M60050.000967

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MCAS EL TORO
SSIC # 5090.3

COLLEGE OF ENGINEERING

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Las Cruces, New Mexico 88003-8001
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NEW MEXICO STATE UNIVERSITY

Mr. Lee Saunders
Environmental Public Affairs Officer
Code 00DE
Naval Facilities Engineering Command, Southwest Division
1200 Pacific Highway
San Diego, CA 92131-5190

17 July 1995

SUBJECT: APPROVAL FOR PUBLIC RELEASE OF "HISTORICAL AERIAL PHOTOGRAPH AND LAND-USE ASSESSMENT FOR AN ENVIRONMENTAL REMEDIATION INVESTIGATION: MCAS EL TORO, SOUTHERN CALIFORNIA"

REFERENCE: FINAL REPORT, AERIAL PHOTOGRAPH ASSESSMENT, MCAS EL TORO, CONTRACT No. N68711-91-D-4658, PREPARED BY SCIENCE APPLICATIONS INTERNATIONAL CORPORATION, OCTOBER, 1993

Mr. Saunders:

My co-author, Susan Eastman, and I conducted the work that is the basis for the above-referenced report and subject technical paper. We hope to publish this paper in "Environmental and Engineering Geoscience" (formerly the Bulletin of the Association of Engineering Geologists) and are seeking approval for the paper's public release. I have also submitted a copy of the paper to Mr. Andy Piszkin, Code 1831.AP, who was our technical representative during the course of the project. Included is a copy of my letter to Mr. Piszkin.

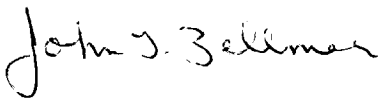
Should there be any political or other sensitivity, we can easily eliminate references to MCAS El Toro in the text and figures, or take other actions that may be required for your approval. Please note that the paper focuses on the advantages and disadvantages of the analysis techniques, and not on the results or their implications. Overall, we believe that the paper will establish the Navy as a leader in the use of historic aerial photography and historic land-use documents for environmental investigations.

We would appreciate any assistance that you may be able to provide in obtaining approval for the paper's release. I have also sent a copy of the paper to Mr. Kurt Schmidt at SAIC asking him to submit it for their release approval. My understanding is that Mr. Piszkin and SAIC had no

objections to releasing the paper, as long as the other party agreed. Thus, I suspect that some discussion between SAIC and the Navy may be necessary.

Because of numerous commitments and deadlines, I would like to receive approval ASAP, hopefully, by no later than 25 August. If you have any questions or concerns, please contact either me or Susan Eastman (PWC Code 980, 556-9651) at any time. Please note that I will be out of town from 5 - 14 August.

Sincerely,



John T. Zellmer, Associate Professor
(505) 646-3551

cc: Andy Piszkin, Code 1831.AP
Kurt Schmidt, SAIC

COLLEGE OF ENGINEERING

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Andy Piszkin
Code 1831.AP
Naval Facilities Engineering Command, Southwest Division
1220 Pacific Highway, Room 18
San Diego, CA 92132-5181

17 July 1995

SUBJECT: APPROVAL FOR PUBLIC RELEASE OF "HISTORICAL AERIAL PHOTOGRAPH AND LAND-USE ASSESSMENT FOR AN ENVIRONMENTAL REMEDIATION INVESTIGATION: MCAS EL TORO, SOUTHERN CALIFORNIA"

Andy,

In previous correspondence I indicated that I would like to publish the results of the aerial photograph investigation that SAIC conducted for MCAS El Toro under contract No. N68711-91-D-4658. Susan Eastman and I have recently completed a draft of the paper and are seeking approval for public release. Our intention is to submit it for publication in Environmental and Engineering Geoscience (formerly the Bulletin of the Association of Engineering Geologists).

My previous understanding, through the grapevine, is that neither you nor SAIC would object to the paper's being published, if there were no objections from the other party. Consequently, I am simultaneously submitting the paper to SAIC for their approval.

Should there be any political or other sensitivity, I can easily eliminate references to MCAS El Toro from the text and figures, or take other actions that may be required for your approval. Please note that the paper focuses on the advantages and disadvantages of the analysis techniques, and not on the results or their implications.

Because of numerous commitments and deadlines, I would like to receive approval ASAP, hopefully, by no later than 25 August. To help expedite the approval process, I am also submitting a copy of the paper, along with this cover letter, to Mr. Lee Saunders, the Environmental Public Affairs Officer.

If you have any questions or concerns, please contact either me or Susan (PWC Code 980, 556-9651) at any time. Please note that I will be out of town from 5 - 14 August.

Sincerely,

John T. Zellmer

John T. Zellmer
(505) 646-3551

cc: Lee Saunders, Environmental PAO, Code 00DE

HISTORICAL AERIAL PHOTOGRAPH AND LAND-USE ASSESSMENT FOR AN ENVIRONMENTAL REMEDIATION INVESTIGATION: MCAS EL TORO, SOUTHERN CALIFORNIA

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Science Applications International Corporation
10260 Campus Point Dr., San Diego, CA, 92121

17 July, 1995

For Submission To:

ENVIRONMENTAL AND ENGINEERING GEOSCIENCE
(Formerly the Bulletin of the Association of Engineering Geologists)

Present address:

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Key Words:
Environmental Geology, Hazardous Waste, Remote Sensing, Site Investigations

FIGURES

Figure 1	1946 photo
Figure 2	1979 photo
Figure 3	Land-use map 1946
Figure 4	Land-use map 1991
Figure 5	Drainage map 1946
Figure 6	Drainage map 1992

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Table 1	Photo documentation
Table 2	Annotated features
Table 3	Explanatory text
Table 4	Land-use classifications

HISTORICAL AERIAL PHOTOGRAPH AND LAND-USE ASSESSMENT FOR AN ENVIRONMENTAL REMEDIATION INVESTIGATION: MCAS EL TORO, SOUTHERN CALIFORNIA

ABSTRACT

Historical aerial photographs and historical land-use documents were valuable tools in the environmental site assessment process for a military installation slated for closure and conversion to civilian usage. Although the photographs and documents could not prove the existence of contamination, information interpreted from them helped to identify features commonly associated with environmental contamination, such as abandoned landfills, trenches possibly used for waste disposal, discolored soil, and surface-water discharge from maintenance facilities. These features then served as focal points for the investigation of possible contamination.

The investigation identified about 600 sites and occurrences of "possible environmental concern", as defined by the criteria specified for the project, and verified about 600 additional, previously identified features. The project team considered a total of 346 aerial photographs and ultimately selected and interpreted 106 of these during the investigation. In addition, numerous land use and planning documents were also evaluated. The final report of the investigation included annotated photographs depicting sites and areas of concern for each of the 21 years that were considered, land-use maps for five time periods, and surface-drainage maps for nine specific years.

INTRODUCTION

This report describes the results of an environmental investigation (SAIC, 1993) that used historical aerial photographs and historical land-use documents to identify and verify areas of "possible environmental concern" at the Marine Corps Air Station (MCAS) at El Toro, in the Los Angeles, California area, which is slated for closure and conversion to civilian usage. The aerial photographs and documents, spanning the period 1942 through 1993, were used to identify features commonly associated with releases of contamination to the environmental. Such features, especially those that existed prior to modern environmental legislation, are not always documented due to the loss of records, or because their potential for environmental degradation was not recognized, and adequate records were not kept. The lack of documentation exacerbates identifying contaminated sites and their source areas. However, other sources of historical information, such as are discussed here, can be invaluable in this regard.

The purpose of the investigation was to identify sites and areas of potential environmental concern that had not been previously recognized. Consequently, the aerial photograph analysis focused on the identification and documentation of features often indicative of contaminant release or of having the potential for contaminant release. These features

include, but are not limited to: stained or wet soil, flowing or ponded liquids, drums, open storage areas, trenches, disposal areas, tank farms, wet soil, and aircraft and vehicle maintenance areas, liquid storage tanks, disturbed ground, trenches, excavations, impoundments, refuse, and mounded material. During the investigation, about 600 of these features were identified and about an additional 600 previously recognized features and occurrences (U.S.E.P.A., 1991) were verified. The results of the analysis discussed here generally reaffirm the findings of a previous, more limited aerial photograph review, but, more importantly, identify new sites that may require investigation.

Once identified, specific sites and areas can be targeted for further investigation, while areas not containing such features, and therefore less likely to be contaminated, are given a lower priority, or, perhaps, may be excluded from further consideration, unless there is other evidence to the contrary. For example, photographic evidence may indicate the flow of a liquid from a building known to have stored solvents at the time that the photographs were taken. This would be a cause for concern, whereas liquids flowing from a residential lawn area could largely be discounted as excessive irrigation. Even though the individual aerial photographs provide site information at only discrete times, the experienced photo interpreter is commonly able to make inferences about a site's environmentally-related history by reviewing photographs and documents for different time periods. The analysis is markedly aided by land-use and drainage maps that accurately reflect the extant conditions.

