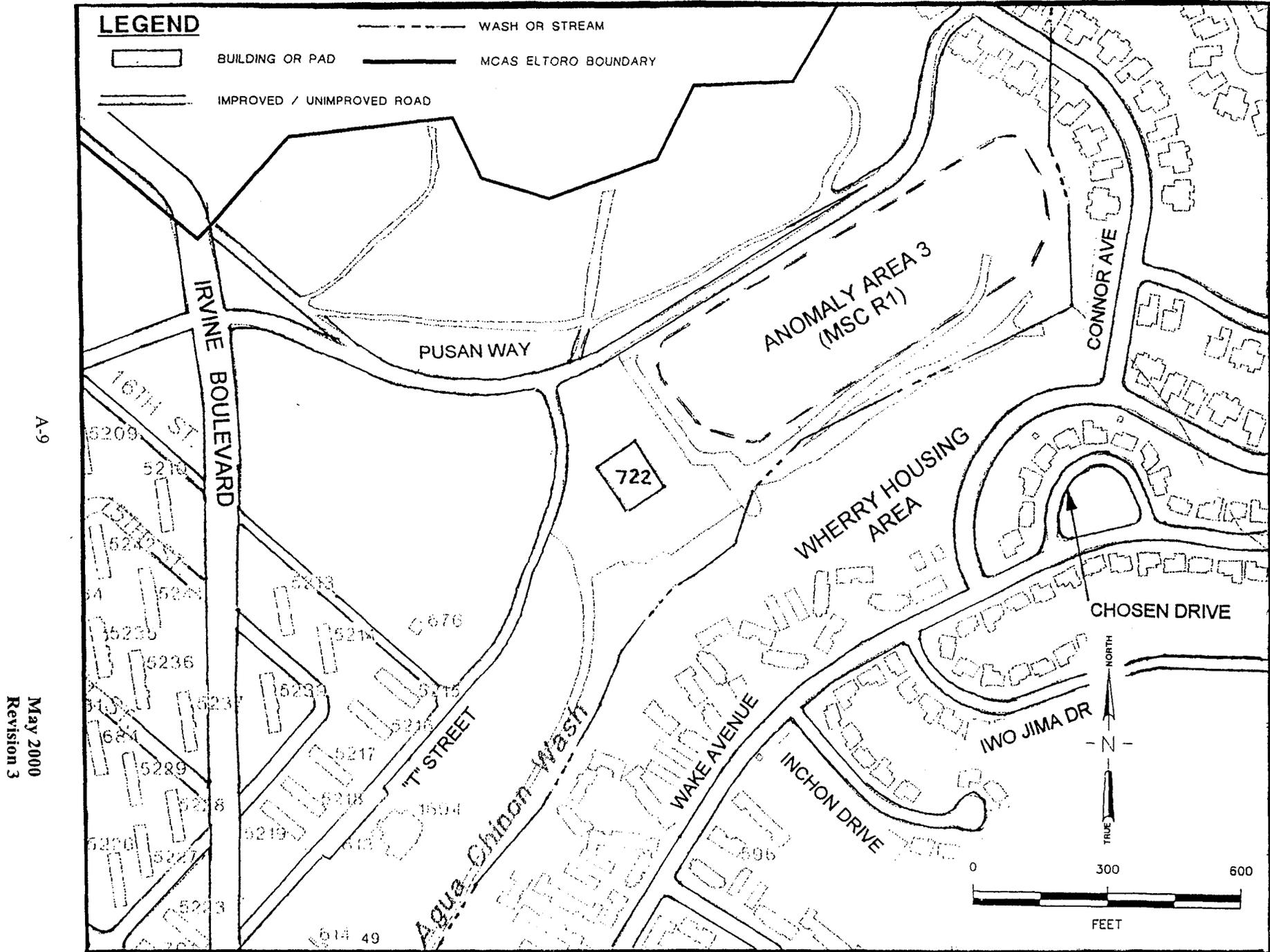
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Figure A-8

Former Industrial Waste Treatment Plant (IR Site #12) - Out-Fall Portion of Bee Canyon Wash (IR Site #25)



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Figure A-9
Former Landfill at Station Family Housing – Anomaly Area 3 (MSC R1)

