FINAL REMEDIAL INVESTIGATION REPORT
FOR THE
MONTROSE SUPERFUND SITE

LOS ANGELES, CALIFORNIA

Volume I of II

Originally prepared by

Montrose Chemical Corporation of California

and

Revised by

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 HAWTHORNE STREET
SAN FRANCISCO, CALIFORNIA 94105

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Acronyms

AOC	Agreement on Consent
APPL	Agriculture & Priority Pollutants Laboratory, Inc.
Armco Site	Armco Royal Boulevard Site
ASTM	American Society for Testing and Materials
ATI	Analytical Technologies, Inc.
Atm x m^3/mol	atmosphere-meters cubed per mole
BCAL	BC Analytical, formerly Brown and Caldwell Analytical Laboratories
BHC	benzene hexachloride
BNA	base neutral/acid extractable organic compounds
BOD	Biochemical oxygen demand
bls	Below land surface
BTEX	Benzene, toluene, ethylbenzene, and xylene
°C	Degrees Celsius
CB	chlorobenzene
CDHS	California Department of Health Services
CDWR	California Department of Water Resources
Central process area	Portion of the Property, approximately 300 feet by 400 feet in area, where the processing building, processing equipment, water recycling pond, electrical transformer station, filtration area, acid recovery plant, and several below-grade tanks were located
CERCLA Section 106 Order	Comprehensive Environmental Response Compensation and Liability Act, Section 106 Order; Administrative Order, EPA Region IX, Docket No. 83-01 (May 6, 1983)

Acronyms, Continued

CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
cm	Centimeter
CMC	Critical Micelle Concentration
Coastal Plain	Los Angeles Coastal Plain
COC	Chemicals of Concern
COD	Chemical oxygen demand
Consent Order	Administrative Order on Consent, U.S. Environmental Protection Agency Docket Number 85-04, as amended through July 11, 1989
CRWQCB	California Regional Water Quality Control Board
DCB	Dichlorobenzene
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DNAPL	Dense nonaqueous phase liquid
DTSC	Department of Toxic Substances Control
EC	Electrical conductivity
EDB	ethylene dibromide
EE/CA	Engineering Evaluation and Cost Analysis
EDF	Environmental Defense Fund
EDI	Envirologic Data, Inc.
Eh	oxidation-reduction potential
EPA	U.S. Environmental Protection Agency
E&E	Ecology and Environment, Inc.

°F	Degrees Fahrenheit
Farmer Brothers	Farmer Brothers Coffee Company
FRC	Federal Records Center
FS	Feasibility Study
g/cc	Grams per cubic centimeter
gpd	Gallons per day
gpd/ft	Gallons per day per foot
gpd/ft^2	Gallons per day per foot squared
gpm	Gallons per minute
gpm/ft	Gallons per minute per foot
H_c	Henry's Law Constant
H+A	Hargis + Associates, Inc.
H&M	Hargis & Montgomery, Inc.
HSP	Health and Safety Plan
J.O. 'D'	Joint Outfall 'D'
Jones Chemical	Jones Chemical Company
JWPCP	Joint Water Pollution Control Plant
K_b	Microorganism-water partition coefficient
K_{oc}	Adsorption partition coefficient
K_{ow}	Octanol-water partition coefficient
LACDPW	Los Angeles County Department of Public Works
LACFCD	Los Angeles County Flood Control District
LACSD	Los Angeles County Sanitation District

Acronyms, Continued

LADPW	Los Angeles Department of Public Works
LADWP	Los Angeles Department of Water and Power
LARWQCB	Los Angeles Regional Water Quality Control Board
LAX	Los Angeles International Airport
LCS	Laboratory control standards
LEMESCO	Lockheed Environmental Management Service Company
LNAPL	Light non-aqueous phase liquid
McDonnell Douglas	McDonnell Douglas Corporation of California
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MEK	Methyl ethyl ketone
M&E	Metcalf & Eddy, Inc.
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
mm	Millimeter
mm Hg	Millimeters of mercury
Montrose	Montrose Chemical Corporation of California
Montrose plant	Former DDT-manufacturing plant
msl	Mean sea level
NaOH	sodium hydroxide
NAPL	Nonaqueous phase liquid
NCP	National Contingency Plan
ng/L	Nanograms per liter

NOAA	National Oceanic and Atmospheric Administration
NPL	National Priorities List
Off-Property	Land off the approximately 13-acre property commonly known as 20201 South Normandie Avenue, Torrance, California
On-Property	Land on the approximately 13-acre property commonly known as 20201 South Normandie Avenue, Torrance, California
PCB	Polychlorinated biphenyl
p-CBSA	Para-chlorobenzene sulfonic acid
PCE	Perchloroethylene
PEA	Preliminary Endangerment Assessment
PHEE	Public Health and Environmental Evaluation
ppb	parts per billion
ppm	parts per million
PRG	Preliminary Remediation Goals
Property	Approximately 13-acre property commonly known as 20201 South Normandie Avenue, Torrance, California
PVC	Polyvinyl chloride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RCRA	Resources Conservation and Recovery Act
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RI work	Work associated with the Remedial Investigation, including construction and sampling activities performed to fulfill EPA requirements

Acronyms, Continued

RPD	Relative percent difference
RWQCB	Regional Water Quality Control Board
Site	Property and locations in the vicinity of the former Montrose manufacturing plant, located at 20201 South Normandie Avenue, Torrance, California
SPRR	Southern Pacific Railroad
Stauffer	Stauffer Chemical Company
SRC	Superfund Records Center
STP	Standard temperature and pressure
TCA	Trichloroethane
TCE	Trichloroethylene
TDS	Total dissolved solids
TOC	Total organic carbon
total BHC	The sum of the four BHC isomers alpha-BHC, beta-BHC, delta-BHC, and gamma-BHC
total DCB	The sum of the three DCB isomers 1,2-DCB, 1,3-DCB, and 1,4-DCB
total DDT	The sum of all isomers of DDT and all isomers of the DDT metabolites DDD and DDE. These isomers are p,p-DDT, o,p-DDT, p,p-DDD, o,p-DDD, p,p-DDE, and o,p-DDE. In those soil samples in which the o,p- series isomers were not analyzed, total DDT is the sum of the p,p- isomers of DDT, DDD, and DDE.
µg/L	Micrograms per liter
µmhos/cm	Micromhos per centimeter
USDA	U.S. Department of Agriculture
VOC	Volatile organic compound
Vp	Vapor pressure

West Coast Basin	The groundwater basin in the portion of the Los Angeles Coastal Plain in which the Property is located

Monitor Well and Groundwater Sample Identifiers

MW-series	Monitor wells screened in the upper Bellflower Aquitard
BF-series	Monitor wells screened in the Bellflower Sand
G-series	Monitor wells screened in the Gage Aquifer
LG-series	Monitor wells screened in the lower portion of the Gage Aquifer
LW-series	Monitor wells screened in the Lynwood Aquifer

Soil Sample Identifiers

S-series	Pre-Part 1, pre-grading soil samples collected On- and Off-Property in 1983
MW-series	Pre-Part 1, post-grading soil samples collected On-Property in 1985
__D series	Part 1 soil samples collected by EPA subcontractor Metcalf & Eddy On-Property in 1985
S-200 series	Part 2 Phase 1 soil samples collected On-Property in 1986
S-300	Part 2 Phase 2A soil samples collected On-Property in 1988 series
MD-series	Part 2 Phase 1, Round 1 soil samples collected from McDonnell Douglas property along Property perimeter in 1986
JC-series	Part 2 Phase 1, Round 1 soil samples collected from Jones Chemical Company property along Property perimeter in 1986
SP-series	Part 2 Phase 1, Round 1 and Part 2 Phase 2A soil samples collected from Southern Pacific Railroad right-of-way in 1986 and 1988, respectively
T-series	Part 2 Phase 1, Round 1 and Part 2 Phase 2A samples collected from transects across the Normandie Avenue Ditch in 1986 and 1988, respectively
LA-series	Part 2 Phase 1, Round 1 and Part 2 Phase 2A soil samples collected from LADWP right-of-way in 1986 and 1988, respectively
NS-series	Part 2 Phase 1, Round 2 surficial soil samples collected from nearby-

Acronyms, Continued

	property areas in 1986
___(B) series	Part 2 Phase 1 additional soil samples

Sediment Sample Identifiers

KD-series	Part 2 Phase 1, Round 2 sediment samples collected from Kenwood Drain in 1986
SED-series	Part 2 Phase 1, Round 2 sediment samples collected from Torrance Lateral, Dominguez Channel and Consolidated Slip in 1986
T-series	Part 2 Phase 2A sediment samples collected from Dominguez Channel in 1988
B-series	Part 2 Phase 2A additional sediment samples collected from Dominguez Channel in 1988

Surface Water Sample Identifiers

SW-series	Part 2 Phase 1, Round 2 dry weather surface water samples collected from Torrance Lateral, Dominguez Channel, and Consolidated Slip in 1986 and Part 2 Phase 1, Round 2 wet weather surface water samples collected from Jones Chemical Company Ditch, Normandie Avenue Ditch, Torrance Lateral, Dominguez Channel, and Consolidated Slip in 1986

1.0 Introduction

This Remedial Investigation (RI) Report is part of the remedial decisionmaking processes for the Montrose Superfund Site in Los Angeles near Torrance, California. On approximately May 8, 1947, Montrose Chemical Corporation of California (Montrose) began operating a dichlorodiphenyltrichloroethane (DDT) manufacturing plant on an approximate 13-acre property located at 20201 South Normandie Avenue, in Los Angeles near Torrance, California. Following the domestic ban on DDT use in 1972, Montrose continued to manufacture DDT for export as its use was not banned in other countries. The manufacturing plant was closed in mid-1982 and dismantled and demolished over the course of a 3-month period from June through August 1982. The Montrose Site was added to the U.S. Environmental Protection Agency's (EPA) National Priorities List (NPL) in 1989.

The property has been owned by other entities since Montrose first began manufacturing DDT in 1947. Montrose leased the property while operating its plant. For clarity of discussion only, this report will refer to the approximate 13-acre property located at 20201 South Normandie Avenue, in Los Angeles (near Torrance), California, as the "Property."

The RI was conducted both on the Property (On-Property) and in the surrounding area (Off-Property). The Montrose Site refers to property and locations in the vicinity of the former Montrose manufacturing plant located at 20201 South Normandie Avenue, Los Angeles (near Torrance), California: groundwater that may have been impacted by former operations at the Property; surface water drainage areas downstream of the Property including the Kenwood Drain, the Torrance Lateral, the Dominguez Channel, and terminating at the downstream extremity of the Consolidated Slip; and other nearby commercial and residential land that may have been impacted by releases of DDT from the Property. Soil, groundwater, surface water, and sediment were the four environmental media of concern investigated as part of this RI. The sampling conducted during the RI was performed by Montrose unless specified otherwise.

1.1 Purpose and Scope

Hazardous substances, pollutants, and contaminants originating from the former Montrose plant and property entered the environment, and have moved and continue to move in the environment according to various physical and chemical mechanisms that govern their fate and transport. The purpose of the RI Report is to provide data and information to characterize the nature and extent of contamination at the Montrose Site. The information contained in the RI Report in turn is used to support feasibility studies, risk assessments, and ultimately, the selection of any remedial actions by EPA pursuant to CERCLA, the Superfund law, and its attending promulgated regulation, the National Contingency Plan (NCP). In addition to sampling data, the RI Report contains information about the operational history of the Montrose plant, the natural and physical context of the Montrose Site in the environment, and the fate and transport mechanisms affecting contaminants in the environment.

Because of the size, complexity, and large number of ways in which contaminants have migrated in the environment, EPA has undertaken and is undertaking several remedial investigation efforts and remedial selection processes for the Montrose Site. It is EPA's intention to supplement the information in this RI Report with other reports as necessary to address the nature and extent of all contamination related to the Montrose Site. The data and information in this report address primarily the contamination on or in the immediate contiguous proximity to the former Montrose plant property, and the entire groundwater contamination from the former Montrose plant. EPA may elect to collect additional data in these areas as necessary to select response actions, after this report is published. In such a case, EPA will supplement this report to represent any additional data collected.

This report also contains data related to sampling of soils in neighborhoods surrounding the Montrose facility and sampling of sediments in the stormwater pathways leading away from the Montrose facility. However, at this time, EPA expects that data related to these areas will be significantly supplemented with additional investigative efforts which will be reported under separate cover. Ongoing investigations not covered (or only partially covered) in this RI Report include but are not limited to DDT-contaminated fill in the residential neighborhood on 204th Street, the investigation of possible aerial DDT dust dispersion in neighborhoods, the sanitary sewer investigation, and ecological effects of DDT in the existing stormwater pathway. These investigations will also be reported under separate cover at a later date.

It is noted that EPA is addressing the groundwater from the Montrose Superfund Site together with the groundwater from the nearby Del Amo Superfund Site. The Del Amo Superfund Site, the former location of a synthetic rubber manufacturing plant, lies immediately east of the former Montrose property, and was operated between 1942 and 1972 by Shell Chemical Company, Dow Chemical Company, and other entities. EPA has prepared a Joint Groundwater Feasibility Study, that evaluates remedial alternatives for groundwater for both of these sites (U.S. EPA, 1998). The RI data and information used to support the Joint Groundwater Feasibility Study is found in two documents, this RI Report and the Del Amo Groundwater RI Report, prepared by Dames & Moore Group for the Del Amo Respondents (Dames & Moore, 1998).

The RI report is divided into the following sections:

- Section 1.0: Introductory discussion of location, historical manufacturing activities, physical, environmental and sociopolitical characteristics, and the history of site investigations
- Section 2.0: Description of site investigations conducted in soil, groundwater, sediment, and surface water
- Section 3.0: Assessment of the quality of the RI data
- Section 4.0: Description of physical characteristics of soil, groundwater, sediment, and surface water
- Section 5.0: Description of the nature and extent of contamination detected in soil, groundwater, sediment, and surface water
- Section 6.0: Discussion of the fate and transport of contaminants detected in soil, groundwater, sediment, and surface water

- Section 7.0: List of the references cited throughout this report. Appendix L contains copies of selected historical documents referred to in Section 1.0 including appropriation requests, county inspection records, and waste discharge information.

Important Note on the State of the RI Report: How EPA Produced This Report

The remedial investigation and the development of RI Report for the Montrose Site has been ongoing since 1986. During the vast majority of this time, Montrose was performing the RI effort and developing drafts of the RI Report under EPA oversight, pursuant to an Agreement on Consent (AOC) between EPA and Montrose. EPA had many disagreements with Montrose about the content and format of the RI Report over those years. However, EPA only very recently (January 1998) took over the effort to complete the RI Report and rectify long-standing problems and deficiencies with Montrose-prepared drafts of the report which EPA considered unacceptable.

In generating this document, EPA did not create a new RI document "from scratch," but rather started from Montrose's last draft of the report and made modifications which EPA believes brings the document to a minimum level of acceptability. Because of this, the format and readability of the document still bears more resemblance to Montrose's original draft than it does to the RI Report EPA would have authored had it done so from the beginning. The reader should therefore consider this document an EPA-modified version of a Montrose document, rather than an "EPA-authored" document. EPA has altered, deleted, and added many conclusions and statements in the document. Figures that were not significantly altered still show the name (logo) of Montrose's consultant, Hargis + Associates. Figures that EPA altered, or that EPA added, do not show the Hargis + Associates name. EPA did not perform any data collection subsequent to its takeover of the RI Report; and prior to this version of the report, EPA's modifications have focused on the report itself.

Among several other issues, one of EPA's long-standing objections to Montrose's drafts of the RI Report was that the text was wordy, repetitious, and disorganized such that the reader had difficulty understanding or making meaningful, much less appropriate, conclusions from the data presented. Thus, while all of the data collected was present in the drafts, the problem of being able to assimilate and understand the nature and extent of contamination (one of the primary objectives for any RI Report) was largely lost.

EPA has improved, but not entirely rectified this problem in the final version of the report. To do so would have required wholesale rewriting of the document by EPA. EPA understands that, all else equal, a wholesale revision would have been preferable and would have resulted in a more clear and concise document. However, given the delay that would have resulted to the remedy decision making process, EPA has decided that on balance, it is better to provide modest improvements to the document rather than to rewrite it entirely. The reader, therefore, may still notice sections of text in the report, particularly in Sections 2 and 5, that present facts in a fashion that can be difficult to follow. Where possible, EPA has added some tables and figures to assist in understanding the data, eliminated redundant text, edited text, provided summary information and interpretation, and deleted or altered language that was biased or reached technically inappropriate conclusions. EPA has added a sizable quantity of new information and text in Sections 1 and 6.

1.2 Location and Description of Property

The Property is located in the City of Los Angeles, California, but has a mailing address in Torrance, California. The location of the Property relative to other properties in the immediate vicinity and relative to other cities in the greater Los Angeles area is described below. Present property features, zoning, demography, and land use in the surrounding area are also described.

1.2.1 Location

The Property occupies approximately 13 acres in the City of Los Angeles near Torrance, California (Figures 1.1 and 1.2). As shown in Figure 1.3, the Property is bound by the Southern Pacific Railroad (SPRR) right-of-way and Normandie Avenue to the east, Jones Chemical Company (Jones Chemical) and a right-of-way owned by the Los Angeles Department of Water and Power (LADWP) to the south, and McDonnell Douglas Corporation (McDonnell Douglas) property to the north and west. The Farmer Brothers Coffee Company (Farmer Brothers) property is located to the south of the LADWP right-of-way (Figure 1.4).

The area surrounding the Property includes portions of the cities of Carson, Gardena, Torrance, and Los Angeles and portions of Los Angeles County (Figure 1.2). A narrow strip of land east of the Property is located in Los Angeles County. The City of Carson is located east of this narrow strip of Los Angeles County land. The City of Torrance is located west of the Property beyond Western Boulevard. The Gardena city limits are located about 1 mile north of the Property.

Other unrelated soil and groundwater contamination investigations being conducted under the direction of EPA, the California Environmental Protection Agency—Department of Toxic Substances Control (DTSC), and/or the Los Angeles Regional Water Quality Control Board (RWQCB) on properties adjacent to the Montrose Site include the Del Amo Superfund Site, the Jones Chemical Company, and the McDonnell Douglas Property. Soil and groundwater investigations being conducted under the direction of various agencies within about a 1-mile radius of the Montrose Site also include the Armco Royal Boulevard Site (Armco Site), Mobil Oil Refinery, International Light Metals, Trico Industries, Amoco Chemicals Corporation, Golden Eagle Refinery sites, and various landfills. Figure 1.4 shows the locations of these sites. As discussed in Section 5, data obtained from many of these other sites have been used to supplement data obtained during this RI.

1.2.2 Present Property Features

Over the course of a 3-month period from June through August 1982, the Montrose manufacturing plant was dismantled and demolished. In 1983, a temporary earthen berm was constructed to prevent surface water runoff from leaving the Property. In early 1985, some of the remaining foundations and footings were removed and crushed On-Property, and the majority of the Property was graded and capped with asphalt to prevent the potential for air or surface water transport of soil, to minimize infiltration of surface water, and to prepare the Property for subsequent development as a commercial warehouse facility.

A railroad spur bisects the southern portion of the Property. The small portion of the remaining unpaved Property located south of the railroad spur was tilled and mixed with lime, compacted, and subsequently paved with asphalt in 1988. A concrete curb was constructed around the perimeter of this portion of the Property to minimize the potential for entry of upgradient drainage. The majority of the Property was graded to direct surface water runoff to the southeastern corner, which drains to the Normandie Avenue Ditch.

Entrance to the Property is via South Normandie Avenue through a locking gate situated at the northeast corner of the Property (Figure 1.3). Chain link fencing has been erected along the Property perimeter to prevent public access. Presently there is one structure on the Property. A former guard shack, now used for equipment storage, is located adjacent to the gate at the northeast corner of the Property. Water, electrical, and telephone services are available at the Property.

1.2.3 Zoning

The Property is currently zoned as heavy industrial (M3), according to the Los Angeles Municipal Code (Figure 1.4). The areas east and west of the Property are occupied by manufacturing facilities and oil refineries. Land use is also zoned as heavy industrial up to 1 mile north of the Property, where Interstate 405 is located. The land use north of Interstate 405 is primarily residential. The land use south and southeast of the Property is a mixture of manufacturing and residential zoning with commercial land use generally limited to the major streets.

The Property is also planned for heavy industrial (M3) use, according to the Harbor Gateway District Plan (City of Los Angeles, 1989). The plan is a 20-year projection of land use.

1.2.4 Demography

The community within a 2-mile radius of the Property is fully urbanized. The urban population lives to the north and southeast to southwest of the Property. The areas directly to the north, east, west, and southwest of the Property are zoned for manufacturing.

The 1990 estimate for the population currently residing within a 2-mile radius of the Property was 68,654 (National Decision Systems, 1991a). The population was approximately 50 percent male and 50 percent female. Approximately 8 percent were younger than 5 years old, and another 9 percent were 65 years old or older. The 1994 population projection forecast that the male-to-female ratio would remain fairly constant but that the percentage of population under 5 years old would decrease to 7 percent and the percentage of people 65 years of age or older would increase to 10 percent. Information regarding population demographics within a 1- and 2-mile radius of the Property is summarized in Table 1.1. Sensitive populations including schools, day care facilities, senior citizen centers, nursing homes, and hospitals located within an approximate 2-mile radius of the Montrose Site are summarized in Table 1.2 and Figure 1.5 (Envirologic Data, Inc. [EDI], 1993).

The overall population growth in this area has reflected the growth, decline, and revitalization in economic conditions in the nation as a whole in the past three decades (National Decision Systems, 1989). The population within a 2-mile radius of the Property grew by 37 percent between 1960 and 1970, declined by 3 percent between 1970 and 1980,

then increased by 18 percent between 1980 and 1989. This decline between 1970 and 1980 is in contrast to the rest of California, which steadily increased in population throughout these same years. The population within a 2-mile radius of the Property was predicted to increase to more than 75,000 by 1995.

1.2.5 Land Use

Prior to the 1930s, the principal land use in the vicinity of the Property was agricultural. In the 1930s, the land use in the area was still primarily agricultural, but in 1934 the Hughes-Mitchell paint manufacturing plant began operating on the future site of Montrose. Some farm houses and outbuildings were also present in the vicinity of the Montrose Site , but there were no major highways, railroads, or business developments observable (Seeley et al., 1986). By the early 1940s, after drainage of the Dominguez Slough, industry was developing and residential areas were clustering around the farmlands (Metcalf & Eddy, Inc. [M&E], 1986). This development included the synthetic rubber manufacturing plant (now the Del Amo Superfund Site) to the north and east of Montrose property, the adjacent McDonnell Douglas property, and residential areas to the south and east. Montrose began operations in 1947.

A large community based on light commerce and industry existed in the Torrance area by the 1960s and 1970s (M&E, 1986). In the mid-1970s, the industrial facilities of the Del Amo Superfund Site were redeveloped into a business park. Land use within the business park is characterized by light industrial/manufacturing activities, import/export and warehousing businesses, and commercial office space.

1.3 Site and Operational History

This section describes historical operations at the Montrose Site including plant locations; processes; chemical use, handling, storage, and disposal; and previous operations. The site history discussion which follows is primarily intended to support the selection of remedial actions for groundwater and on-property/near-property soils for the Montrose Site. This site history may be supplemented as necessary to support additional remedial decision processes at the Montrose Site. The site history discussion is based on information available at this time. Both Montrose and EPA are continuing their respective investigations into past operations and activities at the Montrose Site. This site history discussion is subject to revision should new information come to light in the course of these investigations.

1.3.1 Site History Synopsis

From approximately May 1947 until August 1982, Montrose operated a DDT manufacturing plant on about 13 acres of leased property at 20201 Normandie Avenue in the vicinity of Torrance, California. Regulatory actions were taken by State and local agencies against Montrose during its operations due to releases of contaminants from plant operations to the sewers and surface water pathways. EPA conducted a CERCLA inspection at the Montrose plant in 1982, during which DDT was detected in surface water drainages leaving the plant property in the nearby Normandie Avenue Ditch. After plant operations terminated, the plant was dismantled and the majority of concrete footings were removed, crushed and stored onsite. The demolition was completed in early 1983, when environmental

investigations of the plant commenced under the oversight of the U.S. EPA and the California RWQCB, Los Angeles Region. EPA proposed the Montrose Site for the Superfund National Priorities List in 1984 and the proposal was finalized in 1989.

Throughout this section, the text will refer to numerous aerial photographs and figures illustrating the historical operations. Figures 1.6A through 1.6K are aerial photographs that show the Property, including potential waste discharges, at various points in its history. Figures 1.7A, 1.7B, and 1.7C show the layout of Montrose plant before and after 1953, when the operation was changed from a batch to a continuous-batch process. Figures 1.8A and 1.8B are conceptual diagrams of the batch and continuous-batch processes, respectively. The batch and continuous batch processes will be discussed in detail later in this section.

1.3.2 Site History

Until the early 1930s, the Montrose plant property was undeveloped land (Figure 1.6A). In about 1934, a paint manufacturing plant was constructed on the Property and it operated until 1943. (Figures 1.6B, 1.6C, and 1.6D). Little is known about this plant, which reportedly was operated by Hughes-Mitchell.

In 1943, the land on which the Montrose plant would be located, and most of the land on which the Jones Chemical plant would be located, were purchased from Hughes-Mitchell by Stauffer Chemical Company (Stauffer). At that time, Stauffer operated a sulfuric acid production plant in an area immediately adjacent to the southwestern portion of the Montrose plant property, as shown in Figures 1.6E, 1.6F, 1.6G and 1.7A. This activity continued until approximately 1952. From the early 1950s until 1964, Stauffer operated a research facility on the southwest quadrant of the Montrose plant property. Beginning in 1954, Stauffer operated a benzene hexachloride (also called hexachlorocyclohexane or BHC) pilot plant in the southeastern corner of the Montrose Property itself and later converted it to a BHC production plant (Figure 1.7B). BHC/Lindane (BHC) production uses benzene as a feedstock chemical. Further processing of BHC to produce Lindane creates a waste stream containing alpha- and beta-BHC. This operation was terminated in 1963. Thereafter, the BHC production plant was dismantled and removed from the Property. EPA's investigation of the Stauffer BHC operations is continuing.

Stauffer leased the northern portion of the overall property to Montrose beginning in 1947 . At that time, Montrose constructed its DDT manufacturing plant in the area previously occupied by the Hughes-Mitchell paint plant (Figures 1.6E, 1.6F, and 1.6G). This area is referred to throughout this report as the Central Process Area. Montrose began the production of DDT on May 8, 1947. The history of the production operations is detailed in Section 1.3.6. During its 35-year operating history, the Montrose plant released hazardous substances into the environment, including but not limited to the soils at and adjacent to the plant, the groundwater, the sanitary sewers, and surface water drainages.

In 1955, Stauffer leased the real property immediately south of the existing Montrose plant (Figure 1.7B) to Jones Chemical Company, Inc. for use as an ammonia and chlorine cylinder filling plant (Los Angeles County Recorder's Office documents, Jones Chemical Building Permit). In December 1968, Stauffer sold this parcel to Jones Chemical Company, Inc. (Los Angeles County Recorder's Office documents). Jones Chemical established a packaging plant for bleach, ammonia, and other industrial chemicals, including acids and solvents. Jones Chemical continues to operate today, on the same real property. Investigations by the

State of California indicated that releases of hazardous substances from Jones Chemical to the environment have occurred, including releases to groundwater via dumping of industrial wastes to a dry well at the Jones Chemical property (see *Preliminary Endangerment Assessment, Jones Chemical Facility, Torrance California*, Levine Fricke, June 28, 1995) and discharge to the stormwater channels.

A 1954 property assessment document indicates that the total land area of the conjoined parcels occupied by Montrose and Jones Chemical was 750 feet by 1050 feet for a total of 737,500 square feet. The Montrose operations took place on approximately 380,000 square feet of this total area. As mentioned, the property is approximately 13 acres in size.

In 1964, after Stauffer dismantled the BHC plant, Stauffer leased the parcel of property, on which the BHC plant had been located to Montrose, which expanded operations into this area.

In 1972, the use of DDT pesticide in the United States was banned by the EPA (except for use pursuant to special permits). Between the years 1972 and 1982, Montrose continued production of DDT at the Torrance plant for overseas markets. On July 2, 1982, the manufacturing plant was closed, and during the remainder of 1982 and 1983, the plant was dismantled and the majority of the concrete footings were crushed and stored onsite. In 1985, the Property was graded, crushed concrete was redistributed as a sub-base, and most of the Property was paved with asphalt. EPA did not approve the regrading and paving as a response action. This asphalt pavement continues to exist today. The property is now owned by Atkemix Thirty-Seven, Inc., a subsidiary of Stauffer Management Company, and Montrose continues to lease the property from Atkemix Thirty-Seven.

1.3.3 Montrose Operational History Synopsis

During the 35 years of its operation, production at the Montrose plant ranged from 1 million to 8 million pounds of technical grade DDT per month, and the Montrose Torrance plant came to be the only producer of technical grade DDT in California. Between the late 1940s and the mid 1960s, DDT was one of the most widely used pesticides in the United States. Montrose produced technical grade DDT in several forms including lump or "cake" DDT and flake DDT. As operations were expanded, Montrose also produced a number of formulations including wettable powders and special product formulations that mixed Malathion, another pesticide, and oils with DDT.

In the early years of operation (1947-1964), DDT was ground on the Montrose property in a grinding room located in Warehouse #1 (See Figure 1.7A), or shipped to various facilities for grinding and formulation, including Stauffer's Dominguez facility. Beginning in 1964, Montrose produced various DDT formulations at the Torrance plant on a larger scale, most significantly wettable powders that were produced by grinding lump or flake DDT in mills located in Warehouse #3, the Formulating and Grinding Plant (Figure 1.7B). As DDT is insoluble in water, these product grinds and formulations allowed for more uniform application of the pesticide when it was suspended in water. Montrose also produced oil-based formulations of DDT after 1964.

The basic reaction for making technical grade DDT remained unchanged during the plant history. However, there were periodic changes to the plant that affected the processing of DDT, plant output, waste streams, and waste handling systems, and these changes are

pertinent to understanding the findings in this RI Report. The following four particularly notable changes are discussed in more detail in subsequent sections:

- Between 1951 and 1953, the plant was changed from a "batch process" to a "continuous-batch process." This was the single most significant modification to the plant over its history. Also during this period, the DDT neutralization and washing processes were dramatically changed, waste conveyances were filled in and moved, new waste handling systems were installed, a caustic waste stream was created in addition to the previously existing acidic waste stream, different sewer lines were used for industrial waste discharge, and Montrose attempted to segregate rainwater from industrial wastewater.
- In 1960, an acid recovery plant was built to recover some of the waste acid that was previously shipped or discharged offsite.
- In 1964, the Formulating and Grinding Plant was built at Montrose for grinding and formulating DDT into wettable powders and other commercial pesticide products.
- Around 1970, partially in response to a lawsuit from an environmental group and pressure from the Los Angeles County Sanitation Districts, Montrose modified its operations to eliminate the discharge of industrial wastewaters to the sewer and completed an on-property water recycling system for plant wastewaters.

Production at the Montrose plant ranged from approximately 1 million to 8 million pounds per month of technical grade DDT as the manufacturing process changed throughout the 35 years of plant operation. In 1962, production reached 5.5 to 6.0 million pounds per month of DDT.

1.3.4 Plant Layout—General

The Montrose technical grade DDT manufacturing plant was periodically modified during its 35 years of operation. The process changes are discussed in subsequent sections. As shown in Figures 1.3, 1.7A, 1.7B, and 1.7C the plant generally included a DDT-processing building, large-capacity raw feedstock tank areas, concentrated and waste acid tanks, a wastewater settling/recycling pond, waste conveyance trenches, steam-generating and brine-cooling facilities and cooling tower, a DDT rework area, belowgrade wastewater holding and neutralization tanks (beginning in 1954), a formulating and grinding plant (beginning in 1964), warehouses, an acid-recovery plant (beginning in 1960), an electrical transformer station, various maintenance, storage, and salvage areas, an onsite chemical laboratory, and administrative office/locker rooms. The locations of the buildings, equipment, and processes as shown in Figures 1.7A, 1.7B, 1.7C, 1.8A, and 1.8B are based on interviews with former employees, historical drawings of the plant, historical records pertaining to the plant, and an interpretation of aerial photographs of the plant. Figure 1.3 is based on a 1982 photograph.

The Central Process Area of the plant was a rectangular area, approximately 300 feet by 400 feet, where the following process units were located: the processing building, processing equipment, wastewater recycling pond, in-ground waste conveyance trenches, steam and brine lines, pipelines for molten DDT and feedstock, DDT rework area, transformer station, filtration area, acid recovery plant, and several abovegrade tanks containing feedstock chemicals, concentrated acid, waste acid, and, after 1953, two

25,000-gallon, belowgrade wastewater treatment tanks. This was the primary area in the plant for the production of technical grade DDT.

The DDT rework area was used to reprocess "off-spec" DDT by dissolving the DDT and filtering out the impurities. The rework system was originally located in the Central Process Area at the southeast corner of the process building. Accounts vary as to whether the rework area was ever moved. Some testimony indicates that in 1951 it was moved to just south of acid recovery; other testimony indicates that it was moved to just north of the wastewater pond (Figures 1.7A and 1.7B).

The two belowgrade tanks were redwood-lined concrete tanks used for treatment of industrial wastewater prior to discharge to the sewer. These tanks, installed in 1953, were located south of the existing Quonset hut in the Central Process Area (Figures 1.3 and 1.7C). The Formulating and Grinding Plant, or Warehouse #3, was built directly south of the Central Process Area (Figure 1.7B; Figure 1.6J, and 1.6K). The Special Products Plant was assembled in the old Stauffer research laboratory building located approximately 100 feet east of the existing Formulating and Grinding Plant/Warehouse No. 3 (Figure 1.7B). All of these plant operations are discussed below.

1.3.5 Chemical Storage/Use

1.3.5.1 Raw Materials and Solvents

Raw materials consisting of chlorobenzene, trichloroacetaldehyde (chloral), and oleum were stored in aboveground tanks located in or near the Central Process Area (Figures 1.7A, 1.7B, and 1.7C). Initially, raw material storage consisted of four 10,000-gallon tanks that contained chlorobenzene, oleum, a mixture of chlorobenzene and chloral, and spare oleum. All four tanks were located aboveground in the northeast quadrant of the Central Process Area. An additional 10,000-gallon tank was added in 1950 to store a mixture of chlorobenzene and chloral. A 17,000-gallon tank was added in 1965 to store chlorobenzene. Both of these two additional tanks were located aboveground in the northeast quadrant of the Central Process Area.

In 1968, the rail spur was modified, and two 50,000-gallon storage tanks were installed east of the Formulating and Grinding Plant to allow transport of chloral and chlorobenzene via tank car (Figure 1.7B). Dikes were constructed around these two tanks as a safety measure. Approximately in January 1975, Montrose installed a 100,000-gallon fuel oil storage tank and related accessories west of the process building (Figure 1.7B).

A Montrose appropriation request dated October 11, 1957 (No. 186-17) (Montrose; 1957a) described Montrose building an airhouse structure for the storage of DDT product. This structure combined with another airhouse structure proposed at the same time provided an additional storage capacity of 6 million pounds of DDT. A Montrose appropriation request dated October 13, 1964 (No. 186-59) (Montrose, 1964) described the installation of a 100,000-gallon waste acid storage tank, which was to double the plant's waste acid storage capability. The purpose of the additional waste acid tank was to allow more time for the acid tars to settle out of the spent acid before it was reused.

Records also indicate that smaller amounts of other various chemicals were used and stored by Montrose. A Jones Chemical price card indicates that Jones Chemical sold Montrose a

variety of chemicals including, but not limited to tetrachloroethylene, or perchloroethylene (PCE), trichloroethylene (TCE), and acetone between 1968 and 1973 (Gaffney, 1992).

Dichlorobenzene (DCB) also appears to have been stored, used, or otherwise handled at Montrose. A Montrose balance sheet indicates that Montrose spent almost $5,000 in 1950 under Authorization 577 to purchase an unknown quantity of para-dichlorobenzene (Montrose, 1950). Analysis of a water sample from the recycle pond in 1978, indicated 4 ppm of para-DCB and 0.9 ppm of ortho-DCB (Stauffer, 1978).

The raw materials used for the production of DDT included xylene and two aromatic petroleum derivatives, Agrisolv 75 and Toxisol (Montrose, 1990). Agrisolv 75 is a heavy aromatic but contains benzene, toluene, ethylbenzene, and xylene at levels up to 1 percent. By weight, Toxisol-B is approximately 84 percent xylene, and 8 percent ethylbenzene. Toxisol-PX is mostly ethylbenzene and approximately 3 percent xylene by weight. Both Toxisol-B and Toxisol-PX also contain benzene and toluene (Noreyko, 1993).

1.3.5.2 Fuel and Oil Storage

Fuel oil, lubricating oil, and gasoline were also stored on the Montrose Property. As shown in Figure 1.7B and 1.7C, fuel oil was stored in two aboveground tanks, a 100,000-gallon tank located west of the Central Process Area and a 10,000-gallon tank inside the Central Process Area. Lubricating oil was stored in four locations shown in Figure 1.7B in 500-gallon storage tanks. Two of the lubricating oil tanks were located outside of Warehouse No. 3. A containment system was designed so that spills from these tanks would flow by gravity into cleanout sumps and underground drainage lines, which discharge into a 1,250-gallon Nottingham oil separator. When the level of the oil exceeded 4 inches, a vacuum truck was used to remove the oil layer and transport it to a Class I landfill. The lubricating oil tank in the refrigeration area was designed so that spills drain to the wastewater recycle pond. The lubricating oil tank near the truck repair area also drained to a 1,250-gallon Nottingham oil separator. The fuel oil tank were each surrounded by a concrete -filled block dike (Montrose, 1982). A gasoline storage tank of unknown size and a gasoline pump were located south of the machine shop.

1.3.6 Technical Grade DDT Manufacturing Process

The specific manufacturing processes used by Montrose varied during the 35-year history of operations but generally consisted of five steps (Figures 1.8A, 1.8B, and 1.9). The first step was the actual chemical reaction, termed "condensation," which created DDT. Condensation was followed by four conceptual processing steps (at certain times in plant history, one or more of these was accomplished by the same process):

- Separation, in which the DDT was separated from the bulk of the acid and residual raw materials at the end of the reaction
- Neutralization, in which the remaining acid in the DDT was neutralized
- Purification, in which the DDT was washed and impurities removed
- Crystallization, in which the DDT was cooled from molten to solid form and packaged

The principal raw materials used for production of technical grade DDT were **chlorobenzene, chloral,** and **oleum,** a form of highly concentrated sulfuric acid (also

referred to as "fuming sulfuric acid"). These raw materials were generally shipped to the Montrose plant by trucks or by rail car (railroad spurs are present on the Montrose Property). Often, the chloral and chlorobenzene were sent to the plant already mixed together, but the reaction to form DDT did not proceed in the mixture because the sulfuric acid catalyst necessary drive the reaction forward was absent. The Montrose plant also received oleum and pure chlorobenzene in addition to pre-mixed chloral and chlorobenzene. In its pure form, chlorobenzene can be classified as a dense nonaqueous phase liquid, or DNAPL. DNAPL compounds are liquids that are heavier than water, only slightly soluble in water, and difficult to remove once they enter the environment. A list of raw materials used in manufacturing DDT is shown in Table 1.3.

The Montrose plant usually operated around the clock, with at least three production shifts. A shift supervisor stated that the plant was shut down with careful planning once or so per year for maintenance (Suhrer, 1996). Another former Montrose worker testified that there was no annual plant shutdown, but that maintenance was always ongoing (Bratter, 1997). However, in 1971, the production superintendent told the Los Angeles County Sanitation District (LACSD) that the plant was shut down a few times each year during the draining and dredging of the wastewater settling pond (LACSD, 1971b).

1.3.6.1 Condensation

The DDT manufacturing process started with a condensation reaction that combined two moles of chlorobenzene and one mole of chloral in the presence of oleum that acted as the condensing agent or catalyst. Chlorobenzene and chloral, when combined, form DDT and water. The reaction is as follows:

$$\text{Chloral} + 2\ \text{Chlorobenzene} \xrightarrow{\text{(in presence of concentrated sulfuric acid)}} \text{DDT} + \text{Water}$$

In this reaction, the acid is not incorporated into the DDT product, but serves as a catalyst by absorbing the water on the products side of the reaction, driving the chemical equilibrium toward DDT production.

During all phases of its history, Montrose synthesized DDT by introducing the concentrated oleum into the reactant mixture at a controlled rate. The reaction is exothermic (produces heat) so refrigeration units were necessary to control the reaction temperature. The reaction produced a slurry of DDT or "DDT beans" in a diluted or "spent" sulfuric acid solution. The water produced by the condensation reaction acted to dilute the oleum and resulted in "spent acid." Throughout the years, the reactants for the process consisted of a combination of fresh as well as recycled raw materials from the DDT production process. The oleum used to charge the reaction was a combination of spent acid from the various process steps and fresh oleum. Likewise, the chlorobenzene consisted of fresh chlorobenzene and recycled chlorobenzene from the process.

Standard Batch Process. The condensation reaction at the Montrose plant was carried out in a batch process. Between 1947 and about 1951, the standard batch process, shown conceptually in Figure 1.8A, was used. Batches were run to completion in each reactor and

then loaded *en masse* onto the remaining processes. The standard batch process initially employed six 1,600-gallon batch reactors or condensators to produce DDT. Two additional 1,600-gallon reactors and four 4,500-gallon reactors were eventually added to increase DDT production.

The reactors were surrounded by a jacket containing chilled brine in a closed system to absorb the heat of the reaction. As shown in Figure 1.7C, the brine system originated in an area outside and just to the west of the Central Process Building, where ammonia compressors refrigerated the brine solution and pumped it to the condensators inside the building.

Continuous Batch Process. The change to a "continuous-batch process" was initiated in 1951, with the addition of a 3,800-gallon post reactor/holding tank to the process to attenuate the load on the remaining processes. This modification resulted in a "continuous-batch process" in which batches could be started and completed at staggered intervals, loaded into the large holding tank, and then continuously loaded onto the remaining processes. Figure 1.8B shows a conceptual diagram of the continuous-batch process. The holding tank was upgraded to a 45,000-gallon holding tank in 1953. As the reaction in each reactor neared completion, the reaction products were transferred to the holding tank. The reaction products from several reactors at a time were thus combined in the holding tank, where the last vestiges of the DDT-forming chemical reaction took place. As soon as a batch reactor was empty, more reactants could be added to begin a new batch. This continuous-batch process allowed for uninterrupted operation of the processing equipment, resulting in increased DDT production and a more uniform product.

p-CBSA Formation. During reaction in both the standard and continuous-batch processes, a certain amount of the sulfuric acid would react directly with the chlorobenzene, to produce para-chlorobenzene sulfonic acid, or p-CBSA. Because this unwanted side reaction consumed some of the raw chlorobenzene, Montrose minimized the side reaction by keeping the temperature in the reactors within the correct range. This control also had the benefit of allowing Montrose to produce a purer DDT product. Nevertheless, it is likely some p-CBSA was produced with each batch of DDT. p-CBSA, unlike chlorobenzene, is significantly soluble in water. It is not a common industrial chemical or by-product, apparently associated only with the production of DDT.

1.3.6.2 Separation, Neutralization, and Purification Prior to 1953

Between 1947 and 1953 when Montrose was using the standard batch process, the separation, neutralization, and purification processes were not distinct from one another, occurring together in the same process step, as shown in Figure 1.8A. Beginning in about 1953, when Montrose implemented the continuous-batch process, these three processes became distinct, as described in the next section. As previously mentioned, separation removed the bulk of the acid from the DDT, neutralization neutralized the acid remaining in the DDT, and purification ensured that impurities did not exist in the final DDT product.

Between 1947 and 1953, Montrose operated each batch reaction to completion. After allowing the reaction to settle, the first and primary acid separation was accomplished by draining off the bulk of the excess acid through the bottom of the reactor (Figure 1.8A). This was accomplished by decanting the acid through a spigot on the reactor. The spent acid was either disposed (see section on Waste Products below) or recycled back to the

beginning of the DDT manufacturing process, where it was fortified with fresh oleum to increase its strength and reused as a catalyst. Whether the waste acid was disposed or recycled depended on whether it could be refortified to produce acid strong enough to catalyze a new reaction.

In the first year or two of plant operation, the settled DDT that contained some residual acid was sent directly to the washers (described below). However, this did not produce an acceptable DDT product, so Montrose modified the process. Therefore, for most of the period prior to 1953, the settled acidic DDT in the reactor was dissolved by adding more chlorobenzene (about 500 gallons) into the reactor (DDT is soluble in chlorobenzene, though not in water). This process change accomplished an additional degree of separation; the DDT went into solution in the chlorobenzene and the DDT/chlorobenzene solution floated on top of the heavier spent acid.

The DDT/chlorobenzene solution was then neutralized in the reactor in a washing process with hot water. The wash water effluent from this process containing sulfuric acid flowed into the wastewater pond where it was treated with lime to adjust pH and then discharged to the sewer (see section on Waste Products below). After washing, the DDT/chlorobenzene solution was transferred from each reactor to one of six steam strippers (Figure 1.8A). Next, steam from the boilers was sparged into the chlorobenzene solution. The chlorobenzene was distilled by the steam into vapor and collected in a condenser, where it was recovered for reuse in the production process. The molten DDT was left on the bottom of the stripper, with a residual water fraction, resulting from the washing process and condensed steam, floating on top.

The steam stripper was then emptied from a spigot at the bottom. The water fraction in the steam stripper was discharged through a trap tank to ground trenches leading to the wastewater pond (see section on Industrial Wastewater, Sewers, and Surface Drainage Releases below). Finally, the washed but still molten DDT was released into the cooling pans or flakers for crystallization and then bagged (see section on Crystallization below).

1.3.6.3 Separation, Neutralization, and Purification After 1953

Beginning in approximately 1953, when Montrose changed to the continuous-batch process, the separation, neutralization, and purification step also changed As shown in Figure 1.8B, the process was modified so that neutralization took place in vessels independent from separation. Also, Montrose began to use caustic to neutralize acid in the DDT (see section on Neutralization below, Figure 1.8B). The process of dissolving the DDT in chlorobenzene and the use of steam stripping was discontinued. Instead, DDT was separated from the DDT beans and acid slurry in a device called an "oliver filter." This modification of the process increased production capacity to 2.5 million pounds of DDT per month. The oliver filter captured the DDT in a DDT-acid cake by pulling the DDT out of the acid solution and onto a rotating filter drum. This procedure isolated the bulk of the spent acid. Just as prior to 1953, the spent acid (also referred to as "filtrate acid") was either disposed (see section on Waste Products below) or recycled back to the spent acid holding tank, where it was fortified and reused at beginning of the DDT manufacturing process.

Next, the DDT-acid cake from the filter was melted with 100°C steam in a device called a "melter." The molten DDT was then separated from most of the remaining acid in a static separator. In the static separator, the spent acid flowed out the bottom to be either disposed

or recycled and the DDT continued to the neutralization process. To recycle the acid, an onsite acid recovery plant was constructed about 1960 just south of the area where separation, filtration, and neutralization occurred. The location of the Acid Recovery Plant is shown in Figures 1.7B and 1.7C.

The molten DDT was next transferred to a scrubber where it underwent a caustic wash. Here, molten, but still acidic, DDT emerging from the static separator was neutralized with a 15 percent caustic (sodium hydroxide or "NaOH") solution (Figure 1.8B). The alkaline waste from this process was discharged to the two 25,000-gallon, belowgrade wastewater treatment tanks (see section on Waste Products below). The DDT was next transferred to the DDT water wash, where the neutralized DDT was purified by washing with boiling or near boiling water. This wash water was also discharged to the two 25,000-gallon belowgrade wastewater treatment tanks or to the wastewater pond (see section on Waste Products below). After washing, the liquid DDT was dried to remove any remaining moisture.

1.3.6.4 Crystallization

Between 1947 and the early 1950s molten DDT was poured into large pans where it crystallized into its final form (Figure 1.8A). The crystallized DDT was broken up by hand into 2- to 6-inch lumps and bagged for shipment. This was called "cake" or "lump" DDT. The final product was known commercially as "technical grade DDT," meaning "close to pure, not intentionally diluted or mixed." Typically, this was at least 96 percent pure DDT. Starting in the early 1950s, the now dried (but still molten) DDT was fed through cooled roller "flakers" where it cooled and crystallized to form chips or flakes (Figures 1.8A and 1.8B). Starting in 1955, the DDT was fed instead to a water-cooled crystallizing turntable. In 1956, a second turntable was added that increased production capacity to 3.0 million pounds per month. The crystallized DDT was then put into 50-lb. bags for shipment and sale to customers. The product that resulted from the tables or flakers was still termed "technical grade DDT" but was marketed under the Montrose name as "Krisp Chips." According to an appropriation request dated September 11, 1974 (No. 186-188). Montrose installed a baghouse in the DDT plant to package the technical grade DDT more efficiently and, presumably, to control the dust and fumes associated with packaging of the technical grade DDT (Montrose, 1974).

1.3.7 Grinding, Formulating, Packaging

From nearly the beginning of the Montrose operation, a portion of the technical grade DDT was ground into several grades of ground DDT. Even so, prior to 1954, Montrose primarily produced lump DDT and DDT Krisp Chips for formulating and grinding by others. Approximately March 1954, Montrose purchased, installed, and operated used grinding, drying, and packaging equipment. The initial grinding operation was located in Warehouse #1 on the Montrose property (Figure 1.7B). It was not until 1964 that Montrose began production of 75 percent DDT water-dispersible powder at the onsite Formulating and Grinding Plant.

In June 1964, Montrose constructed a 24,000-square-foot steel warehouse to house air milling equipment and to store raw and finished materials for the new formulation and grinding operations. This building was known as the Formulating and Grinding Plant, or Warehouse #3, and was built directly south of the Central Process Area (Figure 1.7B). At

about the same time, Montrose leased and occupied the land formerly occupied by the Stauffer BHC plant and laboratory. Montrose began to use this area for product development and laboratory work.

The Formulating and Grinding Plant converted technical DDT chips into 75 percent DDT water-dispersible powder by adding various dispersing agents and amorphous silica and grinding the mixture into fine particles (Montrose, 1976). In the "pre-grind" portion of this plant, added in 1965, the DDT Krisp Chips were ground in a ball mill and the resulting pre-grind powder was pneumatically conveyed to a baghouse where the powder was collected (Montrose, 1977a). The ball mill was located outside of Warehouse #3, as shown in Figure 1.7B. The air flowed through a grind cooler and back to the ball mill (Montrose, 1977b). The DDT pre-grind powder was then fed to three air mills where it was ground to an average particle size of between two and three microns by the impact of the particles against each other. Compressed air supplied the energy for the size reduction and also conveyed the powder to two baghouses. In the baghouses, the air and DDT were separated. The DDT powder dropped into a mixer from where it was conveyed to a packaging machine, while the filtered air was cleansed in a scrubbing system and then exhausted to the atmosphere (see section on Fume Scrubbing System below).

An appropriation request dated September 11, 1974, provided for installation of a baghouse in the Formulating and Grinding Plant to control the dust and fume problem at the plant (Montrose, 1974). According to the request, "a nuisance dust and fume problem exists at the DDT plant (Montrose, 1974)." DDT dust was generated along the conveyor belts and where the belts enter the hoppers for the flake DDT and Krisp Chips. The fumes were being generated at the upper part of the hopper, particularly the flake hopper.

A Montrose appropriation request dated May 7, 1975, provided for an extension of the existing building to enclose more of the dust plant (Montrose, 1975). According to the appropriation request, the process had evolved over the years and some equipment had been located outdoors. As a result, the process at that time required that open bins filled with finely ground DDT dust be transported outside where wind could scatter the dust throughout the building and in the surrounding area. The project was undertaken to enclose the process area, mitigate the dust problem, and add new office space. The request provides the following information:

> "In the grinding operation, it is necessary to transport many open bins filled with a finely ground material into this outside area for processing. When it is windy the air scatters this dust throughout the building and into the surrounding area. A protective windshield has been installed in this area, but it is ineffective. The proposed addition will not only provide needed shelter, but will also prevent the loss of DDT into the environment (Montrose, 1975).

A photograph taken in the mid-to-late-1960s, Figure 1.6J, apparently shows a very large amount of packaged DDT being stored outside on pallets throughout the Property. The photograph shows pallets stacked as many as four high on the ground in the northwest corner, next to the parking lot, south of the Central Process Area, as well as outside the Formulating and Grinding Plant. It is not known why the packaged DDT was being stored on the Property.

1.3.8 Special Products Plant

Since Montrose's Formulating and Grinding Plant had such large capacity, cleaning the equipment made grinding costs excessive if small runs of grinding other chemicals and insecticides with DDT were undertaken. Moreover, Montrose's grinding plant production schedule made it impractical to grind other products. Therefore, in 1971 Montrose installed used grinding equipment in the old Stauffer research laboratory building located approximately 100 feet east of the existing Formulating and Grinding Plant/Warehouse No. 3 (Figure 1.7B). The new facility became known as the "Special Products Plant."

Once installed, the Special Products Plant was used to prepare low volume non-standard formulations including DDT dusting powder (consisting of 10 percent DDT mixed with filler, often talc), DDT/Malathion water dispersible powder, 25 percent DDT emulsifiable concentrate, and 5 to 20 percent DDT oil solutions. The plant consisted of three ribbon blenders, two bucket elevators, a screw conveyor, a baghouse, a packager hopper, and other packaging equipment .

1.3.9 Rework Process

Between 1947 and about 1955, the rework area was used to dissolve DDT floor sweepings, off-color DDT, and other contaminated DDT (in general, "off-spec" DDT). The off-spec DDT was dissolved in a tank of chlorobenzene, and the insoluble contaminants were filtered out. The chlorobenzene was then distilled away, leaving molten DDT. The rework system included a still, receiver, condenser, filter press, rework dissolving tank, bin dumping rack, pumps, piping, and the necessary electrical connections. Testimony from a former employee indicates that the early rework filter press leaked considerable quantities of chlorobenzene.

Accounts differ as to the location of the DDT rework area. A former employee indicated that the DDT rework area was located at the southwest corner of the DDT Processing Building. Montrose facility drawings place the rework area between the DDT Processing Building and the wastewater pond, as shown in Figures 1.7A and 1.7B. Some testimony also indicated that approximately in November 1951, Montrose moved the rework system from south of the DDT processing building to a new location south of acid recovery.

In about 1955, the rework system was changed to eliminate the filter step. As before, the DDT was dissolved in chlorobenzene. Then the insoluble material was allowed to settle and the chlorobenzene/DDT solution was pumped directly to the condensators as part of the chlorobenzene charge at the beginning of the main reaction process. The DDT recovered by this method was comparable to that produced in a regular condensation reaction.

1.3.10 Waste Products

Major waste products from the production of technical grade DDT were principally of three types: (1) wastewaters (initially acidic only, and later both acidic and caustic) from the washing and neutralization of DDT and washdown from spills at the plant, maintenance, and repairs, (2) waste acid that could no longer be fortified enough to cost-effectively catalyze the DDT reaction, and (3) tars and sludges from the acid recovery process and the caustic scrubbers. Though the amount of wastes varied over time due to changes in manufacturing processes, these wastes were usually disposed by one of four principal

methods: (1) discharge to the sanitary sewer system, (2) disposal in landfills, (3) disposal in the open ocean by disposal companies, paid and arranged for by Montrose, and (4) resale or reuse. Incidental release of industrial waste to surface drainage pathways also occurred. These disposal methods are discussed in subsequent sections, after a general accounting of the various waste products.

From 1947 until 1953, before the major process changes occurred at the plant, only acid wastes were directly produced from the manufacture of DDT (see description of process steps in the section on Industrial Wastewater, Sewers, and Surface Drainage Releases above). These acidic wastes primarily consisted of water from the steam strippers and DDT washers and spent acid from the reactors that could not be recycled. In addition, spills and washdown water, resulting from maintenance, pump or valve packing leaks, steaming/cleaning of clogged lines, washdown from the rework area, and a variety of other situations also produced wastes at Montrose plant.

The change to the continuous-batch process in 1953 resulted in significant modifications to the waste streams and the waste handling system. Under the new process, two different types of liquid waste were generated in the DDT manufacturing process: a waste stream that consisted primarily of diluted sulfuric acid from the static acid separator and an alkaline waste stream from the neutralization process. Spills and washdown water continued to be waste products in this time period as well.

1.3.11 Industrial Wastewater, Sewers, and Surface Drainage Releases

There are a number of documents in Los Angeles Department of Public Works (LADPW) and LACSD's files concerning Montrose's handling of industrial wastewater. Because of LACSD and LADPW reports of overflows from the sewer to the surface drainage pathways, wastewater handling, sewer discharges, and surface drainage releases are discussed together. Figure 1.10 shows the generalized surface water runoff pathway from the Montrose Property to the Torrance Lateral. Figure 1.11 shows detail of the surface drainages on the Property and the Normandie Avenue Ditch.

Between 1947 and about 1953, a series of concrete or brick trenches in the ground in the Central Process Area, as well as a series of pipelines, conveyed wastes to an unlined surface impoundment, variously referred to as "settling pond," "wastewater neutralization pond," "waste pond," "wastewater pond," or "water recycling pond," depending on the time frame and purpose of the pond at the time. Figures 1.7A, 1.7B, and 1.7C show some of the waste trenches and surface drains. The waste pond was enlarged more than once during the course of operations. In 1952, the dimensions of the pond were 60 feet by 45 feet and it was approximately 12 feet deep (LADPW, 1953).

From 1947 until 1953, slightly acidic wastewater from the steam strippers along with other miscellaneous drainage from the plant site flowed to the wastewater pond. The drainage included water captured from various sources, such as the locker room facilities, stormwater runoff from the Central Process Area, and process cooling water. Prior to discharge to the sewer system, the pH of the wastewater pond was adjusted by passing wastewater through a "lime bed" consisting of sugar lime. The neutralized wastewater was then discharged from the pond through a 6,000-foot section of a 10-inch-diameter pressurized sewer line that tied into the Los Angeles Public Sewer System, adjacent and parallel to Western Avenue (Figure 1.7B).

According to LACSD reports, this early industrial wastewater system periodically backed up, causing wastewater to overflow into the surface water drainages. The sugar lime used to neutralize the discharge was inconsistent in quality and caused gummy deposits in the sewer line. These deposits restricted the sewer pipe, causing backups of the sewer wastes, occasionally overflowing to the surface water drainages.

Three documents in the LACSD files refer to the problem. An LADPW inspection document dated February 24, 1953, indicates that strongly acidic wastes were detected in samples taken from the "stream outflow" near the southeast corner of the Montrose plant and from the drain at the corner of Florence and Maple Streets (the head of the Kenwood Ditch and what is today the corner of 204th Street and Kenwood Avenue) (LADPW, 1953a). (Discharges from the Montrose plant are visible in aerial photographs taken in that time period, including Figure 1.6G.) According to the inspection document, A. R. Wilcox, plant superintendent, confirmed that industrial waste from the Montrose plant had entered the surface water drainages as a result of a backup in the sewage system. It was noted in this inspection that large areas of the plant were subject to open area drainage.

The same February 24, 1953, inspection memorandum describes the rework area of the plant as a 60-foot by 40-foot open area that also drains to the sewer. Wastes listed as originating from rework include "leaky valves and packing, and area washdown." In this inspection, the LADPW gave notice to Mr. Wilcox "requiring the immediate cessation of all waste flow into the storm channel and of all stormwater to the sewer." Mr. Wilcox was directed to "revise manufacturing procedures as soon as possible to correct the excessive acidity and flow to the storm channel."

On March 3, 1953, LADPW issued a letter to Montrose stating that "industrial waste from [the Montrose] facility into the adjacent drainage ditch has been the subject of numerous complaints from nearby residents and the County Engineer (LACSD)." The letter required that Montrose make provisions for discharge of these wastes to the sanitary sewer and segregate its rainwater from its industrial waste, and cease discharges of industrial wastes to the surface water drainages (LADPW, 1953b).

On March 17, 1953, Montrose responded to LADPW explaining the surface water discharges. According to their letter, Montrose's problem arose because of the necessity to dispose of relatively large quantities of diluted sulfuric acid. The letter states that the sugar lime they were using to neutralize the discharge was of "low grade[and]... uncontrollable... and frequently... cause[d] gummy deposits in the sewer line." The deposits restricted the sewer pipe and occasionally caused backups of sewer wastes. This occasionally resulted in drainage of industrial waste to surface water channels (Montrose, 1953a).

In response to these problems, Montrose changed its industrial wastewater system in 1953. In June of 1953, Montrose installed two 25,000-gallon belowground, redwood-lined, concrete tanks to act as the plant's sewer treatment facility. As shown in Figure 1.7C, these tanks were installed south of the existing lunchroom Quonset hut in the Central Process Area. Brick-lined and lead-lined underground trenches (Figure 1.7C) were installed to divert most process area liquid wastes (other than separator acid) from the Central Process Area to these two concrete vessels. At the same time, areas around the outside of the DDT process building that might contain contaminated surface water were curbed and allowed to drain to the belowground treatment tanks through troughs lined with acid brick or tile. Water in these tanks was then neutralized and directed to the sewer.

By March 1953, Montrose had instituted several process changes which eliminated much of the waste acid and made possible the use of sodium hydroxide, a more expensive, but soluble, neutralizer. Montrose eventually ceased using lime entirely, utilizing sodium hydroxide exclusively. Additionally, Montrose replaced the existing sewer line with a new 18-inch-diameter line approximately 425 feet long. The 18-inch line began at the two redwood-lined concrete tanks in the Central Process Area and traveled generally to the east toward Normandie Avenue where it connected with the LACSD 57-inch trunk line running along Normandie Avenue, called the "Joint Outfall 'D' (J.O. 'D') (Figure 1.7B). The J.O. 'D' line was also interconnected with a parallel sewer line, the "District 5 Interceptor", located about 25 feet to the west. Thus, the changes in the manufacturing process and waste streams in 1953 also were accompanied by a change in Montrose's sewer connections.

An April 1, 1953, letter from Montrose to LADPW further described changes to drainages within the plant. Montrose planned to segregate stormwater and wastewater drainage channels by curbing areas where water contamination could not be avoided and directing flow from these areas through new drainage troughs to the new wastewater treatment tanks. The other trenches that were not directed to the new wastewater treatment tanks would continue to flow to the old wastewater pond. The pond was to be cleaned out, disconnected from the sewer, and tied directly to the surface drainage channels. In the letter, A. R. Wilcox, plant superintendent, indicated that the pond was intended to serve as a reservoir such that no water, "except during heavy rains," would flow into surface drainage channels (Montrose, 1953b).

John Kallok, former Montrose plant engineering and maintenance supervisor, and plant manager, stated that there were a series of valves, trenches, vitrified clay pipes, and box drains in the new surface water drainage system to keep rainwater accumulation in the plant and to prevent it from entering the surface water drainages outside the plant (Kallok, 1997). He also stated that there were times after 1953 when heavy rains produced too much water and in order to avoid flooding the plant, Montrose was forced to open the valves to allow flow to the outside drainage channels.

A November 27, 1959, LADPW data sheet indicated that Stauffer Chemical was planning to build a 900-gallon tank for neutralizing their wastewaters from the BHC plant with caustic soda (LADPW, 1959). This neutralization was independent of the Montrose neutralization system. Section 1.3.2 and 1.3.21 provide additional details on Stauffer BHC operations.

After the process change in 1953, Montrose continued to discharge to the County J.O. 'D'. During this time, LADPW inspection cards and letters issued to Montrose reveal that the pH of Montrose's discharge was varying widely from acidic to caustic and that DDT and chlorobenzene were present in the discharge.

Several LACSD reports indicate that there were problems with the pH control system. A letter from LACSD to Montrose dated July 9, 1956, indicated that acidic discharges had been identified in the sewers and demanded that Montrose respond by indicating how they would mitigate the problem (LACSD, 1956). A subsequent letter from A. R. Wilcox to LACSD, dated July 16, 1956, states that when the batch neutralization tanks reached capacity, an operator would test the water with pH paper and would add caustic if necessary to increase the pH prior to discharge (Montrose, 1956). Normally, no adjustment was required, but sometimes an acid leak from pumps, broken lines, and other emergencies would make it necessary to add considerable amounts of caustic. Montrose had tried

different automatic pH monitoring and control systems, but none of them had worked adequately to control the pH. The letter indicates that operator error could have resulted in some acid leaks. The letter also describes a series of improvements, valve replacements, installation of bypass lines, and changes in piping materials which Montrose had undertaken or was proposing to eliminate the problem (Montrose, 1956).

An LADPW file inspection record dated August 26, 1964, related that LACSD had complained to LADPW about odors in the sewer line in the vicinity of Montrose. The record indicates that the odors turned out to be chlorobenzene from Montrose. Montrose had a 10-inch vent installed in the sewer connection manhole to alleviate the odor problem, but the record does not indicate that Montrose stopped the actual chlorobenzene discharge to the sewer at that time (LADPW, 1964).

A continuous pH chart run from June 17 to June 18, 1965, revealed pH levels in the Montrose sewer discharge varying from 3 to more than 10 (Montrose, 1965a). A similar pH chart run 6 months later on December 18, 1965, showed pH levels varying from 4.2 to more than 10 (Montrose, 1965b).

In a January 7, 1966, LADPW internal file memorandum, Inspector Chambers described how Montrose sewer discharges backed up and entered the surface water drainages (LADPW, 1966). Low pH discharges to the surface water drainages from the Montrose plant were observed on December 21, 1965. Two Teflon plugs were found to be leaking in the junction box of the Montrose plant drain. The plant drain is shown in Figure 1.11. These plugs were designed to prevent discharge of acids into the railway ditch west of Normandie Avenue, and south of Montrose (the Normandie Avenue Ditch). This memorandum indicates that on August 20, 1965, acid was discharged through Montrose's 12-inch sewer connection into the junction box, through the leaking plugs and into the railway ditch due to overflow of the primary neutralization pit (i.e., the wastewater pond). From other records discussed elsewhere in this section, it is clear that this wastewater also contained DDT and chlorobenzene. The acid traveled along the Normandie Avenue Ditch for a distance of some 500 feet. It is not known how long this situation existed before the plugs were repaired; however, lime was used to attempt to neutralize the acid in the ditch and a portion of the drain adjacent to the wastewater pond was removed by Montrose to prevent recurrence of the leak.

A June 17, 1968, LADPW office memorandum describes another incident of low pH (acid) discharges into the sewer (LADPW, 1968). The memorandum indicates that LACSD had informed LADPW that measured pH values downstream of Montrose ranged from 2 (acidic) to 11 (caustic) and that LACSD had observed a low pH problem (acid) with Montrose "on and off for 10 years." Montrose was discharging 600,000 gallons per day to the J.O. 'D' sewer system at that time. A similar memorandum dated June 28, 1968, described Montrose acid spills on June 25 and June 26 of that year. In this instance, the low pH problem reportedly resulted from plugged caustic jets in the belowgrade wastewater treatment/neutralization tanks. As a result, acidic wastewater was discharged to the sewer. The June 17, 1968, memorandum further explains that Montrose was operating on a continuous flow basis, rather than a batch flow basis, and despite the occasional dips in the pH of the Montrose discharge, the County treatment plant downstream had not reported pH problems.

LADPW inspections on March 11, 1970, and again on April 22, 1970, indicated that "chlorobenzene (monochlorobenzene)[was] leaking to [the] sewer" and that Montrose was "still losing chlorobenzene [to the sewer] (LADPW, 1970a and 1970b)." In March of 1970, LACSD inspectors made 24-hour sewer flow surveys upstream and downstream of the Montrose Property. Upstream of Montrose, the sewer flow was found to contain 7.2 pounds per day of DDT. Downstream, the sewer flow contained 654 pounds per day DDT. The report stated that these values should only be treated as "ballpark" values, indicating that there was a one to two order of magnitude increase in DDT in the sewer flow as one passed the Montrose facility (LACSD, 1970c). A June 7, 1976 memorandum from LACSD references another 1970 study that indicated a net input to the sewer of 640 pounds of DDT per day from Montrose itself, and that the remainder of the DDT inflow was due to sediments already contaminated by Montrose (LACSD, 1976).

Aware that DDT was being discharged into the sewer and motivated to reduce its industrial waste costs, Montrose instituted a water recycling plan in April of 1970. The goal of this system was to recycle 90 percent or more (Montrose, 1970a) of the plant's water. The complete water recycle modification to the Montrose plant was designed to eliminate process waste discharge into the sewer with the exception of two streams: (1) the blowdown water for the steam boiler and water softener, and (2) sanitary waste from the lunch room, changing house, and offices. The sanitary sewer system remained essentially unchanged between 1971 and plant closure in 1982. During that period, minor changes made in response to LACSD requests included directing the floor drains in the restrooms and locker rooms to the wastewater pond. According to supplemental information provided for an April 14, 1970, Montrose appropriation request, the system was to be designed to "eliminate the discharge of DDT concentration streams into the sewer" (Montrose, 1970c). According to the information, Montrose was discharging 350,000 gallons per day of wastewater to the sewer system at that time, including caustic liquors and tar pot liquor wastes. Under the new system, these wastes were to be disposed in alternate locations. According to the August 12, 1970 letter from Montrose to LACSD, one phase of the Montrose design changes "should result in a ten-fold decrease in the DDT concentration" of its sewer discharge (Montrose, 1970a). These changes were intended to stop further discharges of wastewater to the sewers from the manufacturing process because it was being recycled for use in the plant's cooling tower.

For one phase of the plan, Montrose excavated the contents of the existing wastewater pond, hauled the material to an offsite disposal facility, reshaped the pond, placed suitable fill material where required, installed an impervious polyethylene liner, placed reinforcing wire mesh inside the pond, and installed gunite lining. The purpose of the change was to provide for a holding pond to collect processed water. The processed water entered the pond only in the event of a failure of the pumps which delivered water to the cooling tower. After the solids had settled in the pond, water could be returned to the cooling tower for further use.

In 1970, during the course of a trunk sewer survey aimed at locating sources of pesticide, LACSD discovered a net input to the sewer system of 640 lbs/day of DDT in the vicinity of Montrose. It was determined that 600 lbs per day were due to Montrose itself, and 40 lbs per day were due to resuspension of DDT from DDT-laden sediments previously deposited in the sewer (LACSD, 1976). The letter indicates that shortly after this discovery, Montrose

ceased its discharge of caustic liquor waste to the sewer. This indicates that Montrose likely discharged such wastes to the sewer prior to 1971.

Subsequent sampling starting in July 1970 showed that the net difference in DDT levels between an upstream and a downstream location relative to Montrose appeared to be decreasing, and that Montrose's wastewater recycling program appeared to be effective. The relative difference, in pounds per day, was 59 on July 27, 47 on August 4, 40 on August 11, 11 on August 18, -4 on August 24, and -3 on August 31 (the last two negative values indicating that sampling results indicated higher values upstream of Montrose on that day). Samples of Montrose effluent by LACSD inspectors later that year indicated DDT levels ranging from 0.14 pounds per day (October 7) to 2 pounds per day (November 12).

A September 18, 1970 letter from Montrose to LACSD reported Montrose's progress in its total water recycling program (Montrose, 1970b). The letter indicated that Montrose was blocking off all drain troughs that lead to the sewer and pumping any accidental spills to storage tanks for reprocessing, in order to eliminate the discharge of any DDT-containing materials to the sewers.

On October 22, 1970, the Environmental Defense Fund "EDF" sued Montrose and LACSD, alleging that the discharge of DDT into the sewer system was contaminating the estuaries and coastal waters of Southern California and violating various laws. Although Montrose disagreed with the EDF allegations, Montrose agreed to eliminate all process water discharge to the sewer, which was completed in about April 1971.

Subsequently, in 1970 or 1971, LACSD performed a cleanout in the J.O. 'D' sewer and District 5 Interceptor trunk lines, which previously had been used by Montrose for industrial wastewater discharge. Approximately 346,000 pounds of sediment were removed from the siphon between 212th and 213th Streets, and a total of 450,000 pounds of sediments were removed from both sewer lines (the J.O. 'D' line and the District 5 Interceptor ran parallel to one another and were interconnected). According to an LACSD file memorandum dated March 1971, the sediments averaged 10,800 ppm DDT by weight and contained an estimated 4,900 pounds of DDT (LACSD, 1971f). LACSD documents also indicate that LACSD attempted a second cleaning of the same sewer line in 1975-1976. The measurement of sediment and DDT removed in that effort is not immediately available.

On May 12-13, 1971, LACSD made a survey of remaining sewer sediments in the vicinity of Montrose to determine the effect that the sewer cleaning effort had had (LACSD, 1971a). Two sediment samples collected just upstream of Montrose had 44 ppm and 300 ppm of DDT. Samples immediately downstream of Montrose contained 165,000 ppm; 130,000 ppm; 4,800 ppm; and 3,200 ppm of DDT. Samples collected as far south as Carson Street contained 6,600 ppm and 7,000 ppm of DDT. From 1971 to 1974, monthly LACSD surveys and reports document DDT in sewage and sewer sediments in the vicinity of the Montrose plant.

In 1971, Jones Chemical's sewer discharge permit was canceled because of discharge violations and their sewer connection was sealed off by the County. A March 22, 1971, LADPW inspection card indicated that Jones Chemical was discharging 400 to 600 gallons per day into the sewer connection through the Montrose tie line (LADPW, 1971a). A May 26, 1971, LADWP inspection card states "cancell [sic] - all i.w. hauled to Montrose re-circ. Pond from pit." (LADPW, 1971b). This indicates waste from a pit at the Jones Chemical may have been hauled to the Montrose wastewater pond. John Kallok, Montrose

plant manager at the time, and Bernie Bratter, Montrose facilities manager at the time, have stated that Jones Chemical never dumped industrial waste in the Montrose wastewater pond, which at that time was being used to store process water for recycling to the DDT manufacturing process. After it was disconnected from the sewer system on May 26, 1971, it appears that Jones Chemical discharged their industrial wastewater to a dry well on their property; although, Jones Chemical had been using this dry well whenever a sewer connection was not available (such as when the Montrose pressure line, to which Jones Chemical had been connected, was disconnected in 1953). The location of the dry well is shown in Figures 1.3 and 1.7B.

An October 20, 1976, Montrose appropriation request (No. 186-208) provided for enlarging and simplifying the DDT-acid separator vent piping (Montrose, 1976a). According to the request, this was to reduce clogging in the DDT vent pipeline. The clogging had resulted in spills, DDT running down the acid vent line, and complications associated with unplugging the line.

An analysis of the recycle pond water was conducted in 1978. The results indicate an MCB concentration of 40 ppm, a para-DCB concentration of 4 ppm, and an ortho-DCB concentration of 0.9 ppm (Stauffer, 1978). It is possible that higher MCB concentrations were present at the bottom of the recycle pond because DNAPLs like MCB tend to sink.

In 1980, there was a spill of caustic from the Jones Chemical property at the same time there was a large chlorobenzene spill at Montrose. These two spills drained off the property and ponded along the train tracks parallel to Normandie (Kallok, 1992). It is possible that this spill traveled further down the surface water drainages and entered the Kenwood Drain and Torrance Lateral.

A November 6, 1980, Montrose appropriation request (No. 186-261) states that the 20,000-gallon belowground, wastewater holding tanks, installed in 1966, were replaced that year because they had corroded (Montrose, 1980a). According to the request, the tanks were used to collect liquid waste from the DDT processing plant, spent caustic from the fume scrubbers, DDT wash water, and organic tars. Wastes were reportedly neutralized and sent to a Class I landfill, as needed.

In 1981, a small pond of liquid, approximately 200 gallons, was observed in the Normandie Avenue Ditch about 500 feet south of the property (Montrose, 1981). The memorandum indicated the upper aqueous layer was a caustic solution with a pH of 14 and the lower organic layer was chlorobenzene (CB). The source of the liquid was not identified.

When Montrose ceased operations in 1982, Montrose and Jones Chemical shared a common drainage ditch on the south end of the property. Several documents describe ponding in the southeast corner of the property at the outlet of this ditch, as well as ponding on the Farmers' Brothers property to the south of Montrose. In 1981, the California Department of Health Services took samples from the common Montrose/Jones Chemical drainage ditch, which revealed as much as 100-ppm DDT and 1.7-ppm chlorobenzene (water phase) as well as some pure chlorobenzene (nonaqueous phase liquid) in the trench.

On November 9-10, 1982, EPA Inspector Steven Simanonok inspected the Montrose plant and took water samples in the Montrose/Jones Chemical Ditch along the southeastern border of the property, where surface drainage from the plant site joined the Normandie Avenue Ditch and entered the Off-Property surface water drainages. DDT was discovered

in these water samples at levels up to 695 ppb. Based on a quality control review, these results were qualified because the unfiltered samples were allowed to settle for 4 hours prior to analysis. The true unfiltered DDT concentration was likely significantly higher.

In 1991, Montrose completed an Engineering Evaluation and Cost Analysis (EE/CA), a document that evaluated various alternatives for a Superfund removal action for the remaining contaminated sediments in the J.O. 'D' and District 5 Interceptor sanitary sewer lines. Montrose's evaluation found DDT throughout the J.O. 'D' sewer connection to the treatment plant at White's Point, just prior to ocean discharge. However, an estimated 97 percent of the DDT mass was located within about a kilometer of the plant in the J.O. 'D' line. Based on the EE/CA, on September 21, 1992, EPA signed an Action Memorandum authorizing a removal action in the sewers and requiring that all remaining sediments be removed from the J.O. 'D' sewer between manholes D32 and A468.

The execution of the removal action was deferred until LACSD constructed a relief sewer to accept sewer flow while the J.O. 'D' was out of service. In 1996, Montrose removed approximately 175 tons of sediment from the J.O. 'D' sewer between manholes D32 and A468, from just upstream of the former Montrose plant to just south of Torrance Boulevard. These sediments contained, on average, 24 percent (240,000 ppm) DDT by weight and up to 2,200 ppm chlorobenzene. An estimated 70 tons of highly viscous sediments , with similar DDT concentrations remain in this portion of the sewer at the time this report was prepared. Montrose, in conjunction with LACSD and EPA, is studying various means for removing the remaining sediment and results will be reported in separate documents.

1.3.12 Sewer Permits

On April 1, 1953, Montrose applied for an industrial waste permit from the LADPW. The application indicated that Montrose was applying for an Industrial Waste permit for its "chemical manufacturing" operations. The character of Montrose's operation and the types of chemicals, solvents, or other substances contained in Montrose's liquid waste discharges were set forth in a report attached to the waste permit application (Montrose, 1953c).

In response to the application, the City of Los Angeles, Department of Public Works issued Industrial Waste Permit No. W8427 to Montrose on May 15, 1953. The permit granted Montrose the right to discharge industrial waste liquids from its chemical manufacturing plant using "at a minimum the methods and facilities as shown on their corrected Plans Nos. 966-1-2-3-4, dated 5-9-53, on file and approved by this Bureau" (LADPW, 1953c). This discharge was allowed to enter the J.O. 'D' sewer in the right-of-way west of Normandie Avenue.

A review of Montrose documents indicates that Montrose next submitted an application for an industrial waste permit to the LADPW, Bureau of Sanitation, Industrial Waste Control Section on July 22, 1971 (Montrose, 1971). Apparently, this application was for a permit revision in response to Montrose's operational changes, which curtailed all disposal of process waste to the sanitary sewer. The chemical and physical characteristics of waste that Montrose proposed to discharge to the sanitary sewer in 1971 included boiler blowdown (alkaline discharge with a high solids content), water softener backwash (salt NaCl) and some solids), and sanitary wastes (from the restrooms). The 1971 permit application was apparently approved on July 30, 1971. The permit established that Montrose was to install a 3,000-gallon surge tank to accommodate the boiler blowdown and waste softener effluent.

The blowdown water and the water softener effluents were required to be pumped first to the surge tank and then to the sewer system.

On March 29, 1974, Montrose submitted an application for a permit for industrial waste water discharge to the LACSD (Permit 1487). The permit, Permit No. 1487, was approved by the LACSD on June 5, 1974 (LACSD, 1974). The permit stated that "all industrial wastes are hauled by a contractor to a Class 1 landfill. Boiler blowdown, water softener backwash and sanitary sewage from the restrooms are discharged to sewer."

1.3.13 Caustic Liquors, Sludges, and Shipments to Landfills

As mentioned earlier, in 1970 and 1971, Montrose instituted a water recycling program and ceased its discharges of industrial wastes to the County sewer system. A permit was retained, however, for discharging boiler blowdown and sanitary wastes to the sewer. Prior to 1971, Montrose apparently discharged significant quantities of their "caustic liquors" and "tar pot liquors" into the sanitary sewer system (according to a Montrose appropriation request dated May 12, 1980, the tar pot was a tank in the acid recovery plant, used to recover chlorobenzene from waste tars; the resulting tars were saturated in chlorobenzene) (Montrose, 1980b). A letter from LACSD to Ralph Wilkinson, dated June 7, 1976, indicates such discharges took place until 1970. According to the letter, the majority of the DDT load to the sewer was contained in the caustic liquor that came from the DDT washing process (LACSD, 1976).

According to a Stauffer Chemical Company appropriation request dated April 14, 1970, Montrose undertook a project in 1970 attempting to "...eliminate the discharge of caustic and tar pot liquors into the county sewer" (Montrose, 1970d). The supplemental information provided with this request stated "...in this project caustic and tar pot liquors will be transported from the plant and dumped. At the present time there are three places available for disposal. One is a permitted area in the ocean which is approximately 60 miles from shore, one is a class [sic] I landfill that permits a certain amount of liquid dumping, and one is an abandoned quarry (Montrose 1970c)." During this project, Montrose installed a 50,000-gallon waste holding tank for holding the liquors and tars.

After the water recycling system was installed in 1971, Montrose apparently recycled significant amounts of its process water. An LACSD internal memorandum dated October 22, 1970 indicated that DDT levels entering the sewer had fallen by as much as two orders of magnitude (LACSD, 1970a). Remaining waste streams included some unrecyclable water, "caustic liquors" from the caustic scrubbers, and acid tars from the Acid Recovery Plant (see Acid Recovery Plant, Acid Tars discussion below). According to a May 12, 1971, LACSD file memorandum, Montrose sent this waste to the LACSD Disposal Site No. 1 in Rolling Hills (Palos Verdes Landfill) (LACSD, 1971b). The memorandum states that prior to April of 1970, Montrose sent pond dredgings to this landfill and the effluent went to the sewer. After April 1970, unrecycled water was sent to the Palos Verdes Landfill, as well. The memorandum cites Mr. Sobelman of Montrose saying that the water effluent from the wastewater pond (presumably not including the dredgings) contained 10 to 15 pounds per day of DDT.

According to a May 11, 1971, LACSD internal memorandum, the first load of waste was sent to the Palos Verdes Landfill on April 17, 1970, and Montrose had hauled approximately 100,000 gallons of waste per week to the landfill since that time (LACSD, 1971c). The

memorandum also states that on some days, Montrose used the BKK Landfill for this purpose. An internal LACSD memorandum dated April 30, 1971, noted that grab samples were taken from vacuum trucks used to transfer the waste to the Palos Verdes Landfill. These samples indicated DDT at a concentration of about 3,400 ppm. The report estimated that 16,000 gallons of this waste were hauled the day the samples were taken (LACSD, 1971d).

Throughout the history of the plant, the wastewater pond was periodically dredged. The dredgings were dewatered in the trash dike and, as described above, sent to a landfill. It is believed that this process was alluded to in the May 12, 1971, LACSD memorandum in which LACSD states that Montrose was drying their pond dredging sludge prior to disposal (LACSD, 1971b).

During the wastewater process change in 1970 when the wastewater pond was reconstructed, the dredgings were dewatered elsewhere on the property. According to an April 1, 1970, LADPW inspection record, Montrose had a large drying bed for sludge in the "back of prop[erty] (LADPW, 1970b)." An LACSD inspection card record dated April 6, 1970 mentions a "small pond in the back of the property" that contained chlorobenzene tars. A similar record dated April 22, 1970, says that the "small pond" referred to in the April 6, 1970 LACSD record had been filled in (LADPW, 1970d). The April 6 record also indicates that Montrose was staging "tars" in the "large pond" on the property. A March 23, 1971 LADPW office memorandum, in describing process changes to the plant at this time stated, "scrubber waste" from [chlorobenzene] will go to pit s[outh] side of prop[erty] by r[ail] r[oad] spur and be pumped to main reservoir for re-cir[culation] (LADPW, 1971c)." It is not known whether these abbreviated reports describe the same or different pits on the Montrose property (see discussion of "Acid Tars," next section).

A letter from LACSD dated June 5, 1974, approving Montrose's sewer permit modifications, stated that Montrose was collecting all process water (presumably including caustic liquors) in the two belowground wastewater neutralization tanks, and reaffirms that Montrose was using vacuum trucks owned by Chancellor and Ogden to transfer the waste to at least two landfills: (1) the LACSD Disposal Site No. 1 in Rolling Hills (Palos Verdes Landfill), and (2) the BKK Landfill in West Covina, California (LACSD, 1974). According to the letter, this waste was primarily neutralized caustic liquor from the DDT washing operation. Montrose was landfilling 30,000 to 35,000 gallons per day of this waste in June of 1974, although an earlier (December 27, 1972) inspection card from LADPW indicated 56,325 gallons per day of wastewater and/or caustic liquor were being hauled by vacuum truck to landfills (LADPW, 1972).

As mentioned above, a November 6, 1980, Montrose appropriation request (No. 186-261) stated that the two belowground wastewater neutralization tanks collected spent caustic from the fume scrubbers, DDT wash water and organic tars (Montrose, 1980a). These tanks were periodically emptied and the waste sent to one of the disposal locations discussed above.

1.3.14 Disposal of Waste Acids and Tars, Acid Recovery Plant

1.3.14.1 Waste Acid

As mentioned, the DDT-forming reaction between chloral and chlorobenzene did not consume the sulfuric acid; however, the reaction increasingly diluted the acid with water.

While Montrose would recycle and reuse the acid when possible, after a while acid could no longer be fortified cost-effectively. Thus, throughout plant history, the Montrose operations routinely generated waste acid (Figures 1.8A and 1.8B show these waste acid streams and some of their disposal locations.) This acid contained a certain amount of DDT.

Between 1947 and 1953, before the separation step was achieved by filtration (see Separation in section on Technical Grade DDT Manufacturing Process above), excess acid from the condensation reaction was returned to the spent acid holding tank where it was fortified with oleum and reused in the reaction. If too much acid built up over time in the spent acid holding tank, it was shipped to approved ocean disposal areas and dumped (see section on Waste Products above). Montrose contracted California Salvage Company to perform this disposal activity. Other acid still entrained in the DDT was washed from the DDT into the wastewater pond, neutralized, and discharged to the sewer (see section on Industrial Wastewater, Sewers, and Surface Drainage Releases above).

After 1953, when the separation step was first accomplished by "oliver" filter, melter, and static separators (see Separation in section on Technical Grade DDT Manufacturing Process, above), but before 1960 when the acid recovery plant was built, acid was filtered from the acid/DDT slurry and returned to the spent acid holding tank for reuse in the manufacturing process. Acid from the static acid separator was held temporarily in storage tanks and either sold, fortified and reused, or shipped to approved ocean disposal areas by California Salvage Company (see section on Waste Products above).

1.3.14.2 Acid Recovery Plant

In March of 1960, Montrose completed the acid recovery plant (Figures 1.7B and 1.7C) and some of the waste acid of the plant was recovered with the intent to resell. The acid recovery plant had two functions: (1) to clean the spent acid by removing the majority of the p-CBSA, formed by the side reaction of oleum with chlorobenzene, thereby making the spent acid more marketable; and (2) to transform p-CBSA into chlorobenzene for reuse in the DDT production process. It was designed to process approximately 8,000 gallons per hour of separator acid. Generally, acid from the static-acid separator was processed in the acid recovery plant by first extracting p-CBSA from the spent acid. After the p-CBSA was removed, the so-called "recovered acid" was formed. The recovered acid (containing small but measurable quantities of DDT, p-CBSA, and traces of tar) was either sold, or disposed at sea or in landfills, depending upon the time frame.

Upon completion of the acid recovery plant, all of the recovered acid was sold to fertilizer manufacturer customers. Sometime later, however, when all of the recovered acid could no longer be sold, some of the acid was sent to disposal sites and some of the recovered acid was "fortified" and sent to Montrose's Henderson, Nevada plant for use in dehydrating chloral.

Montrose shipped its first load of recovered acid to the Stringfellow Acid Pits a disposal site located near Glen Avon, California, on January 3, 1968. At that same time it ceased fortifying the recovered acid for use at the Henderson plant. Based on Stringfellow Site records, Montrose shipped 6,485,200 gallons of waste acid to the Stringfellow Site. Montrose ceased shipping recovered acid to the Stringfellow Site in November 1972, thereafter, disposing its recovered acid at approved waste disposal sites, including the Palos Verdes Landfill and the BKK Landfill in West Covina, California.

These methods of sale and disposal apparently became problematic for Montrose. A January 23, 1973 Stauffer Chemical inter-office correspondence (Stauffer Chemical had 50 percent ownership of Montrose at that time) discusses Montrose's spent acid (Stauffer, 1973). According to the correspondence, it had been determined that the acid contained high levels of chloride and was therefore not suitable for fertilizer. Moreover, it was determined that regeneration of the acid at Stauffer's Dominguez chemical plant was not practical. There was also concern that regulators might soon cut off approval for the BKK Landfill to receive these types of wastes.

Mr. John Kallok, former Montrose plant engineering and maintenance supervisor, mentioned to EPA that some of the recovered waste acid was sold in the Los Angeles area as a cesspool and drain cleaner (Kallok, 1992). The exact time period of this practice and the amount of acid involved are not known.

1.3.14.3 Acid Tars

The p-CBSA removed from the separator acid was hydrolyzed into chlorobenzene and sulfuric acid. The chlorobenzene was separated from the sulfuric acid and returned to the production process. The acid formed by the hydrolysis was returned to the front of the acid recovery plant for retreatment.

In the process of extracting p-CBSA from separator acid, acid soluble tars precipitated in the extraction column. These tars were a mixture of p-CBSA and decomposed organic material. The tars were removed from the distillation column and further treated with steam to remove any remaining chlorobenzene, which condensed in the heat exchanger and collected in the chlorobenzene receiver. According to Montrose appropriation request dated October 13, 1964 (No. 186-59), acid tars would precipitate and settle at the bottom of the 100,000-gallon waste spent acid holding tank at the plant, as well (Montrose, 1964). Presumably, these tars would have to be removed from the tank from time to time. A May 12, 1980 Montrose appropriation request also referred to the "tar pot," a neutralization tank used for the recovery of chlorobenzene from the tars (Montrose, 1980b).

From about 1960 to early 1970, Montrose would stage the tars, after treatment to remove chlorobenzene, in the wastewater pond near the acid recovery plant and, after drying, the tars were periodically dredged and transported in tank trucks for offsite disposal.

In early 1971, when Montrose ceased discharging its industrial waste streams into the sewer, the tar from the acid recovery system was placed into the two belowground wastewater treatment tanks formerly utilized in connection with Montrose's pre-treatment sewer discharge system. After treatment with an alkali waste stream from the Montrose operation to facilitate disposal, the tars were then pumped into tank trucks and transported for offsite disposal in the same locations as previously discussed for caustic liquors, above.

1.3.15 Acid Recovery Plant Process

Extraction Column. The first step in the acid recovery process was the extraction column which extracted p-CBSA from the separator acid. Sulfuric acid from the DDT-acid separator was steam heated and fed into the top of the extraction column while chlorobenzene from the chlorobenzene makeup tank (holding chlorobenzene from the chlorobenzene-p-CBSA separator) was fed into the bottom of the column. Chlorobenzene, which is lighter than sulfuric acid, would rise to the top of the extraction column while the

heavier acid would settle to the bottom. As they passed one another, the chlorobenzene would dissolve the p-CBSA contained in the sulfuric acid mixture and carry the p-CBSA/chlorobenzene solution out the top of the column. The acid, now substantially free of p-CBSA, flowed out the bottom of the extractor column and into a recovered acid storage tank from where it was either sold or shipped elsewhere for disposal (see section on Waste Products above).

By August 1971, after installation of a new rotor and cover on the extraction column, the acid recovery plant was recovering approximately 300,000 pounds of chlorobenzene per month.

Mixer Separator and Pre-Heater. Chlorobenzene and p-CBSA from the top of the extraction column flowed into a mixer where water was added and the mixture was agitated. The chlorobenzene, p-CBSA, and water mixture flowed into the chlorobenzene/p-CBSA separator. The p-CBSA, which is more soluble in water than in chlorobenzene, would dissolve into the water. Because water and chlorobenzene are immiscible and have different specific gravities, the chlorobenzene and water would separate and form two liquid layers. The top layer, chlorobenzene, overflowed into a tank where it was recycled back to the extraction column. The bottom layer, containing p-CBSA, water and impurities, flowed into a preheater.

The preheater's function was to raise the temperature and concentrate the p-CBSA solution by stripping out the water and chlorobenzene. Some of the chlorobenzene and water, because of their lower boiling points, were driven off and trapped in condensers. The recovered chlorobenzene was returned back to the beginning of the manufacturing process and the water was discharged to the two belowground wastewater treatment tanks (see section on Waste Products above). The concentrated p-CBSA solution was sent to the hydrolyzer to be hydrolyzed into chlorobenzene and sulfuric acid.

Hydrolyzer. The key piece of process equipment in the acid recovery plant was the high-temperature, agitating, hydrolyzer tank. In the 200°C heat of the hydrolyzer, the p-CBSA/water mixture would gradually break down to form chlorobenzene and sulfuric acid. The chlorobenzene would then boil off while the sulfuric acid would flow out the bottom of the hydrolyzer and back to the separator acid storage tanks. The chlorobenzene vapors would be carried to condensers, where they were condensed, drained to storage tanks, and eventually returned to the DDT manufacturing process.

1.3.16 Fume Scrubber System

A fume scrubber system was installed in 1947 when the plant was constructed. Montrose also added various scrubbers to new pieces of equipment as plant processes were added or modified. Los Angeles Air Pollution Control District permits were obtained for each scrubber added. The various scrubbers used water or 15 percent caustic solution to clean the vent gases. The spent caustic from the scrubbers was then dumped into the belowground wastewater treatment tanks where vacuum trucks picked it up and hauled it to disposal sites.

1.3.17 Air Permits and Violations

As of its closure in 1982, Montrose maintained at least 39 air permits with the South Coast Air Quality Management District for the Montrose Plant. These permits regulated

inorganic and organic gases, particulates, and/or fugitive DDT dust emissions from the plant. The facilities at the plant requiring one or more such permits include chlorobenzene and acid tank scrubbers; chemical storage tanks; oleum (fuming acid) storage tanks; DDT Plant baghouse; the DDT manufacturing system; the acid recovery plant; the acid recovery caustic scrubber; the bag baler at the Formulating and Grinding Plant; baghouses; blending systems; the grinding mill in Warehouse #1; the Special Products Plant blending and packing system; the boilers; underground gasoline storage tank; and the cooling tower.

In the 1960s and 1970s, Montrose received several citations from the Los Angeles County Air Pollution Control District for violating the California Health and Safety Code. For instance, on October 3, 1974, Montrose received a citation, and was fined for releasing fumes from the post reactor (LACAPCD, 1974). In addition, in July 1975, Montrose received a citation from the Air Pollution Control District for the discharge of particulate matter from a roof vent at a capacity of 75 percent (LACAPCD, 1975).

1.3.18 Northwest Corner

The northwest corner of the Montrose property was utilized as a storage and salvage area for miscellaneous trash and equipment related to Montrose's operations. The trash dike, salvage area, and junk yard are depicted in Figure 1.7A and 1.7B. The trash dike, salvage area, and junk yard, as well as the area north of the trash dike were used at various times during the operation of the plant for the storage of scrap metal, scrap building materials, used equipment and pipe. Dredgings from the wastewater pond were dewatered in the trash dike prior to offsite disposal. An LACSD inspection card dated April 6, 1970, indicates the presence of a small pond in the back of the property. In addition, as new areas of the plant were developed and paved, some "rubble" (dirt, bricks, and concrete) was staged in these areas. The area west of the rail spur contained a row of trees throughout that time period and generally contained brush or other vegetation, some stored materials, and often showed disturbed areas on the ground. It is likely that the large drying bed for sludge and the small pond for chlorobenzene tars, both mentioned in LADPW inspection records, were located in the northwest portion of the property. Some aerial photographs, such as Figure 1.6E and 1.6G, show unidentified piles of material in the northwest corner of the Montrose property. This material may have been off-specification DDT.

1.3.19 Plant Shutdown, Disassembly, and Demolition

Montrose ceased its actual production process on or about July 2, 1982. Prior to that in June 1982, Montrose initiated an orderly plant closure. By August 1982, Montrose had completely ceased operating the plant. The plant was fully dismantled and demolished by early 1983. At about this time, the Montrose Site was being proposed for the Superfund National Priorities List. Subsequently, Montrose graded and paved the Property with asphalt. EPA did not approve the grading and paving of the property and, in fact, requested that Montrose not move forward with these operations until sampling could be conducted. Montrose disregarded EPA's requests and, by grading the property, irrevocably disrupted the DDT contaminant distribution in the surface soils. Today, the entire Property is empty except for a few temporary structures associated with the ongoing Remedial Investigation/Feasibility Study.

1.3.20 Neighboring Operations

Prior to World War II, the land surrounding the Montrose Property was used for agriculture and cattle grazing. Delanco, a small residential community, was located to the southeast in the area between Torrance Boulevard and Del Amo Boulevard. In 1942, the federal government built a 275-acre synthetic rubber plant to the east of what would become the Montrose Property in the area contained within the Del Amo Superfund Site. Shell Chemical, Dow Chemical, U.S. Rubber, Goodyear, and Firestone operated the plant, which remained under government ownership until it was sold to Shell in 1955. In 1947, the Eston Chemical Co. (subsequently Kerr-McGee) established an ethylene dibromide (EDB) pesticide manufacturing plant at the rubber plant site using by-products of the rubber process. Also during the war, aluminum plants were built just north of what would become the Montrose Property. One was operated by Harvey Aluminum, and the other immediately to the north became an Alcoa plant and is now owned and operated by McDonnell Douglas. By 1947, Shell Chemical built additional facilities along Vermont Avenue east of the rubber plant. This property is now part of the Del Amo Superfund Site. During this time frame, Armco Steel Corporation built a foundry and located a dump site for slag at the bottom of the Kenwood Drain to the southeast of the Montrose Property. The location of these sites are shown in Figure 1.4.

In the 1950s and 1960s, other small industries sprang up nearby, including Jones Chemical to the southwest of Montrose and Farmer Brothers Coffee to the south. With the increased manufacturing now located in the area, residential development expanded and agricultural use decreased.

1.3.21 Stauffer Facility Operations

Stauffer operated a research facility on the Montrose Site itself from the mid-1940s until approximately 1957. As part of its research activities, Stauffer operated a benzene hexachloride (BHC) plant on the southeast corner of the Property from approximately 1954 until 1957 (Figure 1.7B). The gamma isomer of BHC is known as Lindane, another organochlorine pesticide. To make Lindane, the alpha and beta isomers of BHC are removed. The result is waste alpha and beta BHC, known as "alpha-cake." Documents suggest that the Stauffer plant was involved with experimentation to see whether alpha cake could be marketable. In or about 1957, the pilot plant was converted to a high-production, gamma-BHC plant. The BHC production plant operated until approximately 1963. Thereafter, the plant was dismantled and removed from the Property.

Benzene was a feedstock in the production of BHC. Information currently available suggests that benzene was stored on the Property in a 5,000-gallon, aboveground tank situated on a concrete pad. The benzene was trucked to the tank and then delivered from the tank to the plant through aboveground piping. U.S. Patent 2,218,148 covers the manufacture of BHC, accomplished by the chlorination of pure benzene in the presence of actinic radiation (an ultraviolet light source). Thus, just as chlorobenzene was a raw material and was used to redissolve DDT at the Montrose plant, it is reasonable to assume that benzene was a raw material and was used to redissolve BHC within the Stauffer pilot plant, though on a much smaller scale.

As shown in Figure 1.7A and 1.6E, Stauffer also operated a sulfuric acid manufacturing plant on property adjacent to the southwestern portion of the Montrose Property where

Jones Chemical is currently located. The sulfuric acid plant was operated from the early 1940s until approximately 1952.

1.3.22 Well Number 795

Well No. 795, owned by Stauffer Chemical, was located near the northeast edge of the Jones Chemical property (Figure 1.3). The well was originally drilled in 1943 to a depth of 722 feet. Over the years, Montrose obtained some of its water supply from the well. The pumping equipment was removed in 1967 and the well was capped in 1969.

An inspection of the original surface cap in 1989 revealed that the well was subject to surface water infiltration and subsequent testing confirmed that contaminants existed in the well water, including DDT, PCE, TCE, alpha-BHC, and chlorobenzene. TCE and PCE are chemicals known to be associated with the Jones Chemical operations. Montrose never used PCE or TCE in the production of DDT but may have used solvents on the property for maintenance purposes. The distribution of contaminants within the well and the condition of the original cap both indicated that the contaminants may have originated from surface water runoff. In 1995, the floating oil in the well was removed, and the well was properly and permanently sealed with EPA oversight and approval to prevent the release of contaminants into the environment (H+A, 1996C-a).

TCE and PCE are chemicals known to be associated with the Jones Chemical operations. Montrose never used PCE or TCE in the production of DDT but may have used solvents on the property for maintenance purposes. A Jones Chemical price card indicates that Jones Chemical sold Montrose a variety of chemicals including PCE and TCE (Gaffney, 1992).

1.3.23 Del Amo Pipeline Corridor

As many as 14 existing or abandoned pipelines pass east-west along the LADWP right-of-way and Del Amo Street between Vermont Avenue and Western Avenue immediately south of Montrose (Figure 1.3). Shell Chemical operated numerous pipelines associated with the rubber plant on the east side of Vermont Avenue. At least two Shell lines carried benzene, but these lines did not extend as far west as Normandie. In the Del Amo corridor, however, Shell has operated pipelines since 1927 transporting gasoline and crude oil.

Dow Chemical maintains an active styrene line in the Del Amo corridor. Styrene is manufactured by combining benzene and ethylene. The line formerly belonged to Mobil who transported gasoline at one time. In 1986, the line was replaced due to frequent leaks.

GATX Pipeline Co. (formerly General Petroleum) operates a dedicated 6-inch jet fuel line that runs through the Del Amo corridor. The line was built by Mobil in 1942, sold to Conoco Pipeline Co. in 1971, and purchased by GATX in 1982. In addition to jet fuel, gasoline was likely transported through the line at some time.

In 1970, Santa Fe Pacific Pipeline Company built a 12-inch line running north along Normandie Avenue, turning east at the Del Amo corridor. The line is currently operated by Union Oil Company. Over the years, it has conveyed both gasoline and diesel fuel.

Mobil Oil Company has at least ten lines that pass through the Del Amo corridor. Beginning in the 1920s and continuing today, Mobil transported crude oil, gasoline, kerosene, jet fuels, and gasoline additives through the various lines. Three lines formerly carried natural gas, amines, and hydrogen sulfide.

Chevron Oil has one main pipeline that follows the Del Amo corridor. This 20-inch line was installed in 1975 and is still in service carrying diesel, jet fuel, and gasoline.

Union Oil Company has one 20-inch line that runs along Normandie Avenue south of Montrose into the Kenwood community at Milton Street, north to the Del Amo corridor around New Hampshire Avenue, and then east. The line was built in 1985 and has carried gasoline.

Atlantic Richfield owns one line that passes through the Del Amo corridor and uses it to deliver crude oil. The line was built in 1958.

1.4 Surface Water Drainage Pathways and History

As described in the Site and Operational History section, at various times Montrose industrial wastes entered surface water drainages within the plant leading to the surface water drainages outside the Property. It appears that discharges to the surface water drainages may have been more frequent during 1947-1953, when Montrose's sugar lime neutralization was causing backup of the pressure line leading to the Western Avenue sanitary sewer (see Industrial Wastewater, Sewers, and Surface Drainage Releases above) and the wastewater pond was overflowing during heavy rains.

During the course of Montrose operations, the surface drainages leading away from the Montrose property changed several times. The following sections detail the history and development of surface water drainage at, in the vicinity, and leading away from the Property. Historical surface water drainages are described based on review of available records and aerial photographs. The present day surface water drainages are described based on existing conditions at and in the vicinity of the Property. A discussion of the waste constituents entering the surface water drainages is presented in the Site and Operational History Section.

The surface water drainages leading away from the former Montrose plant involved several major structures, as shown in Figures 1.10 and 1.16. The *Kenwood Ditch* (which later became the *Kenwood Drain*) drained to the *Slough* (which later became the *Torrance Lateral*), which in turn drained to the *Dominguez Channel*, a major drainage channel for the south Los Angeles area. The Dominguez Channel terminates at the *Consolidated Slip* and the *Los Angeles Harbor* for a total distance of approximately 8 miles. These structures are progressively larger surface water runoff/flood control improvements, serving areas in the neighborhood of the plant and the greater southern Los Angeles Basin.

1.4.1 In-Plant Drainages

As discussed above, between 1947 and 1953, Montrose discharged its plant effluent waste into a wastewater pond which in turn drained to the Los Angeles Public Sewer System. At this time, surface drains directly around the DDT building drained to the sewer line. As previously discussed, in 1953, Montrose modified its wastewater treatment by, among other changes, adding treatment tanks, using NaOH, and connecting to the 57-inch J.O. 'D' sewer trunk near Normandie Avenue. Until 1971, when Montrose implemented its complete water recycling program, surface water drains directly around the DDT process building continued to flow ultimately to the sewer system. Drainage from all areas where surface

water was not expected to be contaminated and was allowed to flow Off-Property in open ditches.

The Montrose Property was graded to allow surface water to generally flow towards the southern edge and southeast corner of the property (Figure 1.11). Drainage ditches existed along the northern boundary, the southern boundary (including the structure called the "Jones Ditch"), the eastern boundary (called the "Normandie Avenue Ditch"), and on either side of the railroad spur that curved into the property from the southeast corner. These drains directed surface water to the southeast corner and offsite. The surface water drainage from the Montrose Site then generally flowed to the Kenwood Ditch, which later became the Kenwood Drain (Figure 1.11).

1.4.2 Kenwood Swale, Kenwood Ditch, and Kenwood Drain

1.4.2.1 Kenwood Swale

In this discussion, the term Kenwood Swale is given to a natural historical depression. The Kenwood Swale was later developed into the Kenwood Ditch, which in turn was replaced by the Kenwood Drain. The latter two terms refer to man-made improvements to the water drainage pathway. Note that these terms were not in use at the time of the existence or construction of these structures. Rather, they have come to be used by EPA, Montrose and other involved parties for convenience in the remedial investigation for the Montrose Site.

The Kenwood Ditch and Drain developed out of a natural surface water drainage channel that ran one to two blocks east of Normandie Avenue in Torrance, California (Figure 1.12). A portion of a natural channel and swale (a wide depression or relative low point) followed Florence Street (later to become Kenwood Avenue) south from Maple Street (later to become 204th Street) to Torrance Boulevard. To avoid confusion, these streets are hereafter referred to by their current, rather than historical names.

Based on a 1928 aerial photograph (Montrose operations did not begin until 1947), the natural Kenwood Swale began in open fields north of Del Amo Boulevard and east of Normandie Avenue (Figures 1.12 and 1.6A). A secondary swale entered the main Kenwood Swale from the west, just south of 204th Street. This swale drained from irrigated farm fields to the west of the area that subsequently became the Montrose Site. The "channel" or low point continued near the south Montrose (Jones Chemical) boundary in the approximate location now occupied by the LADWP substation, crossed the LADWP right-of-way, and, by 1928, was blocked by the construction of Normandie Avenue. Ponding occurred at a low point at the approximate location of the current Farmer Brothers plant and opposite the extension of 204th Street. Flows from this area appear to run south along the west side of Normandie to a point just north of Torrance Boulevard.

Another short, secondary swale ran east-west just north of Torrance Boulevard and fed into the main channel of the Kenwood Swale at the intersection of Kenwood and Torrance (Figure 1.12). The 1928 aerial photograph suggests that a ponding area on the west side of Normandie, which received waters from the ditches on the west side of the avenue, ran into this swale through a culvert, and some additional ponding occurred at its intersection with Kenwood Avenue and Torrance Boulevard.

1.4.2.2 Kenwood Ditch

As part of the pre-1928 Delanco development, an improved open ditch, the Kenwood Ditch, was constructed to contain surface waters on the west side of Kenwood between 204th Street and Torrance Boulevard. North and south of these two streets, the surface waters followed the natural drainage courses at that time.

As shown on a 1938 aerial photograph, surface-water drainage exited from the southeast corner of the Property (Figure 1.6C). The drainage appears to originate in the south rail spur/loading dock area of the Property. The stream collects into a pond against the railroad lines that run along Normandie Avenue, passes to an area between the tracks and the street, and crosses under Normandie Avenue through a culvert. Many of the later, as-built drawings that show improvements to the Kenwood Ditch and Drain continue to show this as an 18-inch corrugated iron culvert (see, for instance, Los Angeles City Map #599). As shown in Figure 1.13, the culvert was located about 260 feet south of the Montrose southern property line and 300 feet north of the north edge of 204th Street. In Figure 1.6C, the drain initially appears to spill down adjacent slopes in the depression at the head of the Kenwood Swale, in the area north of Del Amo Boulevard and north of the Kenwood Ditch which began south of 204th Street. A 1941 aerial photograph shows a straight east-west ditch about 100 feet long that directs flow to the swale (Figures 1.6D and 1.10). Los Angeles City Map #599 depicts an "unimproved channel" that conveys water around houses on 204th Street and south to the north end of the Kenwood Ditch (Figure 1.13).

There are varying interpretations of whether drainage from the synthetic rubber plant constructed during the early 1940s could have made its way into the head of the Kenwood Ditch along with flow from the culvert under Normandie Avenue south of the railroad spur from the direction of Montrose. The U.S. Government and its private sector operators, as part of the new synthetic rubber plant, constructed a curved railroad access spur, which separated from the Normandie Avenue mainline, curved east across Normandie Avenue near the southern edge of Montrose, and then curved north to various portions of the rubber plant site. As clearly shown on a May 10, 1952 aerial photograph, Figure 1.6F, the spur left Normandie Avenue north of the 18-inch culvert. This railroad spur may have cut off water flow from the north that might previously have entered the Kenwood Swale. The presence of culverts under the spur cannot be immediately discerned from the photograph. Montrose has interpreted features on the photograph to be a linear ditch extending from the southern boundary of the tracks to the northern boundary of the LADWP right-of-way, and also another ditch which traveled parallel to the tracks and then curved east and north towards the synthetic rubber plant. According to Montrose, these ditches picked up drainage flow along the east side of Normandie Avenue, a drainage system on the west side of the synthetic rubber plant, and from still extant fields to the north of the former swale, and directed the flow to a culvert under the tracks and to the head of the Kenwood Ditch.

Shell Oil Company and Dow Chemical Company, in a document entitled, *Technical Memorandum: Topography and Surface Runoff History, Southwestern Portion of the Del Amo Study Area, 1924 to the Present* (Dames & Moore, 1997), also imply that drainage pathways from just north of the spur, in the extreme southwestern "panhandle" portion of the synthetic rubber plant (Figure 1.6F), appear to have been aligned southerly toward the head of the Kenwood Ditch. At the same time, this document refutes that drainage east of the rubber plant panhandle flowed to the head of the Kenwood. A drainage divide exists at roughly the point where the panhandle attached to the main rubber plant property and the

topography east of this divide sloped to the east, not the west. While the existence of former flow from north of the railroad spur remains possible, at present EPA concurs with the assertion that there was and is generally eastward-sloping topography east of the panhandle area. Therefore, drainage from the Del Amo waste pits area, if it existed, would not have traveled westward to the head of the Kenwood Drain.

Figure 1.6F shows the 18-inch culvert south of the railroad spur intact and still channeling water from south of the Montrose plant under Normandie Avenue and over to the head of the Kenwood Ditch, via the "unimproved channel." By this time, the Montrose plant was operating and the sugar lime was causing the sewer to back up at the Montrose plant, as referenced in LADWP documents.

Despite the railroad spur, a complete pathway existed in 1953 for surface drainage to flow from Montrose to the Kenwood Ditch. For more information on these releases, see earlier discussions contained in above sections: Site and Operational History; Industrial Wastewater, Sewer Discharges, and Surface Drainage Releases.

During the 1950s and 1960s, few changes occurred to the channelized ditch between 204th Street and Torrance Boulevard. By 1953, several houses had been built on the west side of the avenue with culverted-fill driveways over the ditch (Figure 1.13). By 1956, the practice of double-housing lots had begun on the west side of the street. The Kenwood Ditch appeared to run about halfway between the edge of the street, as it then existed, and the front of the nearest houses. The unimproved channel segment between 204th Street and Del Amo Boulevard became straightened and improved by 1956. By 1958, the same segment had been fully ditched and straightened through a 10-foot easement held by the Los Angeles County Flood Control District. Housing was then constructed on fill adjacent to the main drainage channel (Figure 1.6I).

Additional activities also reshaped drainage patterns along Normandie Avenue. By 1950, the Farmers Brothers Company established a plant just south of the LADWP right-of-way on the west side of Normandie. Fill placement reduced the available storage area for runoff in the previously wet portion of this land. By 1958, additional fill, building construction, and development of parking further reduced the low points west of Normandie Avenue, and drainage appears channelized along the south margin of the LADWP strip leading to the head of the Kenwood Ditch system.

1.4.2.3 Kenwood Drain

In the late 1960s, major improvements were made throughout the Kenwood-Torrance area as part of a long-planned regional flood control initiative. Authorized under a supplement to the 1958 storm drain bond issue program, the Kenwood Ditch and the drainage to the Dominguez Channel were improved and replaced with a combination of enclosed and open permanent structures. This began the process by which the Kenwood Ditch was replaced by the buried Kenwood Drain. These improvements to the Kenwood Ditch occurred in two distinct segments. One segment is located between Torrance Boulevard and Milton Street, the other between Milton Street and north of 204th Street (Figure 1.14).

Work on the first segment of the Kenwood Drain began in early September 1969 under Project No. 685. The contractor, Kruse Construction Co., began operations at the lower end of Kenwood, working upstream to Milton Street. The section north of Milton Street remained unimproved. In the Kenwood Avenue area, the new structure consisted of a

poured-in-place box culvert 4 to 9 feet below the existing ground surface. To the south of Torrance Boulevard, the structure surfaced, and fill was placed over the drain.

Likely due to the moisture content, excavated soil was stockpiled south of the Kenwood Avenue area. County engineering correspondence related to reuse of the removed materials indicates suitability for reuse in the construction of the Kenwood Drain as long as moisture content could be addressed. Soils were not placed in yards adjacent to excavation. The design required substantial quantities of imported fill material to complete the job. A stockpile, either construction residual or unused cover, was identified nearby at the old Main Street Dump landfill (west of the I-110). Approximately 208,000 cubic yards of this material was purchased and imported for backfilling.

The extension of the Kenwood Drain improvements continued in 1977 to the north of Milton Street (Figure 1.14). Authorized under the 1970 Storm Drain Bond Issue Program, planning had been ongoing since the late 1960s. Construction work began in spring of 1977 under Mitrovitch, Inc. As-built plans for this work appear under Southwest County Project No. 1250, Line C, Unit 2, Los Angeles County Flood Control District. Unlike the previously-installed box drain system, the section from Milton to north of Del Amo consisted of a combination of 30-inch and 42-inch reinforced concrete pipe. North of 204th Street, the 10-foot easement held by the Los Angeles County Flood Control District for the channel (see discussion above, during the 1950s), and the culvert under 204th Street connecting the channel to the Kenwood Ditch, was replaced by a segment of 30-inch reinforced concrete pipe. A new inlet structure replaced an existing catch basin north of the Del Amo railroad spur. The pipe passed under the tracks and followed the former ditch alignment to 204th Street. The new piping lies seven to ten feet below the bottom grade of the former ditch. At 204th, the pipeline elbows eastward, then turns south to align with the edge of the paved surface of Kenwood Avenue.

A buried 42-inch reinforced concrete pipe was then laid the length of Kenwood Avenue between 204th Street and Milton Street, where it connects with the previously constructed box drain. Based on aerial photos, it appears that the former Kenwood Ditch between 204th Street and Kenwood Avenue lay to the west of the alignment of this Kenwood Drain, and that after the drain was built, the ditch was backfilled. Again, existing materials were specified as adequate for backfilling as long as moisture content met specifications. However, during the earlier installation of the box drain, Kruse Construction had to stockpile the material because it was too wet, using imported fill. Because the construction of the Kenwood Drain reportedly resulted in a net surplus of fill material, it is possible that the excavation to lay the pipe produced the fill which was used to fill the former Kenwood Ditch. Subsequently, the easement retained by the County for maintaining the Kenwood Ditch was vacated (i.e., property owners took back full control of the property on which the ditch had been located).

At some point, the 18-inch corrugated iron pipe culvert leading from Montrose under Normandie Avenue came into disuse. Instead, a buried connector drain was constructed in a bermed area in the Farmers Brothers parking lot. This drain is a 24-inch vitrified clay pipe and runs eastward, under Normandie Avenue, connecting with the northern end of the Kenwood Drain. Inspections by EPA in 1982, prior to Montrose plant demolition, indicated that the drainage from the Montrose plant was now flowing along the bermed area and into this drain.

1.4.3 The Slough and the Torrance Lateral

The open Kenwood Ditch, before it was replaced by the Kenwood Drain, ran through a culvert at the corner of Kenwood Avenue and Torrance Boulevard and opened into a slough, or natural open swampy area, south of Torrance Boulevard (Figure 1.12 and Figure 1.6A). A few blocks south of Torrance Boulevard, the slough turned to the east and widened into an open swampy flood plain with significant vegetation. This slough ran eastward to Vermont Street, then angled northeastward and ultimately emptied into the Dominguez Channel.

During the 1950s, "reclamation" began in the swampy area south of Torrance Boulevard. During this time, the Torrance Lateral project was constructed, and the slough was leveled and graded. In a Supplemental Extension to Project #685, under which the first segment of the Kenwood Drain was constructed in the 1960s, a buried drain, placed in the same location as the slough, was installed to intercept the water from the Kenwood Drain. This drain emptied into the new Torrance Lateral, which in turn emptied to the Dominguez Channel. This arrangement still exists today (Figure 1.15).

The metal foundry operated by Armco Steel Co. may have used part of the slough area for disposal of waste slags and casting materials from their operation. This landfilling corresponds to a pattern of dumps, fills, and land developments that dot the drainage down the Torrance Lateral system to the Dominguez Channel. As stated in correspondence over Permit Application No. 75523-A, Armco Steel used their properties as a "refuse dump (LACFCD, 1975)." The permit, which was for installing improved culverts for Armco, also anticipated that filling and leveling with Armco materials would be conducted within the drain right-of-way.

1.4.4 Dominguez Channel and Consolidated Slip

Throughout the period of Montrose operations until the present day, the Dominguez Channel was a lined major conveyance leading to the Los Angeles Harbor via the Consolidated Slip (Figure 1.16). Between Montrose and the Los Angeles Harbor, the Dominguez Channel passes some of the most highly industrial areas in California, including chemical and petroleum refineries.

1.4.5 Present Stormwater Pathway

Surface water runoff presently flows under the fence at the southeast corner of the Property and into the asphalt-lined portion of the Normandie Avenue Ditch (Figure 1.15). Runoff then flows through a culvert beneath a railroad spur and into the gunite-lined portion of the Normandie Avenue Ditch. Runoff from the gunite-lined portion of the Normandie Avenue Ditch discharges into a 24-inch vitrified clay pipe storm drain located south of the Property adjacent to the Farmer Brothers parking lot. The storm drain is part of a subsurface corrugated pipe storm drain system. The storm drain system is connected to a catchment basin at the west curb of Normandie Avenue. Surface water runoff flows from the catchment basin east to the Kenwood Drain, picking up flow from several additional catchment basins.

A concrete-lined ditch located between the Jones Chemical property and the LADWP right-of-way (the Jones Chemical Ditch) currently drains surface water runoff from the Jones

Chemical property. The Jones Chemical Ditch joins with the Normandie Avenue Ditch immediately downstream from the railroad spur culvert.

The buried concrete storm sewer system that comprises the Kenwood Drain drains to the south, then turns eastward and merges with the Torrance Lateral (Figure 1.15). The Kenwood Drain varies in design, including both reinforced concrete pipe and reinforced concrete box sections.

Runoff flows from the Kenwood Drain into the Torrance Lateral, an open concrete-lined drainage with a flat bottom and tapered or vertical sides (Figure 1.15). The Torrance Lateral is fenced to prevent public access. The Torrance Lateral is dry most of the year, carrying intermittent flow consisting of urban runoff from industrial, commercial, or residential water use and runoff from rainfall events. The Torrance Lateral drains the area between approximately 190th Street and Sepulveda Boulevard and flows eastward where it merges with the Dominguez Channel (Figure 1.16).

The Dominguez Channel is a flood-control drainage that bisects the Torrance Plain and discharges into the Los Angeles Harbor at the Consolidated Slip (Figure 1.16). Upstream from Vermont Avenue, which is approximately 3 miles upstream of the confluence with the Torrance Lateral, the Dominguez Channel has a concrete bottom and concrete revetments. Downstream from Vermont Avenue the Dominguez Channel changes configuration to stone revetments, or rip-rap, and a clay-lined bottom.

1.5 Regional Setting

The following sections describe physical and environmental characteristics at and in the vicinity of the Property, including:

- Physiography
- Climate
- Surface water features
- Soil types
- Geology
- Hydrogeology
- Ecology

1.5.1 Physiography

The Property is located on the Torrance Plain, which is a portion of the Los Angeles Coastal Plain (Coastal Plain) (California Department of Water Resources [CDWR], 1961). The physiographic features of the Coastal Plain are the Torrance and Long Beach plains, the El Segundo Sand Hills, the Dominguez and Alamitos gaps, and portions of the Baldwin Hills, Rosecrans Hills, Dominguez Hill, Signal Hill, and the Palos Verdes Hills (Figure 1.17). The Baldwin Hills, Rosecrans Hills, Dominguez Hill, and Signal Hill are the surface expression of part of the Newport-Inglewood belt of hills, or the Newport-Inglewood Uplift (CDWR, 1961) (Figure 1.18).

The Torrance Plain is a marine plain that parallels the Newport-Inglewood Uplift from Ballona Gap southwestward to Dominguez Gap. Historically, this broad, featureless plain was poorly drained and only dissected by local streams. These streams included Centinela

Creek in the northern portion of the plain and Dominguez Creek in the southern portion of the plain. In order to alleviate drainage problems within the Torrance Plain, Dominguez Creek was channelized by 1930 to drain marshy areas and provide flood control.

The El Segundo Sand Hills extend south from Ballona Gap to Torrance and the Palos Verdes Hills, located approximately 3 miles inland from the Pacific Ocean (Figure 1.17). The El Segundo Sand Hills consist of a wide belt of inactive Pleistocene dunes that originally contained many closed depressions and were overlain by a narrow strip of active dunes along the coast. Coastal development has encroached upon these dunes and has filled many of the closed depressions.

The Newport-Inglewood Uplift is an elongated structural feature extending from the foot of the Santa Monica Mountains near Beverly Hills southeastward to Newport Beach (Figure 1.18). This belt of hills is 1 to 4 miles wide and is underlain by a series of folds and faults. This structural deformation underlying the Rosecrans Hills and Dominguez Hills may influence groundwater flow in the vicinity of the Montrose Site. These hills are underlain by upper Pleistocene sediments that dip to the southwest and merge with the Torrance Plain.

1.5.2 Climate

The climate of Los Angeles in the Torrance area is monitored at the Los Angeles International Airport (LAX), the Los Angeles Civic Center, and the Long Beach Airport (Table 1.4). Annual summaries covering the past 30 years, used with comparative data from these three weather stations, are available from the National Oceanic and Atmospheric Administration (NOAA), Asheville, North Carolina. Based on these reports, precipitation, temperature, wind, and general weather patterns are summarized below.

Each of the three NOAA stations is located approximately 10 miles from the Property. The LAX station is to the northwest, the Long Beach Airport station is to the southeast, and the Los Angeles Civic Center station is to the northeast. Additional meteorological measurements are taken at and are available from the Torrance Airport, located approximately 4 miles southwest of the Property. The Torrance airport is not an official NOAA station.

The average daily temperature range reported by the LAX weather station for 1988 was 55.5 degrees Fahrenheit (°F) to 70.3°F (NOAA, 1988a). The average daily temperature range for the years 1941 through 1971 was 54.1°F to 69.2°F (Table 1.4). LAX station temperature ranges have been compared with those of the Civic Center stations. High temperatures are infrequent but occur when air reaches the coast from the interior in the form of "Santa Ana" winds as described below (NOAA, 1988a, 1988b, and 1988c).

Prevailing wind directions, as indicated by the annual LAX summary for 1988, are from the west and southwest (Table 1.4). Generally, the prevailing daytime winds are from the west, but lighter prevailing night and early morning winds are from the east and northeast. The strongest winds prevail from the west and north following winter storms. Occasionally during the fall, winter, and spring, gusty and dry northeasterly winds from the interior blow toward the coast. These winds are known as the Santa Ana winds (NOAA, 1988a, 1988b, and 1988c).

The GCA Corporation constructed a wind rose diagram based on wind directions from the LAX and the Long Beach Airport during the period from 1965 to 1974. The GCA study indicates a leeward direction toward the east (Seeley et al., 1986).

Total precipitation at the LAX weather station was 7.96 inches in 1988 (NOAA, 1988a). The precipitation normal for the years 1941 through 1971 was 11.59 inches (Table 1.4). Measurable rainfall occurs mainly in the winter months, from October through April (NOAA, 1988a).

The dominant influence on the climate of the Coastal Plain is the Pacific Ocean. Daily weather patterns consist of night and morning low clouds followed by sunny afternoons. In general, humidity is highest and temperatures are lowest along the coast. Precipitation increases with distance from the ocean (NOAA, 1988a, 1988b, and 1988c). Another characteristic of the Coastal Plain is the smog that prevails throughout the West Coast Basin.

1.5.3 Surface Water Features

The Coastal Plain is drained primarily by the Los Angeles and the Rio Hondo-San Gabriel river systems (CDWR, 1961). Historically, these river systems have meandered across the Coastal Plain and have entered the ocean at various locations, from the Ballona Gap in the north to the Santa Ana Gap near Huntington Beach in the south. Streams within the Coastal Plain have typically flowed intermittently, carrying large flows only after winter storms.

The Los Angeles River is the largest stream within the Coastal Plain and has significantly affected the drainage of the plain. Historically, the Los Angeles River has radically changed course as a result of episodic flooding. For some undetermined time before 1825, the Los Angeles River flowed westward through the Ballona Gap (Figure 1.17). During floods of 1825, the river breached its banks and began flowing through the Dominguez Gap. Subsequent flooding caused the river to partially return to the Ballona Gap, but since 1884 the river has flowed southward through the Dominguez Gap into San Pedro Bay. These relatively rapid course changes suggest that the rivers of the Coastal Plain have deposited their debris across most of the plain and have acted as a factor in its formation (Poland et al., 1959).

The Torrance Plain was historically drained primarily by Dominguez Creek (Poland et al., 1959). Dominguez Creek drained an area called the Dominguez Slough, located to the east of the City of Torrance. This area was a topographic low fed by intermittent streams and, at the turn of the century, contained a body of water covering an area of approximately 2 square miles. The slough included surrounding marshy areas and drained to the southeast into San Pedro Bay via Dominguez Creek. By 1930, the creek was channelized from the slough to the bay and was renamed the Dominguez Channel (Figure 1.17).

By 1947, the Dominguez Channel drained the Dominguez Slough, and the remaining marshy area was named Laguna Dominguez. Because of the continuing industrialization of the area, the Dominguez Channel was extended to drain Laguna Dominguez.

The present-day Dominguez Channel was completed in the 1970s to assist in flood control and drainage of the Torrance Plain (Figures 1.6 and 1.17). The upper reaches of the Dominguez Channel have concrete revetments and a concrete bottom. The Dominguez Channel changes configuration to stone revetments and a clay-lined bottom approximately

3 miles north of the Property. Standing surface water presently exists throughout the length of the clay-lined portion of the Dominguez Channel. Water levels are affected by tides. Laterals, such as the Torrance Lateral, were constructed to help drain adjacent low-lying areas into the channel.

The Dominguez Channel flows into the Consolidated Slip located approximately 5 miles downstream from the confluence between the Dominguez Channel and the Torrance Lateral (Figure 1.16). The Consolidated Slip is part of the Los Angeles Harbor and is used as a recreational marina and commercial port.

1.5.4 Soil Types

Three soil type associations have been mapped within a 2-mile radius of the Montrose Site: the Ramona-Placentia Association, the Oceano Association, and the Cropley Association (U.S. Department of Agriculture [USDA], 1969). These soil types generally describe the top 5 feet of soil, excluding present fill material.

The Ramona-Placentia Association occurs at the Property. The Ramona-Placentia Association consists of 80 percent Ramona soil and 20 percent Placentia soil (USDA, 1969). The Ramona soil extends to a depth greater than 60 inches. This soil is well drained. Available water-holding capacity is 8.0 to 10.0 inches per 60 inches of soil depth. The available water-holding capacity decreases with an increase in the percentage of coarse fragments. The surface soil is brown to reddish brown, heavy loam, loam, or sandy loam to a depth of approximately 18 inches. The subsoil, from a depth of approximately 18 to 48 inches, is brown to reddish brown, dense clay loam or clay. The substratum consists of brown to reddish brown loam or light clay loam. The subsoil may be stratified beds of silt to sand. Some areas consist of up to 60 percent by volume gravel and cobbles (USDA, 1969).

The Placentia soil extends to a depth greater than 18 inches. This soil is moderately well drained. Available water-holding capacity is 2.0 to 2.5 inches per 18 inches of soil depth. The surface soil is brown to reddish brown loam or sandy loam to a depth of approximately 18 inches. From a depth of approximately 18 to 48 inches, the surface layer is abruptly underlain by subsoil consisting of a dense, dark reddish brown clay loam. Below approximately 48 inches, the substratum consists of a brown loam. Some areas contain subsoil consisting mainly of gravelly deposits and some have an iron-cemented hardpan (USDA, 1969).

The Oceano Association occurs along the coast and in the southwestern portion of the area within a 2-mile radius of the Montrose Site. The Oceano Association consists of soil to a depth greater than 60 inches. This soil is excessively drained and is highly susceptible to wind erosion. Available water-holding capacity is 3.5 to 4.5 inches per 60 inches of soil depth. The surface soil is grayish brown and slightly acid to medium acid sand to a depth of approximately 4 inches. The underlying subsoil, from a depth of approximately 4 to 20 inches, is light brownish gray and strongly acid sand. Below approximately 20 inches, the substratum consists of a pale brown, strongly acid sand (USDA, 1969).

The Cropley Association occurs within a strip of land that is bounded on either side by the Ramona-Placentia Association and is located north of the Property. The Cropley Association consists of soil to a depth of greater than 60 inches. This soil is well drained. When dry, this soil forms numerous wide cracks. Available water-holding capacity is 9.0 to

10.5 inches per 60 inches of soil depth. The surface soil is dark gray, neutral, and mildly alkaline clay to a depth of approximately 38 inches. The subsoil, from a depth of approximately 38 to 50 inches, is grayish brown, moderately alkaline, calcareous clay. Below approximately 50 inches, the substratum consists of a grayish brown, moderately alkaline, and calcareous gravelly clay loam containing approximately 20 percent by volume of gravels (USDA, 1969).

1.5.5 Geology

The Los Angeles Basin is a broad synclinal depression composed of a thick sequence of marine and continental sediments. In the structurally deepest part of the basin beneath the central part of the Downey Plain, the rocks of Tertiary and Quaternary age are more than 20,000 feet thick (Poland et al., 1959). To the north at the Santa Monica Mountains and to the southwest at the Palos Verdes Hills, these rocks have been extensively elevated, folded, faulted, and eroded to expose the underlying complex of igneous and metamorphic rocks (Figure 1.18).

The Newport-Inglewood Uplift, a composite faulted anticlinal belt, transects the Los Angeles Basin and extends from Beverly Hills to Newport Beach (Norris and Webb, 1989). The surface expression of the uplift is a series of en echelon faults and anticlinal folds and domes that underlie the Beverly, Baldwin, Rosecrans, Dominguez, Signal, Bixby Ranch, and Landing hills (Figures 1.17 and 1.18). This anticlinal belt creates two synclinal troughs: the Central Basin, a broad syncline to the northeast, and the West Coast Basin, a relatively narrower syncline to the southwest.

The Montrose Site is located within the West Coast Basin in the Torrance Plain. The basin is bounded on the north by the Ballona Escarpment, on the east by the Newport-Inglewood Uplift, on the southwest by the Palos Verdes Hills, and on the west by the Pacific Ocean (Figures 1.17 and 1.18). There are four major structural features in the vicinity of the Montrose Site within the Torrance Plain. These features are the Charnock Fault, the Palos Verdes Fault, the Torrance Anticline, and the Gardena Syncline.

The stratigraphy of the West Coast Basin includes Quaternary age continental and marine deposits and Tertiary age marine sediments overlying a basement complex of igneous and metamorphic rocks. The geologic units of hydrogeologic interest are (in order from oldest to youngest): the Pico Formation, the San Pedro Formation, the Lakewood Formation, older dune sand, alluvium, and active dune sand (Figure 1.19).

Tertiary age marine sediments in the West Coast Basin underlie the Pleistocene age deposits and include the Pliocene age Pico and Repetto Formations and the Miocene Puente and Monterey Shale Formations (Figure 1.19). These formations are almost entirely of marine origin and consist of sandstone, siltstone, mudstone, diatomite, and siliceous shale.

The lower Pleistocene age San Pedro Formation unconformably overlies the Pico Formation (Figure 1.19). The San Pedro Formation consists of unconsolidated to semiconsolidated gravel, sand, silt, and clay. These sediments are marine and continental in origin and attain a maximum thickness of approximately 1,000 feet.

The upper Pleistocene age Lakewood Formation unconformably overlies the San Pedro Formation (Figure 1.19). Marine and continental sediments comprising the Lakewood Formation consist of gravel, sand, sandy silt, silt, and clay; these sediments attain a

maximum thickness greater than 400 feet. Upper Pleistocene age deposits include the Palos Verdes sand. The Recent age deposits lie conformably on the Lakewood Formation and comprise alluvium and active dune sand that are typically present at surface outcrops throughout the basin (Poland et al., 1959). Recent age deposits include the Playa deposits.

1.5.6 Hydrogeology

The Property is located in the groundwater basin known as the West Coast Basin (Figure 1.17). The West Coast Basin is located immediately west of the Newport-Inglewood Uplift (Figure 1.18). Pleistocene age and older formations have been downwarped forming the West Coast Basin. Groundwater in the West Coast Basin occurs in aquifers of varying water quality and usage. The principal aquifers at and in the vicinity of the Property are, in order from shallowest to deepest, the Gage Aquifer, the Lynwood Aquifer, and the Silverado Aquifer (Figures 1.19 and 1.20).

Regionally, the aquifers are primarily replenished with fresh water injected at two saltwater intrusion barrier projects (Figure 1.21). The only significant source of natural replenishment comes from the Central Basin across the Newport-Inglewood Uplift. Water levels and flow directions within the basin are primarily controlled by injection barrier projects and pumpage. In the West Coast Basin, the base of the fresh water occurs at approximately 1,300 feet below sea level.

1.5.6.1 Hydrogeologic Units

Hydrogeologic units in the West Coast Basin include aquitards and aquifers of varying compositions and water-yielding properties. These units, in order from first water encountered to deeper units, include the Bellflower Aquitard, the Gage Aquifer, an unnamed aquitard, the Lynwood Aquifer, another unnamed aquitard, and the Silverado Aquifer (Figure 1.20).

The terms aquifer and aquitard are relative terms with regard to the ability of a geologic unit to transmit water. An aquifer, as defined by the American Geological Institute, is "a body of rock that is sufficiently permeable to conduct groundwater and to yield economically significant quantities of water to wells and springs" (Bates and Jackson, 1987). The Gage, Lynwood, and Silverado hydrogeologic units were designated aquifers by CDWR (CDWR, 1961).

An aquitard is defined as "a confining bed that retards but does not prevent the flow of water to or from an adjacent aquifer" (Bates and Jackson, 1987). A confining bed is defined as "a body of impermeable or distinctly less permeable material stratigraphically adjacent to one or more aquifers" (Bates and Jackson, 1987). The aquitards in the West Coast Basin were also designated by the CDWR. The aquitards identified at the Montrose Site are the Bellflower Aquitard and the unnamed aquitard that separates the Gage Aquifer from the Lynwood Aquifer.

Across much of the West Coast Basin, the first groundwater is encountered within the Bellflower Aquitard, which has also been referred to as the Bellflower aquiclude (CDWR, 1961). The Bellflower Aquitard is a predominantly fine-grained unit that overlies and partially confines the Gage Aquifer (Figure 1.20). The Bellflower Aquitard varies in lithology and regionally ranges from interbedded fine- to medium-grained sand, silty sand, and silt to sandy or gravelly clay. The fine-grained nature of the unit tends to retard the

movement of groundwater. Groundwater in the aquitard is generally of poor quality due to high total dissolved solids. The Bellflower Aquitard is not a source of water supply in the West Coast Basin (CDWR, 1989).

The Bellflower Aquitard as described in the literature is consistent with the general lithology encountered during the installation of monitoring wells and exploratory borings at the Montrose Site. Three lithologically distinct subunits of the Bellflower Aquitard were encountered at the Montrose Site. For the purposes of the RI, these subunits are described as the Upper Bellflower Aquitard, Bellflower Sand, and lower Bellflower Aquitard. These three Bellflower Aquitard subunits were identified by H+A based on lithologic data collected during drilling and logging of exploratory borings and monitoring well construction. These subunits were first identified and designated in 1986 during RI Part 2, Phase 1 drilling activities. Investigators at the adjacent Del Amo Superfund Site have more recently, further subdivided the Bellflower Aquitard into several additional subunits comprised of alternating sequences of sand, silt, and mud (Dames & Moore, 1996).

The Bellflower Aquitard has been reported to be absent in areas of the West Coast Basin (CDWR, 1961). These areas are located north of the Montrose Site in the City of Inglewood, along the coast from El Segundo to Redondo Beach, and inland on the northern flank of the Palos Verdes highlands. The Bellflower Aquitard was not present at monitoring well DA-2A, located approximately 1-1/2 miles southwest of the Property (Ecology & Environment [E&E], 1989a) (Figure 1.21).

The Gage Aquifer occurs throughout most of the West Coast Basin except for the Long Beach Plain (Figures 1.17, 1.19, and 1.20). The Gage Aquifer is partially confined from above by the Bellflower Aquitard except where the Bellflower Aquitard is absent (CDWR, 1961). The Gage Aquifer is reportedly composed mostly of sand with minor gravel and interbeds of silt and clay (CDWR, 1961). This lithology is consistent with that encountered during the installation of monitoring wells and exploratory borings at the Montrose Site. Historically, wells screened in the Gage Aquifer supplied water for irrigation and domestic purposes (CDWR, 1961). Well yields from the Gage Aquifer are low, and the Gage Aquifer is of secondary importance for groundwater supply (CDWR, 1961).

An aquifer that is stratigraphically equivalent to the Gage Aquifer extends eastward from Redondo Beach to the Newport-Inglewood uplift north of the Property (Figures 1.17 through 1.20). This aquifer is called the Gardena Aquifer and forms a narrow band of coarse-grained sediment. The Gardena Aquifer was deposited by an ancestral stream. The unit comprises sand and gravel with minor lenses of sandy silt. This aquifer is highly transmissive and is considered usable for water supply. Many wells were completed in the Gardena Aquifer near the City of Gardena, approximately 3 miles north of Montrose (CDWR, 1961). As of 1988, only one well was still producing from this aquifer (CDWR, 1989). The Gardena Aquifer is not present at the Montrose Site, but occurs about 1-mile west of the Montrose Site.

A clayey aquitard of variable thickness has been encountered between the Gage Aquifer and the underlying Lynwood Aquifer (CDWR, 1989). This unnamed aquitard has been designated the Gage-Lynwood Aquitard for the purpose of this report. The Gage Aquifer merges with the underlying Lynwood and Silverado Aquifers west of the Montrose Site (Figure 1.20). E&E reported that the Gage-Lynwood Aquitard was not encountered

between the Gage and Lynwood Aquifers during drilling of EPA monitoring well DA-2A, located approximately 1-1/2 miles southwest of the Property (E&E, 1989a) (Figure 1.21).

The Lynwood Aquifer occurs throughout most of the West Coast Basin and is confined except where it merges with the overlying Gage Aquifer (Figure 1.20). The Lynwood Aquifer is reported to be primarily composed of gravel and sands with minor amounts of silt and clay and has moderate yields. This lithology is consistent with the lithology encountered during the installation of monitoring wells and exploratory borings at the Montrose Site. Some water supply wells are perforated in the Lynwood Aquifer, but few actually produce water solely from the Lynwood Aquifer (CDWR, 1961). Based on the driller's log for Los Angeles County Flood Control District (LACFCD) well No. 795, located on Jones Chemical property approximately 50 feet south of the Montrose Property, the thickness of the Lynwood Aquifer in the vicinity of the Property is about 35 feet (H+A, 1995). Most water supply wells screened in the Lynwood Aquifer are also screened in the underlying Silverado Aquifer.

The Silverado Aquifer is laterally continuous throughout the basin (Figure 1.20). The Silverado Aquifer merges with the Lynwood Aquifer along the coast from Ballona Gap to Redondo Beach for 2 to 3 miles inland. The Silverado Aquifer also merges with the Lynwood Aquifer along the Newport-Inglewood Uplift and along the Palos Verdes Hills.

An unnamed aquitard separates the Lynwood Aquifer and the underlying Silverado Aquifer beneath and east of the Property (Figure 1.20). This aquitard has been designated the Lynwood-Silverado Aquitard for the purpose of this report. Based on the driller's log of LACFCD well No. 795, the Lynwood-Silverado Aquitard is about 205 feet thick in the vicinity of the Property (H+A, 1996C-a).

The underlying Silverado Aquifer consists of fine- to coarse-grained blue-gray sands and gravels with discontinuous layers of silt and clay (Figure 1.20). These deposits reportedly attain a maximum thickness of about 500 feet. LACFCD well No. 795 was drilled to a total depth of 727 feet bls and encountered more than 220 feet of the Silverado Aquifer adjacent to the Montrose Site (H+A, 1996C-a). Wells completed in the Silverado Aquifer have high yields, and for this reason the Silverado Aquifer is the major source of groundwater in the West Coast Basin (CDWR, 1961).

1.5.6.2 Groundwater Occurrence

The Newport-Inglewood Uplift is a partial barrier to groundwater flow from the Central Basin to the West Coast Basin (CDWR, 1961) (Figures 1.17 and 1.18). In general, folding and faulting can produce changes in lithology and permeability that inhibit groundwater flow. Groundwater flow across the Newport-Inglewood Uplift is also controlled by the difference in water levels between the Central Basin and the West Coast Basin. These water levels are artificially influenced by extractions, outflow, and replenishment in both basins. However, natural replenishment in the West Coast Basin is minor compared to artificial replenishment from injection barrier projects (CDWR, 1989).

West Coast Basin groundwater resources were developed in the early 1900s due to the absence of adequate surface water supplies (CDWR, 1989). During the 1920s, the demand for water was greater than the natural replenishment, and groundwater levels began to drop. By 1932, groundwater levels had dropped below sea level and coastal wells had become saline due to the resultant seawater intrusion. The seawater front advanced

landward and many wells were abandoned. In 1945, the California Water Service Company, the City of Torrance, and the Palos Verdes Water Company filed a complaint against the City of Compton and others in Los Angeles County Superior Court to establish adjudication of water rights in the basin. In 1953, the Los Angeles County Flood Control District (LACFCD) installed the saltwater intrusion barrier along the Santa Monica Bay to prevent seawater intrusion into groundwater production wells in the West Coast Basin. In 1971, the LACFCD installed the Dominguez Gap Barrier along San Pedro Bay to prevent seawater intrusion into West Coast Basin water wells (Figure 1.21).

Most of the actual recharge to the West Coast Basin aquifers occurs at the West Coast Barrier Project and the Dominguez Gap Barrier Project (Figure 1.21). Fresh water is injected into a line of injection wells that parallel the coastline. The injected water forms a freshwater pressure ridge that acts as a barrier to protect basin groundwater from saltwater intrusion. A slight seaward flow of groundwater is maintained between the barrier and the ocean that prevents intrusion of seawater (CDWR, 1989). The majority of the injected water flows from the barrier toward the interior of the basin.

The regional direction of groundwater flow within the West Coast Basin is controlled by the injection barriers and pumping centers. The predominant flow direction in the Silverado (deep) Aquifer is to the east from the West Coast Basin Barrier Project to pumping centers located in Gardena, Torrance, Wilmington, and Carson (Figure 1.21). The Torrance pumping center is located upgradient (to the west) of the Montrose Property. The direction of groundwater flow at and in the vicinity of the Montrose Property in the Lynwood Aquifer is predominantly to the southeast toward the Wilmington/Carson pumping centers. At the south end of the basin, groundwater flows northward from the injection barrier to the pumping centers at Wilmington and Carson.

The control of groundwater extractions in the West Coast Basin beginning in 1955 resulted in stabilization and minor continued recovery of the water levels in the Silverado Aquifer (Bookman-Edmonston Engineering, Inc., 1989a) (Figure 1.22). Some slight year-to-year variations in water levels in the West Coast Basin continue to occur as a result of changes in pumping patterns. Water level elevations at the injection barriers typically range from 5 feet to 10 feet mean sea level (msl). Water level elevations decrease inland, reaching elevations of -50 feet msl to -70 feet msl in the vicinity of pumping centers (Bookman-Edmonston Engineering, Inc., 1989a).

The majority of the groundwater pumped from the West Coast Basin is extracted from the deeper aquifers. The pressure in these aquifers tends to be lower than in the overlying aquifers, due to pumping. Recent water level measurements indicated an approximate 30-foot head difference between water levels measured in LACFCD Well No. 795, perforated in the Silverado Aquifer and nearby Gage Aquifer monitoring wells, which indicates a steep downward vertical gradient between the Gage and Silverado Aquifers adjacent to the Property (H+A, 1990R-c).

1.5.6.3 Water Supply Wells

Sixty public, industrial, domestic, and irrigation water supply wells were identified within an approximate 2-mile radius of the Property (Table 1.5; Figure 1.23) (H+A, 1990R-f). Eight wells are classified for public water supply, 18 wells are classified for industrial water supply, 9 wells are classified for domestic water supply, 15 wells are classified for irrigation

water supply, and 3 wells are classified for domestic/irrigation water supply. Seven additional wells of unknown use have also been identified. The majority of the water supply wells are located upgradient and to the north of the Property.

Four major water service agencies surround the City of Torrance. These agencies include: the City of Torrance Municipal Water Department, the Southern California Water Company, the Dominguez Water Corporation, and the City of Los Angeles Department of Water and Power. In the vicinity of the Property, public supply wells are operated by the Torrance Municipal Water Department, the Dominguez Water Corporation, and the Southern California Water Company (Table 1.5; Figure 1.23).

The Torrance Municipal Water Department supplies water to over 70 percent of the city's developed areas, including the greatest portion of the industrial sector. Water sources for the Torrance Municipal Water Department include approximately 80 percent from the Colorado and State Water Project, and approximately 20 percent from groundwater. Approximately 25,000 customers are served via the Torrance Municipal Water Department. Three of the extraction wells owned by the City of Torrance are located in the vicinity of the Montrose property. The newest City of Torrance well, Well No. 7, was reportedly constructed in 1996 approximately 1-3/4 miles south-southwest of the Property (McLaren/Hart and Dames & Moore, 1997) (Figure 1.23).

The Dominguez Water Corporation, a private purveyor, obtains 75 percent of its water source from well water and 25 percent from the Metropolitan Water District. Approximately 6,500 customers are served by the Dominguez Water Corporation. Two of the Dominguez Water extraction wells are located in the vicinity of the Montrose Site. The other private purveyor, California Water Service Company, acquires 85 percent of its water supply from the Metropolitan Water District and 15 percent from well water. This water supplier serves approximately 2,000 customers (H+A, 1989).

The LADPW plots actively monitored wells and inactive wells on Thomas Brothers Guide maps for use by the public. Actively monitored wells are those wells that the LADPW actively monitors as part of a basinwide monitoring program (Table 1.5). This program includes wells that are periodically checked for water levels and wells that are periodically sampled for water quality analysis.

Four wells within about a 2-mile radius of the Property are regularly monitored for water quality (Figure 1.23). Well 794C, located approximately 3,000 feet north of the Property, is the only actively monitored well identified within a 1-mile radius of the Property. Wells 763J, 792, and 813N, located within about 1.3 to 2.2 miles northeast, north, and northwest of the Property, are the only other actively monitored wells within about a 2-mile radius of the Property. Inactive wells are on record but are not actively monitored by LADPW.

Inactive well 795, located approximately 50 feet south of the Montrose Property on Jones Chemical property, was destroyed in 1995 (H+A, 1996C-a) (Figure 1.23).

1.5.6.4 Water Quality

The West Basin Water Association conducts monitoring programs for water supplied for domestic use to meet the requirements of the California Department of Health Services (CDHS). The CDHS requirements are set forth in Title 22 of the California Administrative Code and Assembly Bill 1803 (Bookman-Edmonston Engineering, Inc., 1989b). Title 22

requires monitoring for general minerals, trace organic compounds, physical properties, and radioactivity in groundwater supplies. Assembly Bill 1803 requires monitoring of trace organic compounds in groundwater supplies.

LADPW, formerly LACFCD, and CDWR are responsible for monitoring water levels and groundwater quality in the West Coast Basin. Groundwater samples are collected annually from selected extraction wells and are routinely analyzed for total dissolved solids (TDS), general minerals, and physical properties. Results of the groundwater monitoring program are presented in the Central and West Basin Water Replenishment District's annual reports (Bookman-Edmonston Engineering, Inc., 1988 and 1989a).

Four active wells located within approximately 1 to 2 miles upgradient from the Montrose Property are routinely monitored for general water quality. These wells include LADPW wells 763J, 792, 794C, and 813N (Figure 1.23). Perforated intervals for these wells range from 130 to 450 feet bls to 550 to 650 feet bls. Information regarding actively monitored wells in the vicinity of the Property has been compiled and reported (H+A, 1990R-f).

Results of the groundwater monitoring program for the West Coast Basin water supply indicate good water quality in the major aquifers (Bookman-Edmonston Engineering, Inc., 1988). The TDS of groundwater monitored basinwide is variable and ranges from approximately 700 milligrams per liter (mg/L) in the southern portion to 200 mg/L in the southeastern portion of the basin. The general TDS of groundwater from the Lynwood and Silverado Aquifers in the vicinity of the Montrose Property ranges from approximately 300 mg/L to 400 mg/L (Bookman-Edmonston Engineering, Inc., 1988).

To comply with DHS Assembly Bill (AB) 1803, selected wells in the West Coast Basin were sampled for trace organic compounds (Bookman-Edmonston Engineering, Inc., 1989b). Eleven public water supply wells were selected for sampling basinwide based on recommendations made by a group of interested water supply members of the West Coast Basin Water Association. Water purveyors in the vicinity of the Montrose Property that participated in the basinwide sampling included the Dominguez Water Corporation, the City of Torrance, and the Southern California Water Company (H+A, 1990R-f). The wells sampled to comply with AB 1803 are shown in Figure 1.23.

Eight public water supply wells are located within approximately 2 miles of the Montrose Property (Table 1.5; Figure 1.23). Four of these eight wells were sampled during the AB 1803 investigation in 1984. These four public supply wells were the Dominguez Water Corporation Well No. 19, also referred to as LADPW Well No. 836A; Dominguez Water Corporation Well No. 33, also referred to as CDWR Well 4S/14W-10D4; Southern California Water Company Well Dalton No. 1, also referred to as LADPW Well No. 392W; and City of Torrance Well No. 6, also referred to as LADPW Well No. 762JJ. These wells were selected due to their proximity to industrial areas and/or hazardous materials facilities (H+A, 1990R-f). City of Torrance Well Nos. 4 and 5, located within 2 miles southwest of the Property and also referred to as LADPW Wells 766A and 766B, were not sampled because of their proximity to Dominguez Water Corporation Well No. 33 (CDWR Well 4S/14W-10D4). Groundwater samples collected in 1984 from these and other extraction wells located within the West Coast Basin did not contain detectable quantities of trace organic constituents (Bookman-Edmonston Engineering, Inc., 1989b).

Analytical results for samples collected from one of the four public water supply wells located approximately 2 miles northwest of the Montrose Property were obtained (H+A,

1990R-f). Samples were collected from City of Torrance Well No. 6 (LADPW Well 762JJ) on December 11, 1984 (Figure 1.23). Samples were analyzed for trace organic compounds including volatile organic compounds (VOCs), base neutral/acid organic compounds, and pesticides by J.M. Montgomery Laboratory. Trace organic compounds were not detected.

1.5.7 Ecology

The ecology of the Montrose Site was characterized based on available literature. Ecologically sensitive areas and wildlife habitats were identified from published reports obtained from government agencies and from independent environmental impact reports (City of Los Angeles/EPA, 1977; U.S. Fish and Wildlife Service, 1981 and 1989; M&E, 1985).

The present ecology of the Montrose Site and surrounding urban area has been largely determined by human activities. Most of this area has been devoid of native vegetation and wildlife habitat for decades. One remaining relict community of native vegetation has been identified at the Harbor Lake Regional Park, which supports a rare freshwater marsh community. In addition, 45 urban parks were identified within a 5-mile radius of the Property. These parks provide limited habitat for some species.

The transition of the environment from its natural state to an urbanized state has impacted wildlife species. As a result of habitat degradation, species diversity has been reduced to include only those species adaptable to urban environments. Consequently, birds, insects, rodents, and other development-tolerant small mammals are the dominant forms of wildlife within a 5-mile radius of the Montrose Site.

Four primary habitat types are located within a 5-mile radius of the Montrose Site: marine, estuarine/marine, freshwater marsh, and urban-terrestrial. The marine environment is represented in the Consolidated Slip. The Consolidated Slip is located at the mouth of the Dominguez Channel, approximately 5 miles downstream from the confluence of the Torrance Lateral with the Dominguez Channel. The area surrounding the Consolidated Slip is heavily industrialized. Industrial activities in the area have caused habitat degradation in the Consolidated Slip. Fishing and swimming are prohibited. In spite of the degradation, species expected to exist in this area include algae, plankton, fish, shrimp, crab, mollusks, barnacles, anemones, sea urchins, and benthic biota.

The estuarine/marine habitat occurs along the Dominguez Channel and in the area near the confluence of the Torrance Lateral. The freshwater marsh habitat is represented in Harbor Lake Regional Park. This park is located approximately 3 miles south of the Property.

The urban-terrestrial habitat comprises the balance of the evaluated area surrounding the Property. Most terrestrial habitat in the evaluated area has been impacted by urbanization, resulting in a very limited natural community. Terrestrial species in this area include birds, insects, semi-aquatic species such as frogs and toads, and small mammals.

Four bird species with federal-protected status range within a 5-mile radius of the Property: the California Least Tern, the California Brown Pelican, the Bald Eagle, and the Peregrine Falcon. The results of three field surveys conducted by EPA in February 1992, May 1992, and April 1994 were used to determine which migratory bird species or special-status wildlife species occurred in the vicinity of the Montrose Site (CH2M HILL, 1992 and 1995). These data were supplemented by data obtained in the Wildlife Habitats Relationships

database and the California Natural Diversity database maintained by the California Department of Fish and Game.

About 39 bird species, including cormorants, herons, egrets, grebes, coots, mallards, mergansers, scaup, sandpipers, and gulls, were identified in the vicinity of the Montrose Site. These species are protected under the Migratory Bird Treaty Act.

Other information regarding the ecology in potentially affected areas such as the Dominguez Channel and Consolidated Slip has been summarized by EPA in an Ecological Risk Assessment and field investigation reports prepared by CH2M HILL (CH2M HILL, 1992 and 1995). Ongoing ecological risk assessment activities in the Montrose Site vicinity are being conducted by EPA.

1.6 Pre-RI Investigations

This section provides an overview of site investigation activities conducted at the Montrose Site prior to the RI which commenced in 1985. Section 2.0 provides details on each of the investigations. Pre-RI activities were conducted during the period 1982 to 1985.

An EPA investigation in November 1982 detected DDT in surface water runoff and sediment Off-Property. As a result, Montrose was issued enforcement orders by EPA and the California RWQCB that required plans for remedial action. In 1983, Montrose submitted a proposal for remedial action at the Property in response to EPA's Comprehensive Environmental Response Compensation and Liability Act (CERCLA) Section 106 Order/Resources Conservation and Recovery Act (RCRA) Section 3013; Administrative Order, EPA Region IX, Docket Number 83-01 (May 6, 1983). In 1983, Montrose constructed a temporary earthen berm to contain stormwater and prevent surface water drainage Off-Property. A flow chart has been prepared to summarize the sequence of remedial investigation activities conducted since 1983 (Figure 1.24).

1.6.1 Pre-grading Soil and Surface Water Sampling, 1981 and 1983

In February 1981, DHS collected seven surface water samples in the ditch that runs between Jones Chemical and Montrose and the Normandie Avenue Ditch. The samples in the Normandie Avenue Ditch were collected from a small pond that had formed from surface water runoff.

In May 1981, Montrose collected 37 soil samples at 10 locations in the Jones Ditch and Normandie Avenue Ditch. Samples were collected from 5 depths; surface soil, 0.5 foot, 1.0 foot, 1.5 feet, and 2.0 feet. Each sample was divided into three splits, one analyzed by the Department of Health Services, one analyzed by Smith-Emery laboratory for both Jones Chemical and Montrose, and one analyzed internally by Stauffer Chemical. Samples were analyzed for DDT, chlorobenzene, pH, alkalinity, and PCBs.

In August 1981, Montrose collected 14 samples for DDT analyses, On-Property, and on the property perimeter. Four of the samples (8-81-10, -11, -13, and -14) were collected in "areas of high exposure" (Montrose, 1981c).

Records indicated that in October 1981, Montrose collected seven soil samples for DDT analyses from locations on all four sides of the Property. Four samples were collected east of Normandie Avenue (in flower beds), one sample was collected north in the area between

Montrose and McDonnell Douglas, and one sample was collected west and south of the plant (Montrose, 1981e). The results of these samples could not be located.

In November 1981, Montrose collected two surface water samples and three soil samples for DDT and chlorobenzene analysis in the southwest portion of the Property and in the Normandie Avenue Ditch.

In June 1983, Montrose drilled and sampled 19 shallow soil borings On-Property both within and outside of the Central Process Area. Montrose also drilled and sampled 5 shallow soil borings immediately south of the Property to characterize concentrations of chemical compounds in Off-Property shallow soil along the LADWP right-of-way and the Normandie Avenue Ditch. Soil samples were collected and analyzed for total DDT and its metabolites dichlorodiphenyldichloroethane (DDD) and dichlorodiphenyldichloroethylene (DDE) and their isomers. In August 1983, 6 On-Property and 3 Off-Property soil borings were deepened, and additional soil samples were collected from these and 12 additional On-Property soil borings and 4 Off-Property borings. Samples were analyzed for total DDT and the metabolites DDD and DDE and their isomers. All work conducted by Montrose in 1983 was conducted in response to EPA's May 6, 1983, CERCLA Section 106 Order to Montrose.

Other On-Property soil sampling was conducted in July 1983 (Stauffer, 1983). Five On-Property areas were sampled and analyzed for DDT and related compounds. A total of 48 soil samples were collected from 5 sampling areas located in the northwest corner of the Property; along the northern and southern Property boundaries; from excavated soil from the recycle pond area; and from a debris pile in the southeast area of the Property.

EPA proposed the Montrose Site for inclusion on the Superfund NPL in 1984.

1.6.2 Grading and Capping, 1985

In early 1985, shallow soil on the Property was redistributed when the majority of the On-Property area was graded and capped with asphalt. The asphalt cover was constructed to prevent the potential for air and surface water transport of soil and to minimize infiltration of surface water. In addition, a concrete curb was constructed around the Property perimeter to minimize the potential for upgradient drainage entering the Property.

1.6.3 Soil and Groundwater Sampling, 1985

A soil and groundwater investigation was conducted by Montrose in April and May 1985, prior to EPA direction. In April and May 1985, On-Property soil sampling, monitoring well construction, and groundwater sampling activities were performed at the request of Montrose (H+A, 1985R-b) (Figure 1.24). Soil samples were collected from a deep soil boring located within the Central Process Area in the center of the former water recycling pond. Soil samples were also collected from 5 monitoring well borings drilled On-Property inside and outside of the Central Process Area. Soil samples collected during this investigation were analyzed for total DDT, the metabolites DDD and DDE and their isomers, VOCs, and chloral.

Five monitoring wells were constructed On-Property in the Upper Bellflower Aquitard and screened at the water table. Monitoring wells MW-1 through MW-5 were constructed to evaluate geologic conditions, determine directions of groundwater flow, and to determine if

chemical compounds related to the activities at the former DDT-manufacturing plant were present in groundwater beneath the Property. Groundwater samples collected from these monitoring wells were analyzed for the same analytes as the soil samples, as well as for common ions and base neutral/acid organic compounds.

In April 1985, EPA subcontractor M&E conducted a preliminary field investigation that included soil and groundwater sample collection.

1.7 History of Remedial Investigations

The following sections provide an overview of the parts and phases of RI activities conducted at the Montrose Site since 1985. Beginning in June 1985, RI work was performed under the direction of EPA. In October 1985, Montrose began conducting the remainder of the RI under the terms of the Consent Order. Part 2 of the RI consisted of soil, groundwater, sediment, and surface water sampling both On- and Off-Property conducted during the period 1985 to 1990. In 1986, EPA conducted a separate investigation of neighborhood and background soil using its subcontractor E&E. Upon completion of Part 2 of the RI, the Additional Groundwater Assessment was conducted during the period from May through November 1991 and included monitoring well installation and groundwater and soil sampling (Figure 1.24). Sampling was conducted by Montrose unless otherwise specified. The following description outlines the chronology of RI work conducted during the period from 1985 to 1995. Specific information regarding RI activities conducted for each environmental media of potential concern is subsequently provided in Section 2.

1.7.1 Part 1 Remedial Investigation

In June 1985, EPA began the RI using EPA subcontractor M&E. Part 1 of the RI consisted of On-Property soil and groundwater sampling. M&E collected additional On-Property soil samples from soil borings located in a square grid approximately 200 feet between sampling points throughout the Property. Seven background soil samples were also collected from two soil borings drilled Off-Property by EPA subcontractor M&E in June 1985. These background soil borings were located approximately 1 mile west and 1.7 miles north of the Property. Soil samples were analyzed for pesticides, VOCs, base neutral/acid organic compounds, and trace metals. Results of background soil samples were compared with results of samples collected from the On-Property soil borings drilled in June 1985.

In August 1985, M&E collected groundwater samples from the five existing On-Property monitoring wells constructed by Montrose in 1985. M&E also collected groundwater samples from an industrial well located on the McDonnell Douglas property situated north of the Property and from an LACFCD well located south of the Property.

In March 1986, M&E reported its findings from the 1985 study (M&E, 1986). The report included recommendations for collection of additional field data and a list of organic compounds recommended for analysis during future RI sampling. These compounds were designated as target chemicals.

1.7.1.1 Target Chemicals

Target chemicals identified by EPA's contractor M&E were all isomers of DDT, all isomers of the DDT metabolite DDD, all isomers of the DDT metabolite DDE, all isomers of BHC,

chlorobenzene, all isomers of dichlorobenzene (DCB), benzene, chloroform, and acetone. DDT and chlorobenzene were selected as target chemicals because of their presence in soil and groundwater On-Property and their known relationship to Montrose's manufacturing processes. The remaining target chemicals were selected because they were reported in analytical results for samples collected.

Soil, groundwater, sediment, and surface water samples collected throughout the remainder of the RI sampling were analyzed for target chemicals at a minimum. Target chemical pesticides were analyzed using EPA Methods 608/8080. Target chemical VOCs were analyzed using EPA Methods 624/8240.

1.7.2 Part 2 Remedial Investigation

Part 2 of the RI consisted of soil, groundwater, sediment, and surface water sampling both On- and Off-Property conducted during the period from 1985 to April 1990 (Figure 1.24). Part 2 activities comprised three distinct phases of work designated as Phase 1, Phase 2A, and Phase 2B. Tasks for Part 2 Phase 1 of the RI are specified in Appendix A of the original Consent Order signed in October 1985. Sampling Plans and Quality Assurance Project Plans (QAPPs) for Phase 1 were prepared by Montrose and approved by EPA (H+A, 1986R-a, 1986R-b, 1986R-f, and 1986R-g).

In October 1987, Montrose and EPA agreed to modify and expand the technical tasks described in Appendix A of the Consent Order. These expanded Part 2 Phase 2A RI tasks are specified in the First Amendment to the Consent Order. A Sampling Plan and a Quality Assurance Project Plan (QAPP) to address Part 2 Phase 2A RI tasks were prepared by Montrose and approved by EPA (H+A, 1988R-d and 1988R-e). Subsequent revisions to the Sampling Plan and the QAPP are documented in correspondence (EPA, 1988C-b; H+A, 1988C-b).

Part 2 Phase 2B of the RI was initiated following EPA's review of Phase 2A results (Figure 1.24). Tasks to conduct Part 2 Phase 2B of the RI are specified in Appendix C of the Second Amendment to the Consent Order, signed in July 1989. Locations and methods for soil and groundwater sampling for Phase 2B activities were approved by EPA through meetings and correspondence between Montrose and EPA (H+A, 1989C-c, 1989C-d, 1989C-e, and 1989C-i; EPA, 1989C-a, 1989C-b, 1989C-c, and 1989C-d). Changes in the scope and frequency of groundwater sampling were discussed in correspondence between Montrose and EPA, and approved by EPA in 1989 and 1990 (H+A, 1989C-f, 1989C-g, and 1990C-a; EPA, 1989C-g and 1990C-a).

In October 1990, EPA requested a proposal from Montrose to install additional groundwater monitoring wells pursuant to Section IV.K. (Additional Investigation and Evaluation Work) of the Consent Order (EPA, 1990C-c). A proposal specifying tasks to conduct the Additional Groundwater Assessment of the RI was prepared by Montrose and approved by EPA (H+A, 1990C-k and 1991C-f; EPA, 1990C-h and 1991C-b). Subsequent revisions to the Additional Groundwater Assessment tasks were approved by EPA through meetings and correspondence between Montrose and EPA (H+A, 1991C-i and 1991C-l).

1.7.2.1 Phase 1

Part 2 Phase 1 of the RI consisted of soil and groundwater sampling On-Property, and soil, sediment, and surface water sampling Off-Property. The Off-Property investigation was conducted in two separate events designated as Round 1 and Round 2 (Figure 1.24).

Part 2 Phase 1 On-Property sampling was conducted during the period from September 1986 to January 1987 (Figure 1.24). The On-Property work consisted of soil sampling in the vicinity of the Central Process Area and monitoring well construction in the Bellflower Sand and the underlying Gage Aquifer. The Bellflower Sand is one of three subunits of the Bellflower Aquitard. Groundwater samples collected from monitoring wells constructed during Part 2 Phase 1 of the RI were analyzed for common ions, pesticides, and VOCs.

Round 1 of the Part 2 Phase 1 Off-Property activities was conducted in April and May 1986. Fifty-nine soil borings were constructed adjacent to the Property, both around the Property perimeter and to the south and southeast of the Property in the LADWP right-of-way and the Normandie Avenue Ditch. Soil samples were analyzed for pesticides and VOCs.

Background soil samples were collected from two soil sample locations by Montrose in 1986. These background soil sample locations were approximately 2.4 miles west of the Property and approximately 2 miles southwest of the Property. Background soil samples were analyzed for pesticides. Results of background soil samples were compared to results of the samples collected from soil borings drilled along the Property perimeter, in the Normandie Avenue Ditch, and in the SPRR right-of-way.

Round 2 of the Part 2 Phase 1 activities was conducted during the period May 1986 to March 1987. Fifty-two neighborhood soil samples were collected from 32 locations near the Property and analyzed for pesticides. The objective of this soil sampling was to determine if DDT and its metabolites DDE and DDD had been transported from the Property via airborne releases and to determine the presence of pesticides in surficial soil near the Property (E&E, 1986; H+A, 1986R-d). Soil samples were collected from business and residential locations within the northeast, southeast, and southwest quadrants surrounding the Property in 1986 by EPA subcontractor E&E under contract to the EPA.

Five background soil samples were collected approximately 3 to 5 miles west and southwest of the Property. These samples were analyzed for pesticides. Analytical results of background soil samples were compared to the analytical results of the soil samples collected within a 1-mile radius of the Property. Analytical results of these soil samples were reported in 1986 (E&E, 1986; H+A, 1986R-d).

Round 2 also included sediment and surface water sampling. Sediment samples collected from drainages located downstream from the Property were analyzed for pesticides and VOCs. Surface water samples collected from drainages located downstream from the Property during dry weather and during five rainfall events were analyzed for pesticides and VOCs.

In 1986, four Bellflower Sand and four Gage Aquifer monitoring wells were constructed On-Property outside the Central Process Area. The objectives of monitoring well construction were to determine the depth, thickness, and lateral continuity of the hydrogeologic units and to further define the direction of groundwater flow and chemical quality of groundwater. Prior to monitoring well construction, two On-Property

exploratory borings were drilled to obtain lithologic data and determine appropriate screened intervals for On-Property monitoring wells.

1.7.2.2 Phase 2A

Part 2 Phase 2A of the RI consisted of soil, groundwater, and sediment sampling both On- and Off-Property. Phase 2A was conducted during the period from August 1988 to May 1989 (Figure 1.24). Thirteen soil borings were drilled On-Property in the Central Process Area. Soil samples collected from these soil borings were analyzed for pesticides and VOCs.

Results of Part 2 Phase 1, Round 1 soil sampling indicated that additional sampling was necessary to further define the nature and extent of pesticides in the LADWP right-of-way, Farmer Brothers property, and Normandie Avenue Ditch. Additional soil borings were drilled, and soil samples were collected Off-Property in 1988 as part of the Part 2 Phase 2A remedial investigation activities. The objective of Off-Property soil sampling was to further determine the horizontal and vertical distribution of pesticides and VOCs beneath the Normandie Avenue Ditch and to further determine the horizontal and vertical distribution of pesticides along the SPRR right-of-way, the LADWP right-of-way, and a historical drainage located on the north portion of the Farmer Brothers property. All soil samples collected during Phase 2A activities were analyzed for pesticides.

Twenty additional monitoring wells were installed both On- and Off-Property during Part 2 Phase 2A activities. Ten Upper Bellflower Aquitard, 5 Bellflower Sand, and 5 Gage Aquifer monitoring wells were installed in 1988 and 1989. The objectives of monitoring well construction were to determine the depth, thickness, and lateral continuity of the three hydrogeologic units and to further define the direction of groundwater flow and chemical quality of groundwater at the Montrose Site. Prior to monitoring well construction, exploratory borings were drilled at selected locations to obtain lithologic data and determine appropriate screened intervals for associated monitoring wells. Groundwater samples collected from monitoring wells constructed during Part 2 Phase 2A activities were analyzed for common ions, pesticides, and VOCs.

Phase 2A included a sediment survey and sediment sampling in the Dominguez Channel. Sediment thickness was surveyed in the Dominguez Channel to identify sediment distribution and optimal sample locations. Sediment samples, collected based on the sediment distribution, were analyzed for pesticides.

In 1988, soil samples were collected On-Property in the Central Process Area from soil borings at five locations to further determine horizontal and vertical distribution of chemical compounds in soil in the vicinity of the former water recycling pond. Total depths of these soil borings ranged from 18 feet bls to 136 feet bls. Soil samples were analyzed for pesticides and VOCs.

1.7.2.3 Phase 2B

In 1989, based on results of the Phase 2A investigation, EPA requested that Montrose prepare a proposal for additional characterization of the extent of groundwater contamination downgradient from the Property. In response, Montrose proposed the construction of a series of additional Off-Property monitoring wells.

Part 2 Phase 2B of the RI consisted of constructing and sampling 27 additional Off-Property monitoring wells. Eleven Upper Bellflower Aquitard, eight Bellflower Sand, five Gage Aquifer, and three Lynwood Aquifer monitoring wells were installed during the period from July 1989 to April 1990.

Monitoring wells installed during Phase 2B were constructed in two arcs approximately 1,500 feet and 4,000 feet from the Property, respectively. Monitoring wells along the 1,500-foot arc were located north, northeast, east, and southeast of the Property. Monitoring wells along the 4,000-foot arc were located southeast of the Property. The objectives of monitoring well construction were to determine the depth, thickness, and lateral continuity of the identified hydrogeologic units and to further define the direction of groundwater flow and chemical quality of groundwater at and downgradient of the Montrose Site. Prior to monitoring well construction, six exploratory borings were drilled to determine lithology and appropriate screened intervals for monitoring wells. Groundwater samples collected from these wells were analyzed for common ions, pesticides, and VOCs. Phase 2B also included aquifer testing conducted at 24 monitoring wells.

1.7.3 Additional Groundwater Assessment

In October 1990, based on results of the Part 2 Phase 2B RI investigation activities, EPA requested that Montrose conduct additional activities to characterize the extent of groundwater containing chlorobenzene at, in the vicinity of, and downgradient from the Property. In response, Montrose proposed and EPA approved the construction of another series of monitoring wells located both On- and Off-Property (Figure 1.17). This next phase of RI activity was termed the Additional Groundwater Assessment.

The Additional Groundwater Assessment consisted of constructing and sampling monitoring wells Off-Property in the Upper Bellflower Aquitard, the Bellflower Sand, the Gage Aquifer, and the Lynwood Aquifer, and On-Property in the Lynwood Aquifer. The Additional Groundwater Assessment was conducted during the period from May through November 1991 (Figure 1.17).

Monitoring well locations for the Additional Groundwater Assessment were selected to provide sufficient data to define the extent of groundwater containing chlorobenzene concentrations greater than the then applicable maximum contaminant level (MCL) for drinking water of 30 micrograms per liter (µg/L) in each of the hydrogeologic units monitored at the Montrose Site. The current MCL for chlorobenzene in drinking water is 70 µg/L. Upper Bellflower Aquitard monitoring wells were constructed downgradient and crossgradient from the Property. Bellflower Sand, Gage, and Lynwood Aquifer monitoring wells were constructed upgradient, downgradient, and crossgradient from the Property.

Groundwater samples collected from monitoring wells constructed as part of the Additional Groundwater Assessment were analyzed for pesticides, VOCs, base/neutral acid organics, trace metals, total organic carbon, para-chlorobenzene sulfonic acid (p-CBSA), general minerals, and nitrate.

1.7.4 EPA Sediment and Surface Water Sampling

Because most of the sediment and some of the surface water sample data collected by Montrose in 1986 and 1988 as part of Phase 1 and 2A of the Part 2 Remedial Investigation (see Sections 1.7.2) were rejected as unusable by EPA (due to lack of documentation on the

analytical instrument calibrations), EPA conducted additional surface water and sediment as well as biota sampling in 1994 in the surface water runoff pathway. Sediment samples were collected from the Normandie Avenue Ditch, the Kenwood Drain, the Torrance Lateral, the Dominguez Channel, and the Consolidated Slip. In general, sediment samples were analyzed for pesticides, PCBs, metals, cyanide, TOC, and grain size. Some samples were analyzed for VOCs. Surface water samples were collected from the Kenwood Drain, the Torrance Lateral, the Dominguez Channel, and the Consolidated Slip by EPA in 1994 (CH2M HILL, 1995). In general, surface water samples were analyzed for pesticides, PCBs, metals, cyanide, TDS, and TSS. A limited number of samples were analyzed for VOCs and semivolatiles.

1.7.5 Northwest Corner Investigation

In response to a request by EPA, Montrose conducted an additional investigation in 1997 in the northwest portion of the property to characterize the nature and extent of contamination existing after the grading was conducted in 1985. The investigation included the areas known as the trash ditch, junkyard and salvage area focusing on the areas where very high concentration of DDT (710,000 ppm) were found in 1983 and assessing the extent of contamination offsite in the northwest corner.

Of the 76 samples collected on-property in this investigation, 44 were analyzed for DDT using immunoassay methods, 43 were analyzed for pesticides and polychlorinated biphenyls (PCBs) using contract laboratory program (CLP) methods and 12 were developed for VOCs. An additional 63 samples were collected at 32 borings north and west of the property. All 63 samples were analyzed for DDT by immunoassay methods and 15 were analyzed also for pesticides and PCBs using CLP methods.

1.8 Neighboring Investigations

Several hazardous waste investigations at neighboring property have been used in this RI Report to supplement the data collected by Montrose as a part of this RI. These neighboring investigations include the 1994 Preliminary Endangerment Assessment (PEA) conducted at Jones Chemical Company by Levine-Fricke (Levine Fricke, 1995) and surface soil sampling conducted in 1994 at Farmer Brothers for a building expansion (McLaren/Hart, 1994). These two investigations are briefly summarized below. The data from these investigations are included in figures in Section 5.0, but not included in the database tables in Appendix H.

1.8.1 Jones Chemical PEA—1995

In 1995, a PEA was conducted at Jones Chemical located just south of the Montrose property. The objective of the PEA was to determine whether current or past waste management activities have resulted in the release of hazardous substances. The PEA included a review of the history of operations at Jones Chemical, soil gas sampling, soil sampling, and risk screening. Analytes in soil included pesticides, VOCs, semivolatiles, PCBs, and metals. Seventy-five soil gas samples were collected from 73 locations and over 150 soil samples were collected from 77 locations.

1.8.2 Farmer Brothers Surface Soil Sampling—1994

In 1994, the Farmer Brother began construction of a building expansion on the east side of the property. Because at the proximity to the Montrose Property, EPA requested that soil samples be collected to determine whether hazardous substances are present. At the request of EPA, Montrose authorized McLaren-Hart to collect near surface soil samples in the area slated for development by Farmer Brothers and analyze the samples for DDT and its isomers and BHC. Ten samples were collected on an equal area grid basis over the area scheduled for construction.

