W.Q. Section

# Final Report
# Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
# Salinas Valley, California

Harding ESE
A MACTEC COMPANY

# Final Report
# Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina Salinas Valley, California

Prepared for

**Monterey County Water Resources Agency**
893 Blanco Circle
Salinas, California 93901-4455

Harding ESE Project No. 51750 007


Michael Taraszki, R.G., C.Hg.
Senior Hydrogeologist

Daniel J. Craig, R.G., C.Hg.
Associate Hydrogeologist


April 12, 2001


Harding ESE
A MACTEC Company

Engineering and Environmental Services
90 Digital Drive
Novato, CA 94949 - (415) 883-0112

**Final Report**
**Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina**
**Salinas Valley, California**

Harding ESE Project No. 51750 007

This document was prepared by Harding ESE, a MACTEC Company (Harding) at the direction of the Monterey County Water Resources Agency (MCWRA) for the sole use of the MCWRA, the only intended beneficiary of this work. No other party should rely on the information contained herein without prior written consent of the MCWRA. This report and the interpretations, conclusions, and recommendations contained within are based, in part, on information presented in other documents that are cited in the text and listed in the references. Therefore, this report is subject to the limitations and qualifications presented in the referenced documents.

# CONTENTS



## TABLES



## PLATES

## APPENDIXES



## DISTRIBUTION

# EXECUTIVE SUMMARY

Geologic and hydrogeologic data from the Salinas Valley ground water basin (Salinas Valley basin), including the city of Marina and former Fort Ord, were examined to assess hydrostratigraphic continuity throughout the study area with respect to the potential for seawater intrusion. Aquifers evaluated in this study area include the perched zone or A-aquifer, the Pressure 180-Foot Aquifer (180-Foot Aquifer), the Pressure 400-Foot Aquifer (400-Foot Aquifer), the Deep Aquifer, and aquifers within the Purisima and Santa Margarita Formations. The 180-Foot and 400-Foot Aquifers are the focus of this study because both aquifers outcrop along the canyon walls of Monterey Bay where they interface with seawater. Ground water withdrawal from the Salinas Valley, primarily for agricultural irrigation, has steadily resulted in seawater intrusion in the 180-Foot Aquifer and the 400-Foot Aquifer, proportional to the use of each aquifer. Seawater has currently intruded (as defined by chloride concentrations exceeding 500 mg/L) about 6 miles in the 180-Foot Aquifer and about 3 miles in the 400-Foot Aquifer along the Salinas Valley floor (*MCWRA, 2001*). Beneath the Marina and former Fort Ord area, seawater has intruded about 2 miles in the 180-Foot Aquifer and about 3 miles in the 400-Foot Aquifer, although the extent of the intrusion in the 400-Foot Aquifer is unclear.

This report evaluates the current state of or potential for seawater intrusion in the city of Marina and former Fort Ord area in the 180-Foot and 400-Foot Aquifers. Ground water from this area has primarily supplied drinking water wells as opposed to agricultural wells as in the Salinas Valley. Marina and former Fort Ord began developing their drinking water supply systems in the 1940's and 1950's, primarily in the 180-Foot Aquifer. The city of Marina replaced its 180-Foot Aquifer production wells with 400-Foot and Deep Aquifer wells in the 1980's when water quality was degraded by seawater intrusion. At the same time, Fort Ord abandoned the last of its Main Garrison well field and became reliant on four new wells about two miles east (installed in the 180-Foot and 400-Foot Aquifers).

The first step to evaluate current seawater intrusion in the city of Marina and former Fort Ord area in this study was to review available lithologic data and correlate those data to lithology further east within the Salinas Valley. Of primary interest is the lateral continuity of the Salinas Valley Aquitard (SVA) and the 180-Foot Aquifer (valley fill deposits), and the 400-Foot Aquifer (Aromas Sand and Paso Robles Formation). Deeper portions of the Paso Robles Formation and the Purisima and Santa Margarita Formations were also correlated where possible.

In the former Fort Ord and city of Marina area, dune sand has buried the marine SVA clay that caps the fluvial sand and gravel sequences of the valley fill deposits; these deposits, in turn, unconformably overlie the Aromas Sand or Paso Robles Formation. South of the Main Garrison area (roughly south of Gigling and Watkin's Gate Roads) the valley fill deposits pinch out and the Aromas Sand is found overlying the Paso Robles. Much of the Aromas Sand north of Gigling and Watkin's Gate Roads has been removed by fluvial erosion by the Salinas River prior to deposition of the valley fill deposits. The Paso Robles Formation is found throughout the study area and overlies what may be the Purisima Formation or an upper member of the Santa Margarita Formation.

The SVA clay overlies the 180-Foot Aquifer in the Pressure zone of the Salinas Valley and is laterally extensive in the valley from about Gonzales north to Monterey Bay. A similar clay is found beneath the former Fort Ord area and has been referred to as the Fort Ord-Salinas Valley Aquitard (FO-SVA). It is concluded in this report that the two clay units are the same or at least hydraulically equivalent and are collectively referred to as the SVA. The SVA clay is thinner beneath the former Fort Ord area

and abruptly thickens beneath the Salinas Valley northeast roughly of the Salinas River.

The SVA clay defines the Pressure Zone of the 180-Foot and 400-Foot Aquifers beneath the Salinas Valley. Even though the SVA clay and underlying 180-Foot Aquifer extend westward to Monterey Bay, the Pressure Zone extends only to a political boundary following the Salinas River. Because the hydrogeologic conditions of the Pressure Zone as defined beneath the Salinas Valley are also found further west beneath the city of Marina and former Fort Ord area, it is recommended in this report that the Pressure Zone area be redefined to include this western area and reflect the larger confined area of the 180-Foot and 400-Foot Aquifers.

Beneath the SVA, the confined 180-Foot Aquifer is a coarse sand and gravel unit that has long been the target aquifer of many agricultural wells in the valley since early ground water development. The gravel units of this aquifer extend westward from the Salinas Valley to the Marina and former Fort Ord area into what is called the Lower 180-Foot Aquifer. A sandy upper member of the 180-Foot Aquifer present only beneath Marina and former Fort Ord area does not extend east of the Salinas River where the SVA beneath the valley thickens. Ground water elevation and quality data from the Upper and Lower 180-Foot Aquifers beneath former Fort Ord and the 180-Foot Aquifer beneath the Salinas Valley are presented in this report.

The 400-Foot Aquifer is thinner but similar in composition to the 180-Foot Aquifer and is divided from it by one or more clay layers. This aquifer extends throughout the study area but it is thinner and sandier beneath former Fort Ord than beneath the Salinas Valley. The 400-Foot Aquifer has increasingly become a target aquifer for development with the advancement of seawater intrusion in the 180-Foot Aquifer.

Historical (1975 and 1985) and recent (1997 and 1999) ground water quality data from the 180-Foot and 400-Foot Aquifers in the former Fort Ord and city of Marina area were evaluated with respect to chloride concentrations and chemical signatures using Piper diagrams.

Chloride concentration data have been used most prevalently to delineate the advancement of seawater intrusion historically; however, additional chemical data are used in this report to illustrate ground water signatures to identify the source of elevated chloride concentrations. Alternative sources, such as agricultural return water or landfill waste, may also result in elevated chloride concentrations, but each may have a distinctive chemical signature.

Ground water quality data are available from agricultural and municipal production wells and from dedicated monitoring wells (also referred to simply in this report as 'monitoring wells'). Data from these wells differ because of construction and usage differences. Data from dedicated monitoring wells at former Fort Ord differ from production wells because they typically reflect water quality conditions in the upper portion of a specific aquifer as opposed to fully penetrating it. Current data from these dedicated monitoring wells for much of the city of Marina and former Fort Ord area indicate that the upper portion of the Lower 180-Foot Aquifer is not intruded by seawater; however, insufficient data exists to evaluate the lower portion of this aquifer, where seawater would be expected due to its relatively high density. Collecting depth-specific samples from monitoring wells is recommended to better evaluate the presence of seawater.

Although current data in the 180-Foot Aquifer generally indicate only low concentrations of chloride (less than 250 mg/L) beneath former Fort Ord, data from agricultural wells north of Marina in the 400-Foot Aquifer do indicate seawater intrusion. Samples from 14S/2E-21N01 and 14S/2E-21E01 indicate elevated chloride concentrations and a chemical signature consistent with seawater intrusion. Because little data is available from the recently installed wells and both are west of the primary extraction areas of the Salinas Valley, it is unclear how seawater came to intrude this area. Ground water production at wells west or east of -21N01 and -21E01 may have contributed to seawater intrusion in the area but cannot be identified as a potential source without additional ground water quality data.

The three active Fort Ord production wells and two agricultural production wells to their north (14S/2E-28C01 and 14S/2E-33P01) were also evaluated for seawater intrusion. Chloride concentrations have slowly but steadily risen in the Fort Ord production well closest to the Salinas Valley (FO-30). Of the two agricultural wells to the north, ground water from -33P01 (screened in the 180-Foot and 400-Foot Aquifers) has a chemical signature nearly identical to those of the Fort Ord supply wells. Well –33P01 also has similar chloride concentrations to those at FO-30 (about 100 mg/L). Well -28C01 is primarily screened in the 400-Foot Aquifer and chloride concentrations are lower. It is concluded that the leading or peripheral edge of seawater intrusion in the 180-Foot Aquifer beneath the Salinas Valley is migrating toward the Fort Ord production wells. Unabated use of these and other wells in the 180-Foot Aquifer within the Salinas Valley will eventually result in the continued intrusion of seawater and rise in chloride concentrations.

Several measures have recently been initiated by the Monterey County Water Resources Agency (MCWRA) to stem the advancement of seawater intrusion. These measures rely partly upon reducing ground water withdrawal from the 180-Foot and 400-Foot Aquifers in the northern portion of the Salinas Valley and supplying growers instead with recycled wastewater for irrigation. Ground water elevations are anticipated to rise in response and reverse the landward ground water gradient that contributes to continued seawater intrusion. Ground water elevations and quality will continue to be monitored by MCWRA to observe such a response.

# 1.0 INTRODUCTION

This report was prepared for the Monterey County Water Resources Agency (MCWRA) to evaluate hydrostratigraphic continuity of the Pressure 180-Foot and Pressure 400-Foot Aquifers in the area west of the Salinas River leading into former Fort Ord and the city of Marina. The primary focus of this study is to evaluate the current status of seawater intrusion beneath the Marina and former Fort Ord area with historical data that indicated seawater intrusion in this area.

The Salinas Valley (Plate 1) is a narrow intermontane valley oriented about N20W and extending about 90 miles southeast inland from Monterey Bay in central California. The valley ranges in width from approximately ten miles in the north to two miles in the south and is contained by the Gabilan and Diablo Ranges to the northeast and the Sierra de Salinas and Santa Lucia Range to the southwest. The valley extends northwest beyond the Sierra de Salinas and from this point is bounded on the west by dune sand deposits overlying the Seaside Basin. The city of Marina lies on the western edge of the Salinas Basin adjacent to Monterey Bay. Former Fort Ord straddles the eastern edge of the Seaside Basin and western edge of the Salinas Basin, with most of its ground water supplies developed within the Salinas Basin.

The study area extends from Monterey Bay east to Nashua/Cooper Road in the western portion of the Pressure Area in the Salinas Valley and from the northern portion of Seaside to the northern extent of Marina (Plate 2). Cross-sections illustrated in this report extend somewhat beyond this area to tie stratigraphy within the study area to that underlying the Salinas Valley. Well and boring logs evaluated in the study area are almost entirely within township 14 south and range 2 east (14S/2E); the northern portion of 15 south 2 east (15S/2E), and the eastern portion of 14 south 1 east (14S/1E) are also included. Throughout this text, wells will be referred to by their private name (if one exists); both state well names and private names are included on Table 1.

Drinking water for city of Marina residents is supplied by the Marina Coast Water District (MCWD) which owns and operates three large capacity production wells and several smaller capacity wells with minimal contribution to the system. MCWD is in the process of acquiring the water supply system on former Fort Ord (including the three active production wells), which currently provides drinking water to residents on the former base. Marina and former Fort Ord were annexed to Zones 2 and 2a in 1996 to actively participate in MCWRA's management of the Salinas Valley ground water basin. Zones 2 and 2a were established to provide payment for the construction and operation of the Nacimiento and San Antonio Reservoirs, respectively. These reservoirs conjunctively provide flood control for the Salinas Valley and ground water basin recharge through the Salinas River (Plate 1).

Ground water is the primary source of water for urban and agricultural use in the Salinas Valley. Agricultural demands for ground water account for the majority of ground water extracted from the valley. Several hydraulic subareas have been designated within the valley. From south to north these areas include: the Upper Valley, Forebay, East Side, and Pressure subareas (Plate 1). Each area is hydraulically in contact with the adjacent subarea and each are defined by their distinct hydrogeologic properties. Aquifers within the Pressure subarea are primarily recharged from the Forebay subarea because the overlying clay prevents direct recharge from rainfall. The focus of this report is on the main aquifers within the Pressure subarea and equivalent aquifers west of the Pressure subarea.

A seawater intrusion monitoring program has been in effect in Monterey County since the early 1950's and several agencies have used these data to educate water users on the impacts of continued ground water pumping in coastal areas. One indirect benefit of the monitoring and education programs has been the overall decrease in ground water production from the valley since the 1970's. The lower production rates primarily resulted from better irrigation management practices encouraged by the MCWRA and a continued decrease is projected (*MCWRA, 1998*). Unfortunately, ground water extraction rates have not yet decreased in amount sufficient to halt the intrusion of seawater in the Pressure 180-Foot and Pressure 400-Foot Aquifers.

The Castroville Seawater Intrusion Project (CSIP) was completed in 1998 by the MCWRA. In conjunction with this project, the Salinas Valley Reclamation Project was constructed by the Monterey Regional Water Pollution Control Agency (MRWPCA). Together these projects are to mitigate seawater intrusion in ground water in the valley (*DWR, 1998*). A small portion of this program supplies Castroville farms with recycled water or a blend of recycled water and ground water, to replace their reliance entirely on ground water. CSIP will allow water levels in the Pressure 180-Foot and Pressure 400-Foot Aquifers to recover and possibly reverse the landward ground water gradient that causes continued inland seawater intrusion.

MCWRA is also in the process of designing the Salinas Valley Water Project (SVWP) to further control seawater intrusion and nitrate contamination, meet water demands projected to 2030, and hydraulically balance the Salinas Valley ground water basin. The project design includes modifying dams and reservoir operation and providing river conveyance and diversion facilities (*MCWRA, 1996; DWR, 1998*).

## 1.1 Previous Investigations

Several hydrogeologic investigations have been conducted on the northern (lower) portion of the Salinas Valley in an effort to understand the complexity of the geologic conditions effecting seawater intrusion including the following:

Salinas Valley area:

- 1904, Hamlin published the earliest document describing the Salinas Valley hydrogeology in detail.
- 1946, 1949, the Department of Public Works (DPW), Division of Water Resources (later named the Department of Water Resources [DWR]) published Bulletins 52 and 52a. These reports described geology of the Salinas Valley and the current state of seawater intrusion, which had at that time rendered about 1,000 acres of land without potable ground water in the 180-Foot Aquifer. Further studies were conducted by the DWR in 1958, 1970, 1973, and 1975, and by the Monterey County Flood Control and Water Conservation District (MCFCWCD).
- 1970, 1977, 1990, H. G. Greene conducted a geologic investigation of the Monterey Bay area in 1970 and included a correlation between offshore geology and subsurface geology observed inland, specifically the gravel units of the 180-Foot and 400-Foot Aquifers.
- 1975, Tinsley published a doctoral thesis describing the Quaternary geology of the northern Salinas Valley, and estimated ages of the major aquifer and aquitard materials from fossil examination. These age estimates have since become widely accepted.
- 1975, Dupré published his dissertation on the Quaternary history of the Watsonville area which also included a discussion of sediments in the former Fort Ord and Monterey area. His age estimates were based on fossil analysis and the interpretation of fluvial terraces (also called strandlines) throughout the area. Dupré published another description of Quaternary history of the area in 1990.
- 1976, Thorup evaluated a potential irrigation well site for the Castroville Irrigation Project and completed a deep (1,718 feet) boring

and evaluated boring logs throughout much of the Salinas Valley to construct cross sections illustrating valley stratigraphy. His report includes numerous isopach maps and cross-sections illustrating the Paso Robles Formation throughout the Salinas Valley.

- 1985, Leedshill-Herkenhoff, Inc. published a report describing seawater intrusion in the Salinas Valley.
- 1986, Brown (of DWR) published a draft geologic study of township/ranges 13S/2E and 14S/2E of the Salinas Valley.
- 1989, Todd Engineers investigated sources of seawater intrusion in the Castroville area, reviewing the causes of contamination, whether from seawater intrusion or cross contamination due to poor well construction.
- 1992, Hall (of Earthware of California for the MCWRA) published select geological cross-sections using GEOBASE; these cross-sections covered much of the Salinas Valley.
- 1993, Staal, Gardner and Dunne, Inc. published a seawater intrusion study of the 180-Foot Aquifer in the Salinas Valley, which included the installation of several monitoring wells and a surface geophysical investigation to locate seawater.

City of Marina and former Fort Ord areas:

- 1975, Kaiser published an invaluable report in 1975 through the Army Corps of Engineers on the hydrogeology of Fort Ord to understand historical seawater intrusion problems in that area and to recommend the placement of the four new supply wells.
- 1986, Geotechnical Consultants updated the Kaiser report and provided the most complete data set concerning ground water elevations and chloride concentrations in the Fort Ord Main Garrison well field (since destroyed).
- 1985, Thorup reported to the MCFCWCD his evaluation of the four then new drinking water supply wells at Fort Ord to assess what aquifers had been penetrated. Because of the similarity in cross-section locations with this study, Thorup's report is reproduced in Appendix E.
- 1987, Harding Lawson Associates (HLA) began a remedial investigation began at the former Fort Ord army base near the Fritzsche Army Airfield (now the Marina Airport). Other investigations throughout the former base started in 1990, and a significant remedial investigation began in 1992 which described hydrogeologic conditions throughout the base and the extent of soil and ground water contamination.
- 1993, Geoconsultants published a report summarizing the findings and construction details of MCWD deep wells 10, 11, and 12. This report includes sediment age estimates based on analysis of formanifera collected in samples in all three borings. Geoconsultants referred to the thick sequence of Pleistocene sediments beneath the city of Marina as the "Marina trough".
- 1994, HLA published a Basewide Hydrogeologic Characterization report as part of the remedial investigation/feasibility study and extensively described geology and hydrogeology throughout the Fort Ord boundary, including descriptions of the Seaside and Salinas ground water basins.

The former Fort Ord remedial investigation is ongoing, and approximately 400 borings and monitoring wells of varying depth have been installed since 1985. A significant amount of water level and water quality data has been collected for the A-aquifer, the Upper and Lower 180-Foot Aquifers, and the 400-Foot Aquifers. Several consultants have contributed to this investigation, and although numerous more recent site-specific reports have been published concerning former Fort Ord hydrogeology, the most encompassing publication describing the Fort Ord area geology is the Basewide Hydrogeologic Characterization Report (*HLA, 1994*). HLA published the OU 2 Plume Delineation Investigation Report, Phase II, in 2000 that focuses on the ground water plume emanating from the former landfills. This more recent report includes cross-sections that include the area of this study.

## 1.2 Study Goals

This study was tasked with three goals concerning the hydrogeologic evaluation of the study area (Plate 2).

1. examine the lithologic continuity of stratigraphy underlying the study area
2. evaluate ground water elevation and quality throughout the study area
3. examine the construction of specific wells included in the MCWRA monitoring program and determine which aquifers are penetrated at each locale.

The Scope of Work (SOW) authorized by the MCWRA is reproduced in Section 2.0.

Stratigraphy beneath the city of Marina and former Fort Ord and beneath the Salinas Valley has historically been studied independently of one another and correlation between the two areas on a regional scale is not well understood. Therefore, the first goal of this study was to correlate lithology throughout the study area to a depth including at least the 400-Foot Aquifer.

The second goal addresses the effects pumping from the Salinas Valley has on ground water elevation beneath the city of Marina and former Fort Ord, specifically with respect to the potential for seawater intrusion. Lithologic, hydraulic, and water quality data were all evaluated to complete this goal.

In addition to assigning aquifers screened or perforated by specific wells, the third goal includes identifying cross-screened wells or wells with gravel packs that extend to multiple aquifers. Knowing which wells potentially allow the vertical migration of seawater contaminated water from one aquifer to another is essential to halt the further advancement of seawater in the valley.

Although the focus of this study is on the 180-Foot and 400-Foot Aquifers, lithologic data from several wells penetrating the deep zone aquifers are also evaluated and correlation across the study area is attempted. Because of the few numbers of these deeper wells, however, many uncertainties exist concerning the continuity of the deep zone aquifers and further work is needed.

## 1.3 Data Sources

Available data used to make lithologic correlations include, in order of reliability, geophysical (electric) logs, driller's logs, and well construction data. Driller's logs, although most plentiful, do not refer to a consistent standard of description making the lithologic correlation between adjacent wells a somewhat subjective process. Geophysical logs are more objective, but are less numerous and require a more sophisticated evaluation process to interpret. Well construction data is useful to determine where the driller may have observed water production, regardless of recorded lithologic data. Thus, well construction data may indicate geologic conditions observed by the driller that were not explicitly recorded on the boring log. The construction data are particularly useful at wells with no geophysical log data.

Boring logs were obtained with permission from the MCWRA library, Marina Coast Water District (MCWD), Monterey Peninsula Water Management District (MPWMD), U.S. Army, and from previous reports of investigations conducted throughout the study area, including many from the former Fort Ord.

# 2.0 SCOPE OF WORK

This section describes the scope of work as stated in the Contract authorized by the MCWRA on October 10, 2000.

## Exhibit A - Scope of Work and Work Schedule

- Task 1 – Construct cross-sections in appropriate digital format

Harding ESE Inc. (HESE) will construct cross-sections from the western edge of the Salinas Valley westward toward Monterey Bay, incorporating borings and well logs already interpreted at the former Fort Ord wherever possible. It is understood that these cross-sections will be presented to the Monterey County Water Resources Agency (MCWRA) in a digital format compatible with the software package to be used by the MCWRA (to be determined). HESE currently uses the gINT format, which is capable of producing cross-sections. The cross-sections will be limited by the depth of available boring or well logs, but is anticipated to include the 400-Foot Aquifer as understood in the Salinas Valley aquifer (it is possible that this aquifer is not present beneath much of Fort Ord).

The number and length of each cross-section remains to be determined by MCWRA. For the purposes of estimating time to complete this task, it is assumed that three cross-sections with up to 10 well logs each will be constructed. The digital format of these cross-sections will be determined by HESE and MCWRA during the first meeting. Additional information, such as NAD 83 coordinates for each well to be evaluated, will also be addressed in the first meeting.

- Task 2 – Illustrate historical saltwater intrusion fronts in the Marina/Fort Ord area

Historical saltwater intrusion at 500 mg/L chloride for the 180-Foot Aquifer will be provided for 1975 and 1985. Intrusion at 500 mg/L chloride in the 400-Foot Aquifer will be provided for 1966, 1975, and 1985 (*no data from 1966 in the 400-Foot Aquifer near Marina and former Fort Ord was found during this study*). This task is basically a digital reproduction of mapping previously performed by MCWRA based on available historical data, which will be provided by MCWRA. Well construction information and water quality data used for the previous MCWRA mapping will be reviewed to confirm that interpretation of ground water conditions was reasonable based upon data available at that time. Available production records will also be presented to explain the advancement of saltwater intrusion in the area and any change between historical and current conditions. The historical saltwater intrusion fronts will be provided in a GIS coverage format compatible with MCWRA's GIS software.

- Task 3 – Illustrate saltwater intrusion contours from 1997 and 1999 in 180-Foot and 400-Foot Aquifers

Saltwater intrusion lines (based on 100 mg/L, 250 mg/L and 500 mg/L chloride ) observed in 1997 and 1999 in the 180-Foot and 400-Foot Aquifers in the former Fort Ord and Marina vicinity will be presented to the MCWRA. HESE understands that this data will be used in conjunction with data from aquifers beneath the Salinas Valley and data will be presented in a GIS coverage format compatible with MCWRA's GIS software.

- Task 4 – Construct piper diagrams

HESE will produce Piper diagrams of the 180-Foot and 400-Foot Aquifers for 1997 and 1999 in the former Fort Ord and Marina vicinity. Data from production or agricultural wells from these time periods in the former Fort Ord vicinity will also be used if available, with the intent to identify inorganic signatures indicative of saltwater intrusion.

- Task 5 – Evaluate wells new to the MCWRA monitoring program

Several agricultural wells have recently been added to the monitoring program to obtain ground water elevation and ground water quality data. Due to the higher ground surface elevation west of the Salinas Valley and the slight differences in subsurface geology, particularly with respect to the continuity of the 400-Foot Aquifer, correlating stratigraphy at these locations with well logs in the Salinas Valley may be difficult. HESE will therefore plot available lithologic data onto cross-sections prepared in Task 1 to correlate stratigraphy with areas better understood beneath the former Fort Ord with similar ground surface elevations. The ultimate goal is to fully understand the continuity of hydrostratigraphic units from the Salinas Valley westward to Monterey Bay, including the former Fort Ord area. Based upon the stratigraphic interpretations, new monitoring wells will be assigned to the appropriate aquifer or ground water zone.

- Task 6 – Illustrate August trough ground water elevation contours from 1997 and 1999 in 180-Foot and 400-Foot Aquifers

Ground water elevations measured in the 180-Foot and 400-Foot Aquifers in 1997 and 1999 in the former Fort Ord/Marina vicinity will be reproduced for the MCWRA. These data will be used in conjunction with water quality data (chloride and TDS) to explain the pattern of historical saltwater advancement and retreat and address the potential for future advancement. This ground water contour data will be provided in a GIS coverage format compatible with MCWRA's GIS software.

- Task 7 – Summarize findings in a report

A report summarizing results from the above Tasks will be submitted to the MCWRA by December 2000. The report will include text supporting tabulated data and plates illustrating ground water elevation and quality contours, as well as west-east cross-sections from Monterey Bay to the Salinas Valley. A major goal will be to establish hydrostratigraphic continuity along this traverse to better understand hydraulic connections west of the Salinas Valley and address the potential for saltwater to migrate into the valley across the former Fort Ord area in the 180-Foot or 400-Foot Aquifers.

For cost estimate purposes, it is assumed that the report will total 50 pages, not including 20 plates. Of the plates, 16 are assumed to be presented on oversize sheets (22x34 inches) and will be black and white. Four (the piper diagrams) are assumed to be presented on letter size sheets in color.

It is also assumed that 3 copies will be presented to the MCWRA in draft format (by December 2000) and will be followed by 25 more copies in final format after MCWRA Board of Directors' approval. Plates will be presented on a scale consistent with previously published maps and on oversized sheets.

- Task 8 – Meetings

HESE anticipates 3 meetings in your Salinas office will be necessary to collect available lithologic data and present preliminary findings during our investigation. These meetings will be attended by one senior hydrogeologist and should require no more than two days each. The first meeting will be used to clarify digital cross-section formats and cross-section locations, and to collect available lithologic data. Production wells recently added to the monitoring program will also be visited by an MCWRA representative and the HESE hydrogeologist. Thus, the first meeting may require two days. The second meeting will be used to collect additional data and to present preliminary findings and should only require one day. The third meeting will be used to present the final report to the MCWRA's Board of Directors.

# 3.0 STUDY AREA HYDROSTRATIGRAPHY

A hydrostratigraphic unit can be defined as a formation, part of a formation, or groups of formations in which there are similar hydraulic characteristics allowing for grouping into aquifers or confining layers (aquitards). A simple example is an extensive gravel unit deposited during a single fluvial event that could be considered both a geologic unit and also, if saturated, a hydrostratigraphic unit.

Many times the boundaries defining a hydrostratigraphic unit overlay those defining a single geologic unit. Several geologic units with similar hydraulic properties also may represent a single hydrostratigraphic unit if they are in direct contact with one another, despite lithologic or age differences. For example, although a Pliocene sand unit in contact with a Pleistocene gravel unit differ lithologically, they could be considered a single hydrostratigraphic unit (an aquifer) because ground water can easily flow between the two. Similarly, a blue clay adjacent to a brown or yellow clay are considered a single hydrostratigraphic unit (an aquitard) even though the colors may indicate different depositional environments, ages, or events.

This section discusses both lithologic variations and hydrostratigraphic units throughout the study area. Because a fundamental goal of this study is to assess the potential for continued or renewed seawater intrusion and because the pathway of seawater intrusion is primarily determined by pressure differences and hydraulic continuity, not just lithologic differences, understanding the hydrostratigraphy of the study area is of primary importance.

## 3.1 Lithologic Data Interpretation

Lithologic data available from different sources may differ substantially in quality and purpose. Within the Salinas Valley, agricultural wells are numerous and most have a lithologic record that has been submitted to the State (DWR); some wells have also been geophysically logged.

Many of the agricultural wells in the study area were installed using cable tool techniques. Geologic logging at these wells is often done by the driller who often notes material, grain size, and color, but usually does not refer to a standard (such as ASTM grain sizes or Munsell colors). For this reason, lithologic comparison between different wells logs can be difficult.

In contrast, most of the wells installed at the former Fort Ord have been small-diameter monitoring wells installed as part of the remedial investigation of ground water contamination by solvent chemicals and were logged by geologist/driller teams. Geophysical logs were performed at many of these wells and continuous cores were collected to represent lithology of the northern portion of former Fort Ord to depths including the 400-Foot Aquifer. Almost all of these monitoring wells were installed using rotary techniques. The ASTM standard was most often referred to and colors were consistent with Munsell color charts. This consistency has lead to a more straight-forward lithologic comparison of the Fort Ord monitoring wells to each other than between agricultural wells logs.

Well logs are also available for municipal wells at the former Fort Ord and city of Marina, and because many of these wells were installed with techniques consistent with agricultural wells in the Salinas Valley, they provide an opportunity to 'calibrate' logs from small-diameter, rotary-drilled monitoring wells to those from large agricultural wells drilled with cable tool.

Well logs evaluated in this program and the types of data available for evaluation are listed in Appendices A and B. Data from these wells, including driller's logs, geophysical logs, and well construction data, were compiled to construct the cross-sections shown on Plates 3, 4, 5, and 6. Cross-section locations are shown on Plate 2. Well construction details (including screened intervals, grouted interval, and gravel pack intervals) and lithologic data are shown on these cross-sections. Additional data such as geophysical logs, not included on these cross-sections, were also used to construct the interpreted lithologic illustration shown on each cross-section.

Because geophysical log data are generally more comparable between wells (although only after careful evaluation) and may indicate the presence of lithologic units not observed or recorded by the driller or geologist, geophysical log data were usually preferred in the final interpretation. Additionally, lithologic logs indicating inconsistent conditions compared to logs from multiple nearby wells were generally weighted less and data from the nearby wells were favored; however, it is understood that local variations in lithology may exist. For these reasons, several lithologic logs shown on the cross-sections do not appear to correlate with the recorded lithology included in Appendix A.

## 3.2 Lithologic Units Description

Most wells evaluated in this study are between 300 and 2,000 feet deep and penetrate several formations including, in increasing age, older dune sand, the valley fill deposits, the Aromas Sand, the Paso Robles Formation, and possibly the Purisima and Santa Margarita Formations. Although these formations are regionally underlain by the Monterey Formation, only the logs from 14S/2E-22K01 (Fontes-1) and possibly 14S/1E-24L indicated the presence of Monterey shale. These lithologic units are described in this section.

### *Older Dune Sand (Qod)*

The Pleistocene-age older dune sand blankets most of the northwestern portions of study area and is the predominant surface deposit present at the former Fort Ord. This unit comprises most of the bluffs along the western bank of the Salinas River, which has successfully controlled the migration of dune sand further east into the valley. This dune field has also been referred to as the Fort Ord erg complex (*Dupre, 1975 and 1990*). Subsurface data indicate that the sand is up to 250 feet thick. This sand is predominantly fine- to medium-grained, with thin gently to moderately dipping laminae (cross-bedding). Quartz and feldspar are abundant. Seismic reflectors within the sand and the occasional occurrence of brown, silty strata in borings indicate the presence of paleosols buried within the older dune sand. A paleosol represents a soil layer that formed on a landscape in the past that has since been buried by more recent sediment.

In addition to the older dune sand, beach sand and more recent dune sand deposits are observed at the cities of Seaside and Marina. These units are limited in extent and for the purposes of this report are not distinguished on the cross-sections. Beach sand is restricted to the coastline and consists of well-sorted, fine- to coarse-grained sand composed largely of quartz and feldspar. Localized concentrations of sand composed largely of heavy mineral constituents and rounded gravel occur sporadically as a result of segregation by wave action. Steep bluffs border much of the landward portion of the beach and at least a portion of the beach sand derived from erosion of the dunes forming the bluff.

Active and recently active dunes parallel the beach and extend several hundred feet inland. These dunes are composed of typically loose, well-sorted, fine- to medium-grained quartzose sand. The dune sand is similar to the beach sand but it is generally finer-grained. Paleosols exist within the dunes and paleosols indicate that one or more cycles of dune deposition have occurred with intervening periods of soil development. The paleosols in the dunes bordering the beach indicate older dune sand is locally present beneath the recent dune sand.

### *Salinas Valley Alluvium (Qal)*

A thin veneer of alluvial Holocene-age sediments is found at the surface along the Salinas Valley floor. These sediments were recently deposited by the Salinas River and overlay an extensive marine clay described below. The perched aquifer within the alluvium has not been intruded by seawater because ground water elevations remain above sea level; however, agricultural return water percolating into the perched aquifer has resulted in highly mineralized water.

### *Valley Fill Deposits (Qvf)*

As used in this report, this Pleistocene-age unit is considered to include two distinct depositional sequences: an estuarine clay (Salinas Valley Aquitard [SVA]) underlying the older dune sand and a sand and gravel fluvial sequence beneath the SVA. From the basal gravels to the fine-grained SVA, the valley fill deposits consist of fining upward depositional sequence reflecting an episode of marine transgression.

Beneath former Fort Ord, the SVA is composed of blue-gray, plastic clay with abundant shells or shell fragments, thin beds of fine-grained sand typically less than 10 feet thick, and occasional, very thin layers of peat. Up to five layers of clay or silt have been observed to comprise the SVA, although three layers are most commonly observed on geophysical logs. Many lithologic logs incorrectly record one continuous clay unit.

Although this description is essentially identical beneath the Salinas Valley, a yellow sandy clay is often observed overlying the SVA clay in the Salinas Valley which may represent a different depositional event (e.g., flood plain deposits versus estuarine deposits). Regardless, the two clay units are collectively referred to in this report as the SVA because they behave as one hydrostratigraphic unit.

Two to three thin (typically less than 10 feet thick) but laterally extensive sand units are found throughout the SVA beneath former Fort Ord. None were recorded at wells MCWD-10 or MCWD-11 but have been observed in nearby monitoring wells. For simplicity, these multiple "intra-SVA" sand lenses are illustrated as one unit on Plates 4 and 5. It is suspected that the SVA contains several minor sand units throughout much of the Pressure subarea as beneath former Fort.

The SVA is limited to the northern portion of the Salinas Valley (corresponding with the Pressure subarea of the Salinas Valley) and the northern portion of the former Fort Ord (Plates 1 and 2). The maximum thickness of the SVA is approximately 100 feet. The SVA extends beneath the Salinas Valley from Monterey Bay south approximately to the city of Chualar, and extends from the valley axis westward almost to Highway 1 and eastward to an irregular boundary with the East Side Area (Plate 1). Beneath former Fort Ord the SVA extends south approximately to Gigling and Watkin's Gate Roads.

The SVA pinches out just east of Highway 1 in the city of Marina/Fort Ord area and terminates to the south beneath former Fort Ord against an erosional contact with the Aromas Sand and Paso Robles Formation. There have been questions over whether the SVA beneath former Fort Ord (called the FO-SVA in Fort Ord ground water investigation reports) is an extension of the SVA underlying the Pressure subarea of the Salinas Valley. Reasons to suspect the two represent different units include greater thickness beneath the valley and a steeper dip beneath former Fort Ord. Elevations of the SVA surface beneath former Fort Ord are also generally higher than in the valley. The southernmost surface of the SVA beneath former Fort Ord is about 100 feet above MSL whereas the SVA surface beneath the valley is slightly above sea level. Nonetheless, this study concludes that the SVA clay is a single hydrostratigraphic unit throughout much of the study area.

The higher elevations and steeper northward dip of the SVA surface beneath much of former Fort Ord are probably a result of locally higher rates of tectonic uplift, possibly related to the Santa Lucia range to the south, although this is speculative and additional information is needed. The greater thickness of the SVA beneath the Salinas Valley may reflect that the estuary in which the SVA clays were deposited was deepest beneath the current valley axis. The SVA clay deposited beneath former Fort Ord probably represents a period when the estuary expanded westward from the valley axis. It is not clear whether the SVA pinches out near Highway 1 beneath former Fort Ord and Marina because the estuary did not extend past this area (perhaps because of a barrier island complex present at the time) or whether it was deposited but subsequently eroded.

The underlying fluvial sand and gravel sequence extends from the Salinas Valley westward beyond the pinch-out of the SVA near Marina and former Fort Ord and outcrops on the Monterey Bay floor as has been documented in previous studies (*Greene, 1970, 1977, 1990; DWR, 1946*). Within the valley, these sediments also extend somewhat beyond the southern limits of the SVA near Chualar. These deposits range from approximately 100 to 300 feet thick. As described on boring logs at former Fort Ord, a sandy portion of the unit is commonly present immediately below the SVA, with gravel deposits occurring beneath the sand. Numerous thin clays are present throughout. Sandy clay and clayey gravel separates the sandy portion from the gravel deposits in the vicinity of the Fort Ord supply wells. The abundance of rounded gravel to several inches in diameter in the lower portion of the valley fill deposits suggest a fluvial origin, probably representing river deposits during a Pleistocene-age low sea level stand.

As will be discussed in Section 3.3, only the gravel of the lower member beneath former Fort Ord is continuous with the 180-Foot Aquifer in the Pressure subarea of the Salinas Valley which is usually described in boring logs as having coarse gravel or cobbles throughout with no distinctive upper or lower members.

The valley fill deposits lie unconformably over the Aromas Sand as a result of fluvial erosion by an ancestral Salinas River. The valley was subsequently filled with fluvial, marine, and finally, eolian sediments. Valley fill deposits may also locally overlie the Paso Robles Formation where the Aromas Sand was removed entirely.

### *Aromas Sand (Qar)*

The Aromas Sand is a Pleistocene-age deposit composed of fine- to coarse-grained, friable quartz and feldspar sand. Cross-bedding and a uniform grain size exposed in an abandoned borrow area on former Fort Ord indicate eolian deposition. The unit is also recognized in the north side of the Salinas Valley in the Moss Landing-Prunedale area. Outcrops of the Aromas become isolated and scattered toward the west of Fort Ord and ultimately becomes buried beneath older dune sand in the city of Seaside. Although definitive correlation is lacking, previous studies indicate that the sand sequence present on the northwest side of the Salinas Valley, in and adjacent to former Fort Ord, is also the Aromas Sand (*DWR, 1969*); in this report, the conclusions of the previous studies are assumed to be correct. According to Muir (*1982*), the Aromas Sand may range up to 300 feet thick.

The Aromas Sand is exposed throughout the ridge and hilltop areas in much of the southeast portion of former Fort Ord, south of approximately Gigling and Watkin's Gate Roads. Cemented beds within the Aromas are erosion-resistant and contribute to the formation of prominent ridges in the otherwise erodible sands. These ridges typically have abrupt and steep south-facing slopes and gentle northward-facing dip slopes. In much of the southeast portion of the base, the Aromas can be observed to dip gently toward the northeast. In particular, an erosion-resistant clayey 'cap-rock' is easily seen in outcrops overlying the Aromas along Gigling and Watkin's Gate Roads on former Fort Ord reflecting relict morphology. Dupré (*1975*) described a similar cap-rock in eolian deposits of the Aromas Sand in the Watsonville area and referred to it as a duripan, implying a paleosol formation. If this is an accurate description of the cap-rock found on former Fort Ord, it is reasonable to assume the duripan would be widespread and reflect paleo-morphology.

Because the Aromas Sand has been partially buried by recent dune sands, the cap-rock is only visible at surface outcrops. Lithologic logs from two wells north of Gigling and Watkin's Gate Roads (Test Wells 3 and 4) indicate what could be the buried cap-rock, based on similar elevation and the description of a hard clayey unit; however, the presence of such a cap-rock is absent in boring logs further north (*HLA, 2000*). Subsurface boring data from wells in the Main

Garrison of former Fort Ord do not indicate the presence of the cap-rock and at least the upper portion of the Aromas has been removed roughly north of Gigling and Watkin's Gate Roads, including the northern portion of former Fort Ord, the city of Marina, and throughout much of the Salinas Valley within the study area. Thus the valley fill deposits lie unconformably over the Aromas Sand.

The "red sands" of the Aromas Sand unit have been referred to in previous investigations (*Thorup, 1976*; *Kaiser, 1975; HLA, 1994; Dupré, 1975*). Although Dupré described the color as a result of oxidation and deposition of red clay cutans (*Dupré, 1975*), small clay nodules observed in the cap-rock at former Fort Ord are gray, not red, in contrast with the red sand matrix. Nonetheless, it is assumed that the duripan Dupré observed in the Watsonville area is the same or similar to the cap-rock found on former Fort Ord.

It should be noted that red sands may be observed throughout the Aromas, but it is the clayey or hard red bed often observed at the base of the Aromas that defines the contact with the underlying Paso Robles Formation. A road cut in the hill near the eastern base boundary exposes the Aromas contact with the underlying Paso Robles Formation; the contact contains abundant angular granitic clasts suggesting relatively high-energy alluvial or alluvial fan deposition. At the same location, the uppermost Paso Robles Formation is oxidized to a red-brown color, indicating that an unconformity exists, at least locally, between the two units. This basal 'red-bed' correlates with many of the red beds noted on many boring logs throughout the study area.

The stratigraphic relationship between the Aromas Sand and the Paso Robles Formation is difficult due to lithologic similarities and the complex interface between them (*Tinsley, 1975; Dupré, 1975 and 1990*). For this reason, the Aromas Sand is illustrated on Plates 3 through 6 as the "Aromas/Paso Robles Formation", although this report assumes that this combined unit primarily represents the Aromas Sand.

### *Paso Robles Formation (Tpr)*

The Paso Robles Formation is a late Pliocene to early Pleistocene age continental sequence. It is exposed in the southeast hills of the base and near Laguna Seca but is buried by alluvium within the Salinas Valley. This formation is commonly exposed at lower elevations in the central and southern portions of former Fort Ord in drainages where the overlying Aromas Sand has been removed by stream erosion. Roadcut exposures of the Paso Robles Formation typically display lenticular beds of sand, gravel, silt, and clay. Where exposed, these deposits are uncemented and exhibit limited lateral continuity, suggesting poorly sorted alluvial fan and/or braided stream deposition. Correlation based on subsurface observation recorded on boring logs is very difficult.

The Paso Robles Formation is found in both the Salinas and Seaside Basins. It comprises the most important aquifers in the central and southern portions of the Salinas Valley. Thorup installed a deep boring in the valley (14S/2E-22K01, also called Fontes -1) and used lithologic and fossil data to describe the Paso Robles Formation consisting of three different members totaling up to 1,800 feet thick (*Thorup, 1976*). Based on the log of 14S/2E-22K01 and logs from two other deep wells, Thorup concluded there are three members of the Paso Robles Formation. The "A" member is the 400-Foot Aquifer and is about 200-feet thick. The "B" member contains the Deep Aquifer (previously called the 900-Foot Aquifer) and varies in depth about from 600 to 1,200 feet bgs. The "C" member is an unnamed section of water-bearing sediments about 200 feet thick (*Thorup, 1976*).

More recent data from the three deep MCWD wells and well 14S/1E-24L indicate a laterally complex geology within the Paso Robles Formation that is difficult to correlate. Although Thorup identified Pliocene sediments beneath the Pleistocene-age Paso Robles Formation, only Pleistocene-age and younger sediments were found at the three deep MCWD wells, based on micro-fossil analysis (*Geoconsultants, 1993; Ingle 1985, 1986, 1989*). This finding was concluded to mean that the Paso Robles Formation is unusually thick beneath Marina relative to the Salinas Valley, possibly explained by a local trough called the "Marina trough". However, the orientation or lateral extent of the Marina trough cannot be determined with available data and data from surrounding wells do not corroborate these findings.

The U.S. Geological Survey was tasked in March 2000 to install 14S/2E-24L to a depth of 2,000 feet bgs immediately adjacent to Monterey Bay; this depth is comparable to the deep MCWD wells. Correlating lithology data between this well and the three deep MCWD wells is difficult and fossil analysis results differ. As mentioned above, micro-fossils were not found at the three deep MCWD wells older than Pleistocene-age, but macro and micro-fossil analysis at 14S/1E-24L indicate Pliocene sediments below 1,150 feet bgs (about 1,100 feet below MSL) (*Hanson, 2001*). This contact at 14S/1E-24L is comparable to the Pleistocene/Pliocene contact elevation identified by Thorup (about 1,200 feet below MSL) at Fontes-1. Thus, if the "Marina trough" does exist, 14S/2E-24L seems to control its western extent. It should be noted that high temperatures at well 14S/2E-24L and the deep MCWD wells were observed and are probably related to faulting in the area. This feature in common indicates that the "Marina trough", if present, does not entirely isolate the deep MCWD wells from the surrounding area. A full report of the 14S/2E-24L well was not available at the time of this writing.

Direct correlation between the Paso Robles Formation surface exposures and subsurface boring data is difficult due to the few wells that fully penetrate it and its potential structural complexity. However, the proximity of the Paso Robles Formation at the ground surface near the East Garrison of former Fort Ord suggests that the Paso Robles clay and sand sequence is present below about 60 feet MSL. The general similarity between the sand-clay sequence in these wells and geologic materials encountered in the deeper wells in the former Fort Ord area suggest the Paso Robles Formation may form portions of the 400-Foot Aquifer. Additionally, the irregular nature of the subsurface contact and the zone of red-brown oxidation between the Paso Robles and the overlying Aromas Sand in the study area resemble the Aromas Sand-Paso Robles Formation contact exposed in a roadcut in the southeast portion of the base.

### *Purisima Formation (Tp)*

This Pliocene-age marine deposit is thickest to the north within Pajaro Valley and further north, but has been postulated to extend southward as far as Monterey, conformably underlying the Paso Robles Formation (*Greene, 1970 and 1990*). Sediment within the Purisima include sand interbedded with clay and shale in the lower member, intercalated beds of sand, silt, and clay with some gravel in the middle member, and interbedded sand, silt, and clay layers in the upper member (*USGS, 1980*).

Although not conclusive, lithology recorded at the MPWMD-11 (15S/1E-07B) monitoring well may indicate the presence of Purisima underlying the Paso Robles Formation (*Oliver, 1997*). Macro- and micro-fossil evidence collected at Well 14S/1E-24L, recently installed by the USGS near the MCWD headquarters in Marina, indicates that the Purisima Formation may have been encountered (*Hanson, 2001*). Likewise, Thorup (*1976*) also identified the Purisima Formation at his deep boring Fontes-1 (14S/2E-22K01). The lateral extent of the "Marina trough", if present, is thus limited by MPWMD-11, 14S/1E-24L, and Fontes-1.

### *Santa Margarita Formation (Tsm)*

The Miocene-age Santa Margarita Formation, of marine origin, is composed of white or blue-gray, well-sorted, fine- to coarse-grained, quartzose sand and friable sandstone with little clay content and high porosity. Unconformably underlying the Paso Robles Formation in the Seaside basin, the Santa Margarita Formation is reported to interfinger with the shale and diatomaceous members of the Miocene Monterey Formation a few miles east of the city of Monterey (*Bowen, 1969*).

This formation is locally associated more with the Seaside basin than the Salinas basin, but it is also present in boring logs that penetrate valley fill deposits, which are limited in lateral extent to the Salinas Valley Basin. Thorup (*1976*) identified the Santa Margarita Formation just south of the Nashua-Cooper Road intersection at the Fontes-1 boring (14S/2E-22K01). Preliminary data available at the time of this writing indicated that this formation was not observed at 14S/1E-24L.

## 3.3 Hydrostratigraphic Units

There is general correlation between the aquifers and the geologic formation within which they are found. The A-aquifer is found exclusively in the older dune sand beneath former Fort Ord and is the equivalent perched aquifer within the Salinas Valley alluvium; both of these unconfined aquifers overlay the SVA clay. The Pressure 180-Foot Aquifer is found within the valley fill deposits (although Thorup [1976] placed it within the Aromas Sand), and the Pressure 400-Foot Aquifer is found locally in either or both the Aromas Sand and Paso Robles Formation. The Deep Aquifer is found within the Paso Robles Formation, although it has been speculated that it may also be found in the Purisima Formation (*USGS, 1980*).

As mentioned above, the Pressure 180-Foot and Pressure 400-Foot Aquifers are the primary focus of this study. The evaluation of ground water elevation and quality data for both aquifers are presented below. Both of these aquifers are found within the Pressure subarea of the Salinas Valley ground water basin and also beneath the city of Marina and former Fort Ord, west of the Pressure subarea. Aquifers within the Deep Aquifer are only discussed in terms of lithologic continuity; no ground water elevation or quality data is evaluated for these deeper aquifers in this report.

The correlation of the 180-Foot and 400-Foot Aquifers throughout the study area is of particular interest in this study because of documented historical seawater intrusion in the Marina area and the relationship of this intrusion event to that beneath the Salinas Valley. The potential for renewed intrusion beneath Marina and former Fort Ord must be better understood to properly manage ground water resources of the area.

As illustrated on the four cross-sections (Plates 3, 4, 5, and 6), the major aquifers are defined by several laterally thick and generally continuous clay units (aquitards) that are observed consistently throughout the study area. The most prominent aquitard in the area overlies the 180-Foot Aquifer and is most often described as a blue-gray clay, called in this report the Salinas Valley Aquitard (SVA), but also referred to as the Salinas Aquiclude or the Salinas Valley Aquiclude. This report recommends the term aquitard instead of aquiclude to account for the inevitable permeability of the clay, however low.

A shallow aquifer is perched over the SVA throughout the study area (called the A-aquifer beneath the former Fort Ord area and the perched zone beneath the Salinas Valley), but is not a source of water for agricultural or municipal purposes. Its relevance to the goals of this study is only with respect to water quality when inadequate well seals allow the relatively very poor water quality of the perched zone to directly enter the deeper aquifers.

### *180-Foot Aquifer*

The 180-Foot Aquifer consists of several hydraulically connected sand and gravel units dispersed among several semi-continuous clay and clayey units. The 180-Foot Aquifer name was derived from its approximate depth beneath the valley floor and is the shallowest major aquifer within the Pressure subarea. The lateral extent of the 180-Foot Aquifer is generally defined by the overlying SVA clay, which maintains confined conditions throughout much of the study area. Because of this clay, most recharge enters the 180-Foot Aquifer where the clay pinches out, such as in the Forebay area in the Salinas Valley and near Highway 1 in the Marina/Fort Ord area (Plate 1). The 180-Foot Aquifer extends to submarine outcrops on the floor and canyon walls of Monterey Bay (*Greene, 1970, 1977, 1990; DWR, 1946*).

Although the 180-Foot Aquifer is usually described as a single aquifer within the Salinas Valley, it has been divided into upper and lower units beneath former Fort Ord. As described in Section 3.2, the upper portion of the fluvial valley fill deposits beneath former Fort Ord is typically comprised of sand; this unit is called the Upper 180-Foot Aquifer and is about 20 to 60 feet thick. The Upper 180-Foot Aquifer is separated from the lower gravelly portion of the valley fill deposits by about 20 feet of silty or clayey beds. The gravelly portion is called the Lower 180-Foot Aquifer and is up to 120 feet thick. A seasonal hydraulic head difference of several feet (about 20 feet near the active Fort Ord drinking water supply wells) has been observed between these two members of the 180-Foot Aquifer.

Although the predominantly sandy Upper 180-Foot Aquifer is observed beneath much of the northern portion of former Fort Ord, it pinches out against the SVA east of the Salinas River beyond which are found the gravelly deposits of the 180-Foot Aquifer (Plates 4, 5, and 6). The Upper 180-Foot Aquifer is also much thinner to the west of the three active Fort Ord supply wells beneath Panziera Ranch (*HLA, 2000*). Ground water elevation data also suggest that the Upper 180-Foot Aquifer terminates against the SVA near the Salinas River or becomes much thinner, as will be discussed in Section 4.0.

The confined Lower 180-Foot Aquifer is equivalent to the 180-Foot Aquifer in the Salinas Valley and has historically been the major water producer beneath the former Fort Ord and city of Marina. This aquifer contains the coarsest materials within the valley fill deposits beneath former Fort Ord, including cobbles and boulders. Ground water generally flows east toward the Salinas Valley all year in response to the ground water withdrawal for irrigation. Seasonal ground water elevation fluctuations increase to the east across former Fort Ord and are highest within the Salinas Valley; maximum fluctuations reach about 30 feet but are relatively stable approaching Monterey Bay.

During summer months when demand for water is highest, ground water elevations beneath former Fort Ord closest to the Salinas Valley typically drop 15 to 20 feet in the Lower 180-Foot Aquifer, whereas they may only drop 5 feet in the Upper 180-Foot Aquifer at the same location. The hydraulic head difference indicates that the clay units separating the Upper and Lower 180-Foot Aquifers, called the Intermediate 180-Foot Aquitard, is at least a partially effective aquitard and has been observed consistently throughout the former Fort Ord area.

### *400-Foot Aquifer*

The 400-Foot Aquifer has been documented to include two to three coarse sand and gravel units bounded by brown and blue clay layers of various thickness. The 400-Foot Aquifer is about 200 feet thick and is separated from the overlying 180-Foot Aquifer by what has been called the "intermediate" or 180/400 Aquitard, comprising about 20 feet of clay (*Thorup, 1976; SGD, 1993; Leedshill-Herkenhoff, 1985; Tinsley, 1975*). The SVA prevents direct recharge from rainfall to the 400-Foot Aquifer, as in the 180-Foot Aquifer, but the 180/400 Aquitard displaces recharge to the 400-Foot Aquifer further south, possibly to the Arroyo Seco area (Plate 1).

The 400-Foot Aquifer is shown on Plates 3 through 6 contained in the Aromas Sand or shallow Paso Robles Formation. Previous investigations have been unclear as to which formation this aquifer belongs, if only one, which is probably due to the difficulty distinguishing one from the other (*Greene, 1970; HLA, 1994; Thorup, 1976 and 1985*). Beneath former Fort Ord, the 400-Foot Aquifer consists of sand and very little gravel, if any, and is separated from the Lower 180-Foot Aquifer by one or more layers of clay except in the southern Main Garrison area (Plates 3 through 6).

Comparison of water levels between the Aromas and the Paso Robles portions of the 400-Foot Aquifer is somewhat tenuous because few wells specifically penetrate either portion. Further, due to an absence of marker beds within the Paso Robles (except the red-bed near the top), it is difficult to ascertain the degree of hydraulic continuity within the Paso Robles portions of the 400-Foot Aquifer.

### *Deep Aquifer*

The Deep Aquifer refers to the aquifer(s) contained in the middle or lower portions (the "B" and "C" members) of the Paso Robles Formation and include what have been called the 800-foot, 900-foot, 1,000-foot, and 1,500-Foot Aquifers (*Thorup, 1976 and 1985; Geoconsultants, 1993*). MPWMD-11, Fontes-1, MCWD production wells 10, 11, and 12, 14S/2E-24L, 14S/2E-18E01, and 14S/2E-06L01 all penetrate this aquifer system. Several other wells shown on the cross-sections penetrate shallow portions of the Paso Robles formation, but only reach the shallowest portion of the "B" member which are not clearly part of the Deep Aquifer.

Due the greater depth and higher cost of installation, most production wells (municipal or agricultural) have not penetrated the Deep Aquifer; however, wells have been installed progressively deeper to avoid saline contaminated water and future production from the Deep Aquifer may increase. Generally, water from this aquifer contains higher natural concentrations of salt and has high sodium adsorption ratios (SAR). For this reason, growers in the Salinas Valley have found the Deep Aquifer to be less desirable as a source of irrigation water. Seawater intrusion has not been documented at the few wells that penetrate this aquifer and water quality in the Deep Aquifer; however, chloride concentrations typically range from 100 to 130 mg/L at MCWD-12 and typically about 60 mg/L at MCWD-10 and -11 (*MCWD, 2001*).

About 400 feet of Pliocene sediments, including the Purisima and Santa Margarita Formations, were observed underlying the Paso Robles Formation. Shale and clay of the Miocene-age Monterey Formation were observed at the bottom of Fontes-1. Water-bearing units within these formations are not considered part of the Deep Aquifer.

### *Aquifer and Salinas River Interactions*

Analysis of limited ground water elevation data near the Salinas River and review of published water levels from the aquifers beneath the Salinas Valley indicate that the Salinas River is not gaining water from the Pressure 180-Foot Aquifer (*HLA, 1994*). Since river stage elevations are above sea level, and ground water elevations in the 180-Foot Aquifer are commonly below sea level, the potential for flow from the river to the 180-Foot Aquifer exists. The Salinas River loses water to aquifers within the Upper Valley and Forebay subareas, but becomes a gaining stream roughly north of Chualar, where the SVA is present (*MCWRA, 1996*). Recharge from the Salinas River to any aquifers except the shallow perched aquifer within the Pressure subarea is probably minor due to the presence of the SVA north of Chualar. Eastward flowing ground water from the A-aquifer probably discharges at least partially to the Salinas River along the western bluff bordering former Fort Ord.

## 3.4 Study Area Stratigraphy

The cross-sections shown on Plates 3, 4, 5, and 6 were constructed primarily to illustrate the continuity or discontinuity of aquifer and aquitard units throughout the study area, including the Pressure subarea of the Salinas Valley. Fine grained sediments (clay, clayey sand, an silt) are shown with unique patterns on the cross-sections. Well construction is also represented on these cross-sections: screened intervals are shown in blue, the gravel pack, if present, is shown in yellow, sanitary seals of the wells are shown with a single line, and blank casing is shown as an empty column (no color). Wells installed with the cable tool technique (as opposed to rotary methods) are not installed with a well seal or gravel pack; however, the multiple casings typically installed with cable tool wells sufficiently seal off shallower aquifers and effectively act as a "well seal".

### *Cross-Section A-A'*

This cross-section illustrates subsurface geology paralleling the coastline of Monterey Bay (Plate 3). Older dune sands, valley fill deposits, Aromas Sand, the Paso Robles Formation and possibly the Purisima Formation were all interpreted to be present along this transect, although significant differences distinguish this cross-section from the others.

The valley fill deposits are about 250 to 350 feet thick along this section, including up to 200 feet of SVA clay along the northern portion of the section. The upper portion of the valley fill deposits along the southern portion of the section has been replaced with about 100 feet of dune sand. Sand and gravel underlying the valley fill deposits are assigned to the Aromas Sand; the contact between these two units is assumed to be erosional and is consistent with the other three cross-sections.

The thick blue clay of the SVA is absent along the southern half of A-A'; however, a deeper thin silty unit is present and joins the lower portion of the SVA to the north. A thick sequence of blue clay has been recorded, however, beneath the northern portion of A-A', indicating that the SVA was either not deposited along the coastline of the city of Marina (southern portion) or it was deposited but subsequently eroded, presumably by wave action.

The deeper thin silty units are collectively referred to as the Intermediate 180-Foot Aquitard and separate the overlying Upper 180-Foot Aquifer from the underlying Lower 180-Foot Aquifer. That the Intermediate 180-Foot Aquitard may join with the SVA toward the valley implies that the overlying Upper 180-Foot Aquifer pinches out west of or becomes much thinner beneath the Salinas Valley (between 14S/2E-18E01 and the 14S/2E-07 cluster on this section). The Upper 180-Foot Aquifer is unconfined and may be as much as 120 feet thick along this transect, whereas the Lower 180-Foot Aquifer is about 50 to 100 feet thick.

Well 14S/2E-24L was installed by the U.S. Geological Survey (USGS) in 1999 to monitor the Deep Aquifer zones adjacent to Monterey Bay. The boring was completed with four piezometers, numbered 02, 03, 04, and 05 from top to bottom. A complete geologic report from the USGS was not available for review at the time this report was written. Lithology encountered at well 14S/2E-24L includes about 90 feet of dune sand underlain by about 80 feet of gravelly sand, the saturated portion of which correlates with the Upper 180-Foot Aquifer, consistent with observed lithology to the south. The Upper 180-Foot Aquifer is underlain by two clayey sand and clayey silt units (about 40 feet thick each) separated by about 60 feet of gravelly sand. The Lower 180-Foot Aquifer at this location extends from about -210 to -250 feet MSL and is underlain by a 50 foot thick sandy clayey silt. Between about -305 and -485 feet MSL coarse to very coarse sand comprise the 400-Foot Aquifer. At about -485 feet MSL, clayey sand and cemented sand, in addition to a shift in the geophysical log, are indicative of the upper members of the Paso Robles Formation. Based primarily on the geophysical log, the "B" member may be present from between -845 and -995 feet MSL; lithology observed at this interval indicated interbedded clay and sand bounded above and below by silty clay with shell fragments. The two shallowest piezometers of the four installed in this boring have been installed in the "B" member of the Paso Robles Formation.

The Lower 180-Foot Aquifer, which is the equivalent of the 180-Foot Aquifer as described within the Pressure subarea of the Salinas Valley, continues along the southern portion of A-A'. The bottom of this aquifer is defined by a continuous clay or sandy clay unit. Well 14S/2E-13J02 is screened in both the 180-Foot and 400-Foot Aquifers.

Well 14S/2E-18E01 may have been referred to as 14S/2E-18D01 by Thorup (*1976*) as he referred to the latter well on the same property with the same total depth as the former. If the two wells are the same, Thorup concluded that it is screened in the "B" member of the Paso Robles Formation (formerly designated as the 900-Foot Aquifer) (*Thorup, 1976*). The gravel pack at 14S/2E-18E01 extends into the Lower 180-Foot Aquifer and hence may act as a vertical conduit from the 180-Foot Aquifer to the deep zone. Because the 180-Foot Aquifer has been intruded in this area by seawater, it is likely that water quality data from this well may be negatively impacted from cross-contamination.

The 400-Foot Aquifer along this transect consists of a single unit to the south and is contains several clay or clayey sand units. The cluster of 14S/2E-07 wells are screened within the 400-Foot Aquifer.

The well furthest north along A-A' is 14S/2E-06L01 and is 1,809 feet deep with perforations from 880 feet to 1,540 feet below ground surface (bgs). The well screen penetrates the Deep Aquifer between 900 and 1,000 feet bgs (Paso Robles Formation) but also probably penetrates deeper aquifers in the Purisima Formation. The geophysical log indicates several geophysically resistive units (coarse grained material as opposed to clay) throughout the screened interval although lithology recorded through this interval was primarily brown or blue clay except for sand and gravel between about 1,400 and 1,600 feet. This poor correlation between the geophysical log and lithologic log makes identifying deep formations like the Purisima difficult. Even though the screen probably intercepts Purisima Formation, 14S/2E-06L01 is assigned to the Deep Aquifer.

### Cross-Section B-B'

This cross-section extends north from the former Fort Ord, through the Marina Airport, to the Pressure subarea of the Salinas Valley, terminating with CSIP well 4 (14S/2E-16G01) and CSIP well 2 (14S/2E-09D04) (Plate 4). Valley fill deposits are present along the entire length of this transect to an elevation of about -200 feet MSL. Most boring logs illustrated are 300 to 600 feet deep, with the exception of Marina Coast Water District (MCWD) supply wells 10 and 11, and MPWMD-11. The MCWD wells are 1,569 and 1,700 feet deep, respectively, and penetrate the Paso Robles Formation. As mentioned above, the "Marina trough" contains a thick sequence of Pleistocene age sediments of the Paso Robles Formation. Wells MW-OU2-07-400 and MW-OU2-10-400 penetrate the uppermost portion of the Paso Robles Formation. The remaining wells penetrate only the valley fill deposits or the Aromas Sand unit.

The SVA clay is present along the length of this transect, however, the blue-gray clay component has been buried by a brown or yellow silty clay within the Salinas Valley. The shallower clay was probably deposited as alluvium and does not represent a marine environment of deposition. As mentioned above, because both clays are in direct contact they are considered a single hydrostratigraphic unit and are collectively called the SVA (Plate 4). The bottom elevation of the SVA is generally encountered at about -50 feet MSL and indicates a very gentle northward dip.

The Upper 180-Foot Aquifer pinches out and the Lower 180-Foot Aquifer extends into the 180-Foot Aquifer in the northern portion of the transect beneath the Pressure subarea. The Intermediate 180-Foot Aquitard merges with the SVA east of the Salinas River and the river presents itself as an approximate divide between the 180-Foot Aquifer to the north and the Lower 180-Foot Aquifer (equivalent to the 180-Foot) to the south.

The southern extent of B-B' approaches the erosional contact between the valley fill deposits and the Paso Robles Formation and Aromas Sand, which will be discussed more with cross-section C-C' (Plate 5).

The Upper 180-Foot Aquifer is generally 50 feet thick through much of this area and the underlying Intermediate 180-Foot Aquitard is about 30 feet thick. The Lower 180-Foot Aquifer near MCWD-11 contains coarse gravel and cobbles and was historically the main water producer for the army base and the city of Marina. This aquifer ranges from 50 to 100 feet thick and may contain at least one substantial clayey unit (as at the Airfield well and 14S/2E-21N01).

A laterally extensive brown clay that occurs at the erosional contact between the valley fill deposits and the Aromas Sand is identified as the 180/400-foot Aquitard. This aquitard has been observed as far south as Chualar in the Salinas Valley, but probably terminates beneath former Fort Ord near Gigling and Watkin's Gate Roads. The Aromas Sand originally blanketed the Paso Robles Formation but was substantially removed by an ancestral Salinas River system. Continental fines were presumably deposited prior to the fluvial sand and gravel comprising the valley fill deposits. Geophysical logs often indicate a decrease in resistivity and an increase in spontaneous potential at depths where the erosional contact is suspected and aid in corroborating vague lithologic data to determine the appropriate interface between the 180-Foot and 400-Foot Aquifers.

The 400-Foot Aquifer is contained primarily in the Aromas Sand and the contact between it and the underlying Paso Robles formation is identified by a highly oxidized zone consisting of red sand, possibly partially lithified. This 'red-bed' is a common marker noted on many boring logs extending to this depth and is contained within the very upper portion of the Paso Robles Formation. Red beds have also been observed within the Aromas Sand and are representative of paleosols; however, red clay or red sandstone is often noted at the contact with the Paso Robles Formation which seems to distinguish it from shallower red beds. The bottom of the 400-Foot Aquifer is defined in this report by the red marker bed.

The 400-Foot Aquifer extends from about -200 feet MSL to -400 feet MSL throughout much of this cross-section and contains sand grading into coarse sand and gravel northward toward the axis of the valley. The gradual increase in grain size northward reflects a facies change toward the central Valley axis where the fluvial depositional environment probably had the highest energy and deposited coarser material.

Beneath former Fort Ord and its vicinity, one to three thin clay layers are recorded within the 400-Foot Aquifer and are laterally continuous, but of variable thickness. In contrast, beneath the Pressure subarea of the Salinas Valley, particularly at the two CSIP wells, a significantly thicker clay unit was observed in the upper portion of the 400-Foot Aquifer indicating a possible facies change. It is not clear whether the deepest clay layer encountered in these borings represents the bottom of the 400-Foot Aquifer because a red bed consistent with other well logs was not recorded. Both CSIP wells are screened within the 400-Foot Aquifer.

### *Cross-Section C-C'*

This cross-section most clearly illustrates the unconformable contact (shown as a heavy dot-dash line) between the valley fill deposits and Aromas Sand south of the Main Garrison at former Fort Ord (Plate 5). The erosional contact is inferred from the difference in lithology recorded at the DB-1 (15S2E-09E) and Henneken wells to the south and the municipal and agricultural wells to the north. Deep wells to the west of C-C' (Test Wells 3 and 4) were also used to locate this unconformity (*HLA, 2000*). Lithologic and geophysical data to the south indicated a thick sand section overlaying a thick clay sequence that does not correlate with boring logs to the north. The upper portion of the sand sequence south of the contact consists of dune sands exposed at ground surface that conformably overlie the Aromas Sand. The deeper clay sequence could be representative of either the Aromas Sand or Paso Robles Formation.

The top portion of the Aromas, where exposed to the surface south of Inter-Garrison Road on former Fort Ord, is readily observable by a partially lithified "cap-rock" composed of red-brown sand and gray clay nodules. Given the distinctive properties of the cap-rock relative to the surrounding dune sand or fluvial sand and gravel, this material would be expected to be a notable unit on boring logs further north. In fact, a subsurface clayey interval consistent with the Aromas Sand cap-rock outcrop is recorded at only two boring logs to the east of cross-section C-C' (Test Wells 3 and 4) (*HLA, 2000*). Similar clayey units are not recorded at wells to the north and it is concluded that the upper portion of the Aromas has been removed and replaced by valley fill deposits north of Gigling and Watkin's Gate Roads.

The irregular erosional continues north to illustrate the interface between the 180-Foot and 400-Foot Aquifers. The interface between these aquifers is usually associated with one or more clay layers separating coarse gravel in the lower member of the 180-Foot Aquifer from fine- to medium-grained sand in the 400-Foot Aquifer, although grain size in the 400-Foot Aquifer increases toward the Salinas Valley.

The first three wells north of the erosional contact along C-C' 15S/2E-04C01 (FO-29), 14S/2E-33Q01 (FO-30), and 14S/2E-33P01 were constructed atop the dune bluffs overlooking the Salinas Valley. All three wells are screened within the 180-Foot and 400-Foot Aquifers, although at this location the 400-Foot Aquifer consists of fine sand and sandy clay and presumably most water is produced from the lower member of the 180-Foot Aquifer.

In addition to these three boring logs, lithologic and geophysical logs from four test wells drilled in 1975 in the area were also evaluated (*Kaiser, 1975; HLA, 2000*) as was the boring log from a test well installed in 1995 adjacent to FO-32 (*Creegan & D'Angelo and Geotechnical Consultants, 1995)*. Test Well 1 was located adjacent to FO-29 and the two logs are consistent with one another. The boring log for Test Well 2 also indicates the presence of valley fill deposits, including the SVA, but Test Wells 3 and 4 (further south) are located south of the valley fill erosional contact with the Aromas Sand and Paso Robles Formation and hence the SVA is not present.