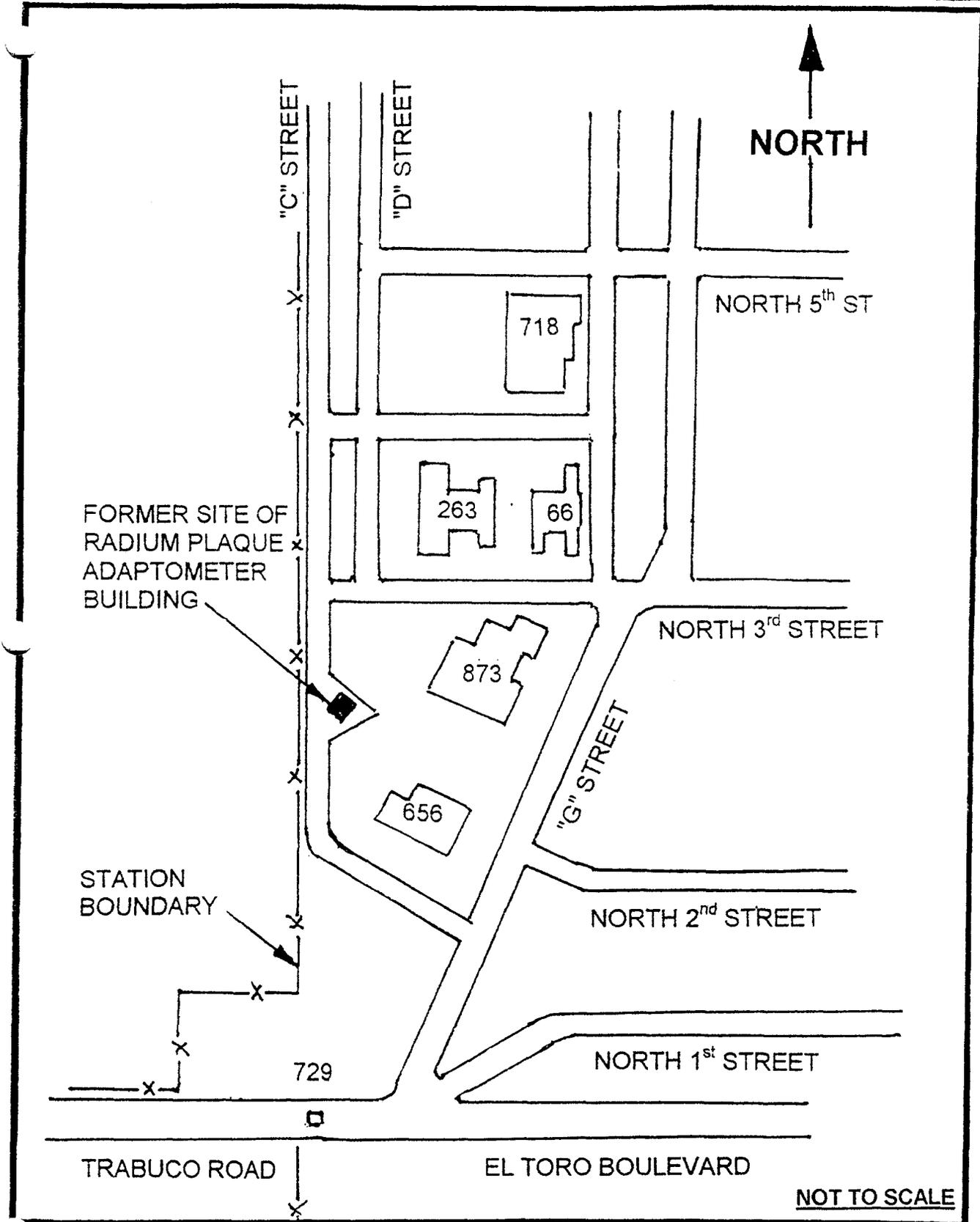


Figure A-10
Former Site of Radium Plaque Adaptometer Building

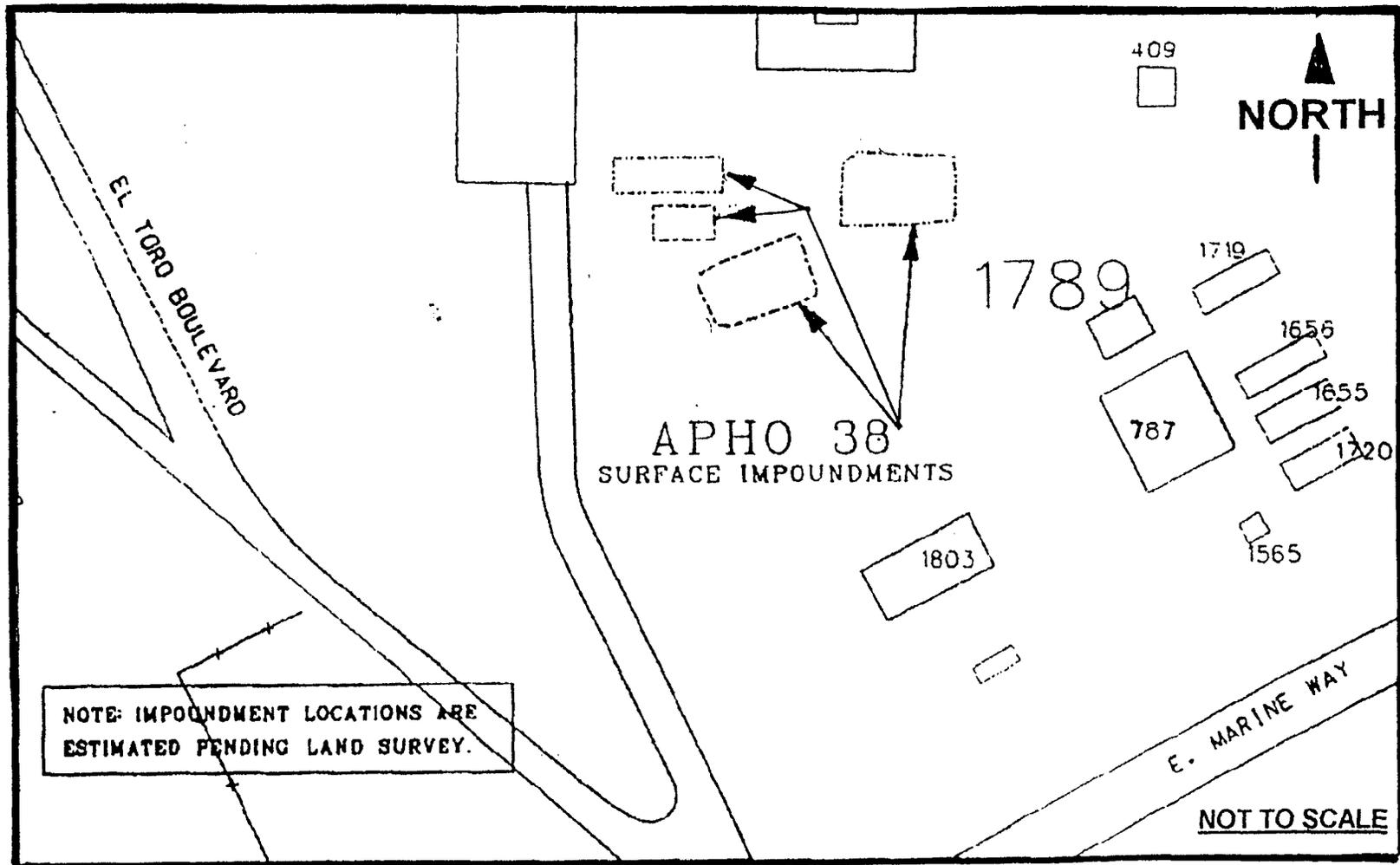


Figure A-11

Nuclear, Biological and Chemical Buildings 787, 1789, 1803 and Adjacent Surface Impoundments

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Appendix B

List of Documents

Appendix B
List of Documents

The following is as list of the documents reviewed and used as references for the preparation of the Historical Radiological Assessment (HRA) for MCAS El Toro. Reference numbers are provided in the text of the HRA when information is taken directly from the reference document.

1. Southwest Division, Naval Facilities Engineering Command - July 1993; Final Resource Conservation and Recovery Act (RCRA) Facility Assessment Report, MCAS El Toro, CA, Volume 1
2. P & D Consultants, Inc. - December 1996; Final Environmental Impact Report No. 563, MCAS El Toro, Volume 1B
3. Base Realignment and Closure Team - March 1998; Base Realignment and Closure Plan (BCP), MCAS El Toro, CA
4. Western Division, Naval Facilities Engineering Command - 1991; Master Plan, MCAS El Toro, CA
5. Southwest Division, Naval Facilities Engineering Command - April 1995; Final Environmental Baseline Survey Report, MCAS El Toro, CA
6. Brown and Caldwell - May 1986; Initial Assessment Study (IAS), MCAS El Toro, CA
7. Bechtel National Inc. - April 1998; Technical Memorandum, Radionuclides in Groundwater, MCAS El Toro, CA
8. Bechtel National Inc. - August 1996; Installation Restoration Program Remedial Investigation Program, Vol. II, MCAS El Toro, CA
9. Western Division, Naval Facilities Engineering Command - 1982; Master Plan, MCAS El Toro CA
10. Jacobs Engineering Group Inc., June 1994; Interview with Active and Retired Personnel from MCAS El Toro
11. Southwest Division, Naval Facilities Engineering Command, July 1991; Installation Restoration Program RCRA Facility Assessment Draft Preliminary Review/Visual Site Inspection Report, Volume I - MCAS El Toro, CA
12. Bechtel National Inc., December 1994; Draft Health & Safety Plan for RFA Extension Activities - MCAS El Toro, CA

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13. Bechtel National Inc., April 1995; Final Site - Specific Health & Safety Plan for the Addendum to the RFA - MCAS El Toro, CA
14. Bechtel National Inc., April 1997; Draft Final Phase II Remedial Investigation Report, Sites #3 and #5 - El Toro, CA
15. Base Realignment and Closure Team - March 1997; Base Realignment and Closure Plan (BCP), MCAS El Toro, CA
16. JRP Historical Consulting Services, November 1997; Inventory and Evaluation of Historic Places Eligibility for buildings and Structures at MCAS El Toro, CA
17. Bechtel National Inc., November 1998; Draft Record of Decision – Landfill Sites 2 and 17, MCAS El Toro, CA
18. Bechtel National Inc., June 1999; Draft Record of Decision – Sites 8, 11 and 12, MCAS El Toro, CA
19. Bechtel National Inc., June 1998; Technical Memorandum, Radionuclides in Groundwater, MCAS El Toro, CA
20. Bureau of Aeronautics (BuAer) letter Serial Aer-MA-223-JCH, June 7, 1945 - Subject: Radium Paint Shop – MCAS El Toro, Assembly and Repair Department
21. BuAer Technical Order No. 7-48, March 15, 1948 - Designation of Naval and Marine Air Stations authorized to handle radioactive luminous compounds
22. Eleventh Naval District route slip, August 11, 1948 - Reactivation of Overhaul and Repair (O&R) Department at MCAS El Toro
23. Eleventh Naval District letter Serial 254/04, September 3, 1948 - Subject: Reactivation of O&R Department at MCAS El Toro - Request for Increase in Allotment; Able to Support
24. BuAer letter Aer-FI-3 Serial 74269, October 8, 1948 - Subject: Reactivation of O&R Department -Request for Increase in Allotment to Support
25. MCAS El Toro letter Serial 18-98, October 27, 1948 - Subject: Shop Equipment Required for O&R Department, Request for Procurement of
26. BuAer letter Serial Aer-MA-45-3, November 5, 1948 - Subject: Shop Equipment Required for O&R Department, Information Concerning
27. MCAS El Toro letter Serial 41-98, February 17, 1949 - Subject: Shop Equipment Required for O&R Department, Request for Funds for Procurement of; revision of

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28. BuAer letter Serial Aer-MA-45-2, March 17, 1949 - Subject: Shop Equipment Required for O&R Department - Request for Funds for Procurement of
29. MCAS letter Serial 1469-40, March 21, 1949 - Subject: MCAS El Toro Instrument Shop; Material Required for
30. MCAS El Toro Organization Manual of the Overhaul and Repair Department, April 18, 1949
31. Eleventh Naval District letter Serial 313-80, May 13, 1949 - Subject: MCAS El Toro – Alterations to O&R Hangar No. 2, Building No. 296, for Installation of Master Gauge Room and Graphic Arts Shop
32. Eleventh Naval District, Public Works Office letter Serial 6401/DB-400, June 20, 1949 - Subject: MCAS El Toro Alterations to O&R Hangar No. 2, Building No. 296, for Installation of Master Gauge Room and Graphic Arts Shop
33. MCAS El Toro letter Serial KV40/A9-3, August 1, 1949 - Subject: MCAS El Toro, History of (Period January 1 through June 30, 1949)
34. SecNav letter Op-503E5/AVG, Serial 2341P50, September 14, 1949 - Subject: Inactivation of the Overhaul and Repair Department of the MCAS El Toro
35. BuAer letter Serial Aer-SE-32, September 22, 1949 - Subject: MCAS El Toro – Alterations to O&R Hangar No. 2, Building No. 296, for Installation of Master Gauge Room and Graphic Arts Shop
36. BuAer message Serial 142156Z Feb 1950 - Subject: Discontinue Immediately Application of Radioactive Paint to All Aircraft Instrument Dials
37. MCAS El Toro report Serial OpRep 41-25, October 6, 1950 – Subject: Fire Protection Inspection, MCAS El Toro
38. NAVFAC SWDIV Technical Memorandum, Aerial Photograph Anomalies MCAS El Toro, April 1999 – Anomaly Area 3
39. NAVFAC SWDIV Correspondence dated 2 July and 27 July 1999 – Construction Debris Disposal and Potential Ground water Verification Project; Anomaly Area 3
40. Bechtel National, Inc., December 1999; Draft 1998 Annual Groundwater Monitoring Report, Volumes I and II – MCAS El Toro, CA
41. March 2000; Base Realignment and Closure Business Plan - MCAS El Toro, CA

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42. Class 2 Property Records—Building 1789 dated 10/29/94; Building 787—dated 8/31/85; Building 1719—dated 4/27/91; Building 1720—dated 4/27/91; Building 1655—dated 4/27/91
43. Code of Federal Regulations – Title 10 part 30
44. EARTH TECH Inc., March 2000; Draft Technical Memorandum – Evaluation of Radionuclides in Groundwater at Former Landfill Sites and the EOD Range