1.9 Other Studies Not Specifically Part of This RI Report

EPA has conducted, is conducting, or is considering conducting other investigations at the Montrose Site which are not specifically discussed as part of this RI Report. These investigations include studies of historical aerial dispersion of DDT to areas near the property and more distant from the Property; soil investigation and soil removal actions in the vicinity of the 204th Street neighborhood; soil investigations along the length of the Kenwood Drain and historical Kenwood Ditch; ecological studies and sewer sediment characterization and removal actions conducted in sewers near the Property. Other investigations being conducted by Montrose that are not specifically discussed in this RI report include additional studies to evaluate the chemical and physical properties of DNAPL which occurs On-Property beneath the Central Process Area, and studies to evaluate the occurrence and rate of biodegradation of chemical compounds which occur in groundwater. These investigations will be documented under separate cover.

TABLE 1.1

POPULATION DEMOGRAPHICS

DESCRIPTION	1.0 MILE RADIUS	2.0 MILE RADIUS	REFERENCE
1990 Census Population (actual)	13,178	68,654	National Decision Systems, 1991a
1980 Census Population (actual)	14,754	58,104	National Decision Systems, 1991a
1970 Census Population (actual)	15,026	59,956	National Decision Systems, 1991a
1990 Estimate (based on 1980 actual)	19,022	69,485	National Decision Systems, 1991a
1995 Projection (based on 1980 actual)	21,251	75,550	National Decision Systems, 1991a
Employment and professionals	13,977	54,426	National Decision Systems, 1991b
Executive and professionals	4,153	16,433	National Decision Systems, 1991b
Administration and support	4,222	14,676	National Decision Systems, 1991b
Service personnel	449	2,958	National Decision Systems, 1991b
Trade and labor	5,153	20,359	National Decision Systems, 1991b

Source:

Envirologic Data, Inc., 1993. Final Draft Public Health and Environmental Evaluation, Montrose Site, Torrance, California, Volume I. Prepared for Montrose Chemical Corporation of California by Envirologic Data, A Subsidiary of Groundwater Technology, Inc., April 23, 1993.

TABLE 1.2

SENSITIVE POPULATIONS

FACILITY REFERENCE NUMBER[1]	FACILITY NAME	ADDRESS
1.	Arlington Elementary School	17800 Van Ness Avenue Torrance, CA 90504
2.	Casimir Middle School	17220 Casimir Avenue Torrance, CA 90504
3.	Edison Elementary School	3800 182nd Street Torrance, CA 90504
4.	Magruder Middle School	4100 185th Street Torrance, CA 90504
5.	North High School	3620 West 182nd Street Torrance, CA 90504
6.	Torrance High School	2200 Carson Street Torrance, CA 90501
7.	Gardena Senior High School	1301 West 182nd Street Gardena, CA 90248
8.	St. Philomena Elementary School	21832 South Main Street Carson, CA 90745
9.	Carson Senior High School	22328 South Main Street Carson, CA 90745
10.	Caroldale Elementary School	22424 Caroldale Avenue Carson, CA 90745
11.	Carson Elementary School	161 East Carson Street Carson, CA 90745
12.	Catskill Avenue Elementary School	23536 Catskill Avenue Carson, CA 90745
13.	Eagle Tree Continuation School	22628 South Main Street Carson, CA 90745
14.	White Junior High School	22102 South Figueroa Street Carson, CA 90745
15.	Dolores Elementary School	22526 Dolores Street Carson, CA 90745
16.	Meyler Street School	1123 West 223rd Street Torrance, CA 90502
17.	Van Deene Elementary School	826 West Javelin Street Torrance, CA 90502
18.	Fern Elementary School	1314 Fern Avenue Torrance, CA 90503
19.	Sherry High School	2600 Vine Avenue Torrance, CA 90501
20.	Torrance Elementary School	2125 Lincoln Avenue Torrance, CA 90501

TABLE 1.2 (continued)
SENSITIVE POPULATIONS

FACILITY REFERENCE NUMBER[1]	FACILITY NAME	ADDRESS
21.	Halldale Elementary School	21514 Halldale Avenue Torrance, CA 90501
22.	Ms. Beasley's Children Center	1511 West Torrance Boulevard Torrance, CA 90501
23.	Crenshaw Children's Center	18909 Crenshaw Boulevard Torrance, CA 90504
24.	Dolores Combination Children's Center	22309 Catskill Avenue Carson, CA 90745
25.	Gardena Valley Christian Preschool	1409 West 182nd Gardena, CA 90248
26.	North Torrance Pre-School & Kindergarten	2806 West 182nd Torrance, CA 90504
27.	Harbor UCLA Medical Center	1000 West Torrance Street Torrance, CA 90509
28.	Heritage Convalescent Center of Torrance	21414 South Vermont Avenue Torrance, CA 90502
29.	Harbor Convalescent Hospital	21521 South Vermont Avenue Torrance, CA 90502
30.	Sunnyside Nursing Center	22617 South Vermont Avenue Torrance, CA 90502
31.	Vermont Care Center	22035 South Vermont Avenue Torrance, CA 90502

Source:

Envirologic Data, Inc., 1993. Final Draft Public Health and Environmental Evaluation, Montrose Site, Torrance, California. Prepared for Montrose Chemical Corporation of California by Envirologic Data, A Subsidiary of Groundwater Technology, Inc., April 23, 1993.

(1) See Figure 1.5 for Facility locations.

TABLE 1.3

RAW MATERIALS USED IN DDT MANUFACTURING

Alkyl Aryl Polyether Alcohol (Triton X-155)
Ammonium and Sodium Lignin Sulfonates (Orzan)
Amorphous Silicon Dioxide Hydrated (Hi-Sil 233)
Aromatic Petroleum Derivative (Agrisolv-75)
Aromatic Petroleum Derivative (Toxisol)
Calcium Silicate Synthetic (Micro-Cel E)
Calcium Sulfate Dihydrate (Industrial Ground Gypsum)
Chloral (Trichloroethanol)
Kerosene-De-odorized
Magnesium Silicate Hydrate (Talc)
Malathion (Organo phosphate)
Monochlorobenzene
Oleum - 65 percent (Fuming Sulfuric Acid)
Sodium-N-Methyl-N-Oleoyl Taurate (Igepon T-77)
Sulfonated Lignin (Reax 45A)
Sodium Hydroxide - 50 percent Solution
Xylene-solvent

Source: Montrose, 1990

TABLE 1.4

CLIMATE DATA

YEAR/WEATHER STATION LOCATION	AVERAGE DAILY TEMPERATURE (°F) Maximum	Minimum	AVERAGE WIND SPEED (mph)	WIND DIRECTION	TOTAL PREVAILING PRECIPITATION (inches)
1977/LAX	70.8	56.1	7.3	Northwest	13.68
1977/Civic Center	75.1	56.6	(not stated)	(not stated)	14.97
Normals from 1941-1971/ LAX	69.2	54.1	7.4	Northwest	11.59
Normals from 1941-1970/ Civic Center	74.3	55.3	6.2	West	14.05

TABLE 1.5

WATER SUPPLY WELLS

WELL IDENTIFICATION			OWNER	ELEVATION (feet msl)	DEPTH (feet)	DIAMETER (inches)	PERFORATIONS (feet)	HYDROGEOLOGIC UNIT	DATE DRILLED	USE	ACTIVE STATUS	REMARKS
CDWR	LACDPW	OTHER										
	762C	USGS 3/14-27K3	Mr. Ralph	47	65					DO	A	
3S/14W-32C2	762JJ	Well #6	City of Torrance		810	16	200-786	LW/SIL	1966	PS	A	
3S/14W-34B2	763J		So. California Edison Co.	65	485	12			1929	IN	A	Monitored for water quality
4S/14W-3L2	764A	USGS 4/14-3L2	General Petroleum Corp. (Mobil Oil)	73.4	450	30 (0-24) 16 (24-450)	130-450	GA/SIL	1938	IN	A	
	764B	USGS 4/14-3C3	General Petroleum Corp. (Mobil Oil, 1961)	75	450	16	130-450	GA/SIL	1940	IN	A	
	764C		General Petroleum Corp. (Mobil Oil, 1961)		454	16	124-448	GA/SIL	1942	IN	A	
		T0005	Mobil							IN	UN	
4S/14W-3L7		T0007	Mobil							IN	IA	
4S/14W-3L4		T0008	Mobil							IN	A	
4S/14W-3L8		T0009	Mobil							IN	A	
		T0010	Mobil							IN	A	
4S/14W-10K2	766A	Well #4	City of Torrance		812	16	180-812	LW/SIL	1965	PS	A	
4S/14W-10K3	766B	Well #5	City of Torrance		816	16	210-786	LW/SIL	1966	PS	A	
3S/14W-35M7	773N		Allied Signal		324	12	292-321	LW	1964	IR	A	
4S/14W-10J1	776	Well #2	City of Torrance		823	16-12	170-320 360-520	GA/GAR/SIL	1935	PS	A	
3S/14W-35B3	782B		W. Ogle		400	8			1923	IR/DO	IA	
4S/14W-11G2	785	#1	U.S. Steel		613	14	293-304	LW/SIL	1927	IN	IA	
4S/14W-11F1	785B	#3	Columbia Steel Corp.		600	16	198-200 260-280 305-390	LW/SIL	1935	IN	UN	
4S/14W-11F2	785C	#4	Columbia Steel Corp.		460	24-16	140-450	GA/SIL	1939	IN	UN	
4S/14W-11G3	785D		U.S. Steel	68.1		16	198-218 260-280 305-390	LW/SIL	1935	IN	A	Stand by

NOTE: Refer to page 4 of this table for footnotes

TABLE 1.5 (continued)
WATER SUPPLY WELLS

WELL IDENTIFICATION COWR	LACDPW	OTHER	OWNER	ELEVATION (feet msl)	DEPTH (feet)	DIAMETER (inches)	PERFORATIONS (feet)	HYDROGEOLOGIC UNIT	DATE DRILLED	USE	ACTIVE STATUS	REMARKS
	792	USGS 3/14-26J1	Mrs. E.V. Kuapo	36	231	8			1927	DO	A	Monitored for water quality
3S/14W-25L1	792E		M G. Marcellus			8			1936	IR	UN	
3S/14W-25P4	792W	Dalton #1	Southern California Water Company	22	751	16	544-734	SIL	1948	PS	A	
3S/14W-36P3	793A									UN	IA	
3S/14W-36N1	793J		John Zurkte		80	4				UN	IA	
4S/14W-1F1	794A	Alcoa #3	McDonnell-Douglas Corporation	51	600	14	473-514	SIL	1942	IN	IA	
4S/14W-1F2	794B	Alcoa #2	McDonnell-Douglas Corporation	51	600	14	477-506 525-530 535-540	SIL	1942	IN	A	Formerly Alcoa
4S/14W-1F3	794C	Alcoa #1	McDonnell-Douglas Corporation	51	600	14	427-433 478-516 538-550	SIL	1942	IN	A	Monitored for water quality; formerly Alcoa
4S/14W-1P1	795		Stauffer Chemical Co. (Jones Chemical Co)	46	727	16	486-560 603-650 673-714	SIL	1943	IN	IA	Pump removed 1967 Destroyed 1995
3S/14W-25K6	802T		Mayflower Nursery		120	6	112-120	GA/GAR	1947	IR	A	
3S/14W-36P2	803N									UN	IA	
3S/14W-36P1	804									UN	IA	
3S/14W-36Q2	804A		Joe B. Ramos	46	352	6				IR	IA	
3S/14W-36Q3	804B		M E. Woods		702	12				UN	IA	
4S/14W-24A01	808		L A. United School District	55	563	12	245-258 280-288 338-344 380-388 460-470	LW/SIL	1929	DO	A	Capped 04/19/73
3S/13W-30K1	812D		Olaf and Anna Nolson		200	12			1932	DO	IA	

NOTE: Refer to page 4 of this table for footnotes

TABLE 1.5 (continued)
WATER SUPPLY WELLS

WELL IDENTIFICATION			OWNER	ELEVATION (feet msl)	DEPTH (feet)	DIAMETER (inches)	PERFORATIONS (feet)	HYDROGEOLOGIC UNIT	DATE DRILLED	USE	ACTIVE STATUS	REMARKS
COWB	LACDPW	OTHER										
	812M	USGS 3/13-31C2	Glen Voss	27	650	12			1920	IR	A	Well has air gauge
3S/13W-30Q7	812Z		Morningside Service Garage	30	152	8			1949	IR	A	
3S/13W-31M1	813N		Maxwell Zeigler	35	664	10	550-574 638-644	SIL	1949	DO	A	Monitored for water quality
3S/13W-31K1	813Y		Ben F. Karran	25	35	8			1948	DO	A	
3S/13W-31K2	813Z		Pet Haven Cemetery	25					1959-1960	IR	A	
4S/13W-18P01	818A	USGS 4/13-18H1	C G. Fiesel	43.1	250	8				DO	A	
4S/13W-19B1	818B		General Petroleum		251	12			1922	IN	IA	
3S/13W-30J5	822B		C F. Johnson		156	18	135-142	GA/GAR	1937	IR/DO	IA	
3S/13W-31B7	822FF		Clark and Grace Day	27	384	10	365-370	SIL	1948	IR	A	
3S/13W-30Q1	822F		Emily Cost		80	7			1933	IR/DO	IA	
3S/13W-32E2	823F		Clyde Sheets	25	579	10			1953	IR	A	10 hp pump
	825		Clyde Sheets		698	16	555-562 570-636 640-644 672-676	SIL	1948	IR	UN	
	833D	USGS 3/13-32C1	J. Larrande	35 9	275	8				IR	A	
4S/13W-5L1	834		Del Amo Estate Co.	36.1	720	16	555-562 570-636 640-644 672-676	SIL	1948	IR	A	Recapped 05/03/61
4S/13W-17D1	836A	Well #19	Dominguez Water Corp.	30	1,701	12	504-511 525-560 585-610 635-660	SIL	1918	PS	IA	
4S/14W-10D4		Well #33	Dominguez Water Corp		600	18-12	312-353 462-556	LW/SIL	1969	PS	A	
3S/14W-25K6		K6	Mayflower Nurseries							IR	IA	
3S/14W-25N4										UN	IA	

NOTE: Refer to page 4 of this table for footnotes
SCO/980070001.DOC/1

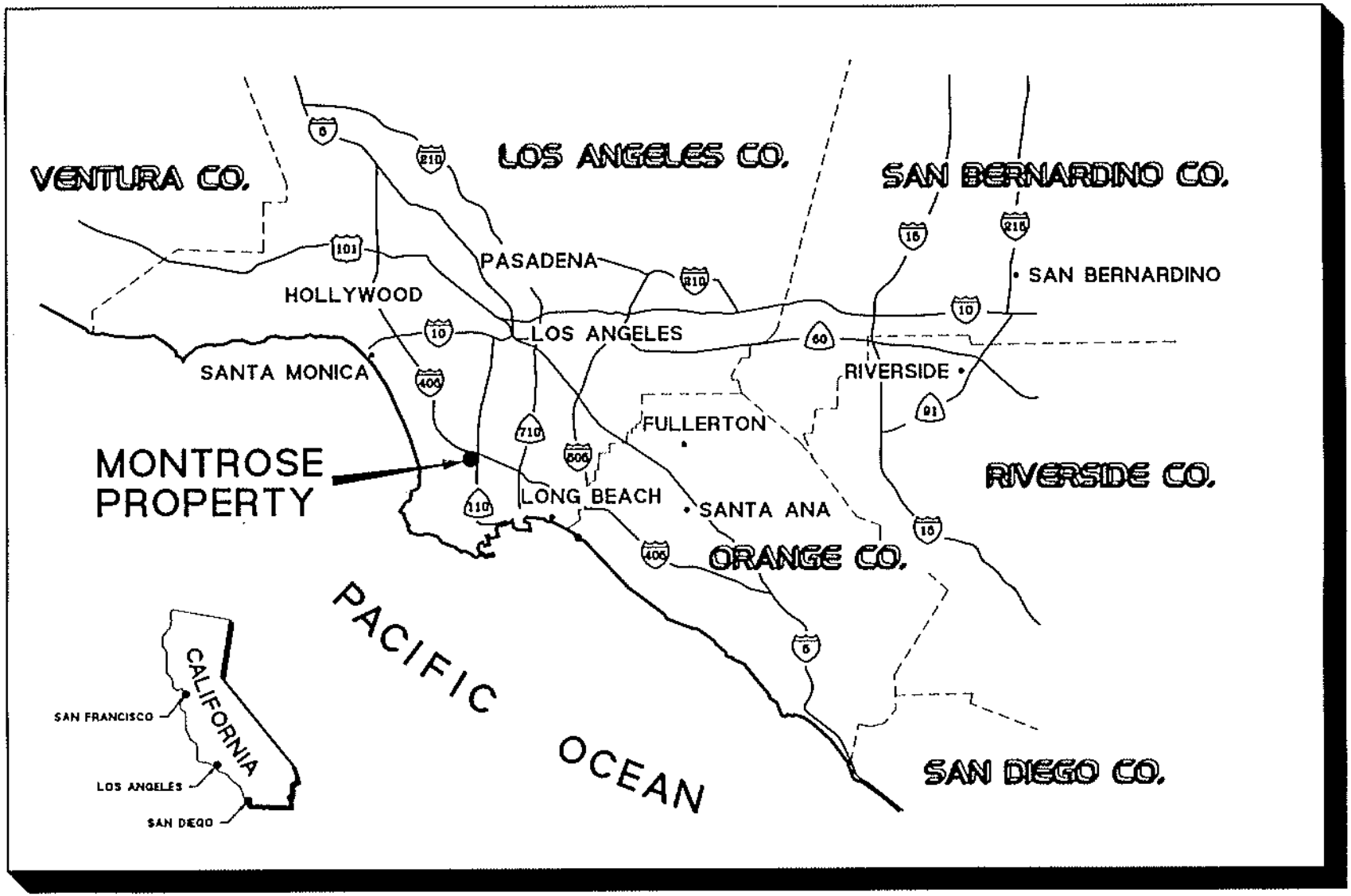
TABLE 1.5 (continued)
WATER SUPPLY WELLS

WELL IDENTIFICATION CDWR	LACDPW	OTHER	OWNER	ELEVATION (feet msl)	DEPTH (feet)	DIAMETER (inches)	PERFORATIONS (feet)	HYDROGEOLOGIC UNIT	DATE DRILLED	USE	ACTIVE STATUS	REMARKS
4S/14W-35P7		P7	The Garrel Corp.							IR	A	
3S/14W-36P4										UN	IA	
3S/14W-36R1		36R1	F. J. Easler	37	254	10				DO	IA	
3S/14W-36R2		36R2	Bennett	36	70					DO	IA	
3S/14W-36K1		36K1	L. H. Figge	42	322					IR	IA	

NOTES: Well locations are shown on Figure 1.23.
Data compiled on this table were supplemented with data obtained in preparation of the Draft Joint Groundwater Feasibility Study for the Montrose and Del Amo sites.

FOOTNOTES

CDWR = State of California, Department of Water Resources
LACDPW = Los Angeles County, Department of Public Works; formerly well identifications were referred to as Los Angeles County Flood Control District (LACFCD)
msl = Mean sea level
USGS = U.S. Geological Survey
DO = Domestic Supply Well
A = Active
LW = Lynwood Aquifer
SIL = Silverado Aquifer
PS = Public Supply Well
IN = Industrial Supply Well
GA = Gage Aquifer
IA = Inactive
IR = Irrigation Supply Well
hp = Horsepower
UN = Unknown
GAR = Gardena

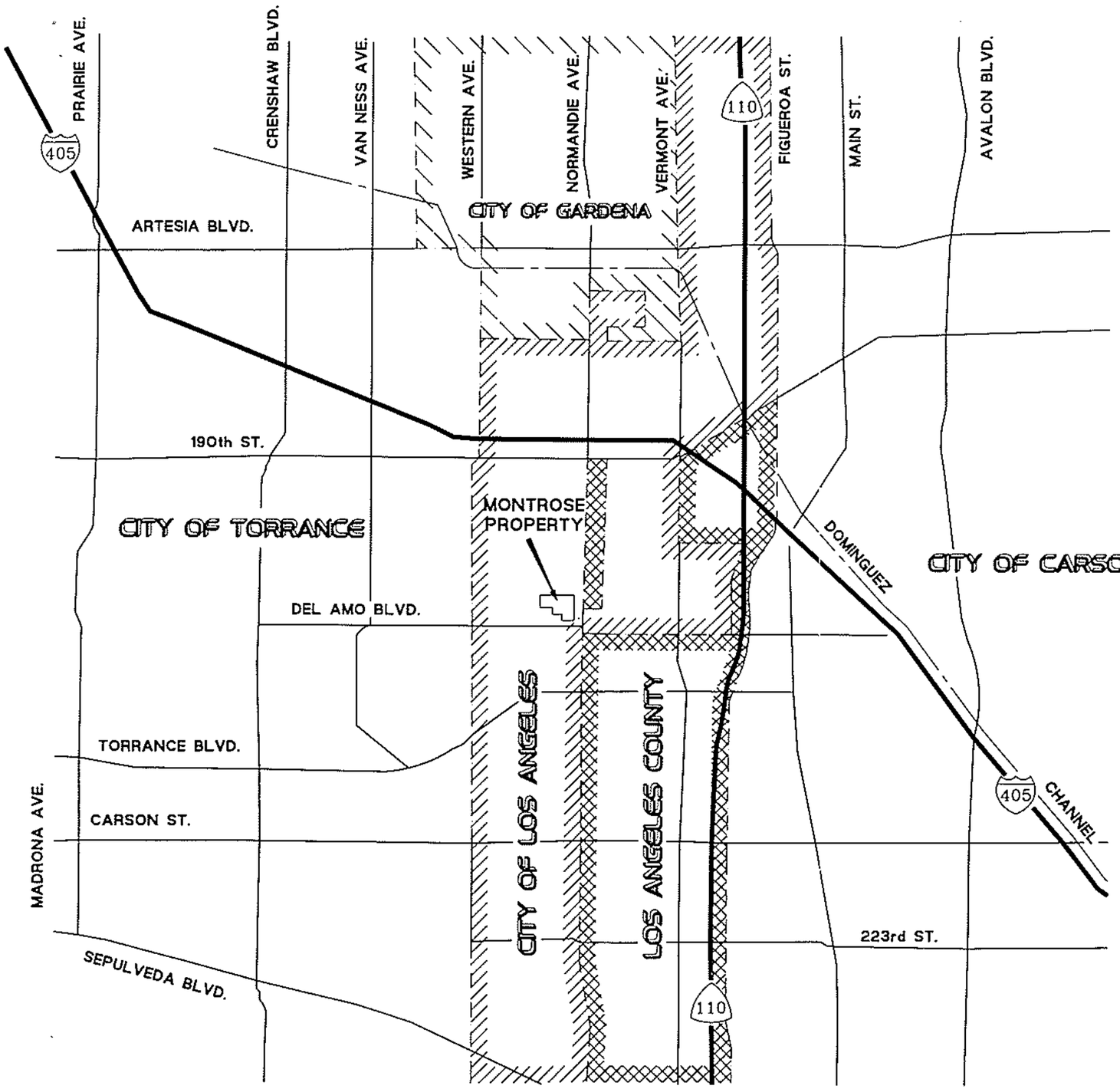


I:\PROJECTS\MONTROSE\HARGIS\410-0189.DWG 1/6/98

HARGIS + ASSOCIATES, INC.

RPT NO 218.19 | 410-0189 | 8

FIGURE 1.1 MONTROSE PROPERTY LOCATION



EXPLANATION

- CITY OF GARDENA
- CITY OF LOS ANGELES
- LOS ANGELES COUNTY
- JURISDICTIONAL BOUNDARY

N

0 3,000 6,000

FEET

I:\PROJECTS\MONTROSE\HARGISRI\410-0191.DWG 1/6/98

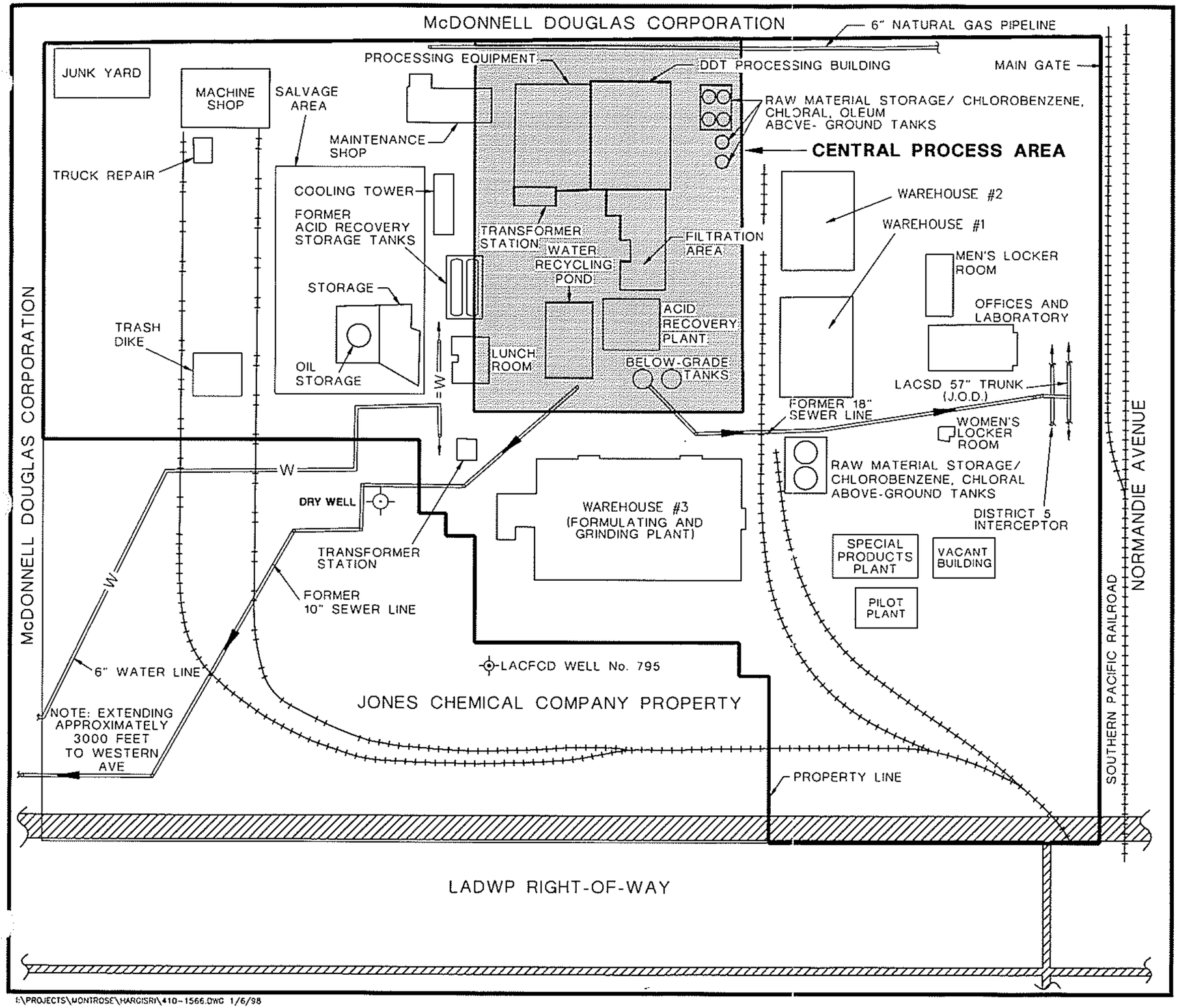
MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

MUNICIPAL JURISDICTIONS IN THE VICINITY OF THE MONTROSE PROPERTY

HARGIS+ASSOCIATES, INC. 7/97

FIGURE 1.2

PREP BY _____ REV BY _____ RPT NO. 218.544 | 410-0191 | B



EXPLANATION

- MONTROSE PROPERTY BOUNDARY
- PROPERTY BOUNDARY
- RAILROAD TRACKS
- ABANDONED RAILROAD BED
- LADWP — LOS ANGELES DEPARTMENT OF WATER AND POWER
- CENTRAL PROCESS AREA
- CHEMICAL AND PETROLEUM PRODUCT PIPELINE CORRIDORS
- DRY WELL

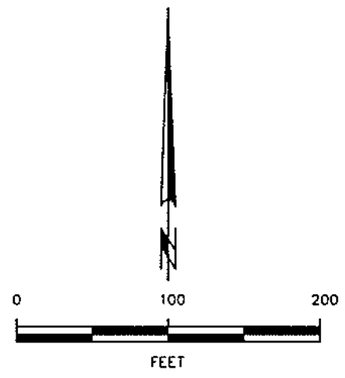
NOTES:

ADAPTED FROM: METCALF & EDDY, INC., 1986 BASED ON PLANT OPERATIONS IN 1982.

ALL LOCATIONS ARE APPROXIMATE.

LADWP LOS ANGELES DEPARTMENT OF WATER AND POWER

LACSD LOS ANGELES COUNTY SANITATION DISTRICT



MONTROSE CHEMICAL CORPORATION OF CALIFORNIA

TORRANCE, CALIFORNIA

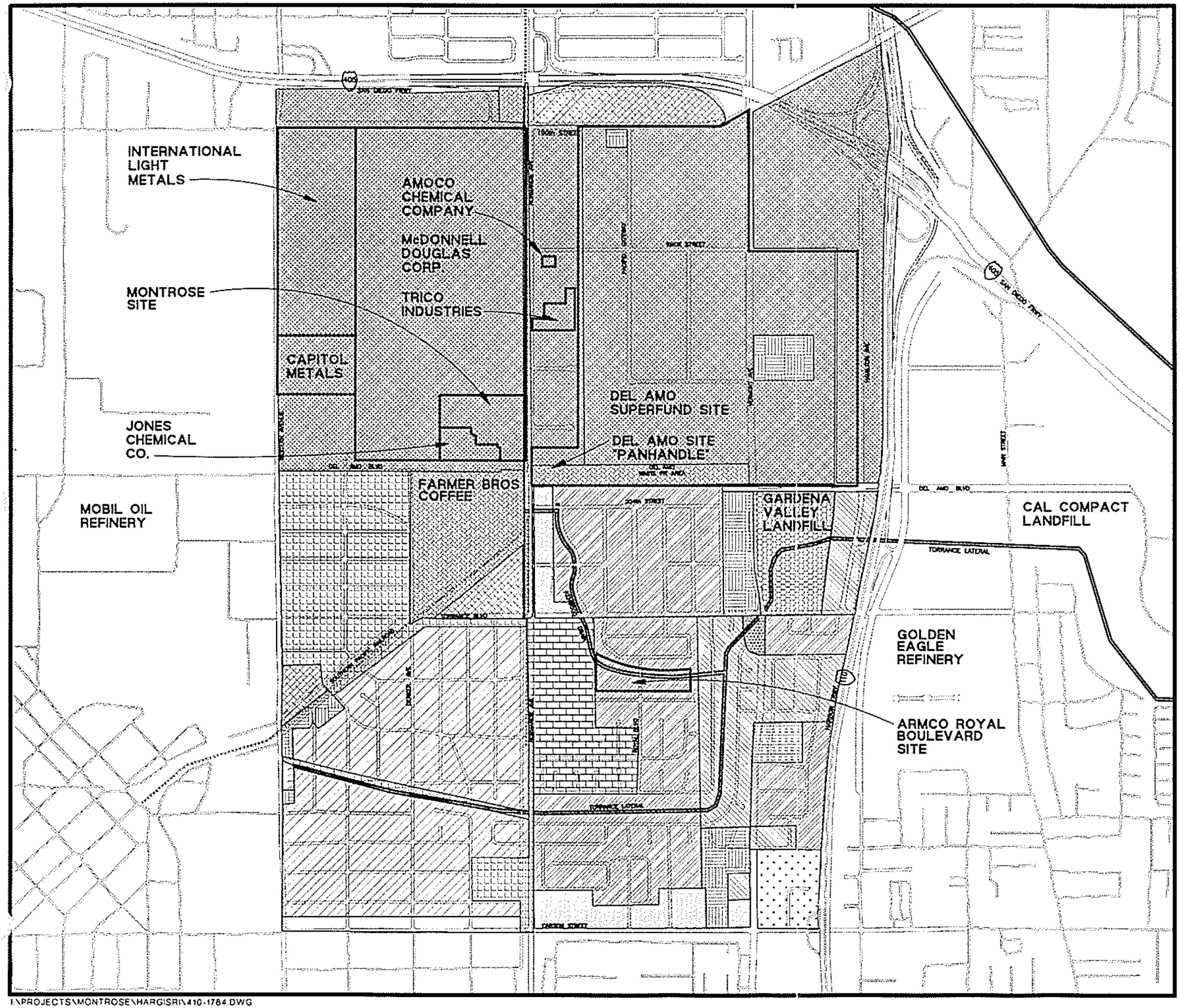
SCHEMATIC OF MONTROSE PLANT AND SURROUNDING PROPERTY

HARGIS + ASSOCIATES, INC. 7/97

FIGURE 1.3

PREP BY _____ REV BY _____ RPT NO. 218.544 | 410-1566 | B

I:\PROJECTS\MONTROSE\HARGISRI\410-1566.DWG 1/6/98



RESIDENTIAL

- LOW
- NEIGHBORHOOD AND OFFICE
- RESIDENTIAL PLANNED DEVELOPEMENT

MULTIPLE FAMILY

- LOW MEDIUM
- MEDIUM

COMMERCIAL

- COMMERCIAL MANUFACTURING
- UNLIMITED COMMERCIAL
- NEIGHBORHOOD BUSINESS

AGRICULTURE

- LIGHT AGRICULTURE

INDUSTRIAL

- HEAVY
- RESTRICTED HEAVY
- LIGHT
- LIMITED
- MANUFACTURING PLANNED DEVELOPMENT

I:\PROJECTS\MONTROSE\HARGISRI\410-1784.DWG

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

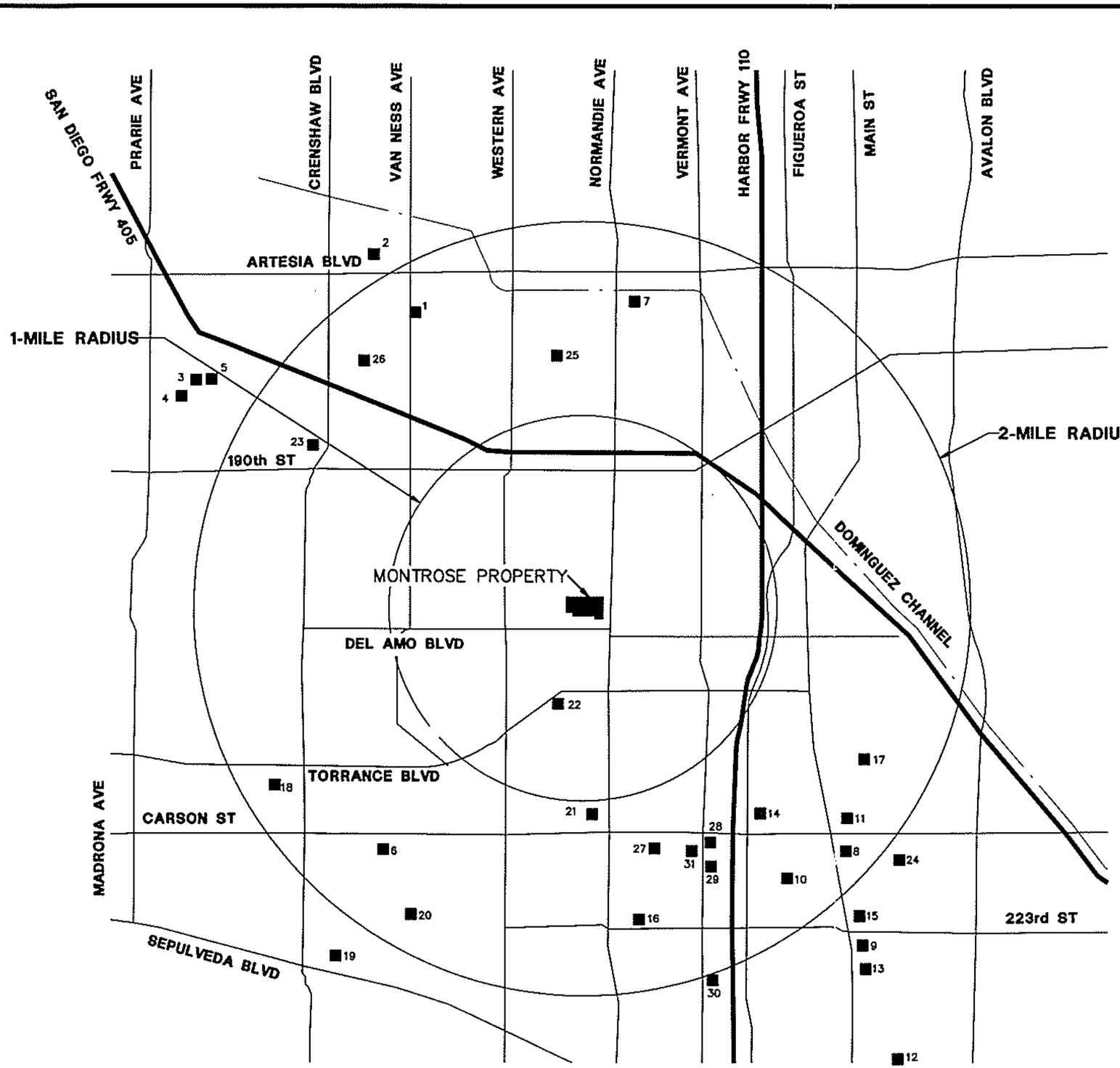
LAND USE, ADJACENT INDUSTRIAL FACILITIES AND AREA HAZARDOUS WASTE SITES

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering
225 South Lake Avenue, Suite 405
Pasadena, California 91101
Phone (818) 583-8121

7/97

FIGURE 1.4

PREP BY _____ REV BY _____ RPT NO. _____ | 410-1784 | B



I:\PROJECTS\MONTROSE\HARGISRI\410-1516.DWG 1/6/98

EXPLANATION

30 ■ APPROXIMATE LOCATION OF SENSITIVE POPULATION SEE TABLE 1.2 FOR CROSS REFERENCED NAMES AND ADDRESSES OF IDENTIFIED FACILITIES

0 3,000 6,000

FEET

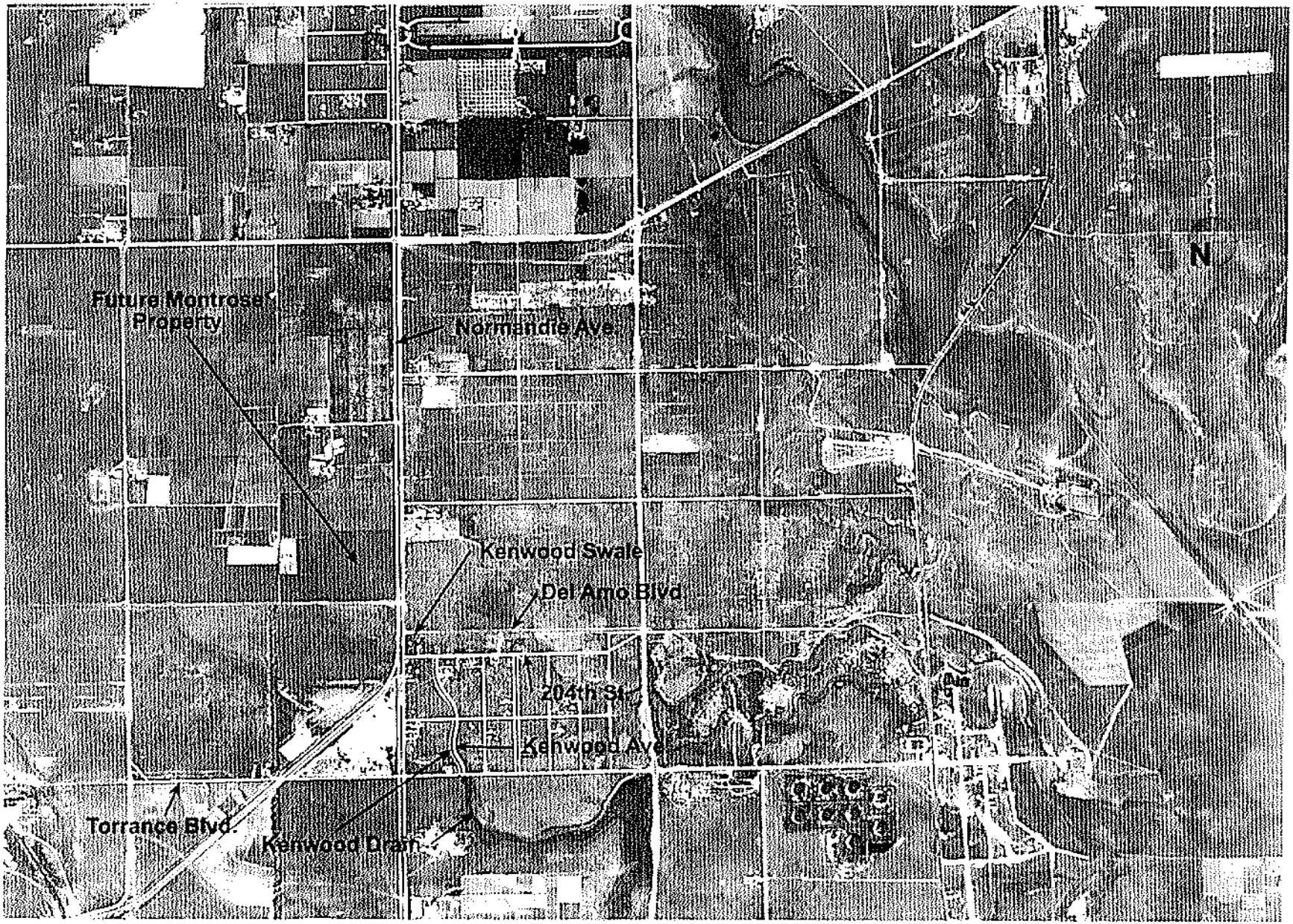
MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

SENSITIVE POPULATIONS

HARGIS+ASSOCIATES, INC. 7/97

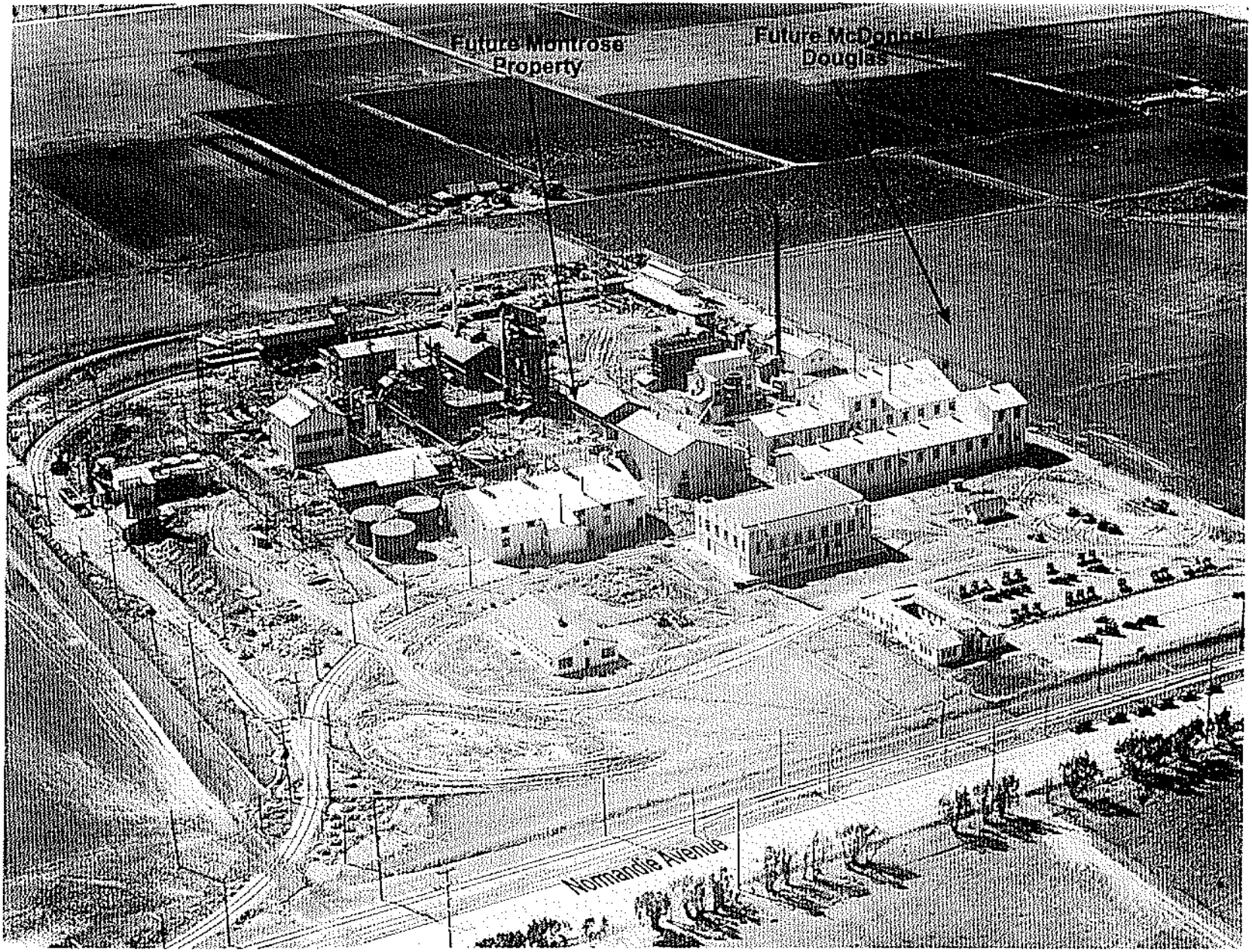
FIGURE 1.5

PREP BY _____ REV BY _____ RPT NO. 218.544 | 410-1516 | B



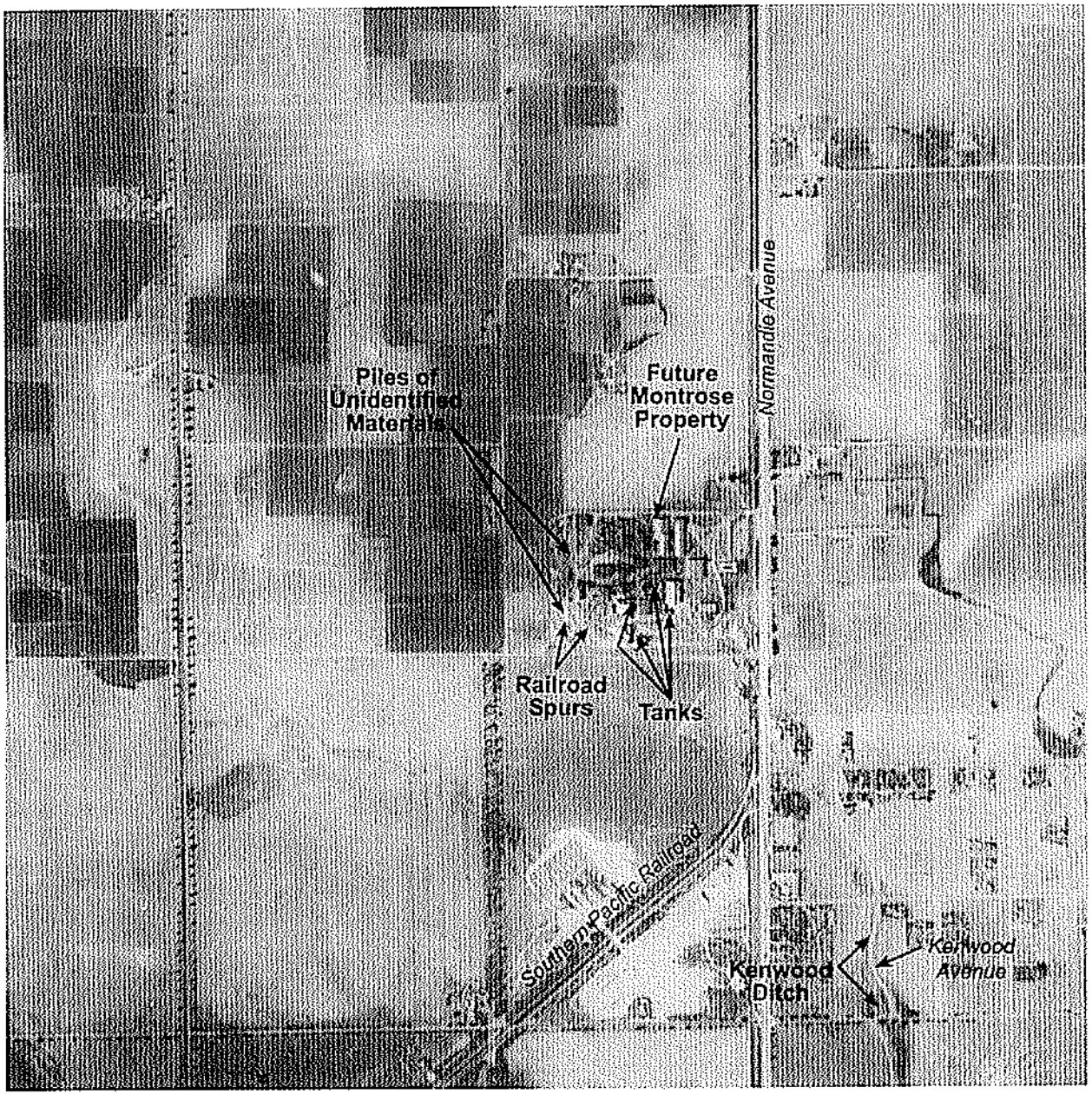
Source: Whittier College, Flight C-300, Frame M:89, 1928.

Figure 1.6A
Torrance Area - 1928



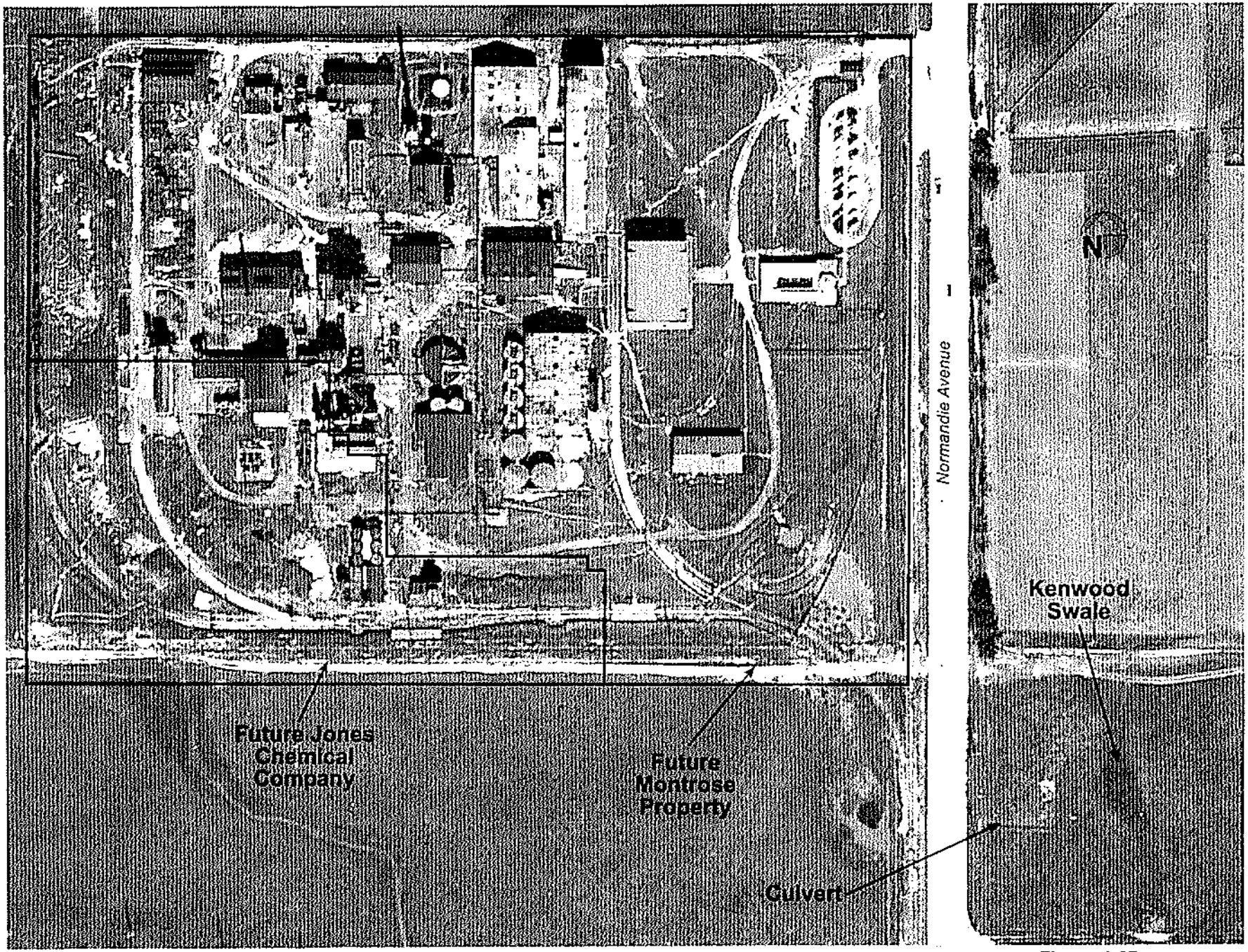
Source: Spence Air Photos - UCLA, Photo G-883-46, April 10, 1935

Figure 1.6B
Hughes-Mitchell Paint Manufacturing Plant - 1935



Source: Unknown, July 2, 1938

Figure 1.6C
Hughes-Mitchell Paint Manufacturing Plant - 1938



Source: Whittier College, Flight C-6972, Frame No. 55, March 6, 1941

Figure 1.6D
Hughes-Mitchell Paint Manufacturing Plant - 1941

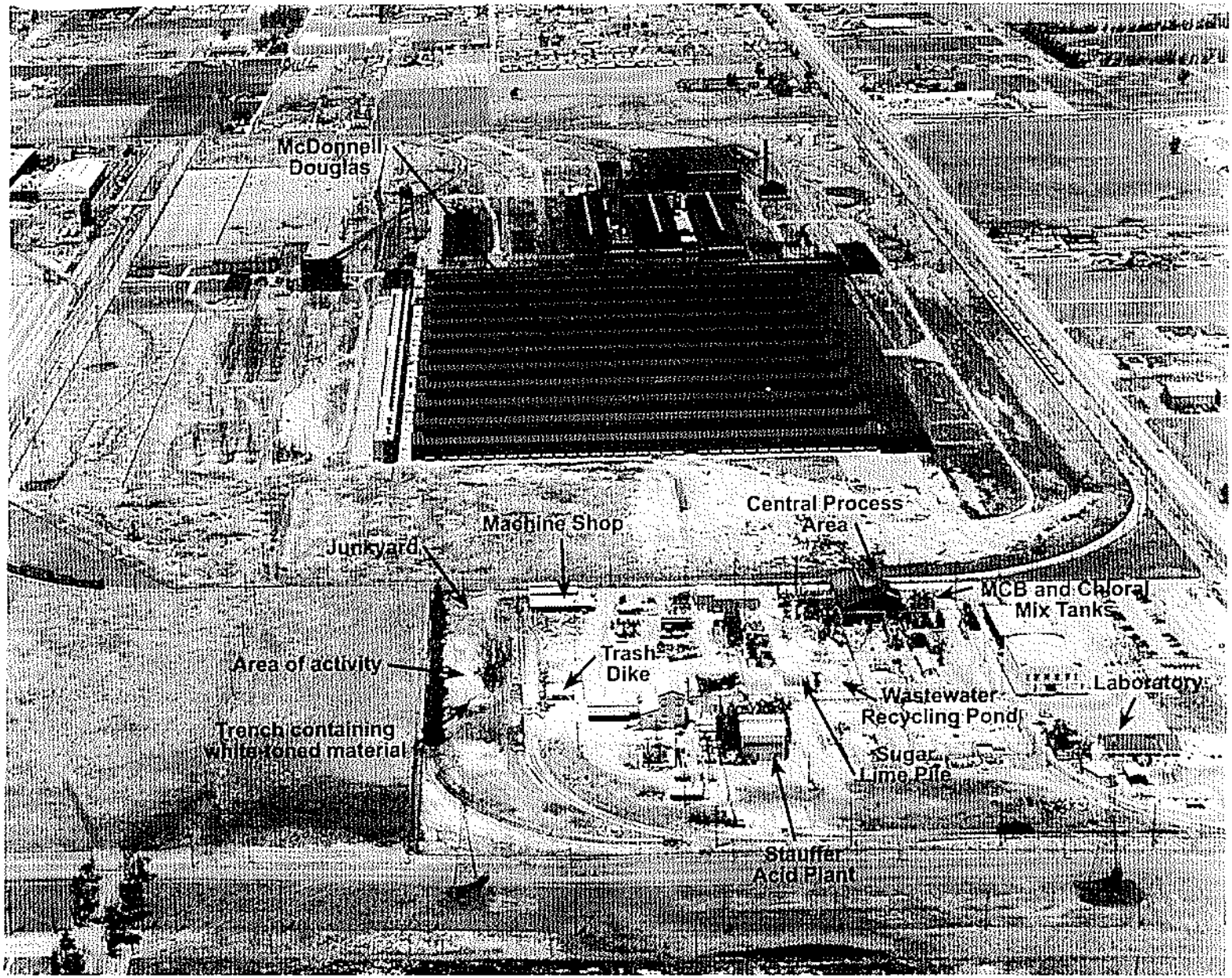
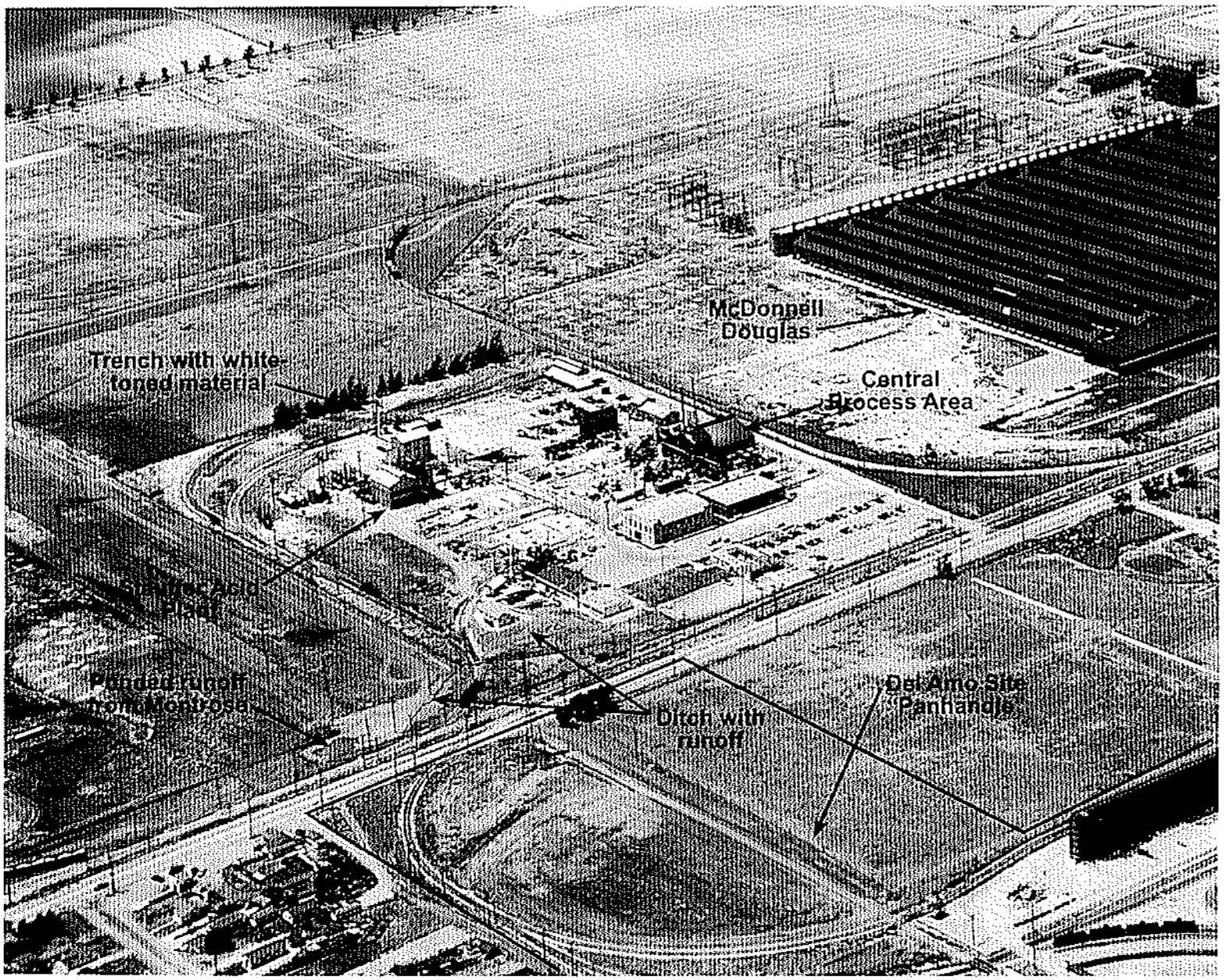


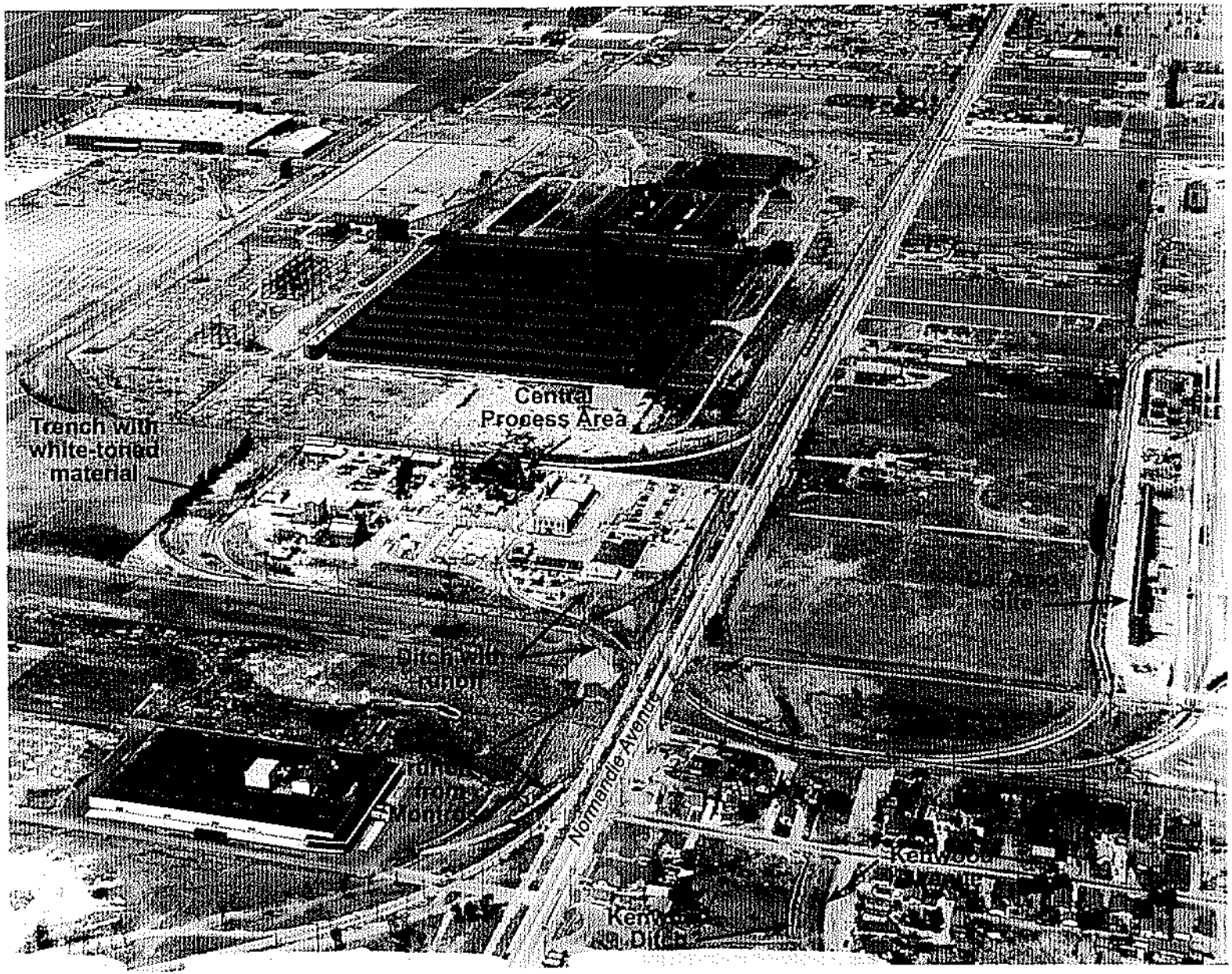
Figure 1-6E
Montrose Property - 1952

Source: PAI/UCSB, Photo No. N-2034, May 10, 1952



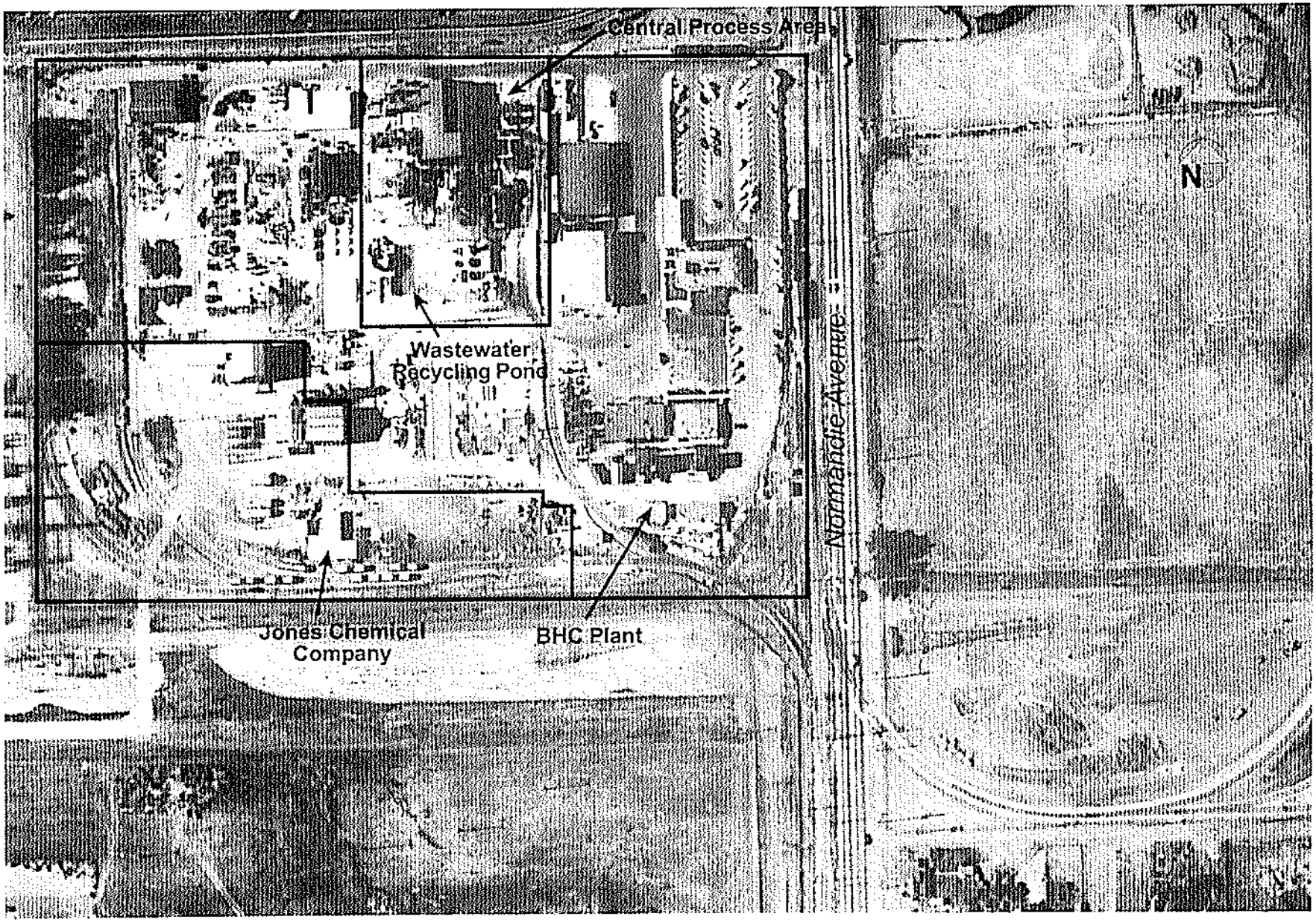
Source: PAI/UCSB, Photo No. N-2030, May 10, 1952

Figure 1.6F
Montrose Property - 1952



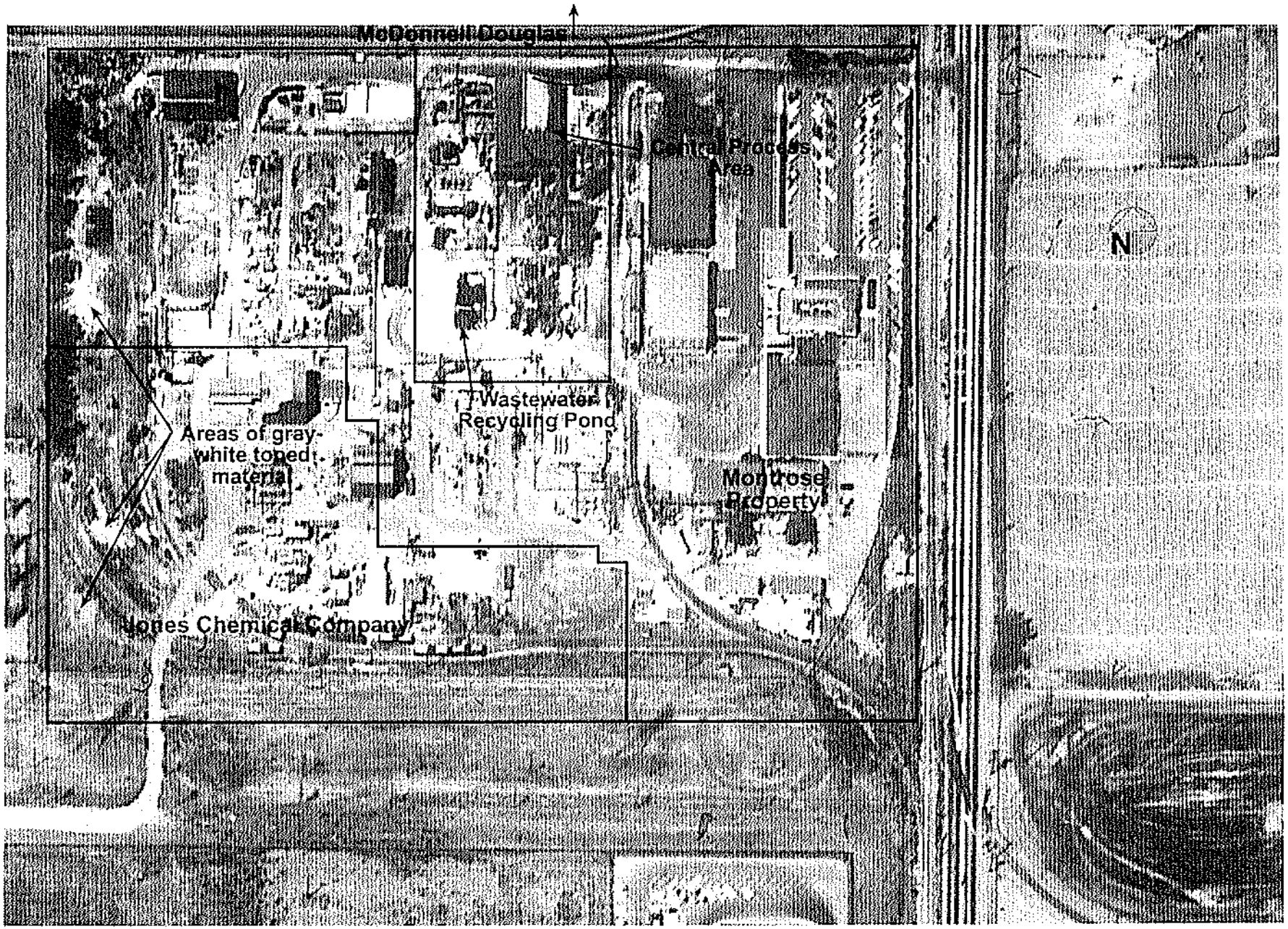
Source: PAI/UCSB, Photo No. N-2031, May 10, 1952

Figure 1.6G
Montrose Property - 1952



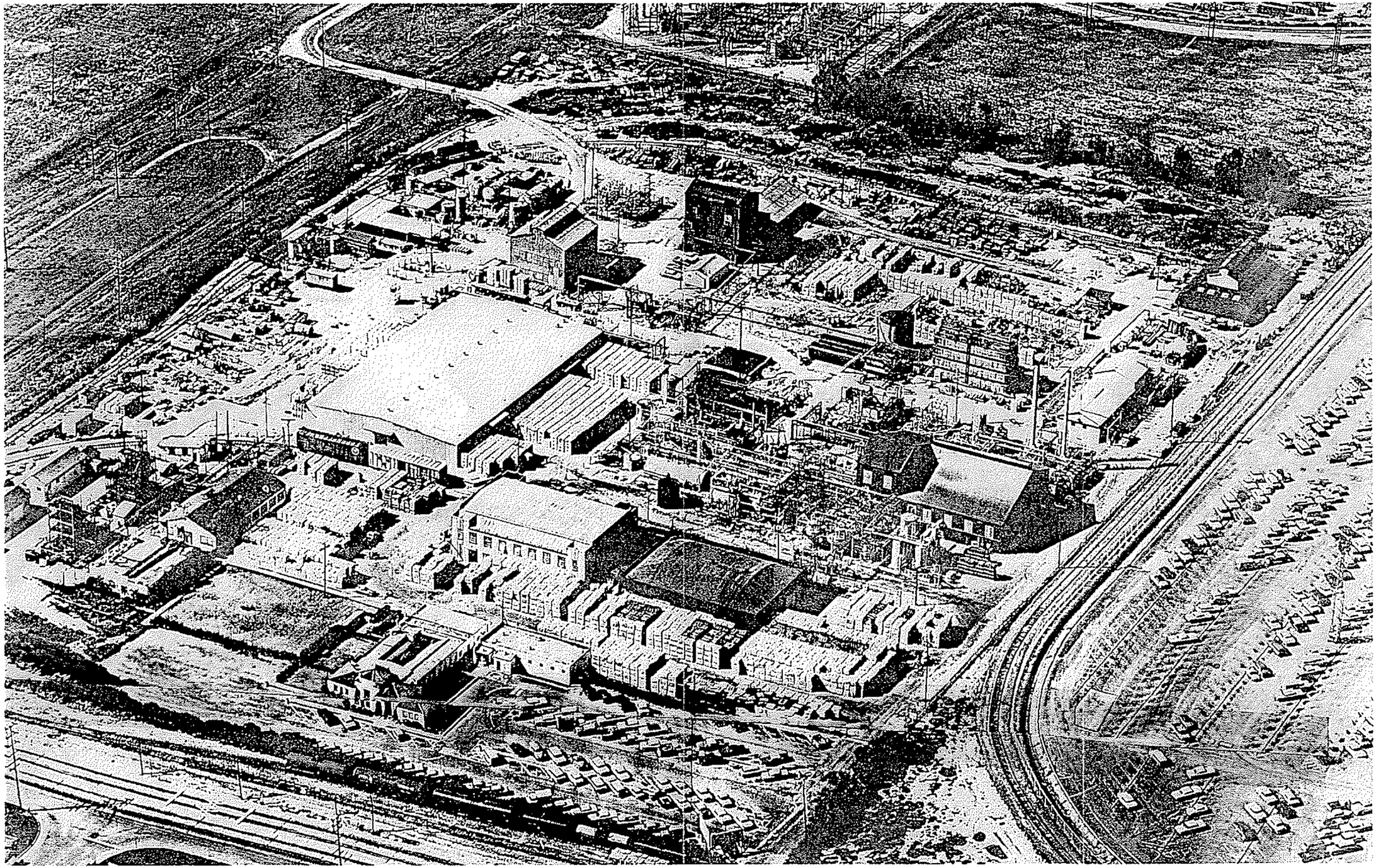
Source: USGS Frame No. 26, PIC 95704, August 13, 1956

Figure 1-6H
Montrose Property - 1956



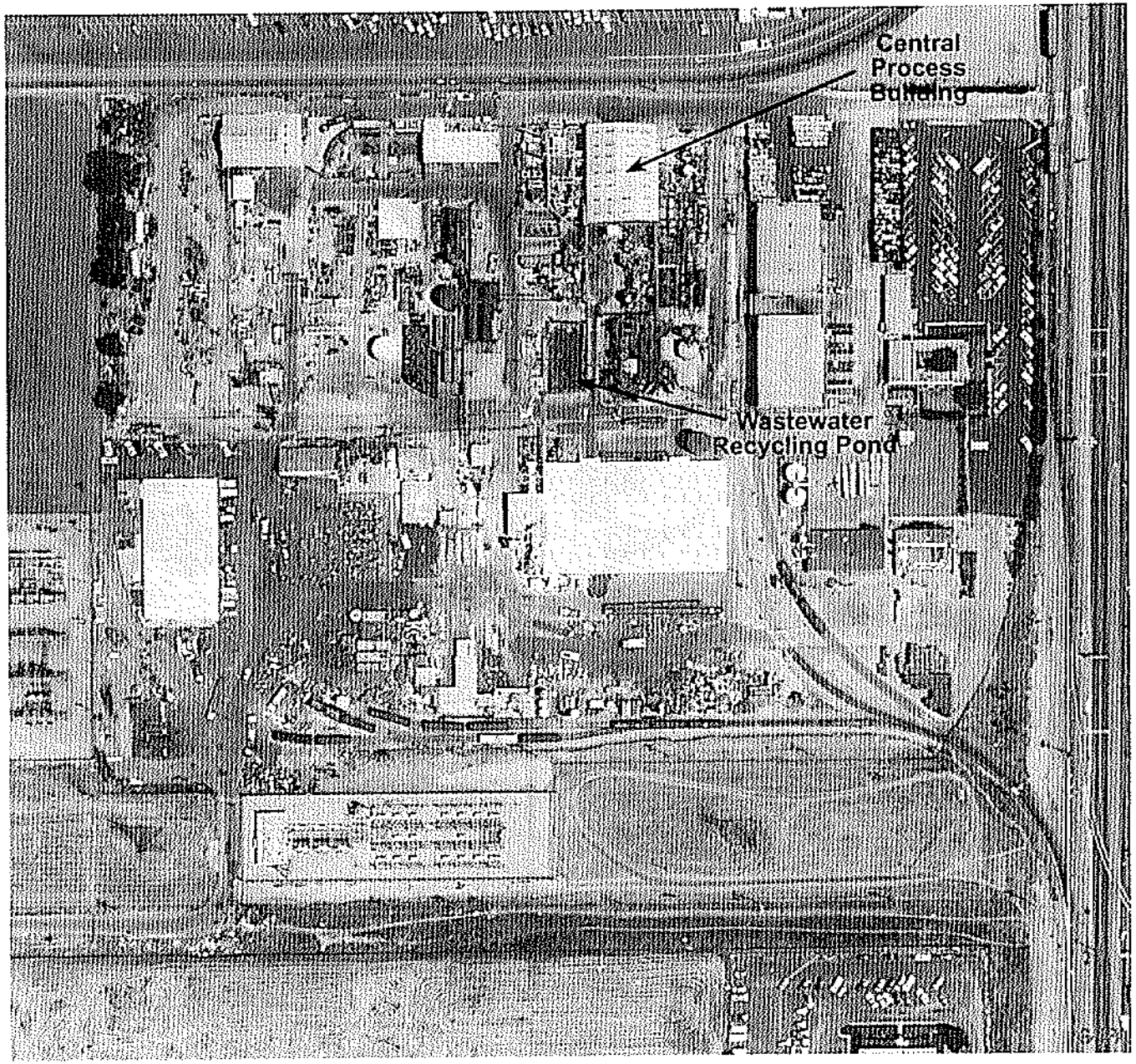
Source: USGS Frame No. 17, PIC 95704, October 1962

Figure 1.6l
Montrose Property - 1962



Source: Unknown

Figure 1.6J
Montrose Property -
Mid- to Late 1960s



Source: EPA EMSL, June 22, 1981

Figure I.6K
Montrose Property - 1981

McDONNELL DOUGLAS CORPORATION

SURFACE DRAIN/OPEN DITCH

DDT PROCESSING BUILD NG

JUNK YARD

MACHINE SHOP

MAINTENANCE SHOP

TRUCK REPAIR

AMMONIA COMPRESSOR / BRINE REFRIGERATION / STEAM GENERATION

COOLING TOWER

NH_3 CONDENSERS

REFRIG. MACHINE ROOM

NH_3 COMPRESSORS

TURNTABLES (1955)

BRINE TANK

BOILERS

FUEL OIL

TRANSFORMER STATION

MCB AND MCB AND CHLORAL MIX TANKS

STEAM STRIPPERS

TRAP TANK

FRESH OLEUM TANK - 7,000 GALLON TANK

WAREHOUSE #2

MONTROSE PROPERTY

SALVAGE AREA

STAUFFER TANKS

DDT REWORK

SPENT ACID HOLDING TANK - >12,000 GALLON TANKS

APPROXIMATE LEAD-LINED WASTE TRENCH LOCATION

OPEN TANK TO RECEIVE WASTES AND SUGAR LIME

LUNCHROOM QUONSET HUT

OFFICES AND LABORATORY

TRASH DIKE

SUGAR LIME PILE

WASTEWATER RECYCLING POND

WAREHOUSE #1 AND GRINDING PLANT (WHERE CRYSTALLIZATION OCCURRED)

SULFUR BURNER

STORAGE

STORAGE

DEVELOPMENT LABORATORY

LABORATORY #2

LABORATORY #1

TRANSFORMER STORAGE

SULFURIC ACID PLANT

H_2SO_4 TANKS

FORMER LOCATIONS OF SEVERAL HUGHES-MITCHELL PAINT PLANT TANKS AND BUILDINGS

BUILDING

COVERED WORK AREA

SURFACE DRAIN/OPEN DITCH

10' SEWER TO WESTERN AVE.

TANKS

BUILDING

STAUFFER ACID PLANT

SURFACE DRAIN/OPEN DITCH

PROPERTY LINE

LADWP RIGHT-OF-WAY

McDONNELL DOUGLAS CORPORATION

NORMANDIE AVENUE

Legend:

- Central Processing Area
- Unlined Waste Trench
- Surface Drain/Open Ditch
- Railroad Tracks
- Stauffer Property Boundary
- Montrose Operations Boundary
- LADWP — Los Angeles Department of Water and Power

Note:
Not all tanks and process units are shown on this figure.

N

0 100 200

FEET

APPROXIMATE SCALE

Figure 1.7A
Pre-1953 Plant Layout:
Standard Batch Process
Montrose Chemical Corporation of California

McDONNELL DOUGLAS CORPORATION

SURFACE DRAIN/OPEN DITCH

CENTRAL PROCESSING AREA

MONTROSE PROPERTY

JUNK YARD

MACHINE SHOP

55-GALLON DRUM OIL STORAGE AREA

MAINTENANCE SHOP

SEE FIGURE 1.7C FOR DETAILS ON THE CENTRAL PROCESS AREA

CLEANOUT SUMP

OIL SEPARATOR 1,250 GAL

OIL SUMP

TRUCK REPAIR

COOLING TOWER

AMMONIA COMPRESSOR / BRINE REFRIGERATION / STEAM GENERATION

DDT PROCESSING BUILDING

FILTRATION AREA

LUBE OIL TANK 500 GAL (1975)

GASOLINE TANK AND PUMP

DDT REWORK

WAREHOUSE #2

SALVAGE AREA

RECOVERED ACID TANKS

WASTE-WATER POND/ WATER RECYCLING POND (1970)

ACID RECOVERY PLANT

WAREHOUSE #1 (AND GRINDING PLANT PRIOR TO 1964)

MEN'S LOCKER ROOM

OFFICES AND LABORATORY

TRASH DIKE

OIL STORAGE TANK - 100,000 GAL (1975)

LUNCH ROOM

18' SEWER

LACSD 57-INCH SEWER (JOINT OUTFALL 'D')

DISTRICT 5 INTERCEPTOR

OIL SEPARATOR 1,250 GAL

LUBE OIL TANK 500 GAL

MCB AND CHLORAL TANKS - 50,000 GAL (1968)

WOMEN'S LOCKER ROOM

DRY WELL

WAREHOUSE #3 (FORMULATING AND GRINDING PLANT) (1964)

BLOCK VALVE

LABORATORY #2

SPECIAL PRODUCTS PLANT (1971)

LUBE OIL TANK 500 GAL

BALL MILL

STAUFFER BHC PLANT (1954-1964)

DISCONNECTED 10' SEWER TO WESTERN AVE.

LACFCD WELL NO. 795

SHOP

SHOP

JONES CHEMICAL COMPANY (Leased 1955, Purchased 1968)

COVERED WORK AREA

SURFACE DRAIN/OPEN DITCH

SURFACE DRAIN/OPEN DITCH

PROPERTY LINE

LADWP RIGHT-OF-WAY

McDONNELL DOUGLAS CORPORATION

NORMANDIE AVENUE

Legend:

- Central Processing Area
- Surface Drain/Open Ditch
- Vitrified Clay Pipe with Sumps
- Railroad Tracks
- Stauffer Property Boundary
- Montrose Operations Boundary
- LADWP — Los Angeles Department of Water and Power
- Dry Well

Note:

- Not all tanks and process units are shown on this figure.
- Dates in parentheses indicate the date the item operated or first appeared or constructed.

N

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FEET

APPROXIMATE SCALE

Figure 1.7B
Post-1953 Plant Layout: Continuous Batch Process
Montrose Chemical Corporation of California

SCO/p102573.17.01 post53.FH7 3/98

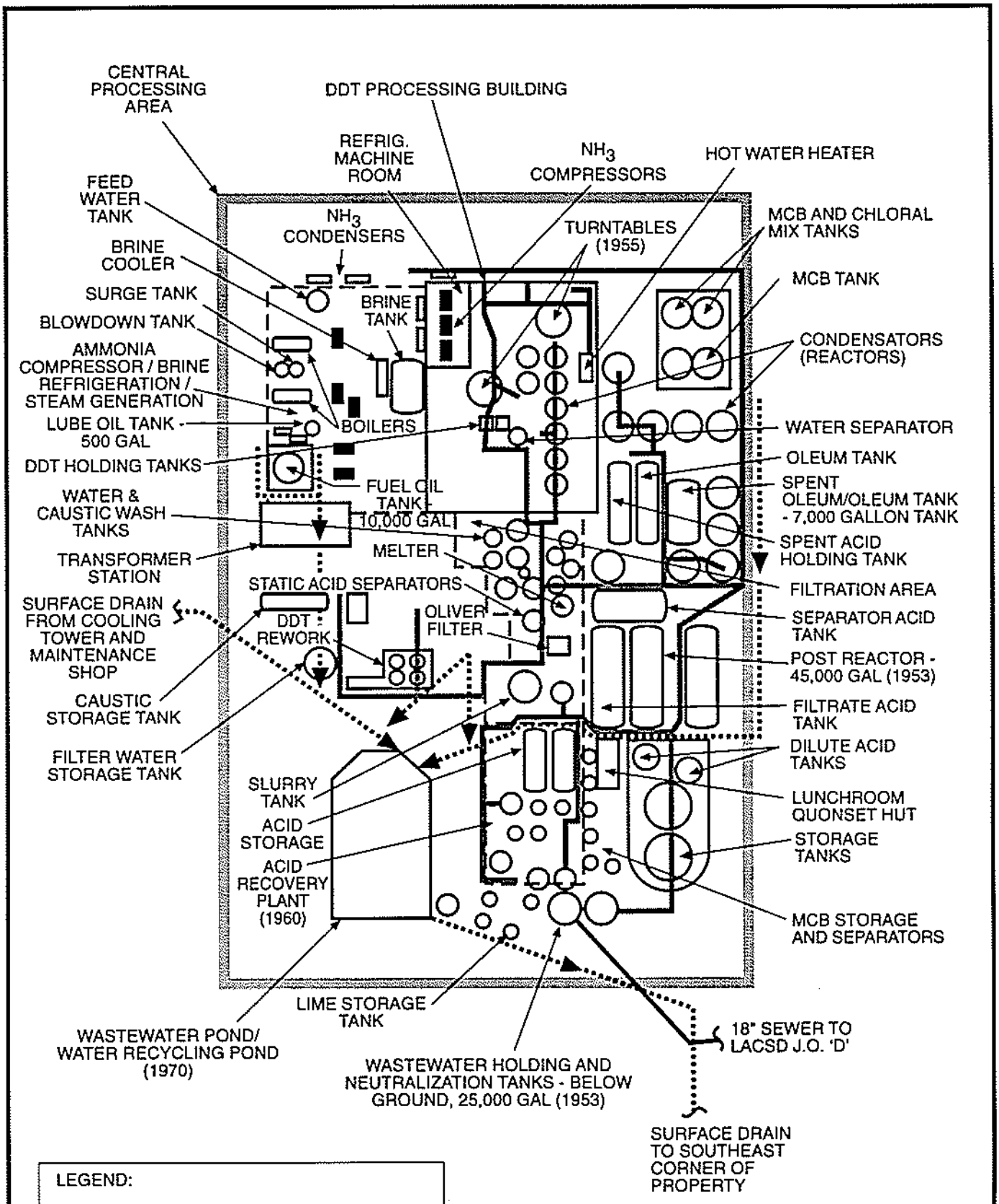


Figure 1.7C
Post-1953 Central Process Area
Montrose Chemical Corporation of California

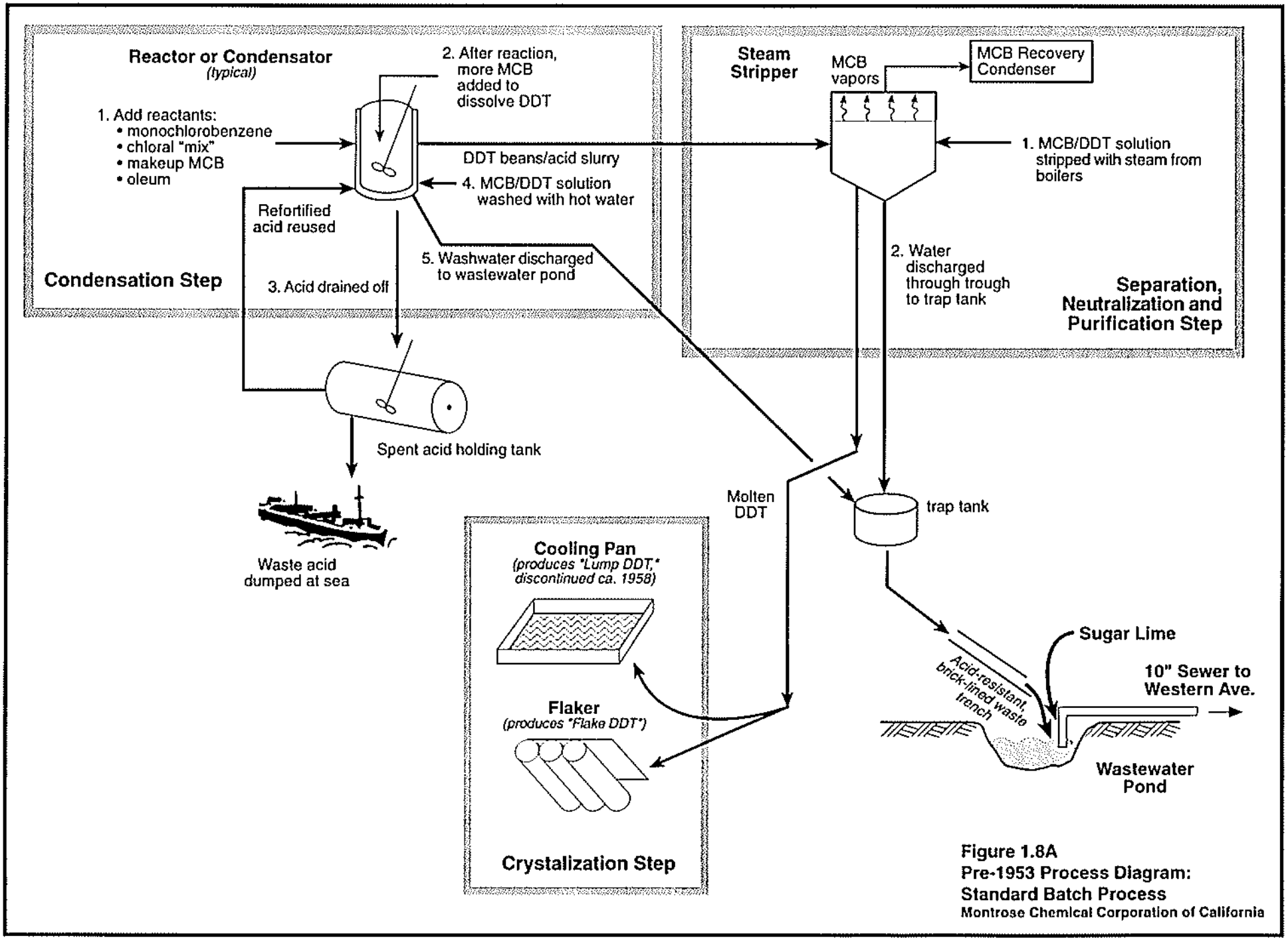


Figure 1.8A
Pre-1953 Process Diagram:
Standard Batch Process
Montrose Chemical Corporation of California

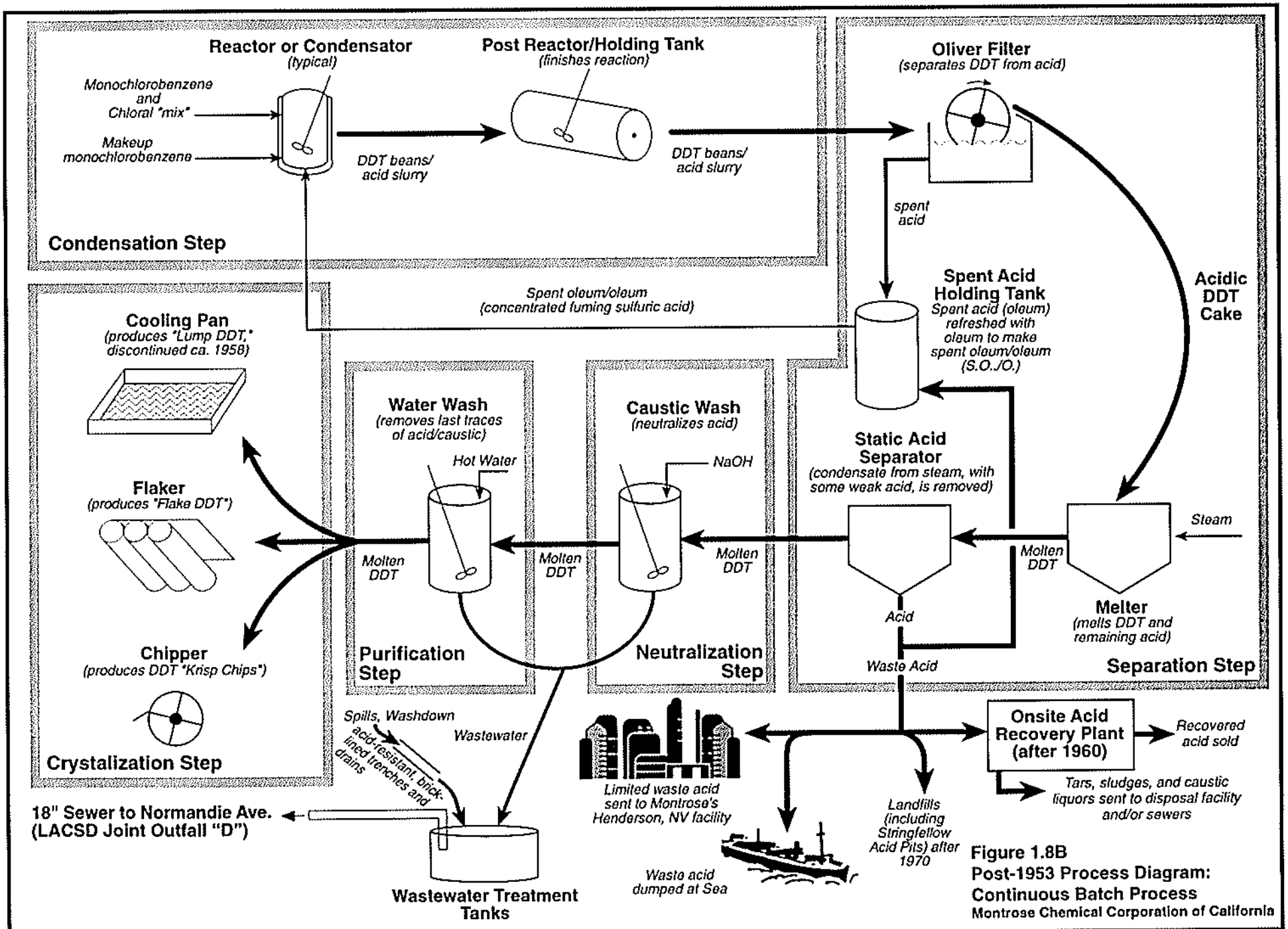
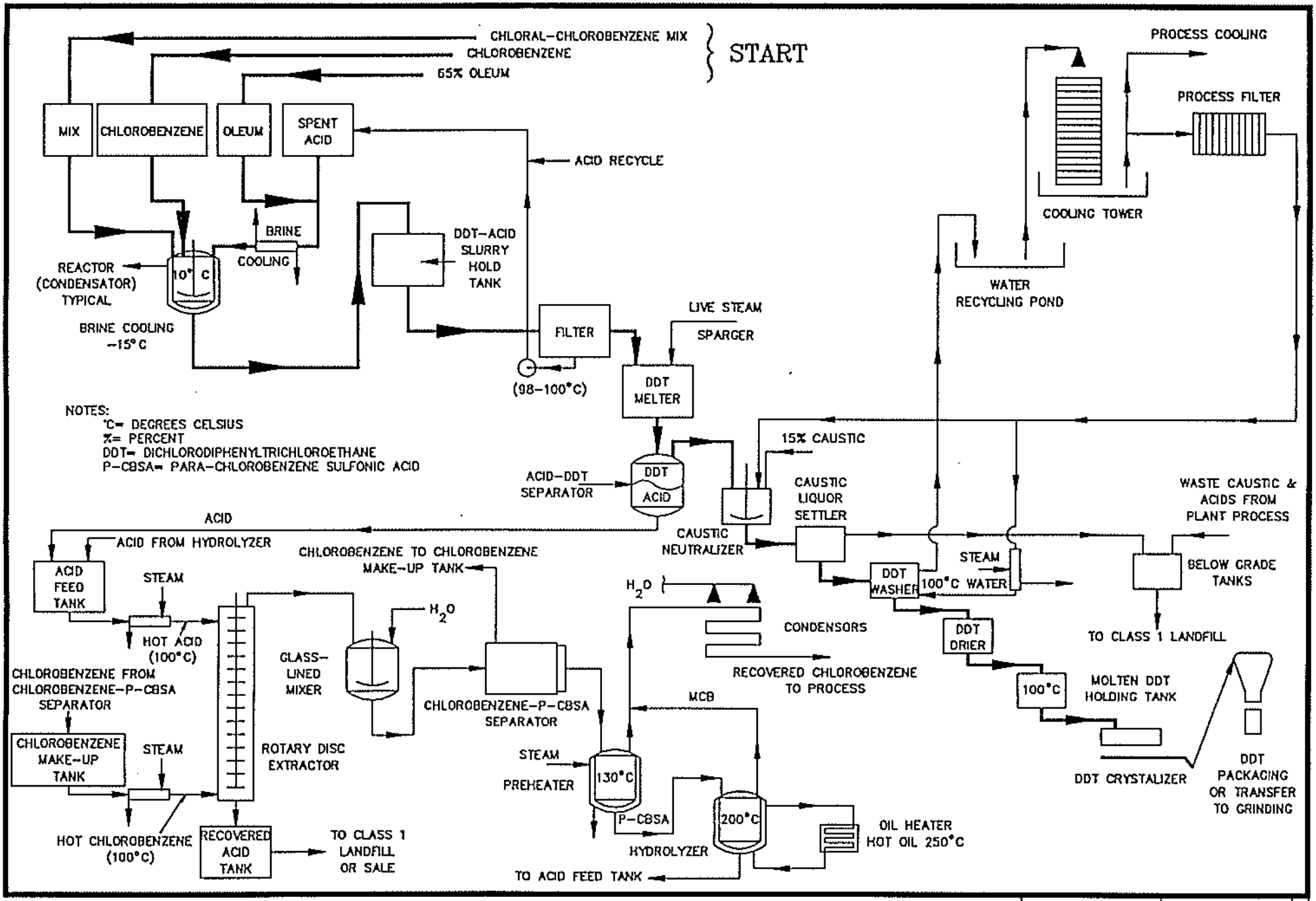


Figure 1.8B
Post-1953 Process Diagram: Continuous Batch Process
Montrose Chemical Corporation of California



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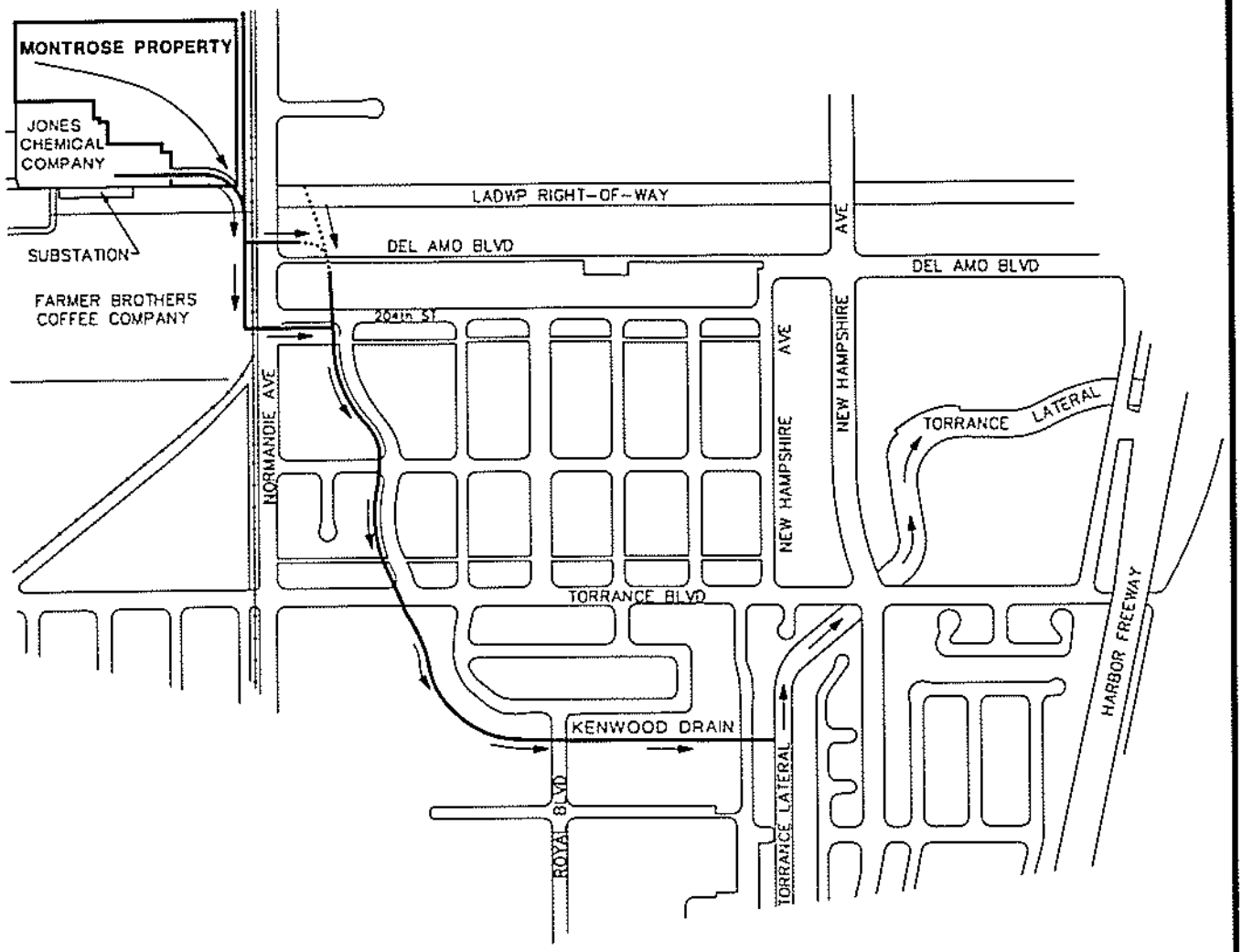
RPT NO. 218.544 | 640-0026 | A

FIGURE 1.9 PRODUCTION AND WASTE STREAM SCHEMATIC FOR DDT, 1977



EXPLANATION

- SURFACE WATER FLOW
- JONES CHEMICAL COMPANY CONCRETE LINED DITCH
- CONCRETE LINED NORMANDIE AVENUE DITCH
- LADWP — LOS ANGELES DEPARTMENT OF WATER AND POWER
- SOUTHERN PACIFIC RAILROAD
- APPROXIMATE LOCATION OF DRAINAGE SWALE INTERPRETED FROM AERIAL PHOTOGRAPHS DATED 1941 THROUGH 1956
- APPROXIMATE LOCATION OF CULVERT AND DRAINAGE DITCH INTERPRETED FROM AERIAL PHOTOGRAPHS DATED 1938 AND 1941

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FEET

HARGIS + ASSOCIATES, INC.

RPT NO. 218.544 | 410-0214 | A

FIGURE 1.10 SURFACE WATER RUNOFF PATHWAY

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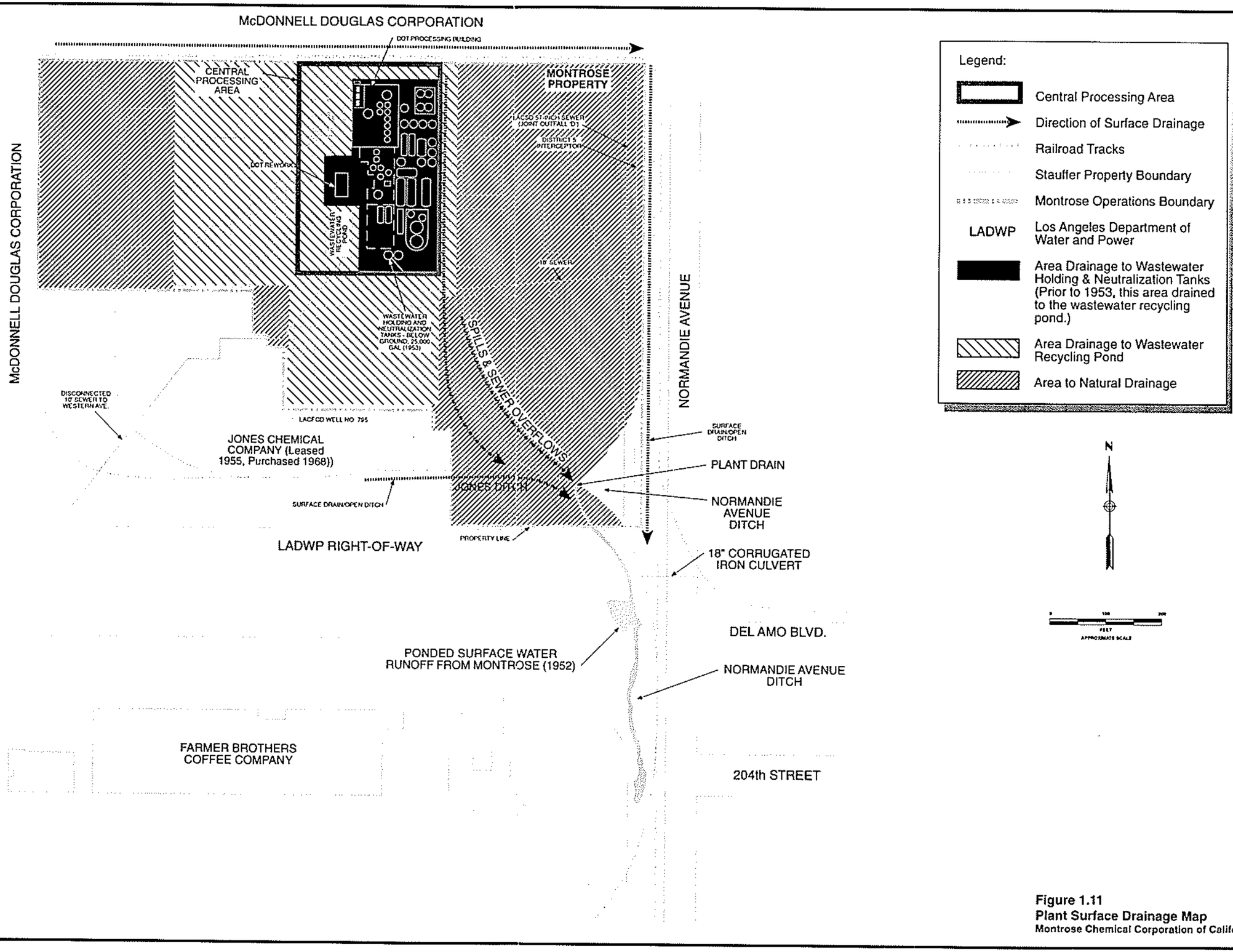

Figure 1.11
Plant Surface Drainage Map
Montrose Chemical Corporation of California

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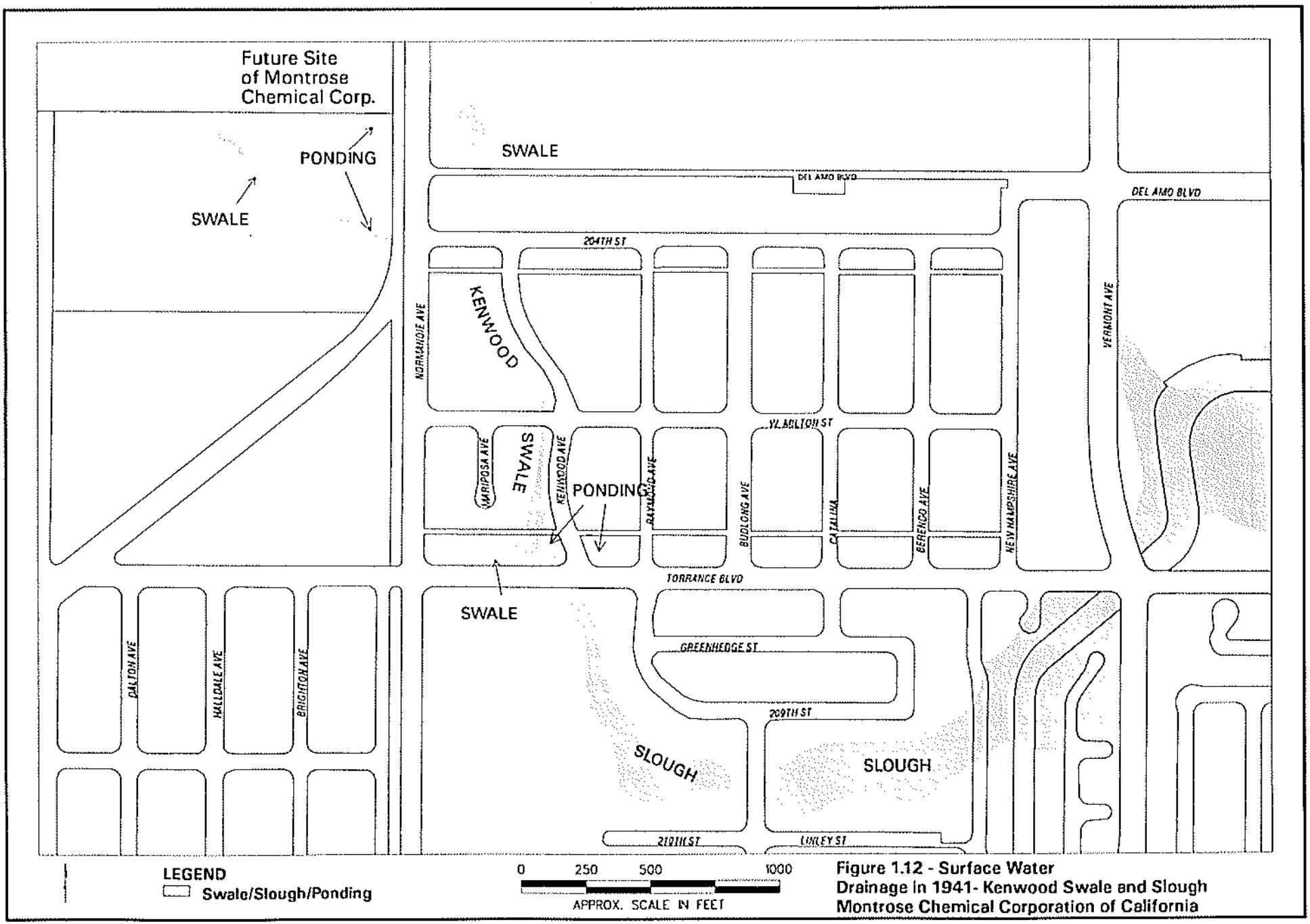


Figure 1.12 - Surface Water Drainage in 1941- Kenwood Swale and Slough Montrose Chemical Corporation of California

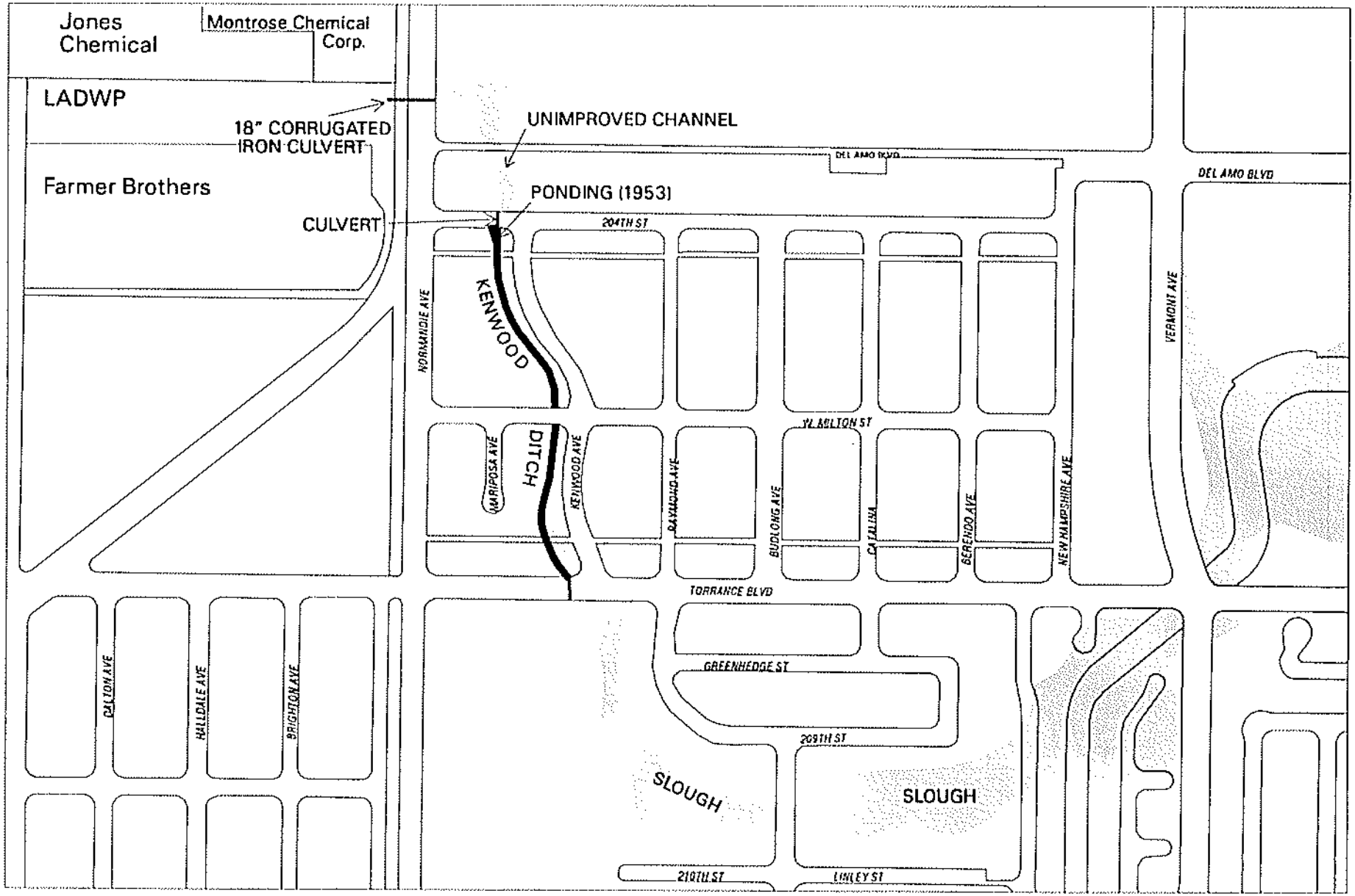


Figure 1.13 - Surface Water Drainage in the 1950's - Culverts, Unimproved Channel, Kenwood Ditch, Slough Montrose Chemical Corporation of California

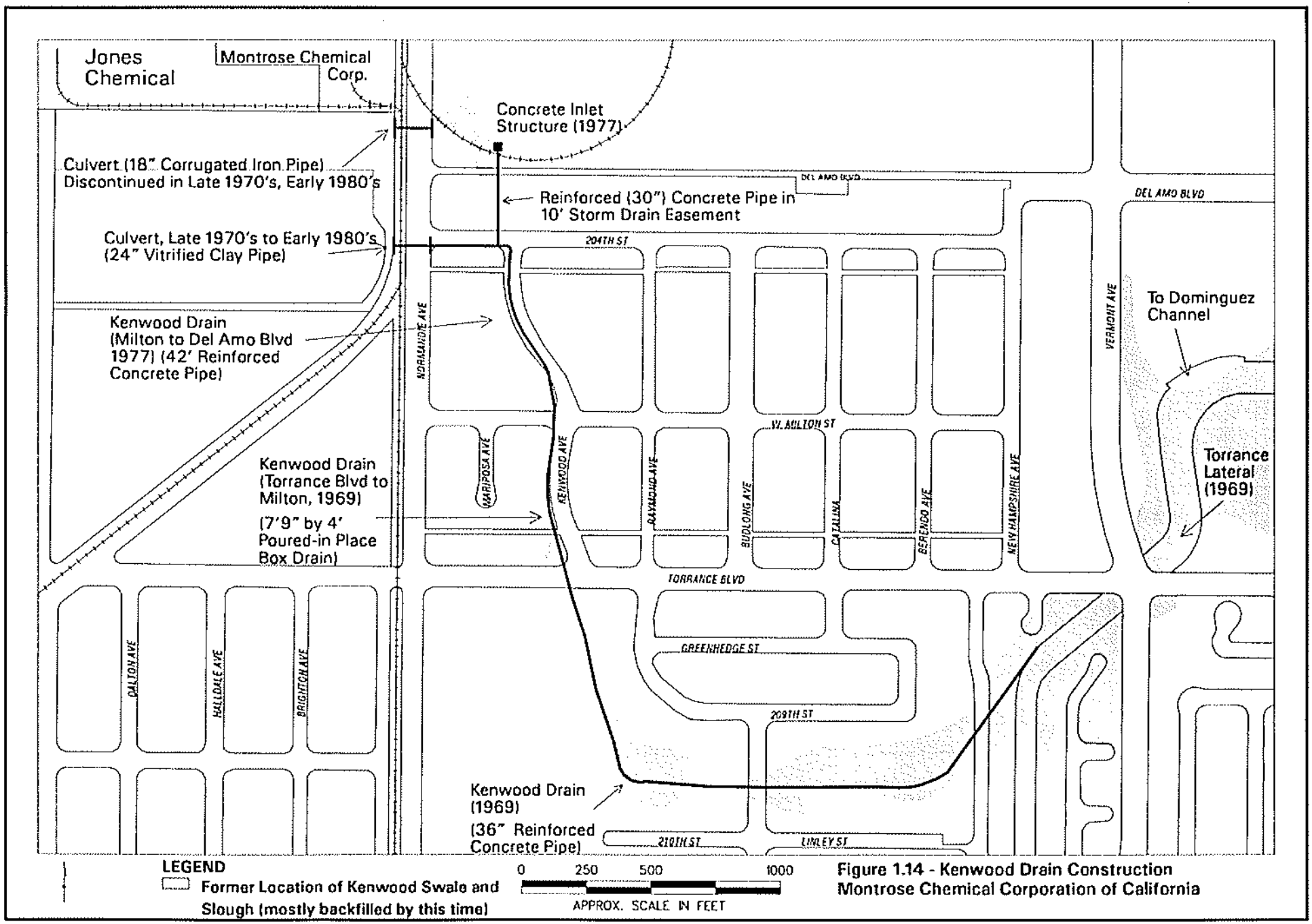


Figure 1.14 - Kenwood Drain Construction
Montrose Chemical Corporation of California

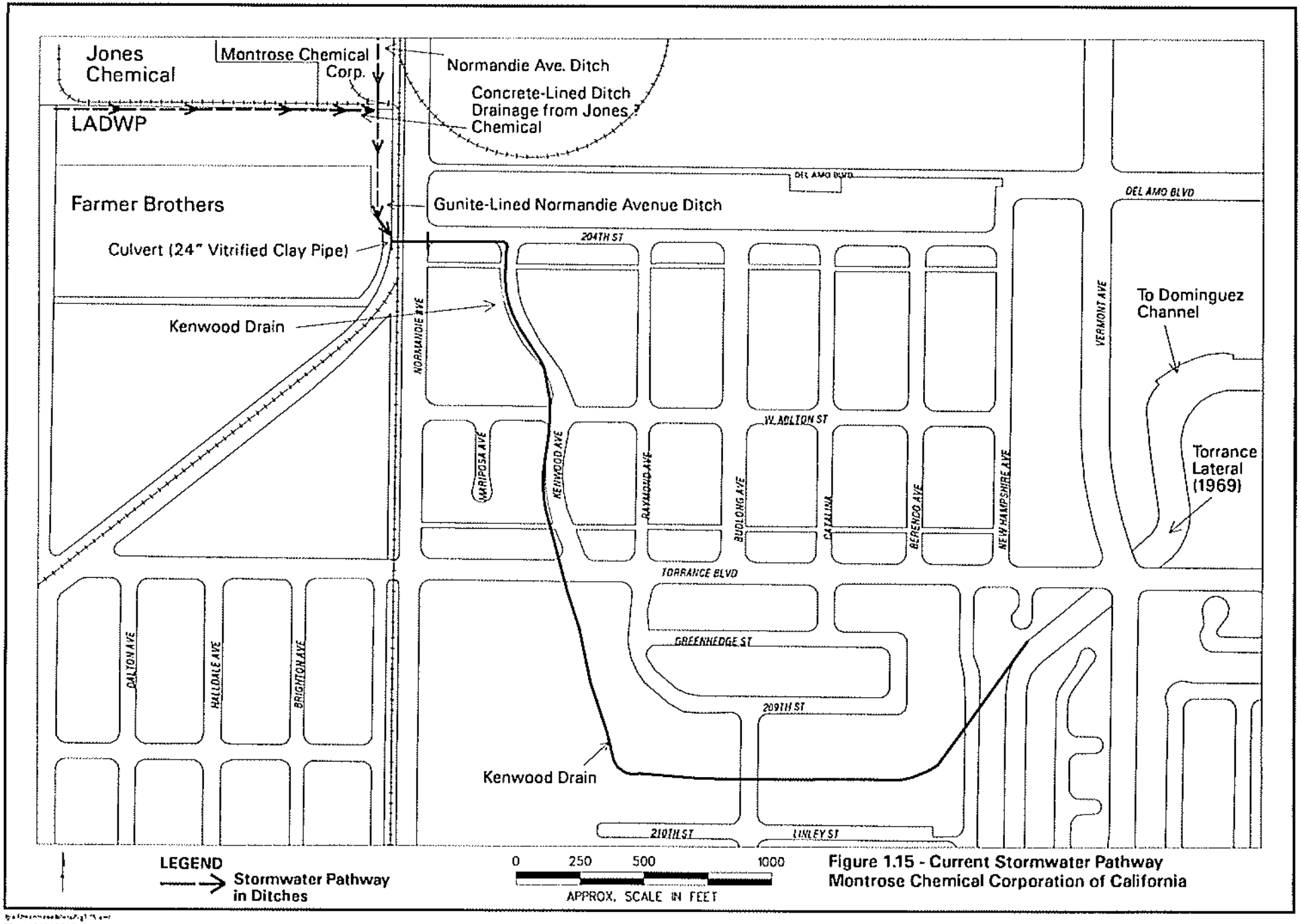
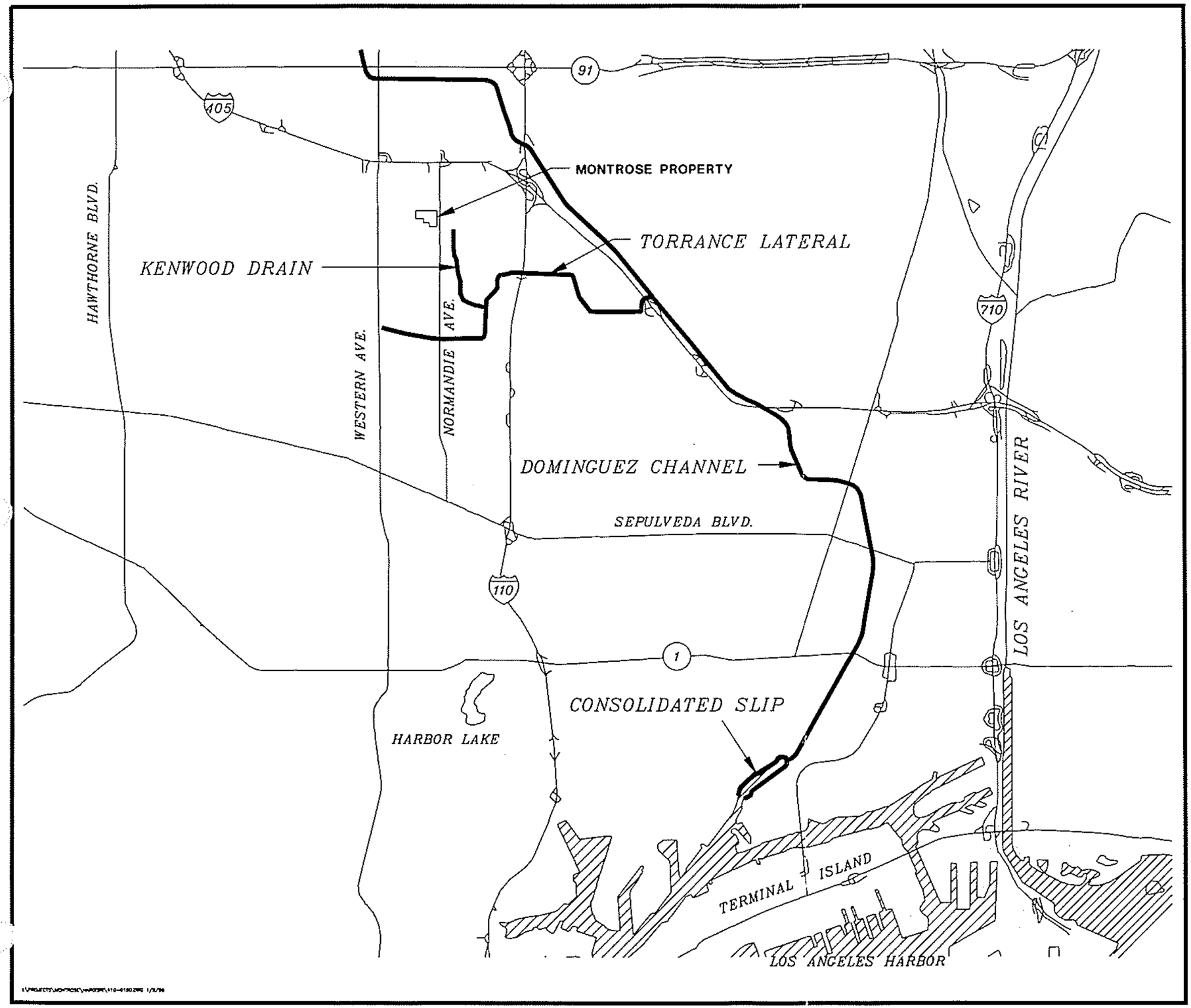


Figure 1.15 - Current Stormwater Pathway
Montrose Chemical Corporation of California



EXPLANATION

SURFACE WATER DRAINAGE

BASE MAP FROM: USGS DLG 7.5 MINUTE QUADRANGLES

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FEET

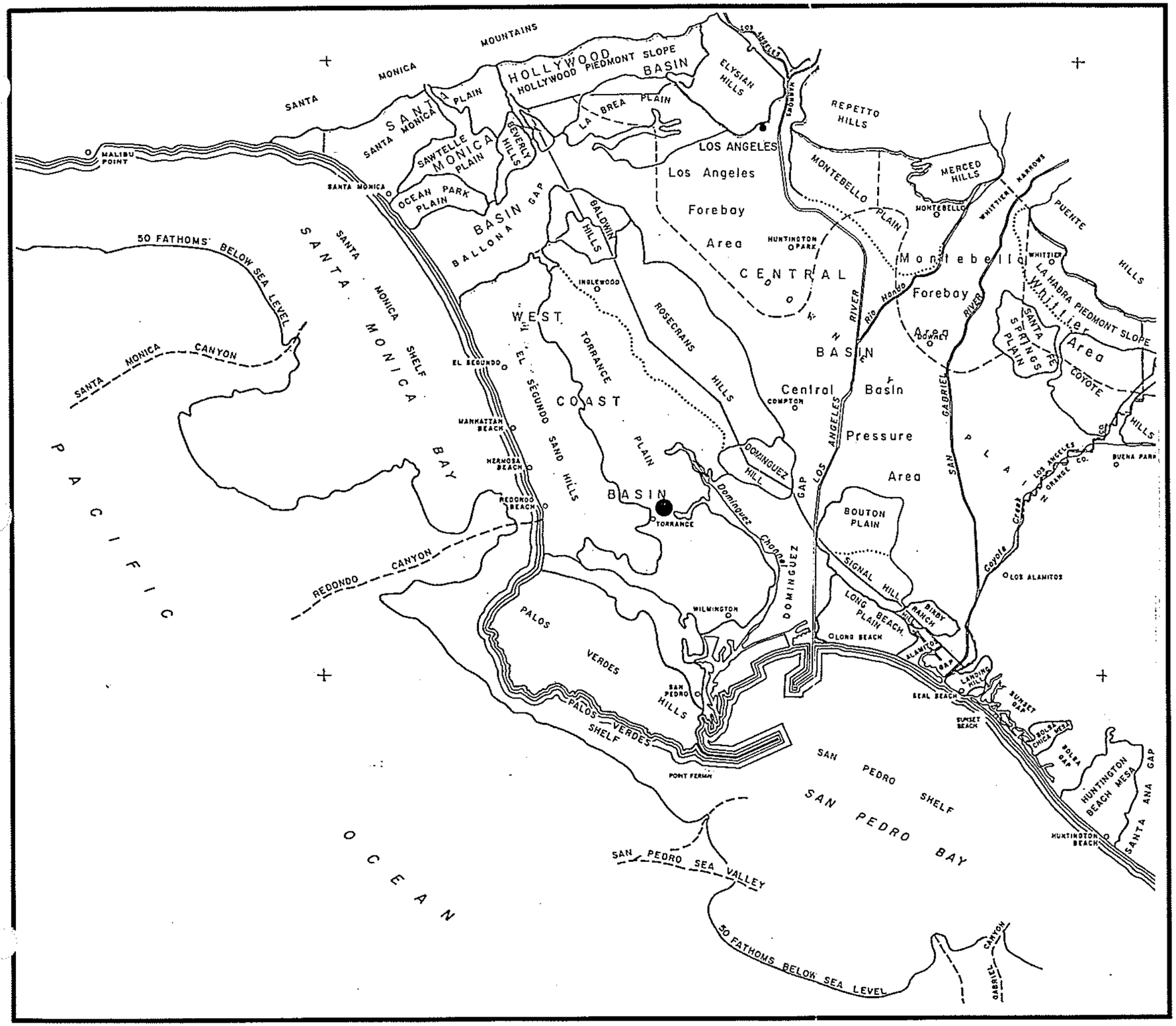
MONTROSE CHEMICAL CORPORATION
OF CALIFORNIA
TORRANCE, CALIFORNIA

SURFACE WATER FEATURES

HARGIS+ASSOCIATES, INC. 10/92

FIGURE 1.16

PREP BY _____ REV BY _____ RPT NO. 218.544 | 410-0190 | A



EXPLANATION

- MONTROSE PROPERTY
- BOUNDARY BETWEEN PHYSIOGRAPHIC FEATURES (DOTTED WHERE APPROXIMATE OR POORLY DEFINED)
- BOUNDARY OF GROUNDWATER BASIN
- BOUNDARY OF FOREBAY AND WHITTIER AREA
- AXIS OF SUBMARINE CANYON

SOURCE: CDWR, 1961

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MILES

MONTROSE CHEMICAL CORPORATION
OF CALIFORNIA
TORRANCE, CALIFORNIA

PHYSIOGRAPHY,
TORRANCE AREA

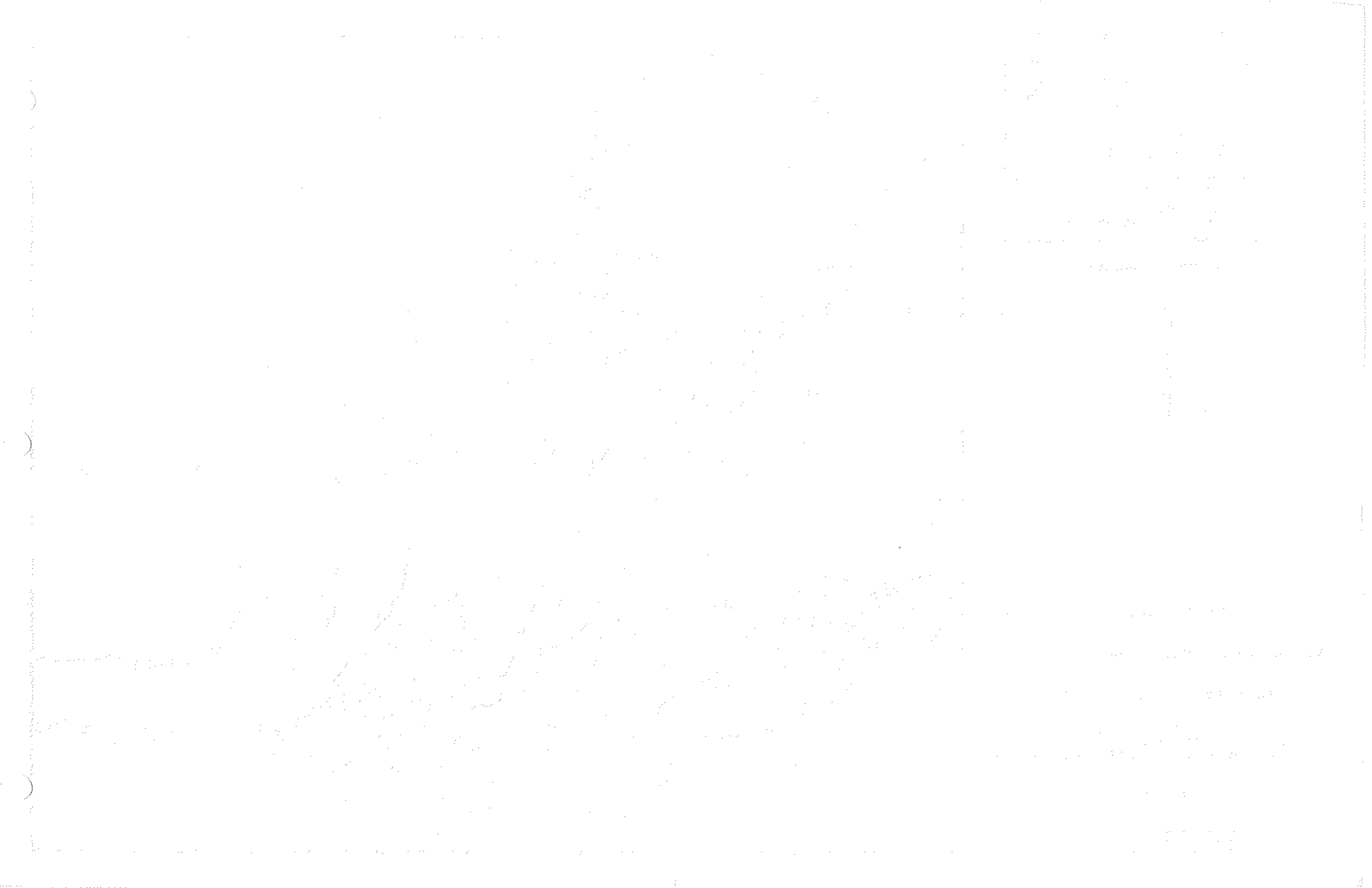
HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

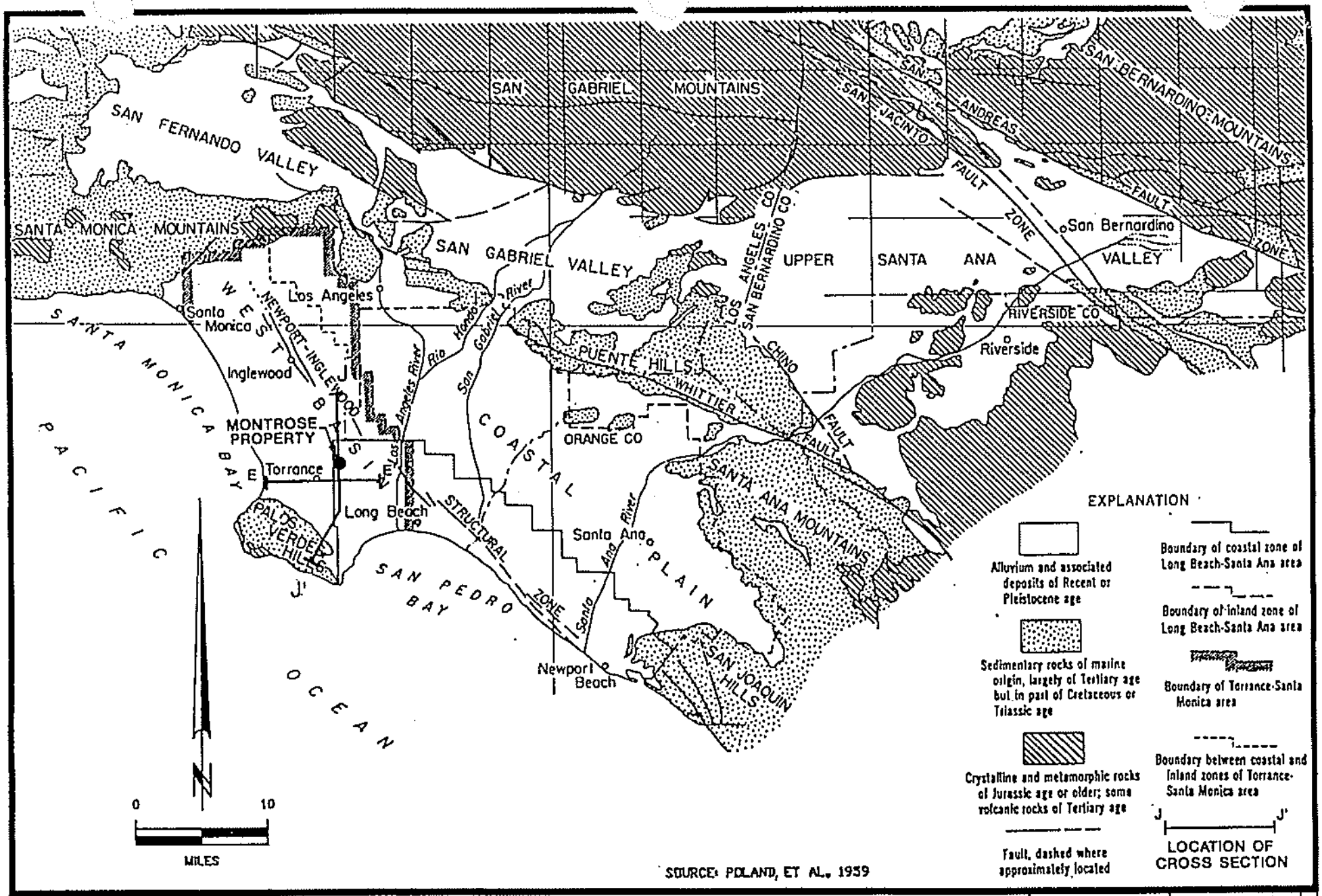
11/90

FIGURE 1.17

PREPARED BY _____ REVIEWED BY _____

RI504-1\F01-5





HARGIS+ASSOCIATES, INC.

RPT NO. 218.544 | 410-0209 | A

FIGURE 1.18 REGIONAL GEOLOGY

SYSTEM	SERIES	FORMATION	LITHOLOGY	AQUIFER AND AQUICLUDE	MAX. THICKNESS (FEET)	PREVIOUS FORMATION NAMES*	PREVIOUS AQUIFER NAMES*
QUATERNARY	RECENT	ACTIVE DUNE SAND		SEMIPERCHED	60	ALLUVIUM	SEMIPERCHED†
		ALLUVIUM		BELLFLOWER AQUICLUDE	140		
				GASPUR	120		GASPUR†
				BALLONA	40		"50 FOOT GRAVEL"
	UPPER PLEISTOCENE	OLDER DUNE SAND		SEMIPERCHED BELLFLOWER AQUICLUDE	200	TERRACE COVER	
		LAKEWOOD FORMATION		EXPOSITION ARTESIA	140	PALOS VERDES SAND	SEMIPERCHED†
				GARDENA	160	UNNAMED UPPER PLEISTOCENE	GARDENA†
				GAGE	160		"200 FOOT SAND"
		UNCONFORMITY				LOCAL UNCONFORMITY	
	LOWER PLEISTOCENE	SAN PEDRO FORMATION		HOLLYDALE	100	SAN PEDRO FORMATION	
				JEFFERSON	140		
				LYNWOOD	200		"400 FOOT GRAVEL"†
				SILVERADO	500		SILVERADO †
				SUNNYSIDE	500		
TERTIARY		LOCAL		UNCONFORMITY			
	UPPER PLIOCENE	PICO FORMATION		UNDIFFERENTIATED		PICO FORMATION	

EXPLANATION

- GRAVEL AND SAND
- SAND
- SILTY OR SANDY CLAY
- CLAY OR SHALE

DESIGNATED AS "WATER-BEARING ZONES" IN CDWR 1961

SOURCE: MODIFIED FROM CDWR, 1961

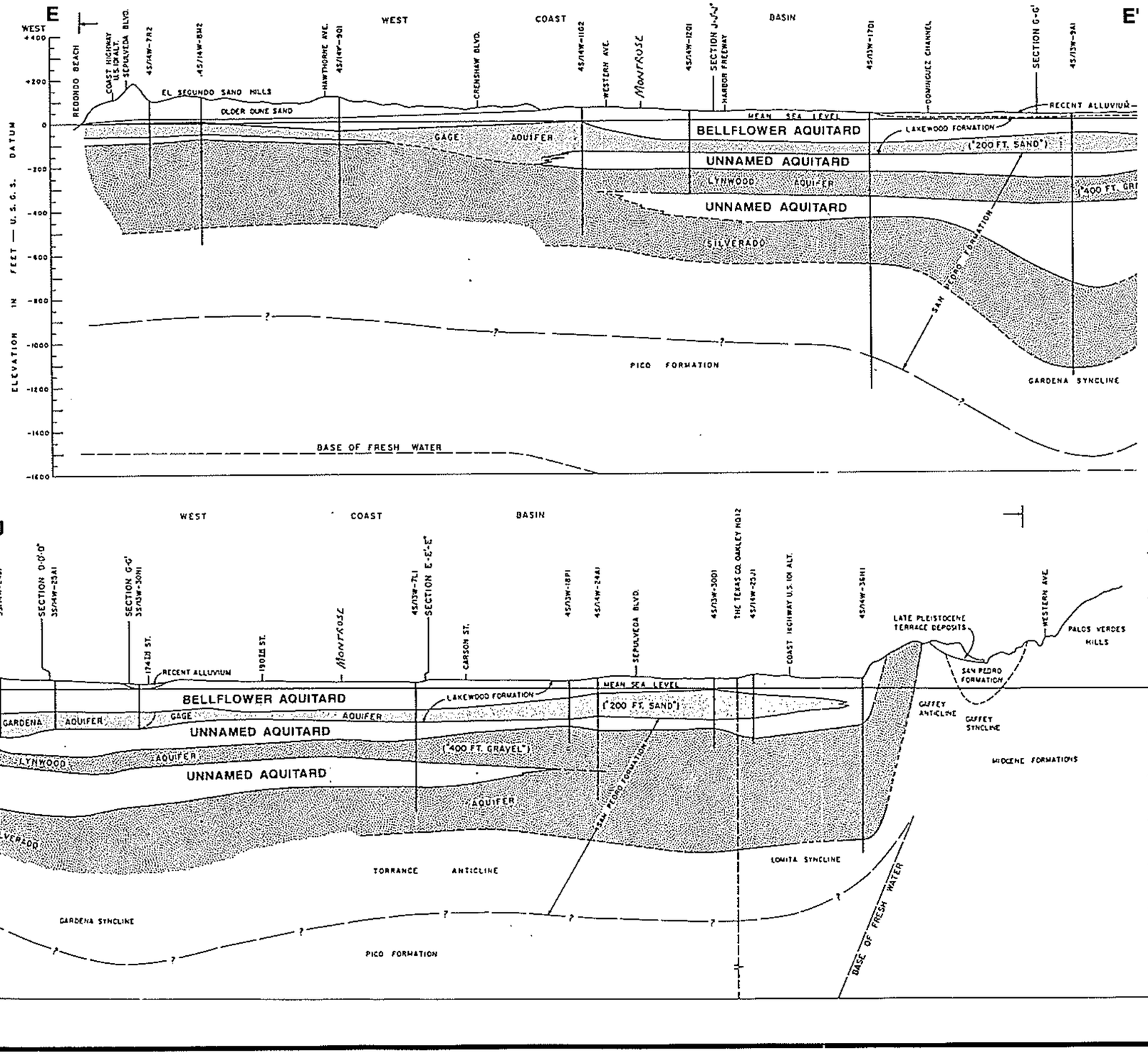
MONTROSE CHEMICAL CORPORATION
OF CALIFORNIA
TORRANCE, CALIFORNIA

GENERAL STRATIGRAPHIC COLUMN COASTAL PLAIN

HARGIS+ASSOCIATES, INC. 10/92

FIGURE 1.19

PREP BY ____ REV BY ____ RPT NO 218.544 | 710-0054 | A



EXPLANATION

- AQUITARDS AND DEEPER UNDIFFERENTIATED FORMATIONS
- AQUIFERS IN LAKEWOOD FORMATION (INCLUDES THE ARTESIA, EXPOSITION, GAGE, AND GARDENA AQUIFERS)
- AQUIFER IN SAN PEDRO FORMATION (INCLUDES THE HOLLYDALE, JEFFERSON, LYNWOOD, SILVERADO, AND SUNNYSIDE AQUIFERS)
- WATER WELLS
- OIL WELLS
- BOUNDARY BETWEEN HYDROGEOLOGIC UNITS DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED
- INDICATES APPROXIMATE DIRECTION OF GROUNDWATER FLOW

NOTE: LOCATIONS OF CROSS SECTIONS ARE SHOWN ON FIGURE 1.18

ADAPTED FROM: CDWR, 1961.

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HORIZONTAL SCALE IN FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

HYDROGEOLOGIC CROSS SECTIONS TORRANCE AREA

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

11/90

FIGURE 1.20

PREPARED BY _____ REVIEWED BY _____

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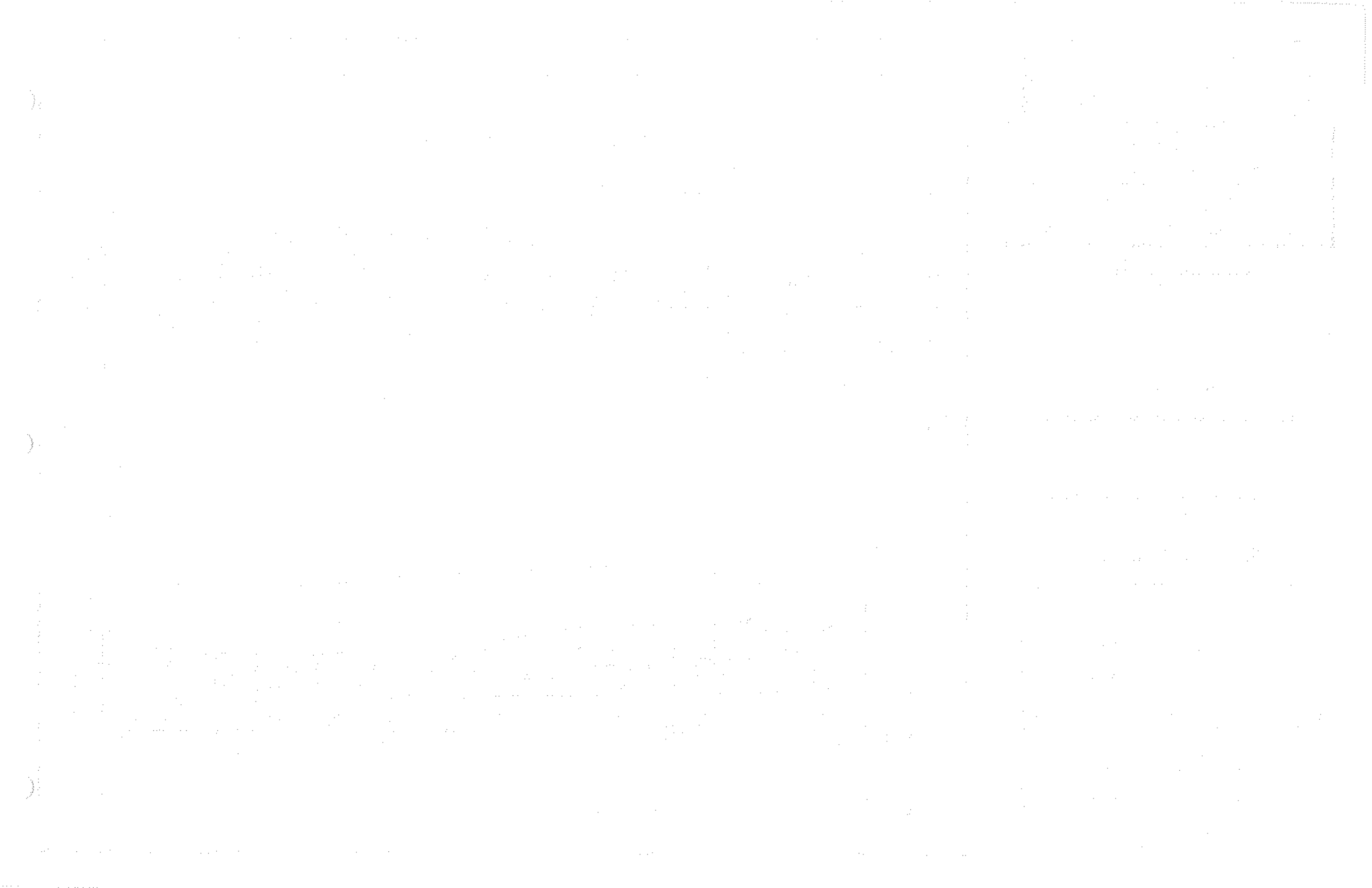

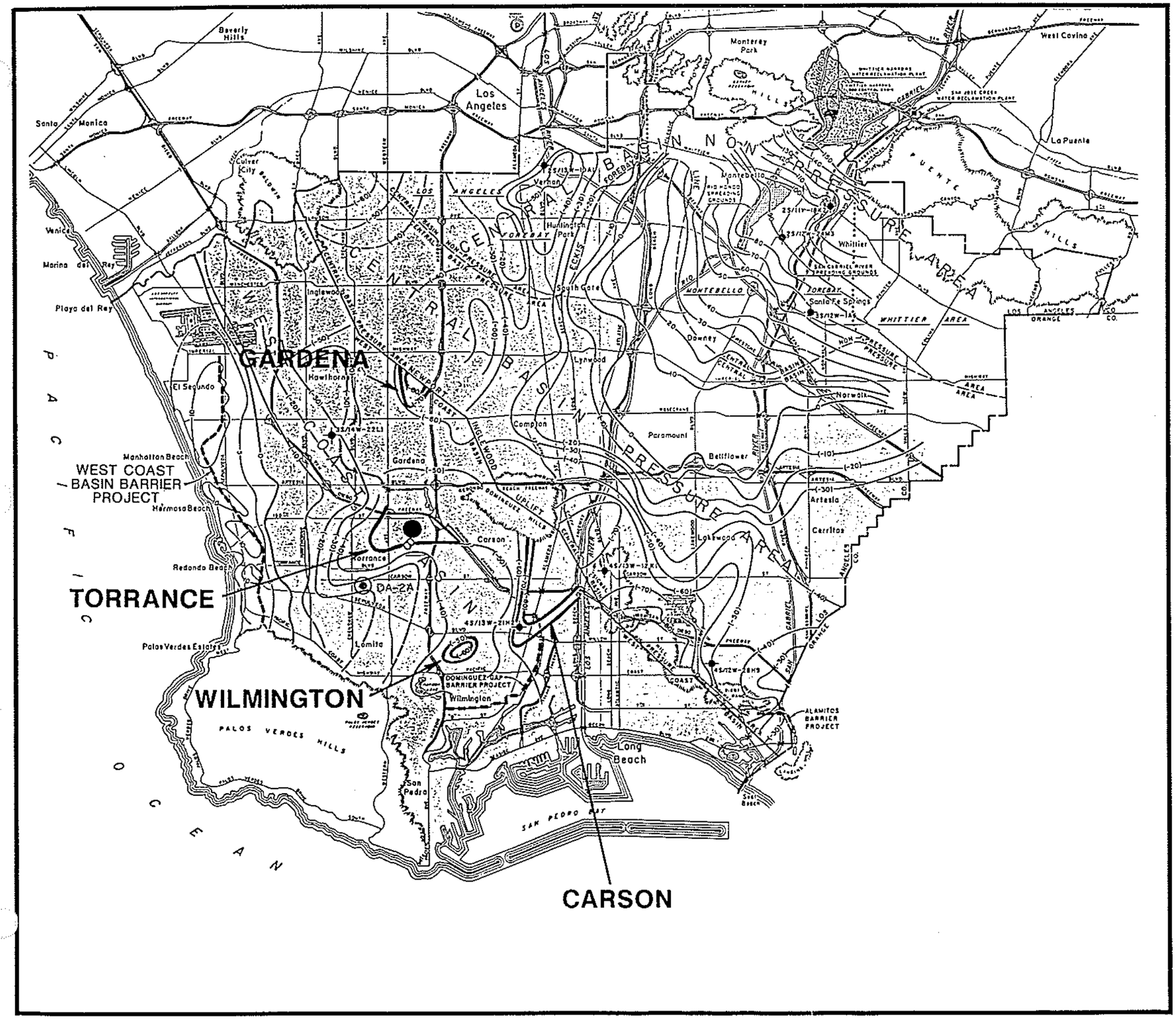

EXPLANATION

- MONTROSE PROPERTY
- BOUNDARY OF CENTRAL AND WEST COAST BASIN WATER REPLENISHMENT DISTRICTS
- 45/13W-21H2 — KEY WELLS
- DA-2A — MONITOR WELL CONSTRUCTED BY ECOLOGY & ENVIRONMENT (E&E)
- EXISTING BARRIER FACILITIES
- PROPOSED BARRIER FACILITIES
- AREA IN WHICH GROUNDWATER ELEVATIONS IN PRINCIPAL AQUIFER ARE BELOW SEA LEVEL
- 20 — CONTOUR LINE OF EQUAL WATER LEVEL ELEVATION IN FEET MEAN SEA LEVEL; DASHED WHERE APPROXIMATE

NOTE: GROUNDWATER CONTOURS ADAPTED FROM UNPUBLISHED DATA OF THE LOS ANGELES COUNTY FLOOD CONTROL DISTRICT WHICH ARE SUBJECT TO REVISION

SOURCE: BOOKMAN-EDMONSTON ENGINEERING, INC., 1989a

WATER LEVELS MEASURED NOVEMBER 1988

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MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

REGIONAL WATER LEVEL ELEVATIONS SILVERADO AQUIFER

HARGIS+ASSOCIATES, INC. 10/92

FIGURE 1.21

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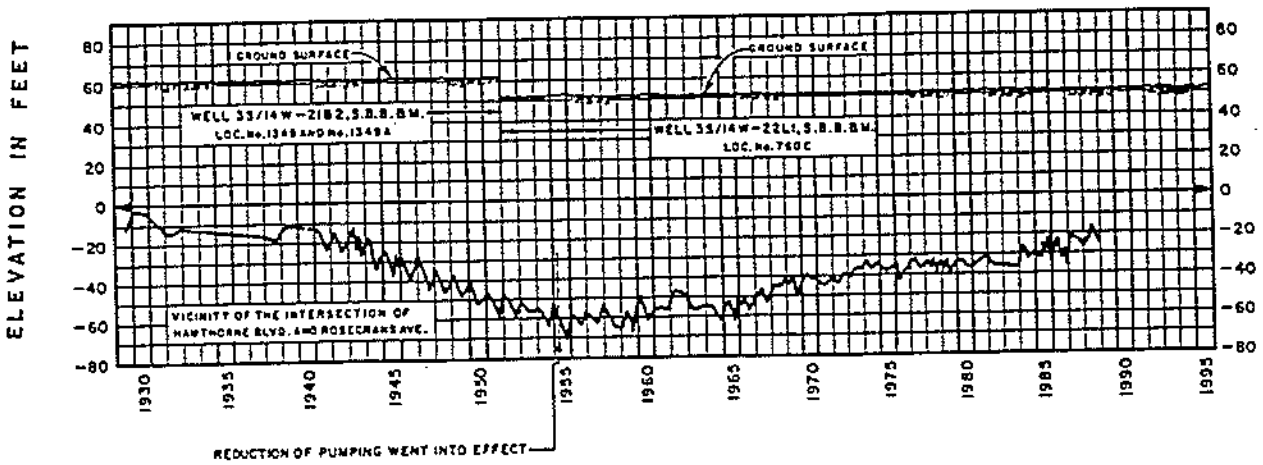


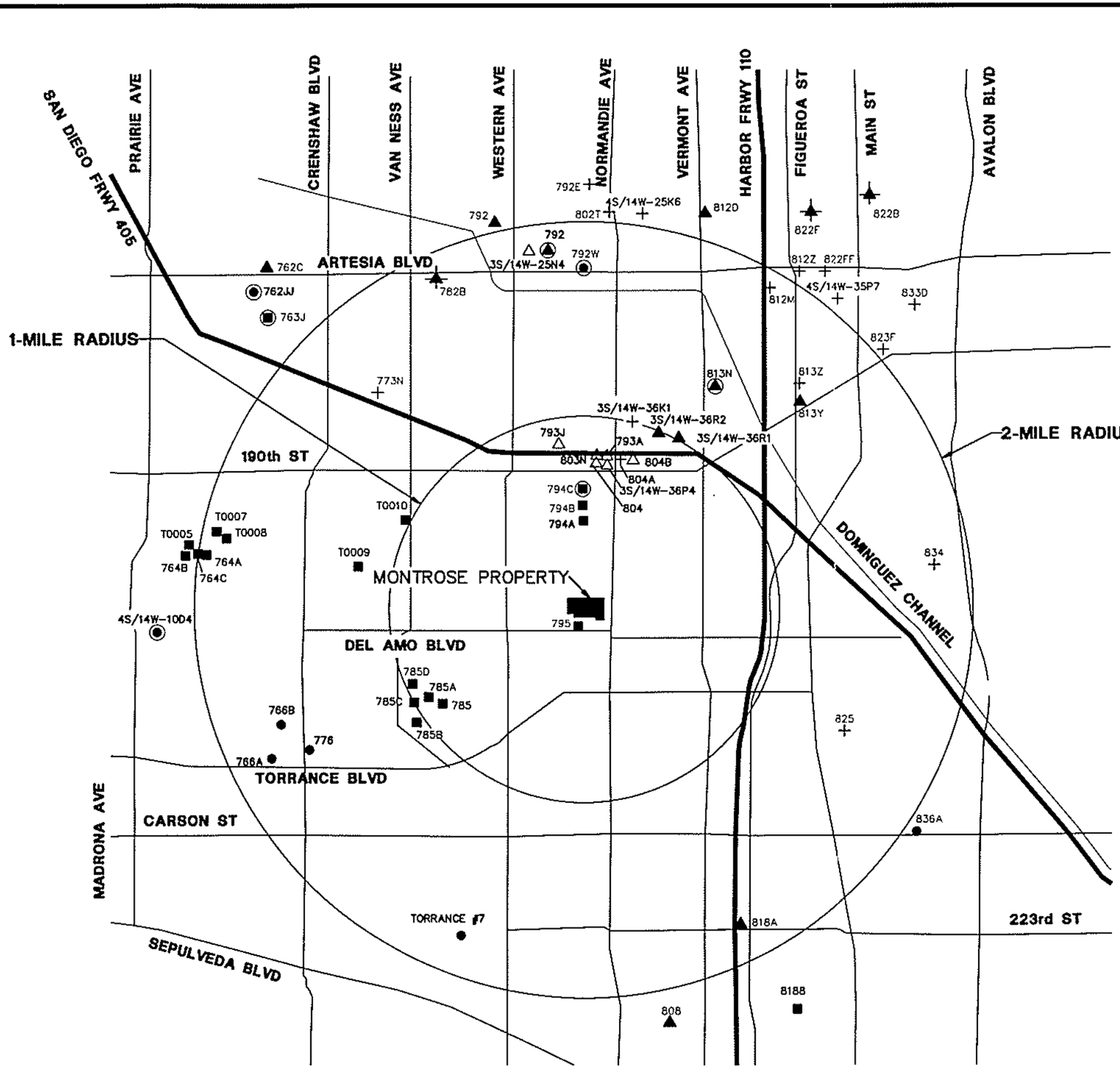
YEARS

NOTE: SEE FIGURE 1.21 FOR LOCATION OF WELL

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

7/97	RPT NO. 857 01	C/P	A

FIGURE 1.22 WATER LEVEL ELEVATIONS SILVERADO AQUIFER WELL 3S/14W-22L1



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EXPLANATION

- PUBLIC WATER SUPPLY WELL
- DENOTES WELL SAMPLED IN 1984 TO COMPLY WITH ASSEMBLY BILL 1803
- INDUSTRIAL WELL
- DENOTES WELL ACTIVELY MONITORED BY LACDPW
- DOMESTIC WELL
- DENOTES WELL ACTIVELY MONITORED BY LACDPW
- IRRIGATION WELL
- DOMESTIC/IRRIGATION SUPPLY WELL
- WELL OF UNKNOWN USE

794C — WELL NUMBERING SYSTEM USED BY LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS (LACDPW). FORMERLY LOS ANGELES COUNTY FLOOD CONTROL DISTRICT (LACFCD)

4S/14W-10D4 — WELL NUMBERING SYSTEM USED BY THE STATE OF CALIFORNIA, DEPARTMENT OF WATER RESOURCES

NOTE: DOES NOT INCLUDE MONITOR, OBSERVATION OR DESTROYED WELLS WITH THE EXCEPTION OF LACFCD WELL 795 LOCATED ADJACENT TO THE MONTROSE PROPERTY WHICH WAS DESTROYED IN DECEMBER, 1995

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FEET

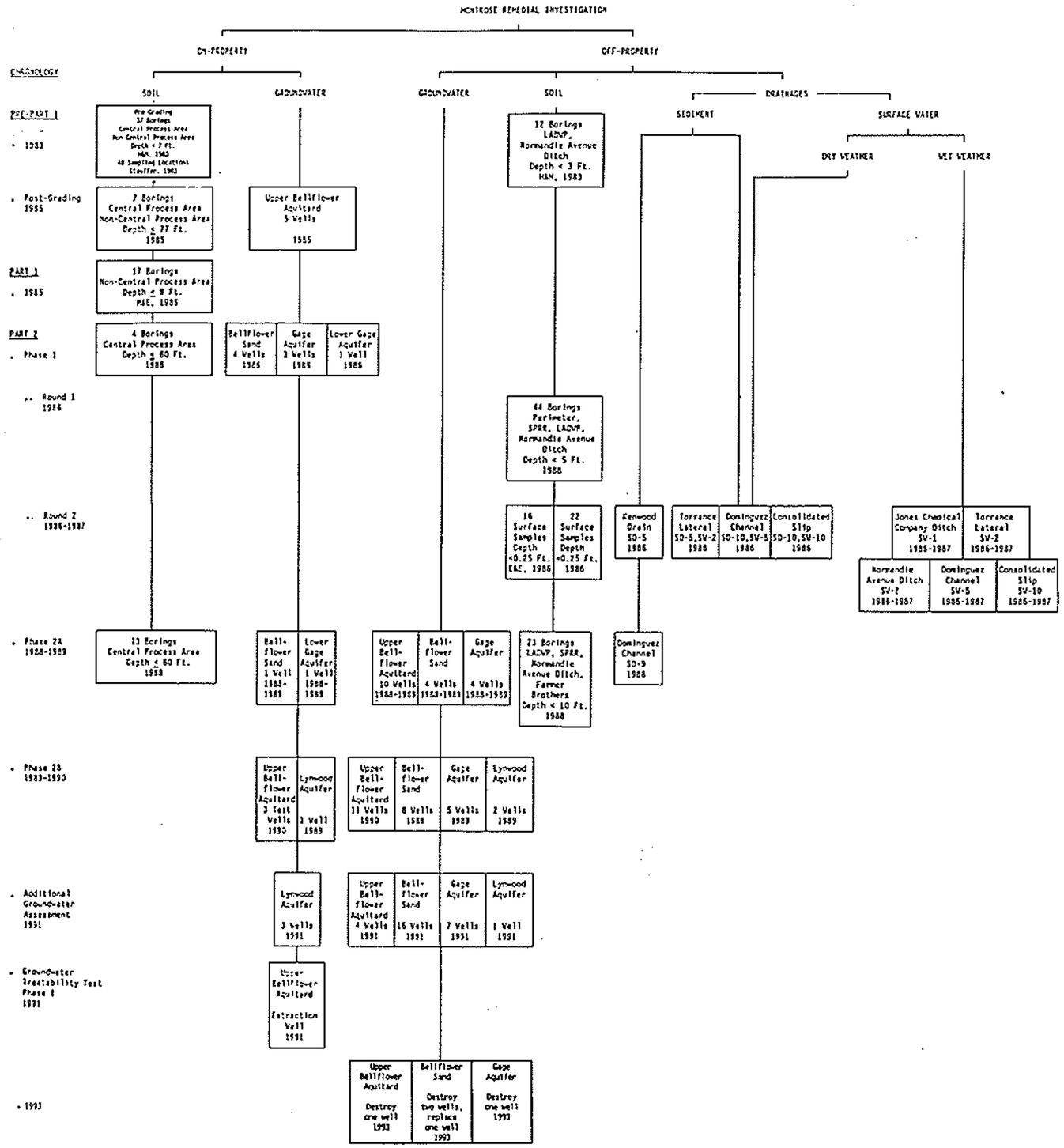
MONTROSE CHEMICAL CORPORATION
OF CALIFORNIA
TORRANCE, CALIFORNIA

WATER SUPPLY
WELLS WITHIN 2-MILE RADIUS
OF MONTROSE PROPERTY

HARGIS+ASSOCIATES, INC. 7/97

FIGURE 1.23

PREP BY _____ REV BY _____ RPT NO. 218.544 | 410-0206 | E



EXPLANATION

H&M	=	HARGIS AND MONTGOMERY, INC.
E&E	=	ECOLOGY AND ENVIRONMENT, INC.
LADWP	=	LOS ANGELES DEPARTMENT OF WATER AND POWER
M&E	=	METCALF & EDDY, INC.
SPRR	=	SOUTHERN PACIFIC RAILROAD
Ft	=	FEET
<	=	LESS THAN
≤	=	LESS THAN OR EQUAL TO
SD	=	SEDIMENT SAMPLING
SW	=	SURFACE WATER SAMPLING
SD-5	=	SEDIMENT SAMPLES COLLECTED IN 5 LOCATIONS
SW-10	=	SURFACE WATER SAMPLES COLLECTED IN 10 LOCATIONS

NOTES:

SEDIMENT AND DRY WEATHER SURFACE WATER SAMPLES COLLECTED CONCURRENTLY.
MONITOR WELL CONSTRUCTION DATA HAS BEEN SUMMARIZED (APPENDIX C).
SAMPLES COLLECTED BY MONTROSE, UNLESS OTHERWISE SPECIFIED.
DOES NOT INCLUDE 1981 SAMPLING, EPA SEDIMENT AND SURFACE WATER SAMPLING CONDUCTED IN 1994, NEIGHBORING INVESTIGATIONS, OR THE 1997 NORTHWEST CORNER INVESTIGATION.

MONTROSE CHEMICAL CORPORATION
OF CALIFORNIA
TORRANCE, CALIFORNIA

FLOW CHART OF MONTROSE REMEDIAL INVESTIGATION WORK 1983 THROUGH 1998

HARGIS+ASSOCIATES, INC. 8/97

FIGURE 1.24

PREP BY ____ REV BY ____ RPT NO 218.544 | 620-0047 | b

2.0 Site Investigation Activities

This section provides a summary of site investigation activities conducted in each of the four environmental media of concern investigated as part of this RI. Soil, groundwater, sediment, and surface water sampling was conducted from 1981 through March 1997 to evaluate the occurrence and potential migration of contaminants from the Property. RI activities were conducted in accordance with EPA-approved sampling plans, QAPPs, and health and safety plans. Changes in scope or modifications to these plans were documented in correspondence with EPA.

Additional studies conducted according the Consent Order included: an evaluation of groundwater treatability; a regional hydrogeologic assessment; a sanitary sewer investigation; and an Engineering Evaluation and Cost Analysis (EE/CA). The purpose and scope of the media specific RI activities, and the additional studies, are described in the following sections. A summary of the contents of H+A reports referenced in this report is provided in Appendix A.

As previously discussed in Section 1.9, EPA is planning to conduct other investigations at and in the vicinity of the Montrose Site that are not specifically discussed as part of this RI report. The chronology of site investigations for each of the environmental media described in this section is discussed in Sections 1.6 and 1.7 and summarized in Figure 1.24.

2.1 Soil Sampling

This section describes soil investigation activities conducted by Montrose and others since 1981. Soil at the Montrose Site was investigated primarily during the period 1983 to 1988, but Montrose also collected some samples in 1981. Soil sample collection and analysis took place as part of pre-RI activities conducted in 1981 and 1983 prior to the grading of the Property; in 1985 prior to beginning the RI; and during the period 1985 to 1988 as part of RI Part 1 and Part 2 activities. Additional soil sampling in the northwest portion of the Montrose property occurred in 1997, including the trash dike, junk yard, and salvage areas.

Soil sampling was conducted both On-Property and Off-Property. On-Property areas are further defined as within the Central Process Area and outside the Central Process Area. Off-Property sampling areas consist of the property perimeter, the Normandie Avenue Ditch, the LADWP right-of-way, Jones Chemical property, Farmer Brothers property, neighborhood, and background locations. Soil sampling was performed by Montrose unless otherwise specified.

The objectives of RI soil sampling, number and locations of soil borings, soil sample intervals, and chemical analyses performed during soil sampling activities are described below. Soil sampling methods and procedures are described in the sampling plans and QAPPs (H+A, 1984R, 1985R-a, 1986R-a, 1986R-b, 1986R-f, 1986R-g, 1988R-d, and 1988R-e). Soil sampling locations, depth intervals, and analytical methods for each phase of investigation were discussed with EPA and documented in the sampling plans that were approved by EPA prior to sample collection. Changes in scope or modifications to these

plans were documented in correspondence with EPA (EPA, 1988C-b, 1989C-a, 1989C-b, 1989C-c, 1989C-d, 1989C-g; H+A, 1988C-c, 1989C-d, 1989C-e, 1989C-f, 1989C-g, and 1989C-i).

Soil sampling locations were determined using a variety of techniques. Some samples were collected in evenly spaced or grid patterns within identified areas, some were collected in transects across identified drainages, and some were collected near known source areas. A random sampling approach was not used. Initial phases of investigation focused on shallow soil and analysis of a wide range of analytes. Subsequent phases of investigation targeted deeper soil intervals and selected analytes, based on the results of the earlier shallow soil sampling.

Soil boring construction data, including results of soil sampling and lithologic logs, have been summarized, compiled, and provided to EPA in the Montrose database and in field data and raw analytical data submittals as specified in the Consent Order (Hargis & Montgomery [H&M], 1983R; H+A 1985R-b, 1986R-c, 1986R-d, 1986R-e, 1986R-h, 1986R-i, 1987R-b, 1987R-c, 1987R-d, 1987R-e, 1988R-n, 1988R-o, 1988R-q, 1988R-r and 1990R-b; Stauffer, 1983).

2.1.1 On-Property Soil Sampling, Pre-Grading, 1981 and 1983

This section describes On-Property soil sampling conducted prior to the Property being graded and prior to the commencement of the RI in 1985.

Pre-grading soil sampling was conducted On-Property in 1981 and 1983. The sampling objectives, sample locations, sample depths, soil boring identifiers, and analytes for the On-Property soil sampling conducted in 1983 are summarized in Table 2.1. Table 2.2 provides the drilling date, total depth of boring, number of samples, and the maximum sample depth for each boring. Figure 2.1 shows the soil sampling locations for the 1981 and 1983 events.

In May 1981, Montrose collected three samples from one boring in the southeastern portion of the property. Samples were collected from 0.5, 1.0, and 1.5 feet bls. Each sample was divided into three splits: one analyzed by the Department of Health Services, one analyzed by Smith-Emery Laboratory for both Jones Chemical and Montrose, and one analyzed internally by Stauffer Chemical. Samples were analyzed for DDT, chlorobenzene, pH, alkalinity, and PCBs. The sampling locations are shown in Figure 2.1. Samples were also collected Off-Property at this time.

In August 1981, Montrose collected five samples for DDT analysis On-Property. Four of the samples (8-81-10, 11, 13, and 14) were collected in "areas of high exposure" (Montrose, 1981c). Sampling locations from this sampling event are shown in Figure 2.1. Samples were also collected Off-Property.

As shown in Figure 2.1, two soil samples were collected by Montrose in the southeast portion of the property in November 1981. Samples were analyzed for DDT and chlorobenzene. An additional Off-Property soil sample and two surface water samples were also collected.

In June 1983, Montrose drilled and sampled 19 soil borings On-Property to total depths of approximately 2.5 feet bls. In August 1983, additional deeper soil samples were collected at six of these On-Property soil boring locations to total depths of approximately 6 feet bls. During the August 1983 sampling event, soil samples were also collected from 12 additional

On-Property soil borings drilled and sampled to depths ranging from approximately 2 to 4 feet bls.

Eighty soil samples collected from soil borings sampled in June and August 1983 were analyzed for total DDT and the metabolites DDD and DDE and their isomers.

In July 1983, composite soil samples were collected from 48 sampling locations across the Property (Stauffer, 1983). The July 1983 soil samples were collected at five specific On-Property areas. As shown in Figure 2.1, samples were collected in the northwest corner of the Property, (in two north-south transects parallel and adjacent to the former location of the railroad tracks) from soil stockpiled along the northern property boundary, from stockpiled soil excavated from the recycle pond, a debris pile (principally stockpiled soil) in the southeast perimeter area, and from an area adjacent to the southern property boundary north of Jones Chemical Company. Soil samples were collected from stockpiled soil (above grade) at 13 locations. Soil samples were collected below grade at sample depths ranging from 1 to 15 feet bls at 10 locations. Core samples were collected at depths of 1 foot bls at 25 locations. Available documentation does not indicate why those five specific areas were selected for sampling. However, it is likely that these areas were selected because they were potential waste discharge areas. At each sampling location, 5 to 25 discrete samples were collected, combined, and homogenized by rolling and crushing. Soil samples were collected according to guidelines in EPA publication SW-846 "Test Methods for Evaluating Solid Waste" (July 1982). The composited soil samples were analyzed for DDT, DDD, DDE, and their isomers based on EPA Method 8080.

2.1.2 1985 Grading and Change In Surface Elevation

In 1985, without the approval of EPA, Montrose graded the Property and redistributed the top few feet of surface soil. Figure 2.2 illustrates approximate changes in surface elevations that resulted from grading activities in 1985. The figure was prepared by comparing surface elevations and contoured topography measured across the Property prior to demolition of the facility in 1982 with surface elevations and contoured topography of the Property after grading and capping in 1985. Surface elevations were digitized, subtracted, and the resulting elevations were contoured electronically to prepare the change in the elevation figure. In general, the post-grading surface elevations in the northwest corner of the Property were approximately 1 to 3 feet lower than the pre-grading elevations. Post-grading elevations in the central and eastern portions of the Property were approximately 1 to 3 feet higher than pre-grading elevations, particularly in the areas where raised building pads were constructed (see Figure 4.1).

2.1.3 On-Property Soil Sampling, Post Grading, 1985-1997

The following sections describe soil investigation activities conducted since 1985 in each of two On-Property investigation areas, the Central Process Area and outside the Central Process Area. The sampling objectives, locations, range of sample depths, soil boring identifiers, and analytes for the On-Property soil investigations conducted from 1985 to 1988 are summarized in Table 2.3. Table 2.4 provides the drilling date, total depth of boring, number of samples, and the maximum sample depth for each boring. Figure 2.3 shows the soil sampling locations. Appendix K shows similar information for the sampling conducted in the northwest corner in 1997.