The FO-32 test well was installed as a triplet to a depth of 1,212 feet bgs (about 1,030 feet below MSL) adjacent to FO-32 as part of plans to rehabilitate or replace this 180-Foot Aquifer production well. Clay layers of the SVA were recorded on the geophysical log (but not on the boring log) above and below sea level, consistent with observations at FO-32 and other nearby wells. The test well boring log correlated well with the log of FO-32 and the triplets are screened in the Lower 180-Foot Aquifer, 400-Foot Aquifer, and the Deep Aquifer. The Lower 180-Foot Aquifer is found 375 to 500 feet bgs and the 400-Foot Aquifer is 500 to about 700 feet bgs. Correlation of deeper formations with other deep wells, such as Fontes-1 or the MCWD deep wells, was difficult except for general similarities.

Boring logs from wells northeast of the Salinas River indicate a thicker sequence of SVA clay, but the top elevations are consistent with those observed south of the River. That is, the bottom elevations are lower within the Pressure subarea of the Salinas Valley along C-C'. The thicker sequence of clay, including a continuous sand lens in the lower portion of the SVA, is consistent in all boring logs north of the Salinas River along C-C'. The thicker SVA clay within the valley indicates that the deepest portion of the ancestral valley flooded by rising sea levels was located beneath its current main axis. Thus, the bottom of the SVA clay mimics topography of the study area prior to inundation by rising sea levels.

A facies change occurs from the Upper 180-Foot Aquifer beneath former Fort Ord and the 180-Foot Aquifer beneath the Salinas Valley. The Upper 180-Foot Aquifer is typically absent of significant gravel, as is the case along the southern portion of C-C'. North of the bluff, however, the gravel content of the upper portion of the 180-Foot Aquifer is considerably higher than south of the bluff. At the intersection of D-D', the 180-Foot Aquifer is almost entirely comprised of coarse gravel, as recorded on the boring log for 14S/2E-28H03.

North of the Salinas River (approximately), lithology is similar for the remaining extent of C-C'. The 180-Foot Aquifer at 14S/2E-28J50 contains an isolated blue clay layer in the upper portion representing a single extension of two clay units observed further south. Rocks up to 5 inches in diameter were recorded within 50 feet of the bottom of the SVA clay, and gravel was observed throughout the 180-Foot Aquifer. The shallowest screened interval in 14S/2E-28J50 is within gravel in the lower portion of the 180-Foot Aquifer. The four deeper screened intervals are within the 400-Foot Aquifer, which was described as primarily yellow clay with "small amounts of water". It is inferred from this description that the 400-Foot Aquifer at this location primarily consists of interbedded sand and clay.

The boring logs of 14S/2E-28H03 and -28H02 are generally very similar to each other and correlate well with 14S/2E-28J50. Well -28H02 was completed to a depth of 450 feet and has been screened in both the 180-Foot and 400-Foot Aquifers. Well -28H03 was completed to 720 feet and is screened within the 400-Foot Aquifer, including the upper part of the Paso Robles Formation.

Further north, well 14S/2E-22P02 was completed to a depth of 304 feet and is screened in the 180-Foot Aquifer. As with the boring logs further south along C-C', the lithology at this location consisted of sand and gravel underlying the SVA; however, the upper portion of the 180-Foot Aquifer consists of less gravel than the lower portion and resembles the Upper 180-Foot Aquifer beneath former Fort Ord. The 180-Foot Aquifer at this location is at least 275 feet thick and probably extends about 30 feet deeper than this well was completed, based on boring logs from wells to the south and the northern boring Fontes-1.

Boring 14S/2E-22K01 was drilled in 1976 by Richard Thorup and is otherwise known as Fontes-1 (*Thorup, 1976*). This boring (no well was installed) was part of a program for the MCFCWCD to evaluate hydrogeology in the northern portion of the Salinas Valley and estimate production from proposed irrigation wells for Castroville. Finding at this boring were discussed above in Section 3.1. Thorup also correlated the lithology between the four Fort Ord drinking water wells (FO-29, FO-30, FO-31, and FO-32) and several agricultural wells within the Pressure subarea of the Salinas Valley, including 14S/2E-22K01 (*Thorup, 1985*). In fact, cross-section C-C' of this report is essentially an update of the cross-section B-B' Thorup included in his 1985 report (Appendix E). Wells on C-C' that were not included in Thorup's B-B' cross-section are 14S/2E-33P01, 14S/2E-27N50, 14S/2E-28J50, and 14S/2E-28H03 (-28H02 was included). The additional data from these wells correlate well with Thorup's original cross-section, the original did not extend far enough to the south to recognize the erosional contact between valley fill deposits and Aromas Sand.

### *Cross-Section D-D'*

The west to east cross-section D-D' illustrates changes in lithology inland from the coastline (Plate 6). Wells 14S/2E-24L02 and 14S/2E-28H03 tie this cross-section to cross-sections A-A' and C-C', respectively. No well directly ties cross-sections D-D' and B-B'.

Marina supply well MCWD-12 (14S/2E-30G03) is one of the three deep wells operated by MCWD installed in 1989. This well extends about 2,000 feet deep and is screened in the Deep Aquifer, including the informally named 1,500-Foot Aquifer (*Geoconsultants, 1993*). Valley fill deposits recorded in the boring log for this well are similar to surrounding wells, including 14S/1E-24L, except for a more massive clay unit or units near the inferred interface with the Aromas Sand.

The correlation of the Paso Robles Formation between 14S/1E-24L and MCWD-12 is difficult due to the potential presence of the "Marina trough", as illustrated conceptually on Plate 6. This illustration is based on fossil analysis results from 14S/2E-24L and Thorup's investigation at Fontes-1. Green sand near the bottom of the test well for MCWD-12 between about 1,925 and 1,975 feet bgs (also observed at MCWD-10, MWCD-11, and MPWMD-11) may be indicative of the Purisima Formation and could represent the trough bottom, if the "Marina trough" exists. The presence of the Purisima Formation was not confirmed, however, from fossil analysis at any of the three MCWD deep wells (*Geoconsultants, 1993*).

The remaining boring logs illustrated on D-D' record similar lithology as illustrated on B-B' and C-C' with one significant exception. East of the intersection with B-B', the boring log for 14S/2E-28C01 did not record the presence of the blue clay associated with the SVA. Instead, in the interval where a 40-foot thick SVA clay is expected, only a two-foot thick "blue-yellow sandy clay" is recorded. A geophysical log was not conducted as recorded on the boring log. Cross-section D-D' illustrates the SVA to be continuous through this area, but the clay pattern near this well was left empty to indicate a potential discrepancy between the expected stratigraphy and the recorded lithology.

It is difficult to reconcile how an otherwise laterally extensive and thick aquitard could not be present in one specific area. Although it is possible that the Salinas River locally eroded through the SVA and deposited fluvial sediments in its place, it is unlikely to have occurred on such a local scale. Because a geophysical log was not conducted at this well, the absence of the SVA at this location cannot be confirmed. Precedent for a well log incorrectly not recording the SVA can be found at FO-29 where sand was recorded in the interval where the geophysical data clearly reflect the presence of clay assigned to the SVA.

Lithology recorded through the 180-Foot and 400-Foot Aquifers at 14S/2E-28C01 is otherwise consistent with nearby boring logs as illustrated on D-D'. The top of the Paso Robles is recorded by red sand or red sandstone at an elevation consistent with nearby boring logs and this well is screened in the 400-Foot Aquifer and in gravelly upper units of the Paso Robles Formation.

The D-D' cross-section terminates with the wells 14S/2E-27C02 and -27G03. Except for the general absence of clay units within the 180-Foot Aquifer, lithology recorded at this location is consistent with wells further west. Neither boring encountered the Paso Robles Formation as neither recorded the presence of a red sand or red sandstone indicative of the oxidation zone observed elsewhere. Both wells are screened in the very lowest portion of the 180-Foot Aquifer and the 400-Foot Aquifer.

# 4.0 GROUND WATER ELEVATIONS

Ground water elevation data are collected regularly from throughout the study area, but at different frequencies and from very different types of wells. Elevations are measured by MCWRA each fall and winter from a consistent group of wells in the Salinas Valley within and beyond the study area. A group of about 50 of these wells are also measured monthly, and an additional 15 are fitted with transducers that continuously record elevation changes on dataloggers. Ground water elevations are predictably low in the fall (August) following the irrigation season; by December, ground water elevations typically have already begun a rapid recovery.

Most wells measured by MCWRA in the study area are agricultural production wells that are pumped regularly from about April through September each year to irrigate farmland. Water level measurements taken in Fall are typically at their lowest elevations, but quickly rebound as indicated by subsequent measurements in Winter. Most measured water levels at former Fort Ord are from monitoring wells and are not pumped except to collect ground water samples.

The MCWRA monitoring program includes agricultural wells screened in only one aquifer and carefully accounts for pumping schedules to minimize or eliminate the effect of local pumping stresses. Because the agricultural monitoring wells are within the major pumping centers of the Salinas Valley, however, the regional pumping stress on the Pressure 180-Foot and Pressure 400-Foot Aquifers is most evident from these data.

Data from dedicated monitoring wells and agricultural production wells in the Salinas Valley ground water basin clearly indicate a seasonal trend in ground water elevations and are generally very comparable between the Lower 180-Foot and Pressure 180-Foot Aquifers. Ground water elevations measured in August and September of 1997 and 1999 for the Upper 180-Foot Aquifer, 180-Foot Aquifer (including the Lower 180-Foot Aquifer), and 400-Foot Aquifers are presented on Plates 7 through 12. Contours were drawn at 10-foot intervals to illustrate high and low areas of ground water elevation (contours in the Upper 180-Foot Aquifer were drawn at five-foot intervals to account for the smaller gradient). Ground water elevations below sea level are particularly important to delineate because they are particularly vulnerable to seawater intrusion, as will be discussed in Section 5.0.

## 4.1 Upper 180-Foot Aquifer

As shown on Plates 7 and 8, ground water elevations in the Upper 180-Foot Aquifer range from slightly above mean sea level (MSL) to about 16 feet below MSL. A ground water divide is consistently present west of the SVA clay pinch out. Ground water flowing westward in the A-aquifer recharges the Upper 180-Foot Aquifer where the SVA pinches out and then flows eastward, with no seasonal variation. Recharge on the west side of this ground water divide enters the Upper 180-Foot Aquifer and flows west toward Monterey Bay.

Seasonal ground water elevation changes are observed throughout the study area in both the Upper 180-Foot and underlying Lower 180-Foot Aquifer. However, the Upper 180-Foot Aquifer has a distinctly different seasonal response to pumping from the Salinas Valley than does the Lower 180-Foot Aquifer, which reflects the degree of lateral hydraulic communication to the aquifers within the valley. Although ground water elevations rise and fall seasonally as monitored in the 180-Foot and 400-Foot Aquifers, the ground water gradient directions in the Upper 180-Foot Aquifer beneath the eastern portion of the Main Garrison differ dramatically from in the Lower 180-Foot Aquifer.

Continuous ground water elevation monitoring at three triplet monitoring wells west of the active Fort Ord supply wells was collected for almost one year (April 1998 to November 1998) to evaluate ground water gradient fluctuations in both the Upper 180-Foot and Lower 180-Foot Aquifers. Quarterly monitoring data clearly indicates an eastward gradient in the Lower 180-Foot Aquifer that steepens during the irrigation season but does not change direction significantly. Ground water flow in the Lower 180-Foot Aquifer alternates between S10E in the winter months (in response to pumping from the Fort Ord supply wells) to N70E in the summer months (normal to the Salinas Valley axis, in response to ground water extraction for irrigation purposes in the valley).

In contrast, ground water flow direction at the same location in the Upper 180-Foot Aquifer varied from S20E to S25W during the same period, reflecting a seasonal ground water depression south of the Blanco Road/Reservation Road intersection and west of the Fort Ord supply wells (*HLA, 2000*). Gradients measure at newly constructed wells near Marina Airport also indicate southeast ground water flow. The difference in ground water flow directions suggests the Upper 180-Foot Aquifer is not in direct hydraulic communication with the 180-Foot Aquifer beneath the Salinas Valley. If the Upper 180-Foot Aquifer does extend beneath the Salinas Valley and is directly influenced by agricultural wells, ground water should flow east or northeast directly toward the Salinas Valley. Instead, ground water in the Upper 180-Foot Aquifer is forced drain through the pinch-out between the Main Garrison and East Garrison and there recharges the Lower 180-Foot Aquifer. Once in the Lower 180-Foot Aquifer, ground water continues to flow eastward toward the Salinas Valley.

Although the Upper 180-Foot Aquifer beneath former Fort Ord lies within the Salinas Valley ground water basin, it is not in direct hydraulic communication with the 180-Foot Aquifer beneath the Salinas Valley floor, even though lithologic data indicate only a thin hydraulic barrier (the Intermediate 180-Foot Aquitard). Ground water elevations at new Upper 180-Foot Aquifer monitoring wells anticipated to be installed at former Fort Ord will be used to further clarify hydraulic communication between the Upper 180-Foot Aquifer and the Salinas Valley.

## 4.2 Lower 180-Foot Aquifer

The Lower 180-Foot Aquifer beneath former Fort Ord is an extension of the 180-Foot Aquifer beneath the Salinas Valley. This interpretation is supported by ground water elevation data and particularly transient data described above, in addition to the lithologic data discussed in Section 3.0. The 180-Foot Aquifer is thus referred to as the Lower 180-Foot Aquifer west of the Salinas River beneath the former Fort Ord area; however, Plates 9 and 10 refer to data from the Lower 180-Foot and 180-Foot Aquifers together as the 180-Foot Aquifer to reflect their equivalence.

Ground water in the Lower 180-Foot Aquifer flows toward the valley floor axis and landward from the coast and range from 0.0007 to 0.0016 feet/foot (ft/ft). These gradients are steeper than gradients measured along the valley axis (typically 0.0006 ft/ft). Ground water elevations range from 5 feet below MSL near Monterey Bay to about 35 feet below MSL beneath the Salinas Valley and remain below sea level throughout the study area throughout the year, as shown on Plates 9 and 10.

The Main Garrison and older MCWD production wells primarily withdrew water from the Lower 180-Foot Aquifer. As will be discussed in Section 5.0, historical seawater intrusion beneath the city of Marina and former Fort Ord occurred almost exclusively within the Lower 180-Foot Aquifer. A ground water trough had been centered beneath the city of Marina during the 1970's due to the concentration of Marina and Fort Ord pumping within a relatively small geographic area. Elevations were recorded as low as 22 feet below MSL at MCWD-5 in 1970 (*GTC, 1986*).

## 4.3 400-Foot Aquifer

Ground water elevations in the 400-Foot Aquifer in 1997 and 1999 (Plates 11 and 12) range from about 10 feet below MSL to as much as 60 feet below MSL slightly north of the study area (north of McFadden Road). Hydraulic distinction between the Lower 180-Foot Aquifer and the 400-Foot Aquifer beneath the eastern portion of former Fort Ord is evidenced by about five feet of head difference. This is comparable to the five to ten feet of head difference between these two aquifers beneath the Salinas Valley. As in the 180-Foot Aquifer, ground water elevations were below MSL throughout the study area at these times. Ground water gradients in the 400-Foot Aquifer range from 0.0011 to 0.0016 ft/ft.

A ground water depression surrounds Fort Ord supply wells 29 and 30 and ground water elevations are locally as low as 30 feet below MSL. Although the lowest ground water elevations are measured north of McFadden Road (60 to 50 feet below MSL), another low elevation area (40 to 30 feet below MSL) was located south of Blanco Road within the valley in 1999 and 1997, respectively. Elevations from the Fort Ord supply wells have not been available since 1997.

The consistent landward gradient in both the 180-Foot and the 400-Foot Aquifers and the persistent sub-sea level elevations are both important preconditions necessary for seawater intrusion. The advancement of seawater intrusion throughout the study area is correlated to ground water elevation changes over time, as is discussed in the following section.

# 5.0 GROUND WATER QUALITY

This section discusses historical and current ground water quality in both the 180-Foot and 400-Foot Aquifers throughout the study area. Although several contaminants have locally degraded ground water quality in the study area (e.g., nitrate and organic solvents), the primary contaminant of concern discussed in this report is seawater which migrates inland from Monterey Bay and can reduce water quality on a regional scale. Nonetheless, concerns about cross-screened wells and vertical conduits, as discussed below, apply to any type of contamination.

Both the 180-Foot and 400-Foot Aquifers outcrop along the floor and canyon walls of Monterey Bay (*Greene, 1970, 1977, 1990; DWR, 1946*). Depending on the pressure gradient in the aquifers, porosity within each aquifer can be saturated with either fresh water or seawater. It is well understood that a density-controlled interface exists between the fresh water found inland and the seawater that is found adjacent to the coast under non-pumping conditions (even where ground water elevations are above MSL).

More ground water is currently extracted from the Salinas Valley ground water basin than can be replenished by seasonal rainfall and recharge from surface water sources (a condition is called overdraft). When freshwater is extracted faster than can be naturally replaced, ground water elevations drop in response. If ground water elevations drop below sea level, a hydraulic gradient in addition to the density gradient is introduced and seawater begins to migrate inland. In the case of the Salinas Valley, ground water elevations in the 180-Foot and 400-Foot Aquifers have remained below sea level for decades and seawater has steadily migrated inland since first documented in 1944 (*DWR, 1946*). Ultimately, if left unchecked, large portions of an aquifer in such a situation can become unsuitable for agricultural or potable use due to high salinity concentrations (primarily sodium and chloride).

Ground water samples have been collected from agricultural, municipal, and monitoring wells for several decades to monitor the seawater intrusion progress. The amount of data for any one particular well, however, may vary considerably over time and consistent sets of data are not available for all locations throughout the study area.

Chloride data collected in 1975, 1985, 1997, and 1999 from Fort Ord and Marina production wells and dedicated monitoring wells are contoured together on Plates 15 through 18 to illustrate the extent of seawater intrusion in the 180-Foot and 400-Foot Aquifers. Chloride data collected in 1997 and 1999 from the Upper 180-Foot Aquifer monitoring wells reflect contamination from the former base landfills rather than seawater intrusion (Plates 13 and 14).

Concentrations are generally compared to the California Secondary Drinking Water Standard recommended limit of 250 mg/L chloride. The upper chloride limit of 500 mg/L is often equated with seawater intrusion, although this is not always an accurate assessment because alternate sources can contribute to elevated chloride concentrations. On many occasions it is necessary to analyze other mineral constituents to accurately determine the source of high salinity water. Nonetheless, contours of chloride concentrations in the 180-Foot and 400-Foot Aquifers exceeding 100, 250, and 500 mg/L are presented on Plates 15 through 18 for the Upper 180-Foot, 180-Foot, and 400-Foot Aquifers and are discussed below.

## 5.1 Seawater Intrusion – Chloride Isoconcentrations

The following section discusses the historical and current detection of seawater intrusion in the study area.

### *Historical Conditions*

Seawater intrusion into the 180-Foot Aquifer in the northern the Salinas Valley was first documented in 1933 by the California State Water Commission. Subsequent intrusion has been closely related to ground water withdrawal that lowered the ground water elevations below sea level. The historical relationship between depressed water levels in the Salinas Valley basin and seawater intrusion has been well documented (*DWR, 1946, 1958, 1970, 1973, 1975; MCWRA 1958-1995 data reports; Leedshill-Herkenhoff, 1985; GTC, 1986; Todd, 1989; SGD, 1993*).

Seawater intrusion into the 400-Foot Aquifer has been slower and less extensive than in the overlying 180-Foot Aquifer because this deeper aquifer was not as extensively relied upon until after water quality in the 180-Foot Aquifer deteriorated. Intrusion into the 400-Foot Aquifer was first recognized near Castroville in 1959 (*MCFCWCD 1958-1959; Leedshill-Herkenhoff, 1985*).

Plates 15 and 17 illustrate chloride isoconcentration lines in the 180-Foot Aquifer beneath the city of Marina and former Fort Ord in 1975 and 1985. These contours generally illustrate the degree of seawater intrusion in each aquifer in response to lowered ground water elevations. The seawater intrusion front advanced about two miles between 1975 and 1985 in the 180-Foot Aquifer and chloride concentrations were observed as high as 1,600 mg/L in 1984.

Plates 16 and 18 illustrate historical seawater intrusion fronts into the city of Marina area in the 400-Foot Aquifer. Few wells solely penetrate the 400-Foot Aquifer, and available data in 1975 are limited to MCWD-7 and wells that are dually perforated (FO-27 and FO-28). At that time, chloride concentrations did not exceed 100 mg/L. In 1985, however, concentrations at FO-27 and FO-28 had risen to 936 and 102 mg/L, respectively, and were measured at 180 mg/L at MCWD-9. The dual perforation of FO-27, FO-28, and nearby MWCD-8 and MCWD-8a wells (also vertical conduits) probably contributed to local cross-contamination of the 400-Foot Aquifer from the 180-Foot Aquifer.

Seawater intrusion beneath the city of Marina was observed soon after installing several production wells in the 180-Foot Aquifer (MCWD-1, the first city well, was installed in 1956). Subsequent seawater intrusion into this area was closely related to ground water withdrawal by the city of Marina and former Fort Ord. Deteriorating water quality forced the city of Marina to discontinue pumping most of its 180-Foot Aquifer wells by the late 1970's and install water-supply wells in the 400-foot (MCWD-8, -8a, and -9) and Deep Aquifers (MCWD-10, -11, and -12).

By 1975, chloride concentrations had already rendered several of the MCWD supply wells nonpotable. It is not clear when operation at each well stopped, but by the 1980's most of the MCWD wells had been abandoned due to either high chloride concentrations (MCWD-1, -3, -4, -5, -6 and -7) or high nitrate concentrations (120 mg/L at MCWD-2). MCWD-2 was never connected to the municipal water distribution system and was used only for "construction water". Chloride concentrations ranged from 440 at MCWD-1 to 2,400 mg/L at MCWD-6a. MCWD-7 was the first to be abandoned in the 1970's due to high chloride concentrations (up to 1,200 mg/L). MCWD-6 and MCWD-8 were abandoned in the 1970's and 1982, respectively, due to collapsed casings (although chloride concentrations up to 268 and 1,700 mg/L were measured at both wells, respectively) and both were replaced with wells of similar construction. The replacement wells became contaminated with high chloride soon after their operation began.

In 1985, only MCWD-9 (400-Foot Aquifer) and MCWD-10 (Deep Aquifer) were operational on a full-time basis (based on the very limited amount of available data at from time). MCWD-11 (Deep Aquifer) had just been constructed and was about to come into operation. Operation of most other supply wells to the city of Marina had stopped due to elevated chloride or nitrate concentrations. MCWD-10 and MCWD-11 (and eventually MCWD-12) were all installed into the Deep Aquifer to produce drinking water not yet affected by seawater intrusion.

About one mile south of Marina, the earliest Main Garrison supply wells (installed the 1940's) were screened in the 180-Foot (Upper and Lower) aquifer and were located near Highway 1, west of where the SVA pinches out. In response to excessive sanding and seawater intrusion, Fort Ord discontinued pumping these early wells and replaced them with wells that were located progressively eastward with each round of installation. Each well was numbered in the order they were installed and Wells FO-6 through FO-28 were collectively referred to as the Main Garrison well field. In 1975, the Army Corps of Engineers evaluated long-term options for a potable water supply and recommended installing several wells at the current well field location. The recommended location was as far east on Army property as possible but still within the valley fill deposits, between the Blanco Road/Reservation Road intersection and the East Garrison (*Kaiser, 1975*). The new well field was installed in 1984 and is comprised of FO-29, FO-30, FO-31, and FO-32. The former three are still active and Well FO-32 has been inoperable since 1990. All Main Garrison well field wells (FO-06 through FO-28) have been destroyed.

In 1975, only former Fort Ord supply wells 11, 14, 18, 19, 23, 24, 25, 26, 27, and 28 of the Main Garrison well field were still operational and were sampled for chlorides. All but FO-27 and FO-28 were completed in the 180-Foot Aquifer; FO-27 and FO-28 were completed in both the 180-Foot and 400-Foot Aquifers. Of these wells, chloride concentrations exceeded 250 mg/L only at FO-14 (300 mg/L) and FO-18 (350 mg/L) but remained as low as 60 mg/L at FO-27 and FO-28. Seawater had initially intruded into the western portion of Marina and former Fort Ord, but progressively shifted northward and eastward following the actively operated supply wells. By the early 1980's, seawater intrusion was present throughout most of Marina and reached the bordering Fort Ord supply wells 24, 25, 26, and 27.

Chloride concentrations in the Main Garrison well field had risen steadily between 1975 and 1984 and reached a concentration of 1,600 mg/L in the 180-Foot Aquifer at FO-26 (*GTC, 1986*). By 1985, the operating Main Garrison well field had been reduced to only FO-24, -26, -27, and -28 (all placed on standby status) and the new well field (FO-29, FO-30, FO-31, and FO-32) had just been installed about two miles to the east of the Main Garrison well field. Thus, while the city of Marina moved its production wells into the Deep Aquifer to avoid seawater intrusion, former Fort Ord moved its wells further from Monterey Bay.

As a result of the reduced ground water extraction from the remaining Main Garrison wells, the chloride concentration in 1985 at FO-26 dropped to 136 mg/L, although the concentration at FO-27 and FO-28 had risen to 936 and 102 mg/L, respectively. Chloride concentrations in the new well field did not increase substantially during this time period and have remained consistent since their installation, as will be discussed below.

During the 1990's, about 300 monitoring wells were installed to various depths at former Fort Ord to monitor ground water quality in the A-aquifer, the Upper and Lower 180-Foot Aquifers, and the 400-Foot Aquifer as part of an ongoing remedial investigation. General inorganic compounds were annually analyzed for from most of these wells. In 1992, chloride concentrations exceeding 200 mg/L were observed primarily near the coastline, although concentrations generally were higher in the southern portion of the Main Garrison.

One exception was briefly noted at monitoring well MW-OU2-07-400 (400-Foot Aquifer, located next to MCWD-9. In 1994, chloride concentrations in samples from this well were as high as 955 mg/L in 1994, but have been about 80 mg/L since 1998. The high chloride concentrations are unusual because comparable levels in adjacent MCWD-9 had only been briefly reached in 1987; subsequent samples indicated a rapid decline in chloride levels.

The general pattern of low chloride concentrations throughout the northern portion of former Fort Ord has remained consistent throughout the on-going ground water investigation; however, this pattern probably only partially reflects the extent of seawater intrusion. These monitoring wells are generally installed to shallower depths than were the production wells and do not extract ground water as frequently or at the same high rates the production wells did. Therefore, ground water quality data from monitoring wells are probably not comparable to historical production well data unless the monitoring well penetrates the lowest portion or most permeable portion of the aquifer (where the relatively dense seawater is expected to be found).

### *Current Conditions*

Chloride concentrations are contoured on Plates 13 through 18 for data collected in 1997 and 1999 for the Upper 180-Foot Aquifer, the 180-Foot Aquifer, and the 400-Foot Aquifer. Testing of the Main Garrison production wells, however, had stopped by 1991 and all Main Garrison wells had been destroyed by 1998. Similarly, the city of Marina also stopped testing their shallow production wells once they were abandoned in the 1980's. Where data is no longer available, chloride concentrations (due to seawater intrusion) are considered to be the same as the farthest inland documented seawater intrusion.

Instead of data from production wells, most available ground water quality data from the Marina and former Fort Ord area in 1997 and 1999 comes from dedicated monitoring wells installed as part of the ongoing remedial programs at former Fort Ord. Significant differences exist between production wells and dedicated monitoring wells, however, and these differences are reflected in water quality data from the two data sets.

Seawater intrusion is expected to preferentially migrate along the bottom of an aquifer due to the its higher density (compared to freshwater), assuming the aquifer is uniformly permeable. Production wells typically fully penetrate an aquifer and thus draw from the entire aquifer, including the bottom portion. Dedicated monitoring wells at former Fort Ord, conversely, specifically target a portion of the aquifer to collect particular data. In the case of the ongoing investigations at former Fort Ord, many dedicated monitoring wells are screened in the upper portion of the target aquifer because the contamination of interest derives from a surface source. Therefore, data from the former Fort Ord monitoring well network to monitor seawater intrusion may be misleading because many of these wells are too shallow.

Because aquifers are almost never uniformly permeable throughout their thickness, seawater may preferentially penetrate the most permeable portion of an aquifer, despite its position with respect to the top or bottom of the aquifer. If a well fully penetrates an aquifer, ground water samples from the well will represent a composite water quality, including high chloride concentrations from intruded highly permeable zones and lower chloride concentrations from the non-intruded lower permeable zones of the aquifer.

If a well is allowed to remain inactive for a long period of time, however, fresh water from less permeable zones within the screened or gravel packed section of a well may migrate into the high permeable zone(s) and thereby locally displace intruded seawater. This phenomenon may result in a bubble of fresh water surrounding a well in a zone that is otherwise intruded by seawater. Once the well is reactivated, water quality may initially appear very good and not indicate the presence of seawater intrusion.

Such a condition was documented at an aquifer test at MCWD-5 in 1991 (*SGD, 1991*). As discussed above, chloride concentrations at this well had risen to 1,800 mg/L in 1982 when its use was discontinued. The test included pumping water at 100 gpm for two days, whereupon water quality was initially very good (conductivity was less than 500 µsiemens/cm)and a vertical profile indicated no zone of intrusion. As pumping continued into the second day, water quality began to degrade (about 3,000 μsiemens/cm) and a vertical profile indicated a 10-foot interval containing very saline water (greater than 10,000 μsiemens/cm). The zone with low water quality corresponded with a relatively coarse gravel unit described on the well log.

The test at MCWD-5 demonstrates that even wells that only penetrate one aquifer probably penetrate multiple zones of varying permeability that allow for variable intrusion of seawater. Additionally, hydraulic pressure within the screened or gravel packed section of a well may require large amounts of water to be extracted before realizing the true water quality conditions around a well. Because of this, water quality data from active production wells may be more representative than data from dedicated monitoring wells or intermittently active production wells because the aquifer may not be stressed sufficiently or be pumped long enough to remove local 'bubbles' of fresh water that may have developed within seawater-intruded high permeable zones within the well.

Chloride data from dedicated monitoring wells at former Fort Ord indicate that chloride concentrations exceeding 500 mg/L are not found east of Highway 1. Concentrations near the coastline routinely exceed 1,000 mg/L and are clearly a result of seawater intrusion. Further inland, chloride concentrations in the Lower 180-Foot and 400-Foot Aquifers beneath former Fort Ord typically do not exceed 100 mg/L and either represent residual seawater intrusion in the upper portions of the aquifers or the onset of seawater intrusion, as will be discussed below and in Section 5.2. The Lower 180-Foot and 400-Foot Aquifers are the primary source of drinking water for the former Fort Ord. As mentioned above, the seawater intrusion front in the 180-Foot and 400-Foot Aquifers are shown to extend inland at least as far as monitored in 1985 under the assumption that little flushing has occurred in these aquifers (Plates 15 through 18).

Elevated chloride concentrations in the Upper 180-Foot Aquifer inland beneath former Fort Ord are related to the plume of contaminated water coming from the now-inactive landfills. Prior to the installation of a protective cap over the landfills, infiltration through the landfills dissolved minerals (including chloride) as material within the landfills decayed. This process led to the formation of a plume of contaminated ground water (primarily of organic solvents) flowing away from the landfills. The isolated areas of elevated chloride concentrations detected in 1999 illustrate an especially good correlation of two known organic solvent plumes originating from the former Fort Ord landfills. For this reason, elevated chloride concentration in the Upper 180-Foot Aquifer monitoring wells is attributed to the landfills except for near the coastline. The Upper 180-Foot Aquifer is not a primary source of drinking water for former Fort Ord.

There is a slight indication from Upper 180-Foot Aquifer monitoring wells in the southern portion of the Main Garrison that ground water with higher chloride concentrations is migrating into the valley fill deposits from the Paso Robles Formation (across the erosional contact). However, monitoring wells do not exist in the Upper 180-Foot Aquifer close enough to the erosional contact to confirm this speculation.

The Lower 180-Foot Aquifer is not significantly contaminated by organic solvents from the landfills and elevated chloride concentrations are more likely due to residual or incipient seawater intrusion as was historically observed in the Main Garrison and city of Marina production wells. Fewer wells exist in this aquifer beneath former Fort Ord however and those located inland were not routinely tested for chloride.

Of particular interest is the Airfield well, which was installed in 1963 along with 14S1E-25D (the Beach well) by the U.S. Army specifically to monitor the advancement of seawater intrusion (*Kingman, 1962 and 1964*). Although a routine monitoring program once existed for this and other wells in the 1960's and 1970's, data from this early program has not been found. The Airfield well was sampled in 1999 and analyzed for chloride which was measured at 388 mg/L.

The Airfield well is screened in both the Lower 180-Foot Aquifer and the 400-Foot Aquifer and it is not clear which aquifer contains the higher chloride concentrations; however, results probably represent a composite concentration for these two aquifers. In other words, this chloride concentration probably underestimates the concentration in the aquifer intruded by seawater and overestimates the concentration in the aquifer not intruded. It is recommended in Section 7.0 that depth-specific samples be collected from the Airfield well to better evaluate which aquifer (if only one) has been intruded by seawater.

Current conditions beneath former Fort Ord in the 400-Foot Aquifer are discernable from several monitoring wells near the coastline and inland. Chloride concentrations do not currently exceed 250 mg/L except near the coastline area beneath former Fort Ord. Four agricultural wells (14S/2E-21E01 and 14S/2E-21N01 on Armstrong Ranch and 14S/2E-28C01 and 14S/2E-33P01 to the southeast) have been recently added to the MCWRA monitoring program and analysis of samples collected in 2000 reveal important information on the seawater intrusion front location.

Ground water samples have been sporadically collected from wells 14S/2E-21E01 and 14S/2E-21N01 since 1997. Chloride concentrations ranged from 53 mg/L at -21E01 to 174 mg/L at -21N01 in 1997. Over the following year, chloride concentrations increased to 660 mg/L at –21E01 and 266 mg/L at -21N01. Chloride concentrations in recent samples collected in 2000 exceed 700 mg/L in both wells. Production records for these wells were not available for review. These concentrations are indicative of seawater intrusion; however, its presence at this location in the 400-Foot Aquifer and the rate of its onset was unexpected.

Wells 14S/2E-21N01 and 14S/2E-21E01 were constructed only six years ago with cable tool and dual casings were installed to depths of 580 and 602 feet bgs, respectively. Perforations for both wells are only in the 400-Foot Aquifer and the outer portion of dual casing in cable tool wells act as a well seal and is effective for sealing off upper aquifers. It is not likely that the elevated concentrations are deriving from unsealed shallow aquifers. Ground water production west or east of wells 14S/2E-21E01 and 14S/2E-21N01 may have contributed to seawater intrusion that may have now extended further eastward to reach the –21E01 and -21N01 wells.

The active Fort Ord supply wells and two nearby agricultural wells were similarly evaluated for seawater intrusion trends. Chloride concentrations have slowly but steadily increased at FO-30 from about 36 mg/L in 1985 to 92 mg/L in 1998, but have remained relatively low and constant at FO-29 and FO-31 between about 60 and 70 mg/L. As mentioned above, wells FO-29 and FO-30 are dually perforated in the 180-Foot and 400-Foot Aquifers, whereas wells FO-31 and FO-32 are perforated in the 180-Foot Aquifer only. Wells FO-29, -30, and -31 provide drinking water to residents living on former Fort Ord. Chloride concentrations in monitoring wells to the west generally indicate higher chloride concentrations in the Lower 180-Foot Aquifer than in the 400-Foot Aquifer. This distribution is consistent with the historically prevalent intrusion of seawater in the 180-Foot Aquifer relative to the 400-Foot Aquifer.

Two agricultural wells north of the Fort Ord production wells, 14S/2E-28C01 and 14S/2E-33P01, were recently added to the MCWRA monitoring program and samples collected in August 2000 were analyzed for chloride. Well 14S/2E-28C01 is screened in the 400-Foot Aquifer and 14S/2E-33P01 is primarily screened in the 180-Foot but also penetrates the 400-Foot Aquifer (Plates 6 and 5, respectively). Chloride concentrations were lower in 14S/2E-28C01 in 2000 (56 mg/L) than at 14S/2E-33P01 (110 mg/L) which reflects the distribution of higher chloride concentrations in the 180-Foot Aquifer relative to the 400-Foot Aquifer.

Wells FO-29, FO-30, and 14S/2E-33P01 are all constructed with very similar screen elevations; only 14S/2E-28C01 is solely perforated in the

400-Foot Aquifer. Chloride concentrations are lowest at 14S/2E-28C01 because it is constructed in the 400-Foot Aquifer, despite its closer proximity to the origin of seawater. Thus, seawater is migrating toward the active Fort Ord supply wells and 14S/2E-33P01 through the 180-Foot Aquifer, from the Salinas Valley and not across former Fort Ord.

## 5.2 Seawater Intrusion – Piper Diagrams

Although chloride concentrations are most commonly used to delineate the extent of seawater intrusion, additional inorganic data can also be used to specifically identify seawater or its influence on ground water quality. When available, a more complete data set of inorganic water quality can be plotted on a trilinear Piper diagram; however, a thorough analysis of water quality changes should include a correlation with production from the well(s). Piper diagrams are useful graphical representations to represent water quality conditions on which major cations (sodium, calcium, magnesium, and potassium) and anions (chloride, alkalinity, and sulfate) are plotted in relative concentrations (milliequivalents) to each other on a modified trilinear graph (*Hem, 1989*).

Each quadrant of the central trilinear diagram is indicative of the water quality type, which is usually described in terms of the most prevalent cation and anion. For example, if the most prevalent cation in a water sample is sodium and the most prevalent anion is bicarbonate, the water is described as a sodium-bicarbonate water. Seawater is primarily composed of sodium and chloride and a ground water sample of a sodium-chloride type may be indicative of seawater intrusion.

Todd (*1989*) and Snow (*1990*) both studied the chemical signature of seawater intrusion in ground water in the Salinas Valley using Piper diagrams and Stiff diagrams, respectively. Both noted that the advancement of seawater is usually preceded by a sodium-calcium ion exchange reaction unless seawater is directly introduced into a well via conduit or failed casing, in which case a simple mixing model may be used to explain chemical changes. A cation exchange reaction precedes seawater intrusion because the relatively high sodium content of seawater displaces calcium ions attached to clay particles in the aquifer, thus sending calcium into solution and increasing its concentration in ground water. During this initial phase, clay particles in the aquifer(s) act temporarily as 'sodium sponges'. As clay particles become saturated with respect to sodium, concentrations quickly rise in ground water during the second phase of intrusion. It should be noted that the total dissolved solids (TDS) in ground water usually increases progressively throughout this cation exchange process and chloride concentrations often become high enough to abandon the well prior to the onset of the second phase.

### *Historical Conditions*

Plates C1 through C31 illustrate Piper diagrams for historical data collected from several wells screened in the 180-Foot and 400-Foot Aquifers (Appendix C). Wells evaluated in this study include city of Marina municipal wells, several former Fort Ord production wells (including the currently active wells), select monitoring wells in the former Fort Ord vicinity, and four agricultural wells within the study area. Data supporting the piper diagrams are presented in Appendix D.

The city of Marina has installed 11 wells (MCWD-1 through MCWD-9, including two replacement wells) screened in either the 180-Foot or 400-Foot Aquifers, or both (Plates C1 through C11); three additional wells (MCWD-10 through MCWD-12) were screened in the Deep Aquifer. Of the wells screened in the 180-Foot or 400-Foot Aquifers, all but possibly MCWD-2 and MCWD-3 indicated the presence of seawater intrusion between 1960 and 1992. As mentioned above, MCWD-2 was not connected to the distribution system and probably was not used as extensively as other MCWD wells. It is not clear why concentrations remained lower at MCWD-3; perhaps this well was not used as extensively as other wells.

As was noted by Todd (*1989*) in the Castroville area, many of the MCWD wells had undergone the first phase of seawater intrusion as the proportion of calcium can be observed to have increased with increased or sustained demand. In most cases, the well was abandoned prior to the second phase when the proportion of sodium would have been expected to increase with continued seawater intrusion.

Most MCWD wells (where early data are available) indicate a sodium/calcium-bicarbonate water prior to the intrusion of seawater. The onset of seawater intrusion was recorded by a steady increase in the proportion of calcium and thus ground water signatures are plotted progressively higher in the central portion of the Piper diagram. This phenomenon is best illustrated with data from MCWD-4, MCWD-5, MCWD-7, and MCWD-8.

Piper diagrams were constructed for at least one sample for former Fort Ord supply wells 11, 14, 16, 17, 18, 19, 21, 22, 23, 24, and 28 (Plates C12 through C22). The ground water signatures indicated by these samples generally reflect the intrusion of seawater into the Main Garrison well field (180-Foot Aquifer), as was concluded above from chloride concentrations. Of the currently active wells at former Fort Ord (FO-29 through FO-31), FO-30 and FO-31 indicate a shift in water quality suggestive of seawater intrusion (also in the 180-Foot Aquifer), but have historically not been intruded (Plates C23 through C26).

### Current Conditions

As mentioned above, inorganic chemistry in the Upper 180-Foot Aquifer is controlled inland by the former Fort Ord landfills and near the coast by natural seawater intrusion. Ambient water quality is of a sodium-chloride type, but concentrations are much lower than would be associated with seawater intrusion. Typically, total dissolved solids (TDS) concentrations are less than 500 mg/L inland (although they can exceed 10,000 mg/L near the coastline. Piper diagrams from Upper 180-Foot Aquifer are not presented in this report because results are generally not related to the regional seawater intrusion study.

In addition to relatively low chloride concentrations, few samples from monitoring wells indicate a chemical signature indicative of seawater intrusion. As mentioned above, chloride concentrations from MW-OU2-07-400 were indicative of seawater intrusion in 1994, but decreased in subsequent years. Plate C27 illustrates the chemical signature of these samples and it is concluded that the elevated chloride concentrations in 1994 were, in fact, reflecting seawater intrusion. Samples from 1990, 1995, 1997, and 1998, however, are comparable to water quality at surrounding monitoring wells that reflect ambient conditions. The transient quality of these data may be related to the operation of nearby MCWD-9. Water quality at this production well during the same period was, however, considerably better than at MW-OU2-07-400.

The signature of the 1999 sample collected at well MW-OU2-66-180 is indicative of the first phase of seawater intrusion, that is, a relatively high proportion of calcium was observed. Still, the relatively low TDS concentration of the 1999 sample (554 mg/L) is not indicative of severe intrusion. This well is located west of the Fort Ord production wells, and their chemical signature is similar to the 1999 MW-OU2-66-180 sample. The Piper diagram for this monitoring well is illustrated on Plate C27.

Fewer results are available from the 400-Foot Aquifer, but the 1999 Airfield well sample indicate seawater intrusion to a greater extent than at MW-OU2-66-180. As mentioned above, the chloride concentration at the Airfield well in 1999 was 388 mg/L a greater extent of seawater intrusion is indicated by the higher calcium proportion relative to the sample from MW-OU2-66-180 (Plate C27). The Airfield monitoring well perforates both the 180-Foot and 400-Foot Aquifers and, as mentioned above, it is not possible to determine through which aquifer the seawater is arriving without depth-specific data.

Data from the four agricultural wells recently added to the MCWRA monitoring program were also evaluated using Piper diagrams, as were described above. One sample collected from each well in August 2000 was evaluated with Piper diagrams (Plates C28 through C31).

Seawater intrusion is not only indicated at wells 14S/2E-21E01 and -21N01 (400-Foot Aquifer) from elevated chloride concentrations (discussed above) but also by the chemical signature illustrated on the Piper diagrams. The calcium-chloride signature at both locations reflects an advanced first phase of seawater (*Snow, 1990*). Because of the proximity of these wells to the Airfield well, the approximate area of the 400-Foot Aquifer that has been intruded should also include the Airfield well (unless depth-specific sample results should indicate otherwise). Continued sampling is necessary to monitor additional changes in water quality that may indicate progressive seawater intrusion.

Similarly, a complete suite of inorganic data was tested for in 1999 from the nearby Airfield well. The calcium-chloride signature at this location also indicates an early phase of seawater intrusion. Historical data from this well were not available for comparison to the 1999 sample results. The Airfield well is located just south of Marina Airport about less than two miles south of 14S/2E-21E01 and 14S/2E-21N01 and the relative proximity of these three wells indicates a more extensive area of intrusion north of the Marina Airport in the 400-Foot Aquifer.

Well 14S/2E-28C01 (400-Foot Aquifer) is not currently impacted by seawater intrusion based on the mixed chemical signature; however, the single sample result (August 2000) does not permit the evaluation of a possible trend. The sample from well 14S/2E-33P01 (180-Foot and 400-Foot Aquifers) had a higher proportion of calcium and chloride than at -28C01 that is an indication of incipient seawater intrusion, probably through the 180-Foot Aquifer.

As mentioned above, chloride data from the currently active Fort Ord supply wells indicate possible early seawater intrusion at FO-30. However, calcium proportions have increased slightly at both FO-30 and FO-31 since 1984 and may be indicative of very early seawater intrusion at both wells, despite the relatively low chloride concentrations at FO-31.

It should be noted the single available chemical signature at 14S/2E-28C01 is similar to the Fort Ord supply wells; however, overall concentrations are lower indicating seawater has not intruded this portion of the 400-Foot Aquifer. Active seawater intrusion in the 180-Foot Aquifer is evident from the established trend at the Fort Ord wells. Additional data is required at 14S/2E-28C01 to determine whether ground water quality is diminishing in the 400-Foot Aquifer. Based on available data, the 400-Foot Aquifer at 14S/2E-28C01 is not intruded with seawater whereas shallower units in the 180-Foot Aquifer penetrated by 14S/2E-33P01 and FO-30 and FO-31 are undergoing the earliest stages of seawater intrusion.

# 6.0 CONCLUSIONS

Lithology, hydrostratigraphy, ground water elevations, and ground water quality data were evaluated in this report to collectively evaluate the potential for continued seawater migration into the city of Marina and former Fort Ord area, and to compare current data to historical data in this area. Additionally, previous investigations were reviewed in preparation of this report to maintain continuity with previous conclusions consistent with findings of this study.

The evaluation of lithologic and geophysical data indicates that the confining SVA clay unit and the 180-Foot and 400-Foot Aquifers are continuous throughout the study area. Although lithologic differences exist (e.g., elevation and thickness variations) in the study area, these aquitard/aquifer units behave as consistent hydrostratigraphic units. For instance, the SVA clay is generally thicker beneath the Salinas Valley than beneath former Fort Ord, but is laterally continuous and consists of similar clay throughout. Therefore, the SVA beneath the Salinas Valley and former Fort Ord is considered a single hydrostratigraphic unit in this report.

The 180-Foot Aquifer extends from Monterey Bay to Chualar beneath the Salinas Valley and westward from the valley to former Fort Ord and the city of Marina, although it thins somewhat and includes a shallower upper member beneath former Fort Ord. The gravel units of the Lower 180-Foot Aquifer beneath former Fort Ord are continuous with the 180-Foot Aquifer beneath the Salinas Valley; however, the sandy Upper 180-Foot Aquifer is present only west of the Salinas River.

The 400-Foot Aquifer present beneath the Salinas Valley also extends westward beneath former Fort Ord and city of Marina, but may thin and become sandier in the westward direction. As with the 180-Foot Aquifer, the 400-Foot Aquifer outcrops along the canyon walls of Monterey Bay. The 400-Foot Aquifer is found in the Aromas Sand and the Paso Robles Formation.

The Deep Aquifer (including the "B" and "C" members of the Paso Robles Formation as defined by Thorup) and aquifers within the Purisima and Santa Margarita Formations also extend throughout the study area, but the latter two are not a focus of this study. The Deep Aquifer extends considerably deeper in the "Marina trough" described at MCWD wells 10, 11, and 12. The orientation and lateral extent of the trough was not determined in this report, but does not appear to extend to the coastline or beneath the Salinas Valley. The Purisima Formation was observed near the coastline at 14S/1E-24L and at Fontes-1 beneath the Salinas Valley. The Santa Margarita Formation was also observed at Fontes-1. Both of these formations were concluded in a previous investigation to be absent at the three MCWD deep wells. Correlation of the deeper formations within the study area is complex and a more thorough analysis is needed to determine the orientation and lateral extent of the "Marina trough", if it exists.

Both the 180-Foot and 400-Foot Aquifers have been intruded by seawater intrusion due to excessive ground water extraction for irrigation within the Salinas Valley and drinking water production near Marina and former Fort Ord. Ground water was primarily extracted from the 180-Foot Aquifer until seawater intrusion rendered water quality poor in many areas throughout the study area. Wells in the 180-Foot Aquifer were progressively abandoned and replaced with deeper wells penetrating the 400-Foot Aquifer.

Most of the historical seawater intrusion in Marina and former Fort Ord area occurred in the 180-Foot Aquifer where most drinking water production wells were completed. These older production wells were replaced by both the city of Marina and former Fort Ord in the 1980's. Marina replaced its 180-Foot Aquifer wells with production wells completed in the 400-Foot and Deep Aquifers, whereas Fort Ord installed new

180-Foot Aquifer wells further east away from Monterey Bay to avoid seawater intrusion.

Ground water quality data available from the city of Marina and former Fort Ord production wells illustrate a persistent tongue of seawater that first intruded the oldest former Fort Ord well field but steadily migrated northward and inland toward the continued production from Fort Ord and Marina wells in the 1970's and 1980's. By 1985, seawater had intruded in the 180-Foot Aquifer about two miles inland beneath the city of Marina. The 400-Foot Aquifer was also intruded at this location, but probably as a result of local migration through well bore vertical conduits from the 180-Foot Aquifer.

Data available from 1997 and 1999 in this area are almost entirely from small-diameter monitoring wells which may not represent data equivalent to those from production wells. These wells are not pumped at rates sufficient to stress the aquifer or portion(s) of the aquifer that is intruded and hence may not yield data as representative of true conditions as from active production wells. In addition, construction differences between production and monitoring wells may account for water quality differences. Most production wells fully penetrate the target aquifer and thus probably intercept the highest concentrations of chloride; however, most monitoring wells at former Fort Ord are completed specifically in the upper portion of the aquifers. For these reasons, data from active production wells, where available, are probably more useful for seawater intrusion monitoring than from dedicated monitoring wells.

Monitoring wells installed along the coastline on former Fort Ord indicate chloride concentrations and chemical signatures that are consistent with significant seawater intrusion. The proximity of these wells to the coastline reflect what is probably naturally occurring seawater that is present even under non-pumping conditions.

Monitoring wells located further inland in the Upper 180-Foot Aquifer indicate chemical signatures that are influenced by formerly used landfills on former Fort Ord and do not indicate the presence of seawater intrusion. Although ground water elevations in the Upper 180-Foot Aquifer are below MSL and an inland gradient exists, the potential for seawater intrusion in this aquifer is low because this aquifer is not tapped by the Fort Ord supply wells or agricultural wells in the Salinas Valley.

The Lower 180-Foot Aquifer beneath the city of Marina and former Fort Ord had historically been intruded by seawater and available data do not indicate conditions have improved from 1985 conditions. Current (1997 and 1999) seawater intrusion is illustrated in this report to have extended inland at least as far inland as had been observed in 1985, assuming an insufficient amount of freshwater has since flushed the 180-Foot Aquifer.

Data from two agricultural wells (14S/2E-21N01 and 14S/2E-21E01) on Armstrong Ranch, however, do indicate a significant advancement of seawater intrusion in the 400-Foot Aquifer. South of these two wells, data from the Airfield well on former Fort Ord also indicate seawater intrusion characteristics, but this well is screened in both the 180-Foot and 400-Foot Aquifers and it is unclear which aquifer is most intruded. Chloride concentrations exceed 250 mg/L in all three wells, and exceed 500 mg/L in the two agricultural wells; all three wells have similar chemical signatures indicative of seawater intrusion. It is not clear, however, what pathway the seawater intrusion followed to reach this area. Seawater either migrated from the 180-Foot Aquifer through either natural or manmade vertical conduits to the 400-Foot Aquifer in the vicinity, or through the 400-Foot Aquifer directly inland, possibly in response to the operation of the few production wells west and east of the area.

Further east, water quality data from the Fort Ord supply wells (FO-29, FO-30, and FO-31) and two agricultural wells to their north (14S/2E-33P01 and 14S/2E-28C01) were also evaluated with respect to potential seawater intrusion. Seawater intrusion is migrating inland through the 180-Foot Aquifer and the 400-Foot Aquifer on the Armstrong Ranch beneath the Salinas Valley and is approaching the Fort Ord supply wells area. Chloride concentrations in the Fort Ord supply well closest to the Salinas Valley have slowly but steadily increased since its installation in 1984. The chemical signature of samples from these wells is consistent with early stages of seawater intrusion; however, chloride concentrations are currently relatively low (about 100 mg/L). Well FO-30 is screened in the 180-Foot and 400-Foot Aquifer and is closest to the Salinas Valley of the three active Fort Ord supply wells. Of the Fort Ord supply wells, chloride concentrations are highest at FO-30 and have shown the clearest upward trend since its installation in 1984. The agricultural well immediately north (14S/2E-33P01) is constructed similar to FO-30 and chloride concentrations have also steadily risen since its installation in 1995.

Seawater intrusion is continuing to migrate inland near the city of Marina and former Fort Ord areas, in addition to along the axis of the Salinas Valley. This intrusion is likely due to the continued production of ground water from the 180-Foot and 400-Foot Aquifers in this area, despite a substantial transfer of pumping to the Deep Aquifer since the 1980's.

# 7.0 RECOMMENDATIONS

The following recommendations are made following the evaluation of lithologic, geophysical, ground water elevation, and ground water quality data available in the study area for the 180-Foot and 400-Foot Aquifers:

1. Continue monitoring ground water quality and elevations at the Fort Ord production wells (FO-29, FO-30, and FO-31) and wells to north (14S/2E-33P01 and 14S/2E-28C01). Measurement of elevations have not been possible at the Fort Ord wells for several years and maintenance may be required.

2. Continue monitoring ground water quality at wells 14S/2E-21N01 and 14S/2E-21E01 and collect additional lithologic and ground water quality data from surrounding wells to determine the most likely path of seawater migration to this area.

3. Include the Beach and Airfield wells in MCWRA's ground water monitoring program and continue to search for early monitoring data collected by the U.S. Army.

4. Collect depth-specific samples for chloride analysis at the dually perforated Airfield well near Marina Airport to determine if elevated concentrations derive from the 180-Foot Aquifer or from the 400-Foot Aquifer.

5. Redefine the Pressure Zone to include the Marina and former Fort Ord area as defined by the extent of the SVA clay and underlying valley fill deposits (including the 180-Foot and 400-Foot Aquifers). This will clarify the potential for hydraulic interaction between the Salinas Valley and city of Marina/Fort Ord area.

6. If monitoring well data must be relied upon in lieu of production well data, the monitoring well should specifically be screened at the bottom of and also the most permeable zone of the subject aquifer to account for the higher density of seawater. Alternatively, depth specific samples should be collected to evaluate the potential for stratification within the monitoring well if possible.

7. Install an exploratory boring near well 14S/2E-28C01 to confirm the thickness of the SVA clay at this location. Knowledge of a 'hole' in the SVA has significant implications concerning potential for agricultural runoff migration to deeper aquifers.

8. Collect and analyze clay samples from the SVA beneath both former Fort Ord and the Salinas Valley to clarify the lithologic relationship between these two clay units. Possible analytical methods include radiocarbon dating, x-ray diffraction, or multi-spectral gamma analysis.

9. Reevaluate the lithologic contacts within the Paso Robles Formation and with underlying formations between 14S/1E-24L and the deep MCWD wells after the USGS report on 14S/2E-24L is available. A more in-depth correlation between these two areas will directly address features of the "Marina trough", if it exists.

10. Digitize geophysical logs available for wells in the study area for future evaluation. Most geophysical logs vary in scale and converting this data to an electronic format would allow for rapid comparison and inclusion into computer models.

# 8.0 REFERENCES


Bowen, O.E., 1969. *Geologic Maps of Monterey and Salinas Quadrangles,* California Division of Mines and Geology.

Brown D., 1986 *Geologic Study of 13S/2E & 14S/2E of Salinas Valley, Department of Water Resources*. May 6.

California Department of Public Works, Water Resources Division, 1946. *Salinas Basin Investigation*, Bulletin 52.

_____, 1949. *Salinas Basin Investigation*, Bulletin 52A.

_____, 1958. *Sea-Water Intrusion in California*, Bulletin No. 63.

California Department of Water Resources, 1969. *Geology of the Lower Portion, Salinas Valley Ground Water Basin.* June.

_____, 1970. *Seawater Intrusion, Lower Salinas Valley: Progress Report 1968-1969.* June.

_____, 1973. *Sea Water Intrusion, Lower Salinas Valley, Monterey County.* July.

_____, 1975. *Sea-Water Intrusion in California*, Bulletin 63-5. October.

_____, 1998. *The California Water Plan Update,* Bulletin 160-98.

Creegan & D'Angelo and Geotechnical Consultants, 1995. *Final Report for Test Borehole (Monitoring Well), Fort Ord, California.* Prepared for the U.S. Army Corps of Engineers, Sacramento District. August 9.

Dupré, William R., 1975. *Quaternary History of the Watsonville Lowlands, North-Central Monterey Bay region, California.* Dissertation submitted to the Department of Geology and the committee on graduate studies of Stanford University. July.

_____, 1990 *Quaternary Geology of the Monterey Bay Region, California* in "Geology and Tectonics of the Central California Coast Region, San Francisco to Monterey". Pacific Section of the American Association of Petroleum Geologists. June.

Geoconsultants, 1993. *Identifying Potential Sources of Water Supply.* Prepared for Monterey County Water Resources Agency. January.

Geotechnical Consultants, 1986. *Hydrogeologic Update, Fort Ord Military Reservation and Vicinity, Monterey County, California.* Prepared for U.S. Department of the Army, Sacramento District, Corps of Engineers. July.

Greene, Gary H. 1970. *Geology of southern Monterey Bay and its relationship to ground water basin and sea water intrusion.* U.S. Geologic Survey Open-File Report.

_____, 1977. *Geology of the Monterey Bay region.* U.S. Geologic Survey Open-File Report 77-718.

_____, 1990. *Regional Tectonics and Structural Evolution of the Monterey Bay region, Central California* in "Geology and Tectonics of the Central California Coast Region, San Francisco to Monterey". Pacific Section of the American Association of Petroleum Geologists. June.

Hall, Philip 1992. *Selected Geological Cross Sections in the Salinas Valley Using GEOBASE.* Prepared for Monterey County Water Resources Agency, Basin Management Plan. May.

Hamlin, H. 1904. *Water Resources of the Salinas Valley, California.* U.S. Geological Survey Water-Supply and Irrigation Paper 89. 91 p.

Hanson, R. 2001. Personal communication. January, February. U.S. Geological Survey.

Harding Lawson Associates, 1987. *Remedial Investigation/Feasibility Study of Ground water Contamination, Fritzsche Army Airfield Fire Drill Area, Fort Ord, California.* Prepared for Sacramento COE. June 5.

_____, 1994. *Draft Final, Basewide Hydrogeologic Characterization Report, Fort Ord, California.* Prepared for the U.S. Army Corps of Engineers, Sacramento Division. June 10.

_____, 1995. *Final, Remedial Investigation/Feasibility Study Report, Fort Ord, California.* Prepared for the U.S. Army Corps of Engineers, Sacramento Division.

_____, 2000. *Draft OU 2 Plume Delineation Investigation Report, Phase II, Fort Ord, California.* Prepared for the U.S. Army Corps of Engineers, Sacramento Division. November 13.

Hem, John, 1989. *Study and Interpretation of the Chemical Characteristics of Natural Water*, U.S. Geological Survey Water-Supply Paper 2254. Third edition.

Ingle, James C. 1985. *Analysis of Foraminifera from the Marina 498-01A* [Well No. 10] *Well and the Sand City Macdonald No. 1 Well, Monterey County, California.* Prepared for Geoconsultants, Inc. July 8.

_____, 1986. *Analysis of Foraminifera from the Marina Coast Water District – Well No. 11, Monterey County, California.* Prepared for Geoconsultants, Inc. February 24.

_____, 1989. *Analysis of Foraminifera from the Marina Coast Water District – Well No. 12, Monterey County, California.* Prepared for Geoconsultants, Inc. April 18.

Kaiser, E. P., 1975. *Hydrogeology of Fort Ord and Vicinity.* Department of the Army, Sacramento District, Corps of Engineers. Sacramento, California. May.

Kingman, D.S., 1962. *Fort Ord, California Water Supply Study, Final Report.* Prepared for the Corps of Engineers, U.S. Army, Office of the District Engineer, Sacramento District. Sacramento, California. February.

_____, 1964. *Operation and Maintenance Manual, Water Supply and Distribution System, Fort Ord, California.* Prepared for the Corps of Engineers, U.S. Army, Office of the District Engineers, Sacramento District. Sacramento, California. June.

Lajoie, K.R., et. al., 1990. *Emergent Marine Strandlines and Associated Sediments, Coastal California; A Record of Quaternary Sea-Level Fluctuations, Vertical Tectonic Movements, Climatic Changes, and Coastal Processes.* Geological Society of America Bulletin. October.

Leedshill-Herkenhoff, Inc., 1985. *Salinas Valley Seawater Intrusion Study.* Prepared for Monterey County Flood Control and Water Conservation District. January.

MCWD, 2000. Data provided by Evelina Adlawan of Marina Coast Water District. December.

MCWRA, 1996. *Water Resources Data Report, Water Year 1993-1994.* Published by Monterey County Water Resources Agency. June.

_____, 1998. *Draft Salinas Valley Water Project, Plan Report.* Published by Monterey County Water Resources Agency. October.

_____, 1999. *1997 Ground Water Extraction Summary Report.* Published by Monterey County Water Resources Agency. November.

_____, 2001. 1999 Seawater intrusion front contours. Published by Monterey County Water Resources Agency. In press.

Muir, 1982. *Ground water in the Seaside Area, Monterey County, California.* Water Resource Investigation 82-10, U.S. Geological Survey in cooperation with the Monterey Peninsula Water Management District. September.

Oliver, Joe W., 1997. *Summary of 1996 Seaside Basin Monitor Well Installations.* Prepared for

Monterey Peninsula Water Management District. July.

Snow, G., et. al. 1990. *Identification of Sources of Saline Intrusion in a Confined Aquifer System, Salinas Valley, California.* in Ground Water Management, Number 1. February 20-21.

Staal, Gardner and Dunne, Inc. (SGD), 1991. Letter to Marina Coast Water District, Subject: Ground Water Quality Assessment – District Well No. 5. July 3.

_____, 1993. *Salinas Valley Ground Water Basin Seawater Intrusion Delineation/Monitoring Well Construction Program, 180-Foot Aquifer.* Prepared for Monterey County Water Resources Agency. July.

Thorup, Richard R. 1976. *Report on Castroville Irrigation Project Deep Test Hole and Freshwater Bearing Strata Below the 400-foot Aquifer, Salinas Valley, California.* Prepared for Monterey County Flood Control and Water Conservation District. April 20.

_____, 1985. *Summary Hydrogeological Report on the Relationship of the 4 Recently Completed Water Wells on Fort Ord Military Reservation to the Salinas Valley 180 and 400 foot Aquifers.* Prepared for Monterey County Flood Control and Water Conservation District. March 20.

Tinsley, John C. 1975. Quaternary geology of northern Salinas Valley, Monterey County, California. Dissertation submitted to the Department of Geology and the committee on graduate studies of Stanford University. August.

Todd, David Keith, 1989. *Sources of Saline Intrusion in the 400-foot Aquifer, Castroville Area, California.* Prepared for Monterey County Flood Control and Water Conservation District. June.

U.S. Army Corps of Engineers, 1986. *Long-Range Water Supply Development for Fort Ord, California.* Department of the Army, Sacramento District Corps of Engineers. Sacramento, California. February.

USGS, 1980. *Ground Water in North Monterey County, California.* Water-Resources Investigations Report 83-4023. Prepared in cooperation with the Monterey County Flood Control and Water Conservation District.

# TABLES

**Table 1. Wells with Data Evaluated for Cross-Section Generation**
**Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina**
**Monterey County Water Resources Agency**

| Cross-Section | | | |
|---|---|---|---|
| **A-A'** | **B-B'** | **C-C'** | **D-D'** |
| PZ-12-04-180 | 15S/1E-07B (MPWMD-11) [2] | 15S/2E-9E (DB-1) [2] | 14S/1E-24L05 [2] |
| 14S/1E-25D (Beach) | MW-OU2-10-400 [2] | Henneken [1,2] | 14S/2E-30G03 (MCWD-12) [2] |
| 14S/1E-24L05 [2] | MW-OU2-07-400 [2] | 15S/2E-04C01 (FO-29) [2] | 14S/2E-30H03 (MCWD-12 test well) [1] |
| 14S/1E-24L04 [2] | 14S/2E-31K02 (MCWD-9) [1] | Test Well 1 [1,2] | MW-B-05-180 [1] |
| 14S/1E-24L03 [2] | 14S/2E-31R01 (FO-24) [1,2] | 14S/2E-33Q01 (FO-30) [2] | 14S/2E-28C01 |
| 14S/1E-24L02 [2] | 14S/2E-31H01(MCWD-10) [2] | 15S/2E-04A01 (FO-31) [1,2] | 14S/2E-28H03 |
| 14S/01E-13J02 | 14S/2E-25H01 (FO-25) [1,2] | 15S/2E-03E01 (FO-32) [1,2] | 14S/2E-27C02 |
| 14S/02E-18E1 | 14S/2E-32E01 (FO-26) [1,2] | 14S/2E-33P01 (Dynasty Farm) [2] | 14S/2E-27G03 |
| 14S/2E-7F2 [2] | 14S/2E-32D02 (FO-27) [1,2] | 14S/2E-27N50 | |
| 14S/2E-7L4 | 14S/2E-32D01 (FO-28) [1,2] | 14S/2E-27N01 | |
| 14S/02E-7L5 | 14S/2E-32D04 (MCWD-11) [2] | 14S/2E-28J50 | |
| 14S/2E-18C1 [1] | 14S/2E-32D05 (MCWD-8) [1] | 14S/2E-28H02 [1] | |
| 14S/2E-6L1 [2] | 14S/2E-32D03 (MCWD-8a) [1] | 14S/2E-28H03 | |
| | Airfield | 14S/2E-22P02 | |
| | 14S-2E-21N01 | 14S/2E-22K01 (Fontes-1) [2] | |
| | 14S-2E-21E01 | | |
| | 14S-2E-21F2 | | |
| | 14S-2E-16G01 (CSIP-4) [2] | | |
| | 14S2E-09D04 (CSIP-2) [2] | | |

Notes:

1 lithlogic log evaluated but not presented on cross-section

2 geophysical log evaluated

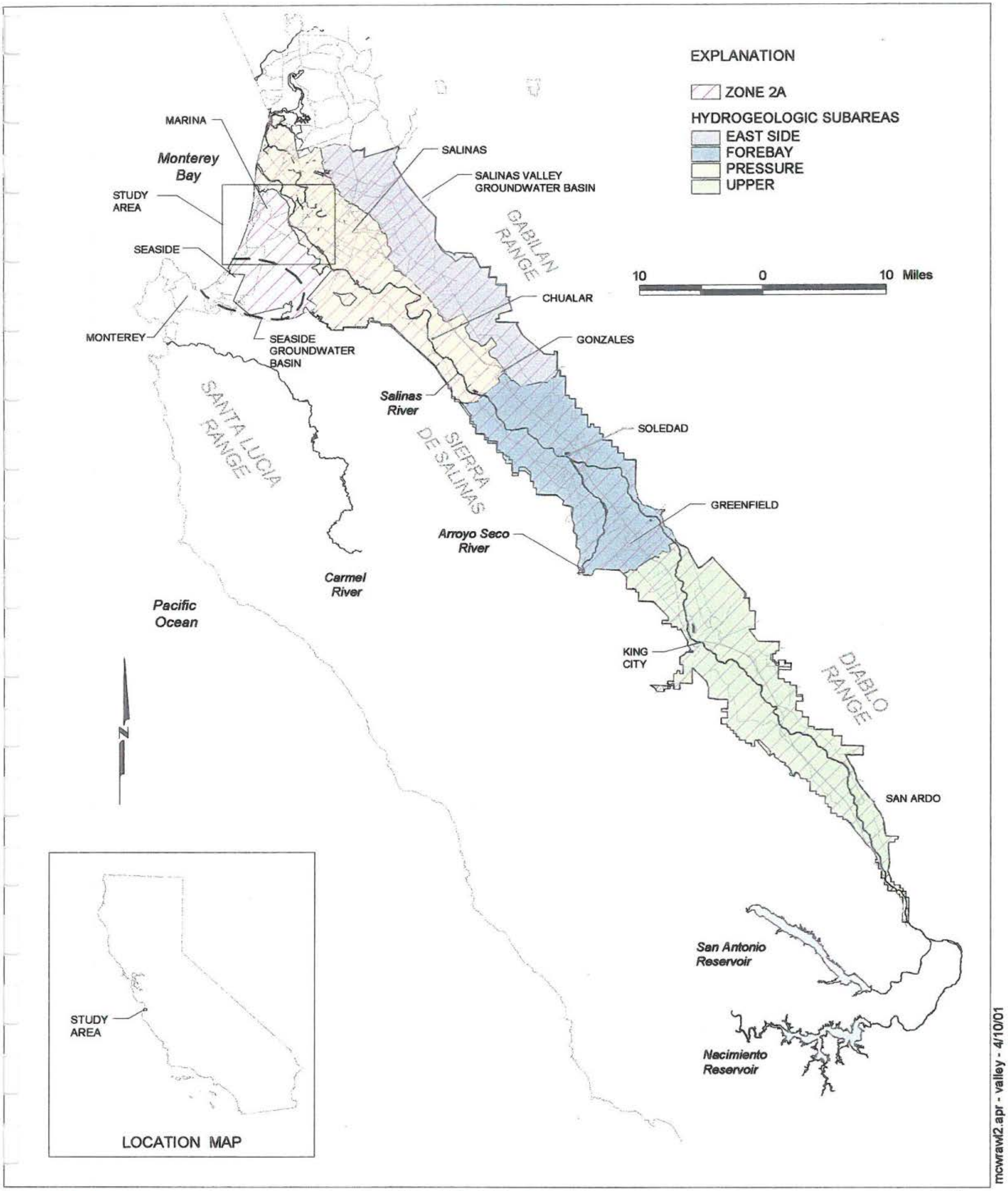
( ) private well name if known

**Table 2. Aquifer Assignment for Wells Included in Cross-Section Generation**
**Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina**
**Monterey County Water Resources Agency**

| Well Name | Screened Aquifer | Well Name | Screened Aquifer |
|---|---|---|---|
| A-A' Cross-Section | | C-C' Cross-Section | |
| PZ-12-04-180 | Lower 180-foot | 15S/2E-9E | Aromas |
| 14S/1E-25D | Lower 180-foot | Henneken * | Paso Robles |
| 14S/1E-24L02 | deep zone | 15S/2E-04C01 | Lower 180/400 |
| 14S/1E-24L03 | deep zone | Test Well 1 * | Lower 180/400 |
| 14S/1E-24L04 | deep zone | 14S/2E-33Q01 | Lower 180/400 |
| 14S/1E-24L05 | deep zone | 15S/2E-04A01 * | Lower 180-foot |
| 14S/01E-13J02 | 180/400 | 15S/2E-03E01 * | Lower 180-foot |
| 14S/02E-18E1 | 180/400/deep zone | 14S/2E-33P01 | Lower 180/400 |
| 14S/2E-7F2 | 400 | 14S/2E-27N50 | 400/deep zone |
| 14S/2E-7L4 | 400 | 14S/2E-28J50 | 180/400 |
| 14S/02E-7L5 | 400 | 14S/2E-28H02 * | 180 |
| 14S/2E-18C1 * | 400 | 14S/2E-28H03 | 400/deep zone |
| | | 14S/2E-22P02 | 180 |
| B-B' Cross-Section | | 14S/2E-22K01 | boring |
| 15S/1E-07B | deep zone | | |
| MW-OU2-10-400 | 400 | D-D' Cross-Section | |
| MW-OU2-07-400 | 400 | 14S/1E-24L02 | deep zone |
| 14S/2E-31K02 * | 180/400 | 14S/1E-24L03 | deep zone |
| 14S/2E-31R01 * | 180 | 14S/1E-24L04 | deep zone |
| 14S/2E-31H01 | deep zone | 14S/1E-24L05 | deep zone |
| 14S/2E-25H01 * | 180 | 14S/2E-30G03 | deep zone |
| 14S/2E-32E01 * | 180 | MW-B-05-180 * | Upper 180-foot |
| 14S/2E-32D02 * | 180/400 | 14S/2E-28C01 | 400/deep |
| 14S/2E-32D01 * | 180/400 | 14S/2E-28H03 | 400/deep |
| 14S/2E-32D04 | deep zone | 14S/2E-27C02 | 180/400 |
| 14S/2E-32D05 * | 180/400 | 14S/2E-27G03 | 180/400 |
| 14S/2E-32D03 * | 180/400 | | |
| Airfield | Lower 180/400 | | |
| 14S-2E-21N01 | 400 | | |
| 14S-2E-21E01 | 400 | | |
| 14S-2E-21F2 | 180 | | |
| 14S-2E-16G01 | 400 | | |
| 14S2E-09D04 | 400 | | |

* Not illustrated on the cross-section (Plates 3, 4, 5, and 6).