For this study, aerial photographs and land-use data covering about 30 years of the 50-year history of the site were available. The intervals between photographs varied from one to six years, but were typically two to three years. This information allowed us to document features and activities as they existed on the date of the photograph, and to infer events that occurred between temporally successive photographs.

Aerial photograph coverage at the frequency available for this project may not be available for all environmental-investigation sites, but governmental, and especially private suppliers of aerial photographs may provide a surprising amount of data. Similarly, land use, engineering and emergency-response reports for various periods can commonly be obtained from archived data. The information obtained from the photographic and document sources can be supplemented by interviews with persons familiar with the site and its activities to provide a more complete and detailed history of the site.

Although the investigation focused primarily on aerial photograph interpretation, the review and analysis of historic land-use data also provided important insights into the search for potentially contaminated sites and areas. The land-use data largely consisted of master plans and various types of engineering documents. These materials illustrated specific types of land use at specific times during the 50 year period addressed during the investigation. By comparing these data, and supplementing them with the aerial photograph data, it was possible to gain an understanding of the general land use and land-use changes over time. This information helped to identify land uses that may be conducive to contamination or contaminant release, even though the historic and present land use for a given area differ markedly.

A third element of the investigation was the preparation of maps of the surface drainage as it existed at various times. These maps may be useful in determining the source of potential contamination detected at a given site, or in tracing the distribution path of a contamination release. These data can be supplemented with engineering information regarding surficial drainage systems and storm-water drainage systems.

AERIAL PHOTOGRAPHS

The search to obtain aerial photographic coverage of MCAS El Toro for the years 1942 through 1993 included four Federal and State governmental agencies, 28 private companies and two university collections, through which 346 aerial photographs were identified. After considering areal coverage, scale, and other photographic criteria, 106 aerial photographs were obtained and interpreted. The photographs covered the years: 1946, 1955, 1958, 1960, 1961, 1964, 1967, 1968, 1971, 1973, 1974, 1975, 1976, 1977, 1978, 1979, 1983, 1984, 1987, 1988, and 1992. These photographs are in addition to those evaluated during a previous investigation but not used here by direction of the sponsor.

The aerial-photograph search criteria included black and white, color and color infrared aerial photographs at scales of 1:36,000 (1 in = 3000 feet) or larger. Photographic scales smaller than 1:36,000 render recognition and identification of small-scale features difficult. If multiple scales or formats were available for a given year, color was typically favored over black and white, and the largest practical scale with the greatest areal coverage was preferred. Preference was also given to photographs providing stereoscopic coverage. All photographs were viewed through a standard mirror stereoscope at multiple levels of magnification. Because precise measurements were not required from the aerial photographs, the true scales were typically not determined, but rather, the nominal scale indicated by the photograph's supplier is generally given, and, when required, used in the discussions.

Many of the photographs used during this investigation were not of optimum scale, several did not provide stereoscopic coverage, some were of poor resolution, and many covered only portions of the investigated area. In some situations, the original negative was no longer available and it was necessary to copy the original photograph and then prepare a second generation print. This process results in degraded photographic resolution, relative to the original. Most of the photographs were not taken for mapping purposes, and, therefore, do not meet the higher standards and stereoscopic coverage required for such work.

All of the photographs obtained or researched for the investigation were documented in a appendix to the final report. Table 1 is an edited example of the aerial photograph data for the year 1973. The information included in the appendix includes: the date of the photograph; whether or not the photograph was used in the investigation; the source of the

photograph; the supplier's photograph-identification number; the flight or job number; the frame number; the nominal photographic scale; the type of photograph (e.g., black and white, color, etc.); the company or agency that photographed the site; and the names of the photograph interpreter and reviewer. This information is generally invaluable to follow-on workers and reviewers.

Table 1. Aerial Photograph Documentation

DATE	USED?	SCENE ID	FLT, ETC.	FRAME	SCALE	TYPE	SOURCE
3/14/73	YES	AB573000999ROLL		193	1:32000	COL	USGS/EROS
3/14/73	YES	AB573000999ROLL		194	1:32000	COL	USGS/EROS
3/14/73	YES	AB573000999ROLL		195	1:32000	COL	USGS/EROS
3/14/73	YES	AB573000999ROLL		196	1:32000	COL	USGS/EROS
3/14/73	NO	AB573000998ROLL		193	1:32000	B&W	USGS/EROS
3/14/73	NO	AB573000998ROLL		194	1:32000	B&W	USGS/EROS
3/14/73	NO	AB573000998ROLL		195	1:32000	B&W	USGS/EROS
3/14/73	NO	AB573000998ROLL		196	1:32000	B&W	USGS/EROS
3/14/73	NO	AB573000997ROLL		193	1:32000	CIR	USGS/EROS
3/14/73	NO	AB573000997ROLL		194	1:32000	CIR	USGS/EROS
3/14/73	NO	AB573000997ROLL		195	1:32000	CIR	USGS/EROS
3/14/73	NO	AB573000997ROLL		196	1:32000	CIR	USGS/EROS
11/15/73	NO	AB625800130ROLL		3	1:23266	CIR	USGS/EROS
11/15/73	NO	AB625800120ROLL		3	1:23266	COL	USGS/EROS
1973	NO		TG-7300	9:09	1:24000	B&W	TELEDYNE
1973	NO		TG-7300	9:10	1:24000	B&W	TELEDYNE
1973	NO		TG-7300	9:11	1:24000	B&W	TELEDYNE
1973	NO		TG-7300	9:12	1:24000	B&W	TELEDYNE
1973	NO		TG-7300	10:09	1:24000	B&W	TELEDYNE
1973	NO		TG-7300	10:10	1:24000	B&W	TELEDYNE
1973	NO		TG-7300	10:11	1:24000	B&W	TELEDYNE
1973	NO		TG-7300	10:12	1:24000	B&W	TELEDYNE
10/1/73	NO				1:24000	B&W	CONTINENTAL
3/1/73	NO				1:24000	B&W	UNICAL

The project operated under a tight schedule and the search and photograph acquisition phases of the investigation were hampered by slow responses from some suppliers, and by lengthy order processing times. Had more time been available for the early phases of the investigation, better and more complete photographic coverage could likely have been

secured, and enlarged photographs of selected areas obtained. However, the major results of the investigation would probably not have changed significantly. That is, more sites of potential concern would probably have been identified, but most would likely have been located in the general areas discussed in the final report due to the tendency for sites of concern to cluster in certain types of land-use areas. These cluster areas could commonly be investigated as a single site.

AERIAL PHOTOGRAPH INTERPRETATION

This section discusses the methods used in the aerial photograph interpretation portion of the investigation and presents examples of the data that were obtained. The final report of the investigation includes annotated photographs for each of the 21 years listed above, and explanatory text that describes the various features noted and makes recommendations regarding the need for additional investigation. The final report presented this information chronologically so that the appearance, disappearance and development of the various sites and areas of concern, and changes in the characteristics of the features, such as size variations or the effects of land-use change, can be evaluated.

The present investigation focused on identifying sites of potential concern that were not previously recognized. Many of the sites identified during the earlier investigation were largely excluded from additional review, except to identify significant discrepancies between the investigations resulting from temporal changes. Thus, sites identified by the earlier work are not always annotated on the photographs reproduced in the final report, even though many of these sites were verified during the investigation. However, all of the sites identified during this and the previous investigations were compiled on maps of the site. Due to the size of the maps, they could not be reproduced here in a useful form.

In the final report, the annotated photographs are presented in chronological order, beginning with the earliest available photographs, 1946, and sequentially progressing through 1992. The features of potential environmental concern are identified on each photograph by a one- to three-letter designator (Table 2), and on the base map by a cross-referenced identification number. Each photograph includes a legend identifying the features. The features are then discussed in the text the accompanies each photograph.

Examples of the annotated photographs are included here as Figures 1 and 2. Edited examples of the explanatory text for the year 1946 are included here as Table 3. Figure 1 is the earliest-found photograph of the developed site and depicts the area as it existed on 12 December 1946. Fifty-nine sites and areas of potential environmental concern are annotated on the photograph. Each of these areas is discussed in the explanatory text. An excerpt of this information is included as Table 3.