Appendix C

Photo Documentation

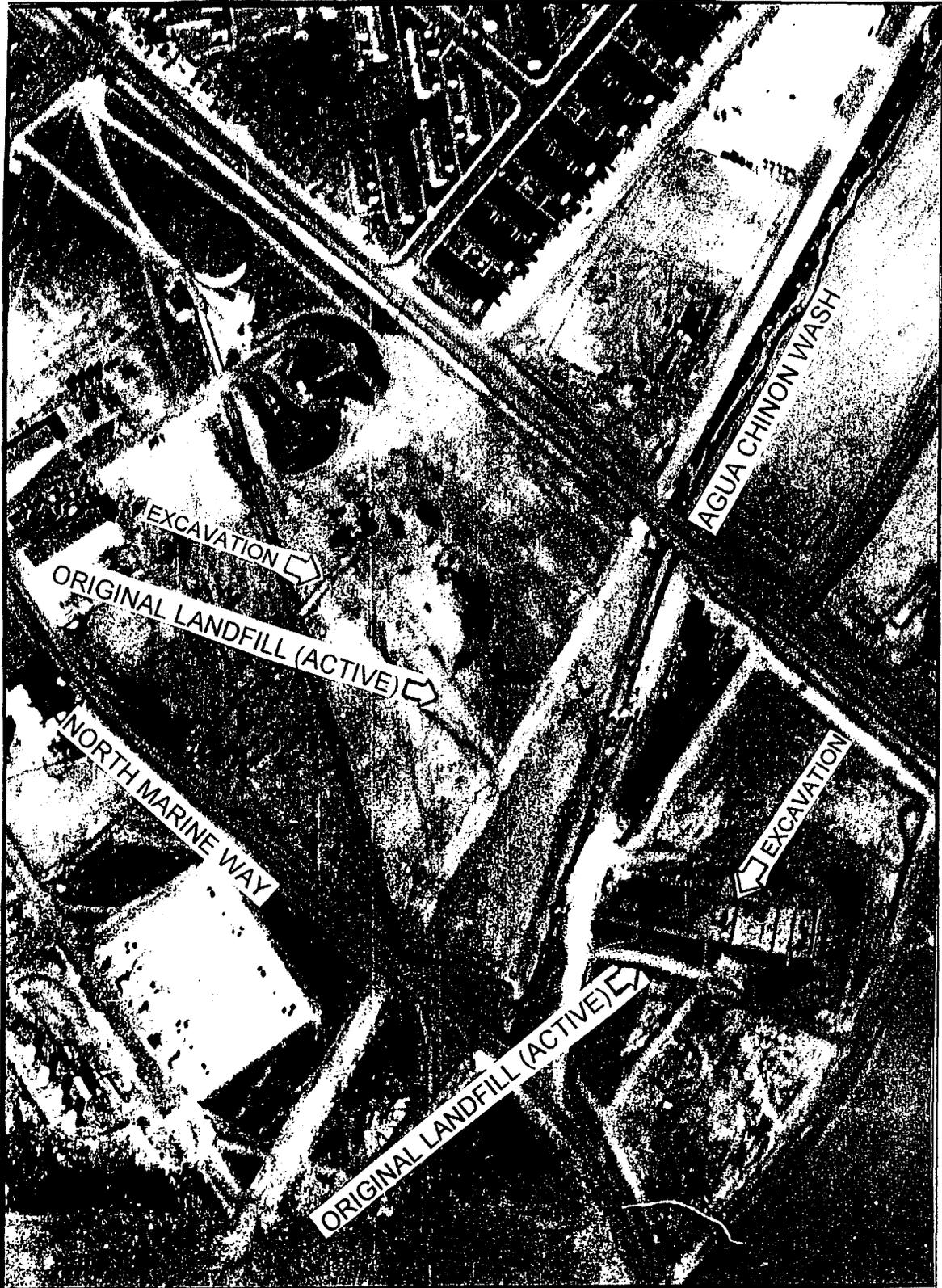


Figure C-1
Aerial Photo of Original Landfill (IR Site #3) - December 12, 1952

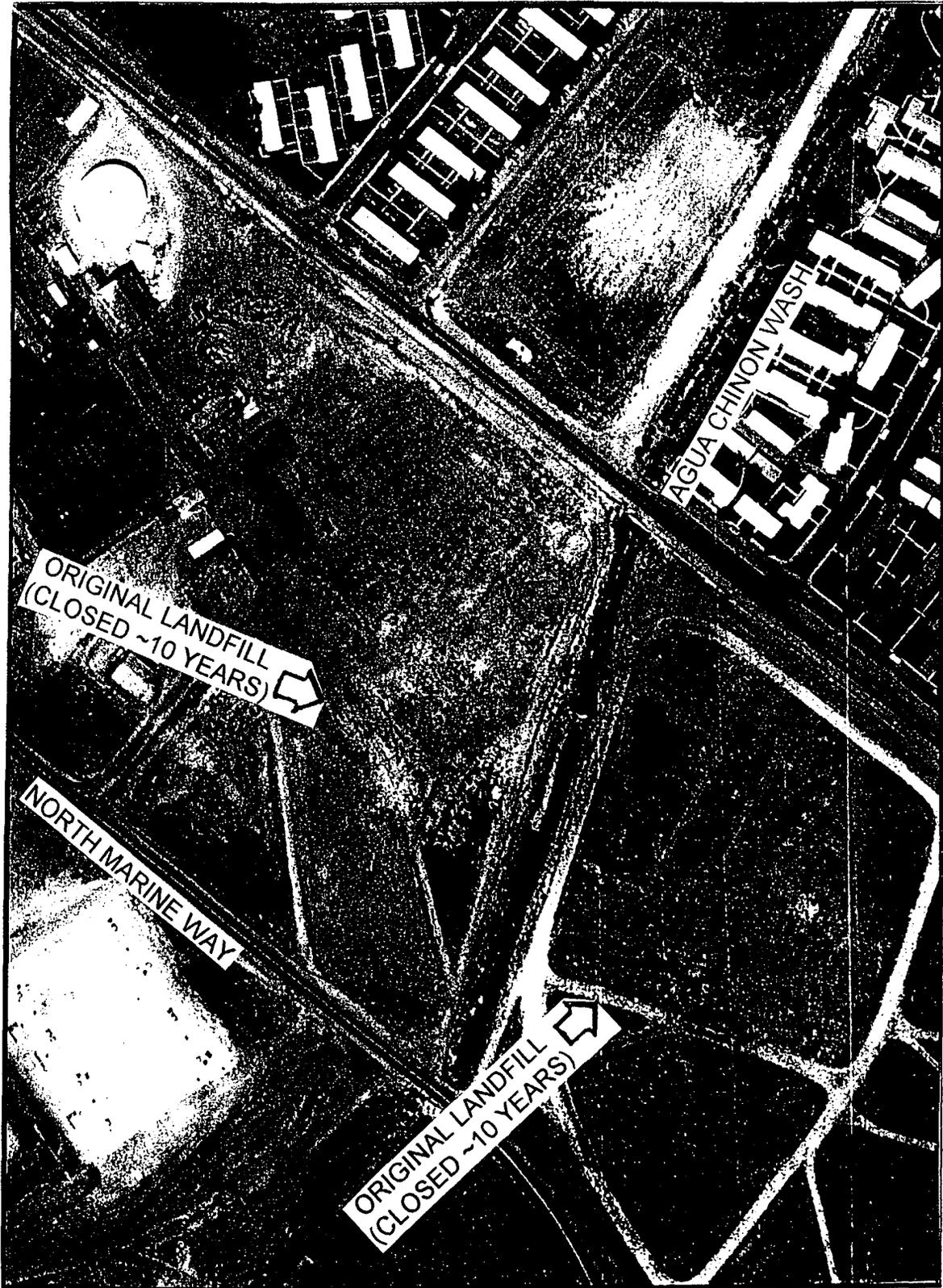


Figure C-2
Aerial Photo of Original Landfill (IR Site #3) - September 20, 1965

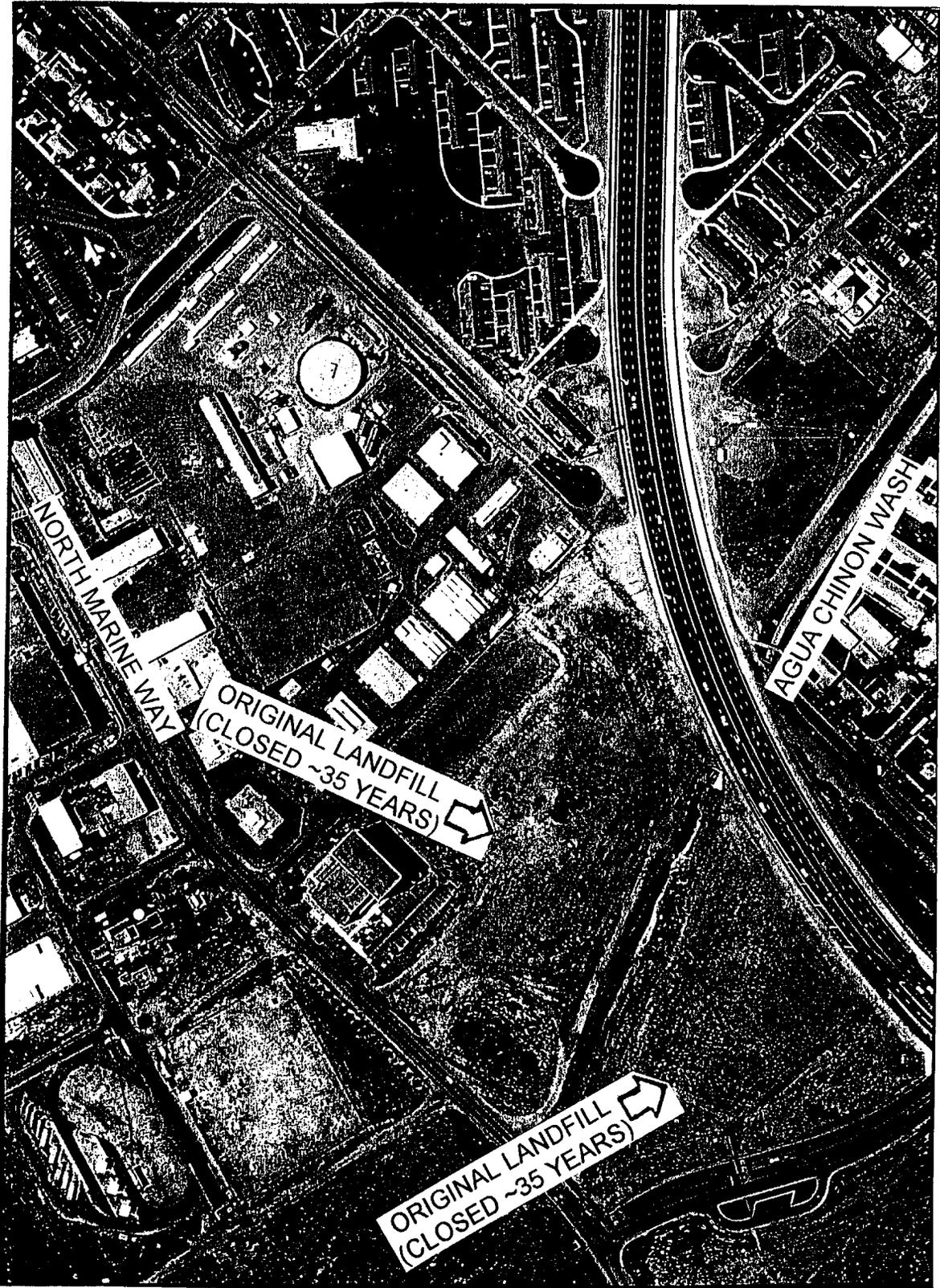


Figure C-3
Aerial Photo of Original Landfill (IR Site #3) - April 5, 1991