PLATES

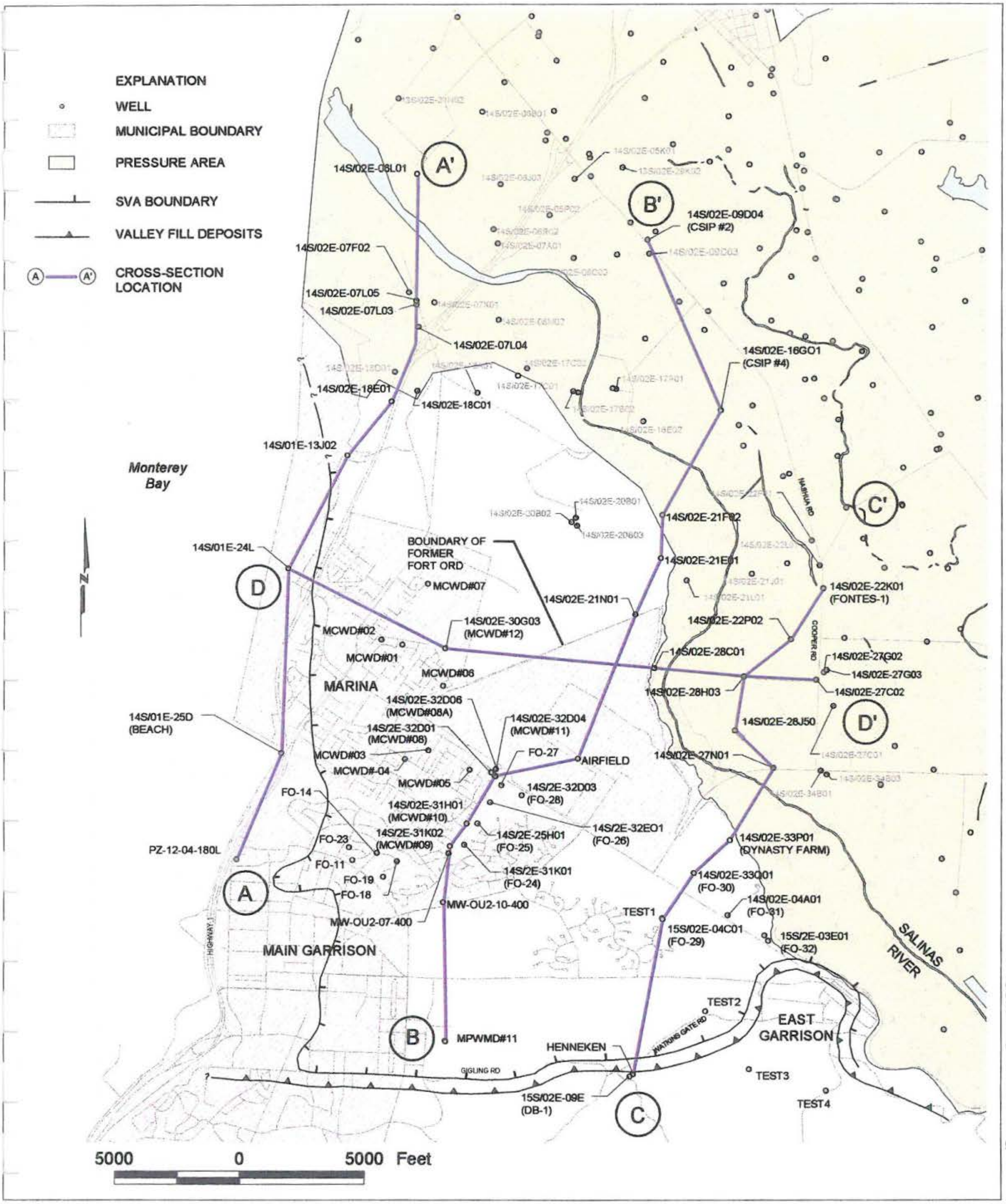



Harding ESE
A MACTEC COMPANY

**Salinas Valley Hydrogeologic Features**
Hydrogeologic Investigation of the Salinas Valley Basin
in the Vicinity of Fort Ord and Marina
Monterey County Water Resources Agency
Salinas Valley, California

PLATE
1

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| TJH | 51750 007 | MDT | 4/01 | |



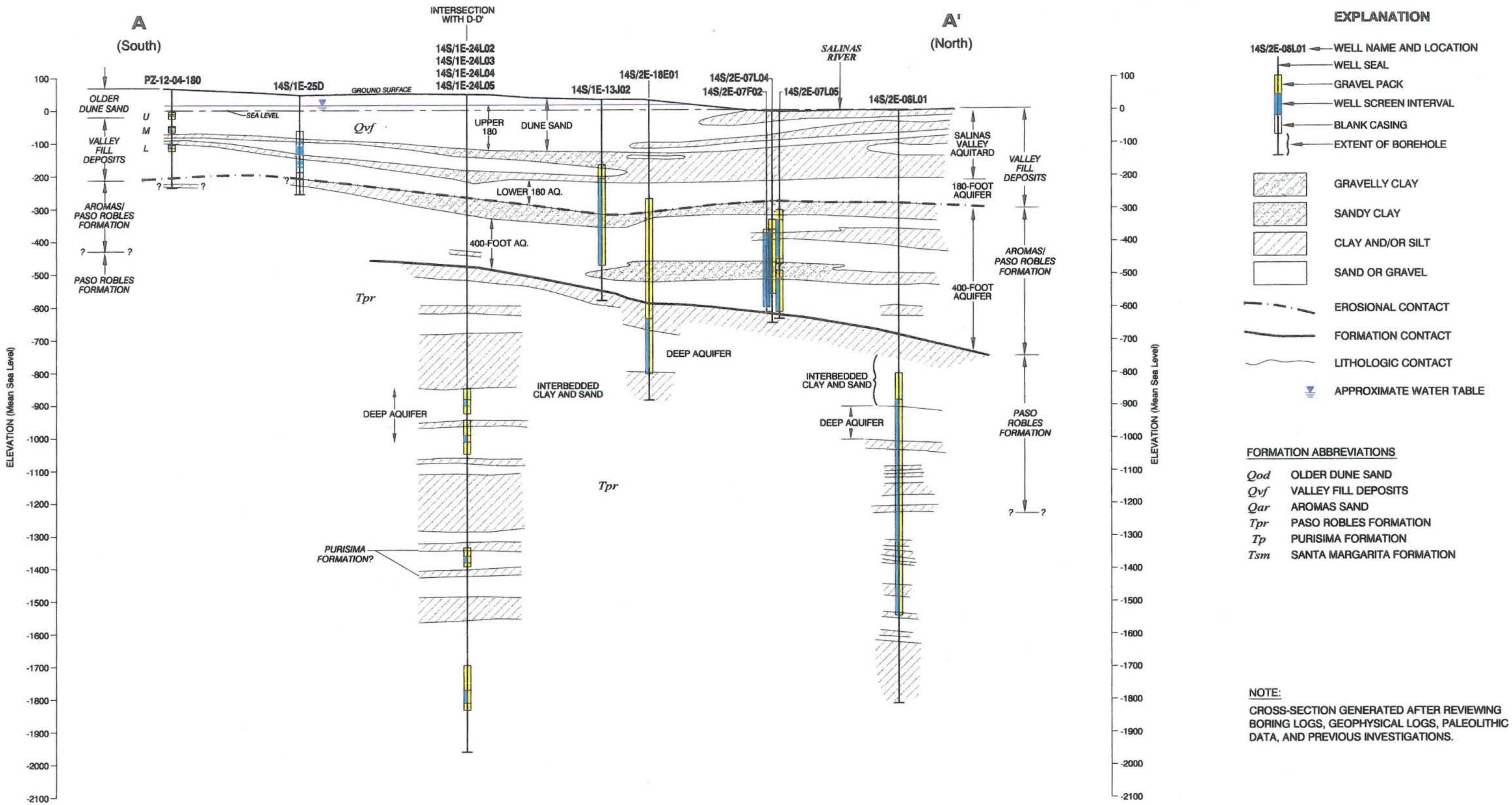

mcwrawl2.apr - cross-section - 4/10/01

Harding ESE
A MACTEC COMPANY

**Study Area and Cross-Section Locations**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Monterey County Water Resources Agency
Salinas Valley, California

PLATE
2

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| TJH | 51750 007 | MDT | 4/01 | |



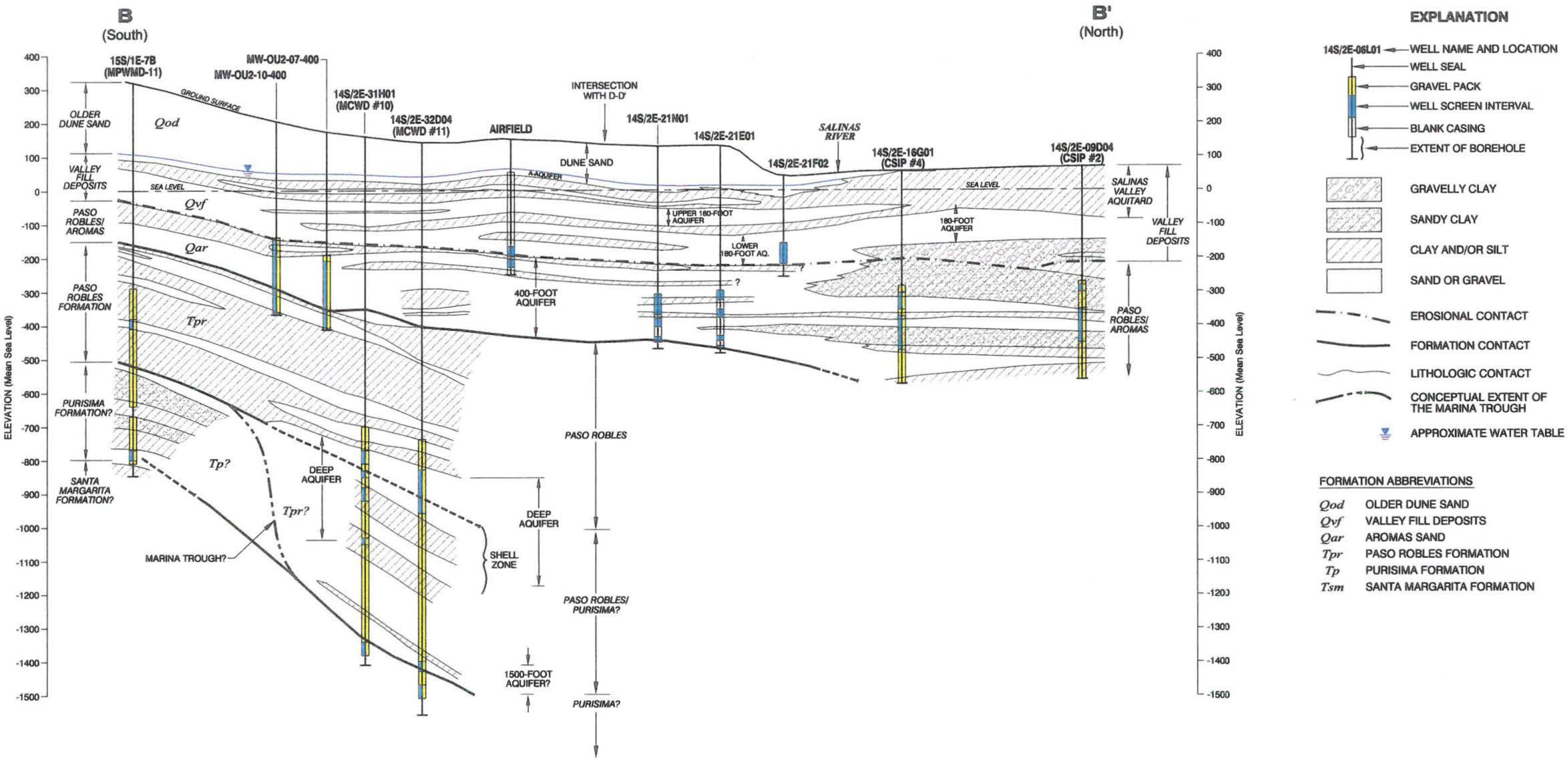

51750001.DWG 20010410.1534 0.0

Harding ESE
A MACTEC COMPANY

**Cross-Section A - A'**
**Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina**
Monterey County Water Resources Agency
Salinas Valley, California

PLATE 3

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| CSN | 51750 001 | MDT | 11/00 | |




NOTE:

CROSS-SECTION GENERATED AFTER REVIEWING BORING LOGS, GEOPHYSICAL LOGS, PALEOLITHIC DATA, AND PREVIOUS INVESTIGATIONS.

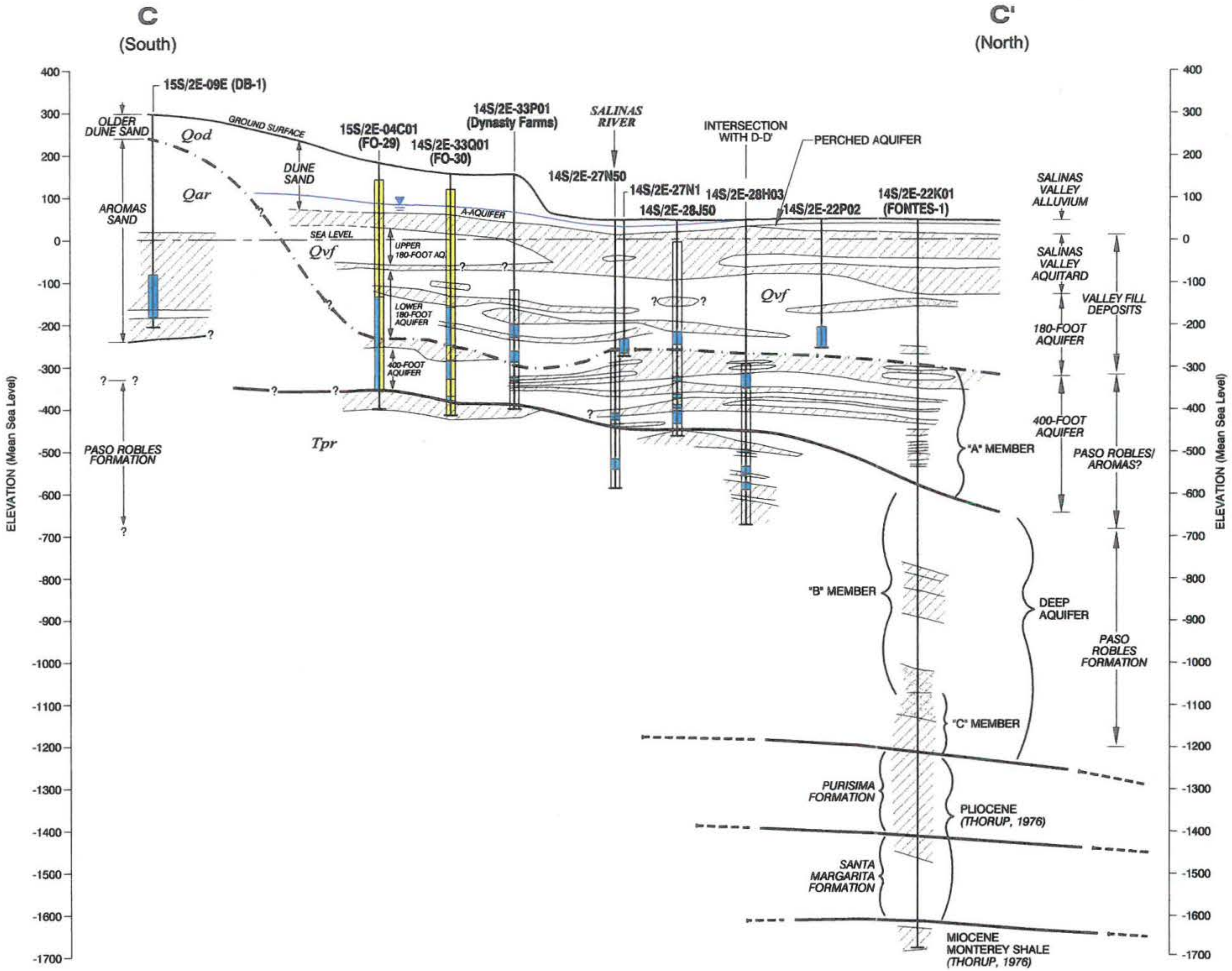
51750002.DWG 0.0
20010410.1537

Harding ESE
A MACTEC COMPANY

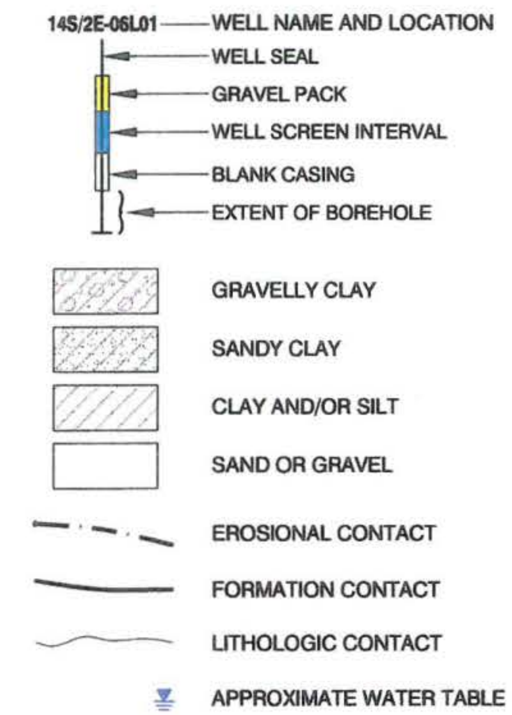
**Cross-Section B - B'**
**Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina**
Monterey County Water Resources Agency
Salinas Valley, California

PLATE
**4**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| CSN | 51750 001 | MDT | 11/00 | |




## EXPLANATION




**FORMATION ABBREVIATIONS**

| | |
|---|---|
| *Qod* | OLDER DUNE SAND |
| *Qvf* | VALLEY FILL DEPOSITS |
| *Qar* | AROMAS SAND |
| *Tpr* | PASO ROBLES FORMATION |
| *Tp* | PURISIMA FORMATION |
| *Tsm* | SANTA MARGARITA FORMATION |

**NOTE:**

CROSS-SECTION GENERATED AFTER REVIEWING BORING LOGS, GEOPHYSICAL LOGS, PALEOLITHIC DATA, AND PREVIOUS INVESTIGATIONS.

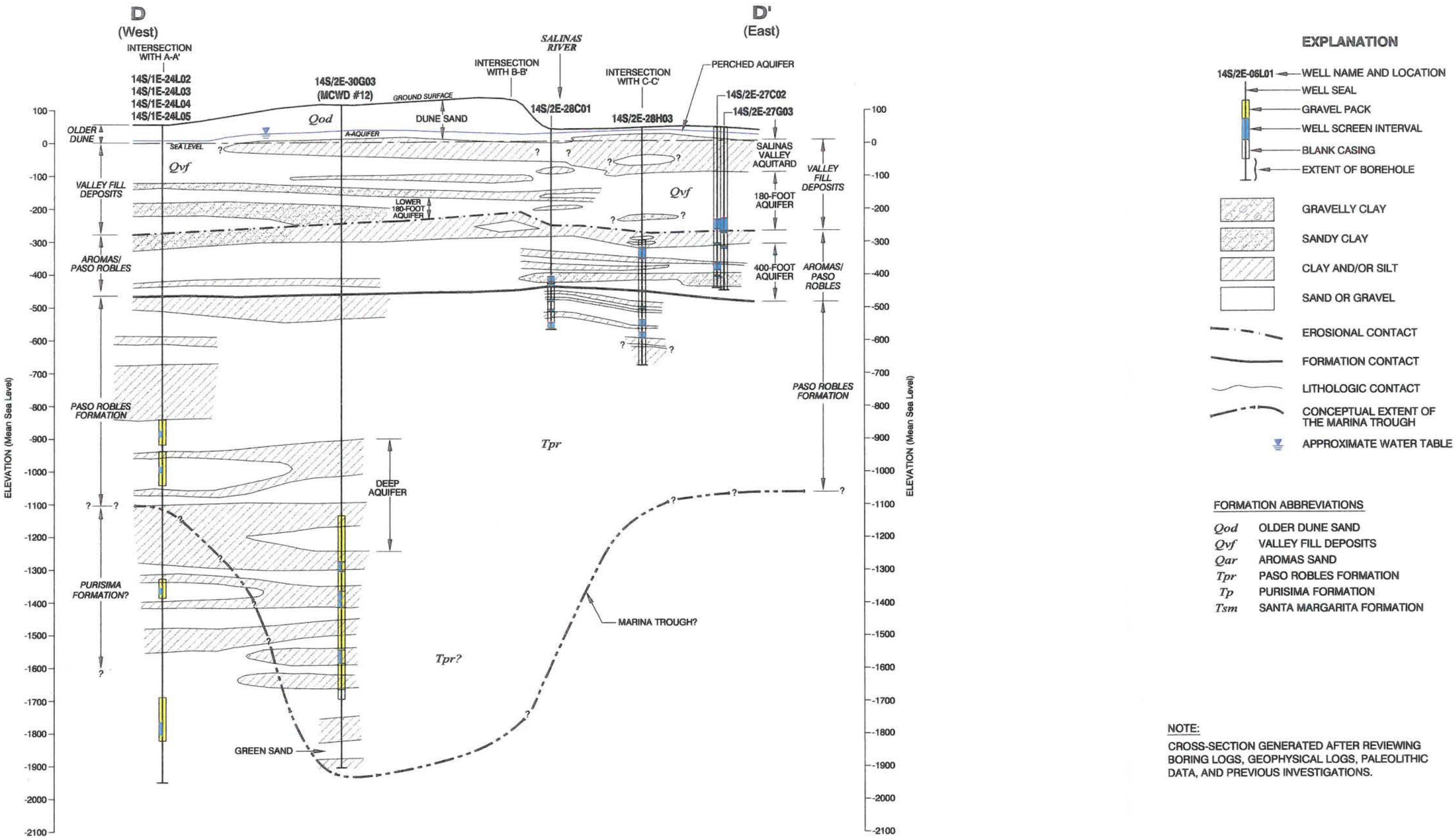
51750003.DWG 0.0
20010410.1543

Harding ESE
A MACTEC COMPANY

**Cross-Section C - C'**
**Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina**
Monterey County Water Resources Agency
Salinas Valley, California

PLATE **5**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| CSN | 51750 001 | MDT | 11/00 | |



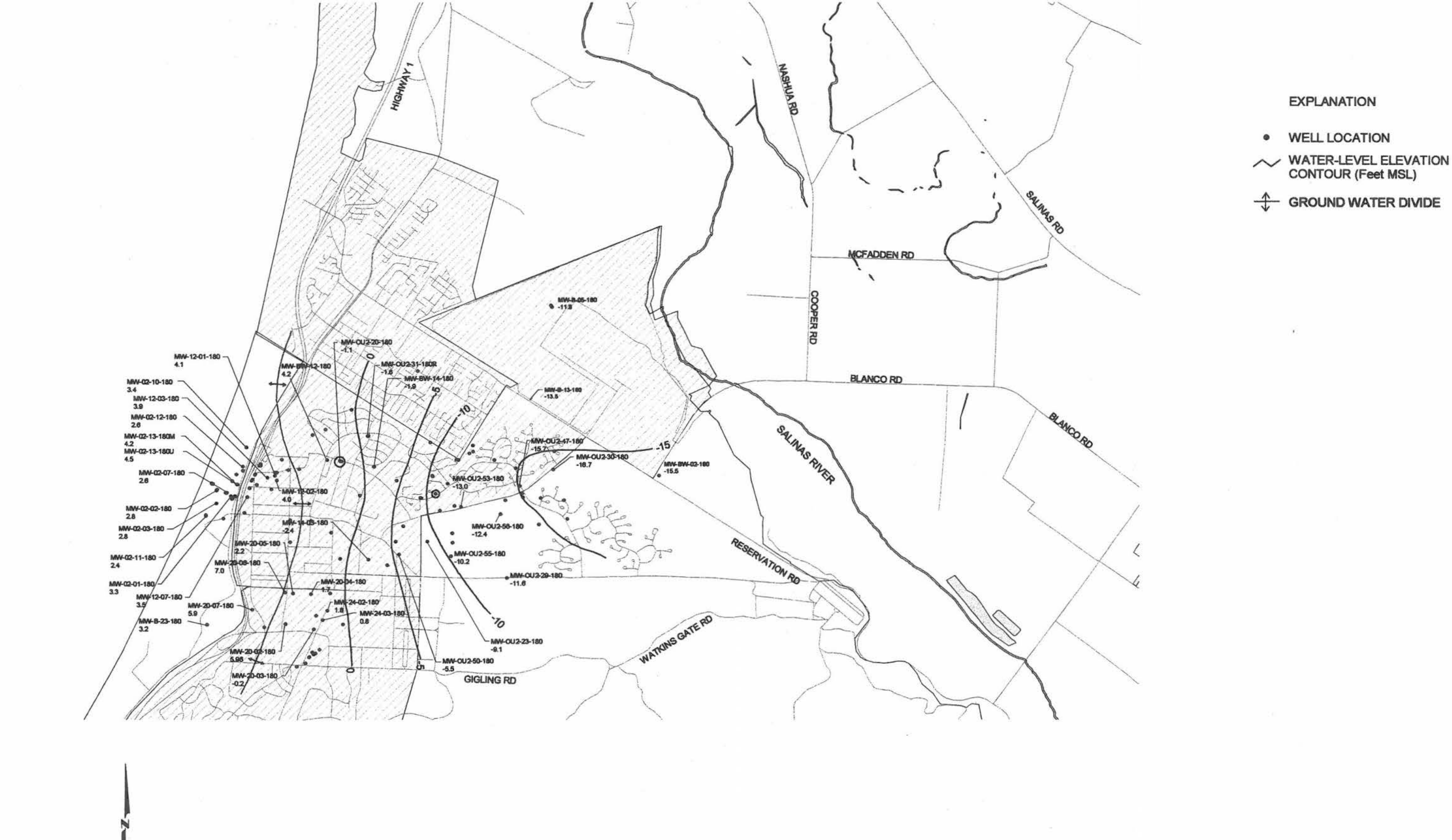

51750004.DWG 1.0
20010410.1521

Harding ESE
A MACTEC COMPANY

**Cross-Section D - D'**
**Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina**
Monterey County Water Resources Agency
Salinas Valley, California

PLATE
**6**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| CSN | 51750 001 | MDT | 11/00 | |




4000 0 4000 Feet

mcwrawl2.apr - wl-U180-97 - 4/10/01

Harding ESE
A MACTEC COMPANY

**Upper-180-foot Aquifer**
**Ground Water Elevations (feet MSL), 1997**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Monterey County Water Resources Agency
Salinas Valley, California

PLATE 7

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| TJH | 51750 007 | MADT | 4/01 | |


4000 0 4000 Feet

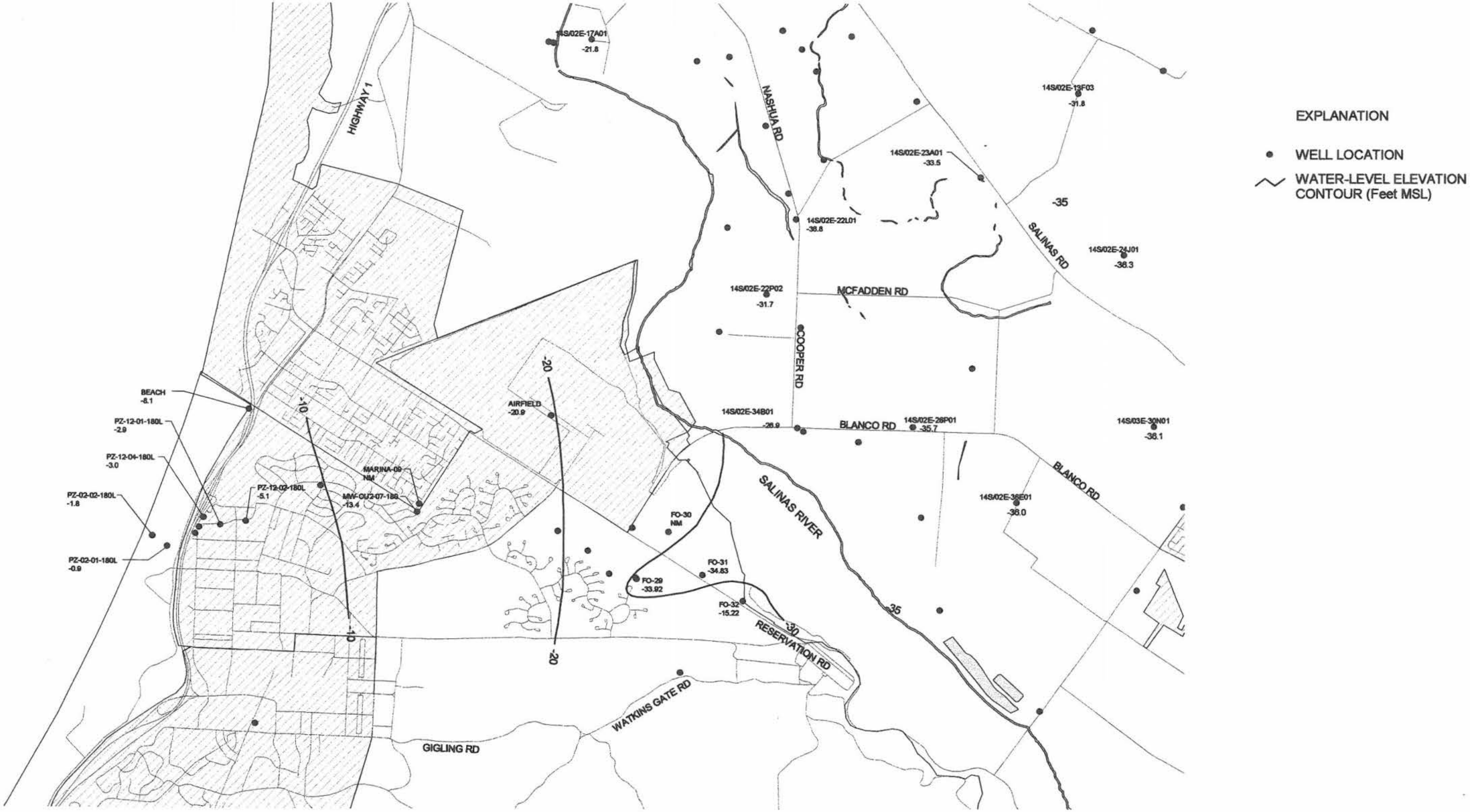
Harding ESE
A MACTEC COMPANY

**Upper-180-foot Aquifer**
**Ground Water Elevations (feet MSL), 1999**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Monterey County Water Resources Agency
Salinas Valley, California

PLATE 8

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| TJH | 51750 007 | MDT | 4/01 | |

mcwrawl2.apr - wlU180-99 - 4/10/01




N

4000 0 4000 Feet

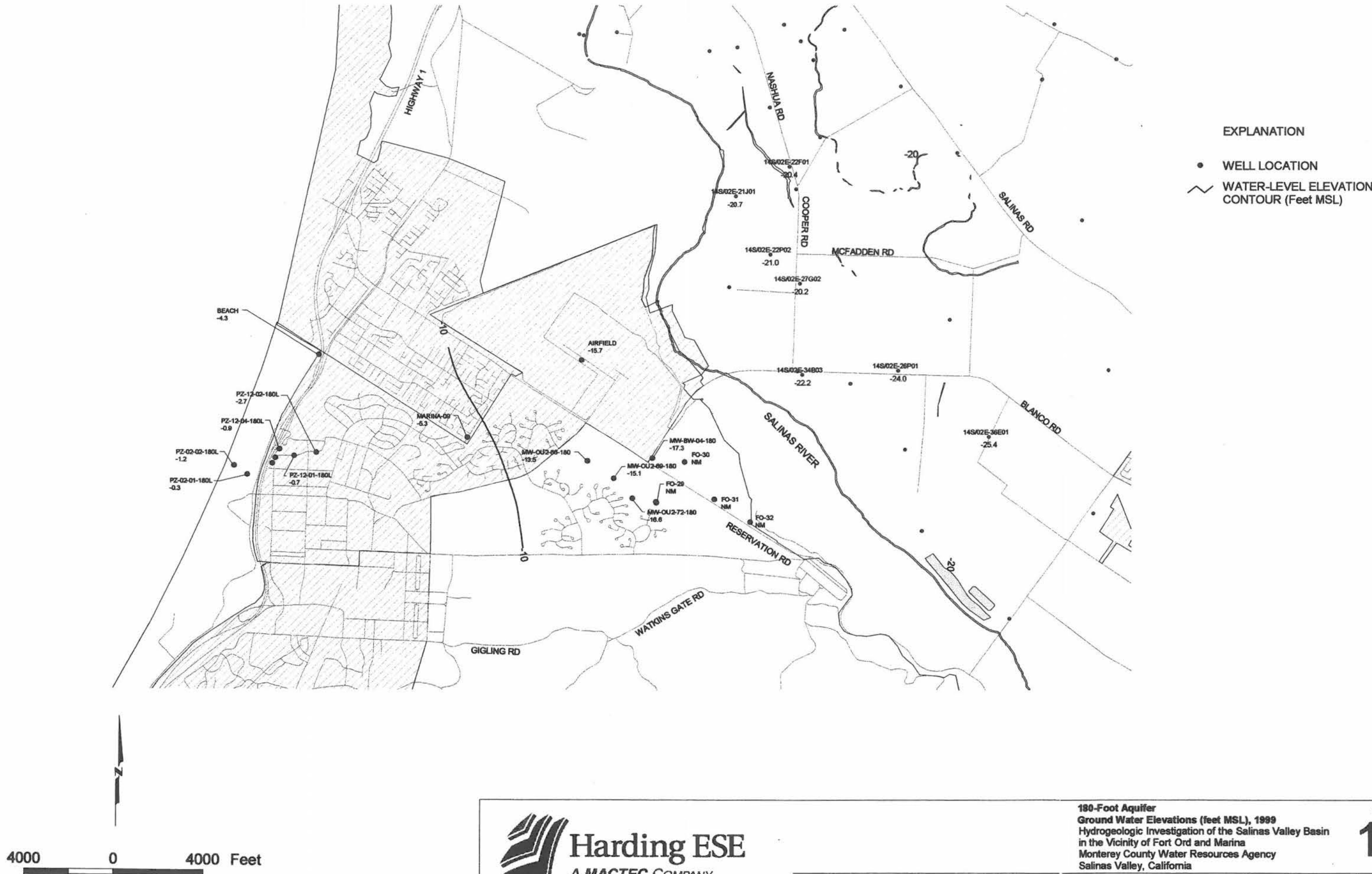
Harding ESE
*A MACTEC COMPANY*

**180-Foot Aquifer**
**Ground Water Elevations (feet MSL), 1997**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Monterey County Water Resources Agency
Salinas Valley, California

PLATE
9

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| TJH | 51750 007 | MDT | 4/01 | |

mcwrawl2.apr - wlL180-97 - 4/10/01




Harding ESE
A MACTEC COMPANY

**180-Foot Aquifer**
**Ground Water Elevations (feet MSL), 1999**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Monterey County Water Resources Agency
Salinas Valley, California

PLATE 10

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| TJH | 51750 007 | MDT | 4/01 | |

mcwraw\2.apr - wlL180-99 - 4/10/01


4000 0 4000 Feet

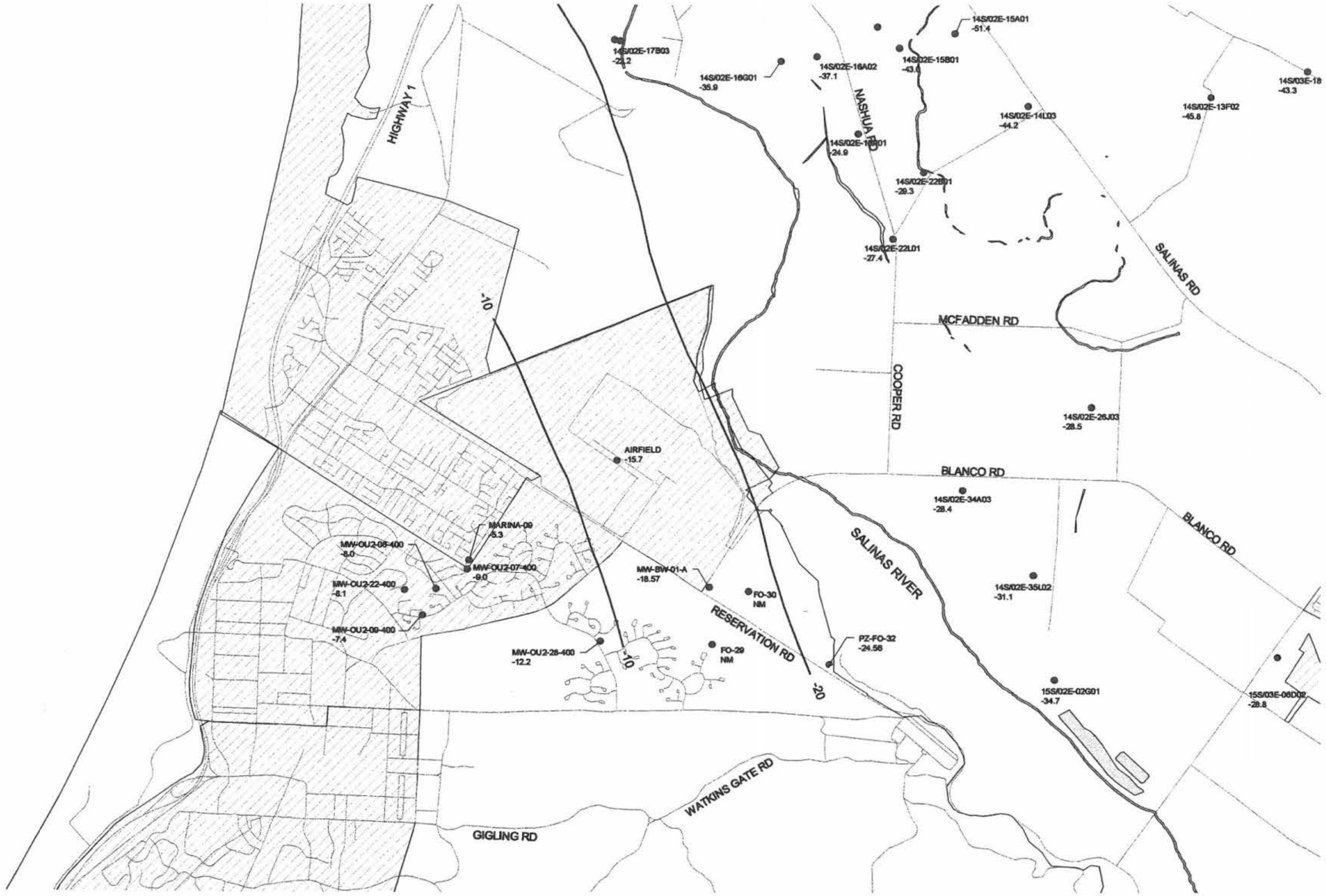
Harding ESE
A MACTEC COMPANY

**400-foot Aquifer**
**Ground Water Elevations (feet MSL), 1997**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Monterey County Water Resources Agency
Salinas Valley, California

PLATE 11

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| TJH | 51750 007 | MDT | 4/01 | |

mcwrawl2.apr - wl400-97 - 4/10/01




EXPLANATION

- WELL LOCATION
- WATER-LEVEL ELEVATION CONTOUR (Feet MSL)

N

4000 0 4000 Feet

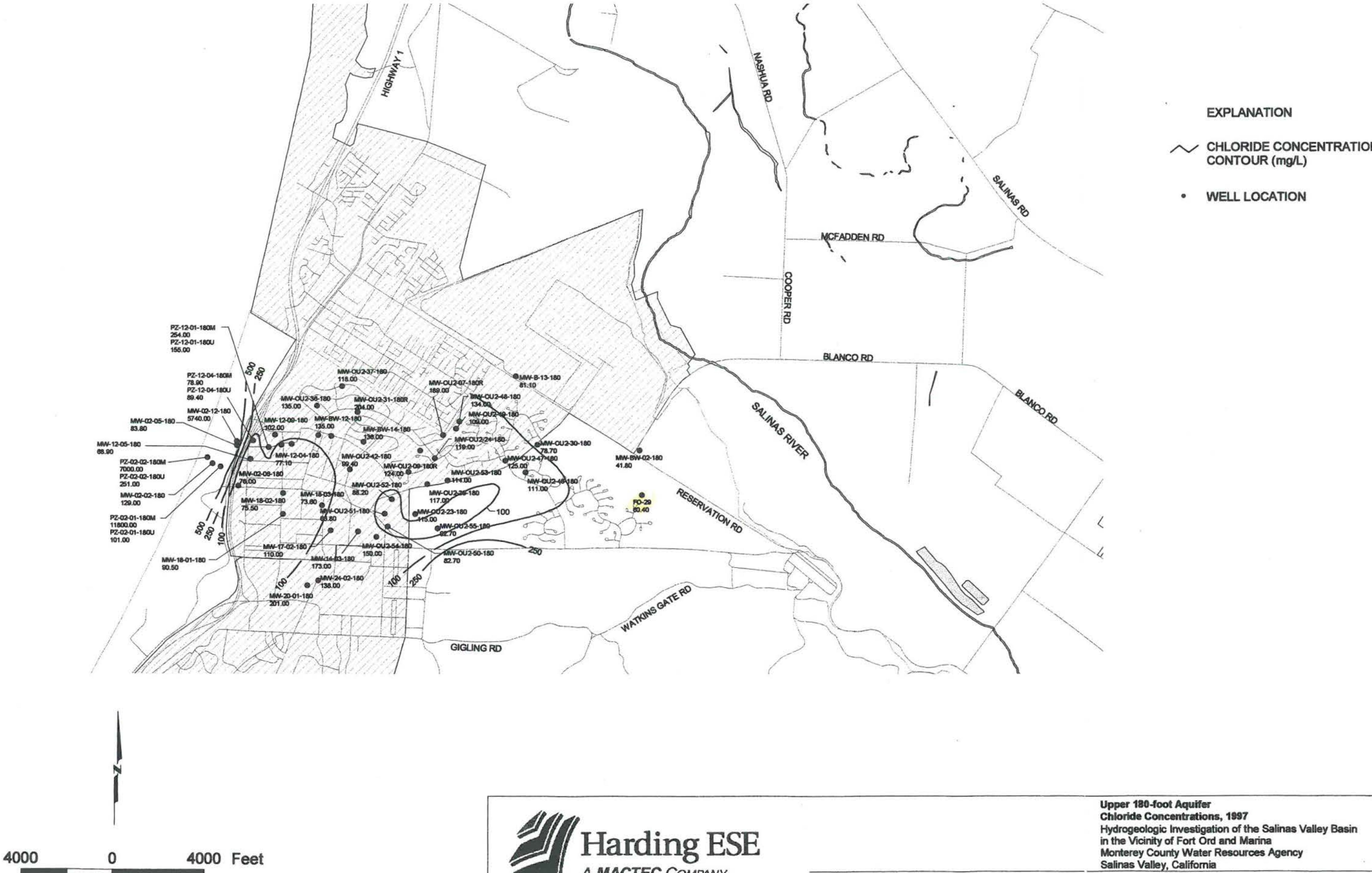
Harding ESE
A MACTEC COMPANY

**400-foot Aquifer**
**Ground Water Elevations (feet MSL), 1999**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Monterey County Water Resources Agency
Salinas Valley, California

PLATE 12

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| TJH | 51750 007 | MDT | 4/01 | |

mcwrawl2.apr - wl400-99 - 4/10/01



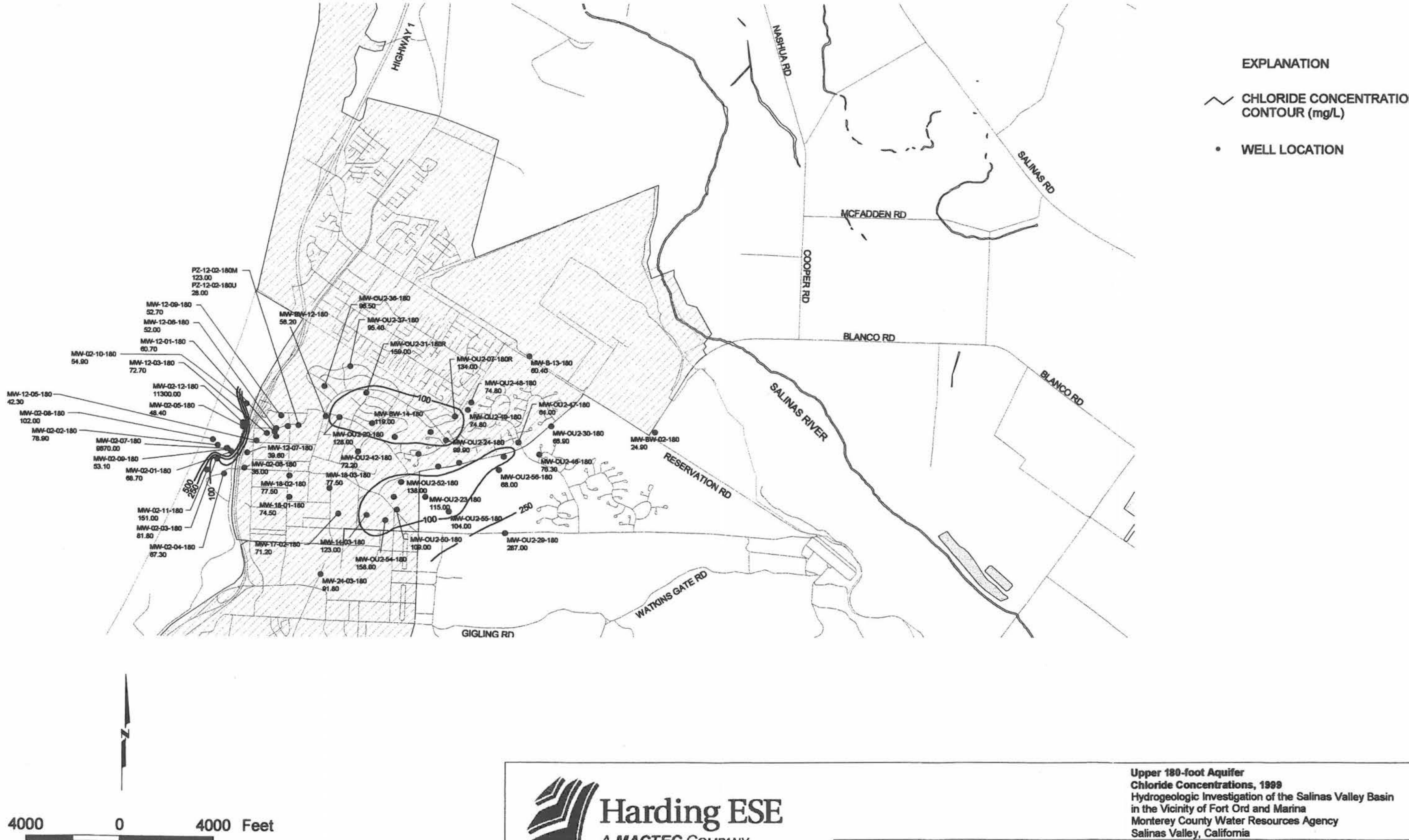

Harding ESE
A MACTEC COMPANY

**Upper 180-foot Aquifer**
**Chloride Concentrations, 1997**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Monterey County Water Resources Agency
Salinas Valley, California

PLATE 13

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| TJH | 51750 007 | NDT | 4/01 | |

mcwra3.apr - Chloride-180-97 - 4/10/01




Harding ESE
A MACTEC COMPANY

**Upper 180-foot Aquifer**
**Chloride Concentrations, 1999**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Monterey County Water Resources Agency
Salinas Valley, California

PLATE
14

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| TJH | 51750 007 | MDT | 4/01 | |

mcwra3.apr - Chloride-180-99 - 4/10/01


4000 0 4000 Feet

Harding ESE
A MACTEC COMPANY

**Seawater Intrusion Map**
**180-foot Aquifer, 1997**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Monterey County Water Resources Agency
Salinas Valley, California

PLATE 15

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| TJH | 51750 007 | MDT | 4/01 | |

mcwra3.apr - Chloride-180-97 - 4/10/01


4000 0 4000 Feet

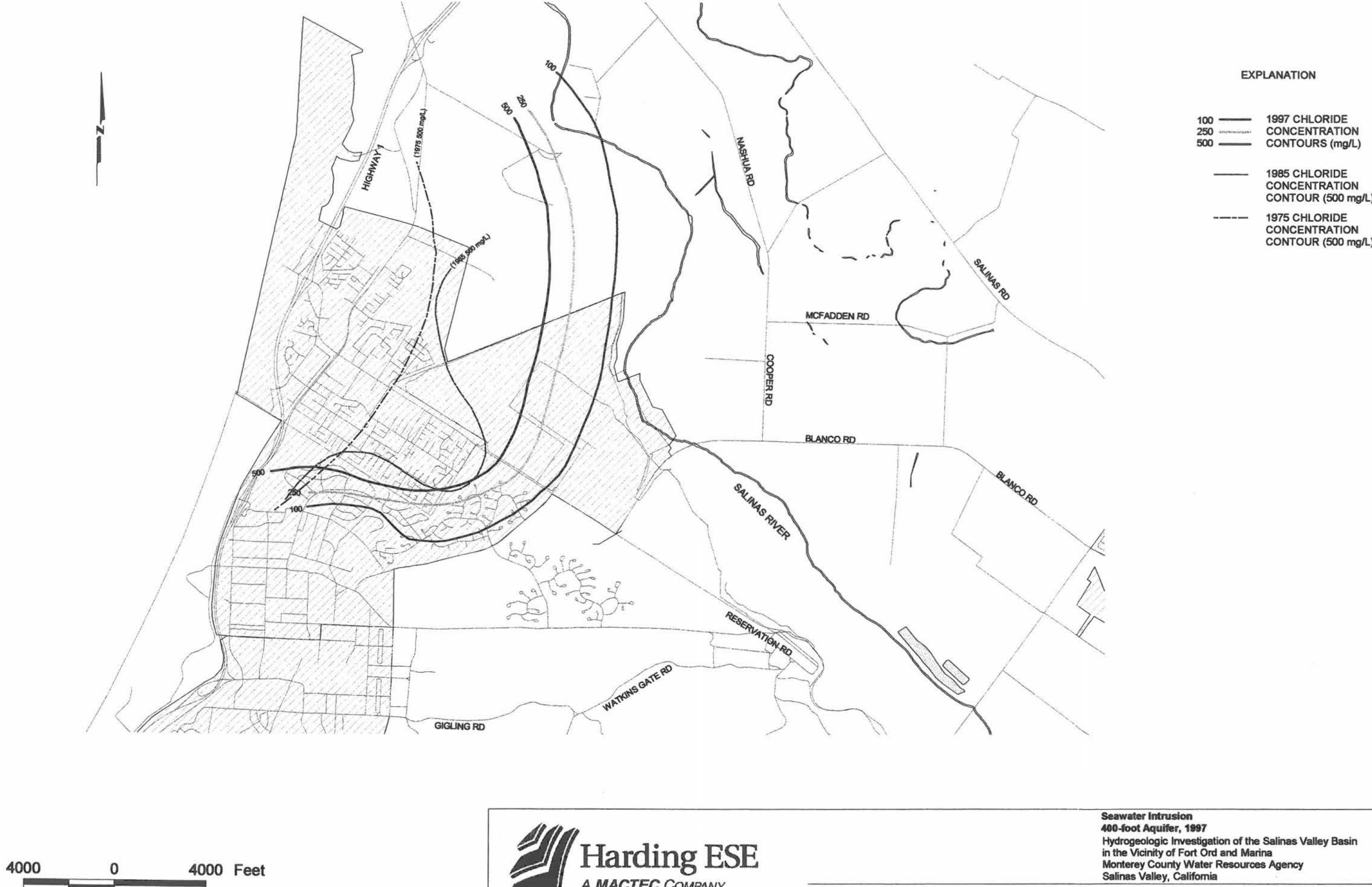
Harding ESE
A MACTEC COMPANY

**Seawater Intrusion**
**180-foot Aquifer, 1999**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Monterey County Water Resources Agency
Salinas Valley, California

PLATE
16

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| TJH | 51750 007 | MDT | 4/01 | |

mcwra3.apr - Chloride-L180-99 - 4/10/01



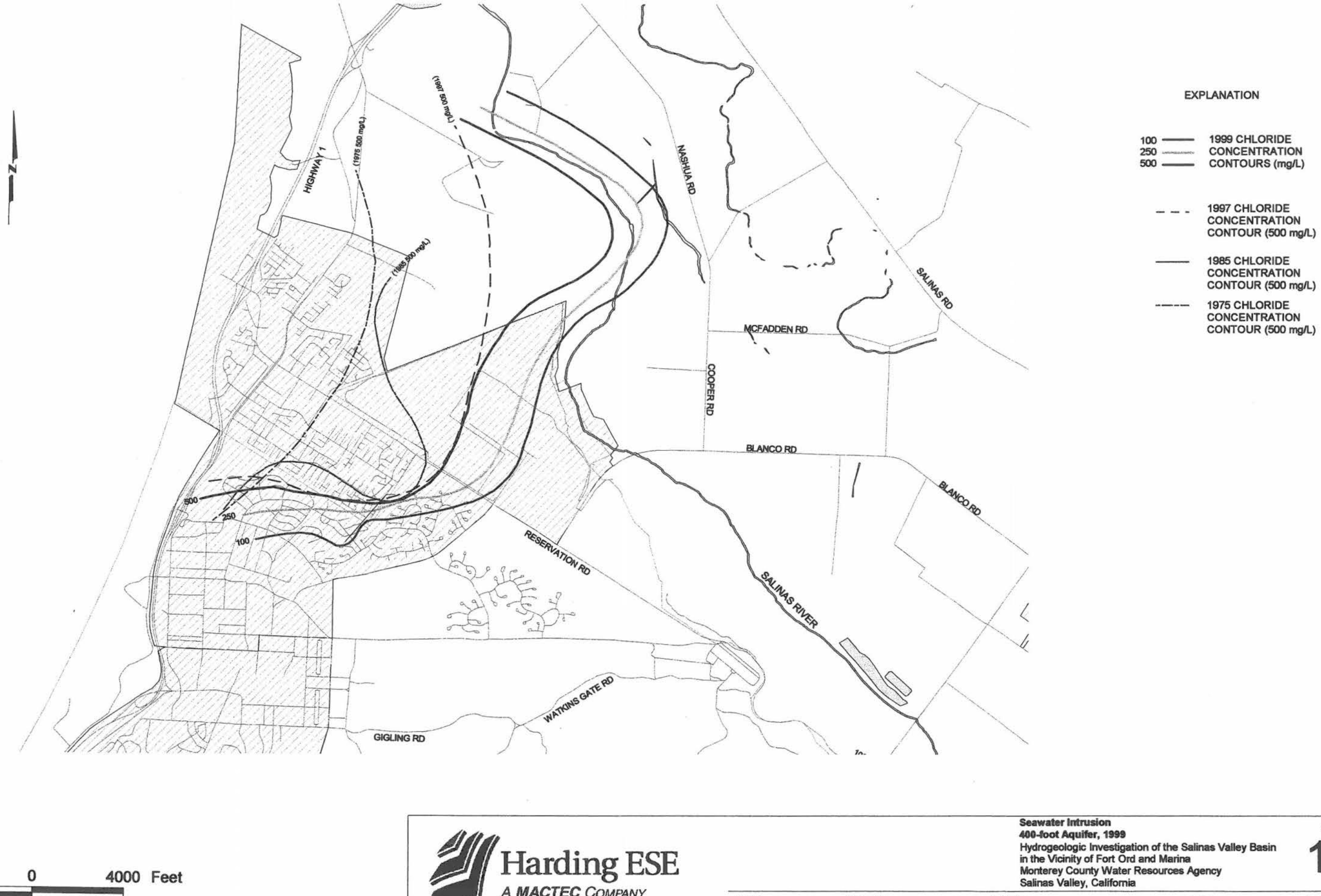

mcwra3.apr - Chloride-400-97 - 4/10/01

Harding ESE
A MACTEC COMPANY

**Seawater Intrusion**
**400-foot Aquifer, 1997**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Monterey County Water Resources Agency
Salinas Valley, California

PLATE 17

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| TJH | 51750 007 | MDT | 4/01 | |




mcwra3.apr - Chloride-400-99 - 4/10/01

Harding ESE
A MACTEC COMPANY

**Seawater Intrusion**
**400-foot Aquifer, 1999**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Monterey County Water Resources Agency
Salinas Valley, California

PLATE 18

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| TJH | 51750 007 | MDT | 4/01 | |

# APPENDIX A

# SUMMARY OF LITHOLOGY RECORDED ON CROSS-SECTION WELL LOGS

## Appendix A. Summary of Lithology Recorded on Cross-Section Well Logs
## Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
## Monterey County Water Resources Agency

| Cross-Section A-A' Well Names | Top (feet bgs) | Bottom (feet bgs) | Boring log record | GEOBASE Code |
|---|---|---|---|---|
| PZ-12-04-180 * | 0 | 137 | yellowish brown sand, fine to medium grain | sand |
| PZ-12-04-180 * | 137 | 147 | olive gray sandy silt | fine sand |
| PZ-12-04-180 * | 147 | 158 | dark brown sand, fine to medium grain | sand |
| PZ-12-04-180 * | 158 | 163 | reddish brown silty sand, fine to medium grain | fine sand |
| PZ-12-04-180 * | 163 | 293 | reddish brown sand | red sand |
| PZ-12-04-180 * | 293 | 297 | dark brown silty sand | fine sand |
| PZ-12-04-180 * | 297 | 300 | dark brown sand | sand |
| 14S/1E-25D | 0 | 8 | dirty sand | sand |
| 14S/1E-25D | 8 | 23 | sand, poorly graded | sand |
| 14S/1E-25D | 23 | 70 | sand, well graded | sand |
| 14S/1E-25D | 70 | 97 | gray medium sand | sand |
| 14S/1E-25D | 97 | 101 | gray fine sand | fine sand |
| 14S/1E-25D | 101 | 113 | coars sand | coarse sand |
| 14S/1E-25D | 113 | 125 | coarse sand and gravel | crs grvl/sd |
| 14S/1E-25D | 125 | 130 | fine dirty sand | fine sand |
| 14S/1E-25D | 130 | 139 | gray clay | clay |
| 14S/1E-25D | 139 | 148 | sand (some gravel) | gravel/sand |
| 14S/1E-25D | 148 | 158 | sand and gravel | gravel/sand |
| 14S/1E-25D | 158 | 159 | gray clay | clay |
| 14S/1E-25D | 159 | 166 | sand and gravel | gravel/sand |
| 14S/1E-25D | 166 | 167 | clay | clay |
| 14S/1E-25D | 167 | 170 | gravel | gravel |
| 14S/1E-25D | 170 | 171 | clay | clay |
| 14S/1E-25D | 171 | 180 | gravel and sand | gravel/sand |
| 14S/1E-25D | 180 | 188 | silty sand | sand |
| 14S/1E-25D | 188 | 192 | sandy mud | sandy clay |
| 14S/1E-25D | 192 | 197 | dirty sand and gravel | gravel/sand |
| 14S/1E-25D | 197 | 204 | gravel | gravel |
| 14S/1E-25D | 204 | 208 | sand | sand |
| 14S/1E-25D | 208 | 210 | gravel | gravel |
| 14S/1E-25D | 210 | 214 | sand | sand |
| 14S/1E-25D | 214 | 220 | gravel | gravel |
| 14S/1E-25D | 220 | 223 | muddy sand and gravel | gravel/sand |
| 14S/1E-25D | 223 | 224 | clay | clay |
| 14S/1E-25D | 224 | 232 | sand, well graded | sand |
| 14S/1E-25D | 232 | 237 | brown muddy sand | sand |
| 14S/1E-25D | 237 | 239 | brown clay | brown clay |
| 14S/1E-25D | 239 | 246 | dirty sand | sand |
| 14S/1E-25D | 246 | 254 | sand and gravel | gravel/sand |
| 14S/1E-25D | 254 | 257 | brown clay | brown clay |

| Cross-Section A-A' Well Names | Top (feet bgs) | Bottom (feet bgs) | Boring log record | GEOBASE Code |
|---|---|---|---|---|
| 14S/1E-25D | 257 | 262 | gray clay | clay |
| 14S/1E-25D | 262 | 271 | sandy clay | sandy clay |
| 14S/1E-25D | 271 | 300 | fine brown sand | fine sand |
| 14S/1E-24L05 | 0 | 90 | dune sand, coarse to very coarse with some finer sands | coarse sand |
| 14S/1E-24L05 | 90 | 170 | gravelly sand, C to VC sand and gravels | gravel/sand |
| 14S/1E-24L05 | 170 | 190 | clayey VF sand with silt | fine sand |
| 14S/1E-24L05 | 190 | 230 | gravelly sand, C to VC sand and gravels | crse grvl/sd |
| 14S/1E-24L05 | 230 | 270 | sandy clayey silt | sandy clay |
| 14S/1E-24L05 | 270 | 330 | gravelly sand, C to VC sand and gravels with some silt | crse grvl/sd |
| 14S/1E-24L05 | 330 | 380 | sandy clayey silt | sandy clay |
| 14S/1E-24L05 | 380 | 440 | sand, C to VC | coarse sand |
| 14S/1E-24L05 | 440 | 540 | sands, fine sand with silt and medium to VC sand | fine sand |
| 14S/1E-24L05 | 540 | 570 | clayey VF sand with silt | fine sand |
| 14S/1E-24L05 | 570 | 630 | partially cemented sands | sand |
| 14S/1E-24L05 | 630 | 660 | silt | clay |
| 14S/1E-24L05 | 660 | 680 | granulas of fine cemented sands | sand |
| 14S/1E-24L05 | 680 | 700 | gravelley VC sands | crse grvl/sd |
| 14S/1E-24L05 | 700 | 900 | silty clays and shales | clay |
| 14S/1E-24L05 | 900 | 970 | interbedded silts, clays, and fine sands | clay |
| 14S/1E-24L05 | 970 | 1040 | sitly clays with shell fragments | clay |
| 14S/1E-24L05 | 1040 | 1080 | sandy silt | sandy clay |
| 14S/1E-24L05 | 1080 | 1120 | shale with some clays and shell fragments | clay |
| 14S/1E-24L05 | 1120 | 1370 | interbedded silts, clays, and fine sands | clay |
| 14S/1E-24L05 | 1370 | 1700 | shales/clays | clay |
| 14S/1E-24L05 | 1700 | 1800 | bedded sands, VC to fine sands, some partially cemented | coarse sand |
| 14S/1E-24L05 | 1800 | 1820 | gravelly, silty, clay | gravelly clay |
| 14S/1E-24L05 | 1820 | 1880 | gravels and shell fragments | gravel |
| 14S/1E-24L05 | 1880 | 2000 | shale fragments | shale |
| 14S/1E-24L05 | 2000 | 2012 | very fine sands | fine sand |
| 14S/1E-13J02 | 0 | 8 | fill | sediment |
| 14S/1E-13J02 | 8 | 20 | sand | sand |
| 14S/1E-13J02 | 20 | 28 | sandy yellow clay | yellow clay |
| 14S/1E-13J02 | 28 | 48 | fine red sand | red sand |
| 14S/1E-13J02 | 48 | 71 | colored sand | sand |
| 14S/1E-13J02 | 71 | 93 | red sand, colored sand, coarse | red sand |
| 14S/1E-13J02 | 93 | 116 | white and colored sand | white sand |
| 14S/1E-13J02 | 116 | 138 | wite sand, streaks of yellow and blue sandy clay | white sand |
| 14S/1E-13J02 | 138 | 161 | white and colored coarse sand, blue sandy clay | coarse sand |
| 14S/1E-13J02 | 161 | 206 | yellow sandy clay, colored sand, coarse | sandy clay |
| 14S/1E-13J02 | 206 | 228 | red and brown crumbly sand, colored sand, coarse | red sand |

| Cross-Section A-A' Well Names | Top (feet bgs) | Bottom (feet bgs) | Boring log record | GEOBASE Code |
|---|---|---|---|---|
| 14S/1E-13J02 | 228 | 251 | red and brown crumbly sand, light blue clay, white sand | red sand |
| 14S/1E-13J02 | 251 | 318 | coarse white sand, thin streaks of white sandy clay | white sand |
| 14S/1E-13J02 | 318 | 341 | coarse colored sand, gravel, brown and gray sandy clay | coarse sand |
| 14S/1E-13J02 | 341 | 363 | hard gray and blue gray clay, sandy | blue clay |
| 14S/1E-13J02 | 363 | 386 | hard gray and blue clay, shale streaks | blue clay |
| 14S/1E-13J02 | 386 | 408 | gray shaley clay, streaks of sand | clay |
| 14S/1E-13J02 | 408 | 431 | colored sand, gravel, hard shell | gravel/sand |
| 14S/1E-13J02 | 431 | 476 | colored sand, gravel, streaks of gray sandy clay | gravel/sand |
| 14S/1E-13J02 | 476 | 521 | blue and gray shaley clay, streaks of sand | blue clay |
| 14S/1E-13J02 | 521 | 566 | gray and yellow sandy clay, sand, blue shaley clay | yellow clay |
| 14S/1E-13J02 | 566 | 588 | yellow sandy clay colored sand | yellow clay |
| 14S/1E-13J02 | 588 | 611 | coarse colored sand, brown shaley clay | coarse sand |
| 14S/2E-18E01 | 0 | 75 | fine sand | fine sand |
| 14S/2E-18E01 | 75 | 100 | coarse gravel | gravel |
| 14S/2E-18E01 | 100 | 125 | gravel-streaks clay | gravel |
| 14S/2E-18E01 | 125 | 150 | clay rock | clay |
| 14S/2E-18E01 | 150 | 175 | coarse gravel | gravel |
| 14S/2E-18E01 | 175 | 200 | coarse gravel | gravel |
| 14S/2E-18E01 | 200 | 225 | fine sand streak clay | fine sand |
| 14S/2E-18E01 | 225 | 250 | fine sand streak clay | fine sand |
| 14S/2E-18E01 | 250 | 275 | gravel | gravel |
| 14S/2E-18E01 | 275 | 300 | fine sand streak clay | fine sand |
| 14S/2E-18E01 | 300 | 325 | white sand | white sand |
| 14S/2E-18E01 | 325 | 350 | sand clay streaks | sand |
| 14S/2E-18E01 | 350 | 375 | sand | sand |
| 14S/2E-18E01 | 375 | 400 | fine sand | fine sand |
| 14S/2E-18E01 | 400 | 425 | sand gravel | gravel/sand |
| 14S/2E-18E01 | 425 | 450 | sand gravel | gravel/sand |
| 14S/2E-18E01 | 450 | 475 | sand streaks clay | sand |
| 14S/2E-18E01 | 475 | 500 | coarse gravel-clay | gravelly clay |
| 14S/2E-18E01 | 500 | 525 | sand clay | sandy clay |
| 14S/2E-18E01 | 525 | 550 | sand clay | sandy clay |
| 14S/2E-18E01 | 550 | 575 | sandy clay | sandy clay |
| 14S/2E-18E01 | 575 | 600 | fine sand clay | sandy clay |
| 14S/2E-18E01 | 600 | 625 | sand | sand |
| 14S/2E-18E01 | 625 | 650 | red clay gravel | gravelly clay |
| 14S/2E-18E01 | 650 | 675 | yellow clay | yellow clay |
| 14S/2E-18E01 | 675 | 700 | yellow clay | yellow clay |
| 14S/2E-18E01 | 700 | 725 | fine gravel | gravel |
| 14S/2E-18E01 | 725 | 750 | coarse gravel | gravel |