Table 2. Annotated Features Identified During The Aerial Photograph Interpretation

Symbol Legend

Symbol	Description	Symbol	Description
B	Building	IM	Impoundment
D	Drums	LQ	Liquid
DB	Debris	LT	Light-toned
DG	Disturbed ground	M	Material
DK	Dark-toned	MM	Mounded material
EX	Excavation	OS	Open storage
EXT	Extraction	R	Refuse
FA	Fill area	ST	Stain
FBR	Fuel bladder revetment	TR	Trench
GR	Graded area	UO	Unidentified object
GS	Ground scar	VT	Vertical tank
HT	Horizontal tank	WS	Wet soil
C	Container		

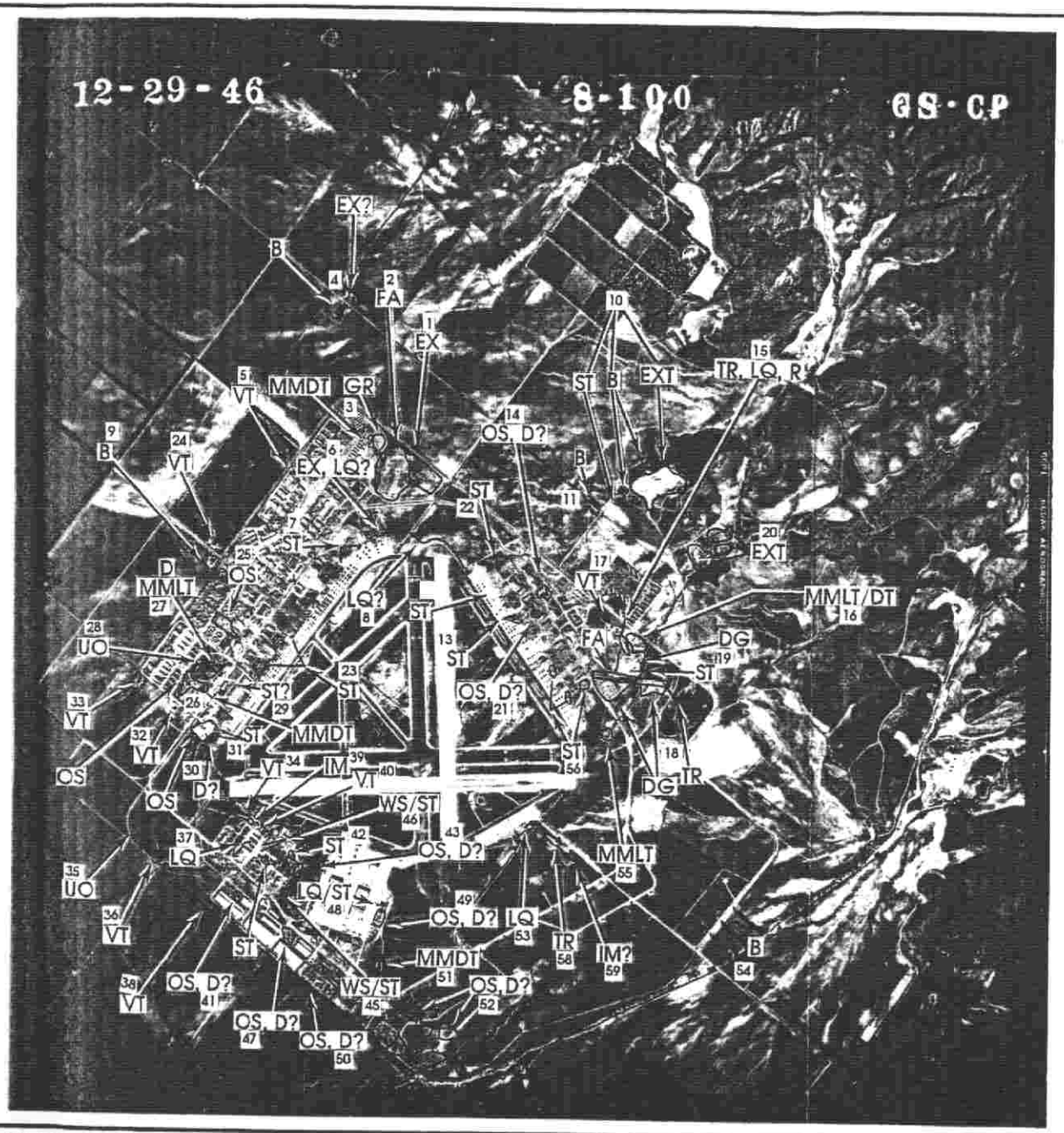
Table 3. Examples of Explanatory Text for the 1946 Aerial Photograph

1946 PHOTOGRAPHS

DATE:	29 DECEMBER 1946
PHOTOGRAPHS:	GS-CP-8-99, -100, AND -101
SOURCE:	U.S. GEOLOGICAL SURVEY
SCALE:	1:24,000

Annotation Number	Explanatory Text
1.	An excavation (EX) about 400 feet wide by 500 feet long is noted beneath the present threshold area of Runway 16L. The purpose of the excavation is unknown, but may be an early, undocumented disposal area.
4.	Farm buildings (B) and a possible excavation (EX) are located north of the activity. The buildings may contain fuel, solvents, pesticides, fertilizers, and other potential contaminants; the excavation may have been used to dispose of these materials.
6.	These is an excavation (EX) at the present intersection of N 7th Place and K Street. There appears to be wet soil (WS) or liquid (LQ) extending into the excavation from a light-colored building at the edge of the aircraft parking apron. The site may have been used as a disposal area.
8.	A drainage channel (EX) with probable liquid (LQ) extends from the aircraft parking apron near the approach end of Runway 21 and into a drainage ditch near the approach end of Runway 16R. The channel probably controls runoff from the apron area, and may convey contaminated water
18.	There is a trench (TR) and fill area (FA) about 1000 feet south of Tank 293. The trench is oriented nearly east-west, and is about 900 feet long. Spoil material (FA) extends about 500 feet to the west, along the trench alignment. There is a large area of disturbed ground (DG) south of the trench. It should be verified that the trench is wholly contained by the present field investigation area of the original landfill site.
32.	A probable vertical tank (VT) is located about 400 feet southwest of Building 31, near S 8th Street and West Marine Way. There also appears to be soil staining (ST) or wet soil (WS) at the base of the tank.
39.	Two impoundments (IM) of unknown purpose can be observed on the southwest side of Building 306, near S 11th Street and L Street.
43.	Open storage (OS) areas with possible drums (D) are noted about 700 and 1000 feet southeast of Tank 174, beneath the present aircraft parking apron.

52.	In the area north of the railroad tracks, there are four open storage (OS) areas. All appear to contain refuse (R) or materials in storage. The westerly area appears to have been excavated (EX) and the spoil (FA) placed toward the southeast. The spoil area (FA) and excavated (EX) area appeared to be covered with refuse (R) or other materials. The southerly open storage (OS) area is an aircraft salvage area with several fuselage and wings sections visible. Smaller open storage (OS) areas occur near the four major sites.



Aerial Photographic Interpretation
MCAS El Toro
Santa Ana, California
1946

Figure 2

Sheet 1 of 1
December 29, 1946
Photo Number GS-CP-8-100
Source:
U.S. Geological Survey

Prepared for:

Southwest Division
Naval Facilities Engineering Command
Contract N68711-92-D-4658

LEGEND:

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
B	Building	IM	Impoundment
D	Drums	LQ	Liquid
DB	Debris	LT	Light-Toned
DG	Disturbed Ground	M	Material
DK	Dark-Toned	MM	Mounded Material
EX	Excavation	OS	Open Storage
EXT	Extraction	R	Refuse
FA	Fill Area	ST	Stain
FBR	Fuel Bladder Revetment	TR	Trench
		UO	Unidentified Object
GR	Graded Area	VT	Vertical Tank
GS	Ground Scar	WS	Wet Soil
HT	Horizontal Tank		

N

2000' 0 2000' 4000'

1" = 2000'