Excluding samples collected in the northwest corner in 1997, 41 On-Property soil borings have been drilled and sampled since the Property was graded and capped in 1985. In April and May 1985, Montrose drilled and sampled seven On-Property soil borings to depths ranging from approximately 6.5 to 80 feet bls. Five of these soil borings were subsequently converted to groundwater monitoring wells. In June 1985, EPA subcontractor M&E drilled and sampled 17 On-Property soil borings ranging in depth from 9.5 feet bls to 19.5 feet bls. These samples were collected on a grid of about 200 feet across the Property. In September 1986, Montrose collected soil samples from four On-Property soil borings drilled and sampled to total depths of approximately 60 feet bls. In September and October 1988, Montrose collected soil samples from 13 soil borings ranging in depth from approximately 11 to 135.6 feet bls. In March 1997, Montrose collected 76 samples from approximately the surface and 2.5 feet bls from 38 borings. Information on the locations, numbers, and types of samples collected in the northwest corner is included in a report (McLaren Hart, 1997) attached as Appendix K.

2.1.3.1 Central Process Area

Twenty-four of the 41 On-Property soil borings were drilled and sampled On-Property within the Central Process Area during the period from April 1985 through November 1988. Most of the 174 soil samples collected from these soil borings were analyzed for pesticides and VOCs. A subset of samples was also analyzed for base neutral/acid organic compounds, chloral, and trace metals. Appendix B lists the analytes for each sample. Analytical results of 25 soil samples collected from 8 of the Central Process Area borings were used to evaluate the distribution of pesticides and VOCs potentially associated with the occurrence of DNAPL below the water table.

Soil borings located within the Central Process Area were drilled in and around the former location of the wastewater recycle pond, the below grade wastewater treatment tanks, and the processing building. Figures 1.2 and 2.3 show the location of the process units and sampling locations, respectively. As indicated in Table 2.4, total depths of these soil borings ranged from approximately 9.5 to 135.6 feet bls. Soil samples were collected approximately every 1.5 feet to a depth of approximately 10 feet bls). Below approximately 10 feet bls, samples were collected every 5 to 10 feet.

2.1.3.2 Outside Central Process Area

One hundred fifty-two soil samples were collected from 17 soil borings drilled On-Property outside of the Central Process Area during the period from April 1985 through June 1985. Analytical results of these soil samples were used to evaluate the distribution of pesticides and VOCs in unsaturated soil beneath the Property in the area outside of the Central Process Area. An additional 76 samples were collected in the northwest corner during March 1997.

As indicated in Table 2.4, the total depths of these soil borings, excluding the northwest corner samples collected in 1997, ranged from approximately 9.5 to 78 feet bls. Soil samples were collected approximately every 1.5 feet to approximately 10 feet bls. Below approximately 10 feet bls, soil samples were collected every 5 to 10 feet. Soil samples were analyzed for pesticides and VOCs. A subset of samples was also analyzed for base neutral/acid extractable organic compounds, chloral, and trace metals. Appendix B lists the analytes for each sample.

Additional samples were collected in 1997 in the northwest portion of the Property including in the trash dike, junk yard and salvage area to characterize the nature and extent of contamination existing after the grading was conducted in 1985. Of the samples collected in the northwest corner in 1997, 44 were analyzed for DDT using immunoassay methods, 43 were analyzed for pesticides and polychlorinated biphenyls (PCBs) using CLP Methods, and 12 were analyzed for VOCs.

2.1.4 Off-Property Soil Sampling

The following sections describe soil sampling conducted Off-Property. Off-Property soil investigations were conducted during the period from 1981 to 1988 and in the northwest corner in 1997. Off-Property soil samples were collected from several locations adjacent to the Property, including the Property perimeter, the LADWP right-of-way, the Normandie Avenue Ditch, and the Farmer Brothers property. Figure 2.4 shows the locations of these areas as well as the sampling locations. Soil samples were also collected from Off-Property areas located more distant from the Property. The more distant Off-Property sampling locations are referred to as neighborhood and background soil sampling locations, shown in Figures 2.5 and 2.6, respectively. Table 2.4 provides the drilling date, total depth of boring, number of samples, and the maximum sample depth for each boring. The objectives, sampling locations, soil boring identifiers, range of sample depths, and analytes for each Off-Property sampling event are summarized in Table 2.5. The sample date and location for background and neighborhood soil samples are listed in Table 2.6.

In 1981, 50 samples were collected Off-Property by Montrose. Excluding the samples collected on the perimeter just outside the northwest corner of the property in 1997, 69 soil borings have been drilled and sampled Off-Property since 1983. The objectives of this soil sampling were to determine the extent of chemical compounds Off-Property that may have resulted from former activities at the Montrose plant and to gather data of sufficient quality to support the FS. The results of 421 soil samples collected from these soil borings were used to evaluate the occurrence and distribution of pesticides and VOCs in Off-Property soil in areas immediately adjacent to the Property (Section 5.2).

In 1997, sampling was also conducted along the perimeter to the north and west of the northwest corner of the property.

Soil samples were also collected Off-Property at locations more distant from the Property. Fifty-four samples were collected from 32 locations in the neighborhood surrounding the Property. Background soil samples were collected at 4 locations located within about 3 to 5 miles of the Property.

The following sections provide specific information regarding soil sampling activities conducted at each of the four near Off-Property soil investigation areas and the two more distant neighborhood and background soil investigation areas.

2.1.4.1 Property Perimeter and Jones Chemical Company

As shown in Figure 2.4, property perimeter soil borings were drilled and sampled Off-Property immediately adjacent to the Property boundaries on the Jones Chemical Company property south of the Property, on the McDonnell Douglas property to the north and west of the Property, and in the SPRR right-of-way to the east of the Property. The locations of

the samples collected just outside of the northwest corner in 1997 are shown in the report attached as Appendix K.

Thirteen soil samples were collected for DDT analysis north, south, east, and west of the Property by Montrose in 1981. Records indicate that four of these samples were collected in flower beds east of Normandie Avenue (Montrose, 1981e). The results of these analyses have not been found.

Eighty soil samples were collected from 14 soil borings drilled around the Property perimeter in April and May 1986. Six MD-series soil borings were drilled on the McDonnell Douglas property north and west of Montrose, five JC-series soil borings were drilled on the Jones Chemical Company property south of Montrose, and two SP-series soil borings were drilled in the SPRR right-of-way east of Montrose. Total depths of these borings ranged from 4 feet bls to 7.75 feet bls. Soil samples were collected at approximately 1-foot intervals. The majority of soil samples collected from these soil borings were analyzed for pesticides and VOCs. Nine soil samples were also analyzed for base neutral/acid organic compounds. Appendix B provides a complete list of the analytes for each sample.

In 1994, as part of a PEA, soil, groundwater, and soil gas samples were collected at Jones Chemical Company (Levine-Fricke, 1995). Although not part of this RI, the data from the PEA are presented in figures in Section 5.0 to supplement the RI data and provide a better understanding of the extent of contamination. The PEA data are not included in the data summaries in Appendix H.

In 1997, as a part of the northwest corner investigation, an additional 63 samples were collected at 32 borings north and west of the property. All 63 samples were analyzed for DDT by immunoassay methods and 15 were analyzed also for pesticides and PCBs using CLP methods.

2.1.4.2 LADWP Right-Of-Way

The LADWP right-of-way is located south of the Property (Figure 2.4). Soil borings located in the LADWP right-or-way include soil borings drilled west of the Normandie Avenue Ditch area and north of the Farmer Brothers property. One hundred twenty soil samples were collected from 24 LA-series soil borings drilled in the LADWP right-of-way during the period from June 1983 through September 1988.

1981 Sampling. As shown in Figures 2.3 and 2.4, four surface soil samples were collected by Montrose in LADWP right-of-way in 1981. Samples were analyzed for DDT.

1983 Sampling. Five S-series soil borings were drilled and sampled to depths of about 1.5 to 2 feet bls in 1983 (Table 2.1). The 11 soil samples collected from these soil borings were analyzed for total DDT, the metabolites DDD and DDE, and their isomers.

1986 Sampling. Fourteen LA-series soil borings were drilled and sampled to depths of about 6 feet bls in 1986. The majority of the 90 soil samples collected from these soil borings were analyzed for pesticides and VOCs. Eleven samples were also analyzed for base neutral/acid organic compounds.

1988 Sampling. Nineteen soil samples collected from 5 LA-series soil borings drilled and sampled to depths of about 3 feet bls in 1988 were analyzed for pesticides.

2.1.4.3 Normandie Avenue Ditch

As shown in Figure 2.4, the Normandie Avenue Ditch parallels Normandie Avenue on the west side of the street and is located south of the Property, east of the Farmer Brothers property. Two hundred ten soil samples were collected from 44 soil borings drilled in the Normandie Avenue Ditch during the period from 1981 through September 1988.

1981 Sampling. Thirty-three soil samples were collected by Montrose at ten locations in the Normandie Avenue Ditch in 1981. In five borings, samples were collected from five depths: the surface, 0.5 feet, 1.0 feet, 1.5 feet, and 2.0 feet. Each sample was divided into three splits: one analyzed by the Department of Health Services, one analyzed by Smith-Emery Laboratory for both Jones Chemical and Montrose, and one analyzed internally by Stauffer Chemical. Samples were analyzed for DDT, chlorobenzene, pH, alkalinity, and PCBs. The sampling locations are shown in Figure 2.3.

1983 Sampling. Fourteen soil samples were collected from 7 S-series soil borings drilled in the Normandie Avenue Ditch in 1983. Sample depths ranged from about 0.5 to 5 feet bls. Soil samples collected from these soil borings were analyzed for total DDT and the metabolites DDD and DDE and their isomers.

1986 Sampling. Ninety-four soil samples were collected from 17 soil borings drilled along four east-west transects across the north-south trending Normandie Avenue Ditch in 1986. The transects were located approximately 75, 150, 250, and 375 feet south of the Property. Transect widths ranged from approximately 10 to 40 feet. Three to six soil borings were drilled at regularly spaced intervals along each transect. Total depths of the soil borings ranged from about 4 to 6 feet bls. The majority of soil samples collected from these soil borings were analyzed for pesticides and VOCs. Six soil samples were also analyzed for base neutral/acid organic compounds. Appendix B lists the analytes for each sample.

1988 Sampling. Fifty-two soil samples were collected from 6 deeper soil borings drilled along the four east-west transects across the Normandie Avenue Ditch in 1988. One to two additional soil borings were drilled along each transect adjacent to boring locations previously drilled and sampled in 1986. T-3 and T-6 series samples were collected to depths of about 22 feet bls. T-4 and T-5 series samples were collected to depths of about 61 feet bls. Soil samples collected from these soil borings were analyzed for pesticides and VOCs.

Seventeen soil samples were collected from 4 SP-series soil borings drilled in the Normandie Avenue Ditch along the Southern Pacific Railroad right-of-way in 1988. Sample depths ranged from 1.5 to 6 feet bls. Soil samples collected from these soil borings were analyzed for pesticides.

2.1.4.4 Farmer Brothers Coffee Company

As shown in Figure 2.4, the Farmer Brothers property is located south of the Property and south of the LADWP right-of-way. Forty-four soil samples were collected from seven shallow soil borings drilled on the Farmer Brothers property during September 1988. The soil borings were drilled along an east-west trending transect located across a possible north-south trending historical surface drainage pathway from the Property. The length of the transect was approximately 30 feet. The seven borings were drilled at regularly spaced intervals along the transect. Total depth of these soil borings was 9.25 feet bls. Soil samples collected from these soil borings were analyzed for pesticides. Additional soil samples

were collected in 1994 at Farmer Brothers in an area slated for construction as part of a building expansion (McLaren/Hart, 1994). Section 1.8 describes the scope of the investigation. Although not a part of the RI, the data from this investigation are presented in figures in Section 5.0 to supplement the RI data. These 1994 data from Farmer Brothers property are not included in the tables in Appendix H.

2.1.4.5 Neighborhood Soil Samples

Forty-six neighborhood soil samples were collected at 32 sampling locations in areas more distant from the Property than the near Off-Property areas previously discussed in Sections 2.1.2.1 through 2.1.2.4. Neighborhood soil sampling was conducted in May and September 1986. The locations of the neighborhood soil samples are shown in Figure 2.5.

May 1986 Sampling. In May 1986, 21 neighborhood soil samples were collected by Montrose from 17 soil sample locations in areas east of the Property. Soil samples were collected along two arcs located at radial distances of approximately 1/2 and 3/4 miles northeast, east, southeast, south, and southwest of the Property, respectively. Total depths of the soil samples collected during this sampling event were less than 0.25-foot bls. All soil samples collected from these sample locations were analyzed for pesticides. Some soil samples collected from these sample locations were also analyzed for VOCs and base neutral/acid organic compounds. Appendix B lists the analytes for each sample.

September 1986 Sampling. In September 1986, 35 neighborhood soil samples were collected from 15 soil sample locations in areas near the Property by EPA subcontractor E&E. These 15 soil sample locations were within about 2,900 feet northeast, east, southeast, south, and southwest of the Property. Soil samples were collected from these 15 soil sample locations at depths ranging from land surface to approximately 2 inches bls. Soil samples collected from these sample locations were analyzed for DDT, DDD, and DDE.

2.1.4.6 Background Soil Samples

Fourteen background soil samples were collected during three sampling events at 9 locations ranging from 1.4 to 5.1 miles from the Property. Figure 2.6 shows the locations of the background samples. The majority of these samples were analyzed for pesticides. Some background samples were also analyzed for VOCs, trace metals, and base neutral/acid organic compounds. Appendix B provides a complete list of the analytes for each sample.

June 1985 Sampling. In June 1985, seven background soil samples were collected from two soil borings located approximately 1 mile west and 1.7 miles north of the Property. Field work was conducted for EPA by M&E. The two background soil borings, designated "Van Ness" and "Artesia," were drilled and sampled to depths of 4.2 and 9.4 feet bls, respectively. The majority of soil samples collected from these soil borings were analyzed for pesticides and VOCs. Some samples were also analyzed for base neutral/acid organic compounds and trace metals. Analytical results of these samples were obtained from EPA and are incorporated in this report.

May 1986 Sampling. In May 1986, three background soil samples were collected at three locations approximately 2.4 miles west, 2 miles southwest, and 3 miles southwest of the Property. Field work was conducted by Montrose. Two background soil samples, designated as 5-5-S(B) and 5-8-S(B), were collected at depths of approximately 1 foot bls.

The sample designated 5-20-S(B) was collected from the top 1 to 3 inches of soil. These soil samples were analyzed for pesticides and VOCs. Analytical results for these samples have been summarized in previous reports as well as this RI Report (H+A, 1986R-c, 1986R-e, and 1987R-c).

September 1986 Sampling. In September 1986, four background soil samples were collected at four locations approximately 3.5 to 5 miles west and southwest of the Property (E&E, 1986). Field work was conducted for EPA by E&E. Soil samples were collected at land surface using a trowel. These soil samples were analyzed for pesticides.

2.2 Groundwater Investigation Activities

This section describes groundwater investigation activities conducted as part of this RI. Groundwater investigations were facilitated by the construction of monitoring wells in each of the primary hydrogeologic units identified as part of this RI. Groundwater in three hydrogeologic units at the Montrose Site, the Bellflower Aquitard, the Gage Aquifer, and the Lynwood-Aquifer, was monitored during the period 1985 to 1995. Monitoring wells were constructed to obtain data necessary to evaluate hydrogeologic conditions and water quality beneath the Montrose Site.

Monitoring wells were screened in four zones within the three hydrogeologic units, the Upper Bellflower Aquitard, the Bellflower Sand, the Gage Aquifer, and the Lynwood-Aquifer. Water level elevations and groundwater samples were collected periodically and analyzed for pesticides and VOCs. Appendix B lists the analysis conducted on each groundwater sample. The assessment of the nature and extent of groundwater contamination is based on the analysis of groundwater samples from 95 groundwater monitoring wells installed in the Montrose Site vicinity (33 wells within the Upper Bellflower Aquitard, 34 wells within the Bellflower Sand, 21 wells within the Gage Aquifer, and 7 wells within the Lynwood Aquifer). The number of groundwater analyses that have been completed for each chemical at each well ranges from 1 to 26 (Table 5.5). VOCs have been analyzed the most often (i.e., 844 analyses for chlorobenzene and as summarized in Table 5.4). Only half as many samples (452) have been analyzed from total BHC and total DDT, and only approximately a quarter of the samples (217) were analyzed for p-CBSA. Groundwater was sampled by Montrose unless otherwise specified. In conjunction with Montrose sampling events, some groundwater samples were collected for analysis by EPA.

Monitoring wells were initially installed On-Property at the water table in 1985. Additional monitoring wells were installed farther from the Property and at greater depths based on the nature and distribution of compounds detected during initial and subsequent sampling efforts. Monitoring wells were installed during five separate phases of RI work. Exploratory borings were drilled and logged at many of the monitoring well locations to assist in the evaluation of hydrogeologic conditions and the design of monitoring wells. Soil core samples were collected from exploratory borings and borings used to construct monitoring wells. Soil core samples were tested for physical parameters. Aquifer tests were conducted in selected monitoring wells to estimate hydraulic parameters. The purpose and scope of each aspect of the groundwater investigation are described below.

2.2.1 Monitoring Well Installation

Ninety-one monitoring wells were constructed between 1985 and November 1991 at the Montrose Site. Table 2.7 lists the monitoring well construction information including the objective, location, and hydrogeologic unit for each well. Figure 2.7 provides a schematic of the wells constructed in each of the four units. Specific monitoring well construction data for each monitoring well have been summarized and are provided in Appendix C. Thirty MW-series monitoring wells were constructed in the Upper Bellflower Aquitard and screened at the water table. Thirty-three BF-series monitoring wells were constructed in the Bellflower Sand. Nineteen G-series monitoring wells were constructed in the upper portion of the Gage Aquifer. Two LG-series monitoring wells were constructed in the lower portion of the Gage Aquifer. Seven LW-series monitoring wells were constructed in the Lynwood-Aquifer. Figure 2.8 shows the location of all of the monitoring wells at the Montrose Site. Figures 2.10, 2.11, 2.12, and 2.13 show the location of the monitoring wells in each of the four hydrogeologic zones, the Upper Bellflower Aquitard, Bellflower Sand, Gage Aquifer, and Lynwood-Aquifer.

Upper Bellflower Aquitard monitoring wells were constructed at the water table using bucket auger and hollow-stem auger drilling methods. Deeper monitoring wells constructed in the Bellflower Sand were constructed using mud-rotary techniques. Deeper monitoring well installation activities included drilling and logging of exploratory borings to assist in the design of monitoring wells and to determine screened intervals. Soil core samples were also collected for testing of physical properties.

Monitoring wells were constructed during five phases of groundwater investigations between 1985 and 1991. Monitoring well construction activities are described in several sampling plans and QAPPs (H+A, 1984R, 1985R-a, 1986R-f, 1986R-g, 1988R-d, and 1988R-e). Changes in scope or modifications to these plans were documented in correspondence with EPA. Summaries of monitoring well construction data have been compiled and submitted to EPA as specified in the Consent Order. Monitoring well construction objectives, construction information, and exploratory boring data are described below.

Exploratory Borings. As shown in Table 2.8, 17 exploratory borings were drilled and logged as part of the groundwater investigation. Exploratory borings were drilled to total depths ranging from about 117 to 380 feet bls. Three exploratory borings were drilled On-Property (EB-1, EB-2, and EB-2A) and 14 exploratory borings were drilled Off-Property (EB-3 through EB-6, EB-8 through EB-17). Figure 2.9 shows the location of the exploratory borings. The exploratory borings were drilled prior to constructing monitoring wells in the Bellflower Sand, Gage Aquifer, and Lynwood-Aquifer to define hydrogeologic conditions, to assist in the design of monitoring wells, and to determine appropriate screen intervals. Geophysical logging was performed in all exploratory borings and in selected monitoring well borings.

Deep Monitoring Well Construction. This subsection describes monitoring well construction techniques for deep monitoring wells constructed in the Bellflower Sand, Gage Aquifer, and Lynwood-Aquifer. Deep monitoring wells were constructed using a dual-casing method to prevent cross-contamination from overlying units. This method of well construction has been shown to be effective in preventing cross contamination of deeper monitoring wells installed beneath highly contaminated shallower zones. This method has been effectively used by H+A and EPA at other sites in Region IX and is recommended by leading experts

in the design of investigations where the occurrence of DNAPL is suspected (CH2M HILL, 1993a and 1993b; EPA, 1996a; and Pankow and Cherry, 1996).

The deep monitoring well construction method involves drilling a 12- to 15-inch-diameter borehole to a target depth above the interval to be screened. Eight- to 10-inch-diameter steel conductor casing, fitted with a stab-in cementing shoe on the bottom, is welded and set into the fluid-filled borehole. The conductor casing is filled with fresh water to overcome buoyancy as it is being set. Used drilling mud is displaced out of the borehole as the conductor casing is lowered into the borehole and, therefore, does not come into contact with the interior of the conductor casing.

The annular space between the steel casing and the borehole is then pressure grouted with neat cement from the bottom of the borehole. This is accomplished by setting a temporary tremie pipe inside the conductor casing and stabbing it into the cement shoe, to seat the pipe and open the check valve in the shoe. Neat cement is mixed using a special mixer which allows the cement/water ratio to meet well construction specification. The proper mix of the neat cement is confirmed using a field balance. Neat cement is then pumped down the tremie pipe using a high pressure grout pump. The neat cement fills the annulus from the bottom up displacing the used mud upward and out of the annulus. Neat cement is pumped until neat cement returns are consistently observed at the surface.

Once the cement grout has set, a smaller diameter borehole is advanced into the interval below the steel conductor casing using new drilling mud. The final casing and screen are then set and the filter pack installed. A bentonite seal is emplaced in the annulus above the filter pack.

Soil Core Sampling. Physical properties of aquifer media were estimated based on the results of laboratory testing of soil samples collected from exploratory borings and borings used to construct monitoring wells. Discrete core samples were collected during the construction of selected monitoring wells and exploratory borings to provide estimates of vertical hydraulic conductivity, dry bulk density, specific gravity, and total organic carbon (TOC) of the aquifer media. Samples were collected at various depth intervals from monitoring wells and exploratory borings constructed upgradient, downgradient, and cross-gradient from the Property.

2.2.1.1 Upper Bellflower Aquitard Monitoring Wells

Thirty Upper Bellflower Aquitard monitoring wells have been constructed at the Montrose Site, all since 1985. As shown in Figure 2.10, 5 of these wells are located On-Property and 25 of these wells are located Off-Property. Upper Bellflower Aquitard monitoring well locations were selected to characterize groundwater conditions in the Upper Bellflower Aquitard and to evaluate the nature and extent of chemical compounds in groundwater that may have originated from Montrose's activities on the Property. Upper Bellflower Aquitard monitoring wells are designated as MW-series wells.

On-Property MW-series monitoring wells are located both inside the Central Process Area and outside the Central Process Area near the Property perimeter as shown in Figure 2.4.

Off-Property MW-series monitoring wells are located upgradient, cross-gradient, and downgradient of the Property. Five Off-Property MW-series monitoring wells are located upgradient of the Property on McDonnell Douglas. The remainder of the Off-Property MW-series wells are located cross-gradient and downgradient of the Property. Monitoring

well construction was conducted using an iterative-phased approach. Monitoring well locations were selected to characterize the nature and extent of contamination in groundwater at the water table in the Upper Bellflower Aquitard. The farthest downgradient Upper Bellflower Aquitard monitoring well is Monitoring Well MW-25 located approximately 2,200 feet southeast of the Property near the Armco Royal Boulevard site.

Monitoring Wells MW-1 through MW-5 were constructed in April 1985 using bucket auger techniques. Monitoring Wells MW-6 through MW-30 were constructed between November 1988 and September 1991 using hollow stem augers. Monitoring Well MW-15, located on Farmer Brothers property, was destroyed in August 1994 to allow for expansion of the Farmer Brothers facility. Monitoring Well MW-15 was not replaced.

Upper Bellflower Aquitard monitoring wells are constructed to total depths ranging from 68 feet bls to 85 feet bls and are screened across the water table. Lithologic logs of the monitoring well drill cuttings and monitoring well construction information were reported in several data submittals provided to EPA (H+A, 1985R-b; 1987R-a; 1989R-a; 1990R-c; and 1991R-d) and summarized in Appendix A.

2.2.1.2 Bellflower Sand Monitoring Wells

Thirty-three Bellflower Sand monitoring wells have been constructed at the Montrose Site since December 1986. As shown in Figure 2.11, 5 of these wells are located On-Property and 28 of these wells are located Off-Property. Bellflower Sand monitoring well locations were selected to characterize groundwater conditions and to evaluate the nature and extent of chemical compounds in groundwater within the Bellflower Sand subunit of the Upper Bellflower Aquitard that may have originated from Montrose's activities on the Property.

Bellflower Sand monitoring wells are designated as BF-series monitoring wells.

On-Property BF-series wells are located both within the Central Process Area and outside the Central Process Area near the Property perimeter. Off-Property BF-series monitoring wells are located upgradient, cross-gradient, and downgradient of the Property. One Off-Property BF-series monitor well (BF-18) is located upgradient of the Property on McDonnell Douglas property. The remainder of the Off-Property BF-series wells are located crossgradient and downgradient of the Property. The farthest downgradient BF-series monitoring wells are BF-26, BF-27, and BF-28 located approximately 1 mile southeast and downgradient from the Property.

On-Property Monitoring Wells BF-1 through BF-4 were drilled using a combination of bucket auger and conventional mud rotary drilling methods. The remainder of the BF-series wells were constructed using conventional mud rotary drilling techniques. The majority of the BF-series monitoring wells were constructed with conductor casing as previously described in Section 2.2.1 (subsection entitled "Deep Monitor Well Construction"). Monitoring Wells BF-32, BF-32A, and BF-33 were constructed without conductor casing. These three monitoring wells are located Off-Property approximately 2,200 to 4,500 feet southwest of the Property near Western Avenue where the Upper Bellflower Aquitard is unsaturated and the water table occurs in the Bellflower Sand.

Monitoring Well BF-32, located approximately 2,400 feet southwest of the Property on 205th Street near Western Avenue, was destroyed in August 1993 to allow for construction of a

sanitary sewer. In December 1993, Monitoring Well BF-32A was constructed as a replacement for Monitoring Well BF-32. Monitoring Well BF-32A is located on 206th Street, one block east of Western Avenue within approximately 700 feet of Monitoring Well BF-32. Monitoring Well BF-8, located next to Monitoring Well MW-15 on Farmer Brothers property, was destroyed in August 1994 to allow for expansion of the Farmer Brothers facility. Monitoring Well BF-8 was not replaced.

Exploratory borings were drilled and logged at 12 of the 33 BF-series well locations prior to well construction to assist in the design of the wells and select appropriate screen intervals. Bellflower Sand monitoring wells were constructed to total depths ranging from 101 feet bls to 145 feet bls. Lithologic logs of the monitoring well drill cuttings, monitoring well construction information, and the lithologic logs and geophysical logs for the exploratory borings were reported in several data submittals provided to EPA (H+A, 1987R-a, 1989R-a, 1990R-c, and 1991R-d) and summarized in Appendix A.

2.2.1.3 Gage Aquifer Monitoring Wells

Twenty-one Gage Aquifer monitoring wells have been constructed at the Montrose Site since November 1986. As shown in Figure 2.12, 5 of these wells are located On-Property and 16 of these wells are located Off-Property. Gage Aquifer monitoring well locations were selected to characterize groundwater conditions in the upper and lower portions of the Gage Aquifer and to evaluate the nature and extent of chemical compounds in groundwater that may have originated from Montrose's activities On-Property. Nineteen Gage Aquifer monitoring wells are designated as G-series wells and two Gage Aquifer monitoring wells are designated as LG-series wells. G-series monitoring wells are screened within about the upper 20 to 50 feet of the Gage Aquifer. LG-series monitoring wells are screened within about the lower 20 feet of the Gage Aquifer.

Three G-series wells are located On-Property outside the Central Process Area near the Property perimeter. The two LG-series wells are located On-Property southeast of the Central Process Area.

One G-series monitor well is located upgradient of the Property on McDonnell Douglas property. The remainder of the Off-Property G-series wells are located cross-gradient and downgradient of the Property. The farthest downgradient G-series monitoring well is G-18 located approximately 3,200 feet southeast and downgradient from the Property.

Monitoring Well G-7, located next to Monitoring Wells MW-15 and BF-8 on Farmer Brothers property, was destroyed in August 1994 to allow for expansion of the Farmer Brothers facility. Monitoring Well G-7 was not replaced.

Exploratory borings were drilled and logged at 8 of the 21 G-series well locations prior to well construction to assist in the design of the wells and select appropriate screened intervals.

Gage Aquifer monitoring wells were constructed to total depths ranging from 184 feet bls to 213 feet bls using conventional mud-rotary drilling methods as previously described in Section 2.2.1 (subsection entitled "Deep Monitor Well Construction"). Lithologic logs of the monitoring well drill cuttings and monitoring well construction information were reported in several data submittals provided to EPA (H+A, 1987R-a; 1989R-d; 1990R-c; and 1991R-d) and summarized in Appendix A.

2.2.1.4 Lynwood Aquifer Monitoring Wells

Seven Lynwood-Aquifer monitoring wells have been constructed at the Montrose Site since September 1989. As shown in Figure 2.13, four of these wells are located On-Property and three of these wells are located Off-Property. Lynwood-Aquifer monitoring well locations were selected to characterize groundwater conditions in the upper portion of the Lynwood-Aquifer and evaluate the nature and extent of chemical compounds in groundwater that may have originated from Montrose's activities on the Property. Lynwood-Aquifer monitoring wells are designated as LW-series monitoring wells.

One On-Property LW-series well is located near the southeast corner of the Central Process Area. Three On-Property LW-series wells are located outside the Central Process Area near the Property perimeter.

Off-Property LW-series wells are located cross-gradient and downgradient of the Property. The most downgradient LW-series monitoring wells are LW-2 and LW-4 located approximately 300 to 500 feet east and southeast of the Property.

In addition to the three On-Property exploratory borings, an exploratory boring was drilled and logged at one Off-Property LW-series well location prior to well construction to assist in the design of the well and select the appropriate screen interval.

Lynwood-Aquifer monitoring wells were constructed to total depths ranging from 246 feet bls to 256 feet bls using conventional mud-rotary drilling methods as previously described in Section 2.2.1 (subsection entitled "Deep Monitor Well Construction"). Lithologic logs of the monitoring well drill cuttings and monitoring well construction information were reported in 1991 (H+A, 1991R-d) and summarized in Appendix A.

2.2.2 Groundwater Sampling

This section describes groundwater monitoring activities conducted as part of this RI. Water quality samples were collected to determine the concentrations of pesticides and VOCs in the groundwater at the Montrose Site. Table 2.9 lists the scope, hydrogeologic unit, monitoring wells, analytes, and date for each groundwater sampling event. General mineral groundwater quality was monitored during initial groundwater sampling rounds following monitoring well construction and by measuring water quality parameters during each subsequent sampling round. The sampling scheme, including the frequency of sampling and the analytes monitored, was modified throughout the development of the RI as described below.

2.2.2.1 Initial Sampling Events

Groundwater samples were collected from newly constructed monitoring wells following well development. The initial samples were collected in two rounds. The first sampling round was conducted shortly after the wells were developed and the pumps were installed. The second sampling round was conducted approximately 2 weeks after the first round. In general, initial samples were analyzed for pesticides, VOCs, and common ions. Groundwater samples collected in 1985 from the five Upper Bellflower Aquitard monitoring wells were also analyzed for base neutral/acid organic compounds (BNAs) and Chlorobenzene. In addition to pesticides, VOCs, and BNAs, groundwater samples collected from monitoring wells constructed during the Additional Groundwater Assessment Phase

in 1991 were analyzed for trace metals, TOC, p-CBSA, common ions, and nitrate. Appendix B provides a complete list of analytes for each groundwater sample.

2.2.2.2 Quarterly and Semiannual Sampling Events

Following initial sampling, monitoring wells were sampled quarterly. Beginning in January 1990, monitoring wells that had been sampled for a minimum of 1 year were sampled semi-annually. Quarterly and semi-annual samples were analyzed for pesticides and VOCs. Groundwater samples collected from some monitoring wells were not analyzed for pesticides if pesticides were not detected during the two previous sampling rounds for the monitoring wells (H+A, 1990C-a, EPA, 1990C-a).

2.2.2.3 Monitoring at Key Wells

Beginning in August 1990, only selected or key wells were sampled quarterly for pesticides and VOCs (H+A, 1990c; EPA, 1990c). The key wells are listed in Table 2.9. Beginning in November 1990, key wells were sampled quarterly for pesticides, VOCs, TOC, BNAs, metals, and p-CBSA (H+A, 1990c-10/06/90; EPA, 1990C-c). Monitoring wells constructed for an additional groundwater assessment were sampled from May through November 1991. Following completion of the additional groundwater assessment, key wells were sampled semi-annually through January 1993. Monitoring Well BF-32 was sampled in August 1993 and Monitoring Wells MW-15, BF-8, and G-7 were sampled in August 1994, prior to destruction of these wells.

In November and December 1995, pursuant to EPA's request to obtain additional data to support the Joint Groundwater Feasibility Study (FS) for the Montrose and Del Amo sites (U.S. EPA, 1998), groundwater samples were collected from 25 Montrose monitoring wells. The purposes of this sampling were to provide a current understanding of groundwater conditions and to verify the existing plume configuration at the Montrose Site in support of the Joint Groundwater FS. Groundwater samples collected from these wells were analyzed for VOCs. A subset of samples were also analyzed for pesticides and p-CBSA.

2.2.2.4 Wells Containing Free Product

Groundwater sampling schedules were modified for monitoring wells where free product was observed. Free product was first observed in Upper Bellflower Aquitard Monitoring Well MW-2 in November 1987. Monitoring Well MW-2 is located On-Property in the Central Process Area (Figure 2.10). The free product was determined to be a DNAPL consisting of chlorobenzene and DDT. The recovery rate of free product at this well was evaluated in a separate study conducted by Montrose (H+A, 1988R-h). In mid-1988, following the completion of this study, routine groundwater sampling of Monitoring Well MW-2 was discontinued because of the presence of DNAPL in the well (H+A, 1988C-c and 1989C-b). Free product continues to be regularly monitored and purged at Monitoring Well MW-2 to monitor its presence and rate of accumulation.

Fuel hydrocarbon free product was observed in Monitoring Well MW-7 following its construction in November 1988. Monitoring Well MW-7 is located Off-Property in the LADWP right-of-way southwest of Jones Chemical (Figure 2.10). The free product was observed floating on the purge water collected from the well during sampling (H+A, 1990R-b). The well was sampled quarterly to evaluate the concentration of nonfuel-related

VOCs and pesticides in groundwater. Beginning in April 1990, routine sampling of Monitoring Well MW-7 was discontinued.

Floating free product was also observed in Monitoring Well MW-20 following its construction. Approximately 2.5 feet of free product was observed floating in the water in the well in April 1990. Monitoring Well MW-20 is located on the Del Amo Superfund Site, east of Normandie Avenue and northeast of the Property (Figure 2.10). The floating product in Monitoring Well MW-20 is primarily benzene, based on analytical results for product samples and groundwater samples collected from the well. The occurrence of benzene free product at and in the vicinity of Monitoring Well MW-20 and elsewhere at the Del Amo Superfund Site is being evaluated as part of ongoing RI activities being conducted by the Del Amo Respondents (Dames & Moore, 1993a, 1993b, and 1996). The occurrence of floating free product in Monitoring Well MW-20 and other monitoring wells at and in the vicinity of the Del Amo Superfund Site does not appear to be related to activities conducted by Montrose.

2.2.2.5 Sampling Methodologies, Water Levels, and Field Parameters

Groundwater samples were collected using dedicated stainless steel and Teflon bladder pumps. Monitoring wells were purged with dedicated stainless steel submersible pumps or with the bladder pumps. Temperature, electrical conductivity (EC), and pH were monitored during purging.

Water levels have been measured in the monitoring wells since 1985. Water levels were generally measured in all monitoring wells during each sampling round. Water levels were measured to determine water level elevations and the directions of groundwater flow in the Upper Bellflower Aquitard, Bellflower Sand, Gage Aquifer, and Lynwood-Aquifer.

The water quality parameters, temperature, pH, and EC were routinely measured during each groundwater sampling event. Water levels and water quality parameters have been compiled and provided to EPA in field data submittals as specified in the Consent Order (H+A, 1985R-b, 1987R-a, 1987R-h, 1987R-k, 1987R-m, 1988R-b, 1988R-g, 1988R-i, 1988R-l, 1989R-c, 1990R-a, 1990R-c, 1990R-e, 1990R-i, 1991R-a, 1991R-c, 1991R-d, 1992R-a, 1993R-a, and 1996R-a). Water level data are also contained in the Montrose database provided to EPA.

2.2.2.6 Reporting

Analytical results for groundwater samples collected during the RI have been compiled and provided to EPA in the Montrose database and in raw analytical data submittals as specified in the Consent Order (H+A, 1987R-f, 1987R-i, 1987R-l, 1988R-a, 1988R-c, 1988R-f, 1988R-j, 1988R-m, 1989R-b, 1989R-d, 1990R-b, 1990R-g, 1990R-i, 1991R-a, 1991R-c, 1991R-d, 1992R-a, 1993R-a, and 1996R-a). These data were used in conjunction with the most recent data obtained from Montrose wells and other wells in the Montrose Site vicinity to prepare updated plume maps for this RI (Section 5).

2.2.3 Aquifer Testing

This section describes aquifer testing activities conducted as part of this RI. As shown in Figure 2.14, aquifer tests were conducted in 24 On-Property and Off-Property monitoring wells constructed for the RI. The objective of aquifer testing was to obtain estimates of

transmissivity, hydraulic conductivity, and storativity from the Upper Bellflower Aquitard, Bellflower Sand, Gage Aquifer, and Lynwood-Aquifer. Additionally, where applicable, leakance of the Upper Bellflower Aquitard, Lower Bellflower Aquitard, and Gage/Lynwood Aquitard was estimated. Aquifer tests consisted of constant discharge (16 wells) and slug withdrawal tests (8 wells) that were performed on selected monitoring wells screened in one of the four zones within the three primary hydrogeologic units.

Constant discharge tests were performed in five Upper Bellflower Aquitard monitoring wells, six Bellflower Sand monitoring wells, three Gage Aquifer monitoring wells, one Lower Gage Aquifer monitoring well, and one Lynwood-Aquifer monitoring well (Table 2.10; Figure 2.14). Nearby monitoring wells were used as observation wells to monitor water level response during each constant discharge aquifer test. Observation wells were screened in the same hydrogeologic unit as the well being pumped and in hydrogeologic units above and below the screened interval of the pumped well. Constant discharge aquifer tests were conducted for approximately a 12-hour period, followed by a recovery period; the duration of the recovery period was dependent on the time until water levels returned to near prepumping levels. Aquifer testing methods, procedures, and results were described in a previous report in addition to this RI Report (H+A, R-1990R-k).

Constant discharge test data were analyzed to obtain estimates of transmissivity, storativity, and where applicable, leakance. Drawdown data from the pumped well were analyzed using the Cooper-Jacob (1946) approximation to the Theis (1935) equation. Recovery data from the pumped well were analyzed using the Theis (1935) recovery analysis method. Observation well drawdown data were analyzed using the Cooper-Jacob (1946) and Theis (1935) analysis methods. In cases where drawdown data indicated potential leaky aquifer behavior, the Hantush (1960) leaky aquifer analysis was also used. Water level recovery data for observation wells were analyzed using the Theis (1935) recovery method. Constant discharge aquifer test data from Upper Bellflower Aquitard wells were analyzed solely by the Theis (1935) recovery method, as water level response in observation wells was limited.

Slug withdrawal tests were performed on eight monitoring wells completed in the Upper Bellflower Aquitard. Slug withdrawal tests were performed on those monitoring wells in which constant discharge could not be sustained during purging for routine sampling. For these tests, the slug was withdrawn using a polyvinyl chloride (PVC) plastic cylinder holding approximately 2.6 gallons of water. Water levels were monitored in the test well until static water level was restored. Slug withdrawal test data were analyzed using the Bouwer and Rice (1976) method. Slug withdrawal data were analyzed to obtain estimates of hydraulic conductivity.

2.3 Sediment Sampling

This section describes sediment survey and sediment sampling investigations conducted as part of this RI. In 1986 and 1988, sediment sampling was conducted in four surface water drainages located downstream from the Property, the Kenwood Drain, Torrance Lateral, Dominguez Channel, and Consolidated Slip. Except for sediment samples collected by EPA in 1994, samples collected from the Normandie Avenue Ditch were included in the soil investigation (Section 2.1). Because most of the sediment and some of the surface water sample data were rejected as unusable by EPA (due to lack of documentation on calibrations), EPA conducted additional surface water and sediment as well as biota

sampling in 1994 in the surface water runoff pathway. This sampling is also described in this section. The sampling conducted by EPA in 1994 is described in detail in a separate document (CH2M HILL, 1995).

The Kenwood Drain is located approximately 750 feet downstream of the Property and discharges to the Torrance Lateral. The Torrance Lateral is located approximately 9,000 feet downstream of the Property and discharges to the Dominguez Channel. The Dominguez Channel is located approximately 5 miles downstream of the Property and discharges to the Consolidated Slip. The Consolidated Slip is located approximately 8.8 miles downstream of the Property and discharges to Los Angeles Harbor. Sediment investigations were conducted during Part 2 Phase 1, Round 2 and Part 2 Phase 2A activities. RI sediment sampling was performed by Montrose unless otherwise specified. Sediment samples were collected for analysis by EPA in conjunction with Montrose sampling.

The objective of the sediment sampling program was to determine the extent and concentration of pesticides and VOCs in Off-Property sediment present in existing drainages located downstream from the Property. Table 2.11 lists the objectives, sample locations, and analytes for the sediment investigations in each of the drainages. Field activities included measuring sediment depth, inspecting drainage structures, describing the sediment composition, and collecting sediment samples for analysis. Table 2.12 describes the methods used to sample sediment at each location. Sediment sampling methods and procedures are described in more detail in the sampling plans and QAPPs (H+A, 1986R-a, 1986R-b, 1988R-d, and 1988R-e).

Grab samples were collected from the Kenwood Drain at manhole locations if sediment existed. Grab samples were also collected from the Torrance Lateral from each of five isolated sediment deposits located between the Kenwood Drain outlet and the Dominguez Channel. Multiple sediment samples were typically collected along evenly spaced transects aligned perpendicular to the flow direction in Dominguez Channel and Consolidated Slip. This approach was used to evaluate the distribution of chemical compounds across and along these drainages. Results of sediment sampling have been compiled and provided to EPA in the Montrose database and in field data and raw analytical data submittals as specified in the Consent Order. These data were reported in previous documents in addition to this RI Report (H+A, 1986R-d, 1986R-e, 1988R-n, and 1988R-q).

During the 1986 sediment sampling event, the surface water runoff pathway from the Property to the Kenwood Drain was different from the present pathway (Section 1). In 1986, surface water runoff flowed under the fence at the southeast corner of the Property and into the unlined Normandie Avenue Ditch. Runoff then flowed through a railroad spur culvert continuing down the unlined Normandie Avenue Ditch. Runoff was then diverted through a small opening in a block wall located on the eastern boundary of the Farmer Brothers property. Runoff then flowed to the west across the Farmer Brothers parking lot, where it entered the subsurface storm drain system. The remainder of the surface water runoff pathway in 1986 was the same as the present pathway.

2.3.1 Normandie Avenue Ditch

This section describes the sediment sampling conducted by EPA in 1994 in the Normandie Avenue Ditch. Samples collected by Montrose in the Normandie Avenue Ditch are from soil borings, and, as such, are included in the soil investigation described in Section 2.1.

EPA collected, surveyed, and divided the ditch into five segments of equal length, as shown in Figure 2.15. The total length of the ditch was 460 feet, and each segment was 92 feet. All segments were sampled for sediment with the exception of Segment 3 because no sediment was present in that segment. A total of four sediment samples were collected for analyses of pesticides, PCBs, metals, cyanide, PCBs, TOC, and grain size.

2.3.2 Kenwood Drain

As shown in Figure 2.15, five KD-series sediment samples were collected from five locations in the Kenwood Drain between Del Amo Boulevard and the Torrance Lateral in 1986. The catchment basin located east of the Farmer Brothers property on Normandie Avenue was also sampled. The volume of sediment at each location was estimated. Where sufficient sediment was present, sediment samples were collected from the concrete storm drain with a dedicated trowel. Sediment samples were analyzed for pesticides and VOCs.

In the 1994 sampling by EPA, two sediment samples were collected from Manhole No. 5 (KD-1) and Manhole No. 11 (KD-2), as shown in Figure 2.15. Sediment samples were analyzed for pesticides, PCB, metals, cyanide, TOC, and grain size. Sample KD-1 was also analyzed for semivolatiles and VOCs.

2.3.3 Torrance Lateral

Five SED-series sediment samples were collected from five discrete locations within the Torrance Lateral in 1986, as shown in Figure 2.16. This open concrete-lined channel was inspected for sediment between the Kenwood Drain discharge and the Dominguez Channel outfall. The volume of sediment at each location was estimated. Where sufficient sediment was present, sediment samples were collected from the open concrete storm drain with a dedicated trowel. Sediment samples were analyzed for pesticides and VOCs.

In the 1994 sampling conducted by EPA, 15 sediment samples were collected in the Torrance Lateral. Seven samples were collected from the lined portion of the lateral, which extends from the end of the Kenwood Drain to the upstream side of the I-405 overpass. Eight sediment samples were collected from the unlined portion of the Torrance Lateral, which extends from the I-405 overpass to the confluence with the Dominguez Channel. Sample locations were chosen using randomly generated numbers. Sediment samples were analyzed for pesticides, PCBs, metals, cyanide, TOC, and grain size at all locations. At two locations, samples were analyzed for VOCs and semivolatiles. Sampling locations for samples collected by EPA in the Torrance Lateral are shown in Figure 2.16A.

2.3.4 Dominguez Channel

Sediment samples were collected from the Dominguez Channel in 1986 and 1988. Five composite SED-series sediment samples were collected from two to three locations along five transects across the Dominguez Channel during the 1986 sampling event, as shown in Figure 2.16. The transects were located approximately 1 mile upstream and 3 miles downstream from the confluence of the Torrance Lateral and the Dominguez Channel. The transects were positioned perpendicular to the direction of flow in the Dominguez Channel. Where sufficient sediment was present, sediment samples were collected with hand augers or benthic samplers. Samples were analyzed for pesticides and VOCs.

Sediment was surveyed and sediment samples were also collected in the Dominguez Channel in 1988. The sediment thickness was measured at three locations along each of 20 transects positioned across the channel. The transects were situated along approximately 7,200 feet of the channel in the vicinity of its confluence with the Torrance Lateral. Figure 2.17 shows the location of the sediment survey locations.

Sediment thickness was measured at three locations along each of the 20 transects (Figure 2.17). Transects T-1 through T-20 were located using survey stations established by the LACFCD as a reference point. The LACFCD station numbers were designated on "As Built" drawings for the channel and painted on the top of the actual channel banks. The sediment thickness was measured at mid-channel and at approximately one-third of the channel width from the two channel banks. The mid-channel point at each transect was designated "A," the point located closest to the northeast bank was designated "B," and the point located closest to the southwest bank was designated "C."

Sediment thickness was measured from a small pontoon barge at each sample location using a hand auger. The channel clay liner served as a marker bed to locate the bottom of the channel. The hand auger was used to remove sediment until the clay liner was encountered. Sediment thickness was estimated as the difference between the depth to the top of the sediment and the depth to the clay liner. Twelve discrete and two composite T-series sediment samples were collected from eight locations along eight transects using thin wall suction samplers. One to two discrete samples were collected at each of six sampling locations. Sample depths ranged from 0.5 feet to 2.4 feet below the top of the sediment. Two composite samples were collected at two of the eight sediment sampling locations. One composite sample was collected using a thin wall suction sampler. The other composite sample was collected using a hand auger. Composite samples were collected at depths from the top of the sediment to about 3.3 to 3.75 feet below the top of the sediment. Composite samples were also analyzed for percent moisture and TOC. Samples were analyzed for pesticides based on results of the 1986 sampling activity.

Background sediment samples were collected from one location in the Dominguez Channel approximately 2.5 miles upstream from its confluence with the Torrance Lateral. Figure 2.16 shows the location of the samples. Five depth discrete BGS-series samples were collected at the upstream location. Background sample depths were 0.5, 2.5, 4.0, 6.2, and 8.0 feet below the top of the sediment. Sediment samples were collected using a hand auger, and analyzed for pesticides. Analytical results of the additional samples were compared to analytical results from the T-series samples described above.

In the 1994 sampling conducted by EPA, 26 sediment samples were collected in the Dominguez Channel. The channel was divided into four segments for sediment sampling. In each of these segments, five sample locations were chosen. The first location in each segment was chosen randomly and the remainder were evenly spaced from the first location. The last segment was located at the mouth of the Torrance Lateral. Six sediments sampling locations were selected along the banks of the Dominguez Channel, three on the east bank and three on the west bank. The three locations on each bank were placed downstream of the Torrance Lateral, at the confluence of the Torrance Lateral, and upstream of the Torrance Lateral. Sampling locations for the Dominguez Channel are presented in Figure 2.17A. Sediment samples were analyzed for pesticides, PCBs, metals, cyanide, TOC, and grain size.

2.3.5 Consolidated Slip

Sediment samples were collected from the Consolidated Slip, located at the mouth of the Dominguez Channel in 1986. As shown in Figure 2.18, five SED-series sediment samples were collected from ten 20-foot transects located in a staggered arrangement across the slip. The transects were positioned approximately perpendicular to the direction of flow in the slip. Five discrete samples collected along each of the 10 transects were composited for analysis. Sediment samples were collected with benthic samplers. Sediment samples were analyzed for pesticides and VOCs.

In the EPA sediment sampling in 1994, five sediment samples were collected in the Consolidated Slip, as shown in Figure 2.17A. Sample Location CS-1 was located at the upper end of the slip, CS-2 was located in the mid-point of the slip, CS-3 was located at the lower end of the slip, CS-4 was located in the intertidal zone at the upper east side of the slip, and CS-5 was located in the intertidal zone at the lower east side of the slip. Sediment samples were collected at all locations for analyses of semivolatiles, pesticides, PCBs, metals, cyanide, TOC, and grain size. Samples for volatile analyses were collected at Sample Location CS-1.

2.4 Surface Water Sampling

This section describes surface water investigation activities conducted as part of this RI as well as those conducted by Montrose in 1981. In February 1981, Montrose collected seven surface water samples, and in November 1981, Montrose collected two surface water samples. In 1986 and 1987, surface water sampling was conducted during dry weather and wet weather rainfall events at 30 locations along the surface water pathway from the Property to the Consolidated Slip. Figures 2.18 through 2.21 show the surface water sampling locations. The surface water investigation was conducted during Part 2 Phase 1, Round 2 activities. Table 2.13 describes the surface water investigations including the objectives, the locations, analytes, and whether the samples were collected during dry or wet weather. Table 2.14 describes the sampling methods used to collect surface water samples. RI surface water sampling was conducted by Montrose unless otherwise specified. Surface water samples were collected for analysis by EPA in conjunction with Montrose sampling.

The objective of the surface water sampling program was to determine the extent and concentrations of pesticides and VOCs in surface water during dry and wet weather and to gather data of sufficient quality to support the FS. Analytical results of filtered and unfiltered surface water samples were evaluated to determine the concentrations of pesticides present as dissolved constituents versus constituents sorbed to suspended sediment. Field activities included measuring the water quality parameters EC, pH, and temperature. Surface water sampling methods and procedures were described in sampling plans and QAPPs (H+A, 1986R-a, 1986R-b, 1988R-d, and 1988R-e).

Dry weather surface water samples were collected from bridges located along the Torrance Lateral and Dominguez Channel and from a boat in the Consolidated Slip. Depth-composited surface water samples were collected along transects perpendicular to the flow direction in the Dominguez Channel and Consolidated Slip to ensure that average ambient conditions were established.

Wet weather samples were collected from the existing surface water pathway extending from the Property to the Consolidated Slip. Sample locations were restricted due to access limitations. Samples were collected from bridges spaced along the Torrance Lateral and Dominguez Channel and from the end of docks in the Consolidated Slip. Wet weather samples were not collected from the Kenwood Drain due to restricted access.

Results of surface water sampling have been compiled and provided to EPA in the Montrose database and in field data and raw analytical data submittals as specified in the Consent Order. These data were reported in previous reports in addition to this RI Report (H+A, 1987R-g, and 1987R-j).

Because many of the Montrose surface water sample results were rejected as unusable by EPA (due to lack of documentation on calibrations), EPA conducted additional surface water sampling in 1994. This sampling is summarized in the following section and described in detail in a separate document (CH2M HILL, 1995).

2.4.1 Dry Weather Surface Water Samples

In 1981, nine surface water samples were collected from the southeastern corner of the property and the Normandie Avenue Ditch. Seven of the samples were collected in February 1981 by DHS. Most of these seven samples were collected in a small pond of water in the Normandie Avenue Ditch formed by storm runoff. Samples were analyzed for chlorobenzene, PCBs, and DDT. Two samples were collected by Montrose in November 1981, one sample (11-81-1) in the drainage ditch and one sample (11-81-3) in a concrete sump. These samples were analyzed for DDT.

SW-series dry weather surface water samples were collected in 1986 from standing water during dry weather in the Torrance Lateral, Dominguez Channel, and Consolidated Slip (Figures 2.16 and 2.18). Dry weather samples and sediment samples were collected concurrently during this period. Unfiltered samples were analyzed for pesticides and VOCs. Selected dry weather surface water samples were filtered in the laboratory and analyzed for pesticides.

For the surface water sampling event conducted by EPA in 1994, surface water samples were collected concurrently with the sediment samples described in Section 2.3. The number of samples and their analytes were as follows:

- Kenwood Drain—Three unfiltered surface water samples (KD-1, KD-2 and KD-3) collected and analyzed for pesticides, PCBs, metals, cyanide, TDS, and TSS. One sample (KD-1) analyzed for VOCs and semivolatiles. Figure 2.15 shows the sampling locations.
- Torrance Lateral—Nine samples from the lined portion of the Torrance Lateral and six samples from the unlined portion were collected and analyzed for pesticides, PCBs, metals, cyanide, TDS, and TSS. Surface water samples from TLL-1 and TLU-1 were analyzed for VOCs and semivolatiles. Sampling locations are shown in Figure 2.16A.
- Dominguez Channel—Twenty samples from four segments collected and analyzed for pesticides, PCBs, metals, cyanide, TDS, and TSS. Sampling locations are shown in Figure 2.17A.
- Consolidated Slip—Five filtered and unfiltered surface water semivolatiles, pesticides, PCBs, metals, cyanide, TDS, and TSS. The sample collected at CS-1 was also analyzed

for VOCs. Figure 2.17A shows the sampling locations for surface water in the Consolidated Slip.

2.4.2 Wet Weather Surface Water Samples

SW-series wet weather surface water samples were collected during five rainfall events at locations along the surface water pathway from the Property to the Consolidated Slip (Figures 2.19 through 2.21). Samples were collected from catchment areas located near the Property including the Jones Chemical Company Ditch and the Normandie Avenue Ditch, and from the Torrance Lateral, Dominguez Channel, and the Consolidated Slip. Montrose collected surface water samples during the first rainfall event. BC Analytical, Glendale, California, formerly Brown and Caldwell Analytical Laboratories (BCAL), was directed by Montrose to collect the surface water samples during the four subsequent rainfall events. Wet weather surface water samples were analyzed for pesticides and VOCs. Selected wet weather surface water samples were filtered in the laboratory and analyzed for pesticides. Appendix B provides a complete list of the analytes for each sample.

Wet weather surface water samples were collected from sample locations SW-1 through SW-5 during five rainfall events with precipitation exceeding 0.20 inch. Surface water samples were not collected from these locations during rainfall events with precipitation exceeding 0.75 inch because a storm of this size did not occur within the sampling period.

Wet weather surface water samples were collected from five sample locations along the Dominguez Channel during two rainfall events with precipitation exceeding 0.20 inch. Wet weather surface water samples were collected from 10 locations in the Consolidated Slip during one rainfall event with precipitation exceeding 0.20 inch.

2.5 DNAPL Characterization and Groundwater Treatability

This section describes additional investigation activities conducted as part of this RI to evaluate the nature and extent of DNAPL in soil and groundwater, the feasibility and accumulation rate of DNAPL from groundwater pumping, and treatability of DNAPL impacted groundwater. Groundwater treatability in the Upper Bellflower Aquitard on the Property was evaluated based on the results of the evaluation of a groundwater treatability study, additional soil sampling, well installations in the Central Process Area, and Phase 1 of a groundwater treatability test. Additional discussions of DNAPL investigations and results are provided in Section 5.5.1.

The first step of the DNAPL evaluation was a field investigation in March 1988 to determine the DNAPL accumulation rate and chemical character of the DNAPL at Monitoring Well MW-2 (H+A, 1988R-h). In September 1988, in response to EPA direction, Montrose proposed to proceed to a second step of evaluation by expanding the scope of the proposed Phase 2A On-Property investigation to provide additional data on the nature and distribution of DNAPL in the vicinity of the Central Process Area (H+A, 1988C-c).

In 1989, upon completion of Phase 2A, EPA directed Montrose, via Task 13 in the Second Amendment to the Administrative Order on Consent, to proceed with the third step of the DNAPL evaluation. Task 13, the Evaluation of Groundwater Treatability Study, directed

Montrose to conduct a field investigation to assess the feasibility of an interim DNAPL and groundwater extraction and treatment remedial action (H+A, 1990R-j).

Upon completion of the Evaluation of Groundwater Treatability Study, EPA directed Montrose to proceed with groundwater treatability testing as the fourth step of the DNAPL evaluation. Phase I of the Groundwater Treatability Test evaluated the ability to contain groundwater in the vicinity of the Central Process Area and evaluated the effect of DNAPL and groundwater on wellfield and treatment system operations (H+A, 1992R-b).

2.5.1 Groundwater Treatability Study

The Evaluation of Groundwater Treatability Study was performed in accordance with Task 13, Appendix C of the Second Amendment to the Consent Order (H+A, 1990R-j). The purpose of this task was to partially evaluate the feasibility of groundwater and DNAPL extraction in the Upper Bellflower Aquifer. The scope of the field investigation included soil sampling, installation of a test well and two observation wells in the Central Process Area, aquifer testing, groundwater sampling of these three wells, and monitoring of DNAPL accumulation rates. These data were evaluated, and preliminary designs for an extraction wellfield in the Upper Bellflower Aquitard and a water treatment facility were prepared to conduct subsequent groundwater treatability testing.

The EPA proposed an interim groundwater remedial action for the Montrose Site during a meeting with H+A in June 1988. Montrose recommended that the scope of the proposed Phase 2A On-Property investigation be expanded to provide additional data on the nature and distribution of DNAPL in the vicinity of the Central Process Area (H+A, 1989C-c). The occurrence of DNAPL in Monitoring Well MW-2 was first observed during the November 1987 quarterly groundwater sampling round. The occurrence of DNAPL in this well led to a field program to observe the DNAPL accumulation rate and partially assess the chemical character of the DNAPL (H+A, 1988R-h). This additional work included expanding the number and depth of the On-Property soil sampling locations and installing Bellflower Sand Monitoring Well BF-9 in the Central Process Area adjacent to Monitoring Well MW-2.

Upon completion of the Phase 2A RI work, EPA directed Montrose to perform additional assessment work to further evaluate the extraction of groundwater and DNAPL from the Upper Bellflower Aquitard. The additional assessment work consisted of installing a test well and two observation wells in the Upper Bellflower Aquitard in the vicinity of Monitoring Well MW-2 (H+A, 1989C-b) (Figure 2.10). Soil cores were collected continuously from approximately 54 feet bls to approximately 100 feet bls at each test well. A rough sense of the distribution of DNAPL was obtained based on lithologic logging and inspection of the core samples. Aquifer tests were conducted at the test well to determine the hydraulic parameters of the Upper Bellflower Aquitard in the vicinity of the Central Process Area. Groundwater samples were collected during the aquifer testing to monitor changes in concentrations of chemical compounds with time. DNAPL accumulation rates were monitored in one monitoring well and the two observation wells following aquifer testing.

2.5.2 Groundwater Treatability Test, Phase 1

Upon completion of the evaluation of groundwater treatability study, EPA directed Montrose to install a pilot groundwater extraction well and groundwater treatment system

(EPA, 1990C-g). Pursuant to EPA direction, Montrose prepared a work plan for Phase I of the groundwater treatability test that was reviewed and approved by the EPA on March 6, 1991, and May 6, 1991, respectively (H+A, 1991C-e; EPA, 1991C-e, and 1991C-g).

The objectives of Phase I of the groundwater treatability test were: (1) to evaluate the ability to contain groundwater with elevated concentrations of DDT and chlorobenzene that occur in the Upper Bellflower Aquitard in the vicinity of the Central Process Area; and (2) to evaluate the effect of DNAPL and groundwater with elevated concentrations of DDT and chlorobenzene on wellfield and treatment system operation.

The scope of the Phase I test included installation of an Upper Bellflower Aquitard extraction well in the Central Process Area, installation and operation of a groundwater treatment system, aquifer testing, sampling of the extraction well, sampling of the treatment system effluent, DNAPL recovery, testing of a pilot-scale DNAPL/water separator, and preparing a report summarizing the Phase I test (H+A, 1992R-b).

2.6 Regional Hydrogeologic Assessment

This section describes activities conducted as part of a regional hydrogeologic assessment performed by Montrose as part of this RI. A regional hydrogeologic assessment was performed to obtain, compile, and analyze data regarding the hydrogeologic environment at the Montrose Site and to identify known and potential sources of groundwater contamination in the vicinity of the Property. The regional hydrogeologic assessment was performed in accordance with Task 15, Appendix C of the Second Amendment to the Consent Order. A work plan describing the objectives, scope, and subtasks for the regional hydrogeologic assessment was provided in correspondence (H+A, 1989C-b).

The study area addressed in the regional hydrogeologic assessment comprised the West Coast Basin in the vicinity of the Property. The hydrogeology was assessed by obtaining and evaluating hydrogeologic reports, well logs, and public records pertaining to the geology, hydrogeology, and groundwater quality and use within the study area; preparing a well inventory; determining the location of wells suitable for sampling; determining potential alternate sources of contamination; and preparing a regional hydrogeologic assessment report containing data compiled during the assessment (H+A, 1990R-f). The inventory of water supply wells located within an approximate 2-mile radius of the Property was recently updated for this revised Final Draft RI Report based on information compiled in support of the Joint Groundwater Feasibility Study prepared by Montrose and the Del Amo respondents.

2.7 Sanitary Sewer Investigation

This section describes additional investigations conducted by Montrose to evaluate the sanitary sewer that underlies and extends away from the Montrose Property. In 1988 and 1990, sewer sediment sampling was conducted in two main trunk sewer lines to the Los Angeles County Sanitation District's (LACSD) Joint Water Pollution Control Plant (JWPCP). The two main trunk sewer lines, referred to as the J.O. "D" line and the District 5 interceptor, are located between the Property and the JWPCP. The sewer sediment sampling was performed by Montrose at the direction of EPA. Sewer sediment samples were collected for analyses by EPA in conjunction with Montrose sampling.

The objective of the sewer sediment sampling was to determine the extent of and concentration of DDT in the sewer sediment that may have resulted from former activities at the Montrose plant. Field activities included measuring sewer sediment depth; measuring sewage temperature, flow depth, flow velocity, pH, and conductivity; describing sediment composition; and collecting sewer sediment and sewage samples for analyses. Sewer sediment sampling methods and procedures are described in a sampling plan and a QAPP (CH2M HILL, 1987a and 1987b). Results of sewer sediment sampling were compiled and provided to EPA in the form of field data submittals, a raw analytical data submittal, and the EE/CA report specified in the Consent Order. These data were reported in separate documents (H+A, 1988R-k, 1989R-f, 1989R-g, 1990R-d, and 1991R-b).

Based on results of the 1988 sewer sediment sampling, sewer sediment between manholes D32 and A468 in the J.O. "D" line was determined to contain approximately 98 percent of the estimated total DDT mass in the sanitary sewers connecting the Property to the JWPCP. The sewer sediment in this section of the J.O. "D" line were observed to be different than other sewer sediments observed in other sections of the sanitary sewers. The sewer sediments between manholes D32 and A468 were tar-like and contained DDT concentrations on the order of 100,000 milligrams per kilogram (mg/kg).

Based on the results of the 1988 sewer sediment sampling, EPA mandated further evaluation of an approximately 3,500-foot section of the J.O. "D" line in the Consent Order. An EE/CA was performed in accordance with Appendix B of the Second Amendment to the Consent Order.

The EE/CA was a comparative analysis and feasibility study of potential removal action alternatives for the 3,500-foot section of the J.O. "D" line. The EE/CA was conducted in accordance with the requirements of CERCLA and submitted to EPA in March 1991 (H+A, 1991R-b). The objectives of the EE/CA were to: (1) develop potential removal action alternatives; (2) independently evaluate each removal action alternative based on effectiveness, implementability, and cost; (3) compare the removal action alternatives; and (4) select a removal action for implementation for the 3,500-foot section of the J.O. "D" line.

EPA finalized the Action Memorandum/Enforcement Request for a Removal Action at the Montrose Superfund Site on September 21, 1992 (EPA, 1992C-b). The removal action addresses the sewer sediment containing DDT that is located in the J.O. "D" line in the immediate vicinity of the Property.

EPA evaluated the five remedial alternatives presented in the EE/CA and selected Alternative 3, which consists of:

- Diversion of sewage flow around the affected manholes using an existing sewer line and a new sewer line to be constructed by LACSD by approximately fall 1993.
- Sewer sediment removal with a bucket dredge followed by manual sewer sediment removal and, if necessary, hydraulic cleaning with high-pressure water.
- Treatment of excess water at the Montrose Site using an existing treatment system or at an off-site treatment facility.
- Treatment of contaminated sewer sediments at an off-site incinerator.

In May 1996, Montrose began activities to remove sewer sediment from the J.O. "D" line between manholes B-32 and A-468 in accordance with a work plan approved by EPA. In 1996, Montrose removed approximately 175 tons of sediment from the sewer. An estimated 70 tons of highly viscous sediments remain in this portion of the sewer and methods to remove the remaining sediment are being studied. The results of the removal actions completed to date have been reported to EPA in separate documentation.

TABLE 2.1

ON-PROPERTY SOIL INVESTIGATIONS PRE-GRADING 1983

OBJECTIVE OF SAMPLING	SAMPLE LOCATIONS AND DEPTHS	SAMPLE LOCATION IDENTIFIERS	ANALYTES
Pre-Part 1, Pre-Grading - June 1983 (Hargis & Montgomery [H&M])			
Obtain data regarding presence of DDT in near-surface soil	Forty soil samples collected from 19 soil borings at depths ranging from land surface to 2.5 feet below land surface (bls)	S001 to S014, S017, S018, S020, S023, S024	Total DDT and the metabolites DDD and DDE and their isomers
Pre-Part 1, Pre-Grading - August 1983 (H&M)			
Obtain additional data regarding presence of DDT in near-surface soil based on results of June 1983 soil sampling	Twenty-six soil samples collected from 12 soil borings at depths ranging from 0.5 to 3.8 feet bls	S029 through S040	Total DDT and the metabolites DDD and DDE and their isomers
	Fourteen additional soil samples collected at 6 locations previously sampled in June 1983 at depths ranging from 2 to 6.3 feet bls	S004A, S005A, S010A, S012A, S023A, S024A	
Pre-Part 1, Pre-Grading - July 1983 (Stauffer)			
Obtain data regarding presence of DDT in soil at 5 specific areas	1) Northwest Corner		Total DDT and the metabolites DDD and DDE and their isomers
	Nine soil samples collected from 7 locations at depths ranging from 1 to 5 feet below grade	02/08/01-B05, 02/08-02-B03, 02/02-01-B01, 02/01-01-B01, 03/01-01-B01, 03/03-01-B01, 04/01-01-B01, 10/03-01-B03, 10/03-02-B04	
	Nineteen soil core samples collected from 16 locations at depths of 1 foot bls	05/01-01-C01, 05/01-02-C01, 06/01-01-C01, 07/01-01-C01, 07/01-02-C01, 07/01-03-C01, 07/03-01-C01, 08/01-01-C01, 09/03-01-C01, 11/03-01-C01, 03/00-01-C01, 03/03-01-C01, 04/03-01-C01, 13/03-01-C01, 14/03-01-C01, 11/01-01-C01, 12/01-01-C01, 13/01-01-C01, 14/01-01-C01	

NOTES: This table does not include 1981 soil sampling by Montrose
On-Property soil sampling locations pre-grading, 1983 are shown in Figure 2.1
Soil boring construction and sampling details are provided in Table 2.2
Analytical methods provided in Appendix B

SCO/980150005.DOC/6/95WU

TABLE 2.1
ON-PROPERTY SOIL INVESTIGATIONS PRE-GRADING 1983

OBJECTIVE OF SAMPLING	SAMPLE LOCATIONS AND DEPTHS	SAMPLE LOCATION IDENTIFIERS	ANALYTES
Pre-Part 1, Pre-Grading - July 1983 (Stauffer) (Continued)			
	2) Northern Property Boundary		
	Four soil samples collected from 4 locations at land surface	00/03-01-A00, 00/08-01-A00, 00/13-01-A00, 00/18-01-A00	
	3) Recycle Pond Area		
	Five soil samples collected from 3 locations at elevations ranging from 8 to 10 feet above grade	12/18-01-A10, 12/18-02-A10, 12/24-01-A10, 12/24-02-A10, 09/21-01-A08	
	One soil sample collected at a depth of 15 feet below grade	12/21-01-B15	
	One soil core sample collected at a depth of 1 foot bls	13/21-01-C01	
	4) Southeast Perimeter Area		
	Four soil samples collected from 2 locations at elevations ranging from 5 to 6 feet above grade	22/38-01-A05, 22/38-02-A06, 22/38-03-A05, 22/39-01-A05	
	5) Southern Property Boundary North of Jones Chemical		
	Five soil core samples collected from 5 locations at depths of 1 foot bls	23/21-01-C01, 23/23-01-C01, 23/24-01-C01, 23/25-01-C01, 23/27-01-C01	

NOTES: On-Property soil sampling locations pre-grading, 1983 are shown in Figure 2.1
Soil boring construction and sampling details are provided in Table 2.2
Analytical methods provided in Appendix B

TABLE 2.2

ON-PROPERTY SOIL SAMPLING
PRE-GRADING 1983

SOIL BORING IDENTIFIER	DATE DRILLED	TOTAL DEPTH OF BORING (ft bls)	NUMBER OF SAMPLES	MAXIMUM SAMPLE DEPTH (ft bls)
Pre-Part 1, Pre-Grading - June 1983 (Hargis & Montgomery [H&M])				
S001	6/15/83	2.5	2	2.5
S002	6/15/83	2.5	2	2.5
S003	6/15/83	2.5	3	2.5
S004	6/17/83	1.6	2	1.6
S005	6/15/83	2.5	2	2.5
S006	6/17/83	1.3	3	1.3
S007	6/15/83	2.5	2	2.5
S008	6/15/83	2.0	2	2.0
S009	6/15/83	2.0	2	2.0
S010	6/17/83	2.0	2	2.0
S011	6/17/83	2.0	2	2.0
S012	6/17/83	2.0	2	2.0
S013	6/16/83	1.6	2	1.6
S014	6/16/83	1.1	2	1.1
S017	6/16/83	2.5	2	2.5
S018	6/16/83	2.0	2	2.0
S020	6/16/83	1.4	2	1.4
S023	6/17/83	1.3	2	1.3
S024	6/17/83	1.3	2	1.3
Pre-Part 1, Pre-Grading - August 1983 (H&M)				
S004A	8/10/83	6.25	3	6.25
S005A	8/9/83	5.5	2	5.5
S010A	8/10/83	4.0	2	4.0
S012A	8/10/83	5.1	2	5.1
S023A	8/10/83	5.2	2	5.2
S024A	8/10/83	6.2	3	6.2
S029	8/9/83	3.0	2	3.0
S030	8/9/83	2.2	2	2.2
S031	8/9/83	3.0	3	3.0
S032	8/9/83	3.8	2	3.8
S033	8/9/83	2.2	2	2.2
S034	8/9/83	2.4	2	2.4
S035	8/9/83	2.6	2	2.6
S036	8/9/83	3.0	3	3.0
S037	8/9/83	3.3	2	3.3
S038	8/9/83	2.6	2	2.6
S039	8/9/83	1.1	2	1.1
S040	8/9/83	3.0	2	3.0

TABLE 2.2

ON-PROPERTY SOIL SAMPLING
PRE-GRADING 1983

SAMPLE IDENTIFIER	DATE SAMPLED	SAMPLE DEPTH (ft bls)	NUMBER OF SAMPLES
Pre-Part 1, Pre-Grading - July 1983 (Stauffer)			
Northwest Corner			
02/01-01-B01	7/25/83	1.0	1
02/02-01-B01	7/24/83	1.0	1
02/08/01-B05	7/22/83	5.0	1
02/08-02-B03	7/22/83	3.0	1
03/01-01-B01	7/25/83	1.0	1
03/03-01-B01	7/22/83	1.0	1
04/01-01-B01	7/25/83	1.0	1
10/03-01-B03	7/24/83	3.0	1
10/03-02-B04	7/24/83	4.0	1
03/00-01-C01	7/27/83	1.0	1
03/03-01-C01	7/27/83	1.0	1
04/03-01-C01	7/27/83	1.0	1
05/01-01-C01	7/26/83	1.0	1
05/01-02-C01	7/26/83	1.0	1
06/01-01-C01	7/26/83	1.0	1
07/01-01-C01	7/26/83	1.0	1
07/01-02-C01	7/26/83	1.0	1
07/01-03-C01	7/26/83	1.0	1
07/03-01-C01	7/26/83	1.0	1
08/01-01-C01	7/26/83	1.0	1
09/03-01-C01	7/26/83	1.0	1
11/01-01-C01	7/28/83	1.0	1
11/03-01-C01	7/26/83	1.0	1
12/01-01-C01	7/28/83	1.0	1
13/01-01-C01	7/28/83	1.0	1
13/03-01-C01	7/27/83	1.0	1
14/01-01-C01	7/28/83	1.0	1
14/03-01-C01	7/27/83	1.0	1
Northern Property Boundary			
00/03-01-A00	7/24/83	Surface	1
00/08-01-A00	7/24/83	Surface	1
00/13-01-A00	7/24/83	Surface	1
00/18-01-A00	7/24/83	Surface	1
Recycle Pond Area			
12/18-01-A10	7/22/83	10 (a)	1
12/18-02-A10	7/23/83	10 (a)	1
12/24-01-A10	7/22/83	10 (a)	1
12/24-02-A10	7/24/83	10 (a)	1
09/21-01-A08	7/23/83	8 (a)	1
21/12-01-B15	7/28/83	15.0	1
13/21-01-C01	7/26/83	1.0	1

TABLE 2.2

ON-PROPERTY SOIL SAMPLING
PRE-GRADING 1983

SAMPLE IDENTIFIER	DATE SAMPLED	SAMPLE DEPTH (ft bls)	NUMBER OF SAMPLES
Southeast Perimeter Area			
22/38-01-A05	7/22/83	5 (a)	1
22/38-02-A06	7/24/83	6 (a)	1
22/39-01-A05	7/22/83	5 (a)	1
38/22-03-A05	7/28/83	5 (a)	1
Pre-Part 1, Pre-Grading - July 1983 (Stauffer)(Continued)			
Southern Property Boundary North of Jones Chemical			
23/21-01-C01	7/27/83	1.0	1
23/23-01-C01	7/27/83	1.0	1
23/24-01-C01	7/28/83	1.0	1
23/25-01-C01	7/27/83	1.0	1
23/27-01-C01	7/27/83	1.0	1

Notes:
Table 2.1 provides soil sampling objectives and analytes
Figure 2.1 provides soil sampling locations
This table does not include 1981 soil sampling by Montrose.
(ft bls) = Feet below land surface
(a) = Soil samples collected at above-grade elevations

TABLE 2.3

ON-PROPERTY SOIL INVESTIGATIONS 1985 to 1988

OBJECTIVE OF SAMPLING	SAMPLE LOCATIONS AND DEPTHS	SAMPLE LOCATION IDENTIFIERS	ANALYTES
Pre-Part 1, Post-Grading - 1985 (Hargis + Associates [H+A])			
Determine if pesticides and VOCs are present in the unsaturated zone between land surface and first water-bearing zone	Central Process Area Thirty-nine soil samples collected from 4 borings at 3 locations at depths ranging from 6.5 to 77 feet below land surface (bls)	MW-2, MW-2A, MW-4, S-101	Total DDT and the metabolites DDD and DDE and their isomers, VOCs and chloral
	Outside the Central Process Area Forty-six soil samples collected from 3 borings at depths ranging from 6.5 to 77 feet bls	MW-1, MW-3, MW-5	
Part 1 - 1985 (Metcalf & Eddy)			
Determine the extent of chemical compounds in soil in a grid pattern across the Property	Central Process Area Thirty-two soil samples collected from 3 borings at depths ranging from 1.5 to 19.5 feet bls	14D, 24D, 25A	Chlorobenzene, total dichloro-benzene, toluene, p,p-DDT, p,p-DDD, p,p-DDE; some samples analyzed for pesticides, VOCs, trace metals, base neutral/acid organics and TOC
	Outside the Central Process Area One hundred eight soil samples collected from 14 borings at depths ranging from 0.5 to 11 feet bls	11D, 12D, 13D, 15D, 16D, 21D, 22D, 23D, 25D, 34D, 35A, 35D, 36D, 46D	

NOTES: On-Property soil sampling locations are shown in Figure 2.3 and 2.4
Soil boring construction and sampling details provided in Table 2.4
Analytical methods provided in Appendix B

TABLE 2.3 (continued)
ON-PROPERTY SOIL INVESTIGATIONS 1985 to 1988

OBJECTIVE OF SAMPLING	SAMPLE LOCATIONS AND DEPTHS	SAMPLE LOCATION IDENTIFIERS	ANALYTES
Part 2 Phase 1 - 1986 (H+A)			
Further determine the extent of chemical compounds in On-Property soils that may have resulted from activities at the Montrose plant	Central Process Area Thirty-four soil samples collected from 4 borings at depths ranging from 16 to 61 feet bls	S-201, S-202, S-203, S-204	Pesticides and VOCs
Part 2 Phase 2A - 1988 (H+A)			
Further determine horizontal and vertical distribution of chemical compounds in soil in the vicinity of the former water recycling pond	Central Process Area Seventy-three soil samples collected from 13 borings at 6 locations at depths ranging from 5.1 to 129.3 feet bls	S-101A, S-301, S-301A, S-301B, S-302A, S-302E, S-302F, S-303, S-303A, S-304, S-304A, S-305, S-305A	Pesticides and VOCs; some samples analyzed for TOC, pH, EC, percent moisture

NOTES: On-Property soil sampling locations are shown in Figure 2.3 and 2.4
Soil boring construction and sampling details provided in Table 2.4
Analytical methods provided in Appendix B

ON- AND OFF-PROPERTY SOIL SAMPLING 1983 TO 1988

SOIL BORING IDENTIFIER	DATE DRILLED	TOTAL DEPTH OF BORING (ft bls)	NUMBER OF SAMPLES	MAXIMUM SAMPLE DEPTH (ft bls)
ON-PROPERTY				
Pre-Part 1, Post-Grading - 1985 (Hargis + Associates [H+A])				
Central Process Area				
MW002	4/24/85	80.0	16	77.0
MW002A	4/24/85	10.0	1	6.5
MW004	4/24/85	77.0	15	77.0
S101	5/1/85	52.0	7	52.0
Outside the Central Process Area				
MW001	4/24/85	77.0	16	77.0
MW003	4/24/85	78.0	16	77.0
MW005	4/24/85	72.0	14	72.0
Part 1 - 1985 (Metcalf & Eddy)				
Central Process Area				
14D	6/19/85	13.5	9	13.5
24D	6/25/85	19.5	16	19.5
25A	6/19/85	9.5	7	9.5
Outside the Central Process Area				
11D	6/26/85	9.5	7	9.5
12D	6/25/85	9.5	9	9.5
13D	6/25/85	9.5	8	9.5
15D	6/19/85	9.5	6	9.5
16D	6/19/85	9.5	8	9.5
21D	6/24/85	9.5	7	9.5
22D	6/26/85	9.5	8	9.5
23D	6/25/85	9.5	7	9.5
25D	6/18/85	11.0	8	11.0
34D	6/25/85	9.5	8	9.5
35A	6/25/85	9.5	8	9.5
35D	6/18/85	9.5	8	9.5
36D	6/19/85	9.5	8	9.5
46D	6/18/85	11.0	8	11.0
Part 2 Phase 1 - 1986 (H+A)				
Central Process Area				
S201	9/26/86	61.0	11	61
S202	9/30/86	61.0	8	60.5
S203	10/1/86	61.0	6	60.5
S204	9/23/86	60.0	9	60

ON- AND OFF-PROPERTY SOIL SAMPLING 1983 TO 1988

SOIL BORING IDENTIFIER	DATE DRILLED	TOTAL DEPTH OF BORING (ft bls)	NUMBER OF SAMPLES	MAXIMUM SAMPLE DEPTH (ft bls)
ON-PROPERTY (Continued)				
Part 2 Phase 2A - 1988 (H+A)				
Central Process Area				
S101A	11/1/88	130.5	3	126.5
S301	10/24/88	61.6	8	60.9
S301A	10/14/88	130.0	5	127.8
S301B	10/28/88	18.0	1	9.2
S302A	10/17/88	135.6	3	125.3
S302E	10/27/88	11.0	3	8.8
S302F	10/28/88	65.4	11	59.2
S303	9/19/88	130.9	9	129.6
S303A	10/27/88	100.0	3	91.6
S304	10/26/88	60.5	8	58.8
S304A	10/13/88	130.5	2	81.0
S305	9/26/88	132.0	13	74.7
S305A	10/16/88	129.9	4	129.3

ON- AND OFF-PROPERTY SOIL SAMPLING 1983 TO 1988

SOIL BORING IDENTIFIER	DATE DRILLED	TOTAL DEPTH OF BORING (ft bls)	NUMBER OF SAMPLES	MAXIMUM SAMPLE DEPTH (ft bls)
OFF-PROPERTY				
Pre-Part 1 -1983 (Hargis & Montgomery [H&M])				
LADWP Right-of-Way				
S015	6/16/83	1.5	3	1.6
S016	6/16/83	1.3	2	1.4
S025	8/9/83	2.2	2	2.2
S026	8/9/83	2.0	2	2.0
S027	8/9/83	2.2	2	2.2
Normandie Avenue Ditch				
S019	6/16/83	1.5	2	1.6
S021	6/16/83	1.1	2	1.1
S022	6/16/83	1.1	2	1.1
S019A	8/9/83	4.0	2	4.0
S021A	8/10/83	4.6	2	4.6
S022A	8/10/83	5.0	2	5.0
S028	8/10/83	5.1	2	5.1
Part 1 - 1985 (Metcalf & Eddy)				
North and West of Property				
VANNESS	6/19/85	NA (b)	4	Surface Samples
ARTESIA	6/24/85	NA (b)	3	Surface Samples
Part 2 Phase 1, Round 1 - 1986 (H+A)				
LADWP Right-of-Way				
LA001	5/8/86	6.0	8	5.75
LA002	5/2/86	6.25	9	6.0
LA003	5/6/86	5.25	7	5.0
LA004	5/2/86	5.75	6	5.5
LA005	5/2/86	5.25	6	5.0
LA006	5/6/86	5.75	6	5.5
LA007	5/6/86	5.5	8	5.25
LA008	5/5/86	5.5	6	5.25
LA009	5/5/86	5.5	5	5.25
LA010	5/5/86	5.25	5	5.0
LA011	5/5/86	6.0	6	5.75
LA012	5/6/86	5.5	5	5.25
LA013	5/6/86	5.75	6	5.5
LA014	5/6/86	5.75	6	5.5

ON- AND OFF-PROPERTY SOIL SAMPLING 1983 TO 1988

SOIL BORING IDENTIFIER	DATE DRILLED	TOTAL DEPTH OF BORING (ft bls)	NUMBER OF SAMPLES	MAXIMUM SAMPLE DEPTH (ft bls)
OFF-PROPERTY (Continued)				
Part 2 Phase 1, Round 1 - 1986 (H+A) (Continued)				
Normandie Avenue Ditch				
T031	5/8/86	6.0	7	5.75
T032	5/8/86	6.0	7	5.75
T033	5/8/86	6.0	6	5.75
T041	5/9/86	6.0	6	5.75
T042	5/9/86	6.0	6	5.25
T043	5/9/86	6.25	6	6.0
T044	5/9/86	6.0	5	5.75
T045	5/9/86	6.0	6	5.75
T051	5/9/86	6.0	6	5.25
T052	5/9/86	4.0	2	3.75
T052A	5/9/86	4.5	3	4.25
T053	5/9/86	5.75	5	5.0
T054	5/9/86	5.75	5	5.0
T061	5/7/86	5.5	7	5.25
T062	5/7/86	5.75	5	5.0
T063	5/7/86	5.5	5	5.25
T064	5/7/86	5.5	5	5.25
Property Perimeter				
MD001	4/30/86	5.5	5	5.5
MD002	4/30/86	6.25	7	5.5
MD003	5/19/86	5.0	5	5.0
MD004	4/30/86	6.5	6	6.25
MD005	4/29/86	5.75	5	5.5
MD006	4/29/86	6.0	8	5.75
JC001	5/1/86	6.5	6	6.25
JC002	5/1/86	6.25	6	5.5
JC003	5/1/86	6.75	8	6.5
JC004	5/1/86	6.25	6	5.5
JC005	4/30/86	5.75	6	5.5
SP001A	5/7/86	7.75	5	7.5
SP002	5/8/86	5.75	7	5.5
West and Southwest of Property				
5-5-S-B	5/5/86	1.0 (a)	1	1.0
5-8-S-B	5/8/86	1.0 (a)	1	1.0

ON- AND OFF-PROPERTY SOIL SAMPLING 1983 TO 1988

SOIL BORING IDENTIFIER	DATE DRILLED	TOTAL DEPTH OF BORING (ft bls)	NUMBER OF SAMPLES	MAXIMUM SAMPLE DEPTH (ft bls)
OFF-PROPERTY (Continued)				
EPA - 1986 (Ecology and Environment, Inc.)				
Northeast, East, Southeast, South, and Southwest from the Property				
E01	9/22/86	NA (b)	1	Surface Sample
E02	9/22/86	NA (b)	1	Surface Sample
E03	9/23/86	NA (b)	1	Surface Sample
E04	9/23/86	NA (b)	1	Surface Sample
E05	9/24/86	NA (b)	1	Surface Sample
E06	9/24/86	NA (b)	1	Surface Sample
E07	9/25/86	NA (b)	1	Surface Sample
E08	9/25/86	NA (b)	1	Surface Sample
E09	9/25/86	NA (b)	1	Surface Sample
E10	9/25/86	NA (b)	1	Surface Sample
E11	9/25/86	NA (b)	1	Surface Sample
E12	9/25/86	NA (b)	1	Surface Sample
E13	9/25/86	NA (b)	1	Surface Sample
E14	9/25/86	NA (b)	1	Surface Sample
E15	9/25/86	NA (b)	1	Surface Sample
West and Southwest from Property				
E-16	9/22/86	NA (a)	1	Surface Sample
E-17	9/23/86	NA (a)	1	Surface Sample
E-18	9/24/86	NA (a)	1	Surface Sample
E-19	9/25/86	NA (a)	1	Surface Sample
Part 2 Phase 1, Round 2 - 1986 (H+A)				
Arc at a Radial Distance of approximately 1/2 Mile from the Property				
NS001	5/20/86	NA (b)	3	Surface Sample
NS002	5/20/86	NA (b)	2	Surface Sample
NS003	5/20/86	NA (b)	1	Surface Sample
NS004	5/20/86	NA (b)	1	Surface Sample
NS005	5/20/86	NA (b)	1	Surface Sample
NS006	5/20/86	NA (b)	1	Surface Sample
NS007	5/20/86	NA (b)	1	Surface Sample
NS008	5/21/86	NA (b)	2	Surface Sample
Arc at a Radial Distance of approximately 3/4 Mile from the Property				
NS009	5/21/86	NA (b)	1	Surface Sample
NS010	5/21/86	NA (b)	1	Surface Sample
NS011	5/20/86	NA (b)	1	Surface Sample
NS012	5/20/86	NA (b)	1	Surface Sample
NS013	5/20/86	NA (b)	3	Surface Sample

ON- AND OFF-PROPERTY SOIL SAMPLING 1983 TO 1988

SOIL BORING IDENTIFIER	DATE DRILLED	TOTAL DEPTH OF BORING (ft bls)	NUMBER OF SAMPLES	MAXIMUM SAMPLE DEPTH (ft bls)
OFF-PROPERTY (Continued)				
Arc at a Radial Distance of approximately 3/4 Mile from the Property (continued)				
NS014	5/20/86	NA (b)	1	Surface Sample
NS015	5/20/86	NA (b)	1	Surface Sample
NS016	5/20/86	NA (b)	1	Surface Sample
NS017	5/20/86	NA (b)	1	Surface Sample
Part 2 Phase 1, Round 2 - 1986 (H+A) (Continued)				
3 Miles Southwest of Property				
5-20-S-B	5/20/86	1.25 (a)	1	1.25
Part 2 Phase 2A - 1988 (H+A)				
Normandie Avenue Ditch				
T033	9/16/88	22.25	7	21.5
T034	9/16/88	6.75	6	6.0
T042	9/13/88	23.0	6	22.75
T046	9/13/88	61.5	14	60.75
T052	9/14/88	62.0	17	61.75
T064	9/14/88	23.0	7	22.75
SP003	9/16/88	6.75	6	5.5
SP004	9/16/88	2.75	4	5.5
SP004A	9/16/88	6.75	1	2.0
SP005	9/16/88	6.75	6	6.0
LADWP Right-of-Way				
LA015	9/17/88	3.5	4	3.5
LA016	9/12/88	3.0	4	3.0
LA017	9/17/88	3.5	3	3.5
LA018	9/12/88	3.0	3	3.0
LA019	9/12/88	3.1	5	3.0
Farmer Brothers				
T021B	9/15/88	9.25	7	9.0
T022	9/15/88	9.25	5	8.5
T023	9/15/88	9.25	7	9.0
T024	9/15/88	9.25	8	8.5
T025	9/15/88	9.25	5	8.5
T026	9/15/88	9.25	5	8.5
T027	9/15/88	9.25	7	9.0

NOTES:
Tables 2.3 and 2.5 provide soil sampling objectives and analytes
Soil sampling locations are shown in Figures 2.4, 2.5, and 2.6
This table does not include 1981 soil sampling by Montrose.
(a) = Background soil sample
(b) = Neighborhood soil sample
(ft bls) = Feet below land surface

TABLE 2.5

OFF-PROPERTY SOIL INVESTIGATIONS 1983-1988

OBJECTIVE OF SAMPLING	SAMPLE LOCATIONS AND DEPTHS	SAMPLE LOCATION IDENTIFIERS	ANALYTES
Pre-Part 1 - June and August 1983 (Hargis & Montgomery [H&M])			
Obtain data regarding the presence of DDT Off-Property in near-surface soil	LADWP Right-of-Way		
	Eleven soil samples collected from 5 borings at depths ranging from 0.6 to 2.2 feet below land surface (bls)	S-15, S-16, S-25, S-26, S-27	Total DDT and the metabolites DDD and DDE and their isomers
	Normandie Avenue Ditch		
	Fourteen soil samples collected from 7 borings at 5 locations at depths ranging from 0.6 to 5.1 feet bls	S-19, S-19A, S-21, S-21A, S-22, S-22A, S-28	
Part 1 - 1985 (Metcalf & Eddy)			
Collect background samples for comparison to On-Property investigation results	North and West of Property		
	Seven soil samples collected from 2 locations at land surface	Van Ness, Artesia	Pesticides, VOCs, trace metals, base neutral/acid organics

NOTES: See last page of this table for footnotes

TABLE 2.5 (continued)
OFF-PROPERTY SOIL INVESTIGATIONS 1983-1988

OBJECTIVE OF SAMPLING	SAMPLE LOCATIONS AND DEPTHS	SAMPLE LOCATION IDENTIFIERS	ANALYTES
Part 2 Phase 1, Round 1 - 1986 (Hargis + Associates [H+A])			
Collect additional samples for Off-Property investigation	LADWP Right-of-Way		
	Eighty-eight soil samples collected from 14 soil borings at depths ranging from 0.5 to 6 feet bls	LA-1 through LA-14	Pesticides, VOCs
	Normandie Avenue Ditch		
	Ninety-two soil samples collected from 17 borings at 6 locations at depths ranging from 1.0 to 6.0 feet bls	T-31 through T-33 T-41 through T-45 T-51, T-52, T-52A T-53, T-54, T-61 through T-64	Pesticides and VOCs
Determine the extent of chemicals compounds in Off-Property soils that may have resulted from activities at the Montrose plant; gather data of sufficient quality to support the Feasibility Study	Property Perimeter		
	Eighty soil samples collected from 13 borings at 12 locations at depths ranging from 0.3 to 7.5 feet bls	MD-1 through MD-6, JC-1 through JC-5, SP-1A, SP-2	Pesticides and VOCs

NOTES: See last page of this table for footnotes

TABLE 2.5 (continued)
OFF-PROPERTY SOIL INVESTIGATIONS 1983-1988

OBJECTIVE OF SAMPLING	SAMPLE LOCATIONS AND DEPTHS	SAMPLE LOCATION IDENTIFIERS	ANALYTES
Collect background soil samples	Approximately 2 to 2.5 Miles West and Southwest of Property		
	Two soil samples collected at two locations at land surface	5-5-S(B), 5-8-S(B)	Pesticides and VOCs
EPA - 1986 (Ecology and Environment, Inc.)			
Determine if DDT and its metabolites had been dispersed from the Montrose plant	Northeast, East, Southeast, South, West, South, and Southwest of Property		
	Thirty-five soil samples collected at 15 locations at land surface	E-1 through E-15	DDT, DDD, DDE
Collect background samples for EPA Off-Property investigation	Approximately 3.5 to 5 Miles West and Southwest of Property		
	Four soil samples collected at 4 locations at land surface	E-16 through E-19	DDT, DDD, DDE
Part 2 Phase 1, Round 2 - 1986 (H+A)			
Determine the presence of pesticides in neighborhood soil	Arc at a radial distance of approximately ½ mile from Property		
	Twelve soil samples collected from 8 locations at 0.3 foot bls	NS-1 through NS-8	Pesticides

NOTES: See last page of this table for footnotes

TABLE 2.5 (continued)
OFF-PROPERTY SOIL INVESTIGATIONS 1983-1988

OBJECTIVE OF SAMPLING	SAMPLE LOCATIONS AND DEPTHS	SAMPLE LOCATION IDENTIFIERS	ANALYTES
Part 2 Phase 1, Round 2 - 1986 (H+A) (continued)			
	Arc at a radial distance of approximately ¾ mile from Property		
	Eleven soil samples collected from 8 locations at 0.3 foot bls	NS-9 through NS-17	Pesticides
Collect additional sample for background soil investigation	3 Miles Southwest of Property		
	One soil sample collected at land surface	5-20-S(8)	Pesticides
Part 2 Phase 2A - 1988 (H+A)			
Further determine the horizontal and vertical distribution of pesticides and VOCs beneath the Normandie Avenue ditch; further determine the horizontal and vertical distribution of pesticides along the SPRR Right-of-Way, and the LADWP Right-of-Way; and determine the horizontal and vertical distribution of pesticides along a historical drainage located on the north portion of the Farmer Brothers property	LADWP right-of-way		
	Nineteen soil samples collected from 5 borings at 5 locations at depths ranging from 0.5 to 3.5 feet bls	LA-15 through LA-19	Pesticides, TOC, pH, EC and soil moisture
	Normandie Avenue ditch		
	Seventy-four soil samples collected from 10 borings at 5 locations at depths ranging from 0.5 to 61.8 feet bls	T-33, T-34, T-42, T-46, T-52, T-64, SP-3, SP-4, SP-4A, SP-5	Pesticides; some samples for VOCs, TOC, pH, EC and soil moisture

NOTES: See last page of this table for footnotes

TABLE 2.5 (continued)
OFF-PROPERTY SOIL INVESTIGATIONS 1983-1988

OBJECTIVE OF SAMPLING	SAMPLE LOCATIONS AND DEPTHS	SAMPLE LOCATION IDENTIFIERS	ANALYTES
Part 2 Phase 2A - 1988 (H+A) (continued)			
	Farmer Brothers		
	Forty-four soil samples collected from 7 borings at 7 locations at depths ranging from 0.8 to 9 feet bls	T-21B, T-22 through T-27	Pesticides

NOTES: Near Off-property soil sampling locations are shown on Figure 2.4
Neighborhood soil sampling locations are shown on Figure 2.5
Background soil sampling locations are shown on Figure 2.6
Soil boring construction and sampling details are provided in Table 2.4
Analytical methods are provided in Appendix B
This table does not include 1981 soil sampling by Montrose

LADWP = Los Angeles Department of Water and Power
Pesticides = DDT and its metabolites and isomers and BHC and its isomers analyzed using EPA Method 608/8080
VOCs = Volatile organic compounds analyzed using EPA Method 624/8240
EPA = U.S. Environmental Protection Agency
SPRR = Southern Pacific Railroad
Farmer Brothers = Farmer Brothers Coffee Company
TOC = Total organic carbon
pH = Acidity/alkalinity
EC = Electrical conductivity

TABLE 2.6

LOCATION OF NEIGHBORHOOD AND BACKGROUND SOIL SAMPLES

SAMPLE IDENTIFIER	DATE SAMPLED	SAMPLE LOCATION
Neighborhood Samples		
NS-1	05/20/86	1205 Knox Street
NS-2	05/20/86	West side of Vermont Avenue, north of Los Angeles Department of Water and Power Right-of-Way
NS-3	05/20/86	New Hampshire Avenue and 204th Street
NS-4	05/20/86	20617 Berendo Street
NS-5	05/20/86	20815 Raymond Avenue
NS-6	05/20/86	20832 Halldale Avenue
NS-7	05/20/86	Torrance Boulevard and Dalton Avenue
NS-8	05/21/86	206th Street and Harvard Boulevard
NS-9	05/21/86	1583 Torrance Boulevard
NS-10	05/21/86	Denker Avenue and 211th Street
NS-11	05/20/86	Normandie Avenue and 211th Street
NS-12	05/20/86	210th Street west of Royal Boulevard
NS-13	05/20/86	1002 210th Street
NS-14	05/20/86	Vermont Avenue and Torrance Boulevard
NS-15	05/20/86	Del Amo Boulevard west of Hamilton Avenue
NS-16	05/20/86	Hamilton Avenue
NS-17	05/20/86	1115 190th Street
E-1	09/22/86	1201 Jon Street
E-2	09/22/86	1617 West 204th Street
E-3	09/23/86	Along Del Amo Boulevard
E-4	09/23/86	1006 204th Street
E-5	09/24/86	1201 Francisco Street
E-6	09/24/86	1129 West 204th Street
E-7	09/25/86	1114 West 204th Street
E-8	09/25/86	1124 West Greenhedge Street
E-9	09/25/86	1117 West Greenhedge Street
E-10	09/25/86	1210 West Knox Street
E-11	09/25/86	1500 Del Amo Boulevard
E-12	09/25/86	1546 Del Amo Boulevard
E-13	09/25/86	1514/1516 West 204th Street
E-14	09/25/86	20906 Dalton Avenue
E-15	09/25/86	20942 Halldale Avenue

NOTE: See Figures 2.5 and 2.6 for Neighborhood and Background Soil Sample Locations, respectively.

TABLE 2.6 (continued)
LOCATION OF NEIGHBORHOOD AND BACKGROUND SOIL SAMPLES

SAMPLE IDENTIFIER	DATE SAMPLED	SAMPLE LOCATION
Background Samples		
VAN NESS	06/85	Van Ness Business Center
ARTESIA	06/24/85	Normandie Avenue and Artesia Boulevard
5-5-S(B)	05/05/86	Emerald Street and Madrana Street
5-8-S(B)	05/08/86	1800 Oak Street
5-20-S(B)	05/20/86	Madrana Avenue and 224th Street
E-16	09/22/86	5430 Torrance Boulevard
E-17	09/23/86	24027 Pennsylvania Avenue
E-18	09/24/86	4915 Emerald Street
E-19	09/25/86	415 Vincent Street

NOTE: See Figures 2.5 and 2.6 for Neighborhood and Background Soil Sample Locations, respectively.

TABLE 2.7

MONITORING WELL CONSTRUCTION

OBJECTIVE OF MONITORING WELL CONSTRUCTION	MONITORING WELL LOCATION	MONITORING WELL IDENTIFIER	HYDROGEOLOGIC UNIT
Pre-RI - 1985	On-Property:		
Evaluate the geologic conditions, determine the direction of groundwater flow, and determine if chemicals related to the activities at the former DDT manufacturing plant were present in the Upper Bellflower Aquitard	Southeast corner of Property	MW-1	Upper Bellflower Aquitard
	Near water recycling pond	MW-2	Upper Bellflower Aquitard
	West Property boundary	MW-3	Upper Bellflower Aquitard
	North Property boundary	MW-4	Upper Bellflower Aquitard
	East Property boundary	MW-5	Upper Bellflower Aquitard
Part 2 Phase 1 - 1986	On-Property:		
Determine the depth, thickness, and lateral continuity of the Upper Bellflower Aquitard, the Bellflower Sand, and the Gage Aquifer; further define the direction of groundwater flow and chemical quality of groundwater in the Bellflower Sand; and define the direction of groundwater flow and chemical quality of groundwater in the Gage Aquifer	Northwest portion of Property	BF-1	Bellflower Sand
	South-central portion of Property	BF-2	Bellflower Sand
	Eastern portion of Property	BF-3	Bellflower Sand
	Southeastern portion of Property	BF-4	Bellflower Sand
	North-central Property boundary	G-1	Gage Aquifer
	Southeast corner of Property	G-2	Gage Aquifer
	South-central portion of Property	G-3	Gage Aquifer
	Southeast corner of Property	LG-1	Lower portion of Gage Aquifer

TABLE 2.7 (continued)
MONITORING WELL CONSTRUCTION
Page 2 of 9

OBJECTIVE OF MONITORING WELL CONSTRUCTION	MONITORING WELL LOCATION	MONITORING WELL IDENTIFIER	HYDROGEOLOGIC UNIT
Part 2 Phase 2A - 1988-1989	Off-Property:		
Determine the depth, thickness, and lateral continuity of the Upper Bellflower Aquitard, the Bellflower Sand, and the Gage Aquifer and further define the direction of groundwater flow and chemical quality of groundwater	South of Jones Chemical Company	MW-6	Upper Bellflower Aquitard
	Southwest of Jones Chemical Company	MW-7	Upper Bellflower Aquitard
	Northwest of Property on McDonnell Douglas Corporation property	MW-8	Upper Bellflower Aquitard
	North of Property on McDonnell Douglas Corporation property	MW-9	Upper Bellflower Aquitard
	Northeast of Property on Francisco Street	MW-10	Upper Bellflower Aquitard
	East of Property on Jon Street	MW-11	Upper Bellflower Aquitard
	East of Property on Jon Street	MW-12 (clustered with BF-5, G-4, and EB-3)	Upper Bellflower Aquitard
	Southeast of Property on LADWP right-of-way	MW-13 (clustered with BF-5, G-5, LW-2, and EB-4)	Upper Bellflower Aquitard
	Southeast of Property at Normandie Avenue and Del Amo Boulevard	MW-14 (clustered with BF-7, G-6, and EB-5)	Upper Bellflower Aquitard
	South of Property on Farmer Brothers Coffee Company Property	MW-15 (clustered with BF-8, G-7, and EB-6)	Upper Bellflower Aquitard
	East of Property on Jon Street	BF-5 (clustered with MW-12, G-4, and EB-3)	Bellflower Sand
	Southeast of Property on LADWP right-of-way	BF-6 (clustered with MW-13, G-5, LW-2, and EB-4)	Bellflower Sand
	Southeast of Property at Normandie Avenue and Del Amo Boulevard	BF-7 (clustered with MW-14, G-6, and EB-6)	Bellflower Sand
	South of Property on Farmer Brother's Coffee Company Property	BF-8 (clustered with MW-15, G-7,	Bellflower Sand

TABLE 2.7 (continued)
MONITORING WELL CONSTRUCTION

OBJECTIVE OF MONITORING WELL CONSTRUCTION	MONITORING WELL LOCATION	MONITORING WELL IDENTIFIER	HYDROGEOLOGIC UNIT
Part 2 Phase 2A (continued)	East of Property on Jon Street	G-4 (clustered with MW-12, BF-5, and EB-3)	Gage Aquifer
	Southeast of Property on LADWP right-of-way	G-5 (clustered with MW-13, BF-6, LW-2, and EB-4)	Gage Aquifer
	Southeast of Property at Normandie Avenue and Del Amo Boulevard	G-6 (clustered with MW-14, EB-5, and BF-7)	Gage Aquifer
	South of Property on Farmer Brothers Coffee Company property	G-7 (clustered with MW-14, BF-8, and EB-6)	Gage Aquifer
	On-Property:		
	In central process area	BF-9 (clustered with MW-2)	Bellflower Sand
	Southeast and adjacent to central process area	LG-2 (clustered with LW-1)	Lower portion of Gage Aquifer
Part 2 Phase 2B - 1989-1990	Off-Property:		
Determine the depth, thickness, and lateral continuity of the Upper Bellflower Aquitard, the Bellflower Sand, the Gage Aquifer, and the Lynwood Aquifer and further define the direction of groundwater flow and chemical quality of groundwater	South of Farmer Brothers Coffee Company property	MW-16	Upper Bellflower Aquitard
	Southwest of well MW-7 on Denker Avenue near Del Amo Boulevard	MW-17	Upper Bellflower Aquitard
	North of Property, northwest of well MW-9	MW-18	Upper Bellflower Aquitard
	North of Property, northwest of well MW-10	MW-19	Upper Bellflower Aquitard

TABLE 2.7 (continued)
MONITORING WELL CONSTRUCTION
Page 4 of 9

OBJECTIVE OF MONITORING WELL CONSTRUCTION	MONITORING WELL LOCATION	MONITORING WELL IDENTIFIER	HYDROGEOLOGIC UNIT
Part 2 Phase 2B (continued)	Northeast of Property, northeast of well MW-10	MW-20	Upper Bellflower Aquitard
	Northeast of Property, east of well MW-10	MW-21	Upper Bellflower Aquitard
	South of Farmer Brothers Coffee Company property	MW-22	Upper Bellflower Aquitard
	Southeast of Property on Budlong Avenue north of West Milton Street	MW-23 (clustered with BF-14, G-13, and EB-11)	Upper Bellflower Aquitard
	Southeast of Property at West Milton Street and Kenwood Avenue	MW-24 (clustered with BF-15 and G-8)	Upper Bellflower Aquitard
	On Raymond Avenue north of Armco site	MW-25	Upper Bellflower Aquitard
	Southeast of Property on West Milton Street and Normandie Avenue	MW-26	Upper Bellflower Aquitard
	Southeast of Property on New Hampshire Avenue south of West Milton Street	BF-10 (clustered with G-9 and EB-12)	Bellflower Sand
	On Berendo Avenue south of Armco site	BF-11	Bellflower Sand
	On Linley Street east of Armco site	BF-12 (clustered with EB-13)	Bellflower Sand
	On Del Amo Boulevard east of Del Amo site	BF-13 (clustered with G-11 and EB-9)	Bellflower Sand
	Southeast of Property on Budlong Avenue north of West Milton Street	BF-14 (clustered with MW-23, G-13, and EB-11)	Bellflower Sand
	Southeast of Property at West Milton Street and Kenwood Avenue	BF-15 (clustered with MW-24 and G-8)	Bellflower Sand
	On Budlong Avenue south of Armco site	BF-16	Bellflower Sand
	On New Hampshire Avenue southeast of Armco site	BF-17	Bellflower Sand

OBJECTIVE OF MONITORING WELL CONSTRUCTION	MONITORING WELL LOCATION	MONITORING WELL IDENTIFIER	HYDROGEOLOGIC UNIT
Part 2 Phase 2B (continued)	Southeast of Property at West Milton Avenue and Kenwood Street	G-8 (clustered with MW-24 and BF-15)	Gage Aquifer
	Southeast of Property on New Hampshire Avenue south of West Milton Street	G-9 (clustered with BF-10 and EB-12)	Gage Aquifer
	On Del Amo Boulevard east of Del Amo site	G-11 (clustered with BF-13 and EB-9)	Gage Aquifer
	Southeast of Property on Catalina Street south of 204th Street	G-12	Gage Aquifer
	Southeast of Property on Budlong Avenue north of West Milton Street	G-13 (clustered with MW-23, BF-14, and EB-11)	Gage Aquifer
	East of Property on LADWP right-of-way	LW-2 (clustered with MW-13, BF-6, G-5, and EB-4)	Lynwood Aquifer
	Northeast of Property on Francisco Street east of Normandie Avenue and well MW-10	LW-3	Lynwood Aquifer
	On-Property:		
	Southeast and adjacent to central process area	LW-1 (clustered with LG-2)	Lynwood Aquifer

TABLE 2.7 (continued)
MONITORING WELL CONSTRUCTION
Page 6 of 9

OBJECTIVE OF MONITORING WELL CONSTRUCTION	MONITORING WELL LOCATION	MONITORING WELL IDENTIFIER	HYDROGEOLOGIC UNIT
Additional Groundwater Assessment - 1991	Off-Property:		
Define the extent of groundwater containing concentrations of chlorobenzene at 30 micrograms per liter or greater in the Upper Bellflower Aquitard, the Bellflower Sand, the Gage Aquifer, and the Lynwood Aquifer	Northeast of Property, east of Normandie Avenue on Francisco Street	MW-27 (clustered with BF-19, G-14, and LW-3)	Upper Bellflower Aquitard
	Northeast of Property, southwest of the intersection of Pacific Gateway and Francisco Street	MW-28	Upper Bellflower Aquitard
	East of Property on LADWP right-of-way, east of MW-13	MW-29	Upper Bellflower Aquitard
	Southeast of Property on the southeast corner of 204th Street and Raymond Avenue	MW-30	Upper Bellflower Aquitard
	North of Property, northwest of MW-18 and G-10	BF-18	Bellflower Sand
	Northeast of Property on Francisco Street	BF-19 (clustered with MW-27, G-14, and LW-3)	Bellflower Sand
	Southwest of Property at the southwest corner of Del Amo Boulevard and Denker Avenue	BF-20	Bellflower Sand
	South of Property at the southwest corner of Normandie Avenue and Torrance Boulevard	BF-21 (clustered with EB-15)	Bellflower Sand
	Southeast of Property on 212th Street, southwest of BF-16	BF-22	Bellflower Sand

TABLE 2.7 (continued)
MONITORING WELL CONSTRUCTION
Page 7 of 9

OBJECTIVE OF MONITORING WELL CONSTRUCTION	MONITORING WELL LOCATION	MONITORING WELL IDENTIFIER	HYDROGEOLOGIC UNIT
Additional Groundwater Assessment - 1991 (continued)	Off-Property (cont'd)		
	Southeast of Property, south of 204th Street and Catalina Street intersection	BF-23 (clustered with G-12)	Bellflower Sand
	Southeast of Property at the intersection of Royal Boulevard and 209th Street	BF-24 (clustered with EB-14)	Bellflower Sand
	Southeast of Property, off of South Doble Avenue, northeast of BF-27 and west of BF-28	BF-25	Bellflower Sand
	Southeast of Property, east of Vermont Avenue on West 214th Street	BF-26	Bellflower Sand
	Southeast of Property, west of Vermont Avenue on West 214th Street	BF-27	Bellflower Sand
	Southeast of Property, east of Vermont Avenue on West Clarion Drive	BF-28	Bellflower Sand
	South of Property, east of Denker Avenue and west of Normandie and north of 209th Street	BF-29	Bellflower Sand
	Southeast of Property, south of 212th Street, east side of Normandie Avenue .	BF-30	Bellflower Sand
	Southwest of Property on Denker Avenue and north of 211th Street	BF-31	Bellflower Sand
	Southwest of Property, southeast corner of west 205th Street and Western Avenue	BF-32	Bellflower Sand
	Southwest of Property at the north end of South Hobart	BF-33 (clustered with EB-17)	Bellflower Sand

TABLE 2.7 (continued)
MONITORING WELL CONSTRUCTION
Page 8 of 9

OBJECTIVE OF MONITORING WELL CONSTRUCTION	MONITORING WELL LOCATION	MONITORING WELL IDENTIFIER	HYDROGEOLOGIC UNIT
Additional Groundwater Assessment - 1991 (continued)	Off-Property (cont'd)		
	North of Property, northwest of G-1	G-10	Gage Aquifer
	Northeast of Property on Francisco Street	G-14 (clustered with MW-27 and BF-19)	Gage Aquifer
	South of Property on Farmer Brothers Coffee Company property	G-15	Gage Aquifer
	Southeast of Property at the intersection of West Milton Street and Mariposa Avenue	G-16	Gage Aquifer
	East of Property on LADWP right-of-way east of Vermont Avenue	G-17	Gage Aquifer
	Southeast of Property just south of the intersection of Torrance Boulevard and New Hampshire Avenue	G-18	Gage Aquifer
	Southeast of Property at the intersection of Catalina Street and West Greenhedge	G-19	Gage Aquifer
	Southeast of Property on the southeast corner of Del Amo Boulevard and Normandie Avenue	LW-4 (clustered with EB-5 and BF-7)	Lynwood Aquifer
	On-Property:		
	North and adjacent to central process area	LW-5 (clustered with MW-4)	Lynwood Aquifer
	East of central process area	LW-6 (clustered with MW-5)	Lynwood Aquifer
	South of central process area	LW-7 (clustered with BF-2 and G-3)	Lynwood Aquifer

TABLE 2.7 (continued)
MONITORING WELL CONSTRUCTION

OBJECTIVE OF MONITORING WELL CONSTRUCTION	MONITORING WELL LOCATION	MONITORING WELL IDENTIFIER	HYDROGEOLOGIC UNIT
Destruction of Monitoring Well BF-32 August 1993 due to sewer construction	Southwest of Property near intersection of 205th Street and Western Avenue	BF-32	Bellflower Sand
Construction of Monitoring Well BF-32A to replace monitoring Well BF-32 December 1993	Southwest of Property near intersection of 206th Street and Harvard Boulevard	BF-32A	Bellflower Sand
Destruction of Monitoring Wells at Farmer Brothers due to expansion of facility (August 1994)	South of Property on Farmer Brothers Company property	MW-15, BF-8, G-7	Upper Bellflower Aquitard, Bellflower Sand, Gage Aquifer

TABLE 2.8

EXPLORATORY BORINGS

BORING IDENTIFIER	TOTAL DEPTH (feet)	DATE DRILLED	ASSOCIATED WELLS
EB-1	239	10/13/86	None
EB-2	240	10/23/86	None
EB-2A	380	10/31/88	None
EB-3	320	11/07/90	MW-12, BF-5, G-4
EB-4	320	11/11/90	MW-13, BF-6, G-5, LW-2
EB-5	320	11/09/90	MW-14, BF-7, G-6
EB-6	300	11/16/90	MW-15, BF-8, G-7
EB-7	---------- Not drilled ----------		
EB-8	265	09/27/89	MW-9
EB-9	280	10/30/89	BF-13, G-11
EB-10	117	10/16/90	None
EB-11	259	08/19/90	MW-23, BF-14, G-13
EB-12	260	11/20/90	G-9, BF-10
EB-13	246	11/28/90	BF-12
EB-14	295	05/15/91	BF-24, G-19
EB-15	245	05/21/91	BF-21
EB-16	303	07/09/91	BF-27
EB-17	305	09/04/91	BF-33

NOTE: See Figure 2.9 for exploratory boring locations.

TABLE 2.9

GROUNDWATER SAMPLING AND ANALYSIS

SCOPE OF SAMPLING	HYDROGEOLOGIC UNIT	SAMPLING ROUND	MONITORING WELLS	ANALYTES
Determine distribution of chemical compounds On-Properly	Upper Bellflower Aquitard	April - May 1985	MW-1 through MW-5	Pesticides, VOCs, BNAs, common ions
		July 1985	MW-1, MW-2, MW-4	Pesticides, VOCs, acid organics, common ions, chloral (MW-1)
		August 1985	MW-1 through MW-5	Pesticides, VOCs, base neutral/acid organics, common ions, PCBs, chloral (MW-3, MW-5)
		August 1986	MW-1 through MW-6	Pesticides, VOCs
Further determine distribution of chemical compounds On-Property	Upper Bellflower Aquitard, Bellflower Sand, Gage Aquifer	January 7-9, 1987	MW-1 through MW-5, BF-1 through BF-4, G-1 through G-3, LG-1	Pesticides, VOCs, common ions
		January 12-14, 1987	MW-1 through MW-5, BF-1 through BF-4, G-1 through G-3, LG-1	Pesticides, VOCs, common ions
		February 1987	MW-1 through MW-5, BF-1 through BF-4, G-1 through G-3, LG-1	Pesticides, VOCs

NOTE: Refer to page 6 of this table for footnotes.

TABLE 2.9
GROUNDWATER SAMPLING AND ANALYSIS

SCOPE OF SAMPLING	HYDROGEOLOGIC UNIT	SAMPLING ROUND	MONITORING WELLS	ANALYTES
		March - April 1987	MW-1 through MW-5, BF-1 through BF-4, G-1 through G-3	Pesticides, VOCs
		November 1987	MW-1 through MW-5, BF-1 through BF-4, G-1 through G-3, LG-1	Pesticides, VOCs
		January 1988	MW-1 through MW-5, BF-1 through BF-4, G-1 through G-3, LG-1	Pesticides, VOCs
		April 1988	MW-1 through MW-5, BF-1 through BF-4, G-1 through G-3, LG-1	Pesticides, VOCs MW-2 for DNAPL
		July 1988	MW-1, MW-3 through MW-5, BF-1 through BF-4, G-1 through G-3, LG-1	Pesticides, VOCs, MW-2 DNAPL only
		October 1988	MW-1, MW-3 through MW-5, BF-1 through BF-4, G-1 through G-3, LG-1	Pesticides, VOCs, MW-2 DNAPL only
Initial sampling of Off-Property wells	Upper Bellflower Aquitard, Bellflower Sand, Gage Aquifer	January - February 3, 1989	MW-6, MW-7, MW-10 through MW-15, BF-5 through BF-9, G-4 through G-7, LG-2	Pesticides, VOCs

NOTE: Refer to page 6 of this table for footnotes.

TABLE 2.9
GROUNDWATER SAMPLING AND ANALYSIS

SCOPE OF SAMPLING	HYDROGEOLOGIC UNIT	SAMPLING ROUND	MONITORING WELLS	ANALYTES
Sample existing wells plus newly constructed wells	Upper Bellflower Aquitard, Bellflower Sand, Gage Aquifer	February 6-10, 1989	MW-1, MW-3 through MW-7, MW-10 through MW-15, BF-1 through BF-9, G-1 through G-7, LG-1, LG-2	Pesticides, VOCs, common ions at new wells, MW-2 DNAPL only
Initial sampling of newly constructed wells	Upper Bellflower Aquitard	May 12, 1989	MW-8 and MW-9	Pesticides, VOCs, common ions
Sample existing wells, no sampling of MW-2	Upper Bellflower Aquitard, Bellflower Sand, Gage Aquifer, Lynwood Aquifer	May 15-19, 1989	MW-1, MW-3 through MW-15, BF-1 through BF-9, G-1 through G-7, LG-1, LG-2	Pesticides, VOCs
Initial sampling of new wells, no sampling of MW-2. Sampling round cut short due to theft. Sampling completed one month later	Upper Bellflower Aquitard, Bellflower Sand, Gage Aquifer, Lynwood Aquifer	October - November 1989	MW-1, MW-3 through MW-15, MW-23 through MW-26, BF-1 through BF-9, BF-13 through BF-15, G-1 through G-7, G-11 through G-13, LG-2, LW-1, LW-2	Pesticides, VOCs, common ions at new wells, fuel hydrocarbon on free product at MW-7
Initial sampling of newly constructed wells	Bellflower Sand, Gage Aquifer, Lynwood Aquifer	December 1989	BF-10 through BF-12, BF-16, BF-17, G-8, G-9, LW-3	Pesticides, VOCs, common ions at new wells
Initial sampling of newly constructed wells	Bellflower Sand, Gage Aquifer	January 1990	BF-16, BF-17, G-8	Pesticides, VOCs
Sample existing wells, no sampling of MW-2	Upper Bellflower Aquitard, Bellflower Sand, Gage Aquifer, Lynwood Aquifer	February 1990	MW-6 through MW-15, MW-23 through MW-26, BF-5 through BF-17, G-4 through G-9, G-11 through G-13, LG-2, LW-1 through LW-3	Pesticides, VOCs

NOTE: Refer to page 6 of this table for footnotes.

TABLE 2.9
GROUNDWATER SAMPLING AND ANALYSIS

SCOPE OF SAMPLING	HYDROGEOLOGIC UNIT	SAMPLING ROUND	MONITORING WELLS	ANALYTES
Initial sampling of newly constructed wells	Upper Bellflower Aquitard	April 5-6, 1990	MW-16 through MW-22	Pesticides, VOCs
Sample key wells	Upper Bellflower Aquitard, Bellflower Sand, Gage Aquifer, and Lynwood Aquifer	August 3-6, 1990	MW-16 through MW-26, BF-10 through BF-17, G-8, G-9, G-11 through G-13, LG-1, LW-1 through LW-3	Pesticides, VOCs
Sample key wells	Upper Bellflower Aquitard, Bellflower Sand, Gage Aquifer, Lynwood Aquifer	November 26 through December 3, 1990	MW-3, MW-5, MW-6, MW-12, MW-14, MW-16, MW-19, MW-23, MW-26, BF-4, BF-8, BF-10, BF-12, BF-16, BF-17, G-1, G-2, G-4, G-7 through G-9, G-13, LW-1, LW-2	Pesticides, VOCs, TOC, BNAs, metals, p-CBSA
Sample key wells	Upper Bellflower Aquitard, Bellflower Sand, Gage Aquifer, Lynwood Aquifer	April 22-25, 1991	MW-3, MW-5, MW-6, MW-12, MW-14, MW-16, MW-19, MW-23, MW-26, BF-4, BF-8, BF-10, BF-12, BF-16, BF-17, G-1, G-2, G-4, G-7 through G-9, G-13, LW-1, LW-2	Pesticides, VOCs, p-CBSA
Initial sampling of newly constructed wells	Upper Bellflower Aquitard, Bellflower Sand, Gage Aquifer, Lynwood Aquifer	May 30 through October 3, 1991	MW-27, MW-29, MW-30, BF-18 through BF-33, G-10, G-14 through G-19, LW-4 through LW-7	Pesticides, VOCs
Sample wells installed during the Additional Groundwater Assessment	Upper Bellflower Aquitard, Bellflower Sand, Gage Aquifer, Lynwood Aquifer	October 7-17, 1991	MW-27, MW-29, MW-30, BF-18 through BF-33, G-10, G-14 through G-19, LW-4 through LW-7	Pesticides, VOCs, BNAs, trace metals, TOC, p-CBSA, general minerals, nitrates

NOTE: Refer to page 6 of this table for footnotes.

TABLE 2.9
GROUNDWATER SAMPLING AND ANALYSIS

SCOPE OF SAMPLING	HYDROGEOLOGIC UNIT	SAMPLING ROUND	MONITORING WELLS	ANALYTES
Initial and second round sampling of monitoring well MW-28	Upper Bellflower Aquitard	November 19-21, 1991	MW-28	Pesticides, VOCs
Sample key wells	Upper Bellflower Aquitard, Bellflower Sand, Gage Aquifer, Lynwood Aquifer	July 1992	MW-1, MW-30, MW-31, BF-9, BF-26, BF-31, G-3, G-9, G-19, LW-1 LW-4	Pesticides, VOCs, p-CBSA
Sample key wells	Upper Bellflower Aquitard, Bellflower Sand, Gage Aquifer, Lynwood Aquifer	January 1993	MW-1, MW-30, BF-9, BF-26, BF-31, G-3, G-9, G-19, LW-1, LW-4	Pesticides, VOCs, p-CBSA
Sample monitoring well before destruction	Bellflower Sand	August 1993	BF-32	VOCs
Sample monitoring wells before destruction on Farmer Brothers Company property	Upper Bellflower Aquitard, Bellflower Sand, Gage Aquifer	August 1994	MW-15, BF-8, G-7	VOCs, p-CBSA

NOTE: Refer to page 6 of this table for footnotes.

TABLE 2.9
GROUNDWATER SAMPLING AND ANALYSIS

SCOPE OF SAMPLING	HYDROGEOLOGIC UNIT	SAMPLING ROUND	MONITORING WELLS	ANALYTES
Sample selected wells to verify the existing plume configuration	Upper Bellflower Aquitard, Bellflower Sand, Gage Aquifer, Lynwood Aquifer	October through December 1995	MW-1, MW-5, MW-6, MW-9, MW-12, MW-17, MW-19, MW-24 through MW-27, UBT-3, BF-9, BF-18, BF-24, BF-26, BF-30, BF-31, BF-32A, G-10, G-16, G-18, G-19, LW-1, LW-2	Pesticides, VOCs, p-CBSA

FOOTNOTES:

Pesticides = See Appendix B for more specific information regarding analyses performed on groundwater samples collected from each monitoring well.
DDT and its metabolites and isomers and BHC and its isomers analyzed by U.S. Environmental Protection Agency (EPA) Method 608/8080.
Note that BHC was not a routine analyte until mid-1985.

VOCs = Volatile organic compounds analyzed by EPA Method 624/8240
PCBs = Polychlorinated biphenyls
DNAPL = Dense nonaqueous phase liquid
TOC = Total organic carbon
BNAs = Base neutral and acid organics
p-CBSA = Para-chlorobenzene sulfonic acid

TABLE 2.10

AQUIFER TEST MONITORING WELLS

HYDROGEOLOGIC UNIT	AQUIFER TEST	WELL IDENTIFIER
Upper Bellflower Aquitard	Constant Discharge Test	MW-13 MW-15 MW-17 MW-25 MW-26
	Slug Withdrawal Test	MW-1 MW-8 MW-9 MW-10 MW-11 MW-13 MW-17 MW-21
Bellflower Sand	Constant Discharge Test	BF-5 BF-7 BF-9 BF-11 BF-13 BF-15
Gage Aquifer	Constant Discharge Test	G-5 G-11 G-13 LG-2
Lynwood Aquifer	Constant Discharge Test	LW-3

NOTE: Only pumped wells listed; observation wells not listed

TABLE 2.11

SEDIMENT INVESTIGATIONS

OBJECTIVE OF SAMPLING	DRAINAGE	SAMPLE LOCATIONS	ANALYTES
Part 2 Phase 1, Round 2 - 1986 In general: Determine the extent and concentration of pesticides and VOCs in sediment present in drainages located downstream from the Property	Kenwood Drain: Up to five locations, inside manhole covers where sediment depths permit	KD-1, KD-3, KD-4, KD-5, KD-7	Pesticides and VOCs
	Torrance Lateral: Open channel, five sampling locations	SED-6 through SED-10	Pesticides and VOCs
	Dominguez Channel: Open channel, two upstream, three downstream from confluence with Torrance Lateral	SED-11 through SED-15	Pesticides and VOCs
At Consolidated Slip: Provide sediment sample coverage for an offset series of transects for the entire length of the slip	Bottom of slip at 10 locations at 5-foot intervals along 20-foot transects	SED-16 through SED-25	Pesticides and VOCs

Note: This table does not include sediment sampling conducted by EPA in 1994
Pesticides = DDT and its metabolites and isomers and BHC and its isomers analyzed by U.S. Environmental Protection Agency (EPA) Method 608/8080
VOCs = Volatile organic compounds analyzed by EPA Method 624/8240
TOC = Total organic carbon

TABLE 2.11 (continued)
SEDIMENT INVESTIGATIONS

OBJECTIVE OF SAMPLING	DRAINAGE	SAMPLE LOCATIONS	ANALYTES
Part 2 Phase 2A - 1988 Determine the distribution and approximate volume of sediment in the Dominguez Channel in the vicinity of the Torrance Lateral	Dominguez Channel, Discrete samples	T-1C, T-3B, T-7C, T-13C, T-14A, T-18C	Pesticides
	Dominguez Channel, Composites: Two composites from areas where sediment is thickest	T-6A, T-9C	Pesticides, percent moisture, TOC
Collect background sediment samples in the Dominguez Channel approximately 2.5 miles upstream from the Torrance Lateral discharge	One background sample in Dominguez Channel near Vermont Avenue	BGS	Pesticides

Note: This table does not include sediment sampling conducted by EPA in 1994
Pesticides = DDT and its metabolites and isomers and BHC and its isomers analyzed by U.S. Environmental Protection Agency (EPA) Method 608/8080
VOCs = Volatile organic compounds analyzed by EPA Method 624/8240
TOC = Total organic carbon

TABLE 2.12

SEDIMENT SAMPLING METHODS

DRAINAGE	SAMPLE DATE	SAMPLE LOCATION	SAMPLING METHOD
Part 2 Phase 1, Round 2 - 1986			
Kenwood Drain	05-29-86	KD-1	Shallow sediments collected by dedicated trowel
Kenwood Drain	05-29-86	KD-3	Shallow sediments collected by dedicated trowel
Kenwood Drain	05-29-86	KD-4	Shallow sediments collected by dedicated trowel
Kenwood Drain	05-29-86	KD-5	Shallow sediments collected by dedicated trowel
Kenwood Drain	05-29-86	KD-7	Shallow sediments collected by dedicated trowel
Torrance Lateral	05-29-86	SED-6	Shallow sediments collected by dedicated trowel
Torrance Lateral	05-29-86	SED-7	Shallow sediments collected by dedicated trowel
Torrance Lateral	05-29-86	SED-8	Shallow sediments collected by dedicated trowel
Torrance Lateral	05-29-86	SED-9	Shallow sediments collected by dedicated trowel
Torrance Lateral	05-30-86	SED-10	Shallow sediments collected by dedicated trowel
Dominguez Channel	05-28-86	SED-11	Composite sediment sample collected by benthic sampler at 31, 62, and 85 feet from east bank

NOTE: B-Shore refers to northeast bank
C-Shore refers to southwest bank
This table does not include sediment sampling conducted by EPA in 1994

TABLE 2.12 (continued)
SEDIMENT SAMPLING METHODS

DRAINAGE	SAMPLE DATE	SAMPLE LOCATION	SAMPLING METHOD
Part 2 Phase 1, Round 2 (continued)			
Dominguez Channel	05-30-86	SED-12	Composite sediment sample collected by benthic sampler at 35, 85, and 135 feet from east bank
Dominguez Channel	05-30-86	SED-13	Composite sediment sample collected by benthic sampler at 35, 85, and 135 feet from east bank
Dominguez Channel	06-11-86	SED-14	Composite sediment sample collected by hand auger 25 and 60 feet (mid-channel) from north bank
Dominguez Channel	06-11-86	SED-15	Composite sediment sample collected by hand auger 30, 50, and 95 feet from east bank
Consolidated Slip	06-05-86	SED-16	Composite sediment sample collected by benthic sampler lowered from boat at 0, 5, 10, 15, and 20 feet along transect
Consolidated Slip	06-05-86	SED-17	Composite sediment sample collected by benthic sampler lowered from boat at 0, 5, 10, 15, and 20 feet along transect

NOTE: B-Shore refers to northeast bank
C-Shore refers to southwest bank
This table does not include sediment sampling conducted by EPA in 1994

TABLE 2.12 (continued)
SEDIMENT SAMPLING METHODS
Page 3 of 7

DRAINAGE	SAMPLE DATE	SAMPLE LOCATION	SAMPLING METHOD
Part 2 Phase 1, Round 2 (continued)			
Consolidated Slip	06-05-86	SED-18	Composite sediment sample collected benthic sampler lowered from boat at 0, 5, 10, 15, and 20 feet along transect
Consolidated Slip	06-05-86	SED-19	Composite sediment sample collected by benthic sampler lowered from boat at 0, 5, 10, 15, and 20 feet along transect
Consolidated Slip	06-06-86	SED-20	Composite sediment sample collected by benthic sampler lowered from boat at 0, 5, 10, 15, and 20 feet along transect
Consolidated Slip	06-06-86	SED-21	Composite sediment sample collected by benthic sampler lowered from boat at 0, 5, 10, 15, and 20 feet along transect
Consolidated Slip	06-08-86	SED-22	Composite sediment sample collected by benthic sampler lowered from boat at 0, 5, 10, 15, and 20 feet along transect
Consolidated Slip	06-07-86	SED-23	Composite sediment sample collected by benthic sampler lowered from boat at 0, 5, 10, 15, and 20 feet along transect
Consolidated Slip	06-06-86	SED-24	Composite sediment sample collected by benthic sampler lowered from boat at 0, 5, 10, 15, and 20 feet along transect

NOTE: B-Shore refers to northeast bank
C-Shore refers to southwest bank
This table does not include sediment sampling conducted by EPA in 1994

TABLE 2.12 (continued)
SEDIMENT SAMPLING METHODS

DRAINAGE	SAMPLE DATE	SAMPLE LOCATION	SAMPLING METHOD
Part 2 Phase 1, Round 2 (continued)			
Consolidated Slip	06-07-86	SED-25	Composite sediment sample collected by benthic sampler lowered from boat at 0, 5, 10, 15, and 20 feet along transect
Part 2 Phase 2A -1988			
Dominguez Channel	09-02-88	T-1C	Discrete sediment sample collected by thin wall suction sampler 37 feet from C-Shore at a depth of 0.5 feet along transect T-1
Dominguez Channel	09-02-88	T-1C	Discrete sediment sample collected by thin wall suction sampler 37 feet from C-Shore at a depth of 1.5 feet along transect T-1
Dominguez Channel	09-02-88	T-3B	Discrete sediment sample collected by thin wall suction sampler 42 feet from B-Shore at a depth of 0.5 feet along transect T-3
Dominguez Channel	09-02-88	T-3B	Discrete sediment sample collected by thin wall suction sampler 42 feet from B-Shore at a depth of 1.5 feet along transect T-3
Dominguez Channel	09-02-88	T-3B	Discrete sediment sample collected by thin wall suction sampler 42 feet from B-Shore at a depth of 2.4 feet along transect T-3

NOTE: B-Shore refers to northeast bank
C-Shore refers to southwest bank
This table does not include sediment sampling conducted by EPA in 1994

TABLE 2.12 (continued)
SEDIMENT SAMPLING METHODS
Page 5 of 7

DRAINAGE	SAMPLE DATE	SAMPLE LOCATION	SAMPLING METHOD
Part 2 Phase 2A -1988 (continued)			
Dominguez Channel	09-02-88	T-6A	Composite sediment sample collected by thin wall suction sampler 62 feet from C-Shore at a depth of 0.0 to 3.3 feet along transect T-6
Dominguez Channel	09-02-88	T-7C	Discrete sediment sample collected by thin wall suction sampler 35 feet from C-Shore at a depth of 0.5 feet along transect T-7
Dominguez Channel	09-02-88	T-7C	Discrete sediment sample collected by thin wall suction sampler 35 feet from C-Shore at a depth of 1.9 feet along transect T-7
Dominguez Channel	09-03-88	T-9C	Composite sediment sample collected by hand auger 38 feet from C-Shore at a depth of 0.0 to 3.75 feet along transect T-9
Dominguez Channel	09-01-88	T-13C	Discrete sediment sample collected by thin wall suction sampler 42 feet from C-Shore at a depth of 0.5 feet along transect T-13
Dominguez Channel	09-01-88	T-13C	Discrete sediment sample collected by thin wall suction sampler 42 feet from C-Shore at a depth of 1.5 feet along transect T-13
Dominguez Channel	09-01-88	T-14A	Discrete sediment sample collected by thin wall suction sampler 72 feet from B- and C-Shores (mid-channel) at a depth of 0.7 feet along transect T-14

NOTE: B-Shore refers to northeast bank
C-Shore refers to southwest bank
This table does not include sediment sampling conducted by EPA in 1994

TABLE 2.12 (continued)
SEDIMENT SAMPLING METHODS

DRAINAGE	SAMPLE DATE	SAMPLE LOCATION	SAMPLING METHOD
Part 2 Phase 2A -1988 (continued)			
Dominguez Channel	09-01-88	T-18C	Discrete sediment sample collected by thin wall suction sampler 33 feet from C-Shore at a depth of 0.5 feet along transect T-18
Dominguez Channel	09-01-88	T-18C	Discrete sediment sample collected by thin wall suction sampler 33 feet from C-Shore at a depth of 1.5 feet along transect T-18
Dominguez Channel	09-27-88	BGS	Discrete background sediment sample collected by hand auger 28 feet from C-Shore approximately 554 feet downstream of the Vermont Street overpass at a depth of 0.5 feet
Dominguez Channel	09-27-88	BGS	Discrete background sediment sample collected by hand auger 28 feet from C-Shore approximately 554 feet downstream of the Vermont Street overpass at a depth of 2.5 feet
Dominguez Channel	09-27-88	BGS	Discrete background sediment sample collected by hand auger 28 feet from C-Shore approximately 554 feet downstream of the Vermont Street overpass at a depth of 4.0 feet

NOTE: B-Shore refers to northeast bank
C-Shore refers to southwest bank
This table does not include sediment sampling conducted by EPA in 1994

TABLE 2.12 (continued)
SEDIMENT SAMPLING METHODS

DRAINAGE	SAMPLE DATE	SAMPLE LOCATION	SAMPLING METHOD
Part 2 Phase 2A -1988 (continued)			
Dominguez Channel	09-27-88	BGS	Discrete background sediment sample collected by hand auger 28 feet from C-Shore approximately 554 feet downstream of the Vermont Street overpass at a depth of 6.2 feet
Dominguez Channel	09-27-88	BGS	Discrete background sediment sample collected by hand auger 28 feet from C-Shore approximately 554 feet downstream of the Vermont Street overpass at a depth of 8.0 feet

NOTE: B-Shore refers to northeast bank
C-Shore refers to southwest bank
This table does not include sediment sampling conducted by EPA in 1994

TABLE 2.13

SURFACE WATER INVESTIGATIONS

OBJECTIVE OF SAMPLING	DRAINAGE	DRY WEATHER	WET WEATHER	ANALYTES
Part 2 Phase 1, Round 2 - 1986 Determine the extent of pesticides and VOCs in surface water during dry and wet weather and gather data of sufficient quality to support the feasibility study	Jones Chemical Ditch SW-1: Drainage ditch leaving Jones Chemical Company	Not sampled	R2 through R5	Pesticides and VOCs
	Normandie Avenue Ditch SW-2: Culvert under railroad track	Not sampled	R1 through R5	Pesticides and VOCs
	SW-3: Drainage ditch at entry point to Farmer Brothers parking lot	Not sampled	R1 through R5	Pesticides and VOCs
	Torrance Lateral SW-4: At Vermont Street	Sampled	R1 through R5	Pesticides and VOCs
	SW-5: At Main Street	Sampled	R1 through R5	Pesticides and VOCs

Note: This table does not include 1981 surface water sampling conducted by Montrose or the 1994 sampling conducted by EPA
Pesticides = DDT and metabolites and isomers and BHC and its isomers analyzed by U.S. Environmental Protection Agency (EPA) Method 608/8080
VOCs = Volatile organic compounds analyzed by EPA Method 624/8240
R = Rainfall event number
Farmer Brothers = Farmer Brothers Coffee Company

TABLE 2.13 (continued)
SURFACE WATER INVESTIGATIONS
Page 2 of 2

OBJECTIVE OF SAMPLING	DRAINAGE	DRY WEATHER	WET WEATHER	ANALYTES
Part 2 Phase 1, Round 2 (continued)	Dominguez Channel SW-6: At Main Street	Sampled		
	SW-7: At the utility bridge upstream of Avalon Boulevard	Sampled	R4, R5	Pesticides and VOCs
	SW-8: At Avalon Boulevard bridge	Sampled	R4, R5	Pesticides and VOCs
	SW-9: At Wilmington Avenue bridge	Sampled	R4, R5	Pesticides and VOCs
	SW-10: At Sepulveda Boulevard bridge	Sampled	R4, R5	Pesticides and VOCs
	Consolidated Slip Dry Weather: SED-16 through SED-25	Sampled	R5	Pesticides and VOCs
	Wet Weather: SW-11 through SW-20	Sampled	R5	Pesticides and VOCs

Note: This table does not include 1981 surface water sampling conducted by Montrose or the 1994 sampling conducted by EPA
Pesticides = DDT and metabolites and isomers and BHC and its isomers analyzed by U.S. Environmental Protection Agency (EPA) Method 608/8080
VOCs = Volatile organic compounds analyzed by EPA Method 624/8240
R = Rainfall event number
Farmer Brothers = Farmer Brothers Coffee Company

TABLE 2.14

SURFACE WATER SAMPLING METHODS

DRAINAGE	SAMPLE DATE	SAMPLE LOCATION	SAMPLING METHOD
Dry Weather Surface Samples: Part 2 Phase 1, Round 2 - 1986			
Torrance Lateral	06-13-86	SW-4	Surface water sample collected in 1-liter beaker approximately 50 feet upstream from Torrance Boulevard-Vermont Avenue bridge
Torrance Lateral	06-13-86	SW-5	Unfiltered and filtered surface water sample collected in 1-liter beaker approximately 50 feet upstream from Main Street bridge; sample was reanalyzed
Dominguez Channel	06-12-86	SW-6	Composited surface water sample collected by thief sampler lowered from upstream side of Main Street bridge at 32 feet, 72 feet, and 112 feet from north bank with sample depths of 1.5, 1.9, and 1.8 feet, respectively
Dominguez Channel	06-12-86	SW-7	Unfiltered and filtered composited surface water sample collected by thief sampler lowered from utility bridge upstream of Avalon Boulevard at 22 feet, 67 feet, and 112 feet from north bank with sample depths of 1.5, 1.8, and 1.4 feet, respectively; sample was reanalyzed

Note: This table does not include surface water sampling conducted by Montrose in 1981 or by EPA in 1994.

TABLE 2.14 (continued)
SURFACE WATER SAMPLING METHODS

DRAINAGE	SAMPLE DATE	SAMPLE LOCATION	SAMPLING METHOD
Dry Weather Surface Samples: Part 2 Phase 1, Round 2 - 1986 (continued)			
Dominguez Channel	06-12-86	SW-8	Unfiltered and filtered composited surface water sample collected by thief sampler lowered from upstream side of Avalon Boulevard bridge at 25 feet, 72 feet, and 125 feet from north bank with sample depths of 1.4, 1.8, and 1.6 feet, respectively; sample was reanalyzed
Dominguez Channel	06-12-86	SW-9	Composited surface water sample collected by thief sampler lowered from upstream side of railroad bridge at 30 feet, 80 feet, and 95 feet from north bank with sample depths of 2.3, 2.3, and 2.2 feet, respectively
Dominguez Channel	06-13-86	SW-10	Composited surface water sample collected by thief sampler lowered from upstream side of Sepulveda Boulevard bridge at 25 feet, 60 feet, and 115 feet from north bank with sample depths of 1.7, 2.4, and 1.5 feet, respectively
Consolidated Slip	06-05-86	SW-16	Composited surface water sample collected by thief sampler lowered from boat at depths of 7.5 and 15 feet
Consolidated Slip	06-05-86	SW-17	Composited surface water sample collected by thief sampler lowered from boat at depths of 6.4 and 25.4 feet

Note: This table does not include surface water sampling conducted by Montrose in 1981 or by EPA in 1994.

TABLE 2.14 (continued)
SURFACE WATER SAMPLING METHODS

DRAINAGE	SAMPLE DATE	SAMPLE LOCATION	SAMPLING METHOD
Dry Weather Surface Samples: Part 2 Phase 1, Round 2 - 1986 (continued)			
Consolidated Slip	06-05-86	SW-18	Composited surface water sample collected by thief sampler lowered from boat at depths of 6.6 and 26.4 feet
Consolidated Slip	06-05-86	SW-19	Composited surface water sample collected by thief sampler lowered from boat at depths of 5.4 and 23.6 feet
Consolidated Slip	06-06-86	SW-20	Unfiltered and filtered composited surface water sample collected by thief sampler lowered from boat at depths of 8.1 and 16 feet
Consolidated Slip	06-06-86	SW-21	Unfiltered and filtered composited surface water sample collected by thief sampler lowered from boat at depths of 8 and 15 feet
Consolidated Slip	06-08-86	SW-22	Composited surface water sample collected by thief sampler lowered from boat at depths of 8 and 15.6 feet
Consolidated Slip	06-07-86	SW-23	Composited surface water sample collected by thief sampler lowered from boat at depths of 5.5 and 11 feet

Note: This table does not include surface water sampling conducted by Montrose in 1981 or by EPA in 1994.

TABLE 2.14 (continued)
SURFACE WATER SAMPLING METHODS

DRAINAGE	SAMPLE DATE	SAMPLE LOCATION	SAMPLING METHOD
Dry Weather Surface Samples: Part 2 Phase 1, Round 2 - 1986 (continued)			
Consolidated Slip	06-06-86	SW-24	Unfiltered and filtered composited surface water sample collected by thief sampler lowered from boat at depths of 7 and 14 feet
Consolidated Slip	06-07-86	SW-25	Composited surface water sample collected by thief sampler lowered from boat at depths of 3 and 6 feet.
Wet Weather Sampling: Part 2 Phase 1, Round 2 - 1986 to 1987			
Rainfall Event 1			
Jones Chemical ditch		SW-1	No sample collected due to insufficient flow
Normandie Avenue ditch	09-24-86	SW-2	Unfiltered and filtered grab sample
Normandie Avenue ditch	09-24-86	SW-3	Unfiltered and filtered grab sample
Torrance Lateral	09-24-86	SW-4	Unfiltered and filtered grab sample
Torrance Lateral	09-24-86	SW-5	Unfiltered and filtered grab sample

Note: This table does not include surface water sampling conducted by Montrose in 1981 or by EPA in 1994.

TABLE 2.14 (continued)
SURFACE WATER SAMPLING METHODS

DRAINAGE	SAMPLE DATE	SAMPLE LOCATION	SAMPLING METHOD
Wet Weather Sampling: Part 2 Phase 1, Round 2 - 1986 to 1987 (continued)			
Rainfall Event 2			
Jones Chemical ditch	01-04-87	SW-1	Grab sample
Normandie Avenue ditch	01-04-87	SW-2	Grab sample
Normandie Avenue ditch	01-04-87	SW-3	Unfiltered and filtered grab sample
Torrance Lateral	01-04-87	SW-4	Grab sample
Torrance Lateral	01-04-87	SW-5	Grab sample
Rainfall Event 3			
Jones Chemical ditch	01-06-87	SW-1	Grab sample
Normandie Avenue ditch	01-06-87	SW-2	Grab sample
Normandie Avenue ditch	01-06-87	SW-3	Grab sample

Note: This table does not include surface water sampling conducted by Montrose in 1981 or by EPA in 1994.

TABLE 2.14 (continued)
SURFACE WATER SAMPLING METHODS

DRAINAGE	SAMPLE DATE	SAMPLE LOCATION	SAMPLING METHOD
Wet Weather Sampling: Part 2 Phase 1, Round 2 - 1986 to 1987 (continued)			
Rainfall Event 3 (cont'd)			
Torrance Lateral	01-06-87	SW-4	Grab sample
Torrance Lateral	01-06-87	SW-5	Unfiltered and filtered grab sample
Rainfall Event 4			
Jones Chemical ditch	02-13-87	SW-1	Grab sample
Normandie Avenue ditch	02-13-87	SW-2	Unfiltered and filtered grab sample
Normandie Avenue ditch	02-13-87	SW-3	Unfiltered and filtered grab sample
Torrance Lateral	02-13-87	SW-4	Unfiltered and filtered grab sample
Torrance Lateral	02-13-87	SW-5	Grab sample
Dominguez Channel	02-13-87	SW-6	Composited grab sample
Dominguez Channel	02-13-87	SW-7	Composited grab sample

Note: This table does not include surface water sampling conducted by Montrose in 1981 or by EPA in 1994.

TABLE 2.14 (continued)
SURFACE WATER SAMPLING METHODS
Page 7 of 9

DRAINAGE	SAMPLE DATE	SAMPLE LOCATION	SAMPLING METHOD
Wet Weather Sampling: Part 2 Phase 1, Round 2 - 1986 to 1987 (continued)			
Rainfall Event 4 (cont'd)			
Dominguez Channel	02-13-87	SW-8	Composited grab sample
Dominguez Channel	02-13-87	SW-9	Composited grab sample
Dominguez Channel	02-13-87	SW-10	Composited grab sample
Rainfall Event 5			
Jones Chemical ditch	03-06-87	SW-1	Grab sample
Normandie Avenue ditch	03-06-87	SW-2	Grab sample
Normandie Avenue ditch	03-06-87	SW-3	Grab sample
Torrance Lateral	03-06-87	SW-4	Grab sample
Torrance Lateral	03-06-87	SW-5	Grab sample
Dominguez Channel	03-06-87	SW-6	Unfiltered and filtered composited grab sample

Note: This table does not include surface water sampling conducted by Montrose in 1981 or by EPA in 1994.

TABLE 2.14 (continued)
SURFACE WATER SAMPLING METHODS

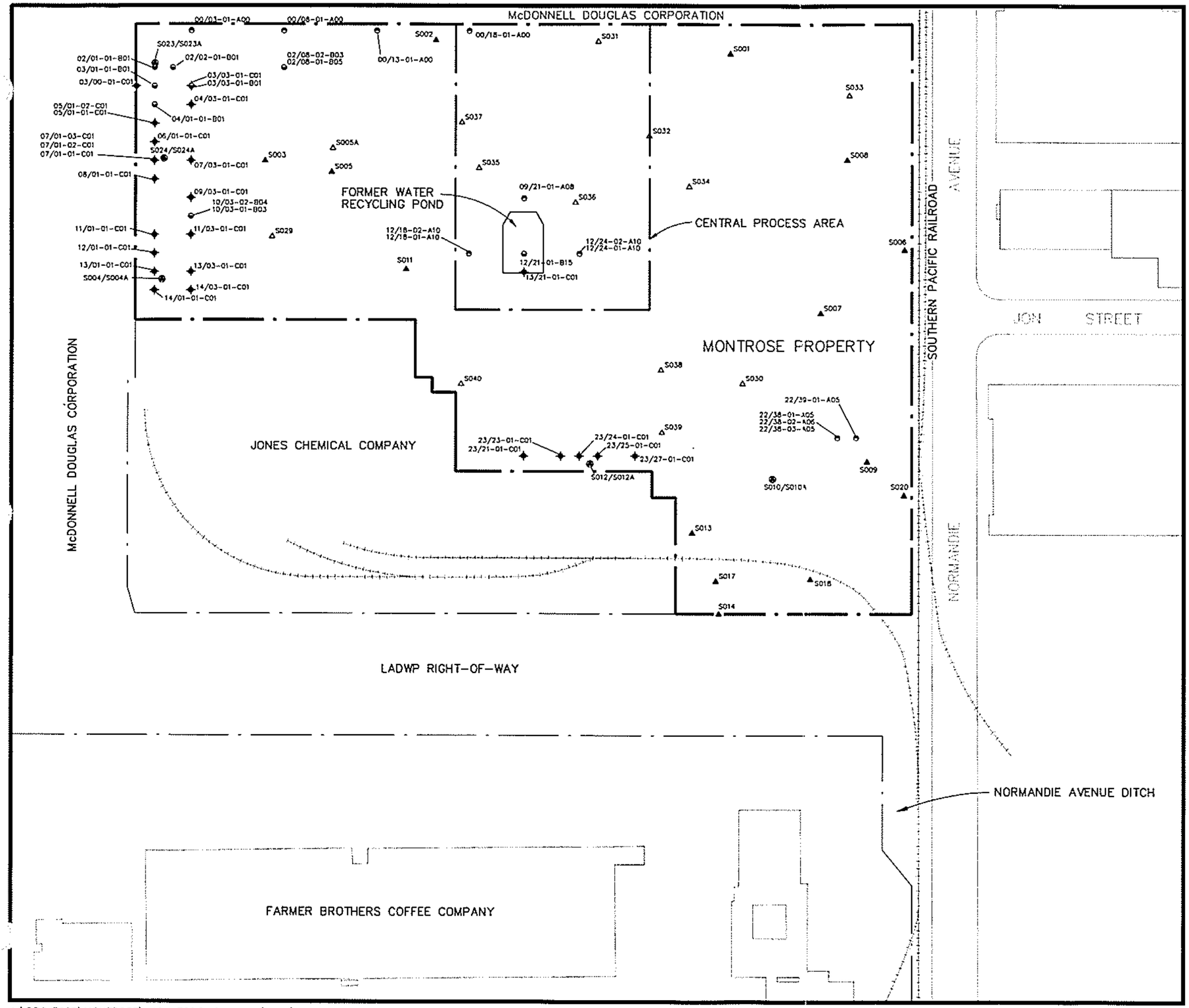
DRAINAGE	SAMPLE DATE	SAMPLE LOCATION	SAMPLING METHOD
Wet Weather Sampling: Part 2 Phase 1, Round 2 - 1986 to 1987 (continued)			
Rainfall Event 5 (cont'd)			
Dominguez Channel	03-06-87	SW-7	Unfiltered and filtered composited grab sample
Dominguez Channel	03-06-87	SW-8	Unfiltered and filtered composited grab sample
Dominguez Channel	03-06-87	SW-9	Unfiltered and filtered composited grab sample
Dominguez Channel	03-06-87	SW-10	Unfiltered and filtered composited grab sample
Consolidated Slip	03-06-87	SW-11	Composited grab sample
Consolidated Slip	03-06-87	SW-12	Composited grab sample
Consolidated Slip	03-06-87	SW-13	Composited grab sample
Consolidated Slip	03-06-87	SW-14	Composited grab sample
Consolidated Slip	03-06-87	SW-15	Composited grab sample
Consolidated Slip	03-06-87	SW-16	Composited grab sample
Consolidated Slip	03-06-87	SW-17	Composited grab sample

Note: This table does not include surface water sampling conducted by Montrose in 1981 or by EPA in 1994.

TABLE 2.14 (continued)
SURFACE WATER SAMPLING METHODS

DRAINAGE	SAMPLE DATE	SAMPLE LOCATION	SAMPLING METHOD
Wet Weather Sampling: Part 2 Phase 1, Round 2 - 1986 to 1987 (continued)			
Rainfall Event 5 (cont'd)			
Consolidated Slip	03-06-87	SW-18	Composited grab sample
Consolidated Slip	03-06-87	SW-19	Composited grab sample
Consolidated Slip	03-06-87	SW-20	Composited grab sample

Note: This table does not include surface water sampling conducted by Montrose in 1981 or by EPA in 1994.



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EXPLANATION

S001 — SOIL BORING SAMPLED IN JUNE 1983 BY HARGIS & MONTGOMERY (H&M). SOIL SAMPLES COLLECTED AT DEPTHS RANGING FROM 0.6 TO 2.5 FEET BELOW LAND SURFACE (FT BLS).

S010/S010A — SOIL BORING SAMPLED IN JUNE 1983 BY H&M SOIL SAMPLES WERE COLLECTED IN AUGUST 1983 AT ADDITIONAL DEPTHS RANGING FROM 2.0 TO 6.3 FT BLS.

S029 — ADDITIONAL SOIL BORINGS SAMPLED IN AUGUST 1983 BY H&M. SOIL SAMPLES WERE COLLECTED AT DEPTHS RANGING FROM 0.5 TO 5.5 FT BLS.

12/24/-01-A10 — ABOVE GROUND SAMPLE COLLECTED IN JULY 1983 AT ELEVATIONS RANGING FROM LAND SURFACE TO APPROXIMATELY 10 FEET ABOVE LAND SURFACE. (REF: STAUFFER, 1983)

12/21-01-B15 — BELOW GROUND SAMPLE COLLECTED IN JULY 1983 AT DEPTHS RANGING FROM APPROXIMATELY 1 TO 15 FEET BELOW GRADE. (REF: STAUFFER, 1983)

12/21-01-C01 — CORED SAMPLE COLLECTED IN JULY 1983 TO DEPTHS OF 1 FOOT BLS. (REF: STAFFER, 1983)

PROPERTY BOUNDARY

NOTE: THIS FIGURE DOES NOT INCLUDE ON-PROPERTY POST GRADING AND NEAR OFF-PROPERTY SOIL BORING LOCATIONS

LADWP = LOS ANGELES DEPARTMENT OF WATER AND POWER

N

0 135 270

FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

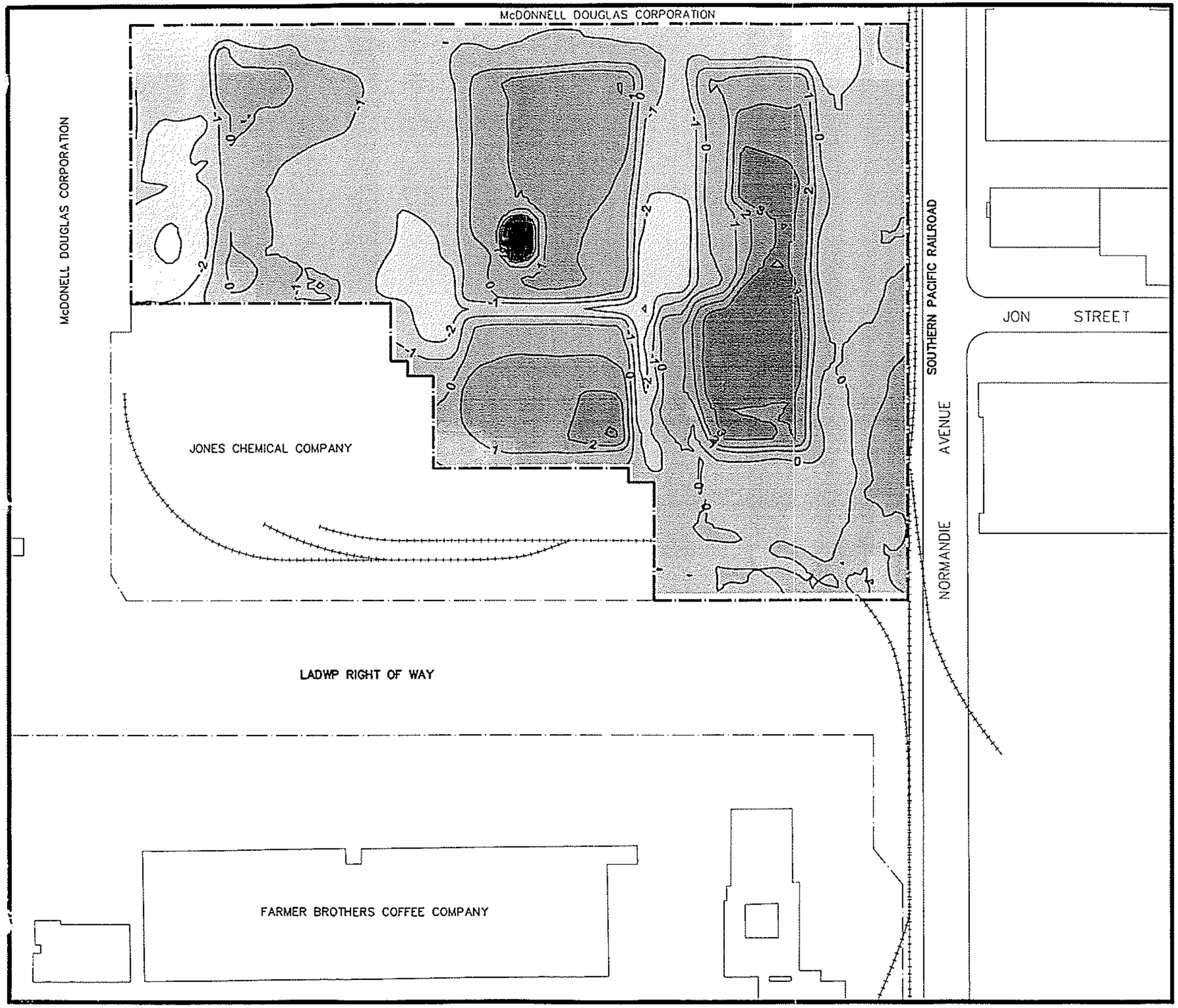
ON-PROPERTY SOIL SAMPLING LOCATIONS PRE-GRADING 1981 AND 1983

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 2.1

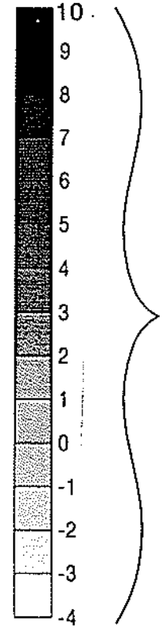
PREP BY ____ REV BY ____ RPT NO. 857.01 | 410-1782 | A



EXPLANATION

—2—
CONTOUR LINE OF ESTIMATED DECREASE IN SURFACE ELEVATION (IN FEET)

—3—
CONTOUR LINE OF ESTIMATED INCREASE IN SURFACE ELEVATION (IN FEET)



APPROXIMATE CHANGE IN SURFACE ELEVATION (IN FEET)

NOTE: POSITIVE WHERE ELEVATION INCREASED, NEGATIVE WHERE ELEVATION DECREASED

LADWP = LOS ANGELES DEPARTMENT OF WATER AND POWER

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

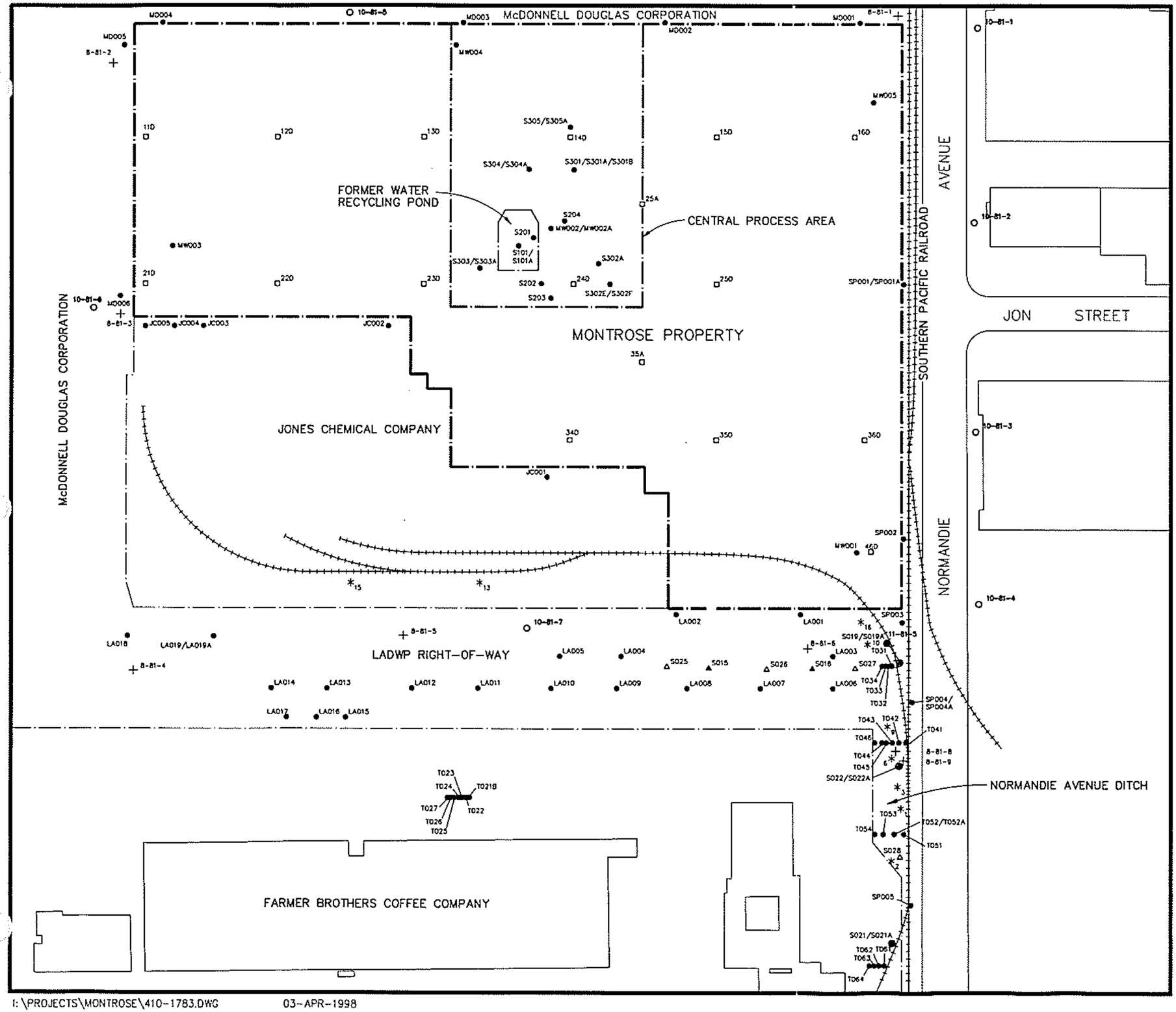
CHANGE IN SURFACE ELEVATION 1985

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 2.2

PREP BY ____ REV BY ____ RPT NO. 857.1 | 410-1631 | C



EXPLANATION

- $*_{13}$ SOIL BORING SAMPLED IN MAY 1981 BY MONTROSE, JONES CHEMICAL, AND DHS. SOIL SAMPLES COLLECTED AT 0, 0.5, 1.0, 1.5, AND 2.0 FT BLS (MONTROSE, 1981b).
- 8-81-5 + SURFACE SOIL SAMPLES COLLECTED IN AUGUST 1981 BY MONTROSE (MONTROSE, 1981c).
- ▲ S015 SOIL BORING SAMPLED IN JUNE 1983 BY HARGIS & MONTGOMERY (H&M). SOIL SAMPLES COLLECTED AT DEPTHS RANGING FROM 0.6 TO 2.5 FEET BELOW LAND SURFACE (FT BLS).
- ● S010/S010A SOIL BORING SAMPLED IN JUNE 1983 BY H&M SOIL SAMPLES WERE COLLECTED IN AUGUST 1983 AT ADDITIONAL DEPTHS RANGING FROM 2.0 TO 6.3 FT BLS.
- △ S029 ADDITIONAL SOIL BORINGS SAMPLED IN AUGUST 1983 BY H&M. SOIL SAMPLES WERE COLLECTED AT DEPTHS RANGING FROM 0.5 TO 5.5 FT BLS.
- ● S201 SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- □ 250 SOIL BORING SAMPLED IN JUNE 1985 BY METCALF & EDDY, INC. FOR EPA
- ○ 10-81-4 SOIL SAMPLES COLLECTD BY MONTROSE IN OCTOBER 1981--RESULTS NOT FOUND (MONTROSE, 1981e)
- ● 11-81-4 SURFACE SOIL SAMPLES COLLECTED IN NOVEMBER 1981 BY MONTROSE (MONTROSE, 1981f).
- PROPERTY BOUNDARY

NOTE: THIS FIGURE DOES NOT INCLUDE ON-PROPERTY SOIL SAMPLING LOCATIONS, PRE-GRADING 1983

LADWP = LOS ANGELES DEPARTMENT OF WATER AND POWER

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FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

ON-PROPERTY POST GRADING AND NEAR OFF-PROPERTY SOIL BORING LOCATIONS

7/97

FIGURE 2.3

PREP BY	REV BY	RPT NO. 857.01	410-1783	B

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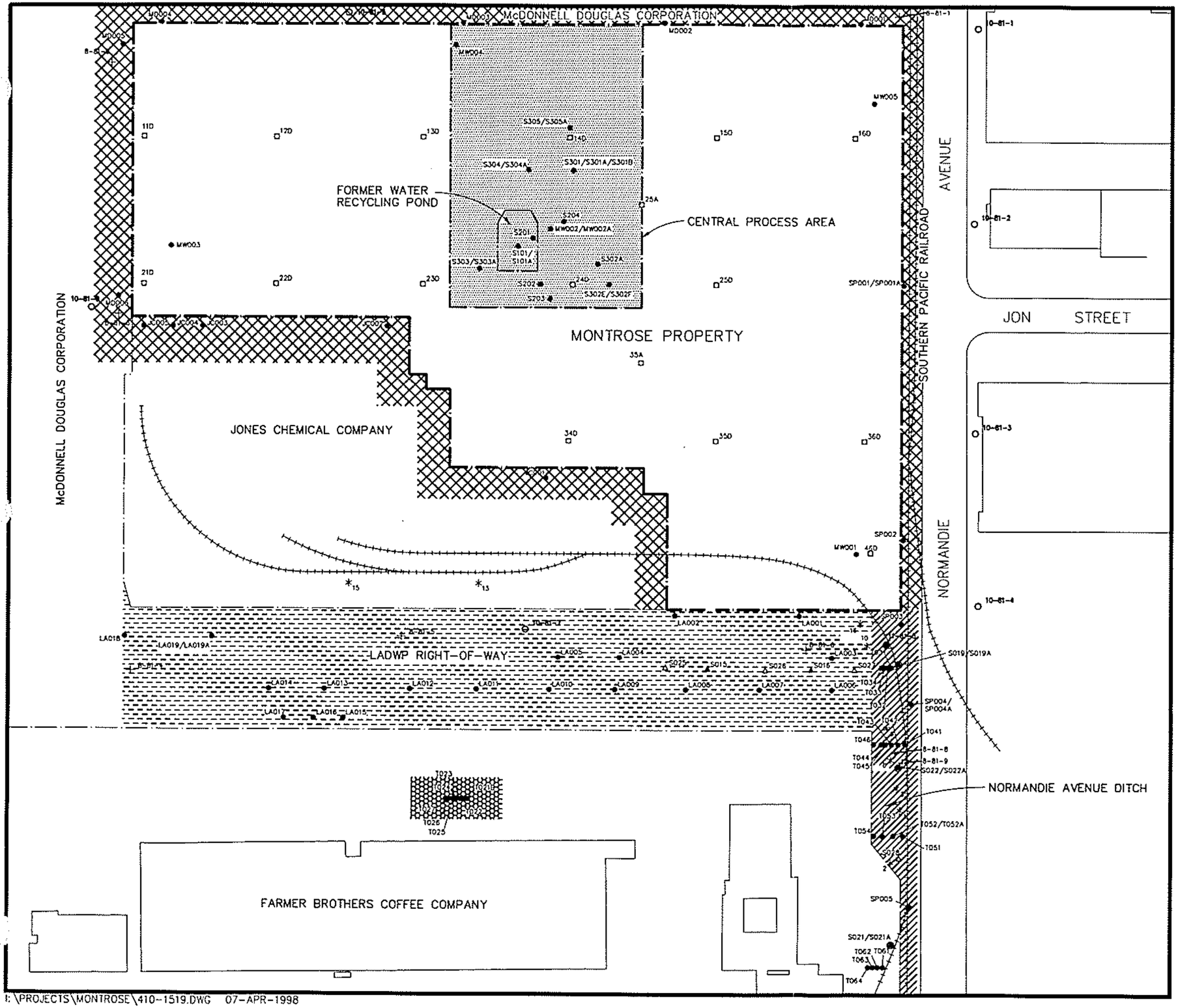

EXPLANATION

ON-PROPERTY

- CENTRAL PROCESS AREA

OFF-PROPERTY

- PROPERTY PERIMETER
- LADWP RIGHT-OF-WAY
- NORMANDIE AVENUE DITCH
- FARMER BROTHERS COFFEE COMPANY
- *13 — SOIL BORING SAMPLED IN MAY 1981 BY MONTROSE, JONES CHEMICAL, AND DHS SOIL SAMPLES COLLECTED AT 0, 0.5, 1.0, 1.5, AND 2.0 FT BLS.
- 8-81-13 — SURFACE SOIL SAMPLES COLLECTED IN AUGUST 1981 BY MONTROSE (MONTROSE, 1981c).
- S026 — SOIL BORING SAMPLED IN 1983 BY HARGIS & MONTGOMERY, INC.
- S201 — SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- 35A — SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E)
- 10-81-4 — SOIL SAMPLES COLLECTD BY MONTROSE IN OCTOBER 1981– RESULTS NOT FOUND (MONTROSE, 1981c)
- 11-81-4 — SURFACE SOIL SAMPLES COLLECTED IN NOVEMBER 1981 BY MONTROSE (MONTROSE, 1981f).
- APPROXIMATE PROPERTY BOUNDARY

NOTE: SEE FIGURES 2.5 AND 2.6 FOR NEIGHBORHOOD AND BACKGROUND SOIL SAMPLING LOCATIONS

LADWP = LOS ANGELES DEPARTMENT OF WATER AND POWER

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FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

ON-PROPERTY AND NEAR OFF-PROPERTY SOIL INVESTIGATION AREAS

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

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FIGURE 2.4

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 410-1519 | A

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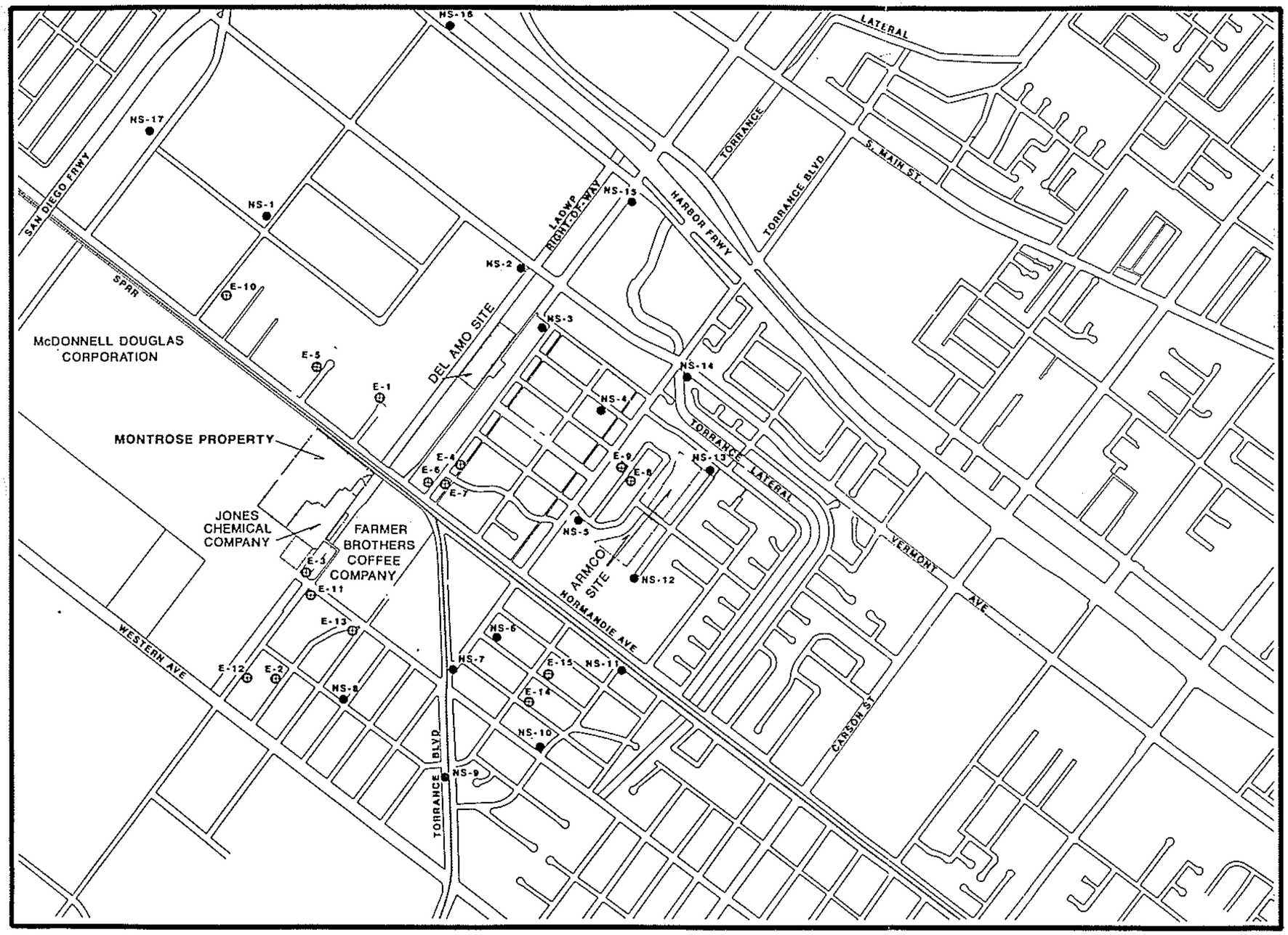


EXPLANATION

NS-6 ●	HARGIS + ASSOCIATES, INC. SURFICIAL SOIL SAMPLE (1986)
E-15 ⊙	ECOLOGY AND ENVIRONMENT, INC. SURFICIAL SOIL SAMPLE (1986)
++++++++++++++++	RAILROAD TRACKS
SPRR	SOUTHERN PACIFIC RAILROAD
LADWP	LOS ANGELES DEPARTMENT OF WATER AND POWER

0 1,200 2,400

FEET

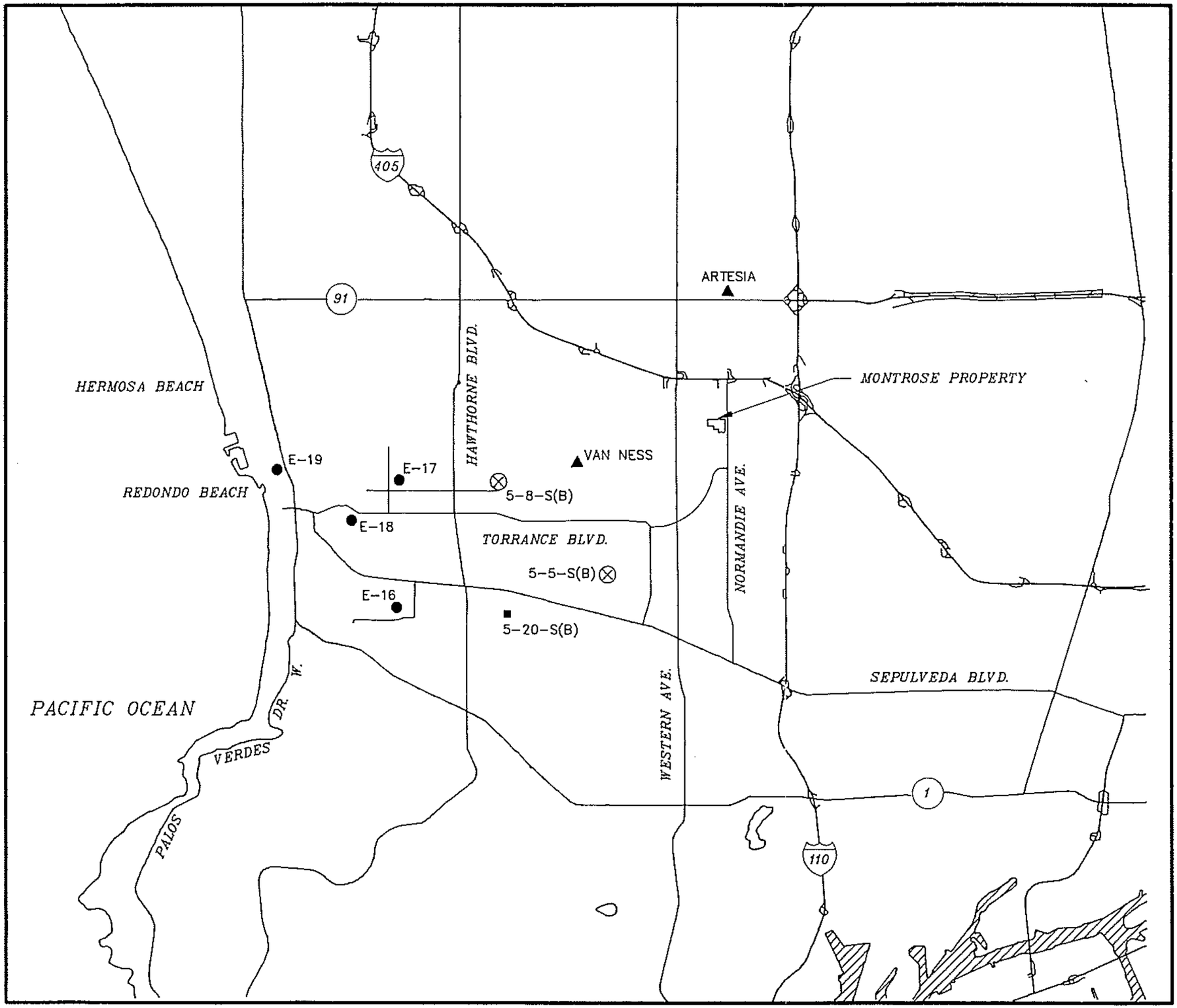
MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

NEIGHBORHOOD SOIL SAMPLE LOCATIONS

HARGIS+ASSOCIATES, INC. 10/92

FIGURE 2.5

PREP BY MHelms REV BY TGM RPT NO. 218.544 | R1504-2/F02-3 | A



EXPLANATION

VAN NESS ▲ — METCALF & EDDY, INC., 1985

5-5-S(B) ⊗ — MONTROSE, 1986

5-20-S(B) ■ — MONTROSE 1986

E-18 ● — ECOLOGY AND ENVIRONMENT, INC., 1986

BASE MAP FROM: USGS DLG 7.5 QUADRANGLES

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FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA

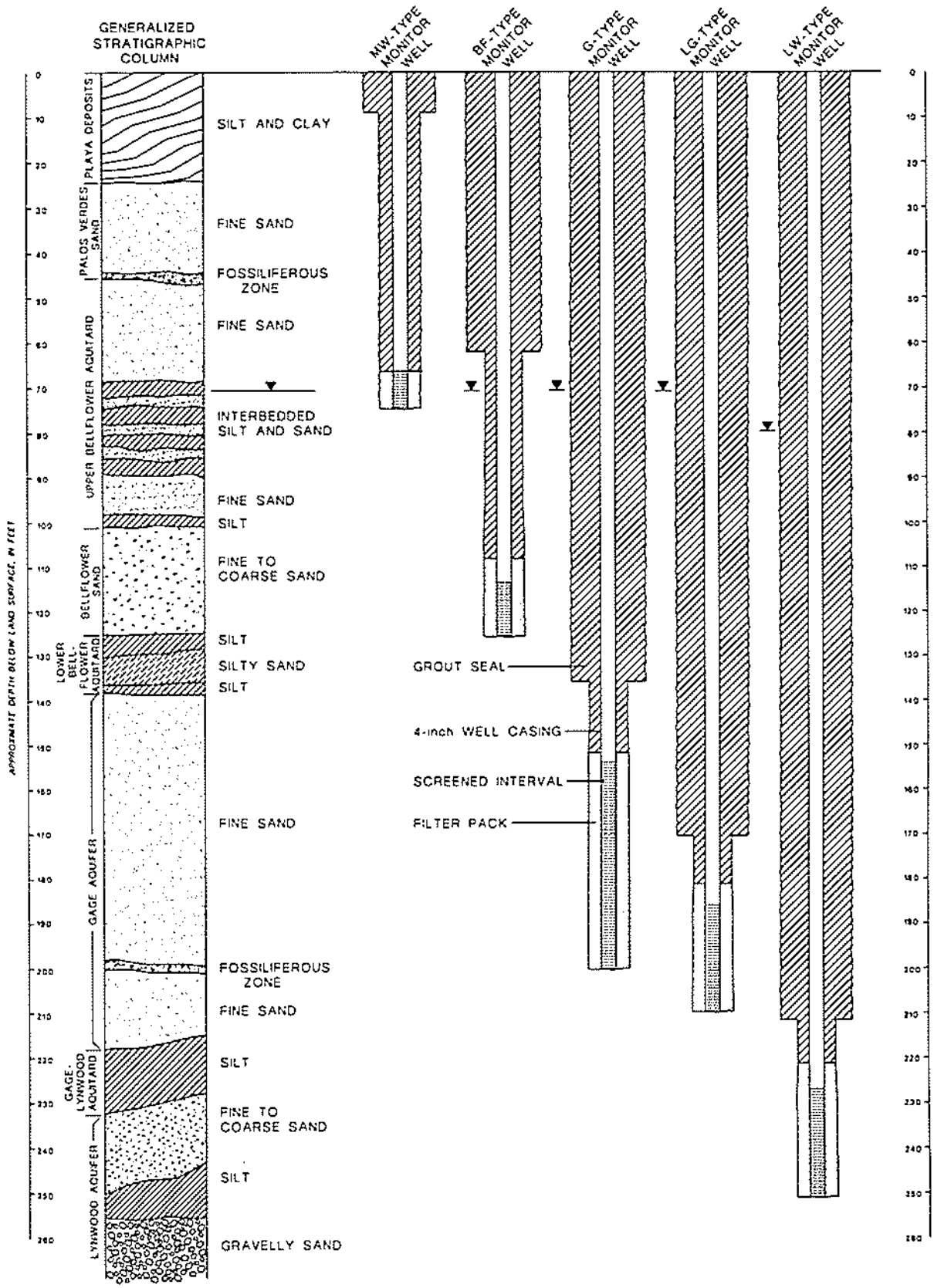
TORRANCE, CALIFORNIA

BACKGROUND SOIL SAMPLE LOCATIONS

HARGIS+ASSOCIATES, INC. 10/92

FIGURE 2.6

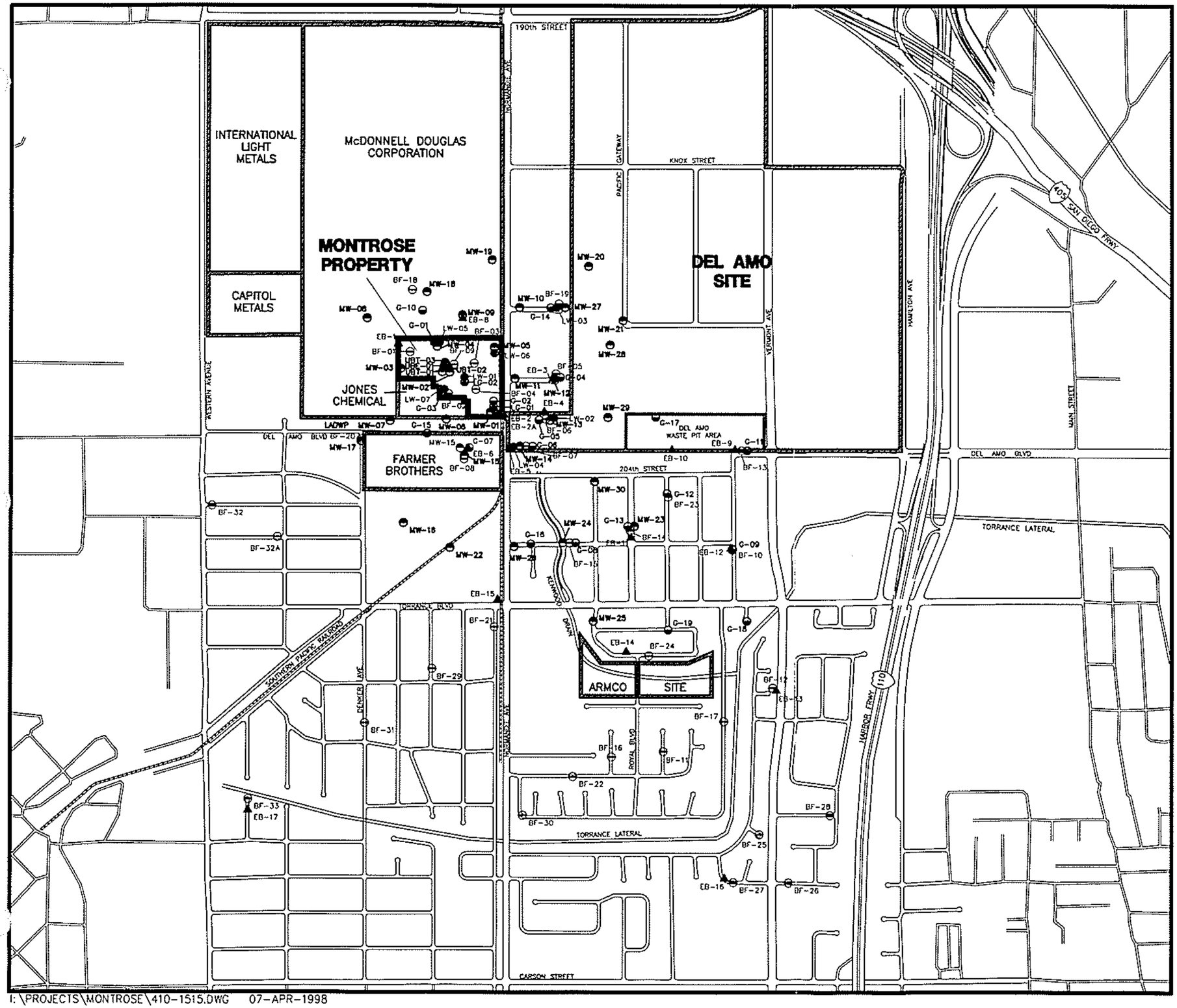
PREP BY JP REV BY RCM RPT NO. 218.544 | R1504-2\F02-4 | A



HARGIS+ASSOCIATES, INC.