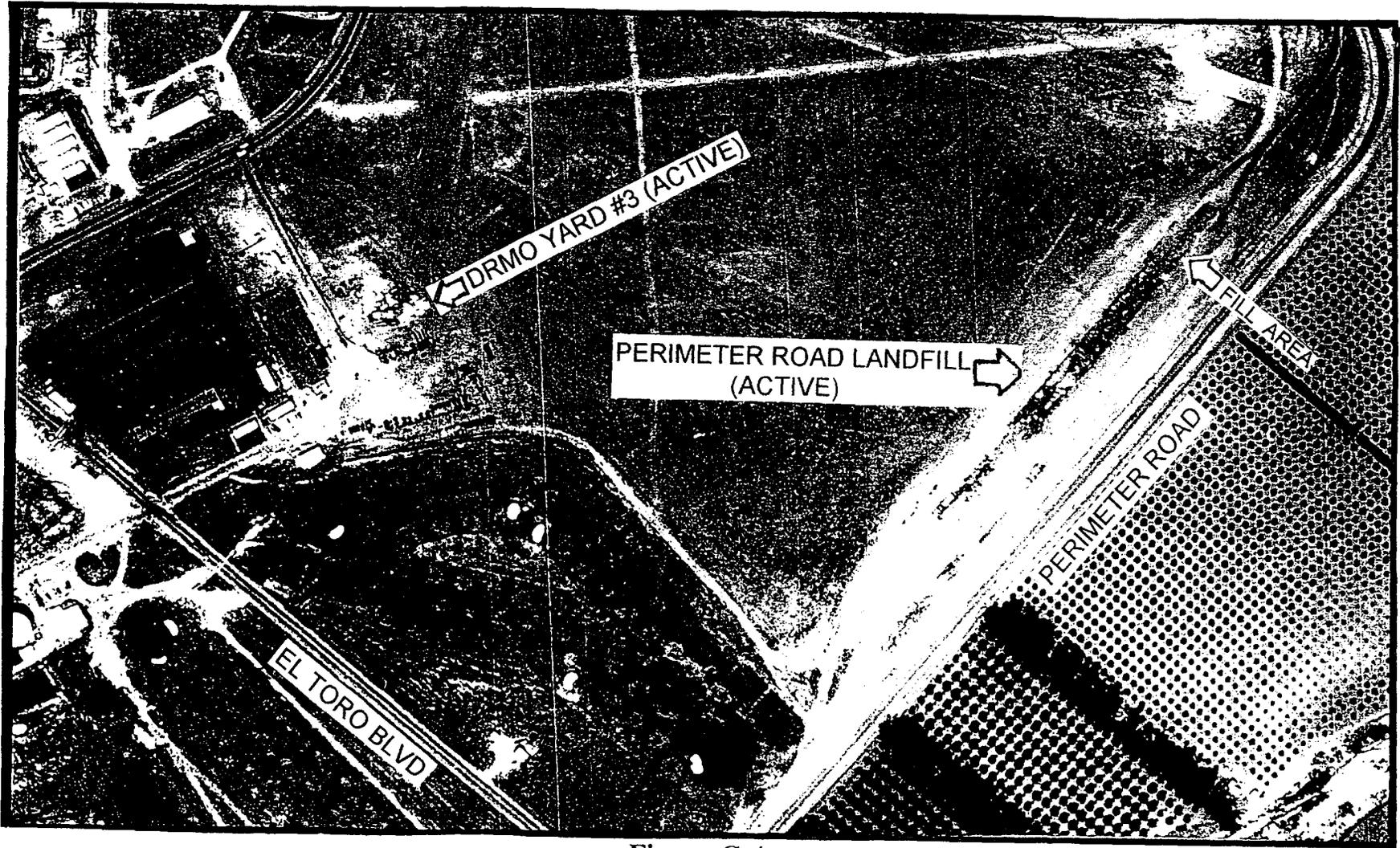


Figure C-4
Aerial Photo of DRMO Yard #3 (AOC #264) and Perimeter Road Landfill (IR Site #5) - September 20, 1965

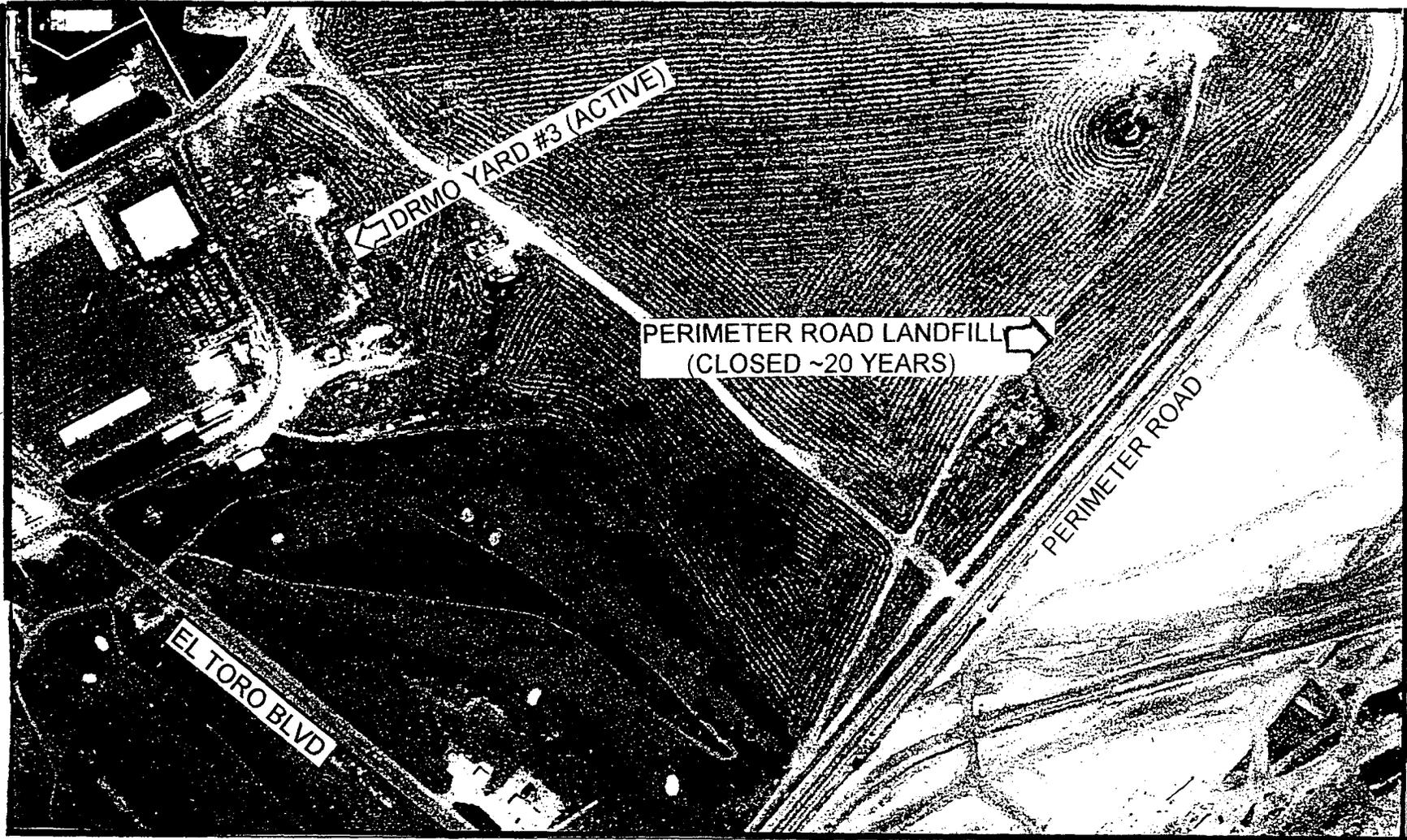


Figure C-5

Aerial Photo of DRMO Yard #3 (AOC #264) and Perimeter Road Landfill (IR Site #5) - April 8, 1986

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Figure C-6
Aerial Photo of DRMO Yard #1 (IR Site #8) - December 12, 1952