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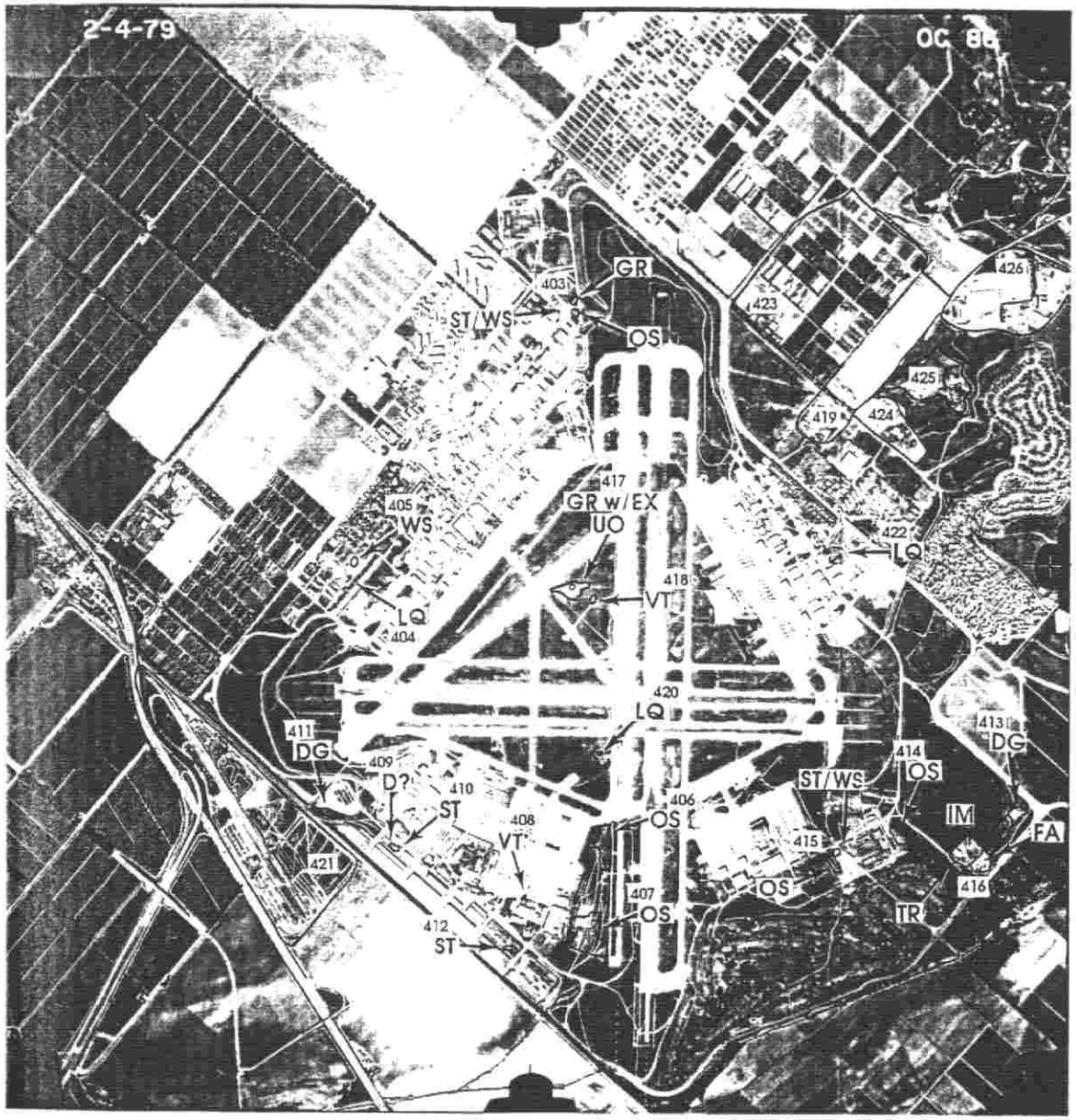
ET02-1R1.DWG



Aerial Photographic Interpretation
MCAS El Toro
Santa Ana, California
1979

Figure 18

Sheet 1 of 1
February 4, 1979
Photo Number M79-OC-86
Source: Brewster Pacific Corporation, Pasadena
(Reproduced by Permission)

Prepared for:

Southwest Division
Naval Facilities Engineering Command
Contract N68711-92-D-4658

LEGEND:

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
B	Building	IM	Impoundment
D	Drums	LQ	Liquid
DB	Debris	LT	Light-Toned
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GS	Ground Scar	WS	Wet Soil
HT	Horizontal Tank		

N

2000' 0 2000' 4000'

1" = 2000'

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ET18-1R1.DWG

Figure 1 provides a baseline to which later photographs can be compared. Many of the features, such as drum storage areas, noted on Figure 1 can also be identified on later photographs, indicating temporal persistence, and thus the possibly of a greater hazard potential. These areas indicate sites that may have contributed to environmental contamination over a long periods of time. However, many of the features cannot be identified on later photographs, indicating that the source of the potential problem was of limited duration. This is not necessarily an acceptable criteria for eliminating a site from further investigation, or assuming that the hazard potential is low.

Figure 2 depicts the site on 4 February 1979. Note that a large amount of development has occurred at the site and in the region, and that while some areas identified on Figure 1 still persist, many newer sites have been identified. These photographs illustrate some of the problems inherent in using historical photographs. The photograph in Figure 1 was taken by the U.S. Geological Survey for mapping purposes, and although of smaller scale that preferred for the purposes of this investigation, provided stereoscopic coverage of the site and vicinity. The photograph was of high quality and resolution. The photograph in Figure 2 was taken for an unknown commercial purpose, and is of larger scale than Figure 1. However, several areas of interest near the site are not covered, and stereoscopic coverage is limited.

In addition to investigating the area within the boundaries of the facility, some areas adjacent to the facility, especially those that appeared to be hydraulically upgradient, were also included in the investigation because of their potential impact on the facility. This allowed the inclusion of sites that may potentially contribute to contamination of the ground water flowing beneath the site from upgradient sources. These areas typically border the activity and include features such as quarries, commercial and industrial sites, and agricultural support areas. These sorts of features typically use or store potential contaminants, such as fuels, oil, solvents, pesticides, and fertilizers.

In contrast to the earlier aerial photograph analysis work by the U.S.E.P.A. (1991), our aerial photograph analysis reports nearly all vertical and horizontal tanks that were observed, but not previously noted. Some water-supply tanks were recognized as such, and, thus, were not noted or discussed. The U.S.E.P.A. report argues that the tanks should be discussed only if they are associated with stains or spills. However, photographic analysis cannot determine the contents or integrity of the tanks and their ancillary systems. Further, evidence of leakage or spills may not be apparent at the ground surface, and, depending on the type of liquid, may be an ephemeral event not detectable at the time, scale, or other characteristic of the photograph. After the tanks are investigated, those used for innocuous materials, such as potable water supply, can be deleted from future consideration.

Conservative assumptions regarding the potential for contaminants being present in a given area are reflected in the photograph annotations and in the recommendations for additional work. For example, stains and liquids on paved or concrete surfaces were often not noted, under the assumption that infiltration was unlikely. However, additional investigation was typically recommended if liquids, stains, drums, etc., occur on, or extend into, soil-covered

areas, under the assumption that infiltration was possible. The degree of certainty in the identifications of the various features is also indicated in the photograph annotations and in the accompanying explanatory text. The certainty with which a feature can be identified ranges from definite, if no modifier is included, to probable, and then to possible as the level of certainty decreases.

Stains and liquids on the aircraft parking aprons, taxiways, and runways were typically not noted unless significant amounts of flowing liquids were observed or suspected, or unless the liquids appeared to have reached exposed-soil areas. In many, if not most cases, these liquids and those flowing from airport buildings are probably wash or rinse water used in maintenance areas. However, the composition of the liquid cannot be determined from the photographs, and thus, the presence of such liquids was noted. Also, the contents or purposes of the buildings were typically not known to the photograph interpreter, preventing inferences about the composition of the liquids.

Open storage areas were noted if stains, drums, or other features of concern appeared to be associated with the area. Because open storage areas tended to fluctuate in size and location over time, decreases in size are typically not noted, under the assumption that the maximum extent of the storage area is of importance to the investigation. The identification of drums in open storage areas was typically problematical due to the small scale and poor resolution of many of the photographs. Consequently many of the photograph are annotated with "D?" indicating that drums appear to be present, but cannot be confirmed. The explanatory text quantifies the degree of certainty in the identification with terms such as "possible" or "probable".

Recommendations for additional investigation do not necessarily imply that detailed field sampling is required. Depending on the particular case, additional investigation may possibly be satisfied by: a review of historical site usage; by a review of potential contaminants that may have been used, stored, or disposed at the site; by a review of spill, emergency response or similar records; by anecdotal evidence; or by other methods. For example, photographic evidence of a liquid discharge from near a building determined to be a residence could possibly be disregarded as being irrigation water, whereas a liquid discharge from a solvent-storage building would require greater consideration.

DATA COMPILATION

This section addresses the compilation of the sites of potential environmental concern identified during this and the previous investigations. A map of the site and area was provided by the investigation's sponsor at the beginning of the investigation. The map served as a base map on which the locations of all sites of potential environmental concern were plotted. The map is undated, but, based on comparisons with the aerial photographs, it was prepared between March 1973, and February 1979.

The present investigation identified about 600 sites meeting the criteria discussed earlier. These are in addition to those identified during the U.S.E.P.A. (1991) investigation. Because of the data density, the two data sets were compiled on separate maps at a scale of 1:7200, but, due to their large size the maps are not reproduced here. The sites identified during this investigations can be readily identified and assessed by cross referencing the maps and photographs with the site identification numbers used on the photograph annotations and explanatory text. The compiled sites of concern are sequentially numbered on each plate.

The sites and areas of potential environmental concern identified on the plates indicate the approximate locations and areal extents of the features. The reader is referred to the annotated photographs for the exact locations of the features. Multiple comment numbers are given for several sites on the plates to reflect changes at the site, or persistence of the identified features over time. Each comment refers to information identified on an aerial photograph taken during a particular year. The sites indicated on the plates also delineate general areas of potential concern mapped during the present investigation and discussed in the investigation report. The limits of the area represent the maximum extent of the feature, for example, a quarried area or open storage, that was identified on the photographs.

HISTORIC LAND USE

General Land Use Categories And Data Sources

Maps illustrating the historic land use and boundaries of the installation for five selected years, 1946, 1956, 1967, 1982, and 1991, are included in the final report. The intent of the maps is to illustrate land use and changes in land use that occurred over similar time intervals as a guide for evaluating the potential for contaminant release. The maps were compiled from: the aerial photographs used during this investigation; data developed by the earlier investigation; and from master plan, development, plot plan, and other historic maps of the activity provided by the investigation's sponsor.