RPT NO. 218.544 | 710-0055 | 8

FIGURE 2.7 MONITOR WELL SCHEMATIC



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EXPLANATION

MW-25 — UPPER BELLFLOWER AQUITARD MONITOR WELL

UBE-1 — UPPER BELLFLOWER AQUITARD EXTRACTION WELL

UBT-3 — UPPER BELLFLOWER AQUITARD OBSERVATION WELL

BF-17 — BELLFLOWER SAND MONITOR WELL

C-7 — GAGE AQUIFER MONITOR WELL

LW-7 — LYNWOOD AQUIFER MONITOR WELL

EB-16 — EXPLORATORY BORING

NOTE: THIS MAP SHOWS LOCATIONS FOR MONITOR WELLS AND EXPLORATORY BORINGS CONSTRUCTED BY MONTROSE DURING REMEDIAL INVESTIGATION ACTIVITIES AND DOES NOT INCLUDE MONITOR WELLS AND EXPLORATORY BORINGS CONSTRUCTED BY OTHERS FOR OTHER INVESTIGATIONS.

N

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FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

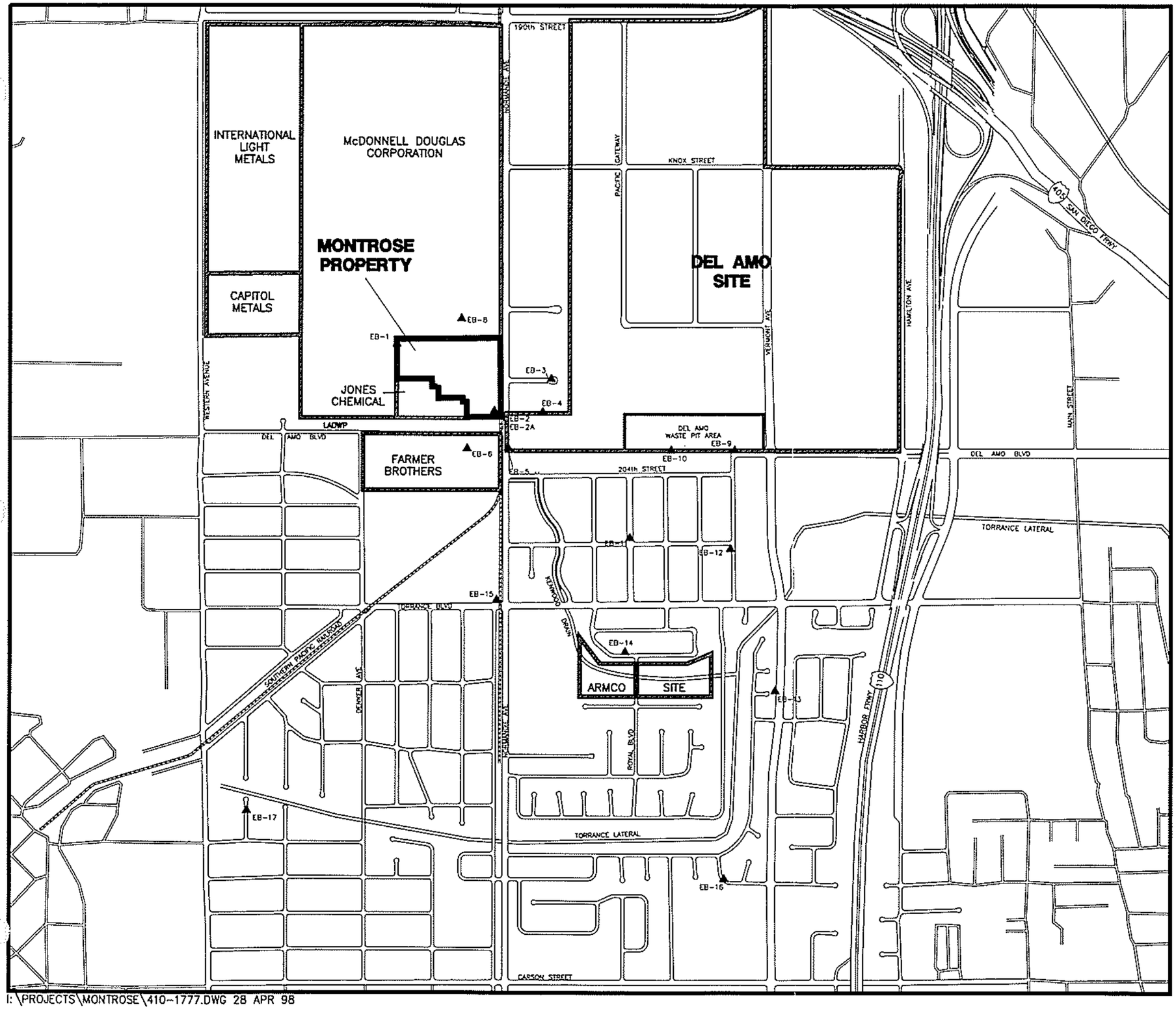
MONITOR WELLS AND EXPLORATORY BORINGS

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 2.8

PREP BY _____ REV BY _____ RPT NO. 218.11.3 | 410-1515 | C



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EXPLANATION

EB-16 ▲ EXPLORATORY BORING

NOTE: THIS MAP SHOWS LOCATIONS FOR MONITOR WELLS AND EXPLORATORY BORINGS CONSTRUCTED BY MONTROSE DURING REMEDIAL INVESTIGATION ACTIVITIES AND DOES NOT INCLUDE MONITOR WELLS AND EXPLORATORY BORINGS CONSTRUCTED BY OTHERS FOR OTHER INVESTIGATIONS.

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FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

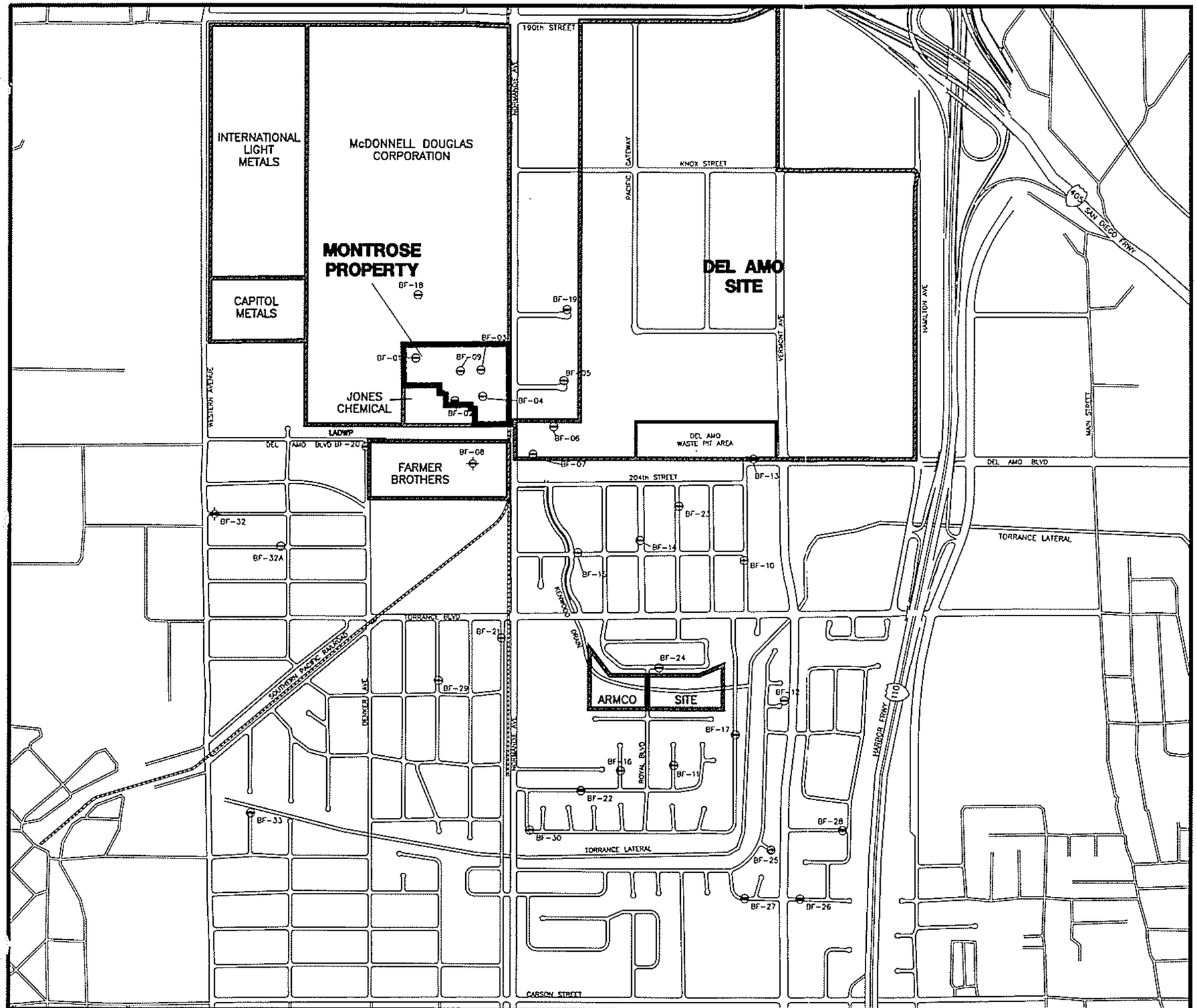
EXPLORATORY BORINGS

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 2.9

PREP BY	REV BY	RPT NO. 857.01	410-1777	A



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EXPLANATION

BF-17 — BELLFLOWER SAND MONITOR WELL

BF-08 — DESTROYED WELL

NOTE: THIS MAP SHOWS LOCATIONS FOR MONITOR WELLS AND EXPLORATORY BORINGS CONSTRUCTED BY MONTROSE DURING REMEDIAL INVESTIGATION ACTIVITIES AND DOES NOT INCLUDE MONITOR WELLS AND EXPLORATORY BORINGS CONSTRUCTED BY OTHERS FOR OTHER INVESTIGATIONS.

0 1,000 2,000

FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

BELLFLOWER SAND WELLS

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 2.11

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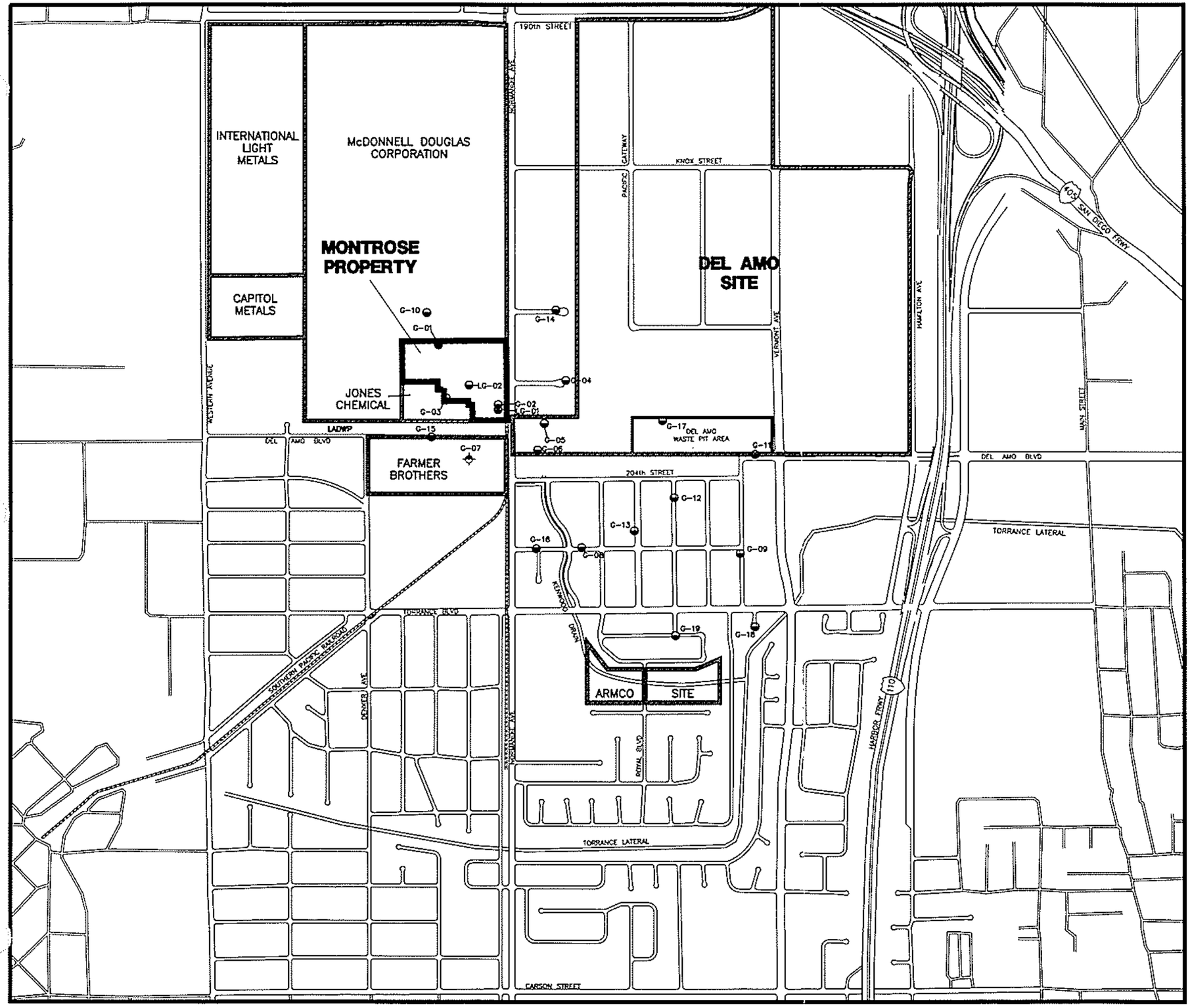

EXPLANATION

- G-08 — GAGE AQUIFER MONITOR WELL
- G-07 — DESTROYED WELL
- LG-01 — LOWER GAGE AQUIFER MONITOR WELL

NOTE: THIS MAP SHOWS LOCATIONS FOR MONITOR WELLS AND EXPLORATORY BORINGS CONSTRUCTED BY MONTROSE DURING REMEDIAL INVESTIGATION ACTIVITIES AND DOES NOT INCLUDE MONITOR WELLS AND EXPLORATORY BORINGS CONSTRUCTED BY OTHERS FOR OTHER INVESTIGATIONS.

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FEET

MONTROSE CHEMICAL CORPORATION
OF CALIFORNIA
TORRANCE, CALIFORNIA

GAGE AQUIFER WELLS

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 2.12

PREP BY _____ REV BY _____ RPT NO. 857.01 | 410-1780 | B

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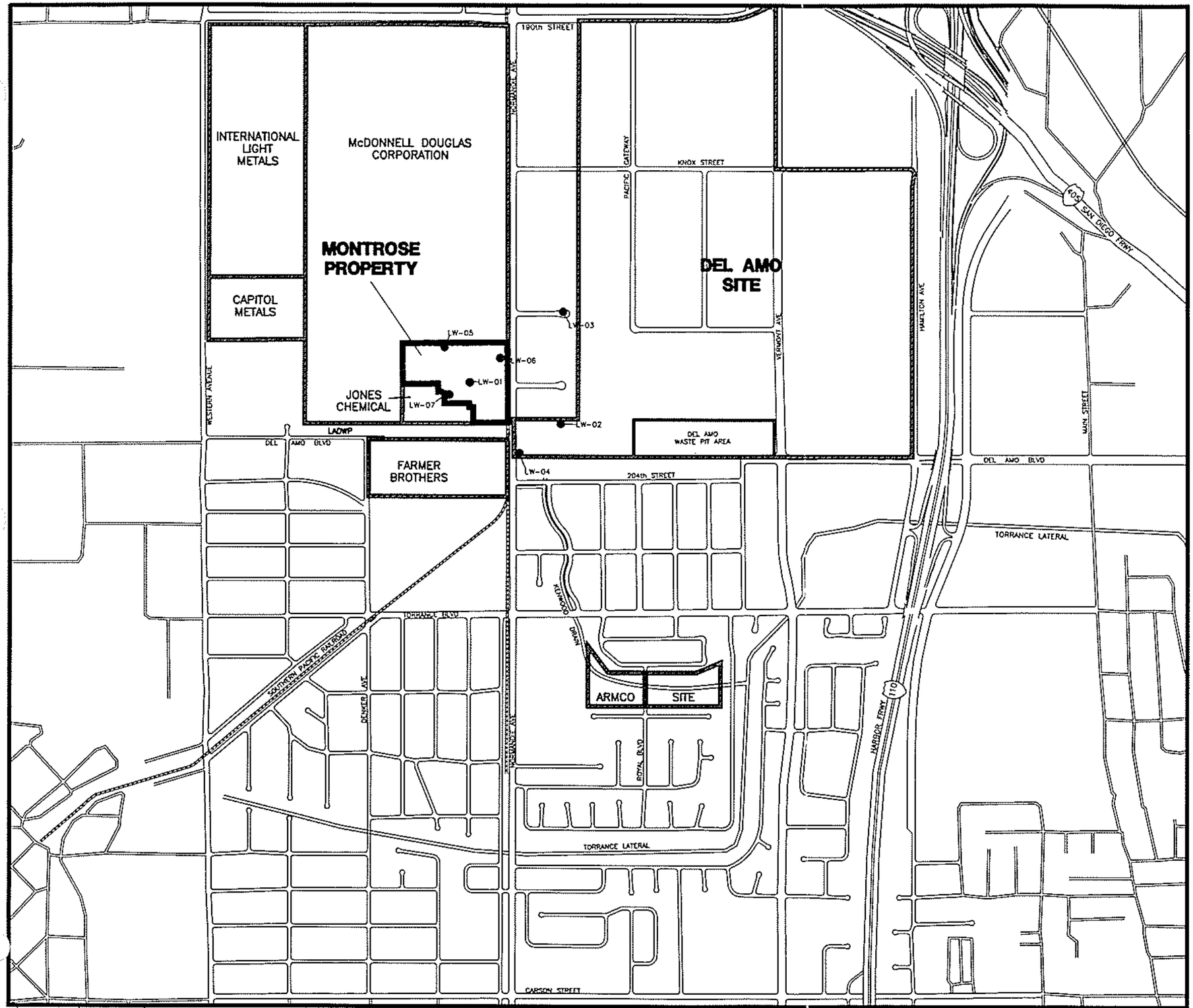

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EXPLANATION

LW-7 ● LYNWOOD AQUIFER MONITOR WELL

NOTE: THIS MAP SHOWS LOCATIONS FOR MONITOR WELLS AND EXPLORATORY BORINGS CONSTRUCTED BY MONTROSE DURING REMEDIAL INVESTIGATION ACTIVITIES AND DOES NOT INCLUDE MONITOR WELLS AND EXPLORATORY BORINGS CONSTRUCTED BY OTHERS FOR OTHER INVESTIGATIONS.

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0 1,000 2,000

FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

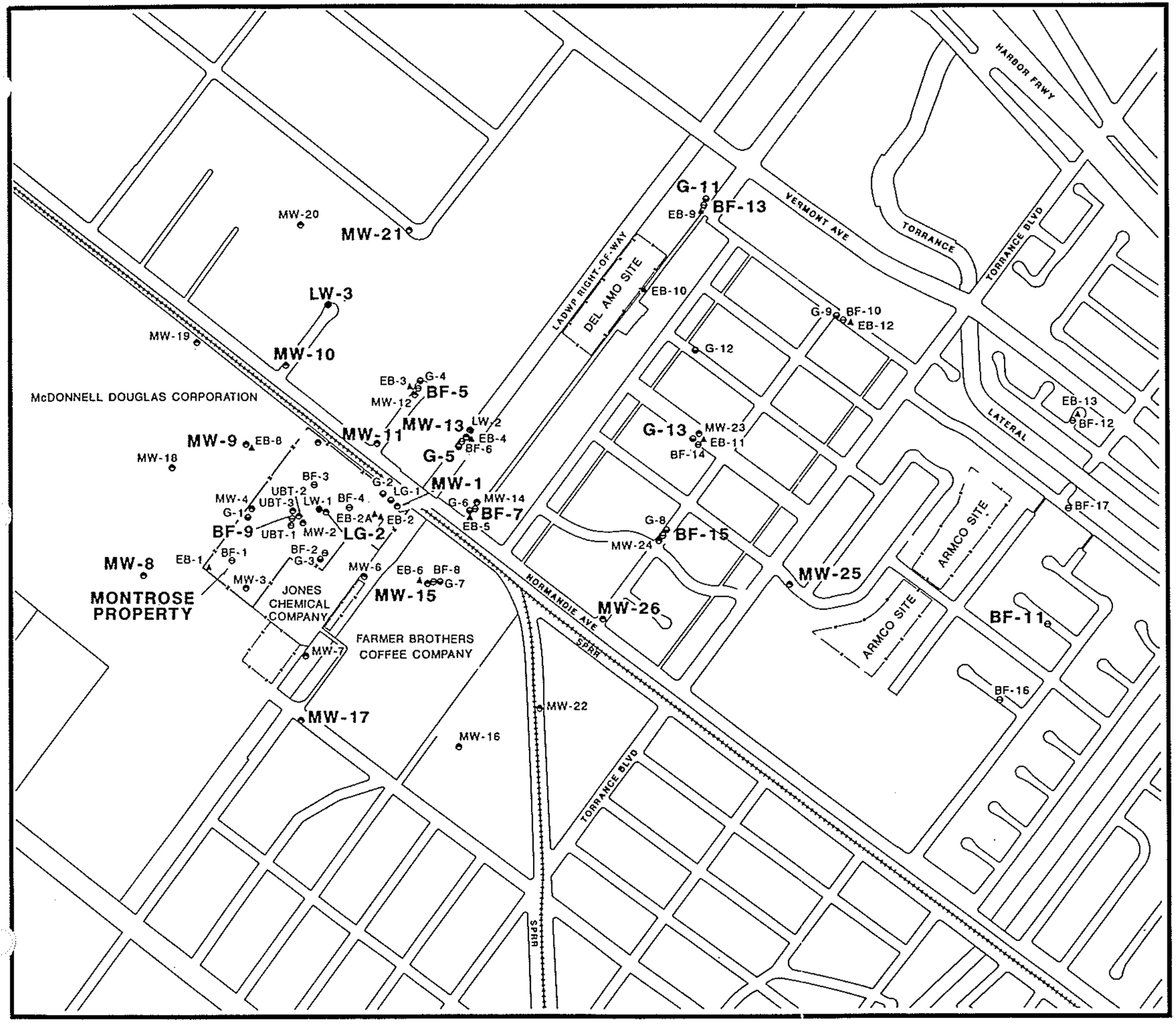
LYNWOOD AQUIFER WELLS

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 2.13

PREP BY	REV BY	RPT NO. 857.01	410-1781	A



EXPLANATION

MONITOR WELLS

MW-1	UPPER BELLFLOWER AQUITARD
BF-1	BELLFLOWER SAND
G-1	GAGE AQUIFER
LW-1	LYNWOOD AQUIFER
MW-10	MONITOR WELL AT WHICH SHORT TERM AQUIFER TEST WAS CONDUCTED
UBT-1	UPPER BELLFLOWER AQUITARD TEST WELL
EB-1	EXPLORATORY BORING
SPRR	SOUTHERN PACIFIC RAILROAD
LADWP	LOS ANGELES DEPARTMENT OF WATER AND POWER

0 600 1,200
FEET

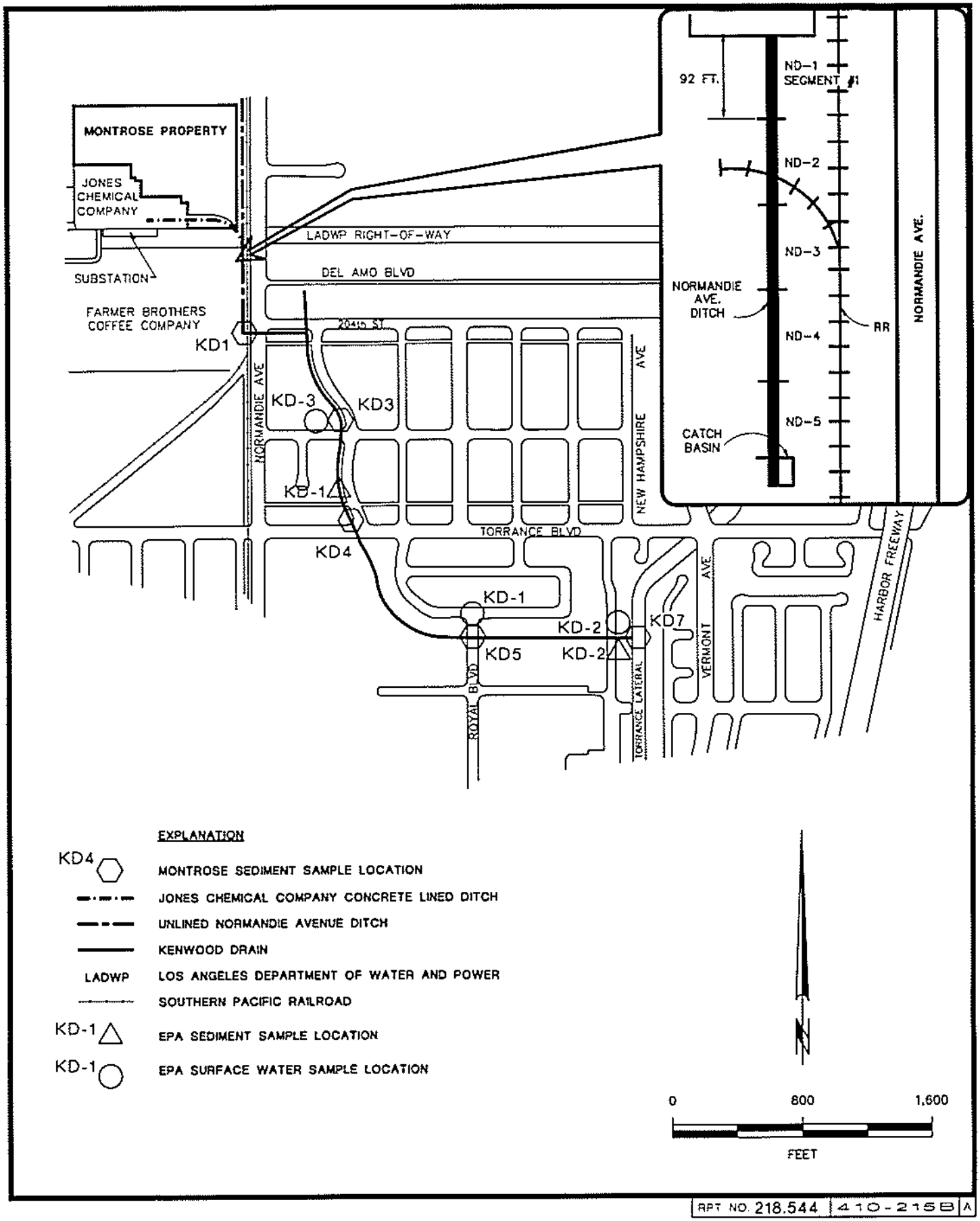
MONTROSE CHEMICAL CORPORATION
OF CALIFORNIA
TORRANCE, CALIFORNIA

AQUIFER TEST LOCATIONS

HARGIS+ASSOCIATES, INC. 10/92

FIGURE 2.14

PREP BY MPalmer REV BY RGM RPT NO. 218.544 R1504-2/F02-7 A



RPT NO. 218.544 | 410-2158 | A

FIGURE 2.15
EPA AND MONTROSE SURFACE WATER AND SEDIMENT SAMPLE LOCATIONS, NORMANDIE AVE. DITCH AND KENWOOD DRAIN

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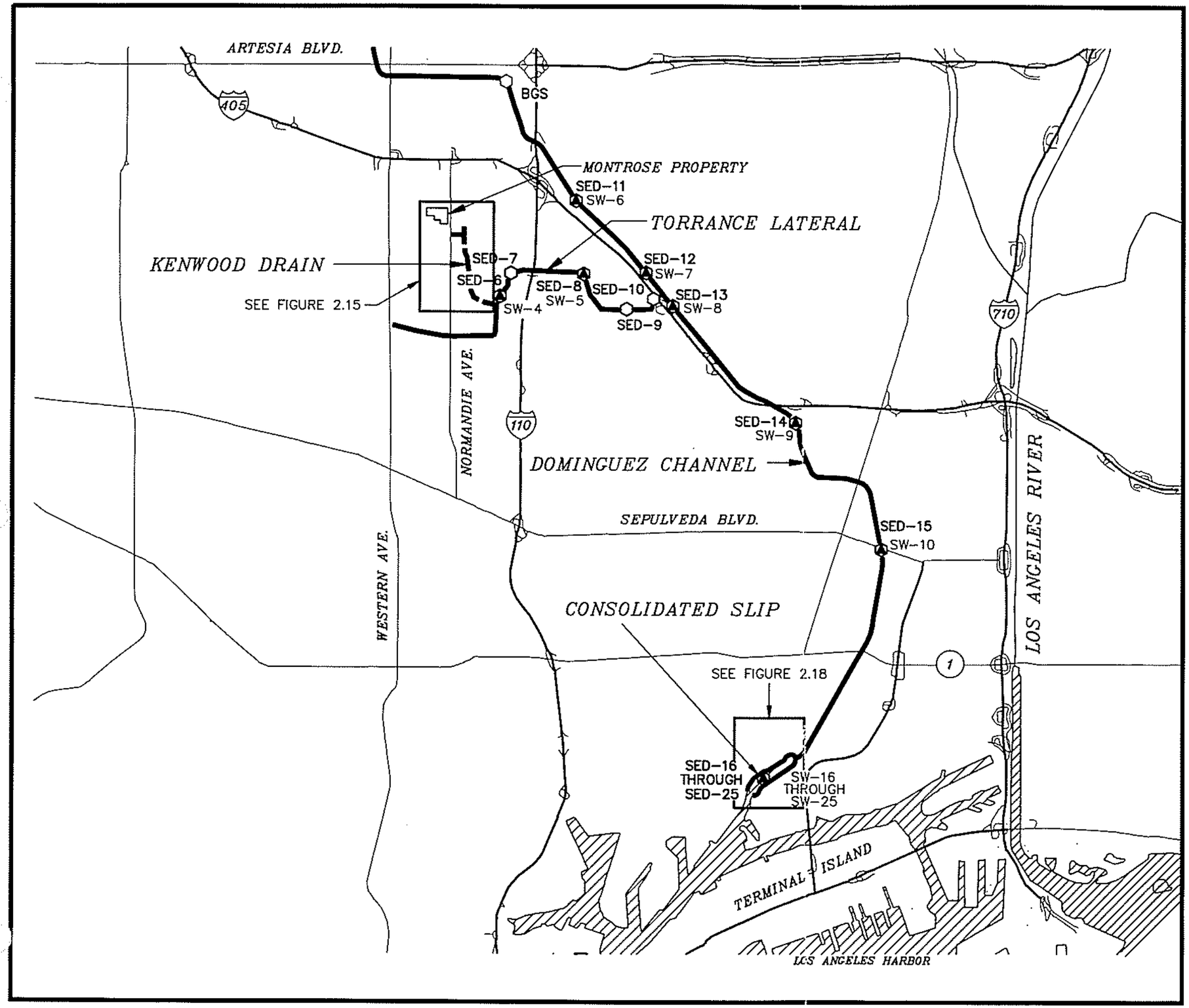

EXPLANATION

SED-11 ⬡ SEDIMENT SAMPLE LOCATION

SW-6 ▲ DRY WEATHER SURFACE WATER SAMPLE LOCATION

BASE MAP FROM: USGS DLG 7.5 MINUTE QUADRANGLES

N

0 5,000 10,000

FEET

MONTROSE CHEMICAL CORPORATION
OF CALIFORNIA
TORRANCE, CALIFORNIA

MONTROSE SEDIMENT AND DRY WEATHER SURFACE WATER SAMPLE LOCATIONS, 1986

7/97

FIGURE 2.16

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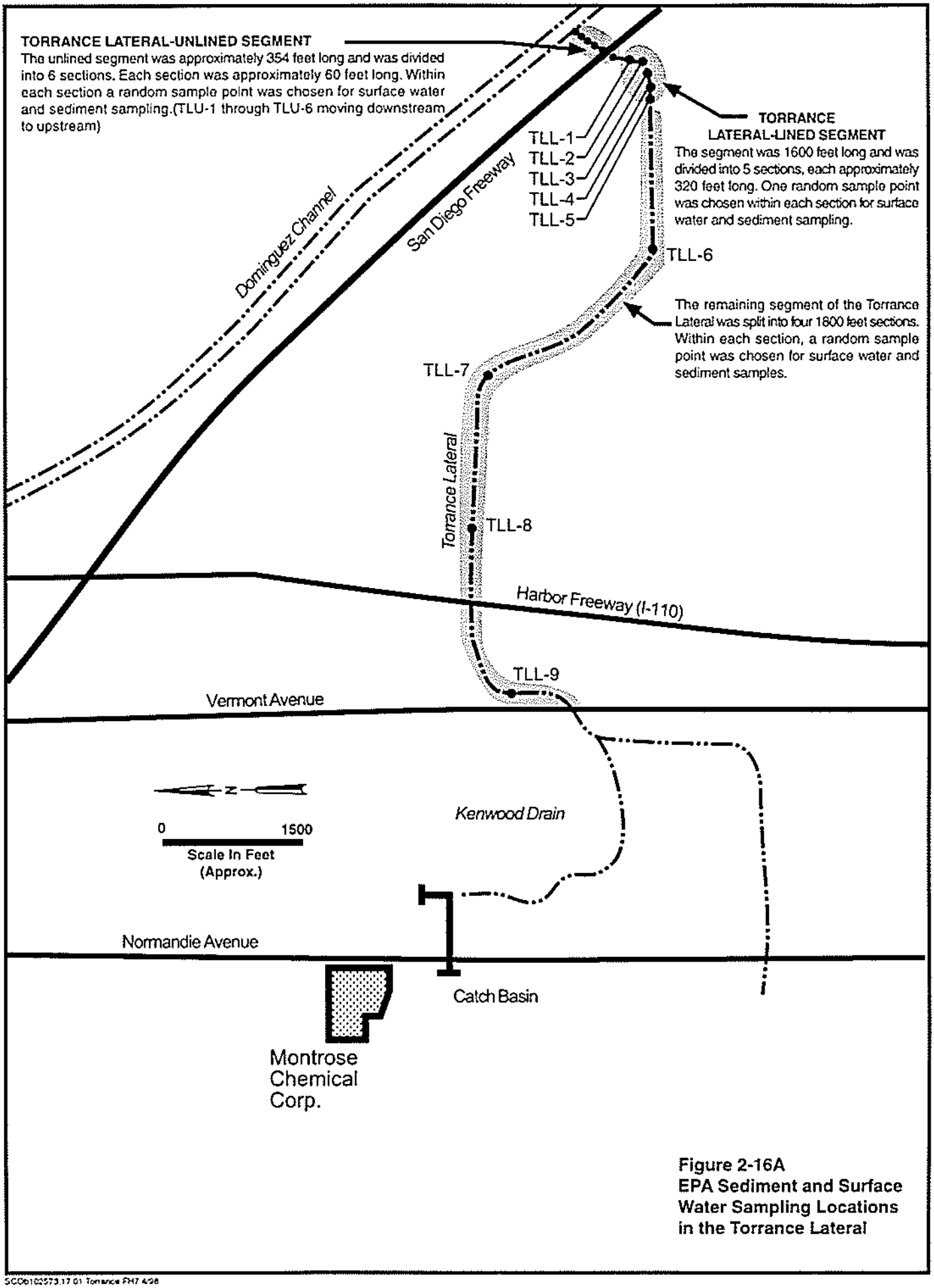


Figure 2-16A
EPA Sediment and Surface Water Sampling Locations in the Torrance Lateral

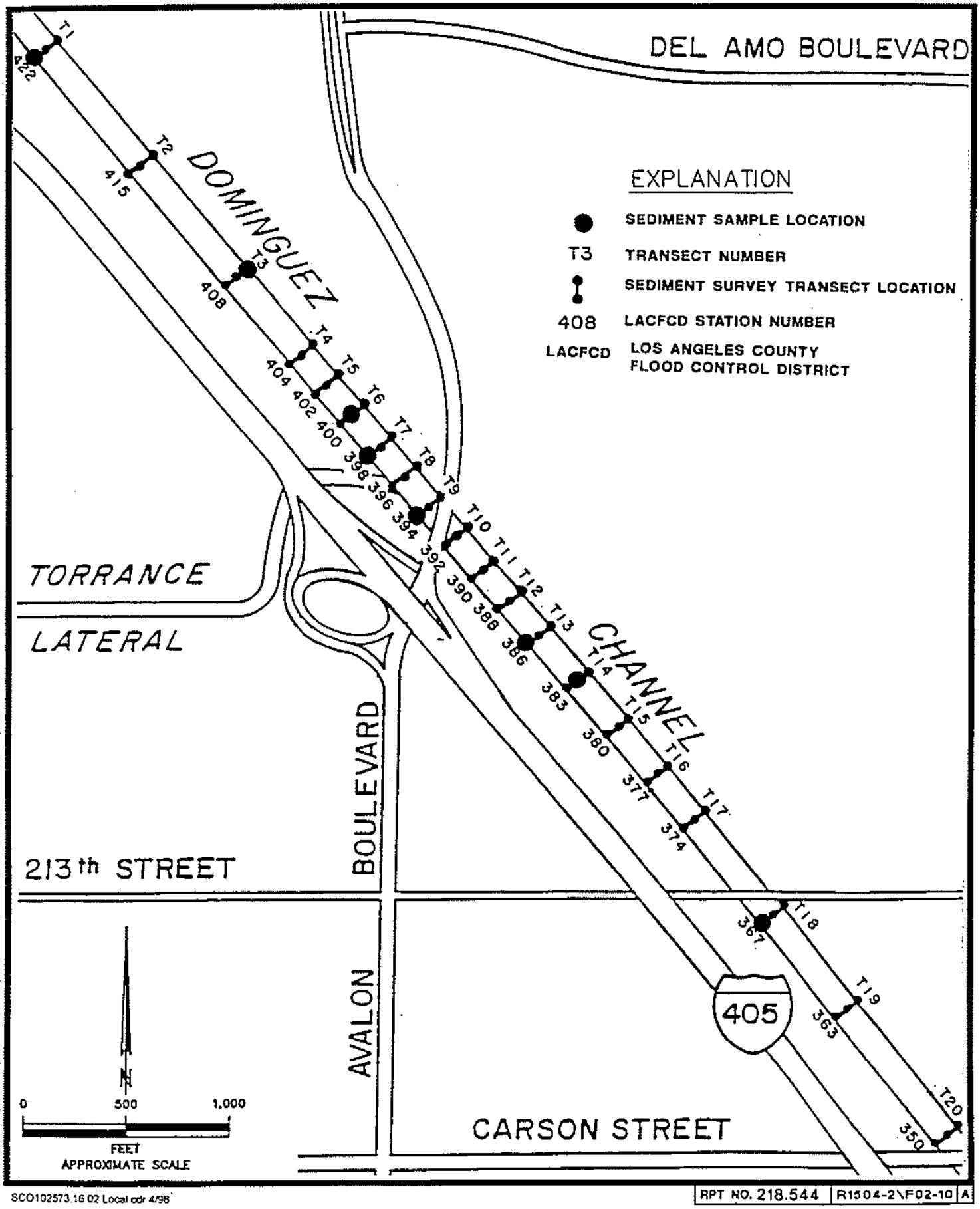


FIGURE 2.17 MONTROSE SEDIMENT SURVEY LOCATIONS, DOMINGUEZ CHANNEL, 1988

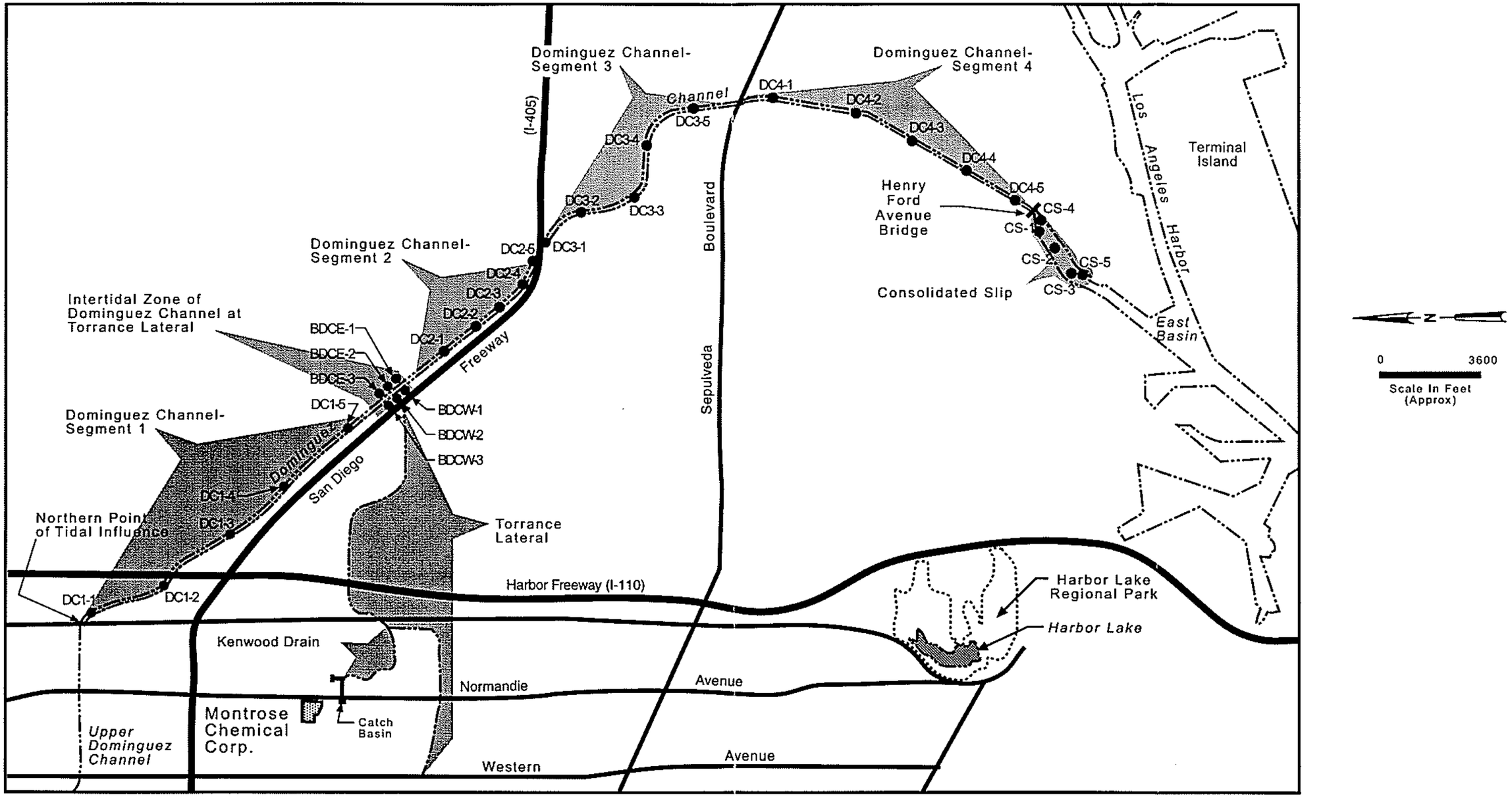
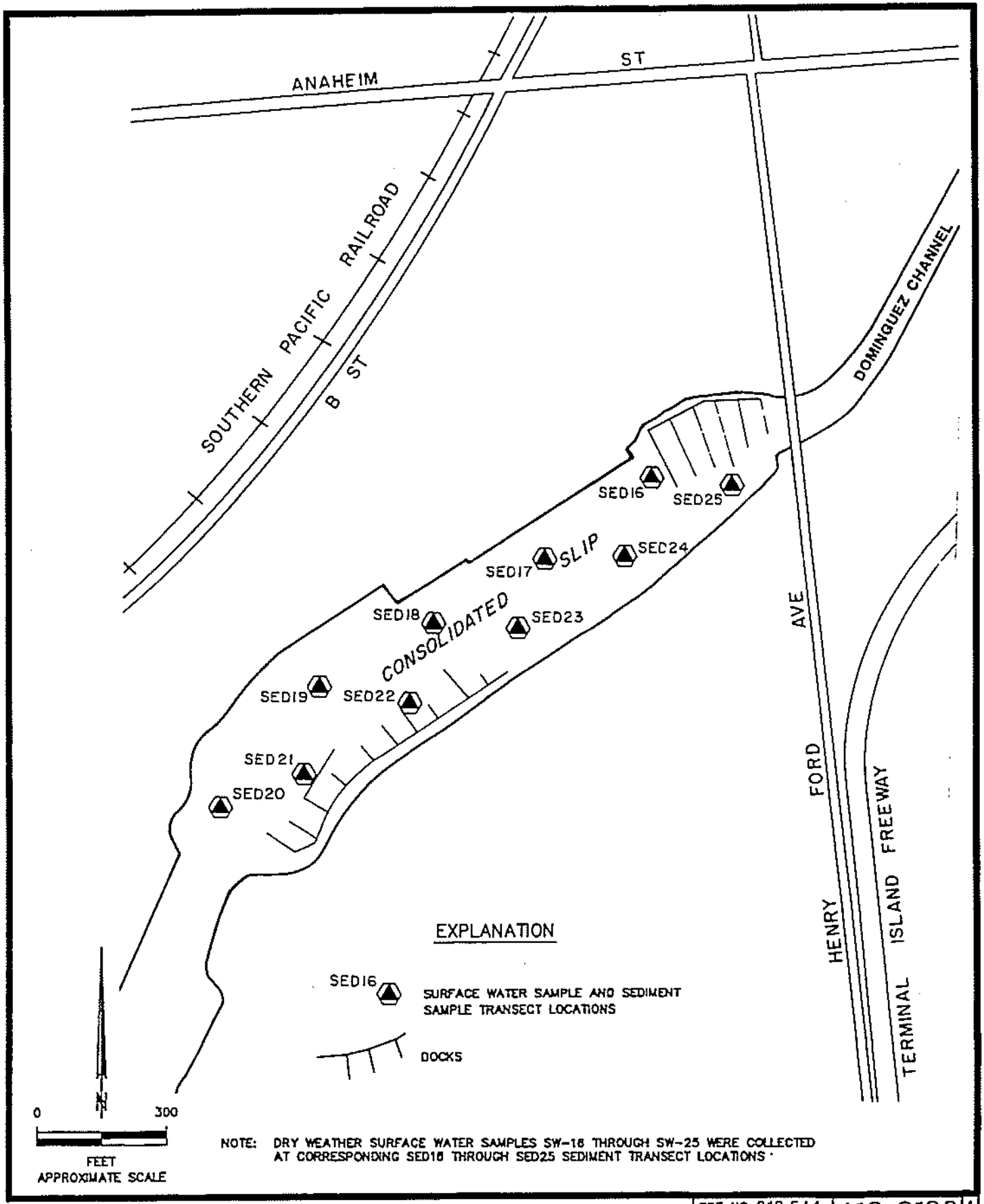


Figure 2-17A
EPA Sediment and Surface Water Sampling Locations in the Dominguez Channel and Consolidated Slip



RPT NO. 218.544 | 410-0198 A

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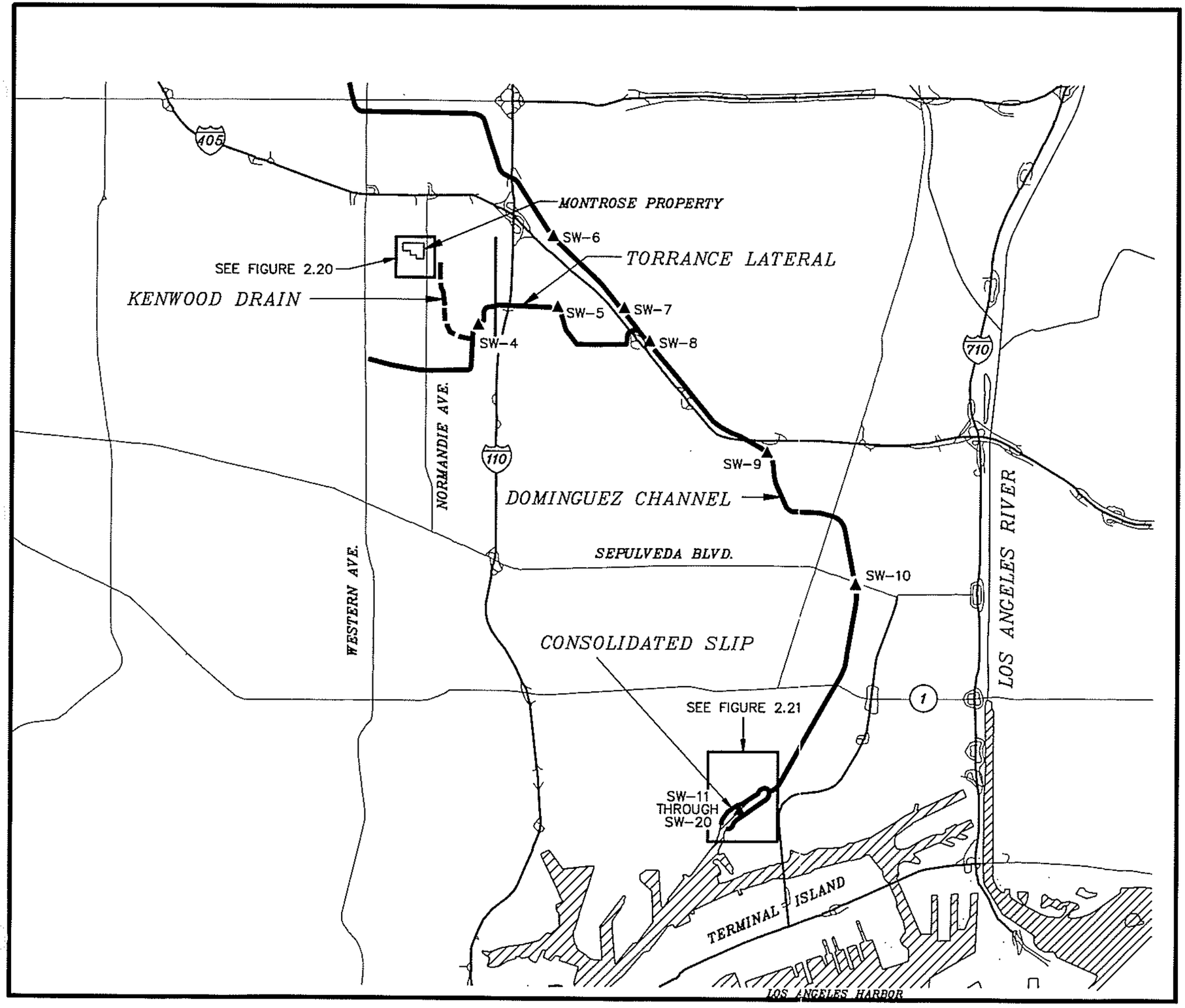
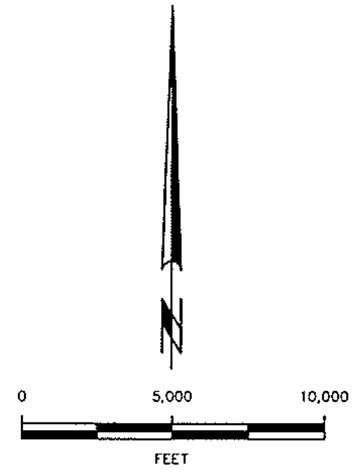
FIGURE 2.18 MONTROSE SEDIMENT AND DRY WEATHER SURFACE WATER SAMPLE LOCATIONS, CONSOLIDATED SLIP



EXPLANATION

SW-6 ▲ WET WEATHER SURFACE WATER SAMPLE LOCATION

BASE MAP FROM: USGS DLG 7.5 MINUTE QUADRANGLES



MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

MONTROSE WET WEATHER SURFACE WATER SAMPLE LOCATIONS

7/97

FIGURE 2.19

PREP BY _____ REV BY _____ RPT NO. 218.544 | 410-0200 | B

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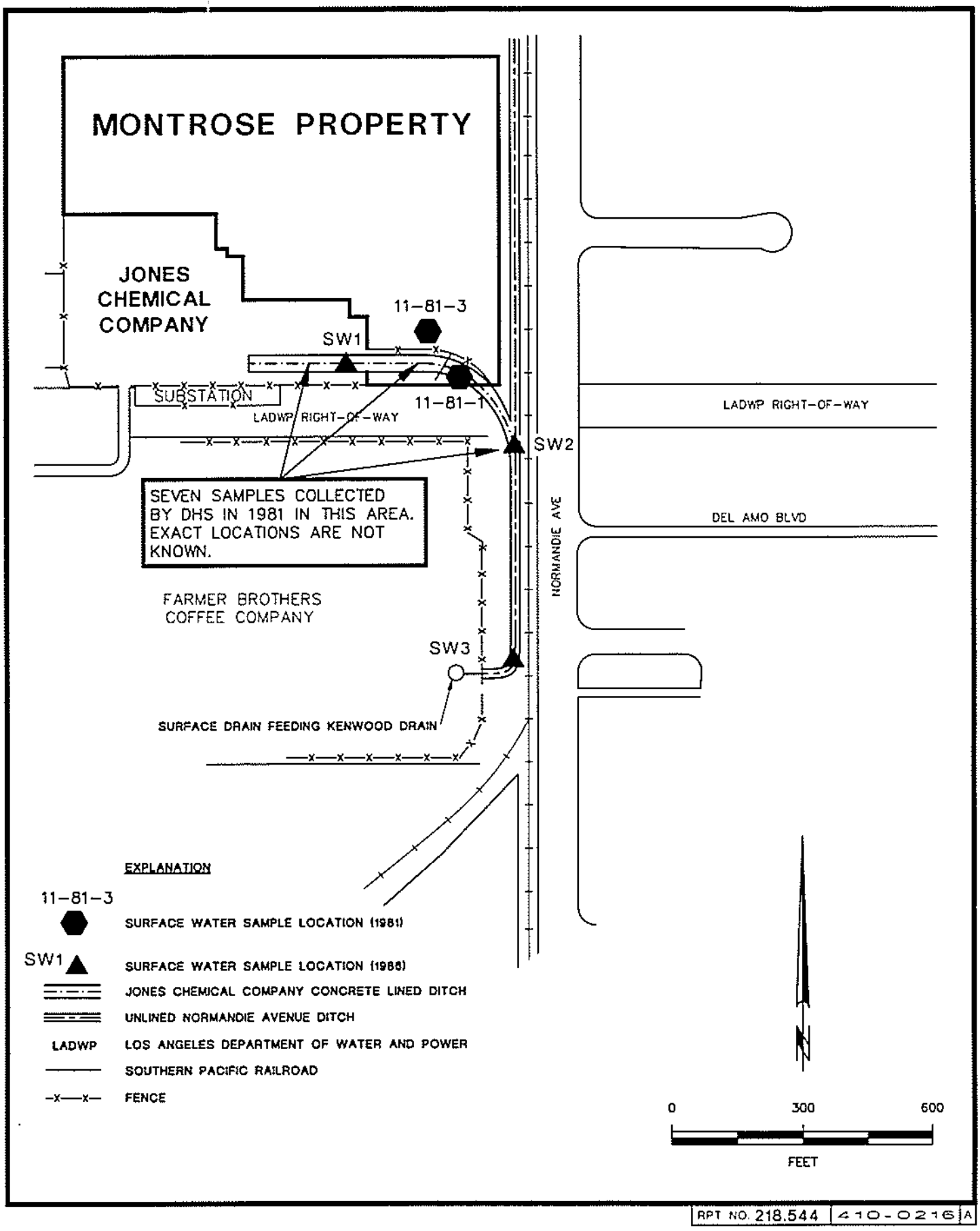
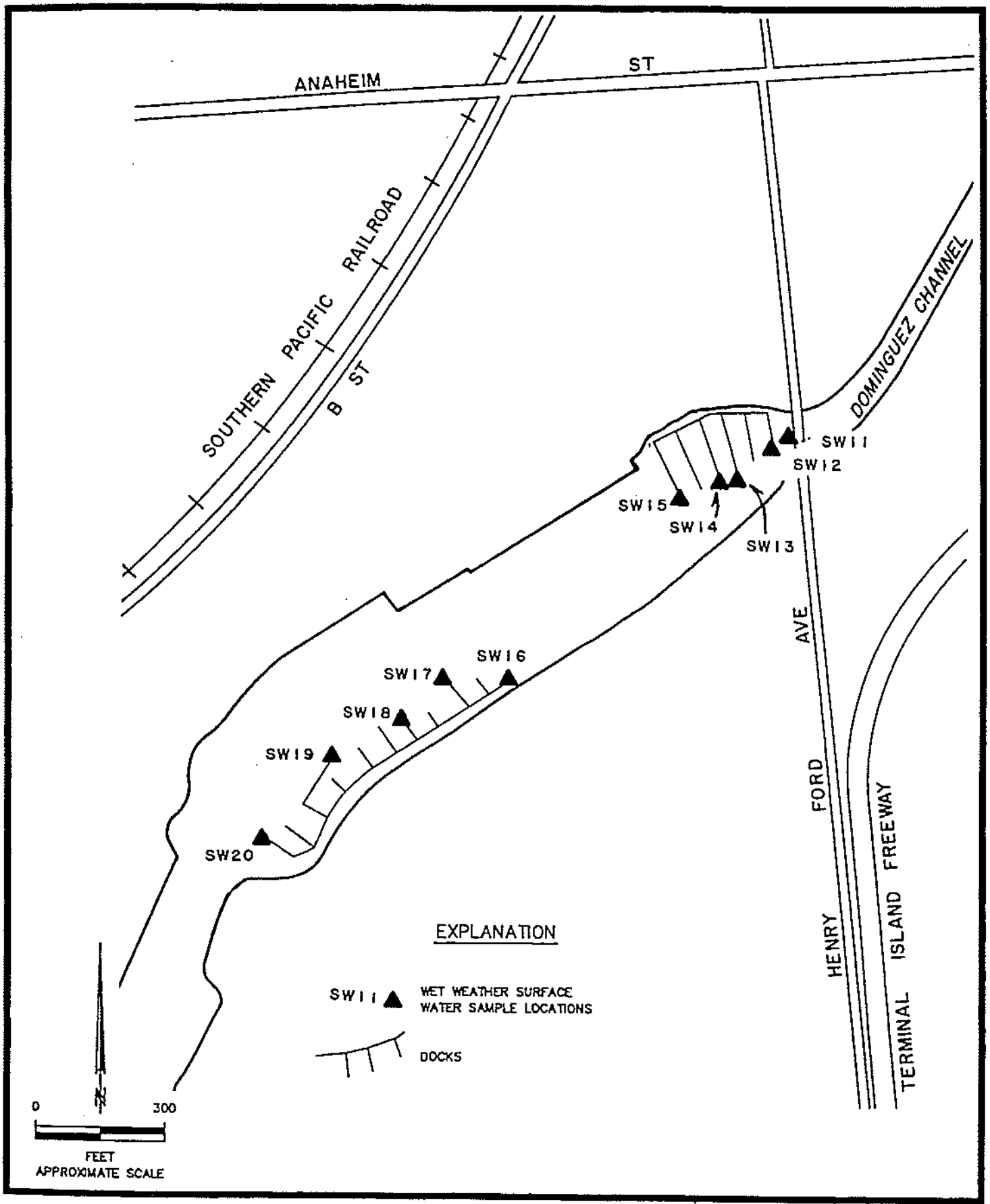


FIGURE 2.20
MONTROSE WET WEATHER SURFACE WATER SAMPLE LOCATIONS, NEAR PROPERTY

I:\PROJECTS\MONTROSE\HARGISRI\410-0216.DWG 03-APR-1998



SCO102573 16 02 WetWea cdr 4/98

RPT NO. 218.544 | 410-0199 | A

FIGURE 2.21 MONTROSE WET WEATHER SURFACE WATER SAMPLE LOCATIONS, CONSOLIDATED SLIP

3. Chemical Data Quality

This section provides an overview of the quality assurance activities and data quality reviews and assesses the data usability for the groundwater, surface water, soil, and sediment data presented in this report. The quality assurance (QA) and data review activities carried out during the period from April 1985 through December 1995 included the following activities:

- Evaluation of split samples (splits) collected by H+A and analyzed by two different laboratories
- Evaluation of split samples collected by EPA and analyzed by the EPA regional laboratory or the EPA Contract Laboratory Program (CLP).
- Independent data quality reviews of the laboratories by H+A project chemists
- Laboratory and field audits completed by H+A
- Data quality reviews completed by the EPA on groundwater data obtained by H+A and split sample data obtained by the EPA
- An overall data quality review and assessment conducted in conjunction with this RI report

A summary of the split sample results is provided in Section 3.1. Data reviews completed by H+A are described in Section 3.2. EPA data validation activities are described in Section 3.3 and an overall data assessment summary is provided is Section 3.4.

3.1 Split Sample Results

Throughout the sampling episodes from 1985 to 1995, H+A collected split samples at an approximate frequency of 10 percent of the total number of samples. The split samples were analyzed by the main (primary) subcontract laboratory as well as a secondary verification laboratory using the same EPA methods. EPA also collected and analyzed split samples periodically during this time period.

BC Analytical of Glendale, California, formerly BCAL, was the primary laboratory used to analyze samples for site characterization from August 1985 through May 1991. Analytical Technologies, Incorporated (ATI) was the secondary verification laboratory for organic analyses from August 1987 through May 1991. Inorganic splits were verified by BC Analytical during this period. Upon commencement of the "Additional Groundwater Assessment" in 1991, ATI became the primary laboratory for analyses, with Agriculture & Priority Pollutants Laboratory, Inc. (APPL) serving as the secondary laboratory. The primary laboratory for the fourth quarter 1995 groundwater sampling was BC Analytical and the secondary laboratory was ATI. All laboratories were state certified at the time of analyses.

The split and the associated original sample results for groundwater are presented in Tables D.22, D.23, D.24, D.25, and D.26 according to analyte groups (volatiles, semivolatiles, pesticides, metals, and common ions). Within each analyte table, the split results are grouped by monitoring well. Monitoring well numbers, sample collection dates, and the laboratory identification are shown in the column headings and are further described in the footnotes. The results for the different monitoring wells are separated by bold lines. These split results tables include EPA split results as well as H+A split results. Split sample data are available for the full time frame of sampling (1985 to 1995) and are well distributed among monitoring well locations.

The split sample analysis results in these tables were reviewed and were considered to agree if:

- Results for both laboratories were nondetections. Differences in reporting limits were not considered significant.
- Results between reported detected concentrations were within an order of magnitude of each other (i.e., higher value was within a factor to 10 of the lower value).

The review of the split samples indicated that there was no significant bias of contaminant concentrations in the samples collected by H+A and that there were no significant detection versus nondetection results (i.e., in general, split samples contained the same contaminants detected in the original samples).

Within the above framework, the split sample results are found to indicate acceptable agreement and data usability as can be seen in Tables D.22, D.23, D.24, D.25, and D.26.

3.2 Data Reviews by H+A

This section discusses the H+A data reviews, including the data review methodology (Section 3.2.1), data completeness (Section 3.2.2), and field and laboratory audits (Section 3.2.3).

3.2.1 Data Review Methodology

Data generated by the H+A subcontracted laboratories were reviewed by H+A project chemists independent of the laboratories. The laboratory quality control (QC) data summaries associated with holding times, accuracy, precision, and blank measurements were reviewed to assess data quality. To evaluate the holding times, accuracy, precision, and blank contamination, the quality control data reviewed included sample collection, extraction, and analysis times; matrix spike recoveries; laboratory control standards (LCS) recoveries; duplicate relative percent differences (RPDs); blank sample results; and detection limits. The 1995 groundwater data were reviewed for additional QC data including laboratory instrument tuning, calibration, internal standard, and raw data.

The holding times, precision, and accuracy QC data were reviewed against laboratory and project specific control limits. For QC data outside these control limits, data flags were assigned to the associated sample data. These flags are shown in Tables D.1 through D.21 and defined in the footnotes. Because the specific data flags assigned during the data QC reviews have varied over the duration of the project, the reader should note the different

footnotes for data usage. The blank sample data and detection limit reviews are discussed in the following sections.

H+A reviewers evaluated the potential contamination of site samples through the review of field and laboratory blank data and qualified sample data. These sample data qualifiers are also shown in Tables D.1 through D.21 and the blank evaluations are described below.

3.2.1.1 Laboratory Blanks

Analytical results associated with laboratory reagent blank contamination were flagged in the database to indicate estimated concentrations and possible false positive results. If compounds detected in the reagent blank sample were detected in the primary (field) sample at concentrations within five times those detected in the reagent blank sample, the result was qualified as "E" (qualified data are presented in Tables D.1 through D.21 in Appendix D). If compounds detected in the laboratory reagent blank sample were detected in the primary sample at concentrations equal to or lower than those detected in the reagent blank sample, the result represented a potential false positive value and was qualified as "U." The "U" flag, as it is used in this RI Report, means that the data point is unusable. This differs from the standard usage of the data flag "U", which is commonly used to represent no detection above the laboratory reporting limit.

The compounds methylene chloride, acetone, and the isomers of DDT and its metabolites DDD and DDE were detected in laboratory reagent blank samples during the period from August 1986 through October 1991. Less than 1 percent of the total number of analyses required qualification as a result of laboratory reagent blank contamination. RI samples associated with the laboratory reagent blank contamination were qualified in the database as "E" or "U" (Tables D.1 through D.21). Further evaluation of the common laboratory contaminants acetone and methylene chloride was performed as described in Section 3.2.1.3.

3.2.1.2 Field and Trip Blanks

If compounds detected in the field or trip blank samples were detected in the primary sample at concentration within five times those detected in the reagent blank sample, the result was qualified as "E". If compounds detected in the laboratory reagent blank sample were detected in the primary sample at concentrations equal to or lower than those detected in the reagent blank sample, the result represented a potential false positive value and was qualified as "U."

Review of field blanks sampled from 1985 through 1995 indicated that benzene, acetone, chlorobenzene, chloroform, the isomers of DDT and its metabolites DDD and DDE, ethylene chloride, toluene, total xylenes, trichlorofluoromethane, methyl ethyl ketone (MEK), and an aliphatic hydrocarbon were detected. Therefore, when these compounds were found in the associated samples, the results were flagged as described above.

Review of the trip blank samples analyzed during the period from 1985 through 1995 indicated that acetone, chlorobenzene, chloroform, benzene, BHC isomers, isobutane, toluene, methylene chloride, MEK, total xylenes, trichlorofluoromethane, tetrahydrofuran, and an aliphatic hydrocarbon were detected. Therefore, when these compounds were found in the associated samples, they were flagged as described above.

3.2.1.3 Additional Blank Reviews

H+A reviewers completed additional blank sample evaluations for the contaminants acetone, methylene chloride, toluene, and MEK following EPA's Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses (EPA, February 1988R-a). These compounds are considered by EPA to be common laboratory contaminants. To assess the source of these compounds in samples, the sample concentrations were compared to 10 times the blank concentrations. If the concentration of the common laboratory contaminant in the sample was less than 10 times the concentration of the contaminant in the blank sample, then the presence of the compound was attributed to field or laboratory contamination rather than the Montrose Site. H+A reviewers compared acetone, methylene chloride, toluene, and MEK data within this context and noted that the majority of the data showed associated blank contamination within a factor of 10. For sample data that had no associated blank samples, the reviewers evaluated the data within the context of other samples that showed similar detected values. Based on the low concentrations of methylene chloride, acetone, and MEK detected in these samples and the presence of these compounds in blanks analyzed during the same time frame, H+A reviewers decided that the reported concentrations of these compounds were not considered to be indicative of actual conditions at the Montrose Site and that the data should be qualified as such.

3.2.1.4 Detection Limit Reviews

The laboratory method detection limits (MDLs) for RI samples were established by the laboratories based on MDL studies. MDLs are specified in the QAPPs (H+A, 1986R-b, 1986R-f, 1988R-e, and 1995). MDLs for RI samples were compared to current federal and state maximum contaminant levels (MCLs) (EPA, 1992R) to assess if the MDLs were low enough to assess if the concentrations of contaminants in groundwater exceeded MCLs.

The MDLs used by the primary and secondary laboratories for all compounds included in the current federal and California MCL listing were less than the MCLs for all of those compounds, with the exception of benzene. The federal MCL of 5 µg/L for benzene was promulgated on July 8, 1987 and became effective January 9, 1989. The California MCL of 1 µg/L for benzene became effective February 22, 1989. Prior to 1989, the BCAL MDL for benzene was 2 µg/L. In early 1989, the BCAL MDL was lowered to 1 µg/L. ATI's MDL for benzene was equal to the California MCL of 1 µg/L.

APPL's MDL for benzene analysis of 12 split groundwater samples collected during the fourth quarter of 1991 was 5 µg/L, which exceeded the California MCL for benzene of 1 µg/L, but was equal to the federal MCL. Analytical results for these 12 groundwater samples were consistent with analytical results obtained prior to, during, and subsequent to the fourth quarter 1991 sampling of these wells. Given the small total population of groundwater samples analyzed by APPL, the elevated MDL for benzene analyzed by APPL in 1991 is expected to have no significant impact to subsequent evaluations and decision making to be conducted as part of this RI/FS process.

3.2.2 Data Completeness

Completeness of analytical data is defined in the QAPPs as the ratio of the number of acceptable analytical results to the total number of analyses requested (H+A, 1986R-b, 1986R-f, 1988R-e, and 1995). Criteria for unacceptable or incomplete results as defined by H+A included: (1) insufficient sample volume for analysis, (2) "greatly exceeding holding

times" for the sample per the judgement of H+A reviewers, or (3) unsatisfactory supporting data, such as dates, locations, or sample identity. A completeness value of less than 90 percent was used as an indication that sample collection or analytical procedures should be reviewed and that corrective action may be necessary to limit the number of incomplete analytical results in future sampling events.

H+A completed a review of the data for completeness, according to the above criteria, and concluded that the completeness goal for analytical data sampling from June 1985 through October 1991 was attained in all but four sampling events. These four sampling events were the July 1985 and August 1986 groundwater sampling events, the April to May 1985 soil sampling event, and the June 1986 surface water sampling event. The failure to meet the completeness goal for the four sampling rounds was based on the laboratories' failure to meet the holding times for the samples. Failure to meet holding times does not in itself disqualify the data as unusable for any purpose. Data were qualified with an "E" when: (1) holding times were exceeded, but not greatly exceeded, and (2) no other data quality problems were identified (see Tables D.1 through D.21). If holding times for VOC analyses were greatly exceeded, data were qualified as unusable for any purpose.

Based on H+A review of the BCAL analytical data according to the above set of criteria, the data completeness ranged from 65 percent to 100 percent. H+A prepared file memoranda for each sampling event summarizing the completeness percentage for the event and indicating incomplete results and any corrective actions required. The rejected data were not used for the analysis and interpretation in this report. Sufficient data were available to support the conclusions of the RI.

3.2.3 Field and Laboratory Audits

H+A completed laboratory audits once a year at the primary and secondary verification laboratories as part of the H+A Laboratory Performance Evaluation program. The laboratory audits are required to monitor the capability and performance of the laboratory. Each audit included an evaluation of the overall laboratory QA program, analytical equipment, standard operating procedures, and QC procedures. Performance evaluation samples were submitted and analyzed as part of the laboratory QA/QC program.

Laboratory audits were conducted in December 1987, April 1988, November 1989, and May 1991 for the primary laboratory BCAL. Laboratory audits were conducted in April 1988, August 1989, and April 1991 for the ATI laboratory, which served as both the primary and secondary verification laboratory during this time period. Laboratory audits were conducted in November 1989, January 1990, and May 1991 for the secondary verification laboratory APPL.

3.3 EPA Data Validation

EPA completed an independent data validation review of a subset of the RI sample analyses. The procedures used by EPA to validate analytical data for VOCs, pesticides/PCBs, base neutral/acid extractable organic (BNA) compounds, and trace metals followed the Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses (EPA, February 1988R-a) and the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses (EPA, February 1988R-b). EPA validated the data collected from the following:

- Groundwater, soil, sediment, and surface water samples collected by H+A in 1986 and 1987
- Soil samples collected by H+A in September through November 1988
- Groundwater samples collected by H+A from January through May 1989
- Split samples collected by EPA (1985 to 1989) shown in Tables D.22 through D.24

Soil, groundwater, sediment, and surface water data collected in 1986 and 1987 were validated by EPA between 1988 and 1991. Based on that review, several sets of pesticide results for these samples were designated by EPA as "presumptive evidence for the presence of the analyte" (validation flag "N") or as "unusable for any purpose" (validation flag "R"). EPA determined that data qualified as "N" were usable for the RI/FS and for risk assessment purposes and that data qualified as "R" were not usable for the RI/FS or for the risk assessment (EPA, 1992C-b).

As a result of the EPA validation, analytical results for 26 groundwater samples collected from 14 monitoring wells were flagged "R" and were not used in the assessment and discussion of the nature and extent of contaminants in groundwater (Section 5). Groundwater data that were downgraded by EPA to validation flag "R" include: a subset of VOC and BNA analyses of groundwater samples collected in August 1985 from Monitoring Wells MW-1, MW-2, MW-3, MW-4, and MW-5; pesticide results for groundwater samples collected in January, February, and April, 1989 from two MW-series, four BF-series, three G-series and one LG-series Monitoring Wells; and pesticide results for groundwater samples collected in February 1989 from Monitoring Well MW-11.

Most of the sediment and some of the surface water data collected by Montrose in 1986 and 1988 was rejected (qualified with an "R") as unusable for any purpose because of calibration documentation deficiencies. Consequently, EPA conducted additional sediment and surface water sampling in 1994. The rejected results of the Montrose sampling in 1986 and 1988 and the results of EPA sampling in 1994 are presented in Section 5.0 of this RI Report.

3.4 Overall Data Assessment Summary

Data collection, analysis, and validation activities were completed by H+A for the Montrose Site to support the RI on behalf of Montrose. In addition, EPA collected, analyzed, and validated a limited number of split samples to assess data usability. To assess the completeness and quality of the data presented in this report, EPA completed an overall review of the Montrose RI database-related documents located at the Superfund Records Center (SRC) and the Federal Records Center (FRC), as well as H+A project files. The review documents included data review reports from H+A and EPA, chain of custody forms, and event-specific data reports. These reviews focused on the data quality and usability as well as completeness within the context of this RI Report.

Review of chain of custody forms and event specific data reports in H+A project files indicate that over 95 percent of the collected data has been entered in database presented in Appendix G.

Based on the descriptions in Sections 3.1 and 3.3, the data have been found to be useable for the purpose of this RI report.

4.0 Physical Characteristics

This section describes the physical characteristics of soil, groundwater, sediment, and surface water encountered during the RI field work at the Montrose Site. Soil lithology and physical parameters of the unsaturated soil from land surface to a depth of approximately 70 feet below land surface (bls) are described for five lithologies identified at and in the vicinity of the Property. These soil characteristics are discussed for surficial soil, fill, Playa deposits, Palos Verdes Sand, and the Upper Bellflower Aquitard.

The lithology and hydraulic characteristics of four primary hydrogeologic units encountered during RI field work are described. These hydrogeologic unit characteristics are discussed for the Bellflower Aquitard (Upper Bellflower Aquitard, Bellflower Sand, Lower Bellflower Aquitard), Gage Aquifer, Gage-Lynwood Aquitard, and the Lynwood Aquifer. Groundwater occurrence and water quality are discussed for water-bearing units.

The distribution, thickness, and composition of sediments in four drainages located downstream from the Property are described. The four drainages are the Kenwood Drain, the Torrance Lateral, the Dominguez Channel, and the Consolidated Slip.

The depth and water quality are described for surface water samples collected during dry weather from the Torrance Lateral, the Dominguez Channel, and the Consolidated Slip. Surface water samples collected during five precipitation events at various locations downstream from the Property are also described. These wet weather samples were collected from the Jones Chemical Company Ditch, the Normandie Avenue Ditch, the Torrance Lateral, the Dominguez Channel, and the Consolidated Slip.

4.1 Soil

The physical characteristics of the soil investigated at the Montrose Site have been evaluated based on lithologic data and physical parameters obtained from soil borings drilled during RI field work. This discussion focuses on unsaturated soil, which occurs from land surface to a depth of approximately 70 feet bls.

The lithology and physical parameters are described for surficial soil, fill, the Playa deposits, the Palos Verdes Sand, and the unsaturated portion of the Upper Bellflower Aquitard. Physical/chemical parameters described include total organic carbon (TOC), pH, electrical conductivity (EC), soil moisture, and grain size.

The soil investigation was conducted both On- and Off-Property. On-Property soil samples were collected from both inside and outside of the Central Process Area. Off-Property soil samples were collected from the Property perimeter, the LADWP right-of-way, the Normandie Avenue Ditch, and the Farmer Brothers property. Neighborhood samples were collected at 32 locations from nearby properties; 14 background samples were collected at 9 locations approximately 1.4 to 5.1 miles from the Property.

4.1.1 Lithology

The lithology of surficial soil, fill material, and the three geologic units encountered in the unsaturated soil underlying the Montrose Site are discussed. The three geologic units that comprise the unsaturated soil encountered at the Montrose Site are the Recent Playa deposits, late Pleistocene marine deposits referred to as the Palos Verdes Sand (Poland et al., 1959), and the unsaturated upper portion of the Pleistocene Bellflower Aquitard (CDWR, 1961).

4.1.1.1 Surficial Soil

Three soil associations have been identified within a 2-mile radius of the Montrose Site: the Ramona-Placentia association, the Oceano association, and the Cropley association (USDA, 1969). Ramona soils are typically reddish-brown loam underlain by reddish-brown clay loam or clay. Placentia soils are characterized by reddish-brown loam or sandy loam underlain by a dark reddish-brown clay loam subsoil. Ramona soils make up approximately 80 percent and Placentia soils make up approximately 20 percent of the association in the Los Angeles Basin (USDA, 1969). The Oceano association is typically a grayish-brown, slightly acid to medium acid sand, underlain in succession by a light brownish gray, strongly acid sand, and a pale brown, strongly acid sand. The Cropley association is typically a dark gray clay underlain by a grayish-brown clay subsoil. Soil at the Property has been identified as the Ramona-Placentia association; her most native soil at the Property has been reworked or removed. For the purposes of the following discussion, non-fill surficial lithologic material will be described as Playa deposits.

4.1.1.2 Fill Material

Land surface features, such as asphalt, were encountered both On- and Off-Property. The majority of the Property is capped with asphalt. A gravel subgrade extending to depths of approximately 0.5 foot bls underlies the asphalt cover. Three raised building pads constructed for proposed warehouses are present on the Property.

Asphalt pavement was present from land surface to depths of 0.25 foot bls to 0.5 foot bls in the soil borings drilled on the Jones Chemical Company property. A railroad gravel bed was present from land surface to depths of 0.25 foot bls and 0.75 foot bls on the McDonnell Douglas property, and to a depth of 2.5 feet bls at Soil Boring SP-1 in the SPRR right-of-way. The LADWP right-of-way was treated with a soil sealant in 1988 when approximately the upper 2 feet of soil was tilled, mixed with lime, and compacted. In 1991, the LADWP right-of-way was capped with asphalt. In 1988, the Normandie Avenue Ditch extending from the southeastern corner of the Property boundary south to the Farmer Brothers property was lined with gunite.

Fill material and reworked native material were encountered both On- and Off-Property. Fill is the result of excavation and backfill or redistribution of native or imported material. Fill identified On- and Off-Property consists of a dark brown clayey silt, silty clay, or clay with debris, such as concrete fragments, gravel, red brick fragments, and wood debris. Fill material occurs from land surface to a depth of approximately 18 feet bls at the location of Soil Boring S-101. Soil Boring S-101 was drilled On-Property through the former water recycling pond. Grading conducted during capping of the Property in 1985 disturbed approximately the upper 3 feet of the surficial soils throughout the Property. Fill material was used to construct the three raised pads on the Property (Figure 4.1). Fill material, with

debris such as wood fragments and glass, was identified in the near-surface soil samples collected from the Property perimeter, the LADWP right-of-way, the Normandie Avenue Ditch, and the Farmer Brothers property.

Subsurface features that occur On- and Off-Property include buried sanitary sewer lines, pipelines, and concrete (Figure 4.2). Two Los Angeles County sanitary sewer lines underlie the eastern edge of the Property parallel to Normandie Avenue and the Normandie Avenue Ditch. One sanitary sewer line was constructed in the early 1950s, and the other sewer line was constructed in early 1960. The sanitary sewer lines are buried at depths of approximately 20 feet bls. A pipeline corridor containing numerous buried pipelines ranging from about 2 inches to 24 inches in diameter is located south of the Property in the LADWP right-of-way. These pipelines transport refinery products, including crude oil, diesel, gasoline, jet fuel, and liquid styrene (H+A, 1990R-f). These pipelines are buried approximately 3 feet bls to 5 feet bls. Buried concrete and concrete footings left in place still exist On-Property, primarily in the Central Process Area. An approximate location of the buried concrete was obtained based on a Property grading map.

4.1.1.3 Playa Deposits

Cross sections of the unsaturated soil from land surface to a depth of approximately 70 feet bls have been prepared to illustrate subsurface conditions encountered On-Property (Figure 4.3). Soil cross-section A-A' is oriented west to east across the Property (Figure 4.4). Soil cross-section B-B' is oriented northwest to southeast across the Property (Figure 4.5).

Playa deposits underlie the surficial soil and fill material (Figures 4.4 and 4.5). Playa deposits consist of a dark brown to light olive-brown silt, clayey silt, or clay, as well as clay-like sand, sandy silt, or sandy clay. Poor drainage from the low-lying Torrance plain resulted in the formation of the fine-grained Playa deposits (Poland et al., 1959). Playa deposits were identified in soil borings drilled On-Property along the perimeter, on the LADWP right-of-way, the Normandie Avenue Ditch, and the Farmer Brothers property. These deposits extend to a depth of approximately 22 feet bls. Playa deposits are relatively flat and appear to be laterally continuous across the Property. At Soil Boring S-101, located On-Property in the former water recycling pond, the Playa deposits have been excavated and replaced with fill.

The contact between the Playa deposits and the underlying Palos Verdes Sand is gradational and characterized by an increase in sand content from a silt to a sand (Figures 4.4 and 4.5). The lower contact of the Playa deposits occurs at depths ranging from approximately 22 feet bls to 30 feet bls. The thickness of the Playa deposits varies from approximately 7 feet to 27 feet.

4.1.1.4 Palos Verdes Sand

The Palos Verdes Sand underlies the Playa deposits (Figures 4.4 and 4.5). The Palos Verdes Sand was identified in deeper soil borings drilled On-Property and in the Normandie Avenue Ditch. The Palos Verdes Sand is a marine deposit correlative to the terrace deposits located in the Palos Verdes Hills (Poland et al., 1959). A fossiliferous sand generally occurs On-Property at a depth of approximately 35 to 40 feet bls. This fossiliferous sand marks the basal portion of the Palos Verdes Sand (Poland et al., 1959). The Palos Verdes Sand is relatively flat and appears to be laterally continuous across the Property.

The Palos Verdes Sand consists of a light olive-brown, fine-grained sand or silty sand. Below the sandy unit is a light-colored fossiliferous sand. This fossiliferous sand is dense and well cemented. The thickness of the fossiliferous sand in the Central Process Area varies from 3 feet to 4 feet except at Soil Boring S-303 where it is approximately 9 feet thick. The base of the fossiliferous sand of the Palos Verdes Sand marks the contact between the Palos Verdes Sand and the underlying Upper Bellflower Aquitard, which occurs at depths ranging from 40 feet bls to 50 feet bls (Figures 4.4 and 4.5). The thickness of the Palos Verdes Sand ranges from approximately 11 feet to 28 feet.

4.1.1.5 Upper Bellflower Aquitard

The Upper Bellflower Aquitard underlies the Palos Verdes Sand (Figures 4.4 and 4.5). The Upper Bellflower Aquitard was identified in soil borings drilled On-Property and Off-Property in the Normandie Avenue Ditch. The Upper Bellflower Aquitard is an interbedded, micaceous, olive-brown sand, silty sand, silt, and clay. The upper portion of the Upper Bellflower Aquitard is unsaturated. The Upper Bellflower Aquitard is saturated at approximately 70 feet bls On-Property. The Upper Bellflower Aquitard is relatively flat and laterally continuous.

4.1.2 Physical/Chemical Parameters

Soil samples for testing of physical/chemical parameters were collected using either a hand-driven sampler, a split-tube drive sampler, or a continuous core device. Soil samples were analyzed for TOC, pH, EC, and soil moisture. Soil samples collected by EPA subcontractor M&E during the Part 1 On-Property soil investigation were analyzed for grain size. Analytical results for physical/chemical parameters of soil samples will be used in evaluation of remedial alternatives as a part of the Feasibility Study conducted for the Montrose Site.

4.1.2.1 Total Organic Carbon

A total of 67 soil samples collected from 13 soil borings were analyzed for TOC (Figure 4.6, Appendix E, Table E-6). Sample depths ranged from 0.5 to 54.3 feet bls. TOC concentrations in unsaturated soil ranged from less than the detection limit of 50 mg/kg to 22,300 mg/kg with a geometric mean concentration of 894 mg/kg.

Twenty-three soil samples collected from fill material were analyzed for TOC (Table 4.1). These samples were collected On-Property both inside and outside the Central Process Area, and Off-Property from the LADWP right-of-way and the Normandie Avenue Ditch (Figure 4.6). Sample depths ranged from 0.5 to 6.5 feet bls. TOC concentrations in these soil samples ranged from 640 mg/kg in the sample collected from On-Property Soil Boring 35A at 1.5 feet bls to 20,000 mg/kg in the sample collected from On-Property Soil Boring S-302E at 5.1 feet bls. The geometric mean of TOC for these samples was 1,349 mg/kg.

Forty soil samples collected from the Playa deposits were analyzed for TOC (Table 4.1). These samples were collected On-Property both inside and outside of the Central Process Area, and Off-Property from the LADWP right-of-way and the Normandie Avenue Ditch (Figure 4.6). Sample depths ranged from 0.5 to 40.75 feet bls. TOC concentrations in these soil samples ranged from less than the detection limit of 50 mg/kg to 22,300 mg/kg in the sample collected from Off-Property Soil Boring LA-16 at 0.5 foot bls. The geometric mean of TOC for these samples was 559 mg/kg.

Two soil samples collected from the Palos Verdes Sand were analyzed for TOC (Table 4.1). These samples were collected On-Property in the Central Process Area (Figure 4.6). TOC concentrations in these soil samples were 1,170 mg/kg in the sample collected from Soil Boring S-305 at 34.3 feet bls and 14,000 mg/kg in the sample collected from Soil Boring S-302F at 31.8 feet bls. The geometric mean of these concentrations was 4,047 mg/kg.

Two soil samples collected from the unsaturated portion of the Upper Bellflower Aquitard were analyzed for TOC (Table 4.1). These samples were collected On-Property in the Central Process Area (Figure 4.6). TOC concentrations in these soil samples were 930 mg/kg in the sample collected from Soil Boring S-305 at 54.3 feet bls and 18,000 mg/kg in the sample collected from Soil Boring S-302F at 49.7 feet bls. The geometric mean of these concentrations was 4,091 mg/kg.

The high concentrations of TOC in four soil samples collected from the Palos Verdes Sand and Upper Bellflower Aquitard in the Central Process Area correspond to soil containing high concentrations of chlorobenzene and/or DDT and may be attributable to the presence of these chemical compounds in soil. High concentrations of TOC detected in Off-Property shallow soil samples collected in the LADWP right-of-way from Soil Boring LA-16 may be attributed to the presence of organic plant material observed during drilling of this shallow soil boring.

4.1.2.2 pH

A total of 15 soil samples collected from 5 soil borings were analyzed for pH (Figure 4.7, Appendix E, Table E-6). Sample depths ranged from 0.5 to 54.3 feet bls. The pH of these unsaturated soil samples ranged from 3.4 to 8.47 with an average pH of 7.1.

Three soil samples collected from fill material were analyzed for pH (Table 4.1). These samples were collected On-Property in the Central Process Area. The pH in these soil samples ranged from 3.4 in the sample collected from Soil Boring S-305 at 5 feet bls to 7.5 in the sample collected from Soil Boring S-302F at 5.9 feet bls (Figure 4.7). The average pH of soil samples collected from the fill material was 6.0.

Eight soil samples collected from the Playa deposits were analyzed for pH (Table 4.1). Two of these samples were collected On-Property in the Central Process Area, and six samples were collected Off-Property from the LADWP right-of-way and the Normandie Avenue Ditch. Sample depths ranged from 0.5 to 24.3 feet bls. The pH in these soil samples ranged from 4.48 in the sample collected from Soil Boring LA-016 at 3.0 feet bls to 8.47 in the sample collected from Off-Property Soil Boring T-064 at 0.75 feet bls. The average pH of soil samples collected from the Playa deposits was 7.3. Soil Boring T-064 is located Off-Property in the Normandie Avenue Ditch (Figure 4.7).

Two soil samples collected from the Palos Verdes Sand were analyzed for pH (Table 4.1). These samples were collected On-Property in the Central Process Area. The pH in these soil samples was 7.7 in the sample collected from Soil Boring S-302F at 31.8 feet bls and 8.0 in the sample collected from Soil Boring S-305 at 34.3 feet bls (Figure 4.7).

Two soil samples collected from the unsaturated portion of the Upper Bellflower Aquitard were analyzed for pH (Table 4.1). These samples were collected On-Property in the Central Process Area. The pH in these soil samples was 7.4 in the sample collected from Soil

Boring S-305 at 54.3 feet bls and 7.6 in the sample collected from Soil Boring S-302F at 49.7 feet bls (Figure 4.7).

4.1.2.3 Electrical Conductivity

A total of 14 soil samples collected from 5 soil borings were analyzed for EC (Figure 4.7; Appendix E, Table E-6). The EC of these samples ranged from 107 micromhos per centimeter (µmhos/cm) to 3,990 µmhos/cm with an average EC of 1,252 µmhos/cm (Table 4.1).

Two soil samples were collected from fill material and were analyzed for EC (Table 4.1). These samples were collected On-Property in the Central Process Area (Figure 4.7). The EC in these soil samples was 490 µmhos/cm in the sample collected from Soil Boring S-305 at 5 feet bls and 600 µmhos/cm in the sample collected from Soil Boring S-302F at 5.9 feet bls.

Eight soil samples collected from the Playa deposits were analyzed for EC (Table 4.1). These samples were collected On-Property in the Central Process Area, and Off-Property from the LADWP right-of-way and the Normandie Avenue Ditch (Figure 4.7). Sample depths ranged from 0.5 to 24.3 feet bls. The EC of these soil samples ranged from 107 µmhos/cm in the sample collected from Off-Property Soil Boring SP-003 at 0.5 feet bls to 3,990 µmhos/cm in the sample collected from Off-Property Soil Boring T-064 at 0.75 feet bls. The average EC for these samples was 1,267 µmhos/cm.

Two soil samples collected from the Palos Verdes Sand were analyzed for EC (Table 4.1). These samples were collected On-Property in the Central Process Area (Figure 4.7). The EC of these soil samples was 760 µmhos/cm in the sample collected from Soil Boring S-305 at 34.3 feet bls and 1,400 µmhos/cm in the sample collected from Soil Boring S-302F at 31.8 feet bls.

Two soil samples collected from the unsaturated portion of the Upper Bellflower Aquitard were analyzed for EC (Table 4.1). These samples were collected On-Property in the Central Process Area (Figure 4.7). The EC of these soil samples was 750 µmhos/cm in the sample collected from Soil Boring S-302F at 49.7 feet bls and 3,400 µmhos/cm in the sample collected from Soil Boring S-305 at 54.3 feet bls.

4.1.2.4 Soil Moisture

A total of 156 soil samples collected from 27 soil borings were analyzed for soil moisture. Sample depths ranged from 0.5 to 69.3 feet bls (Figure 4.8; Appendix E, Table E-6). Soil moisture ranged from less than 1 percent to 29.1 percent by weight, with an average soil moisture of 11.8 percent by weight (Table 4.1).

Thirty-two soil samples collected from fill material were analyzed for soil moisture (Table 4.1). These samples were collected On-Property in the Central Process Area, and Off-Property from the LADWP right-of-way, the Normandie Avenue Ditch, and the Farmer Brothers property (Figure 4.8). Sample depths ranged from 0.5 to 8.8 feet bls. Soil moisture in these soil samples ranged from less than 1.0 percent by weight in the sample collected from Off-Property Soil Boring LA-18 at 0.5 foot bls to 26.3 percent by weight in the sample collected from Off-Property Soil Boring T-26 at 6.5 feet bls. The average soil moisture for these samples was 11.8 percent by weight.

Eighty-two soil samples collected from the Playa deposits were analyzed for soil moisture (Table 4.1). These samples were collected On-Property in the Central Process Area, and Off-Property from the LADWP right-of-way and the Normandie Avenue Ditch (Figure 4.8). Sample depths ranged from 0.5 to 28 feet bls. Soil moisture in these soil samples ranged from 1.14 percent by weight in the sample collected from Off-Property Soil Boring SP-003 at 0.5 foot bls to 24.0 percent by weight in the sample collected from On-Property Soil Boring S-305 at 7.8 feet bls. The average soil moisture for these samples was 13.2 percent by weight.

Eighteen soil samples collected from the Palos Verdes Sand were analyzed for soil moisture (Table 4.1). These samples were collected On-Property in the Central Process Area and Off-Property from the Normandie Avenue Ditch (Figure 4.8). Sample depths ranged from 25.7 to 41.25 feet bls. Soil moisture in these soil samples ranged from 3.1 percent by weight in the sample collected from On-Property Soil Boring S-303 at 36.7 feet bls to 29.1 percent by weight in the sample collected from Off-Property Soil Boring T-46 at 41.25 feet bls. The average soil moisture for these samples was 8.7 percent by weight.

Twenty-four soil samples collected from the unsaturated portion of the Upper Bellflower Aquitard were analyzed for soil moisture (Table 4.1). These samples were collected On-Property in the Central Process Area and Off-Property from the Normandie Avenue Ditch (Figure 4.8). Sample depths ranged from 44.1 to 69.3 feet bls. Soil moisture in these soil samples ranged from 2.0 percent by weight in the sample collected from On-Property Soil Boring S-304 at 58.8 feet bls to 29.0 percent by weight in the sample collected from Off-Property Soil Boring S-305 at 54.3 feet bls. The average soil moisture for these samples was 9.3 percent by weight.

4.1.2.5 Grain Size

Grain size analysis was performed on nine soil samples collected from three On-Property soil borings drilled and sampled by EPA subcontractor M&E (M&E, 1986). Soil samples for grain size analysis were collected from Soil Borings 21D, 34D, and 46D at depths ranging from 2.5 feet bls to 9.0 feet bls. The percent mass of gravel, sand, and fines retained for each sample was determined. Gravel was defined as being greater than 4.75 millimeters (mm) in diameter, sand as being 0.075 mm to 4.75 mm in diameter, and fines as being less than 0.075 mm in diameter. The distribution of gravel for these nine samples ranged from 0.1 percent to 20.3 percent and averaged 5.4 percent. The distribution of sand for these nine samples ranged from 6.2 percent to 38.6 percent and averaged 22.9 percent. The distribution of fines for these nine samples ranged from 52.9 percent to 93.9 percent and averaged 71.8 percent.

4.2 Site Hydrogeology

The physical characteristics of the hydrogeologic units and subunits at the Montrose Site have been evaluated based on data obtained from 91 monitoring wells and 17 exploratory borings drilled On- and Off-Property during RI field work at the Montrose Site. This discussion focuses on hydrogeologic units from the water table, which occurs at approximately 70 feet bls, to the Lynwood Aquifer, which occurs at approximately 210 to 225 feet bls.

The four hydrogeologic units encountered at the Montrose Site during the RI field work have been correlated to hydrogeologic units identified in regional reports based on lithology, depths of occurrence, and unit thickness. From the water table, in descending order, these hydrogeologic units are: the Bellflower Aquitard, the Gage Aquifer, the Gage-Lynwood Aquitard, and the Lynwood Aquifer (Figures 2.7 and 4.9). For the purpose of the RI, the Bellflower Aquitard has been further subdivided into three subunits. The three lithologically distinct subunits within the Bellflower Aquitard are called the Upper Bellflower Aquitard, the Bellflower Sand, and the Lower Bellflower Aquitard (CDWR, 1961; H+A, 1990R-f). The hydrogeologic units below the Lynwood Aquifer have not been sampled as part of the investigations.

The hydrogeologic environment at the Montrose Site consists of multiple hydrogeologic units that differ from each other with respect to lithology, heterogeneity, hydraulic conductivity, hydraulic gradient, and general water quality. Lithology, hydraulic conductivity, groundwater flow direction, and general water quality tend to vary less with depth from the Upper Bellflower Aquitard to the Gage Aquifer. The Upper Bellflower Aquitard consists of interbedded fine-grained sand and silt of varying proportions across the Montrose Site. The Bellflower Sand is comprised of a fine- to coarse-grained sand that is variable in thickness and consists of two lithologic facies. The Lower Bellflower Aquitard is a fine-grained heterogeneous unit consisting of silty sand and silt or clay. The Gage Aquifer consists of a fine-grained sand that grades finer with depth but appears relatively uniform across the Montrose Site. The Gage-Lynwood Aquitard consists of fine-grained silt, sandy silt, clayey silt, and silty sand. The Lynwood Aquifer consists of fine-grained sand to gravel.

Physical characteristics including lithology, groundwater occurrence, hydraulic parameters, and general water quality are described for each of the six hydrogeologic units and subunits identified for the Montrose RI. Lithologic data include the physical description of the units, vertical and horizontal heterogeneity, definition of upper and lower unit contacts, unit thickness, unit thickness variation, and TOC content of the aquitard and aquifer matrix material.

Hydrogeologic data obtained during this RI have been supplemented with data derived from other investigations conducted at the adjacent Del Amo Superfund Site. Investigators at the Del Amo Site have subdivided the Bellflower Aquitard into the Upper Bellflower Aquitard, the Middle Bellflower Sand, and the Lower Bellflower Aquitard. The Middle Bellflower Sand has been further subdivided into the upper-middle Bellflower "B" Sand, the Middle Bellflower Mud, where present, and the lower-middle Bellflower "C" Sand. Where the Middle Bellflower Mud is absent, the sand units within the Bellflower Aquitard are referred to as the merged-middle Bellflower "B" and "C" Sand. The Upper Bellflower "B" Sand and the Middle Bellflower Mud are generally correlative with the Upper Bellflower Aquitard nomenclature used for the Montrose Site. A comparison of hydrogeologic nomenclature for the Montrose and Del Amo Sites has been prepared (Figure 4.9). Hydrogeologic cross-sections discussed in the following subsections provide additional details on the relationship of these units.

4.2.1 Lithology

Hydrogeologic cross-sections have been prepared to illustrate hydrogeologic conditions encountered during RI field work (Figure 4.10). These cross-sections also incorporate data,

hydrostratigraphic nomenclature, and interpretations from other work conducted at the adjacent Del Amo Site. Hydrogeologic Cross-Section A-A' is oriented northwest to southeast through the central portion of the Property, and approximately parallel to the groundwater flow direction (Figure 4.11). Hydrogeologic Cross-Section B-B' is oriented southwest to northeast through the central portion of the Property, and approximately perpendicular to Cross-Section A-A' and the groundwater flow direction (Figure 4.12). Hydrogeologic Cross-Section C-C' is also oriented approximately perpendicular to hydrogeologic Cross-Section A-A' and is located approximately 1,600 feet southeast of the Property (Figure 4.13).

4.2.1.1 Upper Bellflower Aquitard

The Upper Bellflower Aquitard is the first of three lithologically distinct subunits of the Bellflower Aquitard that is encountered beneath the Montrose Site. Thirty monitoring wells were installed in the Upper Bellflower Aquitard by 1991. Groundwater is first encountered beneath the Montrose Site in the Upper Bellflower Aquitard, except in the vicinity of Western Avenue where the Upper Bellflower Aquitard is unsaturated.

The lithology of the Upper Bellflower Aquitard is heterogeneous and consists of interbedded, micaceous, fine-grained olive-brown sand, silty sand, fossiliferous sand, sandy silt, and silt. Sand deposits in the Upper Bellflower Aquitard are generally well sorted and are approximately 0.1 foot to 4 feet thick. Undifferentiated sand deposits as thick as approximately 15 feet have been encountered within the Upper Bellflower Aquitard. Silt deposits are fine-grained and include sandy silt, clayey silt, and clayey sandy silt. The silt deposits generally range in thickness from approximately 0.05 foot to 2 feet; however, silt deposits as thick as approximately 10 feet have been encountered. Continuous core data from closely spaced soil borings drilled in the Central Process Area indicate that individual interbeds of silt and sand, although similar in character, do not generally correlate between borings.

Sand deposits in the saturated portion of the Upper Bellflower Aquitard comprise approximately 50 percent to 90 percent of the saturated thickness in On-Property monitoring wells and soil borings. Silt and clay deposits comprise approximately 10 percent to 50 percent of the saturated thickness On-Property. Off-Property sand deposits in the Upper Bellflower Aquitard comprise approximately 10 percent to 50 percent of the saturated thickness, with silt and clay comprising 50 percent to 90 percent of the thickness.

Fourteen discrete core samples from 13 borings were collected from the saturated portion of the Upper Bellflower Aquitard at depths ranging from 67 to 120.5 feet bls (Table 4.2). The porosity of these core samples ranged from approximately 35.5 percent to 58.2 percent based on laboratory analyses. The average porosity was 42.3 percent. The dry bulk density of these samples ranged from 1.16 grams per cubic centimeter (g/cc) to 1.73 g/cc. The average dry bulk density was 1.55 g/cc. The TOC content of 13 discrete core samples collected from the saturated portion of the Upper Bellflower Aquitard was measured. The TOC content in four of these samples was less than the detection limit of 100 mg/kg. TOC content in the remaining samples ranged from 140 mg/kg to 4,800 mg/kg with a geometric mean of 537 mg/kg.

The contact between the Upper Bellflower Aquitard and the underlying Bellflower Sand is gradational. The contact has no distinct marker beds and is generally identified by a

decrease in silt interbeds with depth or by an increase in sand content and sand grain size with depth. The base of the Upper Bellflower Aquitard occurs between approximately 50 to 130 feet bls and ranges in elevation from approximately -20 feet mean sea level (msl) to approximately -90 feet msl (Figures 4.11 through 4.13). The thickness of the saturated portion of the Upper Bellflower Aquitard ranges up to approximately 70 feet based on water levels measured in 1995.

4.2.1.2 Bellflower Sand

The Bellflower Sand is the second of the three lithologically distinct subunits of the Bellflower Aquitard that is encountered beneath the Montrose Site. The Bellflower Sand underlies the Upper Bellflower Aquitard and overlies the Lower Bellflower Aquitard (Figures 4.11 through 4.13). By November 1991, 33 groundwater monitoring wells were installed at the Montrose Site in the Bellflower Sand.

The Bellflower Sand has been further subdivided into two lithologic facies based on lithologic logs compiled during RI field work. For the purposes of this report, the two facies are referred to as the sandy lithologic facies and the fossiliferous lithologic facies. Both lithologic facies gradually coarsen in texture with depth. The top of the Bellflower Sand is generally fine-grained sand, whereas the bottom of the unit is generally medium-grained or coarse-grained sand.

The sandy lithologic facies of the Bellflower Sand is composed of a fine- to medium-grained sand with trace silt and clay. This lithologic facies is typically yellow and contains multi-colored, moderately well-rounded grains. The sandy facies of the Bellflower Sand was encountered in Exploratory Borings EB-1, EB-2/2A, EB-3, EB-4, EB-6, and EB-8 located near the Property and in Exploratory Borings EB-14, EB-15, and EB-17 located in the southern portion of the Montrose Site (Figures 2.9 and 4.10).

The fossiliferous facies of the Bellflower Sand is composed of fragmented marine bivalve shells up to approximately 1 inch in diameter, and fine- to medium-grained angular to subangular sand. Portions of the unit consist predominantly of the fragmented shells. The overall color of the facies is typically olive to yellow. The fossiliferous facies is occasionally poorly cemented. The fossiliferous facies of the Bellflower Sand was encountered in Exploratory Borings EB-7, EB-11 through EB-14, and EB-16 and in Monitoring Wells BF-11, BF-15 through BF-17, BF-19, BF-24 through BF-26, BF-28, G-12, G-14, G-16 through G-19, and LW-6, generally located in the eastern and southern portions of the Montrose Site (Figures 2.9, 2.11, 2.12, and 4.10).

Twelve discrete core samples from 11 borings were collected from the Bellflower Sand at depths ranging from 105 to 123 feet bls (Table 4.2). The porosity of these core samples measured in the laboratory ranged from 27 percent to 44.2 percent (Appendix E, Table E.4). The average measured porosity in these samples was 38.8 percent. The dry bulk density of these core samples ranged from 1.49 g/cc to 1.93 g/cc (Appendix E, Table E.5). The average measured dry bulk density of these samples was 1.63 g/cc.

TOC content of 13 discrete core samples collected from the Bellflower Sand was measured (Table 4.2). The TOC content in one of these samples was less than the detection limit of 100 mg/kg. The TOC content of one sample, measured at greater than 16,000 mg/kg, was attributed to the occurrence of organic material. The TOC content of the remaining 11 samples ranged from 200 mg/kg to 3,400 mg/kg, with a geometric mean of 632 mg/kg.

The thickness of the Bellflower Sand ranges from approximately 4 feet to greater than 60 feet (Figure 4.14). The average thickness of the Bellflower Sand is approximately 25 feet beneath the Property. Variations in the thickness of the Bellflower Sand occur in four different areas: (1) on and north of the Property; (2) a transitional area immediately northeast and southeast of the Property; (3) an area farther to the south and southeast of the Property; and (4) an area immediately southwest of the Property. Thickness tends to change the least on and north of the Property. The sandy lithologic facies of the Bellflower Sand generally occurs in this area. The Bellflower Sand is thicker immediately northeast of the Property and thinner southeast of the Property. The Bellflower Sand is thickest southwest of the Property. The fossiliferous lithologic facies of the Bellflower Sand occurs in the southwest area.

The contact between the Bellflower Sand and the underlying Lower Bellflower Aquitard is a distinct change from sand to silt that occurs approximately between 100 and 150 feet bls across the Montrose Site at elevations ranging from approximately -70 feet msl to -110 feet msl (Figures 4.11 through 4.13).

4.2.1.3 Lower Bellflower Aquitard

The Lower Bellflower Aquitard is the third lithologically distinct subunit of the Bellflower Aquitard encountered beneath the Montrose Site. The Lower Bellflower Aquitard underlies the Bellflower Sand (Figures 4.11 through 4.13). The lithology and physical characteristics of the Lower Bellflower Aquitard are described below based on lithologic logs from the 15 exploratory borings and 30 monitoring wells that penetrate the unit, as well as on discrete core samples collected from one boring and seven monitoring wells.

The lithology of the Lower Bellflower Aquitard is heterogeneous and consists of silt of varying plasticity as well as clayey sandy silt, fine-grained silty sand, and sand. The Lower Bellflower Aquitard is typically olive to gray in color. Interbeds of silt and silty sand are common. In many locations the Lower Bellflower Aquitard consists of an upper and lower silt layer separated by an intermediate layer of silty sand and fine-grained sand. At some locations the Lower Bellflower Aquitard consists of silt with numerous silty sand and fine-grained sand interbeds. The Lower Bellflower Aquitard appears to be laterally continuous across the Montrose Site (Figures 4.11 through 4.13).

Eight discrete core samples from seven borings were collected from the Lower Bellflower Aquitard at depths ranging from 121.5 to 163 feet bls (Table 4.2). The porosity of these samples ranged from 38.1 percent to 46.4 percent, based on laboratory analyses (Appendix E, Table E.4). The average porosity of these samples was 41.0 percent. The dry bulk density of these samples ranged from 1.43 g/cc to 1.65 g/cc (Appendix E, Table E.5). The average dry bulk density of these samples was 1.58 g/cc.

TOC content of seven discrete core samples collected from the Lower Bellflower Aquitard was measured (Table 4.2). The TOC content of 11,000 mg/kg measured in one of these samples was attributed to the occurrence of organic matter. TOC content in the remaining six samples ranged between 190 mg/kg and 9,900 mg/kg, with a geometric mean of 1,643 mg/kg.

The thickness of the Lower Bellflower Aquitard ranges from less than 10 feet to approximately 40 feet. The Lower Bellflower Aquitard tends to increase in thickness southeast of the Property (Figure 4.15).

The contact between the Lower Bellflower Aquitard and the underlying Gage Aquifer is a moderately well-defined silt to fine-grained sand contact that may be gradational over 5 feet to 10 feet of thickness. The contact between the Lower Bellflower Aquitard and the Gage Aquifer occurs between approximately 125 and 171 feet bls across the Montrose Site, ranging in elevation from approximately -85 feet msl to -140 feet msl.

4.2.1.4 Gage Aquifer

The Gage Aquifer underlies the Lower Bellflower Aquitard (Figures 4.11 through 4.13). By November 1991, 21 groundwater monitoring wells were installed in the Gage Aquifer. In the upper portion of the aquifer, 19 Gage Aquifer monitoring wells are completed, and 2 are completed in the lower portion of the aquifer.

The Gage Aquifer typically consists of fine-grained sand with little silt that grades to a silty sand near the base of the aquifer. The Gage Aquifer is the most homogeneous hydrogeologic unit encountered at the Montrose Site and appears to be laterally continuous across the Montrose Site. The Gage Aquifer is typically gray or bluish-gray in color and is occasionally poorly cemented. The Gage Aquifer is uniform in texture, color, and density across the Montrose Site, based on the lithologic logs.

Five discrete core samples from five borings were collected from within the Gage Aquifer at depths ranging from 163 to 192 feet bls (Table 4.2). The porosity of these samples ranged from approximately 40.3 percent to 44.8 percent, based on laboratory analyses (Appendix E, Table E.4). The average porosity of these samples was 42.2 percent. The dry bulk density of these samples ranged from 1.47 g/cc to 1.57 g/cc (Appendix E, Table E.5). The average dry bulk density of these samples was 1.54 g/cc.

TOC content of eight discrete core samples collected from the Gage Aquifer porous matrix was measured (Table 4.2). The TOC content of 5,900 mg/kg in one of these samples was attributed to the occurrence of organic material. TOC content in the remaining seven samples ranged between 245 mg/kg and 3,500 mg/kg, with a geometric mean of 2,568 mg/kg.

The thickness of the Gage Aquifer ranges from approximately 45 feet to 80 feet (Figure 4.16). The average thickness of the Gage Aquifer is approximately 60 feet.

The contact between the Gage Aquifer and the underlying Gage-Lynwood Aquitard is gradational. The base of the Gage Aquifer is less distinct than the top because of the presence of siltier sand in the lower portion of the Gage Aquifer and interbedding in the underlying aquitard. The contact between the Gage Aquifer and the underlying aquitard occurs between approximately 180 and 220 feet bls across the Montrose Site and ranges in elevation from approximately -155 feet msl to -190 feet msl.

4.2.1.5 Gage-Lynwood Aquitard

The Gage-Lynwood Aquitard underlies the Gage Aquifer (Figures 4.11 through 4.13). The lithology and physical characteristics of the Gage-Lynwood Aquitard are described below based on samples collected from 15 exploratory borings and 7 Lynwood Aquifer monitoring wells.

The Gage-Lynwood Aquitard consists of silt, sandy silt, and/or clayey silt interbedded with fine-grained silty sand. The silt in this unit is typically gray and of variable plasticity. The Gage-Lynwood Aquitard appears to be laterally continuous across the Montrose Site.

Five discrete core samples from four borings were collected from the Gage-Lynwood Aquitard at depths ranging from 217.5 to 245 feet bls (Table 4.2). The porosity of these core samples measured in the laboratory ranged from 40.8 percent to 49.6 percent (Appendix E, Table E.4). The average porosity of these samples was 44 percent. The dry bulk density of these core samples ranged from 1.37 g/cc to 1.58 g/cc (Appendix E, Table E.5). The average dry bulk density of these samples was 1.52 g/cc.

TOC content of three discrete core samples collected from the Gage-Lynwood Aquitard porous matrix was measured (Table 4.2). The TOC content of 4,700 mg/kg measured in one of these samples was attributed to the occurrence of organic material. The TOC content of the two remaining samples was 2,440 mg/kg and 3,160 mg/kg, with a geometric mean of 2,777 mg/kg.

The thickness of the Gage-Lynwood Aquitard ranges from approximately 10 feet to 40 feet. Hydrogeologic cross-sections indicate that the Gage-Lynwood Aquitard is a relatively flat unit (Figures 4.11 through 4.13). The thickness of the unit in the immediate vicinity of the Property ranges from approximately 20 to 45 feet. The thickness of the unit increases Off-Property toward the north and west (Figure 4.17).

The contact between the Gage-Lynwood Aquitard and the underlying Lynwood Aquifer is a distinct contrast between the silt in the Gage-Lynwood Aquitard and the fine- to coarse-grained sand in the Lynwood Aquifer. This contact occurs between approximately 210 to 260 feet bls across the Montrose Site at elevations ranging from approximately -170 feet msl to -230 feet msl.

4.2.1.6 Lynwood Aquifer

The Lynwood Aquifer underlies the Gage-Lynwood Aquitard (Figures 4.11 through 4.13). Seven groundwater monitoring wells were completed in the upper portion of the Lynwood Aquifer by November 1991.

The upper 20 feet of the Lynwood Aquifer consists of dark gray fine- to medium-grained sand. At On-Property Monitoring Well LW-1, the upper 20 feet of the Lynwood Aquifer is slightly coarser and consists of medium- to coarse-grained sand and gravel. This sand is frequently underlain by as much as 8 feet of dark gray silt or clay of varying plasticity. Approximately 10 to 30 feet of gray, well-graded sand, gravelly sand, and sandy gravel with some silty sand interbeds underlie the top 20 to 30 feet of the Lynwood Aquifer.

Three discrete core samples from three borings were collected from the Lynwood Aquifer at depths ranging from 246 to 255 feet bls (Table 4.2). The porosity of these core samples measured in the laboratory was approximately 32 percent, 35.4 percent, and 48.3 percent (Appendix E, Table E.4). The dry bulk density of these samples was 1.77 g/cc, 1.75 g/cc, and 1.43 g/cc, respectively (Appendix E, Table E.5).

The TOC content of four discrete core samples of the Lynwood Aquifer porous matrix was measured (Table 4.2). The TOC contents of 1,600 mg/kg, 3,100 mg/kg, and 4,700 mg/kg in three of these samples was attributed to the occurrence of organic material. The TOC content of the remaining sample was 200 mg/kg.

The lower contact of the Lynwood Aquifer is not well defined because of silty sand interbedding with the coarser sand and gravel encountered in the lower portion of the Lynwood Aquifer. The lithology becomes more fine-grained near the bottom of the aquifer. The base of the Lynwood Aquifer occurs between approximately 270 to 305 feet bls across the Montrose Site at elevations ranging from approximately -230 feet msl to -280 feet msl. The thickness of the Lynwood Aquifer ranges from approximately 33 feet to greater than 108 feet in the exploratory borings drilled at the Montrose Site (Figures 4.11 through 4.13).

An unnamed aquitard occurs beneath the Lynwood Aquifer. For the purpose of this RI, this aquitard has been termed the Lynwood-Silverado Aquitard. The driller's log of LACFCD Well No. 795, located immediately south of the Property on Jones Chemical property, indicates that the Lynwood-Silverado Aquitard extends approximately 483 feet bls and is approximately 208 feet thick. The Silverado Aquifer underlies the Lynwood-Silverado Aquitard. At LACFCD Well No. 795, the Silverado Aquifer extends below the total depth of the well. The thickness of the Silverado Aquifer at this location is greater than 240 feet.

4.2.2 Groundwater Occurrence

Groundwater occurrence including groundwater flow directions, magnitudes of the horizontal hydraulic gradient, ranges in water level elevations, changes in water levels with time, and water level differences between the hydrogeologic units were evaluated based on data obtained from Upper Bellflower Aquitard, Bellflower Sand, Gage Aquifer, and Lynwood Aquifer monitoring wells.

Water levels measured in October 1995 have been plotted and contoured to illustrate water level elevations and directions of groundwater flow in each of the four units (Figures 4.18 through 4.21). In addition, water level hydrographs have been prepared to illustrate changes in water levels with time and differences in water levels between the units (Figures 4.22A through 4.22I). Hydrographs of individual monitoring wells are included in Appendix F (Figures F-1 through F-91). Water level contour maps have been supplemented with water level data provided by the Del Amo Respondents for water levels measured in nearby Del Amo and McDonnell Douglas monitoring wells.

4.2.2.1 Upper Bellflower Aquitard

Groundwater at the Montrose Site is first encountered in the Upper Bellflower Aquitard, except in the southwestern portion of the Montrose Site where the Upper Bellflower Aquitard is unsaturated and the water table occurs within the Bellflower Sand subunit of the Bellflower Aquitard. In October 1995, depth to water ranged from 40.84 feet bls at Monitoring Well MW-24 to 68.27 feet bls at Monitoring Well MW-18 (Table 4.3). Monitoring Well MW-24 is located approximately 1,500 feet southeast of the Property near the intersection of Kenwood Avenue and Milton Street (Figure 4.18). Monitoring Well MW-18 is located approximately 500 feet north of the Property on McDonnell Douglas property.

Water level elevations in October 1995 ranged from -17.35 feet msl at Monitoring Well MW-20 to -19.94 feet msl at Monitoring Well MW-25 (Table 4.3; Figure 4.18). Monitoring Well MW-20 is located approximately 1,100 feet northeast of the Property at the Del Amo Site. Monitoring Well MW-25 is located approximately 2,300 feet southeast of the Property near the Armco Site.

The groundwater flow direction in the Upper Bellflower Aquitard is variable across the Montrose Site. At and in the vicinity of the Property, the direction of groundwater flow in October 1995 was to the southwest and south (Figure 4.18). The direction of the groundwater flow in October 1995 was more southerly than the direction of the groundwater flow during the period from 1987 through 1990. The magnitude of the horizontal hydraulic gradient in the Upper Bellflower Aquitard in October 1995 ranged from about 5.4×10^{-3} at the Del Amo Site to approximately 9×10^{-4} south of the Property (Table 4.4).

Water level elevations in Upper Bellflower Aquitard monitoring wells have been monitored since April 1985. Water levels rose about 8 feet during the period April 1985 through October 1995 (Figures 4.22A through 4.22I, Appendix F). This represents a rise in the water table and a decrease in the thickness of the vadose zone of somewhat less than 1 foot per year. Whether this rising water level trend continues into the future will depend on the rate of natural and artificial recharge and the amount and location of groundwater extraction from the basin. Because groundwater extractions from the West Coast Basin are controlled, it is reasonable to expect that this trend may continue for the foreseeable future. It is unlikely, however, that water levels within the basin will be allowed to rise to more than about 5 to 10 feet above mean sea level since discharge (i.e., loss) of fresh water to the ocean would begin to occur. This suggests that the current water levels could rise an additional 30 feet at most.

A change in groundwater flow directions, hydraulic gradients, or plume migration would not necessarily be anticipated due to rising water levels unless there is also a significant change in the pattern of groundwater extraction and injection in the region around the Montrose Site. This is supported by the fact that there has been little change in flow direction and gradients observed at the Montrose Site during the past 10 years.

4.2.2.2 Bellflower Sand

In October 1995, depth to water in the Bellflower Sand monitoring wells ranged from 42.17 feet bls at Monitoring Well BF-15 to 69.70 feet bls at Monitoring Well BF-32A (Table 4.3). Monitoring Well BF-15 is located approximately 1,500 feet southeast of the Property near the intersection of Kenwood Avenue and Milton Street. Monitoring Well BF-32A is located approximately 2,200 feet southwest of the Property on 206th Street east of Western Avenue (Figure 4.19).

Water level elevations in Bellflower Sand monitoring wells in October 1995 ranged from -18.14 feet msl at Monitoring Well BF-19 to -22.76 feet msl at Monitoring Well BF-26 (Table 4.3; Figure 4.19). Monitoring Well BF-19 is located approximately 700 feet northeast of the Property near the Del Amo Superfund Site. Monitoring Well BF-26 is located approximately 1 mile southeast of the Property between Vermont Avenue and the 110 Freeway.

The Upper Bellflower Aquitard and the upper portion of the Bellflower Sand is unsaturated at the location of Bellflower Sand Monitoring Wells BF-31, BF-32, and BF-32A where the water table occurs within the Bellflower Sand, approximately 20 feet below the contact between the Upper Bellflower Aquitard and the Bellflower Sand (Figures 4.12 and 4.19).

The direction of groundwater flow in the Bellflower Sand in the vicinity of the Property in October 1995 was to the south and southeast (Figure 4.19). Downgradient of the Property,

the direction of groundwater flow was to the southeast. The direction of groundwater flow in October 1995 was generally consistent with the direction of groundwater flow observed since 1987; however, in the vicinity of the Property, groundwater flow directions in 1995 were more southerly. Based on October 1995 data, the magnitude of the horizontal hydraulic gradient in the Bellflower Sand was approximately 1×10^{-3} (Table 4.4).

Water level elevations at Bellflower Sand monitoring wells have been monitored since January 1987. Water levels rose at a rate of 1 foot to 2 feet per year from January 1987 until approximately April 1991 (Figures 4.22A through 4.22I, Appendix F). Water level elevations in Bellflower Sand monitoring wells declined approximately 0.5 foot to 1 foot between April and October 1991. During the period from October 1991 through January 1993 water level elevations in Bellflower Sand monitoring wells remained fairly constant. Water levels measured in October 1995 were about 3 feet higher than water levels measured in January 1993.

Water level elevations in the Bellflower Sand monitoring wells were approximately 0.5 foot lower than water level elevations in adjacent Upper Bellflower Aquitard wells (Table 4.5; Figures 4.22A through 4.22I). This relationship indicates that a downward vertical hydraulic gradient (-0.004 to -0.019) from the Upper Bellflower Aquitard to the Bellflower Sand occurred in October 1995. During the period from January 1987 through December 1990, water level elevations in the On-Property Bellflower Sand monitoring wells were higher than water level elevations in nearby Upper Bellflower Aquitard wells. This relationship indicates that an upward vertical hydraulic gradient from the Bellflower Sand to the Upper Bellflower Aquitard occurred On-Property during the period from January 1987 through December 1990. In April 1991, water level elevations in the On-Property Bellflower Sand monitoring wells were approximately equal to water level elevations in the same area in the Upper Bellflower Aquitard. This relationship indicates that the direction of the vertical hydraulic gradient between the Bellflower Sand and the Upper Bellflower Aquitard On-Property reversed during the period from December 1990 through April 1991.

4.2.2.3 Gage Aquifer

In October 1995, depth to water in Gage Aquifer monitoring wells ranged from approximately 43.4 feet bls at Monitoring Well G-8 to 69.9 feet bls at Monitoring Well G-3 (Table 4.3). Monitoring Well G-8 is located approximately 1,500 feet southeast of the Property near the intersection of Kenwood Avenue and Milton Street. Monitoring Well G-3 is located near the south central portion of the Property (Figure 4.20).

Water level elevations in Gage Aquifer monitoring wells ranged from -18.93 feet msl at Monitoring Well G-1 to -22.14 feet msl at Monitoring Well G-18 (Table 4.3). Monitoring Well G-1 is located near the north central portion of the Property. Monitoring Well G-18 is located approximately 3,300 feet southeast of the Property near the Armco Site and the confluence of the Kenwood Drain and the Torrance Lateral.

The direction of groundwater flow in the Gage Aquifer trends approximately east-southeast and appears to be uniform across the Montrose Site (Figure 4.20). The direction of groundwater flow in October 1995 was generally consistent with the direction of groundwater flow observed during the period 1987 through 1990. The magnitude of the horizontal hydraulic gradient across the Montrose Site in the Gage Aquifer, based on October 1995 data, was approximately 1.6×10^{-3} (Table 4.4).

Water level elevations at Gage Aquifer monitoring wells have been monitored since January 1987 (Figures 4.22A through 4.22I, Appendix F). Water levels rose at a rate of approximately 1 foot to 2 feet per year from January 1987 through approximately August 1990. Gage Aquifer water levels were relatively stable between August 1990 and April 1991, then declined approximately 1 foot between April 1991 and October 1991. By January 1993 water levels had increased by approximately 1 foot. Water levels measured in October 1995 were about 3 feet higher than water levels measured in January 1993.

Gage Aquifer water level elevations at the Montrose Site have been consistently lower than adjacent Bellflower Sand water level elevations. In October 1995, water level elevations in Gage Aquifer monitoring wells were approximately 1.0 foot lower than water level elevations in adjacent Bellflower Sand monitoring wells (Table 4.5). These data indicate that a downward vertical hydraulic gradient (-0.019 to -0.050) exists between the Bellflower Sand and the Gage Aquifer.

Water level elevations at adjacent Gage Aquifer Monitoring Well G-2 and Lower Gage Aquifer Monitoring Well LG-1, located in the southeast corner of the Property, differ by about 0.5 foot (Table 4.5; Figures 4.22A through 4.22I). These data indicate that there is a slight downward vertical hydraulic gradient within the Gage Aquifer at this location.

4.2.2.4 Lynwood Aquifer

In October 1995, depth to water in the Lynwood Aquifer ranged from approximately 71 feet bls at Monitoring Well LW-3 to 79.4 feet bls at Monitoring Well LW-7 (Table 4.3). Monitoring Well LW-3 is located approximately 700 feet northeast of the Property on Francisco Street east of Normandie Avenue. Monitoring Well LW-7 is located near the south central Property boundary (Figure 4.21).

Water level elevations in Lynwood Aquifer monitoring wells ranged from approximately -30.70 feet msl at Monitoring Well LW-3 to -30.93 feet msl at Monitoring Well LW-2 (Table 4.3). Monitoring Well LW-2 is located about 500 feet east of the Property, in the LADWP right-of-way east of Normandie Avenue (Figure 4.21).

The direction of groundwater flow in the Lynwood Aquifer in October 1995 was approximately southeast (Figure 4.21). The magnitude of the horizontal hydraulic gradient, based on October 1995 data, was approximately 2×10^{-4} (Table 4.4).

Water level elevations in the Lynwood Aquifer have been monitored since October 1989 (Figures 4.22A through 4.22I, Appendix F). Water levels in the Lynwood Aquifer rose approximately 1 foot between October 1989 and February 1990, declined approximately 3 feet between February 1990 and July 1992, and increased 5 feet during the period July 1992 to January 1993. Since that time, water levels have fluctuated over a range of about 5 feet. Water levels measured in Lynwood Aquifer wells during the most recent monitoring event in October 1995 were about the same as water levels measured in January 1993.

Water level elevations in Lynwood Aquifer monitoring wells consistently have been approximately 11 to 13 feet lower than water level elevations in adjacent Gage Aquifer monitoring wells (Table 4.5). This difference in water level elevations indicates that a steep downward vertical hydraulic gradient (-0.154 to -0.235) occurs between the two aquifers in the vicinity of the Property.

In December 1995, the water level elevation in LACFCD Well No. 795, perforated in the Silverado Aquifer, was estimated to be approximately -44 feet msl. The water level elevation in nearby Lynwood Aquifer Monitoring Well LW-7 on that date was -30.22 feet msl. The difference in water level elevation between these two wells was approximately 13.8 feet. These data indicate that a steep downward vertical hydraulic gradient occurs between the Lynwood and Silverado Aquifers in the vicinity of the Property.

4.2.3 Hydraulic Parameters

Hydraulic parameters of the Upper Bellflower Aquitard, the Bellflower Sand, the Gage Aquifer, and the Lynwood Aquifer were estimated based on aquifer tests performed on monitoring wells and test wells installed in these units and by the results of laboratory analyses of core samples collected from these units. Hydraulic parameters of the Lower Bellflower Aquitard and Gage-Lynwood Aquitard were estimated based on laboratory results of discrete core samples collected from these units. The methods and results of the aquifer tests were compiled in three reports to the EPA (H+A, 1990R-j, 1990R-k, and 1992R-b). The methods of analysis have been previously described in Section 2.2.3.

4.2.3.1 Upper Bellflower Aquitard

Transmissivity of the Upper Bellflower Aquitard was estimated based on data obtained from constant discharge aquifer tests. Horizontal hydraulic conductivity was also estimated based on the transmissivity obtained and the estimated thickness of the hydrogeologic unit tested. Twelve-hour constant discharge aquifer tests were performed at Monitoring Wells MW-13, MW-15, MW-17, MW-25, and MW-26 (Table 4.6). Water level data were collected from pumping wells. In addition, nearby monitoring wells were used as observation wells during these tests. There was no measured response in the observation wells during the constant discharge aquifer tests indicating that observations wells were not within the radius of influence of the pumping wells. Because of this, the storage coefficient could not be estimated from these tests.

Transmissivity and storage coefficient of the Upper Bellflower Aquitard were also estimated based on data obtained from constant discharge aquifer tests performed at Upper Bellflower Aquitard test and extraction wells (Table 4.6). Aquifer tests conducted at Text Well UBT-1 included two constant discharge and recovery tests at different discharge rates (H+A, 1990R-j). A 28-day aquifer test was conducted at Extraction Well UBE-1 (H+A, 1992R-b).

Horizontal hydraulic conductivity of the Upper Bellflower Aquitard was also estimated based on slug withdrawal aquifer tests. Slug withdrawal tests are an approximate method of estimating hydraulic conductivity and are used in low permeability hydrogeologic units (Lohman, 1979). Slug withdrawal tests were performed on Monitoring Wells MW-1, MW-8, MW-9, MW-10, MW-11, MW-13, MW-17, and MW-21 (Table 4.6). These monitoring wells partially penetrate the Upper Bellflower Aquitard.

The results of constant discharge tests conducted at the Upper Bellflower Aquitard monitoring wells indicate that the transmissivity of the Upper Bellflower Aquitard ranges from approximately 0.16 square feet/minute (ft^2/min) to 1.2 ft^2/min (Table 4.6). The results of constant discharge aquifer tests conducted at Test Well UBT-1 and Extraction Well UBE-1 indicate that the transmissivity of the Upper Bellflower Aquitard ranges from 0.19 ft^2/min

to 0.39 ft^2/min (H+A, 1990R-j and 1992R-b). These two wells are located On-Property in the Central Process Area and are screened throughout the saturated portion of the Upper Bellflower Aquitard.

Horizontal hydraulic conductivity was estimated by dividing the transmissivity estimates obtained from constant discharge aquifer tests by the estimated thickness of the hydrogeologic unit tested at each pumping well. Estimated hydraulic conductivities in the Upper Bellflower Aquitard based on this method ranged from approximately 13 feet per day (ft/day) to 100 ft/day (Table 4.6). Horizontal hydraulic conductivity was also obtained from slug withdrawal aquifer tests. Estimated hydraulic conductivities in the Upper Bellflower Aquitard based on this method ranged from approximately 1.0 ft/day to 13 ft/day.

The hydraulic conductivity estimates based on the constant discharge aquifer tests are higher than the estimates based on the slug withdrawal aquifer tests in part because higher-yielding wells were preferentially selected for pumping tests and lower-yielding wells were preferentially selected for slug tests. Monitoring Well MW-13 and MW-17 were subject to both pumping and slug withdrawal aquifer tests. The results from the pumping tests are considered more reliable and were used to estimate aquifer transmissivity and hydraulic conductivity for these monitoring wells (Table 4.6). Hydraulic conductivity estimates that are derived from aquifer tests are considered more representative of aquifer conditions than estimates derived from slug tests, because aquifer tests measure the hydraulic response of a much larger volume of the subsurface than do slug tests. The changes in water levels monitored during a slug test can be greatly affected by the presence of fine-grained sediments that potentially may be smeared on the borehole during the drilling process and by the volume of water in storage within the borehole. These efforts have a much lower impact on the hydraulic conductivity estimate derived from an aquifer test.

The vertical hydraulic conductivity of the Upper Bellflower Aquitard was estimated by performing laboratory permeameter tests on core samples using American Society for Testing and Materials (ASTM) Method 2434. Fourteen core samples were collected from 13 borings at discrete depth intervals within the Upper Bellflower Aquitard from a range of lithologies. The vertical hydraulic conductivity of these core samples ranged from approximately 3.2×10^{-5} ft/day to approximately 8.1 ft/day based on these tests. The geometric mean vertical hydraulic conductivity for these samples was 6.2×10^{-3} ft/day (Table 4.7).

The specific capacity of four Upper Bellflower Aquitard monitoring wells was estimated based on the constant discharge aquifer test data (Table 4.6). Estimated specific capacity ranged from 0.1 gallons per minute per foot of drawdown in the pumped well (gpm/ft) to 2.0 gpm/ft.

The range of average linear horizontal flow velocities for groundwater in the Upper Bellflower Aquitard was estimated by dividing the product of the horizontal hydraulic conductivity and the horizontal hydraulic gradient by the estimated effective porosity of the Upper Bellflower Aquitard. The range of estimated horizontal hydraulic conductivity values for the Upper Bellflower Aquitard was used. The horizontal hydraulic conductivity values ranged from 1.0 ft/day to 100 ft/day (H+A, 1990R-k). An average total porosity of 42.3 percent was used based on results from laboratory analyses of core samples collected

from the Upper Bellflower Aquitard. Effective porosity was assumed to be approximately 80 percent of the average total porosity. An average effective porosity of 33.8 percent was calculated for the Bellflower Aquitard. An average horizontal hydraulic gradient of 9.4 x 10^{-4} was estimated from water level elevations measured in October 1995. Based on these results, it is estimated that average linear horizontal groundwater flow velocities for the Upper Bellflower Aquitard ranged from approximately 0.036 ft/day to 0.278 ft/day.

4.2.3.2 Bellflower Sand

Transmissivity, horizontal hydraulic conductivity, and storage coefficient of the Bellflower Sand were estimated based on data obtained from constant discharge aquifer tests. Twelve-hour constant discharge aquifer tests were performed at Monitoring Wells BF-5, BF-7, BF-9, BF-11, BF-13, and BF-15 (Table 4.6). Water level data were collected from pumping wells and observation wells during drawdown and recovery. Transmissivity was estimated for each test based on recovery data obtained from the pumping wells. The storage coefficient was estimated based on the data obtained from observation wells if sufficient drawdown occurred.

Transmissivity estimates for the Bellflower Sand, based on the results of constant discharge aquifer tests, range from approximately 1.3 ft^2/min to 8.4 ft^2/min (Table 4.6).

Horizontal hydraulic conductivity was estimated by dividing the transmissivity estimates at each well by the saturated hydrogeologic unit thickness at that monitoring well. The estimated horizontal hydraulic conductivity of the Bellflower Sand ranged from approximately 31 ft/day to 396 ft/day (Table 4.6).

The vertical hydraulic conductivity of the Bellflower Sand was estimated by performing laboratory permeameter tests on 11 core samples collected from 11 borings. These samples were collected at discrete depth intervals within the Bellflower Sand from a range of lithologies. The vertical hydraulic conductivity of these samples ranged from approximately 3.3 x 10^{-4} ft/day to 11 ft/day based on these tests (Table 4.7). The geometric mean vertical hydraulic conductivity for these samples was 1.3 x 10^{-2} ft/day.

The storage coefficient of the Bellflower Sand was evaluated based on observation well data obtained during the Bellflower Sand aquifer tests. The estimated storage coefficient of the Bellflower Sand ranged from 1 x 10^{-4} to 5 x 10^{-4} (Table 4.6).

Specific capacity of six Bellflower Sand monitoring wells was estimated based on the pumping rate and drawdown at the completion of each aquifer test (Table 4.6). The estimated specific capacity ranged from 0.6 gpm/ft to 5.7 gpm/ft for these pumped monitoring wells.

The range of average linear horizontal flow velocities for groundwater in the Bellflower Sand was estimated by dividing the product of the horizontal hydraulic conductivity and the horizontal hydraulic gradient by the estimated effective porosity of the Bellflower Sand. The range of estimated horizontal hydraulic conductivity values for the Bellflower Sand was used. The horizontal hydraulic conductivity values ranged from 31 ft/day to 396 ft/day (H+A, 1990R-k). The average total porosity for the Bellflower Sand was approximately 38.8 percent. An average effective porosity of 31 percent was used based on results from laboratory analyses of core samples collected from the Bellflower Sand and the assumption that effective porosity is about 80 percent of total porosity. An average

horizontal hydraulic gradient of 1×10^{-3} was estimated from water level elevations measured in October 1995. Based on these results, it is estimated that average linear horizontal flow velocities for the Bellflower Sand ranged from approximately 0.1 ft/day to 1.277 ft/day.

4.2.3.3 Lower Bellflower Aquitard

The vertical hydraulic conductivity of the Lower Bellflower Aquitard was estimated by performing laboratory permeameter tests on nine core samples collected from seven borings. These samples were collected at discrete depth intervals within the Lower Bellflower Aquitard from a range of lithologies. The vertical hydraulic conductivities of these core samples ranged from approximately 1×10^{-4} ft/day to 1.0 ft/day, based on these tests (Table 4.7). The geometric mean vertical hydraulic conductivity for these samples was 3.5×10^{-3} ft/day.

4.2.3.4 Gage Aquifer

Transmissivity, horizontal hydraulic conductivity, and storage coefficient of the Gage Aquifer were estimated based on data obtained from constant discharge aquifer tests (Table 4.6). Twelve-hour constant discharge aquifer tests were performed on Monitoring Wells G-5, G-11, G-13, and LG-2. Water level data were collected from the pumping wells and observation wells during drawdown and recovery. Transmissivity was estimated for each test based on recovery data obtained from the pumping wells. The storage coefficient was estimated based on the data obtained from the observations wells if sufficient drawdown occurred.

The results of constant discharge aquifer tests conducted at the Gage Aquifer monitoring wells indicate that the transmissivity of the Gage Aquifer is estimated to range from approximately 0.92 ft^2/min to 1.7 ft^2/min (Table 4.6).

Horizontal hydraulic conductivity was estimated by dividing the transmissivity at each well by the saturated hydrogeologic unit thickness at that well. The estimated horizontal hydraulic conductivity of the Gage Aquifer ranged from approximately 30 ft/day to 38 ft/day, based on these calculations (Table 4.6).

The vertical hydraulic conductivity of the Gage Aquifer was estimated by performing laboratory permeameter tests on five core samples collected from five borings. These samples were collected at discrete depth intervals within the Gage Aquifer from a range of lithologies. The vertical hydraulic conductivity of these core samples ranged from approximately 9.8×10^{-6} ft/day to 4.1 ft/day, based on these tests (Table 4.7). The geometric mean vertical hydraulic conductivity for these samples was 1.5×10^{-2} ft/day.

The storage coefficient of the Gage Aquifer was evaluated based on observation well data obtained during the aquifer tests. The estimated storage coefficient of the Gage Aquifer is approximately 2×10^{-4} to 3×10^{-4} (Table 4.6).

The specific capacity of four Gage Aquifer monitoring wells was estimated from the pumping rate and the drawdown at the completion of the aquifer test (Table 4.6). The estimated specific capacity for these wells ranged from approximately 1.1 gpm/ft to 3.8 gpm/ft at the pumped Monitoring Wells G-5, G-11, G-13, and LG-2. The average specific capacity was 2.1 gpm/ft.

The range of average linear horizontal flow velocities for groundwater in the Gage Aquifer was estimated by dividing the product of the horizontal hydraulic conductivity and the horizontal hydraulic gradient by the estimated effective porosity of the Gage Aquifer. The range of estimated horizontal hydraulic conductivity values for the Gage Aquifer was used. The horizontal hydraulic conductivity values ranged from 30 ft/day to 38 ft/day (H+A, 1990R-k). An average total porosity was determined to be 42.2 percent for the Gage Aquifer. An average effective porosity of 33.8 percent was estimated based on 80 percent of the average total porosity determined from laboratory analyses of core samples collected from the Gage Aquifer. A horizontal hydraulic gradient of 1.6×10^{-3} was estimated from water level elevations measured in October 1995. Based on these results, it is estimated that average linear horizontal flow velocities for the Gage Aquifer ranged from approximately 0.142 ft/day to 0.171 ft/day.

4.2.3.5 Gage-Lynwood Aquitard

The vertical hydraulic conductivity of the Gage-Lynwood Aquitard was estimated by performing laboratory permeameter tests on five core samples collected from four borings. These samples were collected at discrete depth intervals from a variety of lithologies. Vertical hydraulic conductivities of these Gage-Lynwood Aquitard core samples ranged from 1.1×10^{-4} ft/day to 0.0064 ft/day, based on these tests (Table 4.7). The geometric mean vertical hydraulic conductivity for these samples was 1.1×10^{-3} ft/day.

4.2.3.6 Lynwood Aquifer

Transmissivity, horizontal hydraulic conductivity, storage coefficient, and specific capacity of the Lynwood Aquifer were estimated based on data obtained from a 12-hour constant discharge aquifer test performed at Monitoring Well LW-3 (Table 4.6). Water levels were collected from Pumping Well LW-3 and Observation Wells LW-1 and LW-2 during drawdown and recovery. Based on recovery data from the constant discharge aquifer test, the transmissivity of the upper portion of the Lynwood Aquifer is estimated to be approximately 3.2 ft^2/min.

Horizontal hydraulic conductivity of the upper portion of the Lynwood Aquifer was estimated by dividing the estimated transmissivity for the test by the thickness of the interval tested at the pumped well. The estimated horizontal hydraulic conductivity of the upper portion of the Lynwood Aquifer was approximately 192 ft/day (Table 4.6).

The vertical hydraulic conductivity of the Lynwood Aquifer was estimated by performing laboratory permeameter tests on three core samples collected from three borings. These samples were collected at discrete depth intervals from a variety of lithologies. Vertical hydraulic conductivities of the Lynwood Aquifer core samples were 1.3 ft/day, 0.00019 ft/day, and 0.00087 ft/day, based on these tests (Table 4.7). The geometric mean vertical hydraulic conductivity for these samples was 6.0×10^{-3} ft/day.

The storage coefficient of the upper portion of the Lynwood Aquifer was estimated based on observation well data obtained during the Lynwood Aquifer test. The estimated storage coefficient of the Lynwood Aquifer is approximately 3×10^{-4} (Table 4.6).

The estimated specific capacity of Monitoring Well LW-3 is approximately 7.6 gpm/ft based on the 12-hour constant discharge aquifer test (Table 4.6).

The range of average linear horizontal flow velocities for groundwater in the Lynwood Aquifer was estimated by dividing the product of the horizontal hydraulic conductivity and the horizontal hydraulic gradient by the estimated effective porosity of the Lynwood Aquifer. The horizontal hydraulic conductivity value was 192 ft/day, estimated from an aquifer test conducted at Lynwood Aquifer Monitoring Well LW-3 (H+A, 1990R-k). An average total porosity of 38.6 percent was established based on laboratory analyses of core samples collected from the Lynwood Aquifer. An average effective porosity of 30.9 percent was estimated by taking 80 percent of the average total porosity. A horizontal hydraulic gradient of 2×10^{-4} was estimated from water level elevations measured in October 1995. Based on these results, it is estimated that the average linear horizontal flow velocity for the Lynwood Aquifer was approximately 0.124 ft/day.

4.2.4 Inorganic Water Quality

The LARWQCB has classified groundwater in the Bellflower Aquitard, Gage Aquifer, and Lynwood Aquifer as a potential source of drinking water. General groundwater quality for each hydrogeologic unit investigated as part of this RI is discussed based on EC, pH, and temperature data obtained from field measurements and laboratory results of groundwater samples analyzed for common ions and total dissolved solids (TDS). Inorganic water quality was assessed by analyzing groundwater samples for selected common ions, EC, pH, and temperature. The groundwater samples were collected from monitoring wells during their initial groundwater sampling, which was conducted shortly after the wells were installed. The minimum, maximum, and mean concentrations of inorganic compounds in groundwater from each hydrogeologic unit are listed in Table 4.8. The complete sets of analytical results for groundwater samples are provided in Appendix G, trace metals in Table G-4 and common ions in Table G-5.

4.2.4.1 Upper Bellflower Aquitard

Groundwater in the Upper Bellflower Aquitard generally consists of calcium-chloride type water. Groundwater samples collected from Upper Bellflower Aquitard Monitoring Wells MW-8, MW-16, and MW-17, located upgradient of the Property, consisted of mixed calcium-sodium-chloride type waters. Groundwater collected from On-property Monitoring Well MW-2, located within the Central Process Area, consists of mixed calcium-magnesium-chloride-sulfate type water.

TDS concentrations detected in groundwater samples collected from 29 Upper Bellflower Aquitard wells ranged from 430 mg/L in upgradient Monitoring Well MW-18 to 14,000 mg/L in On-Property Monitoring Well MW-2 (Figure 2.23A). Excluding Monitoring Well MW-2, the average TDS concentration detected in Upper Bellflower Aquitard monitoring wells was 1,911 mg/L (Table 4.8; Appendix G, Table G-5). A TDS plume is apparent in the Upper Bellflower Aquitard with its center beneath the Central Process Area. Background (upgradient) TDS concentrations range from 430 mg/L to 780 mg/L. TDS concentrations exceeding 10,000 mg/L occur beneath the Central Process Area (MW-02).

Chloride concentrations detected in groundwater samples collected from Upper Bellflower Aquitard monitoring wells ranged from 93 mg/L in upgradient Monitoring Well MW-18 to 2,400 mg/L in On-Property Monitoring Well MW-2 (Table 4.8; Figure 2.23B). The average chloride concentration detected in Upper Bellflower Aquitard monitoring wells was 537 mg/L. It appears a chloride plume exists in the Upper Bellflower Aquitard with its

center beneath the Central Processing area. Background (upgradient) chloride concentrations range from 93 mg/L to 320 mg/L. Chloride concentrations exceeding 1,000 mg/L occur beneath the Central Processing area (MW-02) and immediately south of the Jones Chemical Company (MW-07).

Sulfate concentrations detected in groundwater samples collected from Upper Bellflower Aquitard wells ranged from 18 mg/L in Monitoring Well MW-03 to 4,800 mg/L at Monitoring Well MW-02 (Table 4.8; Figure 2.23C). Excluding Monitoring Well MW-02, the average sulfate concentration in Upper Bellflower Aquitard monitoring wells was 281 mg/L. A sulfate plume is apparent in the Upper Bellflower Aquitard with its center beneath the Central Process Area. Background (upgradient) sulfate concentrations range from 29 mg/L to 42 mg/L. Sulfate concentrations of approximately 5,000 mg/L occur beneath the Central Process Area (MW-02). The 100 mg/L-contour plume is about 2,200 feet across, but does not extend far beyond the Property.

Nitrate concentrations detected in groundwater samples collected from Upper Bellflower Aquitard monitoring wells ranged from less than 0.1 mg/L in six monitoring wells to 120 mg/L in Monitoring Well MW-23. Monitoring Well MW-23 is located approximately 1,800 feet southeast of the Property.

The EC, pH, and temperature of groundwater samples collected from On-Property well UBT-3 in December 1995 were 7,690 µmhos/cm, 5.2, and 22.8°C, respectively (Table 4.9). During the same monitoring period, the EC of groundwater samples collected from 11 other Upper Bellflower Aquitard monitoring wells ranged from 607 to 2,940 µmhos/cm with an average EC of 1,873 µmhos/cm. The pH of groundwater samples collected from these other Upper Bellflower Aquitard monitoring wells ranged from 6.6 to 7.7 with an average pH of 7.2. Groundwater temperatures ranged from 19.2°C to 23.7°C and averaged 22.7°C.

Inorganic water quality in the Upper Bellflower Aquitard appears to have been affected by industrial processes. Groundwater samples collected from all Upper Bellflower Aquitard monitoring wells with the exception of Monitoring Well MW-18 exceeded the MCL for drinking water established for TDS (Table 4.10; Figure 4.23A). Groundwater samples collected from all Upper Bellflower Aquitard monitoring wells, with the exception of Monitoring Wells MW-03, MW-18, MW-25, and MW-29, exceeded the MCL for drinking water established for chloride (Figure 4.23B). Groundwater samples collected from Upper Bellflower Aquitard Monitoring Wells MW-01, MW-02, MW-05, MW-06, MW-07, MW-09, MW-11, and MW-12 exceeded the MCL established for sulfate (Figure 4.23C).

4.2.4.2 Bellflower Sand

Groundwater in the Bellflower Sand generally consists of mixed calcium-chloride-sulfate type water. Groundwater samples collected from Bellflower Sand Monitoring Well BF-1 located On-Property upgradient of the Central Process Area and Monitoring Well BF-20, located 400 feet southwest of the Property, consisted of mixed calcium-sodium-chloride type waters.

TDS concentrations detected in groundwater samples collected from Bellflower Sands ranged from 346 mg/L at upgradient Monitoring Well BF-18 to 5,600 mg/L at Monitoring Well BF-13, located downgradient of the Del Amo Waste Pits (Table 4.8; Figure 4.24A). With the exception of Monitoring Well BF-13, the average TDS detected in groundwater samples collected from Bellflower Sand monitoring wells was 698 mg/L. A TDS plume

appears to exist in the Bellflower Sand with its center near the Central Process Area. A background (upgradient) TDS concentration of 346 mg/L was measured at Monitoring Well BF-18. TDS concentrations of 1,000 mg/L occur immediately east of the Central Process Area (BF-03).

In addition to Monitoring Well BF-13 located downgradient of the Del Amo Waste Pits, it appears that several other Off-Property TDS sources exist (Figure 4.24A). TDS concentrations exceeded 1,000 mg/L at Monitoring Wells BF-32 and BF-33. Monitoring Well BF-32 is located approximately 2,500 feet southwest and cross gradient from the Property near Western Avenue. Monitoring Well BF-33 is located approximately 4,400 feet southwest of the Property south of the Southern Pacific Railroad tracks and east of Western Avenue.

Chloride concentrations detected in groundwater samples collected from Bellflower Sand monitoring wells ranged from 46 mg/L at Monitoring Well BF-5 located about 800 feet east of the Property to 2,000 mg/L at Monitoring Well BF-13 located immediately southeast of the Waste Pit Area of the former butadiene-styrene rubber manufacturing facility at the Del Amo Site (Figure 4.24B). With the exception of Monitoring Well BF-13, the average chloride concentration in Bellflower Sand monitoring wells was 111 mg/L (Table 4.8). The highest chloride concentration detected beneath the Property was 200 mg/L at Monitoring Well BF-03.

Sulfate concentrations detected in groundwater samples collected from Bellflower Sand monitoring wells ranged from 22.4 mg/L at Monitoring Well BF-32 to 330 mg/L at Monitoring Well BF-13. The average sulfate concentration detected in groundwater samples collected from Bellflower Sand monitoring wells was 126 mg/L (Table 4.8; Figure 4.24C). It appears that a long, narrow sulfate plume exists in the Bellflower Sand with maximum concentrations in the range of 250 to 300 mg/L. The 200 mg/L-contour extends from groundwater beneath the Property (BF-03) to Torrance Avenue (downgradient of BF-15). A background (upgradient) sulfate concentration of 22.6 mg/L was detected at Monitoring Well BF-18.

In addition to Monitoring Well BF-13 located downgradient of the Del Amo Waste Pits, it appears that other Off-Property sulfate sources exist (Figure 4.24C). Sulfate concentrations exceeded 200 mg/L at Monitoring Wells BF-28 and BF-33. Monitoring Well BF-28 is located approximately 5,200 feet southeast of the Montrose Property near the Harbor Freeway (I-110). Monitoring Well BF-33 is located approximately 4,400 feet southwest of the Property south of the Southern Pacific Railroad tracks and east of Western Avenue.

Nitrate concentrations detected in groundwater samples collected from Bellflower Sand monitoring wells ranged from less than 0.1 mg/L at five wells to 2 mg/L at Monitoring Well BF-14. The average nitrate concentration detected in groundwater samples collected from Bellflower Sand monitoring wells was 0.5 mg/L (Table 4.8).

The EC of groundwater samples collected from seven Bellflower Sand monitoring wells during the period November to December 1995 ranged from 698 to 1,449 µmhos/cm and averaged 1,140 µmhos/cm (Table 4.8). During this same monitoring period, the pH for the groundwater samples collected from these wells ranged from 7.3 to 8.1, with an average pH of 7.7. Groundwater temperatures for these samples ranged from 20.7 °C to 23.2°C, and averaged 22°C.

Inorganic water quality in the Bellflower Sand appears to have been affected by industrial processes in the vicinity of Monitoring Well BF-13, located downgradient of the Del Amo Waste Pits, and near Monitoring Wells BF-32 and BF-33, located along Western Avenue (Figures 4.24A through 4.24C). The highest concentrations of TDS, calcium, chloride, magnesium, and sodium in the Bellflower Sand were detected in groundwater samples collected from Monitoring Well BF-13. Concentrations of chloride detected in groundwater samples collected from Monitoring Wells BF-32 and BF-33 located near Western Avenue, exceeded the MCL established for drinking water (Table 4.10). Concentrations of sulfate detected in groundwater samples collected from Monitoring Wells BF-15 and BF-33 exceeded the MCL for drinking water. Concentrations of TDS detected in groundwater samples collected from 25 of the 31 Bellflower Sand monitoring wells exceeded the MCL for drinking water.

It appears that industrial activities at Montrose have also affected the inorganic water quality in the Bellflower Sand. The concentrations of TDS and sulfate in groundwater samples collected from Monitoring Well BF-03, which is located immediately east of the Central Process Area, exceeded their MCLs for drinking water (Figures 4.24A and 4.24C). As described above in Section 4.2.4.1, it appears the same industrial activities associated with Montrose have impacted the inorganic water quality in the Upper Bellflower Aquitard, the hydrogeologic unit immediately above the Bellflower Sand. Groundwater samples collected from MW-02, located in the middle of the Central Process Area and immediately west of Monitoring Well BF-03, were detected with some of the highest concentrations of TDS, chloride, and sulfate in the Upper Bellflower Aquitard (Figures 4.23A through 4.23C).

4.2.4.3 Gage Aquifer

Groundwater in the Gage Aquifer generally consists of calcium-bicarbonate type water. Groundwater samples collected from upgradient Gage Aquifer Monitoring Wells G-10 and G-14 consisted of sodium-bicarbonate type waters.

TDS concentrations detected in groundwater samples collected from Gage Aquifer monitoring wells ranged from 200 mg/L at On-Property Monitoring Well LG-01 to 520 mg/L at Monitoring Well G-5 (Table 4.8; Figure 4.25A). Monitoring Well G-5 is located at the Del Amo Site. TDS concentrations of 510 mg/L were detected at Monitoring Wells G-9 and G-12, both located downgradient of the Montrose Site and the southwestern corner of the Del Amo Site. The average TDS concentration in Gage Aquifer monitoring wells was 348 mg/L. A TDS plume exists in the Gage Aquifer that appears to have originated at the Montrose Site. The 500-mg/L plume contour extends from the intersection of Normandie Avenue and Del Amo Boulevard almost to the intersection of Vermont Avenue and Torrance Boulevard. The shape and lateral extent of the TDS plume are very similar to the chlorobenzene plume in the Gage Aquifer (Figure 5.54).

Chloride concentrations detected in groundwater samples collected from Gage Aquifer monitoring wells ranged from 20 mg/L at Monitoring Wells G-18 and G-19, located south of Torrance Boulevard, to 86 mg/L at On-Property Monitoring Well G-02 (Table 4.8; Figure 4.25B). The average chloride concentration for groundwater samples collected from Gage Aquifer monitoring wells was 54 mg/L. The highest chloride concentrations were detected in groundwater at two general areas, one immediately downgradient of the

Central Process Area (G-02 and G-06) and the second immediately south of the Del Amo Waste Pit Area (G-11, G-12, and G-9).

Sulfate concentrations detected in groundwater samples collected from Gage Aquifer monitoring wells ranged from 10.8 mg/L at Monitoring Well G-15 to 99 mg/L at Monitoring Well G-12 (Table 4.8; Figure 4.25C). Monitoring Well G-15 is located in the LADWP right-of-way south of the Property. Monitoring Well G-12 is located downgradient of the Del Amo Waste Pit Area. The average sulfate concentration for groundwater samples collected from Gage Aquifer monitoring wells was 52.5 mg/L. A long, narrow sulfate plume exists in the Gage Aquifer with maximum concentrations below 100 mg/L. The 80-mg/L contour extends from groundwater beneath the Del Amo Site near the intersection of Normandie Avenue and Del Amo Boulevard (G-05) to Vermont Avenue immediately south of the Del Amo Waste Pit Area (G-09). The orientation and lateral extent of the plume suggest that it may have originated from the Montrose Site. A background (upgradient) sulfate concentration of 19.3 mg/L was detected at Monitoring Well G-10.

Nitrate concentrations detected in groundwater samples collected from Gage Aquifer monitoring wells ranged from less than 0.4 in 11 monitoring wells to 0.86 mg/L in Monitoring Well G-8 (Table 4.8). The average nitrate concentration detected in groundwater samples collected from Gage Aquifer monitoring wells was 0.5 mg/L.

The EC of groundwater samples collected from four Gage Aquifer monitoring wells during the period from November to December 1995 ranged from 533 µmhos/cm to 757 µmhos/cm, and averaged 642 mg/L (Table 4.9). During the same monitoring period, the pH for groundwater samples collected from these wells was 8.0. Groundwater temperatures for these samples ranged from 21.3°C to 22.9 °C.

Concentrations of TDS detected in groundwater samples collected from Monitoring Wells G-5, G-9, and G-12 exceeded the MCL established for drinking water (Table 4.10). Monitoring Wells G-5, G-9, and G-12 are located at and downgradient of the Del Amo Waste Pit Area.

4.2.4.4 Lynwood Aquifer

Groundwater in the Lynwood Aquifer Monitoring Wells LW-1, and LW-4 through LW-7 consisted of sodium-bicarbonate type water. Groundwater samples collected from LW-2 and LW-3 consisted of calcium-bicarbonate type water.

TDS concentrations detected in groundwater samples collected from Lynwood monitoring wells ranged from 230 to 296 mg/L (Table 4.8). The average TDS was 257 mg/L. Chloride concentrations detected in groundwater samples collected from Lynwood monitoring wells ranged from 10 to 31 mg/L. The average chloride concentration was 23 mg/L. Sulfate concentrations detected in groundwater samples collected from Lynwood monitoring wells ranged from 2 mg/L to 31.2 mg/L and averaged 14 mg/L. Nitrate concentrations detected in groundwater samples collected from these wells were less than 0.5 mg/L.

The EC, pH, and temperature of groundwater samples collected from two Lynwood Aquifer monitoring wells during the period November to December 1995 averaged 416 µmhos/cm, 8.6, and 23.4°C (Table 4.9).

4.2.5 Total Organic Carbon

TOC concentrations detected in 9 of 10 groundwater samples collected from 10 Upper Bellflower Aquitard monitoring wells ranged from 1.2 mg/L in Monitoring Well MW-30 to 50 mg/L in Monitoring Well MW-12 (Table 4.11; Figure 4.26). Monitoring Well MW-12 is located on Jon Street, approximately 600 feet east of the Property. The average TOC concentration detected in the 9 groundwater samples was 17.8 mg/L. TOC was not detected above the laboratory detection limit in Upper Bellflower Aquitard Monitoring Well MW-19. No TOC contours are plotted because there are insufficient data points.

TOC concentrations detected in 20 groundwater samples collected from 20 Bellflower Sand monitoring wells ranged from 0.9 mg/L in Monitoring Well BF-29 to 61.7 mg/L in Monitoring Well BF-25 (Table 4.11; Figure 4.27). Monitoring Well BF-25 is located approximately 4,800 feet southeast and downgradient of the Property near Vermont Avenue. The average TOC concentration detected in the 20 groundwater samples was 12.5 mg/L. It appears a distinct TOC plume exceeding 10 and 20 mg/L is visible in the Bellflower Sand and extends to the southeast almost to the Harbor Freeway (I-110). The highest concentrations appear to be just south of the Del Amo Property and not beneath the Montrose Central Process Area, as observed for TDS and sulfate. These are unusually high concentrations of TOC and are probably due to the elevated p-CBSA and chlorobenzene concentrations within the Bellflower Sand that originate from the Montrose Site (Figures 5.53 and 5.58). The extent of the TOC plume closely approximates that of chlorobenzene and of p-CBSA. Upgradient TOC concentrations are approximately 3 to 5 mg/L.

Few TOC analyses were available for the Bellflower Sand monitoring wells within the Montrose Property. It is anticipated that if wells on the Montrose Property were analyzed for TOC, the TOC plume may be shown to originate at Montrose.

TOC concentrations detected in 12 of 13 groundwater samples collected from 13 Gage Aquifer monitoring wells ranged from 0.6 mg/L in Monitoring Well G-16 to 25 mg/L in Monitoring Well G-01 (Table 4.11; Figure 4.28). Monitoring Well G-01 is located in the north central portion of the Property. The average TOC concentration detected in the 12 monitoring wells was 7.3 mg/L. TOC was not detected above the laboratory detection limit in Gage Aquifer Monitoring Well G-18. It appears a TOC plume exists in the Gage Aquifer. Upgradient TOC concentrations are approximately 1 mg/L. No TOC analyses were available for the Gage Aquifer monitoring wells within the Montrose Property. Insufficient TOC samples are available to identify the source of the TOC plume. It is anticipated that if wells on the Montrose Property were analyzed for TOC, the TOC plume may be shown to originate from Montrose.

TOC concentrations detected in four groundwater samples collected from four Lynwood Aquifer monitoring wells ranged from 1.4 mg/L in Monitoring Well LW-4 to 2.7 mg/L in Monitoring Well LW-6 (Table 4.11). Monitoring Well LW-6 is located in the northeastern portion of the Property. The average TOC concentration detected in the four groundwater samples was 2.1 mg/L.

4.3 Sediment

The physical characteristics of the sediment investigated during RI field work at the Montrose Site were evaluated based on data obtained from a 1986 field investigation of sediment in four surface water drainages. Field inspections were made and sediment samples were collected in 1986 in the Kenwood Drain, the Torrance Lateral, the Dominguez Channel, and the Consolidated Slip. A more detailed sediment survey was conducted in the Dominguez Channel in August and September 1988. Twenty-nine locations along the surface water pathways were sampled in April and June 1986 and in September 1988. Table 2.11 provides a list of the sediment investigations conducted by drainage and the corresponding sample locations and analyses requested. Table 2.12 describes the sampling method employed at each sediment sample location. Figures 2.16 through 2.19 show the locations of the sediment samples. The sediment analytical results are provided in Appendix I (Table I.1 through I.3).

The general features of the surface water pathway and the drainages, the sediment depth where sediment was present, and the nature of the sediment are described below

4.3.1 Kenwood Drain

The Kenwood Drain was inspected in 1986 for sediment at seven locations between Del Amo Boulevard and the Torrance Lateral (Table 4.12; Figure 2.17). The catchment basin located east of the Farmer Brothers Property on Normandie Avenue was also inspected.

Sediment was present at five of the seven locations inspected (Table 4.12). The sediment deposits in the catchment basin on Normandie Avenue (Sample Location KD-1) were limited and were derived from several sources of surface water runoff including the Jones Chemical Company Ditch, the Normandie Avenue Ditch, the Farmer Brothers facility, and Normandie Avenue (Figure 2.17). The sediment depth in the catchment basin at Sample Location KD-1 ranged from 4 inches on the north and south sides of the basin to no sediment in the center of the basin. Approximately 1 inch of sediment was present in the catchment basin located on the southwest corner of 204th Street and Kenwood Avenue. Sediment was not observed in the Kenwood Drain upstream or downstream from the catchment basin (Table 4.12).

Sediment was not present at the Kenwood Drain manhole adjacent to 20429 Kenwood Avenue (Table 4.12). Approximately 7 inches of sediment were measured at Sample Location KD-3. Mounds of sediment and refuse up to 1.5 feet thick were measured at sediment Sample Location KD-4. Approximately 1 inch to 2 inches of sediment was present at the drain at 20703 Kenwood Avenue and at sediment Sample Location KD-5. At sediment Sample Location KD-7, a 4-inch thick sand bar was deposited on the north side of the concrete floor.

Sediment samples were collected from Sample Locations KD-1, KD-3, KD-4, KD-5, and KD-7 (Figure 2.17). The sediment was wet, ranged in color from dark brown to black, and consisted of loose sand to silty sand, often mixed with a variety of refuse. Standing water was measured at sediment Sample Locations KD-3 and KD-4 at depths of 0.2 foot and 0.5 foot, respectively.

4.3.2 Torrance Lateral

The Torrance Lateral was inspected in 1986 for sediment between the Kenwood Drain discharge and the Dominguez Channel outfall (Figure 2.16). Sediment was present at five isolated locations along this length of the lateral (Table 4.13). The sediment deposit at Sample Location SED-6 was approximately 2 inches thick. The sediment deposit at Sample Location SED-7 formed a sand bar approximately 3 inches thick. The sediment deposit at Sample Location SED-8 was approximately 0.5 inch thick.

The sediment deposit at Sample Location SED-9 was a sand bar approximately 1-inch thick (Table 4.13). The sediment deposit at Sample Location SED-10 was a large sand bar near the confluence of the Torrance Lateral and the Dominguez Channel. This sand bar was approximately 2 feet thick.

Sediment samples were collected from Sample Locations SED-6 through SED-10 (Figure 2.16). The sediment was fine- to coarse-grained sand with variable coloring and moisture contents. Sediment at Sample Location KD-5 contained metallic fragments, bright orange flakes, and sand grains with an opalescent reflection. Sample Location KD-5 was situated adjacent to the Armco Site. Surface water runoff flowed across the width of the concrete bottom of the lateral and ranged in depth from 0.75 inch to 2 inches.

In June 1987, the Torrance Lateral was inspected by Montrose and EPA subcontractor M&E. Nearly all of the sediment in the Torrance Lateral had been removed (H+A, 1988C-a). There was evidence that the large sediment deposit located near the confluence of the lateral with the Dominguez Channel had been partially removed using heavy equipment.

4.3.3 Dominguez Channel

During the 1986 RI field work, the sediment in the Dominguez Channel was sampled at five transects (Table 4.14). Sediment samples were collected from Transects SED-11 through SED-15. Samples were collected from three locations in each transect wherever possible. Sediment was not present at one of the three sample locations in transects SED-13 and SED-14. Where present, the sediment was composed of sand, silt, and clay and typically contained moss and plant material.

During the 1988 RI sediment sampling, a detailed sediment survey was conducted along approximately 7,200 feet of the Dominguez Channel in the vicinity of its confluence with the Torrance Lateral (Figure 2.18). This sediment survey was conducted based on analytical results from sediment samples collected during the 1986 RI sediment sampling.

Sediment thickness was measured at Dominguez Channel Sample Locations T-1 through T-20. Sediment thickness ranged from 0 to approximately 5.5 feet along the length of channel being surveyed (Table 4.14). The distribution of sediment varied across each transect and along the length of the channel. The sediment was composed of black, nonplastic silt and sandy silt with some organic material.

4.3.4 Consolidated Slip

Sediment samples were collected from Consolidated Slip Sample Locations SED-16 through SED-25 in 1986 (Figure 2.19). Sediment samples collected from the Consolidated Slip

consisted of homogeneous, nonplastic silt with a black oily appearance. The sediment samples emitted a sulfurous odor.

4.4 Surface Water

The physical characteristics of surface water at the Montrose Site have been evaluated based on data obtained in 1986 and 1987 at 30 locations along the surface water pathway leaving the Property. Surface water samples were collected during both dry weather and wet weather sampling events (Tables 4.15 and 4.16; Figures 2.16 and 2.19 through 2.22).

EC, pH, and temperature were measured in water samples collected during the dry and wet weather surface water sampling events. The general features of the surface water drainages and the water quality parameters measured in the surface water samples are described below.

4.4.1 Dry Weather

Surface water samples were collected from 17 locations in the Torrance Lateral, the Dominguez Channel, and the Consolidated Slip during dry weather in June 1986 (Table 4.15; Figures 2.17 and 2.19). The Jones Chemical Company Ditch and the Normandie Avenue Ditch are dry during dry weather and were not sampled. Surface water in the Kenwood Drain was not sampled due to limited access.

4.4.1.1 Torrance Lateral

Surface Water Samples SW-4 and SW-5 were collected from water flowing across the width of the concrete bottom of the Torrance Lateral. The source of water in the lateral during dry weather is urban runoff. The depth of the water at Sample Locations SW-4 and SW-5 ranged from 0.75 inch to 2 inches, respectively.