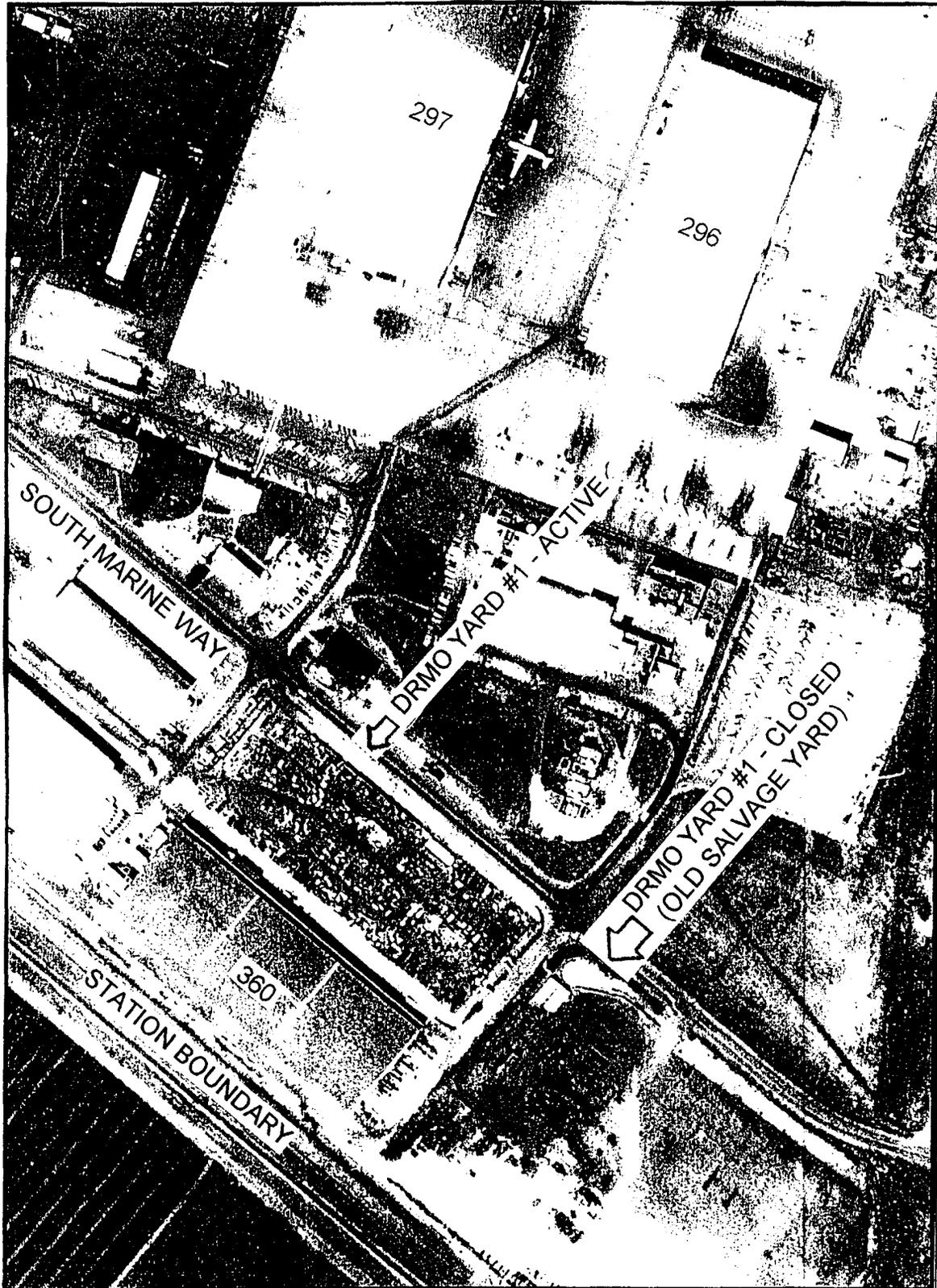


Figure C-7
Aerial Photo of DRMO Yard #1 (IR Site #8) - September 20, 1965



Figure C-8
Aerial Photo of DRMO Yard #1 (IR Site #8) - April 5, 1991



Figure C-9

Aerial Photo of Communication Station and Magazine Road Landfills (IR Sites #2 & #17) - June 28, 1970

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Final Historical Radiological Assessment (HRA)
Marine Corps Air Station, El Toro



Figure C-10

Aerial Photo of Communication Station and Magazine Road Landfills (IR Site #2 & #17) – February 25, 1980

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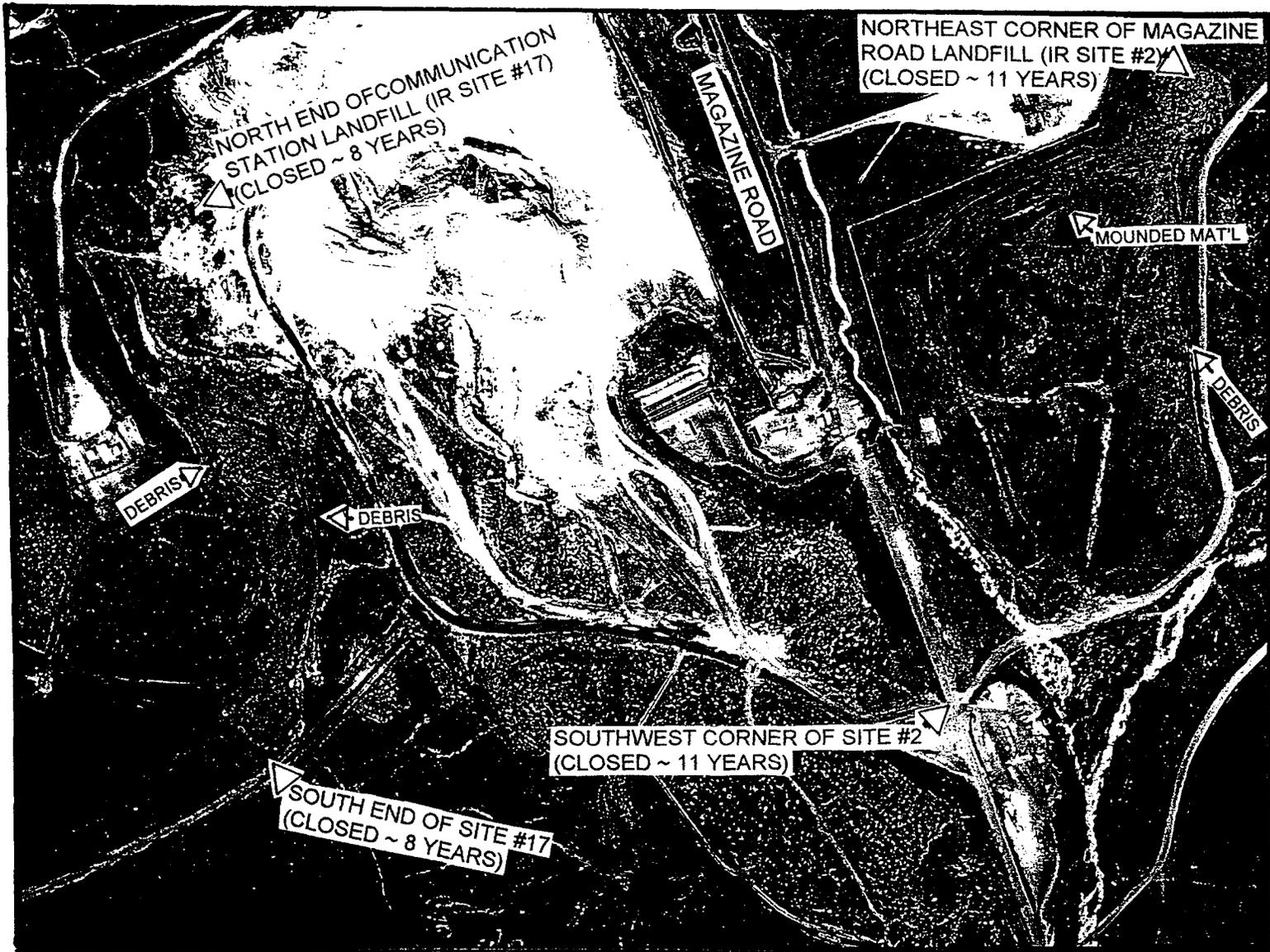


Figure C-11

Aerial Photo of Communication Station and Magazine Road Landfills (IR Site #2 & #17) – April 5, 1991