The maps illustrate seven general land-use categories: commercial, industrial, residential, recreation, open/agriculture, airfield, and flight cone (aircraft approach and departure areas). These categories were distilled from the many, and sometimes imprecise or conflicting, land-use classifications depicted on the various historic maps of the site, observed in the aerial photographs, or noted in the report of the earlier investigation (U.S.E.P.A., 1991). The use of fewer than seven land-use categories appeared to over generalize the data and induce additional conflicts. Subjectivity was commonly required in assigning specific land-use areas to a particular general land-use category. As a consequence, site-specific conflicts with the indicated land use can be expected.

The maps are intended to be general, to focus on areal rather than site-specific land uses, and are based on the available information. A conservative, environmental-hazard approach was used in assigning land-use categories, especially in differentiating between "industrial" and "commercial areas", as described below. If the information was inadequate to differentiate between these categories, the area was typically assigned to the industrial category, as this was considered to have the greater potential for contaminant release.

Data from the aerial photographs, the earlier work, and the various maps were assessed, and the identified or interpreted land uses were assigned to the seven land-use categories. Table 4 lists the general categories and examples of land uses contained within each category. Commercial includes areas that would typically be considered as business areas, for example, administration, community support, and schools, that would generally not use or produce significant volumes of potential contaminants. Industrial areas include areas in which potential contaminants would typically be used, disposed, or stored, such as maintenance areas and disposal areas. Residential includes the installation's housing and barracks areas. Recreation includes designated recreational areas such as the golf course, swimming pools and baseball fields. Open / agriculture is used for areas in which no other land use was noted. Airfield designates aircraft operation areas, including runways and most taxiways, but typically excluding maintenance and hangar areas, which are considered as industrial areas. Portions of the airfield operations area could also be assigned to the industrial category, but for lack of additional information, they were typically not differentiated. Flight cone delineates the aircraft approach and departure corridors.

The years for which land-use maps were prepared were selected primarily on the basis of information availability. Partial and complete master plans, land-use maps and various types of development maps were obtained for about 10 individual years over the period 1942 through 1991. These maps are collectively referred to here as "land-use maps". Data from these were supplemented with aerial photographs and the report of the earlier work. On rare occasions, such as for 1946, it was necessary to combine data, such as land use, the flight cone, or the activity's boundaries, from different years, to prepare a complete land-use map.

Table 4. Land use Classification Categories

General Category	Examples of Identified Land use		
commercial	administration buildings	school	hospital
	base exchange	bowling alley	chapel
	mess halls	bakery	general storage buildings
	parking areas	squadron headquarters	
industrial	warehouses	fuel storage areas	
	auto hobby shop	storage buildings in industrial areas	
	ordnance storage areas	landfills	
	repair facilities	sewage treatment facilities	
	hangars	open storage areas	
	EOD Range	hazardous materials training areas	
residential	housing areas		
	barracks		
recreation	playing fields	park	
	golf course	tennis courts	
	swimming pools	gymnasium	
open / agriculture	undeveloped areas		
	areas under cultivation		
airfield	all areas encompassed by the runways and taxiways		
flight cone	identified aircraft approach and departure areas		

The primary sources of data were the land-use maps. The quality and usefulness of the maps varied widely. Several of the maps were poor copies that were illegible, or difficult to read and interpret. For maps depicting land use, there was a lack of uniformity in the categories. Some maps identified only the general purpose of buildings and areas. Planned development indicated on the master plans and similar maps may not have occurred. These factors required subjectivity in the assignment of the land-use categories presented here.

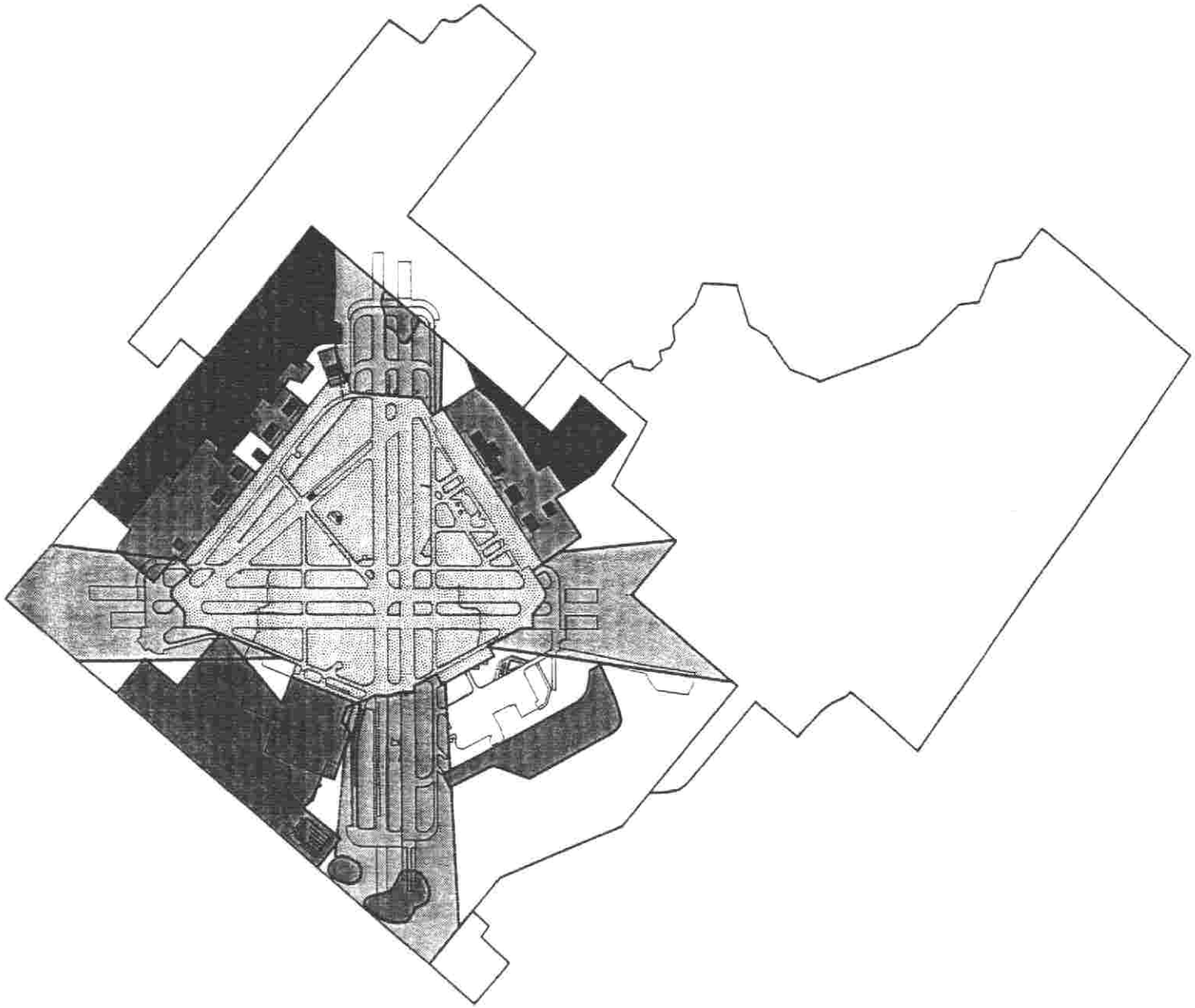
The aerial photographs were used whenever possible to resolve conflicts that were noted in reviewing the maps. The inclusion of the photographic data resulted in the addition of several features not noted on the available maps, such as landfill areas. The data also helped in identifying the proper land-use category. Although several conflicts could not be resolved, the maps are useful in obtaining a general overview of historic land use at the activity.

Land-Use Maps

Land-use maps prepared for the years 1946, 1956, 1967, 1982, and 1991. The land-use maps for 1946 and 1991 are included here as Figures 3 and 4. Each map depicts an interpretation of the general land use that existed as of the year of the map. 1942 is the first year for which a land-use map was available. Data from the 1942 map were combined with the 1946 aerial photography to develop the 1946 land-use map (Figure 3). Therefore, 1946 is the base year from which comparisons of subsequent land-use changes can be made. A comparison of Figure 3 and Figure 4 illustrates the significant changes in land use that occurred between 1946 and 1991.

For consistency, and to ease comparison, the maps are presented at a common scale and are superposed on the 1992 site boundary. The limits of the patterned areas on each map indicates the boundary of the activity, which can be seen to vary over time. On all of the maps, the extended approach corridor (flight cone) for Runway 34 has been eliminated south of the facility. Excluding this area allowed for a larger map scale, and, therefore, the presentation of more detailed data. The excluded area was originally classified as open / agriculture until about 1980, when commercial / industrial and residential development not related to the facility began in the general area.

The original land-use maps (Figures 3 and 4) are color- and pattern-coded relative to the interpreted land use and, thus, are self explanatory. Although the maps do not depict specific areas of environmental concern, they do illustrate the areas where these are most likely to be found, for example, the industrial areas. This information allows the investigator to focus on these areas rather than to expend resources on areas that are like to be nonproductive.