| Cross-Section A-A' Well Names | Top (feet bgs) | Bottom (feet bgs) | Boring log record | GEOBASE Code |
|---|---|---|---|---|
| 14S/2E-18E01 | 750 | 775 | coarse gravel | gravel |
| 14S/2E-18E01 | 775 | 800 | fine gravel | gravel |
| 14S/2E-18E01 | 800 | 825 | coarse gravel | gravel |
| 14S/2E-18E01 | 825 | 850 | coarse gravel | gravel |
| 14S/2E-18E01 | 850 | 875 | yellow clay | yellow clay |
| 14S/2E-18E01 | 875 | 890 | yellow clay | yellow clay |
| 14S/2E-18E01 | 890 | 913 | yellow clay | yellow clay |
| 14S/2E-07F02 | 0 | 2 | surface soil | topsoil |
| 14S/2E-07F02 | 2 | 8 | yellow clay | yellow clay |
| 14S/2E-07F02 | 8 | 40 | sandy blue clay | blue clay |
| 14S/2E-07F02 | 40 | 60 | sandy yellow clay and sand | yellow clay |
| 14S/2E-07F02 | 60 | 82 | yellow coarse sand | coarse sand |
| 14S/2E-07F02 | 82 | 103 | yellow coarse sand and streaks of yellow clay | coarse sand |
| 14S/2E-07F02 | 103 | 124 | yellow coarse sand and streaks of yellow clay | coarse sand |
| 14S/2E-07F02 | 124 | 145 | yellow coarse sand | coarse sand |
| 14S/2E-07F02 | 145 | 166 | coarse gravel and sand | gravel/sand |
| 14S/2E-07F02 | 166 | 188 | coarse gravel and sand | gravel/sand |
| 14S/2E-07F02 | 188 | 209 | coarse gravel and sand and streaks of yellow clay | gravel/sand |
| 14S/2E-07F02 | 209 | 231 | hard packed fine red sand | red sand |
| 14S/2E-07F02 | 231 | 253 | coarse gravel and and and streaks of yellow clay | gravel/sand |
| 14S/2E-07F02 | 253 | 274 | coarse gravel and and and streaks of yellow clay | gravel/sand |
| 14S/2E-07F02 | 274 | 295 | coarse gravel and sand and tough blue clay | gravel/sand |
| 14S/2E-07F02 | 295 | 315 | yellow clay and coarse gravel and sand | snd/grvl/cly |
| 14S/2E-07F02 | 315 | 336 | yellow clay and fine clay and coarse gravel and sand | snd/grvl/cly |
| 14S/2E-07F02 | 336 | 357 | coarse gravel and sand | gravel/sand |
| 14S/2E-07F02 | 357 | 380 | coarse gravel and sand and streaks of blue shale | gravel/sand |
| 14S/2E-07F02 | 380 | 403 | coarse gravel and sand and streaks of blue shale | gravel/sand |
| 14S/2E-07F02 | 403 | 425 | coarse gravel and sand | gravel/sand |
| 14S/2E-07F02 | 425 | 446 | coarse gravel and sand | gravel/sand |
| 14S/2E-07F02 | 446 | 467 | coarse gravel and sand | gravel/sand |
| 14S/2E-07F02 | 467 | 488 | coarse gravel and sand and streaks of blue clay | snd/grvl/cly |
| 14S/2E-07F02 | 488 | 511 | coarse gravel and sand and streaks of yellow clay | snd/grvl/cly |
| 14S/2E-07F02 | 511 | 531 | coarse gravel and sand and streaks of yellow clay | snd/grvl/cly |
| 14S/2E-07F02 | 531 | 552 | coarse gravel and sand and streaks of yellow clay | snd/grvl/cly |
| 14S/2E-07F02 | 552 | 574 | coarse gravel and sand and streaks of yellow clay | snd/grvl/cly |
| 14S/2E-07F02 | 574 | 595 | coarse gravel and sand and streaks of yellow clay | snd/grvl/cly |
| 14S/2E-07F02 | 595 | 612 | coarse gravel and sand and streaks of yellow clay | snd/grvl/cly |
| 14S/2E-07L04 | 0 | 8 | loose top soil and sand | topsoil |
| 14S/2E-07L04 | 8 | 15 | clay | clay |
| 14S/2E-07L04 | 15 | 44 | sand | sand |

| Cross-Section A-A' Well Names | Top (feet bgs) | Bottom (feet bgs) | Boring log record | GEOBASE Code |
|---|---|---|---|---|
| 14S/2E-07L04 | 44 | 46 | clay | clay |
| 14S/2E-07L04 | 46 | 93 | sand | sand |
| 14S/2E-07L04 | 93 | 100 | clay | clay |
| 14S/2E-07L04 | 100 | 112 | sandy clay | sandy clay |
| 14S/2E-07L04 | 112 | 120 | sand | sand |
| 14S/2E-07L04 | 120 | 235 | clay and sandy clay | clay |
| 14S/2E-07L04 | 235 | 251 | sand | sand |
| 14S/2E-07L04 | 251 | 264 | sand and clay | sandy clay |
| 14S/2E-07L04 | 264 | 280 | brown clay | brown clay |
| 14S/2E-07L04 | 280 | 318 | gravel | gravel |
| 14S/2E-07L04 | 318 | 322 | brown clay | brown clay |
| 14S/2E-07L04 | 322 | 340 | gravel | gravel |
| 14S/2E-07L04 | 340 | 343 | brown clay | brown clay |
| 14S/2E-07L04 | 343 | 356 | sand and gravel | gravel/sand |
| 14S/2E-07L04 | 356 | 358 | brown clay | brown clay |
| 14S/2E-07L04 | 358 | 378 | gravel | gravel |
| 14S/2E-07L04 | 378 | 400 | sand and gravel | gravel/sand |
| 14S/2E-07L04 | 400 | 402 | brown clay | brown clay |
| 14S/2E-07L04 | 402 | 409 | gravel | gravel |
| 14S/2E-07L04 | 409 | 414 | sandy clay | sandy clay |
| 14S/2E-07L04 | 414 | 422 | gravel | gravel |
| 14S/2E-07L04 | 422 | 423 | brown clay | brown clay |
| 14S/2E-07L04 | 423 | 432 | sand | sand |
| 14S/2E-07L04 | 432 | 434 | brown clay | brown clay |
| 14S/2E-07L04 | 434 | 446 | gravel | gravel |
| 14S/2E-07L04 | 446 | 448 | brown clay | brown clay |
| 14S/2E-07L04 | 448 | 520 | clay and sandy clay | clay |
| 14S/2E-07L04 | 520 | 558 | gravel | gravel |
| 14S/2E-07L04 | 558 | 564 | brown clay | brown clay |
| 14S/2E-07L04 | 564 | 568 | sand | sand |
| 14S/2E-07L04 | 568 | 570 | brown clay | sand |
| 14S/2E-07L04 | 570 | 624 | sand and gravel | gravel/sand |
| 14S/2E-07L04 | 624 | 645 | brown clay | brown clay |
| 14S/2E-07L05 | 0 | 25 | clay | clay |
| 14S/2E-07L05 | 25 | 38 | sand | sand |
| 14S/2E-07L05 | 38 | 70 | sandy clay | sandy clay |
| 14S/2E-07L05 | 70 | 85 | clay | clay |
| 14S/2E-07L05 | 85 | 105 | sand | sand |
| 14S/2E-07L05 | 105 | 210 | clay w/some sand | sandy clay |
| 14S/2E-07L05 | 210 | 235 | gravel | gravel |

| Cross-Section A-A' Well Names | Top (feet bgs) | Bottom (feet bgs) | Boring log record | GEOBASE Code |
|---|---|---|---|---|
| 14S/2E-07L05 | 235 | 245 | clay | clay |
| 14S/2E-07L05 | 245 | 270 | gravel | gravel |
| 14S/2E-07L05 | 270 | 320 | clay-sandy | sandy clay |
| 14S/2E-07L05 | 320 | 370 | gravel | gravel |
| 14S/2E-07L05 | 370 | 385 | clay | clay |
| 14S/2E-07L05 | 385 | 440 | gravel | gravel |
| 14S/2E-07L05 | 440 | 460 | sand | sand |
| 14S/2E-07L05 | 460 | 510 | clay-sandy | sandy clay |
| 14S/2E-07L05 | 510 | 545 | gravel | gravel |
| 14S/2E-07L05 | 545 | 548 | clay | clay |
| 14S/2E-07L05 | 548 | 585 | gravel | gravel |
| 14S/2E-07L05 | 585 | 598 | clay-sandy | sandy clay |
| 14S/2E-07L05 | 598 | 615 | gravel | gravel |
| 14S/2E-07L05 | 615 | 632 | clay-sandy | sandy clay |
| 14S/2E-06L01 | 0 | 6 | top soil | topsoil |
| 14S/2E-06L01 | 6 | 15 | blue sandy clay | blue clay |
| 14S/2E-06L01 | 15 | 32 | fine blue sand | blue sand |
| 14S/2E-06L01 | 32 | 60 | blue clay w/sea shell | blue clay |
| 14S/2E-06L01 | 60 | 75 | blue soft sand | blue sand |
| 14S/2E-06L01 | 75 | 100 | blue clay | blue clay |
| 14S/2E-06L01 | 100 | 184 | blue clay and sand streak | blue clay |
| 14S/2E-06L01 | 184 | 278 | coarse sand and gravel | gravel/sand |
| 14S/2E-06L01 | 278 | 300 | yellow clay | yellow clay |
| 14S/2E-06L01 | 300 | 330 | blue clay | blue clay |
| 14S/2E-06L01 | 330 | 360 | coarse yellow sand, streak of clay | coarse sand |
| 14S/2E-06L01 | 360 | 434 | yellow clay, streaks blue and brown shale | yellow clay |
| 14S/2E-06L01 | 434 | 440 | yellow clay, streaks blue and brown shale | yellow clay |
| 14S/2E-06L01 | 440 | 490 | white coarse sand | white sand |
| 14S/2E-06L01 | 490 | 528 | blue clay | blue clay |
| 14S/2E-06L01 | 528 | 590 | sand and gravel, streak clay | snd/grvl/cly |
| 14S/2E-06L01 | 590 | 610 | yellow clay | yellow clay |
| 14S/2E-06L01 | 610 | 621 | sand and gravel | gravel/sand |
| 14S/2E-06L01 | 621 | 715 | yellow clay w/streak of sand | sandy clay |
| 14S/2E-06L01 | 715 | 747 | yellow clay w/streak of gravel | sandy clay |
| 14S/2E-06L01 | 747 | 778 | yellow clay w/streak of gravel | sandy clay |
| 14S/2E-06L01 | 778 | 795 | yellow clay w/streak of gravel blue clay | sandy clay |
| 14S/2E-06L01 | 795 | 840 | yellow clay w/streak of gravel blue clay | sandy clay |
| 14S/2E-06L01 | 840 | 872 | blue clay | blue clay |
| 14S/2E-06L01 | 872 | 903 | blue clay | blue clay |
| 14S/2E-06L01 | 903 | 934 | brown clay | brown clay |

| Cross-Section A-A' Well Names | Top (feet bgs) | Bottom (feet bgs) | Boring log record | GEOBASE Code |
|---|---|---|---|---|
| 14S/2E-06L01 | 934 | 965 | hard brown clay and shale | brown clay |
| 14S/2E-06L01 | 965 | 997 | hard brown clay and shale | brown clay |
| 14S/2E-06L01 | 997 | 1028 | hard brown clay and shale | brown clay |
| 14S/2E-06L01 | 1028 | 1059 | blue clay | blue clay |
| 14S/2E-06L01 | 1059 | 1090 | blue and brown clay | blue clay |
| 14S/2E-06L01 | 1090 | 1122 | blue and brown shaley clay | blue clay |
| 14S/2E-06L01 | 1122 | 1153 | blue and brown shaley clay | blue clay |
| 14S/2E-06L01 | 1153 | 1184 | blue shaley clay with streak hard sandstone | blue clay |
| 14S/2E-06L01 | 1184 | 1247 | blue shale streak sand | blue clay |
| 14S/2E-06L01 | 1247 | 1300 | blue clay, streak sand | blue clay |
| 14S/2E-06L01 | 1300 | 1340 | blue clay, streak sand | blue clay |
| 14S/2E-06L01 | 1340 | 1372 | blue clay and shale | blue clay |
| 14S/2E-06L01 | 1372 | 1403 | blue clay, streak gravel and sand | snd/grvl/cly |
| 14S/2E-06L01 | 1403 | 1435 | streak gravel and sand | gravel/sand |
| 14S/2E-06L01 | 1435 | 1466 | streak gravel and sand | gravel/sand |
| 14S/2E-06L01 | 1466 | 1498 | streak gravel and sand | gravel/sand |
| 14S/2E-06L01 | 1498 | 1529 | streak gravel and sand | gravel/sand |
| 14S/2E-06L01 | 1529 | 1561 | streak gravel and sand | gravel/sand |
| 14S/2E-06L01 | 1561 | 1592 | streak gravel and sand | gravel/sand |
| 14S/2E-06L01 | 1592 | 1600 | streak gravel and sand | gravel/sand |
| 14S/2E-06L01 | 1600 | 1630 | blue clay | blue clay |
| 14S/2E-06L01 | 1630 | 1645 | blue clay and sand | blue clay |
| 14S/2E-06L01 | 1645 | 1660 | brown clay and blue clay | blue clay |
| 14S/2E-06L01 | 1660 | 1675 | shale, blue clay | blue clay |
| 14S/2E-06L01 | 1675 | 1690 | shale, blue clay | blue clay |
| 14S/2E-06L01 | 1690 | 1705 | brown clay, blue clay | blue clay |
| 14S/2E-06L01 | 1705 | 1720 | brown clay, sand streak | sandy clay |
| 14S/2E-06L01 | 1720 | 1735 | blue clay | blue clay |
| 14S/2E-06L01 | 1735 | 1750 | blue clay | blue clay |
| 14S/2E-06L01 | 1750 | 1809 | blue shale | shale |

**Notes:**

* a partial boring log description is provided for this well

| Cross-Section B-B' Well Names | Top (feet bgs) | Bottom (feet bgs) | Boring log record | GEOBASE Code |
|---|---|---|---|---|
| 15S/1E-07B * | 0 | 238 | sand, med to drk reddish brown, very fine to fine | fine sand |
| 15S/1E-07B * | 238 | 258 | clay , med steel gray, minor silt content | clay |
| 15S/1E-07B * | 258 | 330 | sand and clay, very fine to med, blue to light brown clay | sand |
| 15S/1E-07B * | 330 | 360 | sand, light med brwn, fine to coarse | coarse sand |
| 15S/1E-07B * | 360 | 420 | clay, med brwn, very silty and snady | brown clay |
| 15S/1E-07B * | 420 | 530 | silt, med brn, clayey and sandy | brown clay |
| 15S/1E-07B * | 530 | 565 | clay, med brn, silty and sandy | brown clay |
| 15S/1E-07B * | 565 | 575 | clay, med brn, vry sandy, abund. chert frags | clay |
| 15S/1E-07B * | 575 | 645 | clay, med brn, silty, minor chert | brown clay |
| 15S/1E-07B * | 645 | 700 | clay, as above but med gry and brwn | brown clay |
| 15S/1E-07B * | 700 | 710 | clay, med gry-brn | brown clay |
| 15S/1E-07B * | 710 | 735 | sand med gry-brn, fine to coarse, granitic and chert comp. | sand |
| 15S/1E-07B * | 735 | 750 | clay: med brn and steel blue-gray, minor chert frags | blue clay |
| 15S/1E-07B * | 750 | 830 | clay and claystone, med tan, silty to sandy, and steel blue gray | blue clay |
| 15S/1E-07B * | 830 | 845 | sand, very clayey, med to coarse | coarse sand |
| 15S/1E-07B * | 845 | 960 | clay and sand blue gray, abund. shell frags 850-950 | blue clay |
| 15S/1E-07B * | 960 | 995 | clay drk steel-gray | clay |
| 15S/1E-07B * | 995 | 1020 | clay (drk gray) and sand, med, minor greenish quartz grains | sandy clay |
| 15S/1E-07B * | 1020 | 1095 | clay, drk gray, mod occurrence of shell frags | clay |
| 15S/1E-07B * | 1095 | 1130 | sand, whitish-green, fine to med | white sand |
| 15S/1E-07B * | 1130 | 1175 | clay, blue-gray | blue clay |
| MW-OU2-10-400 * | 0 | 11 | dark yellowish brown silty sand, fine to med | fine sand |
| MW-OU2-10-400 * | 11 | 16 | very dark grayish brown silty sand, fine to med | fine sand |
| MW-OU2-10-400 * | 16 | 67 | yellowish brown silty sand, fine to med | fine sand |
| MW-OU2-10-400 * | 67 | 69 | dark yellowish brown silty sand, fine to med | fine sand |
| MW-OU2-10-400 * | 69 | 98 | yellowish brown silty sand, fine to med | fine sand |
| MW-OU2-10-400 * | 98 | 170 | brown silty sand fine to med | fine sand |
| MW-OU2-10-400 * | 170 | 173 | olive-gray clay | clay |
| MW-OU2-10-400 * | 173 | 196 | dark greenish gray clay | clay |
| MW-OU2-10-400 * | 196 | 198 | olive-gray clayey sand, fine | fine sand |
| MW-OU2-10-400 * | 198 | 201 | grayish brown sand, fine to med | fine sand |
| MW-OU2-10-400 * | 201 | 202 | olive sandy clay | sandy clay |
| MW-OU2-10-400 * | 202 | 204 | dark yellowish brown sand, fine to med | fine sand |
| MW-OU2-10-400 * | 204 | 205 | dark greenish gray clay | clay |
| MW-OU2-10-400 * | 205 | 206 | reddish brown silty clay | red clay |
| MW-OU2-10-400 * | 206 | 209 | dark greenish clay, shell fragments | clay |
| MW-OU2-10-400 * | 209 | 220 | dark gray clay, shells | clay |
| MW-OU2-10-400 * | 220 | 227 | dark greenish gray silty clay | clay |
| MW-OU2-10-400 * | 227 | 229 | olive-gray clay | clay |
| MW-OU2-10-400 * | 229 | 235 | olive sand, fine to med | sand |
| MW-OU2-10-400 * | 240 | 244 | olive sand, fine to coarse | sand |
| MW-OU2-10-400 * | 244 | 259 | light olive-brown sand, fine to very coarse | yellow sand |
| MW-OU2-10-400 * | 259 | 261 | olive clayey sand, very fine | fine sand |
| MW-OU2-10-400 * | 261 | 266 | yellowish brown and light gray sand, fine to coarse | yellow sand |
| MW-OU2-10-400 * | 266 | 270 | olive clayey sand, very fine | sand |
| MW-OU2-10-400 * | 270 | 278 | light olive-brown sand, very fine | fine sand |
| MW-OU2-10-400 * | 278 | 279 | yellowish brown to light gray gravelly sand, fine to very coarse | gravelly sand |
| MW-OU2-10-400 * | 279 | 293 | light gray and dark yellowish brown sand, fine to coarse | coarse sand |

| Cross-Section B-B' Well Names | Top (feet bgs) | Bottom (feet bgs) | Boring log record | GEOBASE Code |
|---|---|---|---|---|
| MW-OU2-10-400 * | 293 | 303 | light brownish gray and yellowish brown sandy gravel, coarse to very coars | crse grvl/sd |
| MW-OU2-10-400 * | 303 | 319 | brown and light gray sandy gravel, coarse to very coarse | crse grvl/sd |
| MW-OU2-10-400 * | 319 | 331 | brown and light gray sandy gravel, med to coarse | crse grvl/sd |
| MW-OU2-10-400 * | 331 | 341 | grayish brown gravelly sand, fine to very coarse | crse grvl/sd |
| MW-OU2-10-400 * | 341 | 395 | dark yellowish brown sand, fine to very fine | yellow sand |
| MW-OU2-10-400 * | 395 | 425 | dark brown and dark reddish brown sand, very fine | red sand |
| MW-OU2-10-400 * | 425 | 451 | brown/dary brown sand, fine to very fine | fine sand |
| MW-OU2-10-400 * | 451 | 472 | yellowish brown sand, fine to med | yellow sand |
| MW-OU2-10-400 * | 472 | 490 | olive-brown sand, fine to very fine | fine sand |
| MW-OU2-10-400 * | 490 | 493 | light olive-brown clayey sand, fine to me | fine sand |
| MW-OU2-10-400 * | 493 | 498 | light olive-brown sandy clay | sandy clay |
| MW-OU2-10-400 * | 498 | 503 | light-olive brown clay | clay |
| MW-OU2-10-400 * | 503 | 508 | light olive-brown clay | clay |
| MW-OU2-10-400 * | 508 | 536 | reddish brown sand | red sand |
| MW-OU2-10-400 * | 536 | 565 | dark yellowish brown sand, fine to very fine | fine sand |
| MW-OU2-10-400 * | 565 | 570 | olive clay | clay |
| MW-OU2-10-400 * | 570 | 572 | olive-gray silty clay | clay |
| MW-OU2-10-400 * | 572 | 573 | grayish green sandy clay | sandy clay |
| MW-OU2-07-400 * | 0 | 1 | brown sand, fine to coarse | fine sand |
| MW-OU2-07-400 * | 1 | 127 | yellowish brown silty sand, fine to med | yellow sand |
| MW-OU2-07-400 * | 127 | 142 | dark yellowish brown silty sand, fine to very fine | yellow sand |
| MW-OU2-07-400 * | 142 | 179 | olive-gray clay | clay |
| MW-OU2-07-400 * | 179 | 200 | dark bluish gray clay, shells | blue clay |
| MW-OU2-07-400 * | 200 | 203 | olive clayey sand, fine to med | fine sand |
| MW-OU2-07-400 * | 203 | 215 | brown sand, fine to coarse | fine sand |
| MW-OU2-07-400 * | 215 | 232 | light gray gravelly sand, fine to very coarse | crse grvl/sd |
| MW-OU2-07-400 * | 232 | 235 | olive sandy clay | sandy clay |
| MW-OU2-07-400 * | 235 | 251 | olive sand, fine | sand |
| MW-OU2-07-400 * | 251 | 271 | light gray and yellowish brown gravelly sand, med to very coarse | crse grvl/sd |
| MW-OU2-07-400 * | 271 | 278 | light olive-brown clayey sand, fine to coarse | fine sand |
| MW-OU2-07-400 * | 278 | 288 | light gray and yellowish brown gravelly sand, fine to coarse | gravel/sand |
| MW-OU2-07-400 * | 288 | 314 | yellowish brown and light gray sandy gravel, coarse to very coarse | crse grvl/sd |
| MW-OU2-07-400 * | 314 | 316 | light olive-gray clay | clay |
| MW-OU2-07-400 * | 316 | 326 | dark brown and light gray sandy gravel, med to very coarse | crse grvl/sd |
| MW-OU2-07-400 * | 326 | 328 | pale olive and light yellowish brown clay | clay |
| MW-OU2-07-400 * | 328 | 331 | yellowish brown and light gray sandy gravel, very coarse | crse grvl/sd |
| MW-OU2-07-400 * | 331 | 336 | brown silty clay | brown clay |
| MW-OU2-07-400 * | 336 | 339 | brown and light gray sandy gravel, med to very coarse | crse grvl/sd |
| MW-OU2-07-400 * | 339 | 355 | light brownish gray and yellowish brown gravelly sand, med to very coarse | crse grvl/sd |
| MW-OU2-07-400 * | 355 | 356 | light olive-brown sandy clay | sandy clay |
| MW-OU2-07-400 * | 356 | 357 | light olive-brown clay | clay |
| MW-OU2-07-400 * | 357 | 358 | brown/dark brown sand, fine | fine sand |
| MW-OU2-07-400 * | 358 | 360 | light olive-brown clayey sand, fine to coarse | fine sand |
| MW-OU2-07-400 * | 360 | 365 | yellowish brown gravelly sand, fine to very coarse | crse grvl/sd |
| MW-OU2-07-400 * | 365 | 535 | dark brown sand, very fine to fine | fine sand |
| MW-OU2-07-400 * | 535 | 536 | pale brown sandy clay | sandy clay |
| MW-OU2-07-400 * | 536 | 580 | dark brown sand, very fine to fine | fine sand |

| Cross-Section B-B' Well Names | Top (feet bgs) | Bottom (feet bgs) | Boring log record | GEOBASE Code |
|---|---|---|---|---|
| MW-OU2-07-400 * | 580 | 587 | olive-gray clay | clay |
| MW-OU2-07-400 * | 587 | 588 | olive-brown clayey sand | sand |
| 14S/2E-31H01 | 0 | 73 | sand | sand |
| 14S/2E-31H01 | 73 | 93 | sand with cemented lenses | sand |
| 14S/2E-31H01 | 93 | 113 | sand | sand |
| 14S/2E-31H01 | 113 | 133 | sand with brown clay | sandy clay |
| 14S/2E-31H01 | 133 | 153 | fine sand | fine sand |
| 14S/2E-31H01 | 153 | 213 | blue clay | blue clay |
| 14S/2E-31H01 | 213 | 223 | coarse sand | coarse sand |
| 14S/2E-31H01 | 223 | 253 | coarse sand with gravel | gravel/sand |
| 14S/2E-31H01 | 253 | 263 | coarse sand | coarse sand |
| 14S/2E-31H01 | 263 | 273 | fine sand | fine sand |
| 14S/2E-31H01 | 273 | 283 | boulders and sand | sand |
| 14S/2E-31H01 | 283 | 315 | sand and gravel | gravel/sand |
| 14S/2E-31H01 | 315 | 325 | boulders | crse grvl/sd |
| 14S/2E-31H01 | 325 | 374 | cement, coarse sand/gravel | crse grvl/sd |
| 14S/2E-31H01 | 374 | 380 | blue and brown clay | blue clay |
| 14S/2E-31H01 | 380 | 395 | tan clay and sand | sandy clay |
| 14S/2E-31H01 | 395 | 475 | fine sand and silt | sand |
| 14S/2E-31H01 | 475 | 515 | sandy brown clay and silty sand, sea shells | sandy clay |
| 14S/2E-31H01 | 515 | 525 | red sandy clay, brown clay, sand lenses | red clay |
| 14S/2E-31H01 | 525 | 535 | fine silty sand | fine sand |
| 14S/2E-31H01 | 535 | 545 | hard red sandstone, sand, gravel | gravel/sand |
| 14S/2E-31H01 | 545 | 575 | red and gray clay | red clay |
| 14S/2E-31H01 | 575 | 595 | brown sandstone | sandstone |
| 14S/2E-31H01 | 595 | 731 | tan silty clay | clay |
| 14S/2E-31H01 | 731 | 815 | tran clay | clay |
| 14S/2E-31H01 | 815 | 865 | tan sandy clay | sandy clay |
| 14S/2E-31H01 | 865 | 885 | gray clay | clay |
| 14S/2E-31H01 | 885 | 905 | gray clay, gravel streaks | gravelly clay |
| 14S/2E-31H01 | 905 | 925 | tan sandy clay | sandy clay |
| 14S/2E-31H01 | 925 | 950 | cemented gravel, shale and sandy clay streaks | snd/grvl/cly |
| 14S/2E-31H01 | 950 | 965 | brown sandy clay | sandy clay |
| 14S/2E-31H01 | 965 | 975 | coarse sand, tan sand, clay | coarse sand |
| 14S/2E-31H01 | 975 | 985 | cemented gravel, sand, sandy clay | gravel/sand |
| 14S/2E-31H01 | 985 | 1005 | gray clay, sand lenses, shells | clay |
| 14S/2E-31H01 | 1005 | 1025 | gray sandy clay, cem gravel, shells | sandy clay |
| 14S/2E-31H01 | 1025 | 1035 | blue clay, wood at 1033 | blue clay |
| 14S/2E-31H01 | 1035 | 1055 | blue sandstone | sandstone |
| 14S/2E-31H01 | 1055 | 1075 | blue clay | blue clay |
| 14S/2E-31H01 | 1075 | 1085 | tan clay | clay |
| 14S/2E-31H01 | 1085 | 1108 | blue shale, sandstone streaks | shale |
| 14S/2E-31H01 | 1108 | 1137 | black sandy clay, black sandstone shells | sandy clay |
| 14S/2E-31H01 | 1137 | 1155 | black sandy clay | sandy clay |
| 14S/2E-31H01 | 1155 | 1173 | cemented sand, gravel, shells | gravel/sand |
| 14S/2E-31H01 | 1173 | 1180 | black sandy clay | sandy clay |
| 14S/2E-31H01 | 1180 | 1185 | cemented sand, gravel, shells | gravel/sand |

| Cross-Section B-B' Well Names | Top (feet bgs) | Bottom (feet bgs) | Boring log record | GEOBASE Code |
|---|---|---|---|---|
| 14S/2E-31H01 | 1185 | 1212 | dark gray sandy clay | sandy clay |
| 14S/2E-31H01 | 1212 | 1215 | cemented sand, gravel | gravel/sand |
| 14S/2E-31H01 | 1215 | 1225 | sticky blue clay | blue clay |
| 14S/2E-31H01 | 1225 | 1235 | blue sandstone | sandstone |
| 14S/2E-31H01 | 1235 | 1245 | sticky blue clay, sandy lenses | blue clay |
| 14S/2E-31H01 | 1245 | 1255 | sandy black clay with shale | sandy clay |
| 14S/2E-31H01 | 1255 | 1265 | blue clay, fine gravel @ 1260 | gravelly clay |
| 14S/2E-31H01 | 1265 | 1275 | blue sandstone, clay lenses | sandstone |
| 14S/2E-31H01 | 1275 | 1285 | blue sandstone | sandstone |
| 14S/2E-31H01 | 1285 | 1305 | black sandstone an shale | sandstone |
| 14S/2E-31H01 | 1305 | 1317 | sandy black clay | sandy clay |
| 14S/2E-31H01 | 1317 | 1320 | black stone | sandstone |
| 14S/2E-31H01 | 1320 | 1328 | clay and sandstone streaks | sandy clay |
| 14S/2E-31H01 | 1328 | 1343 | sandy black clay | sandy clay |
| 14S/2E-31H01 | 1343 | 1365 | sandstone | sandstone |
| 14S/2E-31H01 | 1365 | 1370 | gray sandy clay | sandy clay |
| 14S/2E-31H01 | 1370 | 1375 | sandstone | sandstone |
| 14S/2E-31H01 | 1375 | 1395 | gray silty clay | clay |
| 14S/2E-31H01 | 1395 | 1398 | sandstone | sandstone |
| 14S/2E-31H01 | 1398 | 1408 | gray silty clay | clay |
| 14S/2E-31H01 | 1408 | 1410 | black sandstone | sandstone |
| 14S/2E-31H01 | 1410 | 1415 | silty blue blay | blue clay |
| 14S/2E-31H01 | 1415 | 1418 | black sandstone | sandstone |
| 14S/2E-31H01 | 1418 | 1435 | silty blue clay | blue clay |
| 14S/2E-31H01 | 1435 | 1437 | gray clay with gravel | gravelly clay |
| 14S/2E-31H01 | 1437 | 1445 | coarse sand, gravel | gravel/sand |
| 14S/2E-31H01 | 1445 | 1455 | blue clay | blue clay |
| 14S/2E-31H01 | 1455 | 1475 | blue clay, sandstone streaks | blue clay |
| 14S/2E-31H01 | 1475 | 1485 | blue shale | shale |
| 14S/2E-31H01 | 1485 | 1505 | cemented gravel | gravel |
| 14S/2E-31H01 | 1505 | 1511 | brown and gray clay | brown clay |
| 14S/2E-31H01 | 1511 | 1523 | white sandy clay | white clay |
| 14S/2E-31H01 | 1523 | 1535 | shale | shale |
| 14S/2E-31H01 | 1535 | 1540 | green clay, shale | clay |
| 14S/2E-31H01 | 1540 | 1544 | fine to coarse sand | sand |
| 14S/2E-31H01 | 1544 | 1546 | green clay, shale | clay |
| 14S/2E-31H01 | 1546 | 1550 | green clay, white sandy clay, blue shale | clay |
| 14S/2E-31H01 | 1550 | 1557 | black sandstone | sandstone |
| 14S/2E-31H01 | 1557 | 1560 | green sandy clay, white sandstone, black shale | sandy clay |
| 14S/2E-31H01 | 1560 | 1569 | blue sandstone, white sandstone | sandstone |
| 14S/2E-32D04 | 0 | 50 | sand, fine gravel | gravel/sand |
| 14S/2E-32D04 | 50 | 60 | gravel | gravel |
| 14S/2E-32D04 | 60 | 80 | caly | clay |
| 14S/2E-32D04 | 80 | 90 | sand and wood | sand |
| 14S/2E-32D04 | 90 | 110 | sticky sand | sand |
| 14S/2E-32D04 | 110 | 120 | sand and wood | sand |
| 14S/2E-32D04 | 120 | 140 | sand | sand |

| Cross-Section B-B' Well Names | Top (feet bgs) | Bottom (feet bgs) | Boring log record | GEOBASE Code |
|---|---|---|---|---|
| 14S/2E-32D04 | 140 | 170 | clay | clay |
| 14S/2E-32D04 | 170 | 190 | fine gravel, little clay | gravelly clay |
| 14S/2E-32D04 | 190 | 200 | gravel | gravel |
| 14S/2E-32D04 | 200 | 210 | clay | clay |
| 14S/2E-32D04 | 210 | 220 | gravel, pieces of clay | gravelly clay |
| 14S/2E-32D04 | 220 | 230 | gravel and clay | gravelly clay |
| 14S/2E-32D04 | 230 | 260 | clay | clay |
| 14S/2E-32D04 | 260 | 270 | gravel | gravel |
| 14S/2E-32D04 | 270 | 290 | gravel, small amt clay | gravelly clay |
| 14S/2E-32D04 | 290 | 310 | fine gravels | gravel |
| 14S/2E-32D04 | 310 | 330 | gravel, clay and sand | snd/grvl/cly |
| 14S/2E-32D04 | 330 | 340 | rock and clay | gravelly clay |
| 14S/2E-32D04 | 340 | 360 | sand and rock | gravel/sand |
| 14S/2E-32D04 | 360 | 370 | clay | clay |
| 14S/2E-32D04 | 370 | 380 | gravel, little clay | gravelly clay |
| 14S/2E-32D04 | 380 | 390 | clay, gravel mixed | gravelly clay |
| 14S/2E-32D04 | 390 | 400 | clay and gravel | gravelly clay |
| 14S/2E-32D04 | 400 | 440 | gravel | gravel |
| 14S/2E-32D04 | 440 | 490 | clay | clay |
| 14S/2E-32D04 | 490 | 500 | gravel and some clay | gravelly clay |
| 14S/2E-32D04 | 500 | 510 | clay | clay |
| 14S/2E-32D04 | 510 | 540 | clay and sand | sandy clay |
| 14S/2E-32D04 | 540 | 550 | sand | sand |
| 14S/2E-32D04 | 550 | 580 | clay | clay |
| 14S/2E-32D04 | 580 | 590 | sandy red clay | red clay |
| 14S/2E-32D04 | 590 | 650 | sandy clay | sandy clay |
| 14S/2E-32D04 | 650 | 660 | gravel and small rock | crse gravel |
| 14S/2E-32D04 | 660 | 670 | clay, small amt gravel | gravelly clay |
| 14S/2E-32D04 | 670 | 790 | clay | clay |
| 14S/2E-32D04 | 790 | 810 | sand and rocks | gravel/sand |
| 14S/2E-32D04 | 810 | 820 | clay and rock | gravelly clay |
| 14S/2E-32D04 | 820 | 830 | gravel, little clay | gravelly clay |
| 14S/2E-32D04 | 830 | 960 | clay | clay |
| 14S/2E-32D04 | 960 | 970 | sand clay and rock | snd/grvl/cly |
| 14S/2E-32D04 | 970 | 990 | sand and rock | gravel/sand |
| 14S/2E-32D04 | 990 | 1000 | small amt clay, gravel and rocks | snd/grvl/cly |
| 14S/2E-32D04 | 1000 | 1010 | gravel, small rocks | gravel/sand |
| 14S/2E-32D04 | 1010 | 1040 | silty clay | clay |
| 14S/2E-32D04 | 1040 | 1050 | silty clay, trace of gravel | clay |
| 14S/2E-32D04 | 1050 | 1060 | silty clay, gravel | gravelly clay |
| 14S/2E-32D04 | 1060 | 1090 | clay | clay |
| 14S/2E-32D04 | 1090 | 1094 | granite, decomposed | granite |
| 14S/2E-32D04 | 1094 | 1100 | granite, sea shells | granite |
| 14S/2E-32D04 | 1100 | 1160 | clay | clay |
| 14S/2E-32D04 | 1160 | 1170 | clay, small amt gravel | gravelly clay |
| 14S/2E-32D04 | 1170 | 1180 | clay | clay |
| 14S/2E-32D04 | 1180 | 1190 | clay, small amt gravel | gravelly clay |

| Cross-Section B-B' Well Names | Top (feet bgs) | Bottom (feet bgs) | Boring log record | GEOBASE Code |
|---|---|---|---|---|
| 14S/2E-32D04 | 1190 | 1220 | clay | clay |
| 14S/2E-32D04 | 1220 | 1230 | sand and clay | sandy clay |
| 14S/2E-32D04 | 1230 | 1240 | rock and clay | gravelly clay |
| 14S/2E-32D04 | 1240 | 1310 | clay | clay |
| 14S/2E-32D04 | 1310 | 1330 | hard brittle clay | clay |
| 14S/2E-32D04 | 1330 | 1350 | chunks of hard clay | clay |
| 14S/2E-32D04 | 1350 | 1390 | clay | clay |
| 14S/2E-32D04 | 1390 | 1480 | soft lay | clay |
| 14S/2E-32D04 | 1480 | 1500 | clay, sand and rock | snd/grvl/cly |
| 14S/2E-32D04 | 1500 | 1510 | clay and snd | sandy clay |
| 14S/2E-32D04 | 1510 | 1530 | clay | clay |
| 14S/2E-32D04 | 1530 | 1539 | clay and sand | sandy clay |
| 14S/2E-32D04 | 1539 | 1570 | sand and clay | sandy clay |
| 14S/2E-32D04 | 1570 | 1580 | greensoft clay, sandy | clay |
| 14S/2E-32D04 | 1580 | 1590 | white sandy clay, little clumps | white clay |
| 14S/2E-32D04 | 1590 | 1600 | clay, soft | clay |
| 14S/2E-32D04 | 1600 | 1620 | clay, some sand, and gravel | snd/grvl/cly |
| 14S/2E-32D04 | 1620 | 1650 | rock, sand and clay | snd/grvl/cly |
| 14S/2E-32D04 | 1650 | 1670 | gravel 85%, white clay:15% | gravelly clay |
| 14S/2E-32D04 | 1670 | 1680 | white clay, sand and small gravel | snd/grvl/cly |
| 14S/2E-32D04 | 1680 | 1700 | hard conglomerates | gravel |
| Airfield | 0 | 2 | sand | sand |
| Airfield | 2 | 6 | black silt | clay |
| Airfield | 6 | 62 | yellow sand | yellow sand |
| Airfield | 62 | 104 | sandy clay | sandy clay |
| Airfield | 104 | 117 | gray clay | clay |
| Airfield | 117 | 132 | blue clay | blue clay |
| Airfield | 132 | 148 | white medium sand | white sand |
| Airfield | 148 | 151 | brown clay | brown clay |
| Airfield | 151 | 156 | medium gray sand | sand |
| Airfield | 156 | 167 | blue clay | blue clay |
| Airfield | 167 | 191 | sand | sand |
| Airfield | 191 | 196 | sand and pebbles | sand |
| Airfield | 196 | 197 | gray clay | clay |
| Airfield | 197 | 215 | sand and small gravel | gravel/sand |
| Airfield | 215 | 226 | dry sand and clay | sandy clay |
| Airfield | 226 | 228 | gray clay | clay |
| Airfield | 228 | 244 | yellow sandy clay | yellow clay |
| Airfield | 244 | 270 | yellow dirty cand | yellow sand |
| Airfield | 270 | 298 | brown clay | brown clay |
| Airfield | 298 | 311 | muddy sand | sand |
| Airfield | 311 | 318 | sandy clay | sandy clay |
| Airfield | 318 | 347 | sand and gravel, well graded | gravel/sand |
| Airfield | 347 | 358 | light brown clay | brown clay |
| Airfield | 358 | 379 | sand and gravel | gravel/sand |
| Airfield | 379 | 383 | clay | clay |
| Airfield | 383 | 386 | sand and gravel | gravel/sand |

| Cross-Section B-B' Well Names | Top (feet bgs) | Bottom (feet bgs) | Boring log record | GEOBASE Code |
|---|---|---|---|---|
| Airfield | 386 | 389 | yellow clay | yellow clay |
| Airfield | 389 | 395 | sand and gravel | gravel/sand |
| Airfield | 395 | 402 | yellow clay | yellow clay |
| 14S/2E-21N01 | 0 | 124 | yellow sand (dry) | yellow sand |
| 14S/2E-21N01 | 124 | 142 | sandy clay | sandy clay |
| 14S/2E-21N01 | 142 | 162 | yellow clay | yellow clay |
| 14S/2E-21N01 | 162 | 170 | sandy clay | sandy clay |
| 14S/2E-21N01 | 170 | 182 | sand | sand |
| 14S/2E-21N01 | 182 | 190 | blue clay | blue clay |
| 14S/2E-21N01 | 190 | 214 | sand and gravel, fine | gravel/sand |
| 14S/2E-21N01 | 214 | 242 | fine sand | fine sand |
| 14S/2E-21N01 | 242 | 256 | yellow | yellow clay |
| 14S/2E-21N01 | 256 | 262 | sand fine | fine sand |
| 14S/2E-21N01 | 262 | 290 | sand and gravel (2-3" rocks) | gravel/sand |
| 14S/2E-21N01 | 290 | 294 | sandstone, red sand | red sand |
| 14S/2E-21N01 | 294 | 308 | yellow clay | yellow clay |
| 14S/2E-21N01 | 308 | 352 | sand and gravel | gravel/sand |
| 14S/2E-21N01 | 352 | 374 | hard blue clay | blue clay |
| 14S/2E-21N01 | 374 | 398 | sand and gravel (1-4" rocks) | gravel/sand |
| 14S/2E-21N01 | 398 | 408 | sand and small gravel | gravel/sand |
| 14S/2E-21N01 | 408 | 412 | gravelly yellow clay | gravelly clay |
| 14S/2E-21N01 | 412 | 430 | sand and small gravel | gravel/sand |
| 14S/2E-21N01 | 430 | 438 | yellow clay | yellow clay |
| 14S/2E-21N01 | 438 | 498 | sand and gravel (pea to 1") clay at top-streaks | snd/grvl/cly |
| 14S/2E-21N01 | 498 | 510 | yellow brown clay | yellow clay |
| 14S/2E-21N01 | 510 | 534 | sand and gravel (1-3" rocks) | gravel/sand |
| 14S/2E-21N01 | 534 | 564 | sand | sand |
| 14S/2E-21N01 | 564 | 580 | sand and gravel (1-4" rocks) | gravel/sand |
| 14S/2E-21N01 | 580 | 596 | red sand | red sand |
| 14S/2E-21N01 | 596 | 600 | red sandstone | red sand |
| 14S/2E-21E01 | 0 | 128 | yellow dry sand | yellow sand |
| 14S/2E-21E01 | 128 | 130 | yellow clay w/streaks of red | yellow clay |
| 14S/2E-21E01 | 130 | 144 | blue clay - hard | blue clay |
| 14S/2E-21E01 | 144 | 156 | hard yellow clay | yellow clay |
| 14S/2E-21E01 | 156 | 180 | fine yellow clay | yellow sand |
| 14S/2E-21E01 | 180 | 188 | blue clay | blue clay |
| 14S/2E-21E01 | 188 | 196 | blue sand | blue sand |
| 14S/2E-21E01 | 196 | 218 | coarse sand w/some gravel | gravel/sand |
| 14S/2E-21E01 | 218 | 242 | brown sand - fine/some gravel | gravel/sand |
| 14S/2E-21E01 | 242 | 272 | hard yellow clay w/some sand | sandy clay |
| 14S/2E-21E01 | 272 | 280 | sand w/some rock | gravel/sand |
| 14S/2E-21E01 | 280 | 396 | sand/gravel rock (3-6") | gravel/sand |
| 14S/2E-21E01 | 396 | 408 | yellow clay | yellow clay |
| 14S/2E-21E01 | 408 | 428 | sand and some gravel | gravel/sand |
| 14S/2E-21E01 | 428 | 442 | sand and heavy gravel/rock (1-3") | gravel/sand |
| 14S/2E-21E01 | 442 | 450 | sand and heavy gravel/clay streaks | snd/grvl/cly |
| 14S/2E-21E01 | 450 | 456 | sand and gravel (1-3") | gravel/sand |

| Cross-Section B-B' Well Names | Top (feet bgs) | Bottom (feet bgs) | Boring log record | GEOBASE Code |
|---|---|---|---|---|
| 14S/2E-21E01 | 456 | 460 | yellow clay | yellow clay |
| 14S/2E-21E01 | 460 | 466 | sand | sand |
| 14S/2E-21E01 | 466 | 470 | yellow clay | yellow clay |
| 14S/2E-21E01 | 470 | 484 | fine sand and some gravel | gravel/sand |
| 14S/2E-21E01 | 484 | 492 | coarse sand and heavy gravel | gravel/sand |
| 14S/2E-21E01 | 492 | 508 | coarse sand and some gravel | gravel/sand |
| 14S/2E-21E01 | 508 | 514 | hard yellow clay | yellow clay |
| 14S/2E-21E01 | 514 | 518 | white sandstone w/yellow clay | sandy clay |
| 14S/2E-21E01 | 518 | 532 | fine sand | fine sand |
| 14S/2E-21E01 | 532 | 542 | coarse sand and gravel/rocks (1-4") | gravel/sand |
| 14S/2E-21E01 | 542 | 550 | sandy clay | sandy clay |
| 14S/2E-21E01 | 550 | 562 | sand and gravel w/clay streaks | gravel/sand |
| 14S/2E-21E01 | 562 | 576 | sand and heavy gravel | gravel/sand |
| 14S/2E-21E01 | 576 | 592 | fine sand | fine sand |
| 14S/2E-21E01 | 592 | 612 | sand and gravel (1-5" rock) | gravel/sand |
| 14S/2E-21E01 | 612 | 614 | red sandstone | red sand |
| 14S/2E-21F02 | 0 | 8 | top soil | topsoil |
| 14S/2E-21F02 | 8 | 65 | sediment | sediment |
| 14S/2E-21F02 | 65 | 90 | blue sandy clay | blue clay |
| 14S/2E-21F02 | 90 | 116 | yellow clay | yellow clay |
| 14S/2E-21F02 | 116 | 130 | mucky sand | sand |
| 14S/2E-21F02 | 130 | 134 | sandy yellow clay | yellow clay |
| 14S/2E-21F02 | 134 | 140 | river gravel | gravel |
| 14S/2E-21F02 | 140 | 166 | yellow clay | yellow clay |
| 14S/2E-21F02 | 166 | 186 | sand and gravel | gravel/sand |
| 14S/2E-21F02 | 186 | 194 | sand and fine gravel | gravel/sand |
| 14S/2E-21F02 | 194 | 263 | heavy gravel | gravel |
| 14S/2E-21F02 | 263 | 277 | red sand | red sand |
| 14S/2E-21F02 | 277 | 280 | yellow clay | yellow clay |
| 14S/2E-21F02 | 280 | 297 | gravel and yellow clay | gravelly clay |
| 14S/2E-21F02 | 297 | 300 | yellow clay | yellow clay |
| 14S/2E-16G01 | 0 | 100 | clay | clay |
| 14S/2E-16G01 | 100 | 170 | coarse sand | coarse sand |
| 14S/2E-16G01 | 170 | 220 | gravel | gravel |
| 14S/2E-16G01 | 220 | 230 | gravel/brown clay | gravelly clay |
| 14S/2E-16G01 | 230 | 240 | gravel/clay | gravelly clay |
| 14S/2E-16G01 | 240 | 260 | coarse sand/clay | sandy clay |
| 14S/2E-16G01 | 260 | 360 | clay/sand | sandy clay |
| 14S/2E-16G01 | 360 | 370 | sand/clay | sandy clay |
| 14S/2E-16G01 | 370 | 420 | coarse sand | coarse sand |
| 14S/2E-16G01 | 420 | 440 | clay/sand | sandy clay |
| 14S/2E-16G01 | 440 | 470 | coarse sand | coarse sand |
| 14S/2E-16G01 | 470 | 490 | sand/clay | sandy clay |
| 14S/2E-16G01 | 490 | 520 | sand/clay | sandy clay |
| 14S/2E-16G01 | 520 | 540 | clay | clay |
| 14S/2E-16G01 | 540 | 570 | sand | sand |
| 14S/2E-16G01 | 570 | 610 | coarse sand | coarse sand |

| Cross-Section B-B' Well Names | Top (feet bgs) | Bottom (feet bgs) | Boring log record | GEOBASE Code |
|---|---|---|---|---|
| 14S/2E-16G01 | 610 | 630 | sand/clay | sandy clay |
| 14S/2E-09D04 | 0 | 150 | brown clay | brown clay |
| 14S/2E-09D04 | 150 | 180 | coarse sand | coarse sand |
| 14S/2E-09D04 | 180 | 220 | coarse sand/gravel | gravel/sand |
| 14S/2E-09D04 | 220 | 230 | clay/gravel | gravelly clay |
| 14S/2E-09D04 | 230 | 260 | silt stone/clay | clay |
| 14S/2E-09D04 | 260 | 270 | clay | clay |
| 14S/2E-09D04 | 270 | 280 | coarse sand/clay | sandy clay |
| 14S/2E-09D04 | 280 | 330 | clay | clay |
| 14S/2E-09D04 | 330 | 420 | sand/clay | sandy clay |
| 14S/2E-09D04 | 420 | 430 | coarse sand/clay | sandy clay |
| 14S/2E-09D04 | 430 | 440 | coarse sand | coarse sand |
| 14S/2E-09D04 | 440 | 460 | coarse sand/clay | sandy clay |
| 14S/2E-09D04 | 460 | 490 | coars sand | coarse sand |
| 14S/2E-09D04 | 490 | 500 | coarse sand/clay | sandy clay |
| 14S/2E-09D04 | 500 | 540 | sand/clay | sandy clay |
| 14S/2E-09D04 | 540 | 550 | hard clay | clay |
| 14S/2E-09D04 | 550 | 570 | hard clay/sand | sandy clay |
| 14S/2E-09D04 | 570 | 580 | coarse sand | coarse sand |
| 14S/2E-09D04 | 580 | 610 | coarse sand/clay | sandy clay |
| 14S/2E-09D04 | 610 | 630 | clay/sand | sandy clay |

**Notes:**

* a partial boring log description is provided for this well

## Appendix A. Summary of Lithology Recorded on Cross-Section Well Logs
## Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
## Monterey County Water Resources Agency

| Cross-Section C-C' Well Names | Top (feet bgs) | Bottom (feet bgs) | Boring log record | GEOBASE Code |
|---|---|---|---|---|
| 15S/2E-09E * | 0 | 0.5 | soil, sandy silt | topsoil |
| 15S/2E-09E * | 0.5 | 1 | sandy silt hardpan | sand |
| 15S/2E-09E * | 1 | 9.5 | sand, fine, brown, well sorted | fine sand |
| 15S/2E-09E * | 9.5 | 12.5 | sand, fine, white | fine sand |
| 15S/2E-09E * | 12.5 | 33 | sand, fine to med, brown | sand |
| 15S/2E-09E * | 33 | 41 | sandy silt, very fine, brown | fine sand |
| 15S/2E-09E * | 41 | 60 | sand, fine to med, slightly cemented | fine sand |
| 15S/2E-09E * | 60 | 70 | silty sand, light brown | sand |
| 15S/2E-09E * | 70 | 87 | sand, fine to med, brown, cemented, bit chatter | sand |
| 15S/2E-09E * | 87 | 170 | sand, fine to med, light brown | sand |
| 15S/2E-09E * | 170 | 235 | sand, fine to med, gray brown | sand |
| 15S/2E-09E * | 235 | 250 | sand, med to coarse, gray brown | sand |
| 15S/2E-09E * | 250 | 269 | sand and gravel, coarse sand, gravel < 1/2" | gravel/sand |
| 15S/2E-09E * | 269 | 330 | silty sand, very fine sand, brown | fine sand |
| 15S/2E-09E * | 330 | 336 | sandy silt, yellow brown | sand |
| 15S/2E-09E * | 336 | 350 | sand, fine to very fine, yellow brown | fine sand |
| 15S/2E-09E * | 350 | 357 | sand, fine to very fine, brown, slightly silty | fine sand |
| 15S/2E-09E * | 357 | 385 | silty sand, very fine sand, brown | fine sand |
| 15S/2E-09E * | 385 | 388 | sandy silt, very fine sand, brown | fine sand |
| 15S/2E-09E * | 388 | 417 | sity sand, very fine sand, brown | fine sand |
| 15S/2E-09E * | 417 | 430 | sity clay, brownish white | clay |
| 15S/2E-09E * | 430 | 436 | sity clay, streaks lean white clay | clay |
| 15S/2E-09E * | 436 | 452 | sity clay, light brown, firm | brown clay |
| 15S/2E-09E * | 452 | 465 | sand and gravel, cemented, white and tan, silty | gravel/sand |
| 15S/2E-09E * | 465 | 473 | sand and gravel, cemented, streaks brown clay | gravel/sand |
| 15S/2E-09E * | 473 | 494 | sandy, clayey silt, brown | sand |
| 15S/2E-09E * | 494 | 500 | clayey silt, brown | brown clay |
| 15S/2E-04C | 0 | 124 | fine to med sand | sand |
| 15S/2E-04C | 124 | 200 | medium sand | sand |
| 15S/2E-04C | 200 | 240 | tight sand - medium | sand |
| 15S/2E-04C | 240 | 255 | sandy clay | sandy clay |
| 15S/2E-04C | 255 | 280 | med to fine sand | fine sand |
| 15S/2E-04C | 280 | 317 | sandy clay | sandy clay |
| 15S/2E-04C | 317 | 383 | rock, cobbles, very hard, tight sand | gravel/sand |
| 15S/2E-04C | 383 | 425 | sand and clay streaks | sandy clay |
| 15S/2E-04C | 425 | 484 | sandy clay | sandy clay |

| Cross-Section C-C' Well Names | Top (feet bgs) | Bottom (feet bgs) | Boring log record | GEOBASE Code |
|---|---|---|---|---|
| 15S/2E-04C | 484 | 528 | fine sand with some clay | fine sand |
| 15S/2E-04C | 528 | 570 | clay with sand stringers | sandy clay |
| 14S/2E-33Q01 | 0 | 5 | top soil | topsoil |
| 14S/2E-33Q01 | 5 | 98 | med sand | sand |
| 14S/2E-33Q01 | 98 | 142 | sandy clay | sandy clay |
| 14S/2E-33Q01 | 142 | 258 | brown med sand | sand |
| 14S/2E-33Q01 | 258 | 280 | clay | clay |
| 14S/2E-33Q01 | 280 | 293 | brown sand | sand |
| 14S/2E-33Q01 | 293 | 316 | brown clay | brown clay |
| 14S/2E-33Q01 | 316 | 390 | rocks, cobbles, hard cemented sand | gravel/sand |
| 14S/2E-33Q01 | 390 | 444 | clay with sand stringers | sandy clay |
| 14S/2E-33Q01 | 444 | 485 | sand with clay stringers | sandy clay |
| 14S/2E-33Q01 | 485 | 522 | silty clay | clay |
| 14S/2E-33Q01 | 522 | 540 | sand | sand |
| 14S/2E-33Q01 | 540 | 570 | clay with sand stringers | clay |
| 14S/2E-33P01 | 0 | 118 | dry sand | sand |
| 14S/2E-33P01 | 118 | 120 | sandy brown clay | sandy clay |
| 14S/2E-33P01 | 120 | 152 | brown clay | brown clay |
| 14S/2E-33P01 | 152 | 172 | sand w/layers of clay | sandy clay |
| 14S/2E-33P01 | 172 | 270 | sand | sand |
| 14S/2E-33P01 | 270 | 272 | red sandstone | red sand |
| 14S/2E-33P01 | 272 | 296 | red sand w/sandstone streaks | red sand |
| 14S/2E-33P01 | 296 | 310 | brown clay | brown clay |
| 14S/2E-33P01 | 310 | 322 | mucky sand | sand |
| 14S/2E-33P01 | 322 | 344 | sandy brown clay | sandy clay |
| 14S/2E-33P01 | 344 | 354 | brown, clay w/rocks | gravelly clay |
| 14S/2E-33P01 | 354 | 384 | sand and gravel (1-4" rock) | gravel/sand |
| 14S/2E-33P01 | 384 | 390 | white clay | white clay |
| 14S/2E-33P01 | 390 | 396 | blue clay | blue clay |
| 14S/2E-33P01 | 396 | 402 | sand w/pea gravel | gravel/sand |
| 14S/2E-33P01 | 402 | 462 | sand and gravel (1-10" rock) | gravel/sand |
| 14S/2E-33P01 | 462 | 472 | yellow clay | gravel/sand |
| 14S/2E-33P01 | 472 | 480 | sand and gravel (pea - 4") | yellow clay |
| 14S/2E-33P01 | 480 | 488 | brown clay | gravel/sand |
| 14S/2E-33P01 | 488 | 498 | sand | sand |
| 14S/2E-33P01 | 498 | 504 | yellow clay | yellow clay |

| Cross-Section C-C' Well Names | Top (feet bgs) | Bottom (feet bgs) | Boring log record | GEOBASE Code |
|---|---|---|---|---|
| 14S/2E-33P01 | 504 | 506 | sand | sand |
| 14S/2E-33P01 | 506 | 518 | sand and gravel (1-4" rock) | gravel/sand |
| 14S/2E-33P01 | 518 | 522 | brown sandstone | sandstone |
| 14S/2E-33P01 | 522 | 578 | fine brown gravelly sand | gravel/sand |
| 14S/2E-33P01 | 578 | 532 | yellow gravelly clay | gravelly clay |
| 14S/2E-33P01 | 532 | 542 | fine brown sand | fine sand |
| 14S/2E-33P01 | 542 | 552 | brown sclay | brown clay |
| 14S/2E-33P01 | 552 | 554 | hard brown clay | brown clay |
| 14S/2E-27N50 | 0 | 16 | top soil | topsoil |
| 14S/2E-27N50 | 16 | 30 | sandy clay | sandy clay |
| 14S/2E-27N50 | 30 | 112 | blue clay | blue clay |
| 14S/2E-27N50 | 112 | 146 | sandy blue clay | blue clay |
| 14S/2E-27N50 | 146 | 186 | sand and gravel (3-4" rocks) | gravel/sand |
| 14S/2E-27N50 | 186 | 204 | fine sand | fine sand |
| 14S/2E-27N50 | 204 | 206 | sand and gravel | gravel/sand |
| 14S/2E-27N50 | 206 | 208 | white clay | white clay |
| 14S/2E-27N50 | 208 | 216 | sandy clay | sandy clay |
| 14S/2E-27N50 | 216 | 258 | sand and rocks (3-6" rocks) | gravel/sand |
| 14S/2E-27N50 | 258 | 270 | yellow clay | yellow clay |
| 14S/2E-27N50 | 270 | 272 | sand and gravel (pea) | gravel/sand |
| 14S/2E-27N50 | 272 | 274 | yellow clay | yellow clay |
| 14S/2E-27N50 | 274 | 302 | sand and gravel (4-8") sand at bottom | gravel/sand |
| 14S/2E-27N50 | 302 | 328 | yellow clay | yellow clay |
| 14S/2E-27N50 | 328 | 334 | sand and gravel (2-6" rocks) | gravel/sand |
| 14S/2E-27N50 | 334 | 354 | yellow clay | yellow clay |
| 14S/2E-27N50 | 354 | 364 | sand | sand |
| 14S/2E-27N50 | 364 | 374 | sandy yellow clay | yellow clay |
| 14S/2E-27N50 | 374 | 382 | sand and gravel (pea to 1") | gravel/sand |
| 14S/2E-27N50 | 382 | 386 | sand and gravel w/clay | snd/grvl/cly |
| 14S/2E-27N50 | 386 | 396 | sand gravel (2-4") | gravel/sand |
| 14S/2E-27N50 | 396 | 410 | yellow clay | yellow clay |
| 14S/2E-27N50 | 410 | 440 | sand | sand |
| 14S/2E-27N50 | 440 | 456 | yellow clay | yellow clay |
| 14S/2E-27N50 | 456 | 472 | sand and gravel (1-2") | gravel/sand |
| 14S/2E-27N50 | 472 | 482 | ywllow clay | yellow clay |
| 14S/2E-27N50 | 482 | 488 | rocks (1-3") | gravel |

| Cross-Section C-C' Well Names | Top (feet bgs) | Bottom (feet bgs) | Boring log record | GEOBASE Code |
|---|---|---|---|---|
| 14S/2E-27N50 | 488 | 492 | red sandstone/white clay | red sand |
| 14S/2E-27N50 | 492 | 508 | sand | sand |
| 14S/2E-27N50 | 508 | 520 | red sand | red sand |
| 14S/2E-27N50 | 520 | 524 | white sandstone | white sand |
| 14S/2E-27N50 | 524 | 564 | sand | sand |
| 14S/2E-27N50 | 564 | 588 | sand and gravel (1-2") | gravel/sand |
| 14S/2E-27N50 | 588 | 618 | sand | sand |
| 14S/2E-27N50 | 618 | 624 | sand and gravel (1-3") | gravel/sand |
| 14S/2E-27N50 | 624 | 634 | sand, yellow clay | yellow clay |
| 14S/2E-28J50 | 0 | 8 | soil | topsoil |
| 14S/2E-28J50 | 8 | 26 | sandy brown clay | sandy clay |
| 14S/2E-28J50 | 26 | 141 | blue clay | blue clay |
| 14S/2E-28J50 | 141 | 150 | sand and gravel rocks to 2" | gravel/sand |
| 14S/2E-28J50 | 150 | 182 | sand and gravel rocks to 5" | gravel/sand |
| 14S/2E-28J50 | 182 | 205 | blue clay | blue clay |
| 14S/2E-28J50 | 205 | 238 | sand | sand |
| 14S/2E-28J50 | 238 | 264 | yellow clay | yellow clay |
| 14S/2E-28J50 | 264 | 285 | cemented gravel | gravel |
| 14S/2E-28J50 | 285 | 293 | sand and gravel rocks to 2" | gravel/sand |
| 14S/2E-28J50 | 293 | 300 | sand | sand |
| 14S/2E-28J50 | 300 | 340 | yellow clay | yellow clay |
| 14S/2E-28J50 | 340 | 370 | blue clay | blue clay |
| 14S/2E-28J50 | 370 | 380 | yellow clay with sand and fine gravel | snd/grvl/cly |
| 14S/2E-28J50 | 380 | 412 | yellow clay | yellow clay |
| 14S/2E-28J50 | 412 | 420 | yellow clay, small amount of gravel | gravelly clay |
| 14S/2E-28J50 | 420 | 436 | yellow clay | yellow clay |
| 14S/2E-28J50 | 436 | 444 | yellow clay, small amount of water | yellow clay |
| 14S/2E-28J50 | 444 | 450 | yellow clay | yellow clay |
| 14S/2E-28J50 | 450 | 482 | brown lumpy sand and clay | sandy clay |
| 14S/2E-28J50 | 482 | 486 | rocks | gravel |
| 14S/2E-28J50 | 486 | 492 | brown sand | sand |
| 14S/2E-28J50 | 492 | 510 | hard brown clay | brown clay |
| 14S/2E-28H03 | 0 | 14 | top soil | topsoil |
| 14S/2E-28H03 | 14 | 36 | sandy clay | sandy clay |
| 14S/2E-28H03 | 36 | 44 | brown clay | brown clay |
| 14S/2E-28H03 | 44 | 48 | sandy blue clay | blue clay |

| Cross-Section C-C' Well Names | Top (feet bgs) | Bottom (feet bgs) | Boring log record | GEOBASE Code |
|---|---|---|---|---|
| 14S/2E-28H03 | 48 | 84 | blue clay | blue clay |
| 14S/2E-28H03 | 84 | 132 | sandy blue clay | blue clay |
| 14S/2E-28H03 | 132 | 154 | fine blue sand and gravel | gravel/sand |
| 14S/2E-28H03 | 154 | 230 | gravel 1-3" | gravel |
| 14S/2E-28H03 | 230 | 262 | sand and some gravel | gravel/sand |
| 14S/2E-28H03 | 262 | 276 | hard yellow sandy clay | sandy clay |
| 14S/2E-28H03 | 276 | 312 | gravel 1-4" | gravel |
| 14S/2E-28H03 | 312 | 322 | brown sandstone | sandstone |
| 14S/2E-28H03 | 322 | 340 | sand and gravel (1-2") | gravel/sand |
| 14S/2E-28H03 | 340 | 344 | yellow clay | yellow clay |
| 14S/2E-28H03 | 344 | 354 | sand and some gravel | gravel/sand |
| 14S/2E-28H03 | 354 | 362 | yellow clay | yellow clay |
| 14S/2E-28H03 | 362 | 386 | gravel 1-5" | gravel |
| 14S/2E-28H03 | 386 | 396 | sand and gravel w/streaks of clay | snd/grvl/cly |
| 14S/2E-28H03 | 396 | 408 | brown clay | brown clay |
| 14S/2E-28H03 | 408 | 422 | sand coarse | coarse sand |
| 14S/2E-28H03 | 422 | 426 | yellow clay | yellow clay |
| 14S/2E-28H03 | 426 | 438 | sand and gravel w/streaks of clay | snd/grvl/cly |
| 14S/2E-28H03 | 438 | 446 | brown clay | brown clay |
| 14S/2E-28H03 | 446 | 472 | blue clay | blue clay |
| 14S/2E-28H03 | 472 | 498 | sand and gravel tight | gravel/sand |
| 14S/2E-28H03 | 498 | 518 | red sand | red sand |
| 14S/2E-28H03 | 518 | 522 | red sandstone | red sand |
| 14S/2E-28H03 | 522 | 530 | mushy brown clay | brown clay |
| 14S/2E-28H03 | 530 | 542 | brown clay | brown clay |
| 14S/2E-28H03 | 542 | 548 | sand and gravel (1-2") w/clay | snd/grvl/cly |
| 14S/2E-28H03 | 548 | 556 | brown clay | brown clay |
| 14S/2E-28H03 | 556 | 582 | sand | sand |
| 14S/2E-28H03 | 582 | 600 | sand and gravel w/streaks of clay | snd/grvl/cly |
| 14S/2E-28H03 | 600 | 606 | yellow clay | yellow clay |
| 14S/2E-28H03 | 606 | 620 | sandy gravel w/streaks of clay | snd/grvl/cly |
| 14S/2E-28H03 | 620 | 636 | sand and gravel (1-3") | gravel/sand |
| 14S/2E-28H03 | 636 | 654 | yellow clay | yellow clay |
| 14S/2E-28H03 | 654 | 656 | gravelly yellow clay | gravelly clay |
| 14S/2E-28H03 | 656 | 660 | yellow clay w/gravel | gravelly clay |
| 14S/2E-28H03 | 660 | 720 | yellow clay | yellow clay |

| Cross-Section C-C' Well Names | Top (feet bgs) | Bottom (feet bgs) | Boring log record | GEOBASE Code |
|---|---|---|---|---|
| 14S/2E-22P02 | 0 | 30 | sandy blue clay | blue clay |
| 14S/2E-22P02 | 30 | 92 | blue clay | blue clay |
| 14S/2E-22P02 | 92 | 105 | fine sand | fine sand |
| 14S/2E-22P02 | 105 | 125 | blue clay | blue clay |
| 14S/2E-22P02 | 125 | 140 | fine sand | fine sand |
| 14S/2E-22P02 | 140 | 160 | sand and gravel | gravel/sand |
| 14S/2E-22P02 | 160 | 204 | sand and gravel | gravel/sand |
| 14S/2E-22P02 | 204 | 223 | yellow clay | yellow clay |
| 14S/2E-22P02 | 223 | 238 | gravel and layers of clay | gravel |
| 14S/2E-22P02 | 238 | 253 | sand and fine gravel | gravel/sand |
| 14S/2E-22P02 | 253 | 261 | gravel and layers of fine clay | gravel/sand |
| 14S/2E-22P02 | 261 | 274 | gravel | gravel |
| 14S/2E-22P02 | 274 | 282 | clay and gravel | gravelly clay |
| 14S/2E-22P02 | 282 | 304 | gravel | gravel |
| 14S/2E-22K01 | 0 | 3 | top soil | topsoil |
| 14S/2E-22K01 | 3 | 30 | brown clay | brown clay |
| 14S/2E-22K01 | 30 | 186 | blue clay | blue clay |
| 14S/2E-22K01 | 186 | 210 | yellow sandy clay | sandy clay |
| 14S/2E-22K01 | 210 | 220 | shale gravel | gravel |
| 14S/2E-22K01 | 220 | 250 | coarse sand | coarse sand |
| 14S/2E-22K01 | 250 | 310 | gravel rock | gravel |
| 14S/2E-22K01 | 310 | 390 | gravel w/yellow streaks of clay | gravel |
| 14S/2E-22K01 | 390 | 450 | gravel - yellow clay | gravelly clay |
| 14S/2E-22K01 | 450 | 470 | gray clay and gravel | gravelly clay |
| 14S/2E-22K01 | 470 | 610 | gravel - streaks of gray clay | gravelly clay |
| 14S/2E-22K01 | 610 | 630 | sand gravel | gravel/sand |
| 14S/2E-22K01 | 630 | 670 | fine sand | fine sand |
| 14S/2E-22K01 | 670 | 720 | coarse sand | coarse sand |
| 14S/2E-22K01 | 720 | 760 | fine sand | fine sand |
| 14S/2E-22K01 | 760 | 780 | fine sand - streak clay | fine sand |
| 14S/2E-22K01 | 780 | 820 | coarse sand | coarse sand |
| 14S/2E-22K01 | 820 | 840 | blue clay | blue clay |
| 14S/2E-22K01 | 840 | 880 | yellow clay | yellow clay |
| 14S/2E-22K01 | 880 | 940 | blue clay | blue clay |
| 14S/2E-22K01 | 940 | 960 | blue clay - gravel | gravelly clay |
| 14S/2E-22K01 | 960 | 1000 | gravel streaks blue clay | gravel |

| Cross-Section C-C' Well Names | Top (feet bgs) | Bottom (feet bgs) | Boring log record | GEOBASE Code |
|---|---|---|---|---|
| 14S/2E-22K01 | 1000 | 1100 | coarse sand - streaks blue clay | blue sand |
| 14S/2E-22K01 | 1100 | 1140 | fine sand - yellow clay | sandy clay |
| 14S/2E-22K01 | 1140 | 1160 | fine sand - yellow clay | fine sand |
| 14S/2E-22K01 | 1160 | 1200 | fine sand | fine sand |
| 14S/2E-22K01 | 1200 | 1240 | fine sand - coarse sand | sand |
| 14S/2E-22K01 | 1240 | 1260 | fine sand - streak clay | fine sand |
| 14S/2E-22K01 | 1260 | 1280 | blue clay - gravel | gravelly clay |
| 14S/2E-22K01 | 1280 | 1320 | clay - gravel | gravelly clay |
| 14S/2E-22K01 | 1320 | 1340 | clay - sand | sandy clay |
| 14S/2E-22K01 | 1340 | 1360 | blue clay - silt | blue clay |
| 14S/2E-22K01 | 1360 | 1380 | blue clay - gravel | gravelly clay |
| 14S/2E-22K01 | 1380 | 1440 | fine sand - silt | fine sand |
| 14S/2E-22K01 | 1440 | 1520 | clay - sand streaks | clay |
| 14S/2E-22K01 | 1520 | 1620 | fine sand - blue clay | sandy clay |
| 14S/2E-22K01 | 1620 | 1640 | shale - fine sand - blue | fine sand |