The EC measured in Surface Water Samples SW-4 and SW-5 was 100 µmhos/cm and 750 µmhos/cm, respectively. The pH of the water samples was 8.98 and 9.40, respectively. The temperature of both water samples was 19°C.

4.4.1.2 Dominguez Channel

Standing water in the Dominguez Channel rises and falls daily due to tidal influences. This results in alternating upstream and downstream flow of surface water. Upstream flow can be strong enough to counter the downstream flow during rainfall events. The depth of standing water in the Dominguez Channel at Sample Locations SW-6 through SW-10 ranged from 6.9 feet to 12 feet.

The EC measured in water samples collected from Sample Locations SW-6 through SW-10 ranged from 31,700 µmhos/cm to 39,700 µmhos/cm. The pH of the water samples ranged from 7.18 to 7.80. The temperature of the water samples ranged from 25°C to 27°C.

4.4.1.3 Consolidated Slip

The depth of water in the Consolidated Slip at Sample Locations SW-16 through SW-25 ranged from 10 feet to 33 feet. The EC of the surface water samples ranged from 33,800 µmhos/cm to 46,000 µmhos/cm. The pH of the water samples ranged from 7.03 to 7.84. The temperature of the water samples ranged from 19°C to 24.5°C.

4.4.2 Wet Weather

Wet weather surface water samples were collected at 20 locations during five rainfall events between September 1986 and March 1987 (Table 4.16; Figures 2.20 through 2.22). Samples were collected from the Jones Chemical Company Ditch, the Normandie Avenue Ditch, the Torrance Lateral, the Dominguez Channel, and the Consolidated Slip. Surface water in the Kenwood Drain was not sampled due to limited access.

Surface water runoff samples were collected from five sample locations in the Jones Chemical Company Ditch, the Normandie Avenue Ditch, and the Torrance Lateral during five rainfall events with precipitation exceeding 0.20 inch (Table 4.16). Samples were not collected from Location SW-1 during the first rainfall event due to insufficient flow. Surface water samples were not collected during rainfall events with precipitation exceeding 0.75 inch at these locations because a rainfall event of this magnitude did not occur within the sampling period.

Surface water samples were collected from five sample locations in the Dominguez Channel during two rainfall events with precipitation exceeding 0.20 inch. Surface water samples were collected from 10 sample locations in the Consolidated Slip during one rainfall event with precipitation exceeding 0.20 inch.

4.4.2.1 Near the Property

Surface water samples were collected from three locations downstream from and near the Property during the five rainfall events (Table 4.16; Figure 2.21). Sample Location SW-1 was situated along a portion of the Jones Chemical Company Ditch. Surface water samples were collected at this location from water ponded behind a small obstruction in the concrete-lined ditch.

Sample Location SW-2 was located where runoff from the Jones Chemical Company and Montrose properties merges (Figure 2.21). Sample Location SW-3 was located at the end of the Normandie Avenue Ditch, immediately upstream from the opening in the concrete wall on the Farmer Brothers property. Surface water samples were collected at these locations from water ponded behind the opening in the concrete wall on the Farmer Brothers property. Surface water flowing south across the LADWP right-of-way and along the Normandie Avenue Ditch frequently ponded when the opening in the concrete wall became plugged with debris.

The EC, pH, and temperature of surface water samples collected from Sample Locations SW-1 through SW-3 varied. The EC of water samples collected from location SW-1 ranged from 700 µmhos/cm to 3,900 µmhos/cm. The pH of these samples ranged from 6.3 to 9. The EC of water samples collected from locations SW-2 and SW-3 ranged from 50 µmhos/cm to 2,500 µmhos/cm. The pH of these samples ranged from 5.1 to 8.2. The temperature of samples collected from locations SW-1 through SW-3 ranged from 11°C to 18°C.

4.4.2.2 Torrance Lateral

Surface water samples were collected from two locations along the Torrance Lateral during all five rainfall events (Table 4.16; Figure 2.20). The EC of these water samples ranged from 75 µmhos/cm to 270 µmhos/cm. The pH of these samples ranged from 6.3 to 7.6. The temperature of these samples ranged from 11°C to 17°C.

4.4.2.3 Dominguez Channel

Surface water samples were collected from five locations along the Dominguez channel during two rainfall events in February and March 1987 (Table 4.16; Figure 2.20). Upstream flow caused by tides was observed during the second rainfall event at Sample Locations SW-8 through SW-10. The EC of the samples collected during the two rainfall events ranged from 170 µmhos/cm to 28,000 µmhos/cm. The pH of these samples ranged from 7.0 to 7.8. The temperature of these samples ranged from 16°C to 28°C.

4.4.2.4 Consolidated Slip

Surface water samples were collected from 10 locations in the Consolidated Slip during a rainfall event in March 1987 (Table 4.16; Figure 2.22). The EC of these samples ranged from 31,000 µmhos/cm to 34,000 µmhos/cm. The pH of these samples ranged from 7.5 to 7.7. The temperature of these samples ranged from 17°C to 20°C.

TABLE 4.1
PHYSICAL PARAMETERS OF UNSATURATED SOIL

	MOISTURE CONTENT (percent)				PH				EC (µmhos/cm)				TOC (mg/kg)			
UNIT/AREA	NO. SAMP	MIN	MAX	MEAN	NO. SAMP	MIN	MAX	MEAN	NO. SAMP	MIN	MAX	MEAN	NO. SAMP	MIN	MAX	MEAN[1]
FILL[2]																
CPA	5	16.0	19.0	18.0	3	5.0	5.9	5.3	2	490	600	545	6	0.78	20,000	4,091
OUTSIDE CPA	27	<1	26.3	10.7	NA	NA	NA	NA	NA	NA	NA	NA	17	0.64	2.1	1.01
PLAYA DEPOSITS[3]																
CPA	13	12	24	17.7	2	7.9	8.0	8.0	2	260	3,000	1,630	9	0.25	18,000	4.64
OUTSIDE CPA	69	1.14	22.3	12.4	6	4.48	8.47	7.05	6	107	3,990	1,144	31	0.05	22,300	2.52
PALOS VERDES SAND[4]																
CPA	13	3.1	11	7.1	2	7.7	8	7.9	2	760	1,400	1,080	2	1,170	14,000	4,047
OUTSIDE CPA	5	8.3	29.1	12.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
UPPER BELLFLOWER AQUITARD[5]																
CPA	16	2.0	29	8.9	2	4.4	7.6	7.5	2	750	3,400	2,075	2	1,170	14,000	4,047
OUTSIDE CPA	8	3.76	20.6	10.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SUMMARY	156	<1	29.1	11.8	15	4.4	8.5	7.1	14	107	3990	1,252	67	0.05	22,300	5.02

NOTES: Soil boring locations where samples were collected for testing and analysis of each parameter are shown in Figures 4.6, 4.7, and 4.8.
Sample identifiers, sample depths, sample dates, and results of testing for each discrete sample have been tabulated and are presented in Appendix E (Table E.6).

FOOTNOTES
1) GEOMETRIC MEAN OF THE SAMPLE VALUES
2) FILL SOIL SAMPLES COLLECTED AT DEPTHS FROM 0.5 TO 8.8 FEET BELOW LAND SURFACE (BLS)
3) PLAYA DEPOSIT SOIL SAMPLES COLLECTED AT DEPTHS FROM 0.5 TO 40.75 FEET BLS
4) PALOS VERDES SAND SOIL SAMPLES COLLECTED AT DEPTHS FROM 25.7 TO 41.25 FEET BLS
5) UPPER BELLFLOWER AQUITARD SOIL SAMPLES COLLECTED AT DEPTHS FROM 44.1 TO 69.3 FEET BLS

EC = electrical conductivity
µmhos/cm = micromhos per centimeter
TOC = total organic carbon
mg/kg = milligrams per kilogram
NO. SAMP = number of samples
MIN = minimum value
MAX = maximum value
MEAN = arithmetic average of values
CPA = Central Process Area
NA = not applicable
< = less than

TABLE 4.2

DRY BULK DENSITY, POROSITY AND TOTAL ORGANIC CARBON CONTENT OF HYDROGEOLOGIC UNITS

	DRY BULK DENSITY (g/cc)				POROSITY (percent)				TOC (mg/kg)			
HYDROGEOLOGIC UNIT	NO. SAMP	MIN	MAX	MEAN	NO. SAMP	MIN	MAX	MEAN	NO. SAMP	MIN	MAX	GEOMETRIC MEAN[1]
UPPER BELLFLOWER AQUITARD	14	1.16	1.73	1.55	14	35.5	58.2	42.3	13	<100	4,800	537
BELLFLOWER SAND	12	1.49	1.93	1.63	12	27.0	44.2	38.8	13	<100	>16,000	632
LOWER BELLFLOWER AQUITARD	8	1.43	1.65	1.58	8	38.1	46.4	41.0	7	190	11,000	1,643
GAGE AQUIFER	5	1.47	1.57	1.54	5	40.3	44.8	42.2	8	245	5,900	2,568
GAGE-LYNWOOD AQUITARD	5	1.37	1.58	1.52	5	40.8	49.6	44.0	3	2,440	4,700	2,777
LYNWOOD AQUIFER	3	1.43	1.77	1.65	3	32.0	48.3	38.6	4	200	4,700	200
SUMMARY	47	1.16	1.93	1.58	47	27.0	58.2	41.1	48	<100	>16,000	853

NOTE: Sample identifiers, sample depths, sample dates, and results of testing for each discrete sample have been tabulated and are presented in Appendix E (Tables E-5 and E-6).

FOOTNOTES

1) GEOMETRIC MEAN TOC CONCENTRATIONS SHOWN ON THIS TABLE DO NOT REFLECT SEVEN SAMPLES WHERE TOC CONCENTRATIONS MAY BE ATTRIBUTABLE TO WOOD/CHARCOAL OR OTHER ORGANIC MATTER OBSERVED IN LITHOLOGIC SAMPLES AND FIVE SAMPLES WHERE TOC CONCENTRATIONS WERE NOT DETECTED ABOVE THE LABORATORY DETECTION LIMIT OF 100 MG/KG.

TOC = total organic carbon
g/cc = grams per cubic centimeter
mg/kg = milligrams per kilogram
NO. SAMP = number of samples
MIN = minimum value
MAX = maximum value
MEAN = arithmetic average of values
GEOMETRIC MEAN = geometric average of values
< = less than; value is the Limit of Detection for this analysis
> = greater than

TABLE 4.3

WATER LEVEL ELEVATIONS
OCTOBER 1995

WELL IDENTIFIER	DATE MEASURED	REFERENCE POINT ELEVATION (feet msl)	DEPTH TO WATER BELOW REFERENCE POINT (feet)	WATER LEVEL ELEVATION (feet msl)
Upper Bellflower Aquitard Monitoring Wells				
MW-1	10/09/95	42.83	61.24	-18.41
MW-2(a)(b)	10/09/95	49.70	67.15	-17.45
MW-3(a)	10/09/95	47.41	65.82	-18.41
MW-4	10/09/95	46.69	64.91	-18.22
MW-5	10/09/95	44.95	62.94	-17.99
MW-6	10/10/95	45.68	64.32	-18.64
MW-7(a)	10/12/95	47.42	65.60 (product) 65.79 (water)	-18.37(product) -18.37(c)
MW-8	10/12/95	49.09	67.16	-18.07
MW-9	10/09/95	48.67	66.68	-18.01
MW-10	10/09/95	43.20	60.93	-17.73
MW-11	10/09/95	42.69	60.88	-18.19
MW-12	10/09/95	40.17	58.38	-18.21
MW-13	10/09/95	42.34	60.81	-18.47
MW-14	10/09/95	43.13	61.68	-18.55
MW-16	10/09/95	41.31	60.34	-19.03
MW-17	10/09/95	48.18	66.66	-18.48
MW-18	10/09/95	50.29	68.27	-17.98
MW-19	10/09/95	46.55	64.01	-17.46
MW-20	10/10/95	43.04	60.21 (product) 60.39 (water)	-17.17(product) -17.35(d)
MW-21	10/09/95	36.49	54.46	-17.97
MW-22	10/09/95	41.85	60.90	-19.05
MW-23	10/09/95	36.35	55.09	-18.74

NOTE: REFER TO PAGE 6 OF THIS TABLE FOR FOOTNOTES

TABLE 4.3 (continued)
WATER LEVEL ELEVATIONS
OCTOBER 1995

WELL IDENTIFIER	DATE MEASURED	REFERENCE POINT ELEVATION (feet msl)	DEPTH TO WATER BELOW REFERENCE POINT (feet)	WATER LEVEL ELEVATION (feet msl)
Upper Bellflower Aquitard Monitoring Wells (con't)				
MW-24	10/09/95	22.40	40.84	-18.44
MW-25	10/09/95	31.98	51.92	-19.94
MW-26	10/09/95	39.17	58.04	-18.87
MW-27	10/09/95	40.83	58.25	-17.42
MW-28	10/09/95	39.82	57.86	-18.04
MW-29	10/09/95	38.87	57.58	-18.71
MW-30	10/09/95	37.59	55.90	-18.31
Bellflower Sand Monitoring Wells				
BF-1	10/09/95	48.28	66.67	-18.39
BF-2	10/12/95	49.49	68.10	-18.61
BF-3	10/09/95	48.27	66.64	-18.37
BF-4	10/09/95	47.67	66.17	-18.50
BF-5	10/09/95	39.37	57.84	-18.47
BF-6	10/09/95	41.70	60.36	-18.66
BF-7	10/09/95	42.64	61.44	-18.80
BF-9	10/12/95	48.69	66.95	-18.26
BF-10	10/11/95	28.67	48.78	-20.11
BF-11	10/09/95	33.66	54.90	-21.24
BF-12	10/09/95	22.20	43.61	-21.41
BF-13	10/09/95	29.52	48.80	-19.28
BF-14	10/09/95	36.30	55.65	-19.35
BF-15	10/09/95	22.82	42.17	-19.35
BF-16	10/10/95	35.31	56.27	-20.96
BF-17	10/09/95	22.67	44.05	-21.38

NOTE: REFER TO PAGE 6 OF THIS TABLE FOR FOOTNOTES

TABLE 4.3 (continued)
WATER LEVEL ELEVATIONS
OCTOBER 1995

WELL IDENTIFIER	DATE MEASURED	REFERENCE POINT ELEVATION (feet msl)	DEPTH TO WATER BELOW REFERENCE POINT (feet)	WATER LEVEL ELEVATION (feet msl)
Bellflower Sand Monitoring Wells (con't)				
BF-19	10/09/95	40.44	58.58	-18.14
BF-20	10/09/95	48.33	67.02	-18.69
BF-21	10/09/95	39.67	59.21	-19.54
BF-22	10/09/95	34.29	55.28	-20.99
BF-23	10/09/95	25.93	45.11	-19.18
BF-24	10/09/95	31.18	51.65	-20.47
BF-25	10/09/95	23.70	45.85	-22.15
BF-26	10/09/95	35.48	58.24	-22.76
BF-27	10/09/95	24.18	46.34	-22.16
BF-28	10/09/95	33.84	56.26	-22.42
BF-29	10/09/95	39.62	59.31	-19.69
BF-30	10/09/95	24.58	45.55	-20.97
BF-31	10/09/95	37.55	57.15	-19.60
BF-32A	10/09/95	50.81	69.70	-18.89
BF-33	10/10/95	35.98	55.44	-19.46
Gage Aquifer Monitoring Wells				
G-1	10/09/95	46.66	65.59	-18.93
G-2	10/09/95	43.46	62.90	-19.44
G-3	10/09/95	49.69	69.88	-20.19
G-4	10/09/95	39.70	59.35	-19.65
G-5	10/09/95	41.71	61.53	-19.82
G-6	10/09/95	42.54	62.44	-19.90
G-8	10/09/95	22.52	43.38	-20.86
G-9	10/11/95	28.58	50.30	-21.72

NOTE: REFER TO PAGE 6 OF THIS TABLE FOR FOOTNOTES

TABLE 4.3 (continued)
WATER LEVEL ELEVATIONS
OCTOBER 1995

WELL IDENTIFIER	DATE MEASURED	REFERENCE POINT ELEVATION (feet msl)	DEPTH TO WATER BELOW REFERENCE POINT (feet)	WATER LEVEL ELEVATION (feet msl)
Gage Aquifer Monitoring Wells (con't)				
G-11	10/09/95	29.48	50.87	-21.39
G-12	10/09/95	25.85	47.00	-21.15
G-13	10/09/95	36.09	57.16	-21.07
G-14	10/09/95	40.62	59.93	-19.31
G-15	10/09/95	46.83	66.17	-19.34
G-16	10/09/95	37.10	57.77	-20.67
G-17	10/09/95	35.99	56.52	-20.53
G-18	10/09/95	21.70	43.84	-22.14
G-19	10/09/95	31.86	53.66	-21.80
Lower Gage Aquifer Monitoring Wells				
LG-1	10/09/95	43.24	62.73	-19.49
LG-2	10/09/95	44.61	63.83	-19.22
Lynwood Aquifer Monitoring Wells				
LW-1	10/09/95	45.02	75.81	-30.79
LW-2	10/09/95	42.07	73.00	-30.93
LW-3	10/09/95	40.33	71.03	-30.70
LW-4	10/09/95	42.65	73.56	-30.91
LW-5	10/09/95	46.25	76.97	-30.72
LW-6	10/09/95	44.25	74.96	-30.71
LW-7	10/09/95	48.68	79.41	-30.73

NOTE: REFER TO PAGE 6 OF THIS TABLE FOR FOOTNOTES

TABLE 4.3 (continued)
WATER LEVEL ELEVATIONS
OCTOBER 1995

WELL IDENTIFIER	DATE MEASURED	REFERENCE POINT ELEVATION (feet msl)	DEPTH TO WATER BELOW REFERENCE POINT (feet)	WATER LEVEL ELEVATION (feet msl)
Central Process Area Extraction and Test Wells				
UBE-1(b)	10/09/95	49.35	67.79	-18.44
UBT-1(b)	10/09/95	49.06	67.57	-18.51
UBT-2(b)	10/09/95	49.19	67.69	-18.50
UBT-3(b)	10/09/95	49.32	67.79	-18.47

NOTE: REFER TO PAGE 6 OF THIS TABLE FOR FOOTNOTES

NOTE: Water level data presented in this table were used to prepare water level elevation contour maps for the Upper Bellflower Aquitard, Bellflower Sand, Gage Aquifer, and Lynwood Aquifer (See Figures 4.18 through 4.21). Data presented on water level elevation contour maps have been supplemented with data obtained by others at the adjacent Del Amo and McDonnell Douglas sites. Composite water level hydrographs for selected well clusters are presented in Figures 4-22A through 4-22I. Individual water level hydrographs for each well are presented in Appendix F.

FOOTNOTES

(a) Reference point elevations for these wells have possibly changed; water level elevations are approximate

(b) Depth to water measurements corrected due to problems encountered with the water level sounder

(c) Equivalent Hydraulic Head Elevation = RFP-DTW+[(DTW-DTFP) x γs]
Where: RFP = Reference point elevation
DTW = Depth to water
DTFP = Depth to free product
γs = Estimated specific gravity of free product = .80

(d) Equivalent Hydraulic Head Elevation = RFP-DTW+[(DTW-DTFP) x γs]
RFP = Reference point elevation
DTW = Depth to water
DTFP = Depth to free product
γs = Estimated specific gravity of free product = .88

msl = Mean sea level

MW = Upper Bellflower Aquitard Well Designator
BF = Bellflower Sand Well Designator
G = Gage Aquifer Well Designator
LG = Lower Gage Aquifer Well Designator
LW = Lynwood Aquifer Well Designator
UBE = Upper Bellflower Extraction Well Designator
UBT = Upper Bellflower Test Well Designator

TABLE 4.4

HORIZONTAL HYDRAULIC GRADIENTS
OCTOBER 1995

HYDROGEOLOGIC UNIT	APPROXIMATE DIRECTION	APPROXIMATE MAGNITUDE
Upper Bellflower Aquitard	South and southwest	9.4×10^{-4}
Bellflower Sand	South to southeast	1×10^{-3}
Gage Aquifer	East-southeast	1.6×10^{-3}
Lynwood Aquifer	Southeast	2×10^{-4}

TABLE 4.5

HYDRAULIC HEAD DIFFERENCES
OCTOBER 1995

MONITORING WELL CLUSTER	UBA TO BFS HYDRAULIC HEAD DIFFERENCE (feet)	APPROXIMATE VERTICAL HYDRAULIC GRADIENT	BFS TO GA (feet)	APPROXIMATE VERTICAL HYDRAULIC GRADIENT	GA TO LW (feet)	APPROXIMATE VERTICAL HYDRAULIC GRADIENT
MW-2, BF-9, LG-2, LW-1	-0.8	-0.017	-1.6	-0.020	-10.5	-0.235
MW-27, BF-19, G-14, LW-3	-0.7	-0.011	-1.2	-0.027	-11.4	-0.154
MW-12, BF-5, G-4	-0.3	-0.005	-1.2	-0.026	NA	NA
MW-13, BF-6, G-5, LW-2	-0.2	-0.004	-1.2	-0.024	-11.1	-0.156
MW-14, BF-7, G-6, LW-4	-0.3	-0.007	-1.1	-0.019	-11	-0.168
MW-24, BF-15, G-8	-0.9	-0.019	-1.5	-0.050	NA	NA
MW-23, BF-14, G-13	-0.6	-0.013	-1.7	-0.047	NA	NA
BF-13, G-11	NA	---	-2.1	-0.047	NA	NA
AVERAGE	-0.5	-0.011	-1.5	-0.032	-11	-0.179

NOTES: (-) Indicates water level elevations lower in the underlying hydrogeologic unit and a downward vertical hydraulic gradient. Vertical hydraulic gradients were estimated by dividing the difference in hydraulic head between adjacent monitoring wells screened in different depth intervals by the distance in feet between the elevations at the mid-point of the screened intervals for each pair of wells. Detailed information regarding well construction specifications and screened intervals are provided in Appendix C. Water level hydrographs for each well cluster are presented on Figures 4-22A through 4-22I.

UBA = Upper Bellflower Aquitard
BFS = Bellflower Sand
GA = Gage Aquifer
LW = Lynwood Aquifer
NA = Not available

TABLE 4.6

HYDRAULIC PARAMETERS

TESTED WELL IDENTIFIER	HYDROGEOLOGIC UNIT	TRANSMISSIVITY (ft^2/min)	HYDROGEOLOGIC UNIT THICKNESS[a] (ft)	HORIZONTAL HYDRAULIC CONDUCTIVITY (ft/day)	STORAGE COEFFICIENT	SPECIFIC CAPACITY (gpm/ft)	AQUIFER TEST METHOD
Upper Bellflower Aquitard Monitoring Wells							
MW-13	UBA	0.46	13.3	49	NA	2.0	Constant discharge
MW-15	UBA	0.25	18.6	19	NA	0.1	Constant discharge
MW-17	UBA	0.3	12.2	35	NA	1.4	Constant discharge
MW-25	UBA	1.2	17.3	100	NA	1.1	Constant discharge
MW-26	UBA	0.16	11.2	21	NA	0.2	Constant discharge
UBE-1	UBA	0.39	20	28	1.5×10^{-2}	0.7	Constant discharge
UBT-1	UBA	0.19	20	13	1.5×10^{-2}	0.36	Constant discharge
MW-1	UBA	---	---	13	NA	---	Slug test
MW-8	UBA	---	---	1.0	NA	---	Slug test
MW-9	UBA	---	---	1.5	NA	---	Slug test
MW-10	UBA	---	---	5.5	NA	---	Slug test
MW-11	UBA	---	---	1.0	NA	---	Slug test
MW-21	UBA	---	---	3.5	NA	---	Slug test
Bellflower Sand Monitoring Wells							
BF-5	BFS	5.5	20	396	2×10^{-4}	3.0	Constant discharge

TABLE 4.6 (continued)
HYDRAULIC PARAMETERS
Page 2 of 3

TESTED WELL IDENTIFIER	HYDROGEOLOGIC UNIT	TRANSMISSIVITY (ft^2/min)	HYDROGEOLOGIC UNIT THICKNESS[a] (ft)	HORIZONTAL HYDRAULIC CONDUCTIVITY (ft/day)	STORAGE COEFFICIENT	SPECIFIC CAPACITY (gpm/ft)	AQUIFER TEST METHOD
BF-7	BFS	1.3	10	187	1×10^{-4}	0.8	Constant discharge
BF-9	BFS	3.5	19.5	258	1×10^{-4}	1.9	Constant discharge
BF-11	BFS	8.4	60	204	---	5.7	Constant discharge
BF-13	BFS	1.3	59.5	31	---	0.6	Constant discharge
BF-15	BFS	5	43.5	166	5×10^{-4}	3.4	Constant discharge
Gage Aquifer Monitoring Wells							
G-5	GA	1.5	61	35	2×10^{-4}	3.8	Constant discharge
G-11	GA	1.1	52	30	2×10^{-4}	2.3	Constant discharge
G-13	GA	0.92	36.5	36	2×10^{-4}	1.3	Constant discharge
LG-2	GA	1.7	64.5	38	3×10^{-4}	1.1	Constant discharge
Lynwood Aquifer Monitoring Wells							
LW-3	LW	3.2	24	192	3×10^{-4}	7.6	Constant discharge

NOTE: Refer to page 3 of this table for footnotes

TABLE 4.6 (continued)
HYDRAULIC PARAMETERS

NOTE: Detailed results of aquifer testing were provided in separate data submittals to EPA. An annotated list of referenced documents is provided in Appendix A.

FOOTNOTES:

(a) Hydraulic conductivity estimates are based on saturated unit thickness except for estimates of hydraulic conductivity for constant discharge aquifer tests conducted in the Upper Bellflower Aquitard. These estimates are based on the saturated screened interval. In some cases the unit thickness is based on data obtained from exploratory boreholes located adjacent to the monitoring well.

ft^2/min = Square feet per minute
ft = Feet
ft/day = Feet per day
gpm/ft = Gallons per minute per foot of drawdown
UBA = Upper Bellflower Aquitard
NA = Not applicable
(---) = No information available
BFS = Bellflower Sand
GA = Gage Aquifer
LW = Lynwood Aquifer

TABLE 4.7

VERTICAL HYDRAULIC CONDUCTIVITY

SAMPLE LOCATION	SAMPLE DEPTH (ft bls)	VERTICAL HYDRAULIC CONDUCTIVITY (ft/day)	LITHOLOGY
Upper Bellflower Aquitard			
G-9	83	7.7×10^{-1}	Fine-grained sand
G-13	81.1	8.1	Silty sand
LW-3	90	3.6×10^{-3}	Sandy, clayey silt
LW-3	120.5	1.0	Silty, sandy clay
EB-13	80	3.4	Fine-grained sand
G-17	93	9.4×10^{-4}	sand/sandy silt
G-19	67	3.2×10^{-4}	Fine-grained silty sand
G-15	101	1.7×10^{-2}	Fine- to medium-grained sand
BF-31	67	1.6×10^{-4}	Clay
BF-33	53	5.4×10^{-3}	Silty sand
EB-17	93	3.2×10^{-5}	Fine- to medium-grained sand
LW-6	89	5.9×10^{-5}	Sandy silt
LW-7	113	4.9×10^{-3}	Silty sand/silt and sandy silt
BF-32	78	3.9×10^{-5}	Fine- to medium-grained sand
	Geometric Mean	6.2×10^{-3}	
Bellflower Sand			
G-8	104.7	2.95	Fine-grained sand
G-13	117.6	11	Fossiliferous sand
EB-13	117	1.1×10^{-3}	Fossiliferous sand
BF-24	113	8.1×10^{-4}	Clayey silt
G-17	123	6.4×10^{-4}	Fine- to medium-grained sand
BF-27	109	8.2×10^{-4}	Fine-grained sand
BF-29	116	1.7	Fine- to medium-grained sand
BF-31	112	8.4×10^{-2}	Fine-grained sand
BF-26	140.5	9.0×10^{-4}	Sandy silt/silty sand
LW-5	108	3.3×10^{-4}	Silty sand
LW-7	123	3.4×10^{-3}	Fine- to medium-grained sand
	Geometric Mean	1.3×10^{-2}	

NOTES: Vertical hydraulic conductivity estimated based on laboratory permeameter tests on core samples using American Society for Testing and Materials (ASTM) Method 2434.
See Figures 2.7 and 4.18 through 4.21 for well and boring locations.
Laboratory results are provided in Appendix E.

ft bls = Feet below land surface
ft/day = Feet per day

TABLE 4.7 (continued)
VERTICAL HYDRAULIC CONDUCTIVITY

SAMPLE LOCATION	SAMPLE DEPTH (ft bls)	VERTICAL HYDRAULIC CONDUCTIVITY (ft/day)	LITHOLOGY
Lower Bellflower Aquitard			
EB-13	121.5	1.4×10^{-4}	Sandy, clayey silt
EB-13	145	2.3×10^{-3}	Silt
G-8	130	5.0×10^{-2}	Silty clay
G-9	163	4.2×10^{-3}	Sandy, clayey silt
G-13	120	5.8×10^{-1}	Silty clay
G-13	144	1.0	Fine-grained sand
G-15	135.85	1.0×10^{-4}	Silty sand/sandy silt
LW-7	135.5	1.4×10^{-4}	Silty, fine sand/sandy silt
LW-6	138	1.5×10^{-4}	Interbedded silt and sand
	Geometric Mean	3.5×10^{-3}	
Gage Aquifer			
G-8	179.2	6.0×10^{-3}	Sandy silt
LW-3	180	1.4	Fine-grained sand
G-13	192	4.1	Silty, clayey sand
LW-5	163	2.2×10^{-3}	Fine- to medium-grained sand
LW-7	167	9.8×10^{-6}	Silty sand/sandy silt
	Geometric Mean	1.5×10^{-2}	
Gage-Lynwood Aquitard			
EB-9	225	4.2×10^{-3}	Clayey, sandy silt
EB-9	245	6.4×10^{-3}	Clayey silt
LW-4	217.5	4.3×10^{-4}	Clayey, silty sand
LW-5	220	1.1×10^{-4}	Silt
LW-6	220.5	1.0×10^{-3}	Silt
	Geometric Mean	1.1×10^{-3}	
Lynwood Aquifer			
LW-3	245.6	1.3	Silty sand
LW-4	228	1.9×10^{-4}	Fine- to medium-grained sand
LW-6	255	8.7×10^{-4}	Fine-grained sand
	Geometric Mean	6.0×10^{-3}	

NOTES: Vertical hydraulic conductivity estimated based on laboratory permeameter tests on core samples using American Society for Testing and Materials (ASTM) Method 2434.
See Figures 2.7 and 4.18 through 4.21 for well and boring locations.
Laboratory results are provided in Appendix E.

ft bls = Feet below land surface
ft/day = Feet per day

TABLE 4.8

INORGANIC COMPOUNDS IN GROUNDWATER

CONSTITUENT	.....CONCENTRATIONS (mg/L)..... MINIMUM	MAXIMUM	MEAN
Upper Bellflower Aquitard (Excluding Monitoring Well MW-2)			
TDS	430	4,800	1,911
Chloride	93	1,400	425
Sulfate	18	1,900	281
Nitrate	<0.1	120	27
Calcium	61	850	308
Magnesium	14	230	84
Potassium	4.6	24	12
Sodium	48	840	207
Fluoride	0.1	0.39	0.2
Boron	0.08	0.94	0.42
Alkalinity as $CaCO_3$	320	620	425
Silica	25	48	35
Upper Bellflower Aquitard/Central Process Area/Monitoring Well MW-2			
TDS	9,650	14,000	12,678
Chloride	1,919	2,400	2,153
Sulfate	3,600	5,800	4,828
Nitrate	<0.4	0.92	0.81
Calcium	430	580	546
Magnesium	540	690	609
Potassium	19	39	25
Sodium	2,400	2,500	2,474
Fluoride	3.90	7.70	6.30
Boron	0.74	1.3	0.96
Alkalinity as $CaCO_3$	NA	NA	NA
Silica	NA	NA	NA

NOTES: Analytical results for groundwater samples collected from On-Property/Central Process Area monitoring well MW-2 were not incorporated into the range and mean data summaries.

Analytical results for discrete samples collected from individual monitoring wells were provided to EPA in separate data submittals and are summarized in Appendix G.

MEAN = Arithmetic average of values
mg/l = Milligrams per liter
TDS = Total dissolved solids
$CaCO_3$ = Calcium carbonate
ND = Compound concentration was less than the Limit of Detection
NA = Not applicable

SCO/980140010.DOC-95/CA

TABLE 4.8 (continued)
INORGANIC COMPOUNDS IN WATER

CONSTITUENT	.....CONCENTRATIONS (mg/L)..... MINIMUM	MAXIMUM	MEAN
Bellflower Sand			
TDS	346	5,600	830
Chloride	46	2,000	111
Sulfate	22.4	330	132
Nitrate	<0.05	2.0	0.52
Calcium	51.2	221	104
Magnesium	2.7	230	15
Potassium	4.2	14	7
Sodium	56	380	101
Fluoride	0.13	0.5	0.26
Boron	0.06	0.36	0.19
Alkalinity as $CaCO_3$	160	440	257
Silica	22	33	27
Gage Aquifer			
TDS	200	520	348
Chloride	20	96	54
Sulfate	10.8	99	52.5
Nitrate	<0.02	0.86	0.49
Calcium	9	85	50.5
Magnesium	0.46	23	12.5
Potassium	4.2	9.2	5.7
Sodium	43.7	80	59.6
Fluoride	0.2	0.5	0.3
Boron	0.06	0.20	0.13
Alkalinity as $CaCO_3$	136	210	180
Silica	26	28	27

NOTES: Analytical results for groundwater samples collected from On-Property/Central Process Area monitoring well MW-2 were not incorporated into the range and mean data summaries.

Analytical results for discrete samples collected from individual monitoring wells were provided to EPA in separate data submittals and are summarized in Appendix G.

MEAN = Arithmetic average of values
mg/l = Milligrams per liter
TDS = Total dissolved solids
$CaCO_3$ = Calcium carbonate
ND = Compound concentration was less than the Limit of Detection
NA = Not applicable

TABLE 4.8 (continued)
INORGANIC COMPOUNDS IN WATER

CONSTITUENT	.....CONCENTRATIONS (mg/L)..... MINIMUM	MAXIMUM	MEAN
Lynwood Aquifer			
TDS	230	296	257
Chloride	10	31	22.6
Sulfate	2	31.2	13.7
Nitrate	<0.05	<0.05	NA
Calcium	19.7	48	32.5
Magnesium	5.8	10.1	7.6
Potassium	2.3	5.1	3.9
Sodium	35	78.7	59.6
Fluoride	<0.5	0.33	0.29
Boron	<0.05	0.09	0.07
Alkalinity as $CaCO_3$	180	190	183
Silica	24	30	26.3

NOTES: Analytical results for groundwater samples collected from On-Property/Central Process Area monitoring well MW-2 were not incorporated into the range and mean data summaries.

Analytical results for discrete samples collected from individual monitoring wells were provided to EPA in separate data submittals and are summarized in Appendix G.

MEAN = Arithmetic average of values
mg/l = Milligrams per liter
TDS = Total dissolved solids
$CaCO_3$ = Calcium carbonate
ND = Compound concentration was less than the Limit of Detection
NA = Not applicable

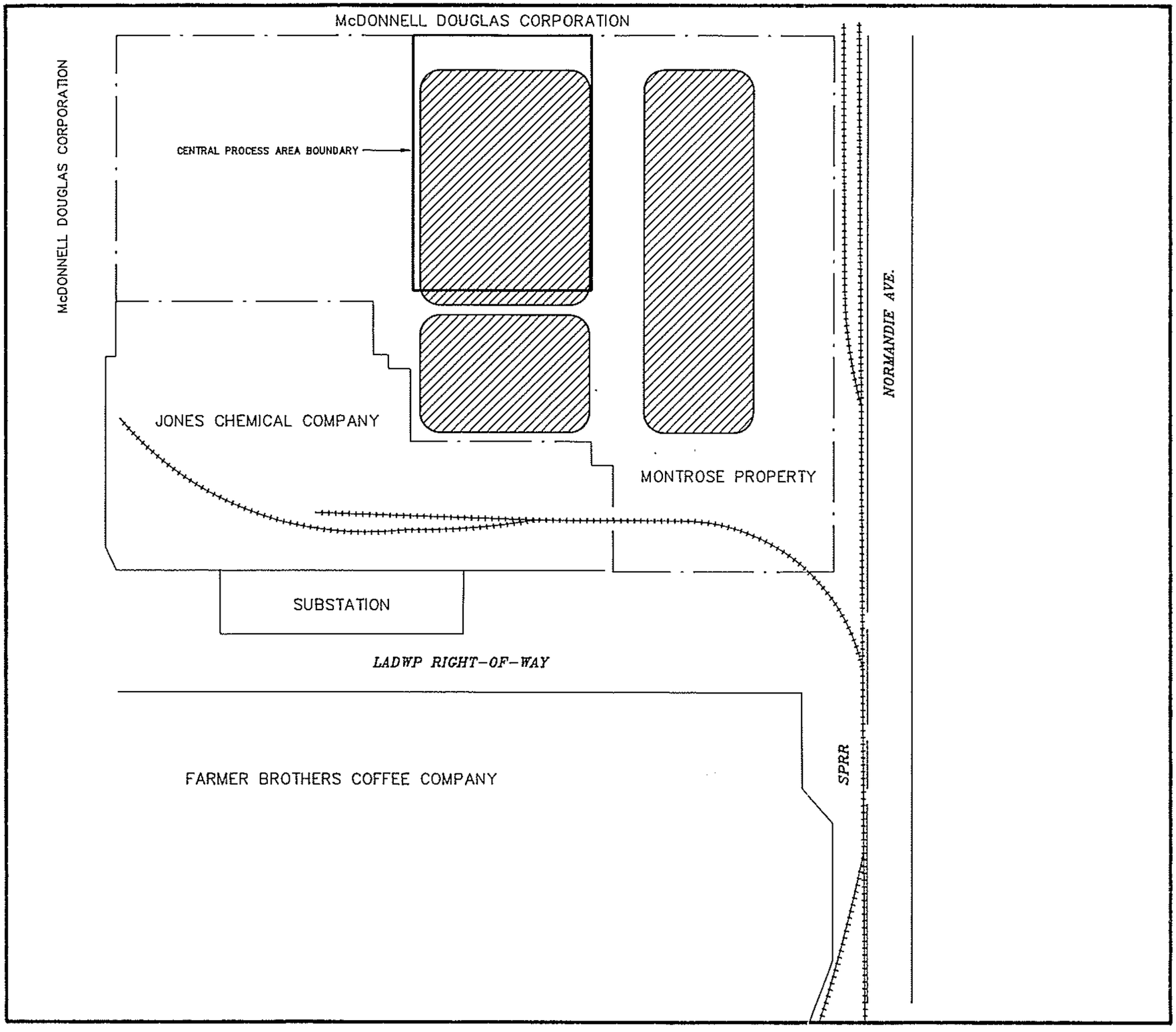
TABLE 4.9

PHYSICAL PARAMETERS OF GROUNDWATER SAMPLES
FOURTH QUARTER (OCTOBER-DECEMBER) 1995

UNIT	ELECTRICAL CONDUCTIVITY (µmhos/cm) MIN	MAX	MEAN	pH MIN	MAX	MEAN	TEMPERATURE (°C) MIN	MAX	MEAN
Upper Bellflower Aquitard (11 wells)	607	2,940	1,873	6.6	7.7	7.2	19.2	23.7	22.0
Bellflower Sand (7 wells)	698	1,449	1,140	7.3	8.1	7.7	20.7	23.2	22.0
Gage Aquifer (4 wells)	533	757	642	8.0	8.0	8.0	21.3	22.9	22.2
Lynwood Aquifer (2 wells)	403	429	416	8.1	9.1	8.6	22.9	23.9	23.4

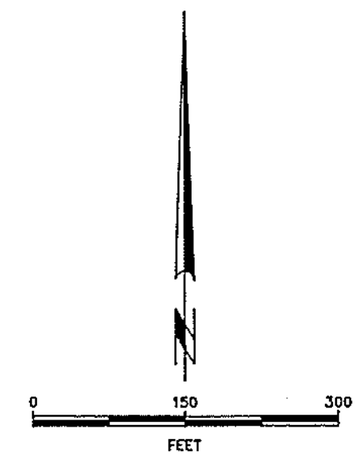
NOTE: Table 2.9 provides a complete list of sampling events and the wells sampled by hydrogeologic unit. Results for test well UBT-3 located On-Property within the Central Process Area are not included in range and average for UBA wells (EC = 7, 690; pH = 5.2; T°C = 22.8).
Water quality data are provided in Appendix G.

µmhos/cm = Micromhos per centimeter
MIN = Minimum
MAX = Maximum
Mean = Arithmetic mean
°C = Degrees Celsius



EXPLANATION

(hatched pattern)	RAISED PADS
—— · ——	MONTROSE PROPERTY BOUNDARY
+++++++++++++++	RAILROAD TRACKS
SPRR	SOUTHERN PACIFIC RAILROAD
LADWP	LOS ANGELES DEPARTMENT OF WATER AND POWER



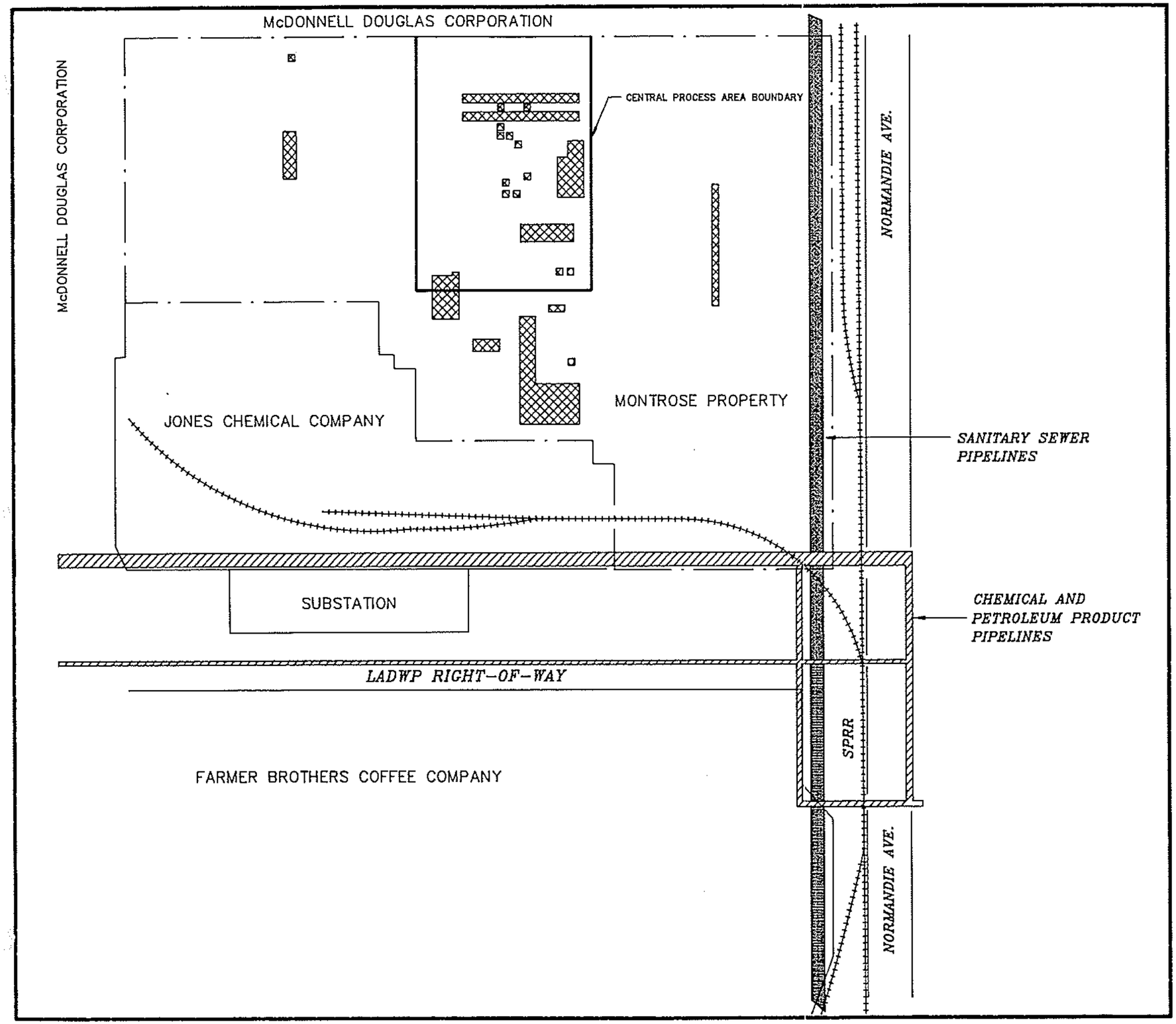
MONTROSE CHEMICAL CORPORATION
OF CALIFORNIA
TORRANCE, CALIFORNIA

ON-PROPERTY
TOPOGRAPHIC FEATURES

HARGIS+ASSOCIATES, INC. 10/92

FIGURE 4.1

PREP BY [signature] REV BY [signature] RPT NO. 218.544 | F04-02 | A



EXPLANATION

- BURIED CONCRETE, LOCATIONS APPROXIMATE
- SANITARY SEWER PIPELINES, LOCATION APPROXIMATE
- CHEMICAL AND PETROLEUM PRODUCT PIPELINES LOCATION APPROXIMATE
- MONTROSE PROPERTY BOUNDARY
- RAILROAD TRACKS
- *SPRR* SOUTHERN PACIFIC RAILROAD
- *LADWP* LOS ANGELES DEPARTMENT OF WATER AND POWER

0 150 300
FEET

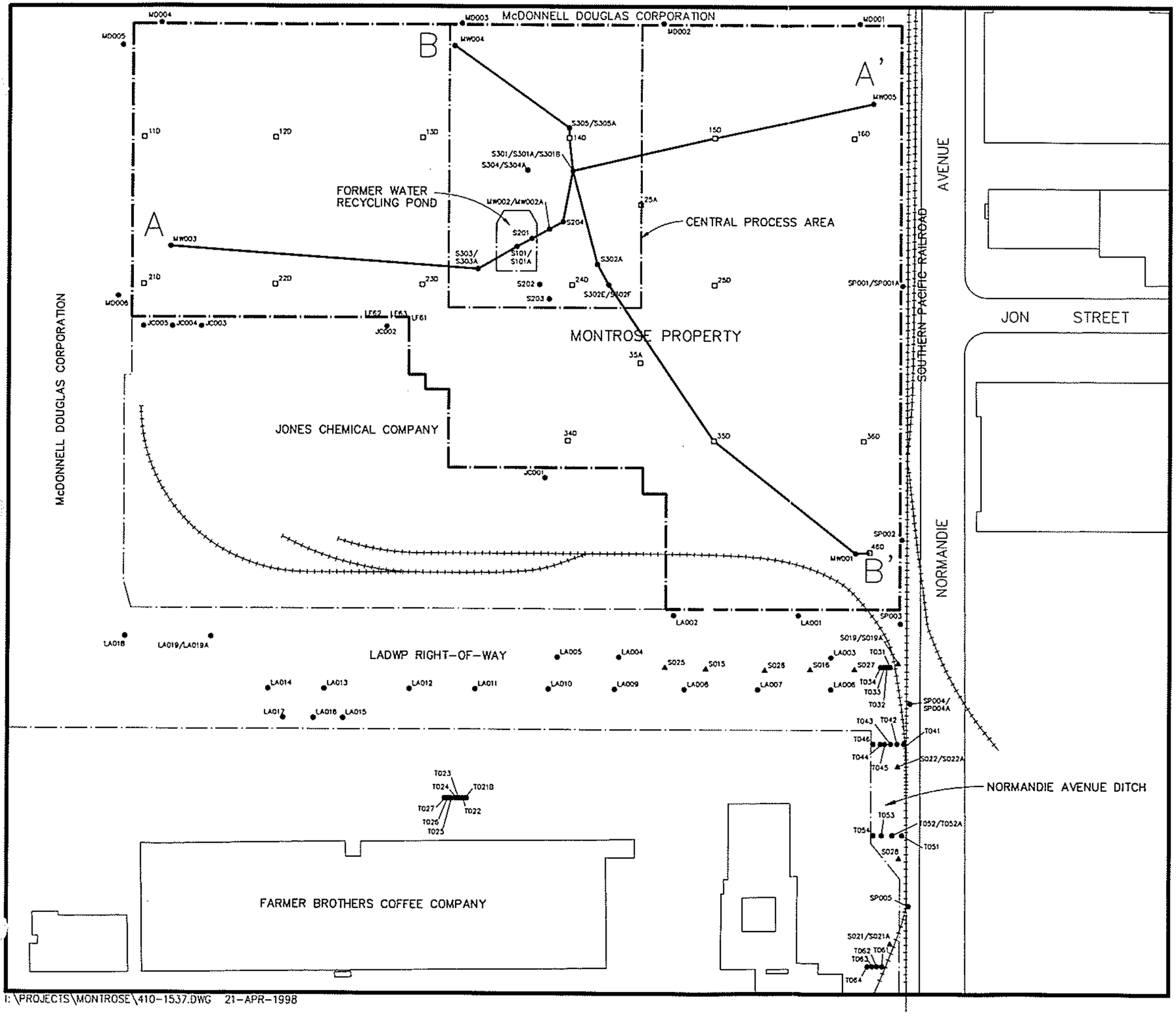
MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

SUBSURFACE FEATURES

HARGIS + ASSOCIATES, INC. 10/92

FIGURE 4.2

PREP BY [signature] REV BY [signature] RPT NO. 218.544 | F04-03 | A



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EXPLANATION

A ——— A'

LOCATION OF CROSS SECTION

S026 — SOIL BORING SAMPLED IN 1983 BY HARGIS & MONTGOMERY, INC.

S201 — SOIL BORING SAMPLED DURING 1995 TO 1988 BY HARGIS + ASSOCIATES, INC.

35A — SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC.

PROPERTY BOUNDARY

LADWP — LOS ANGELES DEPARTMENT OF WATER AND POWER

0 135 270

FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

SOIL CROSS SECTION LOCATIONS

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

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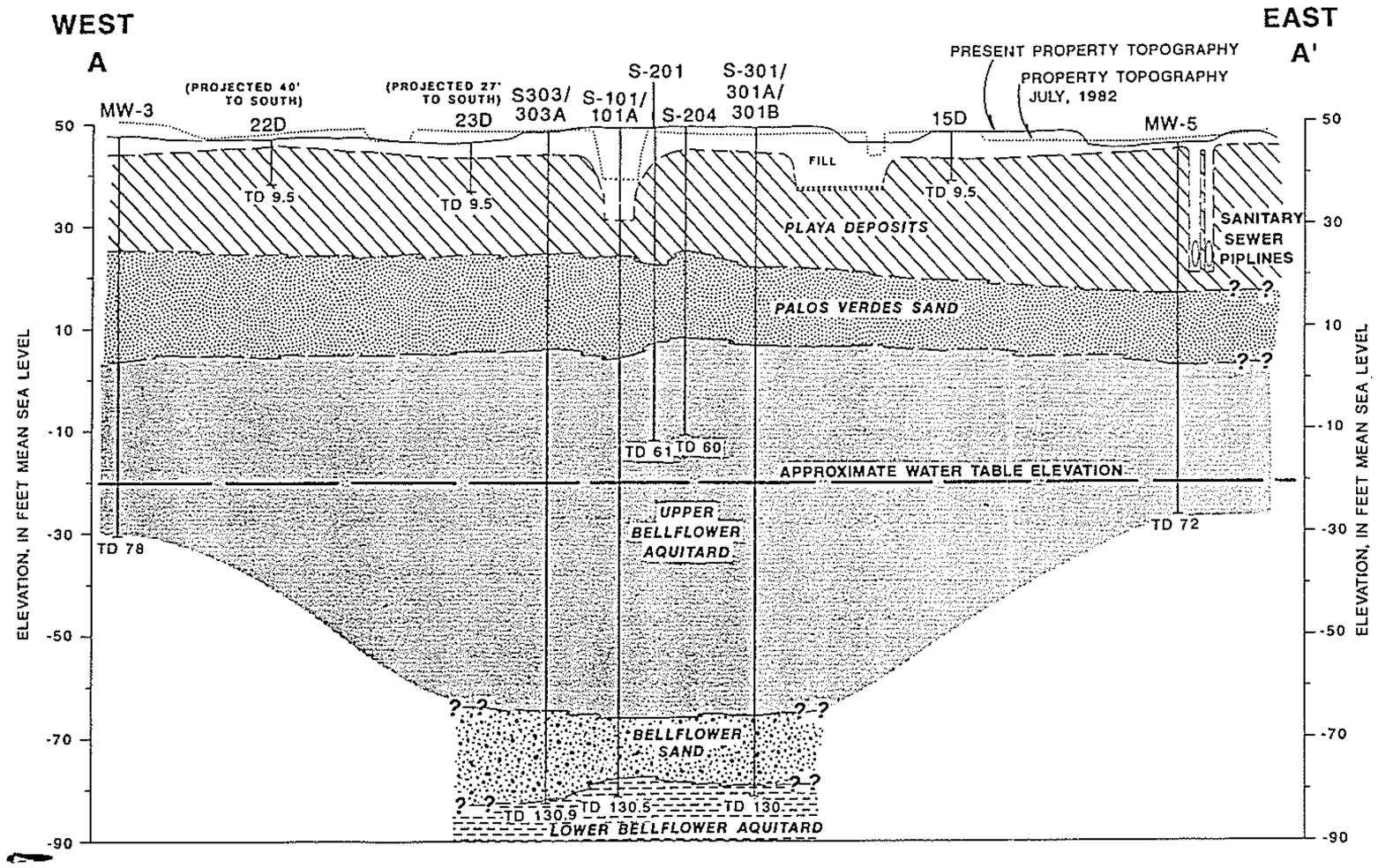
FIGURE 4.3

PREP BY ____ REV BY ____ RPT NO 218.1103 | 410-1537 | B



EXPLANATION

- CLAYEY SILT, SILTY CLAY OR CLAY
- FINE-GRAINED SAND
- INTERBEDDED FINE-GRAINED SAND AND SILT
- FINE TO COARSE-GRAINED SAND
- SILT AND SILTY SAND
- XXXXXX — BURIED CONCRETE
- MW-5 — SOIL BORING IDENTIFIER
- TD 72 — TOTAL DEPTH, IN FEET BELOW LAND SURFACE

NOTE: SEE FIGURE 4.3 FOR LOCATION OF CROSS SECTIONS

0 150 300
FEET

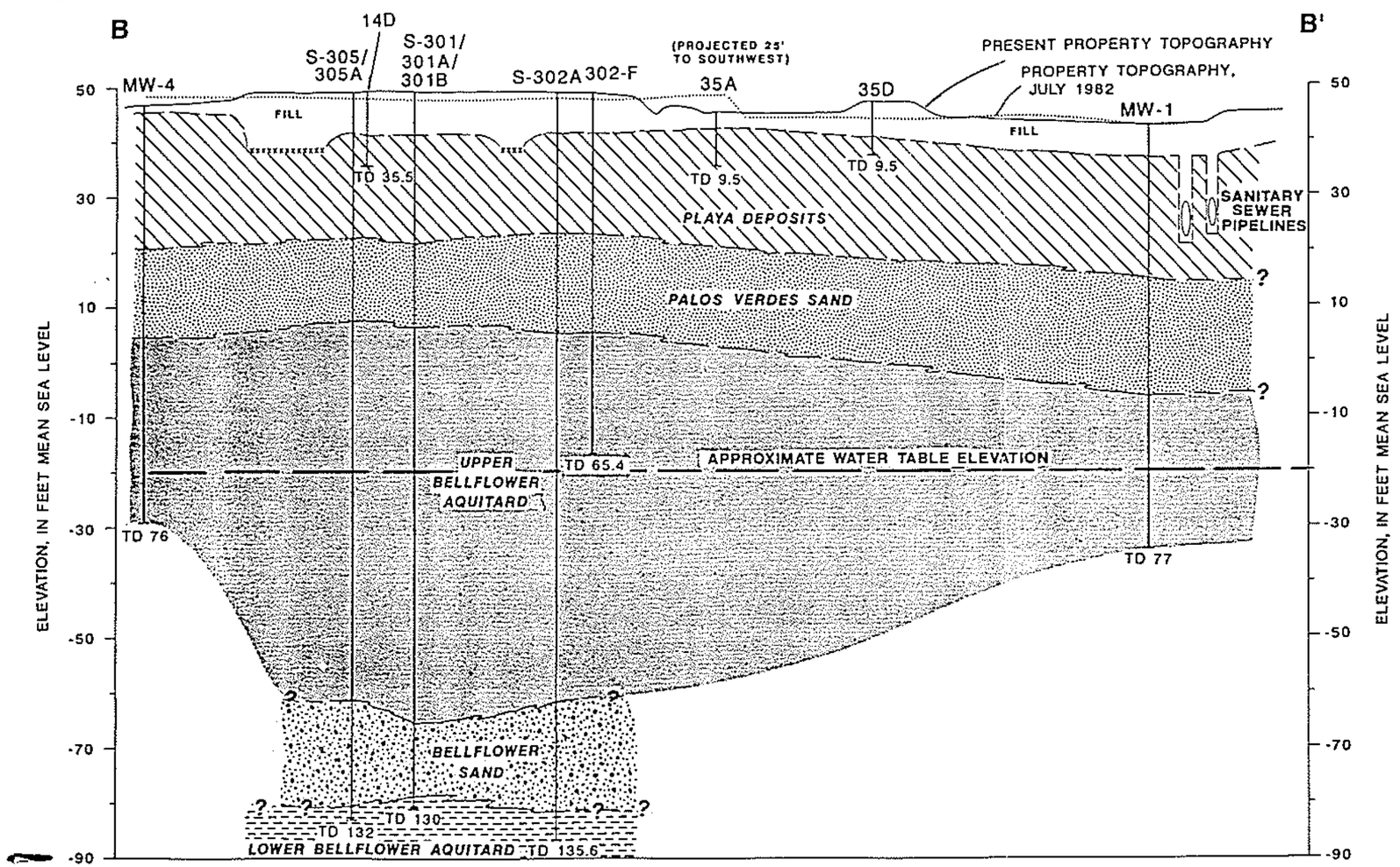
MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

SOIL
CROSS SECTION A-A'

HARGIS+ASSOCIATES, INC. 10/92

FIGURE 4.4

PREP BY MPalmer REV BY R.A.M. RPT NO. 218.544 | F04-05 | A



EXPLANATION

- CLAYEY SILT, SILTY CLAY OR CLAY
- FINE-GRAINED SAND
- INTERBEDDED FINE-GRAINED SAND AND SILT
- FINE TO COARSE-GRAINED SAND
- SILT AND SILTY SAND
- XXXXXX — BURIED CONCRETE
- MW-1 — SOIL BORING IDENTIFIER
- TD 77 — TOTAL DEPTH, IN FEET, BELOW LAND SURFACE

NOTE: SEE FIGURE 4.3 FOR LOCATION OF CROSS SECTIONS

0 150 300
FEET

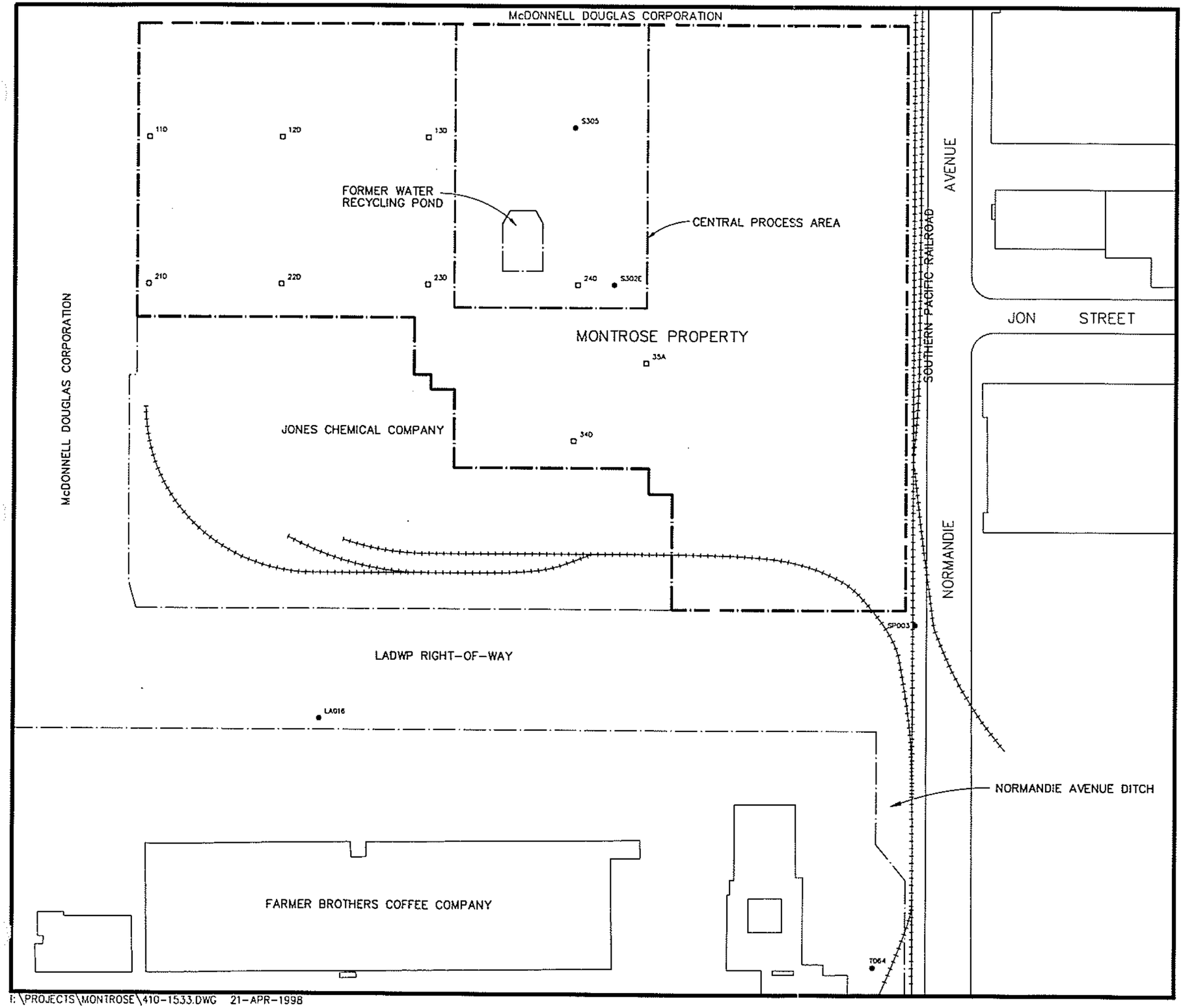
MONTROSE CHEMICAL CORPORATION
OF CALIFORNIA
TORRANCE, CALIFORNIA

SOIL
CROSS SECTION B-B'

HARGIS+ASSOCIATES, INC. 10/92

FIGURE 4.5

PREP BY [illegible] REV BY R.C.M. RPT NO. 218.544 | F04-06 | A



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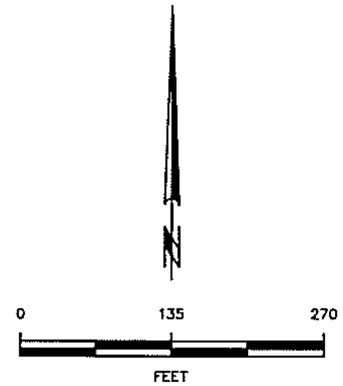
EXPLANATION

S305 — SOIL BORING SAMPLED BY HARGIS + ASSOCIATES, INC.

110 — SOIL BORING SAMPLED BY METCALF & EDDY, INC.

NOTE: SEE TABLE 4.1 FOR SUMMARY OF RESULTS.

SAMPLE IDENTIFIERS, SAMPLE DEPTHS, SAMPLE DATES, AND RESULTS OF TESTING FOR EACH DISCRETE SAMPLE HAVE BEEN TABULATED AND ARE PRESENTED IN APPENDIX E.



MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

TOTAL ORGANIC CARBON SOIL SAMPLING LOCATIONS

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

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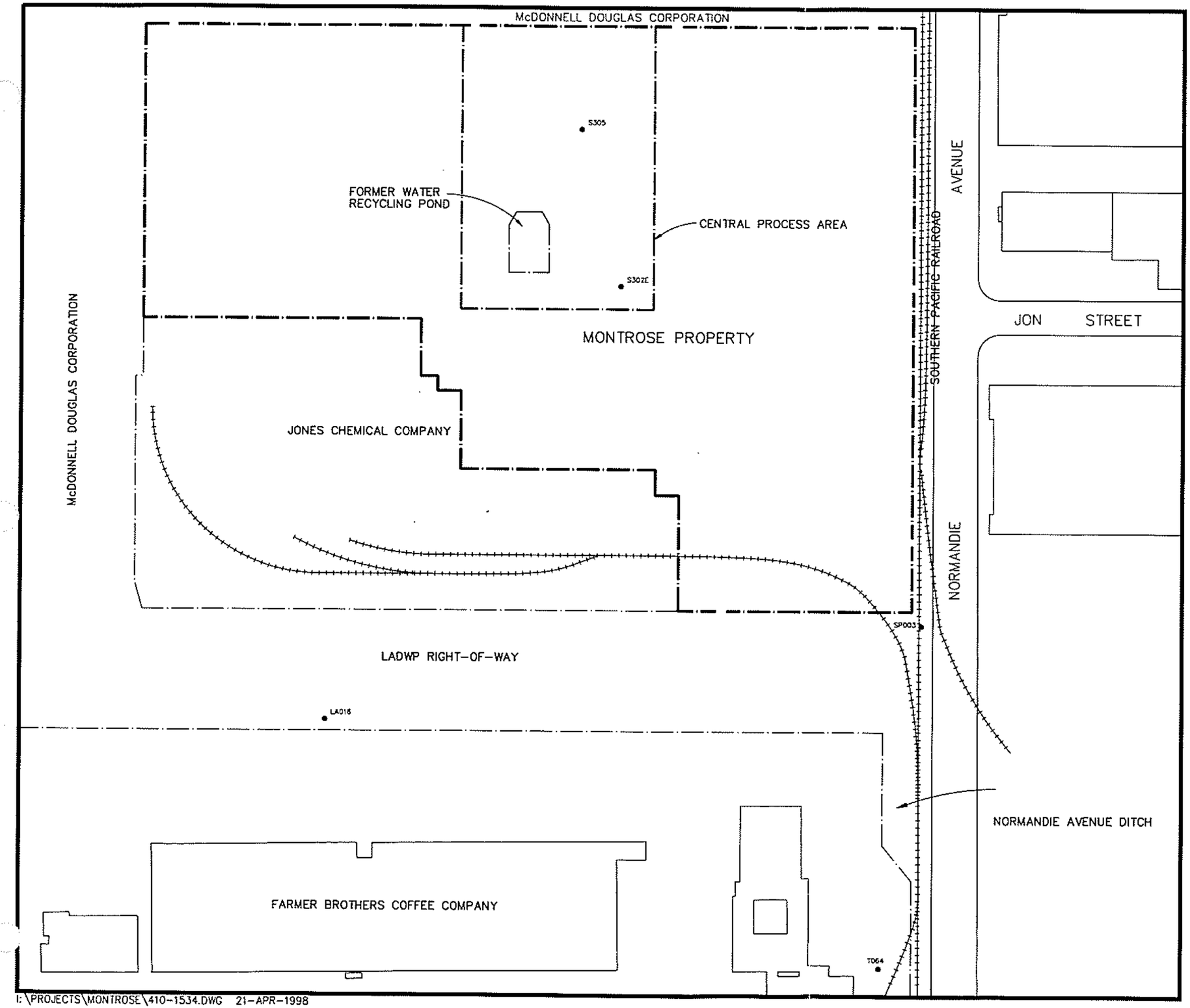
FIGURE 4.6

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 410-1533 | B



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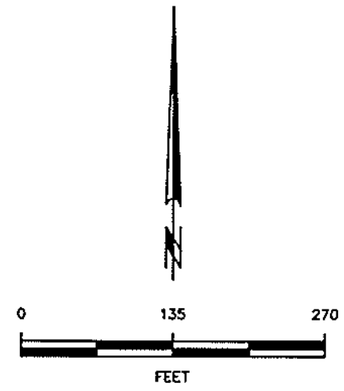
EXPLANATION

S305 — SOIL BORING SAMPLED BY HARGIS + ASSOCIATES, INC.

NOTE: SEE TABLE 4.1 FOR SUMMARY OF RESULTS.

SAMPLE IDENTIFIERS, SAMPLE DEPTHS, SAMPLE DATES, AND RESULTS OF TESTING FOR EACH DISCRETE SAMPLE HAVE BEEN TABULATED AND ARE PRESENTED IN APPENDIX E.



MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

ELECTRICAL CONDUCTIVITY AND PH SOIL SAMPLING LOCATIONS

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

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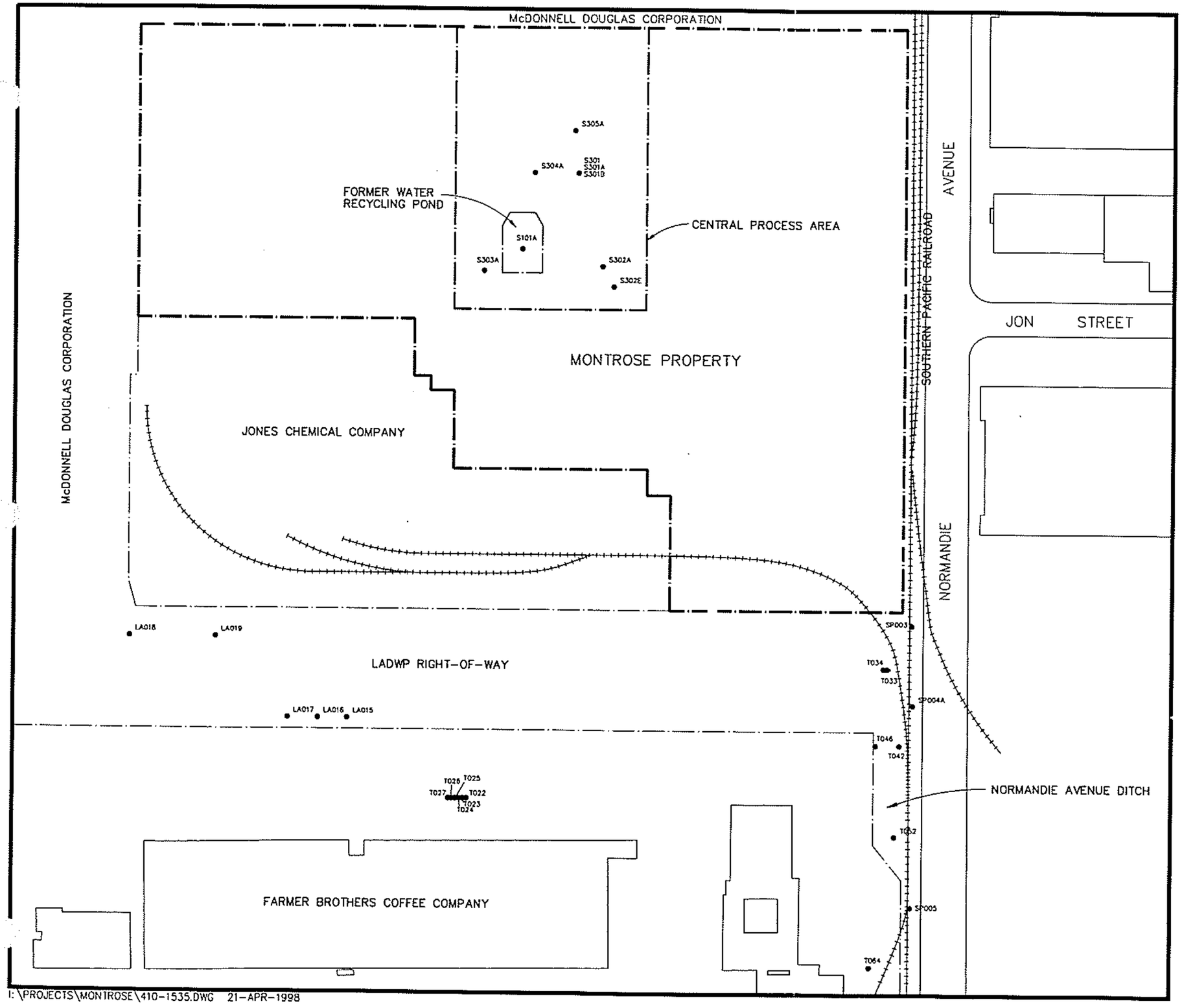
FIGURE 4.7

PREP BY ____ REV BY ____ RPT NO. 218.1103 | 410-1534 | B



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EXPLANATION

S101A — SOIL BORING SAMPLED BY HARGIS + ASSOCIATES, INC.

NOTE: SEE TABLE 4.1 FOR SUMMARY OF RESULTS.

SAMPLE IDENTIFIERS, SAMPLE DEPTHS, SAMPLE DATES, AND RESULTS OF TESTING FOR EACH DISCRETE SAMPLE HAVE BEEN TABULATED AND ARE PRESENTED IN APPENDIX E.

0 135 270

FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

PERCENT MOISTURE SOIL SAMPLING LOCATIONS

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

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FIGURE 4.8

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 410-1535 | B

[2] MONTROSE RI				[3] DEL AMO STUDY AREA RI
HYDROGEOLOGIC UNIT		AVERAGE THICKNESS (ft)	BASE ELEV. RANGE (ft/msl)	HYDROSTRATIGRAPHIC UNIT
[1] UPPER PLEISTOCENE LAKEWOOD FORMATION	UNSATURATED	65 ▼	-12 TO -20	UPPER BELLFLOWER AQUITARD
	UPPER BELLFLOWER AQUITARD	40	-20 TO -90	B-SAND / MUD
	BELLFLOWER SAND	45	-70 TO -110	MIDDLE BELLFLOWER AQUITARD / C-SAND
	LOWER BELLFLOWER AQUITARD	30	-85 TO -140	LOWER BELLFLOWER AQUITARD
	GAGE AQUIFER	60	-155 TO -190	GAGE AQUIFER
[1] LOWER PLEISTOCENE SAN PEDRO FORMATION	GAGE/ LYNWOOD AQUITARD	20	-170 TO -230	GAGE/ LYNWOOD AQUITARD
	[4] LYNWOOD AQUIFER	36	-240	
	[4] LYNWOOD SILVERADO AQUITARD	208	-440	
	[4] SILVERADO AQUIFER	>240	NOT REACHED	

EXPLANATION

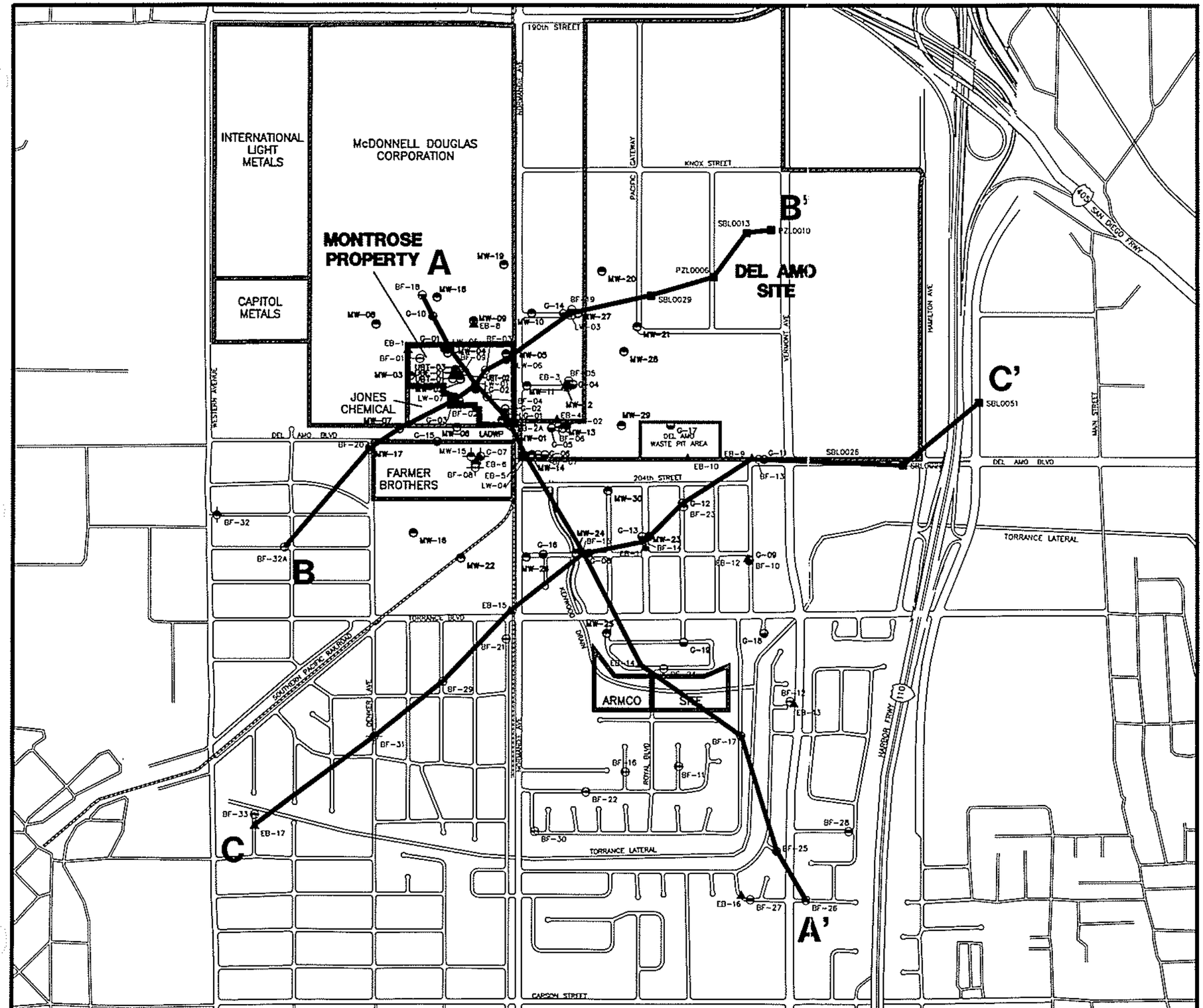
ft = FEET
msl = MEAN SEA LEVEL
▼ = WATER TABLE

SOURCES:

[1] CDWR BULLETIN 104, 1961 AND POLAND ET AL, 1959
[2] HARGIS + ASSOCIATES, 1987
[3] DAMES & MOORE, 1996
[4] DRILLERS LOG WELL No. 795

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

FIGURE 4.9 HYDROSTRATIGRAPHIC NOMENCLATURE



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EXPLANATION

A —— A'
CROSS SECTION LOCATION

MW-25 — UPPER BELLFLOWER AQUITARD MONITOR WELL

UBE-1 — UPPER BELLFLOWER AQUITARD EXTRACTION WELL

UBT-3 — UPPER BELLFLOWER AQUITARD OBSERVATION WELL

BF-17 — BELLFLOWER SAND MONITOR WELL

BF-32 — DESTROYED WELL

G-7 — GAGE AQUIFER MONITOR WELL

LW-7 — LYNWOOD AQUIFER MONITOR WELL

EB-16 — EXPLORATORY BORING

SBL/PZL — DATA PROVIDED BY DEL AMO RESPONDENTS

0 1000 2000
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

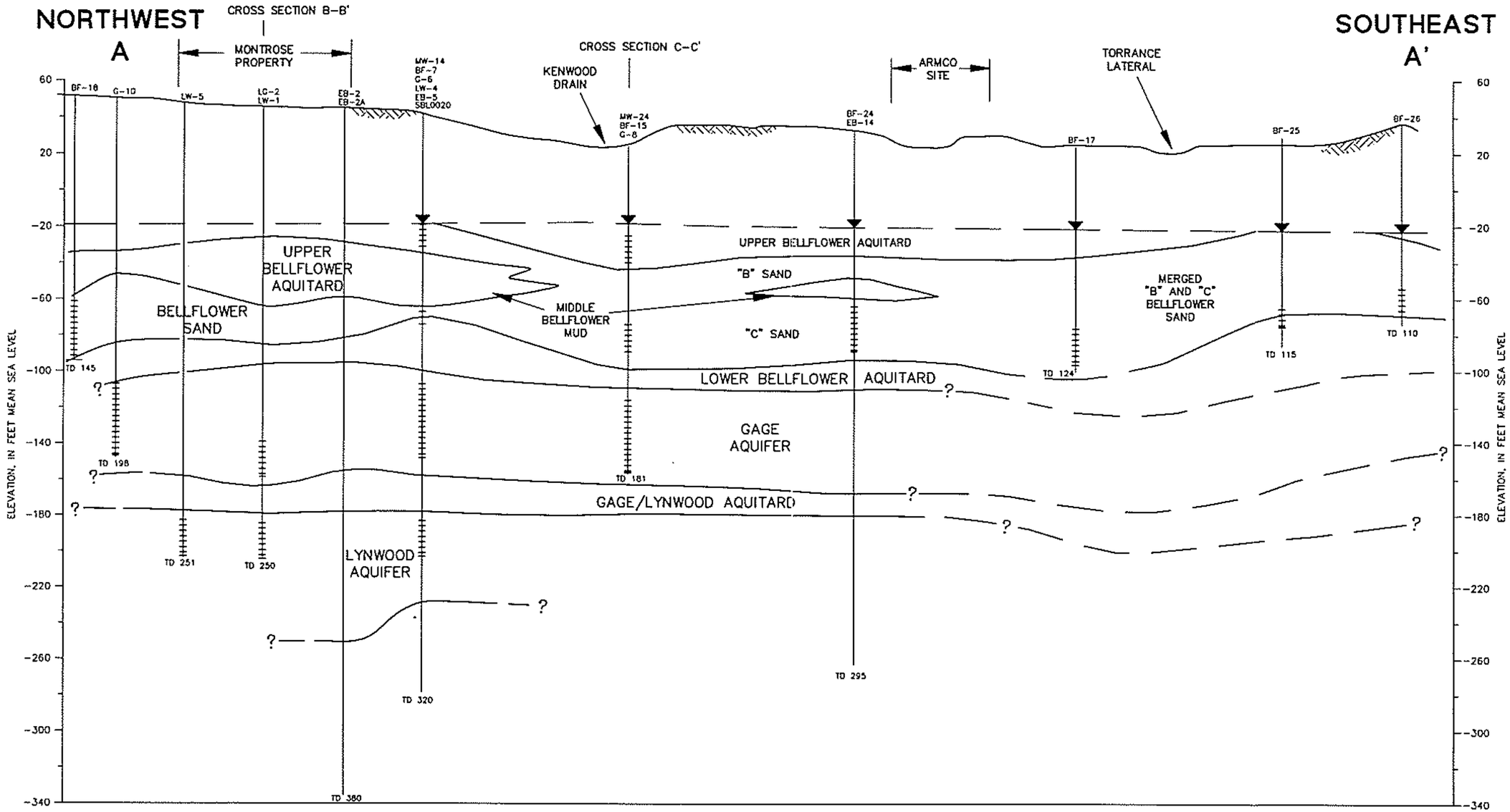
HYDROGEOLOGIC CROSS SECTION LOCATIONS

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 4.10

PREP BY _____ REV BY _____ RPT NO. 218.11.3 | 410-1532 | C



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Hydrogeology/Engineering

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7/97 | RPT NO.218.1106 | 310-0150 | B

FIGURE 4.11 HYDROGEOLOGIC CROSS SECTION A–A'

CROSS SECTION A–A'

SOUTHWEST
B

NORTHEAST
B'

JONES CHEMICAL COMPANY

MONTROSE PROPERTY

DEL AMO SITE

BF-32A
MW-17 BF-20
MW-7
BF-2 G-3 LW-7
LG-2 LW-1
BF-3
MW-5 LW-6
MW-27 BF-19 G-14 LW-3
SBL0029
PZL0006
SBL0013
PZL0010

"B" SAND

UPPER BELLFLOWER AQUITARD

BELLFLOWER SAND

"C" SAND

MERGED "B" AND "C" BELLFLOWER SAND

LOWER BELLFLOWER AQUITARD

GAGE AQUIFER

GAGE/LYNWOOD AQUITARD

LYNWOOD AQUIFER

TD 120
TD 85
TD 130
TD 125.5
TD 70
TD 71
TD 160
TD 181
TD 251
TD 250
TD 256
TD 261

ELEVATION, IN FEET MEAN SEA LEVEL

60
20
-20
-60
-100
-140
-180
-220
-260
-300
-340

EXPLANATION

HYDROGEOLOGIC UNIT CONTACT DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

BF-32A WELL OR BORING IDENTIFIER

STATIC WATER LEVEL ELEVATION MEASURED IN OCTOBER 1995 AND INFERRED WATER TABLE

SCREENED INTERVAL OF WELL. MORE THAN ONE WELL SCREEN INDICATES INDIVIDUAL WELLS CLUSTERED NEAR EACH OTHER

TD 120 TOTAL DEPTH DRILLED IN FEET BELOW LAND SURFACE

MONITOR WELLS AND EXPLORATORY BORINGS

MW	=	UPPER BELLFLOWER AQUITARD
BF	=	BELLFLOWER SAND
G	=	GAGE AQUIFER
LW	=	LYNWOOD AQUIFER
EB	=	EXPLORATORY BORING
SBL	=	DEL AMO SOIL BORING
PZL	=	DEL AMO PIEZOMETER

NOTE: SEE FIGURE 4.10 FOR LOCATION OF CROSS SECTION

VERTICAL SCALE
FEET
120
60
0

HORIZONTAL SCALE
FEET
600
300

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

I:\PROJECTS\MONTROSE\310-0150.DWG 21-APR-1998

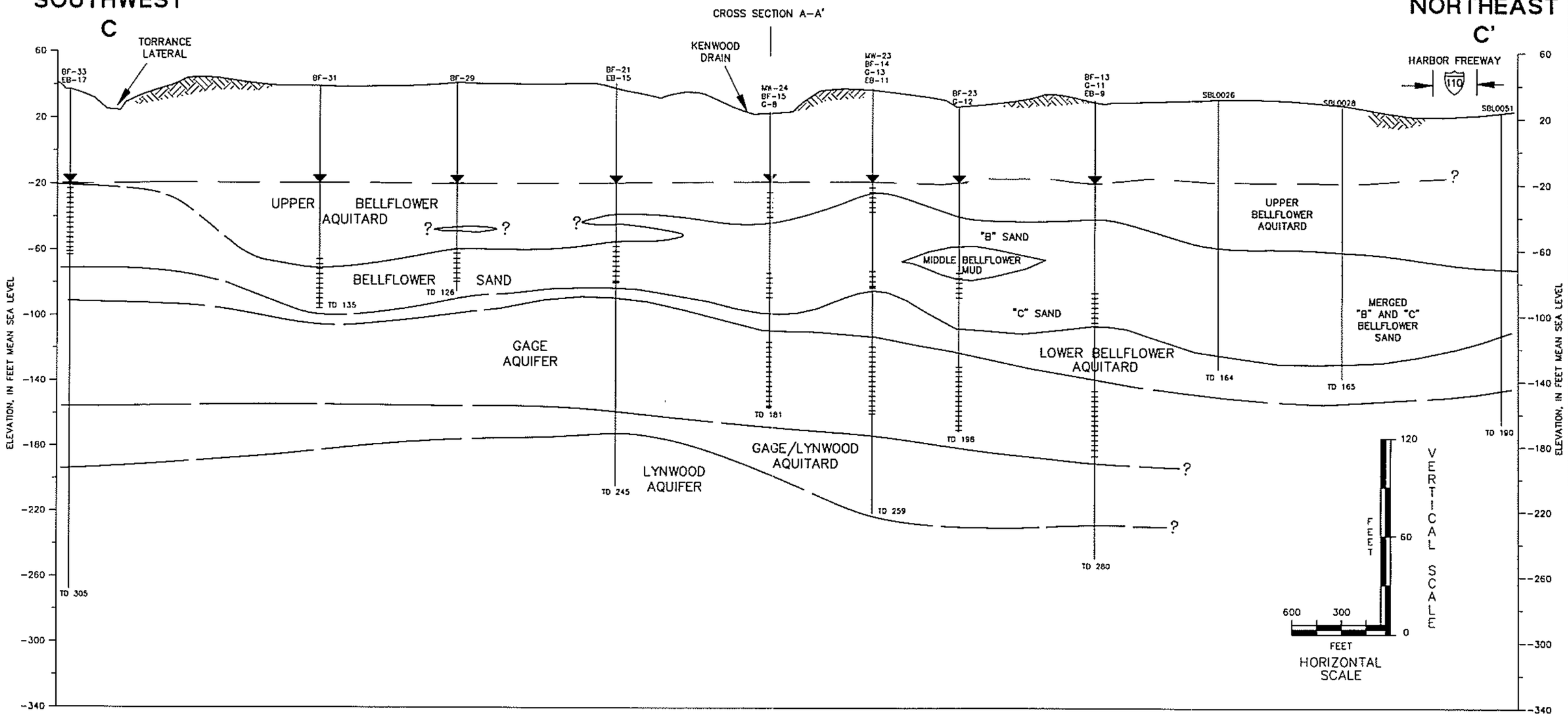
7/97 | RPT NO. 857.01 | 310-0150 | A

FIGURE 4.12 HYDROGEOLOGIC CROSS SECTION B–B'

SOUTHWEST
C

NORTHEAST
C'

CROSS SECTION A–A'



EXPLANATION

BF-31 — WELL OR BORING IDENTIFIER

STATIC WATER LEVEL ELEVATION MESURED IN OCTOBER 1995 AND INFERRED WATER TABLE

SCREENED INTERVAL OF WELL. MORE THAN ONE WELL SCREEN INDICATES INDIVIDUAL WELLS CLUSTERED NEAR EACH OTHER

TD 135 — TOTAL DEPTH DRILLED IN FEET BELOW LAND SURFACE

——— ——— ? ——— HYDROGEOLOGIC UNIT CONTACT
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

MONITOR WELLS AND EXPLORATORY BORINGS

- MW = UPPER BELLFLOWER AQUITARD
- BF = BELLFLOWER SAND
- G = GAGE AQUIFER
- EB = EXPLORATORY BOREHOLE
- SBL = DEL AMO SOIL BORING

NOTE: SEE FIGURE 4.10 FOR LOCATION OF CROSS SECTION

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

7/97 | RPT NO. 857.01 | 310-0150 | B

FIGURE 4.13 HYDROGEOLOGIC CROSS SECTION C–C'

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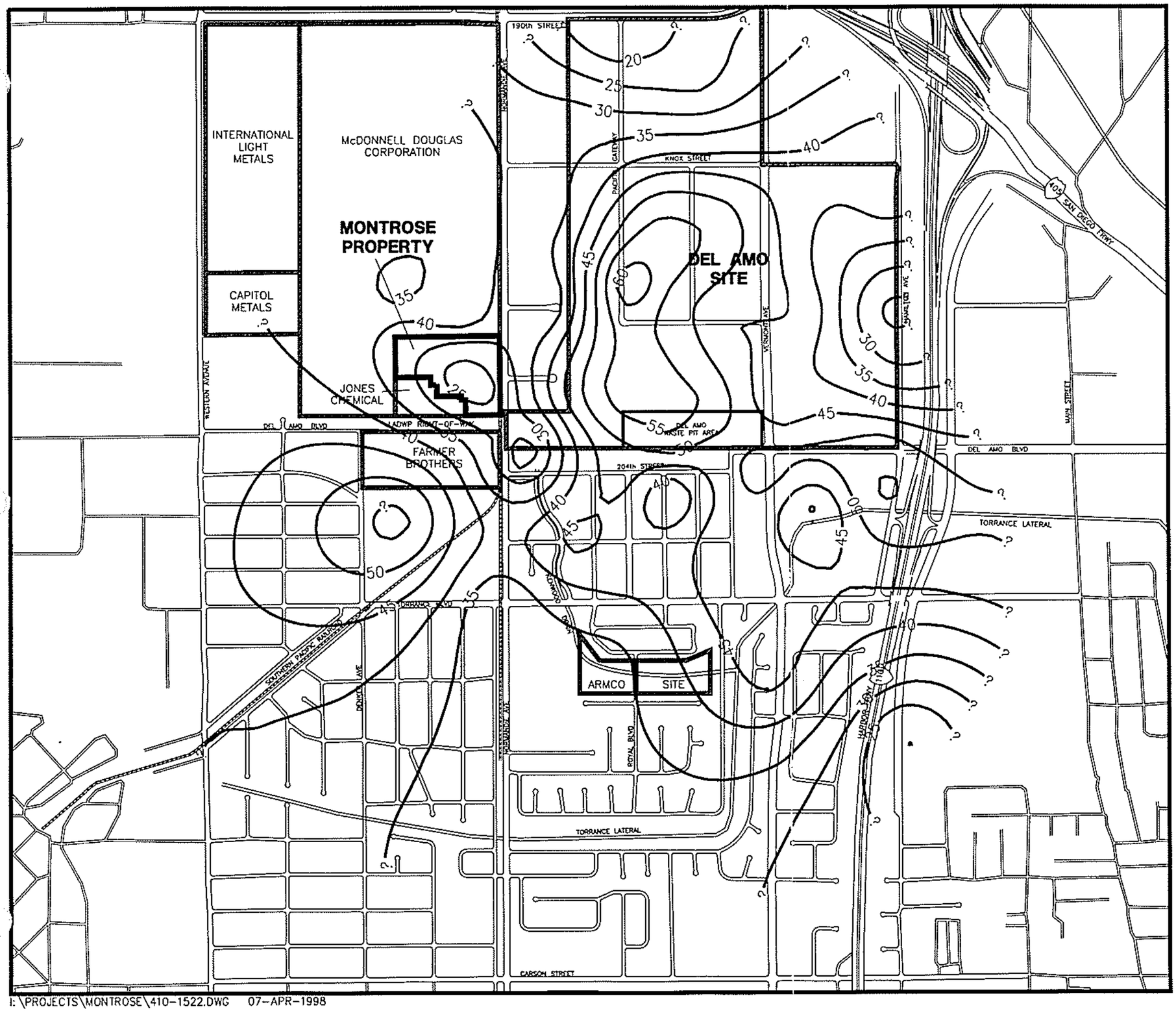

EXPLANATION

? —— 50 —— ?

CONTOUR LINE OF APPROXIMATE EQUAL UNIT THICKNESS IN FEET QUERIED WHERE INFERRED

NOTE: COMPUTER GENERATED THICKNESS CONTOURS BASED ON JOINT GROUNDWATER FEASIBILITY STUDY MODEL INPUT DATA ARRAYS (1987)

N

0 1000 2000

FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

THICKNESS OF BELLFLOWER SAND

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 4.14

PREP BY	REV BY	RPT NO. 218.11.3	410-1522	B

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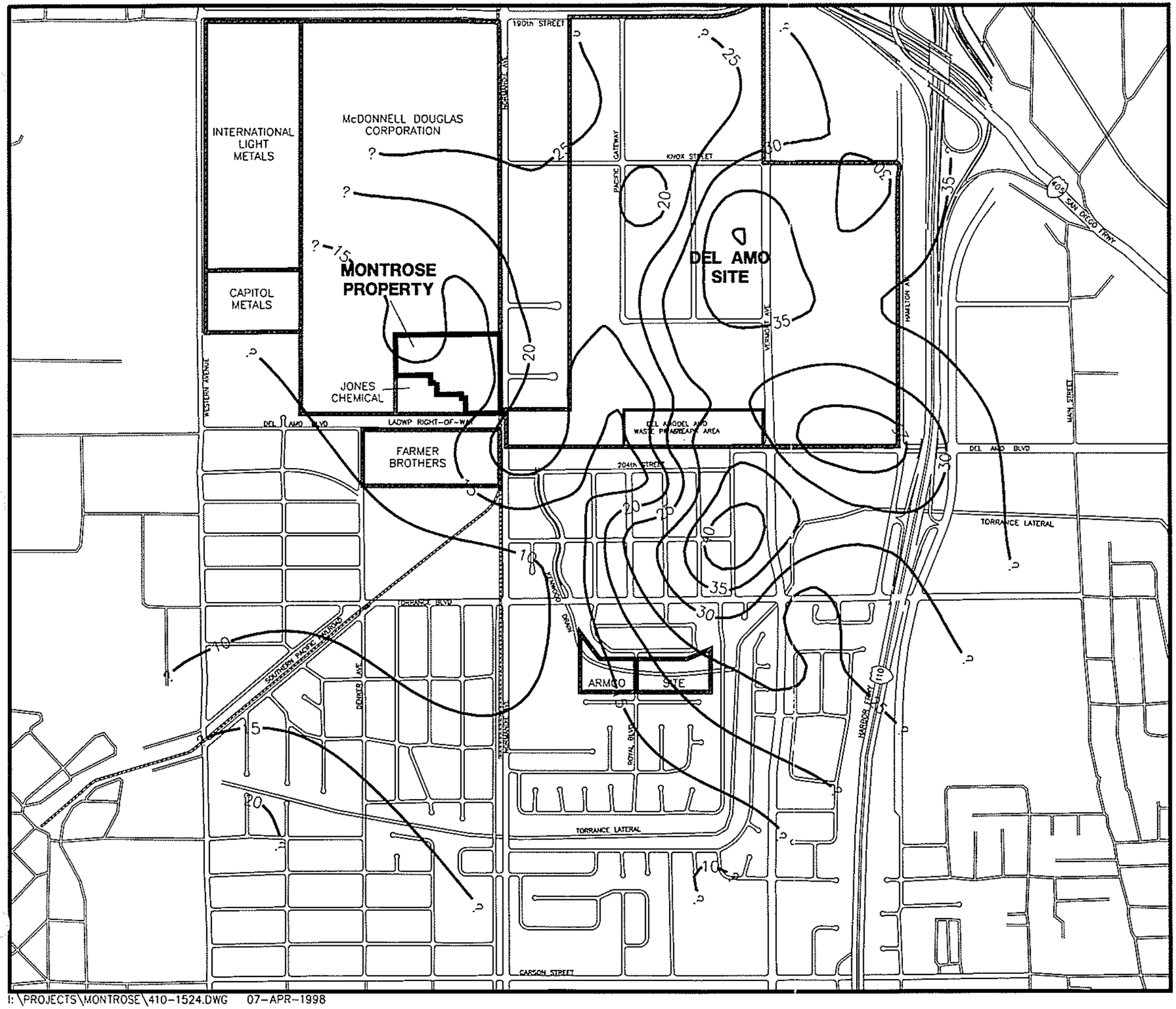

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EXPLANATION

?——50——?

CONTOUR LINE OF APPROXIMATE EQUAL UNIT THICKNESS IN FEET QUERIED WHERE INFERRED

NOTE: COMPUTER GENERATED THICKNESS CONTOURS BASED ON JOINT GROUNDWATER FEASIBILITY STUDY MODEL INPUT DATA ARRAYS (1987)

N

0 1000 2000

FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

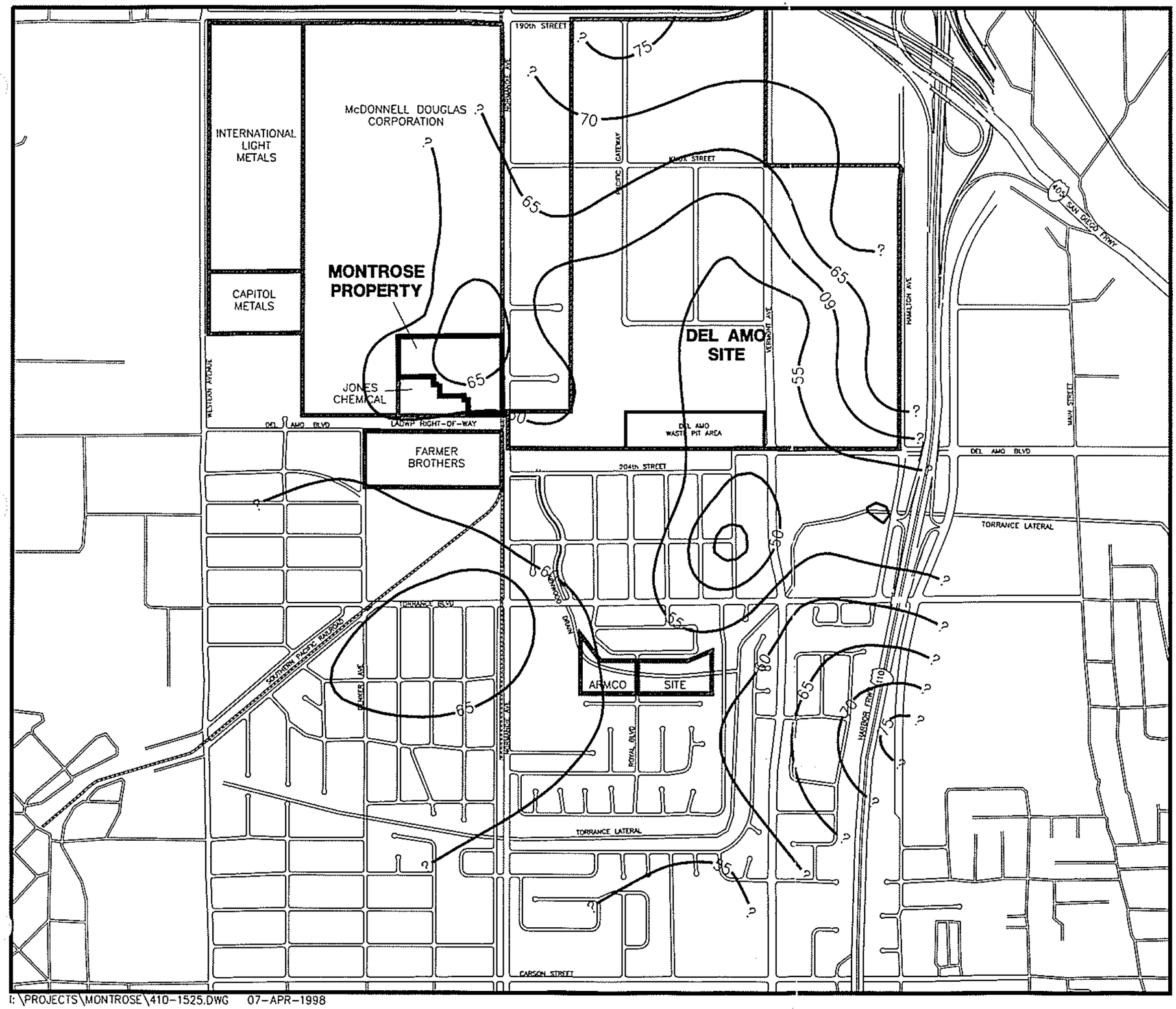
THICKNESS OF LOWER BELLFLOWER AQUITARD

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 4.15

PREP BY _____ REV BY _____ RPT NO. 218.11.3 | 410-1524 | B



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EXPLANATION

?——50——?

CONTOUR LINE OF APPROXIMATE EQUAL UNIT THICKNESS IN FEET
QUERIED WHERE INFERRED

NOTE: COMPUTER GENERATED THICKNESS CONTOURS BASED ON JOINT GROUNDWATER FEASIBILITY STUDY MODEL INPUT DATA ARRAYS (1987)

N

0 1000 2000

FEET

MONTROSE CHEMICAL CORPORATION
OF CALIFORNIA
TORRANCE, CALIFORNIA

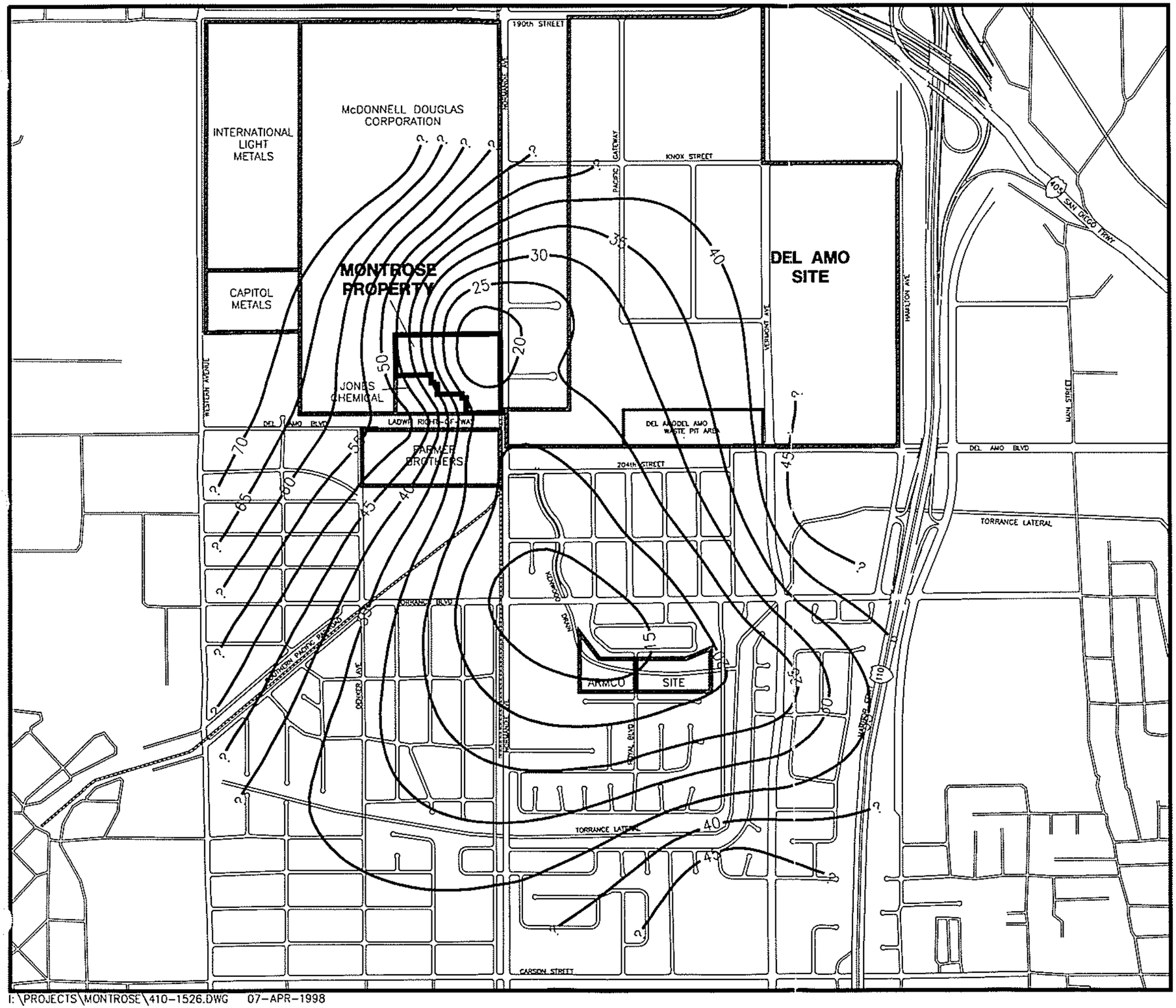
THICKNESS OF GAGE AQUIFER

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 4.16

PREP BY _____ REV BY _____ RPT NO. 218.11.3 | 410-1525 | B



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EXPLANATION

? —— 50 —— ?

CONTOUR LINE OF APPROXIMATE EQUAL UNIT THICKNESS IN FEET
QUERIED WHERE INFERRED

NOTE: COMPUTER GENERATED THICKNESS CONTOURS BASED ON JOINT GROUNDWATER FEASIBILITY STUDY MODEL INPUT DATA ARRAYS (1987)

N

0 1000 2000

FEET

MONTROSE CHEMICAL CORPORATION
OF CALIFORNIA
TORRANCE, CALIFORNIA

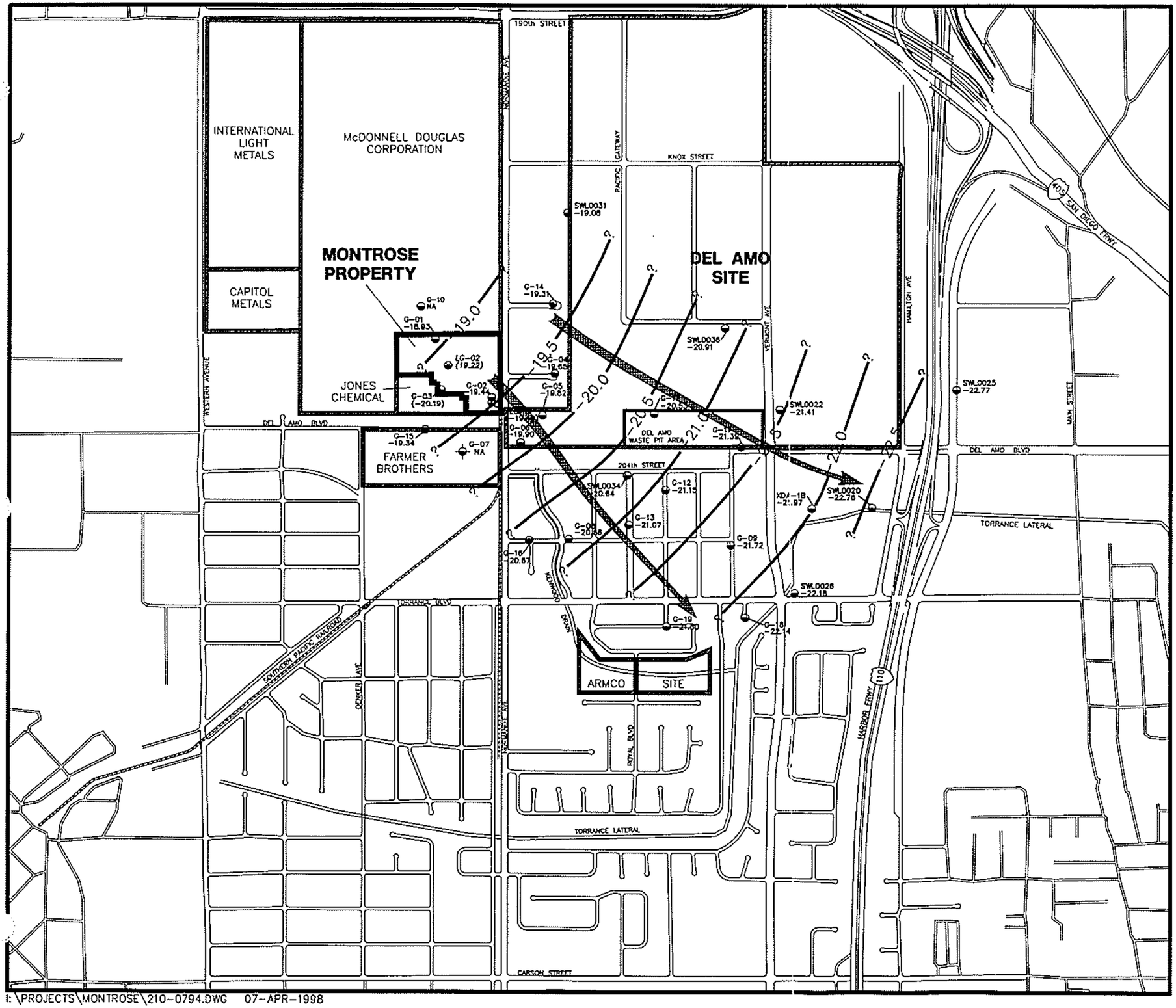
THICKNESS OF
GAGE - LYNWOOD AQUITARD

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 4.17

PREP BY	REV BY	RPT NO. 218.11.3	410-1526	B



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EXPLANATION

G-01 ● −18.93 — GAGE AQUIFER MONITOR WELL; STATIC WATER LEVEL ELEVATION IN FEET MEAN SEA LEVEL

NA — DATA NOT AVAILABLE

LG-01 ⊕ (−19.49) — LOWER GAGE AQUIFER MONITOR WELL (NOT CONTOURED)

G-07 ⊕ — DESTROYED WELL

?——— −19.0 ——— ———? — CONTOUR LINE OF EQUAL WATER LEVEL ELEVATION IN FEET MEAN SEA LEVEL; DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

→ APPROXIMATE DIRECTION OF GROUNDWATER FLOW

LADWP = LOS ANGELES DEPARTMENT OF WATER AND POWER

NOTE: WATER LEVELS MEASURED ON OCTOBER 9, 1995

WELL IDENTIFIER NOTES:
G AND LG = MONTROSE MONITOR WELLS
XDA AND SWL = DEL AMO MONITOR WELLS

N

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FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

WATER LEVEL ELEVATIONS
GAGE AQUIFER
OCTOBER 1995

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering
2223 Avenida De La Playa, Suite 300
La Jolla, California 92037
Phone (619) 454-0165

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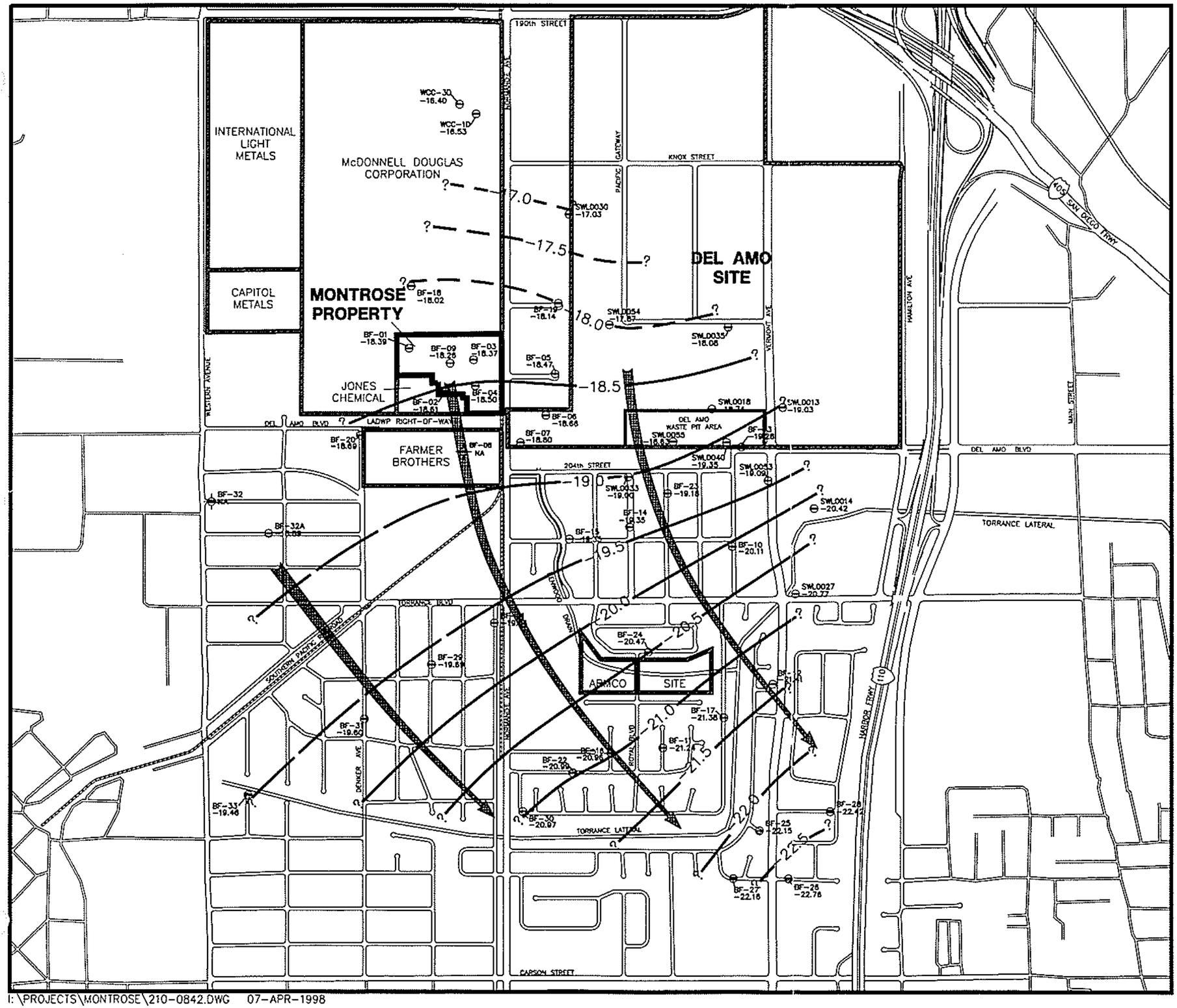
FIGURE 4.20

PREP BY _____ REV BY _____ RPT NO. 218.11.3 | 210-0794 | B



EXPLANATION

BF-18 ⊖ -18.02 — BELLFLOWER SAND MONITOR WELL; STATIC WATER LEVEL ELEVATION IN FEET MEAN SEA LEVEL

BF-18 ⊖ NA — BELLFLOWER SAND MONITOR WELL; NOT AVAILABLE

?——17.5——?

CONTOUR LINE OF EQUAL WATER LEVEL ELEVATION IN FEET MEAN SEA LEVEL
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

APPROXIMATE DIRECTION OF GROUNDWATER FLOW

LADWP = LOS ANGELES DEPARTMENT OF WATER AND POWER

NOTE: WATER LEVELS MEASURED ON OCTOBER 9, 1995

WELL IDENTIFIER NOTES:
BF = MONTROSE MONITOR WELLS
WCC = McDONNELL DOUGLAS MONITOR WELLS
SWL = DEL AMO MONITOR WELLS

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

WATER LEVEL ELEVATIONS BELLFLOWER SAND OCTOBER 1995

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FIGURE 4.19

PREP BY _____ REV BY _____ RPT NO. 218.11.3 | 210-0842 | B

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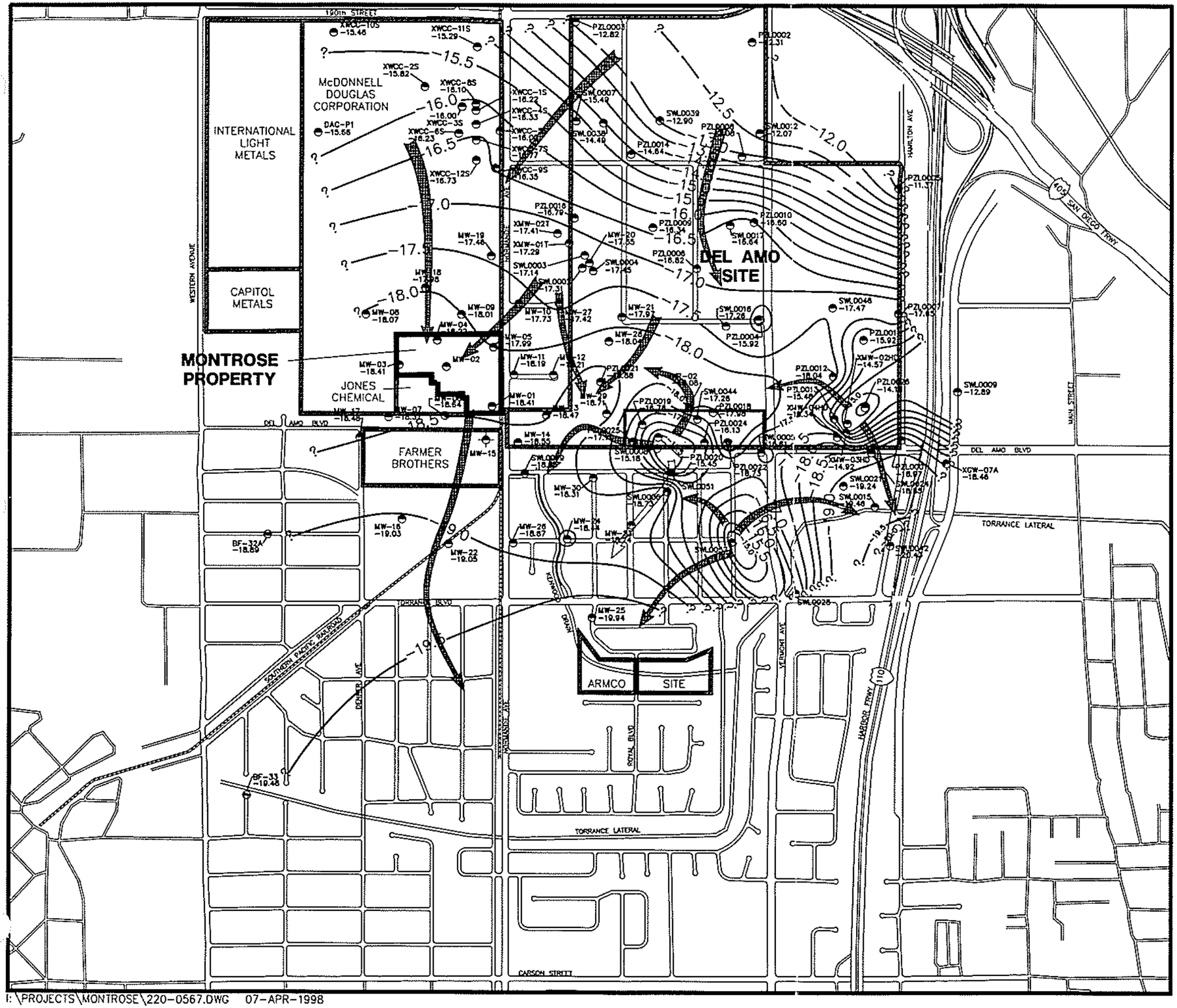

EXPLANATION

MW-03	UPPER BELLFLOWER AQUITARD MONITOR WELL
−18.41	STATIC WATER LEVEL ELEVATION IN FEET MEAN SEA LEVEL
MW-15	DESTROYED WELL
NA	NOT AVAILABLE
BF-32A	BELLFLOWER SAND WATER TABLE WELL

? —— −19.0 —— ?

CONTOUR LINE OF EQUAL WATER LEVEL ELEVATION IN FEET MEAN SEA LEVEL
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

APPROXIMATE DIRECTION OF GROUNDWATER FLOW

LADWP = LOS ANGELES DEPARTMENT OF WATER AND POWER

NOTE:
WATER LEVELS MEASURED ON OCTOBER 9, 1995

WELL IDENTIFIER NOTES:
MW AND BF = MONTROSE MONITOR WELLS
XWCC AND DAC = McDONNELL DOUGLAS MONITOR WELLS
SWL, PZL, XGW, XP, AND XMW = DEL AMO MONITOR WELLS

MONTROSE CHEMICAL CORPORATION
OF CALIFORNIA
TORRANCE, CALIFORNIA

WATER LEVEL ELEVATIONS
UPPER BELLFLOWER AQUITARD
OCTOBER 1995

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FIGURE 4.18

PREP BY _____ REV BY _____ RPT NO. 218.11.3 | 220-0567 | B

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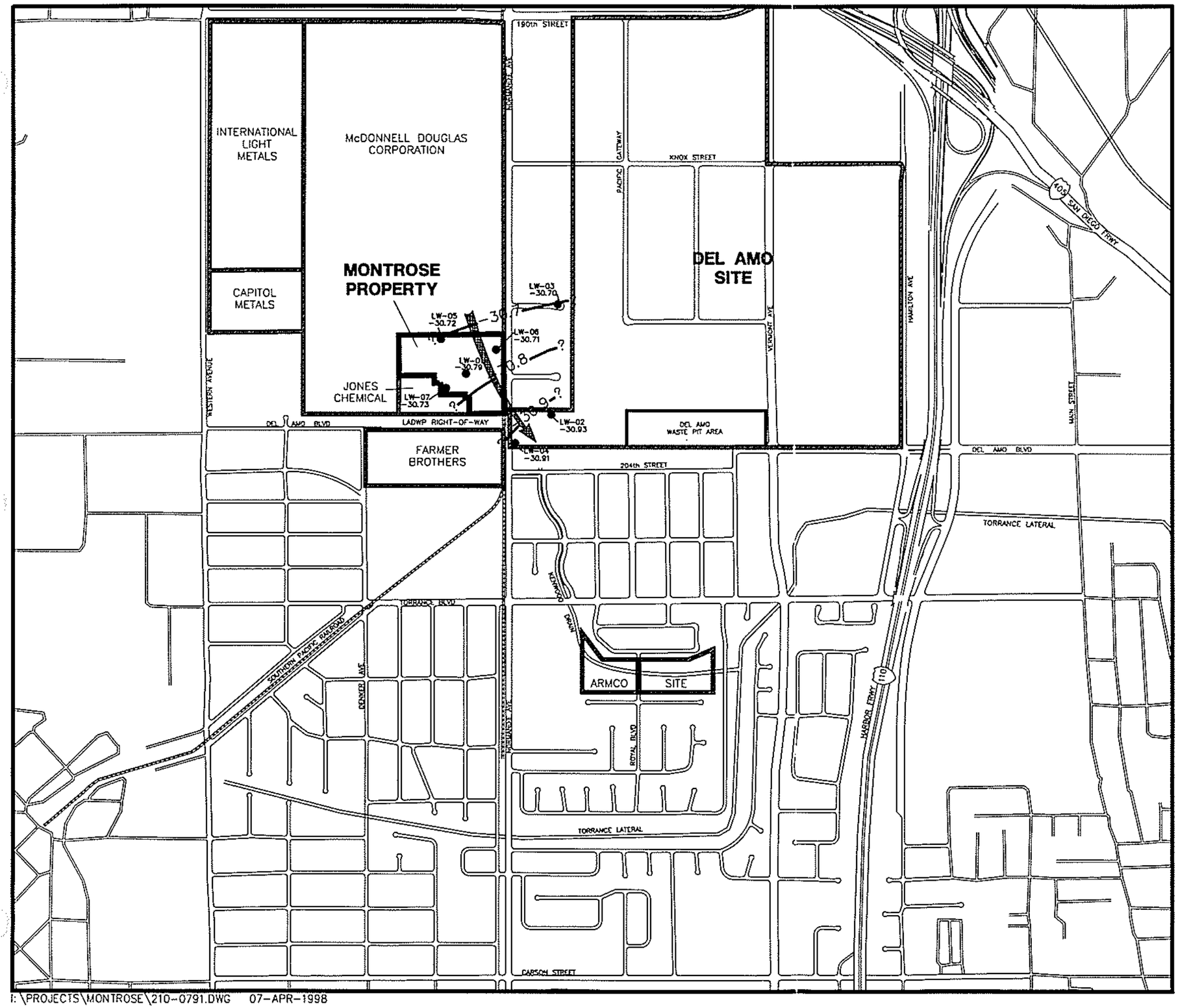

EXPLANATION

LW-04 ● -30.79 — LYNWOOD AQUIFER MONITOR WELL; STATIC WATER LEVEL ELEVATION IN FEET MEAN SEA LEVEL

?——— -30.7 ——— ——? CONTOUR LINE OF EQUAL WATER LEVEL ELEVATION IN FEET MEAN SEA LEVEL DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

APPROXIMATE DIRECTION OF GROUNDWATER FLOW

LADWP = LOS ANGELES DEPARTMENT OF WATER AND POWER

NOTE: WATER LEVELS MEASURED ON OCTOBER 9, 1995

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

WATER LEVEL ELEVATIONS
LYNWOOD AQUIFER
OCTOBER 1995

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FIGURE 4.21

PREP BY ____ REV BY ____ RPT NO. 218.11.3 | 210-0791 | B

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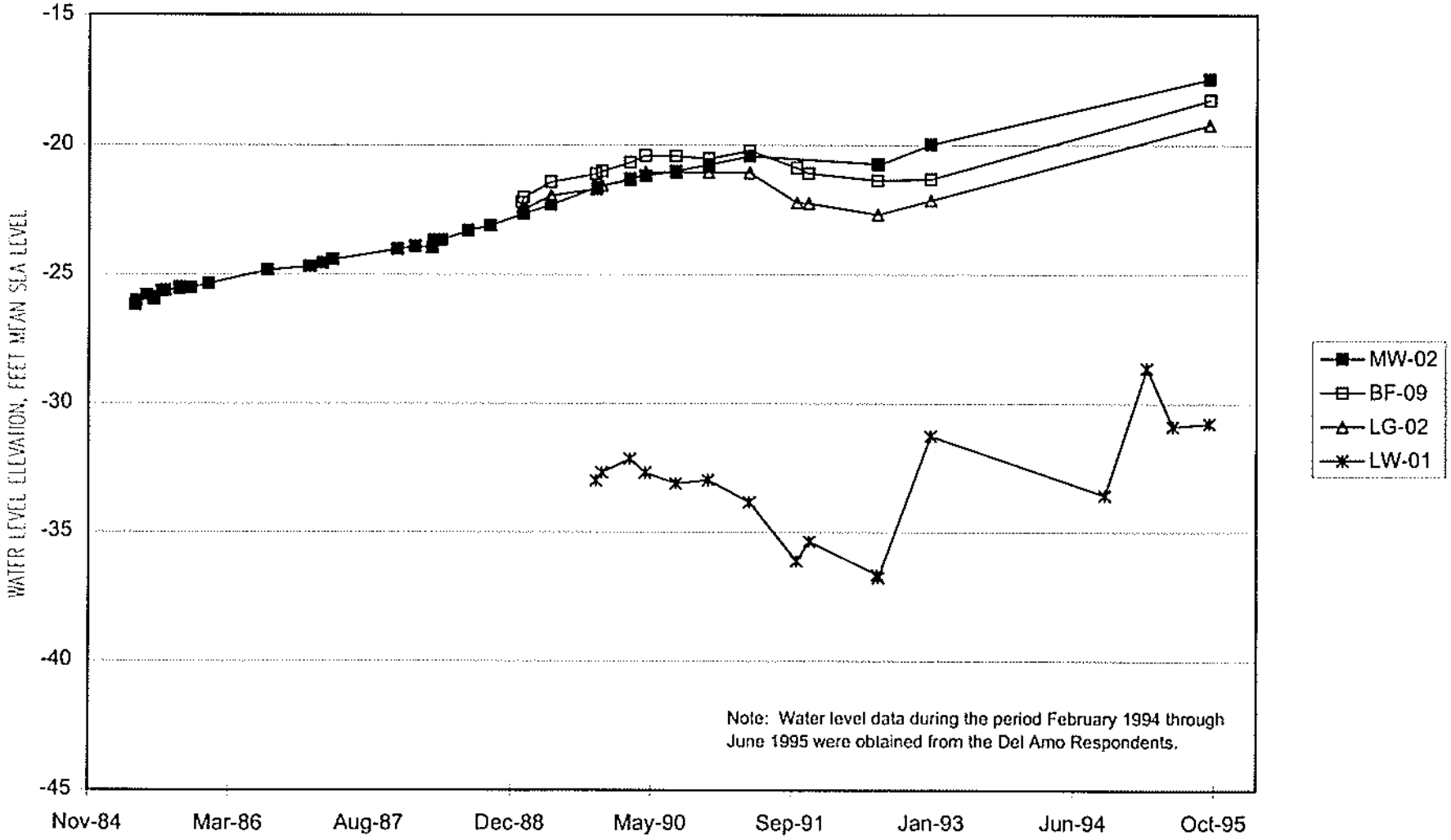


FIGURE 4-22A WATER LEVEL ELEVATIONS, MONITOR WELL CLUSTER
MW-02, BF-09, LG-02 AND LW-01

SCO/981100003.XLS/95WUP - A

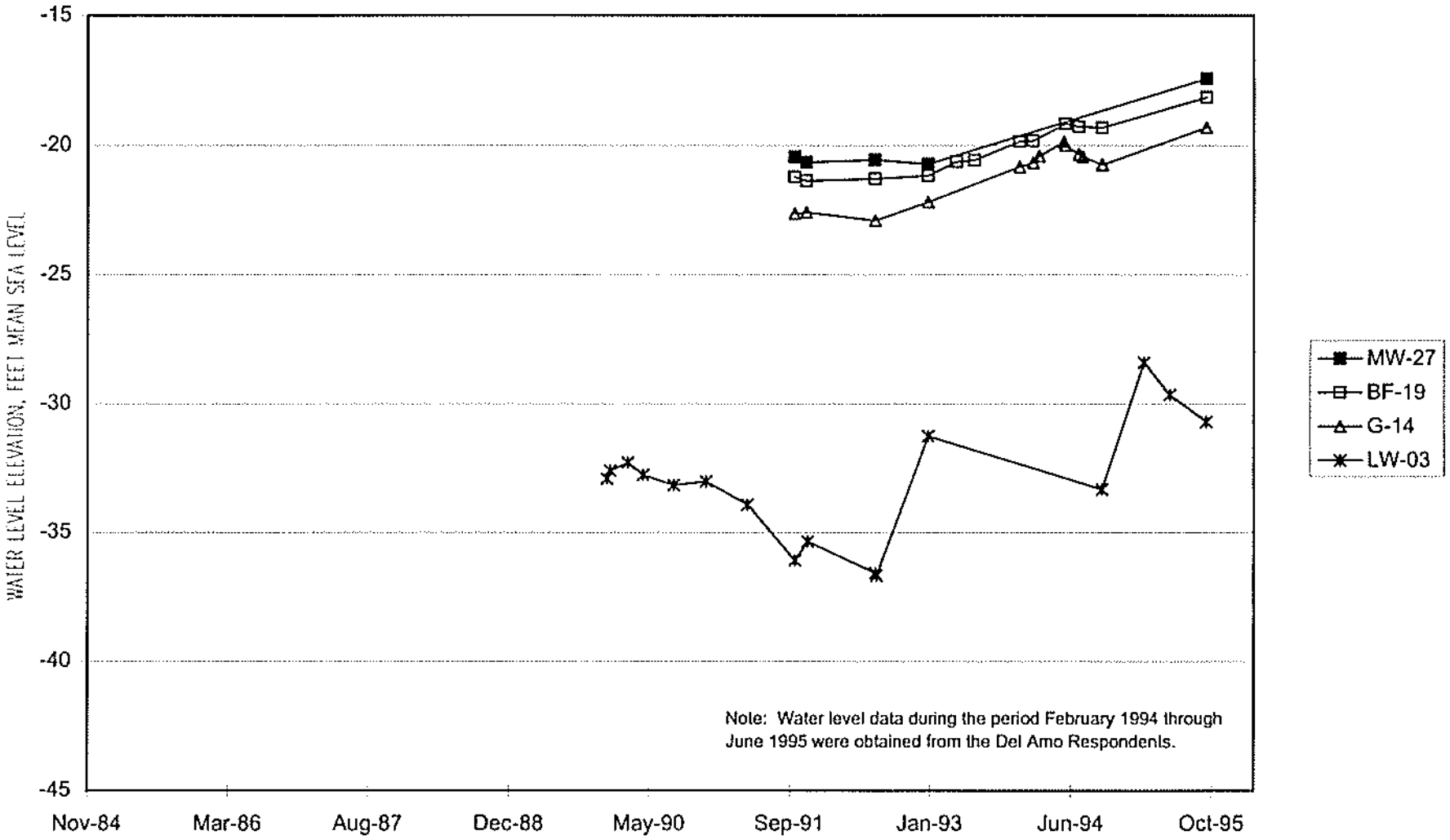


FIGURE 4-22B WATER LEVEL ELEVATIONS, MONITOR WELL CLUSTER
MW-27, BF-19, G-14, AND LW-03

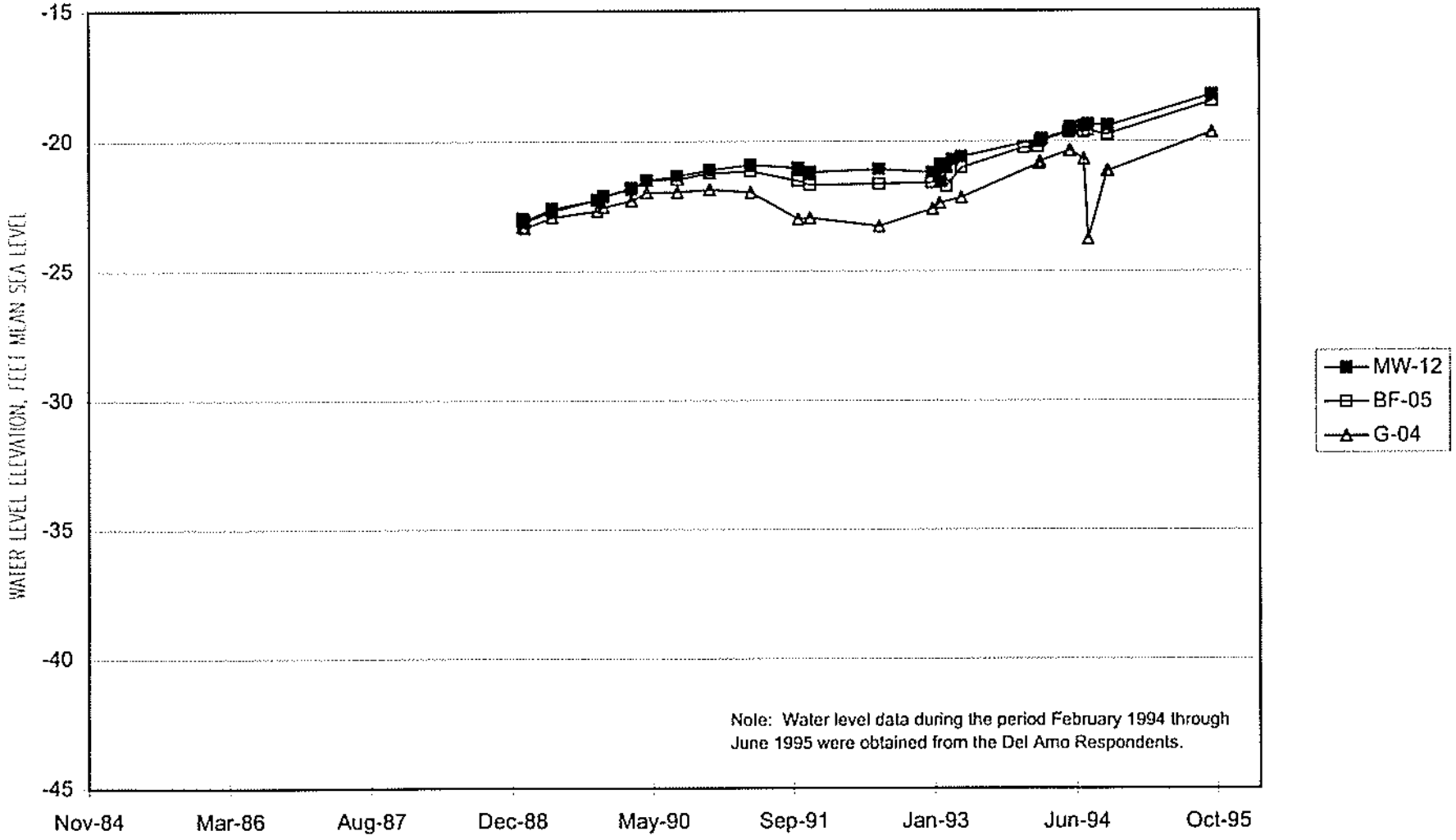


FIGURE 4-22C WATER LEVEL ELEVATIONS, MONITOR WELL CLUSTER
MW-12, BF-05, AND G-04

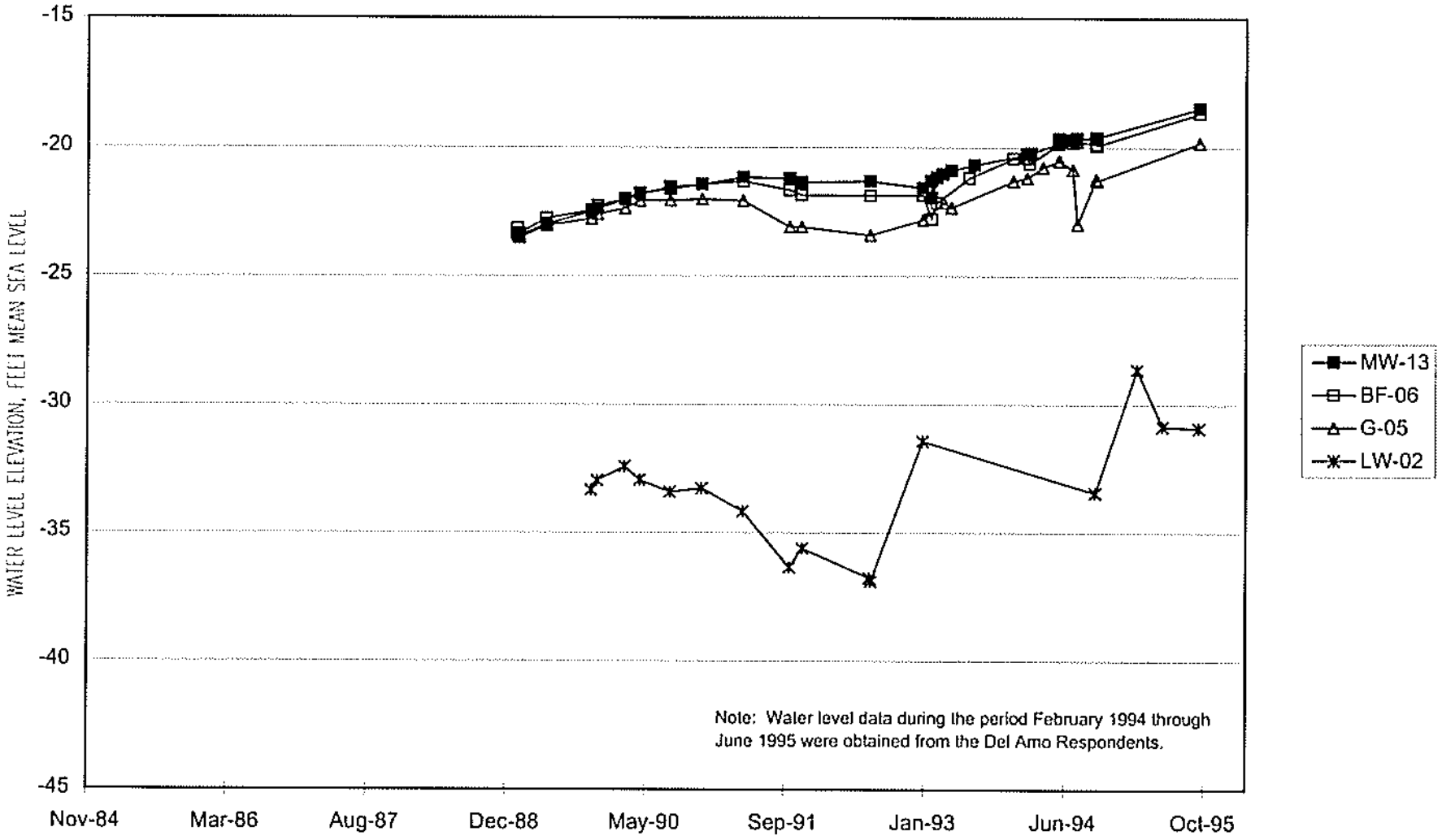


FIGURE 4-22D WATER LEVEL ELEVATIONS, MONITOR WELL CLUSTER
MW-13, BF-06, G-05, AND LW-02

SCO/981100003.XLS/95WUP - D

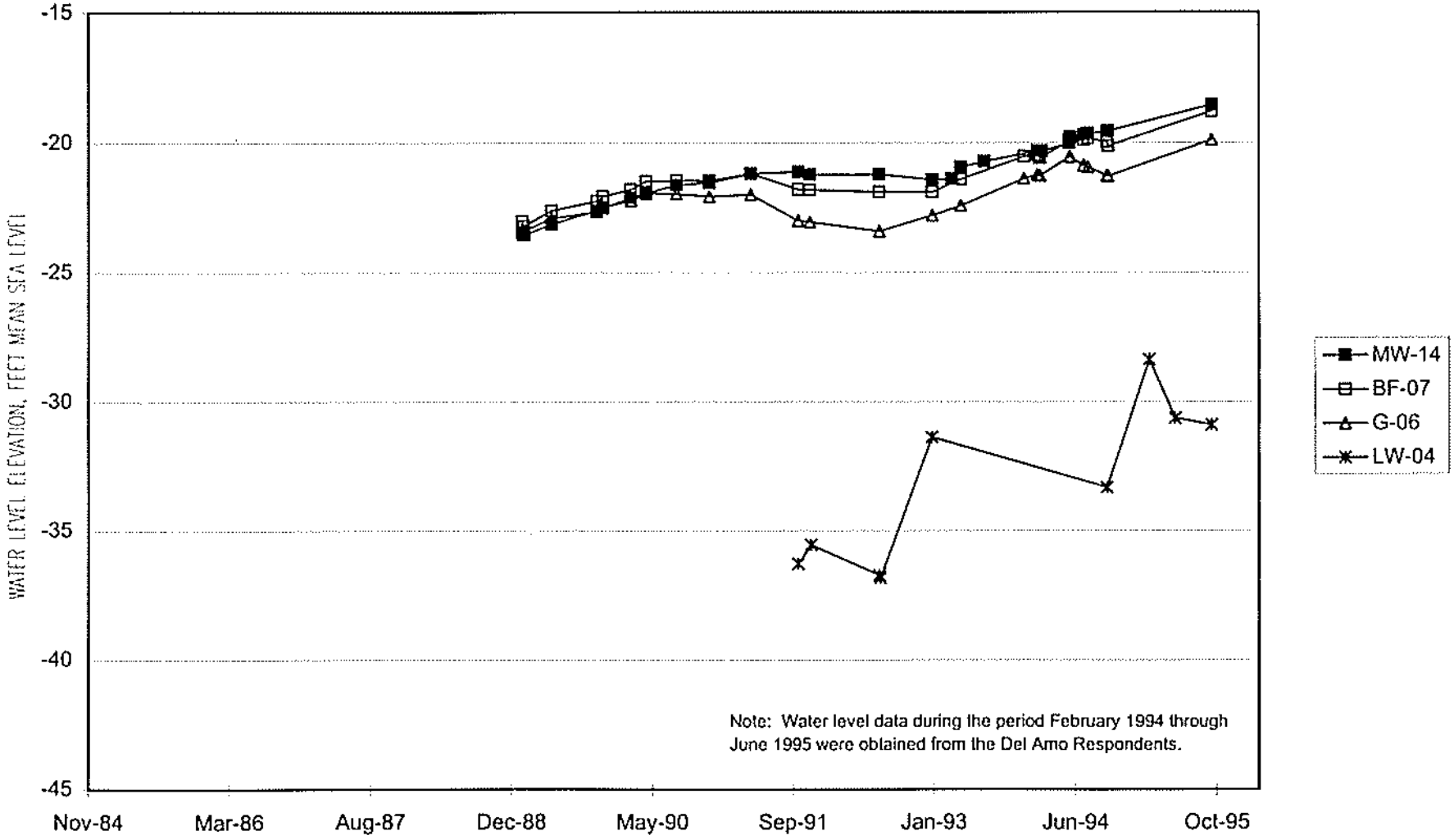


FIGURE 4-22E WATER LEVEL ELEVATIONS, MONITOR WELL CLUSTER
MW-14, BF-07, G-06, AND LW-04

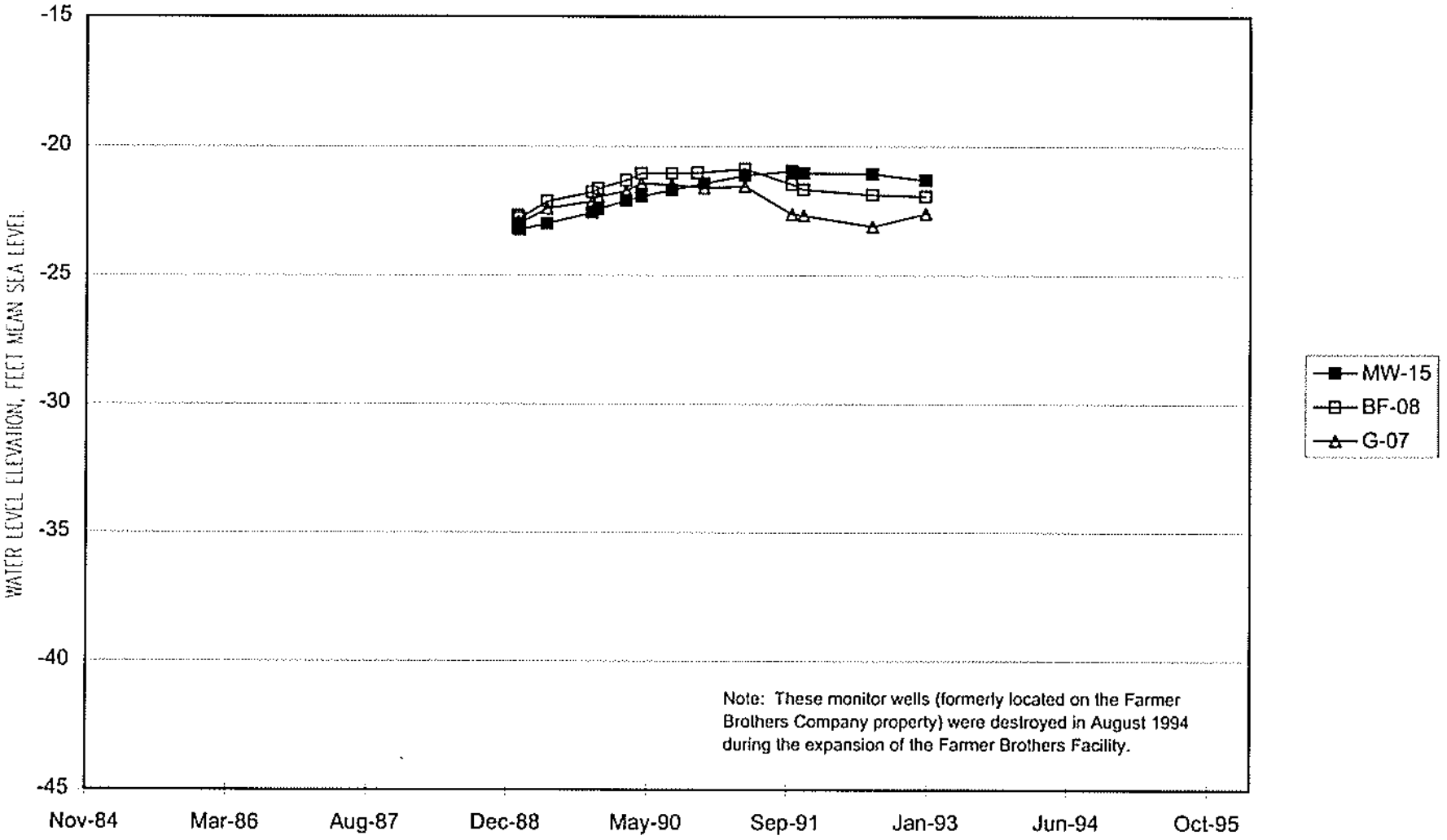


FIGURE 4-22F WATER LEVEL ELEVATIONS, MONITOR WELL CLUSTER MW-15, BF-08, AND G-07

SCO/981100003.XLS/95WUP - F

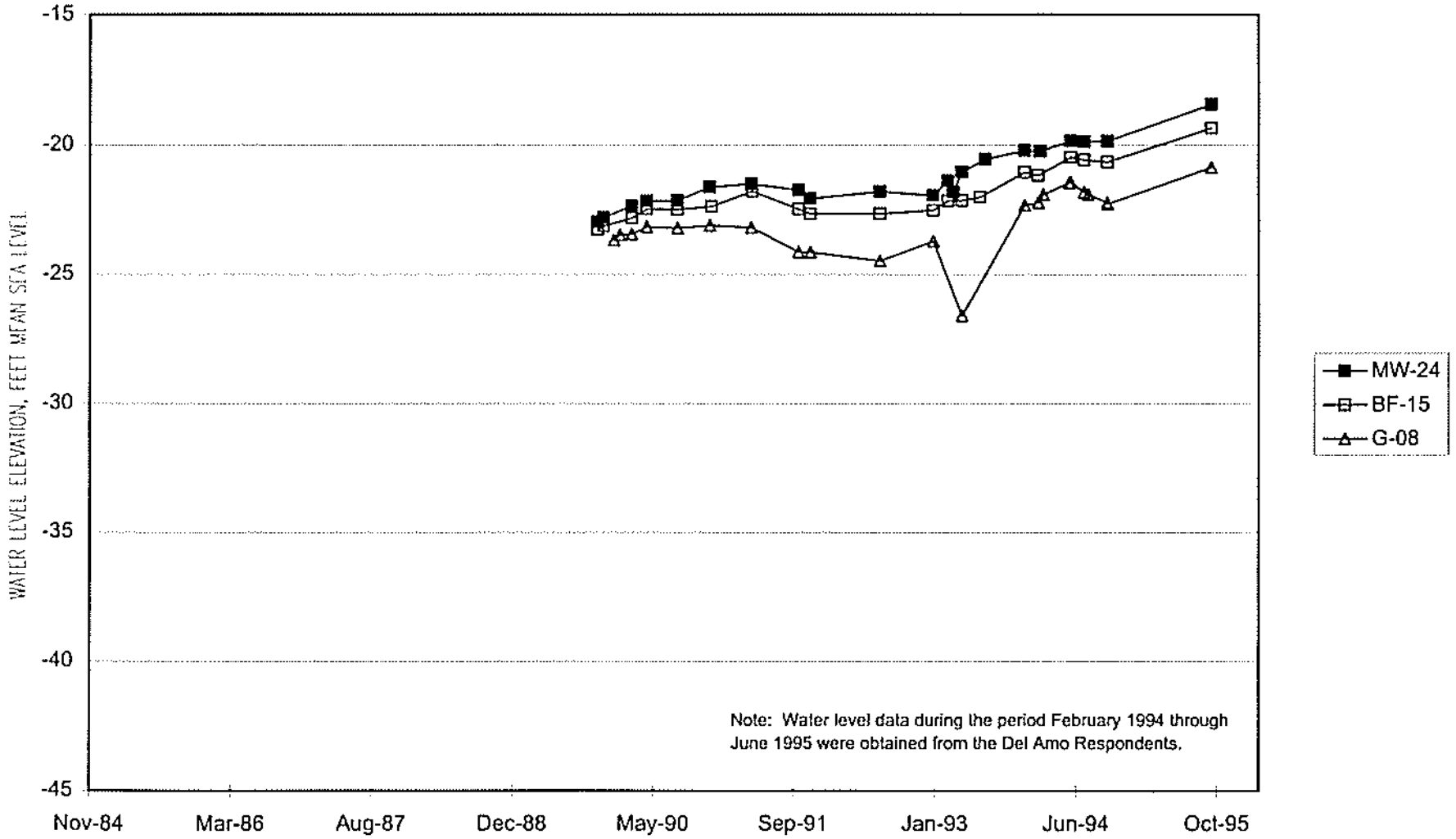


FIGURE 4-22G WATER LEVEL ELEVATIONS, MONITOR WELL CLUSTER
MW-24, BF-15, AND G-08

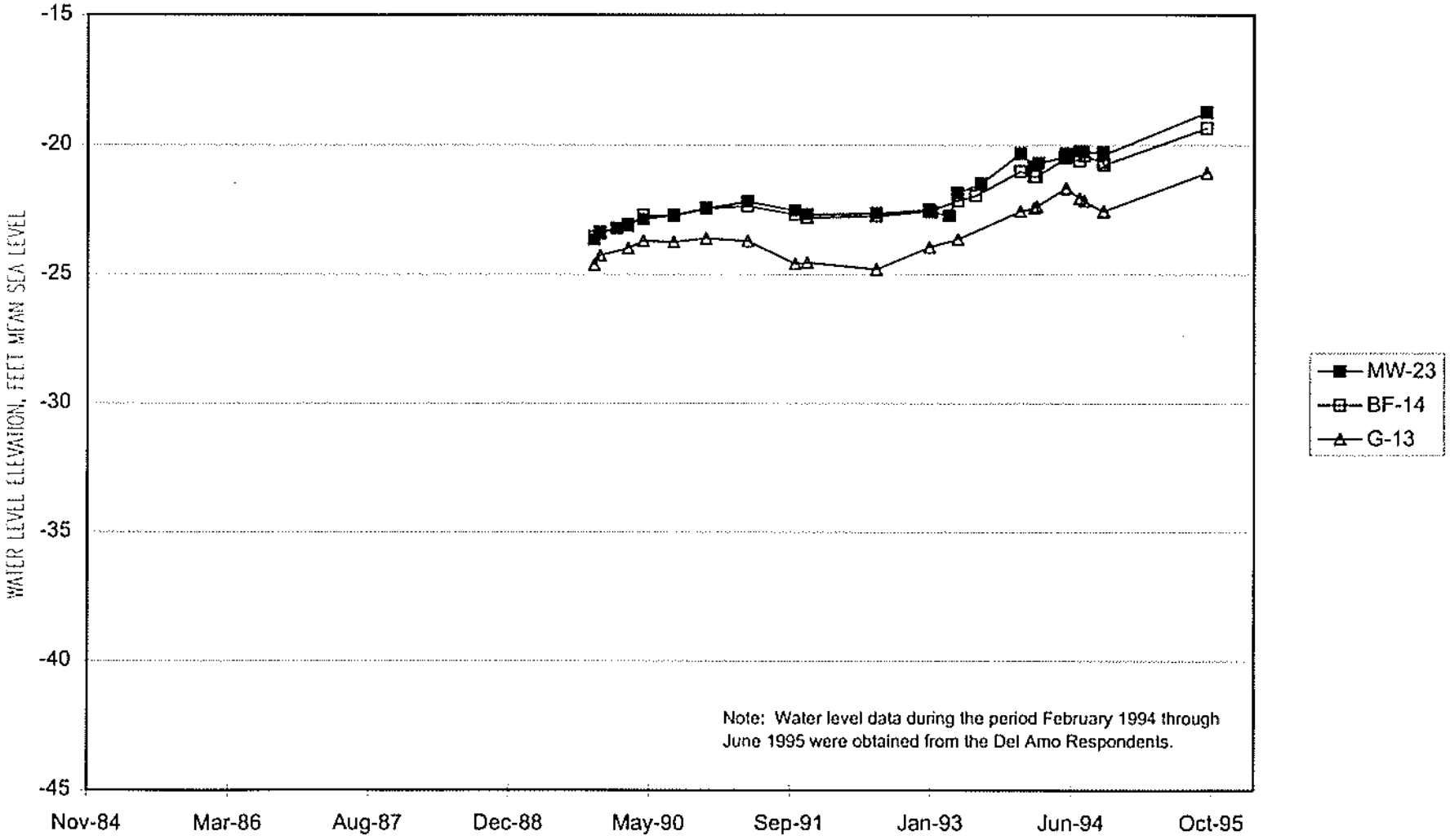


FIGURE 4-22H WATER LEVEL ELEVATIONS, MONITOR WELL CLUSTER
MW-23, BF-14, AND G-13

SCO/981100003.XLS/95WUP - H

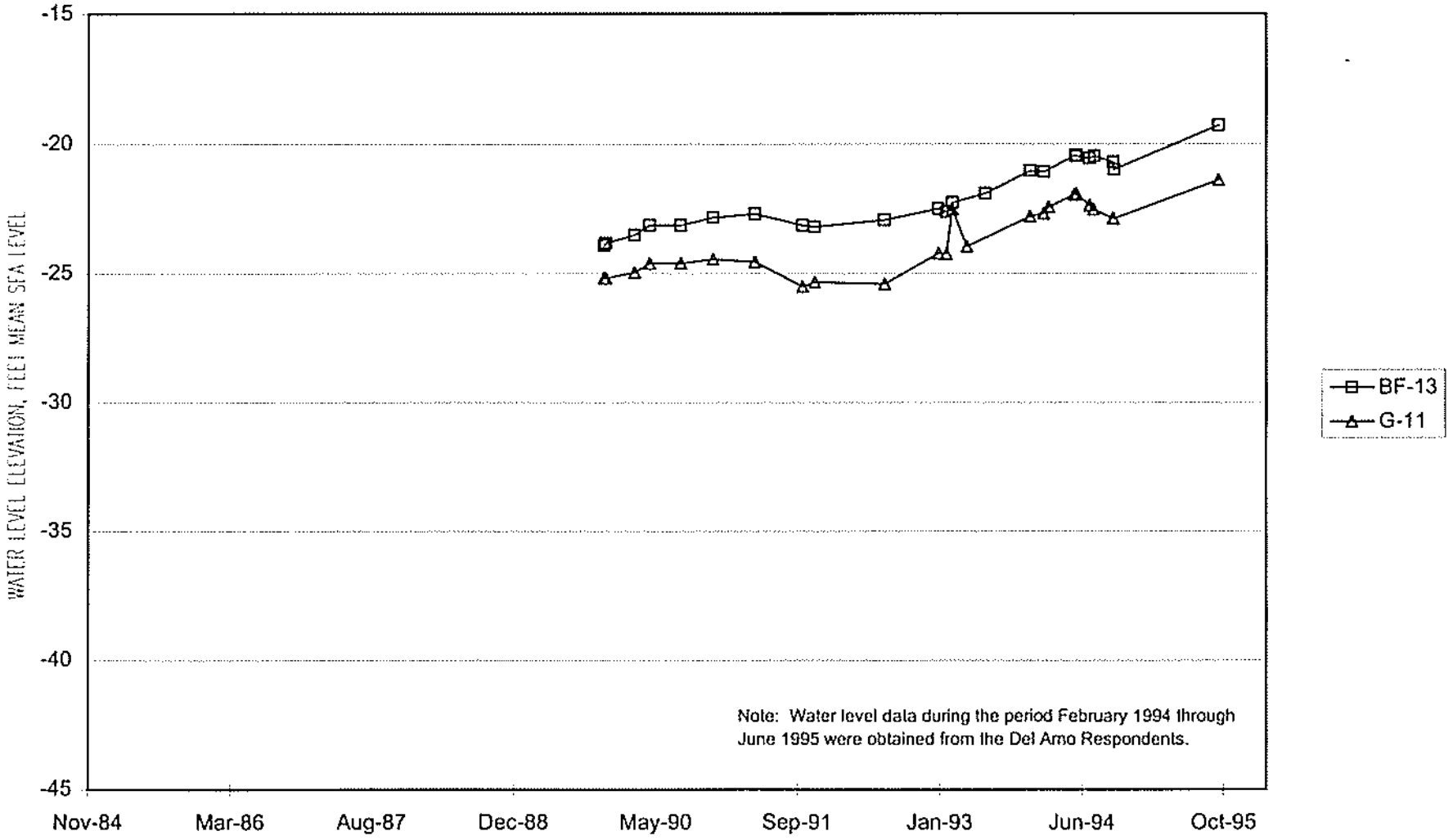
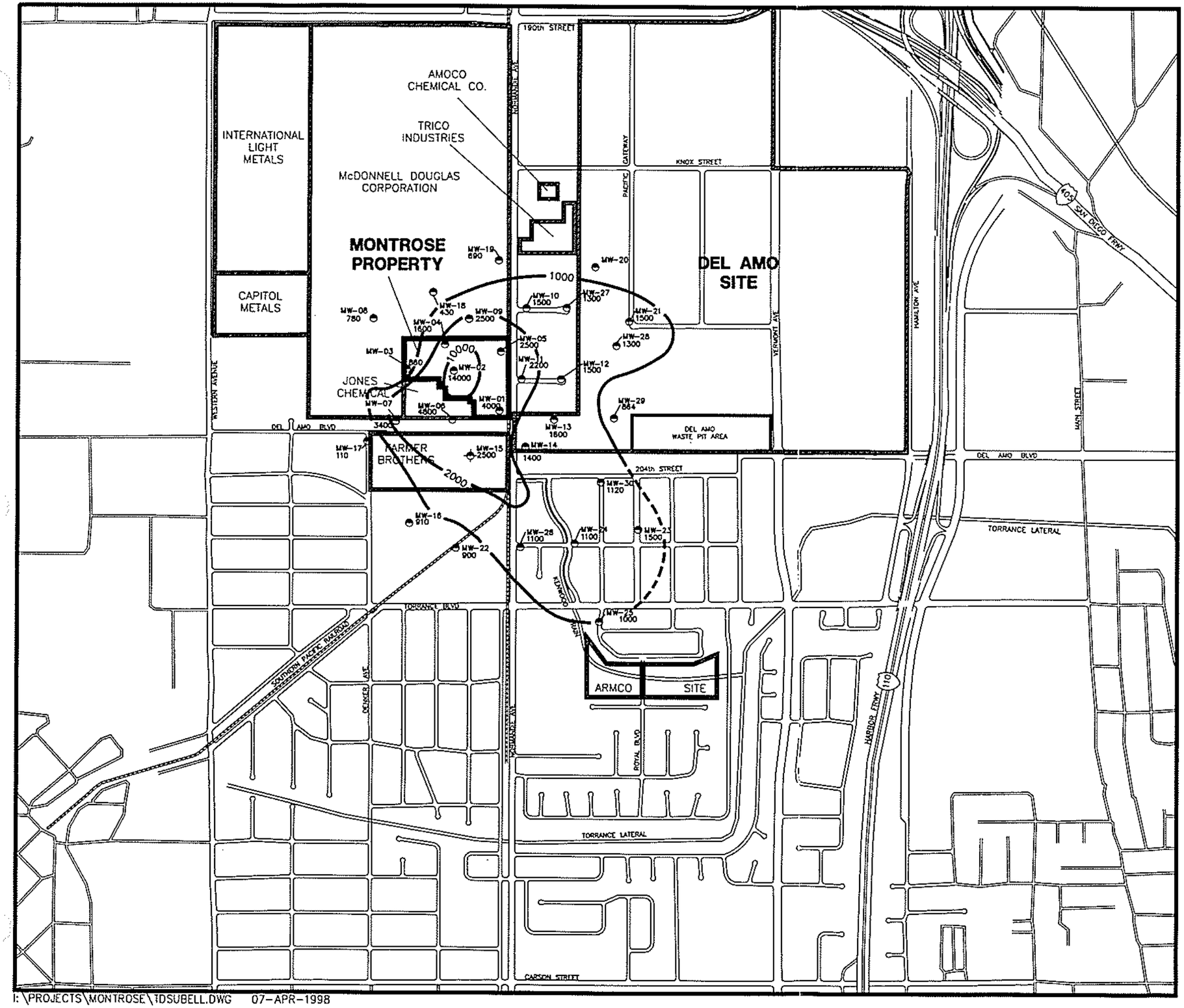


FIGURE 4-22I WATER LEVEL ELEVATIONS, MONITOR WELL CLUSTER
BF-13 AND G-11



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EXPLANATION

MW-03 — UPPER BELLFLOWER AQUITARD MONITOR WELL

1065 — CONCENTRATION IN MILLIGRAMS PER LITER

MW-15 — DESTROYED WELL

?——1000——?

CONTOUR LINE OF EQUAL CONCENTRATION OF TOTAL DISSOLVED SOLIDS IN MILLIGRAMS PER LITER DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995 DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY.

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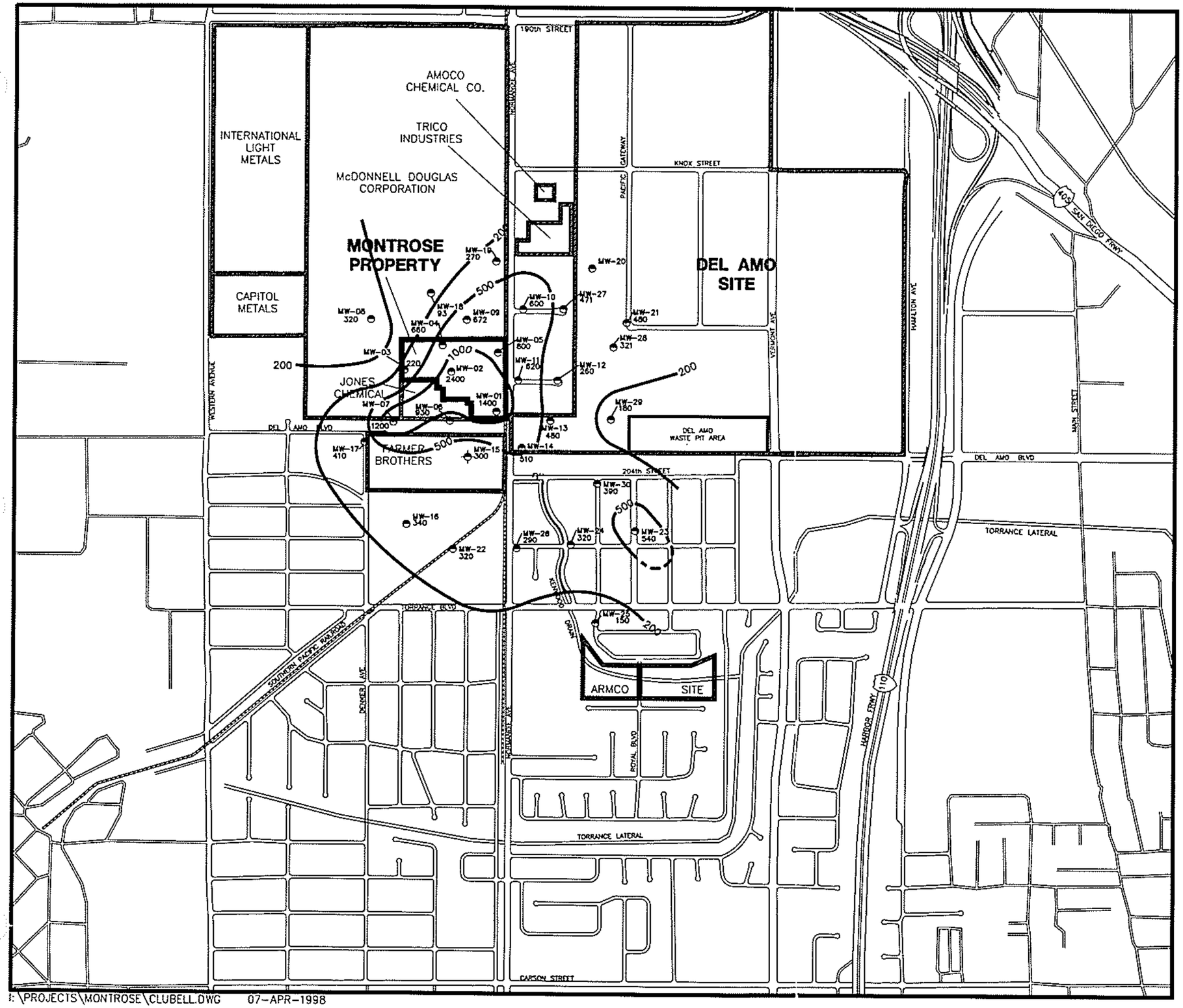
SCALE IN FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

FIGURE 4.23a
TDS IN GROUNDWATER
UPPER BELLFLOWER AQUITARD

TDSUBELL		4/98



EXPLANATION

MW-03 — UPPER BELLFLOWER AQUITARD MONITOR WELL

207 — CONCENTRATION IN MILLIGRAMS PER LITER

MW-15 — DESTROYED WELL

?——200——?

CONTOUR LINE OF EQUAL CONCENTRATION OF CHLORIDE IN MILLIGRAMS PER LITER
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY.

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SCALE IN FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

FIGURE 4.23b
CHLORIDE IN GROUNDWATER
UPPER BELLFLOWER AQUITARD

CLUBELL		4/98

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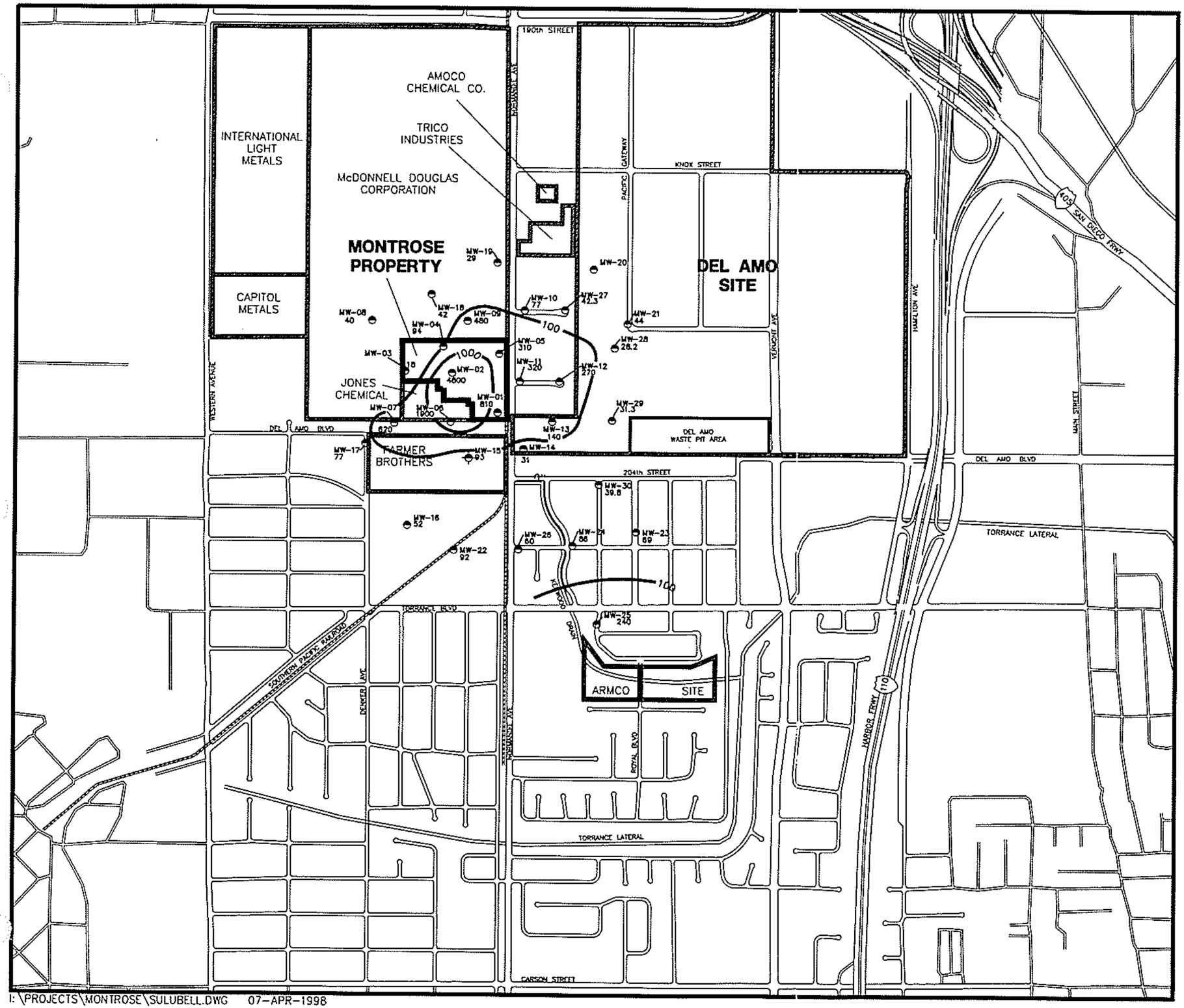

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EXPLANATION

MW-03 — UPPER BELLFLOWER AQUITARD MONITOR WELL

27 — CONCENTRATION IN MILLIGRAMS PER LITER

MW-15 — DESTROYED WELL

?——100——?

CONTOUR LINE OF EQUAL CONCENTRATION OF SULFATE IN MILLIGRAMS PER LITER
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995 DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY.

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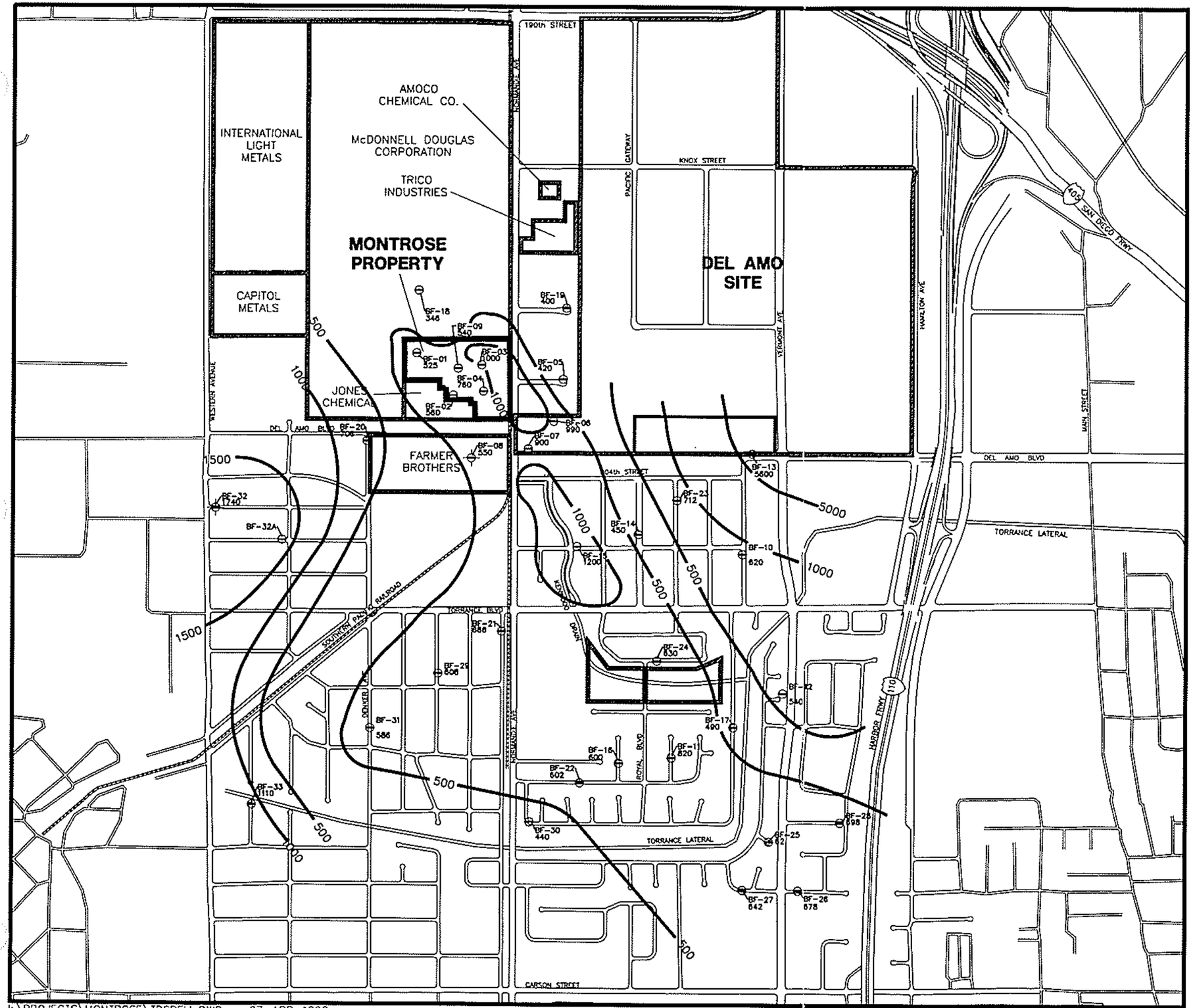
SCALE IN FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

FIGURE 4.23c
SULFATE IN GROUNDWATER
UPPER BELLFLOWER AQUITARD

SULUBELL		4/98



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EXPLANATION

BF-19 ⊖ 400 — BELLFLOWER SAND MONITOR WELL; CONCENTRATION IN MILLIGRAMS PER LITER

BF-08 ⊘ — DESTROYED WELL

?——1000——?
CONTOUR LINE OF EQUAL CONCENTRATION OF TOTAL DISSOLVED SOLIDS IN MILLIGRAMS PER LITER
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

NOTE:
WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY.