1946 Land Use Map

(Land Use Superposed on '99' Base Map)

MCAS El Toro
Santa Ana, California

Figure 26
Sheet 1 of 1

Prepared for:

Southwest Division
Naval Facilities Engineering Command

Contract N68711-92-D-4658

LEGEND:

- Commercial
- Industrial
- Residential
- Recreational
- Open/Agricultural
- Airfield
- Flight Cone (Clear Area)

N

2000' 0 2000'

1" = 2000'

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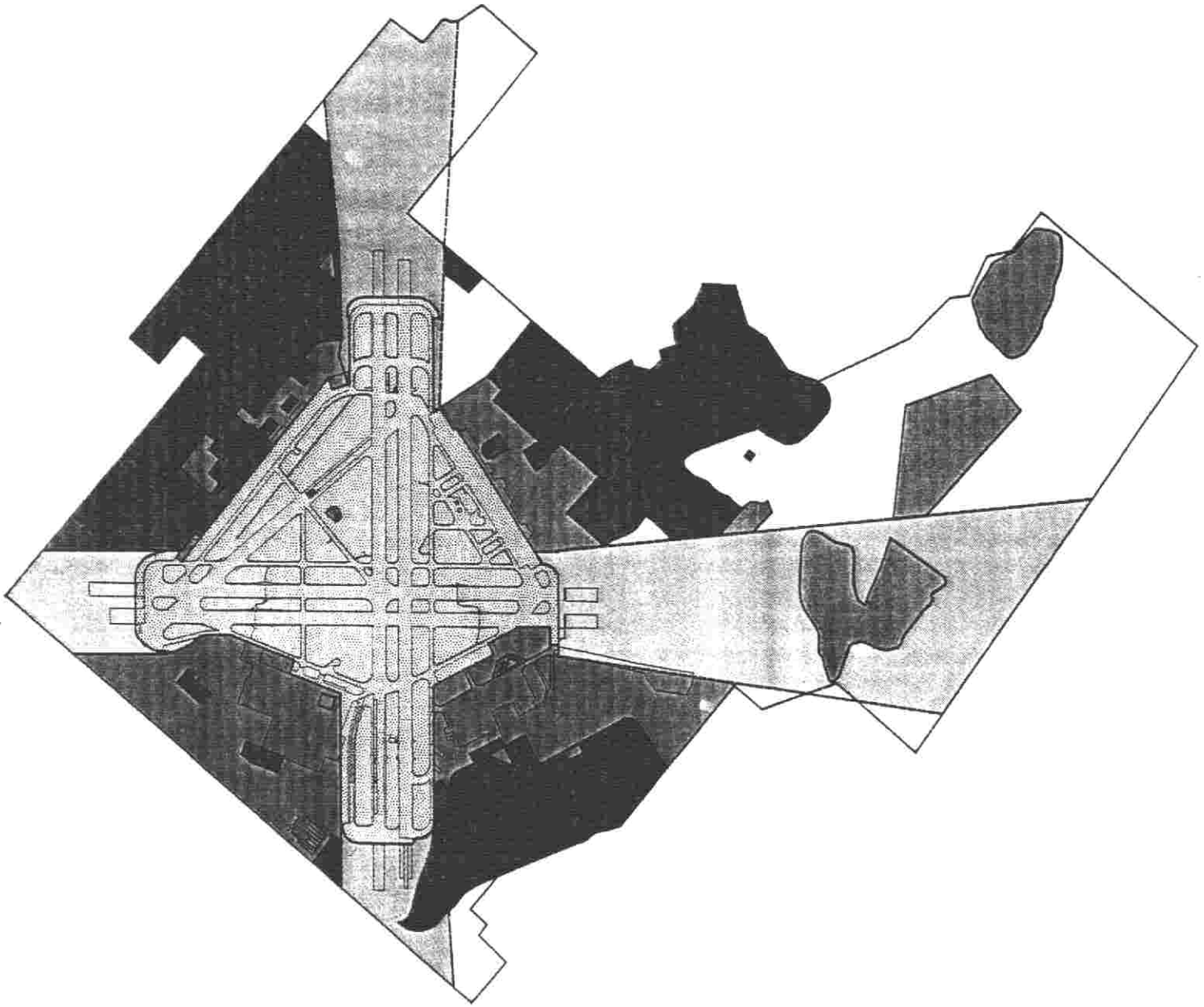

1991 Land Use Map

(Land Use Superposed on '99' Base Map)

MCAS El Toro
Santa Ana, California

Figure 30
Sheet 1 of 1

Prepared for:

Southwest Division
Naval Facilities Engineering Command

Contract N68711-92-D-4658

LEGEND:

- Commercial
- Industrial
- Residential
- Recreational
- Open/Agricultural
- Airfield
- Flight Cone (Clear Area)

N

2000' 0 2000'

1" = 2000'

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DRAINAGE

Introduction

This section presents and discusses the drainage maps prepared for installation and the surrounding area. Surface-water drainage data are important in tracing the source or path of contamination transported by surface waters. Maps were prepared using the aerial photographs for the years 1946, 1952, 1958, 1968, 1971, 1977, 1983, 1988 and 1992. Although mapping at five-year intervals was initially specified, the actual time intervals varied from three to ten years because of data availability. The mapped area is slightly rectangular in plan, with dimensions of about 4.2 miles by 4.5 miles (6.8 km by 7.2 km) and covers about 19 square miles (49 km^2). The drainage maps for some years do not cover this entire area because of incomplete aerial photograph coverage. Elevations range from about 200 feet (msl) along the western border of the area, to over 1200 feet in the northeastern corner (61 m to 366 m).

The years of photography used for preparing the drainage maps were determined by the areal and stereoscopic coverage of the photographs, the photographic scale and resolution, and the five-year mapping interval. Photographs for several years were eliminated from further consideration because they provided only partial areal coverage, or inadequate stereoscopic coverage. These factors are responsible for the ten year gap in the mapping, between 1958 and 1968.

Stereoscopic-photograph coverage is critical to surface-water drainage mapping. The exaggerated, three-dimensional representation of the topography provided by these photographs is an integral aspect of the mapping. Without this representation, smaller-scale topographic features are often difficult to identify, and determining surface-water flow directions, especially in areas of low-relief, may be impossible. In areas for which stereoscopic coverage was not available, data extrapolated from the adjoining stereoscopic-photograph pairs helped define the drainage details. In these areas, the drainage mapping data is typically less dense, and generally focuses only on the dominant drainages.

The scales of the selected photographs ranged from 1:20,000 to 1:36,000; photographs for two of the years have scales of 1:20,000, five have scales of 1:24,000, and the remaining photographs have scales of 1:33,000 and 1:36,000. Although useful for mapping the larger-scale features of the natural drainages and man-made improvements, the photographic scales were inadequate to map many small-scale or subtle features. In particular, determining drainage directions in the low-relief areas, including much of the installation, was difficult. The smallest-scale photographs (1:33,000 and 1:36,000) provide less apparent vertical exaggeration than the larger-scale photographs, and therefore, recognition of subtle topographic features using these photographs was even more difficult. All of the drainage maps included the final report were reproduced at a scale of 1:24,000.

The identification of surface-water drainage paths and the flow directions is affected by grading practices, vegetation, sun angle, season, photograph contrast, orientation of the

feature relative to the illumination direction, topographic relief, and other factors. Drainage characteristics were most easily and reliably determined in the higher-relief, eastern portion of the mapped area where well-defined, natural drainages predominate. In low-relief areas, the direction of flow was often difficult to determine from the photographs. In these situations, data from topographic maps were used to determine the most likely flow direction. If the data were equivocal, the drainage, but not a flow direction, was indicated on the map.

The impact of development and engineered drainage control increases over time, from being minimal over large portions of the area in 1946, to becoming dominant by 1992. In general, land use changed, over time, from natural, to agricultural, to limited development, and finally, to fully developed. Each phase of this process affected the drainage characteristics. In the natural state, the drainage follows geologically and geomorphically controlled paths. But, as the land-use changes, artificial drainage control typically increases. In the extreme case of full development, the drainage is almost completely controlled by engineered drainage improvements.

Due to the scale and resolution of many of the photographs, small-scale, or otherwise subtle features, could often not be recognized. These features may be important for tracing the transport paths of potential contaminants. Similar information for nearby areas may also be valuable. These data will provide detailed information regarding the locations, inlet and outlet areas, flow directions, and other characteristics of drainage features not discernible during the aerial photograph analysis.