**Notes:**

* a partial boring log description is provided for this well

## Appendix A. Summary of Lithology Recorded on Cross-Section Well Logs
## Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
## Monterey County Water Resources Agency

| Cross-Section D-D' Well Names | Top (feet bgs) | Bottom (feet bgs) | Boring log record | GEOBASE Code |
|---|---|---|---|---|
| 14S/2E-30G03 | 0 | 80 | fine sand | fine sand |
| 14S/2E-30G03 | 80 | 100 | fine sand/silt | fine sand |
| 14S/2E-30G03 | 100 | 110 | fine sand | fine sand |
| 14S/2E-30G03 | 100 | 130 | blue clay | fine sand |
| 14S/2E-30G03 | 130 | 160 | sandy clay | blue clay |
| 14S/2E-30G03 | 160 | 250 | fine sand | fine sand |
| 14S/2E-30G03 | 250 | 270 | sandy clay | sandy clay |
| 14S/2E-30G03 | 270 | 310 | coarse sand and clay | sandy clay |
| 14S/2E-30G03 | 310 | 390 | brown clay, coarse fine sands | brown clay |
| 14S/2E-30G03 | 390 | 430 | brown clay | brown clay |
| 14S/2E-30G03 | 430 | 490 | coarse sand | coarse sand |
| 14S/2E-30G03 | 490 | 520 | fine sand | fine sand |
| 14S/2E-30G03 | 520 | 580 | coarse sand/ yellow clay | sandy clay |
| 14S/2E-30G03 | 580 | 610 | yellow clay | yellow clay |
| 14S/2E-30G03 | 610 | 670 | silty brown clay | brown clay |
| 14S/2E-30G03 | 670 | 920 | borwn clay silty clay | brown clay |
| 14S/2E-30G03 | 920 | 950 | coarse sand and clay | sandy clay |
| 14S/2E-30G03 | 950 | 965 | clay | clay |
| 14S/2E-30G03 | 965 | 1000 | blue shale | blue clay |
| 14S/2E-30G03 | 1000 | 1110 | clay and sand | sandy clay |
| 14S/2E-30G03 | 1110 | 1200 | clay and sand | sandy clay |
| 14S/2E-30G03 | 1200 | 1230 | clay and gray clay and sand | sandy clay |
| 14S/2E-30G03 | 1230 | 1300 | sandy clay | sandy clay |
| 14S/2E-30G03 | 1300 | 1350 | blue sandy clay | blue clay |
| 14S/2E-30G03 | 1350 | 1400 | shale and clay | clay |
| 14S/2E-30G03 | 1400 | 1420 | clay and coarse sand | sandy clay |
| 14S/2E-30G03 | 1420 | 1520 | blue clay, coarse sand | sandy clay |
| 14S/2E-30G03 | 1520 | 1570 | blue clay some shale | blue clay |
| 14S/2E-30G03 | 1570 | 1650 | gray clay, sand and shale | sandy clay |
| 14S/2E-30G03 | 1650 | 1680 | fine sand | fine sand |
| 14S/2E-30G03 | 1680 | 1740 | blue clay | blue clay |
| 14S/2E-30G03 | 1740 | 1860 | clay, shale and sand | sandy clay |
| 14S/2E-30G03 | 1860 | 1900 | clay and shale | clay |
| 14S/2E-30G03 | 1900 | 1980 | sand and clay | sandy clay |
| 14S/2E-30G03 | 1980 | 2020 | clay and sandy clay | sandy clay |

| Cross-Section D-D' Well Names | Top (feet bgs) | Bottom (feet bgs) | Boring log record | GEOBASE Code |
|---|---|---|---|---|
| 14S/2E-28C01 | 0 | 10 | hill clay | clay |
| 14S/2E-28C01 | 10 | 40 | red sand | red sand |
| 14S/2E-28C01 | 40 | 58 | yellow sand | sand |
| 14S/2E-28C01 | 58 | 60 | blue-yellow sandy clay | blue clay |
| 14S/2E-28C01 | 60 | 70 | red-yellow sand | red sand |
| 14S/2E-28C01 | 70 | 94 | sand - tight gravel | gravel/sand |
| 14S/2E-28C01 | 94 | 118 | fine brown sand | fine sand |
| 14S/2E-28C01 | 118 | 140 | hard yellow clay | yellow clay |
| 14S/2E-28C01 | 140 | 150 | fine sand | fine sand |
| 14S/2E-28C01 | 150 | 164 | gravel, sand, layers of clay | snd/grvl/cly |
| 14S/2E-28C01 | 164 | 184 | sand-gravel (2" rocks) | gravel/sand |
| 14S/2E-28C01 | 184 | 200 | hard brown clay | brown clay |
| 14S/2E-28C01 | 200 | 212 | sand- fine gravel | gravel/sand |
| 14S/2E-28C01 | 212 | 218 | brown clay, layers of sand | sandy clay |
| 14S/2E-28C01 | 218 | 238 | sand - fine gravel | gravel/sand |
| 14S/2E-28C01 | 238 | 248 | hard yellow clay | yellow clay |
| 14S/2E-28C01 | 248 | 280 | sand - fine gravel | gravel/sand |
| 14S/2E-28C01 | 280 | 288 | white gravel, sand, clay (2" rock) | snd/grvl/cly |
| 14S/2E-28C01 | 288 | 290 | hard yellow clay | yellow clay |
| 14S/2E-28C01 | 290 | 308 | hard blue clay | blue clay |
| 14S/2E-28C01 | 308 | 312 | yellow clay | yellow clay |
| 14S/2E-28C01 | 312 | 340 | sand, gravel, yellow clay (1-2" rock) | snd/grvl/cly |
| 14S/2E-28C01 | 340 | 371 | sand, gravel (3" rock) | gravel/sand |
| 14S/2E-28C01 | 371 | 375 | hard red clay | red clay |
| 14S/2E-28C01 | 375 | 378 | sand red clay | sand |
| 14S/2E-28C01 | 378 | 392 | red-yellow clay | red clay |
| 14S/2E-28C01 | 392 | 402 | sand, gravel, layers of clay | snd/grvl/cly |
| 14S/2E-28C01 | 402 | 412 | sand, gravel (3" rock) | gravel/sand |
| 14S/2E-28C01 | 412 | 430 | yellow clay | yellow clay |
| 14S/2E-28C01 | 430 | 435 | sand, gravel (1" gravel) | gravel/sand |
| 14S/2E-28C01 | 435 | 450 | yellw clay and sand | yellow clay |
| 14S/2E-28C01 | 450 | 464 | gravel and sand (6" rock) | gravel/sand |
| 14S/2E-28C01 | 464 | 472 | sand | sand |
| 14S/2E-28C01 | 472 | 478 | gravel and sand (3" rock) | gravel/sand |
| 14S/2E-28C01 | 478 | 480 | red sand | red sand |

| Cross-Section D-D' Well Names | Top (feet bgs) | Bottom (feet bgs) | Boring log record | GEOBASE Code |
|---|---|---|---|---|
| 14S/2E-28C01 | 480 | 494 | red sand - thin layers of sandstone | red sand |
| 14S/2E-28C01 | 494 | 502 | yellow brown clay | yellow clay |
| 14S/2E-28C01 | 502 | 511 | fine sand and gravel | gravel/sand |
| 14S/2E-28C01 | 511 | 520 | brown clay | brown clay |
| 14S/2E-28C01 | 520 | 526 | sand and pea gravel | gravel/sand |
| 14S/2E-28C01 | 526 | 542 | sand and some pea gravel | gravel/sand |
| 14S/2E-28C01 | 542 | 550 | sand - fine gravel | gravel/sand |
| 14S/2E-28C01 | 550 | 555 | white gravel (3" rock) | gravel |
| 14S/2E-28C01 | 555 | 574 | red-yellow clay | red clay |
| 14S/2E-28C01 | 574 | 582 | sand | sand |
| 14S/2E-28C01 | 582 | 590 | brown-white sandy clay | sandy clay |
| 14S/2E-28C01 | 590 | 604 | gravel (3" rock) | gravel |
| 14S/2E-28C01 | 604 | 607 | fine red sand | red sand |
| 14S/2E-28C01 | 607 | 608 | white sandstone | white sand |
| 14S/2E-27C02 | 0 | 2 | soil | topsoil |
| 14S/2E-27C02 | 2 | 31 | sandy yellow clay | sandy clay |
| 14S/2E-27C02 | 31 | 147 | blue clay | blue clay |
| 14S/2E-27C02 | 147 | 173 | sand and gravel, mostly sand | gravel/sand |
| 14S/2E-27C02 | 173 | 187 | sand and gravel, rocks to 3" | gravel/sand |
| 14S/2E-27C02 | 187 | 199 | sand and fine gravel | gravel/sand |
| 14S/2E-27C02 | 199 | 215 | sand and gravel, rocks to 3" | gravel/sand |
| 14S/2E-27C02 | 215 | 239 | sand and gravel, rocks to 4" | gravel/sand |
| 14S/2E-27C02 | 239 | 241 | sand, clay, and gravel | snd/grvl/cly |
| 14S/2E-27C02 | 241 | 276 | sand | sand |
| 14S/2E-27C02 | 276 | 309 | sand and gravel, rocks to 4" | gravel/sand |
| 14S/2E-27C02 | 309 | 325 | yellow clay | yellow clay |
| 14S/2E-27C02 | 325 | 330 | blue clay | blue clay |
| 14S/2E-27C02 | 330 | 352 | yellow clay | yellow clay |
| 14S/2E-27C02 | 352 | 357 | yellow clay streaked with sand and gravel | snd/grvl/cly |
| 14S/2E-27C02 | 357 | 375 | sand | sand |
| 14S/2E-27C02 | 375 | 383 | clay, sand, gravel | snd/grvl/cly |
| 14S/2E-27C02 | 383 | 405 | sand | sand |
| 14S/2E-27C02 | 405 | 411 | yellow clay | yellow clay |
| 14S/2E-27C02 | 411 | 433 | yellow clay, sand and gravel | snd/grvl/cly |
| 14S/2E-27C02 | 433 | 450 | yellow clay, sand and fine gravel, mostly sand | snd/grvl/cly |

| Cross-Section D-D' Well Names | Top (feet bgs) | Bottom (feet bgs) | Boring log record | GEOBASE Code |
|---|---|---|---|---|
| 14S/2E-27C02 | 450 | 454 | sand and gravel | gravel/sand |
| 14S/2E-27C02 | 454 | 477 | yellow clay | yellow clay |
| 14S/2E-27C02 | 477 | 479 | sand and gravel | gravel/sand |
| 14S/2E-27C02 | 479 | 483 | yellow clay | yellow clay |
| 14S/2E-27G03 | 0 | 3 | soil | topsoil |
| 14S/2E-27G03 | 3 | 34 | sandy yellow clay | sandy clay |
| 14S/2E-27G03 | 34 | 130 | blue clay | blue clay |
| 14S/2E-27G03 | 130 | 141 | sand | sand |
| 14S/2E-27G03 | 141 | 149 | sand and gravel | gravel/sand |
| 14S/2E-27G03 | 149 | 157 | sand | sand |
| 14S/2E-27G03 | 157 | 165 | sand and gravel, rocks to 3" | gravel/sand |
| 14S/2E-27G03 | 165 | 173 | sand and fine gravel with yellow clay | snd/grvl/cly |
| 14S/2E-27G03 | 173 | 242 | sand and gravel, rocks to 3" | gravel/sand |
| 14S/2E-27G03 | 242 | 272 | sand | sand |
| 14S/2E-27G03 | 272 | 320 | sand and gravel, rocks to 3" | gravel/sand |
| 14S/2E-27G03 | 320 | 327 | yellow clay | yellow clay |
| 14S/2E-27G03 | 327 | 341 | blue clay | blue clay |
| 14S/2E-27G03 | 341 | 345 | blue clay streaked with fine gravel | blue clay |
| 14S/2E-27G03 | 345 | 358 | sand and yellow clay with fine gravel | blue clay |
| 14S/2E-27G03 | 358 | 368 | sand and gravel | gravel/sand |
| 14S/2E-27G03 | 368 | 372 | yellow clay | yellow clay |
| 14S/2E-27G03 | 372 | 378 | sand | sand |
| 14S/2E-27G03 | 378 | 389 | sand and gravel, mostly sand | gravel/sand |
| 14S/2E-27G03 | 389 | 408 | sand | sand |
| 14S/2E-27G03 | 408 | 414 | yellow clay | yellow clay |
| 14S/2E-27G03 | 414 | 440 | muddy sand | sand |
| 14S/2E-27G03 | 440 | 493 | yellow sandy clay | sandy clay |
| 14S/2E-27G03 | 493 | 495 | sand and gravel, considerable sand | gravel/sand |

**Notes:**

* a partial boring log description is provided for this well

# APPENDIX B

# WELL CONSTRUCTION DETAILS

## Appendix B. Well Construction Details
## Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
## Monterey County, California

| Well Names | Total Depth (feet bgs) | Screen Intervals (feet bgs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Top 1 | Bottom 1 | Top 2 | Bottom 2 | Top 3 | Bottom 3 | Top 4 | Bottom 4 | Top 5 | Bottom 5 | Top 6 | Bottom 6 |
| *cross-section A-A'* | | | | | | | | | | | | | |
| PZ-12-04-180L | 180.2 | 170 | 180 | | | | | | | | | | |
| 14S/1E-25D (Beach) | 300 | 139 | 148 | 154 | 180 | 197 | 210 | 214 | 220 | 232 | 235 | | |
| 14S/1E-24L02 | 2012 | 930 | 950 | | | | | | | | | | |
| 14S/1E-24L03 | 2012 | 1040 | 1060 | | | | | | | | | | |
| 14S/1E-24L04 | 2012 | 1410 | 1430 | | | | | | | | | | |
| 14S/1E-24L05 | 2012 | 1820 | 1860 | | | | | | | | | | |
| 14S/1E-13J02 | 611 | 242 | 506 | | | | | | | | | | |
| 14S/2E-18E01 | 913 | 666 | 834 | | | | | | | | | | |
| 14S/2E-7F02 | 612 | 371 | 612 | | | | | | | | | | |
| 14S/2E-7L04 | 645 | 360 | 560 | | | | | | | | | | |
| 14S/2E-7L05 | 632 | 330 | 450 | 510 | 610 | | | | | | | | |
| 14S/2E-6L01 | 1809 | 880 | 1540 | | | | | | | | | | |
| *cross-section B-B'* | | | | | | | | | | | | | |
| 15S/1E-07B (shallow) | 1175 | 700 | 730 | | | | | | | | | | |
| 15S/1E-07B (deep) | 1175 | 1090 | 1120 | | | | | | | | | | |
| MW-OU2-10-400 | 573 | 348.5 | 563.4 | | | | | | | | | | |
| MW-OU2-07-400 | 587.5 | 381.9 | 579.4 | | | | | | | | | | |
| 14S/2E-31H01 | 1569 | 930 | 970 | 990 | 1010 | 1040 | 1080 | 1190 | 1210 | 1500 | 1540 | | |
| 14S/2E-32D04 | 1700 | 970 | 110 | 1540 | 1570 | 1610 | 1650 | | | | | | |
| Airfield | 402 | 318 | 347 | 357 | 379 | | | | | | | | |
| 14S/2E-21N01 | 600 | 438 | 498 | 510 | 534 | 564 | 580 | | | | | | |
| 14S/2E-21E01 | 614 | 428 | 456 | 484 | 508 | 532 | 542 | 562 | 576 | 592 | 602 | | |
| 14S/2E-21F2 | 300 | 200 | 261 | | | | | | | | | | |
| 14S/2E16G01 | 630 | 360 | 410 | 430 | 530 | | | | | | | | |
| 14S/2E-09D04 | 630 | 350 | 370 | 420 | 520 | 540 | 550 | 560 | 600 | | | | |
| *cross-section C-C'* | | | | | | | | | | | | | |
| DB-1 | 500 | 377.5 | 477.5 | | | | | | | | | | |
| 15S/2E-04C01 | 570 | 315 | 535 | | | | | | | | | | |
| 14S/2E-00Q01 | 570 | 315 | 405 | 440 | 485 | 525 | 535 | | | | | | |
| 14S/2E-33P01 | 554 | 354 | 384 | 417 | 442 | 480 | 488 | | | | | | |
| 14S/2E-27N01 | 322 | 281 | 314 | | | | | | | | | | |
| 14S/2E-27N50 | 634 | 456 | 472 | 482 | 488 | 564 | 588 | | | | | | |
| 14S/2E-28J50 | 510 | 264 | 293 | 370 | 380 | 412 | 420 | 436 | 444 | 450 | 480 | | |
| 14S/2E-28H03 | 720 | 362 | 396 | 542 | 548 | 282 | 600 | 620 | 636 | | | | |
| 14S/2E-22P02 | 304 | 255 | 304 | | | | | | | | | | |
| 14S/2E-22K01 | 1718 | 1718 | 1718 | | | | | | | | | | |
| *cross section D-D'* | | | | | | | | | | | | | |
| 14S/2E-30G03 | 2020 | 1390 | 1420 | 1480 | 1530 | 1660 | 1700 | 1780 | 1810 | 1830 | 1880 | 1900 | 1940 |
| 14S/2E-28C50 | 608 | 450 | 464 | 472 | 478 | 520 | 526 | 550 | 555 | 590 | 604 | | |
| 14S/2E-27C02 | 483 | 279 | 309 | 352 | 357 | 411 | 433 | 450 | 454 | | | | |
| 14S/2E-27G03 | 495 | 276 | 320 | 362 | 368 | | | | | | | | |

## Appendix B. Well Construction Details
## Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
## Monterey County, California

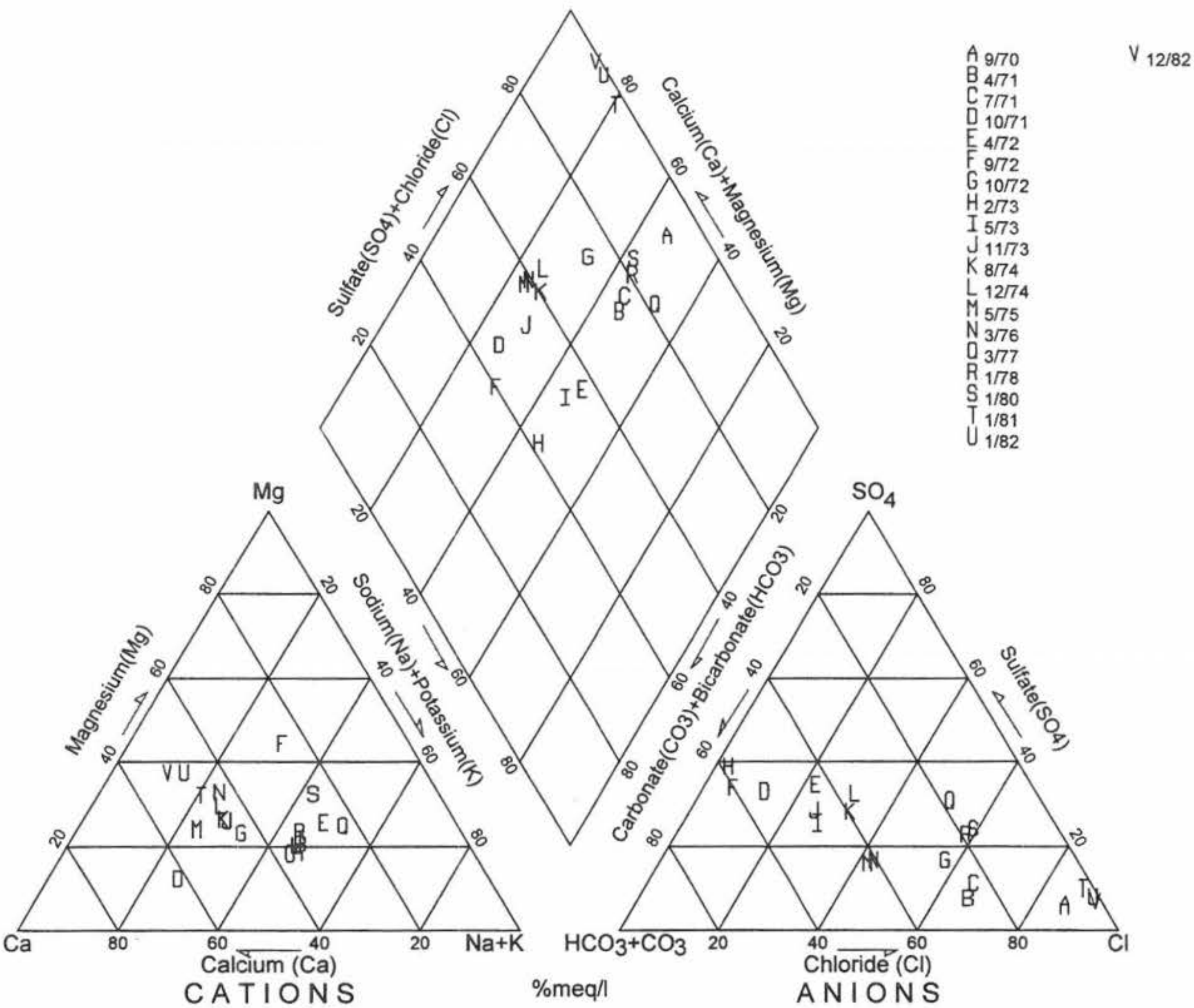
| Well Names | Installation Technique | Sanitary Seals (feet bgs) Top 1 | Bottom 1 | material | Top 2 | Bottom 2 | material | Top 3 | Bottom 3 | material | Strata Seal? | Gravel Pack (feet bgs) Top 1 | Bottom 1 | Top 2 | Bottom 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *cross-section A-A'* | | | | | | | | | | | | | | | |
| PZ-12-04-180L | mud rotary | 0 | 62.4 | bentonite | 90 | 103.3 | bentonite | 130.5 | 153.5 | bentonite | yes | 153.5 | 188.2 | | |
| 14S/1E-25D (beach) | cable tool | 0 | 109 | grout | | | | | | | no | | | | |
| 14S/1E-24L02 | mud rotary | 0 | 898 | grout | | | | | | | | 898 | 974 | | |
| 14S/1E-24L03 | mud rotary | 974 | 994 | grout | | | | | | | | 994 | 1098 | | |
| 14S/1E-24L04 | mud rotary | 1098 | 1384 | grout | | | | | | | | 1384 | 1442 | | |
| 14S/1E-24L05 | mud rotary | 1442 | 1745 | grout | | | | | | | | 1745 | 2012 | | |
| 14S/1E-13J02 | rotary | 0 | 200 | cement | | | | | | | na | | | | |
| 14S/2E-18E01 | rotary | 0 | 300 | concrete | | | | | | | yes | 300 | 870 | | |
| 14S/2E-7F02 | rotary? | 0 | 361 | | | | | | | | na | | | | |
| 14S/2E-7L04 | reverse rotary | 0 | 330 | cement | | | | | | | na | 330 | 560 | | |
| 14S/2E-7L05 | mud rotary | 0 | 300 | cement | 465 | 485 | cement | | | | 465-485 | 300 | 465 | 485 | 610 |
| 14S/2E-6L01 | rotary | 0 | 800 | concrete | | | | | | | yes | 600 | 1563 | | |
| *cross-section B-B'* | | | | | | | | | | | | | | | |
| 15S/1E-07B (shallow) | direct rotary (mud) | 0 | 258 | | 590 | 610 | | | | | | 610 | 960 | | |
| 15S/1E-07B (deep) | direct rotary (mud) | 960 | 990 | | | | | | | | | 990 | 1175 | | |
| MW-OU2-10-400 | ARCH | 0 | 342.5 | neat cement | | | | | | | | 342.5 | 567 | | |
| MW-OU2-07-400 | ARCH | 0 | 365 | neat cement | | | | | | | | 365 | 586.5 | | |
| 14S/2E-31H01 | reverse rotary | 0 | 860 | | | | | | | | no | 860 | 1550 | | |
| 14S/2E-32D04 | reverse rotary | 0 | 880 | grout | | | | | | | 0-880 | 880 | 1660 | | |
| Airfield | cable tool | 0 | 98 | grout | | | | | | | no | | | | |
| 14S/2E-21N01 | cable tool | 0 | 300 | cement | | | | | | | na | | | | |
| 14S/2E-21E01 | cable tool | 0 | 76 | conductor | | | | | | | | | | | |
| 14S/2E-21F02 | cable tool | ? | ? | | | | | | | | na | | | | |
| 14S/2E-16G01 | reverse rotary | 0 | 340 | cement | | | | | | | na | 340 | 615 | | |
| 14S/2E-09D04 | reverse rotary | 0 | 340 | cement | | | | | | | | 340 | 630 | | |
| *cross-section C-C'* | | | | | | | | | | | | | | | |
| DB-1 | direct rotary | ? | ? | | | | | | | | | | | | |
| 15S/2E-04C01 | reverse rotary | 0 | 50 | | | | | | | | yes | 50 | 555 | | |
| 14S/2E-00Q01 | reverse rotary | 0 | 50 | | | | | | | | yes | 50 | 570 | | |
| 14S/2E-33P01 | cable tool | 0 | 272 | cement | | | | | | | | | | | |
| 14S/2E-27N01 | cable tool | ? | ? | | | | | | | | | | | | |
| 14S/2E-27N50 | cable tool | 0 | 303 | cement | | | | | | | | | | | |
| 14S/2E-28J50 | cable tool | 0 | 52 | | | | | | | | | | | | |
| 14S/2E-28H03 | cable tool | 0 | 320 | cement | | | | | | | | | | | |
| 14S/2E-22P02 | cable tool? | ? | ? | | | | | | | | | | | | |
| 14S/2E-22K01 | rotary | n/a | n/a | | | | | | | | | | | | |
| *cross section D-D'* | | | | | | | | | | | | | | | |
| 14S/2E-30G03 | reverse rotary | 0 | 1250 | cement/grout | | | | | | | 0-1250 | 1250 | 2020 | | |
| 14S/2E-28C01 | cable tool | ? | ? | | | | | | | | | | | | |
| 14S/2E-27C02 | cable tool | ? | ? | | | | | | | | | | | | |
| 14S/2E-27G03 | cable tool | 0 | 60 | | | | | | | | | | | | |

# APPENDIX C

# SELECT PIPER DIAGRAMS

# MCWD-1

Marina, California

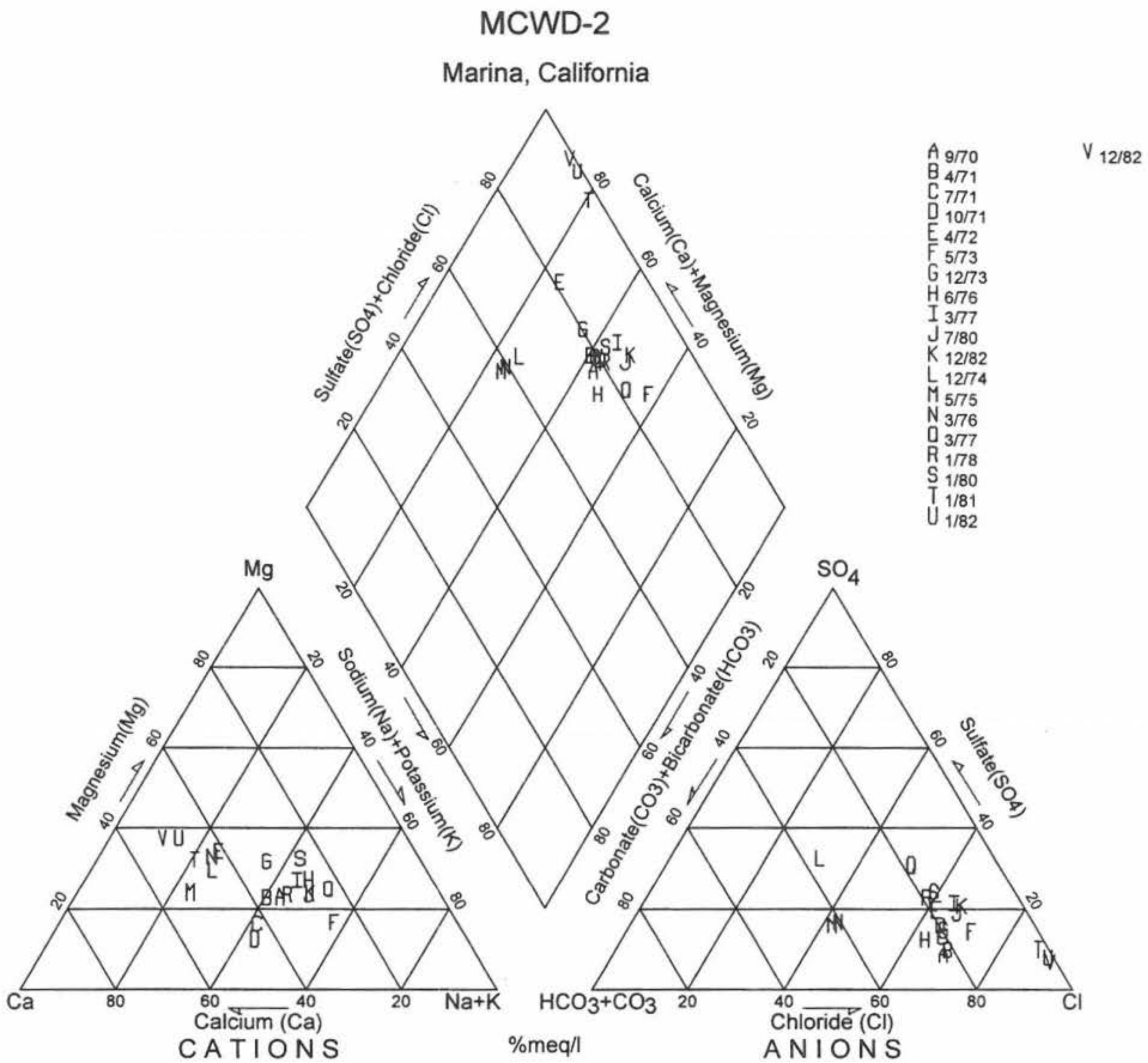



Harding ESE
*A MACTEC Company*

**Piper Diagram**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

PLATE
**C1**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |




**Harding ESE**
*A MACTEC Company*

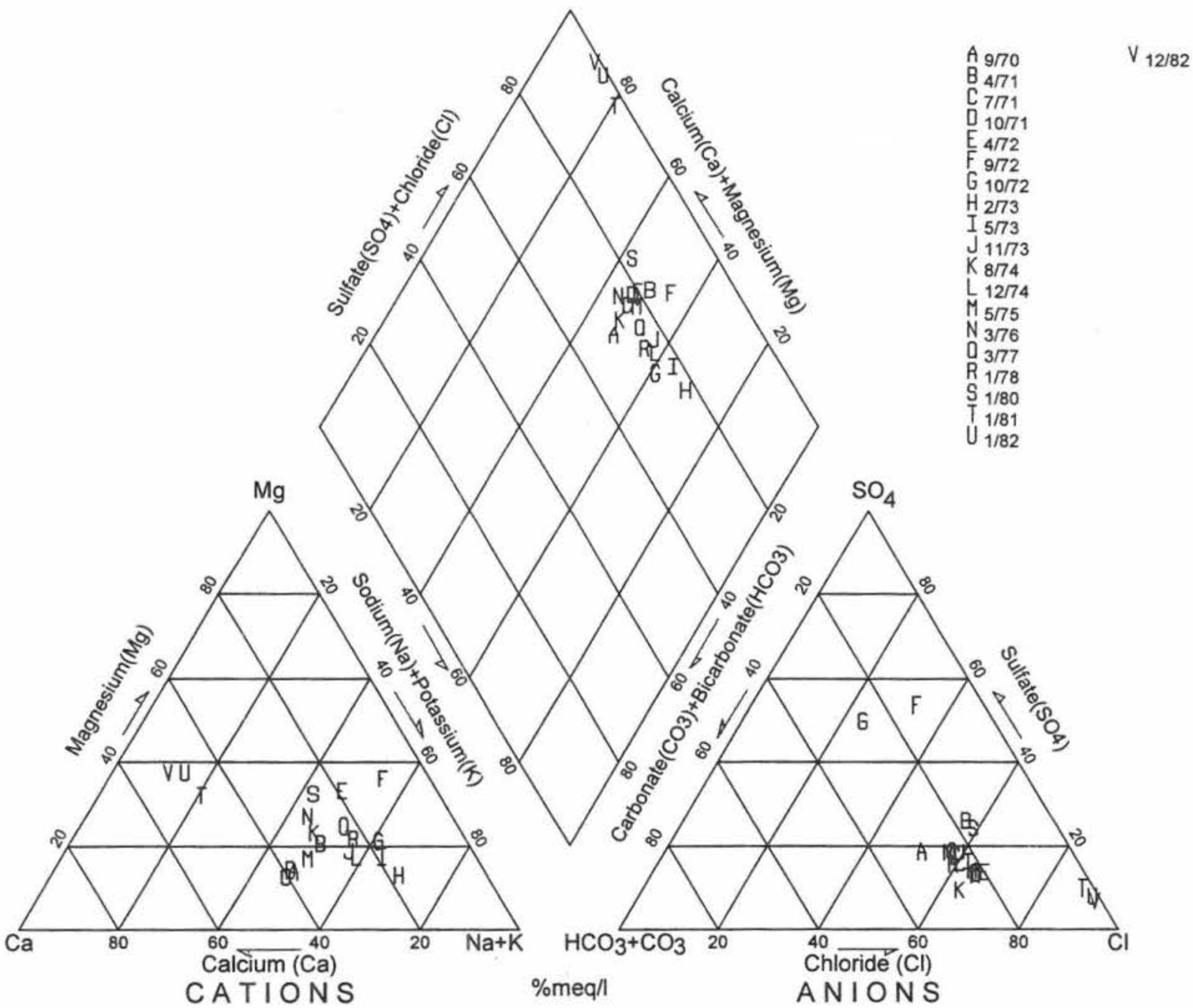
**Piper Diagram**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

PLATE
**C2**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |

# MCWD-3

Marina, California

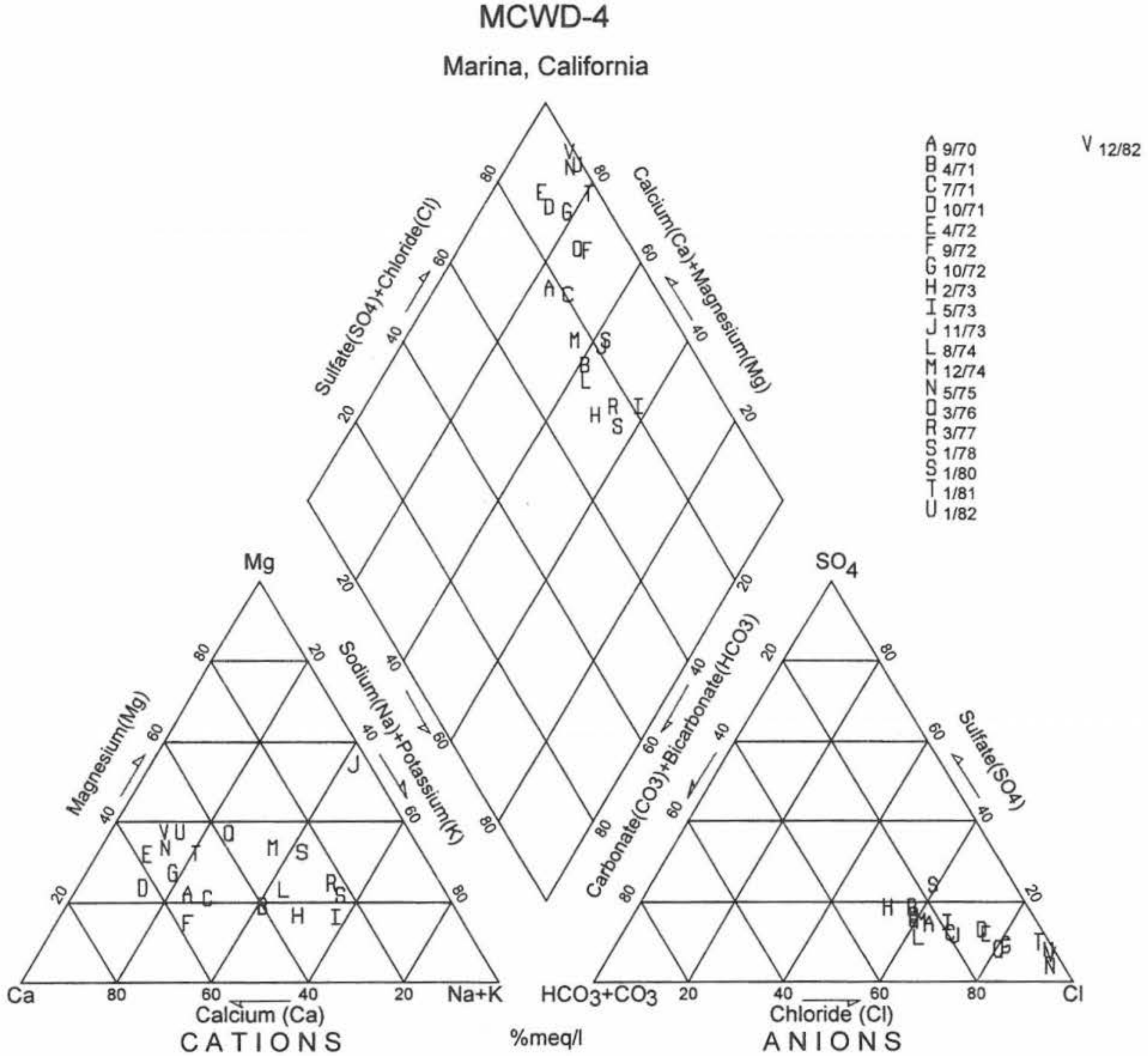



Harding ESE
A MACTEC COMPANY

**Piper Diagram**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

PLATE
**C3**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |

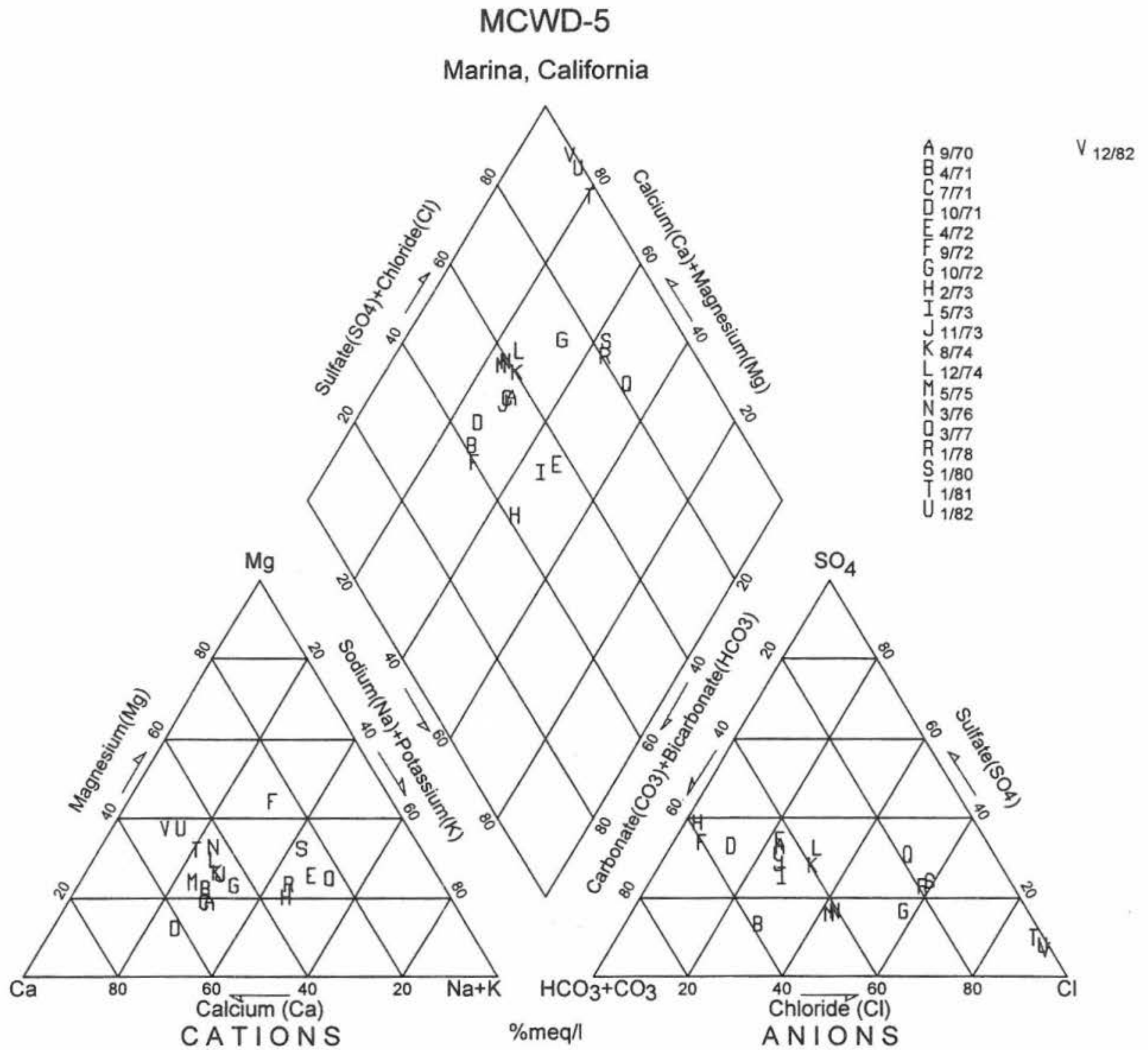



Harding ESE
*A MACTEC Company*

**Piper Diagram**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

PLATE
**C4**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |



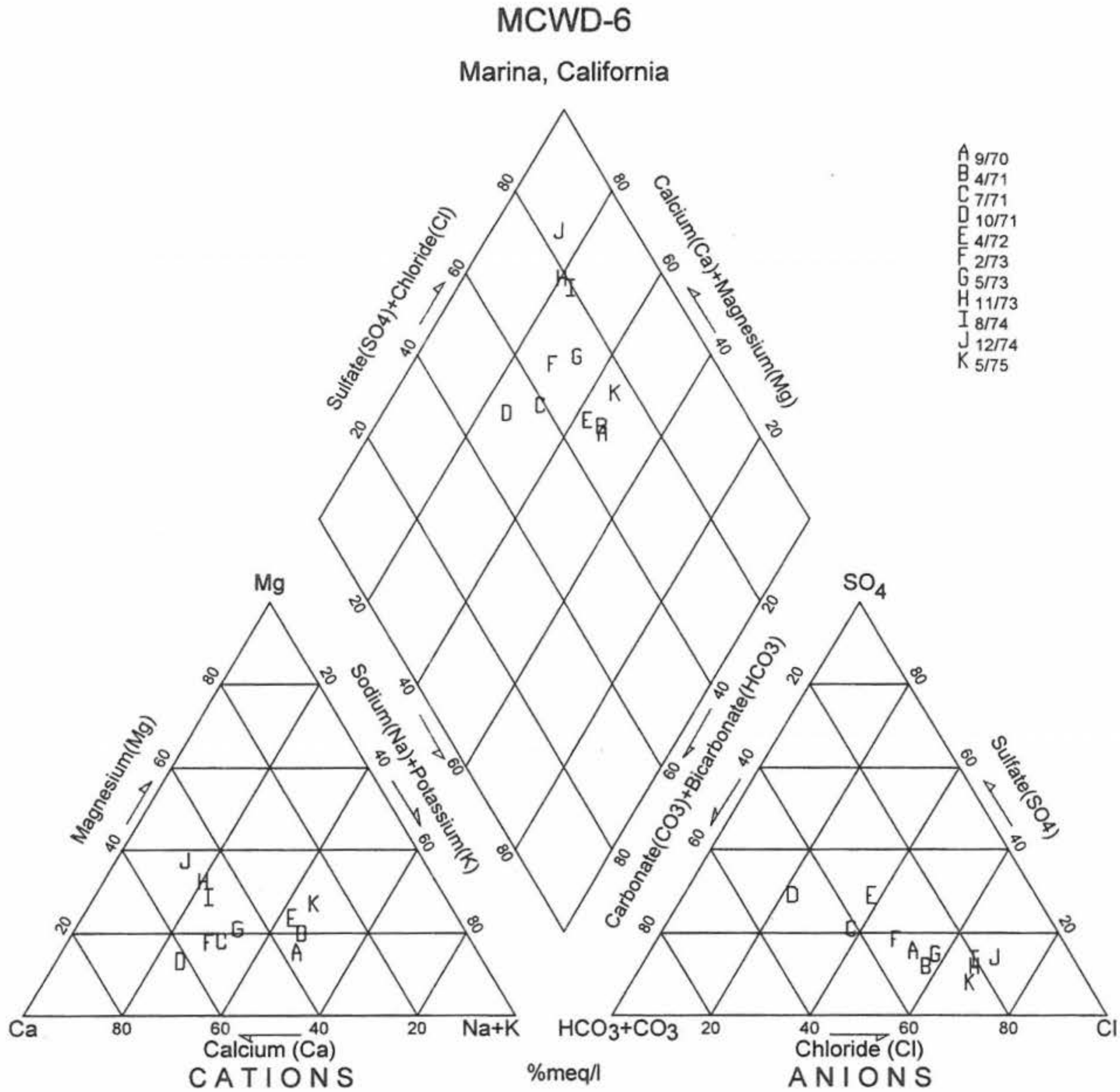

**Piper Diagram**

Harding ESE
A MACTEC COMPANY

Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

PLATE
**C5**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |

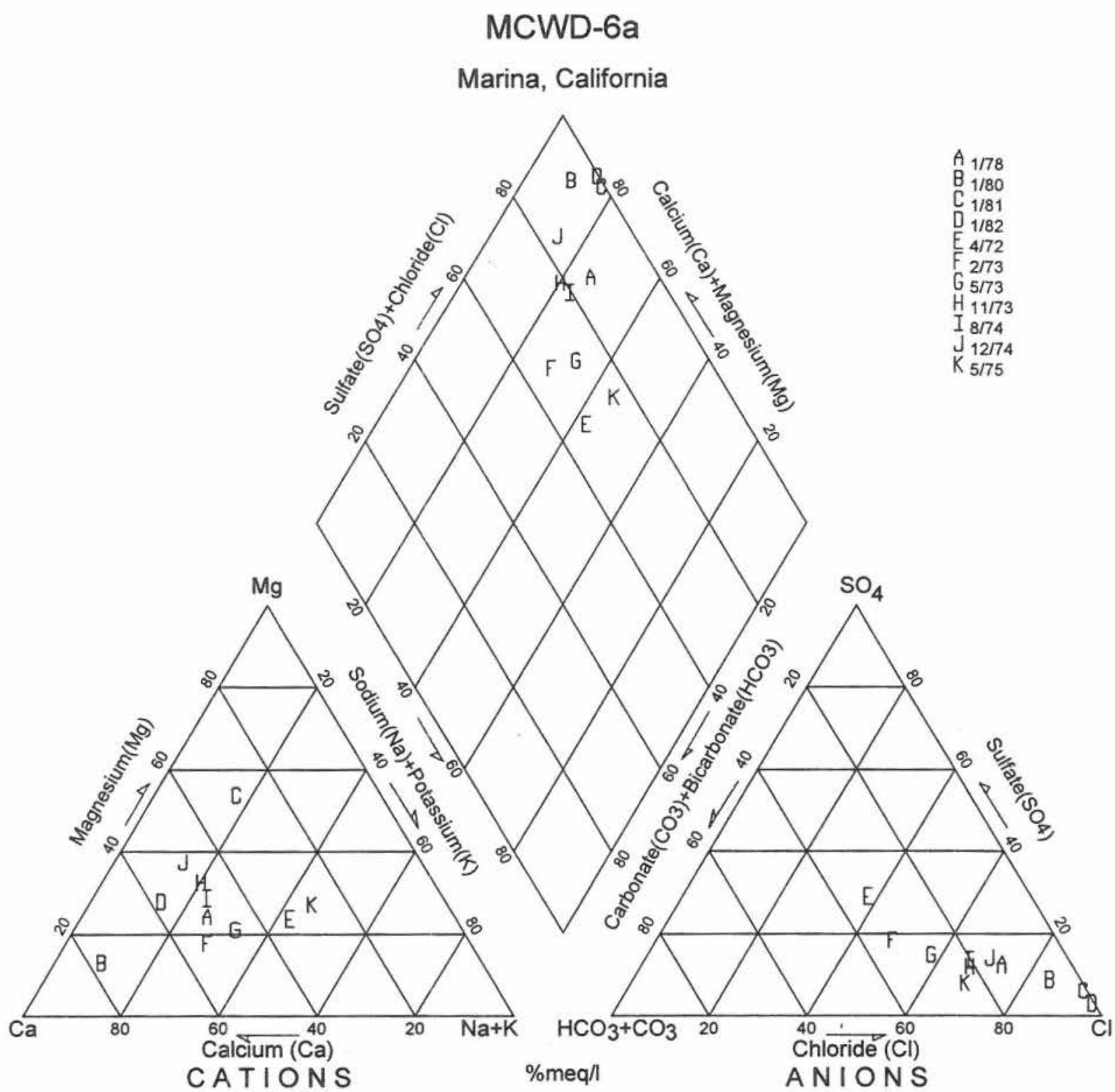



**Piper Diagram**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

Harding ESE
A MACTEC COMPANY

PLATE
**C6**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |

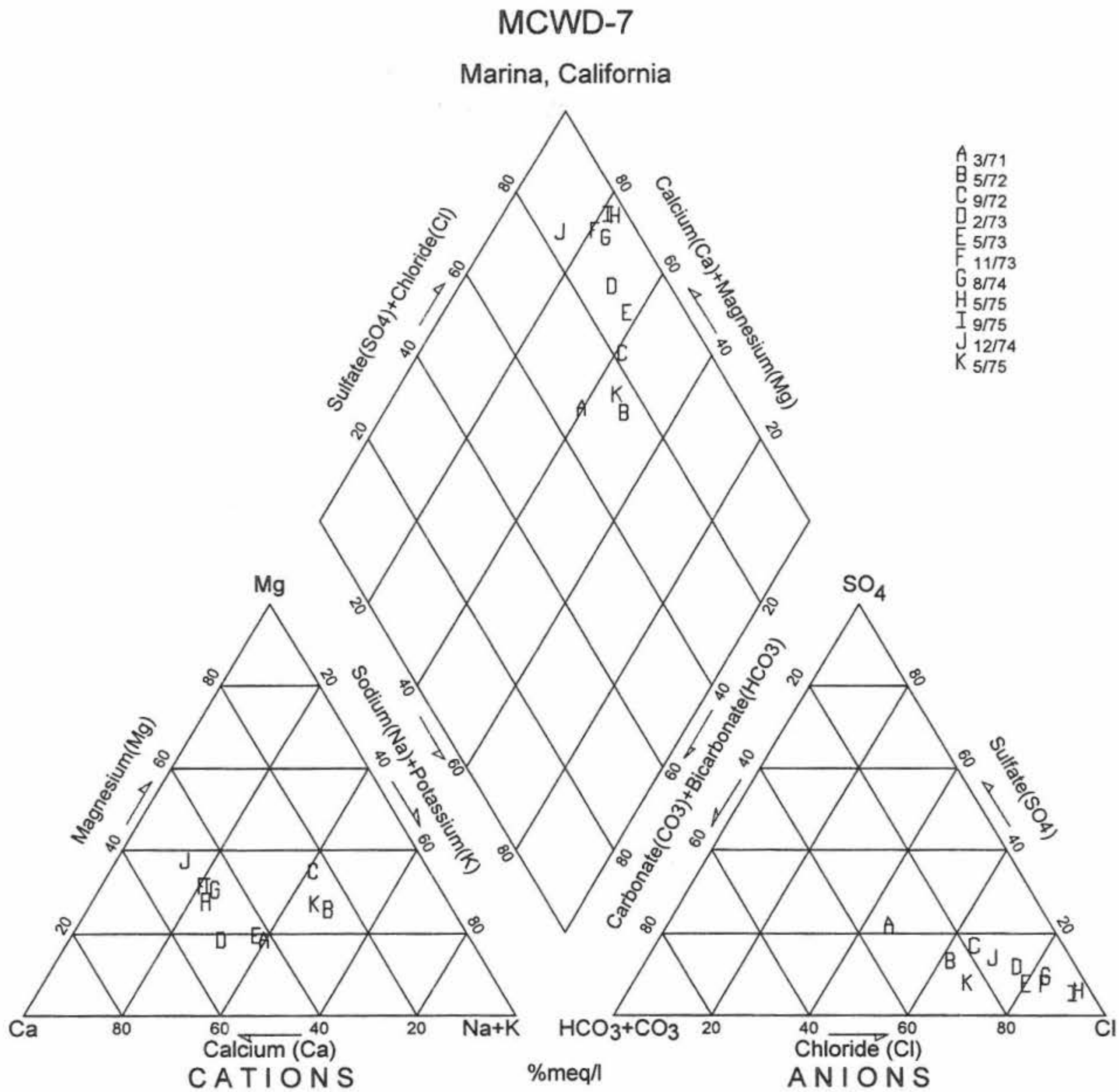



Harding ESE
A MACTEC COMPANY

**Piper Diagram**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

PLATE
**C7**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |

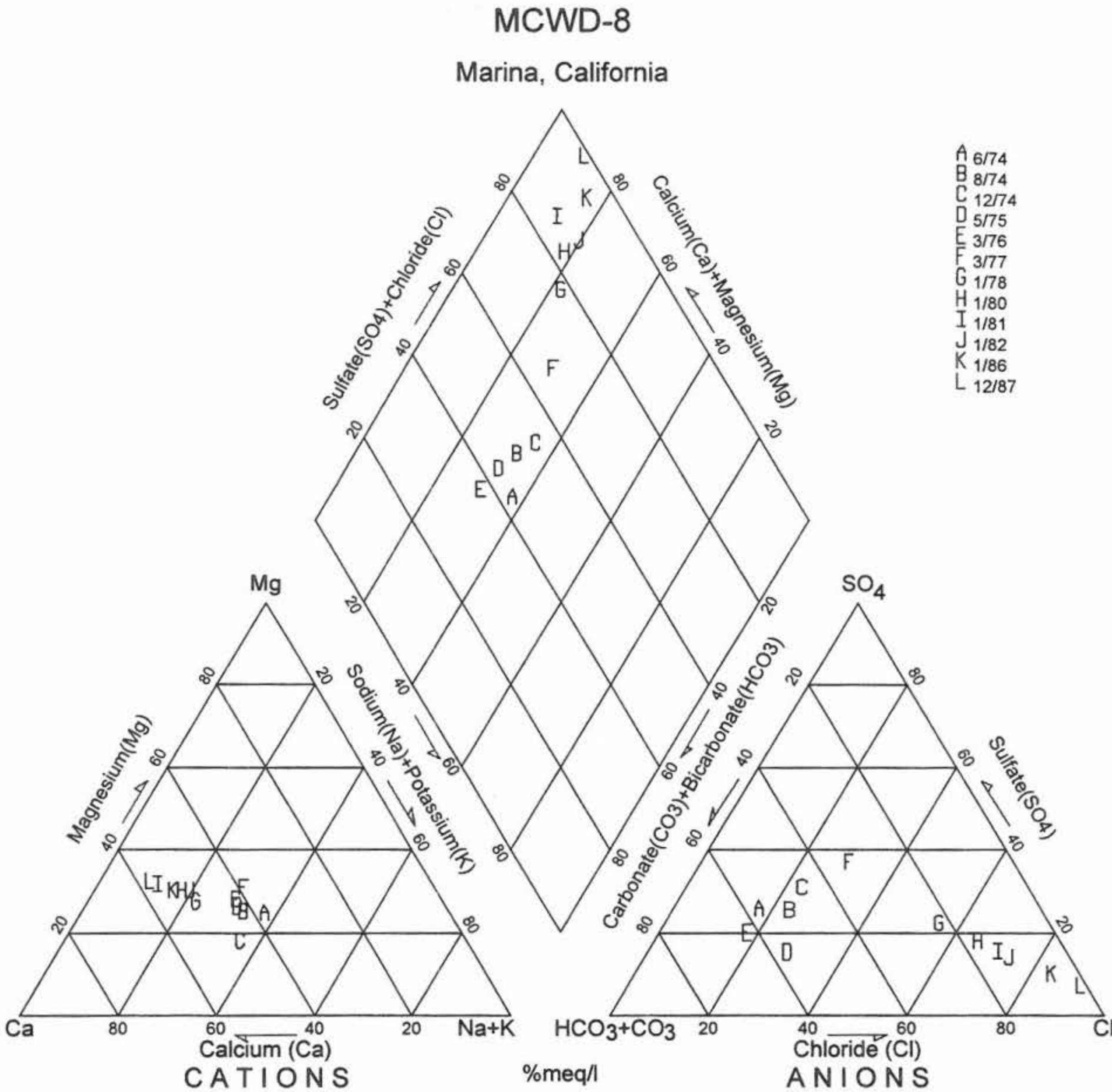



**Piper Diagram**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

Harding ESE
A MACTEC COMPANY

PLATE
**C8**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |

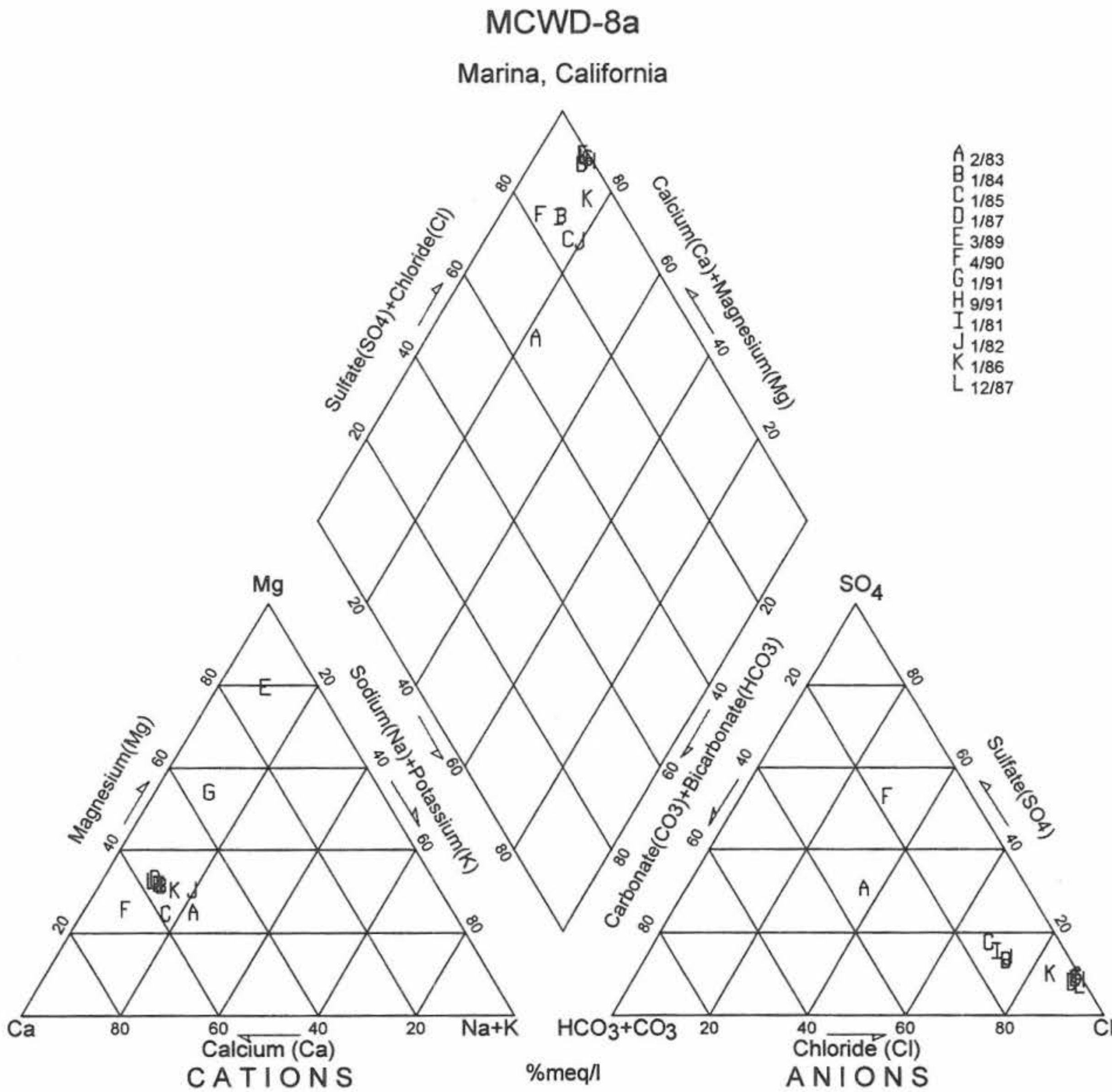



Harding ESE
*A MACTEC Company*

**Piper Diagram**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

PLATE
**C9**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |




Harding ESE
A MACTEC COMPANY

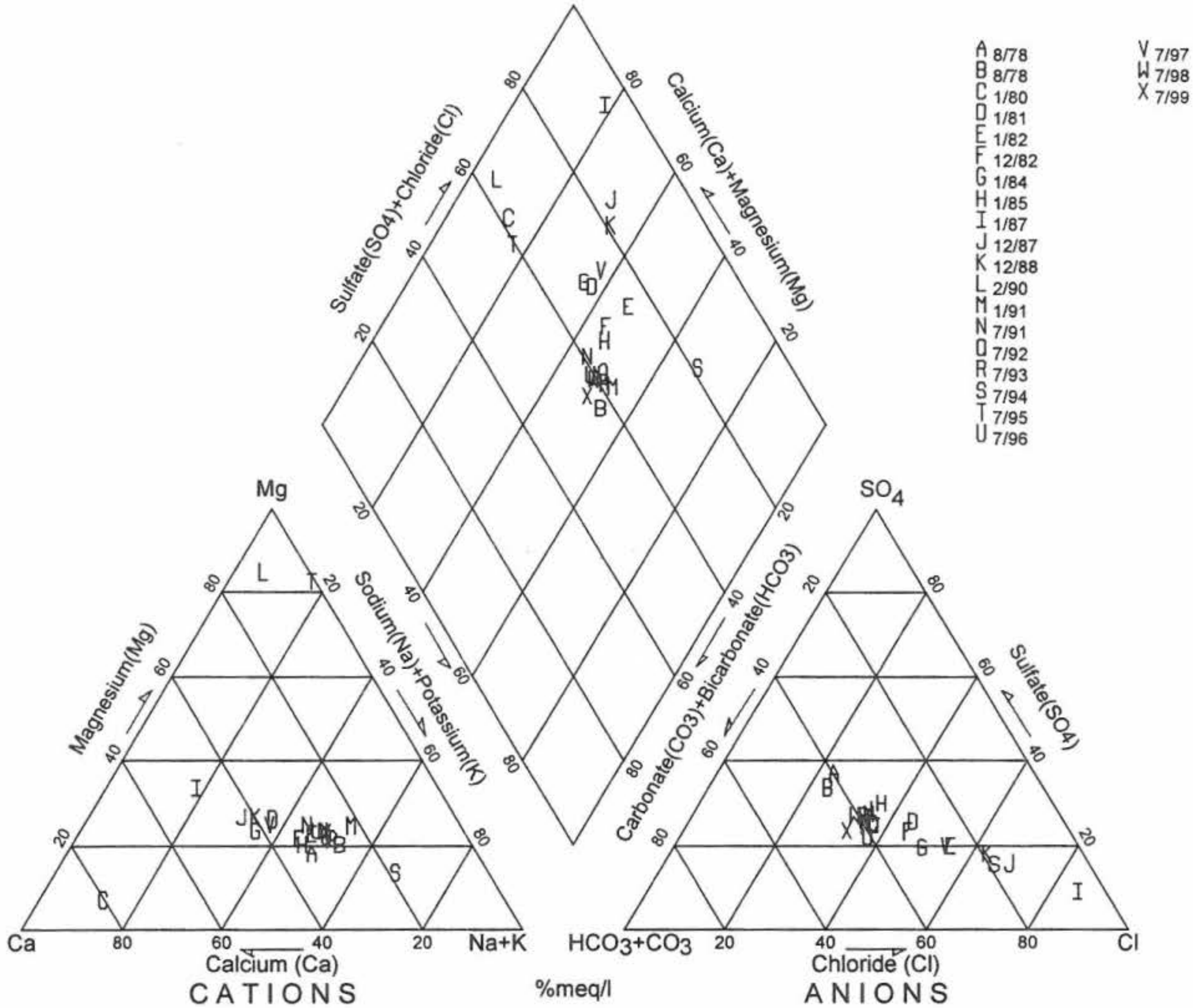
**Piper Diagram**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

PLATE
**C10**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |

# MCWD-9

Marina, California




Harding ESE
A MACTEC COMPANY

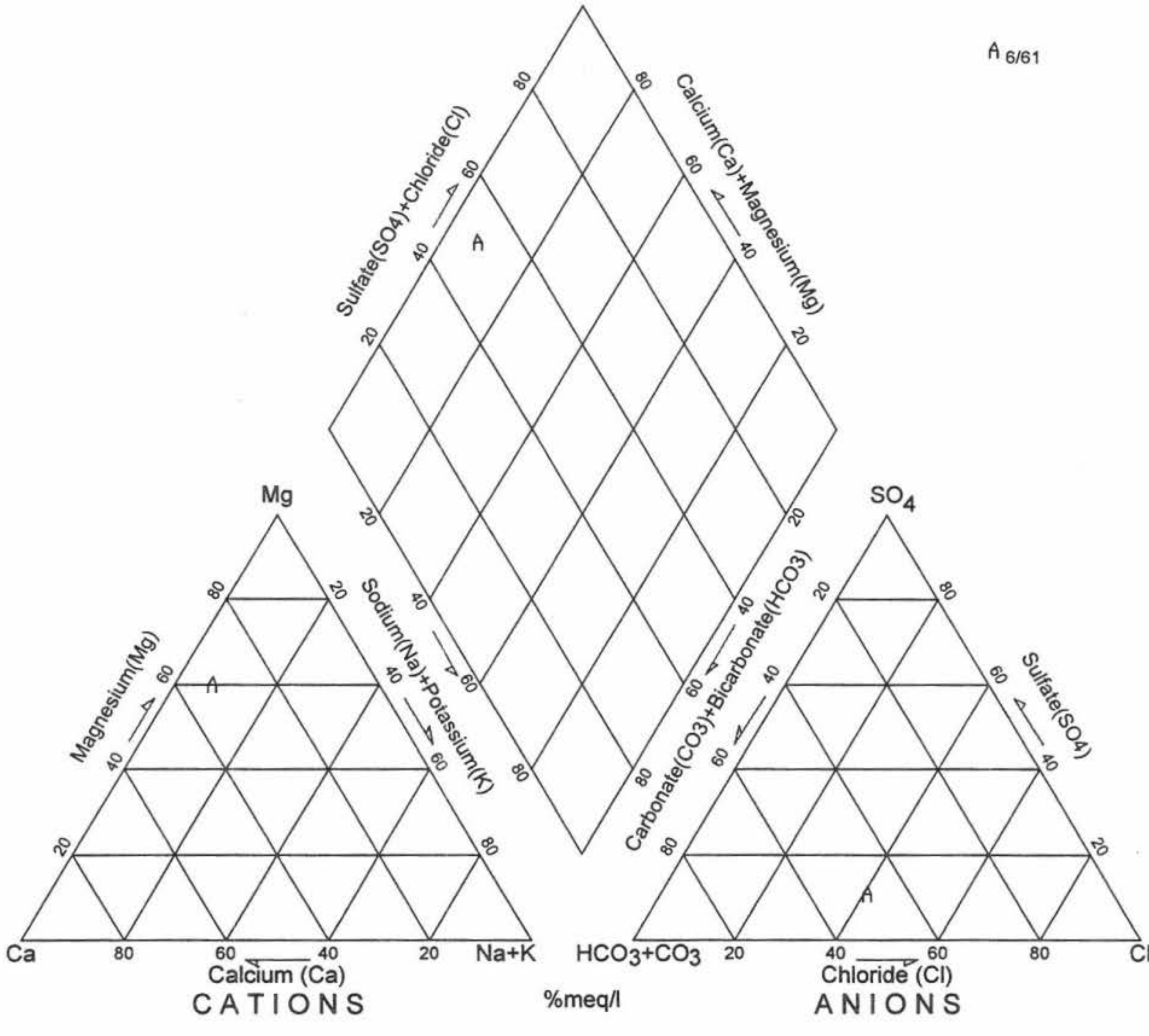
**Piper Diagram**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