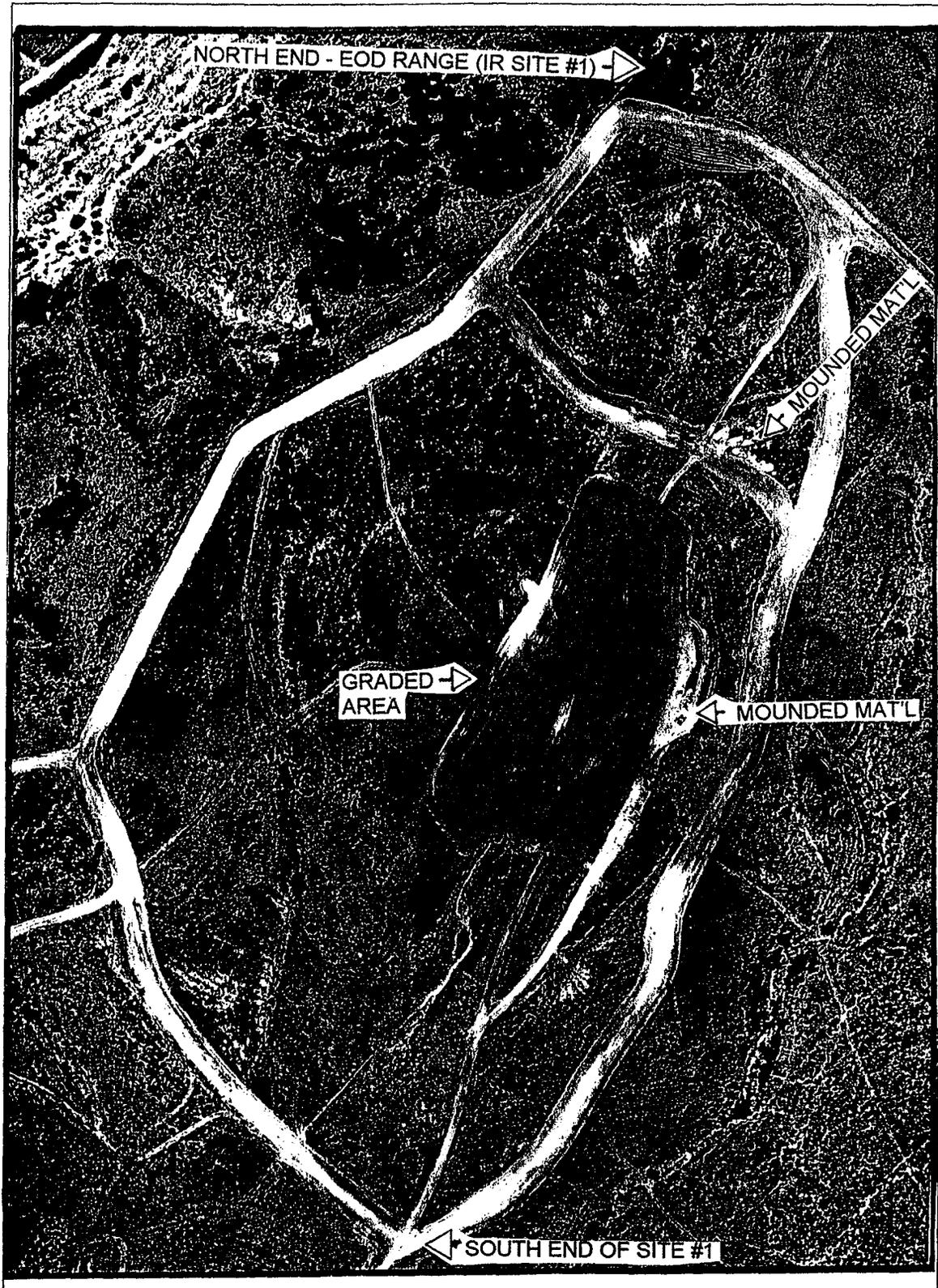


Figure C-12
Aerial Photo of EOD Range (IR Site #1) – August 8, 1970



Figure C-13
Aerial Photo of EOD Range (IR Site #1) - October 30, 1981



Figure C-14
Aerial Photo of EOD Range (IR Site #1) - April 18, 1986

Appendix D

Potential for Non-Regulated Materials being Disposed of at MCAS El Toro

**Potential for Non-regulated General Radioactive Materials Being Disposed of
in the Explosive Ordnance Disposal Range (Site 1) at MCAS El Toro**

**Table 7-1
(Sheet 1 of 2)**

No	Report	Description of Finding	Action	Results
1	Initial Assessment Study (IAS) of MCAS El Toro; NEESA 13-074; Brown and Caldwell, May 1986	Page 2-7; Paragraph 2.2.1 - "...it was reported that low-level radioactive waste may have been disposed of in the Explosive Ordnance Disposal (EOD) Range. Although no information could be obtained concerning the location of the site within the EOD range or the specific material disposed of, the possibility of its existence there should be recognized."	Page ES-1; Site 1(EOD) warrants further investigation under the NACIP program to assess long range impact	"Confirmation Study is recommended to confirm or deny the presence of suspected contamination and quantify extent of any problems which may exist."
2	Initial Assessment Study of MCAS El Toro; NEESA 13-074; Brown and Caldwell, May 1986	Page 3-1; Paragraph 3.2.1 - " <u>Site 1, Explosive Ordnance Disposal Range</u> ...Type of Samples: soil, ... Testing Parameters: radium isotopes.... The ten samples collected are to be composited to four, per figure 3-1."	IR Program - Phase II; RI Program, Feasibility Study, November 9, 1993. Site 1; CTO145, para. A1.8.2: <u>Subsurface Soil</u>	"No subsurface soil samples were collected during Phase I RI because of the danger of explosives..... in the absence of complete characterization and/or remediation of soil at Site 1, a land use restriction will likely be instituted."
3	El Toro MCAS, CERCLIS No. CA6170023208, April 1993 - Public Health Assessment	Page 22; "Materials containing low level radiation have been reportedly buried at the Site 1, Explosive Ordnance Disposal Range. Although access to Site 1 is restricted, anyone disturbing radioactive buried material may be exposed to low level radiation." Page 34; "RECOMMENDATIONS: Perform radiological surveys at Site 1 - EOD Range."	IR Program - Phase II; RI Program, Feasibility Study, November 9, 1993. Site 1, CTO145, para. A1.9.1: <u>Shallow Soil</u>	"Sampling Strategy: No further investigation is proposed for Phase II. Site 1 is recommended for further investigation during base closure, once explosive ordnance activities have been discontinued."
4	MCAS El Toro, Installation Restoration Program Draft RCRA Facility Assessment Report, Vol. III, July 1993	Page 3-5; Table 3-1 - "Suspected Waste Types and Contaminants at MCAS El Toro RI/FS Sites: Site Number 1 -(sulfur trioxide chlorosulfuric acid), low-level radioactive material, metals, nitrated toluene,....."	IR Program - Phase II; RI Program, Feasibility Study, November 9, 1993. Site 1, CTO145, para. A1.9.3: <u>Groundwater</u>	"Sampling Strategy: Monitor for gross alpha and beta particle activity to follow up the unsubstantiated reports that radioactive materials may have been disposed of at the site."

**Potential for Non-regulated General Radioactive Materials Being Disposed of in the
Explosive Ordnance Disposal Range (Site 1) at MCAS El Toro**

**Table 7-1
(Sheet 2 of 2)**

No.	Report	Description of Finding	Action	Results
5	Final BRAC Cleanup Plan (BCP) for MCAS El Toro, March 1998	Page 3-5, Paragraph 3.1.1 - "OU-3 consists of 7 IRP Sites that still require further action...These remaining 7 sites focus primarily on potential shallow soils and do not necessarily relate to contamination in groundwater..... Site 1 (Explosive Ordnance Disposal [EOD] Range)" Page 3-49, Table 3-1a, IRP-1; "Remedial Investigation to begin in 1997"	Page 3-8: "Site 1 formal closure activities will begin once training range is operationally closed in July 1999"	Table 3-1a; Regulatory mechanism will be through FFA (Federal Facility Agreement).
6	Final BRAC Cleanup Plan (BCP) for MCAS El Toro, March 1998	Page 4-4, Paragraph 4.1.3, item 6 -"Since Site 1, EOD Range, continues as an active training range, environmental closure and investigation activities will begin post operational closure...in July 1999."	The RI is expected to complete in summer of 2000. Feasibility Study to complete in 2001.	Final Record of Decision will be signed in 2002 to allow any required Remedial Design and Remedial Action to formally begin.
7	Final BRAC Cleanup Plan (BCP) for MCAS El Toro, March 1998	Page 6-19, Table 6-1, Site 1 - "Contaminants: Groundwater - Gross alpha/beta (and others); Anticipated Use - Habitat Preserve."	Technical Memo dated April 1998 - Radionuclides in Groundwater MCAS El Toro. Analyses were performed for following: Gross alpha, Gross beta, Radium- 226 and 228, Strontium- 89 and 90	Groundwater sample results from wells associated with Site 1 indicate gross alpha levels below State and Federal drinking water MCL (15 pCi/l) and gross beta levels below drinking water MCL (50 pCi/l). Maximum Ra-226 concentration was 2.8 pCi/l. Ra-228, Sr-89 and 90 concentrations were below the minimum instrument detection limits.
8	Tour of EOD Range by SSPORTS representatives in October 1998	See section 5.5 of this HRA: EOD personnel stated that the Range was used for ordnance disposal, not for disposal of Station waste. Further, the EOD Range is not licensed for radioactive materials and does not handle or dispose of nuclear/radioactive ordnance.		

Potential for Non-regulated General Radioactive Materials Being Present in the Station Defense Reutilization and Marketing Office (DRMO) Yards at MCAS El Toro

Table 7-2
(Sheet 1 of 2)