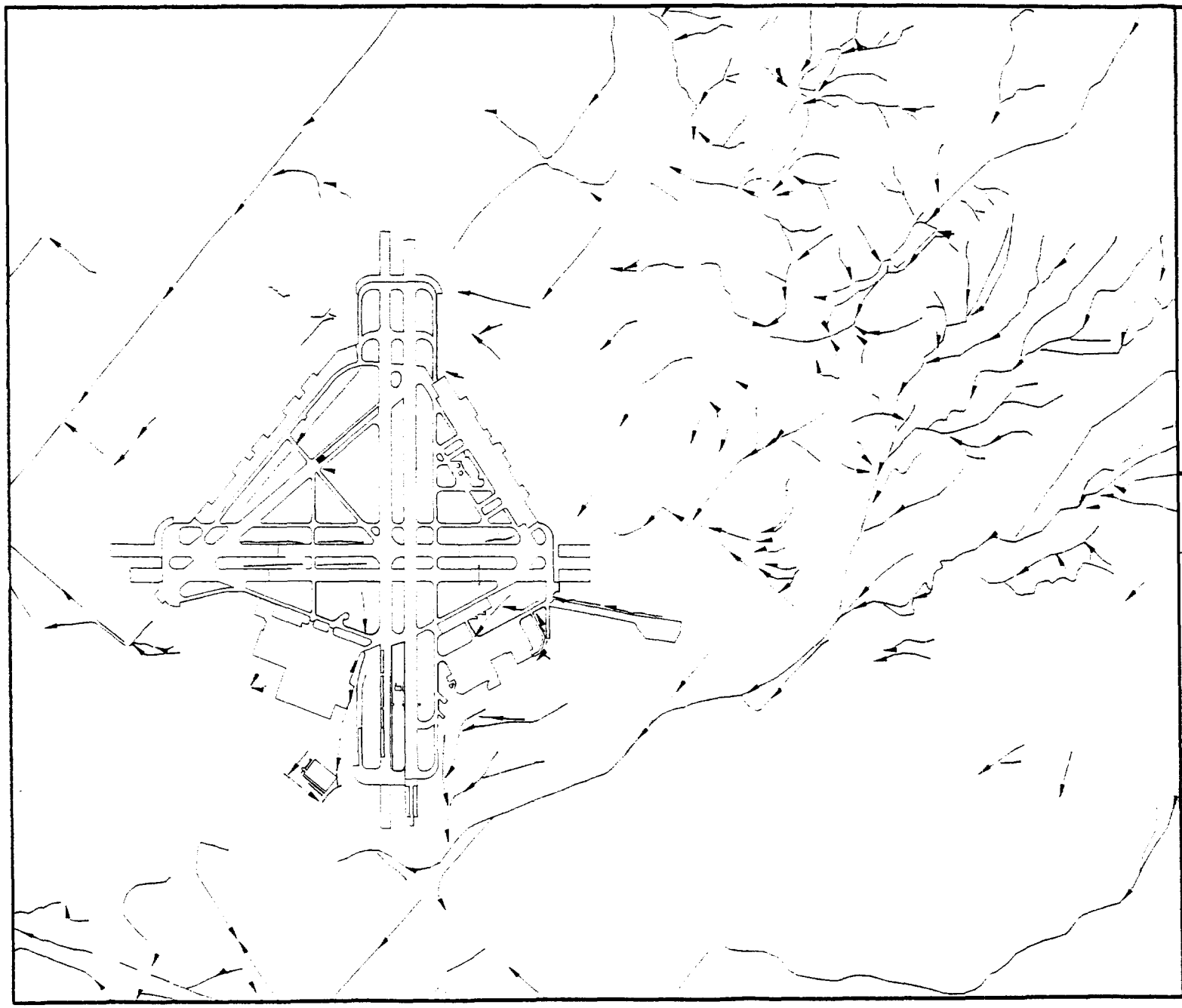
A review of the drainage maps indicates that various drainage-related features may appear or disappear over time, locations may vary slightly, and occasionally, the indicated flow direction may reverse. While many of the changes reflect modifications to the drainage system, others may result from factors affecting the photograph interpretation process, or from distortion of the photographic image.

The effects of photographic scale, resolution, illumination direction, vegetation and other factors were identified in a previous section of this report. In addition, the photographic process induces radial distortions into the image. That is, distortion of the image and dislocation of features from their geometrically-correct positions increases with increasing distance from the center of the photograph. These distortions and dislocations can be eliminated by special processing of the photographs, or by sophisticated photographic-analysis equipment. Neither option was available for this investigation, and only standard aerial photographs were used. The problem is exacerbated by the necessary use of aerial photographs not specifically planned for use as stereoscopic pairs. As a consequence, transparent overlays of drainage features from different years, or from different photographs taken during the same year, may not match perfectly if superposed.

Two of the drainage maps are included here. Figure 5 depicts the map prepared from the 1946 photographs, and Figure 6 depicts the map prepared from the 1992 photographs. These data were digitized from the transparent photograph overlays and processed using an AutoCAD system. Due to the photographic distortions, sometimes severe, that were

discussed in the previous paragraph, it was not practicable to accurately represent all of the mapped drainages on the 1992 topographic base map without more sophisticated data processing. While the accuracy was acceptable in the low-gradient areas that comprise much of the area, the accuracy markedly degenerates in the high-gradient areas toward the east. Consequently, rather that attempting to artificially rectify the drainage data relative to the geometrically-correct topographic map, the data are presented with minimal manual adjustment, and without the topographic base.

In spite of the possible shortcomings of using and presenting unrectified mapping data, the maps depict a acceptably-accurate, qualitative representation of the individual drainages and the integrated drainage patterns. All of the maps were produced at a scale of 1:24,000, regardless of the scale of the original photograph. Each map contains a representation of the airfield area for location and orientation purposes. The reader is referred to the original photographs to determine the exact location and character of any features depicted on the drainages maps.



DRAINAGE MAP
Aerial Photographic Interpretation
MCAS El Toro
Santa Ana, California
1992

Figure 39

Sheet 1 of 1
January 20, 1992
Photo Numbers C85-10-8, C85-10-10, C85-11-10, and C85-11-12
Source:
Continental Aerial Photo, Inc.

Prepared for:

Southwest Division
Naval Facilities Engineering Command
Contract N68711-92-D-4658

LEGEND:

SYMBOL	DESCRIPTION
	Natural Drainage
	Improved or Artificial Drainage

N

2000' 0 2000'

1" = 2000'
APPROXIMATE SCALE

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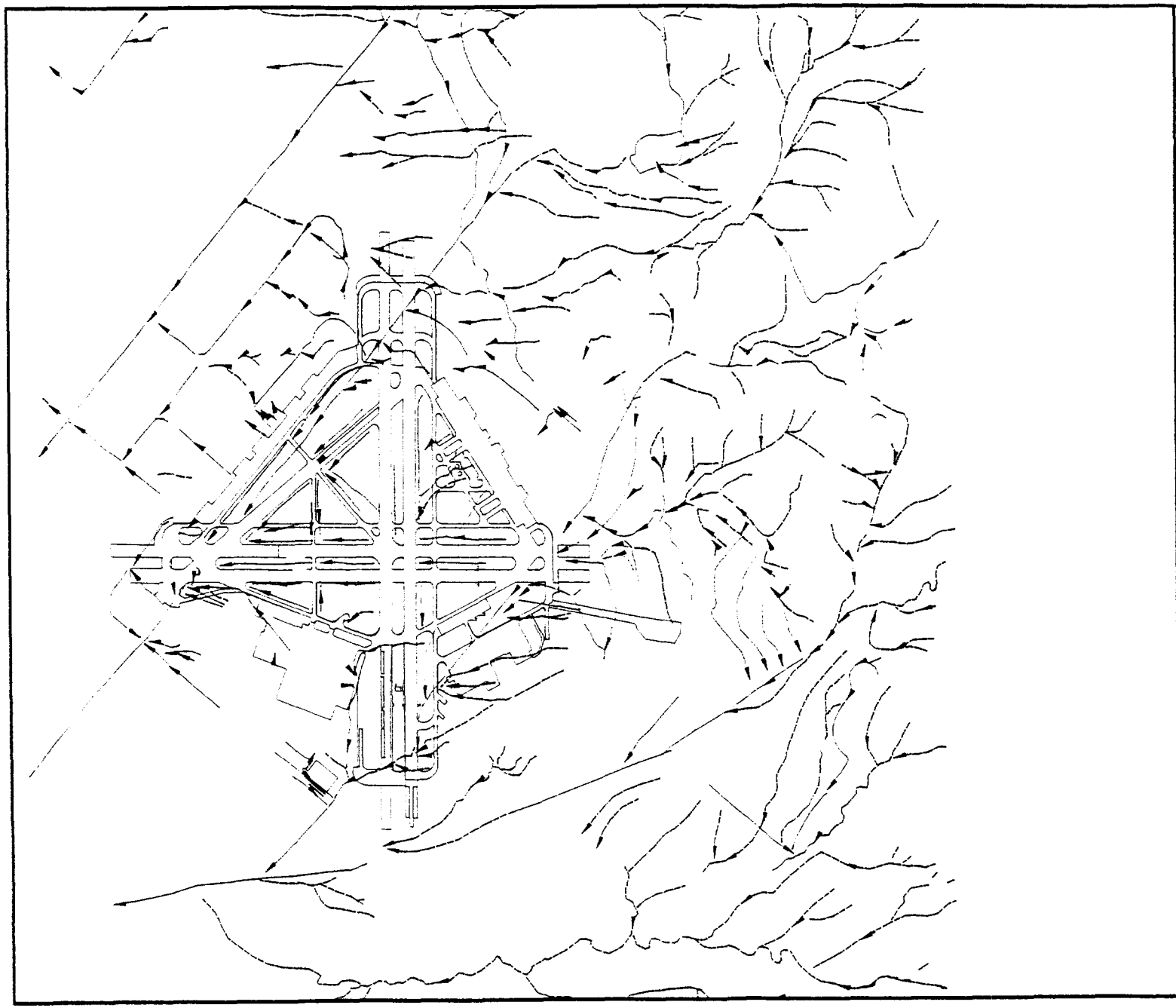
DM39-1R1.DWG