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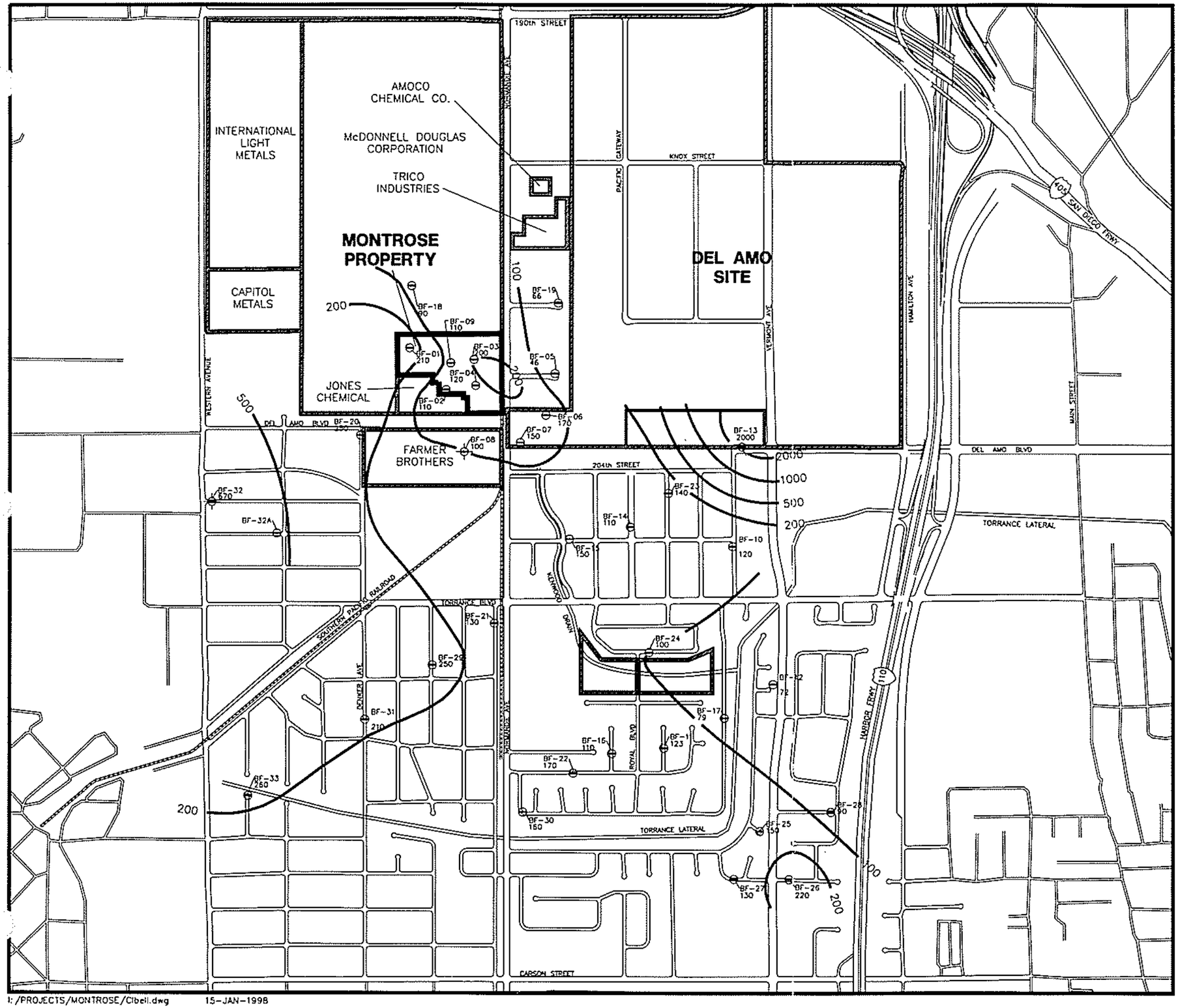
SCALE IN FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

FIGURE 4.24a
TDS IN GROUNDWATER
BELLFLOWER SAND

TDSBELL		4/98



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EXPLANATION

BF-19 — BELLFLOWER SAND MONITOR WELL

66 — CONCENTRATION IN MILLIGRAMS PER LITER

BF-08 — DESTROYED WELL

?——100——?
CONTOUR LINE OF EQUAL CONCENTRATION OF CHLORIDE IN MILLIGRAMS PER LITER
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

NOTE:
WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY.

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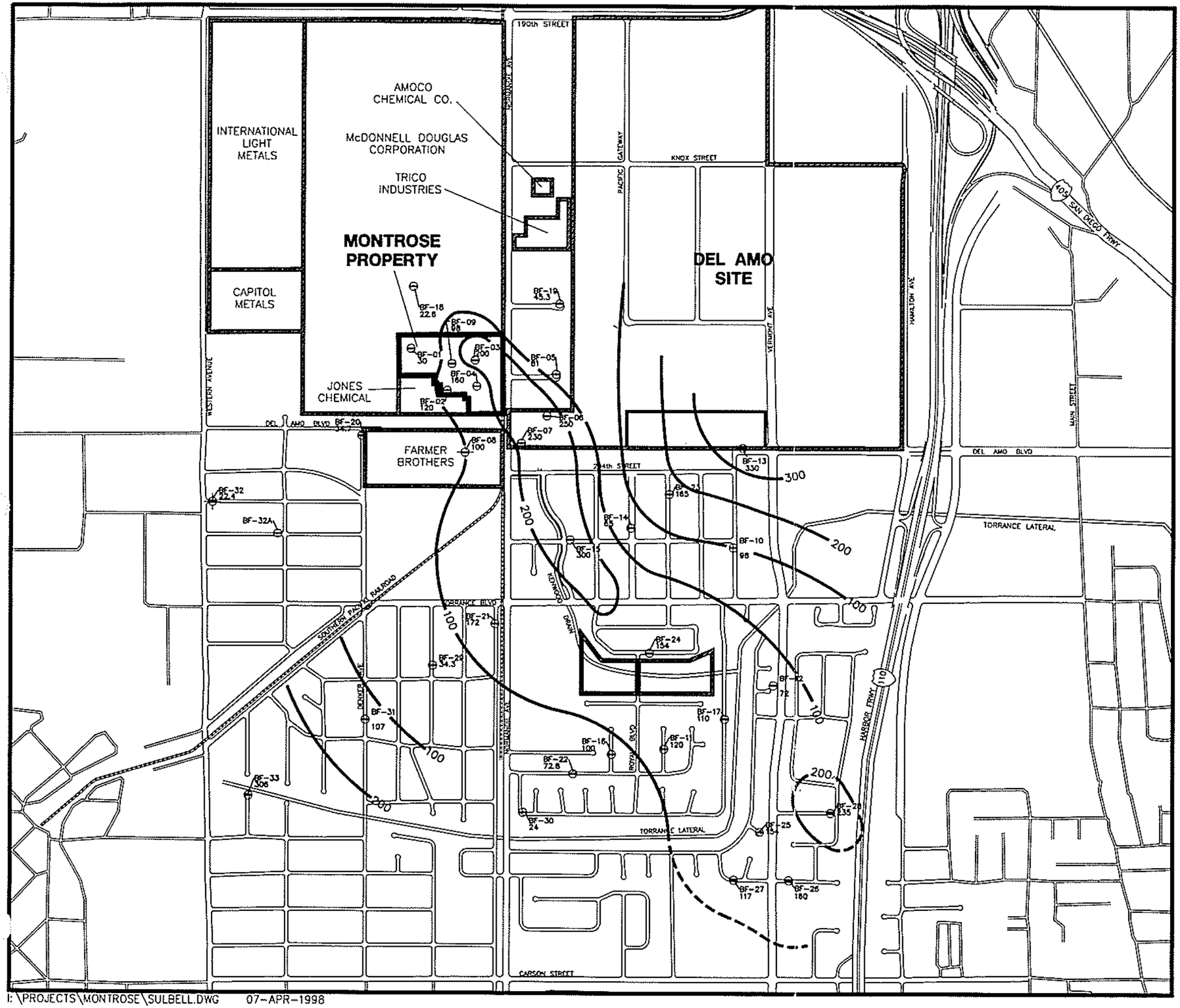
SCALE IN FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

FIGURE 4.24b
CHLORIDE IN GROUNDWATER
BELLFLOWER SAND

CLBELL		1/98



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EXPLANATION

BF-19 ⊖ 45.3 — BELLFLOWER SAND MONITOR WELL; CONCENTRATION IN MICROGRAMS PER LITER

BF-08 ⊖ — DESTROYED WELL

?——100——?
CONTOUR LINE OF EQUAL CONCENTRATION OF SULFATE IN MILLIGRAMS PER LITER
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY. SAMPLE DATES RANGE FROM APRIL 1990 TO DECEMBER 1995. SAMPLE DATES AND A SAMPLE RESULTS SUMMARY FOR MONTROSE WELLS ARE PROVIDED IN TABLE 5.5.

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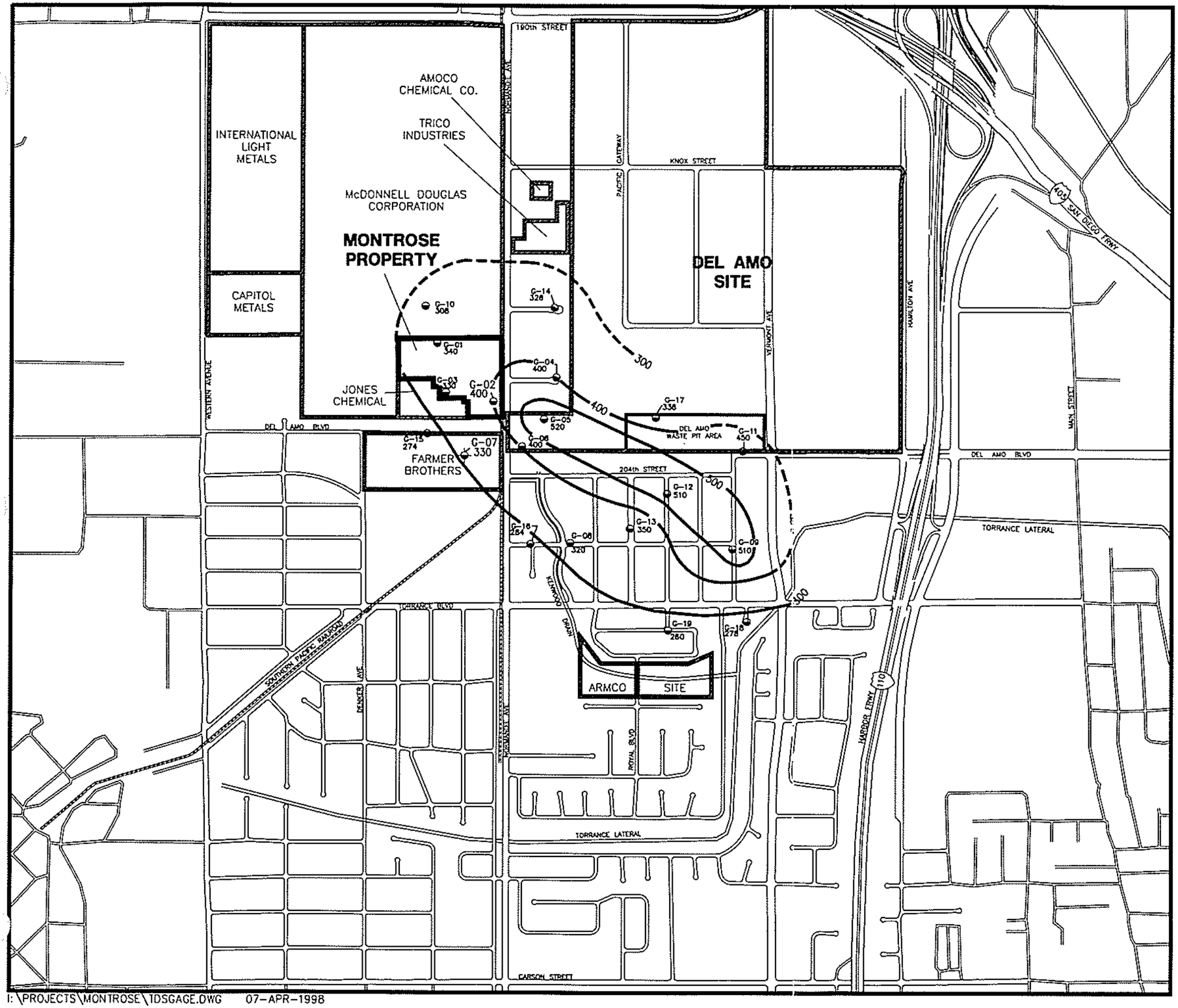
SCALE IN FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

FIGURE 4.24c
SULFATE IN GROUNDWATER
BELLFLOWER SAND

SULBELL		4/98



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EXPLANATION

G-05 — GAGE AQUIFER MONITOR WELL

520 — CONCENTRATION IN MILLIGRAMS PER LITER

G-07 — DESTROYED WELL

LG-01 — LOWER GAGE AQUIFER MONITOR WELL

?——300——?

CONTOUR LINE OF EQUAL CONCENTRATION OF TOTAL DISSOLVED SOLIDS IN MILLIGRAMS PER LITER DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY.

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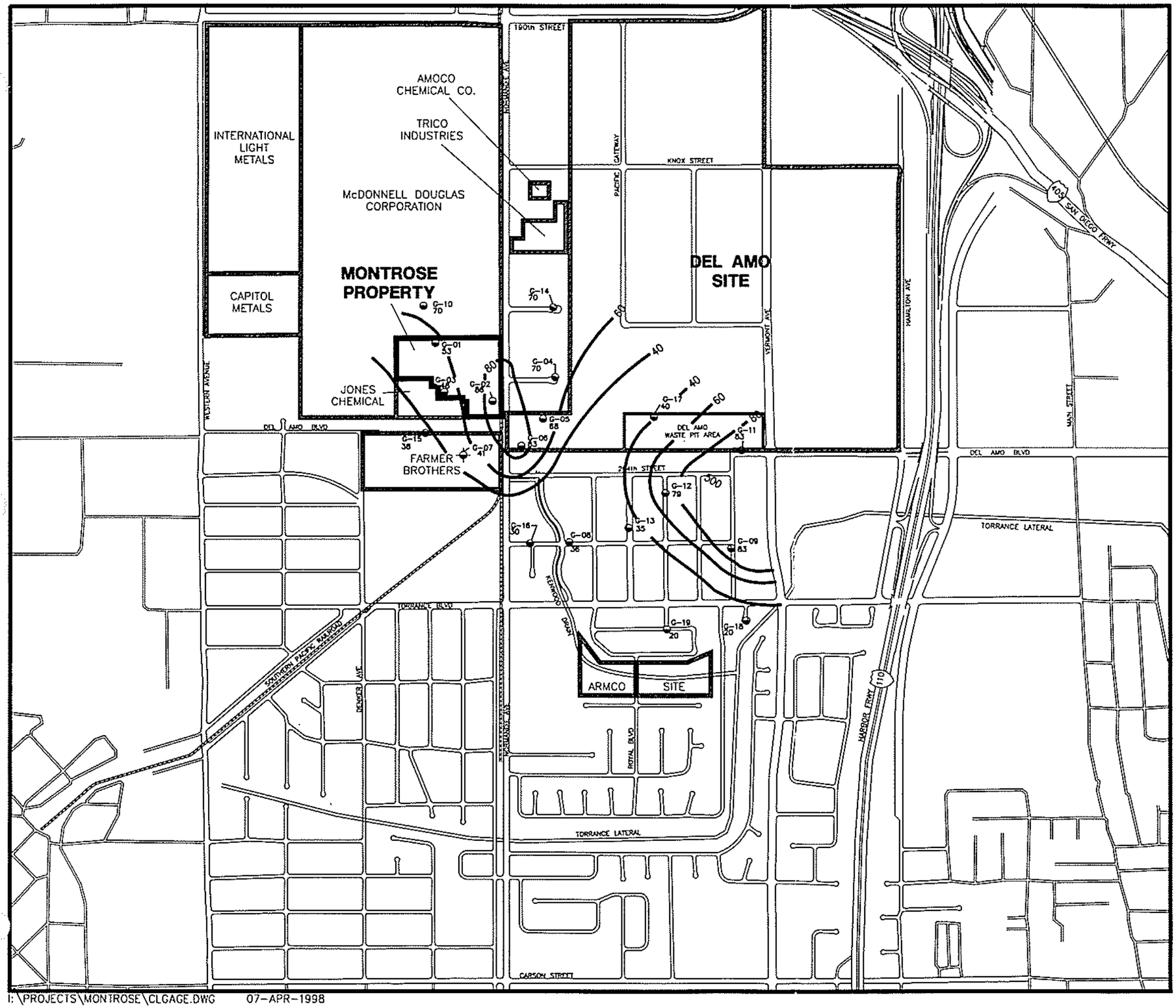
SCALE IN FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

FIGURE 4.25a
TDS IN GROUNDWATER
GAGE AQUIFER

TDSGAGE		4/98



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EXPLANATION

G-05 — GAGE AQUIFER MONITOR WELL

68 — CONCENTRATION IN MILLIGRAMS PER LITER

G-07 — DESTROYED WELL

LG-01 — LOWER GAGE AQUIFER MONITOR WELL

?——— 40 ——— ——? CONTOUR LINE OF EQUAL CONCENTRATION OF CHLORIDE IN MILLIGRAMS PER LITER DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY.

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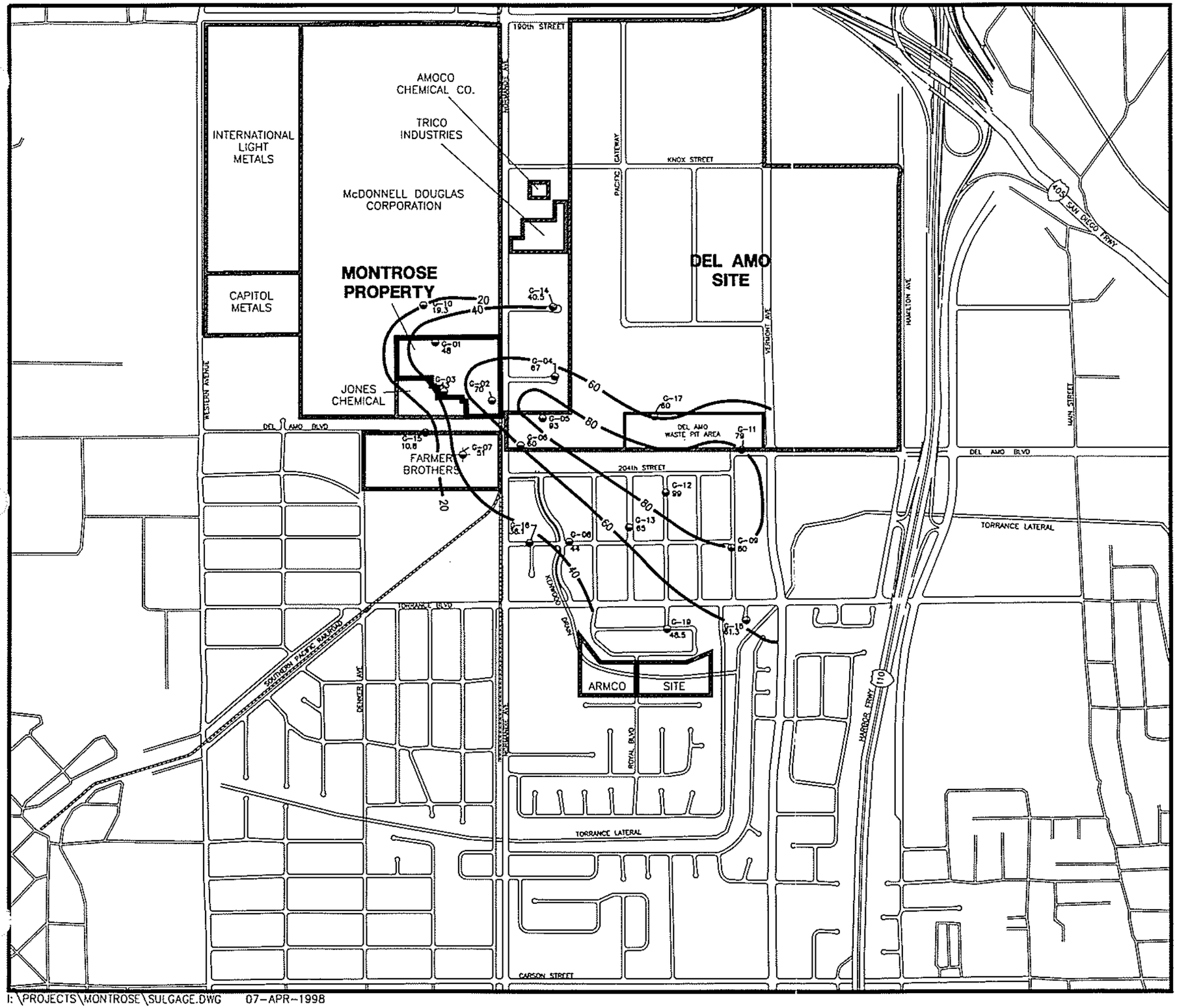
SCALE IN FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

FIGURE 4.25b
CHLORIDE IN GROUNDWATER
GAGE AQUIFER

CLGAGE		4/98



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EXPLANATION

G-05 — GAGE AQUIFER MONITOR WELL

<0.04 — CONCENTRATION IN MILLIGRAMS PER LITER

G-07 — DESTROYED WELL

LG-01 — LOWER GAGE AQUIFER MONITOR WELL

? —— 20 —— ? CONTOUR LINE OF EQUAL CONCENTRATION OF SULFATE IN MILLIGRAMS PER LITER DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY.

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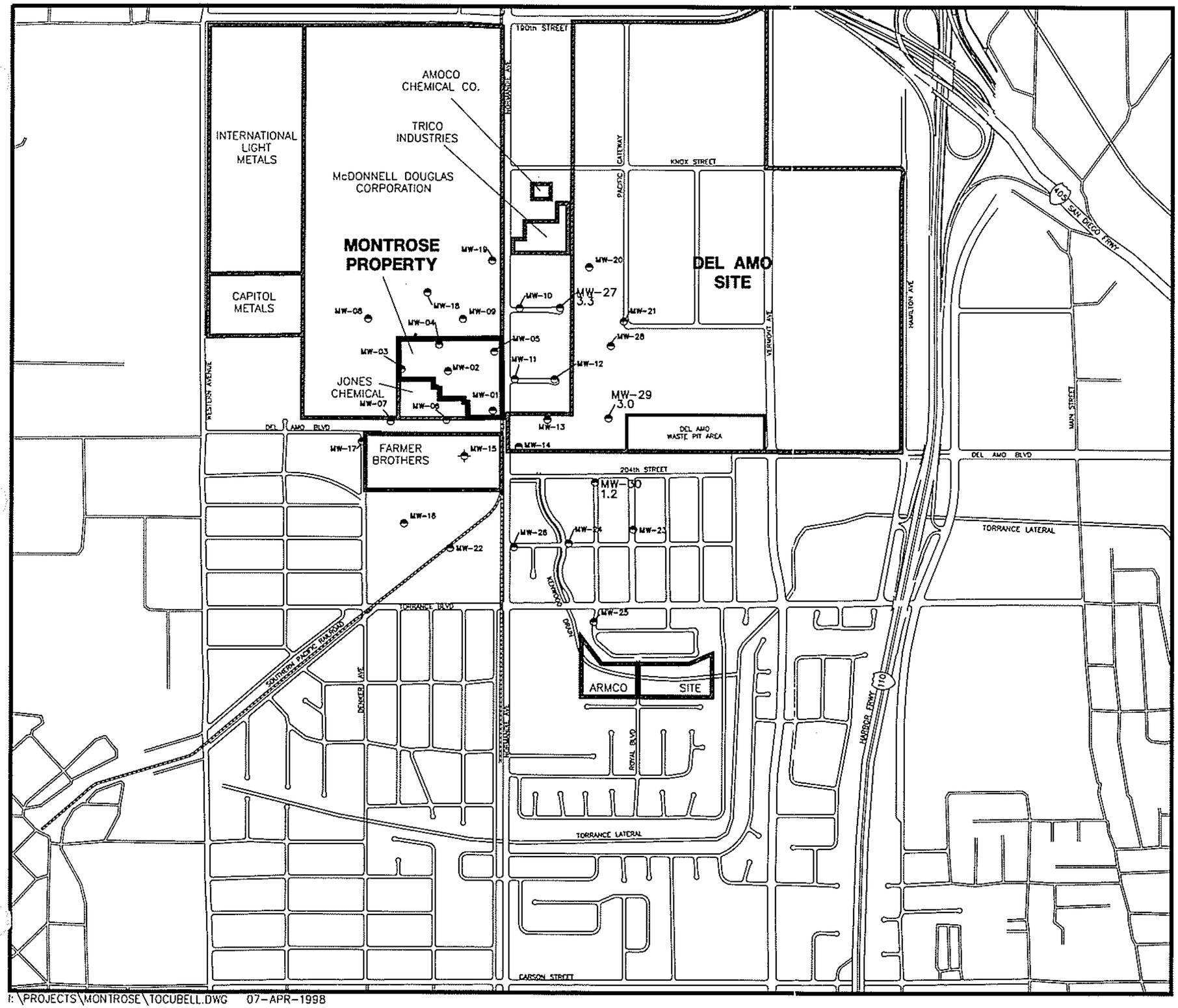
SCALE IN FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

FIGURE 4.25c
SULFATE IN GROUNDWATER
GAGE AQUIFER

SULGAGE		4/98



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EXPLANATION

MW-27 — UPPER BELLFLOWER AQUITARD MONITOR WELL

3.3 — CONCENTRATION IN MILLIGRAMS PER LITER

MW-15 — DESTROYED WELL

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995 DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY.

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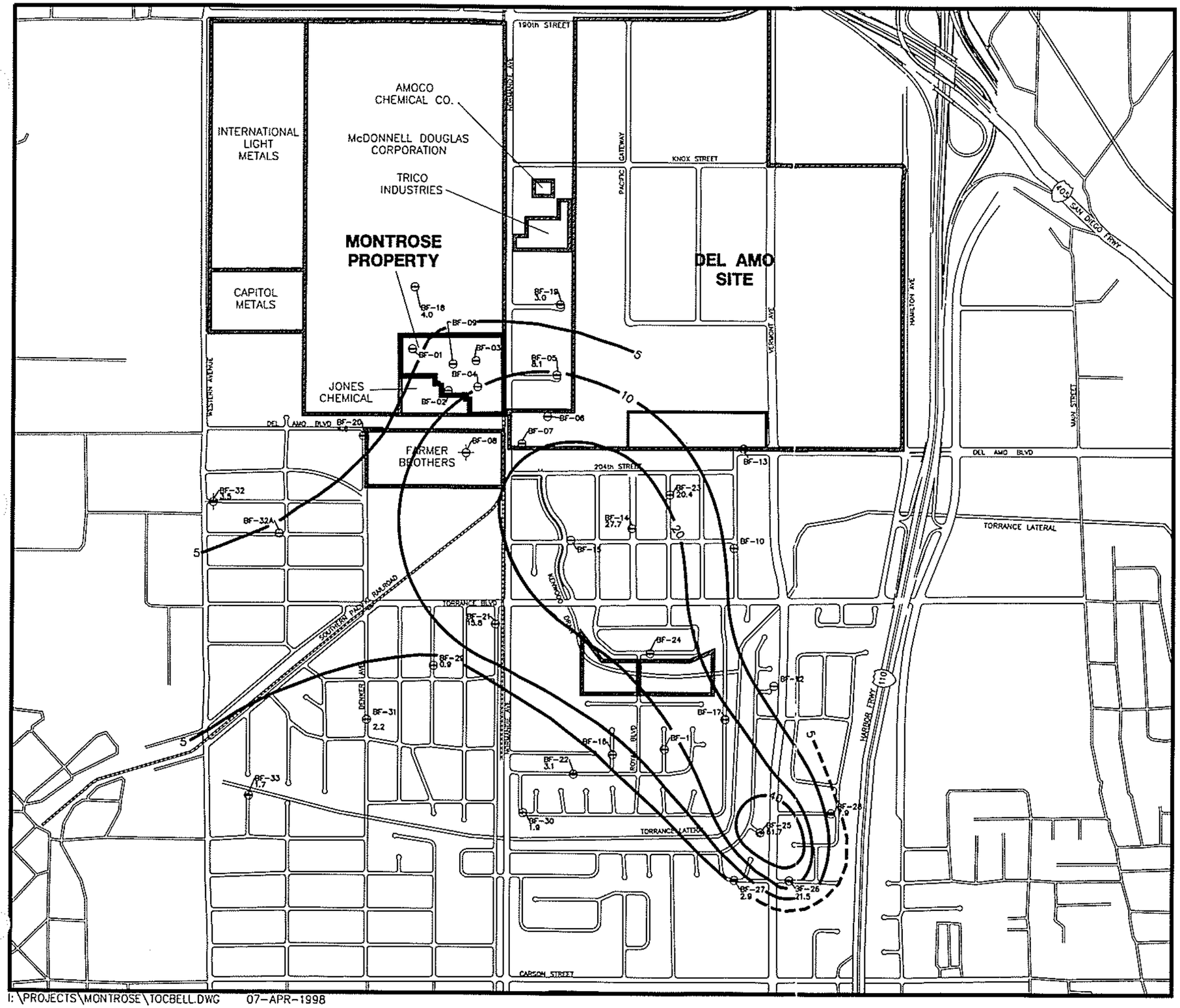
SCALE IN FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

FIGURE 4.26
TOC IN GROUNDWATER
UPPER BELLFLOWER AQUITARD

TOCUBELL		4/98



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EXPLANATION

BF-19 — BELLFLOWER SAND MONITOR WELL

3.0 — CONCENTRATION IN MILLIGRAMS PER LITER

BF-08 — DESTROYED WELL

?——— 10 ———? CONTOUR LINE OF EQUAL CONCENTRATION OF TOC IN MILLIGRAMS PER LITER
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY.

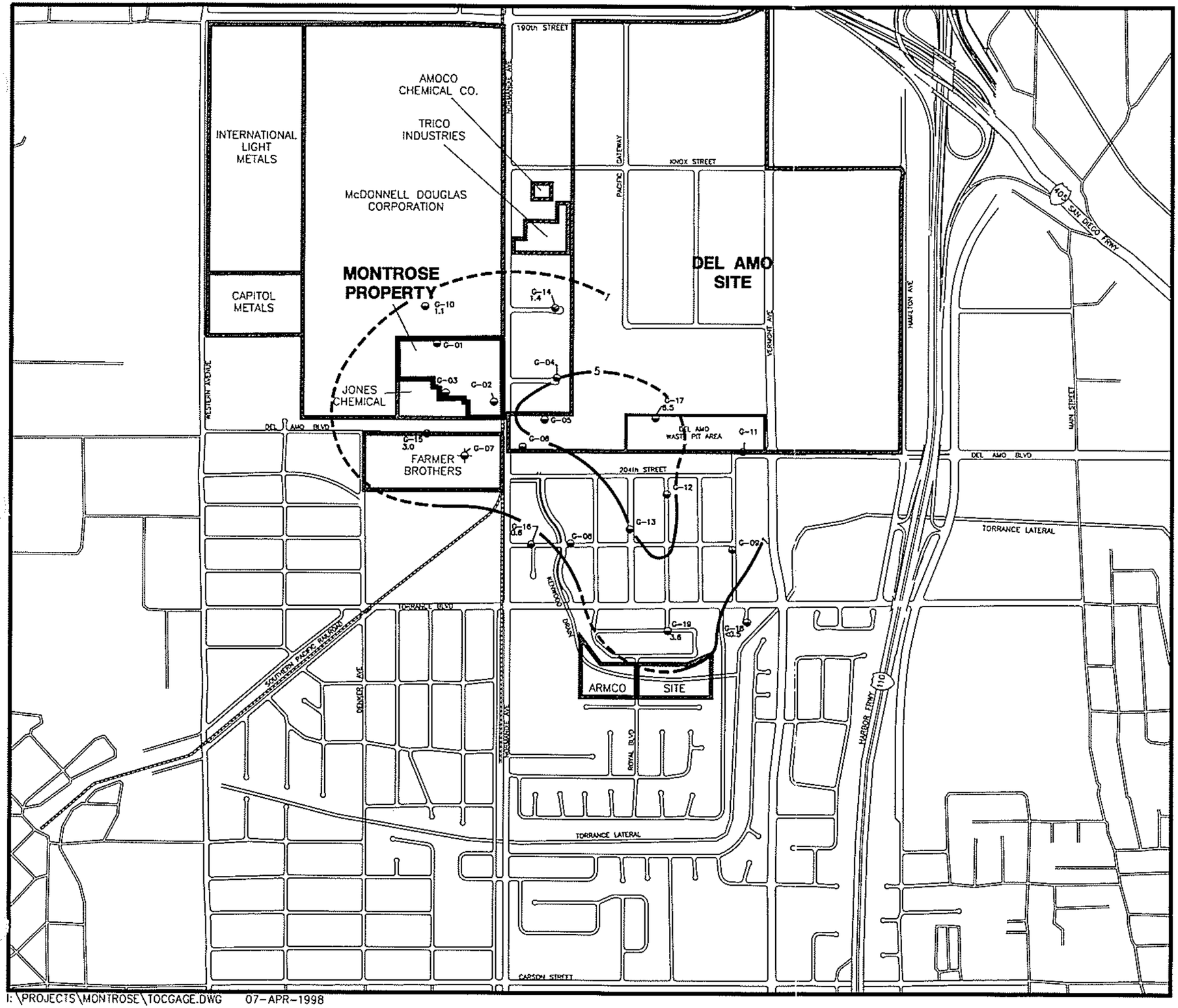
0 1000 2000

SCALE IN FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

FIGURE 4.27
TOC IN GROUNDWATER
BELLFLOWER SAND

TOCBELL		4/98



I:\PROJECTS\MONTROSE\TOCGAGE.DWG 07-APR-1998

EXPLANATION

G-18 — GAGE AQUIFER MONITOR WELL

<0.05 — CONCENTRATION IN MILLIGRAMS PER LITER

G-07 — DESTROYED WELL

LG-01 — LOWER GAGE AQUIFER MONITOR WELL

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

?——— 5 ———? CONTOUR LINE OF EQUAL CONCENTRATION OF TOC IN MILLIGRAMS PER LITER DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY.

N

0 1000 2000

SCALE IN FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

FIGURE 4.28
TOC IN GROUNDWATER
GAGE AQUIFER

TOCGAGE		4/98

5. Nature and Extent of Contamination

This section describes the nature and extent of contamination at the Montrose Site in each of the four environmental media of concern investigated as part of this RI. The nature and extent of chemical compounds occurring in soil, groundwater, sediment, and surface water were investigated as part of RI field work conducted at the Montrose Site during the period from 1983 through December 1997.

Remedial investigation activities conducted to evaluate the nature and extent of contamination are discussed by medium in Section 2. The chronology of the RI investigation activities are discussed in Sections 1.6 and 1.7. The data from the RI have been supplemented with data obtained at the Montrose Site prior to commencing the RI and data obtained by others at nearby facilities at and in the vicinity of the Montrose Site. Other investigations not specifically described in this RI report are briefly summarized in Section 1.9.

5.1 Introduction

5.1.1 Organization of Section 5

Section 5 provides a discussion of the contaminants in each of the environmental media investigated: soil, groundwater, sediment, and surface water. It is organized as follows:

- **Section 5.1** discusses the organization of Section 5, analytes and reporting of sample analyses, prevalence of contaminants tables, and supplemental data.
- **Section 5.2** provides a summary of the nature and extent of contamination in soil, groundwater, sediment, and surface water.
- **Section 5.3** presents the results of On-Property near surface soil sampling conducted in 1983 prior to the grading and redistribution of near surface soil in 1985.
- **Section 5.4** presents results from On-Property soil sampling conducted since 1985 and Off-Property soil sampling. In addition, Section 5.4 provides a discussion of the analytical results of soil samples collected below the water table from deep borings located On-Property. These results were used to evaluate the distribution of pesticides and VOCs potentially associated with DNAPL.
- **Section 5.5** discusses the nature and extent of dense non-aqueous phase liquid (DNAPL) which occurs On-Property in the subsurface beneath the Central Process Area and light non-aqueous phase liquid (LNAPL) which occurs Off-Property at various unrelated sites.
- **Section 5.6** describes the nature and extent of chemical compounds detected in groundwater samples collected from each monitored hydrogeologic unit at the Montrose Site. Groundwater quality was monitored in the Upper Bellflower Aquitard, the Bellflower Sand, the Gage Aquifer, and the Lynwood Aquifer as part of the RI work at the Montrose Site.

- **Section 5.7** discusses the nature and extent of contaminants in sediment in four surface water drainages located downstream from the Property. Sediment samples were collected from the Kenwood Drain, the Torrance Lateral, the Dominguez Channel, and the Consolidated Slip.
- **Section 5.8** discusses the nature and extent of contaminants in surface water runoff sampled along the surface water pathway located downstream from the Property. Analytical results are discussed for samples collected during dry weather from the Torrance Lateral, the Dominguez Channel, and the Consolidated Slip. Analytical results are discussed for samples collected during five rainfall events from the Jones Chemical Company Ditch, the Normandie Avenue Ditch, the Torrance Lateral, the Dominguez Channel, and the Consolidated Slip.

5.1.2 Analytes and Reporting

The primary chemical compounds investigated at the Montrose Site were pesticides and VOCs. A subset of soil and groundwater samples were also analyzed for base neutral/acid extractable (semivolatile) organic compounds, trace metals, and chloral. Groundwater samples from most Montrose monitoring wells were also analyzed for p-CBSA, a by-product of the manufacture of DDT. Sampling and analysis schedules and analytical methods for samples collected and analyzed as part of this RI are presented in Section 2. Appendix B lists the analytes for each sample.

Because the DDT and BHC isomers and their metabolites were the only pesticides routinely detected at the Montrose Site, Section 5 discusses only these two pesticides. The analytical results for these pesticides are presented as total DDT and total BHC. Total DDT is the sum of all isomers of DDT and all isomers of the DDT metabolites DDD and DDE unless otherwise specified. These isomers are: p,p-DDT; o,p-DDT; p,p-DDD; o,p-DDD; p,p-DDE; and o,p-DDE. p,p-DDT is the most common isomer of DDT detected at the Montrose Site. The o,p- series isomers of DDT, DDD, and DDE were not analyzed in all soil samples. In those samples in which the o,p- series isomers were not analyzed, total DDT is the sum of the p,p- isomers of DDT, DDD, and DDE. Total BHC is the sum of the four BHC isomers: alpha-BHC, beta-BHC, delta-BHC, and gamma-BHC (Lindane). alpha-BHC generally comprises about 50 percent of the total BHC detected in soil samples at the Montrose Site. The results for other pesticides are provided in the appendices. The DDT results are listed by isomer in Appendix G and H.

Chlorobenzene was the most frequently detected VOC at the Montrose Site. Other VOCs detected in soil and groundwater included chloroform, benzene, tetrachloroethylene (PCE), trichloroethylene (TCE), acetone, dichlorobenzene (DCB), and methylene chloride. Analytical results for DCB are presented as total DCB. Total DCB is the sum of the three DCB isomers: 1,2-dichlorobenzene (1,2-DCB); 1,3-dichlorobenzene (1,3-DCB); and 1,4-dichlorobenzene (1,4-DCB). Analytical results for base neutral/acid organic compounds, trace metals, p-CBSA, and chloral are also discussed.

Analytical results of soil samples were originally reported by the laboratories in several different units of measure, including milligrams per kilogram (mg/kg), micrograms per kilogram, or micrograms per gram. For the purpose of this report, the analyte concentrations in all soil samples were converted to units of mg/kg.

EPA laboratory protocols require that the analytical results for soil samples be reported on a dry-weight basis. For reasons unknown to EPA, analytical results for soil samples collected

and analyzed by Montrose during the period 1981 to 1988 were reported by the laboratories on a wet-weight basis. Higher concentrations would have been indicated in these soil samples if the analytical results were reported, as required by EPA, on a dry-weight basis. As previously discussed in Section 4.1.2.4, soil samples collected from unsaturated soil above the water table ranged in moisture content from less than 1 percent to approximately 29 percent by weight. A typical moisture content for soil in the unsaturated zone was approximately 12 percent by weight. A concentration of 1 mg/kg DDT reported on a wet-weight basis would therefore be equivalent to a dry-weight DDT concentration of between 1.01 mg/kg and 1.29 mg/kg, assuming the original sample had a moisture content comparable to those observed at the Montrose Site. On average, dry-weight concentrations, if reported, would be expected to be approximately 12 percent greater than the reported wet-weight concentrations. Therefore, it should be noted that the soil sample results from 1981 to 1988 in this report are, on average, approximately 12 percent lower than what should have been reported using standard EPA reporting protocols.

5.1.3 Prevalence Tables

One of the methods of displaying the results in this section is through the use of prevalence tables. In general, the prevalence contaminants at the Montrose Site were tallied using the analytical results for On-Property and near Off-Property soil samples collected above the water table. The prevalence tables do not include background samples, neighborhood samples, samples collected by McLaren/Hart at Farmer Brothers Coffee in 1994, or samples collected below the water table. Several tables in Section 5 show the prevalence of contaminants (percentage of detections per number of samples analyzed) in the environmental media investigated. Prevalence was determined based on the results of original and duplicate analyses for soil samples collected by Montrose that include results of original, duplicate, split, and duplicate split analyses for soil samples collected by EPA; and results of original soil samples collected by Levine-Fricke as part of the Jones Chemical Company investigation. Duplicate and split sample analyses were included in the prevalence table for because these QA/QC samples represent independent soil samples analyzed at each depth interval. The results of the re-analysis of EPA split and EPA split duplicate samples were not incorporated into the prevalence table for soil. The prevalence evaluation for soil also does not incorporate analytical results for On-Property soil samples collected prior to the grading of the Property in 1985, nor does it reflect results for neighborhood and background soil samples collected at more distant Off-Property locations.

5.1.4 Supplemental Data

In addition to data collected during the RI, this report includes data from shallow soil sampling conducted at the Farmer Brothers Company property in 1994 (McLaren/Hart, 1994) and from investigations conducted under the direction of DTSC on the adjacent Jones Chemical Company property (Levine-Fricke, 1995). These data are shown in some of the figures in this section with the RI data, but are not included in the data summary tables in Appendix H. The sampling locations for Jones Chemical Company supplemental data begin with the prefix "LF." The sampling locations for the Farmer Brothers supplemental data begin with the prefix "FB."

5.2 Summary of Nature and Extent of Contamination

This section provides a brief summary of the nature and extent of contamination for soil, groundwater, DNAPL, sediment, and surface water at the Montrose Site. Detailed discussions of the nature and extent of contamination are provided in Section 5.3 (On-Property, Pre-Grading Soil Sampling), Section 5.4 (On-Property [post Grading] and Off-Property Soil Sampling), Section 5.5 (Non-aqueous Phase Liquids), Section 5.6 (Groundwater Contamination), Section 5.7 (Sediment), and Section 5.8 (Surface Water).

5.2.1 Nature and Extent of Soil Contamination

Figure 5.1 shows On-Property and near Off-Property soil sampling locations for the period 1981 to 1995. The figure includes sampling locations for the pre-RI, RI, and nearby investigations at Jones Chemical Company and Farmer Brothers. Because the northwest corner investigation was only recently completed, sampling locations (and analytical results) for that investigation are provided in Figure 5.5A and Appendix K.

Table 5-1A (located at the end of Section 5) presents a summary of the evaluation of soil analyses for the Montrose RI by geographical area, compound, and depth interval. Concentrations of specific contaminants in soil at all depth intervals have been compared to EPA Region IX Preliminary Remediation Goals (PRGs) for residential soil. Residential soil PRGs have been used in the evaluation because they are more conservative (i.e., lower) than industrial soil PRG values, and their use accommodates the uncertainty with the future use of the Montrose Site. It should be noted that the PRG values for compounds are only used as a basis to compare the analytical results for soil samples analyzed under this RI. The PRGs do not necessarily represent action levels that would require remedial action, nor are they cleanup goals that would need to be met by a remedial action implemented at the site. Even though residential PRGs are being used, the property may be used for industrial purposes in the future. Future use of the site and cleanup goals for soil will be established for the Montrose Site at a later date.

Three basic geographical areas are covered in Table 5-1A as follows, starting inside the Montrose Property from the area where the DDT manufacturing plant was located and moving outward:

- Central Process Area
- On-Property, Outside the Central Process Area
- Nearby Off-Property (Property Perimeter, Normandie Avenue Ditch, Jones Chemical Company property, LADWP right-of-way, and Farmer Brothers Coffee)

For each of the areas listed above, the soil data is evaluated in Table 5-1A for the following depth intervals:

- 0 to 3 feet below land surface (bls)
- 3 to 6 feet bls
- 6 to 10 feet bls
- 10 to 70 feet bls
- Greater than 70 feet bls (below the water table)

An evaluation of the soil data for the following compounds is included in Table 5-1A for the three geographical areas and the five depth intervals listed above:

- Total DDT
- Chlorobenzene
- Total BHC
- Chloroform
- Benzene
- Other VOCs (PCE, dichlorobenzene, acetone, methylene chloride, ethyl benzene, total xylenes, and methyl ethyl ketone)
- Base Neutral/Acid Extractable Compounds (semivolatile organic compounds)
- Chloral
- Trace Metals

A description of the lateral and vertical extent of contamination in soil is presented in this section for total DDT and chlorobenzene, the two most prevalent contaminants detected in soil samples at the Montrose Site. In addition to being the most prevalent, these two compounds also occur at the highest maximum concentrations of any contaminants detected in soil. Information on the extent of other less prevalent contaminants detected at the site can be found in Table 5-1A.

5.2.1.1 Extent Of Total DDT In Soil

Total DDT On-Property, Pre-Grading. Soil sampling events prior to grading of the Montrose Site in 1985 focused on the near surface soil (upper 6 feet) and soil stockpiles located in and around the Central Process Area. In sampling conducted in 1983 prior to grading, 100 percent of the soil samples collected from the Central Process Area were above the EPA Region IX PRG of 1.3 mg/kg for total DDT in residential soil. In addition, over 90 percent of the soil samples collected On-Property outside the Central Process Area were above the PRG. For the pre-graded site, a maximum DDT concentration of 710,000 mg/kg (71 percent DDT by weight) was detected in a soil sample from the northwest corner of the Property.

While the highest pre-grading DDT concentration was located in the On-Property area, the percentage of samples exceeding the PRG was slightly higher in the Central Process Area (100 percent versus 90+ percent), although both percentages are high and indicate a significant presence of DDT in the pre-graded near surface soils. DDT concentrations exceeded 1,000 mg/kg in about 50 percent of the samples collected from the Central Process Area and 40 percent of the samples from On-Property.

Total DDT All Areas (Post-Grading Data for Near Surface Soils within the Montrose Property). As shown in Table 5-1B and 5-1C, soil sample results confirm that there is a significant presence of DDT in surface soil samples inside and outside the Central Process Area after grading occurred in 1985. At each of these portions of the Property, about 90 percent of the samples from 0 to 3 feet bls exceed the PRG value. Over 50 percent of the samples in the 0- to 3-foot depth interval from each area also exceed 1,000 mg/kg total DDT. When compared to the pre-graded soil results, the post-graded soil results show similar percentages of samples exceeding the PRG, but have a lower maximum concentration of total DDT. This appears to be the result of dilution (i.e., mixing of less contaminated soil with more highly contaminated soil) that occurred during the site grading effort. The highest DDT concentrations are still in the same general area as before the grading, near the former junkyard and machine shop.

The total DDT concentrations in the Central Process Area generally increase from approximately 6 feet bls to depths greater than 70 feet which is below the water table. At a

depth of 78.3 feet, a concentration of 69,000 mg/kg total DDT was detected in the soil sample, which indicates the likely presence or former presence of DNAPL. As described in Section 5.2.2, the Montrose DNAPL is a dense viscous liquid that contains an average of 47 percent DDT and 43 percent chlorobenzene by weight. Therefore, even very small percentages of DNAPL in a soil sample will result in high total DDT concentrations.

Because of the higher solubility of chlorobenzene (500 mg/L) relative to DDT (5.5 µg/L to 100 µg/L for the various isomers and metabolites) [Tables 6.1, 6.2b, and 6.3b], over time the chlorobenzene may selectively dissolve from the DNAPL into the groundwater or soil pore water, resulting in precipitation of DDT into the soil matrix. Elevated concentrations of DDT detected in soil samples from the deeper portions of the vadose zone may be indicative of residual DNAPL, sorbed DDT, or precipitated DDT as a solid phase.

Sampling for DNAPL often reflects the very heterogeneous distribution of DNAPL in the subsurface, and the analytical results may show an uneven distribution of DNAPL, DDT, and MCB in soils. Where DNAPL is present or has been formerly present in the subsurface soil, the DDT concentrations are much higher than areas that are not impacted by DNAPL.

Where DNAPL is present in the soil as free-phase liquid or residuals, the DDT concentrations are much higher than areas that are not impacted by DNAPL. A summary of data results for total DDT in the Central Process Area is presented below:

TABLE 5-1B
Prevalence of Total DDT in Soil in the Central Process Area (Post-Grading)

Depth Interval	Total No. of Samples	% of Samples >PRG (1.3 mg/kg)	% of Samples >1,000 mg/kg	Maximum Conc. (mg/kg)
0 to 3 feet	9	89	56	8,780
3 to 6 feet	7	57	43	4,460
6 to 10 feet	20	65	35	9,900
10 to 70 feet	112	72	31	12,621
>70 feet	25	84	28	69,000

The total DDT concentrations of soil samples On-Property and outside the Central Process Area do not follow the same pattern as the Central Process Area. Outside the Central Process Area, there is a noticeable drop in total DDT concentration with depth, with reductions in the percentage of samples above PRGs and in the maximum concentrations detected, as shown in the table below:

TABLE 5-1C
Prevalence of Total DDT in Soil On-Property, Outside the Central Process Area (Post Grading)

Depth Interval	Total No. of Samples	% of Samples >PRG (1.3 mg/kg)	% of Samples >1,000 mg/kg	Maximum Conc. (mg/kg)
0 to 3 feet	28	93	54	3,808
3 to 6 feet	35	40	11	2,932
6 to 10 feet	45	9	0	550
10 to 70 feet	41	7	0	3.39
>70 feet	5	0	0	0.37

As the distance from the Central Process Area increases, the prevalence of total DDT decreases. Table 5-1A provides Off-Property total DDT results showing this trend. Of the various areas Off-Property, the most significant total DDT concentrations occur along the Normandie Avenue Ditch, in which 64 percent of the samples in the 0- to 3-foot depth interval exceed the PRG. One sample had a concentration as high as 8,600 mg/kg. There is a significant reduction in the total DDT at the Normandie Avenue Ditch with depth, with the 3- to 6-foot depth interval having 33 percent of samples exceeding the PRG and a maximum concentration of 140 mg/kg. Further reduction in total DDT prevalence and concentration occur at the depths below 6 feet.

Summary for Total DDT. The presence of total DDT is most prevalent at the Montrose Site in the 0- to 3-foot depth interval. The highest percentage of soil samples exceeding the PRG in this depth interval occur within the Montrose Property boundaries (i.e., in and outside the Central Process Area). The highest concentrations of DDT detected under this RI also occur within the Montrose Property boundaries. In addition, there are some hot spots (e.g., portions of the Normandie Avenue Ditch) that occur Off-Property.

The Central Process Area shows a significant presence of total DDT from the ground surface to depths greater than 70 feet bls, which is below the water table. The concentrations in the vadose zone (upper 70 feet) are highest in the surface soil at 0 to 3 feet bls, drop at 3 to 6 feet bls, and then increase with decreasing depth from 6 to 70 feet bls. Below the water table, soil sample concentrations are as high as 69,000 mg/kg, which indicates the likely presence of DNAPL.

No other areas investigated under this RI show as significant a presence of total DDT at depths below 10 feet bls as the Central Process Area.

5.2.1.2 Extent Of Chlorobenzene In Soil

Chlorobenzene was primarily detected within the Central Process Area at depths from 6 feet bls to greater than 70 feet bls, although it was detected across the site at low levels. The table below summarizes chlorobenzene concentrations in the Central Process Area.

TABLE 5-1D
Prevalence of Total Chlorobenzene in Soil in the Central Process Area

Depth Interval	Total No. of Samples	% of Samples >PRG (65 mg/kg)	% of Samples >1,000 mg/kg	Maximum Conc. (mg/kg)
0 to 3 feet	27	0	0	7
3 to 6 feet	35	0	0	20
6 to 10 feet	44	37	16	8,200
10 to 70 feet	41	42	29	12,000
>70 feet	5	40	28	81,000

The lack of a significant chlorobenzene presence in the upper 6 feet of soil at the Central Process Area may be the result of the grading of the Property in 1985 and the volatile nature of chlorobenzene. Because chlorobenzene is a volatile organic compound, it is likely that site grading activities would have caused some chlorobenzene present in the near surface soils at that point in time to volatilize to the atmosphere.

Chlorobenzene has a significant presence in the vadose zone in the Central Process Area from a depth of 6 feet bls down to the water table at a depth of about 70 feet bls. The presence of significant chlorobenzene concentrations in soil samples below the water table (i.e., a maximum concentration of 81,000 mg/kg was detected) indicates the likely presence of DNAPL. DNAPL tends to migrate more easily through the vadose zone than in saturated sediments, and DNAPL residuals therefore are commonly observed in higher concentrations at and below the water table. It should be noted that total DDT was also present below the water table at high concentrations in the Central Process Area, indicating a DNAPL presence.

Chlorobenzene was detected at the Montrose Site outside of the Central Process Area, but none of the samples exceed the PRG of 65 mg/kg.

5.2.2 Nature and Extent of DNAPL

A non-aqueous phase liquid (NAPL) is a liquid chemical or mixture of chemicals in the subsurface that is not miscible in water and, therefore, exists as a separate liquid phase. A NAPL may be lighter or heavier than water depending on its density. A dense non-aqueous phase liquid (DNAPL) is heavier than water and tends to sink below the water table. DNAPLs most commonly consist of chlorinated solvents. A NAPL that is lighter than water, referred to as a light non-aqueous phase liquid (LNAPL), tends to be held at or slightly above or below the water table. Fuel hydrocarbons, such as oil, gasoline, and diesel, are the most commonly encountered LNAPLs. The compounds that comprise a NAPL are dissolved into the surrounding groundwater; therefore, NAPL acts as a long-term continuing source of chemical compounds to groundwater.

DNAPL has been observed in soil samples and groundwater from the Upper Bellflower Aquitard beneath the Central Process Area. The average composition of DNAPL samples was 43 percent by weight chlorobenzene and 47 percent by weight total DDT. The average density is 1.3; therefore, the DNAPL tends to sink below the level of the water table. The

DNAPL and associated dissolved constituents in the subsurface beneath the Central Process Area originated from Montrose activities in the Central Process Area.

Mobile DNAPL has been detected under the water table beneath the Central Process Area. In addition, a significant percentage of the DNAPL at the Montrose Site is likely to be present in the vadose zone at lower saturations known as residuals (DNAPL held in the pore spaces by capillary tension) or as ganglia (immobile fingers of DNAPL that are trapped in pore spaces at the trailing edge of moving DNAPL). DNAPL typically accumulates more readily below the water table than in the vadose zone, because the DNAPL drains more easily within the vadose zone. The presence of laterally continuous low permeability clay layers within the Upper Bellflower Aquitard also inhibits the downward migration of DNAPL and cause the DNAPL to spread laterally.

In general, the DNAPL appears to have been localized below the Central Process Area and within the Upper Bellflower Aquitard. DNAPL has been visually observed in soil and groundwater samples below the Central Process Area only within the Upper Bellflower Aquitard in an area approximately 250 feet by 300 feet. The inferred lateral extent of DNAPL based on chlorobenzene and total DDT concentrations in groundwater and soil is approximately 250 feet by 400 feet. The total DDT concentrations in soil within the underlying Bellflower Sand may indicate the past or present occurrence of DNAPL. The DNAPL at the Montrose Site is responsible for the large chlorobenzene plume present in the Upper Bellflower Aquitard and the underlying hydrogeologic units. A summary of the extent of DNAPL at the Montrose Site is provided in Table 5.1E. A detailed discussion of the presence of DNAPL at the Montrose Site is provided in Section 5.5.1.

LNAPL has been observed at several locations at the adjacent Del Amo Site (benzene), and at a location southwest of Jones Chemical Company in the LADWP right-of-way (petroleum hydrocarbons). The occurrence of LNAPL and directly associated dissolved constituents appears to be primarily attributable to sources located Off-Property.

5.2.3 Nature and Extent of Groundwater Contamination

Plumes of groundwater contamination beneath and/or within the vicinity of the Montrose Site are present for the following chemicals: DDT, BHC, chlorobenzene, p-CBSA, chloroform, benzene, PCE, TCE, and the dichlorobenzenes (1,2-dichlorobenzene [1,2-DCB], 1,3, dichlorobenzene, [1,3-DCB], and 1,4-dichlorobenzene [1,4-DCB]). In addition, detections of ethylbenzene, toluene xylenes, 1,2-dichloroethane (1,2-DCA), base neutral/acid extractable (semivolatile) organic compounds, and trace metals in groundwater were observed. However, distinct, identifiable plumes for these detected chemicals could not be contoured, because the detections were sporadic and the locations of the detections were not at contiguous locations. A summary of the presence and size of groundwater plumes for each constituent, the percent detections in the monitoring wells, and the range of detected concentrations is provided in Table 5.1E for each of the four major hydrogeologic units: the Upper Bellflower Aquitard, the Bellflower Sand, the Gage Aquifer, and the Lynwood Aquifer. This text summary will focus on the plumes with the greatest extent and highest concentrations. Detailed discussions of the nature and extent of all compounds listed in Table 5.1E are provided in Section 5.6.

The assessment of the nature and extent of groundwater contamination is based on the analysis of groundwater samples from 95 groundwater monitoring wells installed in the Montrose Site vicinity (33 monitoring wells within the Upper Bellflower Aquitard, 34 monitoring wells within the Bellflower Sand, 21 monitoring wells within the Gage Aquifer,

and 7 monitoring wells within the Lynwood Aquifer). The number of groundwater analyses that have been completed for each chemical at each monitoring well ranges from 1 to 26 (Table 5.5). VOCs have been analyzed the most often (i.e., 844 analyses for chlorobenzene as summarized in Table 5.4). Only half as many samples (452) have been analyzed for total BHC and total DDT, and only approximately a quarter of the samples (217) were analyzed for p-CBSA.

The extent of groundwater contamination is based on plume maps prepared for selected contaminants and hydrogeologic units (Figures 5.45 through 5.72) using the most recent data value for each monitoring well. Because of the age of the groundwater monitoring data (2 to 7 years old), the extent of groundwater contamination described in this report may be potentially underestimated. The most recent groundwater sampling occurred in late 1995; however, not all monitoring wells were sampled in 1995 and, of those sampled, not all chemicals were analyzed. For example, 22 of 33 Upper Bellflower Aquitard monitoring wells, 18 of 34 Bellflower Sand monitoring wells, 14 of 21 Gage monitoring wells, and 2 of 7 Lynwood Aquifer monitoring wells were analyzed in 1995 for chlorobenzene (Table 5.5). The previous data for those monitoring wells not sampled in 1995 is primarily from 1990 and 1991. In addition, VOC analyses from 6 of the 67 monitoring wells sampled and analyzed for VOCs in 1995 are significantly less (from 0.1 percent to 50 percent) than the average concentration value for each contaminant. The reason for the significantly lower concentrations in the 1995 samples is unknown.

5.2.3.1 Chlorobenzene and p-CBSA

A continuous zone of groundwater contamination attributable to contaminant releases from the Montrose plant is present beneath the Montrose Site and extends vertically down to the Lynwood Aquifer. Chlorobenzene and p-CBSA occur in the highest concentrations and have the greatest vertical and lateral extent of all the groundwater contaminants detected in groundwater that appear to originate from the Montrose Site. Both of these compounds are directly related to Montrose activities. The lateral extents of the chlorobenzene and p-CBSA plumes within the Upper Bellflower Aquitard are approximately 2,000 feet by 2,500 feet and 2,000 by 2,800 feet, respectively (Figures 5.52 and 5.57). The highest concentrations of chlorobenzene (up to 1,000,000 µg/L) and p-CBSA (up to 11,000,000 µg/L) occur in groundwater within the Upper Bellflower Aquitard beneath the Central Process Area and are associated with the presence of DNAPL. The 1,000,000 µg/L chlorobenzene concentration exceeds the solubility of chlorobenzene in water, which is approximately 500,000 µg/L. Thus, entrained DNAPL likely contributed to the total measured chlorobenzene concentration at that location.

The lateral extent of chlorobenzene and p-CBSA is greatest in the underlying Bellflower Sand, exceeding 7,000 feet downgradient from the Montrose Site and up to 6,000 feet in width (Figures 5.53 and 5.58). The downgradient extent of detectable p-CBSA plume is not fully characterized with the presently existing monitoring wells; however, the plume is defined to the 1,000 µg/L contour. The p-CBSA concentrations at the downgradient edge of the plume are 890 µg/L at Monitoring Well BF-26 (measured in 1995) and 180 µg/L at Monitoring Well BF-28 (measured in 1991). Chlorobenzene concentrations within the high-concentration core of the Bellflower Sand plume range from 12,000 to 38,000 µg/L.

Within the Gage Aquifer, the chlorobenzene plume is approximately 2,000 feet by 5,000 feet and maximum concentrations are approximately 14,000 µg/L (Figure 5.54). The p-CBSA

plume above 0.1 mg/L within the Gage Aquifer is approximately 2,100 feet by 4,500 feet, and the historical concentration range is 170 µg/L to 78,000 µg/L (Figure 5.59).

The lateral extent of chlorobenzene is the least within the Lynwood Aquifer and is approximately 500 feet by 1,000 feet (Figure 5.55). Chlorobenzene concentrations within the Lynwood Aquifer are approximately 500 µg/L. The p-CBSA plume within the Lynwood Aquifer is approximately 400 feet by at least 1,000 feet (Figure 5.60). The p-CBSA concentrations for all groundwater samples collected to date from the Lynwood Aquifer have ranged from 270 µg/L to 2,100 µg/L.

5.2.3.2 Total DDT

Total DDT has been detected at least once in groundwater from 13 of the Upper Bellflower Aquitard monitoring wells within a zone of contamination approximately 1,500 by 1,500 feet beneath and within 500 feet of the Central Process Area (Figure 5.45). The DDT has not been detected in all of the groundwater samples from each monitoring well, and not all monitoring wells within this zone have contained detectable DDT. The highest concentrations (up to 1,100,000 µg/L total DDT from Monitoring Well UBT-01) are associated with DNAPL. Since these concentrations exceed the aqueous solubility of DDT (which ranges from 5.5 to 140 µg/L for the various isomers), entrained DNAPL or contaminated sediments within the groundwater sample likely contribute to the total DDT concentrations. DDT adsorbs to sediments readily and is, therefore, not very mobile in groundwater. DDT is observed in groundwater beneath the Montrose Site primarily because it is present as a major component of the DNAPL. The zone of detected total DDT is approximately 700 feet by 1,200 feet within the Bellflower Sand with historical concentrations ranging from 0.03 µg/L to 23 µg/L. A clearly definable zone of contamination is not visible in the Gage Aquifer; however, total DDT has historically been detected in groundwater from 7 of 21 monitoring wells within the Gage Aquifer and in 2 of 21 monitoring wells within the most recent sampling event. DDT has been detected in only one sample (0.046 µg/L)from one monitoring well (LW-01) within the Lynwood Aquifer.

5.2.3.3 BHC

BHC plumes beneath and downgradient of the Montrose Site are visible in the Upper Bellflower Aquitard and the Bellflower Sand. The lateral extent of the BHC plume within the Upper Bellflower Aquitard is approximately 2,000 feet by 1,500 feet with historical concentrations ranging from 0.08µg/L to 330 µg/L. Within the Bellflower Sand, the plume is 700 feet by 1000 feet, and historical concentrations range from 0.01 µg/L to 15 µg/L. A second smaller BHC plume is present downgradient near the Armco Site. BHC has been historically detected in groundwater from 5 of 21 Gage Aquifer monitoring wells; however, the data are insufficient to draw a plume. BHC has not been detected within the Lynwood Aquifer.

5.2.3.4 Chloroform

Chloroform was present as an impurity (0.1 to 0.2 percent by weight) in the chlorobenzene feedstock used for DDT manufacture (Kennedy/Jenks/Chilton, 1991) and may also have been generated by the DDT manufacturing process. A plume of chloroform is centered beneath the Central Process Area within the Upper Bellflower Aquitard with a lateral extent of approximately 2,500 feet by 2,500 feet and concentrations historically ranging from 9 µg/L to 85,000 µg/L (Figure 5.61). In addition, separate chloroform plumes are present to the east of the Property within the Del Amo Site and downgradient of the Property in the

vicinity of the Armco Site. Chloroform has been historically detected in groundwater from 6 of the 34 Bellflower Sand monitoring wells; however, a definable plume is not apparent based on the most recent sampling event data (Figure 5.62). Because of the very high detection limits (up to 300 µg/L) in some monitoring wells, a plume could be present but undetected. No plumes are apparent in the Gage Aquifer and Lynwood Aquifer, only scattered and sporadic detections.

5.2.3.5 Benzene

Widespread benzene contamination (over 5,000 feet by 6,000 feet) is present in groundwater within the Upper Bellflower Aquitard with the highest concentrations (up to 1,800,000 µg/L) present to the east of the Montrose Site within the Del Amo Site (Figure 5.64). Other plumes are present in the southwest corner of the Jones Chemical Company property and in the Armco Site vicinity. Within the Bellflower Sand, a benzene plume with concentrations exceeding 100,000 µg/L is present in the Del Amo Site. Additionally, a regional benzene plume within the Bellflower Sand extends from the Montrose Property approximately 5,500 downgradient (Figure 5.65). The benzene concentrations within the core of the regional benzene plume were approximately 20 to 60 µg/L during the most recent sampling. A benzene plume within the Gage Aquifer is approximately 1,200 feet by 3,000 feet with historical concentrations ranging from 1.3 µg/L to 1,300 µg/L. Only Well LW-01 has detected benzene within the Lynwood Aquifer. Three of the 12 samples from Monitoring Well LW-01 have contained detectable benzene with an average concentration of 4.3 µg/L.

Potential sources for the benzene beneath the Montrose Site include:

- The 0.3 percent benzene which occurred as an impurity in the Montrose chlorobenzene feedstock
- Benzene used by the Stauffer BHC plant on the Montrose Property
- The gasoline storage tank located south of the machine shop
- The Del Amo Site
- Fuel transmission pipelines in the LADWP right-of-way
- Underground fuel storage tanks at Jones Chemical Company

Montrose has also proposed that benzene observed within the Bellflower Sand may be due to biodegradation of chlorobenzene, as described in greater detail in Section 5.6.6.

5.2.4 Nature And Extent of Total DDT In Sediment

Sediment samples were collected by Montrose in 1986 and 1988 and by EPA in 1994 from the Kenwood Drain, the Torrance Lateral, the Dominguez Channel, and the Consolidated Slip. EPA also collected sediment samples from the Normandie Avenue Ditch in 1994. EPA collected sediment samples because most of the Montrose sediment samples were rejected due to a lack of documentation on calibrations. In general, the highest detected values of total DDT occurred at the Kenwood Drain, where all samples exceeded the residential PRG for total DDT.

A summary of the total DDT concentrations for the sediment samples (for both validated Montrose results and EPA results) is presented below for each drainage system:

- Kenwood Drain — All six samples were above the PRG for total DDT. Concentrations ranged from 4.9 to 59 mg/kg.
- Torrance Lateral — All 16 samples were below PRGs. Concentrations ranged from 0.019 to 0.252 mg/kg.
- Dominguez Channel — Five of the 41 samples were at concentrations above the PRG. The concentrations detected in these samples ranged from 0.017 to 4.1 mg/kg.
- Consolidated Slip — All nine samples were below the PRG. Concentrations ranged from 0.096 to 0.48 mg/kg.

5.2.5 Nature and Extent of Total DDT in Surface Water

Surface water samples were collected by Montrose at the following locations: Jones Chemical Ditch, Normandie Avenue Ditch, Torrance Lateral, Dominguez Channel, and Consolidated Slip. Both dry and wet weather surface water samples were collected at each location with the exception of the Jones Chemical Ditch and the Normandie Avenue Ditch, that do not contain water during dry weather. EPA also collected surface water samples in the Kenwood Drain, the Torrance Lateral, the Dominguez Channel, and the Consolidated Slip because many of the Montrose samples were rejected due to calibration documentation deficiencies. Total DDT was detected in surface water at four of the locations (Jones Chemical Ditch, Normandie Avenue Ditch, Kenwood Drain, and the Torrance Lateral). Total DDT was not detected at the Dominguez Channel and Consolidated Slip. The results indicate a decrease in DDT concentration with distance from the Montrose Property. A summary of the DDT analyses for each of the locations is presented below:

- Jones Chemical Ditch— total DDT was detected in all three samples (wet weather) at concentrations of 4.1 and 10 µg/L.
- Normandie Avenue Ditch— total DDT was detected in 8 of the 13 samples (wet weather). The maximum concentration was 45 µg/L.
- Kenwood Drain—total DDT was detected in all three samples. The maximum concentration was 0.6 µg/L.
- Torrance Lateral— total DDT was detected in 6 of the 13 wet weather samples, with a maximum concentration of 5.1 µg/L. DDT was not detected in the dry weather samples.
- Dominguez Channel— total DDT was not detected in any of the samples.
- Consolidated Slip— total DDT was not detected in any of the samples.

5.3 On-Property, Pre-Grading Soil Sampling (1981 and 1983)

This section describes the analytical results of soil sampling conducted On-Property in 1981 and 1983. These sampling events investigated only shallow, near surface soil. The results of On-Property soil sampling conducted in 1981 and 1983 are no longer representative of existing conditions because the Property was graded in 1985. Essentially, the DDT detected in the 1981 and 1983 sampling has been distributed throughout the Property through grading. Figure 2.2 shows how the ground surface elevations were changed by the grading. The data collected in 1981 by Montrose was very limited in scope and there was very little,

if any, QA/QC documentation. The data collected in 1983 cannot be verified because there is no backup QA/QC documentation from which to validate the data. Therefore, it is not the same quality of data as other RI data. However, it should be noted that the 1983 data indicated very high levels of DDT, generally in the tens to hundreds of thousands of ppm. While the accuracy cannot be determined, it is much more difficult for an analysis to result in a false positive than a false negative. For this reason, the data are considered indicative of very significant levels of DDT in the northwest corner. Therefore, although the data collected in 1983 lacks QA/QC documentation, the data have been incorporated into this RI to provide an understanding of the original site conditions and DDT releases.

Ten samples were collected by Montrose in May, August, and November 1981 on the Property. One hundred and twenty-six near surface soil samples were collected from 36 On-Property borings and 48 On-Property sampling locations in 1983 prior to grading of the Property. Figure 5.2 shows the sampling locations. These soil samples were analyzed for DDT only. No analyses for VOCs or pesticides other than DDT were performed. Total DDT was detected in all 126 of these samples. A complete list of analytical results for soil is provided in Appendix H.

5.3.1 1981 Soil Sampling Results

In May 1981, Montrose collected three samples from one boring in the southeastern portion of the Property. Samples were collected from 0.5, 1.0, and 1.5 feet bls. Each sample was divided into three splits: one analyzed by the Department of Health Services, one analyzed by Smith-Emery Laboratory for both Jones Chemical and Montrose, and one analyzed internally by Stauffer Chemical. Samples were analyzed for DDT, chlorobenzene, pH, alkalinity, and PCBs. In August 1981, Montrose collected five samples for DDT analysis On-Property. Four of the samples (8-81-10, 11, 13, and 14) were collected in "areas of high exposure" (Montrose, 1981c). Two soil samples were collected by Montrose in the southeast portion of the property in November 1981. Samples were analyzed for DDT and chlorobenzene. The 1981 sampling locations are shown in Figure 5.2 and the DDT results are provided in Figure 5.3. The results for other analytes are shown in the documentation provided in Appendix L. As shown in Figure 5.3, DDT was detected in near surface soils in the east and southeast portion of the Property at concentrations over 1,800 µg/kg.

5.3.2 June 1983 Soil Sampling Results

As shown in Figure 5.3, total DDT was detected to maximum depths of approximately 2.5 feet bls in all 40 soil samples collected in June 1983. Concentrations of total DDT detected in these samples ranged from 0.19 mg/kg in a soil sample collected from Boring S-09 at 2 feet bls to 95,000 mg/kg (i.e., 9.5 percent DDT by weight) in a soil sample collected from Boring S-24 at a depth of 0.6 feet bls.

5.3.3 July 1983 Soil Sampling Results

During July 1983, Stauffer Chemical Company, for and at the direction of Montrose, collected soil samples for DDT analysis. As shown in Figure 5.3, a total of 48 soil samples collected at 38 sampling locations in July 1983 were analyzed for DDT. Total DDT was detected in all 48 soil samples.

Twenty-eight soil samples were collected from 22 locations in the northwest corner of the Property. Nine of these samples were collected below grade at depths ranging from 1 to 5 feet bls. Nineteen core samples were collected from 16 locations in the northwest corner

of the Property at depths of 1 foot bls. Concentrations of total DDT detected in the below grade samples ranged from 110 mg/kg in a sample collected at Location 10/03 at a depth of 3 feet bls to 710,000 mg/kg in a sample collected from Sample Location 02/02 at a depth of 1 foot bls. The concentration of total DDT detected at Sample Location 02/02 is equivalent to a concentration of 71 percent DDT by weight indicating the presence of large amounts of pure DDT product in the soil. Concentrations of total DDT detected in the core samples ranged from 470 mg/kg in the sample collected at Location 23/27 to 68,000 mg/kg in a core sample collected at Sample Location 07/01.

Four samples were collected at land surface from four soil sampling locations along the northern Property boundary, as shown in Figure 5.3. Concentrations of total DDT detected in these samples ranged from 4,100 mg/kg in the sample collected at Sampling Location 00/03 to 38,000 mg/kg at Sampling Location 00/08. The average concentration of total DDT detected in surface soil samples collected along the northern Property boundary was 15,875 mg/kg.

Seven samples were collected in the Central Process Area near the wastewater recycling pond. Five of these samples were collected from stockpiled soil near the wastewater recycle pond. Concentrations of total DDT detected in the stockpiled soil ranged from 3,500 mg/kg in the sample collected from Sample Location 12/24 at 10 feet above land surface to 13,000 mg/kg in the sample collected from Sample Location 09/21 at 8 feet above land surface. Concentrations of total DDT detected in stockpiled soil near the pond averaged 4,180 mg/kg. One sample was collected from the base or wall of the pond excavation at 15 feet bls. The concentration detected in this soil sample was 1,100 mg/kg. One core sample was collected near the southern edge of the pond at a depth of 1 foot bls. The concentration of total DDT detected in this sample was 4,100 mg/kg.

Five core samples were collected at depths of 1 foot bls at five locations along the south-central Property boundary adjacent to Jones Chemical Company. Concentrations of total DDT detected in these samples ranged from 470 to 1,500 mg/kg, with an average of 916 mg/kg.

Four soil samples were collected above grade from two locations in the southeast corner of the Property. Concentrations of total DDT detected in these samples ranged from 860 to 1,600 mg/kg, and averaged 1,240 mg/kg.

5.3.4 August 1983 Soil Sampling Results

Total DDT was detected in all 24 soil samples collected from the 12 additional On-Property borings drilled and sampled to maximum depths at approximately 3.8 feet bls in August 1983. As shown in Figure 5.3, concentrations of total DDT detected in these samples ranged from 0.072 mg/kg in the sample collected from Boring S-29 at 3 feet bls to 15,000 mg/kg in the sample collected from Boring S-36 at 1.8 feet bls.

Total DDT was detected in all 14 deeper soil samples collected in August 1983 to total depths of approximately 6.25 feet bls at locations previously sampled in June 1983. Concentrations of total DDT detected in these samples ranged from 0.0053 mg/kg in the soil sample collected from Boring S-04A at 6.25 feet bls to 50.38 mg/kg in the soil sample collected from Boring S-04A at 3.1 feet bls.

5.3.5 Summary of Pre-Grading Soil Sampling Results

The results of soil sampling conducted in 1981 and 1983 indicated that total DDT pre-grading was fairly uniformly distributed in shallow soil across the Property at depths from land surface to about 3 feet bls. The highest concentrations of total DDT generally occurred in near surface samples collected within the Central Process Area and in the northwest portion of the Property, an area of the Property historically utilized as a trash dike, salvage area, and junkyard. However, elevated DDT concentrations were also found in the east and southeast portion of the Property in 1981. Over 90 percent of the samples collected in 1981 and 1983 exceed EPA Region IX's Preliminary Remediation Goal (PRG) of 1.3 mg/kg established for residential soil. The lowest concentrations were generally detected in deeper soil samples collected at depths greater than about 6 feet bls.

Concentrations of total DDT detected in soil samples collected On-Property in 1981 and 1983 generally decreased with depth (Figure 5.3). At most boring locations, concentrations of total DDT decreased one to four orders of magnitude between land surface and depths of 2 to 6 feet bls. With the exception of samples collected from Borings S-31, S-34, and S-36, located in or adjacent to the Central Process Area, concentrations of total DDT detected in the 25 soil samples collected On-Property at depths greater than 2 feet bls ranged from 0.028 mg/kg to 50.38 mg/kg with an average concentration of 15.1 mg/kg.

5.4 On-Property (Post Grading) and Off-Property Soil Sampling

This section describes the analytical results for RI soil samples collected On-Property since the Property was graded in 1985 and Off-Property. The following discussions focus on unsaturated soil extending from land surface to the water table which occurs at a depth of approximately 70 feet bls. Analytical results of 25 soil samples collected below the water table from 11 borings drilled On-Property are also presented. A complete list of soil analytical results is provided in Appendix H.

5.4.1 Total DDT in Soil

Figures 5.4 through 5.9 present the sampling locations and analytical results by depth for total DDT detected in soil samples collected On-Property since 1985 and in Off-Property soil investigation areas since 1981. These figures show the DDT data in five sample depth intervals: land surface to 3 feet bls (Figure 5.5); from 3 feet bls to 6 feet bls (Figure 5.6); from 6 feet bls to 10 feet bls (Figure 5.7); from 10 feet bls to 70 feet bls (Figure 5.8); and below the water table at depths greater than 70 feet bls (Figure 5.9). The DDT results for the northwest corner investigation conducted in 1997 are shown in Table 5.5A. The RI data in these figures have been supplemented with soil analytical data obtained from soil sampling conducted in 1994 at the Farmer Brothers Company facility and in 1995 at the Jones Chemical Company facility (McLaren, 1994; Levine-Fricke, 1995). The results of near-surface neighborhood and background soil sample analyses for total DDT are presented in Figures 5.10 and 5.11.

As Table 5.1F demonstrates, total DDT is the most prevalent chemical compound in soil samples collected at and in the vicinity of the Montrose Property. Total DDT has been detected in approximately 70 percent of all soil samples collected and analyzed for this compound. Total DDT was detected in 497 of 719 soil samples collected from and 264 On- and Off-Property soil sampling locations (including samples collected prior to the grading of the Property). Although not included in Table 5.1F, total DDT was also detected

in 24 of 30 soil samples collected from 11 On-Property borings below the water table at depths ranging to approximately 130 feet bls.

5.4.1.1 Summary of the Occurrence and Distribution of DDT in Soil

Concentrations of total DDT detected in soil samples collected On-Property ranged several orders of magnitude higher than concentrations detected Off-Property. The highest concentrations of total DDT in On-Property soil occurred in the Central Process Area, where over 55 percent of samples at all depths exceed EPA Region IX's Preliminary Remediation Goal (PRG) of 1.3 mg/kg for residential soil. The highest concentrations of total DDT in Off-Property soil occurred within approximately 150 feet south of the Property boundary in the historical surface water drainage pathway in the eastern portion of the LADWP right-of-way and the Normandie Avenue Ditch.

The vertical extent of total DDT in soil On-Property is the greatest in the Central Process Area, extending below the water table to a depth of to at least 129 feet bls, as shown in Figure 5.9. The highest concentrations of DDT in the Central Process Area were detected at about 80 or 90 feet bls. As discussed in Section 5.5 in more detail, the high concentrations of DDT 130 ft beneath the Central Process Area and more than 60 feet below the water table, are most likely attributable to the disposal of process waste in the wastewater settling pond and the subsequent vertical migration of DDT with DNAPL.

Outside of the Central Process Area, total DDT concentrations at most sampling locations decrease with increasing depth. In most instances, concentrations of DDT detected in soil samples collected outside the Central Process Area at depths greater than about 6 feet bls are less than the PRG (Figures 5.5 through 5.9) (EPA, 1996a). This observed trend of decreasing concentrations with increasing depth is consistent with the immobile nature of DDT in soil.

The vertical extent of total DDT in Off-Property soil is less than the vertical extent of total DDT in On-Property soil. Off-Property, DDT was detected at depths up to 22.75 bls within approximately 150 feet south of the Property boundary in the eastern portion of the LADWP right-of-way and along the upper reaches of the Normandie Avenue Ditch.

The following subsections provide detailed descriptions of the lateral and vertical extent of DDT detected in soil samples collected in each of the 5 sample depth intervals previously described.

5.4.1.2 DDT: Land Surface To 3 Feet Bls

In the depth interval from land surface to 3 feet bls, total DDT was detected in over 90 percent of samples collected On- and Off-Property.

On-Property Soils. Over 85 percent of the DDT concentrations in samples collected On-Property exceeded the PRG. The highest concentration of total DDT detected in the depth interval from land surface to 3 feet bls was 8,780 mg/kg detected in a soil sample collected from the Central Process Area in Boring 14D). Concentrations of total DDT exceeded 1,000 mg/kg in the majority of soil samples collected from other On-Property locations also.

Outside the Central Process Area, the highest DDT concentrations were found in the northwest corner, in and around the former junkyard and machine shop. The maximum total DDT concentration in this area was 7,620 mg/kg in a sample from Boring 14 collected during the northwest corner investigation, as shown in Table 5.5A. Prior to the grading of

the Property, DDT concentrations in the shallow soil in this area were as high as 710,000 mg/kg, as described in Section 5.3. As a result of the grading, these high concentrations of DDT were mixed and distributed across the Montrose Site. The results of the northwest corner investigation in 1997 indicates that high concentrations of DDT may have been diluted by the grading, but that DDT concentrations remain elevated in the same general area of the Property. Twenty-two of the 36 surface soil samples collected in the northwest corner investigation exceed 1,000 mg/kg (See Appendix K for the report on the northwest corner investigation).

Near Off-Property Soils. Concentrations of DDT exceeding the PRG and 1,000 mg/kg occurred less frequently in near Off-Property soil investigation areas in the interval from 0 to 3 feet bls. Samples from the Normandie Avenue Ditch, Jones Chemical Company Property, and the LADWP right of way exceeded the PRG for DDT in 64, 30, and 55 percent of the samples, respectively. The highest concentration of total DDT detected in the near Off-Property areas in the depth interval from land surface to 3 feet bls was 8,600 mg/kg detected in a soil sample collected from Normandie Avenue Ditch Boring T-45 (Figure 5.5). Total DDT was detected at concentrations greater than 1,000 mg/kg in eight other soil samples collected from six other borings located south of the Property in the eastern portion of the LADWP right-of-way and the Normandie Avenue Ditch, areas known to have received surface water runoff from the Property and other nearby facilities surrounding the Property. Total DDT was detected south of the Property in soil samples collected in the interval from land surface to 3 feet bls from near Off-Property borings located near the northwest corner of the Jones Chemical Company facility, within about 150 feet south of the southern Property boundary, at concentrations ranging to 805 mg/kg. Farther south, along a historical surface water pathway crossing the western portion of the LADWP right-of-way, total DDT was detected in five soil samples collected from three borings at concentrations greater than 100 mg/kg. Elsewhere on the Jones Chemical Company property, in the LADWP right-of-way, and on the Farmer Brothers Coffee Company property, concentrations of total DDT detected in soil samples were less than 50 mg/kg. Concentrations of DDT detected in the majority of these samples were less than 10 mg/kg.

Concentrations of total DDT detected in soil samples collected in the interval from land surface to 3 feet bls from borings located immediately east, north, and west of the Property perimeter were less than concentrations detected On-Property and in the Normandie Avenue Ditch. However, samples from the Property perimeter exceeded the PRG in 20 percent of the samples, indicating that the DDT contamination extends Off-Property in the surface soils. Total DDT was detected at a concentration of 0.53 mg/kg in a soil sample collected from Boring SP002 located Off-Property adjacent to the eastern property boundary. Excluding the sampling conducted in 1997 as part of the northwest corner investigation, the highest concentration of total DDT detected in soil samples collected north of the Property was 14.97 mg/kg in a soil sample collected from Boring MD002 located Off-Property adjacent to the northern Property boundary. Excluding the sampling conducted in 1997 as part of the northwest corner investigation, the highest concentration of total DDT detected in soil samples collected west of the Property was 120 mg/kg in a soil sample collected from Boring MD005 located adjacent to the western Property boundary.

The results of the northwest corner investigation also indicate soil contamination extending Off-Property. As shown in Table 5.5A, Borings SB-41 and SB-42, both located north of Montrose, indicate total DDT concentrations of 0.014 and 0.74 mg/kg, respectively. In addition, six samples just outside the western property boundary exceed 10 mg/kg DDT in the surface soils, with a maximum of 124 mg/kg at SB-24. EPA does not agree with the

conclusion made by Montrose in the report on the northwest corner investigation (attached as Appendix K) that the investigation successfully characterized chemicals in the soil in the adjacent Off-Property area. Because the sampling results indicate DDT soil contamination extending Off-Property an undefined distance in several areas, EPA does not believe that Montrose has fully assessed the extent of DDT concentrations Off-Property. Further sampling may be required.

Neighborhood Surface Soils. Total DDT was detected in 55 of 56 surface soil samples collected at 32 neighborhood sampling locations at depths less than approximately 3 inches bls (Figure 5.10). The total DDT concentrations in over 75 percent of the neighborhood samples exceeded the PRG. The highest concentrations of total DDT detected in soil samples collected at the neighborhood sampling locations were 126.3 mg/kg in a sample collected at location E-1 approximately 600 feet east of the Property on Jon Street and 71.5 mg/kg in a sample collected at location E-3 near the western end of the LADWP right-of-way approximately 600 feet southwest of the Property. Concentrations of total DDT detected at other neighborhood sampling locations ranged from 0.29 to 53.8 mg/kg. Except that the concentrations were distinctly higher than the background samples, the distribution of total DDT detected in neighborhood surface soil samples exhibited no distinct patterns or trends.

Background Soil Samples. Total DDT was detected in 10 of the 11 background soil samples at concentrations ranging from 0.033 mg/kg to 2.58 mg/kg (Figure 5.11). The concentration of total DDT in background soil samples were several orders of magnitude lower than concentrations detected On-Property and near Off-Property, exceeding the PRG in 20 percent of the samples. The highest concentration of total DDT in background soil samples was detected at location E-18, approximately 4.4 miles southwest of the Property, south of Torrance Boulevard. Total DDT was not detected in the background soil sample collected approximately 2.7 miles southwest of the Property at Location 5-8-S(B). The distribution of total DDT detected in background soil samples exhibited no distinct patterns or trends.

5.4.1.3 DDT: Three To Six Feet Bls

In the depth interval from 3 to 6 feet bls, total DDT was detected less frequently and at lower concentrations than in the overlying sampling interval. Figure 5.6 shows the DDT concentrations in soil 3 to 6 feet bls.

On-Property Soils. Although the concentrations of total DDT detected in soil samples in the depth interval from 3 to 6 feet bls are lower the shallower soils, the DDT concentrations are still quite high. Over 55 percent of the soil samples collected in the Central Process Area exceed the PRG. The highest concentration of total DDT detected in soil samples collected from the Central Process Area in this depth interval was 4,460 mg/kg in a soil sample collected from Boring 14D at 5 feet bls. At 6 feet bls, the concentration of total DDT detected in a sample collected from the same Boring was 53.5 mg/kg.

Outside the Central Process Area, total DDT was detected in 20 of 35 soil samples collected in the depth interval from 3 to 6 feet bls. Total DDT exceeded the PRG in approximately 40 percent of the samples. The maximum DDT concentration was 2,932 mg/kg in Boring 15D at 3.5 bls. Concentrations of total DDT in the depth interval from 3 to 6 feet bls were less than concentrations of total DDT detected in soil samples collected from the same borings at shallower depths (i.e., less than 3 feet bls). For example, in the interval from 3 to

6 feet bls, total DDT was not detected in soil samples collected from Borings 16D and 36D located On-Property near the eastern Property boundary. At 2 feet bls, however, DDT concentrations in Borings 16D and 36D were 3,410 mg/kg and 1,173 mg/kg, respectively. Furthermore, total DDT was not detected in five of nine soil samples collected in the depth interval from 3 to 6 feet bls from Borings 25A, 25D, and 35A, located east of the Central Process Area. But, in the 0 to 3 feet depth interval, DDT was detected in seven of eight samples from these borings.

Near Off-Property Soils. The highest concentrations in near Off-Property soils were detected in the Normandie Avenue Ditch, with over 30 percent of the samples exceeding the PRG. In the other Off-Property areas, only three other samples exceeded the PRG.

Concentrations of total DDT in Off-Property soil samples were highest in the surface water pathway at the eastern end of the LADWP right-of-way and the northern portion of the Normandie Avenue Ditch. Concentrations of total DDT ranged to 140 mg/kg. Farther south along the Normandie Avenue Ditch, DDT was detected less frequently and the maximum concentration detected was 3 mg/kg. The highest concentration of total DDT detected in soil samples from 3 and 6 feet bls in the LADWP right-of-way and on Farmer Brothers property was 0.79 mg/kg.

DDT was detected in 11 of 22 soil samples collected in the interval from 3 to 6 feet bls from eight borings in near Off-Property soil investigation areas located east, north, and west of the Property. Concentrations of total DDT were less than concentrations detected in the same borings at depths less than 3 feet bls. With the exception of one soil sample collected from Boring MD-2 located north of the Property with a concentration of 3.8 mg/kg, concentrations of total DDT detected in soil samples collected west, north, and east of the Property in the depth interval from 3 to 6 feet bls were all less than 1 mg/kg.

South of the Property, the highest concentration of total DDT detected in soil samples collected in the depth interval from 3 to 6 feet bls was 22.72 mg/kg in a soil sample collected in the northwest portion the Jones Chemical Company property, near the Montrose Property boundary (Figure 5.6). Total DDT was also detected in two samples located in the southeast portion of the Jones Chemical property at concentrations of 1.1 mg/kg and 1.92 mg/kg. Concentrations of total DDT in 37 other soil samples collected in the depth interval from 3 to 6 feet bls from borings on the Jones Chemical Company property ranged from less than the detection limit of 0.03 mg/kg to 0.184 mg/kg in a sample located in the northwest corner of the Jones Chemical Company property.

5.4.1.4 DDT: Six To Ten Feet Bls

In the depth interval from 6 to 10 feet bls, total DDT occurred less frequently and at lower concentrations in all soil investigation areas than the 3 to 6 feet bls interval except the Central Process Area. Figure 5.7 shows the DDT concentrations in the 6 to 10 feet bls interval. Inside the Central Process Area, the concentrations of total DDT were higher than the 3 to 6 feet bls interval, mostly likely due to vertical migration of DDT contained in DNAPL. Because DDT absorbs readily to soil and is not very soluble in water, DDT is generally immobile in soil. However, DDT is soluble in some highly mobile solvents like chlorobenzene. Consequently, the chlorobenzene or DNAPL can facilitate the transport of DDT to much greater depths in soil than DDT typically migrates alone. The concentration of DDT in DNAPL is approximately 40 percent by weight. As DDT migrates vertically through the soil, residual droplets of DNAPL are left in the soil matrix that result in high total DDT concentrations. The solubility of DDT isomers and metabolites in water is less

than 0.1 mg/L at standard temperature and pressure, and DDT readily adsorbs to aquifer sediments; therefore, DDT transport is much less in groundwater than by DNAPL migration (Section 6.2).

On-Property Soils in the Central Process Area. Within the Central Process Area, concentrations of total DDT detected in soil samples collected in the depth interval from 6 to 10 feet bls ranged from 0.4 mg/kg to 9,900 mg/kg and 65 percent of the samples exceeded the PRG. The vertical distribution of total DDT detected in soil samples exhibited no distinct pattern or trend. High and low concentrations of total DDT were frequently detected in alternating samples collected from the same boring.

On-Property Soils Outside the Central Process Area. Outside the Central Process Area, approximately 9 percent of the samples exceeded the PRG in this depth range. In the northwest corner of the Property, total DDT was detected in 9 of 21 soil samples collected from 7 borings at concentrations ranging from 0.016 mg/kg to 7.45 mg/kg. Concentrations of total DDT detected in eight of these nine samples were less than 0.7 mg/kg.

Total DDT was detected in 10 of the 25 soil samples collected from 10 On-Property borings located east and south of the Central Process Area. The highest concentrations of total DDT in this area in the depth interval from 6 to 10 feet bls were 72.4 mg/kg in a soil sample collected from Boring 25D, and 550 mg/kg in a soil sample collected from Boring 34D Concentrations of total DDT detected in other soil samples collected east and south of the Central Process Area ranged from 0.016 to 12.8 mg/kg.

Near Off-Property Soils. Concentrations of DDT detected in near Off-Property two soil samples in two borings in the depth interval from 6 to 10 feet bls were less than 1.0 mg/kg.

5.4.1.5 DDT: Ten To Seventy Feet Bls

In the depth interval from 10 to 70 feet bls, total DDT was detected less frequently and at lower concentrations than at shallower depths in all soil investigation areas except the Central Process Area. Figure 5.8 shows the DDT concentrations in the 10 to 70 feet bls range. In the Central Process Area, the concentrations of total DDT were higher than shallower soils, mostly likely due to vertical migration with DNAPL. Total DDT was detected in 102 of 161 soil samples collected from 19 On-Property borings and 14 of 36 soil samples collected from 5 near Off-Property borings sampled in the depth interval from 10 to 70 feet bls.

On-Property Soils In the Central Process Area. In this depth interval, total DDT occurred most frequently and at the highest concentrations in soil samples located within the Central Process Area. Total DDT was detected in 97 of 114 soil samples collected from the Central Process Area. Over 70 percent of the samples exceeded the PRG for DDT. Concentrations of total DDT detected in these samples ranged from 0.011 mg/kg to 12,621 mg/kg.

The highest concentrations of total DDT were detected in soil samples collected from Boring S-101 located at the former water recycling pond. Concentrations of total DDT exceeding 5,000 mg/kg were detected in five of the eight samples collected from this boring in the depth interval from 10 to 70 feet bls. Concentrations of total DDT detected in two of these samples exceeded 10,000 mg/kg.

Concentrations of total DDT greater than 1,000 mg/kg were detected in soil samples collected from Central Process Area Borings S304, S305, and 14D, located within approximately 70 to 125 feet north and northeast of the former water recycling pond. Concentrations of total DDT greater than 1,000 mg/kg were also detected in soil samples collected from other Central Process Area borings located within approximately 100 feet east and southeast of the former pond.

The vertical distribution of total DDT detected in soil samples collected from any given boring located within the Central Process Area did not exhibit any apparent concentration gradient. In most instances, alternating high and low concentrations were detected in samples collected at successive depth intervals. However, as discussed in subsequent sections, the occurrence of distribution of DDT at these depths in the subsurface beneath the Central Process Area is attributable to the occurrence of DNAPL. The physical characteristics, nature, and extent of DNAPL are described in subsequent sections of this RI Report.

On-Property Soils Outside the Central Process Area. The frequency of detection and concentrations of total DDT detected in soil samples collected in the depth interval from 10 to 70 feet bls from On-Property borings located outside the Central Process Area were less than those detected in soil samples collected from Central Process Area. Approximately 7 percent of the samples outside the Central Process Area exceeded the PRG. Total DDT was detected in 5 of 42 samples collected in the depth interval from 10 to 70 feet bls from 5 On-Property borings located outside the Central Process Area. Concentrations of total DDT detected in these samples were less than 4 mg/kg.

West of the Central Process Area, total DDT was detected in three samples collected from Boring MW-3 at depths of 57, 62, and 67 feet bls. Boring MW-3 is located approximately 375 feet west of the Central Process Area. Total DDT was not detected in the 12 samples collected from Boring MW-3 in the interval from 10 to 52 feet bls. Total DDT detected in soil samples collected from boring MW-3 may be the result of cross contamination from shallower soil. Surface soil in the area was found to contain DDT concentrations exceeding 1,000 mg/kg. Soil samples collected from Boring MW-3 were not collected using conventional coring and sampling methods. Boring MW-3 was drilled and sampled using a large diameter bucket auger during the initial On-Property subsurface investigation conducted in 1985. However, except for the surface, most of the shallower depths contain little, if any, DDT contamination. Another possible source of the DDT at this depth is the migration of DDT with the groundwater. Mounding of groundwater from discharges to the wastewater settling pond may have resulted in lateral transport and deposition of DDT at this depth. Chlorobenzene was also found at this depth and was not detected at most of the shallower depths.

Near Off-Property Soils. In the depth interval from 10 to 70 feet bls, total DDT was detected in soil samples collected on the Jones Chemical property and in the Normandie Avenue Ditch.

On the Jones Chemical Company property, total DDT was detected in about 20 percent of the samples. Total DDT was detected in 11 soil samples collected in the interval from 10 to 45 feet bls from two borings located in the vicinity of a dry well located on the northern portion of the Jones Chemical Company property approximately 65 feet south of the Montrose Property (Figure 5.8). Concentrations of total DDT detected in these samples ranged from 0.0055 mg/kg in a sample collected at 45 feet bls in Boring LF-33 to 64.2 mg/kg

in a sample collected at 15 feet bls in Boring LF-34. With the exception of a concentration of 4.4 mg/kg detected in one soil sample at a depth of 35 feet bls, the concentrations of total DDT detected in the other nine samples collected from these borings were all less than 0.2 mg/kg.

Total DDT was detected in 14 of 36 soil samples collected Off-Property from 4 borings in the Normandie Avenue Ditch. Concentrations of total DDT detected in these soil samples ranged from 0.005 to 1.9 mg/kg, with one exceeding the PRG at 13.75 feet bls. Concentrations of total DDT detected in the other 13 samples were less than 0.5 mg/kg. Concentrations of total DDT detected in soil samples collected from the Normandie Avenue Ditch borings decreased with depth. The highest concentration of total DDT detected in soil samples collected from Normandie Avenue Ditch borings at depths greater than 15 feet bls was 0.02 mg/kg. Total DDT was not detected in 20 of 29 soil samples collected from Normandie Avenue Ditch borings at depths greater than 15 feet bls.

5.4.1.6 DDT: Greater Than 70 Feet Bls

Soil samples were collected below the water table from 11 On-Property borings at depths greater than 70 feet bls, as shown in Figure 5.9. Nine soil samples were collected from five borings as part of the first phase of On-Property monitoring well construction conducted in 1985. Soil samples from these borings were collected at depths of 72 and 77 feet bls using bucket auger drilling and sampling techniques. The DDT concentrations detected at this depth are higher than other depths within the Central Process Area. The maximum DDT concentration of 69,000 mg/kg was detected at S304/304A at 78 feet bgs. Over 80 percent of the samples collected in this depth range exceed the PRG.

DDT Below the Water Table in the Central Process Area. Six soil borings (S101A, S301, S302, S303, S304, S305) were drilled to and sampled below the water table to characterize the nature and extent of DNAPL which occurs in the subsurface beneath the Central Process Area (Figure 5.9). Boring S101A is located near the center of the former water recycling pond. Borings S301, S304, and S305 are located northeast of the former pond. Boring S302 is located southeast of the former pond in the vicinity of the two former below ground redwood lined concrete tanks once located near the southeast corner of the Central Process Area. Boring S303 is located near the southwest corner of the former pond.

Total DDT was detected in 20 of 21 soil samples collected from these six borings at depths ranging from about 2 to 60 feet below the water table that occurs at about 70 feet bls. Concentrations of total DDT detected in these samples ranged from 1.5 mg/kg in a soil sample collected from Boring S301 at 127.8 feet bls to 69,000 mg/kg in a sample collected from boring S304 at 78.3 feet bls.

The highest concentrations of total DDT were detected in soil samples located within, north, and northeast of the former pond. Concentrations of total DDT exceeding 20,000 mg/kg were detected in four soil samples collected from three borings (Figure 5.9). Southeast of the pond, in the vicinity of the former below grade tanks, concentrations of total DDT detected in soil samples collected from Boring S302 were less than 100 mg/kg. Near the southwest corner of the former pond, concentrations of total DDT detected in soil samples collected from Boring S303 were less than 10 mg/kg.

DDT in Soil Samples Collected from the Upper Bellflower Aquitard. Sixteen of the 21 soil samples collected at depths below the water table were collected from the Upper Bellflower Aquitard. At three boring locations, concentrations of total DDT detected in soil samples

collected from the saturated portion of the Upper Bellflower Aquitard were higher than concentrations of DDT detected in soil samples collected above the water table. At all boring locations, concentrations of total DDT detected in Bellflower Sand soil samples were less than concentrations of total DDT detected in the shallower Upper Bellflower Aquitard soil samples.

The highest concentrations of total DDT detected in soil samples collected from Central Process Area borings located at and northeast of the former pond were detected in soil samples collected below the water table in the Upper Bellflower Aquitard. The highest concentrations of total DDT detected at Borings S101 and S305 were detected in soil samples collected 20 feet below the water table, at a depth of about 90 feet bls (Figure 5.9).

The vertical distribution of total DDT detected in soil samples collected from the Upper Bellflower Aquitard exhibited no other discernible trends or patterns within or between borings. Concentrations of total DDT varied by orders of magnitude between successive soil samples collected from the same boring and between adjacent borings at similar sample depths and in similar lithologies.

DDT in Soil Samples Collected from the Bellflower Sand. Five of the 21 soil samples collected below the water table were collected from the Bellflower Sand. In the vicinity of the Central Process Area, the Bellflower Sand occurs at depths of about 110 to 115 feet bls and ranges in thickness from about 15 to 20 feet. Soil samples collected from the Bellflower Sand were collected near the base of the sand just above the contact with the silty Lower Bellflower Aquitard. Sample depths ranged from 125.3 to 129.6 feet bls.

Total DDT was detected in four of the five soil samples collected from the Bellflower Sand at concentrations Bellflower Sand ranging from 1.5 mg/kg in the sample collected from Boring S301 to 190 mg/kg in the sample collected from Boring S101 located at the center of the former pond.

The occurrence of total DDT in soil samples collected at depths below the water table may represent DDT adsorbed to the aquifer matrix; DDT dissolved in groundwater held in pore spaces within the porous matrix; DDT in DNAPL held in the pore space; and/or DDT precipitate. The occurrence of total DDT in soil samples collected from the Bellflower Sand may also be the result of cross contamination from shallower soil or shallower DNAPL which may have occurred during drilling, sample collection, and sample handling and preparation at these Central Process Area boring locations. The nature and extent of DNAPL in the subsurface beneath the Central Process Area is discussed in more detail in Section 5.5.

5.4.2 Total BHC in Soils

Figures 5.12 through 5.16 present the sample locations and analytical results by depth for total BHC detected in soil samples collected On- and Off-Property. These figures have been supplemented with soil analytical data obtained from soil sampling conducted in 1994 at the Farmer Brothers and in 1995 at Jones Chemical. (It should be noted that other figures and tables, except Table 5-1A, in this report do not include this data.)

As shown in Table 5.1F, total BHC has been detected in approximately 28 percent of all soil samples collected and analyzed for this compound. During the period from 1985 through 1995, total BHC was detected in 150 of 560 soil samples collected from 136 On- and Off-Property borings and 1 Off-Property soil sampling location. Because BHC was first

included as an analyte by Montrose in 1985, there are fewer analytical results for BHC than for DDT. BHC was analyzed for less frequently than DDT because, unlike DDT, BHC was not a routine analyte until the commencement of RI activities in 1985.

Summary of the Occurrence and Distribution of BHC in Soil. BHC was analyzed for much less frequently than DDT. Only one sample was analyzed in the 0 to 3 ft bls depth interval for BHC, On-Property. The number of BHC samples is insufficient to accurately determine the extent of the BHC contamination in soils. Total BHC was detected in soil samples collected On-Property in the Central Process Area and in the vicinity of the pilot scale BHC plant formerly operated by Stauffer Chemical (see Figure 1.7B for the location of the BHC pilot plant). Total BHC was also detected north of the Property, and south of the Property on the Jones Chemical property, the LADWP right-of-way, the Farmer Brothers Coffee Company property, and the Normandie Avenue Ditch soil investigation areas.

The frequency of detection, concentrations, and distribution of total BHC detected in soil samples is different than that of total DDT. Total BHC was detected less frequently and at lower concentrations than DDT. BHC also appeared to be distributed more to the south and southeast of the Property and the adjoining Jones Chemical Company property, closer to the former BHC plant compared to DDT. The highest concentrations of total BHC were detected in soil samples collected in the southern portion of the Central Process Area and Off-Property on the eastern portion of the Jones Chemical Company property. Concentrations of total BHC were detected in soil samples collected from borings located in the historical surface water drainage pathway located south of the Property in the LADWP right-of-way and the Normandie Avenue Ditch.

In a manner similar to DDT, concentrations of BHC detected in soil samples generally decreased with depth. The vertical extent of total BHC in soil is less than the vertical extent of DDT in soil. Total BHC was not detected in soil samples collected at depths greater than about 60 feet bls.

The following subsections provide detailed descriptions of the lateral and vertical extent of BHC detected in soil samples collected in each of the 5 sample depth intervals previously described.

5.4.2.1 BHC: Land Surface To Three Feet Bls

Only one sample was analyzed for BHC On-Property in the depth interval from land surface to 3 feet below land surface and total BHC was detected in this sample. The concentration of BHC in this sample was 100 times the residential PRG of 0.071 mg/kg for the alpha isomer of BHC. The PRG for the alpha isomer of BHC is used for comparison in this RI Report because the majority of the BHC detected at the Montrose Site was alpha-BHC. The total BHC concentration in this sample was 35.1 mg/kg and it was collected at 2 feet bls from Boring 35D located in the southeastern portion of the Montrose Property, near the location of Stauffer's former BHC plant. The highest concentrations of total BHC detected in the depth interval from land surface to 3 feet bls were 55.6 mg/kg and 73 mg/kg detected in soil samples collected at depths of 1.0 and 1.5 feet from Borings LF-10 and LF-48 located in the western and eastern portions of the Jones Chemical Company property, respectively (Figure 5.12). BHC was detected in 15 samples collected from 11 borings drilled on Jones Chemical Company property. BHC concentrations also exceeded the PRG in the one soil sample collected in the near Off-Property area west of the Property (Figure 5.12). BHC exceeded the PRG in approximately 28 percent of the samples in the Normandie Avenue Ditch and approximately 10 percent of the samples collected at

Jones Chemical Company. BHC concentrations in soil collected from the LADWP right-of-way and Farmer Brothers exceeded the PRG in about 10 percent of the samples.

Total BHC was detected at concentrations exceeding 1 mg/kg in three soil samples collected in the western portion of the LADWP right of way; two soil samples collected on Farmer Brothers property; and six soil samples collected in the eastern portion of the LADWP right-of-way and the Normandie Avenue Ditch.

Concentrations of total BHC detected in all other soil samples collected in the depth interval from land surface to 3 feet bls were less than 1 mg/kg and ranged from 0.008 mg/kg to 0.74 mg/kg.

Total BHC was detected in a surface soil sample collected from neighborhood soil sampling location NS-9 at a concentration of 0.1 mg/kg. Neighborhood sampling location NS-9 is located approximately 0.6 miles southwest of the Property along Torrance Boulevard near 209th Street. Neighborhood sampling locations are shown in Figure 5.10. Total BHC was not detected in the 20 other neighborhood samples analyzed for BHC. Total BHC was also not detected in the seven background soil samples analyzed for BHC.

5.4.2.2 BHC: Three To Six Feet Bls

Figure 5.13 presents the BHC concentration in soil from three to six feet bls. Concentrations of total BHC detected in the soil samples in this depth interval were less than concentrations detected in the interval from land surface to 3 feet bls.

In this depth interval, approximately 20 On-Property soil samples were analyzed for BHC. One of four samples exceeded the PRG in the Central Process Area and about 12 percent exceeded the PRG outside the Central Process Area. The highest concentration of total BHC detected in soil samples collected from borings sampled for BHC analysis in this depth interval was 27 mg/kg in a soil sample collected from On-Property Boring 34D located south of the Central Process Area, west of the former BHC pilot plant, adjacent to the northern boundary of the Jones Chemical Company property. Total BHC was detected in 2 of 19 other soil samples collected from 17 On-Property borings sampled in the depth interval from 3 to 6 feet bls. Concentrations of total BHC detected in Borings 24D and 46D were 0.401 mg/kg and 0.09 mg/kg, respectively.

Concentrations of total BHC detected in Off-Property soil samples collected in the depth interval from 3 to 6 feet bls were most often less than the PRG of 0.071 mg/kg, exceeding the PRG in 12 of 89 samples. Total BHC was detected in 1 of 12 soil samples collected from 4 Off-Property borings located adjacent to the northern Property Boundary. The concentration of total BHC detected in the soil sample collected from Boring MD002 at 3.25 feet bls was 0.086 mg/kg.

Total BHC was detected in 15 of 39 soil samples collected from 27 borings on the Jones Chemical Company property at concentrations ranging from 0.00027 mg/kg to 0.331 mg/kg.

Total BHC was detected in two soil samples collected in the LADWP right-of-way and on Farmer Brothers property south of Jones Chemical Company at concentrations of 0.001 mg/kg and 0.06 mg/kg.

Total BHC was detected in 21 soil samples collected from 9 borings in the Normandie Avenue Ditch. Concentrations of total BHC detected in these samples ranged from 0.006 mg/kg to 0.45 mg/kg.

5.4.2.3 BHC: Six To Ten Feet Bls

In the depth interval from 6 to 10 feet bls, total BHC generally occurred less frequently and at lower concentrations than in the overlying sample depth intervals. One sample exceeded the PRG in the Central Process area. BHC concentrations did not exceed the PRG in other samples at this depth interval. The highest concentration of total BHC detected in this depth interval was 14.17 mg/kg in a soil sample collected from Central Process Area boring 24D. Total BHC was detected in 1 of 28 other soil samples collected from On-Property borings in this depth interval. Total BHC was detected at a concentration of 0.012 mg/kg in a soil sample collected from Boring 35D located in the southeastern portion of the Property, near the location of the former BHC pilot plant.

Concentrations of BHC detected in soil samples collected Off-Property in the depth interval from 6 to 10 feet bls were less than the PRG for residential soil (0.071 mg/kg). Total BHC was detected in 7 of 10 soil samples collected from 10 borings on the Jones Chemical Company property at concentrations ranging from 0.0008 mg/kg to 0.00543 mg/kg. Total BHC was detected in 1 of 19 soil samples collected from 7 borings located on the Farmer Brothers property at a concentration of 0.001 mg/kg. Total BHC was also detected in one soil sample collected from the Normandie Avenue Ditch borings at a concentration of 0.011 mg/kg.

5.4.2.4 BHC: Ten To Seventy Feet Bls

In the depth interval from 10 to 70 feet bls, total BHC was detected in soil samples collected from borings in the Central Process Area and at the Jones Chemical Company and in the Normandie Avenue Ditch. Over 23 percent of the samples collected in the Central Process Area exceeded the PRG for BHC. BHC was not detected above the PRG at other locations. As shown in Figure 5.15, the highest concentrations of total BHC detected in this depth interval were 26.7 mg/kg and 51.9 mg/kg in two soil samples collected from Central Process Area Boring 24D at depths of 12.5 and 18 feet bls. Boring 24D is located southeast of the former water recycling pond. Total BHC was also detected in 22 of 34 soil samples collected to depths of 60.5 feet bls from Borings S201, S202, S203, and S204 located near the eastern and southeastern side of the former pond. Concentrations of total BHC detected in soil samples collected from these borings ranged from 0.009 mg/kg to 10 mg/kg. Because BHC alone is relatively immobile in soil, it is likely that the DNAPL facilitated the transport of BHC to these depths.

Total BHC was detected in 6 of 11 soil samples collected at depths ranging to 35 feet bls from two borings drilled and sampled near the dry well on the Jones Chemical Company property. Concentrations of total BHC detected in these samples ranged from 0.00057 mg/kg to 0.01766 mg/kg.

Total BHC was detected in 20 of 36 soil samples collected at depths ranging to 41.25 feet bls from five Normandie Avenue Ditch borings. Concentrations of total BHC detected in these soil samples ranged from 0.002 mg/kg to 0.034 mg/kg. These concentrations are less than EPA Region IX's PRGs for residential soil (0.34 mg/kg).

5.4.2.5 BHC: Greater Than Seventy Feet Bls

Twenty-one soil samples collected below the water table from six Central Process Area borings were analyzed for total BHC. Total BHC was not detected in any of these soil samples, as shown in Figure 5.16. However, laboratory detection limits for these BHC analyses exceeded the PRG in many cases, ranging from 0.003 mg/kg to 10,000 mg/kg.

5.4.3 Chlorobenzene in Soils

Figures 5.17 through 5.21 present the soil sampling locations and the analytical results for chlorobenzene detected in soil samples collected On-Property and Off-Property. These figures have been supplemented with soil analytical data obtained from soil sampling conducted in 1994 at Jones Chemical Company (Levine-Fricke, 1995). Other figures and tables in this report do not include the 1994 data.

Chlorobenzene was the most prevalent VOC detected in soil samples collected at and in the vicinity of the Montrose Property. As shown in Table 5.1F, chlorobenzene was detected in approximately 38 percent of all soil samples collected and analyzed for this compound. Chlorobenzene was detected in 234 of 618 soil samples collected from 101 On- and Off-Property borings and 5 soil samples collected from 6 Off-Property background soil sampling locations. Except for one sample, the concentrations of chlorobenzene detected in soil samples outside the Central Process Area are less than EPA Region IX's PRG of 65 mg/kg established for residential soil (EPA, 1996a).

Summary of the Occurrence and Distribution of Chlorobenzene in Soil. At the Montrose Site, chlorobenzene occurs in many of the same areas as DDT. On-Property, the highest concentrations of chlorobenzene were detected in the Central Process Area. The vertical extent of contamination in the Central Process Area extended to below the water table where, the highest concentrations of chlorobenzene were detected.

Outside the Central Process Area and Off-Property, chlorobenzene was detected less frequently and occurred at lower concentrations than inside the Central Process Area. Chlorobenzene was detected On-Property outside the Central Process Area and Off-Property on the Jones Chemical Company property and in the Normandie Avenue Ditch. The vertical extent of chlorobenzene On-Property outside the Central Process Area and Off-Property was less than the vertical extent of chlorobenzene in soil beneath the Central Process Area. Concentrations of chlorobenzene outside the Central Process Area generally decrease with depth, whereas concentrations inside the Central Process Area increase with depth.

The occurrence of chlorobenzene in the subsurface beneath the Central Process Area, both in a dissolved phase and as a separate dense liquid phase, appears to have facilitated the vertical transport of DDT to depths below the water table. Further discussion of DNAPL is provided in Section 5.5.

The following subsections provide detailed descriptions of the lateral and vertical extent of chlorobenzene detected in soil samples collected in each of the five sample depth intervals previously described.

5.4.3.1 Chlorobenzene: Land Surface To Three Feet Bls

In the depth interval from land surface to 3 feet below land surface, chlorobenzene was detected in 31 of 34 soil samples collected from 17 On-Property borings at concentrations

ranging from 0.018 mg/kg in Boring 35D to 360 mg/kg in Boring 15D. Chlorobenzene concentrations in soil from the surface to 3 feet bls are shown in Figure 5.17. With the exception of the 360 mg/kg chlorobenzene detected in the soil sample collected from Boring 15D at 2 feet bls, concentrations of chlorobenzene detected in all other On-Property and Off-Property soil samples collected from the land surface to 3 feet bls were below the PRG of 65 mg/kg established for chlorobenzene in residential soil.

The highest concentrations of chlorobenzene On-Property were detected in soil samples collected east and southeast of the Central Process Area. Concentrations of chlorobenzene exceeding 10 mg/kg were detected in soil samples collected from Borings 15D, 25D, and 35A.

Chlorobenzene was analyzed for in samples from three borings inside the Central Process Area. Concentrations of chlorobenzene detected in seven soil samples collected from the three borings located inside the Central Process Area were not as high, ranging from 0.19 to 7.1 mg/kg averaging 2.6 mg/kg.

West of the Central Process Area, concentrations of chlorobenzene detected in 10 soil samples collected from six borings ranged from 0.26 to 1.6 mg/kg and averaged 0.8 mg/kg. An additional 11 samples collected as part of the northwest corner investigation indicated chlorobenzene concentrations up to 3.7 mg/kg in the western portion of the Property. Figure 5-17A presents the results of the VOC analyses for the northwest corner investigation. In the southeast corner of the Property, chlorobenzene was detected in four soil samples collected from three borings at concentrations ranging from 0.018 mg/kg to 2.1 mg/kg with an average concentration of 0.8 mg/kg.

Off-Property, none of the chlorobenzene concentrations exceeded the PRG. Chlorobenzene was detected in 4 of 12 soil samples collected from 4 borings drilled and sampled on the Jones Chemical Company property at concentrations ranging from 0.6 mg/kg to 7 mg/kg (Figure 5.17). The highest concentrations were detected in soil samples collected in the northwest corner of that property adjacent to the Montrose Property.

In the Normandie Avenue Ditch, chlorobenzene was detected in four soil samples collected from three borings at concentrations ranging from 0.3 mg/kg to 0.5 mg/kg. Chlorobenzene was not detected in soil samples collected from borings located around the Property perimeter, in the LADWP right-of-way, or at any of the three neighborhood sampling locations where soil samples were analyzed for chlorobenzene.

Chlorobenzene was detected in five of seven background soil samples collected at six sampling locations at concentrations ranging from 0.013 mg/kg to 8.4 mg/kg. The highest concentration of chlorobenzene detected in background soil samples was detected in the background soil sample located along Normandie Avenue about ¾ miles north of the Property.

5.4.3.2 Chlorobenzene: Three To Six Feet Bls

In the depth interval from 3 to 6 feet bls, the distribution, frequency of detection, and concentrations of chlorobenzene were similar to that observed in the interval from land surface to 3 feet bls. As shown in Figure 5.18, chlorobenzene was detected On-Property and Off-Property on the Jones Chemical Company property and in the Normandie Avenue Ditch. Chlorobenzene was not detected in other Off-Property soil investigation areas.

Concentrations of chlorobenzene detected in all soil samples collected from all investigation areas in the depth interval from 3 to 6 feet bls were below the PRG of 65 mg/kg for chlorobenzene in residential soil.

The highest concentrations of chlorobenzene in the depth interval from 3 to 6 feet bls were detected in soil samples collected from borings located in the Central Process Area, east of the Central Process Area and southeast of the Central Process Area. Concentrations of chlorobenzene detected in soil samples collected from Borings 24D, 15D, and 35D exceeded 10 mg/kg.

Within the Central Process Area, concentrations of chlorobenzene detected in soil samples collected in the depth interval from 3 to 6 feet bls ranged from 0.0059 to 20 mg/kg and averaged 4.2 mg/kg. The highest concentration of chlorobenzene was detected in a soil sample collected from Boring 24D located southeast of the former wastewater pond. Chlorobenzene was detected in approximately 57 percent of soil samples from the Central Process Area at this depth interval.

Off-Property, on the Jones Chemical Company property, chlorobenzene was detected in 9 of 17 soil samples collected from 16 borings sampled in the depth interval from 3 to 6 feet bls. Concentrations of chlorobenzene detected in these samples ranged from 0.0015 mg/kg to 1 mg/kg. The highest concentrations of chlorobenzene were detected in soil samples collected near the northwest corner of the Jones property adjacent to the Montrose Property boundary.

Chlorobenzene was detected in 1 of 93 soil samples collected from 28 borings drilled and sampled in the LADWP right-of-way and the Normandie Avenue Ditch. Chlorobenzene was detected at a concentration of 0.5 mg/kg in a soil sample collected from Normandie Avenue Ditch Boring T052 at a depth of 4.25 feet bls.

5.4.3.3 Chlorobenzene: Six To Ten Feet Bls

In the depth interval from 6 to 10 feet bls, chlorobenzene concentrations in the Central Process Area were higher than shallower depths. Chlorobenzene occurred less frequently and at lower concentrations in areas outside the Central Process Area versus areas inside the Central Process Area. Figure 5.19 shows the chlorobenzene results in soil 6 to 10 feet bls. Chlorobenzene was detected both On-Property and Off-Property on the adjacent Jones Chemical Company property. Chlorobenzene was not detected in other Off-Property soil investigation areas.

The highest concentrations of chlorobenzene were detected in soil samples collected in the Central Process Area. Concentrations of chlorobenzene exceeded the PRG of 65 mg/kg in 35 percent of the soil samples. Concentrations of chlorobenzene in excess of 5,000 mg/kg were detected in two of these samples. Chlorobenzene was detected in 16 of 18 soil samples collected from 10 Central Process Area borings sampled in the depth interval from 6 to 10 feet bls. Concentrations of chlorobenzene detected in these samples ranged from 0.05 to 8,200 mg/kg and averaged 1,031 mg/kg. The highest concentrations of chlorobenzene were detected in soil samples collected northeast of the former water recycling pond from Borings S301, S304, S305, and 14D.

Outside the Central Process Area, chlorobenzene was detected in 30 percent of the samples, but did not exceed the PRG in any samples. Off-Property, on the Jones Chemical Company property, chlorobenzene was detected in 9 of 17 soil samples collected from 16 borings

(Figure 5.19). Concentrations of chlorobenzene detected in these samples ranged from 0.00075 mg/kg to 0.02 mg/kg with an average of 0.01 mg/kg. The highest concentration was detected in a soil sample collected in the southwest corner of the Jones Chemical Company property.

5.4.3.4 Chlorobenzene: Ten To Seventy Feet Bls

The frequency of detection and distribution of chlorobenzene detected in soil samples collected in the interval from 10 to 70 feet bls were similar to that in the overlying sampling interval. Concentrations of chlorobenzene detected in soil samples collected from borings located inside the Central Process Area were greater than concentrations detected in the depth intervals less than 10 feet bls, exceeding the PRG in over 42 percent of the samples. As shown in Figure 5.20, chlorobenzene was detected in soil samples collected both On-Property and Off-Property on the Jones Chemical Company property. Chlorobenzene was not detected in the other Off-Property soil investigation areas. Concentrations of chlorobenzene detected in soil samples collected in all investigation areas outside the Central Process Area were below the PRG).

The highest concentrations of chlorobenzene were detected in soil samples located in the Central Process Area. Chlorobenzene was detected in 90 of 112 soil samples collected from 14 Central Process Area borings. Concentrations of chlorobenzene detected in these samples ranged from 0.2 mg/kg to 14,000 mg/kg. Concentrations of chlorobenzene in excess of 100 mg/kg were detected in 46 of these soil samples. Of these samples, concentrations of chlorobenzene in 31 samples exceeded 1,000 mg/kg and concentrations of chlorobenzene in two samples exceeded 10,000 mg/kg.

Within the Central Process Area, the highest concentrations of chlorobenzene were detected in soil samples collected within the area of the former wastewater recycling pond, north and northeast of the former pond, and approximately 50 feet southeast of the former pond (Figure 5.20). With the exception of Boring S303, Central Process Area borings either have concentrations of chlorobenzene that increase with increasing depth or exhibit no distinct trend or pattern.

West of the Central Process Area, chlorobenzene was detected in 4 of 15 soil samples collected from Boring MW-3. Concentrations of chlorobenzene detected in these samples ranged from 0.6 mg/kg at a depth of 52 feet bls to 24 mg/kg at a depth of 67 feet bls. As previously discussed with respect to DDT concentrations detected in soil samples collected from this boring, the occurrence of chemical compounds in these soil samples may be the result of cross contamination from shallower depth intervals. However, the results of the soil sampling indicate little, if any, chlorobenzene in the shallower soil. Another possible source of the chlorobenzene at this depth is the migration of chlorobenzene dissolved within wastewater from the unlined wastewater recycling pond. Infiltration of the wastewater would result in mounding of groundwater beneath the pond and the resultant lateral radial flow of groundwater at the water table. Chlorobenzene and DDT dissolved in the groundwater would be transported laterally and would adsorb to sediments, thus concentrating both chemicals in the sediments at the water table. In support of this hypothesis, DDT was also found at this depth and was not detected at most of the shallower depths.

Off-Property, on the Jones Chemical Company property, chlorobenzene was detected in 13 of 14 soil samples collected from 7 borings (Figure 5.20). Concentrations of chlorobenzene detected in these samples ranged from 0.00042 mg/kg to 0.025 mg/kg with an average of

0.0053 mg/kg. The highest concentration was detected in a sample collected near the dry well (LF-33) on the northern portion of the Jones Chemical Company property south of the Montrose Property boundary.

5.4.3.5 Chlorobenzene: Greater Than Seventy Feet Bls

Chlorobenzene concentrations exceeded the PRG in approximately 40 percent of the soil samples from this depth interval. Chlorobenzene was detected in 25 of 27 soil samples collected below the water table from seven borings located within the Central Process Area, one boring located west of the Central Process Area, and one boring located southeast of the Central Process Area, as shown in Figure 5.21.

This depth interval contained the highest concentrations of chlorobenzene. Concentrations of chlorobenzene detected in these samples ranged from 0.6 mg/kg to 81,000 mg/kg. The highest concentrations of chlorobenzene detected in soil samples collected below the water table occurred in soil samples collected beneath the former pond and north and northeast of the former pond (Figure 5.21). Concentrations of chlorobenzene detected in 4 of these samples exceeded 10,000 mg/kg.

As previously discussed, the occurrence of chemical compounds in soil samples collected from Borings MW-1 and MW-3 located southeast and west of the Central Process Area, respectively, may be the result of cross contamination from shallower depth intervals. Soil samples were collected from these borings using bucket auger drilling and sampling techniques. Because there is little or no chlorobenzene in the shallower soils, the contamination at this depth may also be due to lateral transport in the groundwater.

Concentrations of chlorobenzene detected in soil samples collected from the Upper Bellflower Aquitard were generally higher than concentrations of chlorobenzene detected in the underlying Bellflower Sand. Concentrations of chlorobenzene detected in soil samples collected from the Bellflower Sand ranged from 4.2 to 51 mg/kg, with the highest concentration being detected in a soil sample collected from Boring S-302 located southeast of the former pond.

Comparison of the Occurrence, Distribution, and Extent of Chlorobenzene and DDT in Soil. The occurrence, distribution, and extent of chlorobenzene in the subsurface soil at the Property is similar to that of DDT (Figures 5.5 through 5.9 and 5.17 through 5.21). The highest chlorobenzene concentrations are found between 10 and 70 feet bls, directly below the Central Process Building and the wastewater recycling pond. The DNAPL, consisting primarily of chlorobenzene, has greatly increased the mobility and lateral and vertical extent of DDT as ~~monitoring~~ well as BHC.

Figures 5.22 and 5.23 present data for chlorobenzene and DDT beneath the Property, the relationship of these compounds to each other, and the occurrence of these compounds in relation to subsurface conditions encountered from land surface to the base of the Bellflower Sand beneath the Property. Cross section A-A' extends from west to east across the Property through the Central Process Area and the former pond (Figure 5.22). Cross section B-B' extends from north to south across the Property (Figure 5.23). Figure 4.3 shows the location of the cross sections.

5.4.4 Chloroform in Soil

As shown in Table 5.1F, chloroform was detected in approximately 15 percent of soil samples collected at and in the vicinity of the Property. Chloroform was detected On-

Property both within and outside the Central Process Area and Off-Property at Jones Chemical and in the Normandie Avenue Ditch. Figures 5.24 through 5.28 show chloroform concentrations at different depth ranges. Chloroform concentrations exceeded the PRG in about 20 to 40 percent of the samples in each depth interval between 3 and 70 feet bls. Concentrations of chloroform detected in soil samples ranged from 0.00058 mg/kg to 72 mg/kg. The highest concentrations were detected in Central Process Area borings located northeast of the former pond near the former location of the Central Processing Building.

Chloroform was also frequently detected in soil samples collected in Jones Chemical Company borings sampled in the vicinity of the dry well in the north central portion of the Jones property. Chloroform was detected in three soil samples collected at depths below the water table from borings located at and near the former pond in the Central Process Area (Figure 5.28). Concentrations of chloroform detected in these samples ranged from 0.4 mg/kg to 64 mg/kg.

Available records do not list chloroform as a chemical that was used, handled, stored, or disposed of at the Property by either Montrose or Stauffer. Nonetheless, it is possible, although not proven, that chloroform was released to the soil at the Montrose Site by the following mechanisms:

- Spills of the chloral-chlorobenzene mix during railroad car off-loading operations. Chloroform, 0.1 to 0.2 percent by weight, was known to be an impurity in the chloral chlorobenzene mix.
- Leaks from the above-ground chlorobenzene-chloral mix storage tanks
- Discharge of acid process waters to the wastewater recycling pond
- Potential chloroform generation during the caustic neutralization step of the DDT liquor
- Potential chloroform generation from reaction of unreacted chloral with base in the wastewater settling pond

Section 5.6.5.5 discusses these potential sources of chloroform in further detail.

5.4.5 Benzene in Soil

As shown in Table 5.1F, benzene was detected in approximately 3 percent of soil samples collected from borings in the vicinity of the Property. Benzene was detected in 14 of 519 soil samples collected from 99 borings at concentrations ranging from 0.00074 mg/kg to 0.0065 mg/kg, as shown in Figures 5.29 through 5.33. Samples from each depth interval were analyzed for benzene with all of the detections occurring in samples from Jones Chemical Company property and most within 0 to 10 feet bls. The highest concentration of benzene was detected in a soil sample collected on the southeastern portion of the Jones Chemical Company property at 10 feet bls. Benzene was not detected in any of the 198 soil samples collected from borings drilled and sampled on the Montrose Property.

Even though benzene was not detected in soil samples collected on Montrose Property, very few soil samples were taken in the area of the former Stauffer BHC plant, which presumably used benzene as a feedstock. Also, benzene can biodegrade more rapidly in the vadose zone over time than in the saturated zone. Therefore, while the soil samples that were analyzed did not reveal significant benzene, there are several possible contributors of

the benzene found in the saturated zone emanating from the Montrose Property. Possible sources of benzene in groundwater include:

- Benzene used in the production of BHC, stored near the location of BHC plant
- The 0.3 percent benzene which occurred as an impurity in the Montrose chlorobenzene feedstock
- The gasoline storage tank located south of the machine shop
- Fuel transmission pipelines in the LADWP right-of-way
- Underground fuel storage tanks located at Jones Chemical Company
- The Del Amo Site

A more detailed discussion of the source of benzene is provided in Section 5.6.6.

5.4.6 Tetrachloroethylene in Soil

PCE was detected in approximately 13 percent of soil samples collected from borings at and in the vicinity of the Property (Table 5.1F). PCE was detected in 68 of 516 soil samples collected from 99 borings at concentrations ranging from 0.00069 mg/kg to 6,700 mg/kg, as shown in Figures 5.34 through 5.38. PCE was most frequently detected in soil samples collected at and in the vicinity of the Jones Chemical Company property. PCE was frequently detected above EPA Region IX PRG of 5.4 mg/kg in the general area of the dry well and the former location of the PCE storage tank on Jones Chemical Company property. The highest concentrations of PCE were detected in soil samples collected from the eastern portion of the Jones Chemical property south of the Montrose Property boundary. PCE was detected above the PRG at all depth intervals on Jones Chemical Company property. The maximum concentration of 6,700 mg/kg was detected 8.5 feet bls near the former location of the PCE storage tank.

Sources of PCE have been documented at the Jones Chemical Company property south of the Property and at other facilities located northwest, north, and northeast of the Property (Levine-Fricke, 1995; Dames & Moore, 1996). Records also indicate that Jones Chemical Company sold Montrose various chemicals including PCE between 1968 and 1973. The occurrence of PCE in the subsurface beneath the Montrose and Jones Chemical property appears to be primarily due to sources of PCE that originate at the Jones Chemical Property. PCE tanks were located on the Jones Chemical Property near Borings LF-44 and LF-47. Groundwater concentrations of PCE appear to extend northward from the Jones Chemical Property, upgradient and under the Montrose facility. As discussed in the Montrose Site and Operational History Section, Jones Chemical, for some period of time, may have dumped some of its wastes into the Montrose wastewater recycle pond at the time that the LADPW cancelled Jones Chemical's permit to discharge to the county sewer. The locations of the soil samples collected in this RI were not necessarily sufficient to fully evaluate this potential release point for PCE. Therefore, the Montrose Property may potentially be a contributing source of PCE to the subsurface.

PCE was detected at 0.15 mg/kg and 0.21 mg/kg in two soil samples collected from one boring (34D) located On-Property adjacent to the Jones Chemical property approximately 130 feet north of the location of the PCE tank. PCE was also detected at concentrations between 0.3 and 1.0 mg/kg in seven soil samples collected from two borings located On-

Property adjacent to the sewer lines that extend north-south beneath the eastern portion of the Property parallel to Normandie Avenue. These sewer lines are buried at depths of approximately 20 feet bls. The sewer lines beneath the Property and the sewer line excavation itself may provide a preferred migration pathway for chemical compounds to be transported from their point or points of origin at Off-Property sources located north and northeast of the Property to the subsurface beneath the Montrose Property.

5.4.7 Trichloroethylene in Soil

As shown in Table 5.1F, TCE was detected in approximately 8 percent of soil samples collected from borings at and in the vicinity of the Property. TCE was detected in 44 of 517 soil samples collected from 99 borings at concentrations ranging from 0.00051 mg/kg to 320 mg/kg. TCE occurs most frequently in soil samples collected from borings located at and in the vicinity of the Jones Chemical Company property. The highest concentrations of TCE were detected in soil samples collected on the northern portion of the Jones Chemical property south of the Montrose Property boundary. Table H.2 of Appendix H provides a complete listing of trichloroethylene results.

Based on records reviewed for this RI, Montrose is not known to have used TCE in its manufacturing operations. The distribution of TCE at and in the vicinity of the Jones Chemical Company property is similar to the distribution of PCE and other VOCs that appear to originate from sources at Jones Chemical Company. The occurrence of TCE in the subsurface beneath the Montrose and Jones property is most likely due to sources of TCE that originate at Jones Chemical Company. However, as discussed in the Montrose Site and Operational History section and Section 5.4.6 for PCE, Jones Chemical Company for some period of time may have dumped some of its waste into the Montrose wastewater recycle pond at the time that the LADPW cancelled Jones Chemical's permit to discharge to the county sewer. The locations of the soil samples collected in this RI were not necessarily sufficient to fully evaluate this potential release point for TCE. Therefore, the Montrose Property may potentially have contributed TCE to the subsurface.

TCE was detected in three soil samples collected from two On-Property borings located approximately 162 and 270 feet northeast of the area on Jones Chemical property where TCE is most frequently detected and where the highest concentrations of TCE occur. TCE was detected in one soil sample collected from On-Property Boring 23D at 9 feet bls; one soil sample collected from Central Process Area Boring S303 at 8 feet bls and one soil sample collected from Boring S101 at 23 feet bls. Boring S101 is located in the Central Process Area at the location of the former wastewater recycle pond. Concentrations of TCE detected in these soil samples were 0.0069 mg/kg, 0.4 mg/kg, and 0.6 mg/kg, respectively.

TCE was also detected at a concentration of 0.9 mg/kg in a soil sample collected below the water table from On-Property Boring MW-1 at a depth of 72 feet bls. Boring MW-1 is located in the southeast corner of the Property, approximately 250 feet directly east of Jones Chemical Company. The occurrence of TCE at this location may be attributable to sources of TCE at Jones Chemical Company or may be associated with TCE that originated from other more distant sources and has preferentially migrated by way of the sewer lines or past sewer line excavations beneath the Property and adjacent to this sampling location.

5.4.8 Acetone in Soil

Acetone was detected in approximately 17 percent of soil samples collected from borings located at and in the vicinity of the Property (Table 5.1F). Acetone was detected in soil

samples collected from borings located On-Property both within and outside the Central Process Area and Off-Property at Jones Chemical Company, in the LADWP right-of-way, and the Normandie Avenue Ditch, but none of the samples exceeded the EPA Region IX PRG of 2,100 mg/kg.

Acetone was detected in all soil samples collected On-Property in the depth interval from land surface to 6 feet bls and the majority of samples collected from 6 to 10 feet bls at concentrations ranging from 0.031 mg/kg to 57 mg/kg. The highest concentrations of acetone were detected in borings located within the Central Process Area and southeast of the Central Process Area.

In the interval from land surface to 6 feet bls, acetone was also frequently detected in soil samples located in the northwest and southeast corners of Jones Chemical and the eastern portion at the LADWP right-of-way, and the northern portion at the Normandie Avenue Ditch.

Acetone was detected less frequently in the interval from 10 to 70 feet bls. The highest concentration of acetone was 86 mg/kg in a soil sample collected from Central Process Area Boring S201 at a depth of 61 feet bls. Acetone was not detected in soil samples collected at depths below the water table.

The source of the acetone in Montrose soil samples is not immediately clear. A portion of the acetone detected in samples may be a result of laboratory contamination. EPA lists acetone as a common laboratory contaminant (EPA, 1991g). Another possible source is the Jones Chemical facility. Acetone was stored on the Jones Chemical Property and was detected in approximately 20 percent of the soil samples analyzed for VOCs (Levine-Fricke, 1995). As discussed previously, Jones Chemical Company may have dumped some of its wastes into the Montrose wastewater recycle pond at the time that the LADPW cancelled Jones Chemical's permit to discharge to the county sewer system.

5.4.9 Dichlorobenzene in Soil

DCB was detected in approximately 8 percent of soil samples collected at and in the vicinity of the Property (Table 5.1F). DCB was detected in soil samples collected from borings located On-Property and on the adjacent Jones Chemical property.

DCB was most frequently detected in soil samples collected from borings located at and in the vicinity of the Central Process Area and Jones Chemical Company as shown in Figures 5.39 through 5.43. Concentrations of DCB detected in soil samples ranged from 0.00027 to 370 mg/kg. The highest concentrations were detected in Central Process Area borings located within the former pond and approximately 50 feet southeast of the former wastewater recycle pond. Figure 5.43 indicates that DCB was not detected in soil samples collected at depths below the water table.

Records indicate Montrose stored, used, or otherwise handled DCB (Montrose, 1950). In fact, DCB was detected in water from the recycle pond in an analysis conducted in 1978 (Stauffer, 1978). Jones Chemical Company is not known to have had DCB on their property.

5.4.10 Methylene Chloride in Soil

Methylene chloride was detected in approximately 20 percent of soil samples collected at and in the vicinity of the Property (Table 5.1F). Some of the detections exceeded the EPA

Region IX residential PRG of 7.8 mg/kg. Table H.2 of Appendix H provides a complete listing of the methylene chloride results.

Methylene chloride was detected in 9 of the 120 soil samples collected and analyzed above the water table in the Central Process Area. Methylene chloride was detected at concentrations ranging from 0.005 mg/kg in a soil sample collected from Boring 24D at a depth of approximately 10 feet to 21 mg/kg in a soil sample collected from Boring S-201 at a depth of 61 feet bls. Methylene chloride was also detected in soil samples collected from Borings 24D, 25A, S-201, and S-204.

The source of the methylene chloride is not immediately clear. Some of the methylene chloride detections are likely a result of laboratory contamination. EPA lists methylene chloride as a common laboratory contaminant (EPA, 1991g). Another possible source is Jones Chemical. Methylene chloride was repacked and distributed by Jones Chemical between 1982 and 1984 (Levine-Fricke, 1995). Methylene chloride was detected at low levels in most samples collected on the Jones Chemical Company property.

5.4.11 Ethylbenzene in Soil

As shown in Table 5.1F, ethylbenzene was detected in 3 of the 120 soil samples collected from the Central Process Area above the water table. Ethylbenzene was not detected in the 25 soil samples collected below the water table in the Central Process Area. Ethylbenzene concentrations in the three samples collected above the water table ranged from 0.86 mg/kg in the sample collected from Boring S-204 at 51 feet bls to 2.1 mg/kg in the sample collected from Boring S-201 at 17 feet bls. Table H.2 provides a complete listing at the ethylbenzene results.

As discussed in Section 1.3.5, ethylbenzene was one of the primary constituents of Toxisol, an aromatic petroleum distillate used in the manufacturing of DDT. Another source of ethylbenzene may be the gasoline storage tank located south of the machine shop. Jones Chemical Company may also be a potential source of ethylbenzene, because it was detected on the Jones Chemical Company property more frequently and in higher concentrations than on the Montrose Property. Ethylbenzene was detected in 16 of 50 soil samples collected from soil at concentrations ranging to 410 mg/kg at Jones Chemical Company. The highest concentrations of ethylbenzene on the Jones Chemical property are located near the dry well in Boring LF-36 at a depth of 15 feet bls.

5.4.12 Total Xylenes in Soil

Total xylenes were detected in 3 of the 15 soil samples collected from the Central Process Area above the water table (Table 5.1F). Concentrations of total xylenes detected in these samples ranged from 1.1 mg/kg in the sample collected from Boring S-204 at 51 feet bls to 19 mg/kg in the sample collected from Boring 14D at 9.5 feet bls. Soil samples collected below the water table in the Central Process Area were not analyzed for total xylenes. Table H.2 provides a complete listing of total xylenes results.

As discussed in Section 1.3.5, xylene was a primary component of Toxisol, an aromatic petroleum distillate used in the production of DDT. Xylene was also used by Montrose as a solvent. Jones Chemical Company may also be a potential source of xylene because it was detected on the Jones Chemical Company property more frequently and in higher concentrations than on the Montrose Property. Total xylene was detected on the Jones Chemical Property in 15 of 50 soil samples at concentrations up to 115 mg/kg. The highest

concentrations of total xylenes on the Jones Chemical property are located near the dry well in Boring LF-36 at a depth of 15 feet bls. Xylene was also distributed by Jones Chemical Company between 1973 and 1984 (Levine-Fricke, 1995).

5.4.13 Methyl Ethyl Ketone (MEK) in Soil

MEK was detected in 33 percent of soil samples collected from borings located at and in the vicinity of the Central Process Area (Table 5.1F). Concentrations of MEK detected in these samples ranged from 0.0014 to 45 mg/kg. The highest concentrations of MEK were detected in soil samples in the vicinity of the Central Process Area. MEK was detected in soil samples collected to depths of 51 feet bls. MEK was not analyzed in soil samples collected below the water table.

Based on records reviewed for this RI, Montrose did not routinely use MEK in its operations. The source of MEK in Montrose soils is not immediately clear. MEK was detected on the Jones Chemical Property in 11 of 50 soil samples at concentrations up to 1.2 mg/kg. The highest concentrations of MEK on the Jones Chemical property are located in Boring LF-44. The PEA conducted at Jones Chemical indicate that MEK was stored onsite from 1973 to 1984 (Levine-Fricke, 1995). As discussed previously, Jones Chemical may have dumped some of its wastes into the Montrose wastewater recycle pond at the time that LADPW cancelled Jones Chemical's permit to discharge to the county sewer system. Some the MEK detections may also be a result of laboratory contamination. EPA lists MEK as a common laboratory contaminant (EPA, 1991g).

5.4.14 Base Neutral/Acid Organic Compounds (Semivolatiles) in Soil

As shown in Table 5.2, 73 soil samples were analyzed for base neutral/acid organic compounds. Bis (2-ethylhexyl) phthalate and di-n-butyl phthalate were the most frequently detected compounds, found in 34 and 17 of 73 samples, respectively. The next most frequently detected compounds were 2-chlorophenol and 1,2,4-trichlorobenzene. The source of the phthalates is not immediately clear, although some the phthalate detections are likely a result of laboratory contamination. EPA lists phthalates as a common laboratory contaminant (EPA, 1991g).

Thirteen samples collected from the Central Process Area above the water table were analyzed for base neutral/acid organic compounds. Nine base neutral/acid organic compounds were detected in these soil samples, at concentrations less than 70 mg/kg. Appendix H lists the specific base neutral/acid organic compounds detected in each sample.

Thirty-five soil samples were collected On-Property outside of the Central Process Area above the water table and analyzed for base neutral/acid organic compounds. Four base neutral/acid organic compounds were detected in some of these samples at concentrations less than 60 mg/kg.

Eight samples were collected from the Property perimeter and analyzed for base neutral/acid organic compounds. Nine base neutral/acid organic compounds were detected in these soil samples, at concentrations less than 1.2 mg/kg.

Nine samples were collected from the LADWP right-of-way and analyzed for base neutral/acid organic compounds. Three base neutral/acid organic compounds were detected in these soil samples, at concentrations equal to or less than 0.5 mg/kg.

Four soil samples were collected from the Normandie Avenue Ditch and analyzed for base neutral/acid organic compounds. Six base neutral/acid organic compounds were detected in these soil samples, at concentrations less than 10 mg/kg.

Two neighborhood soil samples were collected from areas near the Property and analyzed for base neutral/acid organic compounds. Eighteen base neutral/acid organic compounds were detected in these neighborhood soil samples, at concentrations less than 25 mg/kg.

Twelve base neutral/acid organic compounds were detected in the two background soil samples analyzed for these compounds, at concentrations less than 1.0 mg/kg.

5.4.15 Chloral in Soil

Inside the Central Process Area, 35 soil samples collected from above the water table and 4 soil samples collected from below the water table were analyzed for chloral. These soil samples were collected from Borings MW-2, MW-2A, MW-4, and S-101. Chloral was not detected in these soil samples. The detection limit for chloral was 0.57 mg/kg.

On-Property, outside the Central Process Area, 46 soil samples collected from Borings MW-1, MW-3, and MW-5 were analyzed for chloral. Forty-one soil samples were collected from above the water table and five soil samples were collected from below the water table. Chloral was not detected in these soil samples. The detection limit for chloral was 0.5 mg/kg. Chloral data are provided in Appendix H, Table H.1.

5.4.16 Trace Metals in Soil

The analytical results for trace metals detected in soil samples are summarized Table 5.3. Nine soil samples were collected from the Central Process Area above the water table and analyzed for trace metals. Fourteen trace metals were detected in these soil samples. Mercury was detected at a concentration of 26 mg/kg in one soil sample collected from Boring 24D at 4.5 feet bls to 5 feet bls.

Thirty-five soil samples were collected outside of the Central Process Area above the water table and analyzed for trace metals. Eighteen trace metals were detected in these soil samples.

Sixteen trace metals were detected in the two background soil samples analyzed for these constituents.

Concentrations of trace metals detected in soil samples are compared to EPA Region IX PRGs for industrial and residential soil (EPA, 1996b) in Table 5.3. With the exception of arsenic, trace metals were not detected at concentrations greater than PRGs for industrial soil. Arsenic was detected in 23 of 46 soil samples; all detected values exceeded the PRG for industrial soil (2.4 mg/kg) and the PRG for residential soil (0.38 mg/kg). Twenty-one of these soil samples were collected On-Property, and two were collected at background locations. The maximum concentration of arsenic (116 mg/kg) was detected in a background surficial soil sample located approximately 1.5 miles southwest of the Property. The detections of arsenic occurred primarily in the east and southeast part of the Property.

Lead concentrations exceeded the CAL-Modified PRG for residential soil of 130 mg/kg in 7 of 46 samples. Two of the samples exceeded the lead PRG were from borings located within the Central Process Area and three of the samples were from borings located On-Property, but outside of the Central Process Area. All of the samples exceeding the PRG

were from a depth of 2 to 5 feet bls. The maximum concentration of lead (999 mg/kg) was detected in a soil sample collected from On-Property Boring 34D at a depth of 5 feet bls.

Cadmium was detected in one of 46 soil samples at a concentration exceeding 9 mg/kg, the CAL-Modified PRG for residential soil. The concentration of cadmium detected in this soil sample, collected from On-Property Boring 14D was 12.1 mg/kg.

5.4.17 Other Compounds in Soil

Other VOCs detected in soil samples collected from borings located at and in the vicinity of the Property with a frequency of detection less than 4 percent include 1,1-DCE and trichlorofluoromethane. Other compounds detected in soil samples collected Off-Property include polychlorinated biphenyls (PCBs) and other pesticides.

PCB-1260 was detected at a concentration of 0.11 mg/kg in a soil sample collected from Property perimeter Boring SP-2 at a depth of 1.5 feet bls. The EPA Region IX PRG is 0.066 mg/kg.

Beta-endosulfan was detected at a concentration of 25 mg/kg in a soil sample collected from Normandie Avenue Ditch Boring T-34 at a depth of 6 feet bls. PCB-1254 was detected at a concentration of less than 1 mg/kg in a soil sample collected from Normandie Avenue Ditch Boring T-42 at a depth of 19 feet bls. The EPA Region IX PRG for endosulfan is 390 mg/kg. Chlordane was detected in a soil sample collected from neighborhood soil sample location NS-1 at a concentration of 28 mg/kg. The EPA Region IX PRG is 0.34 mg/kg.

Heptachlor was detected in a soil sample collected from neighborhood soil sample NS-1 at a concentration of 0.28 mg/kg. The EPA Region IX PRG is 0.099 mg/kg.

5.5 Non-Aqueous Phase Liquids

This section describes the nature and extent of non-aqueous phase liquid (NAPL) which occurs in the subsurface at the Montrose Site. NAPL was observed at locations both On-Property and Off-Property. A NAPL is a liquid chemical or mixture of chemicals in the subsurface that is not miscible in water and, therefore, exists as a separate liquid phase. Most NAPLs are composed of hydrophobic organic compounds such as solvents, pesticides, or petroleum hydrocarbons. A NAPL may be lighter or heavier than water depending on its density. The compounds that comprise a NAPL dissolve into the surrounding groundwater; therefore, NAPL acts as a long-term continuing source of chemical compounds to groundwater.

A dense non-aqueous phase liquid (DNAPL) is heavier than water and tends to sink below the water table. Most halogenated solvents, such as chlorobenzene, are DNAPLs. DNAPL has been observed in soil samples and groundwater from the Upper Bellflower Aquitard beneath the Central Process Area. The occurrence of DNAPL and associated dissolved constituents in the subsurface beneath the Central Process Area appears to be attributable to chemical compounds originating from Montrose activities in the Central Process Area. DNAPLs are discussed in further detail in the following Section 5.5.1.

A NAPL that is lighter than water, referred to as a light non-aqueous phase liquid (LNAPL), tends to be held at or slightly above or below the water table. Fuel hydrocarbons, such as oil, gasoline, and diesel, are the most commonly encountered LNAPLs. LNAPL has been observed at several locations at the adjacent Del Amo Site, and at a location southwest

of Jones Chemical Company in the LADWP right-of-way. The occurrence of LNAPL and directly associated dissolved constituents does not appear to relate to Montrose activities, and appears to be attributable to sources located Off-Property. LNAPLs are discussed in further detail in Section 5.5.2.

5.5.1 Dense Non-aqueous Phase Liquid

The presence of DNAPL at the Montrose Site was first observed during the November 1987 groundwater sampling round when DNAPL was extracted during routine sampling of Central Process Area Monitoring Well MW-2. The occurrence of DNAPL in groundwater samples collected from Central Process Area Monitoring Well MW-2 in 1987 led to an evaluation of the presence and occurrence of DNAPL discussed in the following Section 5.5.1.1 (Summary of DNAPL Field Investigations). DNAPL has since been recovered On-Property from Monitoring Well MW-2, Test Monitoring Wells UBT-1, UBT-2, and UBT-3, and Extraction Monitoring Well UBE-1, all located in the Central Process Area (Figure 5.44). Within this section, discussions are also provided of the physical/chemical properties of DNAPL (Section 5.5.1.2), the observed extent of DNAPL (Section 5.5.1.3), the interpreted extent of DNAPL (Section 5.5.1.4), and DNAPL recovery (Section 5.5.1.5). Additional discussion of DNAPL are provided in Section 6 (Contaminant Fate and Transport) including the following: Section 6.2.4 (Mobility and persistence of DNAPL), Sections 6.3.3 and 6.3.4 (Contaminant Migration Pathways and Processes, Transport as DNAPL in Unsaturated Media and Groundwater), Sections 6.4.1 and 6.4.2 (Transport of VOCs and Pesticides as DNAPL in Unsaturated Soil and in Groundwater), and Section 6.4.5 (Potential Migration Pathways for DNAPL).

5.5.1.1 Summary of DNAPL Field Investigations

Field investigations to study the nature and extent of DNAPL in soil and groundwater at the Montrose Site, the feasibility and accumulation rate of DNAPL recovery from groundwater pumping, and groundwater treatability studies were completed as discussed in Section 2.5. This section provides additional detail on the field investigations as a preface to the presentation of results.

DNAPL Characterization. The scope of the field investigation to characterize the nature and extent of DNAPL included soil sampling; installation of an Upper Bellflower Aquitard test monitoring well, two observation monitoring wells, and an extraction monitoring well; aquifer testing; groundwater sampling from the test, observation, and extraction monitoring wells; and monitoring of DNAPL accumulation rates (Figure 5.44).

Soil samples were collected from the Upper Bellflower Aquitard test monitoring well (UBE-1) and two observation monitoring wells (UBT-1 and UBT-2) during the course of the investigation to further evaluate the occurrence of DNAPL in the Bellflower Aquitard. Soil samples had also been collected from six borings, one Lynwood monitoring well, and an exploratory boring during previous investigations to evaluate the occurrence of DNAPL in the Bellflower Aquitard. Data regarding the distribution of DNAPL were obtained based on lithologic logging and visual inspection of the continuous core samples.

The test and observation monitoring wells are located in the Central Process Area in the vicinity of Monitoring Well MW-2 (Figure 5.44). Soil cores were collected continuously from approximately 54 feet bls to approximately 100 feet bls at the test and observation monitoring wells. Six previously sampled borings located in the Central Process Area were drilled in 1988 during the Phase 2A RI field work. Borings S-101A, S-301A, S-302A, S-303A,

S-304A, and S-305A were continuously cored from the water table through the Upper Bellflower Aquitard to the base of the Bellflower Sand, which occurs at approximately 130 feet bls. Soil samples collected below the water table from these borings were analyzed using EPA Methods 8080 and 8240.

Other data included in the field program to characterize the occurrence of DNAPL included data obtained from Lynwood Aquifer Monitoring Well Boring LW-1, located approximately 100 feet southeast of the Central Process Area and Exploratory Boring EB-8, located adjacent to Monitoring Well MW-9 on McDonnell Douglas property approximately 250 feet northeast of the Central Process Area (Figure 4.23). Lynwood Aquifer Monitoring Well Boring LW-1, drilled in 1989 during the Phase 2B RI field work, was continuously cored from depths of 55 feet bls to 95 feet bls. Exploratory Boring EB-8, also drilled during the Phase 2B RI field work, was continuously cored from depths of 45 feet bls to 105 feet bls. These borings were drilled and sampled using mud-rotary continuous coring methods.

DNAPL Recovery Investigations. In September 1989, Test Monitoring Well UBT-1 and Observation Monitoring Wells UBT-2 and UBT-3 were installed in the Upper Bellflower Aquitard adjacent to Monitoring Well MW-2 where DNAPL was first detected. Observation Monitoring Wells UBT-2 and UBT-3 are located approximately 15 feet and 40 feet, respectively, from Test Monitoring Well UBT-1. The spacing of the observation monitoring wells was determined based on preliminary estimates of the potential radius of influence of the test monitoring well. A sump was installed at the bottom of each monitoring well to facilitate the collection of DNAPL and to prevent downward migration of DNAPL through the annular space. Aquifer tests were conducted in Test Monitoring Well UBT-1 in 1990 to estimate transmissivity and the coefficient of storage of the Upper Bellflower Aquitard. Groundwater samples were collected during the aquifer tests to evaluate changes in concentrations of chemical compounds with time. DNAPL accumulation was monitored in Observation Monitoring Wells UBT-2 and UBT-3 and Monitoring Well MW-2 upon completion of the aquifer testing. Results of the aquifer tests conducted in the test and observation monitoring wells are summarized in the Evaluation of Groundwater Treatability Study (H+A, 1990R-j).

Following an aquifer testing conducted in 1990 at Test Monitoring Well UBT-1, DNAPL accumulation was monitored in Monitoring Well MW-2 and Observation Monitoring Wells UBT-2 and UBT-3 during the period from June through August 1990. DNAPL was removed from these monitoring wells by bailing from the bottom of the casing using a Teflon bailer. Each monitoring well was bailed until DNAPL could no longer be contained. The volume of DNAPL obtained was estimated. A submersible pump installed in Test Monitoring Well UBT-1 during this time period prevented the evaluation of DNAPL accumulation in this monitoring well.

Extraction Monitoring Well UBE-1 was installed in the Upper Aquitard Bellflower in April 1991. A 28-day aquifer test was conducted at the extraction monitoring well to determine the hydraulic parameters of the Upper Aquitard Bellflower Aquitard in the vicinity of the Central Process Area and to evaluate the effect of DNAPL and groundwater on the operation of the monitoring well and treatment system. Results of the aquifer test conducted at the extraction monitoring well are summarized in the Groundwater Treatability Test Results, Phase 1 (H+A, 1992R-b).

Groundwater samples were collected during the aquifer testing to measure the concentration of chemical compounds with time. Effluent water samples were collected

from the treatment system to monitor compliance with discharge objectives and to evaluate treatment system operation. DNAPL accumulation rates in Extraction Monitoring Well UBE-1 were also monitored.

The results of these investigations are described in Section 5.5.1.5 (DNAPL Recovery Test Results).

5.5.1.2 Physical/Chemical Properties of DNAPL

DNAPL recovered from Monitoring Well MW-2 and Observation Monitoring Well UBT-3 was a dense, dark brown immiscible liquid. Four samples of DNAPL collected from Monitoring Well MW-2 during the period from January to April 1988 were analyzed for pesticides and VOCs using EPA Methods 8080 and 8240 (H+A, 1988R-h). The specific gravity of these four samples, and the pH and specific conductance of three of these samples were also measured. A summary of the DNAPL analyses is provided in Table 5.3b.

The reported laboratory analytical results for DNAPL samples indicated that chlorobenzene comprised anywhere from 33 percent to 53 percent by weight of the total composition of DNAPL. The reported laboratory results for DDT indicated that DDT comprised anywhere from 16 to 87 weight percent of the total chemical composition of DNAPL samples. The average composition of all DNAPL samples was 43 percent by weight of chlorobenzene and 47 percent by weight of DDT. An anomalously low value of 12,000 mg/L chlorobenzene (sample date May 14, 1998) and anomalously high value of DDT (3,100,000 mg/L were not included in the calculation of the range and average composition of the DNAPL.

Mass balance errors for DNAPL analyses resulted due to limitations of the analytical methods. The sum of the results exceeded unity for a mass balance between the two methods for one sample (dated July 27, 1988). Other factors resulting in the sum of chlorobenzene and total DDT exceeding 100 percent include the extraordinary laboratory dilution factors, which ranged from 5,000 to 200,000.

The specific gravity of DNAPL ranged from 1.1 to 1.3. An average specific gravity of 1.2 was used for the calculation percent by weight of chlorobenzene and DDT. The pH of the DNAPL was mildly acidic. The pH ranged from 5.0 to 7.0 an averaged 6.4. The specific was used for the calculation of percent by weight of chlorobenzene and DDT. The pH of the 3.7 μmhos/cm to 1,500 μmhos/cm. Organic solutions generally do not conduct electricity; therefore, the low specific conductance observed for some samples was likely due to dissolved and entrained inorganic constituents.

5.5.1.3 Observed Extent of DNAPL

The presence of DNAPL in soil samples and groundwater has been directly observed in the Bellflower Sand, as described in this section. In addition, the lateral and vertical extent of DNAPL may potentially be indicated by elevated chlorobenzene and DDT concentrations in soil and groundwater, as described in Section 5.5.1.4 (Interpreted Extent of DNAPL).

The areal extent of DNAPL in the Upper Bellflower Aquitard is estimated to encompass an area of about 250 by 300 feet centered around the southeast portion of the Central Process Area based on observed DNAPL in soil core samples and DNAPL accumulation in monitoring wells (Figure 5.44). DNAPL was not directly observed in the underlying Bellflower Sand; however, its likely presence could be inferred from groundwater concentrations.

Observed DNAPL in Upper Bellflower Aquitard Core Samples. DNAPL was visually observed in core samples collected from the Upper Bellflower Aquitard, but was not visible in core samples collected from the Bellflower Sand or any of the deeper hydrogeologic units. DNAPL observed in core samples consisted of an iridescent oily or purple sheen.

DNAPL was observed in core samples collected beneath the Central Process Area from the water table at approximately 70 feet bls to approximately 95 feet bls at Borings S-101A, S-301A, S-302A, S-304A, and S-305A and at Observation Monitoring Well UBT-3. The locations of these borings and the observed extent of DNAPL occurrence is shown in Figure 5.44. DNAPL was observed in core samples collected beneath the Central Process Area in Test Monitoring Well UBT-1 and Observation Monitoring Well UBT-2 from approximately 5 feet above the water table to the base of the Upper Bellflower Aquitard that occurs at approximately 100 feet bls. The water table beneath the Central Process Area has since risen approximately 5 feet.

DNAPL was also observed in Upper Bellflower Aquitard core samples collected from the boring used to construct Lynwood Aquifer Monitoring Well LW-1, located southeast of the Central Process Area (Figure 5.44). The oily sheen observed in core samples collected from Monitoring Well LW-1 was less distinctive and generally not as thick as that observed in core samples collected from the Central Process Area. DNAPL was not observed in core samples collected from Boring S-303A located near the southwestern corner of the former pond, nor from Exploratory Boring EB-8 located Off-Property northeast of the Central Process Area.

Observed DNAPL in Groundwater Samples. In addition to observed DNAPL within core samples, DNAPL was recovered from Extraction Monitoring Well UBE-1, Observation Monitoring Well UBT-2, and Monitoring Well MW-2. Chlorobenzene concentrations in excess of 100,000 µg/L in groundwater samples collected from Monitoring Wells MW-9 and MW-5 in April 1990 and January 1987, respectively, suggest that DNAPL may have extended to the vicinity of these monitoring wells.

Core data obtained from Boring S-303A and groundwater data obtained from Monitoring Well MW-4 indicate that DNAPL probably does not occur west and northwest of the Central Process Area. Soil core data and water quality data obtained from borings and monitoring wells in the vicinity of the Central Process Area indicate that recoverable DNAPL probably does not occur in the Bellflower Sand.

5.5.1.4 Interpreted Extent of DNAPL

Because of the difficulty in directly observing DNAPL in the subsurface and the very heterogeneous distribution of DNAPL, the presence and extent of DNAPL in the subsurface is commonly estimated based on measured dissolved concentrations of DNAPL components in groundwater samples or the total concentrations of DNAPL components in soil samples.

Interpreted Lateral Extent of DNAPL Based on Groundwater Concentrations. The analytical results of groundwater samples collected from Upper Bellflower Aquitard Monitoring Wells MW-4, MW-5, MW-9, and MW-19, and Bellflower Sand Monitoring Wells BF-01, BF-02, BF-03,BF-04, and BF-09 were reviewed as a potential indicator of the lateral extent of DNAPL. Recent literature suggests that dissolved concentrations in groundwater samples on the order of 1 percent of the aqueous solubility may indicate the presence of DNAPL (EPA, 1992). The locations of these monitoring wells and concentrations of chlorobenzene

in groundwater in the Upper Bellflower Aquitard and Bellflower Sand are shown on Figures 5.52 and 5.53.

Chlorobenzene and/or total DDT concentrations have approached and in some cases exceeded the solubility limit of these compounds in groundwater samples collected from the test, extraction, and monitoring wells in the vicinity of the Central Process Area (Monitoring Wells UBT-01, UBT-03, UBE-01, and MW-02). The single component solubility limit of chlorobenzene in water is approximately 500,000 µg/L at 20 degrees Celsius (°C) (Section 6.2.2.1, Table 6.3b). The effective solubility of chlorobenzene from DNAPL composed of chlorobenzene and DDT is estimated to be approximately 410,000 µg/L (Section 6.2.2.1). The solubility limits of individual DDT isomers and metabolites in water range from approximately 5.5 µg/L to 100 µg/L at 25°C (Tables 6.1 and 6.2b). Table 5.5 summarizes the minimum, maximum, and average concentrations of chlorobenzene and DDT in groundwater from Montrose monitoring wells. A summary of the percent solubility of chlorobenzene and DDT in groundwater from the monitoring wells of interest is provided in Tables 5.3c and 5.3d, respectively. The percent of solubility for chlorobenzene and DDT have been calculated for the minimum, average, maximum, and most recent sample concentrations.

Interpreted Lateral DNAPL Extent Based on Chlorobenzene Solubility. Table 5.3c indicates that the observed chlorobenzene concentrations in groundwater have exceeded 1 percent of the chlorobenzene solubility for Monitoring Wells MW-5 and MW-9 within the Upper Bellflower Aquitard and for Monitoring Wells BF-02, BF-03, BF-04, and BF-09 within the Bellflower Sand. Therefore, the potential presence of DNAPL is indicated at those monitoring well locations. The chlorobenzene concentrations in groundwater from MW-4, MW-19, and BF-01 did not indicate the presence of DNAPL. Based on the high chlorobenzene concentrations detected in groundwater samples collected from Monitoring Wells MW-5 and MW-9, DNAPL may be inferred to extend farther to the east and northeast from the Central Process Area than is shown by observed DNAPL in soil and groundwater samples (Figure 5.44). The presence of chlorobenzene above 1 percent of the aqueous solubility in Monitoring Wells BF-02, BF-03, BF-04, and BF-09 also indicates that DNAPL likely migrated into the Bellflower Sand and that DNAPL residuals may continue to be present.

The chlorobenzene concentrations in groundwater samples from six of the Upper Bellflower Aquitard monitoring wells (including MW-5 and MW-9) were significantly less in the 1995 sampling event samples than during the previous samplings, as discussed in greater detail in the introduction to Section 5.6. Therefore, the average chlorobenzene and DDT concentrations are thought to be more representative of actual subsurface conditions than the most recent (1995) sample analysis.

The chlorobenzene concentrations in groundwater samples collected from Monitoring Well MW-9 decreased from 180,000 µg/L in April 1990 to 8,400 µg/L in November 1995. This represents a decrease from approximately 49 percent of the effective solubility of chlorobenzene to about 2 percent of the effective solubility. Chlorobenzene concentrations in groundwater samples collected from Monitoring Well MW-5 decreased from 200,000 µg/L in January 1987 to 8.4 µg/L in November 1995. This represents a decrease from about 50 percent of the effective solubility to about 0.002 percent of the effective solubility. The chlorobenzene concentration in the groundwater sample collected from Monitoring Well MW-4 in April 1990 was 500 µg/L or about 0.1 percent of the chlorobenzene solubility. The chlorobenzene concentration in the groundwater samples

collected from Monitoring Well MW-19 has ranged between 9 µg/L to less than the detection limit of 1 µg/L.

The large decrease in concentrations of chlorobenzene observed at Monitoring Wells MW-5 and MW-9 may be the result of either: (1) the dissolution of DNAPL residuals and adsorption of contaminants to aquifer sediments, (2) the presence of previously occurring lateral flow of groundwater or vadose zone water containing high dissolved chlorobenzene concentrations during plant operations, or (3) infiltration of surface water during the late 1995 rainy season and subsequent dilution of dissolved contaminants. An additional round of groundwater monitoring is needed to confirm if the 1995 chlorobenzene concentrations were representative.

Interpreted Lateral DNAPL Extent Based on DDT Solubility. The percent solubility of total DDT for groundwater samples from monitoring wells of interest are provided in Table 5.3d. The solubility of DDT used for the calculations was 5.5 µg/L, the solubility of p,p-DDT. If all DDT isomers were considered, the solubility of total DDT would be higher. Table 5.3d shows that total DDT in groundwater has exceeded 1 percent of the solubility for Monitoring Wells MW-4, MW-5, BF-01, BF-02, BF-03, BF-04, and BF-09. This indicates that DNAPL residuals may have been or are potentially present in both the Upper Bellflower Aquitard and the Bellflower Sand in the vicinity of these monitoring wells.

The average and maximum DDT concentrations from Monitoring Wells MW-4, MW-5, BF-01, and BF-02 have ranged from 27 percent to more than 6 times the solubility; however, the total DDT concentrations in the most recent (1995) samples were much lower and less than 1 percent of the DDT solubility.

The total DDT concentration in the groundwater sample collected from Monitoring Well MW-9 in April 1990 was 0.05 µg/L, which is less than 1 percent of the solubility of DDT. Total DDT concentrations in groundwater samples collected from Monitoring Well MW-5 ranged from less than 0.2 µg/L to 5 µg/L during the period from April 1985 through April 1991. The concentration of total DDT in the groundwater sample collected from MW-5 was 0.4 µg/L in April 1991. Total DDT concentrations in groundwater samples collected from Monitoring Well MW-4 ranged from less than 0.02 µg/L to 36 µg/L during the period from July 1985 through April 1990. The upper end of this range exceeds the solubility of DDT by a factor of 6. The total DDT concentration in the groundwater sample collected from Monitoring Well MW-4 in April 1990 was less than 0.04 µg/L. The total DDT concentration in the groundwater sample collected from Monitoring Well MW-19 in April 1991 was less than 0.04 µg/L.

Because of the very low aqueous solubility of DDT, the presence of reported concentrations of DDT in groundwater samples may not by itself be a reliable indicator of DNAPL presence. DDT may potentially be transported down the borehole during monitoring well drilling activities. However, in conjunction with the elevated chlorobenzene concentrations in groundwater, this analysis has provided the basis for an interpreted extent of DNAPL within the Upper Bellflower Aquitard that is shown on Figure 5.44.

The fact that chlorobenzene concentrations in the Bellflower Sand exceed 1 percent of the aqueous solubility does not necessarily indicate that DNAPL is present in this unit. Given the downward hydraulic gradient, high chlorobenzene concentrations in the Bellflower Sand may be the result of dissolution of DNAPL residing in the overlying Lower Bellflower Aquitard. However, the presence of elevated DDT and chlorobenzene concentrations in

groundwater from Bellflower Sand monitoring wells tends to support the interpretation of the presence of DNAPL residuals.

Interpreted Vertical Extent of DNAPL Based on Soil Concentrations. The presence of elevated concentrations of DDT in aquifer matrix samples collected at depth may indicate the presence, or former presence, of DNAPL at depth. Sampling and analysis of aquifer matrix samples for DDT performed to date have extended to a maximum depth of approximately 130 feet bls, which is near the base of the Bellflower Sand. Concentrations of DDT in aquifer matrix samples collected from beneath the Central Process Area from the known DNAPL impacted interval, that occurs in the Upper Bellflower Aquitard at depths from 70 to 90 feet bls were as high 69,000 mg/kg. DDT concentrations in this range are commonly associated with extremely high concentrations of chlorobenzene and are most likely indicative of the presence of DNAPL.

Concentrations of DDT detected in aquifer matrix samples collected from beneath the Central Process Area in the Bellflower Sand at depths ranging from about 115 to 130 feet bls were as high as 190 mg/kg. The occurrence of DDT at these concentrations may be related to the past or present occurrence of DNAPL or may be a remnant of having drilled through high concentrations in the overlying DNAPL-impacted zone.

Soil samples have not been collected and analyzed for VOCs or pesticides at depths greater than about 130 feet bls. As such, there are no data which provide direct evidence for the occurrence of DNAPL at greater depths. Indirect evidence, such as sporadic detections of DDT in groundwater samples collected from the Gage Aquifer, combined with high concentrations of chlorobenzene in groundwater may provide some indication of the occurrence or previous occurrence of DNAPL beneath the Central Process Area.

5.5.1.5. DNAPL Recovery Test Results

DNAPL accumulation was evaluated in Monitoring Well NW-2, Extraction Monitoring Well UBE-1, Test Monitoring Well UBT-1, and Observation Monitoring Wells UBT-2 and UBT-3. A field investigation was conducted in March 1988 to determine the chemical character of the DNAPL and the rate of DNAPL accumulation in Monitoring Well MW-2 (H+A, 1988R-h). DNAPL accumulation in Monitoring Well MW-2 was subsequently monitored during quarterly groundwater sampling rounds.

The volume of DNAPL recovered from Monitoring Well MW-2 during each of five sampling events conducted during the period from January to March 1988 ranged from about 0.02 to 0.25 gallons. The rate of DNAPL recovery indicated a decrease in accumulation and recovery rate with time during the March 1988 DNAPL investigation. The rate of DNAPL recovery under non-groundwater pumping conditions during the March 1988 DNAPL investigation was less than 0.02 gallons per week (H+A, 1988R-h).

DNAPL was recovered from On-Property Monitoring Well MW-2 and from Observation Monitoring Well UBT-3 during the period from June through August 1990. DNAPL did not accumulate in Observation Monitoring Well UBT-2 during this time period. During each of the three sampling events conducted between June and August 1990, the volume of DNAPL recovered from Monitoring Well MW-2 ranged from about 0.1 to 0.2 gallons, and the volume of DNAPL recovered from Observation Monitoring Well UBT-3 ranged from about 0.01 to 0.5 gallons.

The volume of DNAPL recovery from Extraction Monitoring Well UBE-1 during the aquifer test averaged 10 gallons per day (gpd) during the 28 days when groundwater was being pumped from the monitoring well. DNAPL accumulation from Extraction Monitoring Well UBE-1 when it was not actively pumping was less than 0.1 gpd. The results demonstrated that DNAPL recovery from Extraction Monitoring Well UBE-1 was enhanced when groundwater was being extracted from the monitoring well.

5.5.2 Light Non-aqueous Phase Liquid

LNAPL was recovered at Monitoring Well MW-7, located south of the Property, and at Monitoring Well MW-20, located northeast of the Property. LNAPL recovered at Monitoring Well MW-7 during the initial sampling round in January 1989 consisted of fuel hydrocarbons. LNAPL recovered at Monitoring Well MW-20 during monitoring well development in April 1990 consisted primarily of benzene.

Monitoring Well MW-7 is located in the LADWP right-of-way southwest of the Property. The LNAPL recovered at Monitoring Well MW-7 appears to be associated with sources of fuel hydrocarbons located along the pipeline corridor which extends through the LADWP right-of-way adjacent to this monitoring well.

The horizontal and vertical extent of NAPL, dissolved phase fuel hydrocarbons, and related chemical compounds occurring at and in the vicinity of Monitoring Well MW-7 and the LADWP right-of-way west of Normandie Avenue has not been assessed as part of any other investigation being conducted at and in the vicinity of the Property. LNAPL at this location is most likely providing a continuing source of chemical compounds including benzene, toluene, ethylbenzene, and xylenes (BTEX) and potentially 1,2-dichloroethane (1,2-DCA). 1,2-DCA was previously used as a lead scavenger in leaded gasoline; however, 1,2-DCA is also a common degradation product of TCE and PCE, which is known to exist in groundwater in the vicinity of the Montrose Site.

Monitoring Well MW-20 is located northeast of the Property on the adjacent Del Amo Site. The occurrence of benzene LNAPL in this and several other monitoring wells located throughout the Del Amo Site, as well as the occurrence and distribution of dissolved phase benzene and related compounds detected in groundwater over a broad area east of the Property, is being characterized as part of on-going investigations being conducted by the Del Amo respondents under the direction of EPA at the adjacent Del Amo Site. The highest concentrations of benzene detected in groundwater within the vicinity of the Montrose Site occur at the Del Amo Site. The Del Amo site is located directly east of the Montrose Property.

5.6 Groundwater

This section describes the nature and extent of organic chemical contaminants in groundwater for each of the four monitored hydrogeologic units at the Montrose Site. A discussion of inorganic constituents in groundwater was provided in Section 4.2.4.

Ninety-two monitoring wells have been installed by Montrose both On-Property and Off-Property since 1985. Groundwater samples collected from Montrose monitoring wells were analyzed to assess the distribution of pesticides and VOCs in groundwater. Groundwater quality has been monitored in 30 Upper Bellflower Aquitard monitoring wells, 34 Bellflower Sand monitoring wells, 21 Gage Aquifer monitoring wells, and

7 Lynwood Aquifer monitoring wells as part of RI work at the Montrose Site. Groundwater data obtained from Montrose monitoring wells have been supplemented with available groundwater data obtained from more than 100 additional monitoring wells located at the nearby Del Amo, Armco Royal Boulevard, McDonnell Douglas, International Light Metals, Golden Eagle Refinery, Amoco Chemical, and Trico Industries sites.

Groundwater quality data at the Montrose Site were derived from groundwater samples analyzed for pesticides using EPA Method 608/8080; for VOCs using EPA Method 624/8240; for base neutral/acid extractable (semivolatile) organic compounds using EPA Method 625 and/or 8270; for chloral using EPA Modified Method 608/8080; and for trace metals and p-CBSA using various appropriate EPA methods. Analytical methods for groundwater samples are summarized in Section 2 and detailed in Table B.2, Appendix B. The analytical results for groundwater samples are provided in Appendix G.

Total DDT and total BHC were detected in groundwater samples collected from some On-Property and near-Property monitoring wells. Chlorobenzene, benzene, chloroform and PCE were the most prevalent VOCs detected in groundwater samples. Other VOCs detected in groundwater samples include ethylbenzene, toluene, total xylenes, TCE, 1,2-DCA, 1,4-DCB, carbon tetrachloride, acetone, and methylene chloride. The compound p-CBSA, a by-product of the manufacture of DDT, was also detected in groundwater samples collected from monitoring wells at the Montrose Site and Off-Property. Table 5.4 provides a summary of the prevalence (percent detection) of VOCs, pesticides, and p-CBSA in groundwater from all monitoring wells. The occurrence of many of these compounds in groundwater may be attributable to sources other than Montrose.