PLATE
**C11**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |

# FO-11

Fort Ord, California




Harding ESE
*A MACTEC COMPANY*

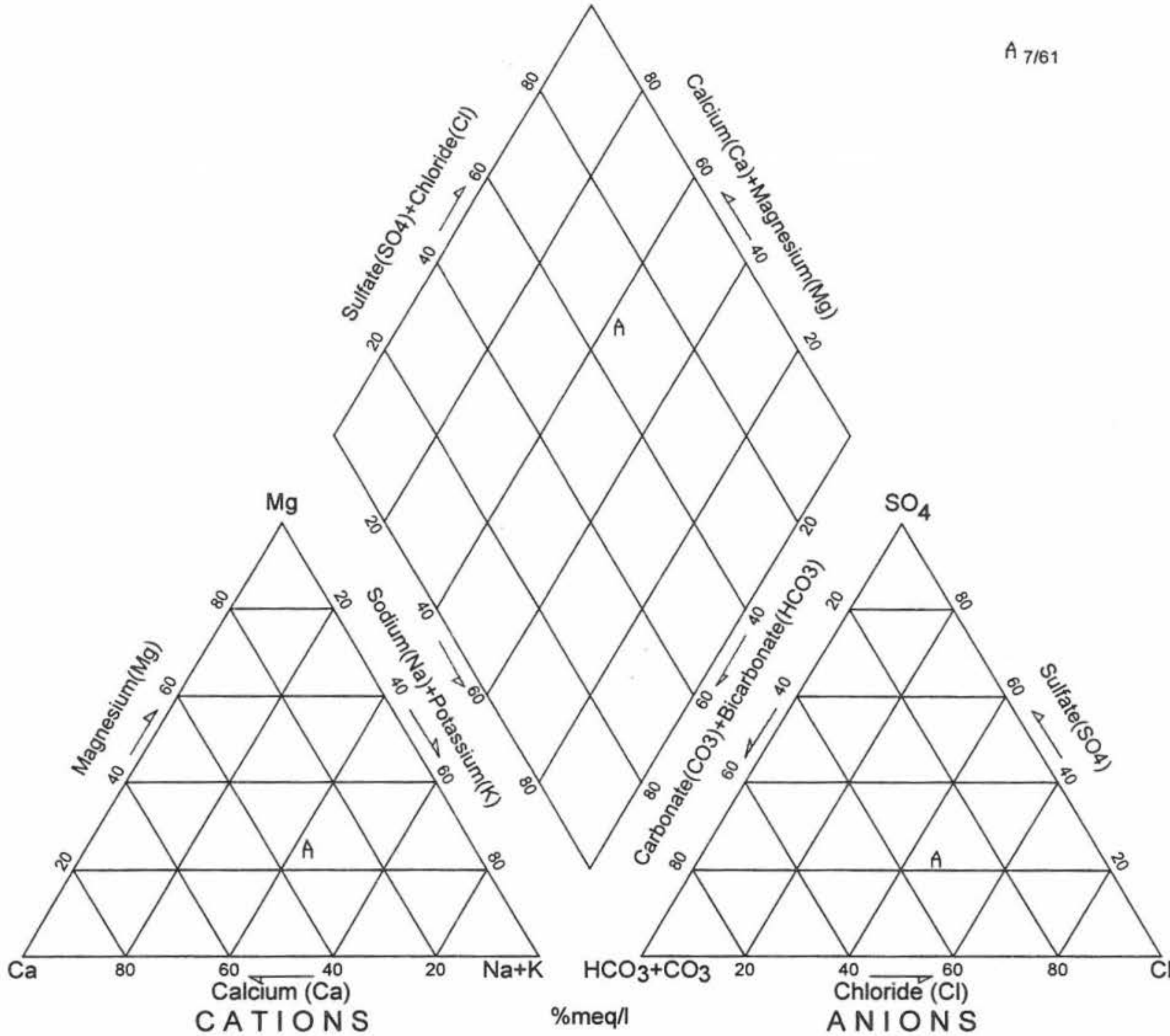
**Piper Diagram**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

PLATE
**C12**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |

# FO-14

Fort Ord, California

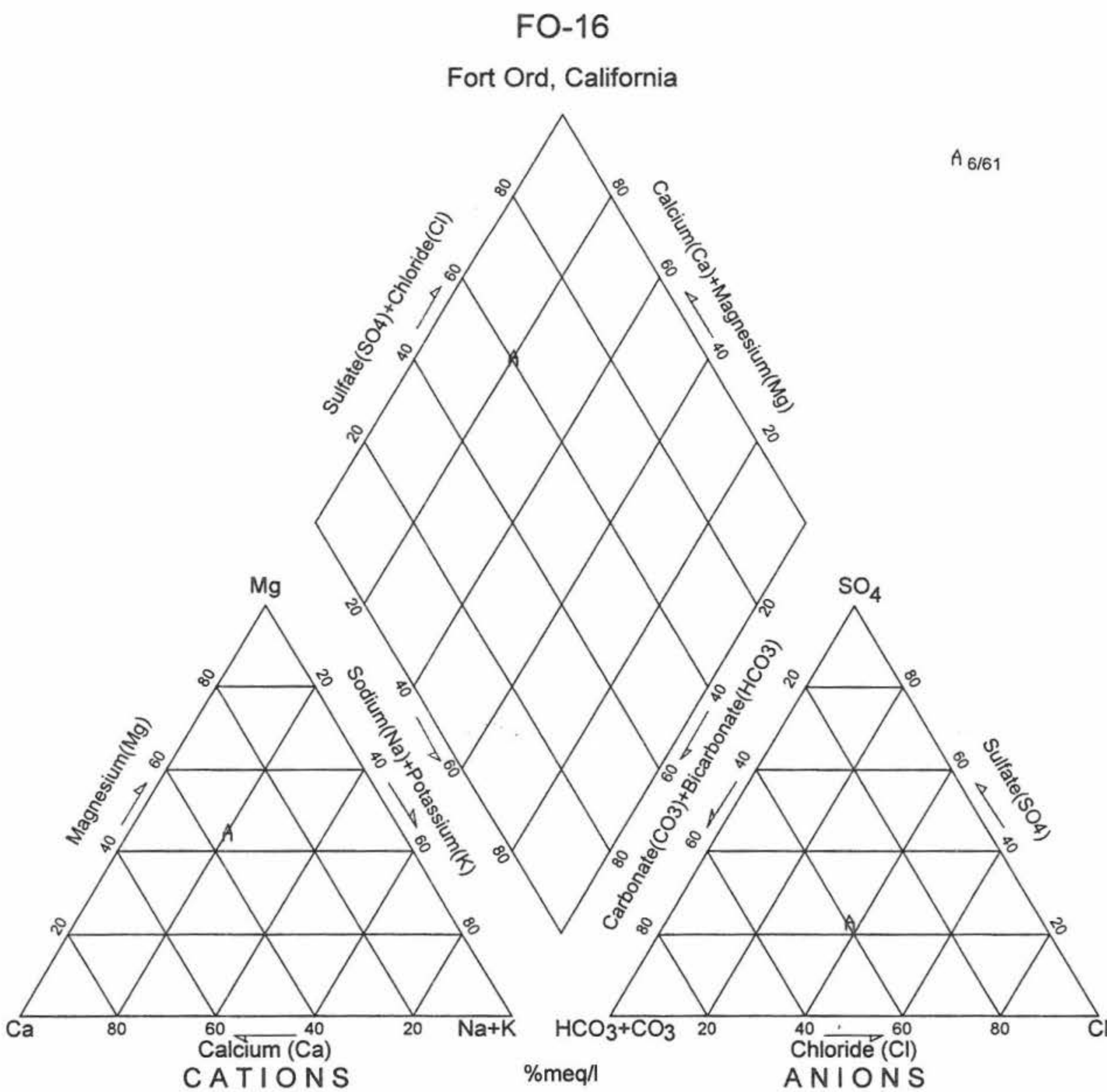



Harding ESE
*A MACTEC COMPANY*

**Piper Diagram**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

PLATE
**C13**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |

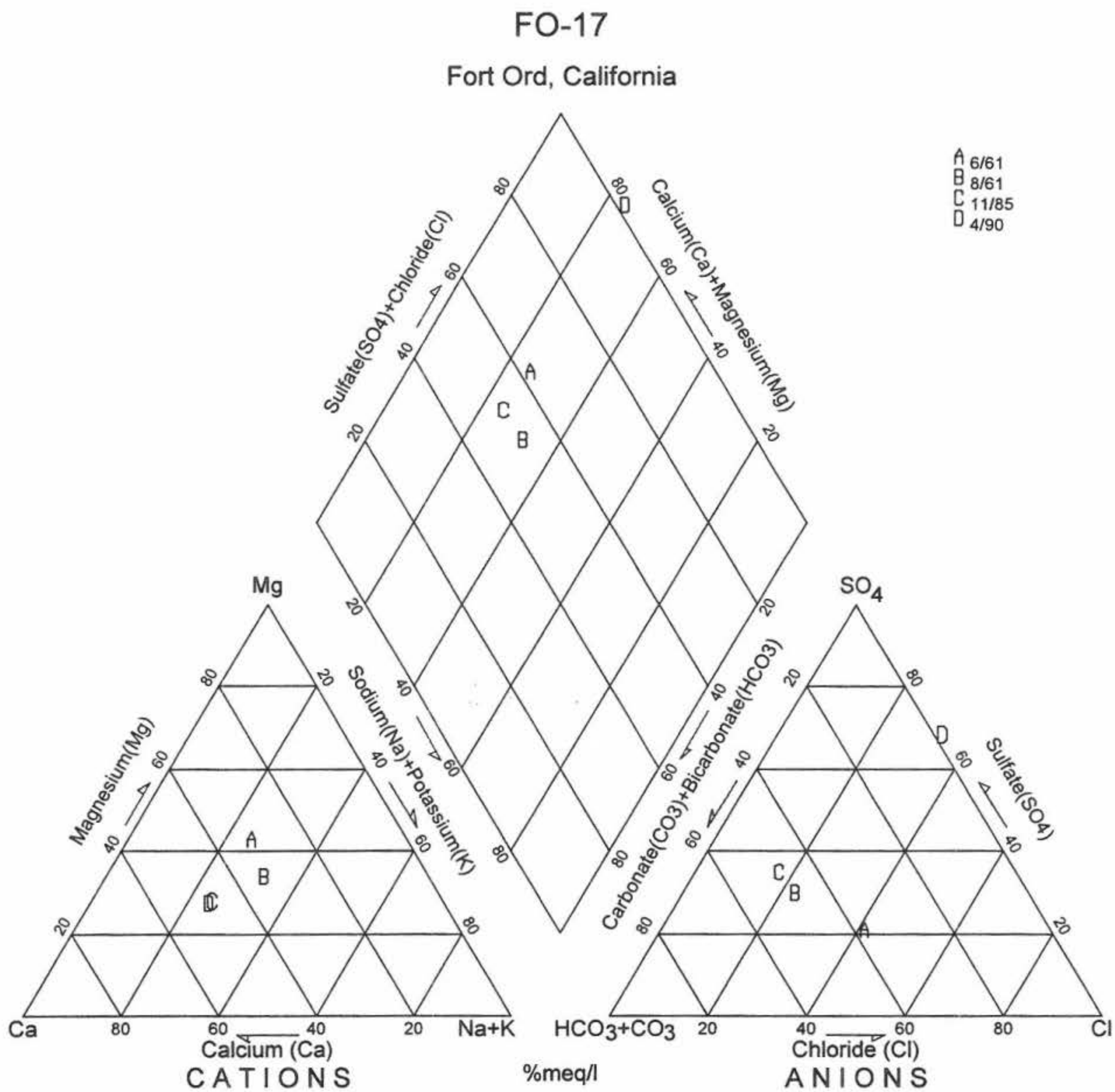



Harding ESE
*A MACTEC COMPANY*

**Piper Diagram**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

PLATE
**C14**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |




**Piper Diagram**

Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

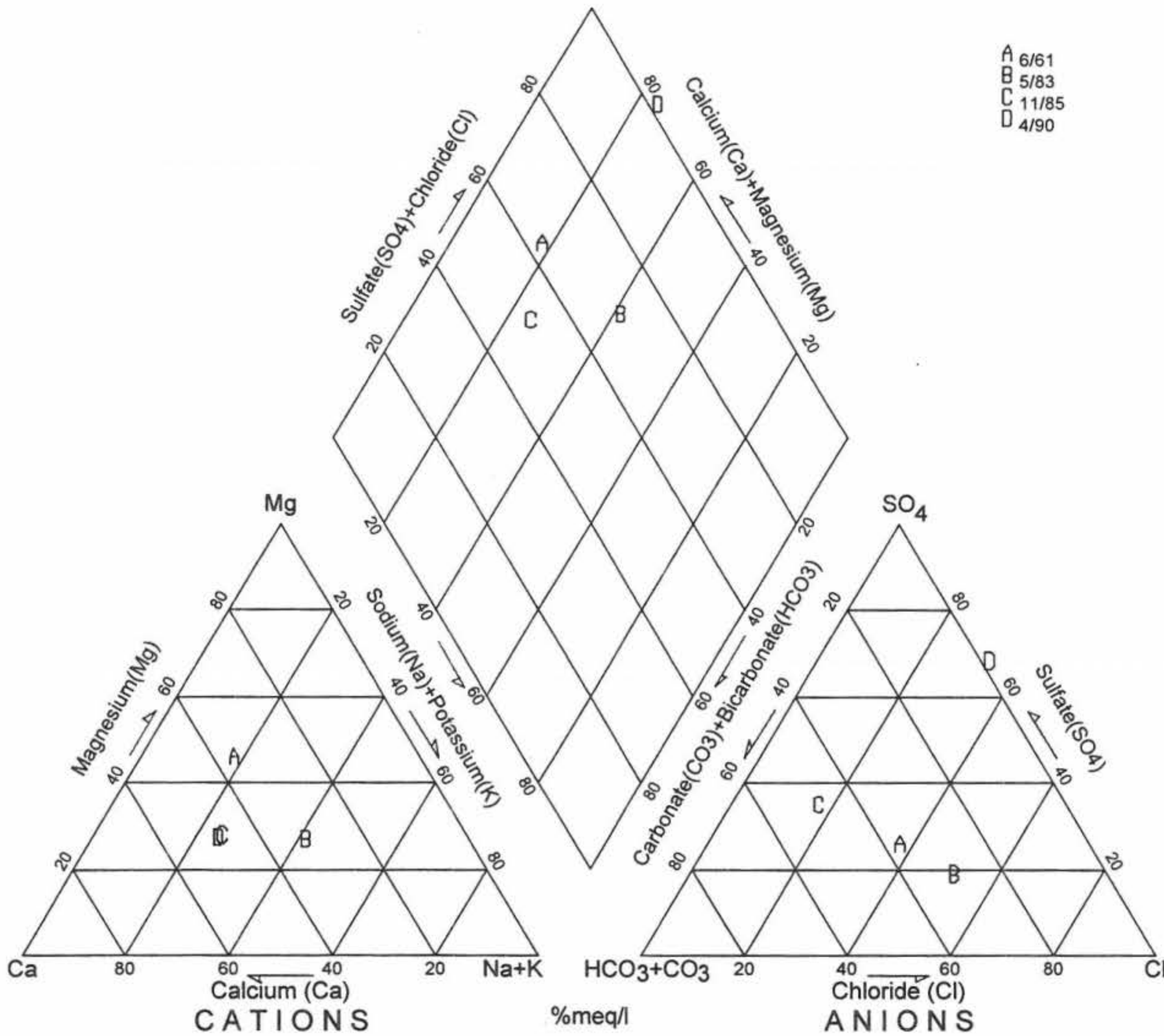
Harding ESE
*A MACTEC Company*

PLATE
**C15**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |

# FO-18

Fort Ord, California



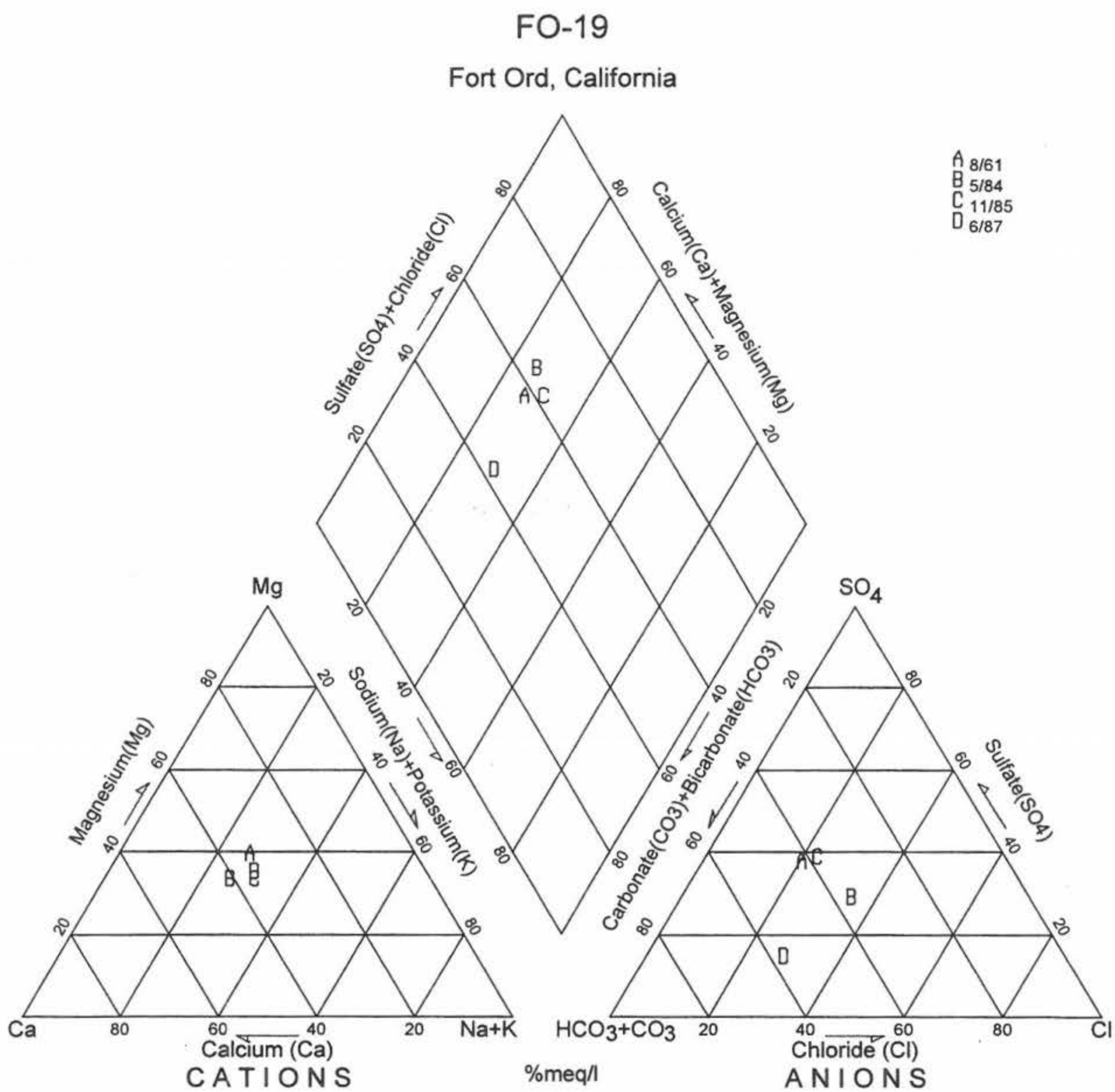

**Piper Diagram**

Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina Salinas Valley, California

Harding ESE
*A MACTEC COMPANY*

PLATE **C16**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |

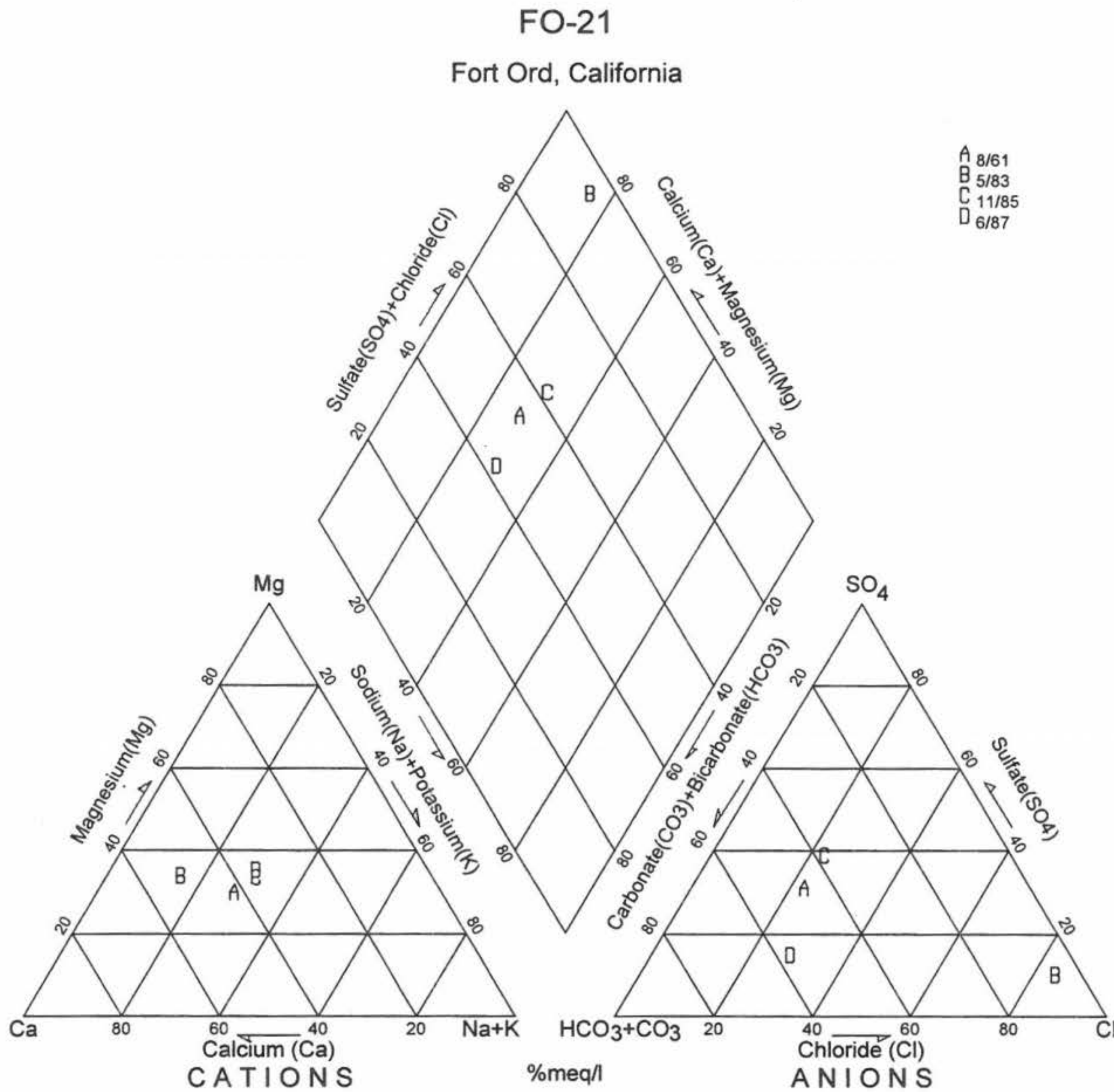



Harding ESE
*A MACTEC COMPANY*

**Piper Diagram**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

PLATE
**C17**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |



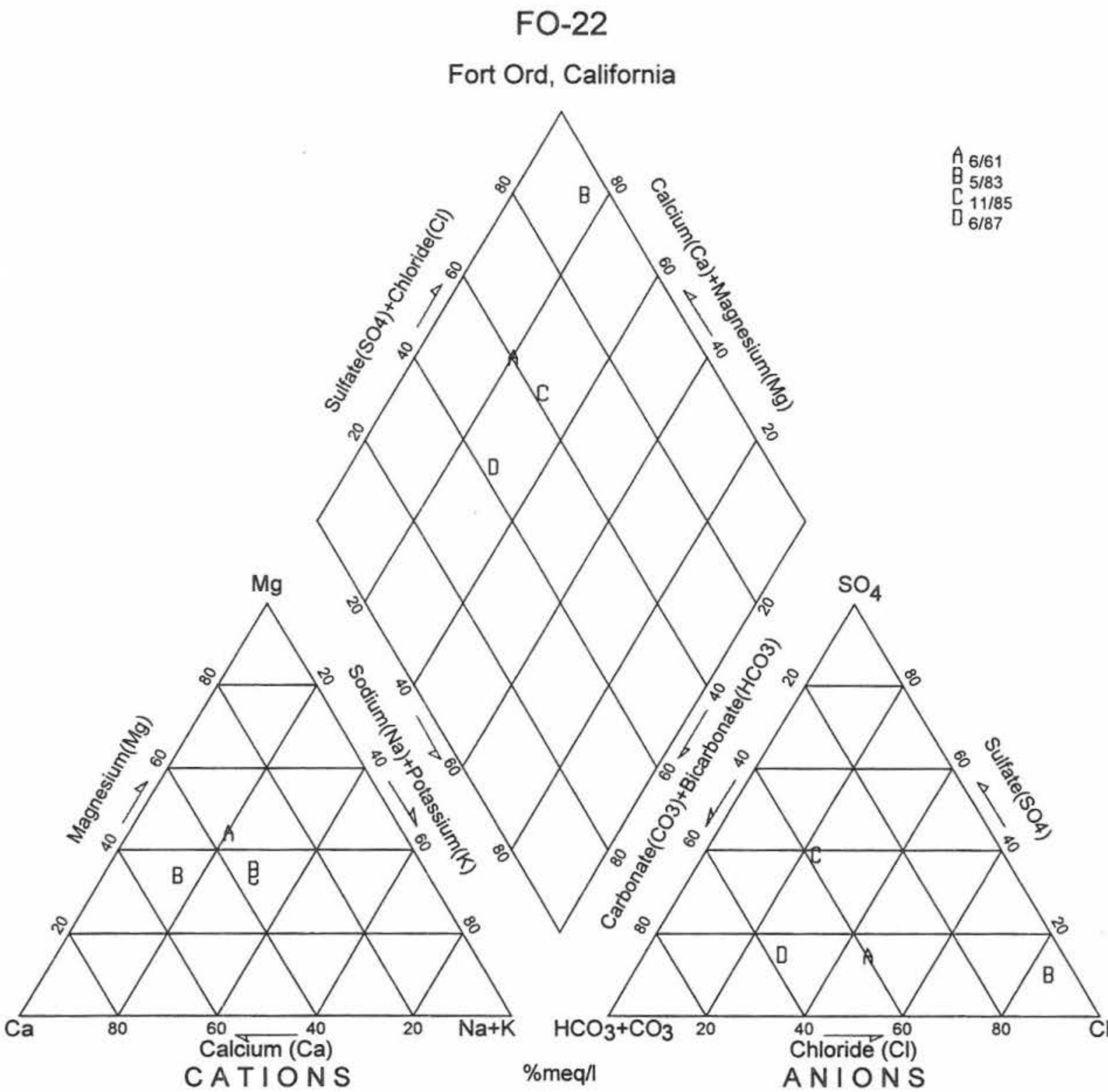

**Piper Diagram**

Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina Salinas Valley, California

Harding ESE
*A MACTEC COMPANY*

PLATE
**C18**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |

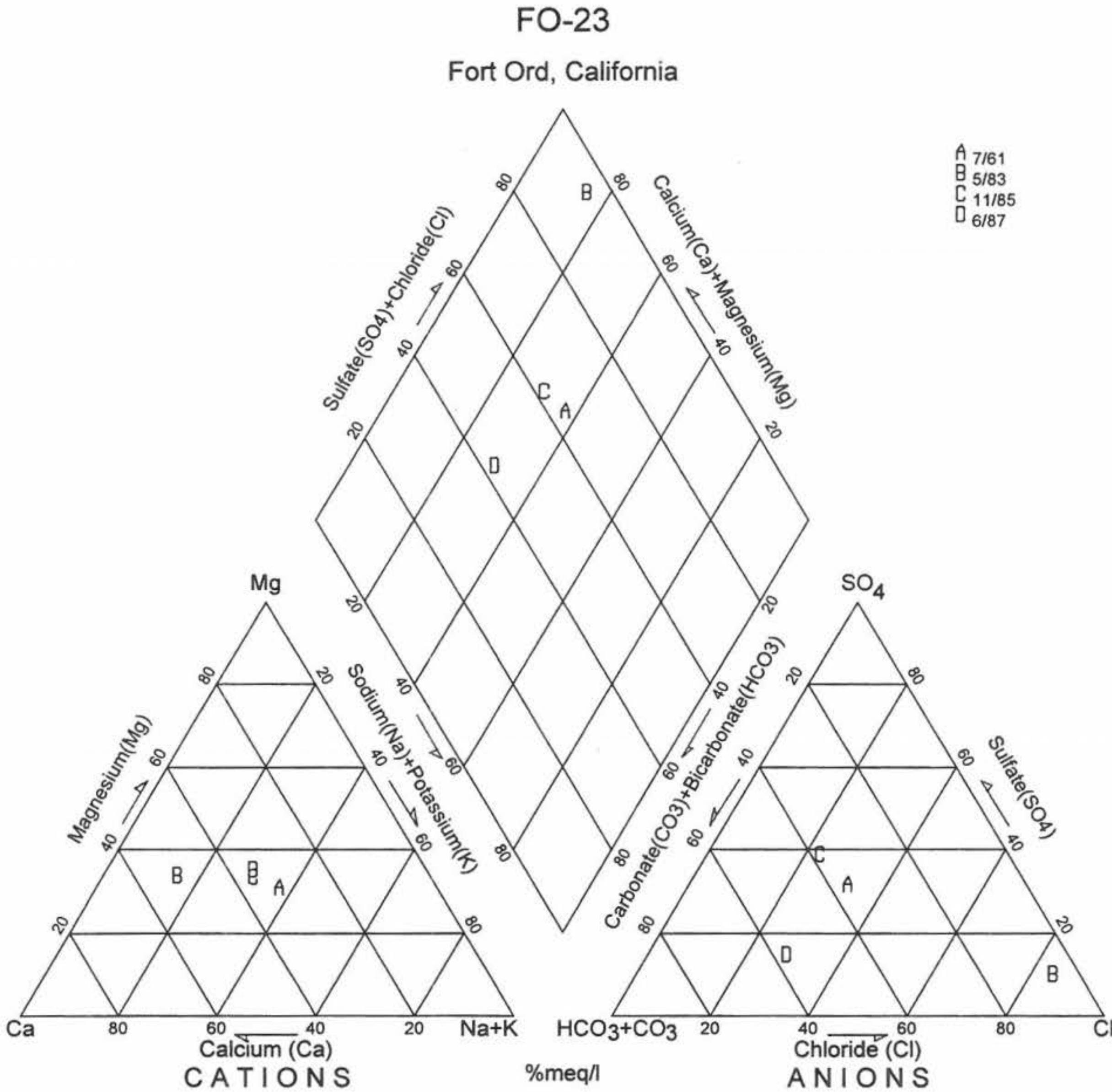



Harding ESE
*A MACTEC COMPANY*

**Piper Diagram**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

PLATE
**C19**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |



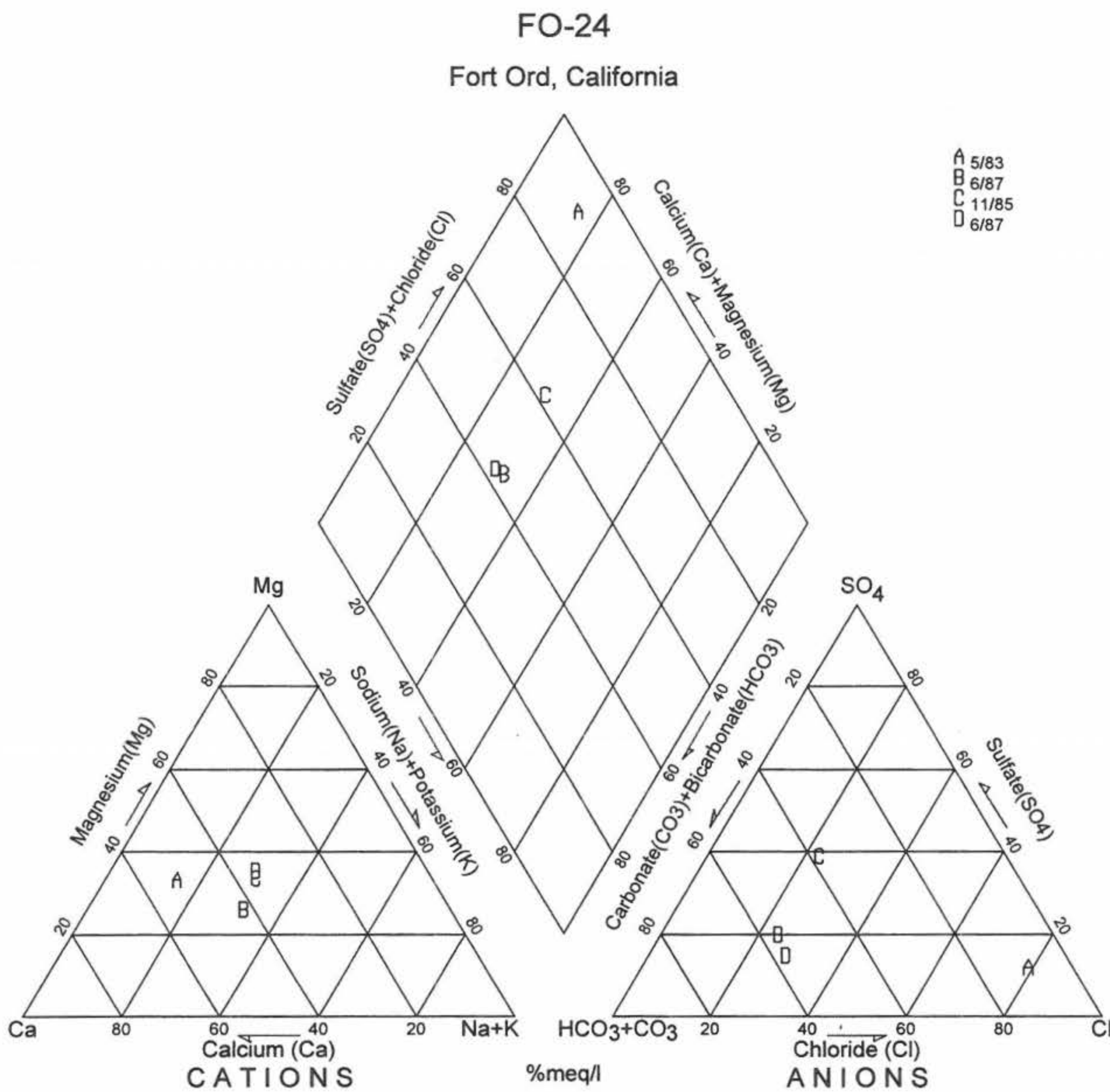

**Piper Diagram**

Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

Harding ESE
A MACTEC COMPANY

PLATE
**C20**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |



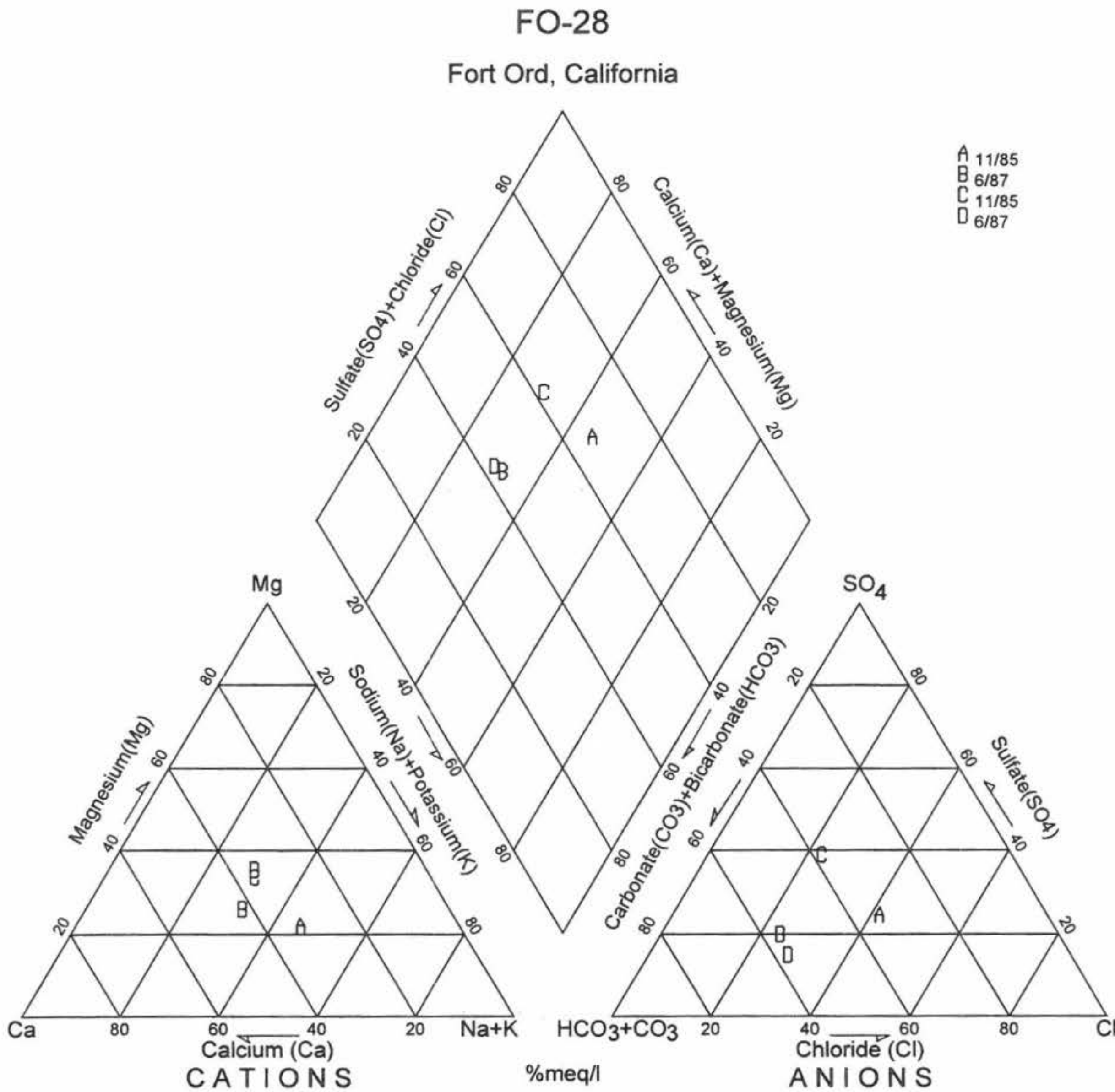

**Piper Diagram**

Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

Harding ESE
*A MACTEC COMPANY*

PLATE
**C21**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |

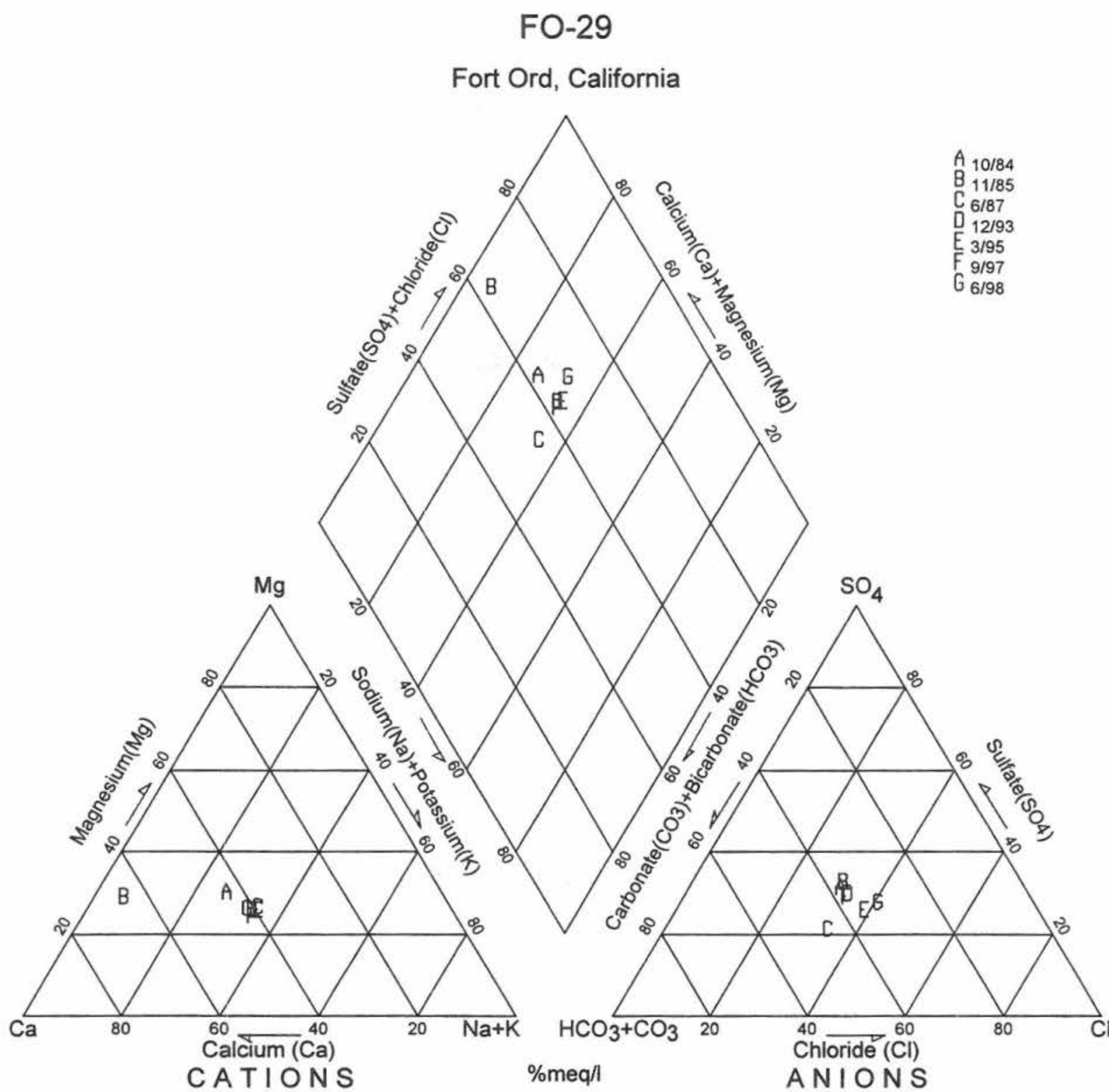



**Piper Diagram**
Hydrogeologic Investigation of the Salinas Valley
Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

Harding ESE
*A MACTEC COMPANY*

PLATE
**C22**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |



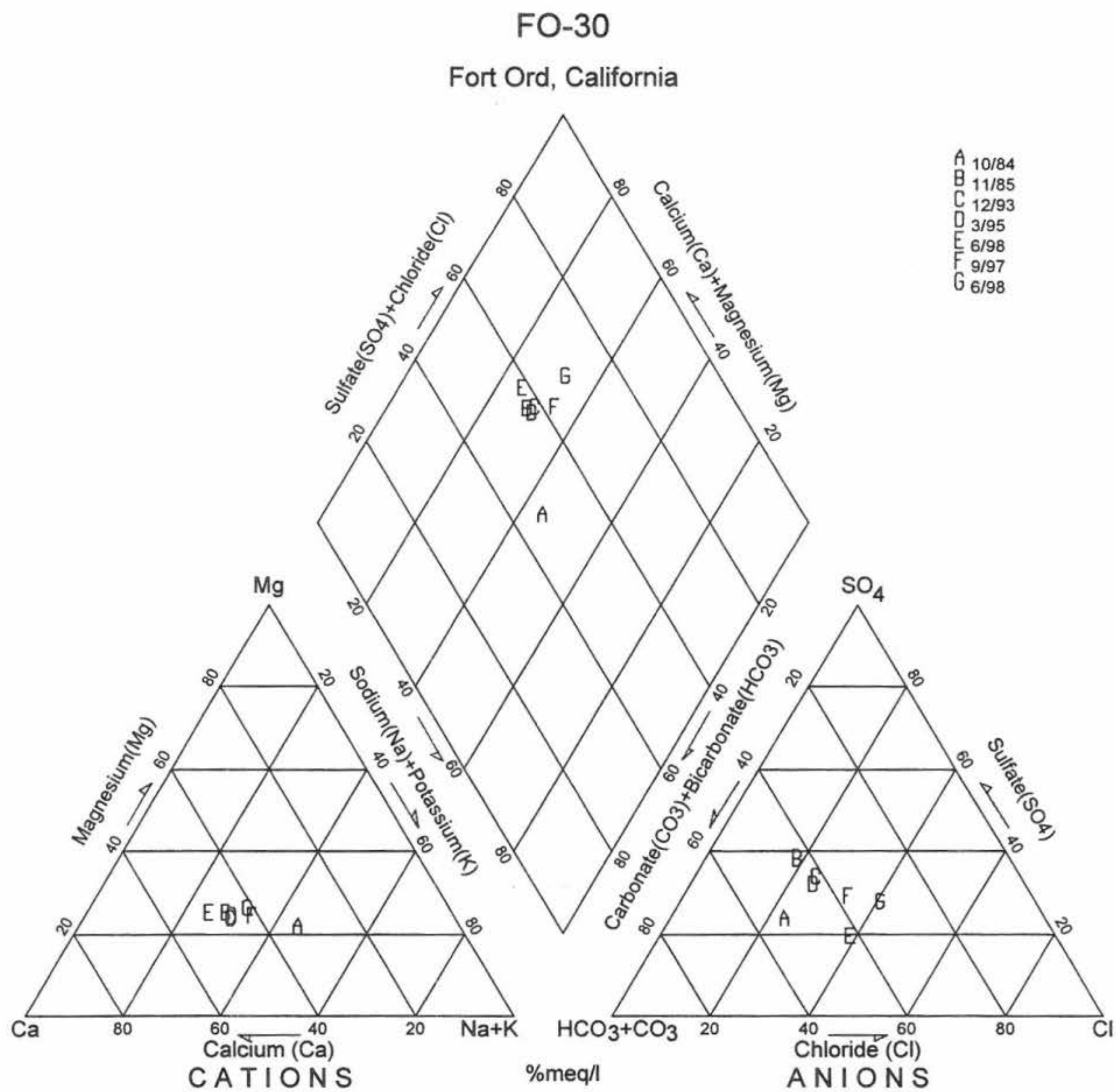

**Piper Diagram**

Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

Harding ESE
*A MACTEC Company*

PLATE
**C23**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |

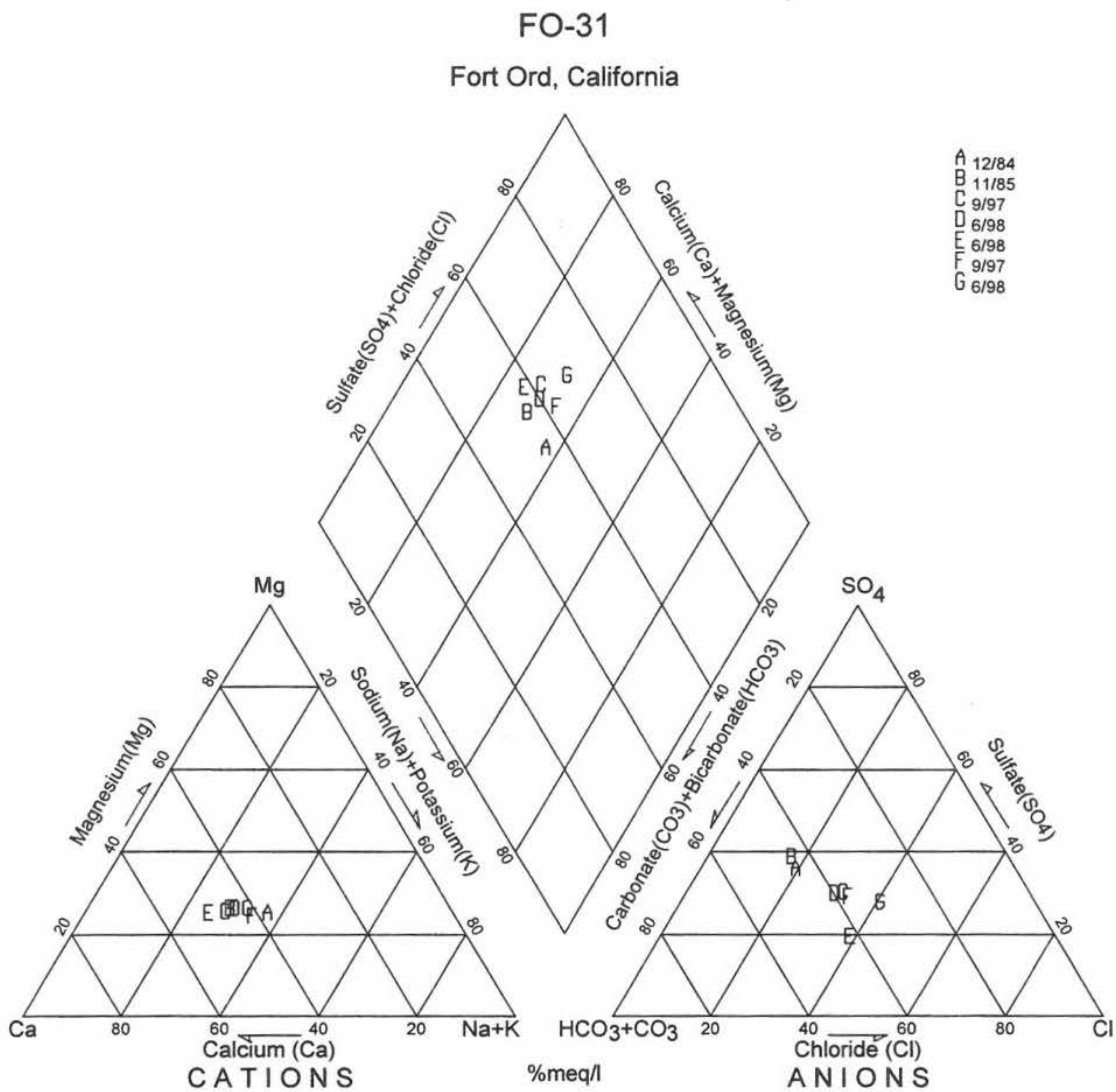



Harding ESE
*A MACTEC COMPANY*

**Piper Diagram**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

PLATE
**C24**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |

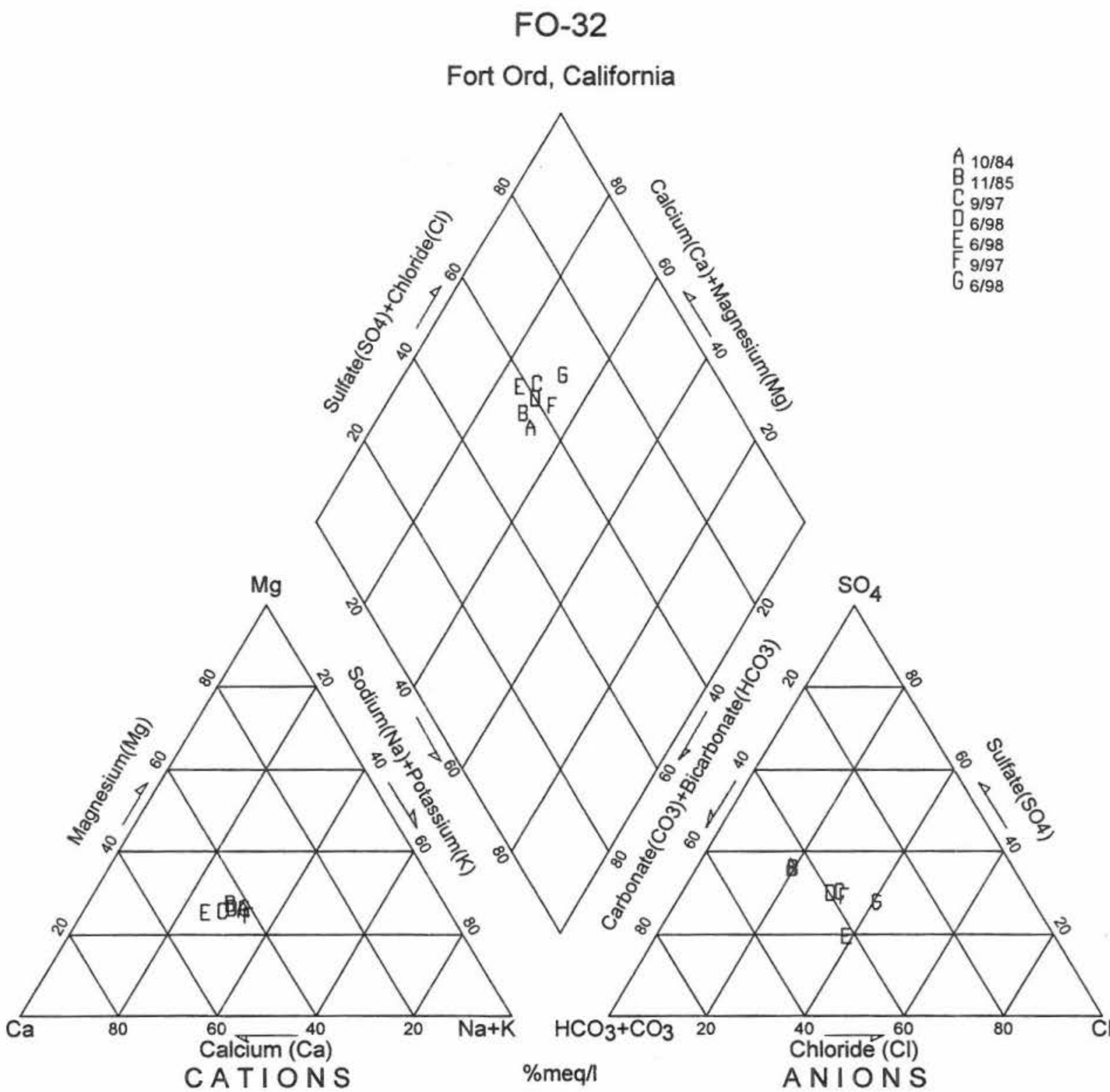



Harding ESE
A MACTEC COMPANY

**Piper Diagram**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

PLATE
**C25**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |




Harding ESE
*A MACTEC COMPANY*

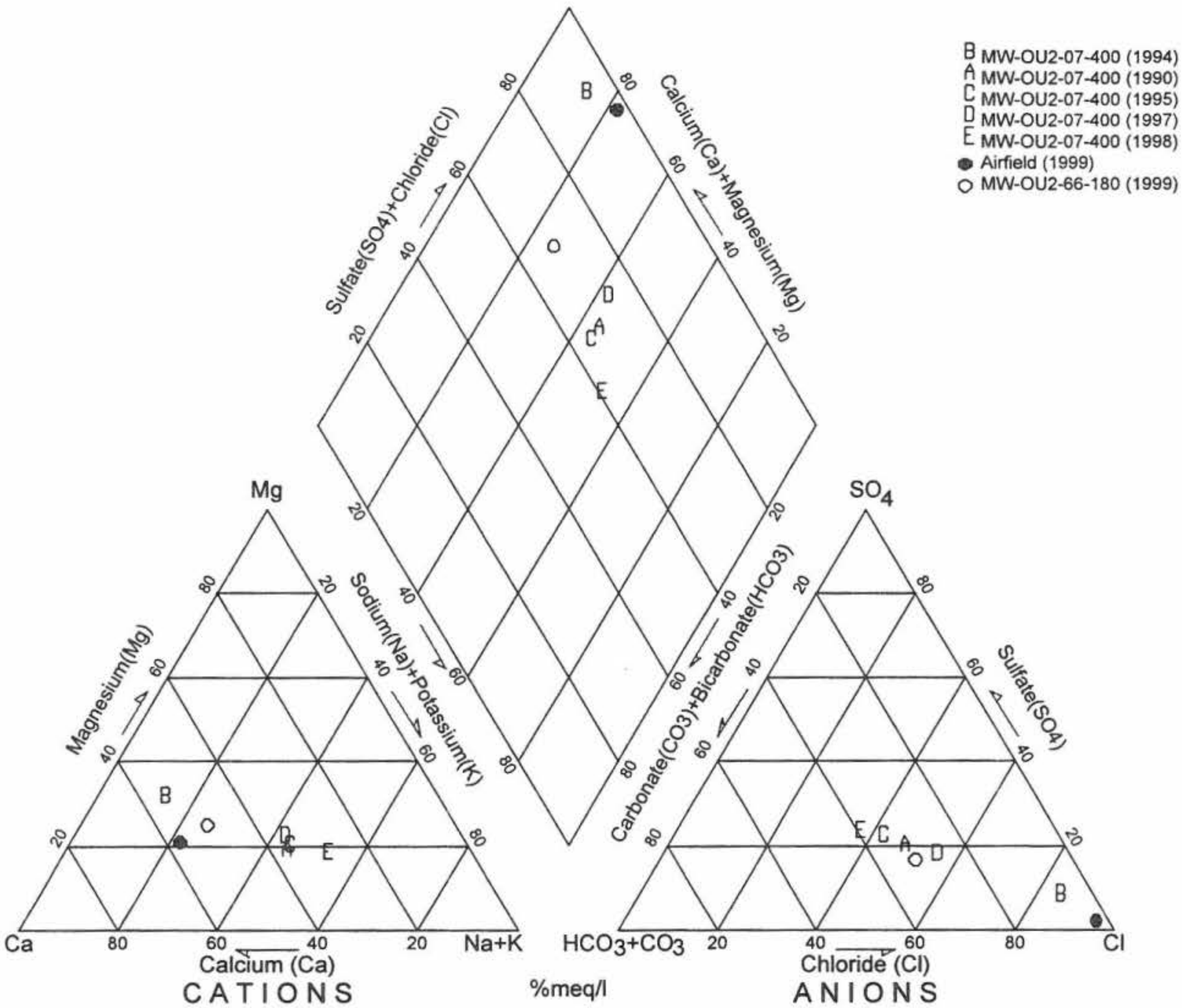
**Piper Diagram**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

PLATE
**C26**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
| --- | --- | --- | --- | --- |
| MDT | 51750.004 | MDT | 1/01 | |

## MW-OU2-07-400, MW-OU2-66-180, and Airfield Wells

Fort Ord, California

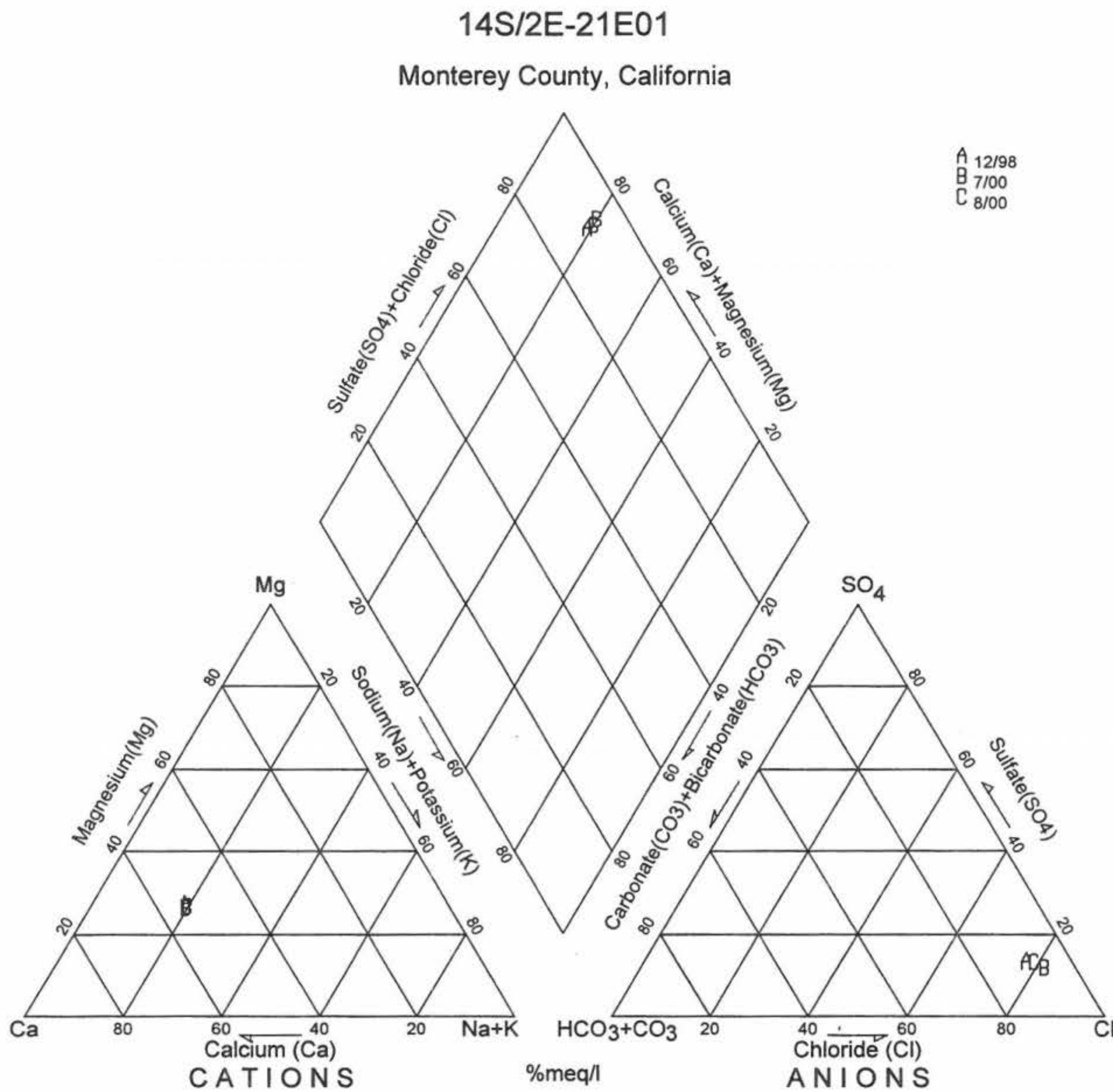



Harding ESE
*A MACTEC COMPANY*

**Piper Diagram**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

PLATE **C27**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |



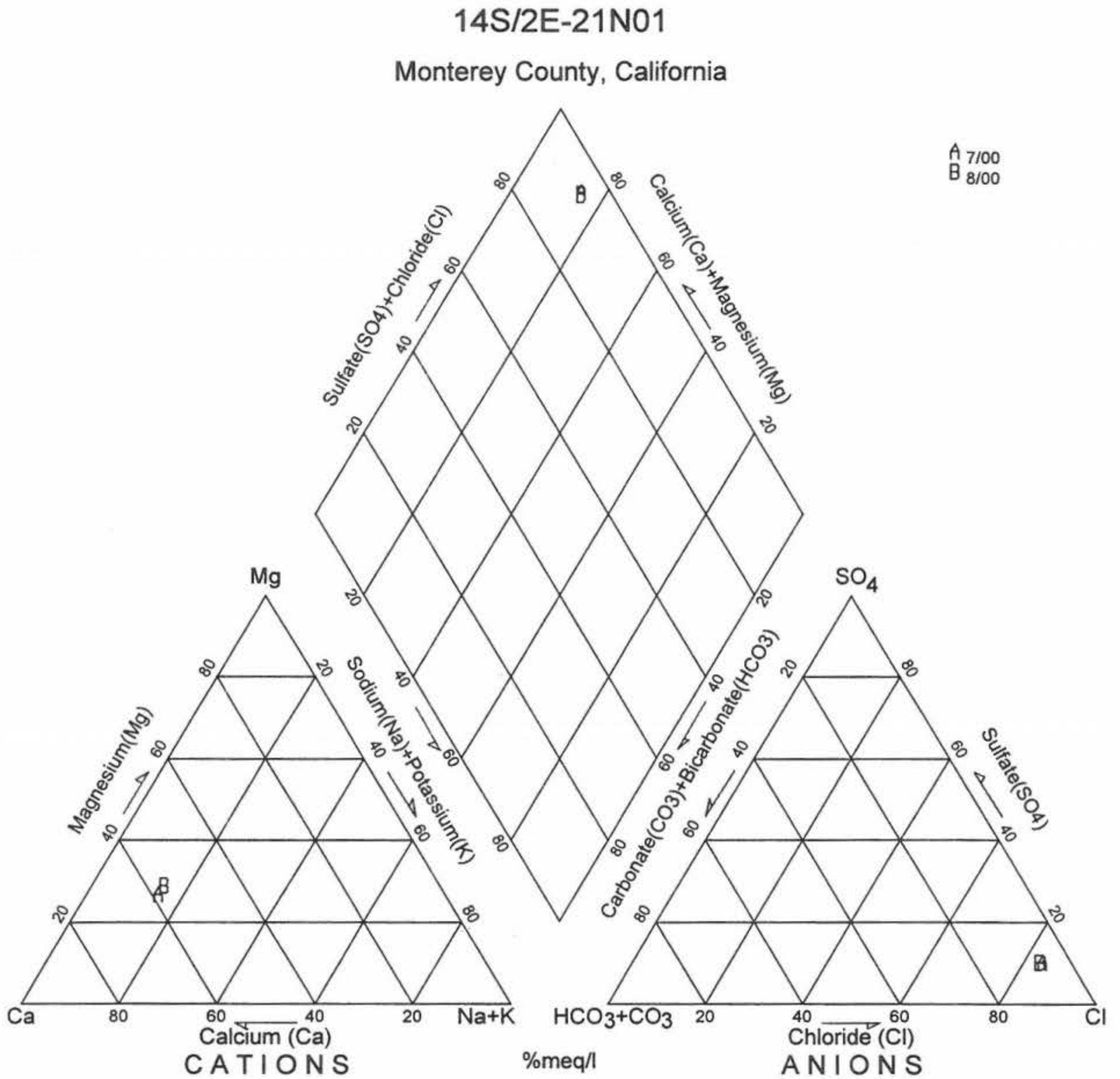

**Piper Diagram**

Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina Salinas Valley, California

Harding ESE
*A MACTEC COMPANY*

PLATE
**C28**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |

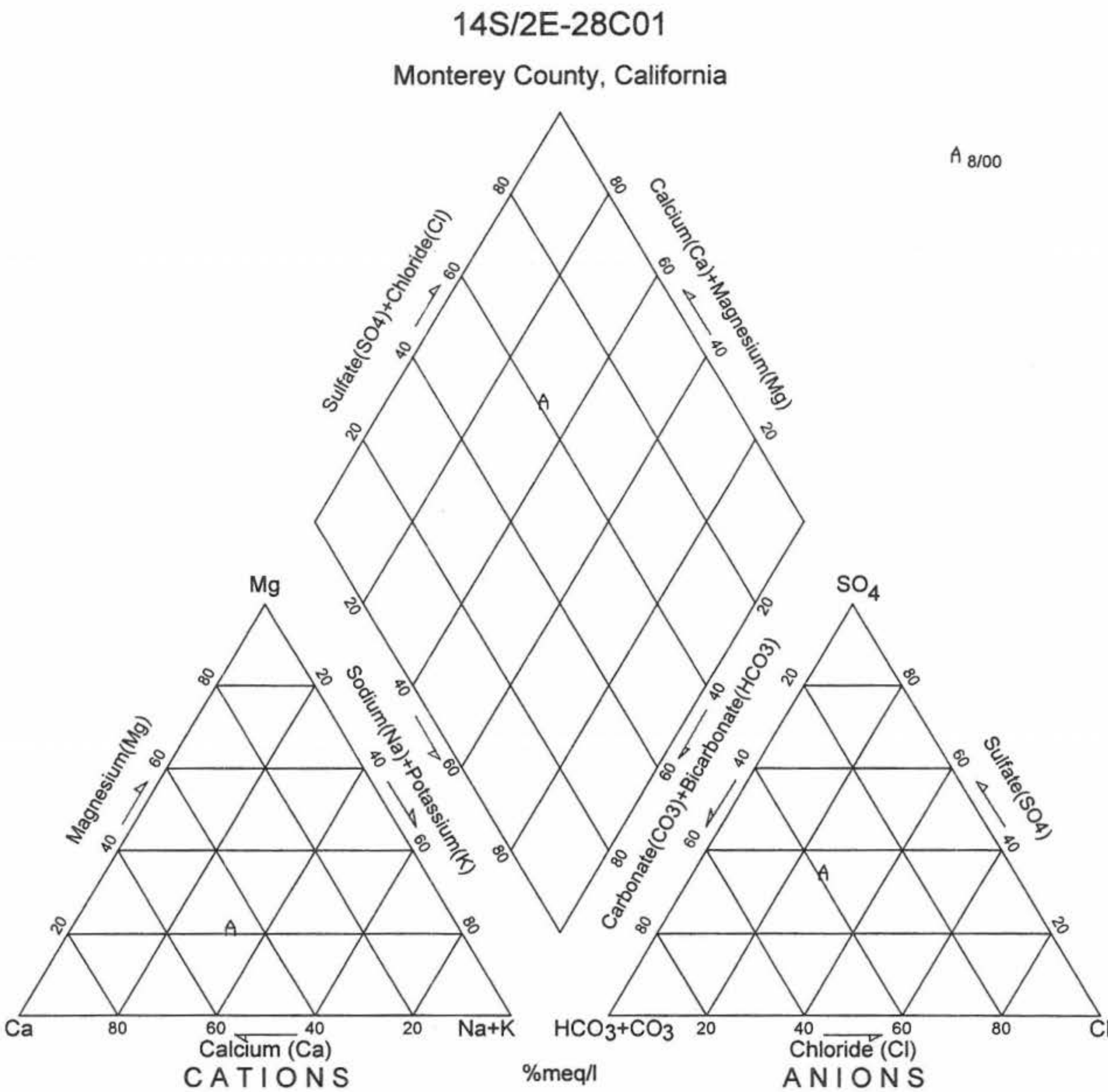



Harding ESE
A MACTEC COMPANY

**Piper Diagram**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

PLATE
**C29**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |




Harding ESE
A MACTEC COMPANY

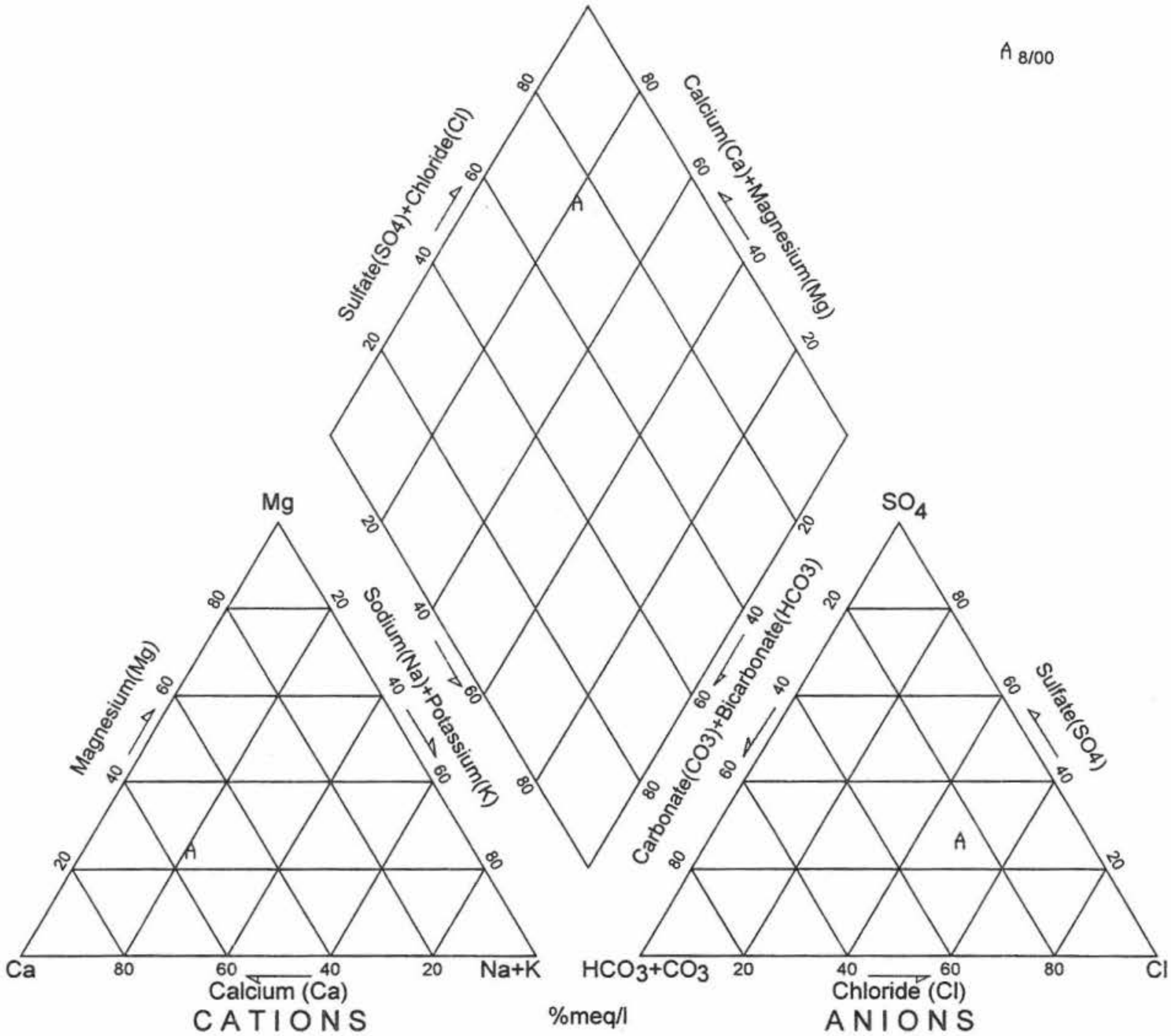
**Piper Diagram**
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