No	Report	Description of Finding	Action	Results
1	Initial Assessment Study of MCAS El Toro; NEESA 13-074, Brown and Caldwell, May 1986	Page 6-2; Paragraph 6.2.2 - "...From the start of the base until approximately 1982, some potentially hazardous materials were received for storage at Defense Property Disposal Office El Toro prior to public sale." Page 8-15; Paragraph 8.9 - "Site 8, DPDO Storage Yard....the yard has served as a storage area for various scrap and salvage materials since the early years of El Toro operations. These materials include mechanical and electrical components and containerized liquids from MCAS El Toro and MCAS Tustin."	In 1984 soil containing PCBs was excavated to a depth of one foot at Site 8 and disposed of off-Station. No soil was analyzed for radioactivity	The IAS concluded that there was no threat to human health or to the environment; therefore a confirmation study was not recommended for Site 8.
2	Final Resource Conservation and Recovery Act (RCRA) Facility Assessment Report, Volume 1, July 1993	During the RCRA Facility Assessment conducted in 1992, the following areas were identified: Page 4-29; SWMU/AOC 46 (DRMO Yard #2) was recommended for a sampling visit, and Page 4-37; SWMU/AOC 264 (DRMO Yard #3) was recommended for a sampling visit.	4 hand auger borings (5 ft. deep) were taken at each yard.	No samples were analyzed for radioactivity; Yard #2 required additional samples and Yard #3 was recommended for NFA.
3	Draft - Health and Safety Plan for RFA Extension Activities, MCAS El Toro, December 1994 (DRMO Yard #3, SWMU/AOC 264)	Page E5-1; Paragraph 5.2.2 - "The potential for being exposed to radioactive materials exists during work at MCAS El Toro Defense Reutilization Marketing Office (DRMO), Yard #3. Radiation monitoring will be conducted for health and safety purposes on soil samples and suspect objects or material uncovered during intrusive work at these locations."	Research of El Toro files and sighting the area, apparently no intrusive work was performed	No radiation monitoring was required to be conducted, since no intrusive work was performed in Yard #3.
4	Final BRAC Cleanup Plan, MCAS El Toro, March 1998 (DRMO Yard #2, SWMU/AOC 46)	Pages 3-26 and 3-27; Paragraph 3.2.7.4 - recommended that DRMO Yard #2 be transferred to the Remedial Action Contractor for limited removal/cleanup of surface soils for cleanup of diesel, since it was a vehicle maintenance and parking DRMO Yard.	Page 3-185; Table 3-13, indicated, the "release" did not extend into area.	Page 3-185; Table 3-13, Environmental Condition of Property is #2: Area where only petroleum products have been disposed of or released.
5	Final BRAC Cleanup Plan, MCAS El Toro, March 1998 (DRMO Yard #3, SWMU/AOC 264)	Page 3-27; Paragraph 3.2.7.4 - "In a letter dated 17 May 1994, DTSC approved the RFA under the conditions that further investigation (i.e., sampling) be performed. The eight additional SWMUs/AOCs...investigated (included)....264 (DRMO Storage Yard #3)." Page 3-199; Table 3-13, "Summary of SWMUs - DTSC letter dated 23 July 1996 concurs with recommendation by Bechtel National of NFA."	Sampling completed; Final Add'm to RFA of 5/31/96 recommended no further action for Yard #3	DTSC letter of 7/23/96 concurs that no further action is required for DRMO Yard #3, however, there is no indication of any radiological considerations.

Potential for Non-regulated General Radioactive Materials Being Present in the Station Defense Reutilization and Marketing Office (DRMO) Yards at MCAS El Toro

Table 7-2
(Sheet 2 of 2)

No.	Report	Description of Findings	Action	Results
6	Draft - Health and Safety Plan for RFA Extension Activities, MCAS El Toro, December 1994	Page E10-2; Paragraph 10.6 - "Radiation Monitoring: A general purpose, alpha-beta-gamma-sensitive Geiger-Muller detector will be utilized for health and safety screening at the Defense Reutilization Marketing Office Area (DRMO)(Site 8). Radiation monitoring will be conducted for health and safety purposes on soil samples and suspect objects or material uncovered during intrusive work at these locations."	Research of El Toro files and sighting the area revealed that, apparently no intrusive work was performed.	No radiation monitoring was required to be conducted, since apparently, no intrusive work was performed in Site 8.
7	Final - Site Specific Health and Safety Plan for the Addendum to the RFA MCAS El Toro, April 1995	Page E5-3; Table 5-1, "Ionizing Radiation - Not expected, but possible in some areas. Radiation monitoring shall be performed at DRMO areas"	Research of El Toro files does not indicate any radiation monitoring.	Not Applicable
8	Final BRAC Cleanup Plan (BCP) for MCAS El Toro, March 1998	Page 3-5; Paragraph 3.1.1 - "OU-3 consists of 7 IRP Sites that still require further action...These remaining 7 sites focus primarily on potential shallow soils and do not necessarily relate to contamination in groundwater... Site 8 (Defense Reutilization and Marketing Office [DRMO] Storage Yard)."	Page 3-49, Table 3-1a - IRP-8; Draft Remedial Investigation submitted in 1996.	Table 3-1a; Regulatory mechanism will be through FFA (Federal Facility Agreement).
9	Technical Memorandum; Radionuclides in Groundwater, MCAS El Toro, April 1998; prepared by Bechtel National Inc.	Page 7; Groundwater wells 08-DGMW 73 and 08-DGMW 74. Samples from Site 8 were only analyzed for Radon-222 and Strontium-89/90. Radon is a decay product of uranium via Ra-226 and, in groundwater typically ranges from 100 to 3,000 pCi/l. There is currently no promulgated USEPA drinking water standard for Rn-222.	Page 7 of Table 1 provides the results of groundwater samples taken in 1996 and 1997 at Site 8.	Page 7: Radon maximum level was 384 pCi/l. The Strontium levels were below the minimum instrument concentration limits.

**Potential for Non-regulated General Radioactive Materials Being Disposed of in the Station
Landfills (Sites 2, 3, 5 and 17) at MCAS El Toro**

**Table 7-3
(Sheet 1 of 5)**

No	Report	Description of Finding	Action	Results
1	Initial Assessment Study of MCAS El Toro; NEESA 13-074; Brown and Caldwell, May 1986	Page 2-7, Paragraph 2.2.2 - Site 2 (Magazine Road) Landfill; 22 acres - received all solid wastes (est. volume 800,000 to one million cu. yards) generated at El Toro; late 1960s to 1980. Page 2-8, Paragraph 2.2.3 - Site 3 (Original) Landfill; 20 acres - received any waste (est. volume 243,000 cu. Yards maximum) generated at El Toro; 1943 to 1955. Page 2-9, Paragraph 2.2.4 - Site 5 (Perimeter Road) Landfill; Approximately 1.5 acres - used for any types of waste (est. volume 60,000 cu. yards maximum) generated at El Toro from 1955 to late 1960s. Page 2-12, Paragraph 2.2.9 - Site 17 (Communication Station) Landfill; Approximately 26 acres - used to dump almost any type of waste (no est. volume) generated on Station from 1981 to 1983. Now covered by cut from nearby hill.	Page ES-1; Sites 2, 3, 5 and 17 warrant further investigation under the NACIP program to assess long range impacts.	Confirmation Studies, involving sampling and monitoring of the sites are in progress to confirm or deny the presence of suspected contamination and quantify the extent of any problems which may exist.
2	Jacobs Engineering Group Inc.- Interviews with Active and Retired Personnel from MCAS El Toro, May 26, 1994	Page 11, Question 30 - "Do you know if radioactive material/waste was disposed of in Landfill, Site 2? Other Landfills? " Answer: "...members had no knowledge of radioactive material ever being disposed of into any of the landfills by the Facility Management Department....., it is possible that equipment painted with radium paint could have been disposed of into the landfills by the Marines"	No Action was taken regarding response to this question since the answer was based on supposition.	Not applicable.
3	Final Environmental Baseline Survey Report; MCAS El Toro - Southwest Division, Naval Facilities Engineering Command, April 1, 1995	Table 3-2, IRP Sites MCAS El Toro - Each of the Landfills (Sites 2, 3, 5 and 17) are listed as "Area Type 6 - Areas where storage, release, disposal, and/or migration of hazardous substances or petroleum products has occurred, but required response actions have not yet been implemented."	Installation Restoration RI Report of August 1996 and Final Phase II RI Report dated April 1997	Results of groundwater and soil sampling at Sites 2, 3, 5 and 17 are provided below.
4	Installation Restoration Remedial Investigation Report of August 1996 (Site 2)	Page 4-30, Paragraph 4.6 Gross Alpha and Beta Particle Activity - "Analyses for gross alpha... ..and.....beta particle activity were performed... at Site 2."	Groundwater Sampled at four wells associated with Site 2	Two downgradient samples exceeded State and Federal gross alpha drinking water MCL of 15 pCi/l
5	Installation Restoration Remedial Investigation Report of August 1996 (Site 3)	Page 4-30, Paragraph 4.6 Gross Alpha and Beta Particle Activity - "Analyses for gross alpha... ..and.....beta particle activity were performed... at Site 3/4."	Sampled six wells at Site 3/4	One sample exceeded State and Federal gross alpha drinking water MCL of 15 pCi/l

**Potential for Non-regulated General Radioactive Materials Being Disposed of in the Station
Landfills (Sites 2, 3, 5 and 17) at MCAS El Toro**

**Table 7-3
(Sheet 2 of 5)**

No.	Report	Description of Finding	Action	Results
6	Installation Restoration Remedial Investigation Report of August 1996 (Site 5)	Page 4-30, Paragraph 4.6 Gross Alpha and Beta Particle Activity - "Analyses for gross alpha... ..andbeta particle activity were performed... at Site 5."	Sampled three wells at Site 5	One downgradient sample exceeded State and Federal gross alpha drinking water MCL of 15 pCi/l
7	Draft Phase II Remedial Investigation Report - Site 2 of March 1996	Page 8-15, Paragraph 8.1.2- Conclusions and Recommendations: "Groundwater samples from Site 2 contained detectable concentrations of metals, and gross alpha and beta activity..... The gross beta activity appears to (be) derived from naturally occurring potassium in the area." It is possible that gross alpha activity may be the result of naturally occurring uranium in the area.	Technical Memorandum, Radionuclides in Groundwater; April 1998 - Table 1, Radionuclide Activity Samples; before 1996.	9 of the 23 samples analyzed prior to issue of the Phase II RI Report of March 1996 exceeded State and Federal gross alpha drinking water MCL of 15 pCi/l. No sample exceeded two times the MCL.
8	Draft Final Phase II Remedial Investigation Report - Site 3, of April 1997	Page 2-27, Paragraph 2.5.3 Field Screening - Soil samples collected ..were..screened at Site 3 to assess: <ul style="list-style-type: none"> • whether radioactive material was present... • whether significant radioactivity was detected and...identify the range of natural variability of the radioactive material. Field screening for radiation sources was performed using a thin window pancake Geiger-Muller (GM) detector. If a reading above the background level was noted on any of the field-screening instruments, the sample was selected for further analysis.	Soil samples were taken at 13 holes; 3 deep (85 ft to 100 ft) and 10 shallow (3 ft to 30 ft). Average of 10 samples were screened in each deep hole; Average of 4 samples were screened in shallow holes.	<u>Deep holes:</u> 8 of 29 samples were above average background (50 cpm), with the four highest samples = 80 cpm. <u>Shallow holes:</u> 13 of 36 samples were above the average background (~50 cpm), with one (highest) sample = 80 cpm. Next highest 12 samples = 60 cpm.
9	Draft Record of Decision; Landfill - Sites 2 and 17, dated November 1998	Page 1-1 and 1-5, Para. 1.3, Site Description - "The operational landfill...(Site 2)..was used from the late 1950s until about 1980." "Aerial photographs indicate that landfilling activities were under way (Site 17) as early as 1970.."	Investigate the types of waste disposed of at Sites 2 and 17.	All solid waste from El Toro and some from Tustin was disposed in Site 2. Any type of waste generated may have been disposed of at Site 17.