DRAINAGE MAP

Aerial Photographic Interpretation
MCAS El Toro
Santa Ana, California

1946

Figure 31

Sheet 1 of 1
December 29, 1946
Photo Numbers GS-CP-8-100
and GS-CP-8-101

Source:
U.S. Geological Survey

Prepared for:

Southwest Division
Naval Facilities Engineering Command
Contract N68711-92-D-4658

LEGEND:

SYMBOL	DESCRIPTION
	Natural Drainage
	Improved or Artificial Drainage

N

2000' 0 2000'

1" = 2000'
APPROXIMATE SCALE

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DM31-1R1.DWG

Drainage Changes Over Time

This section briefly discusses the salient drainage features observed during the aerial photograph analysis and drainage mapping. These maps depict drainage paths and patterns discernible at the scales and resolutions of the available photographs, and with the analytical equipment used during the investigation. To avoid excessive detail in plotting natural drainage paths, the maps do not always illustrate the lowest-order drainages that could be recognized. Where practicable, all improved and artificial drainages are indicated, regardless of size. Drainage maps for the years 1946, 1952, 1958, 1968, 1971, 1977, 1983, 1988 and 1992 were developed for the investigation. The maps depict only the drainages, with limited cultural features for orientation purposes. The drainage maps for the years 1946 and 1992 are included here as Figures 5 and 6.

On each drainage map, natural drainages are indicated by dashed lines, with arrows illustrating the flow direction of the surface water. All of the natural drainages appear to be ephemeral, that is, water does not typically flow during the entire year. Artificially enhanced drainages and engineered drainage controls are depicted by solid lines with flow direction arrows. A change from a dashed to a solid line indicates that the natural drainage was improved or intercepted by an engineered drainage. Locally, dashed drainage lines abruptly terminate at the edge of developed areas. In actuality, the drainage is intercepted by engineered controls, such as brow ditches, an inlet structure, or other drainage improvement, but these could not be identified on the photographs.

Several observations are common to most, if not all, of the drainage maps. Prior to the 1946 photographs, the earliest photographs analyzed, several natural drainages had been altered for agricultural and drainage control purposes. The alterations included reservoir construction, channel improvements, channel diversions for irrigation, construction of irrigation channels, construction of drainage diversion channels and berms, storm drain construction, and road construction. These features typically persist to the present and have commonly been incorporated into subsequent land development activities.

By 29 December 1946, the date of the earliest photographs analyzed during this investigation, the major drainage patterns and engineering controls affecting the site and adjacent areas had been established. Changes noted relative to later photographs are generally refinements of, and additions to, this existing, basic drainage system. The drainage maps are self explanatory, and as such, are not discussed in detail.

The drainage map for 1946 indicates that the pre-development natural drainage was toward the west and southwest, generally normal to the topographic contours depicted on the topographic maps of the area. After leaving the topographically-confined drainages of the higher-relief areas to the east, surface waters typically flowed across alluvial fans and within pre-existing channels from which the water either percolated or eventually discharged into the higher-order regional streams. Discharges from the larger arroyos were largely controlled by artificial or improved channels. Water from some of the lowest-order streams was locally intercepted and directed subparallel to the topographic contours for

irrigation. Several of the drainage improvements were for agricultural purposes, but most were directly related to the development of the facility.

Many natural drainages were cut off by drainage or irrigation improvements, but the drainage path below the diversion point is commonly indicated. Surface water will often concentrate in these drainage remnants and continue its downgradient flow. Some of these diversions were later breached, and the original, natural drainage re-established. As a consequence, the original, natural discharge routes may be of interest to later investigations. Locally, stream capture or drainage improvements, may result in apparent cross-cutting of streams.

In addition to controlling the primary drainages, numerous other drainage improvements can be seen at the site. These include open storm drains, inlet and outlet structures, drainage diversions and interceptors, runway and taxiway drainages and other features. The pattern of the airfield drainage depicted on the drainage map is not as readily apparent on many later photographs where continued improvement of the area is evident. Some of the areas adjacent to the runways and taxiways may be, or have been, sump areas from which runoff was allowed to percolate, or enter subsurface drains. The photographic evidence is not definitive.

It appears that nearly all of the drainage that leaves the facility ultimately discharges into one of the four main drainages. Several inlet and outlet structures for the major storm drains leading to these channels were identified; but many smaller-scale inlet and outlet structures that must exist could not be recognized at the scale and resolution of the photographs. It is assumed, that within the site boundaries, most nuisance and storm water flows overland, along streets, and within secondary or unimproved drainages until it is intercepted by the storm drain system, or percolates into the soil. With the exception of streets, most of these pathways could not be identified during the present investigation.

Only minor changes to the overall drainage pattern are noted in the drainage map for 1952. Construction of the residential area had begun near the mouth of a major drainage. The construction truncated or forced the improvement of natural drainages in this area. Markedly increased agricultural development is also noted. No significant changes were noted for drainage-map year 1958, except that the interstate highway is under construction. The next drainage map, 1968, similarly indicates only minor changes. The first, large, commercial development noted in the area, is in operation, but this affects drainage only near the southwestern corner of the activity. East of the activity, a sewage treatment plant and other facilities have been built, but they affect only a limited area.

In drainage-map year 1971, mass grading and development is noted about one mile southeast of the installation, but no other significant impacts on the overall drainage are noted. By drainage-map year 1977), additional residential development is noted at the mouth of a major arroyo. This necessitated mass grading of the site, interception of minor natural drainages, and the construction of an underground storm drain to convey flood waters. Residential development and mass grading are also continuing southeast of the activity. After an area is mass-graded and fully developed, the natural drainage is

completely disrupted, and typically, only the major, surface-drainage controls can typically be identified. As a consequence, the smaller-scale drainage features are usually not noted on the maps.

By drainage-map year 1983, there has been extensive mass grading and commercial / industrial and residential development southeast of the installation. Development and drainage modifications in the immediate vicinity of the activity are limited to a racetrack and an apparent warehouse complex near the southern tip of the activity. By drainage-map year 1988, much of the area south of the activity has undergone extensive grading and residential and commercial / industrial development. Elsewhere, agricultural activities have continued, but significant changes to the overall drainage pattern are not noted.

The 1992 drainage map is similar to the 1988 map, except that a markedly larger area has been graded and developed. No other significant modifications to the overall drainage pattern are noted.

SUMMARY

The work described here was conducted as one element of the overall environmental assessment of a military installation that is scheduled for closure and conversion to civilian use. The purpose of the investigation was to identify potentially contaminated sites using historical aerial photographs, and aided by various land-use documents. The aerial photographs allowed the investigators to identify features that are commonly associated with contaminant use, storage or disposal, such as fuel farms, trenches, and drums in open storage areas. The investigators analyzed 106 aerial photographs taken over a period of 21 years. Consequently, we were able to identify about 600 new sites or occurrences of "potential environmental concern" during 21 years of the 50 year history of the installation. In addition, we verified the existence of about 600 known sites.

The land-use documents helped to identify areas in which contaminants would typically be found, thereby focusing the overall investigation's efforts. Using the land-use documents and aerial photographs, we were able to identify several general categories of land use, in addition to specific sites of environmental concern. The land-use maps developed during the investigation focused on five specific years of operation at the installation, thereby providing a chronological and historical perspective of land use and land-use changes. Of the general land-use categories adopted for the investigation, the "industrial" classification was of greatest interest to the search for potentially contaminated sites because it contained vehicle and aircraft maintenance areas, known waste disposal sites, and similar land uses that are commonly associated with contaminant releases.

The aerial photographs allowed us to prepare maps of the surface drainage at about five-year intervals. These maps are important because contaminants are commonly transported

by surface-water flow. Therefore, the maps can be useful in identifying contaminant pathways, sources and receptors.

The use of historical aerial photographs and historical land-use documents is a valuable aid to environmental investigations. They provide information that may not be available from other sources. While the land-use documents provide general information about where contamination is most likely to occur, the aerial photographs can identify specific sites. Often these sites are not documented, due to the loss of records, or because inadequate records, or no records, were kept. Although this investigation focused on a military installation in a populated area, the use of aerial photographs and other sources of historic data should be considered for almost all environmental investigations.

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ACKNOWLEDGMENTS

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