The distribution of pesticides and VOCs is described based on data obtained from groundwater sampling events conducted by Montrose during the period from 1985 through 1995. The most recent sampling event for each monitoring well during this period was used to prepare updated contaminant distribution maps for selected prevalent compounds (Figures 5.45 through 5.72). These contaminant distribution maps also incorporate available data from other nearby sites which surround the Montrose Site. The maps were then used to describe the extent of groundwater contamination for each constituent and hydrogeologic unit.

It is important to realize that not all monitoring wells were sampled in 1995, and for those monitoring wells that were sampled, analyses were not completed for all chemicals. Therefore, the plume maps represent a composite of data mostly from the years 1990, 1991, and 1995. Only 3 monitoring wells (all in the Upper Bellflower Aquitard) were sampled and analyzed for pesticides (DDT and BHC) in 1995. Twenty-two of 33 Upper Bellflower Aquitard monitoring wells, 18 of 34 Bellflower Sand monitoring wells, 14 of 21 Gage monitoring wells, and 2 of 7 Lynwood Aquifer monitoring wells were analyzed for VOCs during the 1995 sampling. Sixteen of 33 Upper Bellflower Aquitard monitoring wells, 16 of 34 Bellflower Sand monitoring wells, 14 of 21 Gage monitoring wells, and 2 of 7 Gage monitoring wells were analyzed for p-CBSA during the 1995 sampling. Seventy-one of the 95 Montrose Site monitoring wells have 2 or less analyses for p-CBSA, and 14 of the monitoring wells have not been analyzed for p-CBSA to date.

Table 5.4 summarizes the prevalence of detected VOCs, pesticides, and p-CBSA in groundwater (i.e., the percent of detected values relative to the total number of samples). Table 5.5 provides the maximum, minimum, and arithmetic mean concentrations of DDT, BHC, chlorobenzene, benzene, chloroform, p-CBSA, and other prevalent VOC contaminants

detected in groundwater samples collected from each monitoring well at the Montrose Site during the period from 1985 through 1995. The number of analyses and number of detected values are also provided. The average (arithmetic mean) concentrations for each compound detected in groundwater samples collected from each monitoring well were calculated using the analytical results for groundwater samples collected from each monitoring well. Values below the detection limit were not used in calculating the mean. Average values were not provided for samples with only one detected value. A complete listing of groundwater quality data are provided in Appendix G (Tables G-1 through G-6) along with time-series graphs for the chlorobenzene concentration in groundwater for all monitoring wells (Figures G-1 through G-91).

Table 5.4 and Table 5.5 summarize analytical results for groundwater samples collected from Montrose monitoring wells by Montrose or by Del Amo from April 1984 through December 1995. Appendix G includes only samples collected by Montrose from Montrose groundwater monitoring wells during the period 1985 through 1995. Analytical results for samples collected by others (e.g. Dames & Moore on behalf of the Del Amo Respondents) are not included.

An evaluation of all available groundwater monitoring data (provided in Appendix G) for the Montrose Site monitoring wells indicates that the reported chlorobenzene concentration for 6 of the 67 monitoring wells sampled for VOCs in 1995 was significantly lower than that for the previous monitoring record. These monitoring wells are MW-05, MW-06, MW-09, MW-10, MW-25, and MW-27. The most recent chlorobenzene values for these monitoring wells were approximately 50 percent to 0.1 percent of the previous concentration values. The reason for the decrease is not known, but may be due to: (1) rapid infiltration of rainfall during the above-average late 1995 winter rainy season in the Los Angeles Area and the resultant dilution of dissolved groundwater contaminants at the water table or (2) potential QA/QC problems. The fact that all of these monitoring wells are screened within the Upper Bellflower Aquitard supports the first interpretation. With the exception of these monitoring wells, 1995 monitoring data appear to be generally representative of the historical monitoring record at each monitoring well. A text discussion is provided under the section for each contaminant of concern where the most recent data are significantly less than the previous monitoring record.

The discussion of the changes in pesticide and VOC concentrations with time is based on more than 10 years of analytical data obtained from Montrose monitoring wells. The groundwater monitoring program for Montrose monitoring wells began in 1985 for the Upper Bellflower Aquitard, in 1986 for the Bellflower Sand and the Gage Aquifer, and in 1989 for the Lynwood Aquifer. Only certain monitoring wells have been monitored over the entire time period, and many monitoring wells have received only 2 or 3 analyses, so it is important to consult the groundwater summary presented in Table 5.5 and the complete listings of groundwater monitoring data when interpreting time trends.

5.6.1 DDT in Groundwater

Total DDT was detected in approximately 20 percent of groundwater samples collected from Montrose monitoring wells that were analyzed for pesticides (Table 5.4). Total DDT has been detected at least once in groundwater samples collected from 13 Upper Bellflower monitoring wells; 5 Bellflower Sand monitoring wells, 7 Gage monitoring wells, and 1 Lynwood Aquifer monitoring well (Table 5.5). The complete listing of DDT analyses for groundwater samples is provided in Appendix G-1. With the exception of Monitoring

Wells MW-01, MW-06, and MW-12, which were sampled in 1995, the most recent monitoring data for DDT in groundwater is from 1990 and 1991.

The Upper Bellflower Aquitard groundwater monitoring wells that have historically detected total DDT occur within a zone of contamination approximately 1,500 feet by 1,500 feet beneath and within 500 feet of the Central Process Area (Figure 5.45). Not all monitoring wells within this area have detected DDT, and some of the monitoring wells have detected DDT only once (i.e., MW-6, MW-8, MW-9, and MW-14). The zone of detected total DDT is approximately 700 feet by 1,200 feet within the Bellflower Sand with historical measured concentrations ranging from 0.03 µg/L to 23 µg/L. A clearly definable zone of total DDT contamination is not present in the Gage Aquifer; however, total DDT has historically been detected in groundwater in 7 of 21 monitoring wells within the Gage Aquifer and in 2 of 21 monitoring wells within the most recent sampling event. DDT has been detected in only one sample (0.046 µg/L) from one monitoring well (LW-01) within the Lynwood Aquifer.

The highest detected concentrations of total DDT and the most frequent detections of total DDT were in groundwater samples collected from Upper Bellflower Aquitard Monitoring Wells (MW-01 through MW-30, UBT-01, and UBE-01) located at and in the vicinity of the Central Process Area. The reported concentrations of total DDT detected in groundwater samples collected from Upper Bellflower Aquitard monitoring wells have ranged from 0.03 µg/L (MW-08) to 1,100,000 µg/L (Monitoring Well UBT-01) [Table 5.5]. State and Federal drinking water standards for DDT do not exist. The EPA Preliminary Remediation Goal for tap water for total DDT is 0.2 µg/L.

The highest concentrations of total DDT detected in Central Process Area Monitoring Wells MW-2, UBT-01, and UBE-01 (average total DDT concentrations of 4,021µg/L, 401,650 µg/L, and 4,699 µg/L, respectively) are associated with the occurrence of the DDT/chlorobenzene DNAPL which accumulates in these monitoring wells. These concentrations greatly exceed the solubility of DDT and are, therefore, not considered representative of dissolved DDT concentrations. Entrained droplets of DNAPL that occur with the groundwater sample greatly increase the total DDT concentration of the groundwater sample, because the DNAPL contains approximately 40 percent DDT. The solubility of the DDT isomers and the DDT metabolites DDD and DDE range from 5.5 to 140 µg/L). A more detailed comparison of measured total DDT concentrations in groundwater to the solubility limit was previously provided in Section 5.5.1.4 (Interpreted Extent of DNAPL Based on Groundwater Concentrations). Additional detail on DDT solubility is provided in Section 6.2.1.1.

5.6.1.1 DDT: Upper Bellflower Aquitard

Total DDT was detected in groundwater samples collected from two Upper Bellflower Aquitard monitoring wells and Extraction Monitoring Well UBE-1 located within the Central Process Area and four Upper Bellflower Aquitard monitoring wells located outside the Central Process Area during the most recent sampling event for each Montrose monitoring well (Figure 5.45). Concentrations of total DDT detected in groundwater samples collected from Monitoring Well MW-2 and Test Monitoring Well UBT-1 ranged from 600 µg/L to 1,100,000 µg/L and are associated with the occurrence of DNAPL in these monitoring wells (Table 5.5). Concentrations of total DDT detected in groundwater samples collected from Monitoring Wells MW-3, MW-9, MW-14, and MW-17 ranged from 0.05 µg/L

to 0.62 µg/L. Monitoring Well MW-14 is located southeast of the Property in the LADWP right-of-way east of Normandie Avenue.

The highest concentration of total DDT historically detected in Upper Bellflower Aquitard monitoring wells located outside the Central Process Area was 19 µg/L detected in a groundwater sample collected from Monitoring Well MW-1 in November 1995 (Table 5.5). Monitoring Well MW-1 is located in the southeast corner of the Property (Figure 5.45). Concentrations of total DDT exceeding 1 µg/L have also been frequently detected in groundwater samples collected from On-Property Monitoring Wells MW-3 and MW-5, located west and east of the Central Process Area. The occurrence of total DDT detected in the groundwater sample collected from Monitoring Well MW-6 at a concentration of 9 µg/L in December 1995 was the first time since the first sampling event in 1986 that total DDT was detected at this monitoring well. Off-Property Monitoring Well MW-6 is located south of the Property in the LADWP right-of-way.

In addition to these monitoring wells, lower concentrations of total DDT have been sporadically detected in groundwater samples collected from Upper Bellflower Aquitard Monitoring Wells MW-8, MW-9, MW-14, MW-17, and MW-20 located Off-Property within about 1,000 feet northwest, north, northeast, southeast, and southwest of the Property (Table 5.5; Figure 5.45). Maximum concentrations of total DDT detected in groundwater samples collected from these monitoring wells have ranged from 0.03 to 0.62 µg/L, with the highest concentration being detected in a groundwater sample collected from Monitoring Well MW-14 located approximately 300 feet southeast of the Property in the LADWP right-of-way east of Normandie Avenue.

5.6.1.2 DDT: Bellflower Sand

Total DDT was detected in groundwater samples collected from three Bellflower Sand monitoring wells during the most recent sampling event for each Montrose monitoring well (Figure 5.46). Concentrations of total DDT detected in groundwater samples collected from Monitoring Wells BF-3, BF-4, and BF-9 ranged from 0.3 to 5 µg/L. The highest concentration of total DDT was detected in a groundwater sample collected from Monitoring Well BF-9, located in the Central Process Area. Monitoring Wells BF-3 and BF-4 are located within 300 feet east and southeast of Monitoring Well BF-9.

Total DDT has been historically detected in groundwater samples collected from 5 of 34 Bellflower Sand monitoring wells (Table 5.5). Total DDT has been frequently detected in groundwater samples collected from On-Property Bellflower Sand Monitoring Wells BF-1, BF-2, BF-3, BF-4, and BF-9 at average concentrations ranging from 1 µg/L to 11 µg/L (Figure 5.46). The highest concentrations have been detected in groundwater samples collected from Monitoring Well BF-9, located in the Central Process Area, and Monitoring Well BF-3 located northeast of the former water recycling pond. The area of historically detected DDT is approximately 700 feet by 1,200 feet. Total DDT has not been detected in Off-Property Bellflower Sand monitoring wells.

5.6.1.3 DDT: Gage Aquifer

Total DDT was detected in groundwater samples collected from 2 of the 21 Gage Aquifer monitoring wells during the most recent sampling event for each monitoring well (Figure 5.47). Total DDT was detected at concentrations of 0.06 µg/L and 0.09 µg/L in groundwater samples collected from Monitoring Wells G-2 and G-7, respectively (Table 5.5). Monitoring Well G-2 is located in the southeast corner of the Property. Prior to

its abandonment and destruction in 1994, Monitoring Well G-7 was located on Farmer Brothers Company property south of the Property.

Total DDT has been sporadically detected in groundwater samples collected from 7 of 21 Gage Aquifer monitoring wells during the period from 1985 through 1995 (Table 5.5). Reported concentrations of total DDT detected in these seven monitoring wells have ranged from 0.03 µg/L to 52 µg/L. The DDT detections in groundwater samples from 6 of the 7 DDT-contaminated monitoring wells occur in only 10 to 30 percent of the analyses. The monitoring wells and the ratio of the number of detected values to the number of total samples are: Monitoring Well G-01 (3 of 11 samples), Monitoring Well G-02 (3 of 12 samples), Monitoring Well G-03 (1 of 11 samples), G-04 (1 of 7 samples), Monitoring Well LG-01 (2 of 12 samples), Monitoring Well LG-02 (1 of 5 samples). The detected DDT concentrations in these six Gage monitoring wells could potentially be due to: (1) cross-contamination of the borehole with DDT-contaminated sediment during the monitoring well drilling process, (2) DDT released from isolated DNAPL ganglia that potentially have migrated to the Gage Aquifer, (3) vertical migration of DDT-contaminated groundwater from overlying hydrogeologic units, (4) leakage along monitoring well seals or casing joints from overlying contamination.

The reported concentrations of total DDT in groundwater samples from monitoring wells G-01, G-02, G-03, and LF-01 from the October 1988 sampling appear to be anomalously high compared to the rest of the monitoring data for each monitoring well. The total DDT concentrations for these monitoring wells were 52 µg/L, 18 µg/L, 7 µg/L, and 13 µg/L, respectively. The cause of the higher total DDT values for this sampling round is not known.

Total DDT was most frequently detected in groundwater samples collected from Monitoring Well G-07 located south of the Property on Farmer Brothers Company property (Figure 5.47). DDT has been detected in 5 of 6 samples from Monitoring Well G-07. The total DDT concentrations steadily decreased from 0.79 µg/L on January 30, 1989 to 0.09 µg/L on April 18, 1990. The trend of decreasing DDT concentrations since the installation of Monitoring Well G-07 may have been the result of cross-contamination of DDT-contaminated sediments or drilling mud during monitoring well drilling and construction. DDT would desorb from soil and drilling mud in the monitoring well bore to the groundwater resulting in a trend of initial high concentrations of DDT in groundwater and subsequent decreasing concentrations. Another mechanism that could explain the total DDT concentration trend is the presence of a nearby DNAPL ganglia. If this were the case, a trend of significantly decreasing chlorobenzene concentrations would also be expected, but is not observed. Therefore, cross contamination with DDT-contaminated drilling mud appears to be a likely explanation for the total DDT detected in groundwater from Monitoring Well G-07.

5.6.1.4 DDT: Lynwood Aquifer

With a singular exception, total DDT has not been detected in groundwater samples collected from Lynwood Aquifer monitoring wells (Table 5.5). Total DDT was reportedly detected in the initial groundwater sample collected from Monitoring Well LW-1 in October 1989 at a concentration of 0.046 µg/L. Total DDT has not been detected in groundwater samples collected from Monitoring Well LW-1 during seven subsequent sampling events with detection limits ranging from 0.02 to 0.04 µg/L.

5.6.2 BHC in Groundwater

A plume of BHC groundwater contamination beneath the Montrose Property that is approximately 2,000 feet long and 1,500 feet wide is present in the Upper Bellflower Aquitard (Figure 5.48). Maximum BHC concentrations have historically ranged from approximately 100 to 300 µg/L and are centered in the southeastern corner of the Montrose Site. The BHC plume in the underlying Bellflower Sand is approximately 700 by 100 feet in extent and has detected total BHC concentrations of approximately 1 µg/L or less (Figure 5.49). BHC has been sporadically detected in groundwater samples from the underlying Gage Aquifer, but none was detected in the most recent analyses (Figure 5.50).

The California and Federal MCLs for drinking water established for Lindane, the gamma isomer of total BHC, are both 0.2 µg/L (Table 5.6). The EPA Region IX Preliminary Remediation Goal (PRG) for Lindane is 0.052 µg/L. Federal or California MCLs are not established for total BHC or the three other isomers of total BHC, which include alpha-BHC, beta-BHC, and delta-BHC. The Lindane percentage of the total BHC concentration in groundwater from MW-1, which has the highest detected total BHC concentrations at the Montrose Site, ranges from 39 to 69 percent and averages 50 percent (Appendix G, Table G.1).

Total BHC was detected in 23 percent of groundwater samples collected from Montrose monitoring wells that were analyzed for this compound (Table 5.4). Total BHC has been detected in groundwater samples collected from 13 of the 29 Upper Bellflower Aquitard monitoring wells, 10 of the 34 Bellflower Sand monitoring wells, and 5 of the 21 Gage monitoring wells (Table 5.5). Total BHC has not been detected in groundwater samples collected from Lynwood Aquifer monitoring wells.

Only three of the samples were analyzed for BHC during the 1995 sampling event (MW-01, MW-6, and MW-21). All other sample analyses for BHC are from 1990 and 1991. No samples from the Bellflower Sand, Gage Aquifer, or Lynwood Aquifer were taken in 1995.

5.6.2.1 BHC Upper Bellflower Aquitard

Total BHC was detected in groundwater samples collected from 8 Upper Bellflower Aquitard monitoring wells during the most recent sampling event for each Montrose monitoring well (Table 5.5; Figure 5.48). Concentrations of total BHC detected in these groundwater samples ranged from 0.38 µg/L to 163 µg/L. The highest concentrations of total BHC were detected in groundwater samples collected from Monitoring Well MW-1, located in the southeast corner of the Property southeast of Stauffer's BHC pilot plant, and Off-Property Monitoring Well MW-11, located on Jon Street east of Normandie.

The horizontal extent of total BHC in groundwater in the Upper Bellflower Aquitard covers an area 2,000 feet long and approximately 1,500 feet wide near the southeast corner of the Property (Figure 5.48). The BHC plume is centered on the Montrose Property, with the highest concentrations occurring in the southeastern corner of the property. A second area of total BHC in groundwater occurs in the vicinity of the Armco site, approximately 0.4 mile southeast of the Property.

Historically, total BHC has been detected in groundwater samples collected from 13 of the 29 Upper Bellflower Aquitard monitoring wells at concentrations ranging from 0.08 µg/L to 330 µg/L (Table 5.5). The highest concentrations of total BHC detected in groundwater samples collected from Upper Bellflower Aquitard monitoring wells have been detected in groundwater samples collected from On-Property Monitoring Wells MW-2, MW-3, and

MW-5 (Figure 5.48). Monitoring Well MW-2 is located in the Central Process Area. Monitoring Wells MW-3 and MW-5 are located in the southeast corner and northeast corner of the Property, respectively.

Total BHC has also been detected in groundwater samples collected from nearby Off-Property Monitoring Wells MW-6, MW-11, MW-12, MW-13, MW-15, MW-4, MW-7, MW-10, and MW-25 at concentrations ranging from 0.11 µg/L to 33 µg/L (Table 5.5). The highest concentrations of total BHC detected in groundwater samples collected from these monitoring wells were 33 and 18 µg/L in groundwater samples collected from Monitoring Wells MW-11 and MW-12 located east of the Property on Jon Street east of Normandie Avenue. Total BHC has been detected sporadically in groundwater samples from Monitoring Wells MW-4, MW-7, and MW-10; these monitoring wells are located outside of the interpreted 0.1 µg/L total BHC contour surrounding the main total BHC plume on Figure 5.48. The ratio of total BHC detected values compared to the number of samples for each monitoring well is: MW-4 (2 of 16 samples), MW-7 (1 of 6 samples), and MW-10 (1 of 5 samples).

Total BHC has also been detected in groundwater from 3 monitoring wells located in the vicinity of the Armco Site and the Kenwood Drain (Figure 5.48): Montrose Monitoring Well MW-25 and Armco site Monitoring Wells RB-1 and MW-29 at concentrations of <0.04 µg/L, 1.23 µg/L and 0.294 µg/L, respectively. These three monitoring wells define a small but separate plume of total BHC. Separate small plumes at this location within the Upper Bellflower Aquitard are also present for chlorobenzene (Figure 5.52), and p-CBSA (Figure 5.57). All three chemicals or contaminants of concern from the Montrose Site. The separate small plumes may be due to upward groundwater migration from the underlying Bellflower Sand. Greater detail on this topic is provided in Section 5.6.3.1.

5.6.2.2 BHC: Bellflower Sand

Total BHC was detected in groundwater samples collected from four of the most recent samples for each Bellflower Sand monitoring well (Figure 5.49). The most recent samples are dated 1990 and 1991; none of the Bellflower Sand monitoring wells were sampled during the 1995 sampling. Concentrations of total BHC detected in these groundwater samples ranged from 0.046 µg/L to 1.2 µg/L.

Historically, total BHC has been detected in groundwater samples collected from 10 of the 34 Bellflower Sand monitoring wells at concentrations ranging from 0.01 to 15 µg/L (Table 5.5). The horizontal extent of total BHC in groundwater in the Bellflower Sand is estimated to cover an area approximately 700 feet by 1,000 feet near the southeast corner of the Property (Figure 5.49).

The highest concentrations of total BHC detected in groundwater samples collected from Bellflower Sand Monitoring Wells (15 µg/L) have been detected in groundwater samples collected from Central Process Area Monitoring Well BF-9 (Table 5.5; Figure 5.49). Total BHC has been detected at lower concentrations in groundwater samples collected from On-Property Monitoring Wells BF-02, BF-03, and BF-04, and Off-Property Monitoring Wells BF-6 and BF-7 located southeast of the Property in the LADWP right-of-way east of Normandie Avenue. Maximum concentrations of total BHC detected in groundwater samples collected from these monitoring wells have ranged from 1.2 µg/L to 7.2 µg/L.

Total BHC has also been sporadically detected in groundwater samples collected from three other Bellflower Sand monitoring wells (Table 5.5). These monitoring wells include On-

Property Monitoring Well BF-1, located northwest of the Central Process Area; Monitoring Well BF-8 located south of the Property on Farmer Brothers property; and Monitoring Well BF-15, located approximately 1,400 feet southeast of the Property near the intersection of Kenwood Avenue and Milton Street (Figure 5.49). Concentrations of total BHC detected in these monitoring wells ranged from 0.01 µg/L to 0.21 µg/L.

5.6.2.3 BHC: Gage and Lynwood Aquifers

Total BHC was not detected in any of the most recent groundwater samples collected from each Gage and Lynwood Aquifer monitoring wells (Table 5.5). These samples are all dated 1990 and 1991; no samples were analyzed for BHC during the 1995 sampling event. Historically, total BHC has been sporadically detected in groundwater samples collected from 5 of the 21 Gage Aquifer monitoring wells at maximum concentrations ranging from 0.02 to 0.82 µg/L. Total BHC has not been detected in any groundwater samples collected from Lynwood Aquifer monitoring wells.

Total BHC has been sporadically detected in groundwater samples collected from On-Property Gage Aquifer Monitoring Wells G-1, G-2, G-3, and LG-01 at concentrations ranging from 0.02 to 0.82 µg/L (Table 5.5; Figure 5.50). Total BHC was detected in 1 of 11 samples from Monitoring Well G-1 (0.08 µg/L), 2 of 12 samples from Monitoring Well G-2 (0.24 and 0.82 µg/L), 1 of 5 samples from Monitoring Well G-11 (0.2 µg/L), and 2 of 12 samples from Monitoring Well LG-2 (0.03 and 0.03 µg/L). The highest concentration of total BHC (0.82 µg/L) was detected in a groundwater sample collected from Monitoring Well G-2 located in the southeast corner of the Property.

5.6.3 Chlorobenzene in Groundwater

Chlorobenzene is the most prevalent VOC detected in monitoring wells at the Montrose Site. Chlorobenzene has been detected in approximately 70 percent of groundwater samples collected from Montrose monitoring wells (Table 5.4). Chlorobenzene has been detected in groundwater samples collected from 22 of 30 Upper Bellflower Aquitard monitoring wells, 27 of 34 Bellflower Sand monitoring wells, 18 of 21 Gage Aquifer monitoring wells, and 1 of the 7 Lynwood Aquifer monitoring wells. Concentrations of chlorobenzene detected in groundwater samples collected from these monitoring wells have ranged from 1 µg/L to 660,000 µg/L.

Average concentrations of chlorobenzene detected in groundwater samples collected from 14 Upper Bellflower Aquitard monitoring wells, 20 Bellflower Sand monitoring wells, 14 Gage Aquifer monitoring wells, and Lynwood Monitoring Well LW-01 exceeded the California MCL for drinking water of 70 µg/L established for chlorobenzene (Table 5.6). The Federal MCL for chlorobenzene in drinking water is 100 µg/L.

Chlorobenzene in groundwater at concentrations exceeding the California MCL of 70 µg/L appears to form a contiguous plume of contamination originating at the Montrose Site and extending laterally approximately 1.4 miles in maximum length and 0.9 mile in maximum width (Figure 5.51). The vertical extent of the chlorobenzene plume at concentrations exceeding MCLs appears to extend to a maximum depth of about 250 feet bls beneath the Property and decreases to about 120 feet bls southeast and downgradient of the Property. The highest concentrations of chlorobenzene in each hydrogeologic unit occur in groundwater samples collected at and in the vicinity of the Central Process Area. Extremely high concentrations of chlorobenzene detected in groundwater samples collected from Upper Bellflower Aquitard monitoring wells located at and in the vicinity of the Central Process

Area are associated with the occurrence of DNAPL which accumulates in these monitoring wells.

Chlorobenzene plumes in groundwater at concentrations exceeding the California MCL of 70 µg/L are present in the Upper Bellflower Aquitard, the Bellflower Sand, and the Gage Aquifer (Figure 5.51). The largest lateral extent of the plume occurs within the Upper Bellflower Sand. The estimated dimensions of the plume for the 10 µg/L contour are 7,500 feet in length (1.4 miles) by 4,800 feet in width (0.9 mile). In the Gage Aquifer, the plume of chlorobenzene in groundwater exceeding 10 µg/L is approximately 4,500 feet in length and 2,000 feet in width (Figure 5.54). The extent of chlorobenzene in groundwater exceeding the MCL for drinking water in the Lynwood Aquifer does not appear to extend beyond the Property boundaries. Chlorobenzene has been detected in only one monitoring well (Monitoring Well W-1) within the Lynwood Aquifer. The dimensions of the chlorobenzene plume in the Lynwood Aquifer at concentrations exceeding the MCL for drinking water appears to be approximately 500 feet in length and 250 feet in width (Figure 5.55).

Figure 5.51 is a composite that shows the lateral extent of chlorobenzene in groundwater at concentrations greater than the California MCL for drinking water for each of the hydrogeologic units (Upper Bellflower Aquitard, Bellflower Sand, Gage Aquifer, and the Lynwood Aquifer). Individual plume maps for each hydrogeologic unit are also provided in Figures 5.52 through 5.55. Isoconcentration contours were drawn to illustrate order of magnitude variations in concentrations of chlorobenzene detected in groundwater samples collected from monitoring wells screened in each of the four hydrogeologic units using the most recent analysis for chlorobenzene for each monitoring well (Table 5.5). Data from the 1995 sampling event are available for 22 of 33 Upper Bellflower Aquitard monitoring wells, 18 of 34 Bellflower Sand monitoring wells, 14 of 21 Gage Aquifer monitoring wells, and 2 of 7 Lynwood Aquifer monitoring wells. The data from the monitoring wells not sampled in 1995 is from 1990 and 1991. Data obtained from Montrose monitoring wells have been supplemented with the analytical results for groundwater samples collected from Del Amo monitoring wells in the last quarter of 1995, and from Armco monitoring wells in 1989.

5.6.3.1 Chlorobenzene: Upper Bellflower Aquitard

The highest concentrations of chlorobenzene in groundwater at the Montrose Site occur in the Upper Bellflower Aquitard beneath the Central Process Area where concentrations of chlorobenzene frequently exceed 100,000 µg/L (Figure 5.52). As previously discussed in Section 5.5, the occurrence of extremely high concentrations of chlorobenzene in groundwater in the Upper Bellflower Aquitard is associated with the occurrence of DNAPL in the subsurface.

Chlorobenzene was detected in groundwater samples collected from 21 of the 33 Upper Bellflower Aquitard monitoring wells during the most recent sampling event for Montrose monitoring wells (Table 5.5). With the exception of Monitoring Well MW-2 which was most recently sampled in 1988, sample dates for these wells ranged from April 1990 to December 1995. During December 1995, groundwater samples were also collected from Central Process Area Test Monitoring Well UBT-3.

In the Upper Bellflower Aquitard, chlorobenzene in groundwater forms a contiguous plume of contamination at concentrations greater than 1 µg/L. The plume is centered on the Property and extends approximately 900 feet north, 1,100 feet east, and 1,500 feet south of the Property (Figure 5.52). The greatest lateral extent of chlorobenzene in the Upper

Bellflower Aquitard is to the south and southeast of the Property in the direction of groundwater flow. The total dimensions of the plume are approximately 2,000 feet by 2,500 feet.

The highest concentrations of chlorobenzene were detected in groundwater samples collected from Monitoring Well MW-2 and Test Monitoring Well UBT-3, located in the Central Process Area (Figure 5.52). Concentrations of chlorobenzene detected in groundwater samples collected from Central Process Area monitoring wells where DNAPL is known to occur have ranged from 54,000 µg/L to 660,000 µg/L. Outside of the Central Process Area, chlorobenzene concentrations generally occur at concentrations less than 100,000 µg/L, and concentrations decrease to 1 µg/L at a distance of approximately 2,000 feet downgradient.

Non-contiguous Chlorobenzene Plumes. Detectable concentrations of chlorobenzene in Upper Bellflower Aquitard groundwater occur in three separate areas located outside of the contiguous chlorobenzene plume which is centered on the Property (Figure 5.52). One area is located approximately 1,400 feet northeast of the Property, directly east of the Trico Industries Property. Concentrations of chlorobenzene exceeding the MCL for drinking water were detected in groundwater samples collected from Del Amo Monitoring Well PZL16, located adjacent to this facility.

A second separate area of groundwater in the Upper Bellflower Aquitard where detectable concentrations of chlorobenzene occur is located approximately 2,200 feet southeast of the Property near the Armco Site (Figure 5.52). EPA believes that the occurrence of chlorobenzene in groundwater at and in the vicinity of the Armco Site may be associated with an area of former ponding which occurred along the historical Kenwood Drain in this vicinity. The chlorobenzene detected near Armco may also be due to upward migration from the underlying Bellflower Sand chlorobenzene plume caused by rising water levels. The source of the chlorobenzene plume in the Armco vicinity appears to be from the Montrose Site. This is supported by the fact that separate plumes of BHC, chlorobenzene, and p-CBSA occur at this location within the Bellflower Aquitard. Not only are these the same three groundwater contaminants associated with the Montrose Site, but the use of chlorobenzene, and most certainly p-CBSA cannot be attributed to Armco. All three chemicals occur within contiguous groundwater plumes originating from Montrose within the underlying Bellflower Sand. Although concentrations of chlorobenzene detected in groundwater samples collected from Upper Bellflower Aquitard Monitoring Well MW-25 have previously averaged approximately 900 µg/L, the results of the December 1995 sampling event were only 44 µg/L and 59 µg/L (Table G.2 and Figure G-25). These values are much less than the previous data, and indicate that the 1995 data may be anomalous. Additional sampling is needed to confirm the chlorobenzene concentration at this location.

A third area where detectable concentrations of chlorobenzene occur in Upper Bellflower Aquitard groundwater is located near the intersection of the Torrance Lateral and the Harbor Freeway approximately 3,500 feet east-southeast of the Property (Figure 5.52). Concentrations of chlorobenzene detected in groundwater samples collected from monitoring wells in this vicinity are less than the MCL for drinking water. The source of chlorobenzene to groundwater in this vicinity has not been determined.

Representativeness of Most Recent Groundwater Analyses. Concentrations of chlorobenzene detected in groundwater samples collected from Upper Bellflower Aquitard monitoring wells during the 1995 sampling event were generally within the range of concentrations

previously detected in groundwater samples collected from these monitoring wells with the exception of Monitoring Wells MW-5, MW-6, MW-9, MW-10, MW-11, and MW-25 (Table 5.5). Concentrations of chlorobenzene detected in groundwater samples collected from these six monitoring wells during the most recent monitoring event were significantly less than the range of concentrations previously detected in groundwater samples collected from these monitoring wells. The extent of detectable chlorobenzene contamination shown on Figure 5.52 is generally consistent with past data, but the chlorobenzene concentrations for some monitoring wells are considerably less than historical data. The maximum concentrations of chlorobenzene historically detected in groundwater samples collected from Monitoring Wells MW-5, MW-9, MW-10, and MW-11 were 200,000 µg/L, 180,000 µg/L, 2,200 µg/L, and 34,000 µg/L, respectively (Table 5.5). Concentrations of chlorobenzene detected in groundwater samples collected from these monitoring wells during the most recent monitoring event for each monitoring well were 8.4 µg/L, 8,400 µg/L, 3.7 µg/L, and 780 µg/L, respectively. The substantial reduction in concentrations of chlorobenzene detected in groundwater samples collected from these monitoring wells is not readily explainable based on concentration trends over time, changes in water levels, or distinct changes in observed directions of groundwater flow. Potential explanations for the substantial reduction of chlorobenzene detected in groundwater samples collected from these monitoring wells include rainfall infiltration and percolation of water from leakage or seepage from or along the alignment of the nearby sewer lines paralleling Normandie Avenue resulting in flushing or enhanced biodegradation of chlorobenzene. Monitoring Wells MW-5, MW-10, and MW-11 are located adjacent to Normandie Avenue (Figure 5.52).

Other monitoring wells where substantial reductions in chlorobenzene concentrations were observed include Monitoring Well MW-6, located in the LADWP right-of-way, south of the Property, and Monitoring Well MW-25, located southeast of the Property near the Armco Site (Figure 5.52). The chlorobenzene concentration of 190 µg/L detected during the most recent sampling event for Monitoring Well MW-6 was less than the historical data, which ranged from 5,300 to 16,000 µg/L (Table 5.5). Concentrations of chlorobenzene detected in Monitoring Well MW-25 historically have ranged up to 990 µg/L; however, the most recent chlorobenzene concentration was only 44 µg/L. The reduction in concentrations of chlorobenzene detected in groundwater samples collected from Monitoring Wells MW-6 and MW-25 is not readily explainable based on the available data, but given the fact that these are water table monitoring wells located along the margin of the chlorobenzene plumes the reduction may be attributable to such factors as the rise in water levels, a change in the direction of groundwater flow, or biodegradation.

5.6.3.2 Chlorobenzene: Bellflower Sand

The lateral extent of chlorobenzene in groundwater is much greater within the Bellflower Sand than in the other hydrogeologic units (Figures 5.51 and 5.53). A well-defined plume of detectable chlorobenzene originates at the Central Process Area and extends downgradient for a distance of 6,500 feet. The plume has also migrated upgradient and cross-gradient to the regional groundwater flow. The lateral extent of the plume is approximately 5,000 feet by 7,500 feet. Two of the three monitoring wells located at the downgradient leading edge of the plume contain low levels of chlorobenzene (MW-26 [8 µg/L] and MW-28 [5 µg/L]); therefore, the full downgradient extent of the detectable chlorobenzene plume in the Bellflower Sand is not defined by the existing monitoring wells. The chlorobenzene detection limit at this location is 1 µg/L.

Chlorobenzene was detected in groundwater samples collected from 25 of the 34 Bellflower Sand monitoring wells during the most recent sampling event for Montrose monitoring wells. The highest chlorobenzene concentrations detected in groundwater samples collected were from Bellflower Sand Monitoring Wells BF-4 (23,000 µg/L), BF-6 (27,000 µg/L), BF-7 (45,000 µg/L), and BF-15 (36,000 µg/L). Bellflower Sand Monitoring Well BF-4 is located On-Property, southeast of the Central Process Area, and Monitoring Wells BF-6, BF-7, and BF-15 are located southeast of the Property.

The axis of the chlorobenzene plume in the Bellflower Sand extends southeastward from the Property toward Monitoring Wells BF-25, BF-26, BF-27, and BF-28, located approximately 1 mile southeast of the Property. The higher concentration "core" of the chlorobenzene plume in the Bellflower Sand is characterized by a comparatively narrow elongated expanse of chlorobenzene which occurs at fairly uniform concentrations exceeding 10,000 µg/L and extends from the vicinity of the Central Process Area, southeastward toward the Armco Site. Chlorobenzene in groundwater west of the axis and core of the chlorobenzene plume is distributed at lower concentrations over a broad area extending to just east of Western Avenue. In the area of the chlorobenzene plume east and south of the core, the concentration gradient is steeper, concentrations of chlorobenzene decrease more rapidly with distance, and concentrations attenuate to levels less than the MCL for drinking water within about 600 feet in the cross-gradient direction and within about 1,500 feet in the downgradient direction.

Water quality data from individual monitoring wells at various concentration ranges within the plume and at the margins of the plume indicate that concentrations of chlorobenzene throughout the Bellflower Sand plume have also remained fairly stable over the past 5 years (Appendix G). Graphs of chlorobenzene versus time for Bellflower Sand monitoring wells are shown on Figures G-31 through G-63.

5.6.3.3 Chlorobenzene: Gage Aquifer

A plume of chlorobenzene within the Gage Aquifer extends from sources in the Central Process Area to the southeast in the direction of groundwater flow for a distance of approximately 4,000 feet (Figure 5.54). The lateral extent of the plume is approximately 2,000 feet by 5,000 feet.

Chlorobenzene was detected in groundwater samples collected from 16 of the 21 Gage Aquifer monitoring wells during the most recent sampling event for Montrose monitoring wells (Table 5.5). Concentrations of chlorobenzene detected in these samples ranged from 4 µg/L to 14,000 µg/L. The highest concentration of chlorobenzene was detected in the groundwater samples collected from Monitoring Well G-5, located east of the Property. Chlorobenzene has been historically detected in 18 of 21 Gage Aquifer monitoring wells.

The chlorobenzene plume in the Gage Aquifer is approximately 70 percent the length of the overlying Bellflower Sand chlorobenzene plume and less than half the width (Figures 5.53 and 5.54). The axis of the chlorobenzene plume in the Gage Aquifer is oriented more to the east as compared to the axis of the overlying Bellflower Sand plume. The difference in orientation of the chlorobenzene plume in the Bellflower Sand and Gage Aquifer is consistent with the observed difference in the directions of groundwater flow observed in these units.

The core of the chlorobenzene plume in the Gage Aquifer is characterized by a relatively broader central area of contamination extending southeast from the Property where

concentrations of chlorobenzene uniformly exceed 1,000 µg/L. Outside of this area of higher concentrations, concentrations of chlorobenzene diminish rapidly with distance and are detected at concentrations less the MCLs for drinking water within about 300 feet laterally in all directions.

A second area of chlorobenzene contamination that may be separate from the principal Gage Aquifer plume, occurs to the southeast of the Property in the vicinity of Monitoring Well G-19 and south of the axis of the main plume (Figure 5.54). Concentrations of chlorobenzene detected in groundwater samples collected from this monitoring well have increased steadily from a minimum concentration of less than 1 µg/L to a maximum concentration of 2,600 µg/L detected in the most recent sampling event (Appendix G, Table G.2). The concentrations of chlorobenzene detected in groundwater samples collected from Monitoring Well G-19 are on the same order as concentrations of chlorobenzene which occur at this location in the overlying Bellflower Sand based on estimated chlorobenzene plume concentration contours for the Bellflower Sand (Figure 5.53).

It has been postulated that the chlorobenzene detected in groundwater from Monitoring Well G-19 may have resulted from local vertical migration of chlorobenzene from the Bellflower Sand to the Gage Aquifer rather than lateral migration from the larger Gage plume. This interpretation is supported by the fact that Monitoring Well G-19 is not located directly hydraulically downgradient from the zone of similar concentration within the larger Gage plume (Figure 5.54). The vertical migration could occur: (1) within an area in which the aquitard between the Bellflower Sand and Gage Aquifer is thin, (2) from vertical leakage around the monitoring well seal for Monitoring Well G-19, or (3) from another monitoring well in the vicinity that acts as a conduit of downward migration of contaminated groundwater.

The lithologic log for Monitoring Well G-19 indicates that the aquitard between the Bellflower Sand and the Gage Aquifer in this area is only a few feet thick and consists of interbedded silty sand and sandy silt with slight plasticity. In addition, very similar water levels have been observed for Monitoring Wells G-19 and BF-24. During the period 1991 to 1995, the vertical hydraulic gradient between the overlying Bellflower Sand and the underlying Gage Aquifer has been neutral or slightly upwards. This is in contrast to the downwards hydraulic gradient between the Bellflower Sand and the Gage Aquifer that is observed at most of the monitoring well cluster locations (Figures 4-22A through 4-22I). The absence of a significant gradient at the location of G-19 and BF-24 may indicate hydraulic communication between the two units. This hydraulic communication may have resulted in downwards migration of chlorobenzene contamination from the Bellflower Sand to the Gage Aquifer near the location of Monitoring Well G-19.

Water quality data from individual monitoring wells at various concentration ranges within the plume and at the margins of the plume indicate that with the exception of Monitoring Well G-19, concentrations of chlorobenzene throughout the plume have remained fairly stable over the past 5 years (Appendix G). Concentrations of chlorobenzene in groundwater from Monitoring Well G-19 increased from <1 µg/L in 1991 to 2,600 µg/L in 1995 (Figure G-19); the increase in chlorobenzene at this location may be additional support of the interpretation that vertical migration of chlorobenzene from the Bellflower Sand to the Gage Aquifer occurs at this location. The very rapid increase in chlorobenzene concentrations in groundwater from Monitoring Well G-19 and that fact that the first chlorobenzene analysis for this monitoring well was less than the detection limit, supports the interpretation that leakage around the monitoring well seal may potentially be

occurring. The fact that the chlorobenzene concentrations in Monitoring Well G-09, which is downgradient of the main portion of the Gage Aquifer chlorobenzene plume, have remained below the detection limit indicates that migration of the Gage plume is not rapid. Therefore, downgradient migration of the Gage Aquifer chlorobenzene plume does not appear likely to be responsible for the rapid chlorobenzene concentration increases observed in Monitoring Well G-19. However, the downgradient migration of the chlorobenzene plume within the Gage Aquifer may have partially contributed to the increase in chlorobenzene in groundwater from Monitoring Well G-19.

5.6.3.4 Chlorobenzene: Lynwood Aquifer

During the 1995 sampling event, chlorobenzene was detected at 530 µg/L in groundwater from Monitoring Well LW-1, one of the seven Lynwood Aquifer monitoring wells that is located On-Property in the Central Process Area. Concentrations of chlorobenzene detected in groundwater samples collected from Monitoring Well LW-1 have increased steadily from below the detection limit of 1 µg/L in November 1989 to 530 µg/L in 1995 (Appendix G, Figure G-85). The specific cause of the rapid increase in chlorobenzene concentrations is unknown, but could be due to either vertical migration of chlorobenzene from the chlorobenzene plume in the overlying Gage Aquifer or leakage along the monitoring well seal or casing.

The Lynwood Aquifer monitoring wells are sufficient to estimate the lateral extent of the contamination in the Lynwood Aquifer. The lateral extent of the chlorobenzene plume within the Lynwood Aquifer appears to be approximately 500 feet in width by 1,000 feet in length.

5.6.4 p-CBSA in Groundwater

p-CBSA is a byproduct of the manufacture of DDT and is not known to be associated with any other industrial operations other than DDT manufacture. As such, it provides a reliable indicator of Montrose-derived groundwater contamination. The available data indicate that p-CBSA in groundwater originated from sources of p-CBSA in the Central Process Area. Plumes of p-CBSA groundwater contamination are present in the Upper Bellflower Aquitard, the Bellflower Sand, the Gage Aquifer, and the Lynwood Aquifer. The geometric shape and dimensions of the p-CBSA plumes is generally similar to that of chlorobenzene in the Upper Bellflower Aquitard (approximately 2,000 feet by 2,800 feet), Gage Aquifer (approximately 2,100 feet by 4,000 feet), and Lynwood Aquifer; however, the width (approximately 6,000 feet) and length (greater than 7,000 feet) and of the p-CBSA plume in the Bellflower Sand is greater than that of the chlorobenzene plume (approximately 5,000 feet in width by 7,000 feet in length). The p-CBSA concentrations within these plumes are much higher than that of chlorobenzene. p-CBSA has been detected up to 11,000 mg/L (11,000,000 µg/L) in groundwater from Upper Bellflower Aquitard Extraction Monitoring Well UBE-01 in the Central Process Area; this monitoring well samples an area of known DNAPL occurrence. There are no current or proposed MCLs or action levels promulgated by any state or federal regulatory agency that have been established for this compound in the environment. The state of California has proposed a provisional No Observed Adverse Effect Level (NOAEL) of 1 mg/kg/day which corresponds to a drinking water standard of approximately 25,000 ug/L; however, this value is not promulgated.

For illustrative purposes only, the extent of p-CBSA contamination in groundwater is discussed in this section using concentration contours of 0.1 mg/L to 1 mg/L. Figure 5.56

shows the extent of p-CBSA at concentrations greater than 0.1 mg/L (100 µg/L) in all four hydrogeologic units. The occurrence and extent of p-CBSA at concentrations greater than 0.1 mg/L have been approximately defined by the existing monitoring wells in the Upper Bellflower Aquitard (Figure 5.57), the Gage Aquifer (5.59), and the Lynwood Aquifer (Figure 5.60); however, the full lateral extent of p-CBSA in the Bellflower Sand has not been determined (Figure 5.58).

The p-CBSA plume in the Bellflower Sand extends over a broad area located southwest of the Property. The full extent of detectable p-CBSA to the southwest of the Montrose Site in the Upper Bellflower Sand is unknown, because p-CBSA was detected at 1,200 µg/L in groundwater from the most southwesterly well, Monitoring Well BF-33. p-CBSA in groundwater at concentrations of 1 mg/L extends at least 4,000 feet to the southwest of the Montrose Site and occurs west of Western Avenue.

The observed difference in the occurrence and distribution of p-CBSA in the Bellflower Sand in this vicinity of the Montrose Site as compared to chlorobenzene may be related to differences in fate and transport characteristics of these two compounds, and changes in hydrogeologic conditions which occur southwest of the Property. As subsequently discussed in Section 6.2.3.1, p-CBSA is more mobile in groundwater than chlorobenzene and pesticides due to p-CBSA's high solubility, low volatility, and low adsorption. As previously discussed in Section 4, hydrogeologic conditions in the area of the Montrose Site southwest of the Property are different than elsewhere at the Montrose Site because the Upper Bellflower Aquitard in this area is unsaturated and the water table occurs in the Bellflower Sand.

Groundwater samples have been analyzed for p-CBSA much less frequently than for the VOCs and pesticides. As summarized in Table 5.5, 72 of the 95 Upper Bellflower Aquitard monitoring wells have been sampled and analyzed for p-CBSA. Between one and four p-CBSA analyses are available for these monitoring wells. Forty-eight of the monitoring wells were sampled for p-CBSA during the 1995 sampling event. The analytical results for groundwater samples collected from Montrose monitoring wells has been supplemented with groundwater data obtained by others during unrelated investigations conducted at the adjacent Del Amo Site located east of the Property and the nearby Armco site located southeast of the Property.

5.6.4.1 p-CBSA: Upper Bellflower Aquitard

Groundwater samples collected from 20 of the 33 Montrose Upper Bellflower Aquitard monitoring wells have been analyzed for p-CBSA (Table 5.5). p-CBSA has been detected in groundwater samples collected from 10 of these monitoring wells at concentrations ranging from 0.096 mg/L to 11,000 mg/L (96 µg/L to 11,000,000 µg/L) (Table 5.5; Figure 5.57). The highest concentrations of p-CBSA were detected in groundwater samples collected from Upper Bellflower Aquitard Monitoring Wells MW-2 and UBE-1 located in the Central Process Area. The maximum width and length of the p-CBSA plume in groundwater at concentrations above 0.1 mg/L in the Upper Bellflower Aquitard is approximately 2,000 feet by 2,800 feet, respectively. The extent of p-CBSA at concentrations greater than 1 mg/L is very similar to that for chlorobenzene at concentrations exceeding the MCL for chlorobenzene in drinking water (70 µg/L).

p-CBSA concentrations greater than 0.1 mg/L occur in a contiguous plume centered on the Property and in a separate smaller area located to the southeast of the Property in the vicinity of the Armco Site, as was observed for chlorobenzene and total BHC. As

previously discussed in Section 5.6.3.1, EPA believes that the presence of the separate p-CBSA plume may be due to migration of p-CBSA contaminated surface water from the Kenwood Drain or upward migration from the underlying Bellflower Sand plume.

5.6.4.2 p-CBSA: Bellflower Sand

Groundwater samples collected from 30 of 34 Bellflower Sand monitoring wells constructed by Montrose have been analyzed for p-CBSA. As summarized in Table 5.5, p-CBSA has been detected in groundwater samples collected from 26 of these monitoring wells at concentrations ranging from 0.180 mg/L to 120 mg/L (180 µg/L to 120,000 µg/L). The highest concentrations of p-CBSA occur in groundwater samples collected from monitoring wells located at and in the vicinity of the Central Process Area and within the high-concentration core of the plume extending southeast of the Property in the direction of groundwater flow where p-CBSA occurs at concentrations greater than 10 mg/L (Figure 5.58). The maximum width and length of the p-CBSA plume in groundwater at concentrations above 0.1 mg/L in the Bellflower Sand is at least 6,000 feet and at least 7,000 feet, respectively.

The primary axis of the p-CBSA plume in the Bellflower Sand extends toward the southeast, downgradient of the Property, in the direction of groundwater flow (Figure 5.58). The highest concentrations of p-CBSA in groundwater occur within the 10 mg/L isoconcentration contour along the axis of the plume in the vicinity of Monitoring Well BF-15, which is located approximately 1,500 feet southeast of the Property just east of the Kenwood Drain. The concentration of p-CBSA in the 1995 groundwater sample collected from Monitoring Well BF-15 was 110 mg/L (110,000 µg/L) (Table 5.5). This indicates that the zone of highest p-CBSA groundwater contamination has migrated approximately 2,500 feet downgradient from its original source at the Central Process Area.

Concentrations of p-CBSA detected in On-Property Bellflower Sand Monitoring Wells BF-9 and BF-4 were on the order of 40 mg/L (40,000 µg/L). Southeast of the Property, near the intersection of Normandie Avenue and the LADWP right-of-way, concentrations of p-CBSA detected in groundwater samples collected from Monitoring Wells BF-7 and BF-8 were less than 10 mg/L (10,000 µg/L). Downgradient of Monitoring Well BF-15, concentrations of p-CBSA in groundwater decreased from 88 mg/L (88,000 µg/L) detected in a groundwater sample collected from Monitoring Well BF-24, to 8 mg/L (8,000 µg/L) and 0.890 mg/L (890 µg/L) detected in groundwater samples collected from Monitoring Wells BF-25 and BF-26. Monitoring Wells BF-25 and BF-26 are located within approximately 4,000 feet southeast of Monitoring Well BF-15.

The lateral extent of p-CBSA contamination to the southwest of the Montrose Site has been characterized sufficiently to define the 1 mg/L contour, but the full extent of detectable p-CBSA to the southwest has not been determined. Concentrations of p-CBSA in groundwater samples collected from Bellflower Sand monitoring wells located southwest of the Property range from less than the detection limit of 0.1 mg/L (100 µg/L) to 7.1 mg/L (7,100 µg/L) and 7.2 mg/L (7,200 µg/L) in groundwater samples collected from Monitoring Wells BF-32 and BF-31, respectively (Figure 5.58). Prior to its destruction in 1994, Monitoring Well BF-32 was located approximately 2,000 feet southwest of the Property on 205th Street near Western Avenue. Monitoring Well BF-31 is located on Denker Avenue, approximately 3,200 feet south of the Property.

5.6.4.3 p-CBSA: Gage Aquifer

A plume of p-CBSA groundwater contamination in the Gage Aquifer originates at the Montrose Site and extends downgradient. The maximum width and length of the p-CBSA plume in groundwater at concentrations above 0.1 mg/L in the Gage Aquifer are approximately 2,100 feet and 4,500 feet, respectively (Figure 5.59). The lateral extent of p-CBSA in Gage Aquifer groundwater at concentrations exceeding 1 mg/L has been generally defined in all directions. The geometric shape and dimensions of the p-CBSA plume within the Gage Aquifer at concentrations greater than 1 mg/L is similar to the chlorobenzene plume in the Gage Aquifer at concentrations exceeding the MCL for chlorobenzene (70 µg/L) in drinking water (Figures 5.51 and 5.56).

Groundwater samples collected from 18 of the 21 Gage Aquifer monitoring wells constructed by Montrose have been analyzed for p-CBSA (Table 5.5). Concentrations of p-CBSA detected in groundwater samples collected from 15 of these monitoring wells ranged from 0.17 mg/L to 27 mg/L (170 µg/L to 27,000 µg/L). p-CBSA has also been detected in groundwater samples collected from Del Amo's Gage Aquifer Monitoring Well SWL-34 located approximately 1,400 feet southeast of the Property near the intersection of 204th Street and Budlong Avenue (Figure 5.59). The concentration of p-CBSA detected in the groundwater sample collected from this monitoring well during the last quarter of 1995 was 38 mg/L (38,000 µg/L). p-CBSA was not detected in groundwater samples collected from Montrose's Gage Aquifer Monitoring Wells G-14, G-16, and G-18 nor from the seven other Del Amo Gage Aquifer monitoring wells.

The length of the p-CBSA plume in the Gage Aquifer is approximately 2/3 that of the p-CBSA plume in the overlying Bellflower Sand (approximately 4,500 feet versus 7,000 feet), and the width of the Gage Aquifer plume is approximately one third (approximately 2,000 feet versus greater than 6,000 feet) the width of the Bellflower Sand plume (Figures 5.58 and 5.59). Similar to chlorobenzene, the axis of the p-CBSA plume in the Gage Aquifer is oriented more to the east as compared to the axis of the overlying Bellflower Sand plume. The difference in orientation of the contaminant plumes in the Bellflower Sand and Gage Aquifer is consistent with the difference in the directions of groundwater flow observed in these units.

The core of the p-CBSA plume in the Gage Aquifer is characterized by a relatively broad central area of p-CBSA exceeding 20 mg/L that extends southeast from the Property (Figure 5.59). Outside of this area of higher concentrations, concentrations of p-CBSA diminish to less than 0.1 mg/L within a lateral distance of approximately 700 feet.

A second area of p-CBSA contamination that may potentially be separated from the main Gage Aquifer plume occurs to the southeast of the Property in the vicinity of Monitoring Well G-19 (Figure 5.59). Monitoring Well G-19 is not directly downgradient from the high-concentration core of the p-CBSA plume within the Gage Aquifer, therefore p-CBSA may be entering the vicinity of the monitoring well by a mechanism other than the migration of the main p-CBSA plume. The concentration of p-CBSA detected in a groundwater sample collected from this monitoring well was 24 mg/L (24,000 µg/L). As described for the occurrence of chlorobenzene (Section 5.6.3.3), the occurrence of p-CBSA in groundwater from Monitoring Well G-19 may be due to local vertical leakance from the Bellflower Sand in an area where the intervening aquitard is thin and composed of interbedded fine- and coarse-grained sediments or vertical migration within Monitoring Well G-19 or another unknown monitoring well in the vicinity that acts as a vertical conduit to groundwater migration.

5.6.4.4 p-CBSA: Lynwood Aquifer

p-CBSA has been detected in groundwater samples collected from two of the seven Lynwood Aquifer monitoring wells at concentrations ranging from 0.27 mg/L to 2.1 mg/L (270 µg/L to 2,100 µg/L) (Table 5.5; Figure 5.60). The highest concentration of p-CBSA detected in these monitoring wells was in a groundwater sample collected from Monitoring Well LW-1. The maximum width and length of the p-CBSA plume in groundwater at concentrations above 0.1 mg/L in the Lynwood Aquifer are approximately 400 feet and at least 1,000 feet, respectively. The extent of the p-CBSA plume in the Lynwood Aquifer is not monitoring well defined; however, the occurrence of p-CBSA in the Lynwood Aquifer appears to be limited to the immediate vicinity of the Property.

5.6.5 Chloroform in Groundwater

Chloroform has been historically detected in 25 percent of groundwater samples collected from monitoring wells constructed by Montrose at the Montrose Site (Table 5.4). Chloroform has been detected in 22 of the 30 Upper Bellflower Aquitard monitoring wells, 7 of the 34 Bellflower Sand monitoring wells, 4 of the 21 Gage Aquifer monitoring wells, and 2 of the Lynwood Aquifer monitoring wells (Table 5.5). Chloroform has also been detected in Del Amo Site monitoring wells located northeast of the Property, and Armco Site monitoring wells located southeast of the Property.

In the Upper Bellflower Aquitard, a chloroform plume is centered beneath the Montrose Site with a lateral extent of approximately 2,500 feet by 2,000 feet and concentrations ranging from 9 µg/L to 85,000 µg/L. In addition, separate areas of chloroform contamination are present to the northeast and southeast of the Montrose Site. Although chlorobenzene is detected in the Bellflower Sand and Gage Aquifer, it occurs in too few monitoring wells to contour as a plume. Chloroform may exist in groundwater from other monitoring wells at concentrations below the elevated detection limits.

A chemical specific MCL drinking water standard for chloroform does not exist, however, the EPA MCL for total trihalomethanes is 100 µg/L. The MCL applies to the combined total concentrations of bromodichloromethane, dibromochloromethane, bromoform, and chloroform. The EPA Preliminary Remediation Goal (PRG) for tap water is 0.16 µg/L for chloroform.

5.6.5.1 Chloroform: Upper Bellflower Aquitard

The current distribution of chloroform in the Upper Bellflower Aquitard forms a contiguous plume centered on the Property (Figure 5.61). The chloroform plume at concentrations exceeding 1 µg/L is approximately 2,500 feet wide and at least 2,000 feet long. Maximum concentrations occur beneath the Central Process Area at concentrations up to 35,000 µg/L in Monitoring Well UBT-03. The extent of chloroform upgradient of the Montrose Property is unclear, because chloroform is detected in some monitoring wells located on the McDonnell Douglas Corporation property directly north of Montrose.

Chloroform also occurs in two other areas that appear to be separate from the chloroform detected in groundwater in the vicinity of the Property (Figure 5.61). One area occurs over a broad expanse northeast of the Property at and in the vicinity of the Del Amo Site. In this area, chloroform was detected at concentrations of 82 µg/L in Del Amo Monitoring Well SWL-45, located 3,500 feet northeast of the Property near 190th Street, and 69 µg/L at

Monitoring Well OW-6, located at the Amoco Chemicals Site, east of Normandie Avenue, approximately 1,500 feet northeast of the Property.

A second area where chloroform occurs in groundwater is located southeast of the Property in the vicinity of the Armco Site (Figure 5.61). Concentrations of chloroform detected in groundwater samples collected from Monitoring Well MW-25 have ranged from 14 µg/L to 510 µg/L (Table 5.5).

Chloroform was detected in groundwater samples collected from 16 of the 30 Upper Bellflower Aquitard monitoring wells and 3 Upper Bellflower Aquitard test monitoring wells during the most recent sampling event for Montrose monitoring wells (Table 5.5; Figure 5.61). Chloroform concentrations in groundwater samples collected from these monitoring wells ranged from 2.5 µg/L in Monitoring Well MW-10 located northeast of the Property to 35,000 µg/L in a groundwater sample collected from Test Monitoring Well UBT-03, located in the Central Process Area. Chloroform was not detected in 13 of the 30 Upper Bellflower Aquitard monitoring wells during the most recent sampling event for Montrose monitoring wells above laboratory detection limits ranging from 0.5 µg/L to 10,000 µg/L. The detection limit for three of the monitoring wells was 200 µg/L or greater.

The chloroform plume map for the Upper Bellflower Aquitard is based on the most recent sampling results for each monitoring well and is different than the distribution of chloroform that occurred prior to 1995. During previous sampling events, the highest concentration of chloroform was detected in a groundwater sample collected from Monitoring Well MW-9, located on the McDonnell Douglas Property, upgradient of the Montrose Property. The concentration of chloroform detected in the groundwater sample collected from Monitoring Well MW-9 during the most recent sampling event was 640 µg/L. During the most recent sampling event for Montrose monitoring wells, the highest concentrations of chloroform were detected in groundwater samples collected from monitoring wells located in the Central Process Area where concentrations of chloroform exceeded 10,000 µg/L (Figure 5.61).

The most recent chloroform concentrations detected in groundwater samples collected from Upper Bellflower Aquitard monitoring wells were generally less than the range of concentrations of chloroform previously detected (Table 5.5).

Concentrations of chloroform detected in groundwater samples collected during the 1995 sampling event from 12 Upper Bellflower Aquitard monitoring wells were significantly less than the historical range of concentrations. These monitoring wells include Monitoring Wells MW-3, MW-4, MW-5, MW-6, MW-9, MW-10, MW-11, MW-12, MW-13, MW-19, MW-25, and MW-27. The reason for the decrease of chloroform concentrations during the 1995 groundwater sampling is unknown, but may be due to infiltration of rainfall during the late 1995 winter rainy season and subsequent dilution of VOCs in groundwater at the water table.

5.6.5.2 Chloroform: Bellflower Sand

Chloroform was detected in groundwater samples collected from only 2 of the 34 Bellflower Sand Monitoring Wells (BF-9 and BF-24) during the most recent sampling event for each monitoring well (Table 5.5; Figure 5.62). Therefore, a plume extent has not been drawn on Figure 5.62. In the fourth quarter of 1995, chloroform was detected in groundwater samples collected from Monitoring Wells BF-9 and BF-24 at concentrations of 2.2 µg/L and 2 µg/L, respectively. BF-9 is located beneath the Central Processing Area and BF-24 is located

approximately 3,500 feet downgradient adjacent to the Armco Site. Chloroform has been detected in eight of nine groundwater samples collected from Monitoring Well BF-9 in concentrations ranging from 2.2 µg/L to 710 µg/L.

The usual detection limit of 1 µg/L for chloroform is greatly elevated (up to 300 µg/L) for many of the Bellflower Sand monitoring wells due to the sample dilutions required to reduce matrix interferences during the VOC analysis (Table 5.5). Twelve monitoring wells had detection limits of 25 µg/L or greater. Therefore, chloroform may be present in groundwater at concentrations below the elevated detection limits, and a chloroform plume extending downgradient from the Montrose Site may be present.

Chloroform has been sporadically detected in groundwater samples collected from 6 of the 34 Bellflower Sand monitoring wells (Table 5.5). Chloroform has been infrequently detected in groundwater samples collected from On-Property Monitoring Wells BF-1 (1 detection in 12 analyses [1:12]) and BF-2 (1:13), and from Off-Property monitoring wells BF-13 (2:19), BF-19 (1:3), BF-24 (1:3), and BF-26 (1:5) at maximum concentrations ranging from 1 µg/L to 110 µg/L. The highest concentration of chloroform detected in these monitoring wells occurred in a groundwater sample collected from Monitoring Well BF-9 located on Del Amo Boulevard, east of the Del Amo Waste Pit Area (Figure 5.62).

5.6.5.3 Chloroform: Gage Aquifer

Chloroform was detected in a groundwater sample collected from 1 of the 21 Gage Aquifer monitoring wells (G-19) during the most recent sampling event for each monitoring well (Table 5.5). Chloroform was detected in the groundwater sample collected from Monitoring Well G-19 at a concentration of 4.2 µg/L in November 1995. Monitoring Well G-19 is located southeast of the Property in the vicinity of the Armco Site. The laboratory detection limits for the most recent analyses ranged from 0.5 µg/L to 50 µg/L. Five monitoring wells had elevated detection limits of 10 µg/L or greater (G-02, G-03, G-05, G-06, G-13) due to dilutions required for the VOC analyses. These are the same monitoring wells that contain the highest chlorobenzene concentrations; therefore, chloroform may be present but undetected in other monitoring wells.

Historically, chloroform has been sporadically detected in groundwater samples collected from 4 of the 21 Gage Aquifer monitoring wells at maximum concentrations ranging from 4.2 µg/L to 120 µg/L (Table 5.5). The highest concentration of chloroform was detected in a groundwater sample collected from Monitoring Well G-5, located in the LADWP right-of-way, east of Normandie Avenue, approximately 400 feet east of the Property.

5.6.5.4 Chloroform: Lynwood Aquifer

Chloroform has been detected in groundwater samples collected from Lynwood Aquifer Monitoring Wells LW-5 and LW-7 at concentrations less than 2 µg/L (Table 5.5). Chloroform was not detected in five of the seven Lynwood monitoring wells during the most recent sampling event for Montrose monitoring wells above a laboratory detection limit of 1 µg/L.

5.6.5.5 Potential Sources of Chloroform

The source of chloroform in groundwater at the Montrose Site is not entirely clear. Available records do not list chloroform as a chemical that was used, handled, stored, or disposed of at the Property by either Montrose or Stauffer. Nonetheless, it is possible,

although not proven, that chloroform was released to the subsurface at the Montrose Site from the following potential sources:

- Spills during railroad car off-loading operations
- Leaks from the aboveground chlorobenzene-chloral mix storage tanks
- Discharge of acid process waters to the waste water recycling pond
- Potential chloroform generation during the caustic neutralization step of the DDT liquor
- Potential chloroform generation from reaction of unreacted chloral with base in the wastewater settling pond
- The adjacent Jones Chemical facility, which largely packages bleach and other chemicals

Chloroform, in concentrations of 0.1 to 0.2 percent by weight, was an impurity in the chloral-chlorobenzene mix brought to the Montrose facility in Torrance from the Henderson, Nevada facility (Kennedy/Jenks/Chilton, 1991). Therefore, any spills occurring during railroad car offloading or leaks from the storage tanks or piping at the Central Process Area would result in a release of chloroform to the subsurface. In addition, it is possible that a rail tank car carrying chloroform may have spilled on the rail spur north of the Montrose site; although, there are no records nor other soil sampling evidence of such a spill.

Acid process waters and runoff from the Central Process Area were discharged to the wastewater recycle pond at the Central Process Area. Unreacted chloral/chlorobenzene of which chloroform was a minor component may have been present in the acid process waters. The pond was unlined until 1970, thus infiltration to groundwater could easily occur. The likelihood of this occurring is supported by the large quantities of subsurface DNAPL (chlorobenzene and DDT) that originated primarily from infiltration from the wastewater pond. This pond also served as a backup holding area into which process waste from the two tanks overflowed in the event of an emergency.

If the DDT formulation process were operating correctly, unreacted chloral (trichloroacetaldehyde) would be incrementally removed during acid separation, DDT caking, and cake melting. However, any remaining chloral in the DDT manufacturing liquor could react with NaOH to form chloroform. In the presence of NaOH, chloral decomposes to chloral hydrate and then to chloroform and formate (Tuchel et al, 1961; Budavari, 1989) by the process of base hydrolysis. The DDT formulation process is described in more detail in Section 1.3.6.

Similarly, any unreacted chloral in the waste that was transported to the wastewater pond as dissolved or entrained impurities could react with base in the wastewater pond. Acid and caustic waste streams, emergency overflow, failed batches, and Central Process Area runoff were reportedly directed to the wastewater ponds. Chloral could have been exposed to base, thus generating chloroform.

The release of chloroform from the Montrose facility by these proposed mechanisms is supported by the fact that the distribution of the highest concentrations of chloroform in the Upper Bellflower Aquitard (Figure 5.61) is very similar to the highest concentrations of chlorobenzene in the Upper Bellflower Aquitard (Figure 5.52). The chloroform distribution extends into the McDonnel Douglas property, but the area north of Montrose appears to

have been a parking lot and far from McDonnel Douglas production areas. The distribution of chlorobenzene in groundwater in the Upper Bellflower Aquitard demonstrates essentially radial flow of chlorobenzene-contaminated groundwater from the Central Processing Area. This would account for chlorobenzene concentrations upgradient of the Central Processing Area. It is also possible that a rail tank car carrying chloroform may have spilled on the rail spur north of Montrose, although there are no records nor other soil sampling evidence of such a spill. Jones Chemical, which largely packages bleach and other chemicals, may be a source of chloroform as well. Other potential sources of chloroform in groundwater including the Del Amo Site, Trico Industries, and the Armco Site are suggested by the distribution of chloroform in groundwater within the Upper Bellflower Aquitard (Figure 5.61).

5.6.6 Benzene in Groundwater

Benzene was detected in groundwater samples collected from monitoring wells throughout the area surrounding the Montrose Site (Table 5.5; Figure 5.63). Benzene has been detected in groundwater samples collected from 23 of 30 Upper Bellflower Aquitard monitoring wells, 10 of 34 Bellflower Sand monitoring wells, 10 of 21 Gage Aquifer monitoring wells, and 1 Lynwood Aquifer monitoring well. Maximum concentrations of benzene detected in these wells have ranged from 0.99 µg/L to 1,800,000 µg/L.

Benzene in the Upper Bellflower Aquitard at concentrations exceeding the MCL of 1 µg/L extends over an area approximately 6,000 feet by 5,000 feet. Benzene in groundwater at concentrations exceeding MCLs also occurs in an apparently separate smaller area upgradient of the Property on the McDonnell Douglas property, and in a third area southeast of the Property near the Armco site.

5.6.6.1 Sources of Benzene

Examination of the benzene distribution within the Upper Bellflower Aquitard in the general area of Montrose is consistent with the conclusion that non-Montrose sources of benzene are major contributors to the wider benzene plume in the area (Figure 5.64). The possible non-Montrose sources of benzene include:

- Fuel transmission pipelines in the LADWP right-of-way
- Underground fuel storage tanks at Jones Chemical Company
- The Del Amo Site
- The McDonnell Douglas facility north of the property
- Other area hazardous waste sites

At the same time, the data are consistent with other potential sources of benzene from the Montrose Site itself:

- The 0.3 percent benzene which occurred as an impurity in Montrose chlorobenzene feedstock
- The benzene which was used for BHC production at the Stauffer BHC plant on the Montrose Property
- The gasoline storage tank located south of the machine shop

The benzene distribution in the Upper Bellflower Aquitard and Bellflower Sand indicate many "hot spots" where concentrations are so high (in excess of 100,000 µg/L) that the presence of non-aqueous phase liquid (NAPL) benzene is indicated. The greatest concentration of such sources are to the east of Montrose at the former Del Amo rubber plant, which is a known source of benzene NAPL to the subsurface. The Del Amo Site is also currently under investigation by EPA. Del Amo Site benzene sources are clearly distinct from the Montrose chlorobenzene plume. However, the Del Amo Site benzene is commingled, to the south and southeast of the Montrose Property, with both the Montrose chlorobenzene and several other possible benzene NAPL sources along the southern border of the Montrose facility (Figure 5.63) in the LADWP right-of-way. These benzene NAPL sources could potentially be due to the buried fuel product transmission lines in the LADWP right-of-way (which serve the local petroleum refineries by carrying petroleum products, including benzene, from the ocean ports to those facilities), and/or due to the Jones Chemical facility. It is unclear whether NAPL from the former Stauffer BHC plant may be present and contributing to these extremely high-concentration zones.

As a backdrop to these "hot spot" areas, there is a wider distribution of benzene in groundwater within the Bellflower Sand at lower concentrations in the Central Process Area of the Montrose plant and also downgradient of the Montrose Property within the Bellflower Sand and the Gage Aquifer. These concentrations do not necessarily imply the presence of NAPL, but are still up to hundreds of times the drinking water standard for benzene. This contamination may have emanated from the areas of NAPL just identified. Under the Montrose Central Process Area, which is north and upgradient of the possible pipeline and Jones Chemical NAPL sources, benzene concentrations are in excess of 500 µg/L in the Upper Bellflower Aquitard. In the Bellflower Sand, a benzene plume with concentrations up to 110 µg/L extends more than 4,000 feet downgradient of the Montrose Property and has the same general shape as the chlorobenzene plume, but does not extend as far as the chlorobenzene plume. The shape of the benzene plume within the Gage Aquifer is very similar to that of the chlorobenzene plume within the Gage Aquifer, although concentrations are much lower (not exceeding 20 µg/L).

While sources of benzene outside the Montrose Property clearly exist in the vicinity of Montrose, the concentrations of benzene in groundwater beneath the Central Process Area, as well as the geometrically similar shape of the chlorobenzene and benzene plumes in the downgradient Bellflower Sand and Gage Aquifers, are not inconsistent with a contribution from a benzene impurity in the Montrose chlorobenzene feedstock and/or contamination from the benzene feedstock at the Stauffer BHC plant. The relative lack of benzene found in vadose zone soils on the property is inconclusive with respect to a Montrose benzene source, because benzene can biodegrade more quickly in the oxidizing environment of the vadose zone than in the saturated zone. At the Del Amo Site near Monitoring Well MW-20, pure benzene LNAPL has been found in groundwater due to a former tank, but there is no benzene remaining in the vadose zone. The more rapid degradation of benzene in an oxidizing environment would also explain why a benzene plume that appears to originate from the Central Process Area is not visible in the Upper Bellflower Aquitard, but is visible in the Bellflower Sand and the Gage Aquifer.

The specification for standard commercial grade chlorobenzene used in production of DDT at the Montrose facility allowed a maximum of 0.15 percent benzene, and the specification for technical grade chlorobenzene allowed a maximum of 0.3 percent benzene (H+A, 1991C-j). Based on the most recent chlorobenzene concentrations detected in groundwater from MW-2 (380,000 µg/L), which is located in the middle of the Central Process Area, and

assuming 0.15 percent benzene in the chlorobenzene feedstock, benzene concentrations up to 570 µg/L would be expected in the Upper Bellflower Aquitard. This estimated benzene concentration is high enough to explain the benzene plume within the Bellflower Sand and Gage Aquifer, that appear to originate from the Montrose facility.

The occurrence of benzene and related compounds at various previously existing facilities throughout the Del Amo Site is the subject of a separate RI/FS (Dames & Moore, 1998; U.S. EPA, 1998). The LNAPL observed in Monitoring Well MW-20 located northeast and upgradient of the Property at the Del Amo Site, is comprised primarily of benzene, and is part of a focused investigation being conducted by the Del Amo Respondents as part of the Del Amo RI/FS (Dames & Moore, 1993).

Leakage along the pipeline corridor which extends from west to east in the LADWP right-of-way south of the Property appears to be a likely source of benzene, other fuel hydrocarbons, and other related compounds detected in groundwater at and in the vicinity of Monitoring Wells MW-7 and MW-1 as evidenced by NAPL which occurs in Monitoring Well MW-7, located southwest of the Property (Figure 5.64). In addition to proximity to likely pipeline corridor sources, Monitoring Well MW-1, located in the southeast corner of the Property, is also located adjacent to the Normandie Avenue sewer lines and is downgradient of sources of benzene at the Del Amo Site (Figure 4.18). The results of groundwater monitoring and the observed distribution of benzene in groundwater indicate that sources of benzene and other fuel hydrocarbon-related compounds located in the LADWP right-of-way has most likely impacted water quality in nearby Monitoring Wells MW-3, MW-6, and MW-17 located adjacent to Jones Chemical Company and Farmer Brothers Coffee Company. At this time, no investigations are being conducted under the direction of any regulatory agency to characterize the nature and extent of benzene and other chemical compounds which originate from potential sources of VOCs to groundwater located along the pipeline corridor.

In addition to the Del Amo and LADWP right-of-way sources previously discussed, sources of benzene to groundwater also appear to occur on the McDonnell Douglas facility, located north and upgradient of the Property, and south of the Property at facilities located near the Armco Site (Section 5.3). Benzene which occurs in groundwater at the McDonnell Douglas facility located north of the Property is being characterized as part of subsurface investigations being conducted under the direction of RWQCB. Other investigations are also being conducted southeast of the Property at various facilities located in the vicinity of the Armco Site. The occurrence of benzene in soil samples collected on Jones Chemical property may also indicate a potential source of benzene at Jones Chemical immediately south of the Property (Section 5.2). Underground fuel storage tanks existed in the past on Jones Chemical Company property. A gasoline storage tank also existed on Montrose Property just south of the machine shop.

5.6.6.2 Benzene: Upper Bellflower Aquitard

Benzene was detected in groundwater samples collected from 16 of the 30 Upper Bellflower Aquitard monitoring wells during the most recent groundwater sample from each of the Montrose monitoring wells (Table 5.5; Figure 5.64). Twenty-two of the 33 Upper Bellflower Aquitard monitoring wells were sampled during the 1995 sampling event. Concentrations of benzene detected in these groundwater samples ranged from 2.9 µg/L to 1,800,000 µg/L. The highest concentrations of benzene occur at the adjacent Del Amo Site, in the LADWP right-of-way to the east of the Montrose Site, and the Del Amo pipeline corridor to the

south of the Montrose Site. As discussed in the previous section, although the distribution of benzene in groundwater within the Upper Bellflower Aquitard does not indicate a primary source of benzene contamination, the benzene plume within the Bellflower Sand and Gage Aquifer suggests a source from the Montrose Site.

The highest maximum concentrations of benzene historically detected in groundwater samples from Upper Bellflower Aquitard monitoring wells located On-Property were detected in groundwater samples collected from Monitoring Well MW-1 (11,000 µg/L) and MW-5 (3,700 µg/L). Monitoring Well MW-1 is located in the southeast corner of the Property just north of the LADWP right-of way, and Monitoring Well MW-5 is located in the northeast corner of the Property. Both of these monitoring wells are adjacent to the north-south trending sewer lines just west of Normandie Avenue. These monitoring wells are also located downgradient of the highest concentrations of benzene detected at the adjacent Del Amo Site (Figure 4.18). The most recent benzene analysis for MW-5 was less than 1 µg/L.

In addition to Del Amo pipeline corridor sources, two other Off-Property sources of benzene to groundwater appear to exist in the Montrose Site vicinity (Figure 5.64). At the adjacent McDonnell Douglas site, concentrations of benzene ranging to 130 µg/L were detected in groundwater samples collected from monitoring wells located approximately 2,300 feet north of the Property. In an apparently separate area located southeast of the Property in the vicinity of the Armco Site, concentrations of benzene detected in groundwater samples collected from Monitoring Well MW-25 have ranged to 2,200 µg/L (Table 5.5). The concentration of benzene detected in the most recent groundwater sample collected from Monitoring Well MW-25 was 170 µg/L.

The concentrations of benzene in groundwater from Upper Bellflower Aquitard monitoring wells has been more variable than that observed for the other VOCs and declining benzene concentration trends have been observed in some monitoring wells (MW-03, MW-05, MW-06, MW-12, and MW-30). However, the benzene concentrations from the 1995 sampling event were much lower than the previous historical record for Monitoring Wells MW-05 (<1 µg/L compared to 1,434 µg/L average), MW-06 (120 µg/L compared to 1,510 µg/L average), MW-25 (170 µg/L compared to 1,628 µg/L average), and MW-27 (20 µg/L compared to 110 µg/L average). The reason for the significant decrease in the 1995 benzene values is unknown, but may be due to rainfall infiltration during the unusually wet winter of late 1995 and subsequent dilution of VOCs at the water table.

5.6.6.3 Benzene: Bellflower Sand

Benzene was detected in groundwater samples collected from 9 of the 34 Bellflower Sand monitoring wells during the most recent groundwater sampling event (Figure 5.65). Concentrations of benzene detected in these samples ranged from 5.9 µg/L to 15,000 µg/L (Table 5.5). The highest concentrations of benzene detected in Bellflower Sand monitoring wells occurred at and in the vicinity of the Del Amo Waste Pit Area where concentrations of benzene detected in Monitoring Well BF-13 have ranged from 15,000 to 43,000 µg/L. The concentration of benzene detected in nearby Del Amo Monitoring Well SWL040 was 110,000 µg/L.

In addition to Monitoring Well BF-13, benzene is most frequently detected in groundwater samples collected from Bellflower Sand Monitoring Wells BF-6, BF-7, and BF-14 located at and directly downgradient of the Del Amo Site (Table 5.5; Figure 5.65). Benzene in the range of 1 to 50 µg/L also occurs in a broad area southeast of the Property.

In addition to the very high benzene concentrations in the vicinity of the Del Amo waste pits, the contoured benzene concentrations within the Bellflower Sand (Figure 5.65) indicate the potential presence of a separate (regional) benzene plume with its source at the Montrose Site. The location, lateral extent, and orientation of this benzene plume is very similar to that of the high concentration core of the chlorobenzene plume within the Bellflower Sand (Figure 5.53). The steep benzene concentration gradient adjacent to the Del Amo waste pits has been interpreted as evidence of the rapid biodegradation of benzene in shallow groundwater (U.S. EPA, 1998). In contrast, a much more gradual concentration gradient is present at the perimeter of the regional benzene plume. The lack of biodegradation within this area is thought to be due to the biologically inhibiting impact of the dissolved chlorobenzene.

Benzene has been infrequently detected at much lower concentrations in groundwater samples collected from On-Property Bellflower Sand monitoring wells (Table 5.5; Figure 5.65). Benzene has been detected in 1 of 12 groundwater samples collected from Monitoring Well BF-1, 1 of 17 groundwater samples collected from Monitoring Well BF-4, and 1 of 9 groundwater samples collected from Monitoring Well BF-9. Concentrations of benzene detected in these groundwater samples were 10 µg/L, 61 µg/L, and 22 µg/L, respectively. However, the low frequency of detection for BF-1 and BF-9 are likely a result of the high benzene detection limits (<200 to <1,000 µg/L and <50 to <200 µg/L, respectively) that are a result of the sample dilutions for VOC analysis required due to the very high chlorobenzene concentrations in the samples. If lower detection limits were available, a higher frequency of detection might be observed.

Benzene has also been detected in 1 of 6 groundwater samples collected from Off-Property Monitoring Well BF-15, 1 of 3 groundwater samples collected from Monitoring Well BF-21, and 1 of 3 groundwater samples collected from Monitoring Well BF-24 at concentrations of 27 µg/L, 5.9 µg/L, and 31 µg/L (Table 5.5). These monitoring wells are located southeast of the Property (Figure 5.65). The detection limits for these monitoring wells are also elevated: BF-15 (<100 to <500 µg/L), BF-21 (<50 µg/L), and BF-24 (<50 to <250 µg/L).

5.6.6.4 Benzene: Gage Aquifer

A benzene plume within the Gage Aquifer extends approximately 2,500 feet downgradient (to the southeast) from a location just outside of the southeastern corner of the Montrose Property (Figure 5.66). The total dimensions of the plume are 1,200 feet by 3,000 feet. The axis of the plume is coincident with that for the chlorobenzene and p-CBSA plumes within the Gage Aquifer (Figures 5.54 and 5.59). Therefore, the source of the benzene plume may potentially be from the Montrose Site; however, the proximity of the plume to the very high benzene concentrations adjacent to the Del Amo waste pits complicates a definitive conclusion of the source.

Benzene was detected in groundwater samples collected from 6 of the 21 Gage Aquifer monitoring wells during the most recent sampling event for Montrose monitoring wells (Table 5.5; Figure 5.66). Benzene was also detected in Del Amo Site Gage Aquifer Monitoring Well SWL034. Concentrations of benzene detected in these samples ranged from 1.3 to 19 µg/L. The highest concentrations were detected in groundwater samples collected from monitoring wells located in the vicinity of the Del Amo Site waste pits. A second area of benzene occurrence exists in the vicinity of Monitoring Well G-19 located south of the primary Gage benzene plume where benzene was detected at a concentration of 10 µg/L.

In addition to these monitoring wells, benzene frequently has been detected in 3 of 16 groundwater samples collected from Gage Aquifer Monitoring Well G-4 at concentrations less than 1 µg/L, and in 15 of 17 groundwater samples from Monitoring Well G-9 at concentrations ranging to 1,300 µg/L (Table 5.5; Figure 5.66). Monitoring Well G-12, located downgradient of the Montrose Property in the Gage Aquifer, had 19 µg/L benzene in the most recent sampling round. While Monitoring Well G-9 is located south of the Del Amo Site waste pits, where LNAPL has been identified, there is no benzene contamination from the Del Amo Site in the overlying Bellflower Sand at this location, and Monitoring Well G-11, which is closer to the pits than is Monitoring Well G-9, has consistently had non-detectable levels. The general orientation of the benzene plume in the Gage Aquifer is on a northwest/southeast axis leading back toward Montrose, and it is roughly aligned with the benzene plume in the Bellflower Sand above the Gage Aquifer downgradient of Montrose. Benzene has not been detected in groundwater samples collected from Gage monitoring wells located On-Property.

5.6.6.5 Benzene: Lynwood Aquifer

Benzene has been detected in 3 of 12 groundwater samples collected from Lynwood Aquifer Monitoring Well LW-1 at concentrations less than 6 µg/L (Table 5.5; Figure 5.67). Benzene has not been detected in groundwater samples collected from other Lynwood Aquifer monitoring wells. The benzene contamination within the Lynwood Aquifer appears to be confined to the Montrose Property.

5.6.7 Ethylbenzene, Toluene, Xylenes, and 1,2-DCA in Groundwater

Ethylbenzene, toluene, xylenes, and 1,2-dichloroethane (1,2-DCA) have been historically detected in 14, 11, 16, and 6 percent, respectively, of groundwater samples collected from monitoring wells constructed by Montrose. The frequency of occurrence, range of concentrations, and most recent analytical results for these compounds are summarized in Tables 5.4 and 5.5.

5.6.7.1 Upper Bellflower Aquitard

Ethylbenzene, toluene, total xylenes, and 1,2-DCA are most frequently detected in groundwater samples collected from Off-Property Monitoring Wells MW-7, MW-12, MW-13, MW-14, and MW-21 where the highest concentrations of these compounds also occur (Table 5.5). Monitoring Well MW-7 is located in the LADWP right-of-way where hydrocarbon NAPL has been observed. Monitoring Wells MW-12, MW-13, MW-14, and MW-21 are located east of the Property at and in the vicinity of known sources of benzene NAPL at the Del Amo Site. The occurrence of ethylbenzene, toluene, xylenes, and 1,2-DCA in groundwater appears to be attributable to sources of these compounds which are located Off-Property in the LADWP right-of-way and at the Del Amo Site. However, there are possible sources of ethylbenzene and xylene on Montrose Property. Records indicate that xylene was used by Montrose as a solvent and xylene and ethylbenzene were primary components of Toxisol, an aromatic petroleum distillate used in the production of DDT. Ethylbenzene, toluene, and xylene contamination may also be due to the gasoline storage tank formerly located on Montrose Property.

Maximum concentrations of ethylbenzene detected in groundwater samples collected from Upper Bellflower Aquitard monitoring wells have ranged from 3 µg/L to 46,000 µg/L (Table 5.5). Maximum concentrations of toluene detected in groundwater samples collected from the Upper Bellflower Aquitard monitoring wells have ranged from 1 µg/L to

40,000 µg/L. Maximum concentrations of total xylenes detected in groundwater samples collected from Upper Bellflower Aquitard monitoring wells have ranged from 70 µg/L to 13,800 µg/L. Maximum concentrations of 1,2-DCA detected in groundwater samples collected from the Upper Bellflower Aquitard monitoring wells have ranged from 3 µg/L to 4,100 µg/L.

Ethylbenzene, toluene, total xylenes, and 1,2-DCA also occur in groundwater southeast of the Property in the vicinity of the Armco Site. Maximum concentrations of these compounds detected in groundwater samples collected from Upper Bellflower Aquitard Monitoring Well MW-25 were 60 µg/L; 1,900 µg/L; 1,800 µg/L; and 200 µg/L, respectively (Table 5.5).

5.6.7.2 Bellflower Sand

Ethylbenzene has been detected in 1 of 15 groundwater samples from Monitoring Wells BF-5 (120 µg/L), in 1 of 13 samples from BF-7 (4,500 µg/L), and 12 of 12 samples from BF-13 (310 to 700 µg/L), as summarized in Table 5.5. Toluene has been detected in 1 of 13 samples from BF-02 (2,000 µg/L), 3 of 16 samples in BF-05 (less than 0.5 µg/L to 117 µg/L), 2 of 14 samples in BF-02 (less than 1 µg/L), 1 of 13 samples in BF-14 (2.4 µg/L), and 1 of 9 samples in BF-23 (1.9 µg/L). Total xylenes were detected in 1 of 7 samples from BF-06 (25 µg/L), 1 of 2 samples from BF-08 (100 µg/L), and 1 of 3 samples from BF-09 (6.8 µg/L). Monitoring Wells BF-5, BF-6, BF-7, BF-8, and BF-13 are all located Off-Property adjacent to the Del Amo Site and the LADWP right-of-way where NAPL and high concentrations of benzene originating from these Off-Property sources also occur.

1,2-DCA has been infrequently detected in groundwater from four Bellflower Sand monitoring wells. It was detected in 1 of 7 samples of groundwater from Monitoring Well BF-17 (30 µg/L), in 1 of 3 samples in Monitoring Well BF-24 (60 µg/L), in 1 of 5 samples from Monitoring Well BF-31 (2.7 µg/L), and 1 of 2 samples from Monitoring Well BF-33 (3 µg/L). 1,2-DCA is a commonly used fuel additive and is also a degradation product of TCE and PCE (Figure 6.2). Bellflower Sand µg/L Monitoring Wells BF-17 and BF-24 are located in the vicinity of the Armco Site. Monitoring Wells BF-31 and BF-33 are located southwest of the Property near Western Avenue and on Denker Avenue. The occurrence and distribution of 1,2-DCA detected in groundwater samples collected from these monitoring wells appears to be consistent with the observed directions of groundwater flow, the locations of Off-Property sources of fuel hydrocarbons to groundwater, and the distribution of these compounds in relation to these sources.

5.6.7.3 Gage Aquifer

Ethylbenzene has been detected in groundwater samples collected from Monitoring Wells G-9 and G-12 at concentrations ranging from 20 to 47 µg/L (Table 5.5). Toluene has been detected in groundwater samples collected from Monitoring Wells G-1, G-4, G-7, G-8, G-11, G-12, G-13, and LG-1 at concentrations ranging from 0.8 to 22 µg/L. Total xylenes have been detected in groundwater samples collected from Monitoring Well G-12, and 1,2-DCA has been detected in a groundwater sample collected from Monitoring Well G-9. With the exception of Monitoring Well G-1, all Gage Aquifer monitoring wells with detectable concentrations of ethylbenzene, toluene, total xylenes, and 1,2-DCA are located at and in the vicinity of benzene and fuel hydrocarbon NAPL sources located in the LADWP right-of-way and at the Del Amo Site. The presence of 1,2-DCA in groundwater does not correlate well with the presence of TCE or PCE in groundwater. Therefore, the source of 1,2-DCA

appears to be more likely from a fuel or benzene NAPL sources than from TCE and PCE degradation.

5.6.8 Tetrachloroethylene in Groundwater

A plume of tetrachloroethylene (PCE) contamination within the Upper Bellflower Aquitard underlies the Montrose Site. The plume's center is located along the southern boundary of the Montrose Property and the eastern portion of the Jones Chemical Property (Figure 5.68). The maximum PCE concentrations within this plume from the most recent analysis from each monitoring well were 3,400 µg/L in groundwater from Monitoring Well MW-06 and 3,800 µg/L in MW-01. The dimensions of this plume for the 10 µg/L contour are approximately 1,500 by 2,500 feet. A second PCE plume of roughly comparable size is located 2,500 feet to the northeast on the McDonnel Douglas Corporation property. Four additional small PCE plumes with lower concentrations are located within or adjacent to the Del Amo Site.

PCE historically has been detected in 16 percent of groundwater samples collected at the Montrose Site (Table 5.4). PCE has been detected in groundwater samples collected from 15 of the 30 Upper Bellflower Aquitard monitoring wells at concentrations ranging from 1 µg/L to 4,800 µg/L (Table 5.5). PCE has also been detected in groundwater samples collected from four Bellflower Sand monitoring wells, and two Gage Aquifer monitoring wells (Table 5.5). PCE has not been detected in groundwater samples collected from Lynwood Aquifer monitoring wells (Table 5.5). The California, State, and Federal MCL for PCE is 5 µg/L.

PCE was not used by Montrose in the manufacture of DDT, but may have been used for solvent cleaning at Montrose. Records indicate that Jones Chemical Company sold Montrose various chemicals, including PCE, between 1968 and 1973. Jones Chemical Company, immediately south of the Montrose Plant, is also a known consistent user of volatile organic solvents, including PCE. Jones Chemical is also a known source of PCE to groundwater in the immediate vicinity of the Montrose Site, having discharged VOC wastes, including PCE, to a dry well. PCE concentrations in the soil at Jones Chemical Company were as high as 6,700 mg/kg near the former location of the PCE storage tank. Documents also indicate that Jones Chemical for some time may have used the Montrose wastewater recycle pond for the disposal of wastes, after Jones Chemical was disconnected from the sanitary sewer. The distribution of PCE in groundwater appears to extend further north onto the Montrose Property than would otherwise be expected from Jones operations alone. Accordingly, it is possible that PCE may have been released to groundwater from the Montrose Property as well as from Jones Chemical Company.

5.6.8.1 PCE: Upper Bellflower Aquitard

PCE was detected in 14 of 30 Upper Bellflower Aquitard monitoring wells during the most recent sampling event for Montrose wells (Figure 5.68). Concentrations of PCE detected in these samples ranged from 2 to 3,800 µg/L. The highest concentrations of PCE occur in monitoring wells located in the vicinity of Jones Chemical Company where known sources of PCE occur (Levine-Fricke, 1995). PCE has also been detected at concentrations ranging to 9,400 µg/L upgradient of the Property at the Amoco Chemical Site.

The PCE plumes in the Upper Bellflower Aquitard appear to be centered Off-Property beneath the Amoco Chemical Site located northeast of the Property and the Jones Chemical site located immediately south of the Property (Figure 5.68).

5.6.8.2 PCE: Bellflower Sand

PCE has been detected in 1 of 15 samples from Monitoring Well BF-5 (104 µg/L), 2 of 9 samples from Monitoring Well BF-09 (5.4 and 370 µg/L), 6 of 19 samples in Monitoring Well BF-14 (less than 10 to 44 µg/L), and 1 of 3 samples in Monitoring Well BF-24 (4.2 µg/L). The highest concentration was detected in a groundwater sample collected from Monitoring Well BF-9 located On-Property in the Central Process Area. The detection limits for PCE were elevated in many samples with values as high as 500 µg/L. Therefore, it is possible that the extent of PCE contamination in the Bellflower Sand is greater than is indicated by the detected values. A PCE plume may potentially be present from the Central Process Area to Monitoring Well BF-24 at the Armco Site.

5.6.8.3 PCE: Gage Aquifer

PCE has been detected in 1 of 15 samples of groundwater from Monitoring Well G-5 (510 µg/L) and 1 of 5 samples in Monitoring Well G-19 (4.6 µg/L), as summarized in Table 5.5. Monitoring Well G-5 is located east of the Property downgradient of areas in the overlying Upper Bellflower Aquitard and Bellflower Sand where high concentrations of PCE occur. Monitoring Well G-19 is located in the vicinity of the Armco Site. Six monitoring wells have elevated PCE detection limits ranging from 10 to 100 µg/L; therefore, the extent of PCE contamination may be greater than is indicated by the detected PCE values.

5.6.9 Trichloroethylene in Groundwater

TCE historically has been detected in 14 percent of groundwater samples collected from monitoring wells constructed at the Montrose Site (Table 5.4). TCE has been detected in 15 of 30 Upper Bellflower Aquitard monitoring wells, 5 of 34 Bellflower Sand monitoring wells, and 2 of 21 Gage Aquifer monitoring wells (Table 5.5). Concentrations of TCE detected in groundwater samples collected from these monitoring wells have ranged from 1.0 µg/L to 1,200 µg/L. TCE has not been detected in groundwater samples collected from Lynwood Aquifer monitoring wells.

5.6.9.1 TCE: Upper Bellflower Aquitard

TCE in groundwater occurs over a broad area which may extend from north of 190th Street and west of Western Avenue more than 1.7 miles southeast toward the Harbor Freeway (Figure 5.69). Numerous sources of TCE have been identified in the vicinity surrounding the Montrose Property. TCE occurs at concentrations ranging to 3,100 µg/L upgradient of the Property at the International Light Metals site. Concentrations of TCE ranging to 20,000 µg/L occur upgradient of the Property at the McDonnell Douglas site. Concentrations of TCE ranging up to 21,000 µg/L occur upgradient of the Property at the Amoco Chemical Site. The highest concentrations of TCE at and in the vicinity of the Property occur in monitoring wells located near Jones Chemical and in the LADWP right-of-way east of Normandie Avenue. TCE also occurs at concentrations greater than 100 µg/L in an area near the intersection of the Torrance Lateral and the Harbor Freeway.

Jones Chemical, immediately south of Montrose, is a known consistent user of volatile organic solvents, including TCE. Documents indicate that Jones Chemical Company for some period of time may have used the Montrose wastewater recycle pond for disposal of its own waste, after Jones Chemical Company was disconnected from the sanitary sewer. Accordingly, it is possible that, although Montrose did not use TCE in its operations, TCE

could nonetheless have been released to groundwater from the Montrose Property. TCE in groundwater beneath the Montrose Property may also have originated from Off-Property sources of TCE to groundwater located in all directions surrounding the Property.

5.6.9.2 TCE: Bellflower Sand

TCE has been detected in 1 of 13 groundwater samples from Monitoring Well BF-3 (100 µg/L), 3 of 17 samples from Monitoring Well BF-4 (less than 200 to 250 µg/L), 1 of 13 samples from Monitoring Well BF-7 (220 µg/L), and 3 of 3 samples from Monitoring Well BF-18 (7 to 130 µg/L) [Table 5.5, Figure 5.69]. These monitoring wells are located downgradient of the known sources of TCE to groundwater located north of the Property, and on either side of the sewer lines extending north-south beneath the eastern portion of the Property parallel to Normandie Avenue. Eleven of the Bellflower Sand monitoring wells have elevated TCE detection limits ranging from 25 to 500 µg/L; therefore, TCE may be present in groundwater from other monitoring wells at concentrations below the detection limit.

5.6.9.3 TCE: Gage Aquifer

TCE has been detected in 1 of 15 groundwater samples from Gage Aquifer Monitoring Wells G-12 (10 µg/L) and in 9 of 9 samples from Monitoring Well G-13 (25 to 61 µg/L) [Table 5.5]. These monitoring wells are located downgradient of the Del Amo Waste Pits. Six monitoring wells that contain the highest total VOC concentrations have elevated TCE detection limits ranging from 10 to 100 µg/L; therefore, TCE may be present but undetected in samples from those monitoring wells.

5.6.10 Dichlorobenzene

1,2-Dichlorobenzene (1,2-DCB), 1,3-dichlorobenzene (1,3-DCB), and 1,4-dichlorobenzene (1,4-DCB) have been detected infrequently in groundwater beneath and downgradient of the Montrose Site (Table 5.5). Of these three similar compounds, 1,4-DCB is the most common and occurs in the highest concentrations. 1,2-DCB has been detected in groundwater from five Upper Bellflower Aquitard monitoring wells, six Bellflower Sand monitoring wells, and one Gage Aquifer monitoring well. The maximum concentration detected was 110 µg/L (in MW-01) within the Upper Bellflower Aquitard. Most of the detection limits for 1,2-DCB were between 50 and 1,000 µg/L, because of the sample dilutions required by the high chlorobenzene concentrations in the VOC samples. Therefore, additional detections for 1,2-DCB may have been observed if lower detection limits were achieved.

1,3-DCB was detected in only one monitoring well, MW-01, which is completed in the Upper Bellflower Aquitard. The 1,3-DCB detection limits for groundwater samples from the monitoring wells with the highest chlorobenzene concentrations (MW-01, MW-02, MW-05, MW-06, MW-09, MW-20, MW-21), in which 1,3-DCB would be most likely to occur, ranged from 50 to 20,000 µg/L. Five of these seven monitoring wells had detection limits of 1,000 µg/L or greater. With lower detection limits, more detections of 1,3-DCB may have been observed.

1,4-DCB historically has been detected in 5 percent of groundwater samples collected at the Montrose Site (Table 5.4). 1,4-DCB has been detected infrequently and inconsistently in groundwater samples collected from six Upper Bellflower Aquitard monitoring wells, ten Bellflower Sand monitoring wells, and four Gage Aquifer monitoring wells at

concentrations ranging from 1 to 310 µg/L (Table 5.5). The detection limits for many of the 1,4-DCB analyses were elevated due to required sample dilutions; therefore, additional detection may have been observed if lower detection limits were available. Based on the most recent analyses, a plume of 1,1-DCB is indicated with a width of approximately 800 feet and a length of approximately 2,000 feet. All monitoring wells containing 1,2-DCB contain 1,4-DCB in higher concentrations; therefore, the discussion of the extent of dichlorobenzenes will emphasize 1,4-DCB.

Montrose is a possible source of DCB in the subsurface. DCB was detected in a water sample from the wastewater recycle pond in 1978 (Stauffer, 1978). Records also indicate that Montrose stored, used, or otherwise handled DCB (Montrose, 1990) (Section 1.3.5.1).

5.6.10.1 DCB: Upper Bellflower Aquitard

The compound 1,4-DCB was detected in groundwater samples collected from four Upper Bellflower Aquitard monitoring wells during the most recent sampling event (Table 5.5; Figure 5.70). 1,4-DCB was detected at concentrations of 220 µg/L, 54 µg/L, 8.7 µg/L, and 170 µg/L in Monitoring Wells MW-1, MW-6, MW-9, and UBT-3, respectively. 1,4-DCB has also been sporadically detected in groundwater samples collected from Monitoring Wells MW-2, MW-5, and MW-12. 1,4-DCB has been most frequently detected in groundwater samples collected from MW-1 and MW-6 located near the southeast corner of the Property. As previously mentioned, elevated detection limits have likely resulted in a lower frequency of detection. The California State MCL for 1,4-DCB is 5 µg/L. Figure 5.70 indicates that a plume of 1,4-DCB contamination extends from the Central Processing Area to the Del Amo Monitoring Well SWL0049. Most of the monitoring wells that contained detectable 1,4-DCB in the last sampling also contained 1,2-DCB at concentrations ranging from 1.3 to 110 µg/L. The California State MCL for 1,2-DCB is 600 µg/L.

5.6.10.2 DCB: Bellflower Sand, Gage, and Lynwood Aquifers

The compound 1,4-DCB was detected in groundwater samples collected from five Bellflower Sand and one Gage Aquifer monitoring wells during the most recent sampling event (Table 5.5; Figures 5.71 and 5.72). Concentrations of 1,4-DCB historically detected in groundwater samples collected from ten Bellflower Sand monitoring wells have ranged from 2.6 to 220 µg/L. The highest concentration was detected in On-Property Monitoring Well BF-3. 1,4-DCB most frequently has been detected in Monitoring Well BF-6 located north of Monitoring Well BF-7. Figure 5.70 indicates that a plume of 1,4-DCB exceeding the California MCL of 5 µg/L within the Bellflower Sand originates at the Montrose Site and extends approximately 4,000 feet downgradient to Monitoring Well BF-24. 1,2-DCB was detected in the most recent sampling in Monitoring Well BF-09 at 4 µg/L and at Monitoring Well BF-24 at 7.2 µg/L, but the detection limits of all the monitoring wells in between ranged from 100 to 300 µg/L (Appendix G). Therefore, it is unknown if a continuous plume of 1,2-DCB is present.

1,4-DCB has been detected once each in groundwater samples collected from Gage Aquifer Monitoring Wells G-2, G-12, G-13, and G-19 at concentrations ranging from 2.6 to 10 µg/L (Table 5.5; Figure 5.72).

1,4-DCB has not been detected in groundwater samples collected from Lynwood Aquifer Monitoring Wells (Table 5.5). 1,2-DCB has been detected once in Gage Aquifer Monitoring Well G-19 and has not been detected in groundwater from Lynwood Aquifer monitoring wells.

5.6.11 Other Compounds in Groundwater

Other halogenated VOCs detected in groundwater samples collected from monitoring wells at the Montrose Site include carbon tetrachloride, cis-1,2-dichloroethene (cis-1,2-DCE), 1,1-dichloroethene (1,1-DCE), 1,1,2-trichloroethane (1,1,2-TCA), and methylene chloride. These compounds were detected sporadically and in an irregular distribution across the Montrose Site. Methylene chloride concentrations detected in groundwater samples from Montrose monitoring wells have been attributed to laboratory contamination (Section 3.0). Analytical results for these other VOCs have been summarized (Table 5.5; Appendix G).

Groundwater samples collected from selected monitoring wells were also analyzed for chloral, base neutral/acid organic compounds, and trace metals. The results are provided in the following subsections.

5.6.11.1 Chloral

Chloral (trichloroacetaldehyde) was analyzed for but not detected in groundwater samples collected from Upper Bellflower Aquitard Monitoring Wells MW-1, MW-3, and MW-5 in July and August 1985. Given the absence of chloral in the Upper Bellflower Aquitard, this compound was not analyzed for in groundwater samples collected from other Upper Bellflower, Bellflower Sand, Gage Aquifer, or Lynwood Aquifer monitoring wells.

5.6.11.2 Base Neutral/Acid Organic Compounds

A variety of base neutral/acid extractable organic compounds (BNAs) were sporadically detected in groundwater samples collected from monitoring wells at the Montrose Site. The occurrence and distribution of base neutral/acid organic compounds detected in groundwater samples did not exhibit any distinct trend or pattern.

BNAs: Upper Bellflower Aquitard. Nine different base neutral/acid extractable organic compounds (commonly referred to as semivolatile organic compounds) were detected in the samples collected from Monitoring Wells MW-1, MW-2, MW-5, MW-6, MW-12, and MW-14. Table 5.7 provides the number of monitoring wells sampled for base neutral/acid organic compounds, the number of detections, and the minimum and maximum concentrations. No single compound was detected in groundwater samples collected from all six of these monitoring wells. The occurrence and distribution of base neutral/acid organic compounds detected in groundwater did not exhibit any distinct trend or pattern.

The compound 1,2,4-trichlorobenzene was detected in 3 groundwater monitoring wells (MW-0, MW-02, 1 and MW-05) collected from 13 Upper Bellflower Aquitard monitoring wells during the period from April 1985 through May 1985 (Table 5.7). Maximum detected 1,2,4-trichlorobenzene concentrations were 83 µg/L, 24 µg/L, and 26 µg/L in samples collected from Monitoring Wells MW-1 and MW-5, respectively. Monitoring Wells MW-1 and MW-5 are located in the eastern portion of the Property.

The compound 2-chlorophenol was detected in 4 of the 13 groundwater samples collected from Upper Bellflower Aquitard monitoring wells during the period from 1985 through October 1991. 2-chlorophenol concentrations were 31 µg/L, 43 µg/L, 90 µg/L, and 10 µg/L in the samples collected from Monitoring Wells MW-1, MW-2, MW-5, and MW-6, respectively.

The compound 2,4-dichlorophenol was detected in a groundwater sample collected from Monitoring Well MW-2 in May 1985, at a concentration of 10 µg/L.

Phenol was detected in groundwater samples collected from 1 of 13 Upper Bellflower Aquitard monitoring wells. Phenol was detected at a concentration of 17 µg/L in a groundwater sample collected from Monitoring Well MW-1 in May 1985.

Naphthalene was detected in 3 of the 13 groundwater samples collected from Upper Bellflower Aquitard monitoring wells during the monitoring period from November 1991 through December 1991. Maximum detected naphthalene concentrations were 14 µg/L, 260 µg/L, and 330 µg/L in the groundwater samples collected from Monitoring Wells MW-1, MW-12, and MW-14, respectively.

The compound 2,4,6-trichlorophenol was detected in one of the groundwater samples collected from the Upper Bellflower Aquitard monitoring wells in December 1990. 2,4,6-trichlorophenol was detected at a concentration of 24 µg/L in a sample collected from Monitoring Well MW-6.

The compound 2-methylnaphthalene was detected in one of the groundwater samples collected from the Upper Bellflower Aquitard Monitoring Wells in December 1990. 2-Methylnaphthalene was detected at a concentration of 60 µg/L in the sample collected from Monitoring Well MW-14.

The compound Bis(2-ethylhexyl) phthalate was detected in 3 of the 13 Upper Bellflower Aquitard monitoring wells in December 1990. Bis(2-ethylhexyl) phthalate was detected at concentration of 40 µg/L, 27 µg/L, and 59 µg/L in groundwater samples collected from Monitoring Wells MW-1, MW-6 and MW-14, respectively.

BNAs: Bellflower Sand. Groundwater samples from 20 Bellflower Sand monitoring wells (BF-4, BF-8, and BF-16 through BF-33) were analyzed for base neutral/acid organic compounds. Only one BNA was detected from these monitoring well samples. The compound bis (2-ethylhexyl) phthalate was detected in a groundwater sample collected from Monitoring Well BF-4 at a concentration of 25 µg/L.

BNAs: Gage Aquifer. Groundwater samples were collected from 13 Gage Aquifer Monitoring Wells, G-1, G-2, G-4, G-7, G-8, G-10, and G-13 through G-19, and analyzed for base neutral/acid organic compounds.

The compound bis (2-ethylhexyl) phthalate was detected in groundwater samples collected from Gage Aquifer Monitoring Wells G-1 and G-2 at concentrations of 60 µg/L and 31 µg/L, respectively. Phthalates are common laboratory contaminants.

BNAs: Lynwood Aquifer. Base neutral/acid organic compounds were not detected in groundwater samples collected from Lynwood Aquifer monitoring wells.

5.6.11.3 Trace Metals

The analytical results for trace metals detected in groundwater samples collected from Montrose monitoring wells have been summarized (Table 5.8). Antimony, arsenic, beryllium, cadmium, total chromium, copper, iron, lead, mercury, manganese, nickel, selenium, silver, thallium, and zinc were detected in groundwater samples collected from Montrose monitoring wells. Of these trace metals, nickel, cadmium, iron, manganese, and thallium were sporadically and inconsistently detected at concentrations greater than their respective MCLs for drinking water (Table 5.6). The greatest number of MCL exceedances are for iron and manganese.

5.7 Sediment

The nature and extent of pesticides and VOCs in sediment in four surface water drainages located downstream from the Property were investigated in May and June 1986. Sediment samples were collected from the Kenwood Drain, the Torrance Lateral, the Dominguez Channel, and the Consolidated Slip. Sediment in the Dominguez Channel was sampled again in September 1988 by Montrose. Most of the sediment data collected by Montrose was rejected by EPA because of calibration documentation deficiencies. Consequently, in 1994, EPA collected additional sediment samples in the Normandie Avenue Ditch, the Kenwood Drain, the Torrance Lateral, the Dominguez Channel, and the Consolidated Slip. Although data obtained by Montrose were rejected by EPA, the results of EPA's work appear to be consistent with the data previously obtained by Montrose. In general, both sets of sampling data indicate that contaminants are detected sporadically and at low concentrations in these downstream sampling areas. All of the data collected by Montrose are reported in this RI Report, whether or not the data were rejected by EPA. Tables 5-9 and 5-10 present the analytical results for total DDT and BHC in sediment samples collected by Montrose. A summary of the data collected by EPA is provided in Table 5.10A. Complete results are provided in a separate report (CH2M HILL,1995).

5.7.1 Kenwood Drain Sediment Samples

5.7.1.1 Montrose Sampling

Pesticides and VOCs were analyzed in five discrete sediment samples collected from the Kenwood Drain. This group of samples also includes one sample collected from the catchment basin located east of the Farmer Brothers Property on Normandie Avenue.

The pesticide sample result from Location KD-7 was downgraded by EPA to validation flag "R" (rejected) and, therefore, is not considered usable for the RI (see Section 3.0 for data validation information). The following discussion of the nature and extent of pesticides in sediment in the Kenwood Drain does not include the result of this sample.

As shown in Figure 5.73, total DDT was detected in the four sediment samples from the Kenwood Drain. Total DDT was detected in these samples at concentrations ranging from 6 mg/kg to 59 mg/kg. All four samples contained DDT at concentrations exceeding the EPA Region IX PRG of 1.3 mg/kg for DDT in residential soil. The maximum concentration of total DDT in these samples was detected in the sample collected from Location KD-1 where surface drainage from the Normandie Avenue Ditch enter the culvert which feeds the Kenwood Drain. Total BHC was not detected in the four sediment samples from the Kenwood Drain.

The sediment sampling results indicate that there is a DDT concentration gradient extending from the Montrose Site through the Kenwood Drain to the Torrance Lateral. As would be expected, the highest concentrations of DDT in sediment are nearest to the Property.

Acetone was the only VOC detected in the sediment samples collected from the Kenwood Drain. Acetone was detected at a concentration of 3 mg/kg in the sediment sample from Location KD-5.

5.7.1.2 EPA Sampling

EPA conducted an independent evaluation of the Kenwood Drain in 1994. Concentrations of DDT detected in sediment samples collected by EPA were similar to the concentrations of DDT previously detected in sediment samples collected by Montrose. The total DDT results of the EPA sampling are also provided in Figure 5.73. Results for other analytes are summarized in Table 5-10A.

5.7.2 Torrance Lateral Sediment Samples

5.7.2.1 Montrose Sampling

Pesticides and VOCs were analyzed in five discrete sediment samples collected in the Torrance Lateral. Sediment was present at five isolated locations in the Torrance Lateral between the Kenwood Drain discharge and the Dominguez Channel outfall.

The pesticide sample results from the five samples collected from the Torrance Lateral were downgraded by EPA to validation flag "R" and, therefore, are not considered usable by EPA for the RI (See Section 3.0 for information on the data validation). The total DDT sediment results are shown in Figure 5.74.

5.7.2.2 EPA Sampling

Because the Montrose data was rejected, a follow-up sampling effort was conducted by EPA at the Torrance Lateral in 1994. As shown in Figure 5.74A, total DDT in sediment in the Torrance Lateral ranged between 0.019 and 0.228 mg/kg. Table 5-10A summarizes the results for other analytes detected in the Torrance Lateral.

5.7.3 Dominguez Channel Sediment Samples

Pesticides and VOCs were analyzed in 24 sediment samples collected during 1986 and 1988 RI field work. Figures 5.74 and 5.75 show the location of the sediment samples collected in the Dominguez Channel). These 24 samples consisted of 5 samples collected in 1986, 14 samples collected in 1988, and 5 additional samples collected in 1988 from an upstream location for comparison to the other samples.

5.7.3.1 Montrose 1986 Sediment Sampling

During the 1986 RI field work, the sediment in the Dominguez Channel was sampled at five transects located from approximately 1 mile upstream to 3 miles downstream from the confluence of the channel with the Torrance Lateral. Three discrete samples were collected across each of the five transects and were composited into a single sample for each transect.

The pesticide sample results from transects SED-12, SED-13, and SED-14 were downgraded by EPA to validation flag "R" and, therefore, are not considered usable by EPA for the RI. The following discussion of the nature and extent of pesticides in sediment in the Dominguez Channel does not include the results of these samples.

Total DDT and total BHC were detected in the composited sediment samples collected from the Dominguez Channel during the 1986 RI field work, as shown in Tables 5.9 and 5.10. Total DDT was detected in one of the two sediment samples. Total DDT was detected in the sample collected from SED-11 at a concentration of 2.2 mg/kg, which slightly exceeds the PRG of 1.3 mg/kg for residential soil.

Total BHC was detected in one of the two sediment samples at a concentration of 0.02 mg/kg. Total BHC was detected in the composited sample collected from SED-15, located 3 miles downstream from the confluence of the Torrance Lateral with the Dominguez Channel.

Acetone was the only VOC detected in the sediment samples collected from the Dominguez Channel in 1986. Acetone was detected at a concentration of 5 mg/kg in the sediment sample from location SED-11.

5.7.3.2 Montrose 1988 Sediment Sampling

Total DDT was detected in 9 of the 14 samples collected during the 1988 RI field work, at concentrations ranging from 0.53 mg/kg to 4.1 mg/kg, which exceeds the PRG of 1.3 mg/kg for residential soil. The maximum concentration of total DDT was detected in a discrete sample collected from transect T1-C at a depth of 0.5 foot. Total BHC was not detected in sediment samples collected from the Dominguez Channel during the 1988 RI field work.

Total DDT and total BHC were not detected in the five additional sediment samples collected approximately 2.5 miles upstream from the confluence of the Dominguez Channel and the Torrance Lateral. The detection limits for these additional samples ranged from 0.1 mg/kg to 5 mg/kg. VOCs were not analyzed in sediment samples collected from the Dominguez Channel in 1988.

5.7.3.3 EPA Sampling

Figure 5.75A shows total DDT concentrations in sediment samples collected by EPA in 1994. The lowest total DDT concentrations in the Dominguez Channel are located upstream of the confluence with the Torrance Lateral and in the furthest downstream portion of the channel. The highest total DDT concentrations in the Dominguez Channel are at the confluence of the Torrance Lateral, where total DDT concentrations were as high at 3.83 mg/kg, well above the PRG for residential soil. Table 5.10A summarizes the analytical results for other constituent detected in sediment.

5.7.4 Consolidated Slip Sediment Samples

5.7.4.1 Montrose Sampling

Pesticides and VOCs were analyzed in ten composited sediment samples collected from the Consolidated Slip. Five discrete samples were collected across each of ten transects and composited for analysis.

The pesticide sample results from Locations SED-17, SED-18, SED-19, SED-22, SED-23, and SED-25 were downgraded by EPA to validation flag "R" and, therefore, are not considered usable by EPA for the RI. The following discussion of the nature and extent of pesticides in sediment in the Consolidated Slip does not include the results of these samples.

Total DDT and total BHC were detected in the four sediment samples from the Consolidated Slip, as shown in Tables 5.9 and 5.10. Figure 5.76 also provides the DDT sampling results. Total DDT was detected in the four composited samples at concentrations ranging from 0.32 mg/kg to 0.41 mg/kg. The maximum concentration of total DDT was detected in the composited sample collected from Transect SED-24.

Total BHC was detected in three of the four composited samples from the Consolidated Slip at concentrations ranging from 0.46 mg/kg to 1 mg/kg. The maximum concentration of total BHC was detected in the composited sample collected from Transect SED-24.

The VOC methyl acetate was detected in the composited sediment samples collected from Transects SED-16, SED-17, and SED-18. The maximum concentration of methyl acetate was 7 mg/kg, detected in the composited sample collected from Transect SED-16. No other VOCs were detected in the sediment samples collected from the Consolidated Slip.

5.7.4.2 EPA Sampling

Figure 5.75A provides total DDT concentrations in sediment samples collected by EPA in 1994 in the Consolidated Slip. Concentrations of total DDT ranged from 0.096 to 0.870 mg/kg. The concentrations are generally consistent with the results obtained by Montrose. Table 5.10A presents results for other analytes detected in sediment.

5.8 Surface Water

The nature and extent of pesticides and VOCs in surface water runoff in four surface water drainages located downstream from the Property were investigated in 1986 and 1987 by Montrose. The field investigation consisted of both dry and wet weather sampling events. Because much of the data was rejected by EPA due to calibration documentation deficiencies, EPA conducted additional dry weather surface water sampling in 1994.

5.8.1 Dry Weather Surface Water Sampling

Surface water samples were collected by Montrose from 17 locations in the Torrance Lateral, Dominguez Channel, and the Consolidated Slip during dry weather in June 1986. Tables 5.11 and 5.12 provide the analytical results for DDT and BHC in dry weather surface water samples, respectively, for samples collected by Montrose. Figures 5.77 and 5.78 also show the DDT results for the dry weather samples. The Jones Chemical Company ditch and the Normandie Avenue Ditch are dry during dry weather and were not sampled. Surface water in the Kenwood Drain was not sampled due to limited access.

The results of surface water sampling by EPA in 1994 are summarized in Table 5-12A. DDT isomers were detected only in the Kenwood Drain, the surface water feature closest to the Montrose property. DDT or its isomers were not detected in surface water samples from the Torrance Lateral, Dominguez Channel, or Consolidated Slip. Additional details on the surface water sampling by EPA can be found in a separate report (CH2M HILL, 1995).

5.8.1.1 Torrance Lateral Surface Water Samples

Montrose Sampling. Pesticides and VOCs were analyzed in two discrete samples collected from the Torrance Lateral during dry weather. Two unfiltered surface water samples and one filtered surface water sample were submitted to the laboratory for pesticide analysis.

The filtered pesticide sample results from Sample Location SW-5 was downgraded by EPA to validation flag "R" and, therefore, are not considered usable by EPA for the RI. The following discussion of the nature and extent of pesticides in dry weather surface water in the Torrance Lateral does not include the results of this sample.

Pesticides were not detected in the two unfiltered surface water samples collected from two locations in the Torrance Lateral during dry weather, as shown in Figure 5.77.

Acetone was the only VOC detected in the samples collected from the Torrance Lateral during dry weather. Acetone was detected at a concentration of 12 µg/L in the surface water sample collected from Sample Location SW-4. Because acetone is a common laboratory contaminant, the presence of acetone may be attributable to laboratory cross-contamination.

EPA Sampling. The results of surface water sampling by EPA in 1994 are summarized in Table 5-12A. DDT isomers were not detected in any samples.

5.8.1.2 Dominguez Channel Surface Water Samples

Montrose Sampling. Pesticides were analyzed in five composited surface water samples collected from the Dominguez Channel during dry weather. Two discrete samples were collected from each of three locations across five transects. The six samples for each transect were composited into a single sample for analysis. Five unfiltered and two filtered surface water samples were submitted to the laboratory for pesticide analysis.

The unfiltered pesticide sample results from Sample Location SW-10 and the filtered pesticide sample result from SW-7 and SW-8 were downgraded by EPA to validation flag "R" and, therefore, are not considered usable by EPA for the RI. The following discussion of the nature and extent of pesticides in surface water in the Dominguez Channel does not include the results of these samples.

Pesticides were not detected in the four unfiltered surface water samples from the Dominguez Channel during dry weather, as shown in Figure 5.77. VOCs were not detected in the five unfiltered surface water samples from the Dominguez Channel during dry weather.

5.8.1.3 Consolidated Slip Surface Water Samples

Montrose Sampling. Pesticides and VOCs were analyzed in 10 composited surface water samples collected from the Consolidated Slip during dry weather. Two discrete samples were collected from a single location at each of the 10 sediment sample transects and were composited for analysis. Ten unfiltered and two filtered surface water samples were submitted to the laboratory for analysis.

The unfiltered pesticide sample results from Sample Locations SW-16 through SW-19, SW-21, SW-23 through SW-25, and the filtered pesticide sample results from Sample Locations SW-20, SW-21, and SW-24 were downgraded by EPA to validation flag "R" and, therefore, are not considered usable by EPA for the RI. The following discussion of the nature and extent of pesticides in the surface water in the Consolidated Slip does not include the results of these samples.

Pesticides were not detected in the two unfiltered surface water samples collected from the Consolidated Slip during dry weather, as shown in Figure 5.78.

Acetone was the only VOC detected in surface water samples collected from the Consolidated Slip during dry weather. Acetone was detected at a concentration of 16 µg/L in the surface water sample collected from Sample Location SED-19. Because acetone is a

common laboratory contaminant, the presence of acetone may be attributable to laboratory cross-contamination.

EPA Sampling. The results of surface water sampling by EPA in 1994 are summarized in Table 5-12A. DDT isomers were not detected in any samples.

5.8.2 Wet Weather Surface Water Samples

Wet weather surface water samples were collected at 20 locations during 5 rainfall events between September 1986 and March 1987 by Montrose. Samples were collected from the Jones Chemical Company Ditch, the Normandie Avenue Ditch, the Torrance Lateral, the Dominguez Channel, and the Consolidated Slip. Surface water in the Kenwood Drain was not sampled due to restricted access.

Wet weather surface water samples were collected from five sample locations in the Jones Chemical Company Ditch, the Normandie Avenue Ditch, and the Torrance Lateral during five rainfall events with precipitation exceeding 0.20 inch. Tables 5.13, 5.14, and 5.15 list the results for DDT, BHC, and VOCs in the wet weather surface water samples, respectively. Figures 5.79 and 5.80 show results for DDT and BHC, respectively, near the property. Figures 5.81 and 5.82 show results for DDT and BHC, respectively, in the Torrance Lateral and Dominguez Channel. Samples were not collected from Location SW-1 during the first rainfall event due to insufficient flow. Surface water samples were not collected during rainfall events with precipitation exceeding 0.75 inch at these locations because a storm of this size did not occur within the sampling period.

Wet weather surface water samples were collected from five sample locations in the Dominguez Channel during two rainfall events with precipitation exceeding 0.20 inch. Surface water samples were collected from 10 sample locations in the Consolidated Slip during one rainfall event with precipitation exceeding 0.20 inch.

5.8.2.1 Surface Water Samples Near the Property

Pesticides and VOCs were analyzed in 14 discrete surface water samples collected from three locations near the Property during wet weather. Fourteen unfiltered and five filtered surface water samples were submitted to the laboratory for pesticide analysis.

Three unfiltered pesticide sample results from Sample Locations SW-1, SW-2, and SW-3 were downgraded by EPA to validation flag "R" and, therefore, are not considered usable by EPA for the RI (Section 3.3). The following discussion of the nature and extent of pesticides in the surface water near the Property does not include the results of these samples.

Sample Location SW-1 was situated along a portion of the Jones Chemical Company Ditch. Surface water samples were collected at this location from water ponded behind a small obstruction in the concrete-lined ditch.

Sample Location SW-2 was located where runoff from the Jones Chemical Company and Montrose properties merge. Sample Location SW-3 was located at the end of the Normandie Avenue Ditch, immediately upstream from the opening in the concrete wall on the Farmer Brothers Property. Surface water samples were collected at these locations from water ponded behind the blocked opening in the concrete wall on the Farmer Brothers Property. Surface water flowing south across the LADWP right-of-way and along the

Normandie Avenue Ditch frequently ponded when the opening in the concrete wall became blocked with debris.

Total DDT and total BHC were detected in the unfiltered surface water samples collected near the Property during wet weather, as shown in Tables 5.13 and 5.14. Total DDT was detected in 10 of these 11 unfiltered surface water samples at concentrations ranging from 1.3 µg/L to 45 µg/L. The maximum concentration of total DDT was detected in the unfiltered sample collected from Sample Location SW-3 (Figure 5.79). Total BHC was detected in 9 of these 11 unfiltered surface water samples at concentrations ranging from 0.08 µg/L to 2.1 µg/L. The maximum concentration of total BHC was detected in the unfiltered sample collected from Sample Location SW-3 (Figure 5.80).

Total DDT and total BHC were detected in the filtered surface water samples collected near the Property during wet weather. Total DDT was detected in one of the five filtered surface water runoff samples at a concentration of 0.74 µg/L. Total DDT was detected in the filtered surface water sample from Sample Location SW-2. Total BHC was detected in two of the five filtered surface water runoff samples at concentrations of 0.068 µg/L and 0.19 µg/L. The maximum concentration of total BHC was detected in the filtered sample collected from Sample Location SW-2.

The difference in DDT concentrations between unfiltered and filtered surface water samples may be due to the potential for pesticides to be adsorbed to and transported with sediment in surface water.

VOCs were detected in 9 of the 14 unfiltered surface water samples collected near the Property (Table 5.15). Filtered samples were not analyzed for VOCs. Chloroform was detected in 7 of the 14 unfiltered samples at concentrations ranging from 4 µg/L to 550 µg/L. The maximum concentration of chloroform was detected in a sample collected from Sample Location SW-1, in the Jones Chemical Company Ditch. Chloroform concentrations in samples collected from Sample Location SW-1 ranged from 77 µg/L to 550 µg/L. Toluene was detected in 6 of the 14 unfiltered samples at concentrations ranging from 1 µg/L to 160 µg/L. The maximum concentration of toluene was detected in a sample collected from Sample Location SW-1, in the Jones Chemical Company Ditch. Chloroform and toluene were the two most commonly detected VOCs in surface water near the Montrose Property. Chloroform occurs in groundwater at the Montrose Site at concentrations up to 35,000 µg/L. Chloroform was also detected at Sampling Location SW-3, a surface drain feeding the Kenwood Drain at a concentration of 4 µg/L at the adjacent Farmer Brothers Company facility. Therefore, chloroform in surface water appears to originate either from Montrose Site contamination, the Jones Chemical facility, or the Farmer Brothers facility.

Other VOCs detected in the surface water samples collected near the Property included 1,1,1-TCA, acetone, bromodichloromethane, chloromethane, methylene chloride, and vinyl chloride at concentrations less than 10 µg/L. Because acetone and methylene chloride are common laboratory contaminants, the presence of these compounds may be attributable to laboratory cross-contamination.

5.8.2.2 Torrance Lateral Surface Water Samples

Pesticides and VOCs were analyzed in 10 discrete surface water samples collected from two locations in the Torrance Lateral during wet weather. Ten unfiltered and four filtered surface water samples were submitted to the laboratory for pesticide analysis. One

unfiltered pesticide sample result from Sample Location SW-4 was downgraded by EPA to validation flag "R" and, therefore, is not considered usable by EPA for the RI. The following discussion of the nature and extent of pesticides in surface water in the Torrance Lateral does not include the result of this sample. Sample Location SW-4 was located at the Kenwood Drain outfall. Sample Location SW-5 was located approximately 4,000 feet downstream from Sample Location SW-4.

Total DDT and total BHC were detected in the unfiltered surface water samples collected from the Torrance Lateral during wet weather. Total DDT was detected in six of the nine unfiltered surface water samples at concentrations ranging from 0.16 µg/L to 5.1 µg/L (Table 5.13; Figure 5.81). The maximum concentration of total DDT was detected in an unfiltered sample collected from Sample Location SW-5. Total BHC was detected in six of the nine unfiltered surface water samples at concentrations ranging from 0.08 µg/L to 0.59 µg/L (Table 5.14; Figure 5.82).

Total DDT was not detected in the filtered surface water runoff samples collected from the Torrance Lateral during wet weather. Total BHC was detected in filtered surface water runoff samples collected from the Torrance Lateral during wet weather. Total BHC was detected in two of the four filtered surface water runoff samples at concentrations of 0.076 µg/L and 0.43 µg/L (Table 5.14; Figure 5.82). The maximum concentration of total BHC was detected in a filtered sample collected from Sample Location SW-5.

VOCs were detected in 7 of the 10 unfiltered surface water samples collected from the Torrance Lateral (Table 5.15). Filtered samples were not analyzed for VOCs. Chloroform was detected in 1 of the 10 unfiltered samples, at a concentration of 4 µg/L. This sample was collected from Sample Location SW-5.

1,1,1-TCA was detected in 6 of the 10 unfiltered samples at concentrations ranging from 2 µg/L to 29 µg/L. The maximum concentration of 1,1,1-TCA was detected in a sample collected from Sample Location SW-4. Acetone was detected in surface water samples at concentrations ranging from 40 µg/L to 210 µg/L from Sample Locations SW-4 and SW-5, respectively. Because acetone is a common laboratory contaminant, the presence of acetone may be attributable to laboratory cross-contamination.

5.8.2.3 Dominguez Channel Surface Water Samples

Pesticides and VOCs were analyzed in 10 discrete surface water samples collected from five locations in the Dominguez Channel during wet weather. Ten unfiltered and five filtered surface water samples were submitted to the laboratory for pesticide analysis.

One unfiltered pesticide sample result from SW-9 was downgraded by EPA to validation flag "R" and, therefore, not considered usable by EPA for the RI. The following discussion of the nature and extent of pesticides in surface water in the Dominguez Channel does not include the results of this sample. Sample Locations SW-6 through SW-10 were located from approximately 1.5 miles upstream to 3.5 miles downstream from the confluence of the Dominguez Channel and the Torrance Lateral.

As shown in Figure 5.81, total DDT was not detected in the unfiltered or filtered surface water samples collected from the Dominguez Channel during wet weather. Total BHC was detected in the unfiltered and filtered surface water samples collected from the Dominguez Channel during wet weather. As shown in Figure 5.82, total BHC was detected in five of the nine unfiltered surface water samples at concentrations ranging from 0.07 µg/L to

0.11 µg/L. The maximum concentration of total BHC was detected in an unfiltered sample collected from Sample Location SW-8.

Total BHC was detected in the five filtered surface water samples at concentrations ranging from 0.06 µg/L to 0.11 µg/L. The maximum concentration of total BHC was detected in a filtered sample collected from Sample Location SW-6.

VOCs were detected in the 10 unfiltered surface water samples collected from the Dominguez Channel. Filtered samples were not analyzed for VOCs. 1,1,1-TCA was detected in 9 of the 10 unfiltered samples at concentrations ranging from 2 µg/L to 11 µg/L. The maximum concentration of 1,1,1-TCA was detected in samples collected from Sample Locations SW-9 and SW-10.

Other VOCs detected in the surface water samples collected from the Dominguez Channel were acetone, benzene, methylene chloride, and PCE, at concentrations less than 11 µg/L. Because acetone and methylene chloride are common laboratory contaminants, the presence of these compounds may be attributable to laboratory cross-contamination.

5.8.2.4 Consolidated Slip Surface Water Samples

Pesticides and VOCs were analyzed in 10 discrete surface water samples collected from 10 locations in the Consolidated Slip during wet weather, as shown in Tables 5.13 through 5.15. Sample Locations SW-11 through SW-20 were located at the ends of piers situated throughout the slip. All samples were analyzed unfiltered.

Pesticides were not detected in the 10 unfiltered samples collected from the Consolidated Slip during wet weather.

Acetone was the only VOC detected in the surface water samples collected from the Consolidated Slip during wet weather. Acetone was detected in two of these surface water samples at a maximum concentration of 13 µg/L. Because acetone is a common laboratory contaminant, the presence of acetone may be attributable to laboratory cross-contamination.

Note to Reader

EPA laboratory protocols require that the analytical results for soil samples be reported on a dry-weight basis. For reasons unknown to EPA, analytical results for soil samples collected and analyzed by Montrose during the period of 1981 to 1988 were reported by the laboratories on a wet-weight basis. Higher concentrations would have been indicated in these soil samples if the analytical results were reported, as required by EPA, on a dry-weight basis. As discussed in Section 4.1.2.4, soil samples collected from unsaturated soil above the water table ranged in moisture content from less than 1 percent to approximately 29 percent by weight. A typical moisture content for soil in the unsaturated zone was on the order of 12 percent by weight. A concentration of 1 mg/kg DDT reported on a wet-weight basis would therefore be equivalent to a dry-weight DDT concentration of between 1.01 mg/kg and 1.29 mg/kg, assuming the original sample had a moisture content comparable to those observed at the Site. On average, dry-weight concentrations, if reported, would be expected to be approximately 12 percent greater than the reported wet-weight concentrations. Therefore, it should be noted that the soil sample results from 1981 to 1988 in this report are, on average, approximately 12 percent lower than what should have been reported using standard EPA reporting protocols.

Table 5.1A
Summary of RI Soil Results

	On-Property Soil		Off-Property Soil				
Contaminants	**Central Process Area**	**Outside Central Process Area**	**Property Perimeter**	**Normandie Avenue Ditch**	**Jones Chemical Co. Property**	**LADWP Right of Way**	**Farmer Bros. Coffee**
Total DDT (Pre-Grading*) (residential PRG=1.3 mg/kg)							
0-6 ft bls, stockpiled soil	All samples exceed PRG, 50 percent exceed 1,000 mg/kg, maximum concentration of 15,000 mg/kg.	Over 90 percent of samples exceed PRG, 40 percent exceed 1,000 mg/kg, maximum concentration of 710,000 mg/kg in northwest corner.	No samples.	No samples.	No samples.	No samples.	No samples.
Total DDT (Post-Grading) (residential PRG=1.3 mg/kg)							
0-3 feet bls	Over 85 percent of samples exceed PRG, over 50 percent exceed 1,000 mg/kg, maximum concentration of 8,780 mg/kg.	Over 90 percent of samples exceed PRG, over 50 percent exceed 1,000 mg/kg, maximum concentration of 7,620 mg/kg in western portion of the property.	Approximately 20 percent of samples exceed PRG, mostly outside western property boundary.	Approximately 64 percent of samples exceed PRG. Concentrations are greater at 2 feet bls than at surface and they increase closer to Property, maximum concentration of 8,600 mg/kg.	Approximately 30 percent of samples exceed PRG. Maximum concentration of 805 mg/kg in northwest corner. Contamination mainly in top 2 feet.	Approximately 55 percent of samples exceed PRG. Maximum concentration of 686.5 mg/kg in eastern portion of the property.	Less than 25 percent of samples exceed PRG. Maximum concentration of 4.8 mg/kg.
3-6 feet bls	Over 55 percent of samples exceed PRG, over 40 percent exceed 1,000 mg/kg. Maximum concentration of 4,460 mg/kg.	About 40 percent of samples exceed PRG. Maximum concentration of 2,932 mg/kg east of Central Process Area.	1 of 22 samples exceed PRG. Maximum concentration of 3.8 mg/kg north of Property.	Approximately 30 percent of samples exceed PRG. Maximum concentration of 140 mg/kg. Highest concentrations closest to Property.	2 of 39 samples exceed PRG. Maximum concentration of 22.72 mg/kg north near Property.	No samples exceed PRG.	No samples exceed PRG.
6-10 feet bls	About 65 percent of samples exceed PRG, about 35 percent exceed 1,000 mg/kg. Maximum concentration of 9,900 mg/kg.	Approximately 9 percent of samples exceed PRG. Maximum concentration of 550 mg/kg.	Neither of 2 samples exceed PRG.	None of 3 samples exceed PRGs.	No samples exceed PRG.	No samples.	No samples exceed PRG.
10-70 feet bls	Over 70 percent of samples exceed PRG, over 30 percent exceed 1,000 mg/kg. Maximum concentration of 12,621 mg/kg.	DDT mostly not detected, but approximately 7 percent of samples exceed PRG. Maximum concentration of DDT detected below 50 feet bls, close to water table in MW003 of 3.39 mg/kg.	No samples.	1 of 36 samples located at depth of 13.75 feet bls exceeds PRG.	Less than 20 percent exceed PRG. Samples at 15 and 35 bls near dry well exceed PRG.	No samples.	No samples.
Greater than 70 feet bls	Over 80 percent of samples exceed PRG, over 25 percent exceed 1,000 mg/kg. Maximum concentration of 69,000 at 78 feet bls.	Two detections in MW003, but all samples below PRG.	No samples.	No samples.	No samples.	No samples.	No samples.
Chlorobenzene (Residential PRG= 65 mg/kg)							
0-3 feet bls	None exceed PRG. Maximum concentration of 7.1 mg/kg.	Only one sample exceeds PRG. Maximum concentration of 360 mg/kg detected east of Central Process Area.	No detections.	None exceed PRG. Detected in about 10 percent of samples.	None exceed PRG. Detected in less than 35 percent of samples.	No detections.	No samples.
3-6 feet bls	None exceed PRG. Maximum concentration of 20 mg/kg. Detected in approximately 57 percent of samples.	None exceed PRG. Detected in less than 50 percent of samples.	No detections.	None exceed PRG. Detected in 1 of 52 samples.	None exceed PRG. Detected in approximately 30 percent of samples.	No detections.	No samples.

Table 5.1A
Summary of RI Soil Results

	On-Property Soil		Off-Property Soil				
Contaminants	**Central Process Area**	**Outside Central Process Area**	**Property Perimeter**	**Normandie Avenue Ditch**	**Jones Chemical Co. Property**	**LADWP Right of Way**	**Farmer Bros. Coffee**
6-10 feet bls	Over 35 percent exceed PRG. Maximum concentration of 8,200 mg/kg.	None exceed PRG. Detected in over 30 percent of samples.	No detections.	No detections.	None exceed PRG. Detected in over 50 percent of samples.	No samples.	No samples.
10-70 feet bls	Approximately 42 percent exceed PRG. Maximum concentration of 14,000 mg/kg.	None exceed PRG. Approximately 25 percent detections. Maximum concentration detected below 50 feet bls, close to water table in MW003.	No samples.	No detections.	None exceed PRG. Detected in over 80 percent of samples.	No samples.	No samples.
Greater than 70 feet bls	Approximately 40 percent exceed PRG. Maximum concentration of 81,000 mg/kg.	None exceed PRG. Detected in approximately 80 percent of samples.	No samples.	No samples.	No samples.	No samples.	No samples.
Total BHC (residential PRG = 0.071 mg/kg)							
0-3 feet bls	No samples.	Detected above PRG in only sample. Maximum concentration of 35.1 mg/kg near former location of BHC plant.	Exceeds PRG in one sample outside western boundary and one outside eastern boundary. Total of 14 perimeter samples analyzed.	Approximately 28 percent of samples exceed PRG. Maximum concentration of 4.4 mg/kg.	Approximately 10 percent exceed PRG. Maximum concentration of 73 mg/kg.	Twelve percent exceed PRG. Maximum concentration of 17 mg/kg.	Approximately 13 percent exceed PRG. Maximum concentration of 4.6 mg/kg.
3-6 feet bls	Detected above PRG in 1 of 4 samples. Maximum concentration of 0.401 mg/kg.	Two of 16 samples (12 percent) exceeds PRG. Maximum concentration of 27 mg/kg.	Detected and exceeds PRG in one of 22 samples (approximately 4 percent).	18 percent exceed PRG.	Five percent exceed PRG. Detected in over 40 percent of samples.	None exceed PRG. Detected in over 14 percent of samples (one sample).	None exceed PRG. Detected in approximately 2 percent of samples (one sample).
6-10 feet bls	Over 9 percent (one sample) exceed PRG. Maximum concentration of 14.17 mg/kg. Detection limits greatly exceed PRG in many samples.	None exceed PRG. Detected in over 5 percent of samples (one sample) near former BHC plant.	No detections.	None exceed PRG. Detected in over 30 percent of samples (one sample).	None exceed PRG. Detected in approximately 70 percent of samples.	No samples.	No detections.
10-70 feet bls	Over 23 percent exceed PRG. Maximum concentration of 51.9 mg/kg. Detection limits greatly exceed PRG in many samples.	No detections.	No samples.	None exceed PRG. Detected in over 55 percent of samples.	None exceed PRG. Detected in over 50 percent of samples.	No samples.	No samples.
Greater than 70 feet bls	No detections. Detection limits greatly exceed PRG in many samples.	No samples.	No samples.	No samples.	No samples.	No samples.	No samples.
Chloroform (Residential PRG=0.25)	No samples 0-3 feet bls. The PRG is exceeded in about 20 to 40 percent of samples in each depth interval between 3 and 70 feet bls. Maximum concentration of 72 mg/kg at 9.5 feet bls.	No samples 0-3 feet bls. The PRG in two samples between 3 to 6 feet bls. Below 6 feet bgs, no sample exceed the PRG.	No samples 0-3 feet bgs. No detections in all depths.	Sporadic detections. One sample exceeds PRG on south end of ditch.	Sporadic low level detections between 0-20 feet bls. Several samples exceed PRG.	No detections.	Not sampled.
Benzene (Residential PRG=0.63)	Not detected at all depths.	Not detected at all depths.	Not detected at all depths.	Not detected at all depths.	Sporadic detections from 3-20 feet bls.	Not detected at all depths.	Not detected at all depths.

Table 5.1A
Summary of RI Soil Results

	On-Property Soil		Off-Property Soil				
Contaminants	**Central Process Area**	**Outside Central Process Area**	**Property Perimeter**	**Normandie Avenue Ditch**	**Jones Chemical Co. Property**	**LADWP Right of Way**	**Farmer Bros. Coffee**
PCE (PRG=5.4 mg/kg)	Three low-level detections. Maximum concentration of 2 mg/kg near wastewater settling pond.	Sporadic low level detections mostly on east side of Property.	Two detections.	No detections.	Frequently detections above PRG at all depths in general area of dry well and former location of PCE storage tank.	Three detections.	Not sampled.
Dichlorobenzene	Frequent detections of dichlorobenzene at all depths, primarily in the Central Process Area. Maximum concentrations of 370 mg/kg occurred at Central Process Area, as well as most exceedances of the PRG of 3.6 mg/kg for 1,4-dichlorobenzene.						
Acetone	Frequent detections, well below PRG.						
Methylene Chloride	Frequent detections, with some above PRG. Potential laboratory contaminant.						
Ethylbenzene	Detected in 4 percent of samples. Maximum concentration of 410 mg/kg detected at Jones Chemical exceeds PRG (230 mg/kg).						
Total Xylenes	Detected in 5 percent of samples. All samples were below the PRG. Maximum concentration of 19 mg/kg found in Central Process Area.						
Methyl Ethyl Ketone	Detected in 34 percent of samples. All samples ere below the PRG. Maximum concentration of 45 mg/kg detected in Central Process Area.						
Base Neutral/Acid Organic Compounds	Infrequent detections. Common laboratory contaminants detected most frequently.						
Chloral	Not detected.						
Trace Metals	Isolated detections of metals, including lead up to 999 mg/kg in the Central Process Area.						

*This table does not include 1981 sampling by Montrose.

Table 5.1E
Summary of Groundwater Contamination

Hydrogeologic Unit	Upper Bellflower Aquitard (UBA)			Bellflower Sand			Gage Aquifer			Lynwood Aquifer		
Contaminant	**Size of plume**	**% Detection**	**Min/Max Conc.**	**Size of plume**	**% Detect**	**Min/Max. Conc.**	**Size of plume**	**% Detect**	**Min/Max. Conc.**	**Size of plume**	**% Detect**	**Min/Max. Conc.**
DNAPL	DNAPL visually observed in soil and groundwater samples below Central Process Area in area 250 by 300 feet; inferred extent based on chlorobenzene concentrations is 250 by 400 feet.	NA	NA	No visual observations of DNAPL in Bellflower Sand; DDT concentrations in soil up to 130 mg/kg may indicate the past or present occurrence of DNAPL.	NA	NA	No direct evidence of DNAPLs; sporadic detections of DDT in groundwater samples combined with high chlorobenzene concentrations may indicate the past presence of DNAPL.	NA	NA	No evidence of DNAPL presence	NA	NA
Total DDT	A zone of historically detected DDT is 1,500 feet by 1,500 feet; DDT detections occur beneath the Central Process Area and within 500 feet of Montrose property.	DDT detected in 13 of 33 wells: detected in 6 wells during most recent sampling, 3 within the Central Process Area (CPA), and 4 outside of CPA.	Historical range is 0.03 µg/L to 1,100,000 µg/L; average values range from 0.2 to 401,000 µg/L.	Area of detected DDT approximately 700 by 1,200 feet beneath the Central Process Area.	DDT historically detected in 5 of 34 wells; detected in 3 wells during most recent sampling.	Historical values range from 0.03 µg/L to 23 µg/L; average values for each well range from 2.73 to 11 µg/L.	Contourable plume is not apparent due to sporadic detections.	Historical DDT detections in 7 of 21 wells, 2 of 21 in last sampling.	Historical detections range from 0.03 to 52 µg/L; average detected values range from 0.25 to 17.4 µg/L.	None.	DDT was detected in 1 of 7 wells (Well LW-01); detected only in the first of 8 samplings.	0.046 µg/L is the only detected value.
Total BHC	Plume is approximately 2,000 feet by 1,500 feet, and centered under southeastern portion of Site; a second small plume is present near Armco Site.	Historically detected in 13 of 29 wells; detected in 8 wells during most recent sampling.	Historical range is 0.08 µg/L to 330 µg/L; average detected values range from 0.19 µg/L to 295 µg/L.	Plume is approximately 700 feet by 1,000 feet and centered under southeastern quarter of Site; a second plume present near Armco Site.	Historically detected in 10 of 34 wells, detected in 4 wells during most recent sampling.	Historical values range from 0.01 µg/L to 15 µg/L; average values for each well range from 0.03 to 4.20 µg/L.	Contourable plume is not apparent due to sporadic detections.	Historically detected sporadically in 5 of 21 wells; not detected in most recent sampling.	Historical detections range from 0.02 to 0.82 µg/L; not detected in any well during most recent sampling.	None.	BHC has not been detected in any of the 7 wells.	BHC has never been detected.
Chlorobenzene	Plume is approximately 2,000 feet by 2,500 feet, and centered under the Central Process Area; three separate small plumes are present northeast of the Site, near the Armco Site, and adjacent to the Harbor Freeway.	Historically detected in 25 of 33 wells; detected in 21 wells in most recent analysis.	Historical concentrations range from less than 1 µg/L to 1,000,000 µg/L in Well UBT-01, where DNAPL is present. Concentrations beneath Central Process Area average approximately 300,000 µg/L to 500,000 µg/L.	Plume extent (chlorobenzene > 10 µg/L) is approx. 5,000 feet by 7,500 feet; highest concentrations originate at the Central Process Area. The plume core (>10,000 µg/L) is approximately 1,000 feet by 4,000 feet.	Chlorobenzene was detected in 26 of 34 wells during most recent sampling.	Historical detected concentrations range from 2 µg/L to 66,000 µg/L; most recent sampling ranged from 5 µg/L to 45,000 µg/L. Average concentrations in plume core range from approximately 12,000 to 38,000 µg/L.	The chlorobenzene plume is approximately 2,000 feet by 5,000 feet; chlorobenzene at Well G-19 at Armco Site may be due to migration from overlying chlorobenzene plume in the Bellflower Sand.	Chlorobenzene has been historically detected in 18 of 21 wells; detected in 16 of 21 wells in most recent sampling.	Detected chlorobenzene concentrations have historically ranged from 2 µg/L to 22,000 µg/L; detected values ranged from 4 µg/L to 14,000 µg/L in most recent sampling. Average values in plume core range from approximately 1,600 µg/L to 14,000 µg/L. Concentrations in Well G-19 have increased from 1 µg/L to 2,600 µg/L in most recent sampling.	Plume size is estimated to be less than 500 feet in width and 1,000 feet in length. Chlorobenzene may potentially be due to leakage as a result of the installation of Well LW-01.	Chlorobenzene detected in 1 of 7 monitoring wells (Well LW-01).	Chlorobenzene in groundwater from Well LW-01 has increased from less than 1 µg/L in 1989 to 530 µg/L in 1995.

Table 5.1E
Summary of Groundwater Contamination

Hydrogeologic Unit	Upper Bellflower Aquitard (UBA)			Bellflower Sand			Gage Aquifer			Lynwood Aquifer		
Contaminant	**Size of plume**	**% Detection**	**Min/Max Conc.**	**Size of plume**	**% Detect**	**Min/Max. Conc.**	**Size of plume**	**% Detect**	**Min/Max. Conc.**	**Size of plume**	**% Detect**	**Min/Max. Conc.**
p-CBSA	The extent of the p-CBSA plume exceeding 100 µg/L is approximately 2,000 feet by 2,800 feet with the highest concentrations occurring beneath the Central Process Area; a second small plume is located downgradient near the Armco Site.	p-CBSA has been detected in 10 of the 20 Upper Bellflower Aquitard monitoring wells (of 33 total) analyzed for this chemical.	Detected concentrations range from 96 µg/L to 11,000,000 µg/L (11 mg/L); highest concentrations associated with DNAPL presence in Well UBE-01. Concentrations in secondary p-CBSA plume are 370 to 30,000 µg/L.	The width and length of the p-CBSA plume 1,000 µg/L isocontour is approximately 6,000 feet and 7,000 feet, respectively. The full downgradient extent is not known, but extends at least to the Harbor Freeway.	30 of 34 wells have been analyzed for p-CBSA; of these, p-CBSA has been detected in 26 wells.	Detected p-CBSA concentrations range from 180 u/L to 120,000 µg/L; the highest concentrations occur 2,000 feet downgradient of the Central Process Area at concentrations of 110,000 µg/L.	The p-CBSA plume at concentrations above 100 µg/L is approximately 2,100 feet by 4,500 feet; p-CBSA at Well G-19 may be due to leakage of contaminated groundwater from the overlying plume in the Bellflower Sand.	Eighteen of 21 wells have been analyzed for p-CBSA; of these p-CBSA has been detected in 15 wells.	Detected p-CBSA has ranged from 170 µg/L to 38,000 µg/L; concentrations in the plume core generally exceed 20,000 µg/L.	The estimated width and length of the p-CBSA plume, based on only two wells is approximately 400 feet and at least 1,000 feet; the downgradient extent of the plume is not known.	Six of the 7 Lynwood Aquifer wells have been tested for p-CBSA; of these, p-CBSA has been detected in 2 wells.	Detected values have ranged from 270 to 2,100 µg/L.
Chloroform	The chlorobenzene plume is approximately 2,500 feet wide by at least 2,500 feet in length. Separate plumes are present northeast of the Montrose Site in the Del Amo Site vicinity and in the Armco Site vicinity. A source may be present north of Montrose in the McDonnell Douglas Corp.	Chloroform has been detected in 25 of 33 UBA wells.	Detected chloroform concentrations have ranged from 9 µg/L to 85,000 µg/L. Concentrations in the Armco vicinity chloroform plume are up to 160 µg/L.	A definable plume is not present based on the most recent data; due to elevated detection limits (up to 300 µg/L), a plume could be present, but undetected.	Chloroform has been sporadically detected in 6 of 34 Bellflower Sand wells. In most recent sampling, chloroform was detected in only 2 wells, one at Montrose (BF-09) and one at the Armco Site (BF-24).	Detected chloroform concentrations have ranged from 2 to 710 µg/L. The highest concentrations have been from BF-09 beneath the Central Processing Area.	No plume is visible, only scattered and sporadic detections.	Historically, chloroform has been sporadically detected in 4 of 21 Gage Aquifer wells; during the most recent sampling chloroform was detected in only 1 of 21 wells.	Maximum concentrations have ranged from 4.2 to 120 µg/L. The highest concentration was detected in a groundwater sample from Well G-5, located in the LADWP right-of-way.	Data are insufficient to define a plume.	Chloroform has been detected in 2 of 7 Lynwood wells (LW-05 and LW-07).	Concentrations have ranged from 1 to 2 µg/L.
Benzene	Widespread benzene contamination (5,000 by 6,000 feet) is present with the highest concentrations present to the east of the Montrose Site within the Del Amo Site property. A separate benzene plume is located downgradient in the Armco Site vicinity. Another hot spot is present to the southwest of Montrose in the LADWP right-of way.	Benzene was detected in 16 of 30 wells during the most recent sampling.	Historical benzene concentrations have ranged from 2.9 to 1,800,000 µg/L with the highest concentrations at the adjacent Del Amo Site. The highest on-Site concentrations have occurred on the eastern portion of the Site adjacent to the LADWP right-of-way.	A benzene plume with concentrations exceeding 100,000 µg/L is present east of the Site on the Del Amo Site property. In addition a benzene plume approximately 5,500 feet in length extends from the Central Process Area to the Armco Site.	Benzene was detected in 9 of the 34 Bellflower Sand monitoring wells during the most recent sampling event.	Most recent concentrations of benzene in Montrose monitoring wells range from 5.9 to 15,000 µg/L. The core of the plume that appears to originate at Montrose averaged approximately 20 to 60 µg/L during the most recent sampling.	A benzene plume approximately 1,200 feet by 3,000 feet is present with the high concentration core located approximately 1,000 feet southwest of the Montrose Site property. Contamination at Well G-19 may represent migration from the overlying Bellflower Sand.	Benzene was detected in 6 of the 21 Gage Aquifer monitoring wells during the most recent sampling event.	Historical benzene concentrations have ranged from 1.3 to 1,300 µg/L. Benzene concentrations during the most recent round ranged from 1.3 to 19 µg/L; concentrations within the plume core range from 13 to 19 µg/L.	Only 1 well is contaminated. The plume appears to be contained within the Montrose property.	Benzene has been detected in 1 of 7 Lynwood Aquifer wells.	Benzene has been detected in 3 of 12 groundwater samples from Well LW-1 at concentrations less than 6 µg/L.

Table 5.1E
Summary of Groundwater Contamination

Hydrogeologic Unit	Upper Bellflower Aquitard (UBA)			Bellflower Sand			Gage Aquifer			Lynwood Aquifer		
Contaminant	**Size of plume**	**% Detection**	**Min/Max Conc.**	**Size of plume**	**% Detect**	**Min/Max. Conc.**	**Size of plume**	**% Detect**	**Min/Max. Conc.**	**Size of plume**	**% Detect**	**Min/Max. Conc.**
Ethylbenzene, Toluene, Xylenes, and 1,2-DCA	Detections of these chemicals most frequently occur Off-Property in the LADWP right-of-way, at the Del Amo Site, and near the Armco Site.	Ethyl benzene, toluene, total xylenes, and 1,2-DCA, historically have been detected in 14, 16, 11, and 9 of the 33 UBA wells, respectively. In the most recent sampling they were detected in 5, 7, 7, and 4 wells, respectively.	Maximum concentrations of ethyl benzene, toluene, total xylenes, and 1,2-DCA have ranged from 3 to 46,000 µg/L, 1 to 40,000 µg/L, 70 to 13,800 µg/L, and 3 to 4,100 µg/L, respectively.	Detections of these chemicals occur most frequently in Off-Property wells located adjacent to the Del Amo Site and the LADWP right-of-way.	Ethyl benzene, toluene, total xylenes, and 1,2-DCA, historically have been infrequently detected in 5, 6, 3, and 4 of the 33 Bellflower Sand wells, respectively.	Maximum concentrations of ethyl benzene, toluene, total xylenes, and 1,2-DCA have ranged from 1.3 to 4,500 µg/L, from 1.9 to 2,000 µg/L, from 6.8 to 25 µg/L, and from 2.7 to 60 µg/L, respectively.	With the exception of Well G-1, all Gage Aquifer monitoring wells with detectable ethyl benzene, toluene, total xylenes, and 1,2-DCA are located in the vicinity of benzene and fuel hydrocarbon sources located in the LADWP right-of way and the Del Amo Site.	Ethyl benzene, toluene, total xylenes, and 1,2-DCA, historically have been detected in 2, 8, 1, and 1 wells, respectively of 21 Gage Aquifer wells. During the most recent sampling they were detected in 1, 1, 0, and 0 wells, respectively.	The most recent ethyl benzene, toluene, total xylenes, and 1,2-DCA concentrations are 1.3 to 310 µg/L, <0.5 to 6.0 µg/L, <1 to 6.8, and <0.5 to 3.0 µg/L, respectively.	No plumes or detections.	Ethyl benzene, toluene, total xylenes, and 1,2-DCA were not detected in groundwater from Lynwood Aquifer wells.	Ethyl benzene, toluene, total xylenes, and 1,2-DCA were not detected in groundwater from Lynwood Aquifer wells.
PCE	A plume of PCE is located along the southern boundary of the Montrose Property and eastern portion of the Jones Chemical property. Approximate dimensions are 1,500 feet by 2,500 feet. Four additional smaller plumes are located on the Del Amo Site property vicinity and the Amoco Chemical Co. Site property.	PCE was detected in 14 of 30 wells during the most recent sampling.	The PCE concentrations from the most recent sampling event range from 2 to 3,800 µg/L.	Data are insufficient to contour a PCE plume. Given the elevated detection limits for many wells, it is possible that a PCE plume is present that extends from the Central Process Area to Well BF-24.	PCE was detected in 4 wells historically and in 3 wells during the most recent sampling event.	PCE has historically ranged from 4.2 to 370 µg/L. During the most recent sampling, PCE concentrations ranged from 4 to 44 µg/L.	No plume is definable with available data. The PCE detection limits for wells in between Wells G-5 and G-19 are too high to assess if contamination exists between them.	PCE was detected in 1 of 15 samples from Well G-5 and 1 of 5 samples from Well G-19.	Detected PCE concentrations in Well G-5 and G-19 were 510 µg/L and 4.6 µg/L, respectively.	None.	PCE has not been detected in Lynwood Aquifer wells.	PCE has not been detected in Lynwood Aquifer wells.
TCE	TCE contamination occurs over a broad area east of Western Avenue to the Harbor Freeway. One discreet plume that underlies the Montrose Site appears to be centered beneath the Farmer Brothers property. Other TCE plumes occur upgradient of Montrose on the McDonnell Douglas Corp. property and to the northeast on the Del Amo Site property.	TCE historically has been detected in 15 of 33 UBA monitoring wells.	Detected TCE concentrations have ranged from 3.5 to 1,200 µg/L.	A TCE plume cannot be contoured from existing data. Given the elevated detection limits, a plume of TCE could potentially exist that extends from Well BF-18, located 500 feet north of the Montrose Site, to Well BF-07, located 500 feet downgradient of the Montrose Site property boundary.	TCE historically has been detected in groundwater from 5 of 34 wells and in 3 of 34 wells in the most recent sampling.	Detected TCE concentrations have ranged from 7 to 250 µg/L.	A TCE plume is not evident.	TCE has been detected in 2 of 21 Gage Aquifer monitoring wells.	TCE has been detected in 1 of 15 groundwater samples collected from Monitoring Well G-12 (10 µg/L) and in 9 of 9 samples from Well G-13 (25 to 61 µg/L).	No plume.	TCE has not been detected in Lynwood Aquifer wells.	TCE has not been detected in Lynwood Aquifer wells.

Table 5.1E
Summary of Groundwater Contamination

Hydrogeologic Unit	Upper Bellflower Aquitard (UBA)			Bellflower Sand			Gage Aquifer			Lynwood Aquifer		
Contaminant	**Size of plume**	**% Detection**	**Min/Max Conc.**	**Size of plume**	**% Detect**	**Min/Max. Conc.**	**Size of plume**	**% Detect**	**Min/Max. Conc.**	**Size of plume**	**% Detect**	**Min/Max. Conc.**
Dichlorobenzenes	A 1,4-dichlorobenzene (1,4-DCB) plume is present with its source at the Montrose Central Processing Area and a lateral extent of approximately 800 feet by 2,000 feet.	1,4-DCB, historically has been detected in 7 of 33 UBA wells and in 4 wells during the most recent sampling event.	Historical detected concentrations have ranged from 7.6 to 310 µg/L.	A plume of 1,4-DCB appears to extend from the Montrose Central Processing Area to the Armco Site. The plume length is approximately 4,000 feet.	1,4-DCB, historically has been detected in 10 of 34 Bellflower Sand wells and in 5 wells during the most recent sampling event.	Historical detected concentrations have ranged from 2.6 to 220 µg/L. In the most recent sampling event, concentrations ranged from 2.6 to 53 µg/L.	No plume is evident.	1,4-DCB, historically has been detected in 4 of 21 Bellflower Sand wells and in 1 well during the most recent sampling event.	Historical detected concentrations have ranged from 2.6 to 10 µg/L.	No plume is present.	1,4-DCB has not been detected in any well.	1,4-DCB has not been detected in any well.
Chloral	None.	None.	None.	None.	None.	None.	None.	None.	None.	None.	None.	None.
BNAs (semivolatiles)	No trend in the occurrence of base/neutral and acid extractable (BNA) organic compounds was observed.	Nine BNA compounds were detected.	Various.	No plume.	Only 1 BNA was detected [bis(2-ethylhexyl phthalate)]	25 µg/L bis(2-ethylhexyl phthalate).	No plume.	None.	None.	None.	None.	None.
Trace Metals	No plume of metals is apparent. Nickel, cadmium, iron, manganese, and thallium were sporadically and inconsistently detected at concentrations greater than their respective MCLs for drinking water. The greatest number of MCL exceedances are for iron and manganese.	Various, see Table 5.8	Various, see Table 5.8.	None.	Various, see Table 5.8	Various, see Table 5.8.	None.	Various, see Table 5.8.	Various, see Table 5.8.	None.	Various, see Table 5.8.	Various, see Table 5.8.

NA - Not Applicable

TABLE 5.1F

PREVALENCE OF VOLATILE ORGANIC COMPOUNDS AND PESTICIDES IN SOIL

COMPOUND	NUMBER OF DETECTS	NUMBER OF SAMPLES COLLECTED	PERCENTAGE OF DETECTS	MINIMUM OF DETECTED VALUES (mg/kg)	MAXIMUM OF DETECTED VALUES (mg/kg)	LOCATION OF MAXIMUM DETECTED VALUE	DEPTH OF MAXIMUM DETECTED VALUE (feet bls)	NUMBER OF BORINGS SAMPLED	MINIMUM SAMPLE DEPTH (feet bls)	MAXIMUM SAMPLE DEPTH (feet bls)
Total DDT	497	719	69	0.00056	12,621	S101	42.0	149	0.25	69.3
Chlorobenzene	234	614	38	0.00036	16,000	24D	11.0	101	0.25	69.3
Methyl Ethyl Ketone	55	163	34	0.0014	45	14D	9.5	60	0.25	61.75
TDC Benzene	28	96	29	0.3	370	14D	8.0	17	0.5	19.5
Total BHC	146	560	28	0.00027	73	LF48	1.5	117	0.25	69.3
Methylene Chloride	102	517	20	0.00048	21	S201	61.0	92	0.25	69.3
Acetone	76	445	17	0.001	86	S201	61.0	99	0.25	69.3
Toluene	96	568	17	0.0006	13	LF36	10.0	99	0.25	69.3
Chloroform	78	519	15	0.00058	72	14D	9.5	99	0.25	69.3
Tetrachloroethylene	68	516	13	0.00069	6,700	LF44	8.5	99	0.25	69.3
Trichloroethylene	44	517	8.5	0.00051	320	LF36	10.0	99	0.25	69.3
Total Xylenes	6	113	5.3	0.0078	19	14D	9.5	42	0.25	61.75
Ethylbenzene	21	517	4.1	0.00029	410	LF34	15.0	99	0.25	69.3
1,1-Dichloroethylene	19	517	3.5	0.00067	0.51	LF36	10.0	99	0.25	69.3
Benzene	14	519	2.7	0.00074	0.0065	LF6	10.0	99	0.25	69.3
Trichlorofluoromethane	3	354	0.9	0.4	1.2	S303	48.0	62	0.25	69.3
1,2-Dichlorobenzene	29	435	6.7	0.00039	85	LF36	10.0	92	0.25	69.3
1,3-Dichlorobenzene	6	399	1.5	0.00077	20	24D	5.0	90	0.25	69.3
1,4-Dichlorobenzene	36	435	8.3	0.00027	240	S101A	69.3	92	0.25	69.3

NOTES:

Soil sampling locations and analytical results provided on Figures 5.4 through 5.9 and Figures 5.12 through 5.43.

Analytical results for individual soil samples provided in Appendix H.

This table does not include analytical results reanalysis of EPA split or EPA split duplicate samples.

This tables also does not include analytical results for On-Property soil samples collected in 1981 or 1983 which are no longer representative of actual site conditions, nor does it include results for Off-Property soil samples collected at Farmer Brothers Company, and neighborhood and background soil samples collected at more distant Off-Property locations.

FOOTNOTES

mg/kg = Milligrams per kilogram
bls = below land surface
DDT = Dichlorodiphenyltrichloroethane
TDC Benzene = Total dichlorobenzene
BHC = Hexachlorocyclohexane

TABLE 5.2
BASE NEUTRAL/ACID ORGANIC COMPOUNDS IN SOIL

COMPOUND	TOTAL SAMPLES	NUMBER OF POSITIVIES	CONCENTRATION RANGE OF POSITIVES .....(mg/kg)..... MINIMUM	MAXIMUM	MINIMUM CONCENTRATION SAMPLE ID	MAXIMUM CONCENTRATION SAMPLE ID
1,2,4-Trichlorobenzene	73	4	0.12	50.0	S201-15.5-16.0	24D-11.5-12.5
2,4,6-Trichlorophenol	73	2	0.21	0.45	S201-16.5-17.0	S201-15.5-16.0
2-Chlorophenol	73	8	0.046	13.0	S204-50.5-51.0	24D-11.5-12.5
2,3-Dimethyl heptane	73	1	NA	0.69	NA	T33-1.0-1.5
2,4-Dichlorophenol	73	2	0.17	0.26	S201-16.5-17.0	S201-15.5-16.0
2,6-Dinitrotoluene	73	1	NA	0.68	NA	21D-9.0-9.5
2-Methylnaphthalene	73	1	NA	1.8	NA	NS013
3,4-Benzofluoranthene	73	3	0.44	0.66	MD2-2.75-3.25	VAN DEL SURF DEEP
4-Hydroxy-4-methyl-2-pentanone	73	1	NA	10.0	NA	NS001
4-Methyl-octane	1	1	NA	1.0	NA	T33-1.0-1.5
4-Methyl-3-penten-2-one	73	2	0.29	0.97	T33-1.0-1.5	NS001
Acenaphthene	73	1	NA	1.5	NA	NS013
Acenaphthylene	6	1	NA	0.42	NA	NS013
Anthracene	73	2	0.66	0.76	VAN DEL SURF DEEP	NS013
Benzo (a) anthracene	73	3	0.61	0.66	NS013	VAN DEL SURF DEEP
Benzo (k) fluoranthene	73	3	0.37	0.66	MD2-2.75-3.25	VAN DEL SURF DEEP
Benzo (ghi) perylene	73	2	0.66	1.1	VAN DELSURF DEEP	MD2-2.75-3.25
Benzo (a) pyrene	73	2	0.38	0.66	MD2-2.75-3.25	VAN DEL SURF DEEP
Benzoic acid	73	4	0.2	64.0	S201-60.5-61.0	24D-11.5-12.5
Bis (2-ethylhexyl) phthalate	73	34	0.053	4.7	S204-50.5-51.0	NS001
Butyl benzyl phthalate	73	1	NA	0.97	NA	NS001
Chrysene	73	3	0.65	2.3	MD2-2.75-3.25	NS013
Di-n-butyl phthalate	73	17	0.33	20.0	46D-4.5-5.0	24D-4.5-5.0
Di-n-octyl phthalate	73	1	NA	0.48	NA	LA003-2.25-2.75
Dibenzofuran	73	1	NA	3.4	NA	NS013
Fluoranthene	73	3	0.25	1.5	MD2-2.75-3.25	NS013
Fluorene	73	1	NA	2.4	NA	NS013
Hexachlorobenzene	73	1	NA	13.0	NA	24D-11.5-12.5
Hexachloroethane	73	1	NA	0.42	NA	S201-60.5-61.0

Note: Refer to page 2 of this table for footnotes.

TABLE 5.2 (continued)
BASE NEUTRAL/ACID ORGANIC COMPOUNDS IN SOIL

COMPOUND	TOTAL SAMPLES	NUMBER OF POSITIVIES	CONCENTRATION RANGE OF POSITIVES (mg/kg) MINIMUM	MAXIMUM	MINIMUM CONCENTRATION SAMPLE ID	MAXIMUM CONCENTRATION SAMPLE ID
Indeno (1,2,3-cd) pyrene	73	1	NA	0.66	NA	VAN DEL SURF DEEP
Isopropyl benzene		1	NA	3.4	NA	T33-1.0-1.5
Naphthalene	2	1	2.0	2.0	NS013	NS013
Phenanthrene	73	2	0.66	2.3	VAN DEL SURF DEEP	NS013

NOTE: Analytical results from individual soil samples are provided in Appendix H.

mg/kg = Milligrams per kilogram
ID = Identifier
NA = Not applicable

TABLE 5.3a

TRACE METALS IN SOIL

COMPOUND	TOTAL SAMPLES	CONCENTRATION RANGE OF POSITIVES (mg/kg) MINIMUM	MAXIMUM	MINIMUM CONCENTRATION SAMPLE ID	MAXIMUM CONCENTRATION SAMPLE ID	USEPA PRG FOR INDUSTRIAL SOIL (mg/kg)	USEPA PRG FOR RESIDENTIAL SOIL (mg/kg)
Aluminum	46	9,390.0	32,827.0	13D-3.5	12D-9.5	100,000	77,000
Arsenic	46	6.1	116.0	35A-9.5	VAN NOR SURF	2.4(a)	0.38(a) 22(b)
Barium	46	120.0	235.0	21D-3.5	24D-11.5-12.5	100,000	5,300
Cadmium	46	2.8	12.1	35A-4.5-5.0	14D-4.5-5.0	850	38(c)
Calcium	46	3,506.0	52,250.0	24D-11.5-12.5	14D-9.0-9.5	NA	NA
Chromium (total)	46	17.0	89.0	24D-4.5-5.0	15D-3.5	450	210
Copper	46	20.0	357.0	21D-3.5	24D-17.5-18.0	63,000	2,800
Iron	46	14,593.0	41,462.0	13D-3.0-3.5	12D-9.0-9.5	NA	NA
Magnesium	46	1,471.0	24,990.0	16D-4.5-5.0	VAN NOR SURF	NA	NA
Manganese	46	197.0	1,803.0	24D-11.5-12.5	21D-3.5	43,000	3,200
Mercury	46	0.1	26.0	14D-9.0-9.5	24D-4.5-5.0	NA	NA
Potassium	46	2,538.0	6,151.0	21D-3.0-3.5	21D-9.0-9.5	NA	NA
Sodium	46	2,549.0	5,358.0	21D-9.5	24D-17.5-18.0	NA	NA
Lead	46	0.1	999.0	ART NOR SURF	34D-4.5-5.0	1,000	400 130(c)
Nickel	46	21.0	59.0	14D-4.5-5.0	24D-17.5-18.0	34,000	1,500 150(c)
Selenium	46	2.9	5.9	12D-4.5-5.0	12D-4.0-4.5	8,500	380
Tin	46	25.0	26.0	22D-9.0-9.5	21D-9.0-9.5	100,000	46,000
Vanadium	46	26.5	72.6	24D-4.5-5.0	12D-9.5	12,000	540
Zinc	46	63.0	1,160.0	11D-4.0-4.5	34D-4.5-5.0	100,000	23,000

NOTE: Analytical results for individual soil samples are provided in Appendix H.

FOOTNOTES
(a) Cancer endpoint
(b) Non-cancer endpoint
(c) CAL-Modified PRG (EPA, 1996b)

USEPA = United States Environmental Protection Agency
PRG = Preliminary Remediation Goal (EPA, 1996b)
mg/kg = Milligrams per kilogram
ID = Identifier
NA = Not applicable

TABLE 5.3b
Analytical Results of Dense Nonaqueous Phase Liquid Samples
Collected from Monitoring Well MW-2 and Extraction Well UBE-1
(Concentrations in milligrams per kilogram)

Sample Date	Well Identifier	Chlorobenzene	Xylenes	Total DDT	Alpha BHC	Specific Gravity	pH	Specific Conductance (umhos/cm)
01/18/88	MW-2	530,000	<50	542,000	<500	1.3	NA	NA
03/18/88	MW-2	330,000	<50	870,000	<8,000	1.2	6.6	4
03/25/88	MW-2	450,000	<50	157,530	120	1.2	7.0	UTD
04/22/88	MW-2	410,000	<50	500,000	<8	1.2	5.0	UTD
07/27/88	MW-2	420,000	<50	3,100,000	<160,000	1.2	6.4	1,500
10/14/88	MW-2	440,000	<50	450,000	<40,000	1.2	6.9	3.7
02/09/89	MW-2	460,000	<50	420,000[a]	<5,000	1.1	NA	NA
05/14/91	UBE-1[b]	12,000	50	380,000	<4,000	NA	NA	NA

Source: Hargis & Associates, Inc., 1988R-e

[a]o.p - DDT detected at a concentration of 160,000 milligrams per kilogram

[b]Results for the sample UBE-1 are provided in mg/L; all other results are in mg/kg

DDT = Dichlorodiphenyltrichloroethane
BHC = Hexachlorocyclohexane
umhos/cm = Micromhos per centimeter
(<) = Less than; numerical value is the Limit of Detection for that compound
NA = Not analyzed
UTD = Unable to determine

Table 5.3c
Groundwater Samples Expressed as Percent Solubility of Chlorobenzene

Well	Chlorobenzene Concentration					Percent Solubility of Chlorobenzene (a)			
	Min.	Ave.	Max.	Most Recent Conc.	Most Recent Date	Min.	Ave.	Max.	Most Recent
MW-4	58	386	1,600	500	4/20/90	0.01	0.09	0.39	0.12
MW-5	8.4	91,450	200,000	8.4	11/28/95	0.00	22.30	48.78	0.00
MW-9	8,400	136,400	180,000	8,400	11/30/95	2.05	33.27	43.90	2.05
MW-19	<1	6.2	9	3.4	11/30/95	0.00	0.00	0.00	0.00
BF-01	370	466	570	480	4/18/90	0.09	0.11	0.14	0.12
BF-02	3,600	8,423	16,000	4,700	4/20/90	0.88	2.05	3.90	1.15
BF-03	9,000	14,538	23,000	9,000	4/20/90	2.20	3.55	5.61	2.20
BF-04	21,000	30,765	42,000	21,000	10/24/95	5.12	7.50	10.24	5.12
BF-09	11,000	15,889	20,000	14,000	11/30/95	2.68	3.88	4.88	3.41

[a]The effective solubility of chlorobenzene is assumed to be 410,000 ug/L based on an estimated DNAPL composition of 40 percent and 60 percent chlorobenzene (Section 6.2.2.1).

[b]Shaded areas exceed 1 percent solubility of chlorobenzene.

Table 5.3d.
Groundwater Samples Expressed as Percent Solubility of DDT

Well	Total DDT Concentration					Percent Solubility of DDT (a)			
	Min.	Ave.	Max.	Most Recent Conc.	Most Recent Date	Min.	Ave.	Max.	Most Recent
MW-4	<0.02	9.6	36	<0.04	4/20/90	<0.4	174.5	654.5	<0.7
MW-5	<0.2	1.5	5	<0.2	11/19/91	<3.6	27.3	90.9	<3.6
MW-9	<0.02	N/A	0.05	0.05	4/20/90	<0.4	N/A	0.9	0.9
MW-19	<0.02	N/A	<0.04	<0.02	11/19/90	<0.4	N/A	<0.7	<0.4
BF-01	<0.02	3.74	18	<0.04	4/18/90	<0.4	68.0	327.3	<0.7
BF-02	<0.04	2.73	15	<0.04	4/20/90	<0.7	49.6	272.7	<0.7
BF-03	<0.05	2.75	23	0.3	4/20/90	<0.9	50.0	418.2	5.5
BF-04	<0.2	1	2.3	0.97	11/19/91	<3.6	18.2	41.8	17.6
BF-09	5	11	21	5	4/19/90	90.9	200.0	381.8	90.9

[a]The assumed DDT solubility was 5.5 ug/L for p,p-DDT (solubilities of various DDT isomers are summarized in Table 6.2b).

[b]Shaded areas show samples for which the DDT concentration exceed 1 percent of the DDT solubility.