**Potential for Non-regulated General Radioactive Materials Being Disposed of in the Station
Landfills (Sites 2, 3, 5 and 17) at MCAS El Toro**

**Table 7-3
(Sheet 3 of 5)**

No.	Report	Description of Finding	Action	Results
10	Draft Final Phase II Remedial Investigation Report - Site 5, of April 1997	<p>Page 2-25, Paragraph 2.6.3 Fielding Screening - Soil samples collectedwere field screened at Site 5 to evaluate whether:</p> <ul style="list-style-type: none"> • significant radioactivity was present in soil • significant radioactivity was detected to identify the range of the natural variability of the radioactive material. <p>Field screening for radiation sources was performed using a thin window pancake Geiger-Muller (GM) detector. If a reading above the GM background was noted on field-screening instruments, the sample was selected for further analysis.</p>	Soil samples were taken at 4 holes; 3 80 to 100 ft deep holes and one 210 ft deep hole with avg. of ~11 samples screened in each 100 ft. hole and 38 samples in the 210 ft hole.	100 ft. deep holes: 9 of 31 samples screened were above average background (~60 cpm), with three (highest) samples = 80 cpm. 210 ft. deep hole: 5 of the 38 samples were above average background (45 cpm), with the two (highest) samples = 60 cpm.
11	Technical Memorandum, Radionuclides in Groundwater, MCAS El Toro, dated April 1998 (Site 2)	<p>Page 2, Radionuclide Results at MCAS El Toro- Groundwater samples have been collected at Site 2 at MCAS El Toro as part of remedial investigations and basewide groundwater monitoring programs. The groundwater samples collected from September 1992 to October 1997 from monitoring wells across the Station were analyzed for:</p> <ul style="list-style-type: none"> • gross alpha and gross beta activity • strontium-89/90 • radium-226/228 • radon (Rn-222) <p>There is no USEPA promulgated drinking water MCL for radon, however, groundwater levels are typically between 100 and 3000 pCi/l.</p> <p>* Groundwater results were reviewed to identify activities of gross alpha and gross beta that occur above US EPA and CA MCL for drinking water (alpha - 15 pCi/l and beta - 50 pCi/l).</p>	A total of 62 well samples were analyzed at Site 2.	25** of the 62 samples exceeded State and Federal gross alpha drinking water MCL and three samples from one well exceeded two times the MCL. No samples exceeded State and Federal gross beta drinking water MCL. The maximum level reported for Rn-222 was 831 pCi/l. ***Groundwater samples are now being analyzed for nuclides.

Potential for Non-regulated General Radioactive Materials Being Disposed of in the Station Landfills (Sites 2, 3, 5 and 17) at MCAS El Toro

**Table 7-3
(Sheet 4 of 5)**

No.	Report	Description of Finding	Action	Results
12	Technical Memorandum, Radionuclides in Groundwater, MCAS El Toro, dated April 1998 (Site 3)	<p>Page 2, Radionuclide Results at MCAS El Toro-Groundwater samples have been collected at Site 3 at MCAS El Toro as part of remedial investigations and basewide groundwater monitoring programs. The groundwater samples collected from September 1992 to October 1997 from monitoring wells across the Station were analyzed for:</p> <ul style="list-style-type: none"> • gross alpha and gross beta activity • strontium-89/90 • radium-226/228 • radon <p>*Groundwater results were reviewed to identify activities of gross alpha and gross beta that occur above US EPA and CA MCL for drinking water (alpha - 15 pCi/l and beta - 50 pCi/l).</p>	A total of 38 well samples were analyzed at Site 3.	<p>12** of the 38 samples exceeded State and Federal drinking water gross alpha MCL. No samples exceeded the State and Federal drinking water gross beta MCL. The maximum level reported for Rn-222 was 760 pCi/l.</p> <p>***Groundwater samples are now being analyzed for nuclides.</p>
13	Technical Memorandum, Radionuclides in Groundwater, MCAS El Toro, dated April 1998 (Site 5)	<p>Page 2, Radionuclide Results at MCAS El Toro-Groundwater samples have been collected at Site 5 at MCAS El Toro as part of remedial investigations and basewide groundwater monitoring programs. The groundwater samples collected from September 1992 to October 1997 from monitoring wells across the Station were analyzed for:</p> <ul style="list-style-type: none"> • gross alpha and gross beta activity • strontium-89/90 • radium-226/228 • radon <p>There is no USEPA promulgated drinking water MCL for radon, however, groundwater levels are typically between 100 and 3000 pCi/l.</p> <p>*Groundwater results were reviewed to identify activities of gross alpha and gross beta that occur above US EPA and CA State MCL for drinking water (alpha - 15 pCi/l and beta - 50 pCi/l).</p>	A total of 29 well samples were analyzed at Site 5.	<p>14** of the 29 samples exceeded State and Federal gross alpha drinking water MCL. One beta particle sample (53 pCi/l) in 1992 exceeded the gross beta drinking water MCL. Since another beta sample from the same well at the same time was 8 pCi/l and next highest level from same well is 19 pCi/l, the 1992 analysis appears to be an anomaly. The maximum level reported for Rn-222 was 571 pCi/l.</p> <p>***Groundwater samples are now being analyzed for nuclides.</p>

**Potential for Non-regulated General Radioactive Materials Being Disposed of in the Station
Landfills (Sites 2, 3, 5 and 17) at MCAS El Toro**

**Table 7-3
(Sheet 5 of 5)**

No.	Report	Description of Finding	Action	Results
14	Technical Memorandum, Radionuclides in Groundwater, MCAS El Toro, dated April 1998 (Site 17)	Pages 7 and 8, Table 1 indicates that groundwater samples at Site 17 have been taken since 1995 from monitoring wells located at the site. Groundwater samples were analyzed for: <ul style="list-style-type: none"> • gross alpha and gross beta activity • strontium-89/90 (one of seven analyzed) • radon (two of seven analyzed) There is no USEPA promulgated drinking water MCL for radon, however, groundwater levels are typically between 100 and 3000 pCi/l.	A total of seven well samples were analyzed at Site 17	***All samples were within the State and Federal MCL for drinking water. The maximum level of Rn-222 reported was 1619 pCi/l.
15	Restoration Advisory Board Meeting of March 25, 1998; Report on El Toro landfills given by Bernie Lindsay from Naval Facilities Engineering Command, South West Division	Question from RAB member: "Why did the original hazard ranking done for El Toro state that unknown amounts of radiological materials are present in the landfills?" Joseph Joyce, Navy RAB Co-chairman, stated that investigations did not reveal any nuclear materials disposed of in Station landfills. Glen Kistner of US EPA stated that "... information on nuclear materials in the hazard ranking is probably inaccurate."	Review the possibility of storage or disposal of radioactive materials at the Station	There was the known work on radium instruments in hangar 296 from late 1940s until approx. 1950s. Scrap removed when room was decommissioned is unaccounted for.
16	Draft 1998 Annual Groundwater Monitoring Report, MCAS El Toro, Volumes I and II dated December 1999	In October 1998, groundwater samples taken from IR Sites #2, #3/#4 and #5 were analyzed for gross alpha and gross beta activity. A total of 20 samples were analyzed; nine were found to have gross alpha levels greater than the drinking water MCL of 15 pCi/l; none had gross beta levels greater than the drinking water MCL of 50 pCi/l.	Each of the 20 samples were further analyzed for uranium and radium 226/228.	In each of the 20 samples analyzed, natural uranium was determined to be the isotope responsible for the gross alpha levels in the groundwater. All Ra-226 levels were below the USEPA drinking water limit of 3pCi/l and the total Ra-226/228 was below the USEPA limit of 5pCi/l.

* Gross alpha and gross beta analyses are intended only as screening tests for drinking water and may not be appropriate for non-potable groundwater, particularly in areas where high levels of naturally occurring uranium deposits are likely found. When these MCLs are exceeded, the next step is to determine the radionuclide(s) responsible. Samples from monitoring wells that routinely exceed the gross alpha MCL should then have alpha spectral analysis. Analyses of the uranium series are the most likely radionuclides to start with to determine whether or not the elevated gross alpha levels are from naturally occurring uranium sources.

** Technical Memorandum, Radionuclides in Groundwater dated April 1998, page 14 - GROSS ALPHA ACTIVITY: A histogram of gross alpha activity suggests a log-normal distribution. This may be representative of a natural gross alpha background in groundwater for the Station due to its slightly skewed distribution on a geometric mean of 9.9 pCi/l and may be representative of a single source of gross alpha activity.

*** Starting in 1997, groundwater samples from IR Sites #2, #3 and #5 were analyzed, using gamma spectroscopy, for radium. All of the samples revealed radium levels below the MCL for drinking water. Current Confirmation Studies being performed at IR Sites #2, #3, #5 and #17 include radionuclide investigation of groundwater.