PLATE
**C30**

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |

14S/2E-33P01

Monterey County, California




Harding ESE
A MACTEC COMPANY

**Piper Diagram**

Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Salinas Valley, California

PLATE

C31

| DRAWN | JOB NUMBER | APPROVED | DATE | REVISED DATE |
|---|---|---|---|---|
| MDT | 51750.004 | MDT | 1/01 | |

# APPENDIX D

# INORGANIC DATA SUMMARY

## Appendix D. Inorganic Data Summary
## Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
## Monterey County Water Resources Agency

| Sample Date | Well Name | Sodium (mg/L) | Potassium (mg/L) | Calcium (mg/L) | Magnesium (mg/L) | Chloride (mg/L) | Alkalinity (mg/L) | CO3 (mg/L) | Sulfate (mg/L) | Nitrate (mg/L) | TDS (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 09/03/97 | 14S/2E-21E01 | | | | | 53 | | | | | |
| 08/06/98 | 14S/2E-21E01 | | | | | 660 | | | | | |
| 08/20/98 | 14S/2E-21E01 | | | | | 660 | | | | | |
| 12/29/98 | 14S/2E-21E01 | 81 | 5.4 | 214 | 60 | 536 | 130 | | 110 | 10 | |
| 01/27/99 | 14S/2E-21E01 | | | | | 770 | | | | | |
| 04/30/99 | 14S/2E-21E01 | | | | | 605 | | | | | |
| 06/17/99 | 14S/2E-21E01 | | | | | 620 | | | | | |
| 08/05/99 | 14S/2E-21E01 | | | | | 625 | | | | | |
| 09/20/99 | 14S/2E-21E01 | | | | | 680 | | | | | |
| 10/28/99 | 14S/2E-21E01 | | | | | 610 | | | | | |
| 07/14/00 | 14S/2E-21E01 | 102 | 5.9 | 260 | 70 | 731 | 124 | | 123 | 16 | |
| 08/15/00 | 14S/2E-21E01 | 93 | 5.6 | 234 | 64 | 616 | 126 | | 123 | 14 | |
| 09/01/97 | 14S/2E-21N01 | | | | | 170 | | | | | |
| 10/02/97 | 14S/2E-21N01 | | | | | 174 | | | | | |
| 01/13/98 | 14S/2E-21N01 | | | | | 196 | | | | | |
| 04/23/98 | 14S/2E-21N01 | | | | | 196 | | | | | |
| 06/30/98 | 14S/2E-21N01 | | | | | 230.5 | | | | | |
| 10/15/98 | 14S/2E-21N01 | | | | | 266 | | | | | |
| 01/26/99 | 14S/2E-21N01 | | | | | 366 | | | | | |
| 05/21/99 | 14S/2E-21N01 | | | | | 333 | | | | | |
| 07/27/99 | 14S/2E-21N01 | | | | | 400 | | | | | |
| 08/17/99 | 14S/2E-21N01 | | | | | 439 | | | | | |
| 09/08/99 | 14S/2E-21N01 | | | | | 458 | | | | | |
| 10/19/99 | 14S/2E-21N01 | | | | | 468 | | | | | |
| 07/14/00 | 14S/2E-21N01 | 76 | 5.6 | 283 | 71 | 740 | 118 | | 98 | 5 | |
| 08/22/00 | 14S/2E-21N01 | 79 | 5.9 | 281 | 80 | 702 | 118 | | 96 | 3 | |
| 08/15/00 | 14S/2E-28C01 | 45 | 3 | 61 | 15 | 56 | 146 | | 93 | 2 | |
| 08/15/00 | 14S/2E-33P01 | 32 | 2.8 | 79 | 19 | 110 | 104 | | 75 | 4 | |
| 06/28/61 | FO-11 | 9 | | 36 | 37 | 71 | 150 | | 21 | | |
| 1975 | FO-11 | | | | | 100 | | | | | |
| 07/18/61 | FO-14 | 46 | | 32 | 13 | 71 | 90 | | 43 | | |
| 1975 | FO-14 | | | | | 300 | | | | | |
| 05/21/84 | FO-14 | | | | | 268 | | | | 9.3 | |
| 06/29/61 | FO-16 | 25 | | 40 | 28 | 64 | 120 | | 48 | | |
| 06/29/61 | FO-17 | 28 | | 32 | 24 | 64 | 105 | | 40 | | |
| 08/21/61 | FO-17 | 44 | | 42 | 23 | 43 | 160 | | 72 | | |
| 11/04/85 | FO-17 | 55.4 | | 95.1 | 30.8 | 52 | 257 | | 135 | 0.38 | |
| 04/10/90 | FO-17 | 50 | | 90 | 28 | 63 | | | 170 | 1 | |
| 06/29/61 | FO-18 | 23 | | 42 | 30 | 68 | 120 | | 60 | | |
| 1975 | FO-18 | | | | | 350 | | | | | |
| 05/16/83 | FO-18 | 50.5 | | 35.2 | 16.3 | 84 | 89 | | 38 | 32.3 | |
| 11/13/84 | FO-18 | | | | | 88 | | | | 30.1 | |
| 08/02/61 | FO-19 | 40 | | 46 | 30 | 43 | 160 | | 105 | | |
| 1975 | FO-19 | | | | | 95 | | | | | |
| 05/21/84 | FO-19 | 63.6 | | 91.4 | 41.7 | 98 | 183 | | 105 | 4.3 | |
| 11/04/85 | FO-19 | 52.2 | | 55.4 | 28.6 | 57 | 169 | | 124 | 2 | |
| 05/13/86 | FO-19 | | | | | 50 | | | | | |
| 06/17/87 | FO-19 | 50 | | 54 | 30 | 53 | 190 | | 33 | | |
| 08/02/61 | FO-21 | 34 | | 46 | 18 | 39 | 140 | | 67 | | |
| 05/16/83 | FO-21 | 75.8 | | 230 | 85.5 | 635 | 90 | | 85 | 22.1 | |
| 05/21/84 | FO-21 | | | | | 830 | | | | | |
| 08/28/84 | FO-21 | | | | | | | | | 14.2 | |
| 06/29/61 | FO-22 | 20 | | 32 | 22 | 64 | 100 | | 24 | | |
| 07/18/61 | FO-23 | 46 | | 36 | 19 | 57 | 115 | | 72 | | |
| 1975 | FO-23 | | | | | 130 | | | | | |
| 05/21/84 | FO-23 | | | | | 147 | | | | 12 | |
| 04/02/90 | FO-23 | | | | | 85 | | | | 29 | |
| 1975 | FO-24 | | | | | 140 | | | | | |
| 05/16/83 | FO-24 | 61.7 | | 193 | 68.8 | 490 | 115 | | 84 | 9.7 | |
| 05/21/84 | FO-24 | | | | | 483 | | | | 9.3 | |

## Appendix D. Inorganic Data Summary
## Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
## Monterey County Water Resources Agency

| Sample Date | Well Name | Sodium (mg/L) | Potassium (mg/L) | Calcium (mg/L) | Magnesium (mg/L) | Chloride (mg/L) | Alkalinity (mg/L) | CO3 (mg/L) | Sulfate (mg/L) | Nitrate (mg/L) | TDS (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1985 | FO-24 | | | | | 690 | | | | | |
| 06/17/87 | FO-24 | 45 | | 54 | 18 | 41 | 170 | | 42 | | |
| 04/10/90 | FO-24 | | | | | 86 | | | | 1 | |
| 1975 | FO-25 | | | | | 150 | | | | | |
| 1975 | FO-26 | | | | | 100 | | | | | |
| 05/21/84 | FO-26 | | | | | 247 | | | | 32.3 | |
| 1984 | FO-26 | | | | | 1600 | | | | | |
| 1985 | FO-26 | | | | | 132 | | | | | |
| 1975 | FO-27 | | | | | 60 | | | | | |
| 05/21/84 | FO-27 | | | | | 280 | | | | 8.4 | |
| 1985 | FO-27 | | | | | 936 | | | | | |
| 1975 | FO-28 | | | | | 60 | | | | | |
| 11/04/85 | FO-28 | 46.7 | | 30.2 | 11 | 57 | 83 | | 42 | 9.7 | |
| 08/02/61 | FO-29 | | | | | 53 | | | | | |
| 05/16/83 | FO-29 | | | | | 67 | | | | 12 | |
| 10/30/84 | FO-29 | 40 | | 60 | 23 | 63 | 136 | | 81.5 | 12.8 | |
| 11/05/85 | FO-29 | 0.1 | | 1 | 0.25 | 61 | 128 | | 83 | 53.2 | |
| 03/19/86 | FO-29 | | | | | | | | | 3.7 | |
| 06/17/87 | FO-29 | 42 | 4 | 46 | 17 | 54 | 130 | | 42.6 | 4.4 | 340 |
| 04/10/90 | FO-29 | | | | | 65 | | | | 3.6 | |
| 12/07/93 | FO-29 | 41.3 | 2.58 | 47.2 | 16.3 | 62 | 122 | | 70.3 | 0.94 | 385 |
| 03/14/95 | FO-29 | 42.033 | 2.928 | 45.091 | 16.152 | 65.6 | 108 | | 55.9 | 1.4 | 390 |
| 09/03/97 | FO-29 | 47.7 | 2.6 | 53.6 | 17.3 | 60.4 | 122 | | 67.6 | 1.2 | 403 |
| 06/09/98 | FO-29 | 39.6 | | 45.6 | 15.8 | 66.6 | 94.2 | | 58.2 | | 320 |
| 10/12/84 | FO-30 | 93 | | 63 | 22 | 35 | 142 | | 45 | 5.8 | |
| 11/05/85 | FO-30 | 41.1 | | 59.8 | 17.7 | 36 | 151 | | 97 | 1.6 | |
| 04/02/90 | FO-30 | | | | | 33 | | | | 6.4 | |
| 12/07/93 | FO-30 | 30.7 | 2.5 | 44.3 | 12.5 | 37.7 | 114 | | 66.6 | 2.4 | 329 |
| 03/14/95 | FO-30 | 32.08 | 3.068 | 46.27 | 13.42 | 36.9 | 114 | | 61.1 | 2.1 | 332 |
| 06/09/98 | FO-30 | 34.3 | | 61 | 16.9 | 91.8 | 177.2 | | 56.8 | | 438 |
| 12/07/84 | FO-31 | 57 | | 53 | 19 | 35 | 144 | | 84 | 8.4 | |
| 11/05/85 | FO-31 | 40.5 | | 56.7 | 18.2 | 33 | 153 | | 98 | 0.7 | |
| 04/02/90 | FO-31 | | | | | 46 | | | | 1.3 | |
| 09/03/97 | FO-31 | 43 | 2.9 | 65.5 | 19.8 | 66 | 141 | | 79.9 | 0.61 | 434 |
| 06/09/98 | FO-31 | 44 | | 58.6 | 19.1 | 62.2 | 147 | | 78.1 | | 409 |
| 10/30/84 | FO-32 | 48 | | 56 | 19 | 39 | 162 | | 95 | 5.8 | |
| 11/05/85 | FO-32 | 47.3 | | 64.2 | 22.1 | 43 | 172 | | 101 | 1.6 | |
| 01/15/69 | MCWD-01 | | | | | | | | | 65 | |
| 04/11/69 | MCWD-01 | | | | | | | | | 95 | |
| 07/10/69 | MCWD-01 | | | | | | | | | 110 | |
| 10/20/69 | MCWD-01 | | | | | | | | | 75 | |
| 01/09/70 | MCWD-01 | | | | | | | | | 79 | |
| 04/07/70 | MCWD-01 | | | | | | | | | 84 | |
| 08/06/70 | MCWD-01 | | | | | | | | | 120 | |
| 08/18/70 | MCWD-01 | | | | | | | | | 42.1 | |
| 09/15/70 | MCWD-01 | 66 | 4.5 | 47 | 13 | 440 | 82 | | 29 | 56 | |
| 04/12/71 | MCWD-01 | 62 | 4.5 | 43 | 14 | 116 | 84 | | 14 | 28 | |
| 07/26/71 | MCWD-01 | 60 | 4 | 46 | 12 | 113 | 74 | | 22 | 105 | |
| 07/07/81 | MCWD-01 | | | | | 124 | | | | 3.1 | |
| 07/07/81 | MCWD-01 | | | | | 337 | | | | 3 | |
| 07/07/81 | MCWD-01 | | | | | 2220 | | | | 2.1 | |
| 07/07/81 | MCWD-01 | | | | | 1380 | | | | 18.4 | |
| 01/15/69 | MCWD-02 | | | | | | | | | 70 | |
| 07/10/69 | MCWD-02 | | | | | | | | | 93 | |
| 10/20/69 | MCWD-02 | | | | | | | | | 92 | |
| 01/09/70 | MCWD-02 | | | | | | | | | 113 | |
| 04/07/70 | MCWD-02 | | | | | | | | | 103 | |
| 08/06/70 | MCWD-02 | | | | | | | | | 90 | |
| 08/18/70 | MCWD-02 | | | | | | | | | 64.2 | |
| 09/15/70 | MCWD-02 | 71 | 4.2 | 53 | 19 | 132 | 80 | | 18 | 65 | |

| Sample Date | Well Name | Sodium (mg/L) | Potassium (mg/L) | Calcium (mg/L) | Magnesium (mg/L) | Chloride (mg/L) | Alkalinity (mg/L) | CO3 (mg/L) | Sulfate (mg/L) | Nitrate (mg/L) | TDS (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 04/12/71 | MCWD-02 | 67 | 4.5 | 58 | 19 | 136 | 78 | | 21 | 33 | |
| 07/26/71 | MCWD-02 | 63 | 4 | 60 | 12 | 126 | 73 | | 29 | 111 | |
| 10/29/71 | MCWD-02 | 51 | 4 | 50 | 7 | 125 | 72 | | 37 | 120 | |
| 01/13/72 | MCWD-02 | | | | | 136 | | | | 101 | |
| 04/04/72 | MCWD-02 | 30 | 3 | 48 | 22 | 138 | 78 | | 54 | 56 | |
| 05/22/73 | MCWD-02 | 79 | 3.5 | 34 | 11 | 148 | 56 | | 35 | 74 | |
| 12/05/73 | MCWD-02 | 70 | 3.5 | 60 | 32 | 132 | 74 | | 35 | 101 | |
| 06/01/76 | MCWD-02 | 83 | 4 | 44 | 24.5 | 132 | 95 | | 30 | 14.2 | |
| 03/07/77 | MCWD-02 | 75 | 3 | 45 | 23 | 148 | 62 | | 60 | 102.8 | |
| 04/24/78 | MCWD-02 | | | | | 136 | | | | 106.32 | |
| 07/10/80 | MCWD-02 | 120 | 4.6 | 65 | 29 | 154 | 66 | | 54 | 98 | |
| 08/04/81 | MCWD-02 | | | | | 137.6 | | | | 132 | |
| 06/30/82 | MCWD-02 | | | | | 140 | | | | 115 | |
| 12/22/82 | MCWD-02 | 95 | 4 | 50 | 23 | 160 | 60 | | 61 | 120 | |
| 12/22/82 | MCWD-02 | | | | | 165 | | | | 100 | |
| 10/05/94 | MCWD-02 | | | | | 160 | | | | 110 | |
| 10/11/95 | MCWD-02 | | | | | 160 | | | | 90 | |
| 02/05/96 | MCWD-02 | | | | | 169 | | | | | |
| 02/07/96 | MCWD-02 | | | | | 146 | | | | | |
| 02/12/96 | MCWD-02 | | | | | 155 | | | | | |
| 02/20/96 | MCWD-02 | | | | | 135 | | | | | |
| 02/26/96 | MCWD-02 | | | | | 136 | | | | | |
| 03/04/96 | MCWD-02 | | | | | 164 | | | | | |
| 03/11/96 | MCWD-02 | | | | | 160 | | | | | |
| 03/18/96 | MCWD-02 | | | | | 154 | | | | | |
| 01/15/69 | MCWD-03 | | | | | | | | | 22 | |
| 04/11/69 | MCWD-03 | | | | | | | | | 90 | |
| 06/13/69 | MCWD-03 | | | | | | | | | 38 | |
| 07/10/69 | MCWD-03 | | | | | | | | | 53 | |
| 10/20/69 | MCWD-03 | | | | | | | | | 67 | |
| 01/09/70 | MCWD-03 | | | | | | | | | 150 | |
| 04/07/70 | MCWD-03 | | | | | | | | | 80 | |
| 08/06/70 | MCWD-03 | | | | | | | | | 72 | |
| 08/18/70 | MCWD-03 | | | | | | | | | 42.1 | |
| 09/15/70 | MCWD-03 | 50 | 4.2 | 38 | 7 | 68 | 72 | | 30 | 51 | |
| 09/15/70 | MCWD-03 | | | | | 68 | | | | 51 | |
| 04/12/71 | MCWD-03 | 58 | 4 | 33 | 12 | 90 | 52 | | 52 | 33 | |
| 07/26/71 | MCWD-03 | 47 | 3.1 | 38 | 6 | 79 | 59 | | 29 | 87 | |
| 10/29/71 | MCWD-03 | 41 | 3 | 32 | 6 | 82 | 50 | | 20 | 92 | |
| 12/13/71 | MCWD-03 | | | | | 32 | | | | 96 | |
| 01/10/72 | MCWD-03 | | | | | 59 | | | | 92 | |
| 02/15/72 | MCWD-03 | | | | | 16 | | | | 83 | |
| 03/13/72 | MCWD-03 | | | | | 16 | | | | 78 | |
| 04/04/72 | MCWD-03 | 35 | 4 | 14 | 13 | 83 | 46 | | 20 | 50 | |
| 06/13/72 | MCWD-03 | | | | | 40 | | | | 88 | |
| 09/13/72 | MCWD-03 | 56 | 2 | 10 | 19 | 80 | 63 | | 170 | 92 | |
| 10/27/72 | MCWD-03 | 70 | 3 | 20 | 12 | 28 | 56 | | 76 | 83 | |
| 02/05/73 | MCWD-03 | 68 | 2.8 | 17 | 6 | 85 | 55 | | 22 | 58 | |
| 05/22/73 | MCWD-03 | 52 | 2.8 | 15 | 7 | 76 | 50 | | 24 | 41 | |
| 11/28/73 | MCWD-03 | 53 | 6 | 23 | 9 | 76 | 54 | | 29 | 4.6 | |
| 05/14/74 | MCWD-03 | | | | | 80 | | | | 29 | |
| 08/27/74 | MCWD-03 | 61 | 3 | 36 | 15 | 80 | 62 | 0 | 13 | 37 | |
| 12/02/74 | MCWD-03 | 48 | 3 | 19 | 7 | 72 | 52 | 0 | 23 | 4 | |
| 05/09/75 | MCWD-03 | 54 | 3 | 35 | 9 | 80 | 50 | 0 | 19 | 17 | |
| 03/12/76 | MCWD-03 | 48 | 3 | 30 | 15 | 76 | 60 | | 30 | 74 | |
| 03/07/77 | MCWD-03 | 55 | 2.3 | 23 | 13 | 76 | 58 | | 30 | 48 | |
| 11/11/77 | MCWD-03 | | | | | 80 | | | | | |
| 01/04/78 | MCWD-03 | 57 | 2.4 | 22 | 11 | 74 | 58 | | 23 | 71 | |
| 04/03/78 | MCWD-03 | | | | | 70 | | | | | |
| 07/05/78 | MCWD-03 | | | | | 62 | | | | 327.8 | |

| Sample Date | Well Name | Sodium (mg/L) | Potassium (mg/L) | Calcium (mg/L) | Magnesium (mg/L) | Chloride (mg/L) | Alkalinity (mg/L) | CO3 (mg/L) | Sulfate (mg/L) | Nitrate (mg/L) | TDS (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 01/15/69 | MCWD-04 | | | | | | | | | 2 | |
| 07/10/69 | MCWD-04 | | | | | | | | | 11 | |
| 01/09/70 | MCWD-04 | | | | | | | | | 6.6 | |
| 08/06/70 | MCWD-04 | | | | | | | | | 103 | |
| 08/18/70 | MCWD-04 | | | | | | | | | 6.6 | |
| 08/28/70 | MCWD-04 | | | | | | | | | 9 | |
| 09/15/70 | MCWD-04 | 51 | 5.5 | 110 | 24 | 212 | 140 | 0 | 58 | 5 | |
| 04/12/71 | MCWD-04 | 52 | 4 | 48 | 12 | 96 | 74 | 0 | 33 | 37 | |
| 07/26/71 | MCWD-04 | 54 | 4.6 | 89 | 20 | 180 | 95 | 0 | 37 | 60 | |
| 10/29/71 | MCWD-04 | 42 | 6 | 184 | 38 | 376 | 122 | | 76 | 52 | |
| 12/13/71 | MCWD-04 | | | | | 92 | | | | 37 | |
| 01/10/72 | MCWD-04 | | | | | 298 | | | | 29 | |
| 02/15/72 | MCWD-04 | | | | | 256 | | | | 24 | |
| 03/13/72 | MCWD-04 | | | | | 388 | | | | 10 | |
| 04/04/72 | MCWD-04 | 34 | 3 | 175 | 54 | 424 | 132 | 0 | 76 | 7 | |
| 06/13/72 | MCWD-04 | | | | | 508 | | | | 1.1 | |
| 09/13/72 | MCWD-04 | 65 | 5 | 127 | 17 | 620 | 146 | 0 | 71 | 1.8 | |
| 10/27/72 | MCWD-04 | 91 | 6 | 255 | 70 | 512 | 118 | | 63 | 31 | |
| 02/05/73 | MCWD-04 | 68 | 3.9 | 44 | 11 | 120 | 120 | | 52 | 15 | |
| 05/22/73 | MCWD-04 | 102 | 5 | 44 | 14 | 152 | 80 | | 40 | 37 | |
| 11/28/73 | MCWD-04 | 62 | 6 | 7 | 43 | 224 | 114 | | 42 | 2 | |
| 05/14/74 | MCWD-04 | | | | | 100 | | | | 22 | |
| 08/27/74 | MCWD-04 | 79 | 3.5 | 57 | 21 | 104 | 80 | 0 | 21 | 41 | |
| 12/02/74 | MCWD-04 | 43 | 3 | 35 | 21 | 92 | 66 | 0 | 27 | 10 | |
| 05/09/75 | MCWD-04 | 105 | 7 | 390 | 137 | 1100 | 94 | 0 | 37 | 6 | |
| 03/12/76 | MCWD-04 | 69 | 4 | 98 | 53 | 376 | 106 | | 40 | 25 | |
| 06/14/76 | MCWD-04 | | | | | 176 | | | | 56.7 | |
| 01/15/69 | MCWD-05 | | | | | | | | | 60 | |
| 01/22/69 | MCWD-05 | | | | | | | | | 62 | |
| 07/10/69 | MCWD-05 | | | | | | | | | 12 | |
| 01/09/70 | MCWD-05 | | | | | | | | | 6.6 | |
| 08/06/70 | MCWD-05 | | | | | | | | | 9 | |
| 08/18/70 | MCWD-05 | | | | | | | | | 2.7 | |
| 09/23/70 | MCWD-05 | 35 | 2.7 | 56 | 11 | 40 | 135 | 0 | 72 | 13 | |
| 04/12/71 | MCWD-05 | 33 | 4 | 58 | 14 | 40 | 146 | 0 | 22 | 6 | |
| 07/26/71 | MCWD-05 | 33 | 3.8 | 57 | 11 | 40 | 135 | 0 | 67 | 5.7 | |
| 10/29/71 | MCWD-05 | 26 | 4 | 60 | 6 | 20 | 150 | 0 | 66 | 9 | |
| 12/13/71 | MCWD-05 | | | | | 11 | | | | 4.4 | |
| 01/10/72 | MCWD-05 | | | | | 20 | | | | 5.5 | |
| 02/15/72 | MCWD-05 | | | | | 10 | | | | 2.5 | |
| 03/13/72 | MCWD-05 | | | | | 6 | | | | 47 | |
| 04/04/72 | MCWD-05 | 62 | 4 | 33 | 17 | 40 | 138 | 0 | 80 | 6 | |
| 06/13/72 | MCWD-05 | | | | | 8 | | | | | |
| 09/13/72 | MCWD-05 | 30 | 2 | 24 | 23 | 11 | 188 | 0 | 77 | 5.1 | |
| 10/27/72 | MCWD-05 | 62 | 4 | 77 | 22 | 148 | 124 | | 52 | 11 | |
| 02/05/73 | MCWD-05 | 40 | 3.4 | 29 | 9 | 4 | 150 | | 73 | 5 | |
| 03/27/73 | MCWD-05 | | | | | | | | | 2.6 | |
| 05/22/73 | MCWD-05 | 37 | 3.5 | 26 | 9 | 40 | 124 | | 47 | 5.2 | |
| 11/28/73 | MCWD-05 | 33 | 5.3 | 51 | 16 | 44 | 146 | | 64 | 0.5 | |
| 05/14/74 | MCWD-05 | | | | | 48 | | | | 7 | |
| 08/27/74 | MCWD-05 | 43 | 3.5 | 67 | 21 | 60 | 132 | 0 | 66 | 6.5 | |
| 12/02/74 | MCWD-05 | 35 | 3 | 58 | 21 | 60 | 126 | 0 | 80 | 1.4 | |
| 05/09/75 | MCWD-05 | 32 | 4 | 68 | 17 | 68 | 122 | 0 | 31 | 2.6 | |
| 03/12/76 | MCWD-05 | 35 | 3 | 60 | 25 | 128 | 218 | | 60 | 10 | |
| 03/07/77 | MCWD-05 | 50 | 2.2 | 21 | 12 | 78 | 52 | | 60 | 50 | |
| 11/11/77 | MCWD-05 | | | | | 172 | | | | | |
| 01/04/78 | MCWD-05 | 60 | 2.6 | 41 | 16 | 68 | 42 | | 33 | 66 | |
| 04/03/78 | MCWD-05 | | | | | 71 | | | | | |
| 07/05/78 | MCWD-05 | | | | | 928 | | | | 61.1 | |
| 07/31/78 | MCWD-05 | | | | | | | | | 13 | |

## Appendix D. Inorganic Data Summary
## Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
## Monterey County Water Resources Agency

| Sample Date | Well Name | Sodium (mg/L) | Potassium (mg/L) | Calcium (mg/L) | Magnesium (mg/L) | Chloride (mg/L) | Alkalinity (mg/L) | CO3 (mg/L) | Sulfate (mg/L) | Nitrate (mg/L) | TDS (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 04/02/79 | MCWD-05 | | | | | 780 | | | | 0.8 | |
| 07/03/79 | MCWD-05 | | | | | 100 | | | | 57 | |
| 01/03/80 | MCWD-05 | 45 | 2.2 | 25.3 | 17.6 | 72 | 39.2 | | 36.8 | 53.1 | |
| 04/28/80 | MCWD-05 | | | | | 80 | | | | 50.7 | |
| 11/04/80 | MCWD-05 | | | | | 176 | | | | 35.8 | |
| 11/24/80 | MCWD-05 | | | | | 176 | | | | | |
| 01/06/81 | MCWD-05 | 86 | 4.8 | 184 | 68.8 | 576 | 44 | 0 | 72 | 8.2 | |
| 05/05/81 | MCWD-05 | | | | | 92 | | | | 42.7 | |
| 07/07/81 | MCWD-05 | | | | | 1380 | | | | 18.4 | |
| 01/06/82 | MCWD-05 | 95 | 5.5 | 292 | 128 | 955 | 52.5 | | 88 | 29 | |
| 04/05/82 | MCWD-05 | | | | | 720 | | | | 36 | |
| 12/22/82 | MCWD-05 | 115 | 9 | 490 | 200 | 1800 | 98 | | 136 | 12.5 | |
| 01/15/69 | MCWD-06 | | | | | | | | | 4 | |
| 07/10/69 | MCWD-06 | | | | | | | | | 11 | |
| 01/09/70 | MCWD-06 | | | | | | | | | 7.5 | |
| 08/06/70 | MCWD-06 | | | | | | | | | 24 | |
| 08/18/70 | MCWD-06 | | | | | | | | | 8 | |
| 09/15/70 | MCWD-06 | 45 | 3 | 33 | 7 | 76 | 82 | 0 | 27 | 13 | |
| 04/12/71 | MCWD-06 | 42 | 3 | 29 | 9 | 76 | 74 | 0 | 18 | 18 | |
| 07/26/71 | MCWD-06 | 38 | 3.9 | 59 | 11 | 64 | 124 | 0 | 44 | 5.1 | |
| 10/29/71 | MCWD-06 | 27 | 4 | 64 | 7 | 34 | 134 | 0 | 57 | 8 | |
| 01/13/72 | MCWD-06 | | | | | 49 | | | | 2.3 | |
| 04/04/72 | MCWD-06 | 65 | 3 | 48 | 18 | 82 | 130 | 0 | 80 | 4 | |
| 06/13/72 | MCWD-06 | | | | | 52 | | | | 5.4 | |
| 02/05/73 | MCWD-06 | 42 | 3.7 | 74 | 13 | 115 | 145 | | 54 | 1.5 | |
| 05/22/73 | MCWD-06 | 53 | 4.3 | 70 | 17 | 148 | 128 | | 45 | 2.3 | |
| 11/28/73 | MCWD-06 | 43 | 5.1 | 97 | 37 | 212 | 124 | | 44 | 0.3 | |
| 05/14/74 | MCWD-06 | | | | | 208 | | | | 1 | |
| 08/27/74 | MCWD-06 | 58 | 4.5 | 113 | 37 | 220 | 126 | 0 | 53 | 3.7 | |
| 12/02/74 | MCWD-06 | 36 | 4 | 120 | 52 | 268 | 116 | 0 | 64 | 3.3 | |
| 05/09/75 | MCWD-06 | 39 | 3 | 23 | 12 | 80 | 52 | 0 | 10 | 9 | |
| 04/10/78 | MCWD-06 | | | | | 339 | | | | | |
| 07/05/78 | MCWD-06 | | | | | 368 | | | | 11.1 | |
| 05/05/81 | MCWD-06 | | | | | 2220 | | | | 1.6 | |
| 11/11/77 | MCWD-06A | | | | | 312 | | | | | |
| 01/04/78 | MCWD-06A | 80 | 5 | 146 | 38 | 324 | 120 | 0 | 64 | | |
| 07/31/78 | MCWD-06A | | | | | | | | | 2.3 | |
| 04/02/79 | MCWD-06A | | | | | 490 | | | | 0.08 | |
| 07/03/79 | MCWD-06A | | | | | 588 | | | | 2.4 | |
| 01/03/80 | MCWD-06A | 104 | 7.1 | 772 | 66.5 | 614 | 100 | 0 | 69.5 | 1.42 | |
| 04/28/80 | MCWD-06A | | | | | 1000 | | | | 2.3 | |
| 11/04/80 | MCWD-06A | | | | | 1114 | | | | 2.5 | |
| 01/06/81 | MCWD-06A | 150 | 12 | 254 | 257 | 1998 | 90 | 0 | 126 | 1.2 | |
| 07/07/81 | MCWD-06A | | | | | 2220 | | | | 2.1 | |
| 01/06/82 | MCWD-06A | 242 | 13.8 | 900 | 238 | 2400 | 91.5 | 0 | 42.9 | 1.4 | |
| 04/05/82 | MCWD-06A | | | | | 2520 | | | | 2.1 | |
| 03/03/71 | MCWD-07 | 70 | 5 | 70 | 16 | 115 | 152 | | 70 | 1.2 | |
| 05/16/72 | MCWD-07 | 101 | 5 | 50 | 27 | 212 | 156 | 0 | 53 | 1.7 | |
| 06/13/72 | MCWD-07 | | | | | 248 | | | | 0.3 | |
| 09/13/72 | MCWD-07 | 85 | 4 | 47 | 37 | 295 | 154 | 0 | 94 | 1.9 | |
| 02/05/73 | MCWD-07 | 113 | 6.8 | 172 | 33 | 465 | 145 | | 85 | 0.7 | |
| 03/27/73 | MCWD-07 | | | | | | | | | 0.1 | |
| 05/22/73 | MCWD-07 | 112 | 6.2 | 120 | 29 | 444 | 132 | | 45 | 2.3 | |
| 11/28/73 | MCWD-07 | 120 | 8 | 260 | 94 | 672 | 142 | | 65 | 0.3 | |
| 05/14/74 | MCWD-07 | | | | | 690 | | | | | |
| 07/26/74 | MCWD-07 | | | | | 805 | | | | | |
| 07/26/74 | MCWD-07 | | | | | 815 | | | | | |
| 08/27/74 | MCWD-07 | 133 | 8.3 | 240 | 88 | 776 | 144 | 0 | 98 | 0.9 | |
| 05/09/75 | MCWD-07 | 270 | 11 | 530 | 163 | 1500 | 120 | 0 | 95 | 0.4 | |
| 09/03/75 | MCWD-07 | 205 | 10 | 418 | 153 | 1200 | 128 | 0 | 64 | 0.72 | |

## Appendix D. Inorganic Data Summary
## Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
## Monterey County Water Resources Agency

| Sample Date | Well Name | Sodium (mg/L) | Potassium (mg/L) | Calcium (mg/L) | Magnesium (mg/L) | Chloride (mg/L) | Alkalinity (mg/L) | CO3 (mg/L) | Sulfate (mg/L) | Nitrate (mg/L) | TDS (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 05/05/81 | MCWD-07 | | | | | 278 | | | | 2.5 | |
| 05/14/74 | MCWD-08 | | | | | 52 | | | | 8 | |
| 06/11/74 | MCWD-08 | 50 | 3.7 | 48 | 17 | 28 | 164 | | 53 | 1.8 | |
| 08/27/74 | MCWD-08 | 51 | 3.6 | 61 | 20 | 40 | 154 | 0 | 55 | 1 | |
| 12/02/74 | MCWD-08 | 43 | 4 | 53 | 11 | 40 | 140 | 0 | 68 | 0 | |
| 05/09/75 | MCWD-08 | 38 | 4 | 50 | 17 | 40 | 142 | 0 | 26 | 0.7 | |
| 03/12/76 | MCWD-08 | 37 | 3 | 49 | 18 | 44 | 276 | | 62 | 1.8 | |
| 03/07/77 | MCWD-08 | 41 | 2.9 | 50 | 22 | 74 | 150 | | 120 | 3 | |
| 11/11/77 | MCWD-08 | | | | | 184 | | | | | |
| 01/04/78 | MCWD-08 | 46 | 3.7 | 100 | 30 | 180 | 134 | | 91 | 2.4 | |
| 04/10/78 | MCWD-08 | | | | | 161 | | | | | |
| 07/05/78 | MCWD-08 | | | | | 164 | | | | 12 | |
| 07/31/78 | MCWD-08 | | | | | | | | | 2.8 | |
| 04/02/79 | MCWD-08 | | | | | 210 | | | | 0.1 | |
| 07/03/79 | MCWD-08 | | | | | 312 | | | | 2.6 | |
| 01/03/80 | MCWD-08 | 51 | 4.1 | 138 | 44.4 | 276 | 134 | | 94 | 2.82 | |
| 04/28/80 | MCWD-08 | | | | | 268 | | | | 2.9 | |
| 11/04/80 | MCWD-08 | | | | | 324 | | | | 3.1 | |
| 01/06/81 | MCWD-08 | 31 | 4.5 | 138 | 43.5 | 331 | 125 | 0 | 88 | 1.5 | |
| 05/05/81 | MCWD-08 | | | | | 124 | | | | 1.7 | |
| 05/05/81 | MCWD-08 | | | | | 278 | | | | 2.5 | |
| 07/07/81 | MCWD-08 | | | | | 337 | | | | 3 | |
| 01/06/82 | MCWD-08 | 64 | 4.5 | 154 | 51.3 | 380 | 126.5 | | 85.4 | 2.7 | |
| 04/05/82 | MCWD-08 | | | | | 336 | | | | 3.2 | |
| 06/30/82 | MCWD-08 | | | | | 410 | | | | 3.2 | |
| 10/05/82 | MCWD-08 | | | | | 4 | | | | 5.5 | |
| 07/02/85 | MCWD-08 | | | | | 410 | | | | 2.9 | |
| 01/06/86 | MCWD-08 | 72 | 7.5 | 230 | 72 | 740 | 110 | 0 | 100 | 2.4 | |
| 12/31/87 | MCWD-08 | 100 | 12 | 540 | 170 | 1700 | 92 | 0 | 140 | 14 | |
| 11/14/89 | MCWD-08 | | | | | 2070 | | | | 12 | |
| 02/15/90 | MCWD-08 | | | | | 2240 | | | | 11 | |
| 02/09/83 | MCWD-08A | 35 | 3 | 78 | 20 | 85 | 140 | | 91 | 3 | |
| 02/10/83 | MCWD-08A | | | | | 85 | | | | 3 | |
| 06/30/83 | MCWD-08A | | | | | 340 | | | | 2.7 | |
| 10/03/83 | MCWD-08A | | | | | 560 | | | | 6.5 | |
| 01/04/84 | MCWD-08A | 40 | 5 | 170 | 53 | 375 | 130 | | 80 | 6 | |
| 10/03/84 | MCWD-08A | | | | | 640 | | | | 1.7 | |
| 01/02/85 | MCWD-08A | 49 | 5.5 | 160 | 37 | 280 | 115 | | 89 | 2.8 | |
| 11/05/86 | MCWD-08A | | | | | 1100 | | | | 9.6 | |
| 01/05/87 | MCWD-08A | 85 | 8.5 | 430 | 140 | 1250 | 100 | | 120 | 8.5 | |
| 08/05/87 | MCWD-08A | | | | | 1500 | | | | 8 | |
| 04/04/88 | MCWD-08A | | | | | 1900 | | | | 10 | |
| 07/07/88 | MCWD-08A | | | | | 1840 | | | | 21 | |
| 03/22/89 | MCWD-08A | 124 | | 140 | 530 | 1800 | 100 | 0 | 200 | 16 | |
| 07/05/89 | MCWD-08A | | | | | 1100 | | | | | |
| 10/03/89 | MCWD-08A | | | | | 2300 | | | | 10 | |
| 12/14/89 | MCWD-08A | | | | | 2250 | | | | 12 | |
| 01/16/90 | MCWD-08A | | | | | 2350 | | | | 14 | |
| 03/15/90 | MCWD-08A | | | | | 68 | | | | 13 | |
| 04/14/90 | MCWD-08A | 140 | | 980 | 210 | 120 | 130 | 0 | 280 | 14 | |
| 04/16/90 | MCWD-08A | | | | | 2200 | | | | 16 | |
| 07/17/90 | MCWD-08A | | | | | 2400 | | | | 8.4 | |
| 08/15/90 | MCWD-08A | | | | | 1950 | | | | 13 | |
| 01/02/91 | MCWD-08A | | | | | 2800 | | | | 9.7 | |
| 01/23/91 | MCWD-08A | 180 | 11 | 530 | 460 | 2300 | 100 | 0 | 270 | 13 | |
| 04/03/91 | MCWD-08A | | | | | 1700 | | | | 8.7 | |
| 09/06/91 | MCWD-08A | 239 | 0 | 1010 | 315 | 2410 | 100 | 0 | 251 | 2.2 | |
| 08/16/78 | MCWD-09 | 68 | | 42 | 12 | 43 | 132 | 0 | 88 | 3.1 | |
| 08/17/78 | MCWD-09 | | | | | 43 | | | | | |
| 08/25/78 | MCWD-09 | 70 | 3 | 33 | 13 | 47 | 152 | | 86 | 0.4 | |

| Sample Date | Well Name | Sodium (mg/L) | Potassium (mg/L) | Calcium (mg/L) | Magnesium (mg/L) | Chloride (mg/L) | Alkalinity (mg/L) | CO3 (mg/L) | Sulfate (mg/L) | Nitrate (mg/L) | TDS (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 01/03/80 | MCWD-09 | 74 | 3.9 | 430 | 16.8 | 79 | 148 | | 68.3 | 0.96 | |
| 04/28/80 | MCWD-09 | | | | | 92 | | | | 1.7 | |
| 11/04/80 | MCWD-09 | | | | | 105 | | | | 2 | |
| 01/06/81 | MCWD-09 | 58 | 4.3 | 54.5 | 21 | 116 | 142 | 0 | 84 | 1.8 | |
| 05/05/81 | MCWD-09 | | | | | 124 | | | | 1.7 | |
| 07/07/81 | MCWD-09 | | | | | 124 | | | | 3.1 | |
| 01/06/82 | MCWD-09 | 80 | 4.2 | 49.7 | 19.6 | 155 | 130 | | 69 | 2.4 | |
| 04/05/82 | MCWD-09 | | | | | 118 | | | | 2.8 | |
| 06/30/82 | MCWD-09 | | | | | 140 | | | | 2.4 | |
| 10/05/82 | MCWD-09 | | | | | 4 | | | | 125 | |
| 12/22/82 | MCWD-09 | 78 | 5 | 56 | 19 | 120 | 155 | | 78 | 3 | |
| 12/22/82 | MCWD-09 | | | | | 125 | | | | 2.6 | |
| 06/30/83 | MCWD-09 | | | | | 150 | | | | 0.1 | |
| 10/03/83 | MCWD-09 | | | | | 150 | | | | 7 | |
| 01/04/84 | MCWD-09 | 68 | 5 | 76 | 23 | 140 | 160 | | 68 | 3 | |
| 10/03/84 | MCWD-09 | | | | | 170 | | | | 2 | |
| 01/02/85 | MCWD-09 | 78 | 5 | 54 | 17 | 86 | 145 | | 90 | 1.6 | |
| 07/02/85 | MCWD-09 | | | | | 180 | | | | 2 | |
| 11/05/86 | MCWD-09 | | | | | 150 | | | | 1.6 | |
| 01/05/87 | MCWD-09 | 92 | 7.5 | 230 | 89 | 880 | 130 | | 100 | 5.1 | |
| 08/05/87 | MCWD-09 | | | | | 340 | | | | 1.5 | |
| 12/31/87 | MCWD-09 | 75 | 8 | 100 | 34 | 320 | 140 | 0 | 88 | 3.6 | |
| 04/04/88 | MCWD-09 | | | | | 200 | | | | 1.1 | |
| 07/07/88 | MCWD-09 | | | | | 340 | | | | 2.8 | |
| 10/13/88 | MCWD-09 | | | | | 96 | | | | 0 | |
| 12/07/88 | MCWD-09 | 76 | 6.3 | 86 | 31 | 230 | 130 | 0 | 80 | 0 | |
| 04/03/89 | MCWD-09 | | | | | 290 | | | | 3.8 | |
| 05/01/89 | MCWD-09 | | | | | 110 | | | | 1.1 | |
| 10/03/89 | MCWD-09 | | | | | 100 | | | | 0 | |
| 11/14/89 | MCWD-09 | | | | | 61 | | | | 0 | |
| 12/14/89 | MCWD-09 | | | | | 84 | | | | 0 | |
| 01/16/90 | MCWD-09 | | | | | 140 | | | | 0 | |
| 02/14/90 | MCWD-09 | 120 | | 200 | 914 | 100 | 180 | 0 | 100 | 1.3 | |
| 02/15/90 | MCWD-09 | | | | | 100 | | | | 1.3 | |
| 03/15/90 | MCWD-09 | | | | | 250 | | | | 0 | |
| 04/16/90 | MCWD-09 | | | | | 84 | | | | 1.9 | |
| 07/17/90 | MCWD-09 | | | | | 86 | | | | 0 | |
| 08/15/90 | MCWD-09 | | | | | 250 | | | | 2.3 | |
| 01/02/91 | MCWD-09 | | | | | 74 | | | | 1.6 | |
| 01/23/91 | MCWD-09 | 86 | 3.4 | 34 | 20 | 77 | 150 | 0 | 77 | 0 | |
| 04/03/91 | MCWD-09 | | | | | 76 | | | | 1.5 | |
| 07/03/91 | MCWD-09 | 62 | 0 | 39 | 17 | 79 | 160 | 0 | 74 | 1.4 | |
| 10/02/91 | MCWD-09 | | | | | 74 | | | | | |
| 01/08/92 | MCWD-09 | | | | | 73 | | | | 1.5 | |
| 04/08/92 | MCWD-09 | | | | | 140 | | | | 2.1 | |
| 07/01/92 | MCWD-09 | 76 | 4.2 | 41 | 17 | 82 | 150 | 0 | 69 | 1.5 | |
| 01/06/93 | MCWD-09 | | | | | | | | | 1.6 | |
| 01/13/93 | MCWD-09 | | | | | | | | | 3.8 | |
| 04/07/93 | MCWD-09 | | | | | | | | | 1.8 | |
| 07/07/93 | MCWD-09 | 77 | 3.1 | 39 | 16 | 78 | 160 | 0 | 78 | 1.8 | |
| 01/05/94 | MCWD-09 | | | | | 250 | | | | 3.1 | |
| 04/06/94 | MCWD-09 | | | | | 260 | | | | 1.7 | |
| 07/06/94 | MCWD-09 | 84 | 506 | 100 | 35 | 280 | 150 | 0 | 80 | 3 | |
| 10/05/94 | MCWD-09 | | | | | 120 | | | | 3.7 | |
| 01/04/95 | MCWD-09 | | | | | 170 | | | | 2.7 | |
| 04/05/95 | MCWD-09 | | | | | 84 | | | | 0 | |
| 07/05/95 | MCWD-09 | 71 | 236 | 26 | 539 | 58 | 120 | 0 | 51 | 0 | |
| 10/04/95 | MCWD-09 | | | | | 120 | | | | 0 | |
| 01/10/96 | MCWD-09 | | | | | | | | | 1.9 | |
| 02/12/96 | MCWD-09 | | | | | 90.8 | | | | | |

| Sample Date | Well Name | Sodium (mg/L) | Potassium (mg/L) | Calcium (mg/L) | Magnesium (mg/L) | Chloride (mg/L) | Alkalinity (mg/L) | CO3 (mg/L) | Sulfate (mg/L) | Nitrate (mg/L) | TDS (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 02/20/96 | MCWD-09 | | | | | 242 | | | | | |
| 02/26/96 | MCWD-09 | | | | | 90 | | | | | |
| 03/04/96 | MCWD-09 | | | | | 231 | | | | | |
| 03/11/96 | MCWD-09 | | | | | 563 | | | | | |
| 03/14/96 | MCWD-09 | | | | | 81 | | | | | |
| 03/18/96 | MCWD-09 | | | | | 80 | | | | | |
| 03/25/96 | MCWD-09 | | | | | 74 | | | | | |
| 04/08/96 | MCWD-09 | | | | | 70 | | | | | |
| 04/08/96 | MCWD-09 | | | | | 70.2 | | | | | |
| 04/10/96 | MCWD-09 | | | | | | | | | 3.2 | |
| 04/15/96 | MCWD-09 | | | | | 73 | | | | | |
| 04/22/96 | MCWD-09 | | | | | 112 | | | | | |
| 04/29/96 | MCWD-09 | | | | | 101 | | | | | |
| 05/06/96 | MCWD-09 | | | | | 76.5 | | | | | |
| 05/13/96 | MCWD-09 | | | | | 75.5 | | | | | |
| 05/20/96 | MCWD-09 | | | | | 485 | | | | | |
| 05/28/96 | MCWD-09 | | | | | 710 | | | | | |
| 06/03/96 | MCWD-09 | | | | | 119 | | | | | |
| 06/10/96 | MCWD-09 | | | | | 78 | | | | | |
| 06/17/96 | MCWD-09 | | | | | 77 | | | | | |
| 06/17/96 | MCWD-09 | | | | | 77.3 | | | | | |
| 06/24/96 | MCWD-09 | | | | | 87.5 | | | | | |
| 07/01/96 | MCWD-09 | | | | | 85 | | | | | |
| 07/03/96 | MCWD-09 | 77 | 3.4 | 45 | 19 | 82 | 160 | 0 | 60 | 0 | |
| 07/08/96 | MCWD-09 | | | | | 127 | | | | | |
| 07/15/96 | MCWD-09 | | | | | 95 | | | | | |
| 07/22/96 | MCWD-09 | | | | | 71 | | | | | |
| 07/29/96 | MCWD-09 | | | | | 81 | | | | | |
| 08/05/96 | MCWD-09 | | | | | 90 | | | | | |
| 08/12/96 | MCWD-09 | | | | | 81 | | | | | |
| 08/19/96 | MCWD-09 | | | | | 80 | | | | | |
| 08/26/96 | MCWD-09 | | | | | | | | | 81 | |
| 08/26/96 | MCWD-09 | | | | | 81 | | | | | |
| 09/03/96 | MCWD-09 | | | | | 80.5 | | | | | |
| 09/09/96 | MCWD-09 | | | | | 100 | | | | | |
| 09/16/96 | MCWD-09 | | | | | 102 | | | | | |
| 09/23/96 | MCWD-09 | | | | | 82 | | | | | |
| 09/30/96 | MCWD-09 | | | | | 79 | | | | | |
| 09/30/96 | MCWD-09 | | | | | 78.8 | | | | | |
| 10/07/96 | MCWD-09 | | | | | 77.5 | | | | | |
| 10/14/96 | MCWD-09 | | | | | 83 | | | | | |
| 04/14/97 | MCWD-09 | | | | | 71 | | | | | |
| 04/21/97 | MCWD-09 | | | | | 70.5 | | | | | |
| 04/28/97 | MCWD-09 | | | | | 73.5 | | | | | |
| 05/05/97 | MCWD-09 | | | | | 74.5 | | | | | |
| 05/12/97 | MCWD-09 | | | | | 79 | | | | | |
| 05/19/97 | MCWD-09 | | | | | 75.5 | | | | | |
| 05/27/97 | MCWD-09 | | | | | 76.5 | | | | | |
| 06/02/97 | MCWD-09 | | | | | 74.5 | | | | | |
| 07/02/97 | MCWD-09 | 77 | 4.3 | 74 | 26 | 180 | 160 | 0 | 81 | 0 | |
| 07/14/97 | MCWD-09 | | | | | 83 | | | | | |
| 08/04/97 | MCWD-09 | | | | | 82.5 | | | | | |
| 08/11/97 | MCWD-09 | | | | | 82 | | | | | |
| 08/11/97 | MCWD-09 | | | | | 82.2 | | | | | |
| 08/18/97 | MCWD-09 | | | | | 82 | | | | | |
| 08/25/97 | MCWD-09 | | | | | 81.5 | | | | | |
| 09/02/97 | MCWD-09 | | | | | 83.5 | | | | | |
| 09/08/97 | MCWD-09 | | | | | 82.5 | | | | | |
| 09/22/97 | MCWD-09 | | | | | 52 | | | | | |
| 09/22/97 | MCWD-09 | | | | | 51.8 | | | | | |

| Sample Date | Well Name | Sodium (mg/L) | Potassium (mg/L) | Calcium (mg/L) | Magnesium (mg/L) | Chloride (mg/L) | Alkalinity (mg/L) | CO3 (mg/L) | Sulfate (mg/L) | Nitrate (mg/L) | TDS (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 09/29/97 | MCWD-09 | | | | | 52 | | | | | |
| 09/29/97 | MCWD-09 | | | | | 52.2 | | | | | |
| 10/06/97 | MCWD-09 | | | | | 76.5 | | | | | |
| 10/13/97 | MCWD-09 | | | | | 79.5 | | | | | |
| 10/20/97 | MCWD-09 | | | | | 106 | | | | | |
| 10/27/97 | MCWD-09 | | | | | 85.5 | | | | | |
| 11/03/97 | MCWD-09 | | | | | 79.5 | | | | | |
| 11/17/97 | MCWD-09 | | | | | 75 | | | | | |
| 12/01/97 | MCWD-09 | | | | | 75.5 | | | | | |
| 12/08/97 | MCWD-09 | | | | | 73 | | | | | |
| 12/15/97 | MCWD-09 | | | | | 72 | | | | | |
| 12/15/97 | MCWD-09 | | | | | 72.2 | | | | | |
| 12/22/97 | MCWD-09 | | | | | 74 | | | | | |
| 12/22/97 | MCWD-09 | | | | | 73.8 | | | | | |
| 12/29/97 | MCWD-09 | | | | | 71.5 | | | | | |
| 01/05/98 | MCWD-09 | | | | | 72 | | | | | |
| 01/07/98 | MCWD-09 | | | | | | | | | 6.5 | |
| 01/12/98 | MCWD-09 | | | | | 70.5 | | | | | |
| 01/20/98 | MCWD-09 | | | | | 70 | | | | | |
| 01/26/98 | MCWD-09 | | | | | 80 | | | | | |
| 02/02/98 | MCWD-09 | | | | | 71.5 | | | | | |
| 02/09/98 | MCWD-09 | | | | | 71.2 | | | | | |
| 02/17/98 | MCWD-09 | | | | | 70.5 | | | | | |
| 02/23/98 | MCWD-09 | | | | | 236 | | | | | |
| 03/02/98 | MCWD-09 | | | | | 133 | | | | | |
| 03/09/98 | MCWD-09 | | | | | 82.5 | | | | | |
| 03/23/98 | MCWD-09 | | | | | 71.5 | | | | | |
| 03/30/98 | MCWD-09 | | | | | 72 | | | | | |
| 04/01/98 | MCWD-09 | | | | | | | | | 1.8 | |
| 04/06/98 | MCWD-09 | | | | | 70.5 | | | | | |
| 04/13/98 | MCWD-09 | | | | | 70 | | | | | |
| 04/20/98 | MCWD-09 | | | | | 69.8 | | | | | |
| 04/27/98 | MCWD-09 | | | | | 68.5 | | | | | |
| 05/04/98 | MCWD-09 | | | | | 67.5 | | | | | |
| 05/11/98 | MCWD-09 | | | | | 67.5 | | | | | |
| 05/18/98 | MCWD-09 | | | | | 69.2 | | | | | |
| 05/26/98 | MCWD-09 | | | | | 70.5 | | | | | |
| 06/01/98 | MCWD-09 | | | | | 70.5 | | | | | |
| 06/08/98 | MCWD-09 | | | | | 71 | | | | | |
| 06/15/98 | MCWD-09 | | | | | 72.8 | | | | | |
| 06/22/98 | MCWD-09 | | | | | 94 | | | | | |
| 07/01/98 | MCWD-09 | 71 | 2.1 | 39 | 17 | 75 | 170 | 0 | 80 | 5.9 | |
| 07/06/98 | MCWD-09 | | | | | 79.5 | | | | | |
| 07/13/98 | MCWD-09 | | | | | 85.5 | | | | | |
| 07/14/98 | MCWD-09 | | | | | 83 | | | | | |
| 07/20/98 | MCWD-09 | | | | | 75.5 | | | | | |
| 07/27/98 | MCWD-09 | | | | | 75 | | | | | |
| 08/03/98 | MCWD-09 | | | | | 73.5 | | | | | |
| 08/10/98 | MCWD-09 | | | | | 99 | | | | | |
| 08/17/98 | MCWD-09 | | | | | 75.5 | | | | | |
| 08/24/98 | MCWD-09 | | | | | 73.5 | | | | | |
| 08/31/98 | MCWD-09 | | | | | 73.8 | | | | | |
| 09/08/98 | MCWD-09 | | | | | 74 | | | | | |
| 09/14/98 | MCWD-09 | | | | | 74 | | | | | |
| 09/21/98 | MCWD-09 | | | | | 74 | | | | | |
| 09/28/98 | MCWD-09 | | | | | 70 | | | | | |
| 10/05/98 | MCWD-09 | | | | | 73 | | | | | |
| 10/12/98 | MCWD-09 | | | | | 74.2 | | | | | |
| 10/19/98 | MCWD-09 | | | | | 72 | | | | | |
| 11/02/98 | MCWD-09 | | | | | 72 | | | | | |

| Sample Date | Well Name | Sodium (mg/L) | Potassium (mg/L) | Calcium (mg/L) | Magnesium (mg/L) | Chloride (mg/L) | Alkalinity (mg/L) | CO3 (mg/L) | Sulfate (mg/L) | Nitrate (mg/L) | TDS (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 11/09/98 | MCWD-09 | | | | | 70 | | | | | |
| 11/16/98 | MCWD-09 | | | | | 70.8 | | | | | |
| 12/07/98 | MCWD-09 | | | | | 70 | | | | | |
| 12/14/98 | MCWD-09 | | | | | 68.7 | | | | | |
| 12/28/98 | MCWD-09 | | | | | 70 | | | | 0 | |
| 01/04/99 | MCWD-09 | | | | | 67 | | | | | |
| 01/11/99 | MCWD-09 | | | | | 67 | | | | | |
| 01/19/99 | MCWD-09 | | | | | 67.5 | | | | 0 | |
| 01/25/99 | MCWD-09 | | | | | 68 | | | | 0 | |
| 02/01/99 | MCWD-09 | | | | | 66.3 | | | | 0 | |
| 02/08/99 | MCWD-09 | | | | | 66.4 | | | | 0 | |
| 02/16/99 | MCWD-09 | | | | | 67.2 | | | | 0 | |
| 02/22/99 | MCWD-09 | | | | | 65.4 | | | | 0 | |
| 03/01/99 | MCWD-09 | | | | | 66.7 | | | | 0 | |
| 03/08/99 | MCWD-09 | | | | | 62.9 | | | | 0.56 | |
| 03/15/99 | MCWD-09 | | | | | 63.2 | | | | 0.57 | |
| 05/10/99 | MCWD-09 | | | | | 70.4 | | | | 0.6 | |
| 05/17/99 | MCWD-09 | | | | | 65.6 | | | | 0.6 | |
| 05/24/99 | MCWD-09 | | | | | 64.7 | | | | 0.59 | |
| 06/01/99 | MCWD-09 | | | | | 65.7 | | | | 0.58 | |
| 06/07/99 | MCWD-09 | | | | | 65.7 | | | | 0.59 | |
| 06/14/99 | MCWD-09 | | | | | 65.5 | | | | 0.59 | |
| 06/21/99 | MCWD-09 | | | | | 67.8 | | | | 0.58 | |
| 06/28/99 | MCWD-09 | | | | | 68.5 | | | | 0.59 | |
| 07/06/99 | MCWD-09 | | | | | 68.3 | | | | 0.59 | |
| 07/07/99 | MCWD-09 | 74 | 1.4 | 39 | 17 | 62 | 150 | 0 | 56 | 0 | |
| 07/12/99 | MCWD-09 | | | | | 68.6 | | | | 0.59 | |
| 07/19/99 | MCWD-09 | | | | | 69.3 | | | | 0.56 | |
| 07/26/99 | MCWD-09 | | | | | 69.2 | | | | 0.6 | |
| 08/02/99 | MCWD-09 | | | | | 69.4 | | | | 1.8 | |
| 08/09/99 | MCWD-09 | | | | | 71.5 | | | | 1.58 | |
| 08/16/99 | MCWD-09 | | | | | 70.8 | | | | 0.58 | |
| 08/23/99 | MCWD-09 | | | | | 70.5 | | | | 0.61 | |
| 08/30/99 | MCWD-09 | | | | | 70.3 | | | | 0.59 | |
| 09/07/99 | MCWD-09 | | | | | 70.5 | | | | 0.6 | |
| 04/11/69 | MCWD-10 | | | | | | | | | 120 | |
| 07/15/83 | MCWD-10 | | | | | 71 | | | | | |
| 08/02/83 | MCWD-10 | 82 | 2 | 24 | 6.5 | 45 | 130 | | 67 | 0.1 | |
| 06/22/84 | MCWD-10 | 28 | 4 | 20 | 0 | 35 | 80 | 0 | 33 | 1.4 | |
| 10/03/84 | MCWD-10 | | | | | 56 | | | | | |
| 01/02/85 | MCWD-10 | 75 | 4 | 31 | 5.5 | 52 | 110 | | 62 | | |
| 07/02/85 | MCWD-10 | | | | | 54 | | | | 0 | |
| 11/01/85 | MCWD-10 | | | | | 48 | | | | | |
| 01/06/86 | MCWD-10 | | | | | 78 | | | | | |
| 01/13/86 | MCWD-10 | 76 | 4 | 13 | 2 | 78 | 72 | 0 | 39 | 0 | |
| 07/02/86 | MCWD-10 | | | | | 50 | | | | | |
| 11/05/86 | MCWD-10 | | | | | 55 | | | | 0 | |
| 01/05/87 | MCWD-10 | 68 | 4 | 26 | 6 | 52 | 120 | 0 | 56 | 0 | |
| 05/06/87 | MCWD-10 | | | | | 60 | | | | | |
| 08/05/87 | MCWD-10 | | | | | 80 | | | | 0 | |
| 08/26/87 | MCWD-10 | | | | | 80 | | | | | |
| 11/01/87 | MCWD-10 | | | | | 110 | | | | | |
| 12/31/87 | MCWD-10 | 62 | 5 | 23 | 4.7 | 60 | 100 | 2 | 52 | 0.4 | |
| 04/04/88 | MCWD-10 | | | | | 82 | | | | 0 | |
| 04/06/88 | MCWD-10 | | | | | 77 | | | | | |
| 07/07/88 | MCWD-10 | | | | | 120 | | | | 0.13 | |
| 10/03/88 | MCWD-10 | | | | | 80 | | | | | |
| 10/13/88 | MCWD-10 | | | | | 80 | | | | 0 | |
| 10/25/88 | MCWD-10 | | | | | 75 | | | | | |
| 12/07/88 | MCWD-10 | 70 | 4.2 | 16 | 0.5 | 76 | 58 | 2.4 | 23 | 0 | |

## Appendix D. Inorganic Data Summary
## Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
## Monterey County Water Resources Agency

| Sample Date | Well Name | Sodium (mg/L) | Potassium (mg/L) | Calcium (mg/L) | Magnesium (mg/L) | Chloride (mg/L) | Alkalinity (mg/L) | CO3 (mg/L) | Sulfate (mg/L) | Nitrate (mg/L) | TDS (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 07/12/89 | MCWD-10 | | | | | 80 | | | | 0 | |
| 10/03/89 | MCWD-10 | | | | | 80 | | | | 0 | |
| 11/14/89 | MCWD-10 | | | | | 60 | | | | 0 | |
| 12/14/89 | MCWD-10 | | | | | 87 | | | | 0 | |
| 12/21/89 | MCWD-10 | | | | | 87 | | | | | |
| 01/16/90 | MCWD-10 | | | | | 69 | | | | 0 | |
| 02/14/90 | MCWD-10 | 84 | | 16 | 1.3 | 60 | 100 | 0 | 290 | 0 | |
| 02/15/90 | MCWD-10 | | | | | 48 | | | | 0 | |
| 03/15/90 | MCWD-10 | | | | | 69 | | | | 0 | |
| 04/16/90 | MCWD-10 | | | | | 78 | | | | 0 | |
| 04/20/90 | MCWD-10 | | | | | 78 | | | | | |
| 07/17/90 | MCWD-10 | | | | | 66 | | | | 0 | |
| 08/15/90 | MCWD-10 | | | | | 81 | | | | 0 | |
| 09/14/90 | MCWD-10 | | | | | 58 | | | | 0 | |
| 09/24/90 | MCWD-10 | | | | | 58 | | | | | |
| 01/02/91 | MCWD-10 | | | | | 60 | | | | 0 | |
| 01/23/91 | MCWD-10 | 79 | 2.3 | 25 | 3.6 | 57 | 110 | 0 | 50 | 0 | |
| 04/03/91 | MCWD-10 | | | | | 48 | | | | 0 | |
| 07/03/91 | MCWD-10 | 60 | 0 | 22 | 5.6 | 60 | 110 | 0 | 51 | 0 | |
| 10/02/91 | MCWD-10 | | | | | 44 | | | | | |
| 01/08/92 | MCWD-10 | | | | | 68 | | | | 0 | |
| 04/08/92 | MCWD-10 | | | | | 67 | | | | 0 | |
| 07/15/92 | MCWD-10 | 66 | 2.1 | 13 | 0.45 | 71 | 77 | 0 | 24 | 0 | |
| 10/07/92 | MCWD-10 | | | | | 67 | | | | 0 | |
| 07/07/93 | MCWD-10 | 71 | 2 | 13 | 0.72 | 71 | 76 | 0 | 25 | 0 | |
| 07/06/94 | MCWD-10 | 73 | 0 | 17 | 2.7 | 61 | 84 | 0 | 26 | 0 | |
| 01/04/95 | MCWD-10 | | | | | 80 | | | | 0 | |
| 04/05/95 | MCWD-10 | | | | | 63 | | | | 0 | |
| 07/05/95 | MCWD-10 | 69 | 2.1 | 14 | 1.6 | 62 | 79 | 0 | 41 | 0 | |
| 02/26/96 | MCWD-10 | | | | | 52 | | | | | |
| 03/18/96 | MCWD-10 | | | | | 53 | | | | | |
| 04/08/96 | MCWD-10 | | | | | 63.5 | | | | | |
| 04/29/96 | MCWD-10 | | | | | 46.8 | | | | | |
| 05/20/96 | MCWD-10 | | | | | 71 | | | | | |
| 06/10/96 | MCWD-10 | | | | | 46 | | | | | |
| 07/01/96 | MCWD-10 | | | | | 54 | | | | | |
| 07/03/96 | MCWD-10 | 72 | 2.2 | 22 | 5 | 51 | 120 | 0 | 39 | 0 | |
| 07/22/96 | MCWD-10 | | | | | 81.5 | | | | | |
| 08/12/96 | MCWD-10 | | | | | 39.2 | | | | | |
| 08/19/96 | MCWD-10 | | | | | 31 | | | | | |
| 08/26/96 | MCWD-10 | | | | | 47 | | | | | |
| 09/03/96 | MCWD-10 | | | | | 45.5 | | | | | |
| 09/09/96 | MCWD-10 | | | | | 71 | | | | | |
| 09/16/96 | MCWD-10 | | | | | 50.5 | | | | | |
| 09/23/96 | MCWD-10 | | | | | 70 | | | | | |
| 09/30/96 | MCWD-10 | | | | | 51 | | | | | |
| 10/07/96 | MCWD-10 | | | | | 70.5 | | | | | |
| 10/14/96 | MCWD-10 | | | | | 65 | | | | | |
| 04/14/97 | MCWD-10 | | | | | 46.5 | | | | | |
| 04/21/97 | MCWD-10 | | | | | 46.5 | | | | | |
| 04/28/97 | MCWD-10 | | | | | 47 | | | | | |
| 05/05/97 | MCWD-10 | | | | | 49 | | | | | |
| 05/12/97 | MCWD-10 | | | | | 42 | | | | | |
| 05/19/97 | MCWD-10 | | | | | 47 | | | | | |
| 05/27/97 | MCWD-10 | | | | | 48 | | | | | |
| 06/02/97 | MCWD-10 | | | | | 46.5 | | | | | |
| 07/02/97 | MCWD-10 | 64 | 2.6 | 23 | 6.2 | 50 | 110 | 0 | 53 | 0 | |
| 07/14/97 | MCWD-10 | | | | | 50.5 | | | | | |
| 08/04/97 | MCWD-10 | | | | | 48.5 | | | | | |
| 08/11/97 | MCWD-10 | | | | | 47 | | | | | |

| Sample Date | Well Name | Sodium (mg/L) | Potassium (mg/L) | Calcium (mg/L) | Magnesium (mg/L) | Chloride (mg/L) | Alkalinity (mg/L) | CO3 (mg/L) | Sulfate (mg/L) | Nitrate (mg/L) | TDS (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 08/18/97 | MCWD-10 | | | | | 47.5 | | | | | |
| 08/25/97 | MCWD-10 | | | | | 47.5 | | | | | |
| 09/02/97 | MCWD-10 | | | | | 48 | | | | | |
| 09/08/97 | MCWD-10 | | | | | 48 | | | | | |
| 09/22/97 | MCWD-10 | | | | | 48.5 | | | | | |
| 09/29/97 | MCWD-10 | | | | | 48 | | | | | |
| 10/06/97 | MCWD-10 | | | | | 50.5 | | | | | |
| 10/13/97 | MCWD-10 | | | | | 48 | | | | | |
| 10/27/97 | MCWD-10 | | | | | 46.5 | | | | | |
| 11/03/97 | MCWD-10 | | | | | 48 | | | | | |
| 11/17/97 | MCWD-10 | | | | | 46 | | | | | |
| 12/01/97 | MCWD-10 | | | | | 48.5 | | | | | |
| 12/08/97 | MCWD-10 | | | | | 48 | | | | | |
| 12/15/97 | MCWD-10 | | | | | 47 | | | | | |
| 12/22/97 | MCWD-10 | | | | | 48.5 | | | | | |
| 12/29/97 | MCWD-10 | | | | | 48 | | | | | |
| 01/05/98 | MCWD-10 | | | | | 47 | | | | | |
| 01/12/98 | MCWD-10 | | | | | 46.5 | | | | | |
| 01/20/98 | MCWD-10 | | | | | 73 | | | | | |
| 01/26/98 | MCWD-10 | | | | | 58.5 | | | | | |
| 02/02/98 | MCWD-10 | | | | | 48.5 | | | | | |
| 02/09/98 | MCWD-10 | | | | | 54.5 | | | | | |
| 02/17/98 | MCWD-10 | | | | | 48 | | | | | |
| 02/23/98 | MCWD-10 | | | | | 65.5 | | | | | |
| 03/02/98 | MCWD-10 | | | | | 56.5 | | | | | |
| 03/09/98 | MCWD-10 | | | | | 49.5 | | | | | |
| 03/23/98 | MCWD-10 | | | | | 54 | | | | | |
| 03/30/98 | MCWD-10 | | | | | 69.5 | | | | | |
| 04/06/98 | MCWD-10 | | | | | 47 | | | | | |
| 04/13/98 | MCWD-10 | | | | | 73 | | | | | |
| 04/20/98 | MCWD-10 | | | | | 47 | | | | | |
| 04/27/98 | MCWD-10 | | | | | 74 | | | | | |
| 05/04/98 | MCWD-10 | | | | | 47.5 | | | | | |
| 05/11/98 | MCWD-10 | | | | | 46.2 | | | | | |
| 05/18/98 | MCWD-10 | | | | | 47 | | | | | |
| 05/26/98 | MCWD-10 | | | | | 52.5 | | | | | |
| 06/01/98 | MCWD-10 | | | | | 58.5 | | | | | |
| 06/08/98 | MCWD-10 | | | | | 69.5 | | | | | |
| 06/15/98 | MCWD-10 | | | | | 71.5 | | | | | |
| 06/22/98 | MCWD-10 | | | | | 47 | | | | | |
| 07/01/98 | MCWD-10 | 68 | 3.7 | 13 | 0.75 | 65 | 87 | 4.6 | 33 | 0 | |
| 07/06/98 | MCWD-10 | | | | | 47.5 | | | | | |
| 07/13/98 | MCWD-10 | | | | | 47 | | | | | |
| 07/20/98 | MCWD-10 | | | | | 47 | | | | | |
| 07/27/98 | MCWD-10 | | | | | 48.5 | | | | | |
| 08/03/98 | MCWD-10 | | | | | 63.2 | | | | | |
| 08/10/98 | MCWD-10 | | | | | 47 | | | | | |
| 08/17/98 | MCWD-10 | | | | | 70 | | | | | |
| 08/24/98 | MCWD-10 | | | | | 68.8 | | | | | |
| 08/31/98 | MCWD-10 | | | | | 46.5 | | | | | |
| 09/08/98 | MCWD-10 | | | | | 47.5 | | | | | |
| 09/14/98 | MCWD-10 | | | | | 55 | | | | | |
| 09/21/98 | MCWD-10 | | | | | 47.8 | | | | | |
| 09/28/98 | MCWD-10 | | | | | 46 | | | | | |
| 10/05/98 | MCWD-10 | | | | | 48.5 | | | | | |
| 10/12/98 | MCWD-10 | | | | | 47.5 | | | | | |
| 10/19/98 | MCWD-10 | | | | | 69.8 | | | | | |
| 11/02/98 | MCWD-10 | | | | | 48 | | | | | |
| 11/09/98 | MCWD-10 | | | | | 47.5 | | | | | |
| 11/16/98 | MCWD-10 | | | | | 50 | | | | | |

| Sample Date | Well Name | Sodium (mg/L) | Potassium (mg/L) | Calcium (mg/L) | Magnesium (mg/L) | Chloride (mg/L) | Alkalinity (mg/L) | CO3 (mg/L) | Sulfate (mg/L) | Nitrate (mg/L) | TDS (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 12/07/98 | MCWD-10 | | | | | 57.8 | | | | | |
| 12/14/98 | MCWD-10 | | | | | 52.4 | | | | | |
| 12/28/98 | MCWD-10 | | | | | 49 | | | | 0 | |
| 01/04/99 | MCWD-10 | | | | | 58.8 | | | | | |
| 01/11/99 | MCWD-10 | | | | | 51.5 | | | | | |
| 01/19/99 | MCWD-10 | | | | | 52.1 | | | | 0 | |
| 01/25/99 | MCWD-10 | | | | | 52.4 | | | | 0 | |
| 02/01/99 | MCWD-10 | | | | | 54.8 | | | | 0 | |
| 02/08/99 | MCWD-10 | | | | | 52.7 | | | | 0 | |
| 02/16/99 | MCWD-10 | | | | | 47.6 | | | | 0 | |
| 02/22/99 | MCWD-10 | | | | | 64.8 | | | | 0 | |
| 03/01/99 | MCWD-10 | | | | | 67.4 | | | | 0 | |
| 03/08/99 | MCWD-10 | | | | | 45.8 | | | | 0 | |
| 03/15/99 | MCWD-10 | | | | | 46.2 | | | | 0.33 | |
| 05/10/99 | MCWD-10 | | | | | 46.2 | | | | 0 | |
| 06/07/99 | MCWD-10 | | | | | 44.5 | | | | 0 | |
| 06/14/99 | MCWD-10 | | | | | 43.6 | | | | 0 | |
| 06/21/99 | MCWD-10 | | | | | 44.8 | | | | 0 | |
| 06/28/99 | MCWD-10 | | | | | 45.3 | | | | 0 | |
| 07/06/99 | MCWD-10 | | | | | 44.7 | | | | 0 | |
| 07/07/99 | MCWD-10 | 71 | 0 | 24 | 6 | 50 | 110 | 0 | 46 | 0 | |
| 07/12/99 | MCWD-10 | | | | | 68.8 | | | | 0 | |
| 07/19/99 | MCWD-10 | | | | | 44.8 | | | | 0 | |
| 07/26/99 | MCWD-10 | | | | | 44.9 | | | | 0 | |
| 08/02/99 | MCWD-10 | | | | | 44.9 | | | | 0 | |
| 08/09/99 | MCWD-10 | | | | | 48.1 | | | | 0 | |
| 08/16/99 | MCWD-10 | | | | | 45.4 | | | | 0 | |
| 08/23/99 | MCWD-10 | | | | | 45.3 | | | | 0 | |
| 08/30/99 | MCWD-10 | | | | | 45.3 | | | | 0 | |
| 09/07/99 | MCWD-10 | | | | | 45.2 | | | | 0 | |
| 09/13/99 | MCWD-10 | | | | | 45.5 | | | | 0 | |
| 09/20/99 | MCWD-10 | | | | | 45.3 | | | | 0 | |
| 09/27/99 | MCWD-10 | | | | | 45.3 | | | | 0 | |
| 10/04/99 | MCWD-10 | | | | | 45.5 | | | | 0 | |
| 10/11/99 | MCWD-10 | | | | | 46 | | | | 0 | |
| 10/18/99 | MCWD-10 | | | | | 45.4 | | | | 0 | |
| 10/25/99 | MCWD-10 | | | | | 46.9 | | | | 0 | |
| 11/01/99 | MCWD-10 | | | | | 54.9 | | | | 0 | |
| 11/08/99 | MCWD-10 | | | | | 45 | | | | 0 | |
| 11/15/99 | MCWD-10 | | | | | 45.2 | | | | 0 | |
| 11/22/99 | MCWD-10 | | | | | 45.2 | | | | 0 | |
| 11/29/99 | MCWD-10 | | | | | 45.2 | | | | 0.3 | |
| 12/06/99 | MCWD-10 | | | | | 45.2 | | | | 0 | |
| 01/06/86 | MCWD-11 | 100 | 4.5 | 22 | 6 | 80 | 130 | 0 | 60 | 0 | |
| 01/06/86 | MCWD-11 | | | | | 96 | | | | | |
| 01/08/86 | MCWD-11 | | | | | 76 | | | | | |
| 01/10/86 | MCWD-11 | | | | | 80 | | | | | |
| 01/21/87 | MCWD-11 | 97 | | 12 | 1 | 83 | 57 | | 30 | | |
| 04/02/87 | MCWD-11 | 84 | 1.8 | 25 | | 96 | 72 | | 56 | | |
| 05/06/87 | MCWD-11 | | | | | 85 | | | | | |
| 08/05/87 | MCWD-11 | | | | | 100 | | | | 0.1 | |
| 11/02/87 | MCWD-11 | | | | | 90 | | | | | |
| 03/10/88 | MCWD-11 | | | | | 94 | | | | 0 | |
| 03/11/88 | MCWD-11 | 90 | 10 | 34 | 6.5 | 94 | 120 | 0 | 52 | 0 | |
| 04/04/88 | MCWD-11 | | | | | 76 | | | | 0 | |
| 07/07/88 | MCWD-11 | | | | | 74 | | | | 0 | |
| 10/03/88 | MCWD-11 | | | | | 72 | | | | 0 | |
| 12/07/88 | MCWD-11 | 88 | 3.9 | 24 | 7.7 | 76 | 110 | 0 | 47 | 0 | |
| 04/03/89 | MCWD-11 | | | | | 96 | | | | 1.7 | |
| 05/01/89 | MCWD-11 | | | | | 72 | | | | 0 | |

## Appendix D. Inorganic Data Summary
## Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
## Monterey County Water Resources Agency

| Sample Date | Well Name | Sodium (mg/L) | Potassium (mg/L) | Calcium (mg/L) | Magnesium (mg/L) | Chloride (mg/L) | Alkalinity (mg/L) | CO3 (mg/L) | Sulfate (mg/L) | Nitrate (mg/L) | TDS (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 07/05/89 | MCWD-11 | | | | | 1100 | | | | 13.5 | |
| 10/03/89 | MCWD-11 | | | | | 73 | | | | 0 | |
| 11/14/89 | MCWD-11 | | | | | 62 | | | | 0 | |
| 12/14/89 | MCWD-11 | | | | | 76 | | | | 0 | |
| 12/21/89 | MCWD-11 | | | | | 76 | | | | | |
| 01/16/90 | MCWD-11 | | | | | 71 | | | | 0 | |
| 02/14/90 | MCWD-11 | 100 | | 20 | 5.4 | 70 | 120 | 0 | 37 | 0 | |
| 02/15/90 | MCWD-11 | | | | | 76 | | | | 0 | |
| 03/15/90 | MCWD-11 | | | | | 69 | | | | 0 | |
| 03/17/90 | MCWD-11 | | | | | 70 | | | | | |
| 04/16/90 | MCWD-11 | | | | | 100 | | | | 0 | |
| 04/20/90 | MCWD-11 | | | | | 100 | | | | | |
| 07/17/90 | MCWD-11 | | | | | 50 | | | | 0 | |
| 08/15/90 | MCWD-11 | | | | | 72 | | | | 0 | |
| 01/02/91 | MCWD-11 | | | | | 89 | | | | 0 | |
| 01/23/91 | MCWD-11 | 110 | 4.2 | 24 | 2.6 | 110 | 92 | 0 | 38 | 0 | |
| 04/03/91 | MCWD-11 | | | | | 64 | | | | 0 | |
| 07/03/91 | MCWD-11 | 98 | 0 | 22 | 3 | 99 | 96 | 0 | 36 | 0 | |
| 10/02/91 | MCWD-11 | | | | | 81 | | | | | |
| 01/08/92 | MCWD-11 | | | | | 68 | | | | 0 | |
| 04/08/92 | MCWD-11 | | | | | 61 | | | | 0 | |
| 07/01/92 | MCWD-11 | 97 | 1.6 | 24 | 7.3 | 71 | 150 | 0 | 58 | 0 | |
| 10/07/92 | MCWD-11 | | | | | 63 | | | | 0 | |
| 07/07/93 | MCWD-11 | 95 | 2.9 | 23 | 5.4 | 100 | 110 | 0 | 37 | 0 | |
| 07/06/94 | MCWD-11 | 100 | 3.4 | 25 | 7.2 | 59 | 160 | 0 | 58 | 0 | |
| 01/04/95 | MCWD-11 | | | | | 89 | | | | 0 | |
| 04/05/95 | MCWD-11 | | | | | 94 | | | | 0 | |
| 07/05/95 | MCWD-11 | 93 | 2.9 | 25 | 6.1 | 94 | 140 | 0 | 44 | 0 | |
| 10/04/95 | MCWD-11 | | | | | 60 | | | | 0 | |
| 02/12/96 | MCWD-11 | | | | | 65 | | | | | |
| 03/04/96 | MCWD-11 | | | | | 72 | | | | | |
| 03/25/96 | MCWD-11 | | | | | 65.2 | | | | | |
| 04/15/96 | MCWD-11 | | | | | 68 | | | | | |
| 05/06/96 | MCWD-11 | | | | | 75.5 | | | | | |
| 05/28/96 | MCWD-11 | | | | | 65 | | | | | |
| 06/17/96 | MCWD-11 | | | | | 67 | | | | | |
| 07/03/96 | MCWD-11 | 97 | 3 | 26 | 7.4 | 62 | 150 | 0 | 50 | 0 | |
| 07/08/96 | MCWD-11 | | | | | 59 | | | | | |
| 07/29/96 | MCWD-11 | | | | | 78 | | | | | |
| 08/19/96 | MCWD-11 | | | | | 62.5 | | | | | |
| 08/26/96 | MCWD-11 | | | | | 68 | | | | | |
| 09/03/96 | MCWD-11 | | | | | 64 | | | | | |
| 09/09/96 | MCWD-11 | | | | | 65 | | | | | |
| 09/16/96 | MCWD-11 | | | | | 97.5 | | | | | |
| 09/23/96 | MCWD-11 | | | | | 97.5 | | | | | |
| 09/30/96 | MCWD-11 | | | | | 100 | | | | | |
| 10/07/96 | MCWD-11 | | | | | 65 | | | | | |
| 10/14/96 | MCWD-11 | | | | | 88.5 | | | | | |
| 07/02/97 | MCWD-11 | 84 | 7.2 | 28 | 1.1 | 120 | 100 | 0 | 39 | 0 | |
| 07/14/97 | MCWD-11 | | | | | 108 | | | | | |
| 08/18/97 | MCWD-11 | | | | | 108 | | | | | |
| 08/25/97 | MCWD-11 | | | | | 107 | | | | | |
| 09/02/97 | MCWD-11 | | | | | 109 | | | | | |
| 09/08/97 | MCWD-11 | | | | | 108 | | | | | |
| 09/22/97 | MCWD-11 | | | | | 106 | | | | | |
| 09/29/97 | MCWD-11 | | | | | 107 | | | | | |
| 10/06/97 | MCWD-11 | | | | | 108 | | | | | |
| 10/13/97 | MCWD-11 | | | | | 108 | | | | | |
| 10/20/97 | MCWD-11 | | | | | 105 | | | | | |
| 10/28/97 | MCWD-11 | | | | | 105 | | | | | |

| Sample Date | Well Name | Sodium (mg/L) | Potassium (mg/L) | Calcium (mg/L) | Magnesium (mg/L) | Chloride (mg/L) | Alkalinity (mg/L) | CO3 (mg/L) | Sulfate (mg/L) | Nitrate (mg/L) | TDS (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 11/17/97 | MCWD-11 | | | | | 105 | | | | | |
| 12/01/97 | MCWD-11 | | | | | 107 | | | | | |
| 12/08/97 | MCWD-11 | | | | | 105 | | | | | |
| 12/22/97 | MCWD-11 | | | | | 106 | | | | | |
| 12/29/97 | MCWD-11 | | | | | 105 | | | | | |
| 01/05/98 | MCWD-11 | | | | | 106 | | | | | |
| 01/12/98 | MCWD-11 | | | | | 105 | | | | | |
| 01/20/98 | MCWD-11 | | | | | 99 | | | | | |
| 01/26/98 | MCWD-11 | | | | | 88 | | | | | |
| 02/02/98 | MCWD-11 | | | | | 74.2 | | | | | |
| 02/09/98 | MCWD-11 | | | | | 85.5 | | | | | |
| 02/17/98 | MCWD-11 | | | | | 68.5 | | | | | |
| 02/23/98 | MCWD-11 | | | | | 95.5 | | | | | |
| 03/02/98 | MCWD-11 | | | | | 69 | | | | | |
| 03/09/98 | MCWD-11 | | | | | 68.5 | | | | | |
| 03/23/98 | MCWD-11 | | | | | 65 | | | | | |
| 03/30/98 | MCWD-11 | | | | | 65.5 | | | | | |
| 04/06/98 | MCWD-11 | | | | | 64.5 | | | | | |
| 04/13/98 | MCWD-11 | | | | | 64.5 | | | | | |
| 04/20/98 | MCWD-11 | | | | | 65 | | | | | |
| 04/27/98 | MCWD-11 | | | | | 65.5 | | | | | |
| 05/04/98 | MCWD-11 | | | | | 70.5 | | | | | |
| 05/11/98 | MCWD-11 | | | | | 63.5 | | | | | |
| 05/18/98 | MCWD-11 | | | | | 65 | | | | | |
| 05/26/98 | MCWD-11 | | | | | 102 | | | | | |
| 06/01/98 | MCWD-11 | | | | | 79 | | | | | |
| 06/08/98 | MCWD-11 | | | | | 65.5 | | | | | |
| 06/15/98 | MCWD-11 | | | | | 66.5 | | | | | |
| 06/22/98 | MCWD-11 | | | | | 64.5 | | | | | |
| 07/01/98 | MCWD-11 | 90 | 1.6 | 24 | 7.4 | 62 | 180 | 2 | 60 | 0 | |
| 07/06/98 | MCWD-11 | | | | | 64.5 | | | | | |
| 07/13/98 | MCWD-11 | | | | | 64 | | | | | |
| 07/20/98 | MCWD-11 | | | | | 64 | | | | | |
| 07/27/98 | MCWD-11 | | | | | 65.5 | | | | | |
| 08/03/98 | MCWD-11 | | | | | 64.5 | | | | | |
| 08/10/98 | MCWD-11 | | | | | 63.5 | | | | | |
| 08/17/98 | MCWD-11 | | | | | 64 | | | | | |
| 08/24/98 | MCWD-11 | | | | | 64 | | | | | |
| 08/31/98 | MCWD-11 | | | | | 64.5 | | | | | |
| 09/08/98 | MCWD-11 | | | | | 63.8 | | | | | |
| 09/14/98 | MCWD-11 | | | | | 64 | | | | | |
| 09/21/98 | MCWD-11 | | | | | 65 | | | | | |
| 09/28/98 | MCWD-11 | | | | | 62.5 | | | | | |
| 10/05/98 | MCWD-11 | | | | | 65.5 | | | | | |
| 10/12/98 | MCWD-11 | | | | | 65 | | | | | |
| 10/19/98 | MCWD-11 | | | | | 64 | | | | | |
| 11/02/98 | MCWD-11 | | | | | 59 | | | | | |
| 11/09/98 | MCWD-11 | | | | | 63 | | | | | |
| 11/16/98 | MCWD-11 | | | | | 78 | | | | | |
| 12/07/98 | MCWD-11 | | | | | 64.2 | | | | | |
| 12/14/98 | MCWD-11 | | | | | 64.1 | | | | | |
| 12/28/98 | MCWD-11 | | | | | 66.5 | | | | 0 | |
| 01/04/99 | MCWD-11 | | | | | 63.2 | | | | | |
| 01/11/99 | MCWD-11 | | | | | 62.8 | | | | | |
| 01/19/99 | MCWD-11 | | | | | 64.1 | | | | 0 | |
| 01/25/99 | MCWD-11 | | | | | 64.5 | | | | 0 | |
| 02/01/99 | MCWD-11 | | | | | 63.8 | | | | 0 | |
| 02/08/99 | MCWD-11 | | | | | 64.2 | | | | 0 | |
| 02/16/99 | MCWD-11 | | | | | 94.5 | | | | 0 | |
| 02/22/99 | MCWD-11 | | | | | 64.7 | | | | 0 | |

| Sample Date | Well Name | Sodium (mg/L) | Potassium (mg/L) | Calcium (mg/L) | Magnesium (mg/L) | Chloride (mg/L) | Alkalinity (mg/L) | CO3 (mg/L) | Sulfate (mg/L) | Nitrate (mg/L) | TDS (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 03/01/99 | MCWD-11 | | | | | 85.6 | | | | 0 | |
| 03/08/99 | MCWD-11 | | | | | 85.2 | | | | 0 | |
| 03/15/99 | MCWD-11 | | | | | 62.6 | | | | 0.33 | |
| 05/10/99 | MCWD-11 | | | | | 63.9 | | | | 0 | |
| 05/17/99 | MCWD-11 | | | | | 64.4 | | | | 0 | |
| 05/24/99 | MCWD-11 | | | | | 62.7 | | | | 0 | |
| 06/01/99 | MCWD-11 | | | | | 63.9 | | | | 0 | |
| 06/07/99 | MCWD-11 | | | | | 63.6 | | | | 0 | |
| 06/14/99 | MCWD-11 | | | | | 59 | | | | 0 | |
| 06/21/99 | MCWD-11 | | | | | 61.9 | | | | 0 | |
| 06/28/99 | MCWD-11 | | | | | 61.8 | | | | 0 | |
| 07/06/99 | MCWD-11 | | | | | 61.6 | | | | 0 | |
| 07/07/99 | MCWD-11 | 95 | 1.4 | 24 | 7.5 | 62 | 150 | 0 | 56 | 0 | |
| 07/12/99 | MCWD-11 | | | | | 61.6 | | | | 0 | |
| 07/19/99 | MCWD-11 | | | | | 61.4 | | | | 0 | |
| 07/26/99 | MCWD-11 | | | | | 61.7 | | | | 0 | |
| 08/09/99 | MCWD-11 | | | | | 62.9 | | | | 0 | |
| 08/16/99 | MCWD-11 | | | | | 61.5 | | | | 0 | |
| 08/23/99 | MCWD-11 | | | | | 61.6 | | | | 0 | |
| 08/30/99 | MCWD-11 | | | | | 61.8 | | | | 0 | |
| 09/07/99 | MCWD-11 | | | | | 61.4 | | | | 0 | |
| 09/13/99 | MCWD-11 | | | | | 61.6 | | | | 0 | |
| 09/20/99 | MCWD-11 | | | | | 70.9 | | | | 0.3 | |
| 09/27/99 | MCWD-11 | | | | | 53.5 | | | | 0.36 | |
| 10/04/99 | MCWD-11 | | | | | 101.8 | | | | 0 | |
| 10/11/99 | MCWD-11 | | | | | 62.6 | | | | 0.36 | |
| 10/18/99 | MCWD-11 | | | | | 100.4 | | | | 0 | |
| 10/25/99 | MCWD-11 | | | | | 61.9 | | | | 0 | |
| 11/01/99 | MCWD-11 | | | | | 63.4 | | | | 0 | |
| 11/08/99 | MCWD-11 | | | | | 61.8 | | | | 0 | |
| 11/15/99 | MCWD-11 | | | | | 61.7 | | | | 0 | |
| 11/22/99 | MCWD-11 | | | | | 61.8 | | | | 0 | |
| 11/29/99 | MCWD-11 | | | | | 63.1 | | | | 0 | |
| 12/06/99 | MCWD-11 | | | | | 61.9 | | | | 0 | |
| 05/17/89 | MCWD-12 | 140 | 5.4 | 14 | 0.59 | 120 | 120 | | 46 | | |
| 06/12/89 | MCWD-12 | | | | | 120 | | | | | |
| 08/13/90 | MCWD-12 | 140 | | 21 | 1.5 | 120 | 140 | 0 | 55 | 0 | |
| 04/03/91 | MCWD-12 | | | | | 120 | | | | 0 | |
| 07/03/91 | MCWD-12 | 30 | 11 | 18 | 1.1 | 120 | 140 | 0 | 59 | 0 | |
| 10/02/91 | MCWD-12 | | | | | 120 | | | | | |
| 01/08/92 | MCWD-12 | | | | | 130 | | | | 0 | |
| 04/08/92 | MCWD-12 | | | | | 120 | | | | 0 | |
| 07/01/92 | MCWD-12 | 140 | 4.5 | 18 | 0.61 | 130 | 150 | 0 | 55 | 0 | |
| 07/07/93 | MCWD-12 | 150 | 4.6 | 19 | 0.59 | 120 | 140 | 0 | 58 | 0 | |
| 07/06/94 | MCWD-12 | 150 | 2.2 | 17 | 0.72 | 120 | 120 | 0 | 52 | 0 | |
| 01/04/95 | MCWD-12 | | | | | 110 | | | | 0 | |
| 04/05/95 | MCWD-12 | | | | | 120 | | | | 0 | |
| 07/05/95 | MCWD-12 | 130 | 4 | 15 | 0.61 | 110 | 130 | 0 | 48 | 0 | |
| 10/04/95 | MCWD-12 | | | | | 100 | | | | 0 | |
| 02/20/96 | MCWD-12 | | | | | 115 | | | | | |
| 03/11/96 | MCWD-12 | | | | | 114 | | | | | |
| 04/01/96 | MCWD-12 | | | | | 130 | | | | | |
| 04/22/96 | MCWD-12 | | | | | 132 | | | | | |
| 05/13/96 | MCWD-12 | | | | | 115 | | | | | |
| 06/03/96 | MCWD-12 | | | | | 80 | | | | | |
| 06/24/96 | MCWD-12 | | | | | 113 | | | | | |
| 07/03/96 | MCWD-12 | 150 | 4.8 | 21 | 0.72 | 110 | 140 | 0 | 39 | 0 | |
| 07/15/96 | MCWD-12 | | | | | 113 | | | | | |
| 08/05/96 | MCWD-12 | | | | | 127 | | | | | |
| 08/19/96 | MCWD-12 | | | | | 53 | | | | | |

## Appendix D. Inorganic Data Summary
## Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
## Monterey County Water Resources Agency

| Sample Date | Well Name | Sodium (mg/L) | Potassium (mg/L) | Calcium (mg/L) | Magnesium (mg/L) | Chloride (mg/L) | Alkalinity (mg/L) | CO3 (mg/L) | Sulfate (mg/L) | Nitrate (mg/L) | TDS (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 08/26/96 | MCWD-12 | | | | | 130 | | | | | |
| 09/03/96 | MCWD-12 | | | | | 87 | | | | | |
| 09/09/96 | MCWD-12 | | | | | 117 | | | | | |
| 09/16/96 | MCWD-12 | | | | | 113 | | | | | |
| 09/23/96 | MCWD-12 | | | | | 116 | | | | | |
| 09/30/96 | MCWD-12 | | | | | 113 | | | | | |
| 10/07/96 | MCWD-12 | | | | | 132 | | | | | |
| 10/14/96 | MCWD-12 | | | | | 128 | | | | | |
| 04/14/97 | MCWD-12 | | | | | 116 | | | | | |
| 04/21/97 | MCWD-12 | | | | | 113 | | | | | |
| 05/05/97 | MCWD-12 | | | | | 118 | | | | | |
| 05/12/97 | MCWD-12 | | | | | 117 | | | | | |
| 05/19/97 | MCWD-12 | | | | | 131 | | | | | |
| 05/27/97 | MCWD-12 | | | | | 118 | | | | | |
| 06/02/97 | MCWD-12 | | | | | 116 | | | | | |
| 07/02/97 | MCWD-12 | 120 | 5 | 19 | 0.71 | 100 | 130 | 0 | 43 | 0 | |
| 07/14/97 | MCWD-12 | | | | | 131 | | | | | |
| 08/04/97 | MCWD-12 | | | | | 116 | | | | | |
| 08/11/97 | MCWD-12 | | | | | 115 | | | | | |
| 08/18/97 | MCWD-12 | | | | | 130 | | | | | |
| 08/25/97 | MCWD-12 | | | | | 125 | | | | | |
| 09/02/97 | MCWD-12 | | | | | 126 | | | | | |
| 09/08/97 | MCWD-12 | | | | | 132 | | | | | |
| 09/22/97 | MCWD-12 | | | | | 130 | | | | | |
| 09/29/97 | MCWD-12 | | | | | 115 | | | | | |
| 10/06/97 | MCWD-12 | | | | | 131 | | | | | |
| 10/13/97 | MCWD-12 | | | | | 131 | | | | | |
| 10/20/97 | MCWD-12 | | | | | 116 | | | | | |
| 10/27/97 | MCWD-12 | | | | | 114 | | | | | |
| 11/03/97 | MCWD-12 | | | | | 125 | | | | | |
| 11/17/97 | MCWD-12 | | | | | 129 | | | | | |
| 12/01/97 | MCWD-12 | | | | | 116 | | | | | |
| 12/08/97 | MCWD-12 | | | | | 115 | | | | | |
| 12/15/97 | MCWD-12 | | | | | 112 | | | | | |
| 12/22/97 | MCWD-12 | | | | | 115 | | | | | |
| 12/29/97 | MCWD-12 | | | | | 129 | | | | | |
| 01/05/98 | MCWD-12 | | | | | 116 | | | | | |
| 01/12/98 | MCWD-12 | | | | | 113 | | | | | |
| 01/20/98 | MCWD-12 | | | | | 113 | | | | | |
| 03/23/98 | MCWD-12 | | | | | 130 | | | | | |
| 03/30/98 | MCWD-12 | | | | | 138 | | | | | |
| 04/06/98 | MCWD-12 | | | | | 130 | | | | | |
| 04/13/98 | MCWD-12 | | | | | 129 | | | | | |
| 04/20/98 | MCWD-12 | | | | | 115 | | | | | |
| 04/27/98 | MCWD-12 | | | | | 130 | | | | | |
| 05/04/98 | MCWD-12 | | | | | 130 | | | | | |
| 05/11/98 | MCWD-12 | | | | | 113 | | | | | |
| 05/18/98 | MCWD-12 | | | | | 128 | | | | | |
| 05/26/98 | MCWD-12 | | | | | 113 | | | | | |
| 06/01/98 | MCWD-12 | | | | | 129 | | | | | |
| 06/08/98 | MCWD-12 | | | | | 114 | | | | | |
| 06/15/98 | MCWD-12 | | | | | 130 | | | | | |
| 06/22/98 | MCWD-12 | | | | | 115 | | | | | |
| 07/01/98 | MCWD-12 | 140 | 4.9 | 17 | 0.8 | 130 | 150 | 2.4 | 51 | 0 | |
| 07/06/98 | MCWD-12 | | | | | 114 | | | | | |
| 07/13/98 | MCWD-12 | | | | | 113 | | | | | |
| 07/20/98 | MCWD-12 | | | | | 114 | | | | | |
| 07/27/98 | MCWD-12 | | | | | 114 | | | | | |
| 08/03/98 | MCWD-12 | | | | | 115 | | | | | |
| 08/10/98 | MCWD-12 | | | | | 114 | | | | | |

| Sample Date | Well Name | Sodium (mg/L) | Potassium (mg/L) | Calcium (mg/L) | Magnesium (mg/L) | Chloride (mg/L) | Alkalinity (mg/L) | CO3 (mg/L) | Sulfate (mg/L) | Nitrate (mg/L) | TDS (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 08/17/98 | MCWD-12 | | | | | 129 | | | | | |
| 08/24/98 | MCWD-12 | | | | | 109 | | | | | |
| 08/31/98 | MCWD-12 | | | | | 115 | | | | | |
| 09/08/98 | MCWD-12 | | | | | 113 | | | | | |
| 09/14/98 | MCWD-12 | | | | | 130 | | | | | |
| 09/21/98 | MCWD-12 | | | | | 116 | | | | | |
| 09/28/98 | MCWD-12 | | | | | 128 | | | | | |
| 10/05/98 | MCWD-12 | | | | | 126 | | | | | |
| 10/12/98 | MCWD-12 | | | | | 131 | | | | | |
| 10/19/98 | MCWD-12 | | | | | 127 | | | | | |
| 11/09/98 | MCWD-12 | | | | | 126 | | | | | |
| 11/16/98 | MCWD-12 | | | | | 112 | | | | | |
| 12/07/98 | MCWD-12 | | | | | 119 | | | | | |
| 12/14/98 | MCWD-12 | | | | | 133 | | | | | |
| 12/28/98 | MCWD-12 | | | | | 131 | | | | 0 | |
| 01/11/99 | MCWD-12 | | | | | 132 | | | | | |
| 01/19/99 | MCWD-12 | | | | | 136 | | | | 0 | |
| 01/25/99 | MCWD-12 | | | | | 137 | | | | 0 | |
| 02/01/99 | MCWD-12 | | | | | 137 | | | | 0 | |
| 02/08/99 | MCWD-12 | | | | | 120 | | | | 0 | |
| 02/16/99 | MCWD-12 | | | | | 131 | | | | 0 | |
| 02/22/99 | MCWD-12 | | | | | 105 | | | | 0 | |
| 03/01/99 | MCWD-12 | | | | | 130 | | | | 0 | |
| 03/08/99 | MCWD-12 | | | | | 132 | | | | 0 | |
| 03/15/99 | MCWD-12 | | | | | 135 | | | | 0 | |
| 05/10/99 | MCWD-12 | | | | | 105 | | | | 0 | |
| 05/17/99 | MCWD-12 | | | | | 104 | | | | 0 | |
| 05/24/99 | MCWD-12 | | | | | 101 | | | | 0 | |
| 06/01/99 | MCWD-12 | | | | | 125 | | | | 0 | |
| 06/07/99 | MCWD-12 | | | | | 104 | | | | 0 | |
| 06/14/99 | MCWD-12 | | | | | 106 | | | | 0 | |
| 06/21/99 | MCWD-12 | | | | | 108 | | | | 0 | |
| 06/28/99 | MCWD-12 | | | | | 112 | | | | 0 | |
| 07/06/99 | MCWD-12 | | | | | 112 | | | | 0 | |
| 07/07/99 | MCWD-12 | 150 | 3 | 21 | 0.82 | 130 | 150 | 0 | 49 | 0 | |
| 07/12/99 | MCWD-12 | | | | | 112 | | | | 0 | |
| 07/19/99 | MCWD-12 | | | | | 112 | | | | 0 | |
| 07/26/99 | MCWD-12 | | | | | 112 | | | | 0.3 | |
| 08/02/99 | MCWD-12 | | | | | 111 | | | | 0.38 | |
| 08/09/99 | MCWD-12 | | | | | 105 | | | | 0 | |
| 08/16/99 | MCWD-12 | | | | | 109 | | | | 0 | |
| 08/23/99 | MCWD-12 | | | | | 112 | | | | 0 | |
| 08/30/99 | MCWD-12 | | | | | 113 | | | | 0 | |
| 09/07/99 | MCWD-12 | | | | | 113 | | | | 0 | |
| 09/13/99 | MCWD-12 | | | | | 113 | | | | 0 | |
| 09/20/99 | MCWD-12 | | | | | 112 | | | | 0 | |
| 09/27/99 | MCWD-12 | | | | | 113 | | | | 0 | |
| 10/04/99 | MCWD-12 | | | | | 112 | | | | 0 | |
| 10/11/99 | MCWD-12 | | | | | 113 | | | | 0 | |
| 10/18/99 | MCWD-12 | | | | | 112 | | | | 0 | |
| 10/25/99 | MCWD-12 | | | | | 113 | | | | 0 | |
| 11/01/99 | MCWD-12 | | | | | 133 | | | | 0 | |
| 11/08/99 | MCWD-12 | | | | | 118 | | | | 0 | |
| 11/15/99 | MCWD-12 | | | | | 113 | | | | 0 | |
| 11/22/99 | MCWD-12 | | | | | 113 | | | | 0 | |
| 11/29/99 | MCWD-12 | | | | | 113 | | | | 0 | |
| 12/06/99 | MCWD-12 | | | | | 113 | | | | 0 | |

## APPENDIX E

***Summary Hydrogeological Report on the Relationship of the 4 Recently Completed Water Wells on Fort Ord Military Reservation to the Salinas Valley 180 and 400 foot Aquifers.*** **Prepared for Monterey County Flood Control and Water Conservation District by Richard Thorup. March 20, 1985.**

For: Monterey County Flood Control
and Water Conservation District

# Summary Hydrogeological Report on the Relationship of the 4 Recently Completed Water Wells on Fort Ord Military Reservation to the Salinas Valley 180 and 400 foot Aquifers

Richard R. Thorup
Consulting Geologist
Monterey, Ca 93940

March 20, 1985

OIL WATER

Mailing Address
P. O. BOX 1068
MONTEREY, CALIF. 93940

# Richard R. Thorup

*CONSULTING GEOLOGIST*
REGISTERED GEOLOGIST NO. 2708
STATE OF CALIFORNIA

Office
481 VIA DEL REY
MONTEREY, CALIF.
TELEPHONE (408) 372-2466

March 20, 1985

Monterey County Flood Control &
Water Conservation District
P. O. Box 930
Salinas, CA 93902

Attention: Mohammed A. Zaman
Associate Civil Engineer

Subject: Summary Hydrogeological Report on the Relationship of the 4 Recently Completed Water Wells on Fort Ord Military Reservation to the Salinas Valley 180 and 400 Foot Aquifers

Dear Mr. Zaman:

At your request, I have conducted a study on the relationship of the 4 new Fort Ord water wells, drilled along Reservation Road, to the Salinas Valley 180 and 400 foot aquifers.

My investigation shows that wells C and D are perforated solely in the 180 foot aquifer, and that wells A and B are perforated in both aquifers. It is probable that most of the water in wells A and B will come from the 180 foot aquifer because of the better development of this aquifer at these locations.

Very truly yours,

Richard R. Thorup

RICHARD R. THORUP

OIL WATER

Mailing Address
P. O. BOX 1068
MONTEREY, CALIF. 93940

Richard R. Thorup
*CONSULTING GEOLOGIST*
REGISTERED GEOLOGIST NO. 2708
STATE OF CALIFORNIA

Office
481 VIA DEL REY
MONTEREY, CALIF.
TELEPHONE (408) 372-2466

March 20, 1985

# SUMMARY HYDROGEOLOGIC REPORT ON THE RELATIONSHIP OF THE 4 RECENTLY COMPLETED WATER WELLS ON FORT ORD MILITARY RESERVATION TO THE SALINAS VALLEY 180 AND 400 FOOT AQUIFERS

## Introduction

Because of massive salt water intrusion in the 180 and 400 foot aquifers in the Fort Ord water well field near Marina, the Army found it necessary to develop a new source of groundwater in order to maintain the functions of the base. This they did by drilling and completing 4 new wells in 1984 along Reservation Road, about a mile and a half east of their present well field. The four wells were primarily perforated in the 180 foot zone. Two of them also contained perforations in the upper part of the 400 foot zone.

Subsequent to the completion of the 4 wells, the Army contracted with Geotechnical Consultants, Inc., Ventura, to prepare a hydrogeological update of the groundwater resources of the Fort Ord Military Reservation. This publication, as well as a 1975 report written for the Army by E. P. Kaiser, and a 1968-69 report by the State D.W.R. on "Salt Water Intrusion, Lower Salinas Valley", have been used as references for this study.

## Purpose

The purpose of this report is to identify the aquifers which were perforated in the four Army wells.

## Scope

The following lines of research were used for this report.

1. Significant references were reviewed for interpretive evaluation of the 180 and 400 foot aquifers.

2. Drillers logs and electric logs in the local area were assembled and reveiwed.

3. The Cross Sections drawn thru the Army wells and adjoining Salinas Valley water wells were constructed for the purpose of correlating the strata and identifying the perforated intervals.

4. Two location maps were drawn, one showing the Cross Section lines of the 3 previous publications and the other the Cross Section lines constructed for this report.

5. The Cross Sections and text were submitted to Monterey County Flood Control and Water Conservation District for review and comment.

Methodology

The D.W.R. publication (Reference 1) is taken as the basic reference for the identification of the 180 and 400 foot aquifers. The text and Cross Sections were examined in order to establish the rationale for the establishment of the sand and gravel strata into two separate aquifers. Historical monitoring and testing has shown that the water quality and pressure characteristics of the zones differ from each other, presumably, in part, due to the typical separation of the zones by a blue and yellow clay zone which is distinctive from the lower blue and brown clays.

The aquifers were identified from Cross Sections E-E' and F-F' of the D.W.R. reference, new well data has locally modified their interpretation, but the zones remain essentially intact.

Cross Section lines A-A' (east-west) and B-B' (north-south) in this report were drawn thru the Army wells and neighboring Salinas Valley wells. The strata were correlated from well to well. Perforated intervals are plotted to show which aquifers have been perforated.

Conclusions

Cross Section A-A' shows that wells C and D are perforated in the 180 foot aquifer.

Cross Section B-B' shows that wells A and B are perforated mainly in the 180 foot aquifer, while the lower perforations are in the upper part of the 400 foot aquifer.

Table 1

| Well Identification | Perforated Intervals | Aquifer |
|---|---|---|
| Army A | 315-570 | |
| | 315-430 | 180 |
| | 440-570 | 400 |
| B | 315-405 | 180 |
| | 440-485 | 400 |
| | 525-575 | 400 |
| C | 285-470 | 180 |
| D | 260-500 | 180 |

Enclosures

Plate 1 Location Map showing Plot of Cross Section Lines A-A', B-B'.

Plate 2 Location Map with Plots of pertinent Cross Section Lines as shown in References 1, 2 and 3, listed below.

Plate 3 Cross Section Lines A-A' and B-B' showing correlations of U. S. Army wells A, B, C and D to Salinas Valley 180 and 400 foot aquifers.

References


1. State of California Department of Water Resources, June 1970, Sea Water Intrusion, Lower Salinas Valley, Progress Report 1968-69.

2. Department of Army, Sacramento District, Corps of Engineers, May 1975, Final Report, Hydrogeology of Fort Ord and Vicinity, Fort Ord, Monterey County, California by E. P. Kaiser.

3. Geotechnical Consultants, Inc., October 1984, Hydrogeologic Update, Fort Ord Military Reservation and Vicinity, Monterey County, California: For U. S. Department of Army, Sacramento District, Corps of Engineers.

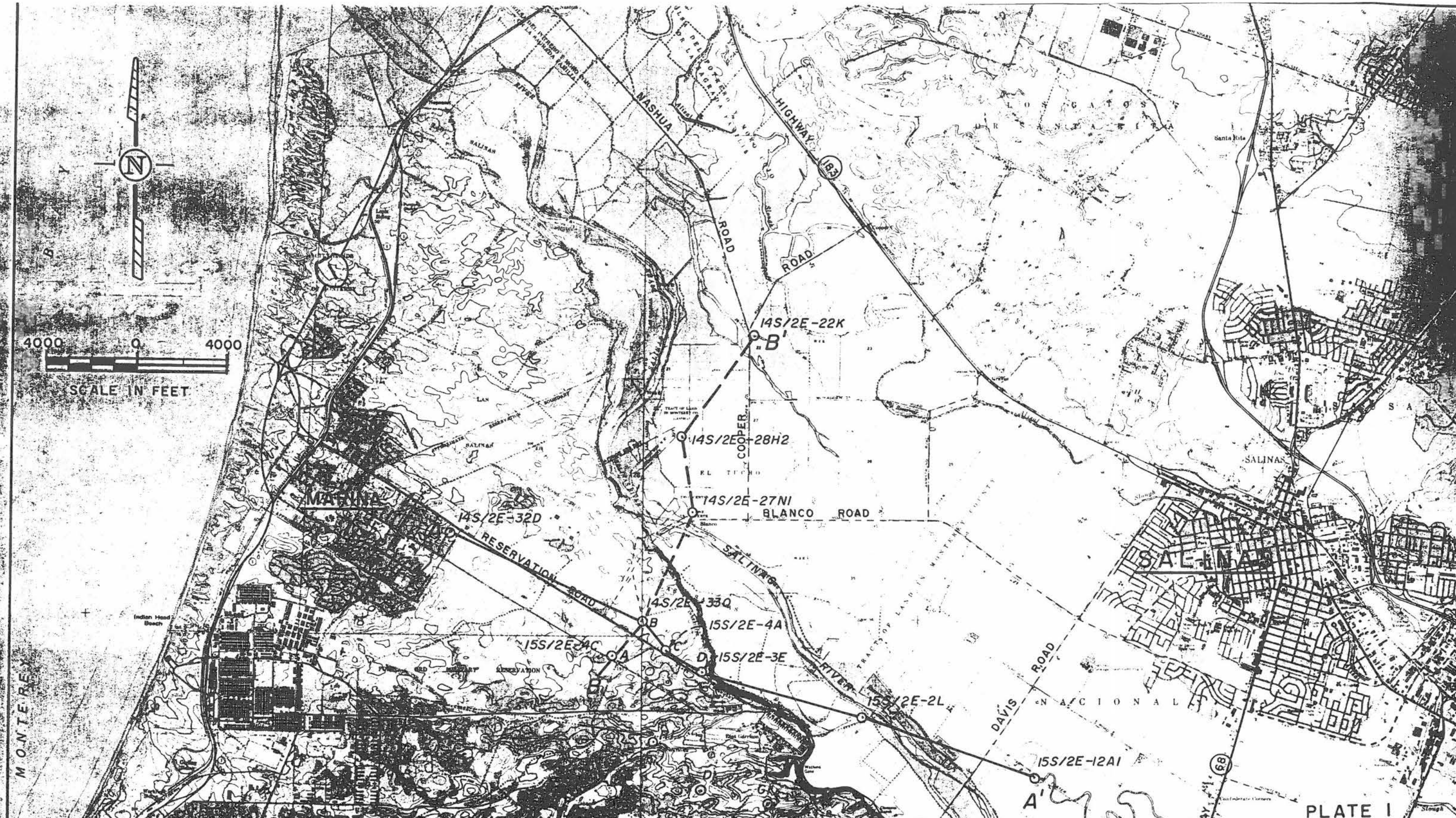
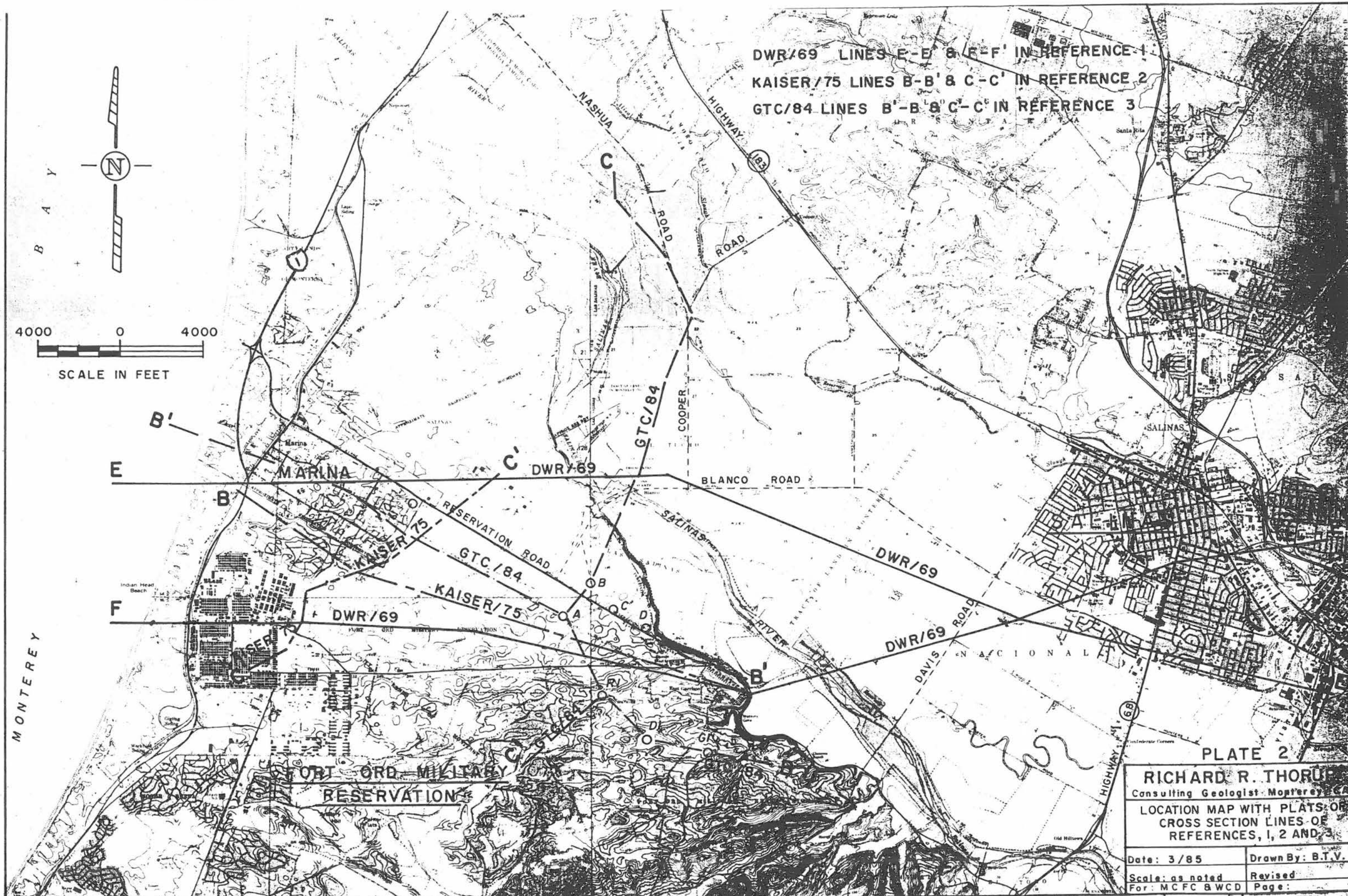


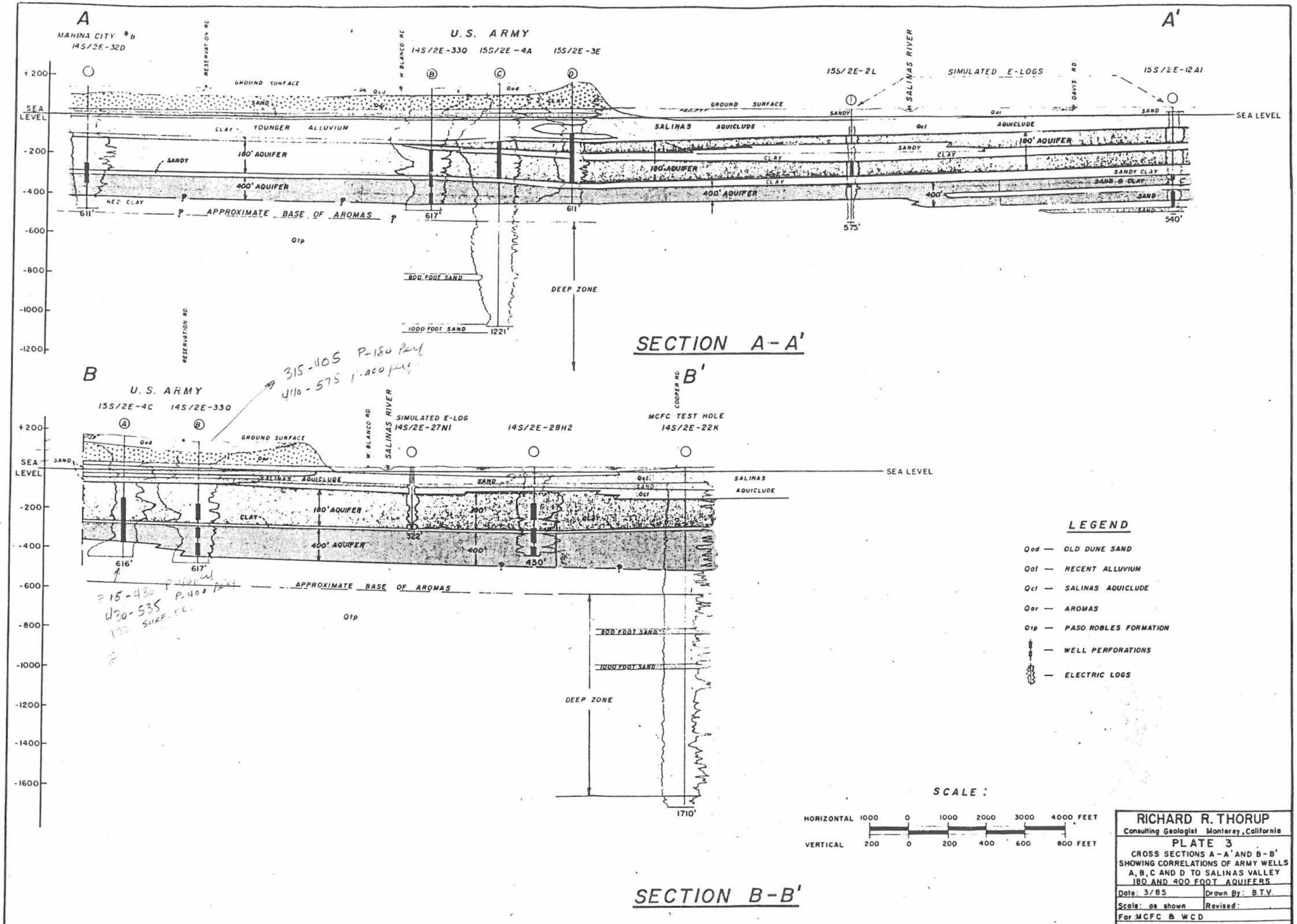

PLATE I

RICHARD R. THORUP
Consulting Geologist Monterey, CA

LOCATION MAP
SHOWING PLAT OF CROSS SECTION LINES A-A' AND B-B'

| | |
|---|---|
| Date: 3/85 | Drawn By: B.T.V. |
| Scale: as noted | Revised: |
| For: MCFC & WCD | Page: |


DWR/69 LINES E-E' & F-F' IN REFERENCE 1
KAISER/75 LINES B-B' & C-C' IN REFERENCE 2
GTC/84 LINES B'-B" & C'-C" IN REFERENCE 3
N
BAY
MONTEREY
4000
0
4000
SCALE IN FEET
NASHUA
ROAD
HIGHWAY
183
COOPER
ROAD
C
B'
E
B
F
C'
MARINA
DWR/69
BLANCO ROAD
RESERVATION ROAD
GTC/84
KAISER/75
KAISER
SALINAS
RIVER
DAVIS ROAD
SALINAS
FORT ORD MILITARY RESERVATION
HIGHWAY
68
PLATE 2
RICHARD R. THORUP
Consulting Geologist Monterey, CA
LOCATION MAP WITH PLATS OF CROSS SECTION LINES OF REFERENCES, 1, 2 AND 3
Date: 3/85
Drawn By: B.T.V.
Scale: as noted
Revised
For: MCFC & WCD
Page:


A
MARINA CITY #8
14S/2E-32D
U.S. ARMY
14S/2E-330
15S/2E-4A
15S/2E-3E
A'
15S/2E-2L
SIMULATED E-LOGS
15S/2E-12A1
SALINAS RIVER
GROUND SURFACE
SEA LEVEL
YOUNGER ALLUVIUM
SALINAS AQUICLUDE
AQUICLUDE
180' AQUIFER
400' AQUIFER
RED CLAY
APPROXIMATE BASE OF AROMAS
800 FOOT SAND
1000 FOOT SAND
DEEP ZONE
SECTION A-A'
B
U.S. ARMY
15S/2E-4C
14S/2E-330
SIMULATED E-LOG
14S/2E-27N1
14S/2E-28H2
MCFC TEST HOLE
14S/2E-22K
B'
315-405 P-180 Perf
410-575 P-400 Perf
SECTION B-B'
LEGEND
Qod — OLD DUNE SAND
Qal — RECENT ALLUVIUM
Qcl — SALINAS AQUICLUDE
Qar — AROMAS
Qtp — PASO ROBLES FORMATION
— WELL PERFORATIONS
— ELECTRIC LOGS
SCALE:
HORIZONTAL 1000 0 1000 2000 3000 4000 FEET
VERTICAL 200 0 200 400 600 800 FEET
RICHARD R. THORUP
Consulting Geologist Monterey, California
PLATE 3
CROSS SECTIONS A-A' AND B-B' SHOWING CORRELATIONS OF ARMY WELLS A, B, C AND D TO SALINAS VALLEY 180 AND 400 FOOT AQUIFERS
Date: 3/85
Drawn By: B.T.V.
Scale: as shown
Revised:
For MCFC & WCD

## DISTRIBUTION

Final Report
Hydrogeologic Investigation of the Salinas Valley Basin
in the Vicinity of Fort Ord and Marina
Salinas Valley, California

April 12, 2001

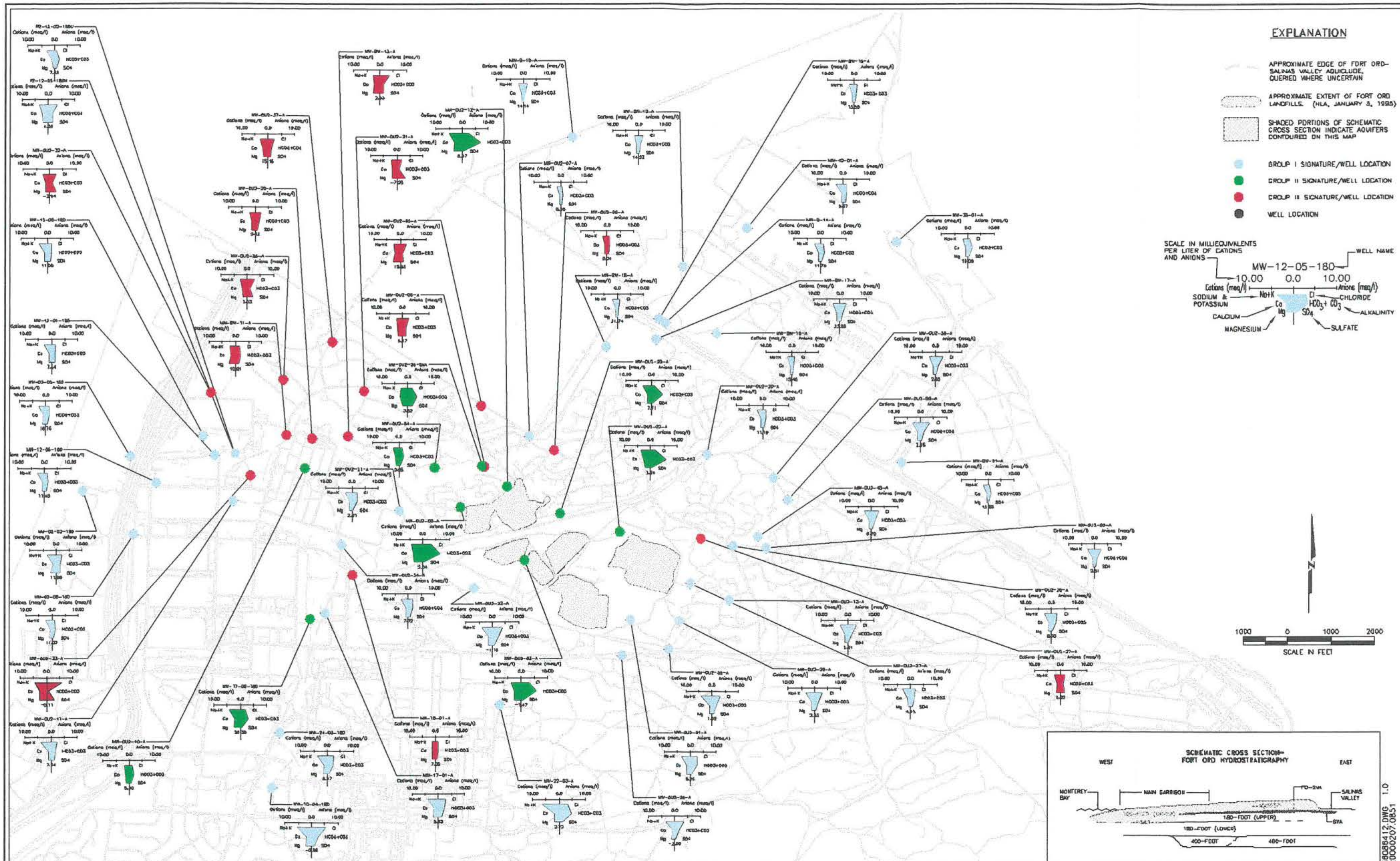
Copy No. ___

| | |
|---|---|
| Copies 1 – 50: | Monterey County Water Resources<br>893 Blanco Circle<br>Salinas, California 93901-4455 |
| Copy 51 – 55: | Harding ESE, Inc. |

Quality Control Reviewer

J. Buck King, R.G., C.Hg.
Senior Hydrogeologist

MT/DJC/YL56965F.doc-M



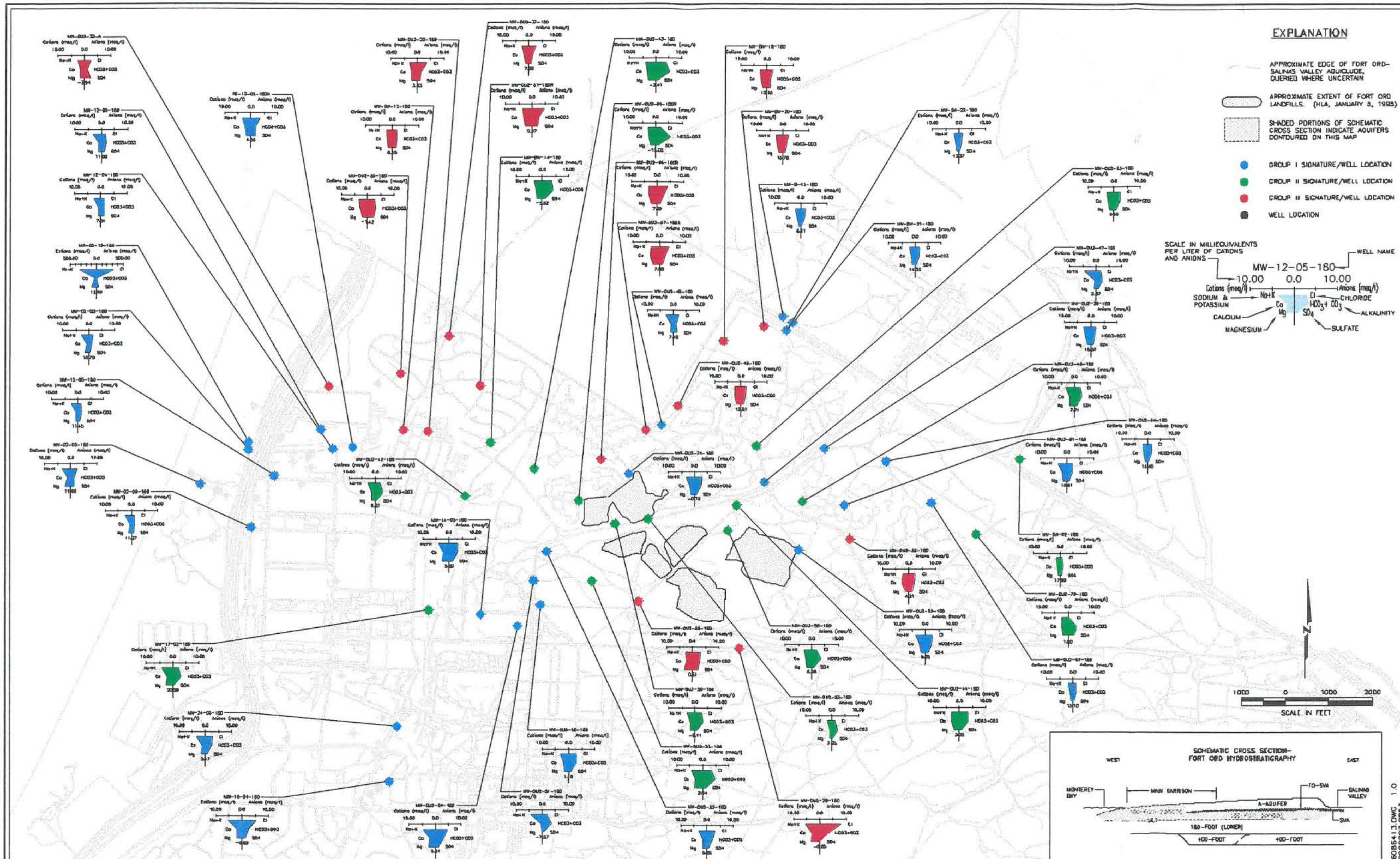

| NO. | DATE | REVISIONS | HLA FILE NO. | PROJECT NO. | APPROVED | APPROVAL DATE | DRAWN BY |
|---|---|---|---|---|---|---|---|
| | 1/2000 | | 36086412 | 36086 010708 | | | PCB |

**Harding Lawson Associates**
Engineering and Environmental Services

Volume I
Fort Ord Groundwater Monitoring
Fort Ord, California

Stiff Diagram
A-Aquifer and Upper 180-Foot Aquifer
West of FO-SVA, September 1999

PLATE: 22



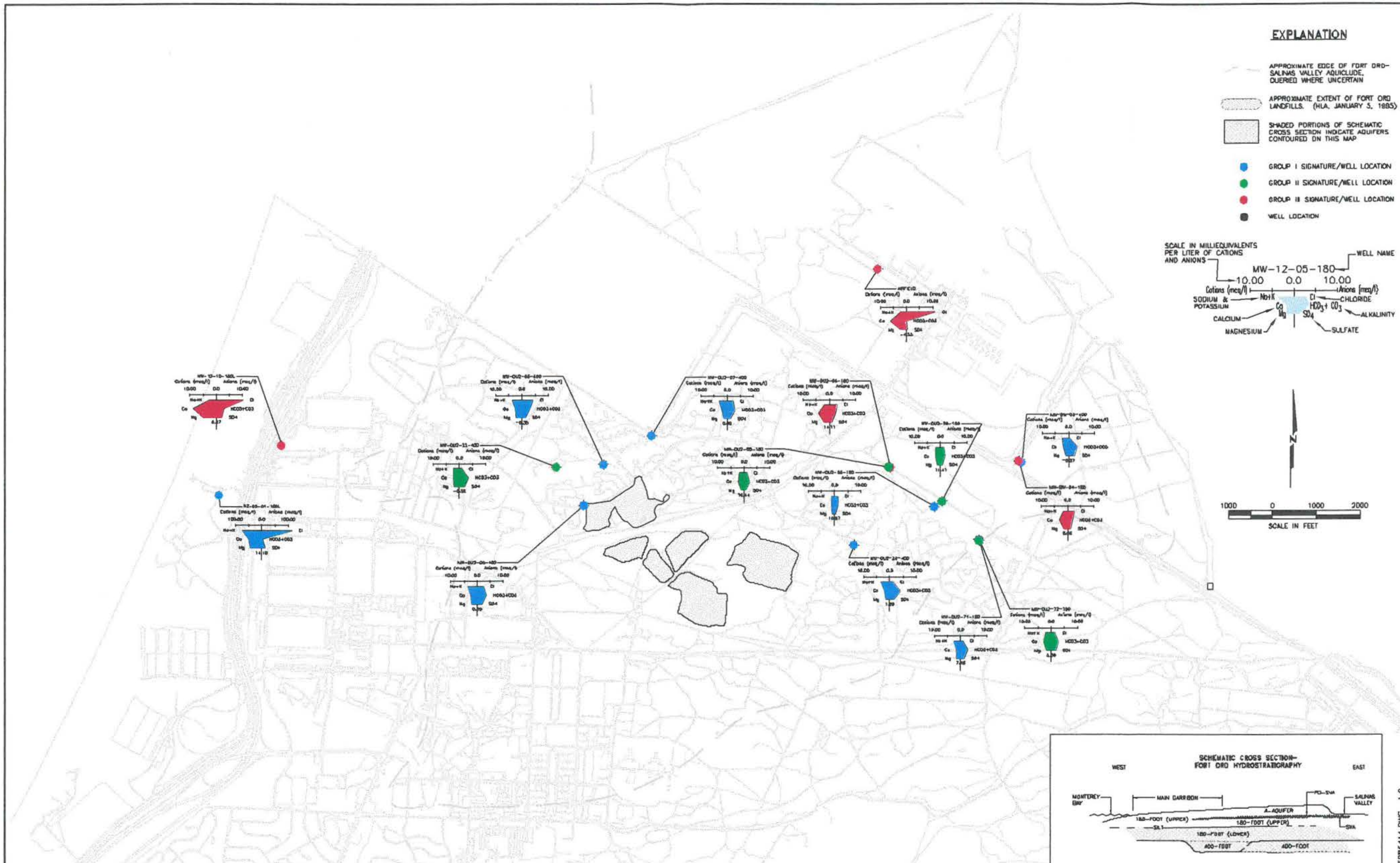

| NO. | DATE | REVISIONS | HLA FILE NO. | PROJECT NO. | APPROVED | APPROVAL DATE | DRAWN BY |
|---|---|---|---|---|---|---|---|
| | 10/98 | | 36086289 | 36086 010706 | | | PCB |

**Harding Lawson Associates**
Engineering and Environmental Services

Volume I
Fort Ord Groundwater Monitoring
Fort Ord, California

Stiff Diagram
Upper 180-Foot Aquifer
September 1999

PLATE: 23




| NO. | DATE | REVISIONS | HLA FILE NO. | PROJECT NO. | APPROVED | APPROVAL DATE | DRAWN BY |
|---|---|---|---|---|---|---|---|
| | 1/2000 | | 36086414 | 36086 010708 | | | PCB |

**Harding Lawson Associates**
Engineering and Environmental Services

Volume I
Fort Ord Groundwater Monitoring
Fort Ord, California

Stiff Diagram
Lower 180-Foot/400-Foot Aquifers
September 1999

PLATE: **24**

36086414.DWG 1.0
20000207.0856