TABLE 5.4

PREVALENCE OF DETECTED VOLATILE ORGANIC COMPOUNDS, PESTICIDES, AND p-CBSA IN GROUNDWATER

COMPOUND	NUMBER OF SAMPLES ANALYZED	NUMBER OF DETECTS	PERCENT PREVALENCE	MINIMUM OF DETECTED VALUES (µg/L)	MAXIMUM OF DETECTED VALUES (µg/L)	MEAN OF DETECTED VALUES(a) (µg/L)	MEAN OF ALL VALUES(b) (µg/L)	LOCATION OF MAXIMUM DETECTED VALUE	DATE OF MAXIMUM DETECTED VALUE	CALIFORNIA STATE MCL (µg/L)	FEDERAL MCL (µg/L)	USEPA PRG (µg/L)
Chlorobenzene	844	594	70	1	200,000	11,752	8,304	MW-05	1/12/87	70	100	39
Benzene	790	272	34	0.55	1,800,000	21,181	7,321	MW-20	8/6/90	1	5	0.39
Chloroform	844	210	25	0.6	85,000	6,493	1,663	MW-09	10/27/89	---	80(c)	0.16
Total Xylenes	381	62	16.3	6.8	20000	3,475	609	MW-01	7/26/88	1,750	10,000	1,400
Tetrachloroethylene	844	137	16	1	4,800	1,008	230	MW-07	4/20/90	5	5	1.1
Ethylbenzene	790	110	14	1.3	46,000	2,931	471	MW-21	4/5/90	700	700	1,300
Trichloroethylene	844	114	13.5	1	1,200	207	102	MW-18	4/5/90	5	5	1.6
Toluene	794	85	11	0.5	40,000	5,336	648	MW-07	2/2/89	150	1,000	720
1,2-Dichloroethane	844	54	6	2	4,100	704	112	MW-07	5/6/89	0.5	5	0.12
1,4-Dichlorobenzene	868	44	5	2.6	310	82	77	MW-01	3/31/87	5	75	0.47
Methylene Chloride	854	32	3.7	0.5	530	99	148	BF-07	2/1/89	---	---	4.3
Carbon Tetrachloride	844	31	4	1	990	205	75	MW-06	2/24/90	5	5	0.17
Acetone	789	28	3.5	10	200,000	8,450	1,023	MW-20	8/6/90	---	---	610
1,2-Dichlorobenzene	870	21	2.4	1.3	110	41	75	MW-01	11/29/95	600	600	370
1,1-Dichloroethylene	854	7	0.8	1.3	220	35	68	MW-06	12/1/95	6	7	0.046
1,1,2-Trichloroethane	854	5	0.6	1.1	85	19	82	MW-06	12/1/95	5	5	0.2
1,3-Dichlorobenzene	869	5	0.6	5.3	200	45	74	MW-01	3/31/87	---	---	180
1,2-Dichloropropane	854	1	0.1	1.4	1	1	68	MW-06	12/195	5	5	0.16
Total BHC	452	102	23	0.01	300	27	6	MW-01	5/19/89	---	---	0.037
Total DDT	452	90	19.9	0.03	52	4	2	G-01	10/13/88	---	---	0.2
pCBSA	217	144	66	96	180,000	20,306	13,490	MW-01	3/10/95	---	---	---

NOTES: This table summarizes analytical results for original groundwater samples collected from Montrose monitoring wells during the period from April 1985 through December 1995 with the exception of 5 Central Process Area wells where dense nonaqueous phase liquid (DNAPL) has been observed. DNAPL has been observed in Upper Bellflower Aquitard monitoring well MW-02, Upper Bellflower Aquitard test wells UBT-01, UBT-02, and UBT-03, and Upper Bellflower Aquitard extraction well UBE-01.
A summary of analytical results for all Montrose monitoring wells is provided in Table 5.5. A summary of groundwater sampling events is provided in Table 2.9. Analytical results for individual groundwater samples are provided in Appendix G.

FOOTNOTES
(a) = Arithmetic mean calculated using detected values
(b) = Arithmetic mean calculated using detected values and one half of non detected values
(c) = MCL is for total trihalomethanes; applies to combined concentrations of bromodichloromethane, dibromochloromethane, bromoform, and chloroform

pCBSA = para-Chlorobenzene sulfonic acid
µg/L = Micrograms per liter
MCL = Maximum Contaminant Level
USEPA = United States Environmental Protection Agency
PRG = Preliminary Remediation Goal for tap water
(---) = No MCL currently in effect
BHC = Hexachlorocyclohexane
DDT = Dichlorodiphenyltrichloroethane

TABLE 5.5
CHEMICALS OF CONCERN IN GROUNDWATER

Well Identifier	TOTAL DDT							TOTAL BHC						
	Num. of Analyses	Num. of Detects	Min. Result (ug/L)	Max. Result (ug/L)	Avg. Result (ug/L)	Most Recent Sample Date	Most Recent Result (ug/L)	Num. of Analyses	Num. of Detects	Min. Result (ug/L)	Max. Result (ug/L)	Avg. Result (ug/L)	Most Recent Sample Date	Most Recent Result (ug/L)
MW-01	14	4	<0.2	19	9.6	11/29/95	<36	14	14	5	300	134	11/30/95	163
MW-02	6	6	13	19,500	4,021	04/22/88	600	6	2	<0.5	330	295	04/22/88	<80
MW-03	19	13	<0.02	8	1.5	11/20/91	0.1	19	0	<0.01	<0.5	NA	11/20/91	<0.01
MW-04	16	8	<0.02	36	9.6	04/20/90	<0.04	16	2	<0.01	1.6	1.05	04/20/90	<0.8
MW-05	17	8	<0.2	5	1.5	11/19/91	<0.2	17	12	<0.4	220	43.2	11/19/91	0.42
MW-06	10	1	<0.02	9	NA	12/01/95	<0.9	10	9	<0.8	5	2.4	12/02/95	2.48
MW-07	6	0	<0.04	<5	NA	04/20/90	<0.04	6	1	<0.2	2.7	NA	04/20/90	<0.8
MW-08	5	1	<0.02	0.03	NA	04/20/90	<0.04	5	0	<0.02	<0.04	NA	04/20/90	<0.04
MW-09	4	1	<0.02	0.05	NA	04/20/90	0.05	4	0	<0.02	<5	NA	04/20/90	<8
MW-10	5	0	<0.02	<0.05	NA	04/20/90	<0.04	5	1	<0.02	0.21	NA	04/20/90	<0.04
MW-11	6	0	<0.04	<5	NA	04/18/90	<2	5	5	14	33	25.6	04/18/90	21
MW-12	9	0	<0.04	<0.5	NA	12/02/95	<0.36	9	4	<0.04	18	8.3	12/03/95	0.572
MW-13	6	0	<0.02	<0.2	NA	04/21/90	<0.04	6	6	0.22	0.62	0.38	04/21/90	0.38
MW-14	9	1	<0.02	0.62	NA	11/19/91	0.62	9	3	<0.04	0.66	0.41	11/19/91	0.47
MW-15	6	0	<0.05	<0.8	NA	04/18/90	<0.8	6	6	0.54	4.9	2.62	04/18/90	2.0
MW-16	5	0	<0.02	<0.04	NA	11/20/91	<0.02	5	0	<0.01	<0.04	NA	11/20/91	<0.01
MW-17	3	2	<0.04	0.26	0.2	08/05/90	0.08	3	0	<0.04	<0.04	NA	08/05/90	<0.04
MW-18	2	0	<0.04	<0.04	NA	04/20/90	<0.04	2	0	<0.04	<0.04	NA	04/20/90	<0.04
MW-19	5	0	<0.02	<0.04	NA	11/19/91	<0.02	5	0	<0.01	<0.04	NA	11/19/91	<0.01
MW-20	2	1	<0.04	0.5	NA	08/06/90	<0.04	2	0	<0.04	<0.04	NA	08/06/90	<0.04
MW-21	1	0	<0.04	<0.04	NA	04/05/90	<0.04	1	0	<0.04	<0.04	NA	04/05/90	<0.04
MW-22	2	0	<0.04	<0.04	NA	04/19/90	<0.04	2	0	<0.04	<0.04	NA	04/19/90	<0.04
MW-23	6	0	<0.02	<0.04	NA	11/21/91	<0.02	6	0	<0.01	<0.04	NA	11/21/91	<0.01
MW-24	3	0	<0.04	<0.04	NA	04/17/90	<0.04	3	0	<0.04	<0.04	NA	04/17/90	<0.04
MW-25	5	0	<0.04	<0.4	NA	08/06/90	<0.04	5	2	0.05	0.3	0.19	08/06/90	<0.4
MW-26	6	0	<0.02	<0.04	NA	11/19/91	<0.02	6	0	<0.01	<0.04	NA	11/19/91	<0.01
MW-27	2	0	<0.02	<0.02	NA	10/09/91	<0.02	2	0	<0.01	<0.01	NA	10/09/91	<0.01
MW-28	2	0	<0.02	<0.02	NA	11/21/91	<0.02	2	0	<0.01	<0.01	NA	11/21/91	<0.01
MW-29	2	0	<0.02	<0.02	NA	10/09/91	<0.02	2	0	<0.01	<0.01	NA	10/09/91	<0.01
MW-30	2	0	<0.02	<0.02	NA	10/17/91	<0.02	2	0	<0.01	<0.01	NA	10/17/91	<0.01
UBT-01	8	8	6,400	1,100,000	401,650	08/08/90	1,100,000	7	0	<200	<40000	NA	08/08/90	<40000
UBT-03	0	0	NA	NA	NA	NA	NS	0	0	NA	NA	NA	NA	NS
UBE-01	9	9	12.2	21,000	4,699	08/21/91	4,323	0	0	NA	NA	NA	NA	NS
BF-01	10	4	<0.02	0.36	0.18	04/18/90	<0.04	11	1	<0.01	0.06	NA	04/18/90	<0.04
BF-02	10	5	<0.04	0.66	0.28	04/20/90	<0.04	11	4	<0.01	1.2	0.36	04/20/90	<0.04
BF-03	10	9	<0.05	0.61	0.50	04/20/90	0.3	11	5	<0.02	1.5	0.45	04/20/90	<0.8
BF-04	14	8	<0.2	2.3	1.0	11/19/91	0.97	14	3	<0.01	7.2	4.20	11/19/91	0.1
BF-05	7	0	<0.02	<0.5	NA	11/21/91	<0.02	7	0	<0.01	<0.5	NA	11/21/91	<0.01
BF-06	6	0	<0.02	<0.2	NA	04/21/90	<0.2	6	6	0.13	1.2	0.75	04/21/90	1.2
BF-07	8	0	<0.02	<0.5	NA	11/20/91	<0.02	8	4	0.1	2.5	0.7	11/20/91	0.1
BF-08	7	0	<0.02	<0.05	NA	11/30/90	<0.04	7	1	<0.04	0.12	NA	11/30/90	<0.04
BF-09	6	6	5	21	11	04/19/90	5	6	2	<0.2	15	14	04/19/90	<2
BF-10	3	0	<0.04	<0.04	NA	04/18/90	<0.04	3	0	<0.04	<0.04	NA	04/18/90	<0.04
BF-11	4	0	<0.04	<0.04	NA	08/04/90	<0.04	4	0	<0.04	<0.04	NA	08/04/90	<0.04
BF-12	3	0	<0.04	<0.04	NA	04/19/90	<0.04	3	0	<0.04	<0.04	NA	04/19/90	<0.04
BF-13	3	0	<0.04	<0.04	NA	04/19/90	<0.04	3	0	<0.04	<0.04	NA	04/19/90	<0.04
BF-14	3	0	<0.04	<0.04	NA	04/18/90	<0.04	3	0	<0.04	<0.04	NA	04/18/90	<0.04
BF-15	5	0	<0.04	<0.04	NA	08/04/90	<0.04	5	2	<0.04	0.21	0.14	08/04/90	<0.04
BF-16	4	0	<0.04	<0.04	NA	08/04/90	<0.04	4	0	<0.04	<0.04	NA	08/04/90	<0.04
BF-17	4	0	<0.04	<0.04	NA	11/29/90	<0.04	4	0	<0.04	<0.04	NA	11/29/90	<0.04
BF-18	2	0	<0.02	<0.02	NA	10/10/91	<0.02	2	0	<0.01	<0.01	NA	10/10/91	<0.01
BF-19	2	0	<0.02	<0.02	NA	10/09/91	<0.02	2	0	<0.01	<0.01	NA	10/09/91	<0.01
BF-20	2	0	<0.02	<0.02	NA	10/11/91	<0.02	2	0	<0.01	<0.01	NA	10/11/91	<0.01
BF-21	2	0	<0.02	<0.02	NA	10/17/91	<0.02	2	0	<0.01	<0.01	NA	10/17/91	<0.01
BF-22	2	0	<0.02	<0.02	NA	10/16/91	<0.02	2	0	<0.01	<0.01	NA	10/16/91	<0.01
BF-23	2	0	<0.02	<0.02	NA	10/10/91	<0.02	2	0	<0.01	<0.01	NA	10/10/91	<0.01
BF-24	2	0	<0.02	<0.02	NA	10/10/91	<0.02	2	0	<0.01	<0.01	NA	10/10/91	<0.01
BF-25	2	0	<0.02	<0.02	NA	10/17/91	<0.02	2	0	<0.01	<0.01	NA	10/17/91	<0.01
BF-26	2	0	<0.02	<0.02	NA	10/17/91	<0.02	2	0	<0.01	<0.01	NA	10/17/91	<0.01
BF-27	2	0	<0.02	<0.02	NA	10/17/91	<0.02	2	0	<0.01	<0.01	NA	10/17/91	<0.01
BF-28	2	0	<0.02	<0.02	NA	10/16/91	<0.02	2	2	0.01	0.04	0.03	10/16/91	0.046
BF-29	2	0	<0.02	<0.02	NA	10/17/91	<0.02	2	0	<0.01	<0.01	NA	10/17/91	<0.01
BF-30	2	0	<0.02	<0.02	NA	10/16/91	<0.02	2	0	<0.01	<0.01	NA	10/16/91	<0.01
BF-31	2	0	<0.02	<0.02	NA	10/16/91	<0.02	2	0	<0.01	<0.01	NA	10/16/91	<0.01
BF-32	2	0	<0.02	<0.02	NA	10/16/91	<0.02	2	0	<0.01	<0.01	NA	10/16/91	<0.01
BF-32A	0	0	NA	NA	NA	NA	NS	0	0	NA	NA	NA	NA	NS
BF-33	2	0	<0.02	<0.02	NA	10/16/91	<0.02	2	0	<0.01	<0.01	NA	10/16/91	<0.01
G-01	10	2	<0.02	0.18	0.10	04/20/90	<0.04	11	1	<0.01	0.05	NA	04/20/90	<0.04
G-02	11	2	<0.02	0.06	0.05	04/21/90	0.06	12	2	<0.01	0.82	0.42	04/21/90	<0.04
G-03	10	0	<0.02	<0.2	NA	04/19/90	<0.04	11	1	<0.01	0.02	NA	04/19/90	<0.04
G-04	7	1	<0.02	0.07	NA	11/21/91	<0.02	7	0	<0.01	<0.5	NA	11/21/91	<0.01
G-05	5	0	<0.02	<0.05	NA	04/21/90	<0.04	5	0	<0.02	<0.05	NA	04/21/90	<0.04
G-06	5	0	<0.02	<0.05	NA	04/18/90	<0.04	5	0	<0.02	<0.05	NA	04/18/90	<0.04
G-07	6	5	<0.05	0.5	0.25	04/18/90	0.09	6	0	<0.02	<0.05	NA	04/18/90	<0.04
G-08	3	0	<0.04	<0.04	NA	04/17/90	<0.04	3	0	<0.04	<0.04	NA	04/17/90	<0.04
G-09	4	0	<0.04	<0.04	NA	08/05/90	<0.04	4	0	<0.04	<0.04	NA	08/05/90	<0.04
G-10	2	0	<0.02	<0.02	NA	10/10/91	<0.02	2	0	<0.01	<0.01	NA	10/10/91	<0.01
G-11	5	0	<0.04	<0.04	NA	08/06/90	<0.04	5	1	<0.04	0.2	NA	08/06/90	<0.04
G-12	3	0	<0.04	<0.04	NA	04/19/90	<0.04	3	0	<0.04	<0.04	NA	04/19/90	<0.04
G-13	4	0	<0.04	<0.04	NA	11/30/90	<0.04	4	0	<0.04	<0.04	NA	11/30/90	<0.04
G-14	2	0	<0.02	<0.02	NA	10/09/91	<0.02	2	0	<0.01	<0.01	NA	10/09/91	<0.01
G-15	2	0	<0.02	<0.02	NA	10/08/91	<0.02	2	0	<0.01	<0.01	NA	10/08/91	<0.01
G-16	2	0	<0.02	<0.02	NA	10/17/91	<0.02	2	0	<0.01	<0.01	NA	10/17/91	<0.01
G-17	2	0	<0.02	<0.02	NA	10/11/91	<0.02	2	0	<0.01	<0.01	NA	10/11/91	<0.01
G-18	2	0	<0.02	<0.02	NA	10/16/91	<0.02	2	0	<0.01	<0.01	NA	10/16/91	<0.01
G-19	2	0	<0.02	<0.02	NA	10/10/91	<0.02	2	0	<0.01	<0.01	NA	10/10/91	<0.01
LG-01	10	1	<0.02	0.08	NA	08/03/90	<0.04	12	2	<0.01	0.03	0.03	08/03/90	<0.04
LG-02	5	1	<0.04	0.09	NA	04/19/90	<0.04	5	0	<0.02	<0.5	NA	04/19/90	<0.04
LW-01	8	1	<0.02	0.046	NA	11/21/91	<0.02	8	0	<0.01	<0.04	NA	11/21/91	<0.01
LW-02	4	0	<0.04	<0.04	NA	12/02/90	<0.04	4	0	<0.04	<0.04	NA	12/02/90	<0.04
LW-03	3	0	<0.04	<0.04	NA	04/20/90	<0.04	3	0	<0.04	<0.04	NA	04/20/90	<0.04
LW-04	2	0	<0.02	<0.02	NA	10/11/91	<0.02	2	0	<0.01	<0.01	NA	10/11/91	<0.01
LW-05	2	0	<0.02	<0.02	NA	10/09/91	<0.02	2	0	<0.01	<0.01	NA	10/09/91	<0.01
LW-06	2	0	<0.02	<0.02	NA	10/08/91	<0.02	2	0	<0.01	<0.01	NA	10/08/91	<0.01
LW-07	2	0	<0.02	<0.02	NA	10/17/91	<0.02	2	0	<0.01	<0.01	NA	10/17/91	<0.01

Note: See page 10 of this table for footnotes.

TABLE 5.5
CHEMICALS OF CONCERN IN GROUNDWATER

	CHLOROBENZENE							PCBSA						
Well Identifier	Num. of Analyses	Num. of Detects	Min. Result (ug/L)	Max. Result (ug/L)	Avg. Result (ug/L)	Most Recent Sample Date	Most Recent Result (ug/L)	Num. of Analyses	Num. of Detects	Min. Result (ug/L)	Max. Result (ug/L)	Avg. Result (ug/L)	Most Recent Sample Date	Most Recent Result (ug/L)
MW-01	25	25	1,400	80,000	40,400	11/29/95	78,000	2	2	100,000	180,000	140,000	06/23/95	100,000
MW-02	11	11	54,000	660,000	309,455	04/22/88	380,000	0	NA	NA	NA	NA	02/01/91	470,000(a)
MW-03	20	3	<1	59	24	10/11/95	<1	2	0	<100	<200	NA	10/11/95	<100
MW-04	17	17	58	1,600	386	04/20/90	500	0	NA	NA	NA	NA	02/01/91	9,300(a)
MW-05	20	20	8.4	200,000	91,450	11/28/95	8.4	1	1	24,000	24,000	NA	02/01/91	6,100(a)
MW-06	9	9	190	16,000	7,410	12/01/95	190	2	2	1,500	11,000	6,250	12/01/95	11,000
MW-07	7	2	3	630	317	04/20/90	<200	0	NA	NA	NA	NA	02/01/91	3,700(a)
MW-08	5	1	<1	5	NA	04/20/90	<1	0	NA	NA	NA	NA	02/01/91	<500(a)
MW-09	6	6	8400	180,000	136,400	11/30/95	8,400	0	NA	NA	NA	NA	02/01/91	32,000(a)
MW-10	13	13	3.7	2,200	607	10/10/95	3.7	0	NA	NA	NA	NA	02/01/91	<500(a)
MW-11	13	13	780	34,000	11,695	10/10/95	780	3	0	<100	<100	NA	10/10/95	<100
MW-12	22	22	2,400	8,200	4,923	12/02/95	4,100	4	4	20,000	54,000	31,000	12/02/95	20,000
MW-13	20	20	1,700	4,500	2,775	10/11/95	4,500	3	3	30,000	47,000	39,667	10/11/95	47,000
MW-14	20	20	97	900	243	10/11/95	150	4	4	96	5,500	1,749	10/11/95	400
MW-15	7	7	22,000	34,000	26,857	08/15/94	34,000	1	1	99,000	99,000	NA	08/15/94	99,000
MW-16	6	0	<5	<5	NA	11/20/91	<5	0	NA	NA	NA	NA	NA	NS
MW-17	4	4	2	8	3.4	12/01/95	7.5	1	0	<100	<100	NA	12/01/95	<100
MW-18	3	0	<10	<20	NA	08/06/90	<10	0	NA	NA	NA	NA	02/01/91	<500(a)
MW-19	7	2	<1	9	6.2	11/30/95	3.4	2	0	<100	<200	NA	11/30/95	<100
MW-20	2	0	<10000	<20000	NA	08/06/90	<20000	0	NA	NA	NA	NA	NA	NS
MW-21	16	0	<0.5	<2000	NA	10/12/95	<0.5	0	NA	NA	NA	NA	NA	NS
MW-22	3	0	<1	<1	NA	08/05/90	<1	0	NA	NA	NA	NA	NA	NS
MW-23	15	0	<1	<1	NA	10/10/95	<1	4	1	<100	1,900	NA	10/10/95	<100
MW-24	8	2	<1	1.3	1.2	12/01/95	1.3	1	0	<100	<100	NA	12/01/95	<100
MW-25	6	6	44	990	771	12/01/95	44	1	1	370	370	NA	12/01/95	370
MW-26	11	6	<1	9	5.4	12/01/95	4.4	2	0	<20	<100	NA	12/01/95	<100
MW-27	3	3	3.9	15	9.6	12/02/95	3.9	2	0	<20	<100	NA	12/02/95	<100
MW-28	16	0	<0.5	<2000	NA	10/12/95	<0.5	1	0	<20	<20	NA	11/21/91	<20
MW-29	16	1	<0.5	25	NA	10/11/95	<0.5	4	0	<20	<100	NA	10/11/95	<100
MW-30	11	0	<1	<1	NA	10/10/95	<1	4	0	<20	<100	NA	10/10/95	<100
UBT-01	8	8	330,000	1,000,000	497,500	06/08/90	380,000	0	NA	NA	NA	NA	NA	NS
UBT-03	1	1	220,000	220,000	NA	12/04/95	220,000	0	NA	NA	NA	NA	NA	NS
UBE-01	9	9	260,000	380,000	316,889	08/21/91	360,000	4	4	840,000	11,000,000	3,910,000	08/21/91	11,000,000
BF-01	12	12	370	570	465	04/18/90	460	0	NA	NA	NA	NA	NA	NS
BF-02	13	13	3,600	16,000	8,423	04/20/90	4,700	0	NA	NA	NA	NA	NA	NS
BF-03	13	13	9,000	23,000	14,538	04/20/90	9,000	0	NA	NA	NA	NA	NA	NS
BF-04	17	17	21,000	42,000	30,765	10/24/95	21,000	2	2	44,000	72,000	58,000	10/24/95	44,000
BF-05	14	14	48	3,400	1,360	10/10/95	48	5	5	<100	7,300	3,334	10/10/95	<100
BF-06	13	13	2,500	34,000	23,600	10/11/95	19,000	7	7	77,000	120,000	93,571	10/11/95	80,000
BF-07	13	13	22,000	66,000	38,538	10/11/95	22,000	1	1	8,900	8,900	NA	04/25/91	8,900
BF-08	10	10	3,500	9,000	5,250	08/15/94	3,500	2	2	9,200	27,000	18,100	08/15/94	9,200
BF-09	9	9	11,000	20,000	15,889	11/30/95	14,000	1	1	43,000	43,000	NA	11/30/95	43,000
BF-10	15	0	<1	<1	NA	10/11/95	<1	8	1	<100	3,200	NA	10/11/95	<100
BF-11	5	5	190	2,300	1,758	08/04/90	2,300	0	NA	NA	NA	NA	NA	NS
BF-12	8	0	<1	<1	NA	11/20/91	<1	1	1	1,100	1,100	NA	04/24/91	1,100
BF-13	19	0	<0.5	<500	NA	10/12/95	<0.5	7	3	<100	44,000	15,733	10/12/95	<100
BF-14	19	19	1,200	4,100	2,432	10/12/95	3,300	7	7	23,000	34,000	27,000	10/12/95	29,000
BF-15	6	6	30,000	42,000	35,833	10/12/95	30,000	1	1	110,000	110,000	NA	10/12/95	110,000
BF-16	7	7	150	200	173	04/24/91	180	1	1	5,500	5,500	NA	11/29/90	5,500
BF-17	7	7	2,300	4,300	3,671	04/24/91	3,600	1	1	36,000	36,000	NA	11/29/90	36,000
BF-18	3	3	5	42	20	12/01/95	42	2	0	<20	<100	NA	12/01/95	<100
BF-19	3	0	<1	<1	NA	10/10/95	<1	2	0	<20	<100	NA	10/10/95	<100
BF-20	2	2	720	1,000	860	10/11/91	720	1	1	3,500	3,500	NA	10/11/91	3,500
BF-21	3	3	6,600	8,900	7,733	10/12/95	6,600	2	2	32,000	33,000	32,500	10/12/95	32,000
BF-22	2	2	360	430	405	10/16/91	360	1	1	3,400	3,400	NA	10/16/91	3,400
BF-23	9	9	12	120	39	10/10/95	12	8	3	<100	2,000	950	10/10/95	220
BF-24	3	3	8,200	17,000	11,633	12/01/95	17,000	2	2	49,000	68,000	58,500	12/01/95	68,000
BF-25	2	2	62	75	69	10/17/91	62	1	1	8,000	8,000	NA	10/17/91	8,000
BF-26	5	5	7.4	46	23	11/27/95	7.4	1	1	890	890	NA	11/27/95	890
BF-27	2	0	<1	<1	NA	10/17/91	<1	1	1	770	770	NA	10/17/91	770
BF-28	2	2	2	5	3.5	10/16/91	5	1	1	180	180	NA	10/16/91	180
BF-29	2	2	270	620	445	10/17/91	270	1	1	790	790	NA	10/17/91	790
BF-30	4	0	<1	<1	NA	11/27/95	<1	2	0	<20	<100	NA	11/27/95	<100
BF-31	5	5	290	430	378	11/27/95	290	1	1	7,200	7,200	NA	10/16/91	7,200
BF-32	3	1	<1	2	NA	08/01/93	<1	1	1	7,100	7,100	NA	10/16/91	7,100
BF-32A	1	1	12	12	NA	11/29/95	12	1	0	<100	<100	NA	11/29/95	<100
BF-33	2	0	<1	<1	NA	10/16/91	<1	1	1	1,200	1,200	NA	10/16/91	1,200
G-01	16	16	110	710	359	11/21/91	190	1	1	500	500	NA	12/01/90	500
G-02	16	16	6,900	20,000	13,875	11/21/91	6,900	1	1	21,000	21,000	NA	12/02/90	21,000
G-03	15	15	240	2,200	689	01/27/93	1,100	0	NA	NA	NA	NA	NA	NS
G-04	16	16	9	2,000	1,079	10/11/95	550	7	6	<100	9,300	4,583	10/11/95	3,100
G-05	13	13	1,700	22,000	10,531	10/12/95	6,900	7	7	23,000	27,000	25,571	10/12/95	25,000
G-06	13	13	2,100	4,600	2,685	10/12/95	2,900	7	6	<100	23,000	20,167	10/12/95	23,000
G-07	10	10	63	90	79	08/15/94	73	2	2	2,000	2,000	2,000	08/15/94	2,000
G-08	15	15	73	400	194	10/11/95	220	8	7	<100	1,800	1,500	10/11/95	1,800
G-09	17	3	<1	2	1	10/11/95	<1	8	8	620	2,700	1,285	10/11/95	670
G-10	3	3	16	79	37	11/30/95	79	2	1	<20	150	NA	11/30/95	150
G-11	12	1	<1	4	NA	10/10/95	<1	7	6	<100	560	437	10/10/95	480
G-12	12	12	750	1,600	1,135	10/10/95	1,100	7	7	12,000	18,000	16,857	10/10/95	18,000
G-13	15	15	1,100	2,600	1,667	10/12/95	1,600	8	8	18,000	25,000	22,750	10/12/95	25,000
G-14	9	0	<1	<1	NA	10/10/95	<1	8	0	<20	<100	NA	10/10/95	<100
G-15	2	2	18	19	19	10/08/91	19	1	1	170	170	NA	10/08/91	170
G-16	3	0	<1	<1	NA	11/29/95	<1	2	0	<20	<100	NA	11/29/95	<100
G-17	9	9	150	350	264	10/11/95	220	8	8	3,000	6,300	4,788	10/11/95	4,700
G-18	3	0	<1	<1	NA	11/29/95	<1	2	0	<20	<100	NA	11/29/95	<100
G-19	5	4	<1	2,600	793	11/29/95	2,600	2	2	210	24,000	12,105	11/29/95	24,000
LG-01	11	10	33	110	57	08/03/90	70	0	NA	NA	NA	NA	NA	NS
LG-02	6	6	180	390	295	04/19/90	390	0	NA	NA	NA	NA	NA	NS
LW-01	11	10	<1	560	236	11/28/95	550	2	2	270	2,100	1,185	11/28/95	2,100
LW-02	9	0	<1	<1	NA	11/28/95	<1	2	1	<100	1,400	NA	11/28/95	<100
LW-03	5	0	<1	<1	NA	08/06/90	<1	0	NA	NA	NA	NA	NA	NS
LW-04	4	0	<1	<1	NA	01/26/93	<1	1	0	<20	<20	NA	10/11/91	<20
LW-05	2	0	<1	<1	NA	10/09/91	<1	1	0	<20	<20	NA	10/09/91	<20
LW-06	2	0	<1	<1	NA	10/08/91	<1	1	0	<20	<20	NA	10/08/91	<20
LW-07	2	0	<1	<1	NA	10/17/91	<1	1	0	<20	<20	NA	10/17/91	<20

Note: See page 10 of this table for footnotes.

TABLE 5.5
CHEMICALS OF CONCERN IN GROUNDWATER

Well Identifier	BENZENE Num. of Analyses	Num. of Detects	Min. Result (ug/L)	Max. Result (ug/L)	Avg. Result (ug/L)	Most Recent Sample Date	Most Recent Result (ug/L)	TOLUENE Num. of Analyses	Num. of Detects	Min. Result (ug/L)	Max. Result (ug/L)	Avg. Result (ug/L)	Most Recent Sample Date	Most Recent Result (ug/L)
MW-01	20	20	660	11,000	7,945	11/29/95	5,300	20	2	6	50	45	11/29/95	<100
MW-02	11	1	<50	150	NA	04/22/88	<5000	11	0	<50	<25000	NA	04/22/88	<5000
MW-03	20	16	<1	160	51	10/11/95	2.9	20	1	<0.5	32	NA	10/11/95	<0.5
MW-04	17	1	<5	660	NA	04/20/90	<10	17	0	<5	<100	NA	04/20/90	<10
MW-05	20	14	<1	3,700	1,434	11/28/95	<1	20	1	<1	1300	NA	11/28/95	<1
MW-06	9	9	120	7,200	1,510	12/01/95	120	9	1	1.3	1.3	NA	12/01/95	1.3
MW-07	7	6	<1	32,000	29,667	04/20/90	27,000	7	6	<1	40,000	36,833	04/20/90	36,000
MW-08	5	0	<1	<1	NA	04/20/90	<1	5	2	<1	3	2.5	04/20/90	<1
MW-09	6	1	62	62	NA	11/30/95	62	6	0	<1	<3000	NA	11/30/95	<1
MW-10	13	3	<0.5	17	9	10/10/95	<0.5	13	1	<1	17	NA	10/10/95	<1
MW-11	13	8	<3	3,100	1,816	10/10/95	<3	13	0	<5	<500	NA	10/10/95	<5
MW-12	16	16	2,000	14,000	7,775	12/02/95	4,100	16	12	<50	17,000	6,827	12/02/95	710
MW-13	13	13	12,000	24,000	16,308	10/11/95	12,000	13	13	4600	16,000	9,908	10/11/95	6,300
MW-14	13	12	<30	9,500	5,557	10/11/95	1,200	13	9	8.5	200	72	10/11/95	<10
MW-15	7	0	<200	<1000	NA	08/15/94	<200	7	0	<200	<1000	NA	08/15/94	<400
MW-16	6	0	<5	<5	NA	11/20/91	<5	6	0	<5	<10	NA	11/20/91	<10
MW-17	4	4	8	32	16	12/01/95	8	4	1	<1	1	NA	12/01/95	<1
MW-18	3	2	<10	50	30	08/06/90	10	3	1	<10	10	NA	08/06/90	10
MW-19	7	0	<1	<2	NA	11/30/95	<1	7	0	<1	<4	NA	11/30/95	<1
MW-20	2	2	1,100,000	1,800,000	1,450,000	08/06/90	1,800,000	2	0	<10000	<20000	NA	08/06/90	<20000
MW-21	9	9	4,100	230,000	67,811	10/12/95	4,100	9	2	<100	6500	4335	10/12/95	<100
MW-22	3	0	<1	<1	NA	08/05/90	<1	3	1	<1	1	NA	08/05/90	<1
MW-23	15	1	<0.5	11	NA	10/10/95	<0.5	15	0	<1	<2	NA	10/10/95	<1
MW-24	8	0	<0.5	<1	NA	12/01/95	<1	8	0	<1	<1	NA	12/01/95	<1
MW-25	6	6	170	2,200	1,625	12/01/95	170	6	6	110	1,900	1,465	12/01/95	110
MW-26	11	0	<0.5	<1	NA	12/01/95	<1	11	0	<1	<2	NA	12/01/95	<1
MW-27	3	3	20	170	110	12/02/95	20	3	3	3.5	180	118	12/02/95	3.5
MW-28	9	9	47,000	130,000	78,111	10/12/95	130,000	9	0	<100	<2000	NA	10/12/95	<2000
MW-29	9	9	3,700	72,000	34,144	10/11/95	24,000	9	0	<50	<1000	NA	10/11/95	<300
MW-30	11	3	<0.5	17	9.4	10/10/95	<0.5	11	0	<1	<2	NA	10/10/95	<1
UBT-01	7	0	<2000	<20000	NA	06/06/91	<10000	7	0	<2000	<20000	NA	06/06/90	<10000
UBT-03	1	1	230	230	NA	12/04/95	230	1	0	<100	<100	NA	12/04/95	<100
UBE-01	0	0	NA	NA	NA	NA	NA	0	0	NA	NA	NA	NA	NS
BF-01	12	1	<5	10	NA	04/18/90	<5	12	0	<5	<25	NA	04/18/90	<5
BF-02	13	0	<50	<400	NA	04/20/90	<50	13	0	<50	<400	NA	04/20/90	<50
BF-03	13	0	<100	<400	NA	04/20/90	<100	13	1	<100	2,000	NA	04/20/90	<100
BF-04	17	1	61	61	NA	10/24/95	61	17	0	<30	<1000	NA	10/24/95	<30
BF-05	15	0	<0.5	<100	NA	10/10/95	<0.5	15	3	<0.5	117	44	10/10/95	<0.5
BF-06	13	10	110	270	178	10/11/95	110	13	4	<0.5	4.5	2.3	10/11/95	0.51
BF-07	14	7	3.8	18,000	2,610	10/11/95	54	14	2	<0.5	0.94	0.7	02/01/89	<500
BF-08	10	0	<20	<250	NA	08/15/94	<25	10	0	<40	<250	NA	08/15/94	<50
BF-09	9	1	22	22	NA	11/30/95	22	9	0	<1	<200	NA	11/30/95	<1
BF-10	15	0	<0.5	<1	NA	10/11/95	<0.5	15	0	<1	<2	NA	10/11/95	<1
BF-11	5	0	<10	<50	NA	08/04/90	<20	5	0	<10	<50	NA	08/04/90	<20
BF-12	8	0	<1	<1	NA	11/20/90	<1	8	0	<1	<2	NA	11/20/91	<2
BF-13	12	12	15,000	43,000	28,083	10/12/95	15000	12	0	<100	<500	NA	10/12/95	<100
BF-14	12	7	5	9	7.1	10/12/95	5.4	13	1	<0.5	2.4	NA	10/12/95	<0.5
BF-15	6	1	27	27	NA	10/12/95	27	6	0	<0.5	<500	NA	10/12/95	<0.5
BF-16	7	0	<1	<10	NA	04/24/91	<1	7	0	<1	<10	NA	04/24/91	<1
BF-17	7	0	<20	<50	NA	04/24/91	<50	7	0	<20	<50	NA	04/24/91	<50
BF-18	3	0	<1	<1	NA	12/01/95	<1	3	0	<1	<2	NA	12/01/95	<1
BF-19	3	0	<0.5	<1	NA	10/10/95	<0.5	3	0	<1	<2	NA	10/10/95	<1
BF-20	2	0	<5	<10	NA	10/11/91	<5	2	0	<10	<20	NA	10/11/91	<10
BF-21	3	1	5.9	5.9	NA	10/12/95	5.9	3	0	<0.5	<100	NA	10/17/91	<100
BF-22	2	0	<4	<5	NA	10/16/91	<4	2	0	<8	<10	NA	10/15/91	<8
BF-23	9	0	<0.5	<1	NA	10/10/95	<0.5	9	1	<1	1.9	NA	10/10/95	<1
BF-24	3	1	31	31	NA	12/01/95	31	3	0	<1	<100	NA	12/01/95	<1
BF-25	2	0	<1	<1	NA	10/17/91	<1	2	0	<2	<2	NA	10/17/91	<2
BF-26	5	0	<1	<1	NA	11/27/95	<1	5	0	<1	<2	NA	11/27/95	<1
BF-27	2	0	<1	<1	NA	10/17/91	<1	2	0	<2	<2	NA	10/17/91	<2
BF-28	2	0	<1	<1	NA	10/16/91	<1	2	0	<2	<2	NA	10/16/91	<2
BF-29	2	0	<2	<5	NA	10/17/91	<2	2	0	<4	<10	NA	10/17/91	<4
BF-30	4	0	<1	<1	NA	11/27/95	<1	4	0	<1	<2	NA	11/27/95	<1
BF-31	5	0	<1	<5	NA	11/27/95	<1	5	0	<1	<10	NA	11/27/95	<1
BF-32	3	0	<1	<1	NA	08/31/93	<1	3	0	<2	<2	NA	08/31/93	<2
BF-32A	1	0	<1	<1	NA	11/29/95	<1	1	0	<1	<1	NA	11/29/95	<1
BF-33	2	0	<1	<1	NA	10/16/91	<1	2	0	<2	<2	NA	10/16/91	<2
G-01	16	0	<1	<50	NA	11/21/91	<2	15	3	2	6	4.3	11/21/91	6.0
G-02	16	0	<50	<400	NA	11/21/91	<50	16	0	<50	<400	NA	11/21/91	<100
G-03	15	0	<4	<20	NA	01/27/93	<10	15	0	<5	<20	NA	01/27/93	<20
G-04	16	3	<0.5	0.99	0.8	10/11/95	<0.5	17	1	<0.5	2.2	NA	10/11/95	<0.5
G-05	13	5	4.7	5.8	5.8	10/12/95	4.7	13	0	<0.5	<250	NA	10/12/95	<0.5
G-06	13	6	<0.5	23	6.2	10/12/95	1.3	13	0	<0.5	<100	NA	10/12/95	<0.5
G-07	10	0	<1	<1	NA	08/15/94	<1	10	3	<1	9	4.3	08/15/94	<2
G-08	15	1	<1	4.8	NA	10/11/95	<3	15	1	<1	1	NA	10/11/95	<5
G-09	17	15	<0.5	1,300	521	10/11/95	<0.5	17	0	<1	<20	NA	10/11/95	<1
G-10	3	0	<1	<1	NA	11/30/95	<1	3	0	<1	<2	NA	11/30/95	<1
G-11	12	1	<0.5	5	NA	10/10/95	<0.5	12	1	<1	22	NA	10/10/95	<1
G-12	12	10	<10	31	22	10/10/95	19	12	1	<0.5	0.8	NA	10/10/95	<0.5
G-13	15	5	<0.5	2.2	1.9	10/12/95	1.6	16	2	<0.5	2.6	1.6	10/12/95	<0.5
G-14	9	0	<0.5	<1	NA	10/10/95	<0.5	9	0	<1	<2	NA	10/10/95	<1
G-15	2	0	<1	<1	NA	10/08/91	<1	2	0	<2	<2	NA	10/06/91	<2
G-16	3	0	<1	<1	NA	11/29/95	<1	3	0	<1	<2	NA	11/29/95	<1
G-17	9	7	<0.5	2.0	1.5	10/11/95	1.4	9	0	<0.5	<5	NA	10/11/95	<0.5
G-18	3	0	<1	<1	NA	11/29/95	<1	3	0	<1	<2	NA	11/29/95	<1
G-19	5	1	<1	10	NA	11/29/95	10	5	0	<1	<4	NA	11/29/95	<1
LG-01	12	0	<1	<2	NA	08/03/90	<1	10	0	<1	<2	NA	08/03/90	<1
LG-02	6	0	<5	<5	NA	04/19/90	<5	6	0	<5	<5	NA	04/19/90	<5
LW-01	12	3	<1	6	4.3	11/28/95	4.8	12	0	<1	<10	NA	11/28/95	<1
LW-02	9	0	<1	<1	NA	11/28/95	<1	9	0	<1	<2	NA	11/28/95	<1
LW-03	5	0	<1	<1	NA	08/05/90	<1	5	0	<1	<1	NA	08/05/90	<1
LW-04	4	0	<1	<1	NA	01/26/93	<1	4	0	<2	<2	NA	01/26/93	<2
LW-05	2	0	<1	<1	NA	10/09/91	<1	2	0	<2	<2	NA	10/09/91	<2
LW-06	2	0	<1	<1	NA	10/08/91	<1	2	0	<2	<2	NA	10/08/91	<2
LW-07	2	0	<1	<1	NA	10/17/91	<1	2	0	<2	<2	NA	10/17/91	<2

Note: See page 10 of this table for footnotes.

TABLE 5.5
CHEMICALS OF CONCERN IN GROUNDWATER

Well Identifier	ETHYLBENZENE							TOTAL XYLENES						
	Num. of Analyses	Num. of Detects	Min Result (ug/L)	Max. Result (ug/L)	Avg. Result (ug/L)	Most Recent Sample Date	Most Recent Result (ug/L)	Num. of Analyses	Num. of Detects	Min. Result (ug/L)	Max. Result (ug/L)	Avg. Result (ug/L)	Most Recent Sample Date	Most Recent Result (ug/L)
MW-01	26	2	33	450	254	11/29/95	<100	12	3	60	140	100	11/29/95	<300
MW-02	11	0	<50	<25000	NA	04/22/88	<2500	1	1	200	200	NA	07/02/85	200
MW-03	20	0	<1	<50	NA	10/11/95	<1	6	3	<1	70	47	10/11/95	<1
MW-04	17	0	<5	<100	NA	04/20/90	<10	0	0	NA	NA	NA	NA	NS
MW-05	20	2	<1	2,100	1,075	11/28/95	<1	3	0	<3	<1000	NA	11/28/95	<3
MW-06	9	0	<1	<100	NA	12/01/95	<1	3	2	13	300	157	12/01/95	13
MW-07	7	6	<1	2,800	2,500	04/20/90	2,800	5	5	10,000	20,000	13,800	04/20/90	20,000
MW-08	5	0	<1	<1	NA	04/20/90	<1	0	0	NA	NA	NA	NA	NS
MW-09	6	0	<1	<3000	NA	11/30/95	<1	1	0	<3	<3	NA	11/30/95	<3
MW-10	13	0	<1	<100	NA	10/10/95	<1	7	0	<1	<100	NA	10/10/95	<1
MW-11	13	1	<5	160	NA	10/10/95	<5	7	0	<5	<200	NA	10/10/95	<5
MW-12	17	16	<1	1,900	1,128	12/02/95	<1	14	14	180	10,000	3,974	12/02/95	430
MW-13	13	13	640	2,200	1,703	10/11/95	640	12	12	2,400	9,000	5,817	10/11/95	2,400
MW-14	13	13	83	2,000	904	10/11/95	83	11	11	23	2,000	792	10/11/95	23
MW-15	7	0	<200	<1000	NA	08/15/94	<200	1	0	<200	<200	NA	08/15/94	<200
MW-16	6	0	<5	<5	NA	11/20/91	<5	2	0	<5	<25	NA	11/20/91	<5
MW-17	4	1	<1	3	NA	12/01/95	<1	1	0	<3	<3	NA	12/01/95	<3
MW-18	3	1	<10	20	NA	08/06/90	<10	0	0	NA	NA	NA	NA	NS
MW-19	7	0	<1	<2	NA	11/30/95	<1	3	0	<2	<5	NA	11/30/95	<3
MW-20	2	0	<10000	<20000	NA	08/06/90	<20000	0	0	NA	NA	NA	NA	NS
MW-21	9	9	1,600	46,000	25,178	10/12/95	23,000	7	2	<100	7,400	3,845	10/12/95	<100
MW-22	3	0	<1	<1	NA	08/05/90	<1	0	0	NA	NA	NA	NA	NS
MW-23	15	1	<1	14	NA	10/10/95	<1	9	0	<1	<5	NA	10/10/95	<1
MW-24	8	0	<1	<1	NA	12/01/95	<1	3	0	<1	<3	NA	12/01/95	<3
MW-25	6	5	3.9	60	46	12/01/95	3.9	3	3	72	1800	1,057	12/01/95	72
MW-26	11	0	<1	<1	NA	12/01/95	<1	5	0	<1	<5	NA	12/01/95	<3
MW-27	3	0	<1	<2	NA	12/02/95	<1	3	2	<3	260	235	12/02/95	<3
MW-28	9	5	<100	5,000	2,732	10/12/95	<2000	9	0	<100	<2000	NA	10/12/95	<2000
MW-29	9	0	<50	<500	NA	10/11/95	<300	9	0	<50	<500	NA	10/11/95	<300
MW-30	11	1	<1	14	NA	10/10/95	<1	11	0	<1	<2	NA	10/10/95	<1
UBT-01	7	0	<2000	<20000	NA	06-08-90	<10000	0	0	NA	NA	NA	NA	NS
UBT-03	1	0	<100	<100	NA	12/04/95	<100	1	0	<300	<300	NA	12/04/95	<300
UBE-01	0	0	NA	NA	NA	NA	NS	0	0	NA	NA	NA	NA	NS
BF-01	12	0	<5	<25	NA	04/18/90	<5	0	0	NA	NA	NA	NA	NS
BF-02	13	0	<50	<200	NA	04/20/90	<50	0	0	NA	NA	NA	NA	NS
BF-03	13	0	<100	<200	NA	04/20/90	<100	0	0	NA	NA	NA	NA	NS
BF-04	17	0	<200	<500	NA	10/24/95	<300	3	0	<200	<1000	NA	10/24/95	<300
BF-05	15	1	<1	120	NA	10/10/95	<1	9	0	<1	<100	NA	10/10/95	<1
BF-06	13	0	<5	<500	NA	10/11/95	<200	7	1	28	28	NA	10/11/95	<200
BF-07	13	1	<5	4,500	NA	10/11/95	<500	7	0	<5	<500	NA	10/11/95	<500
BF-08	10	0	<25	<250	NA	08/15/94	<25	2	1	<20	100	NA	08/15/94	100
BF-09	9	1	2.2	2.2	NA	11/30/95	2.2	3	1	6.8	6.8	NA	11/30/95	6.8
BF-10	15	0	<1	<1	NA	10/11/95	<1	8	0	<1	<1	NA	10/11/95	<1
BF-11	5	0	<10	<50	NA	08/04/90	<20	0	0	NA	NA	NA	NA	NS
BF-12	8	0	<1	<1	NA	11/20/91	<1	1	0	<1	<1	NA	11/20/91	<1
BF-13	12	12	310	700	590	10/12/95	310	7	0	<100	<300	NA	10/12/95	<100
BF-14	12	0	<5	<200	NA	10/12/95	<20	7	0	<5	<200	NA	10/12/95	<20
BF-15	6	0	<200	<500	NA	10/12/95	<500	1	0	<500	<500	NA	10/12/95	<500
BF-16	7	0	<1	<10	NA	04/24/91	<1	0	0	NA	NA	NA	NA	NS
BF-17	7	0	<20	<50	NA	04/24/91	<50	0	0	NA	NA	NA	NA	NS
BF-18	3	0	<1	<1	NA	12/01/95	<1	3	0	<1	<3	NA	12/01/95	<3
BF-19	3	0	<1	<1	NA	10/10/95	<1	3	0	<1	<1	NA	10/10/95	<1
BF-20	2	0	<5	<10	NA	10/11/91	<5	2	0	<5	<10	NA	10/11/91	<5
BF-21	3	0	<50	<100	NA	10/12/95	<100	3	0	<50	<100	NA	10/12/95	<100
BF-22	2	0	<4	<5	NA	10/16/91	<4	2	0	<4	<5	NA	10/16/91	<4
BF-23	9	0	<1	<1	NA	10/10/95	<1	9	0	<1	<1	NA	10/10/95	<1
BF-24	3	1	1.3	1.3	NA	12/01/95	1.3	3	0	<3	<50	NA	12/01/95	<3
BF-25	2	0	<1	<1	NA	10/17/91	<1	2	0	<1	<1	NA	10/17/91	<1
BF-26	5	0	<1	<1	NA	11/27/95	<1	5	0	<1	<3	NA	11/27/95	<3
BF-27	2	0	<1	<1	NA	10/17/91	<1	2	0	<1	<1	NA	10/17/91	<1
BF-28	2	0	<1	<1	NA	10/18/91	<1	2	0	<1	<1	NA	10/18/91	<1
BF-29	2	0	<2	<5	NA	10/17/91	<2	2	0	<2	<5	NA	10/17/91	<2
BF-30	4	0	<1	<1	NA	11/27/95	<1	4	0	<1	<3	NA	11/27/95	<3
BF-31	5	0	<1	<5	NA	11/27/95	<1	5	0	<2	<10	NA	11/27/95	<3
BF-32	3	0	<1	<1	NA	08/31/93	<1	3	0	<1	<1	NA	08/31/93	<1
BF-32A	1	0	<1	<1	NA	11/29/95	<1	1	0	<3	<3	NA	11/29/95	<3
BF-33	2	0	<1	<1	NA	10/16/91	<1	2	0	<1	<1	NA	10/16/91	<1
G-01	16	0	<1	<50	NA	11/21/91	<2	2	0	<2	<5	NA	11/21/91	<2
G-02	16	0	<50	<250	NA	11/21/91	<50	2	0	<50	<250	NA	11/21/91	<50
G-03	15	0	<4	<20	NA	01/27/93	<10	2	0	<4	<20	NA	01/27/93	<20
G-04	16	0	<1	<200	NA	10/11/95	<5	9	0	<5	<200	NA	10/11/95	<5
G-05	13	0	<50	<250	NA	10/12/95	<100	7	0	<50	<200	NA	10/12/95	<100
G-06	13	0	<5	<200	NA	10/12/95	<50	7	0	<5	<200	NA	10/12/95	<50
G-07	10	0	<1	<1	NA	08/15/94	<1	2	0	<1	<1	NA	08/15/94	<1
G-08	15	0	<1	<10	NA	10/11/95	<5	8	0	<1	<10	NA	10/11/95	<5
G-09	17	15	4	47	20	10/11/95	4	10	0	<1	<10	NA	10/11/95	<1
G-10	3	0	<1	<1	NA	11/30/95	<1	3	0	<1	<3	NA	11/30/95	<3
G-11	12	0	<1	<1	NA	10/10/95	<1	7	0	<1	<1	NA	10/10/95	<1
G-12	12	3	<5	29	20	10/10/95	<10	7	2	<10	60	35	10/10/95	<10
G-13	15	0	<5	<200	NA	10/12/95	<30	8	0	<5	<200	NA	10/12/95	<30
G-14	9	0	<1	<1	NA	10/10/95	<1	9	0	<1	<1	NA	10/10/95	<1
G-15	2	0	<1	<1	NA	10/05/91	<1	2	0	<1	<1	NA	10/05/91	<1
G-16	3	0	<1	<1	NA	11/29/95	<1	3	0	<1	<3	NA	11/29/95	<3
G-17	9	0	<1	<10	NA	10/11/95	<5	9	0	<1	<10	NA	10/11/95	<5
G-18	3	0	<1	<1	NA	11/29/95	<1	3	0	<1	<3	NA	11/29/95	<3
G-19	5	0	<1	<2	NA	11/29/95	<1	5	0	<1	<4	NA	11/29/95	<3
LG-01	12	0	<1	<1	NA	08/03/90	<1	0	0	NA	NA	NA	NA	NS
LG-02	6	0	<5	<5	NA	04/19/90	<5	0	0	NA	NA	NA	NA	NS
LW-01	12	0	<1	<5	NA	11/28/95	<1	6	0	<1	<10	NA	11/28/95	<3
LW-02	9	0	<1	<1	NA	11/28/95	<1	2	0	<1	<3	NA	11/28/95	<3
LW-03	5	0	<1	<1	NA	08/05/90	<1	0	0	NA	NA	NA	NA	NS
LW-04	4	0	<1	<1	NA	01/26/93	<1	4	0	<1	<2	NA	01/26/93	<2
LW-05	2	0	<1	<1	NA	10/09/91	<1	2	0	<1	<1	NA	10/09/91	<1
LW-06	2	0	<1	<1	NA	10/05/91	<1	2	0	<1	<1	NA	10/05/91	<1
LW-07	2	0	<1	<1	NA	10/17/91	<1	2	0	<1	<1	NA	10/17/91	<1

Note: See page 10 of this table for footnotes.

TABLE 5.5
CHEMICALS OF CONCERN IN GROUNDWATER

Well Identifier	1,2-DICHLOROETHANE Num. of Analyses	Num. of Detects	Min. Result (µg/L)	Max. Result (µg/L)	Avg. Result (µg/L)	Most Recent Sample Date	Most Recent Result (µg/L)	TETRACHLOROETHYLENE Num. of Analyses	Num. of Detects	Min. Result (µg/L)	Max. Result (µg/L)	Avg. Result (µg/L)	Most Recent Sample Date	Most Recent Result (µg/L)
MW-01	26	1	3	3	NA	11/29/95	<50	26	25	<200	4,800	3,430	11/29/95	3,600
MW-02	11	2	150	150	150	04/22/88	<2500	11	0	<50	<25000	NA	04/22/88	<2500
MW-03	20	0	<0.5	<50	NA	10/11/95	<0.5	20	18	14	86	35	10/11/95	22
MW-04	17	0	<5	<100	NA	04/20/90	<10	17	16	<25	1,700	899	04/20/90	200
MW-05	20	0	<0.5	<1000	NA	11/28/95	<0.5	20	11	150	1,200	621	11/28/95	190
MW-06	9	0	<0.5	<100	NA	12/01/95	<0.5	9	9	1,900	3,700	2,478	12/01/95	3,400
MW-07	7	6	<1	4,100	3,817	04/20/90	3,900	7	0	<1	<500	NA	04/20/90	<200
MW-08	5	0	<1	<1	NA	04/20/90	<1	5	0	<1	<1	NA	04/20/90	<1
MW-09	6	0	<0.5	<3000	NA	11/30/95	<0.5	6	1	55	55	NA	11/30/95	55
MW-10	13	0	<0.5	<100	NA	10/10/95	<0.5	13	4	1.5	2.4	2.0	10/10/95	1.5
MW-11	13	0	<3	<500	NA	10/10/95	<3	13	12	86	1,000	421	10/10/95	86
MW-12	22	8	<0.5	410	215	12/02/95	<0.5	22	1	2	2	NA	12/02/95	2
MW-13	20	10	<50	540	355	10/11/95	320	20	5	<30	120	88	10/11/95	<50
MW-14	20	16	<25	820	538	10/11/95	490	20	3	<5	13	11	10/11/95	11
MW-15	7	0	<200	<1000	NA	08/15/94	<200	7	5	200	330	270	08/15/94	270
MW-16	6	0	<5	<5	NA	11/20/91	<5	6	6	20	30	22	11/20/91	20
MW-17	4	3	<1	12	5.3	12/01/95	12	4	4	1	2.3	1.3	12/01/95	2.3
MW-18	3	0	<10	<20	NA	08/06/90	<10	3	0	<10	<20	NA	08/06/90	<10
MW-19	7	0	<0.5	<2	NA	11/30/95	<0.5	7	0	<1	<2	NA	11/30/95	<1
MW-20	2	0	<10000	<20000	NA	04/06/90	<10000	2	0	<10000	<20000	NA	08/06/90	<20000
MW-21	16	1	<0.5	560	NA	10/12/95	<0.5	16	0	<0.5	<2000	NA	10/12/95	<0.5
MW-22	3	0	<1	<1	NA	08/05/90	<1	3	0	<1	<1	NA	08/05/90	<1
MW-23	15	0	<0.5	<1	NA	10/10/95	<0.5	15	0	<1	<1	NA	10/10/95	<1
MW-24	8	0	<0.5	<1	NA	12/01/95	<0.5	8	0	<1	<1	NA	12/01/95	<1
MW-25	5	4	<1	200	140	12/01/95	<1	5	0	<2	<50	NA	12/01/95	<2
MW-26	11	0	<0.5	<1	NA	12/01/95	<0.5	11	5	<1	2	1.2	12/01/95	2
MW-27	3	0	<0.5	<2	NA	12/02/95	<0.5	3	0	<1	<2	NA	12/02/95	<1
MW-28	16	0	<0.5	<1000	NA	10/12/95	<1000	16	0	<0.5	<2000	NA	10/12/95	<0.5
MW-29	16	0	<0.5	<500	NA	10/11/95	<0.5	16	0	<0.5	<500	NA	10/11/95	<0.5
MW-30	11	0	<0.5	<1	NA	10/10/95	<0.5	11	0	<1	<1	NA	10/10/95	<1
UBT-01	7	0	<2000	<20000	NA	06/06/90	<10000	7	0	<2000	<20000	NA	06/06/90	<10000
UBT-03	1	0	<50	<50	NA	12/04/95	<50	1	1	140	140	NA	12/04/95	140
UBE-01	0	0	NA	NA	NA	NA	NS	0	0	NA	NA	NA	NA	NS
BF-01	12	0	<5	<25	NA	04/18/90	<5	12	0	<5	<25	NA	04/18/90	<5
BF-02	13	0	<50	<200	NA	04/20/90	<50	13	0	<50	<200	NA	04/20/90	<50
BF-03	13	0	<100	<200	NA	04/20/90	<100	13	0	<100	<200	NA	04/20/90	<100
BF-04	17	0	<200	<500	NA	10/24/95	<200	17	0	<200	<500	NA	10/24/95	<300
BF-05	15	0	<0.5	<100	NA	10/10/95	<0.5	15	1	<1	104	NA	10/10/95	<1
BF-06	13	0	<3	<500	NA	10/11/95	<100	13	0	<5	<500	NA	10/11/95	<200
BF-07	13	0	<3	<2000	NA	10/11/95	<300	13	0	<5	<2000	NA	10/11/95	<300
BF-08	10	0	<20	<250	NA	08/15/94	<25	10	0	<20	<250	NA	08/15/94	<25
BF-09	9	0	<1	<200	NA	11/30/95	<1	9	2	5.4	370	188	11/30/95	5
BF-10	15	0	<0.5	<1	NA	10/11/95	<0.5	15	0	<1	<1	NA	10/11/95	<1
BF-11	5	0	<10	<50	NA	08/04/90	<20	5	0	<10	<50	NA	08/04/90	<20
BF-12	8	0	<1	<1	NA	11/20/91	<1	8	0	<1	<1	NA	11/20/91	<1
BF-13	19	0	<0.5	<500	NA	10/12/95	<50	19	0	<0.5	<500	NA	10/12/95	<0.5
BF-14	19	0	<3	<100	NA	10/12/95	<20	19	6	<10	44	24	10/12/95	44
BF-15	6	0	<200	<500	NA	10/12/95	<300	6	0	<200	<500	NA	10/12/95	<500
BF-16	7	0	<1	<10	NA	04/24/91	<1	7	0	<1	<10	NA	04/24/91	<1
BF-17	7	1	30	30	NA	04/24/91	<50	7	0	<20	<50	NA	04/24/91	<50
BF-18	3	0	<0.5	<1	NA	12/01/95	<0.5	3	0	<1	<1	NA	12/01/95	<1
BF-19	3	0	<0.5	<1	NA	10/10/95	<0.5	3	0	<1	<1	NA	10/10/95	<1
BF-20	2	0	<5	<10	NA	10/11/91	<5	2	0	<5	<10	NA	10/11/91	<5
BF-21	3	0	<50	<50	NA	10/12/95	<50	3	0	<50	<100	NA	10/12/95	<100
BF-22	2	0	<4	<5	NA	10/16/91	<4	2	0	<4	<5	NA	10/16/91	<4
BF-23	9	0	<0.5	<1	NA	10/10/95	<0.5	9	0	<1	<1	NA	10/10/95	<1
BF-24	3	1	<0.5	60	NA	12/01/95	<0.5	3	1	4.2	4.2	NA	12/01/95	4
BF-25	2	0	<1	<1	NA	10/17/91	<1	2	0	<1	<1	NA	10/17/91	<1
BF-26	5	0	<0.5	<1	NA	11/27/95	<0.5	5	0	<1	<1	NA	11/27/95	<1
BF-27	2	0	<1	<1	NA	10/17/91	<1	2	0	<1	<1	NA	10/17/91	<1
BF-28	2	0	<1	<1	NA	10/16/91	<1	2	0	<1	<1	NA	10/16/91	<1
BF-29	2	0	<2	<5	NA	10/17/91	<2	2	0	<2	<5	NA	10/17/91	<2
BF-30	4	0	<0.5	<1	NA	11/27/95	<0.5	4	0	<1	<1	NA	11/27/95	<1
BF-31	5	1	<2	2.7	NA	11/27/95	3	5	0	<1	<5	NA	11/27/95	<1
BF-32	3	0	<1	<1	NA	08/31/93	<1	3	0	<1	<1	NA	08/31/93	<1
BF-32A	1	0	<0.5	<0.5	NA	11/29/95	<0.5	1	0	<1	<1	NA	11/29/95	<1
BF-33	2	1	<1	3	NA	10/18/91	3	2	0	<1	<1	NA	10/16/91	<1
G-01	16	0	<1	<50	NA	11/27/91	<2	16	0	<1	<50	NA	11/27/91	<2
G-02	16	0	<50	<250	NA	11/21/91	<50	16	0	<50	<250	NA	11/21/91	<50
G-03	15	0	<4	<20	NA	01/27/93	<10	15	0	<4	<20	NA	01/27/93	<10
G-04	16	0	<1	<100	NA	10/11/95	<3	16	0	<1	<200	NA	10/11/95	<5
G-05	13	0	<30	<250	NA	10/12/95	<50	13	1	<50	510	NA	10/12/95	<100
G-06	13	0	<3	<100	NA	10/12/95	<30	13	0	<5	<200	NA	10/12/95	<50
G-07	10	0	<1	<1	NA	08/15/94	<1	10	0	<1	<1	NA	08/15/94	<1
G-08	15	0	<1	<5	NA	10/11/95	<3	15	0	<1	<10	NA	10/11/95	<5
G-09	17	1	<0.5	18	NA	10/11/95	<0.5	17	0	<1	<20	NA	10/11/95	<3
G-10	3	0	<0.5	<1	NA	11/30/95	<0.5	3	0	<1	<1	NA	11/30/95	<1
G-11	12	0	<0.5	<1	NA	10/10/95	<0.5	12	0	<1	<1	NA	10/10/95	<1
G-12	12	0	<3	<50	NA	10/10/95	<5	12	0	<5	<100	NA	10/10/95	<10
G-13	15	0	<3	<100	NA	10/12/95	<20	15	0	<5	<200	NA	10/12/95	<30
G-14	9	0	<0.5	<1	NA	10/10/95	<0.5	9	0	<1	<1	NA	10/10/95	<1
G-15	2	0	<1	<1	NA	10/08/91	<1	2	0	<1	<1	NA	10/08/91	<1
G-16	3	0	<0.5	<1	NA	11/29/95	<0.5	3	0	<1	<1	NA	11/29/95	<1
G-17	9	0	<1	<5	NA	10/11/95	<3	9	0	<1	<10	NA	10/11/95	<5
G-18	3	0	<0.5	<1	NA	11/29/95	<0.5	3	0	<1	<1	NA	11/29/95	<1
G-19	5	0	<0.5	<2	NA	11/29/95	<0.5	5	1	<1	4.6	NA	11/29/95	3
LG-01	12	0	<1	<1	NA	08/03/90	<1	12	0	<1	<1	NA	08/03/90	<1
LG-02	6	0	<5	<5	NA	04/19/90	<5	6	0	<5	<5	NA	04/19/90	<5
LW-01	12	0	<0.5	<5	NA	11/28/95	<0.5	12	0	<1	<5	NA	11/28/95	<1
LW-02	9	0	<0.5	<1	NA	11/28/95	<0.5	9	0	<1	<1	NA	11/28/95	<1
LW-03	5	0	<1	<1	NA	08/05/90	<1	5	0	<1	<1	NA	08/05/90	<1
LW-04	4	0	<1	<1	NA	01/26/93	<1	4	0	<1	<1	NA	01/26/93	<1
LW-05	2	0	<1	<1	NA	10/09/91	<1	2	0	<1	<1	NA	10/09/91	<1
LW-06	2	0	<1	<1	NA	10/08/91	<1	2	0	<1	<1	NA	10/08/91	<1
LW-07	2	0	<1	<1	NA	10/17/91	<1	2	0	<1	<1	NA	10/17/91	<1

Note: See page 10 of this table for footnotes.

TABLE 5.5
CHEMICALS OF CONCERN IN GROUNDWATER

	TRICHLOROETHYLENE							CHLOROFORM						
Well Identifier	Num. of Analyses	Num. of Detects	Min. Result (ug/L)	Max. Result (ug/L)	Avg. Result (ug/L)	Most Recent Sample Date	Most Recent Result (ug/L)	Num. of Analyses	Num. of Detects	Min. Result (ug/L)	Max. Result (ug/L)	Avg. Result (ug/L)	Most Recent Sample Date	Most Recent Result (ug/L)
MW-01	26	3	<10	190	113	11/29/95	190	26	26	1,100	23,000	9,877	11/29/95	8,100
MW-02	11	0	<50	<25000	NA	04/22/88	<2500	11	10	4,500	8,500	6,520	04/22/88	8,500
MW-03	20	19	1	83	37	10/11/95	17	20	20	9	950	555	10/11/95	9.4
MW-04	17	2	<5	7	6	04/20/90	<10	17	14	<10	7,300	1,665	04/20/90	10
MW-05	20	2	1.1	25	13	11/28/95	1.1	20	20	760	47,000	29,293	11/28/95	760
MW-06	9	4	<50	810	428	12/01/95	810	9	9	1,500	8,300	4,600	12/01/95	1,500
MW-07	7	0	<1	<500	NA	04/20/90	<200	7	6	<1	890	847	04/20/90	800
MW-08	6	0	<1	<1	NA	04/20/90	<1	6	0	<1	<1	NA	04/20/90	<1
MW-09	6	0	<1	<3000	NA	11/30/95	<1	6	6	640	85,000	58,773	11/30/95	640
MW-10	13	7	6	14	10	10/10/95	9.1	13	7	1.1	33	11	10/10/95	2.5
MW-11	13	2	5.2	8.8	7	10/10/95	5.2	13	6	<3	4,100	2,183	10/10/95	<3
MW-12	22	1	3.5	3.5	NA	12/02/95	3.5	22	15	15	8,300	3,444	12/02/95	160
MW-13	20	18	200	950	576	10/11/95	730	20	20	120	1,200	765	10/11/95	420
MW-14	20	15	<50	180	89	10/11/95	140	20	1	<1	5.6	NA	10/11/95	<5
MW-15	7	0	<200	<1000	NA	08/15/94	<200	7	0	<200	<1000	NA	08/15/94	<200
MW-16	6	6	370	920	650	11/20/91	370	6	6	31	150	97	11/20/91	31
MW-17	4	0	<1	<1	NA	12/01/95	<1	4	3	<1	8	4.3	12/01/95	<1
MW-18	3	3	830	1,200	1,010	08/06/90	830	3	3	90	110	100	08/06/90	90
MW-19	7	7	13	35	22	11/30/95	13	7	7	47	230	101	11/30/95	47
MW-20	2	0	<10000	<20000	NA	08/06/90	<20000	2	0	<10000	<20000	NA	08/06/90	<10000
MW-21	16	0	<0.5	<2000	NA	10/12/95	<100	16	0	<0.5	<2000	NA	10/12/95	<0.5
MW-22	3	3	7	13	10	08/05/90	11	3	3	37	48	43	08/05/90	37
MW-23	15	0	<1	<1	NA	10/10/95	<1	15	1	<0.5	1	NA	10/10/95	<0.5
MW-24	8	0	<1	<1	NA	12/01/95	<1	8	6	<0.5	4	2.1	12/01/95	<1
MW-25	6	0	<2	<50	NA	12/01/95	<2	6	6	14	510	351	12/01/95	18
MW-26	11	0	<1	<1	NA	12/01/95	<1	11	0	<0.5	<1	NA	12/01/95	<1
MW-27	3	3	7.9	10	9	12/02/95	7.9	3	2	<1	87	62.5	12/02/95	<1
MW-28	16	0	<0.5	<2000	NA	10/12/95	<2000	16	0	<0.5	<1000	NA	10/12/95	<1000
MW-29	16	0	<0.5	<500	NA	10/11/95	<300	16	0	<0.5	<500	NA	10/11/95	<0.5
MW-30	11	0	<1	<1	NA	10/10/95	<1	11	0	<0.5	<1	NA	10/10/95	<0.5
UBT-01	7	0	<2000	<20000	NA	06/08/90	<10000	7	6	10,000	12,000	11,333	06/08/90	11,000
UBT-03	1	0	<100	<100	NA	12/04/95	<100	1	1	35,000	35,000	NA	12/04/95	35,000
UBE-01	0	0	NA	NA	NA	NA	NS	9	9	9,800	15,000	12,856	08/21/91	15,000
BF-01	12	0	<5	<25	NA	04/18/90	<5	12	1	<5	5	NA	04/18/90	<5
BF-02	13	0	<50	<200	NA	04/20/90	<50	13	1	<50	50	NA	04/20/90	<50
BF-03	13	1	100	100	NA	04/20/90	100	13	0	<100	<200	NA	04/20/90	<100
BF-04	17	3	<200	260	240	10/24/95	<300	17	0	<200	<500	NA	10/24/95	<200
BF-05	15	0	<1	<100	NA	10/10/95	<1	15	0	<0.5	<100	NA	10/10/95	<0.5
BF-06	13	0	<5	<500	NA	10/11/95	<200	13	0	<3	<500	NA	10/11/95	<100
BF-07	13	1	45	220	NA	10/11/95	<500	13	0	<3	<2000	NA	10/11/95	<300
BF-08	10	0	<20	<250	NA	08/15/94	<25	10	0	<20	<250	NA	08/15/94	<25
BF-09	9	1	<100	260	NA	11/30/95	260	9	8	2.2	710	387	11/30/95	2.2
BF-10	15	0	<1	<1	NA	10/11/95	<1	15	0	<0.5	<1	NA	10/11/95	<0.5
BF-11	5	0	<10	<50	NA	08/04/90	<20	5	0	<10	<50	NA	08/04/90	<20
BF-12	8	0	<1	<1	NA	11/20/91	<1	8	0	<1	<1	NA	11/20/91	<1
BF-13	19	0	<0.5	<500	NA	10/12/95	<100	19	2	<0.5	110	56	10/12/95	<0.5
BF-14	19	0	<5	<200	NA	10/12/95	<20	19	0	<3	<100	NA	10/12/95	<20
BF-15	8	0	<200	<500	NA	10/12/95	<500	8	0	<200	<500	NA	10/12/95	<300
BF-16	7	0	<1	<10	NA	04/24/91	<1	7	0	<1	<10	NA	04/24/91	<1
BF-17	7	0	<20	<50	NA	04/24/91	<50	7	0	<20	<50	NA	04/24/91	<50
BF-18	3	3	7	130	49	12/01/95	130	3	0	<1	<1	NA	12/01/95	<1
BF-19	3	0	<1	<1	NA	10/10/95	<1	3	1	<0.5	1	NA	10/10/95	<0.5
BF-20	2	0	<5	<10	NA	10/11/91	<5	2	0	<5	<10	NA	10/11/91	<25
BF-21	3	0	<50	<100	NA	10/12/95	<100	3	0	<50	<50	NA	10/12/95	<50
BF-22	2	0	<4	<5	NA	10/16/91	<4	2	0	<4	<5	NA	10/16/91	<5
BF-23	9	0	<1	<1	NA	10/10/95	<1	9	0	<0.5	<1	NA	10/10/95	<0.5
BF-24	3	0	<1	<50	NA	12/01/95	<1	3	1	2	2	NA	12/01/95	2
BF-25	2	0	<1	<1	NA	10/17/91	<1	2	0	<1	<1	NA	10/17/91	<1
BF-26	5	0	<1	<1	NA	11/27/95	<1	5	1	<1	1	NA	11/27/95	<1
BF-27	2	0	<1	<1	NA	10/17/91	<1	2	0	<1	<1	NA	10/17/91	<1
BF-28	2	0	<1	<1	NA	10/16/91	<1	2	0	<1	<1	NA	10/16/91	<1
BF-29	2	0	<2	<5	NA	10/17/91	<2	2	0	<2	<5	NA	10/17/91	<2
BF-30	4	0	<1	<1	NA	11/27/95	<1	4	0	<1	<1	NA	11/27/95	<1
BF-31	5	0	<1	<5	NA	11/27/95	<1	5	0	<1	<5	NA	11/27/95	<1
BF-32	3	0	<1	<1	NA	08/31/93	<1	3	0	<1	<1	NA	08/31/93	<1
BF-32A	1	0	<1	<1	NA	11/29/95	<1	1	0	<1	<1	NA	11/29/95	<1
BF-33	2	0	<1	<1	NA	10/16/91	<1	2	0	<1	<1	NA	10/16/91	<1
G-01	16	0	<1	<50	NA	11/21/91	<2	16	1	<1	5	NA	11/21/91	<2
G-02	16	0	<50	<250	NA	11/21/91	<50	16	0	<50	<250	NA	11/21/91	<50
G-03	15	0	<4	<20	NA	01/27/93	<10	15	1	<4	5	NA	01/27/93	<10
G-04	16	0	<1	<200	NA	10/11/95	<5	16	0	<1	<100	NA	10/11/95	<3
G-05	13	0	<50	<250	NA	10/12/95	<100	13	1	<30	120	NA	10/12/95	<50
G-06	13	0	<5	<200	NA	10/12/95	<50	13	0	<3	<100	NA	10/12/95	<30
G-07	10	0	<1	<1	NA	08/15/94	<1	10	0	<1	<1	NA	08/15/94	<1
G-08	15	0	<1	<10	NA	10/11/95	<5	15	0	<1	<5	NA	10/11/95	<3
G-09	17	0	<1	<20	NA	10/11/95	<1	17	0	<0.5	<20	NA	10/11/95	<0.5
G-10	3	0	<1	<1	NA	11/30/95	<1	3	0	<1	<1	NA	11/30/95	<1
G-11	12	0	<1	<1	NA	10/10/95	<1	12	0	<0.5	<1	NA	10/10/95	<0.5
G-12	12	0	<5	<100	NA	10/10/95	<10	12	0	<3	<50	NA	10/10/95	<5
G-13	15	1	<5	10	NA	10/12/95	<30	15	0	<3	<100	NA	10/12/95	<20
G-14	9	9	25	61	46	10/10/95	54	9	0	<0.5	<1	NA	10/10/95	<0.5
G-15	2	0	<1	<1	NA	10/08/91	<1	2	0	<1	<1	NA	10/08/91	<1
G-16	3	0	<1	<1	NA	11/29/95	<1	3	0	<1	<1	NA	11/29/95	<1
G-17	9	0	<1	<10	NA	10/11/95	<5	9	0	<1	<5	NA	10/11/95	<3
G-18	3	0	<1	<1	NA	11/29/95	<1	3	0	<1	<1	NA	11/29/95	<1
G-19	5	0	<1	<2	NA	11/29/95	<1	5	1	<1	4.2	NA	11/29/95	4.2
LG-01	12	0	<1	<1	NA	08/03/90	<1	12	0	<1	<1	NA	08/03/90	<1
LG-02	6	0	<5	<5	NA	04/19/90	<5	6	0	<5	<5	NA	04/19/90	<5
LW-01	12	0	<1	<5	NA	11/28/95	<1	12	0	<1	<5	NA	11/28/95	<1
LW-02	9	0	<1	<1	NA	11/28/95	<1	9	0	<1	<1	NA	11/28/95	<1
LW-03	5	0	<1	<1	NA	08/03/90	<1	5	0	<1	<1	NA	08/03/90	<1
LW-04	4	0	<1	<1	NA	01/26/93	<1	4	0	<1	<1	NA	01/26/93	<1
LW-05	2	0	<1	<1	NA	10/09/91	<1	1	1	20	20	20	09/25/91	NA
LW-06	2	0	<1	<1	NA	10/08/91	<1	2	0	<1	<1	NA	10/08/91	<1
LW-07	2	0	<1	<1	NA	10/17/91	<1	1	1	2	2	2	09/25/91	NA

Note: See page 10 of this table for footnotes.

TABLE 5.5
CHEMICALS OF CONCERN IN GROUNDWATER

Well Identifier	CARBON TETRACHLORIDE							1,2-DICHLOROBENZENE						
	Num. of Analyses	Num. of Detects	Min. Result (ug/L)	Max. Result (ug/L)	Avg. Result (ug/L)	Most Recent Sample Date	Most Recent Result (ug/L)	Num. of Analyses	Num. of Detects	Min. Result (ug/L)	Max. Result (ug/L)	Avg. Result (ug/L)	Most Recent Sample Date	Most Recent Result (ug/L)
MW-01	25	5	<10	230	167	11/29/95	120	31	10	<10	110	71.1	11/29/95	110
MW-02	11	0	<50	<25000	NA	04/22/88	<2500	11	1	<10	10	NA	04/22/88	<2500
MW-03	20	2	<0.5	16	13.5	10/11/95	<0.5	21	0	<1	<50	NA	10/11/95	<5
MW-04	17	2	<5	25	17.5	04/20/90	<10	17	0	<5	<100	NA	04/20/90	<10
MW-05	20	2	23	180	102	11/28/95	23	20	2	<1	36	23	11/28/95	<1
MW-06	9	8	<100	990	573	12/01/95	220	10	1	<10	26	NA	12/01/95	26
MW-07	7	0	<1	<500	NA	04/20/90	<200	7	0	<1	<500	NA	04/20/90	<200
MW-08	5	5	2	2	2	04/20/90	2	5	0	<1	<1	NA	04/20/90	<1
MW-09	6	0	<0.5	<3000	NA	11/30/95	<0.5	6	1	1.3	1.3	NA	11/30/95	1.3
MW-10	13	0	<0.5	<100	NA	10/10/95	<0.5	13	0	<1	<100	NA	10/10/95	<1
MW-11	13	0	<3	<500	NA	10/10/95	<3	13	0	<5	<500	NA	10/10/95	<5
MW-12	22	0	<0.5	<500	NA	12/02/95	<0.5	22	0	<1	<500	NA	12/02/95	<1
MW-13	20	0	<5	<1000	NA	10/11/95	<50	27	0	<5	<1000	NA	10/11/95	<100
MW-14	20	0	<1	<100	NA	10/11/95	<5	28	0	<1	<200	NA	10/11/95	<10
MW-15	7	0	<200	<1000	NA	08/15/94	<200	7	0	<200	<1000	NA	08/15/94	<1000
MW-16	6	0	<5	<5	NA	11/20/91	<5	5	0	<5	<5	NA	04/25/91	<5
MW-17	4	0	<0.5	<1	NA	12/01/95	<0.5	4	0	<1	<1	NA	12/01/95	<1
MW-18	3	0	<10	<20	NA	08/06/90	<10	3	0	<10	<20	NA	08/06/90	<10
MW-19	7	0	<0.5	<2	NA	11/30/95	<0.5	7	0	<1	<10	NA	11/30/95	<1
MW-20	2	0	<10000	<20000	NA	08/06/90	<20000	2	0	<10000	<20000	NA	08/06/90	<20000
MW-21	16	0	<0.5	<2000	NA	10/12/95	<0.5	16	0	<0.5	<2000	NA	10/12/95	<100
MW-22	3	3	1	1	1	08/05/90	1	3	0	<1	<1	NA	08/05/90	<1
MW-23	15	0	<0.5	<1	NA	10/10/95	<0.5	14	0	<1	<1	NA	10/10/95	<1
MW-24	8	0	<0.5	<1	NA	12/01/95	<0.5	8	0	<1	<1	NA	12/01/95	<1
MW-25	6	0	<1	<50	NA	12/01/95	<1	6	0	<2	<50	NA	12/01/95	<2
MW-26	11	0	<0.5	<1	NA	12/01/95	<0.5	10	0	<1	<1	NA	12/01/95	<1
MW-27	3	0	<0.5	<2	NA	12/02/95	<0.5	2	0	<1	<10	NA	12/02/95	<1
MW-28	16	0	<0.5	<1000	NA	10/12/95	<0.5	19	0	<0.5	<2000	NA	10/12/95	<2000
MW-29	16	0	<0.5	<500	NA	10/11/95	<0.5	22	0	<0.5	<500	NA	10/11/95	<300
MW-30	11	0	<0.5	<1	NA	10/10/95	<0.5	9	0	<1	<10	NA	10/10/95	<1
UST-01	7	0	<2000	<20000	NA	08/08/90	<10000	7	0	<2000	<20000	NA	08/08/90	<10000
UST-03	1	0	<50	<50	NA	12/04/95	<50	1	0	<100	<100	NA	12/04/95	<100
UST-01	0	0	NA	NA	NA	NA	NS	0	0	NA	NA	NA	NA	NS
BF-01	12	0	<5	<25	NA	04/18/90	<5	12	0	<5	<25	NA	04/18/90	<5
BF-02	13	0	<50	<200	NA	04/20/90	<50	13	0	<50	<200	NA	04/20/90	<50
BF-03	13	0	<100	<200	NA	04/20/90	<100	13	0	<100	<200	NA	04/20/90	<100
BF-04	17	0	<200	<500	NA	10/24/95	<200	18	1	5.5	5.5	NA	10/24/95	<300
BF-05	15	0	<0.5	<100	NA	10/10/95	<0.5	14	0	<1	<100	NA	10/10/95	<1
BF-06	13	0	<3	<500	NA	10/11/95	<100	17	0	<5	<500	NA	10/11/95	<200
BF-07	13	0	<3	<2000	NA	10/11/95	<300	13	0	<5	<2000	NA	10/11/95	<500
BF-08	10	0	<20	<250	NA	08/15/94	<25	10	0	<10	<250	NA	08/15/94	<130
BF-09	9	0	<1	<200	NA	11/30/95	<1	8	1	4.9	4.9	NA	11/30/95	4.9
BF-10	15	0	<0.5	<1	NA	10/11/95	<0.5	14	0	<1	<1	NA	10/11/95	<1
BF-11	5	0	<10	<50	NA	08/04/90	<20	5	0	<10	<50	NA	08/04/90	<20
BF-12	8	0	<1	<1	NA	11/20/91	<1	7	0	<1	<1	NA	04/24/91	<1
BF-13	19	0	<0.5	<500	NA	10/12/95	<50	26	0	<0.5	<500	NA	10/12/95	<100
BF-14	19	0	<3	<100	NA	10/12/95	<20	19	1	<5	35	NA	10/12/95	<20
BF-15	6	0	<200	<500	NA	10/12/95	<300	7	1	7.1	7.1	NA	10/12/95	<500
BF-16	7	0	<1	<10	NA	04/24/91	<1	8	0	<1	<10	NA	04/24/91	<1
BF-17	7	0	<20	<50	NA	04/24/91	<50	8	0	<10	<50	NA	04/24/91	<50
BF-18	3	0	<0.5	<1	NA	12/01/95	<0.5	2	0	<1	<10	NA	12/01/95	<1
BF-19	3	0	<0.5	<1	NA	10/10/95	<0.5	3	0	<1	<10	NA	10/10/95	<5
BF-20	2	0	<5	<10	NA	10/11/91	<5	1	0	<10	<10	NA	10/11/91	<10
BF-21	3	0	<50	<50	NA	10/12/95	<50	2	0	<10	<100	NA	10/12/95	<100
BF-22	2	0	<4	<5	NA	10/16/91	<4	1	0	<20	<20	NA	10/16/91	<20
BF-23	9	0	<0.5	<1	NA	10/10/95	<0.5	15	0	<1	<10	NA	10/10/95	<5
BF-24	3	0	<0.5	<50	NA	12/01/95	<0.5	2	1	7.2	7.2	NA	12/01/95	7.2
BF-25	2	0	<1	<1	NA	10/17/91	<1	1	0	<10	<10	NA	10/17/91	<10
BF-26	5	0	<0.5	<1	NA	11/27/95	<0.5	3	0	<1	<10	NA	11/27/95	<1
BF-27	2	0	<1	<1	NA	10/17/91	<1	1	0	<10	<10	NA	10/17/91	<10
BF-28	2	0	<1	<1	NA	10/16/91	<1	1	0	<20	<20	NA	10/16/91	<20
BF-29	2	0	<2	<5	NA	10/17/91	<2	1	0	<10	<10	NA	10/17/91	<10
BF-30	4	0	<0.5	<1	NA	11/27/95	<0.5	2	0	<1	<20	NA	11/27/95	<1
BF-31	5	0	<0.5	<5	NA	11/27/95	<0.5	3	0	<1	<25	NA	11/27/95	<1
BF-32	3	0	<1	<1	NA	08/31/93	<1	3	1	<5	8	NA	08/31/93	<5
BF-32A	1	0	<0.5	<0.5	NA	11/29/95	<0.5	1	0	<1	<1	NA	11/29/95	<1
BF-33	2	0	<1	<1	NA	10/16/91	<1	1	0	<20	<20	NA	10/16/91	<20
G-01	16	0	<1	<50	NA	11/21/91	<2	16	0	<1	<50	NA	04/23/91	<1
G-02	16	0	<50	<250	NA	11/21/91	<50	16	0	<10	<250	NA	04/23/91	<50
G-03	15	0	<4	<20	NA	01/27/93	<10	14	0	<5	<50	NA	01/27/93	<50
G-04	16	0	<1	<100	NA	10/11/95	<3	16	0	<1	<200	NA	10/11/95	<5
G-05	13	0	<30	<250	NA	10/12/95	<50	13	0	<50	<250	NA	10/12/95	<100
G-06	13	0	<3	<100	NA	10/12/95	<30	13	0	<5	<200	NA	10/12/95	<50
G-07	10	0	<1	<1	NA	08/15/94	<1	10	0	<1	<10	NA	08/15/94	<5
G-08	15	0	<1	<5	NA	10/11/95	<3	15	0	<1	<10	NA	10/11/95	<5
G-09	17	0	<0.5	<20	NA	10/11/95	<0.5	19	0	<1	<20	NA	10/11/95	<1
G-10	3	0	<0.5	<1	NA	11/30/95	<0.5	2	0	<1	<10	NA	11/30/95	<1
G-11	12	0	<0.5	<1	NA	10/10/95	<0.5	16	0	<1	<5	NA	10/10/95	<1
G-12	12	0	<3	<50	NA	10/10/95	<5	16	0	<5	<100	NA	10/10/95	<10
G-13	15	0	<3	<100	NA	10/12/95	<20	15	0	<5	<200	NA	10/12/95	<30
G-14	9	0	<0.5	<1	NA	10/10/95	<0.5	8	0	<1	<10	NA	10/10/95	<1
G-15	2	0	<1	<1	NA	10/08/91	<1	1	0	<10	<10	NA	10/08/91	<10
G-16	3	0	<0.5	<1	NA	11/29/95	<0.5	2	0	<1	<10	NA	11/29/95	<1
G-17	9	0	<1	<5	NA	10/11/95	<3	8	0	<2	<10	NA	10/11/95	<5
G-18	3	0	<0.5	<1	NA	11/29/95	<0.5	2	0	<1	<10	NA	11/29/95	<1
G-19	5	0	<0.5	<2	NA	11/29/95	<0.5	3	1	1.8	1.8	NA	11/29/95	1.8
LG-01	12	0	<1	<1	NA	05/03/90	<1	12	0	<1	<1	NA	05/03/90	<1
LG-02	6	0	<5	<5	NA	04/19/90	<5	6	0	<5	<5	NA	04/19/90	<5
LW-01	12	0	<0.5	<5	NA	11/28/95	<0.5	10	0	<1	<25	NA	11/28/95	<1
LW-02	9	0	<0.5	<1	NA	11/28/95	<0.5	8	0	<1	<1	NA	11/28/95	<1
LW-03	5	0	<1	<1	NA	08/05/90	<1	5	0	<1	<1	NA	08/05/90	<1
LW-04	4	0	<1	<1	NA	01/26/93	<1	2	0	<5	<10	NA	01/26/93	<5
LW-05	2	0	<1	<1	NA	10/09/91	<1	1	0	<10	<10	NA	10/09/91	<10
LW-06	2	0	<1	<1	NA	10/08/91	<1	1	0	<10	<10	NA	10/08/91	<10
LW-07	2	0	<1	<1	NA	10/17/91	<1	1	0	<10	<10	NA	10/17/91	<10

Note: See page 10 of this table for footnotes.

TABLE 5.5
CHEMICALS OF CONCERN IN GROUNDWATER

Well Identifier	1,3-DICHLOROBENZENE Num. of Analyses	Num. of Detects	Min. Result (ug/L)	Max. Result (ug/L)	Avg. Result (ug/L)	Most Recent Sample Date	Most Recent Result (ug/L)	1,4-DICHLOROBENZENE Num. of Analyses	Num. of Detects	Min. Result (ug/L)	Max. Result (ug/L)	Avg. Result (ug/L)	Most Recent Sample Date	Most Recent Result (ug/L)
MW-01	31	5	5.3	200	44.6	11/29/95	<100	31	13	16	310	146	11/29/95	220
MW-02	11	0	<10	<25000	NA	04/22/88	<2500	11	3	17	67	47	04/22/88	<2500
MW-03	21	0	<1	<50	NA	10/11/95	<5	21	0	<1	<50	NA	10/11/95	<5
MW-04	17	0	<5	<100	NA	04/20/90	<10	17	0	<5	<100	NA	04/20/90	<10
MW-05	20	0	<1	<1000	NA	11/28/95	<1	20	3	<1	52	32	11/28/95	<1
MW-06	10	0	<1	<100	NA	12/01/95	<1	10	6	<10	250	132	12/01/95	54
MW-07	7	0	<1	<500	NA	04/20/90	<200	7	0	<1	<500	NA	04/20/90	<200
MW-08	5	0	<1	<1	NA	04/20/90	<1	5	0	<1	<1	NA	04/20/90	<1
MW-09	6	0	<1	<3000	NA	11/30/95	<1	6	1	8.7	8.7	NA	11/30/95	8.7
MW-10	13	0	<1	<100	NA	10/10/95	<1	13	0	<1	<100	NA	10/10/95	<1
MW-11	13	0	<5	<500	NA	10/10/95	<5	13	0	<5	<500	NA	10/10/95	<5
MW-12	22	0	<1	<500	NA	12/02/95	<1	22	1	<1	7.8	NA	12/02/95	<1
MW-13	27	0	<5	<1000	NA	10/11/95	<100	27	0	<5	<1000	NA	10/11/95	<100
MW-14	28	0	<1	<200	NA	10/11/95	<10	28	0	<1	<200	NA	10/11/95	<5
MW-15	7	0	<200	<1000	NA	08/15/94	<1000	7	0	<200	<1000	NA	08/15/94	<1000
MW-16	5	0	<5	<5	NA	04/25/91	<5	5	0	<5	<5	NA	04/25/91	<5
MW-17	4	0	<1	<1	NA	12/01/95	<1	4	0	<1	<1	NA	12/01/95	<1
MW-18	3	0	<10	<20	NA	08/06/90	<10	3	0	<10	<20	NA	08/06/90	<10
MW-19	7	0	<1	<10	NA	11/30/95	<1	7	0	<1	<10	NA	11/30/95	<1
MW-20	2	0	<10000	<20000	NA	08/06/90	<20000	2	0	<10000	<20000	NA	08/06/90	<20000
MW-21	16	0	<0.5	<2000	NA	10/12/95	<100	16	0	<0.5	<2000	NA	10/12/95	<0.5
MW-22	3	0	<1	<1	NA	08/05/90	<1	3	0	<1	<1	NA	08/05/90	<1
MW-23	14	0	<1	<1	NA	10/10/95	<1	14	0	<1	<1	NA	10/10/95	<1
MW-24	8	0	<1	<1	NA	12/01/95	<1	8	0	<1	<1	NA	12/01/95	<1
MW-25	6	0	<2	<50	NA	12/01/95	<2	6	0	<2	<50	NA	12/01/95	<2
MW-26	10	0	<1	<1	NA	12/01/95	<1	10	0	<1	<1	NA	12/01/95	<1
MW-27	2	0	<1	<10	NA	12/02/95	<1	2	0	<1	<10	NA	12/02/95	<1
MW-28	19	0	<0.5	<2000	NA	10/12/95	<2000	19	0	<0.5	<2000	NA	10/12/95	<2000
MW-29	22	0	<0.5	<500	NA	10/11/95	<300	22	0	<0.5	<500	NA	10/11/95	<5
MW-30	9	0	<1	<10	NA	10/10/95	<1	9	0	<1	<10	NA	10/10/95	<1
UBT-01	7	0	<2000	<20000	NA	06/08/90	<10000	7	0	<2000	<20000	NA	06/08/90	<10000
UBT-03	1	0	<100	<100	NA	12/04/95	<100	1	1	170	170	NA	12/04/95	170
UBE-01	0	0	NA	NA	NA	NA	NS	0	0	NA	NA	NA	NA	NS
BF-01	12	0	<5	<25	NA	04/18/90	<5	12	0	<5	<25	NA	04/18/90	<5
BF-02	13	0	<50	<200	NA	04/20/90	<50	13	0	<50	<200	NA	04/20/90	<50
BF-03	13	0	<100	<200	NA	04/20/90	<100	13	1	<100	220	NA	04/20/90	<100
BF-04	18	0	<5	<500	NA	10/24/95	<300	18	2	38	59	49	10/24/95	38
BF-05	14	0	<1	<100	NA	10/10/95	<1	14	0	<1	<100	NA	10/10/95	<1
BF-06	17	0	<5	<500	NA	10/11/95	<200	16	5	<0.5	37	32	10/11/95	<200
BF-07	13	0	<5	<2000	NA	10/11/95	<500	14	1	<5	100	NA	10/11/95	<500
BF-08	10	0	<10	<250	NA	08/15/94	<130	10	0	<10	<250	NA	08/15/94	<130
BF-09	8	0	<2	<500	NA	11/30/95	<2	8	1	36	36	NA	11/30/95	36
BF-10	14	0	<1	<1	NA	10/11/95	<1	14	0	<1	<1	NA	10/11/95	<1
BF-11	5	0	<10	<50	NA	08/04/90	<20	5	0	<10	<50	NA	08/04/90	<20
BF-12	7	0	<1	<1	NA	04/24/91	<1	7	0	<1	<1	NA	04/24/91	<1
BF-13	26	0	<0.5	<500	NA	10/12/95	<100	26	0	<0.5	<500	NA	10/12/95	<5
BF-14	19	0	<5	<200	NA	10/12/95	<20	20	1	<5	12	NA	10/12/95	<20
BF-15	7	0	<5	<500	NA	10/12/95	<500	7	1	47	47	NA	10/12/95	47
BF-16	8	0	<1	<10	NA	04/24/91	<1	8	0	<1	<10	NA	04/24/91	<1
BF-17	8	0	<10	<50	NA	04/24/91	<50	8	0	<10	<50	NA	04/24/91	<50
BF-18	2	0	<1	<10	NA	12/01/95	<1	2	0	<1	<10	NA	12/01/95	<1
BF-19	3	0	<1	<10	NA	10/10/95	<5	3	0	<1	<10	NA	10/10/95	<5
BF-20	1	0	<10	<10	NA	10/11/91	<10	1	0	<10	<10	NA	10/11/91	<10
BF-21	2	0	<10	<100	NA	10/12/95	<100	2	1	18	18	NA	10/12/95	<100
BF-22	1	0	<20	<20	NA	10/16/91	<20	1	0	<20	<20	NA	10/16/91	<20
BF-23	15	0	<1	<10	NA	10/10/95	<5	15	0	<1	<10	NA	10/10/95	<5
BF-24	2	0	<1	<10	NA	12/01/95	<1	2	2	13	53	33	12/01/95	53
BF-25	1	0	<10	<10	NA	10/17/91	<10	1	0	<10	<10	NA	10/17/91	<10
BF-26	3	0	<1	<10	NA	11/27/95	<1	3	0	<1	<10	NA	11/27/95	<1
BF-27	1	0	<10	<10	NA	10/17/91	<10	1	0	<10	<10	NA	10/17/91	<10
BF-28	1	0	<20	<20	NA	10/16/91	<20	1	0	<20	<20	NA	10/16/91	<20
BF-29	1	0	<10	<10	NA	10/17/91	<10	1	0	<10	<10	NA	10/17/91	<10
BF-30	2	0	<1	<20	NA	11/27/95	<1	2	0	<1	<20	NA	11/27/95	<1
BF-31	3	0	<1	<25	NA	11/27/95	<1	3	1	2.6	2.6	NA	11/27/95	2.6
BF-32	2	0	<5	<20	NA	08/31/93	<5	3	0	<5	<20	NA	08/31/93	<5
BF-32A	1	0	<1	<1	NA	11/29/95	<1	1	0	<1	<1	NA	11/29/95	<1
BF-33	1	0	<20	<20	NA	10/16/91	<20	1	0	<20	<20	NA	10/16/91	<20
G-01	16	0	<1	<50	NA	04/23/91	<1	16	0	<1	<50	NA	04/23/91	<1
G-02	16	0	<10	<250	NA	04/23/91	<50	16	1	10	10	NA	04/23/91	<50
G-03	14	0	<5	<30	NA	01/27/93	<50	14	0	<5	<50	NA	01/27/93	<50
G-04	16	0	<1	<200	NA	10/11/95	<5	16	0	<1	<200	NA	10/11/95	<5
G-05	13	0	<50	<250	NA	10/12/95	<100	13	0	<50	<250	NA	10/12/95	<100
G-06	13	0	<5	<200	NA	10/12/95	<50	13	0	<5	<200	NA	10/12/95	<50
G-07	10	0	<1	<10	NA	08/15/94	<5	10	0	<1	<10	NA	08/15/94	<5
G-08	15	0	<1	<10	NA	10/11/95	<5	15	0	<1	<10	NA	10/11/95	<5
G-09	19	0	<1	<20	NA	10/11/95	<1	19	0	<1	<20	NA	11/30/95	<1
G-10	2	0	<1	<10	NA	11/30/95	<1	2	0	<1	<10	NA	11/30/95	<1
G-11	16	0	<1	<5	NA	10/10/95	<1	16	0	<1	<5	NA	10/10/95	<1
G-12	16	0	<5	<100	NA	10/10/95	<10	17	1	3.8	3.8	NA	10/10/95	<10
G-13	15	0	<5	<200	NA	10/12/95	<30	16	1	2.5	2.5	NA	10/12/95	<30
G-14	8	0	<1	<10	NA	10/10/95	<1	8	0	<1	<10	NA	10/10/95	<1
G-15	1	0	<10	<10	NA	10/08/91	<10	1	0	<10	<10	NA	10/08/91	<10
G-16	2	0	<1	<10	NA	11/29/95	<1	2	0	<1	<10	NA	11/29/95	<1
G-17	8	0	<2	<10	NA	10/11/95	<5	8	0	<2	<10	NA	10/11/95	<5
G-18	2	0	<1	<10	NA	11/29/95	<1	2	0	<1	<10	NA	11/29/95	<1
G-19	3	0	<1	<10	NA	11/29/95	<1	3	1	<10	10	NA	11/29/95	10
LG-01	12	0	<1	<1	NA	08/03/90	<1	12	0	<1	<1	NA	08/03/90	<1
LG-02	6	0	<5	<5	NA	04/19/90	<5	6	0	<5	<5	NA	04/19/90	<5
LW-01	10	0	<1	<25	NA	11/28/95	<1	10	0	<1	<25	NA	11/28/95	<1
LW-02	8	0	<1	<1	NA	11/28/95	<1	8	0	<1	<1	NA	11/28/95	<1
LW-03	5	0	<1	<1	NA	08/03/90	<1	5	0	<1	<1	NA	08/03/90	<1
LW-04	2	0	<5	<10	NA	01/26/93	<5	2	0	<5	<10	NA	01/26/93	<5
LW-05	1	0	<10	<10	NA	10/09/91	<10	1	0	<10	<10	NA	10/09/91	<10
LW-06	1	0	<10	<10	NA	10/08/91	<10	1	0	<10	<10	NA	10/08/91	<10
LW-07	1	0	<10	<10	NA	10/17/91	<10	1	0	<10	<10	NA	10/17/91	<10

Note: See page 10 of this table for footnotes.

TABLE 5.5
CHEMICALS OF CONCERN IN GROUNDWATER

ACETONE

Well Identifier	Num of Analyses	Num of Detects	Min Result (ug/L)	Max Result (ug/L)	Avg Result (ug/L)	Most Recent Sample Date	Most Recent Result (ug/L)
MW-01	23	2	<500	2700	2350	11/29/95	<2000
MW-02	8	1	<10000	60,000	NA	04/22/88	<50000
MW-03	18	1	<10	1,800	NA	10/11/95	<20
MW-04	14	1	<50	800	NA	04/20/90	<100
MW-05	18	0	<20	<20000	NA	11/28/95	<20
MW-06	9	0	<20	<10000	NA	12/01/95	<20
MW-07	7	0	<10	<5000	NA	04/20/90	<2000
MW-08	5	0	<10	<10	NA	04/20/90	<10
MW-09	6	0	<20	<30000	NA	11/30/95	<20
MW-10	13	0	<10	<1000	NA	10/10/95	<10
MW-11	13	1	77	77	NA	10/10/95	77
MW-12	16	2	130	1,100	615	12/02/95	130
MW-13	13	1	<1000	2,700	NA	10/11/95	2700
MW-14	13	1	<100	300	NA	10/11/95	300
MW-15	7	0	<2000	<10000	NA	05/15/94	<2000
MW-16	8	0	<50	<100	NA	11/20/91	<100
MW-17	4	1	<10	40	NA	12/01/95	40
MW-18	3	1	<100	100	NA	05/06/90	100
MW-19	7	0	<10	<40	NA	11/30/95	<20
MW-20	2	1	<100000	200,000	NA	05/06/90	200000
MW-21	9	0	<500	<20000	NA	10/12/95	<1000
MW-22	3	0	<10	<10	NA	05/05/90	<10
MW-23	15	0	<10	<20	NA	10/10/95	<10
MW-24	6	0	<10	<20	NA	12/01/95	<20
MW-25	6	0	<40	<500	NA	12/01/95	<40
MW-26	11	0	<10	<20	NA	12/01/95	<20
MW-27	3	1	38	38	NA	12/02/95	38
MW-28	9	0	<1000	<20000	NA	10/12/95	<20000
MW-29	9	0	<500	<10000	NA	10/11/95	<6200
MW-30	11	0	<10	<20	NA	10/10/95	<10
UST-01	7	0	<20000	<200000	NA	06/08/90	<100000
UST-03	1	0	<2000	<2000	NA	12/04/95	<2000
USE-01	0	0	NA	NA	NA	NA	NS
BF-01	12	0	<50	<250	NA	04/18/90	<50
BF-02	13	0	<500	<4000	NA	04/20/90	<500
BF-03	13	0	<1000	<4000	NA	04/20/90	<1000
BF-04	17	0	<2000	<10000	NA	10/24/95	<3000
BF-05	15	0	<10	<1000	NA	10/10/95	<10
BF-06	13	1	<50	2,300	NA	10/11/95	2300
BF-07	13	1	<50	18,000	NA	10/11/95	18000
BF-08	10	0	<250	<2500	NA	05/15/94	<250
BF-09	9	0	<40	<2000	NA	11/30/95	<40
BF-10	15	2	<10	11	10.5	10/11/95	<10
BF-11	5	0	<100	<500	NA	05/04/90	<200
BF-12	8	0	<10	<20	NA	11/20/91	<20
BF-13	12	1	1,100	1,100	NA	10/12/95	1100
BF-14	12	1	<50	350	NA	10/12/95	<310
BF-15	6	0	<2000	<5000	NA	10/12/95	<5000
BF-16	7	0	<10	<100	NA	04/24/91	<10
BF-17	7	0	<200	<500	NA	04/24/91	<500
BF-18	3	0	<20	<20	NA	12/01/95	<20
BF-19	3	0	<10	<20	NA	10/10/95	<10
BF-20	2	0	<100	<200	NA	10/11/91	<100
BF-21	3	0	<1000	<1000	NA	10/12/95	<1000
BF-22	2	0	<80	<100	NA	10/16/91	<80
BF-23	9	0	<10	<20	NA	10/10/95	<10
BF-24	3	0	<20	<1000	NA	12/01/95	<20
BF-25	2	0	<20	<20	NA	10/17/91	<20
BF-26	5	0	<10	<20	NA	11/27/95	<20
BF-27	2	0	<20	<20	NA	10/17/91	<20
BF-28	2	0	<20	<20	NA	10/16/91	<20
BF-29	2	0	<40	<100	NA	10/17/91	<40
BF-30	4	0	<10	<20	NA	11/27/95	<20
BF-31	5	0	<20	<100	NA	11/27/95	<20
BF-32	3	0	<10	<20	NA	05/31/93	<10
BF-32A	1	0	<20	<20	NA	11/29/95	<20
BF-33	2	0	<20	<20	NA	10/16/91	<20
G-01	16	0	<10	<500	NA	11/21/91	<40
G-02	16	0	<500	<4000	NA	11/21/91	<1000
G-03	15	0	<40	<200	NA	01/27/93	<100
G-04	16	1	<10	92	NA	10/11/95	92
G-05	13	1	<500	1,200	NA	10/12/95	<1000
G-06	13	1	<50	470	NA	10/12/95	<500
G-07	10	0	<10	<20	NA	05/15/94	<10
G-08	15	1	<10	110	NA	10/11/95	110
G-09	17	1	<10	11	NA	10/11/95	11
G-10	3	0	<20	<20	NA	11/30/95	<20
G-11	12	0	<10	<10	NA	10/10/95	<10
G-12	12	2	<50	240	170	10/10/95	240
G-13	15	1	<50	260	NA	10/12/95	<300
G-14	9	0	<10	<20	NA	10/10/95	<10
G-15	2	0	<20	<20	NA	10/08/91	<20
G-16	3	0	<20	<20	NA	11/29/95	<20
G-17	9	1	<20	130	NA	10/11/95	130
G-18	3	0	<20	<20	NA	11/29/95	<20
G-19	3	0	<20	<20	NA	11/29/95	<20
LG-01	12	0	<10	<20	NA	05/03/90	<10
LG-02	6	0	<50	<50	NA	04/19/90	<50
LW-01	12	0	<10	<50	NA	11/28/95	<20
LW-02	9	0	<10	<20	NA	11/28/95	<20
LW-03	5	0	<10	<10	NA	05/05/90	<10
LW-04	4	0	<10	<20	NA	01/26/93	<10
LW-05	2	0	<20	<20	NA	10/09/91	<20
LW-06	2	0	<20	<20	NA	10/08/91	<20
LW-07	2	0	<20	<20	NA	10/17/91	<20

Note: See page 10 of this table for footnotes.

TABLE 5.5
CHEMICALS OF CONCERN IN GROUNDWATER

NOTES: Data summarized on this table include analytical results for original groundwater samples collected from Montrose monitoring wells by Montrose or by Del Amo during groundwater sampling events conducted during the period from April 1984 through December 1995.
Where indicated, data for Montrose wells were supplemented with available data obtained by others for Montrose wells in the Site vicinity.
Most recent results for Montrose monitoring wells are provided on Figures 5.45 through 5.50, Figures 5.52 through 5.55, Figures 5.57 through 5.62, and Figures 5.64 through 5.72.
A summary of groundwater sampling events is provided in Table 2.9.
Results for individual groundwater samples are provided in Appendix G.

FOOTNOTES

Num. of Analyses = Number of analyses
Num. of Detects = Number of detections above laboratory detection limit
Min. Result = Minimum value of analytical results
µg/L = Micrograms per liter
Max. Result = Maximum value of analytical results
Avg. Result = Arithmetic average of deteted results; average value not provided for single detections
Recent Sample Date = Most recent sampling date, up to and including the fourth quarter of 1995.
Most Recent Result = Most recent sampling analytical result, up to and including the fourth quarter of 1995.
< = Less than; numerical value is the limit of detection for this analysis
NA = Not applicable
NS = Not sampled
(a) = Groundwater samples collected and analytical results reported by Kennedy Jenks Consultants, for Douglas Aircraft Company (Kennedy Jenks, 1991)

TABLE 5.6

STATE AND FEDERAL MAXIMUM CONTAMINANT LEVELS (MCLs) FOR ORGANIC AND INORGANIC COMPOUNDS IN DRINKING WATER

ORGANIC COMPOUNDS (micrograms per liter)	CALIFORNIA MCL	FEDERAL MCL
Volatile Organic Compounds		
Benzene	1	5
Carbon Tetrachloride	0.5	5
Chlorobenzene (Monochlorobenzene)	70	100
Chloroform	---	80[a]
1,2-Dichloroethane (1,2-DCA)	0.5	5
Ethylbenzene	700	700
Tetrachloroethylene (PCE)	5	5
Toluene	150	1,000
Trichloroethylene (TCE)	5	5
Total xylenes	1,750	10,000
Pesticides		
gamma-BHC (Lindane)	0.2	0.2
INORGANIC COMPOUNDS (milligrams per liter)		
CCR Metals		
Arsenic	0.05	0.05
Cadmium	0.005	0.005
Chromium (total)	0.05	0.10
Copper	1.0[b]	1.3[c]
Lead	0.015	0.015[c]
Mercury	0.002	0.002
Selenium	0.05	0.05
Silver	0.1[b]	0.1[b]
Zinc	5[b]	5[b]
Iron	0.3[b]	0.3[b]
Manganese	0.05[b]	0.05[b]
Thallium	0.002	0.002
Nickel	0.1	0.1[d]
Beryllium	0.004	0.004
Antimony	0.006	0.006

NOTE: Refer to page 2 of this table for footnotes.

SOURCES: California Department of Health Services, 1990. Summary of California Drinking Water Standards. Department of Health Services, Berkeley, California; January 1, 1996.

State of California Department of Water Resources, 1991. Compilation of Federal and State Drinking Water Standards and Criteria; November 1991.

U.S. Environmental Protection Agency (EPA), 1990. Fact Sheet: Drinking Water Regulations Under the Safe Drinking Water Act. Washington, D.C.: EPA Office of Drinking Water (ODW); December 1990.

_____, 1996. Drinking Water Regulations and Health Advisories. Washington, D.C.: EPA ODW; February 1996.

FOOTNOTES

(a) MCL is for total trihalomethanes; applies to combined concentrations of bromodichloromethane, dibromochloromethane, bromoform, and chloroform
(b) Secondary MCL
(c) Action level at tap
(d) Being remanded

MCL = Maximum Contaminant Level
(---) = No MCL currently in effect
BHC = Hexachlorocyclohexane
CCR = California Code of Regulations, Title 22

TABLE 5.7

BASE NEUTRAL/ACID ORGANIC COMPOUNDS IN GROUNDWATER

COMPOUND	TOTAL WELLS	NUMBER OF POSITIVES	CONCENTRATION RANGE OF POSITIVIES .....(µg/L)..... MINIMUM	MAXIMUM	MINIMUM CONCENTRATION SAMPLE ID	MAXIMUM CONCENTRATION SAMPLE ID
UPPER BELLFLOWER AQUITARD						
Phenol	13	1	NA	17	NA	MW-01
2-Chlorophenol	13	4	10	190	MW-06	MW-05
2,4-Dichlorophenol	13	1	NA	10	NA	MW-02
1,2,4-Trichlorobenzene	13	3	10	83	MW-05	MW-01
Naphthalene	13	3	11	330	MW-01	MW-14
2-Methylnaphthalene	13	1	NA	60	NA	MW-14
2,4,6-Trichlorophenol	13	1	NA	24	NA	MW-06
Bis(2-ethylhexyl) phthalate	13	2	27	59	MW-06	MW-14
BELLFLOWER SAND						
Bis(2-ethylhexyl) phthalate	20	1	NA	25	NA	BF-04
GAGE AQUIFER						
Bis(2-ethylhexyl) phthalate	13	2	31	60	G-02	G-01

NOTE: This table summarizes analytical results from initial original groundwater samples collected from Montrose monitoring wells during four groundwater sampling events conducted during the period from April 1985 to November 1991.

A summary of groundwater sampling events is provided in Table 2.9.

Results for individual groundwater samples are provided in Appendix G.

µg/L = Micrograms per liter
ID = Identifier
NA = Not applicable

TABLE 5.8

TRACE METALS IN GROUNDWATER

COMPOUND	TOTAL WELLS	NUMBER OF POSITIVES	CONCENTRATION RANGE OF POSITIVES .....(mg/L)..... MINIMUM	MAXIMUM	MINIMUM CONCENTRATION SAMPLE ID	MAXIMUM CONCENTRATION SAMPLE ID
UPPER BELLFLOWER AQUITARD						
Silver	10	0	NA	NA	NA	NA
Arsenic	13	5	0.015	0.029	MW-12	MW-28
Beryllium	10	0	NA	NA	NA	NA
Cadmium	10	2	0.003	0.006	MW-03	MW-27
Chromium (total)	10	1	NA	0.02	NA	MW-30
Copper	18	4	0.02	0.04	MW-02	MW-27
Iron	15	6	0.01	0.32	MW-29	MW-03
Mercury	10	1	NA	0.0005	NA	MW-27
Manganese	15	10	0.06	35.0	MW-21	MW-02
Nickel	10	2	0.07	0.15	MW-19	MW-30
Lead	10	0	NA	NA	NA	NA
Antimony	10	0	NA	NA	NA	NA
Selenium	10	0	NA	NA	NA	NA
Thallium	10	1	NA	0.003	NA	MW-29
Zinc	13	2	0.02	0.17	MW-01	MW-02

NOTE: This table summarizes analytical results from initial original groundwater samples collected from Montrose monitoring wells during five groundwater sampling events conducted during the period from April 1985 to November 1991.

A summary of groundwater sampling events is provided in Table 2.9. Results for individual groundwater samples are provided in Appendix G.

mg/L = Milligrams per liter
ID = Identifier
NA = Not applicable

TABLE 5.8 (continued)
TRACE METALS IN GROUNDWATER

COMPOUND	TOTAL WELLS	NUMBER OF POSITIVES	CONCENTRATION RANGE OF POSITIVES .....(mg/L)..... MINIMUM	MAXIMUM	MINIMUM CONCENTRATION SAMPLE ID	MAXIMUM CONCENTRATION SAMPLE ID
BELLFLOWER SAND						
Silver	20	5	0.01	0.08	BF-18	BF-23
Arsenic	20	12	0.002	0.046	BF-19	BF-31
Beryllium	20	4	0.02	0.05	BF-24	BF-23
Cadmium	20	4	0.01	0.05	BF-24	BF-23
Chromium (total)	20	4	0.02	0.05	BF-24	BF-23
Copper	23	4	0.02	0.06	BF-32	BF-23
Iron	20	4	0.01	0.06	BF-22	BF-03
Mercury	20	0	NA	NA	NA	NA
Manganese	20	20	0.02	2.8	BF-18	BF-32
Nickel	20	4	0.01	0.13	BF-24	BF-32
Lead	20	1	NA	0.004	NA	BF-30
Antimony	20	1	NA	0.4	NA	BF-23
Selenium	20	1	NA	0.002	NA	BF-18
Thallium	20	2	0.002	0.003	BF-23	BF-18
Zinc	23	9	0.07	4.4	BF-24	BF-32

NOTE: This table summarizes analytical results from initial original groundwater samples collected from Montrose monitoring wells during five groundwater sampling events conducted during the period from April 1985 to November 1991.

A summary of groundwater sampling events is provided in Table 2.9. Results for individual groundwater samples are provided in Appendix G.

mg/L = Milligrams per liter
ID = Identifier
NA = Not applicable

COMPOUND	TOTAL WELLS	NUMBER OF POSITIVES	CONCENTRATION RANGE OF POSITIVES .....(mg/L)..... MINIMUM	MAXIMUM	MINIMUM CONCENTRATION SAMPLE ID	MAXIMUM CONCENTRATION SAMPLE ID
GAGE AQUIFER						
Silver	12	2	0.01	0.02	G-10	G-19
Arsenic	12	3	0.002	0.003	G-01	G-18
Beryllium	12	0	NA	NA	NA	NA
Cadmium	12	1	NA	0.006	NA	G-14
Chromium (total)	12	0	NA	NA	NA	NA
Copper	14	0	NA	NA	NA	NA
Iron	11	1	NA	0.03	NA	G-01
Mercury	12	0	NA	NA	NA	NA
Manganese	11	9	0.006	0.06	G-03	G-17
Nickel	12	0	NA	NA	NA	NA
Lead	12	0	NA	NA	NA	NA
Antimony	12	0	NA	NA	NA	NA
Selenium	12	0	NA	NA	NA	NA
Thallium	12	0	NA	NA	NA	NA
Zinc	15	0	NA	NA	NA	NA

NOTE: This table summarizes analytical results from initial original groundwater samples collected from Montrose monitoring wells during five groundwater sampling events conducted during the period from April 1985 to November 1991.

A summary of groundwater sampling events is provided in Table 2.9. Results for individual groundwater samples are provided in Appendix G.

mg/L = Milligrams per liter
ID = Identifier
NA = Not applicable

TABLE 5.8 (continued)
TRACE METALS IN GROUNDWATER

COMPOUND	TOTAL WELLS	NUMBER OF POSITIVES	CONCENTRATION RANGE OF POSITIVES .....(mg/L)..... MINIMUM	MAXIMUM	MINIMUM CONCENTRATION SAMPLE ID	MAXIMUM CONCENTRATION SAMPLE ID
LYNWOOD AQUIFER						
Silver	4	0	NA	NA	NA	NA
Arsenic	4	3	0.002	0.003	LW-04	LW-07
Beryllium	4	0	NA	NA	NA	NA
Cadmium	4	0	NA	NA	NA	NA
Chromium (total)	4	0	NA	NA	NA	NA
Copper	4	0	NA	NA	NA	NA
Iron	4	3	0.01	0.07	LW-04	LW-06
Mercury	4	0	NA	NA	NA	NA
Manganese	4	4	0.03	0.04	LW-05	LW-07
Nickel	4	0	NA	NA	NA	NA
Lead	4	0	NA	NA	NA	NA
Antimony	4	0	NA	NA	NA	NA
Selenium	4	0	NA	NA	NA	NA
Thallium	4	0	NA	NA	NA	NA
Zinc	4	0	NA	NA	NA	NA

NOTE: This table summarizes analytical results from initial original groundwater samples collected from Montrose monitoring wells during five groundwater sampling events conducted during the period from April 1985 to November 1991.

A summary of groundwater sampling events is provided in Table 2.9. Results for individual groundwater samples are provided in Appendix G.

mg/L = Milligrams per liter
ID = Identifier
NA = Not applicable

TABLE 5.9

TOTAL DDT IN SEDIMENT SAMPLES

SAMPLE CONCENTRATION LOCATION	SAMPLE ID	DATE	TOTAL DDT SAMPLE (mg/kg)
Kenwood Drain			
KD-1	KD-1	05/29/86	59.
KD-3	KD-3	05/29/86	12.
KD-4	KD-4	05/29/86	12.
KD-5	KD-5	05/29/86	6.
KD-7	KD-7	05/29/86	87.R
Torrance Lateral			
SED-6	SED-6	05/29/86	0.24R
SED-7	SED-7	05/29/86	0.52R
SED-8	SED-8	05/29/86	1.2R
SED-9	SED-9	05/29/86	0.65R
SED-10	SED-10	05/30/86	1.2R
Dominguez Channel, Phase 1			
SED-11	SED-11	05/28/86	2.2
SED-12	SED-12	05/30/86	0.63R
SED-13	SED-13	05/30/86	13.R
SED-14	SED14-25-60-COMPOSITE	06/11/86	<0.03R
SED-15	SED15-30-50-95-COMPOSITE	06/11/86	<0.03
Consolidated Slip			
SED-16	SED16-0-20-COMPOSITE	06/05/86	0.4
SED-17	SED17-0-20-COMPOSITE	06/05/86	0.37R
SED-18	SED18-0-20-COMPOSITE	06/05/86	0.4R
SED-19	SED19-0-20-COMPOSITE	06/04/86	0.36R
SED-20	SED20-0-20-COMPOSITE	06/06/86	0.32

NOTE: Sediment sampling locations and analytical results are provided on Figures 5.73 through 5.76.

Analytical results for individual sediment samples are provided in Appendix I.

ID = Identifier
mg/kg = Milligrams per kilogram
(<) = Less than; numerical value is the Limit of Detection for that compound
R = Data qualified by U.S. Environmental Protection Agency as unusable for any purpose

TABLE 5.9 (continued)
TOTAL DDT IN SEDIMENT SAMPLES

SAMPLE CONCENTRATION LOCATION	SAMPLE ID	DATE	TOTAL DDT SAMPLE (mg/kg)
Consolidated Slip (continued)			
SED-21	SED21-0-20-COMPOSITE	06/06/86	0.37
SED-22	SED22-0-20-COMPOSITE	06/08/86	<0.03R
SED-23	SED23-0-20-COMPOSITE	06/07/86	0.04R
SED-24	SED24-0-20-COMPOSITE	06/06/86	0.41
SED-25	SED25-0-20-COMPOSITE	06/07/86	<0.03R
Dominguez Channel, Phase 2A			
T-1C	T-1C-0.5	09/02/88	4.1
T-1C	T-1C-1.5	09/02/88	1.1
T-3B	T-3B-0.5	09/02/88	<0.17
T-3B	T-3B-1.5	09/02/88	0.88
T-3B	T-3B-2.4	09/02/88	0.76
T-6A	T-6A-COMPOSITE	09/02/88	1.3
T-7C	T-7C-0.5	09/02/88	0.53
T-7C	T-7C-1.9	09/02/88	0.56
T-9C	T-9C-COMPOSITE	09/03/88	1.9
T-13C	T-13C-0.5	09/01/88	<0.33
T-13C	T-13C-1.5	09/01/88	<0.33
T-14A	T-14A-0.7	09/01/88	<0.33
T-18C	T-18C-0.5	09/01/88	<0.67
T-18C	T-18C-1.5	09/01/88	0.55
Additional			
BGS	BGS-0.5	09/27/88	<0.1
BGS	BGS-2.5	09/27/88	<5.0
BGS	BGS-4.5	09/27/88	<1.0
BGS	BGS-6.2	09/27/88	<1.0
BGS	BGS-8.0	09/27/88	<5.0

NOTE: Sediment sampling locations and analytical results are provided on Figures 5.73 through 5.76.

Analytical results for individual sediment samples are provided in Appendix I.

ID = Identifier
mg/kg = Milligrams per kilogram
(<) = Less than; numerical value is the Limit of Detection for that compound
R = Data qualified by U.S. Environmental Protection Agency as unusable for any purpose

TABLE 5.10

TOTAL BHC IN SEDIMENT SAMPLES

SAMPLE CONCENTRATION LOCATION	SAMPLE ID	DATE	TOTAL BHC SAMPLE (mg/kg)
Kenwood Drain			
KD-1	KD-1	05/29/86	<1.
KD-3	KD-3	05/29/86	<0.1
KD-4	KD-4	05/29/86	<0.1
KD-5	KD-5	05/29/86	<0.1
KD-7	KD-7	05/29/86	<1.R
Torrance Lateral			
SED-6	SED-6	05/29/86	<0.01R
SED-7	SED-7	05/29/86	<0.01R
SED-8	SED-8	05/29/86	<0.01R
SED-9	SED-9	05/29/86	<0.01R
SED-10	SED-10	05/30/86	<0.01R
Dominguez Channel, Phase 1			
SED-11	SED-11	05/28/86	<0.01
SED-12	SED-12	05/30/86	<0.01R
SED-13	SED-13	05/30/86	<0.1R
SED-14	SED14-25-60-COMPOSITE	06/11/86	<0.01R
SED-15	SED15-30-50-95-COMPOSITE	06/11/86	0.02
Consolidated Slip			
SED-16	SED16-0-20-COMPOSITE	06/05/86	<0.01
SED-17	SED17-0-20-COMPOSITE	06/05/86	<0.01R
SED-18	SED18-0-20-COMPOSITE	06/05/86	<0.01R
SED-19	SED19-0-20-COMPOSITE	06/04/86	<0.01R
SED-20	SED20-0-20-COMPOSITE	06/06/86	0.46
SED-21	SED21-0-20-COMPOSITE	06/06/86	0.86
SED-22	SED22-0-20-COMPOSITE	06/08/86	<0.01R
SED-23	SED23-0-20-COMPOSITE	06/07/86	<0.01R
SED-24	SED24-0-20-COMPOSITE	06/06/86	1.

NOTE: Refer to page 2 of this table for footnotes.

TABLE 5.10 (continued)
TOTAL BHC IN SEDIMENT SAMPLES

SAMPLE CONCENTRATION LOCATION	SAMPLE ID	DATE	TOTAL BHC SAMPLE (mg/kg)
SED-25	SED25-0-20-COMPOSITE	06/07/86	<0.01R
Dominguez Channel, Phase 2A			
T-1C	T-1C-0.5	09/02/88	<0.13
T-1C	T-1C-1.5	09/02/88	<0.07
T-3B	T-3B-0.5	09/02/88	<0.07
T-3B	T-3B-1.5	09/02/88	<0.07
T-3B	T-3B-2.4	09/02/88	<0.07
T-6A	T-6A-COMPOSITE	09/02/88	<0.13
T-7C	T-7C-0.5	09/02/88	<0.03
T-7C	T-7C-1.9	09/02/88	<0.07
T-9C	T-9C-COMPOSITE	09/03/88	<0.13
T-13C	T-13C-0.5	09/01/88	<0.13
T-13C	T-13C-1.5	09/01/88	<0.13
T-14A	T-14A-0.7	09/01/88	<0.13
T-18C	T-18C-0.5	09/01/88	<0.27
T-18C	T-18C-1.5	09/01/88	<0.13
Additional			
BGS	BGS-0.5	09/27/88	<0.04
BGS	BGS-2.5	09/27/88	<2.0
BGS	BGS-4.5	09/27/88	<0.4
BGS	BGS-6.2	09/27/88	<0.4
BGS	BGS-8.0	09/27/88	<2.0

NOTE: Sediment sampling locations are provided on Figures 2.16 through 2.19.
Analytical results for individual sediment samples are provided in Appendix I.

ID = Identifier
mg/kg = Milligrams per kilogram
(<) = Less than; numerical value is the Limit of Detection for that compound
R = Data qualified by U.S. Environmental Protection Agency as unusable for any purpose

TABLE 5.10A
SUMMARY OF DETECTED CHEMICALS
1994 EPA SEDIMENT SAMPLING

Chemical	DL[a]	Range of Detected Concentrations for Sample Location Group[b]										
		ND	KD	TLL	TLU	DC1	BDCE	BDCW	DC2	DC3	DC4	CS
Inorganics (mg/kg)												
Aluminum	40.0	6,180-20,200	3,640-5,360	2,550-10,000	2,870-16,900	3,340-16,300	9,620-14,400	9,720-15,700	11,900-21,200	14,900-22,800	5,080-22,200	11,800-27,200
Arsenic	2.0	4.0-10.2	2.9-6.2	2.9-7.3	2.8-11.3	3.3-8.6	7.5-8.2	8.2-10.1	6.5-10.3	7.8-12.0	5.3-17.9	8.2-15.3
Barium	40.0	70.6-234	58.7-131	51.4-198	58.6-187	58.1-119	99.9-110	92.3-135	86-213	101-151	144-321	125-600
Cadmium	1.0	1.4-1.7	2.1-2.4	1.6-2.7	1.5-4.5	1.5-2.3	1.7-2.3	2.8-4.2	1.6-2.9	2.2-4.7	3.4	1.8-2.8
Chromium	2.0	12.9-33.7	13.8-28.0	30.5-906	27.4-88.8	9.9-77.9	42.7-145	92.7-248	47.7-253	60.5-219	19.3-282	61.3-261
Cobalt	10.0	12.5-15.7	--	--	22.3	--	--	--	--	--	--	--
Copper	5.0	26.1-76.9	40.2-54.3	43-334	43-223	25-252	74.1-156	128-162	81.6-131	106-164	25.5-139	75.9-338
Iron	20.0	9,620-22,800	6,940-9,760	8,440-17,400	5,990-25,700	6,710-25,100	18,200-22,200	17,600-24,400	18,200-30,200	23,000-31,600	8,660-29,900	17,900-40,000
Lead	0.60	34.1-103	73.8-252	41.2-235	41.4-290	82.3-474	97.2-248	215-438	119-142	132-470	28.2-381	93.4-295
Manganese	3.0	201-600	109-132	243-592	205-532	101-220	159-189	206-231	158-263	184-251	96.6-323	193-329
Mercury	0.10	0.12-0.29	--	0.32-0.35	0.14-0.48	0.16-0.27	0.19-0.29	0.3-0.4	0.19-0.31	0.18-0.42	0.41-1.1	0.29-1.4
Nickel	8.0	11.9-25.5	14.9-64.9	10.9-29.8	9.4-49.1	20.6-36.8	23.1-31.7	33-41.9	24.5-30.3	25.7-46.2	27-42.6	18.5-38.3
Selenium	1.0	0.46	--	--	--	--	--	--	--	--	--	--
Silver	2.0	--	--	--	--	3.3	--	--	--	--	--	5.5
Vanadium	10.0	23.1-57.5	12.7-15.7	12.8-33.5	12.8-51.0	23.6-50.0	37.4-47.5	41.5-49.2	40.3-60.4	45.4-66.9	16.4-71.9	37.1-79.5
Zinc	4.0	174-431	195-458	211-806	110-1,040	138-548	373-488	604-887	365-624	511-808	94.1-683	203-542
Organics (µg/kg)												
2,4'-DDD	3.0	--	480-890	8-16	5-42	38-45	15-30	23	45	17-44	23-26	15-120
2,4'-DDE	3.0	--	--	6	--	18	6-13	7	--	8-12	11	6-41
2,4'DDT	3.0	6,900-14,000	600	5-6	16-21	30-160	11-16	8-100	160	6-18	9	92
4,4'-DDD	3.0	7,500	1,700-3,300	31-97	8-75	32-160	38-75	62-870	58-130	49-120	7-88	28-330
4,4'-DDE	3.0	11,000-30,000	9750-3,500	27-79	6-78	6-120	62-68	59-110	67-140	54-140	11-77	27-260
4,4'-DDT	3.0	45,000-100,000	1,800-3,400	16-56	44-53	6-200	7-33	12-2,400	34-520	4-76	6-62	11-62
Aldrin	2.0	--	--	14	--	--	--	--	--	--	--	5
BHC-alpha	2.0	--	--	3	--	--	--	--	--	--	--	7
BHC-beta	2.0	--	--	12	--	---	--	--	--	--	--	--
BHC-delta	2.0	--	--	--	4	61	--	--	--	4	--	3-7
BHC-gamma	2.0	--	--	--	--	--	--	--	--	--	--	5-7

TABLE 5.10A
SUMMARY OF DETECTED CHEMICALS
1994 EPA SEDIMENT SAMPLING

Chemical	DL[a]	Range of Detected Concentrations for Sample Location Group[b]										
		ND	KD	TLL	TLU	DC1	BDCE	BDCW	DC2	DC3	DC4	CS
Bis (2-ethylhexyl) phthalate	330	--	940	--	470	--	--	--	--	--	--	5,300-8,400
Chlordane-alpha	2.0	--	--	4-15	2-12	5-34	14-18	22	21	13-24	2-17	3-190
Chlordane-gamma	2.0	--	--	8-24	4-13	6-46	15-17	21	14-27	17-34	3-23	6-180
Chrysene	330	--	--	--	--	--	--	--	--	--	--	1,100
Dieldrin	3.0	--	--	--	6	17	--	7	--	--	--	7-12
Endrin	3.0	--	--	5	--	10	--	--	--	--	--	6
Endrin aldehyde	3.0	--	--	--	--	--	6	--	--	9	--	6-10
Endrin ketone	3.0	--	--	6	--	6	--	--	--	--	--	11
Endosulfan I	2.0	--	--	5	--	--	--	--	--	--	--	5
Endosulfan II	3.0	--	--	--	--	--	--	--	--	--	--	21
Fluoranthene	330	--	--	--	--	--	--	--	--	--	--	1,200
Heptachlor	2.0	--	--	14	--	--	--	--	--	--	--	12
Heptachlor epoxide	2.0	--	--	4	--	--	--	--	--	--	--	--
Pyrene	330	--	--	--	--	--	--	--	--	--	--	1,600
General Chemistry (mg/kg)												
Total Organic Carbon	26.9	10,400-21,700	6,110-19,200	8,140-30,500	2,920-46,200	5,500-40,500	25,100-34,000	27,400-34,600	22,500-58,000	24,000-58,200	4,760-46,100	10,200-47,700

[a]DL = Detection Limit (Contract Required Detection Limit for inorganics; Contract Required Quantitation Limit for organics). Achieved detection limit sometimes varied among samples because of interference or other factors, but results for each sample are given in Attachment D.

[b]Minimum and maximum detected concentration listed for each Sample Location Group. A single entry indicates that the chemical was either detected only once or there was only one detected value that has been qualified for quantitative use. The Sample Location Group includes all samples collected within the indicated drainage pathway. Drainage pathways are listed from upstream to downstream (left to right).

-- = Not detected, not analyzed for, or not validated for quantitative use (see Table 3-5)
CS = Consolidated Slip
BDCE = East Bank of Dominguez Channel
BDCW = West Bank of Dominguez Channel
DC1 = Dominguez Channel, Segment 1
DC2 = Dominguez Channel, Segment 2
DC3 = Dominguez Channel, Segment 3
DC4 = Dominguez Channel, Segment 4
KD = Kenwood Drain
ND = Normandie Avenue/Jones Ditch
TLL = Torrance Lateral, Lined Portion
TLU = Torrance Lateral, Unlined Portion

TABLE 5.11

TOTAL DDT IN DRY WEATHER SURFACE WATER SAMPLES

SAMPLE CONCENTRATION LOCATION	SAMPLE ID	DATE	TOTAL DDT SAMPLE (µg/L)
Torrance Lateral			
SW-4	SW-4-UNFILTERED	06/13/86	<0.1
SW-5	SW-5-UNFILTERED	06/12/86	<0.1
Dominguez Channel			
SW-6	SW-6-UNFILTERED	06/12/86	<0.1
SW-7	SW-7-UNFILTERED	06/12/86	<0.1
SW-8	SW-8-UNFILTERED	06/12/86	<0.1
SW-9	SW-9-UNFILTERED	06/12/86	<0.1
SW-10	SW-10-UNFILTERED	06/13/86	<0.1R
Consolidated Slip			
SED-16	SW-16	06/05/86	<0.1R
SED-17	SW-17	06/05/86	<0.1R
SED-18	SW-18	06/05/86	<0.1R
SED-19	SW-19	06/05/86	<0.1R
SED-20	SW-20-FILTERED	06/06/86	<0.1R
SED-20	SW-20-UNFILTERED	06/06/86	<0.1
SED-21	SW-21-FILTERED	06/06/86	<0.1R
SED-21	SW-21-UNFILTERED	06/06/86	<0.1R
SED-22	SW-22	06/08/86	<0.1
SED-23	SW-23	06/07/86	<0.1R
SED-24	SW-24-FILTERED	06/06/86	<0.1R
SED-24	SW-24-UNFILTERED	06/07/86	6.7R
SED-25	SW-25	06/07/86	<0.1R

NOTE: Dry weather surface water sampling locations and analytical results are provided on Figures 2.16 and 2.19.

Analytical results for individual surface water samples are provided in Appendix J.

ID = Identifier
µg/L = Micrograms per liter
(<) = Less than; numerical value is the Limit of Detection for that compound
R = Data qualified by U.S. Environmental Protection Agency as unusable for any purpose

TABLE 5.12

TOTAL BHC IN DRY WEATHER SURFACE WATER SAMPLES

SAMPLE CONCENTRATION LOCATION	SAMPLE ID	DATE	TOTAL BHC SAMPLE (µg/L)
Torrance Lateral			
SW-4	SW-4	06/13/86	<0.05
SW-5	SW-5-UNFILTERED	06/12/86	<0.05
Dominguez Channel			
SW-6	SW-6	06/12/86	<0.05
SW-7	SW-7-UNFILTERED	06/12/86	<0.05
SW-8	SW-8-UNFILTERED	06/12/86	<0.05
SW-9	SW-9	06/12/86	<0.05
SW-10	SW-10	06/13/86	<0.05R
Consolidated Slip			
SED-16	SW-16	06/05/86	<0.05R
SED-17	SW-17	06/05/86	<0.05R
SED-18	SW-18	06/05/86	<0.05R
SED-19	SW-19	06/05/86	<0.05R
SED-20	SW-20-FILTERED	06/06/86	<0.05R
SED-20	SW-20-UNFILTERED	06/06/86	<0.05
SED-21	SW-21-FILTERED	06/06/86	<0.05R
SED-21	SW-21-UNFILTERED	06/06/86	<0.05R
SED-22	SW-22	06/08/86	<0.05
SED-23	SW-23	06/07/86	<0.05R
SED-24	SW-24-FILTERED	06/06/86	<0.05R
SED-25	SW-25	06/07/86	<0.05R

NOTE: Dry weather surface water sampling locations are provided on Figures 2.16 and 2.19. Analytical results for individual dry weather surface samples are provided in Appendix J.

ID = Identifier
µg/L = Micrograms per liter
(<) = Less than; numerical value is the Limit of Detection for that compound
R = Data qualified by U.S. Environmental Protection Agency as unusable for any purpose

TABLE 5-12A
SUMMARY OF DETECTED CHEMICALS
1994 EPA SURFACE WATER SAMPLING

Chemical	DL[a]	Range of Detected Concentrations for Sample Location Group[b]								
		KD	TLL	TLU	DC1	DC2	DC3	DC4	CS-U (Unfiltered)	CS-F (Filtered)
Inorganics (µg/L)										
Aluminum	200	562-9,700	627	676	289	--	--	--	--	249
Arsenic	10.0	15.4	--	--	--	--	--	--	--	--
Copper	25.0	35.7-96.4	25.5-29.2	28.1	--	--	--	--	--	--
Cyanide	10.0	31.5	--	--	--	--	--	--	--	--
Iron	100	359-10,100	122-915	102-1,050	248-650	220-272	205-237	162-199	107-180	--
Lead	3.0	3.3-59.9	3.2-11.4	3.0-15.1	3.3	--	--	--	--	--
Manganese	15.0	110-592	15.6-167	28.7-117	91.8-135	58.5-79.1	43.6-62.2	31.3-32.6	21.2-29.6	23.6-31.4
Mercury	0.20	--	0.21-0.66	0.21	0.21-0.65	0.21-1.0	0.39-0.89	0.37	0.2-1.3	0.32
Nickel	40.0	53.6	--	--	--	--	--	--	--	--
Zinc	20.0	41.9-521	24.7-137	23.5-60.5	42.3-68	28.1-40	27.5-30.7	24.7-25.0	60.5-109	21.4-84.3
Organics (µg/L)										
2,4'-DDD	0.10	0.2	--	--	--	--	--	--	--	--
2,4'-DDE	0.10	0.1	--	--	--	--	--	--	--	--
2,4'-DDT	0.10	0.3	--	--	--	--	--	--	--	--
4,4'-DDD	0.10	0.4	--	--	--	--	--	--	--	--
4,4'-DDE	0.10	0.7	--	--	--	--	--	--	--	--
4,4'-DDT	0.10	0.1-0.6	--	--	--	--	--	--	--	--
BHC-beta	0.05	0.08-0.3	--	--	--	--	--	--	--	--
General Chemistry (mg/L)										
Total Dissolved Solids	20.0	551-951	837-10,700	1,280-13,300	10,300-19,700	23,400-34,600	24,100-26,800	29,500-33,200	30,300-38,900	--
Total Suspended Solids	10.0	257	13-19	--	--	--	--	--	--	--

[a]DL = Detection Limit (Contract Required Detection Limit for inorganics; Contract Required Quantitation Limit for organics). Achieved detection limit sometimes varied among samples because of interference or other factors, but results for each sample are given in Attachment D.

[b]Minimum and maximum detected concentration listed for each Sample Location Group. A single entry indicates that the chemical was either detected only once or there was only one detected value that has been qualified for quantitative use. All samples unfiltered except as noted for Consolidated Slip. The Sample Location Group includes all samples collected within the indicated drainage pathway. Drainage pathways are listed from upstream to downstream (left to right).

= = Not detected, not analyzed for, or not validated for quantitative use (see Table 3-4)
CS-F = Consolidated Slip - Filtered Samples
CS-U = Consolidated Slip - Unfiltered Samples
DC1 = Dominguez Channel = Segment 1
DC2 = Dominguez Channel = Segment 2
DC3 = Dominguez Channel = Seg ment 3
DC4 = Dominguez Channel = Segment 4
KD = Kenwood Drain
TLL = Torrance Lateral, Lined Portion
TLU = Torrance Lateral, Unlined Portion

TABLE 5.13

TOTAL DDT IN WET WEATHER SURFACE WATER SAMPLES

SAMPLE CONCENTRATION LOCATION	SAMPLE ID	DATE	TOTAL DDT SAMPLE (µg/L)
Jones Chemical Ditch			
SW-1	R2-SW-1	01/04/87	4.1
SW-1	R3-SW-1	01/06/87	6.8R
SW-1	R4-SW-1	02/13/87	10.
SW-1	R5-SW-1	03/06/87	10.
Normandie Avenue Ditch			
SW-2	R1-SW-2	09/24/86	<0.2
SW-2	R1-SW-2-FILTERED	09/24/86	<0.2
SW-2	R2-SW-2	01/04/87	3.6
SW-2	R3-SW-2	01/06/87	2.7
SW-2	R4-SW-2	02/13/87	1.8R
SW-2	R4-SW-2-FILTERED	02/13/87	0.74
SW-2	R5-SW-2	03/06/87	1.3
SW-3	R1-SW-3	09/24/86	45.
SW-3	R1-SW-3-FILTERED	09/24/86	<0.2
SW-3	R2-SW-3	01/04/87	9.2
SW-3	R2-SW-3-FILTERED	01/04/87	<0.2
SW-3	R3-SW-3	01/06/87	4.
SW-3	R4-SW-3	02/13/87	9.1R
SW-3	R4-SW-3-FILTERED	02/13/87	<0.02
SW-3	R5-SW-3	03/06/87	7.5
Torrance Lateral			
SW-4	R1-SW-4	09/24/86	<0.2
SW-4	R1-SW-4-FILTERED	09/24/86	<0.2
SW-4	R2-SW-4	01/04/87	0.22
SW-4	R3-SW-4	01/06/87	0.16
SW-4	R4-SW-4	02/13/87	<0.02R
SW-4	R4-SW-4-FILTERED	02/13/87	<0.02
SW-4	R5-SW-4	03/06/87	0.37
SW-5	R1-SW-5	09/24/86	<0.2
SW-5	R1-SW-5-FILTERED	09/24/86	<0.2
SW-5	R2-SW-5	01/04/87	0.23
SW-5	R3-SW-5	01/06/87	5.1
SW-5	R3-SW-5-FILTERED	01/06/87	<0.02
SW-5	R4-SW-5	02/13/87	<0.02
SW-5	R5-SW-5	03/06/87	0.41

NOTE: Refer to page 2 of this table for footnote.

TABLE 5.13 (continued)
TOTAL DDT IN WET WEATHER SURFACE WATER SAMPLES

SAMPLE LOCATION	SAMPLE ID	SAMPLE DATE	TOTAL DDT CONCENTRATION (µg/L)
Dominguez Channel			
SW-6	R4-SW-6-COMPOSITE	02/13/87	<0.02
SW-6	R5-SW-6-COMP-FILTERED	03/06/87	<0.02
SW-6	R5-SW-6-COMPOSITE	03/06/87	<0.02
SW-7	R4-SW-7-COMPOSITE	02/13/87	<0.02
SW-7	R5-SW-7-COMP-FILTERED	03/06/87	<0.02
SW-7	R5-SW-7-COMPOSITE	03/06/87	<0.02
SW-8	R4-SW-8-COMPOSITE	02/13/87	<0.02
SW-8	R5-SW-8-COMP-FILTERED	03/06/87	<0.02
SW-8	R5-SW-8-COMPOSITE	03/06/87	<0.02
SW-9	R4-SW-9-COMPOSITE	02/13/87	<0.02R
SW-9	R5-SW-9-COMP-FILTERED	03/06/87	<0.02
SW-9	R5-SW-9-COMPOSITE	03/06/87	<0.02
SW-10	R4-SW-10-COMPOSITE	02/13/87	<0.02
SW-10	R5-SW-10-COMP-FILTERED	03/06/87	<0.02
SW-10	R5-SW-10-COMPOSITE	03/06/87	<0.02
Consolidated Slip			
SW-11	R5-SW-11	03/06/87	<0.02
SW-12	R5-SW-12	03/06/87	<0.02
SW-13	R5-SW-13	03/06/87	<0.02
SW-14	R5-SW-14	03/06/87	<0.02
SW-15	R5-SW-15	03/06/87	<0.02
SW-16	R5-SW-16	03/06/87	<0.02
SW-17	R5-SW-17	03/06/87	<0.02
SW-18	R5-SW-18	03/06/87	<0.02
SW-19	R5-SW-19	03/06/87	<0.02
SW-20	R5-SW-20	03/06/87	<0.02

NOTE: Wet weather surface water sampling locations and analytical results are provided on Figures 5.79 through 5.81.

Analytical results for individual wet weather surface water samples are provided in Appendix I.

ID = Identifier
µg/L = Micrograms per liter
(<) = Less than; numerical value is the Limit of Detection for that compound
R = Data qualified by U.S. Environmental Protection Agency as unusable for any purpose

TABLE 5.14

TOTAL BHC IN WET WEATHER SURFACE WATER SAMPLES

SAMPLE CONCENTRATION LOCATION	SAMPLE ID	DATE	TOTAL BHC SAMPLE (µg/L)
Jones Chemical Ditch			
SW-1	R2-SW-1	01/04/87	0.45
SW-1	R3-SW-1	01/06/87	0.72R
SW-1	R4-SW-1	02/13/87	1.8
SW-1	R5-SW-1	03/06/87	1.7
Normandie Avenue Ditch			
SW-2	R1-SW-2	09/24/86	<0.1
SW-2	R1-SW-2-FILTERED	09/24/86	<0.1
SW-2	R2-SW-2	01/04/87	0.08
SW-2	R3-SW-2	01/06/87	0.2
SW-2	R4-SW-2	02/13/87	0.19R
SW-2	R4-SW-2-FILTERED	02/13/87	0.19
SW-2	R5-SW-2	03/06/87	0.16
SW-3	R1-SW-3	09/24/86	<0.05
SW-3	R1-SW-3-FILTERED	09/24/86	<0.1
SW-3	R2-SW-3	01/04/87	2.1
SW-3	R2-SW-3-FILTERED	01/04/87	<0.1
SW-3	R3-SW-3	01/06/87	0.46
SW-3	R4-SW-3	02/13/87	1.1R
SW-3	R4-SW-3-FILTERED	02/13/87	0.068
SW-3	R5-SW-3	03/06/87	0.5
Torrance Lateral			
SW-4	R1-SW-4	09/24/86	<0.1
SW-4	R1-SW-4-FILTERED	09/24/86	<0.1
SW-4	R2-SW-4	01/04/87	0.59
SW-4	R3-SW-4	01/06/87	0.08
SW-4	R4-SW-4	02/13/87	0.087R
SW-4	R4-SW-4-FILTERED	02/13/87	0.076
SW-4	R5-SW-4	03/06/87	0.11
SW-5	R1-SW-5	09/24/86	<0.1
SW-5	R1-SW-5-FILTERED	09/24/86	<0.1
SW-5	R2-SW-5	01/04/87	0.44
SW-5	R3-SW-5	01/06/87	0.22
SW-5	R3-SW-5-FILTERED	01/06/87	0.43
SW-5	R4-SW-5	02/13/87	<0.01
SW-5	R5-SW-5	03/06/87	0.1

NOTE: Refer to page 2 of this table for footnote.

TABLE 5.14 (continued)
TOTAL BHC IN WET WEATHER SURFACE WATER SAMPLES

SAMPLE LOCATION	SAMPLE ID	SAMPLE DATE	TOTAL BHC CONCENTRATION (µg/L)
Dominguez Channel			
SW-6	R4-SW-6-COMPOSITE	02/13/87	<0.01
SW-6	R5-SW-6-COMP-FILTERED	03/06/87	0.11
SW-6	R5-SW-6-COMPOSITE	03/06/87	0.1
SW-7	R4-SW-7-COMPOSITE	02/13/87	<0.01
SW-7	R5-SW-7-COMP-FILTERED	03/06/87	0.07
SW-7	R5-SW-7-COMPOSITE	03/06/87	0.09
SW-8	R4-SW-8-COMPOSITE	02/13/87	<0.01
SW-8	R5-SW-8-COMP-FILTERED	03/06/87	0.07
SW-8	R5-SW-8-COMPOSITE	03/06/87	0.11
SW-9	R4-SW-9-COMPOSITE	02/13/87	<0.01R
SW-9	R5-SW-9-COMP-FILTERED	03/06/87	0.06
SW-9	R5-SW-9-COMPOSITE	03/06/87	0.07
SW-10	R4-SW-10-COMPOSITE	02/13/87	<0.01
SW-10	R5-SW-10-COMP-FILTERED	03/06/87	0.08
SW-10	R5-SW-10-COMPOSITE	03/06/87	0.1
Consolidated Slip			
SW-11	R5-SW-11	03/06/87	<0.01
SW-12	R5-SW-12	03/06/87	<0.01
SW-13	R5-SW-13	03/06/87	<0.01
SW-14	R5-SW-14	03/06/87	<0.01
SW-15	R5-SW-15	03/06/87	<0.01
SW-16	R5-SW-16	03/06/87	<0.01
SW-17	R5-SW-17	03/06/87	<0.01
SW-18	R5-SW-18	03/06/87	<0.01
SW-19	R5-SW-19	03/06/87	<0.01
SW-20	R5-SW-20	03/06/87	<0.01

NOTE: Wet weather surface water sampling locations are provided on Figures 2.20 through 2.22.

Analytical results for wet weather surface water samples are provided on Figures 5.80 and 5.82.

Analytical results for individual wet weather surface water samples are provided in Appendix J.

ID = Identifier
µg/L = Micrograms per liter
(<) = Less than; numerical value is the Limit of Detection for that compound
R = Data qualified by U.S. Environmental Protection Agency as unusable for any purpose

TABLE 5.15

VOLATILE ORGANIC COMPOUNDS IN WET WEATHER SURFACE WATER SAMPLES

SAMPLE LOCATION	SAMPLE ID	COMPOUND	SAMPLE DATE	VOC CONCENTRATION (µg/L
Jones Chemical Ditch				
SW-1	R2-SW-1	Chloroform	01/04/87	190.
SW-1	R2-SW-1	Toluene	01/04/87	160.
SW-1	R3-SW-1	Tetrachloroethylene	01/06/87	23.
SW-1	R3-SW-1	Toluene	01/06/87	52.
SW-1	R3-SW-1	Vinyl Chloride	01/06/87	2.
SW-1	R3-SW-1	1,1,1-Trichloroethane	01/06/87	2.
SW-1	R3-SW-1	Bromodichloromethane	01/06/87	2.
SW-1	R3-SW-1	Chloroform	01/06/87	110.
SW-1	R3-SW-1	Chloromethane	01/06/87	8.
SW-1	R3-SW-1	Methylene Chloride	01/06/87	49.
SW-1	R3-SW-1	Acetone	01/06/87	80.
SW-1	R4-SW-1	Toluene	02/13/87	32.
SW-1	R4-SW-1	Acetone	02/13/87	10.
SW-1	R4-SW-1	Chloroform	02/13/87	77.
SW-1	R5-SW-1	Chloroform	03/06/87	550.
SW-1	R5-SW-1	Tetrachloroethylene	03/06/87	37.
SW-1	R5-SW-1	Toluene	03/06/87	28.
Normandie Avenue Ditch				
SW-2	R3-SW-2	Acetone	01/06/87	30.
SW-3	R2-SW-3	Chloroform	01/04/87	32.
SW-3	R2-SW-3	Toluene	01/04/87	6.
SW-3	R3-SW-3	Chloroform	01/06/87	10.
SW-3	R3-SW-3	Acetone	01/06/87	40.
SW-3	R3-SW-3	Toluene	01/06/87	1.
SW-3	R4-SW-3	Acetone	02/13/87	10.
SW-3	R5-SW-3	Chloroform	03/06/87	4.
Torrance Lateral				
SW-4	R2-SW-4	1,1,1-Trichloroethane	01/04/87	2.
SW-4	R3-SW-4	1,1,1-Trichloroethane	01/06/87	29.
SW-4	R3-SW-4	Acetone	01/06/87	40.
SW-4	R4-SW-4	Acetone	02/13/87	120.
SW-4	R5-SW-4	Acetone	03/06/87	130.
SW-4	R5-SW-4	1,1,1-Trichloroethane	03/06/87	3.

NOTE: Refer to page 2 of this table for footnote.

TABLE 5.15 (continued)
VOLATILE ORGANIC COMPOUNDS IN WET WEATHER
SURFACE WATER SAMPLES

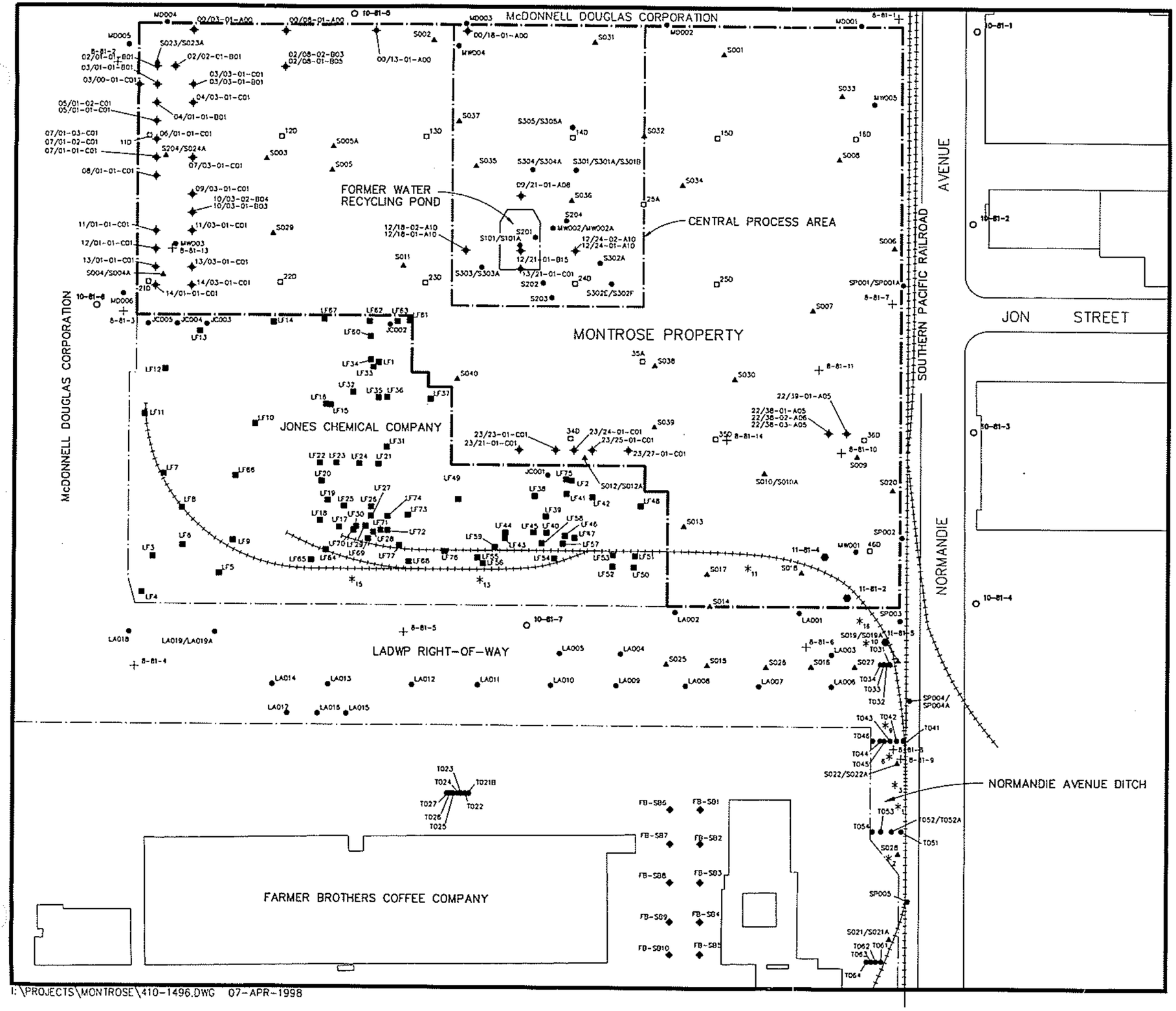
SAMPLE LOCATION	SAMPLE ID	COMPOUND	SAMPLE DATE	VOC CONCENTRATION (µg/L
SW-5	R3-SW-5	Acetone	01/06/87	60.
SW-5	R3-SW-5	1,1,1-Trichloroethane	01/06/87	10.
SW-5	R4-SW-5	1,1,1-Trichloroethane	02/13/87	3.
SW-5	R4-SW-5	Acetone	02/13/87	210.
SW-5	R5-SW-5	Chloroform	03/06/87	4.
SW-5	R5-SW-5	Acetone	03/06/87	82.
SW-5	R5-SW-5	1,1,1-Trichloroethane	03/06/87	4.
Dominguez Channel				
SW-6	R4-SW-6-COMPOSITE	1,1,1-Trichloroethane	02/13/87	10.
SW-6	R4-SW-6-COMPOSITE	Benzene	02/13/87	2.
SW-6	R4-SW-6-COMPOSITE	Tetrachloroethylene	02/13/87	1.
SW-6	R5-SW-6-COMPOSITE	1,1,1-Trichloroethane	03/06/87	8.
SW-7	R4-SW-7-COMPOSITE	1,1,1-Trichloroethane	02/13/87	5.
SW-7	R4-SW-7-COMPOSITE	Tetrachloroethylene	02/13/87	2.
SW-7	R5-SW-7-COMPOSITE	1,1,1-Trichloroethane	03/06/87	8.
SW-8	R4-SW-8-COMPOSITE	1,1,1-Trichloroethane	02/13/87	5.
SW-8	R5-SW-8-COMPOSITE	1,1,1-Trichloroethane	03/06/87	6.
SW-9	R4-SW-9-COMPOSITE	1,1,1-Trichloroethane	02/13/87	2.
SW-9	R5-SW-9-COMPOSITE	1,1,1-Trichloroethane	03/06/87	11.
SW-10	R4-SW-10-COMPOSITE	1,1,1-Trichloroethane	02/13/87	5.
SW-10	R5-SW-10-COMPOSITE	Methylene Chloride	03/06/87	11.
SW-10	R5-SW-10-COMPOSITE	1,1,1-Trichloroethane	03/06/87	11.
Consolidated Slip				
SW-11	R5-SW-11	Acetone	03/06/87	13.
SW-16	R5-SW-16	Acetone	03/06/87	10.

NOTE: Wet weather surface water sampling locations are provided on Figures 2.20 through 2.22.
Analytical results for individual wet weather surface water samples are provided in Appendix J.

ID = Identifier
VOC = Volatile organic compound
µg/L = Micrograms per liter

Note to Reader

EPA laboratory protocols require that the analytical results for soil samples be reported on a dry-weight basis. For reasons unknown to EPA, analytical results for soil samples collected and analyzed by Montrose during the period of 1981 to 1988 were reported by the laboratories on a wet-weight basis. Higher concentrations would have been indicated in these soil samples if the analytical results were reported, as required by EPA, on a dry-weight basis. As discussed in Section 4.1.2.4, soil samples collected from unsaturated soil above the water table ranged in moisture content from less than 1 percent to approximately 29 percent by weight. A typical moisture content for soil in the unsaturated zone was on the order of 12 percent by weight. A concentration of 1 mg/kg DDT reported on a wet-weight basis would therefore be equivalent to a dry-weight DDT concentration of between 1.01 mg/kg and 1.29 mg/kg, assuming the original sample had a moisture content comparable to those observed at the Site. On average, dry-weight concentrations, if reported, would be expected to be approximately 12 percent greater than the reported wet-weight concentrations. Therefore, it should be noted that the soil sample results from 1981 to 1988 in this report are, on average, approximately 12 percent lower than what should have been reported using standard EPA reporting protocols.



EXPLANATION

- *11 — SOIL BORING SAMPLED IN MAY 1981 BY MONTROSE, JONES CHEMICAL, AND DHS SOIL SAMPLES COLLECTED AT 0, 0.5, 1.0, 1.5, AND 2.0 FT BLS.
- 8-81-13 + — SURFACE SOIL SAMPLES COLLECTED IN AUGUST 1981 BY MONTROSE (MONTROSE, 1981c).
- ▲S039 — SOIL BORING SAMPLED IN JUNE AND/OR AUGUST 1983 BY HARGIS & MONTGOMERY, INC.
- ✦12/21-01-015 — COMPOSITE SOIL SAMPLES COLLECTED ABOVE OR BELOW LAND SURFACE OR FROM CORED SAMPLES TO DEPTHS OF 1 FOOT BELOW LAND SURFACE IN JULY 1983 (REF: STAUFFER, 1983).
- ●S201 — SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- □35A — SOIL BORING SAMPLED IN JUNE 1985 BY METCALF & EDDY, INC. FOR EPA
- ◆FB-S01 — SOIL BORING SAMPLED IN AUGUST 1994 BY McLAREN/HART
- ■LF31 — SOIL BORING SAMPLED IN MARCH 1995 BY LEVINE FRICKE INC.
- ○10-81-4 — SOIL SAMPLES COLLECTD BY MONTROSE IN OCTOBER 1981– RESULTS NOT FOUND (MONTROSE, 1981e)
- ●11-81-4 — SURFACE SOIL SAMPLES COLLECTED IN NOVEMBER 1981 BY MONTROSE (MONTROSE, 1981f).
- PROPERTY BOUNDARY

NOTES: THIS FIGURE DOES NOT INCLUDE NEIGHBORHOOD AND BACKGROUND SOIL SAMPLING LOCATIONS

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

ON-PROPERTY AND NEAR OFF-PROPERTY SOIL SAMPLING LOCATIONS 1981 – 1995

HARGIS+ASSOCIATES, INC. Hydrogeology/Engineering — 7/97

FIGURE 5.1

PREP BY ____ REV BY ____ RPT NO.218.1103 | 410-1496 | K

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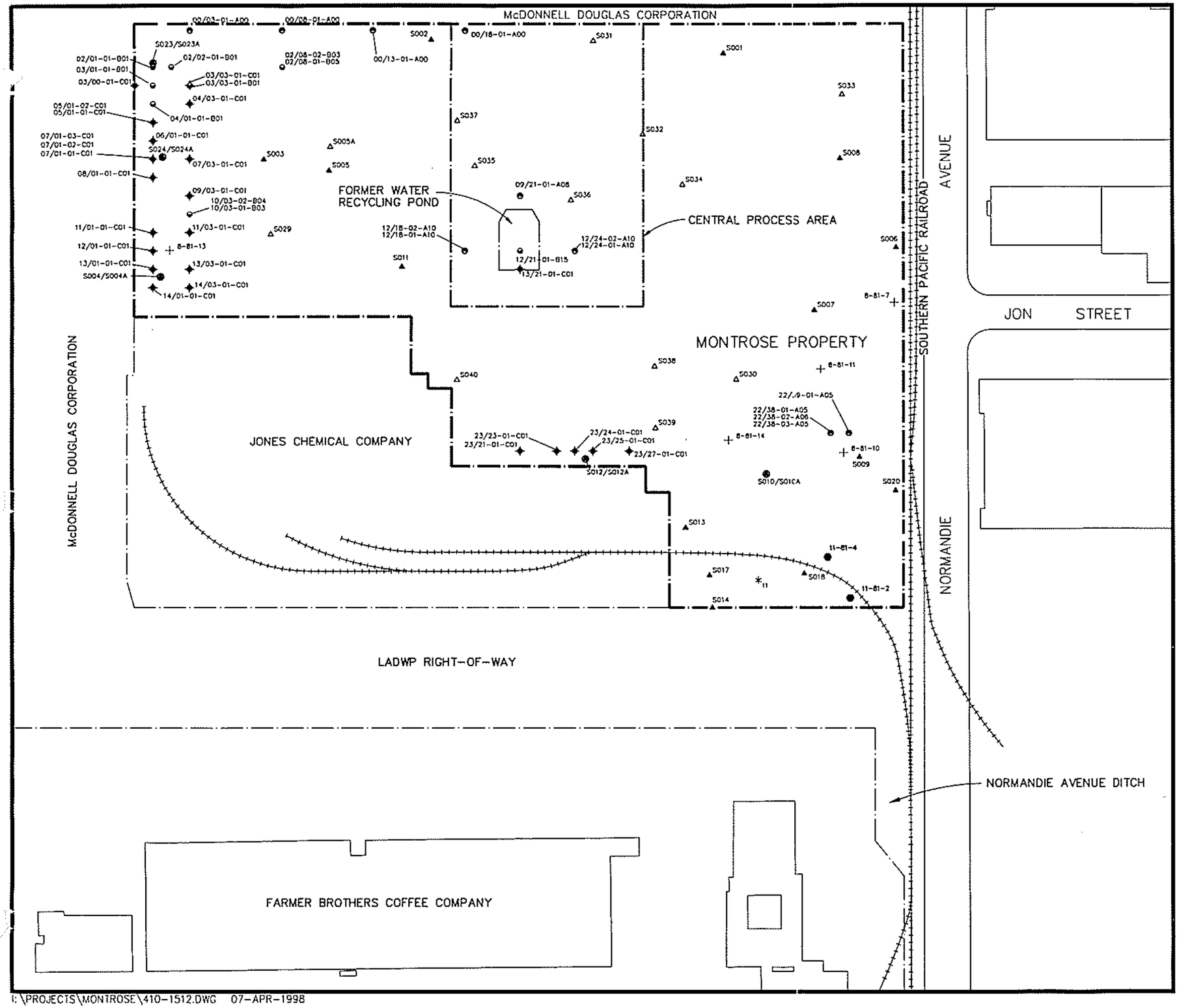

EXPLANATION

- $*_{11}$ — SOIL BORING SAMPLED IN MAY 1981 BY MONTROSE, JONES CHEMICAL, AND DHS SOIL SAMPLES COLLECTED AT 0, 0.5, 1.0, 1.5, AND 2.0 FT BLS.
- 6-81-13 + — SURFACE SOIL SAMPLES COLLECTED IN AUGUST 1981 BY MONTROSE (MONTROSE, 1981c).
- 11-81-4 ● — SURFACE SOIL SAMPLES COLLECTED IN NOVEMBER 1981 BY MONTROSE (MONTROSE, 1981f).
- ▲S001 — SOIL BORING SAMPLED IN JUNE 1983 BY HARGIS & MONTGOMERY (H&M). SOIL SAMPLES COLLECTED AT DEPTHS RANGING FROM 0.6 TO 2.5 FEET BELOW LAND SURFACE (FT BLS).
- S010/S010A ● — SOIL BORING SAMPLED IN JUNE 1983 BY H&M, SOIL SAMPLES WERE COLLECTED IN AUGUST 1983 AT ADDITIONAL DEPTHS RANGING FROM 2.0 TO 6.3 FT BLS.
- △ S029 — ADDITIONAL SOIL BORINGS SAMPLED IN AUGUST 1983 BY H&M. SOIL SAMPLES WERE COLLECTED AT DEPTHS RANGING FROM 0.5 TO 5.5 FT BLS.
- 12/24/-01-A10 ● — ABOVE GROUND SAMPLE COLLECTED IN JULY 1983 AT ELEVATIONS RANGING FROM LAND SURFACE TO APPROXIMATELY 10 FEET ABOVE LAND SURFACE (REF: STAUFFER, 1983).
- 12/21-01-015 ● — BELOW GROUND SAMPLE COLLECTED IN JULY 1983 AT DEPTHS RANGING FROM APPROXIMATELY 1 TO 15 FEET BELOW GRADE (REF: STAUFFER, 1983).
- 13/21-01-C01 ✦ — CORED SAMPLE COLLECTED IN JULY 1983 TO DEPTHS OF 1 FOOT BLS (REF: STAFFER, 1983).
- PROPERTY BOUNDARY

NOTE: THIS FIGURE DOES NOT INCLUDE ON-PROPERTY POST GRADING AND NEAR OFF-PROPERTY SOIL BORING LOCATIONS

LADWP = LOS ANGELES DEPARTMENT OF WATER AND POWER

0 135 270

FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

ON-PROPERTY SOIL SAMPLING LOCATIONS PRE-GRADING 1981 AND 1983

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

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FIGURE 5.2

PREP BY _____ REV BY _____ APT NO. 857.01 | 410-1512 | E

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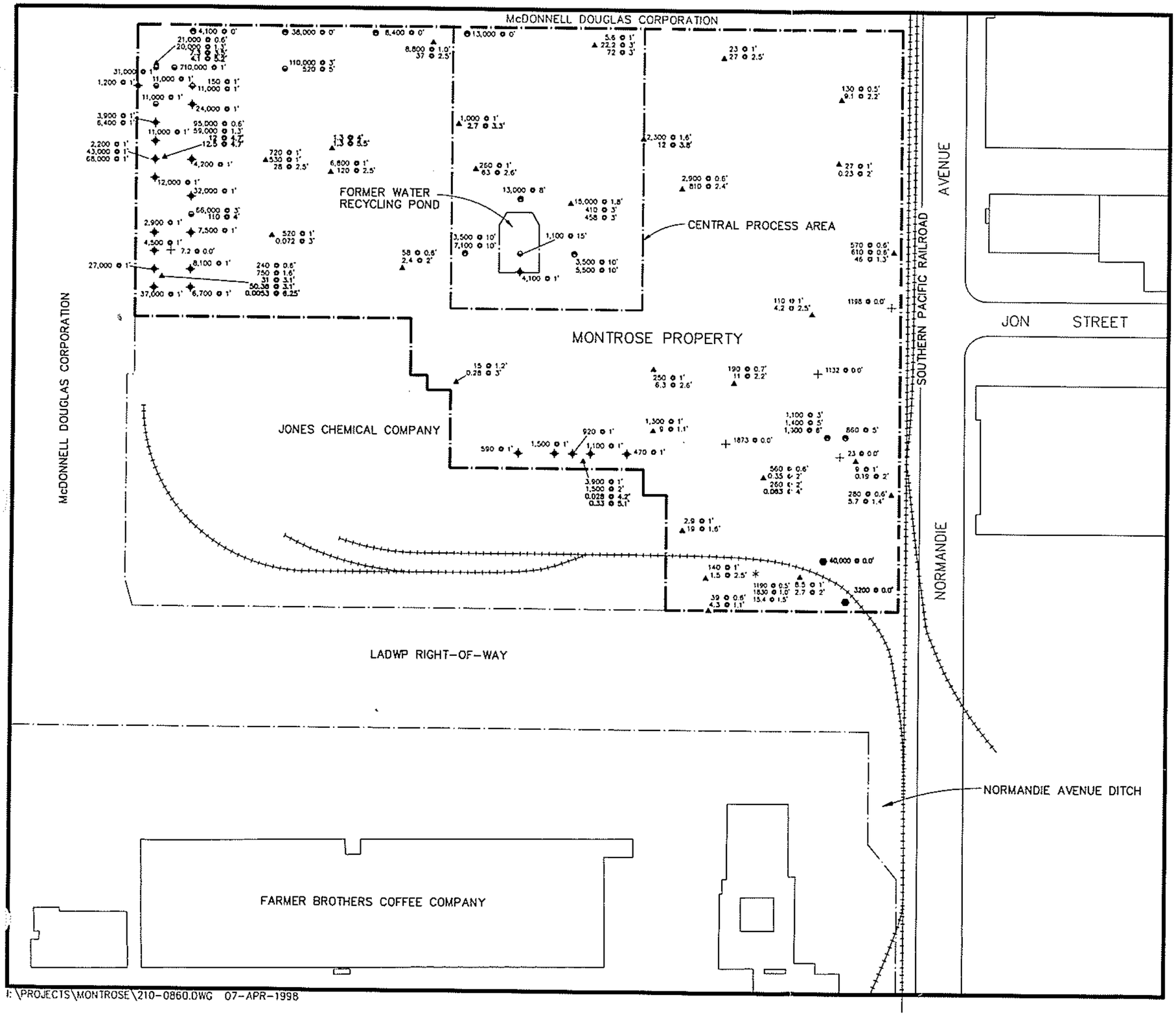

EXPLANATION

- $*_{11}$ — SOIL BORING SAMPLED IN MAY 1981 BY MONTROSE, JONES CHEMICAL, AND DHS SOIL SAMPLES COLLECTED AT 0, 0.5, 1.0, 1.5, AND 2.0 FT BLS.
- $+^{6\text{-}81\text{-}13}$ — SURFACE SOIL SAMPLES COLLECTED IN AUGUST 1981 BY MONTROSE (MONTROSE, 1981c).
- $\bullet^{11\text{-}81\text{-}4}$ — SURFACE SOIL SAMPLES COLLECTED IN NOVEMBER 1981 BY MONTROSE (MONTROSE, 1981f).
- ▲ — SOIL BORING SAMPLED IN JUNE AND/OR AUGUST 1983 BY HARGIS & MONTGOMERY, INC.
- ✦ — CORED SAMPLE COLLECTED IN JULY 1983 TO DEPTHS OF 1 FOOT (REF: STAUFFER, 1983)
- ⊕ — ABOVE GROUND SAMPLE COLLECTED IN JULY 1983 (REF: STAUFFER, 1983)
- ⊖ — BELOW GROUND SAMPLE COLLECTED IN JULY 1983 (REF: STAUFFER, 1983)
- $250 \text{ o } 1'$ ▲ — LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF TOTAL DICHLORODIPHENYLTRICHLOROETHANE (TOTAL DDT) IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE OR FEET ABOVE LAND SURFACE, AS APPROPRIATE
- < = — LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS
- ——·—— — LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:

1. SEE FIGURE 5.2 FOR SOIL BORING IDENTIFIERS
2. TABULATED DATA PROVIDED IN APPENDIX H

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FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

TOTAL DDT IN SOIL
1981, 1983
PRE-GRADING

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

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FIGURE 5.3

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 210-0860 | E

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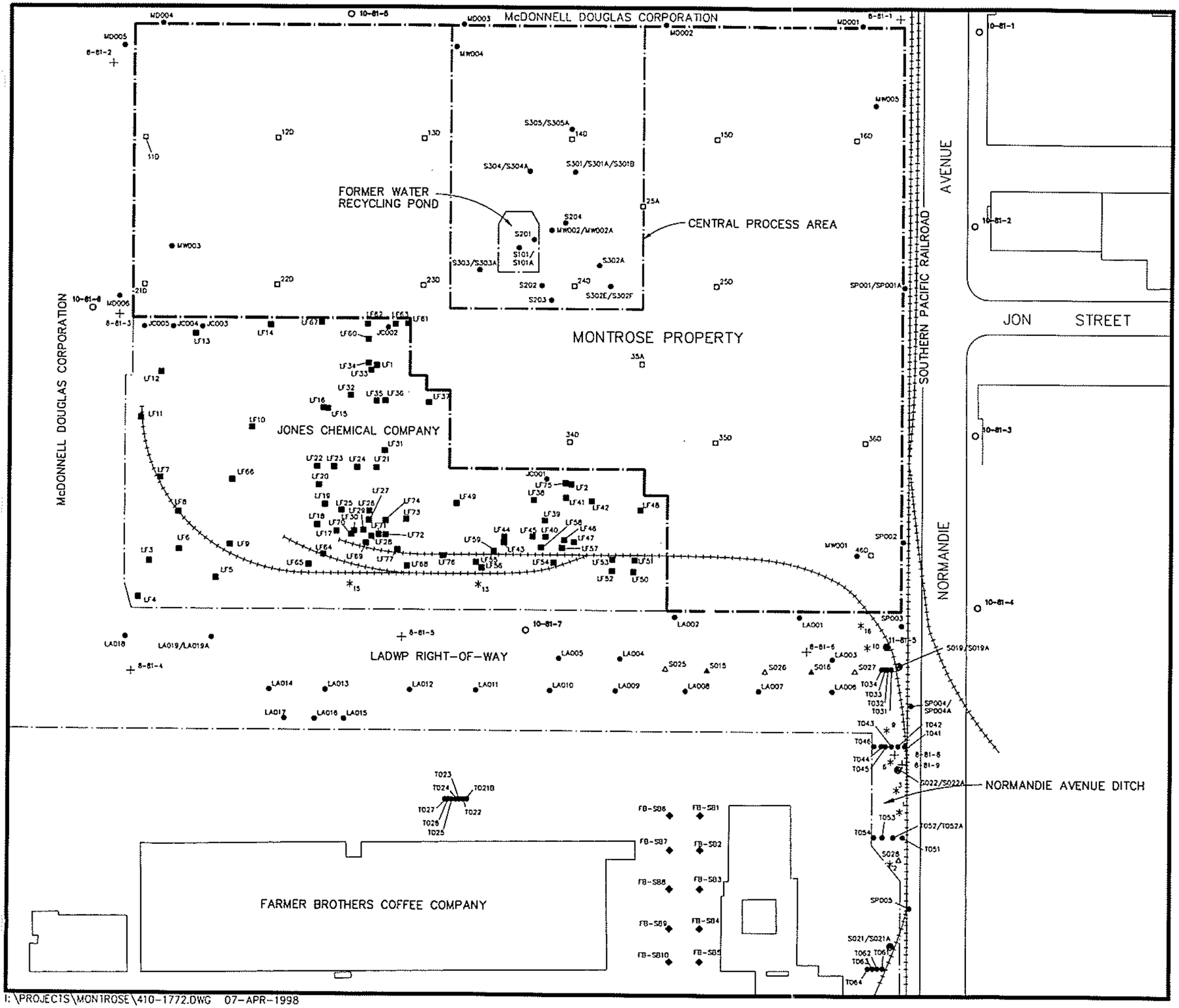

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EXPLANATION

- 8-81-13 — SURFACE SOIL SAMPLES COLLECTED IN AUGUST 1981 BY MONTROSE (MONTROSE, 1981c).
- 11-81-5 — SURFACE SOIL SAMPLES COLLECTED IN NOVEMBER 1981 BY MONTROSE (MONTROSE, 1981f).
- S001 — SOIL BORING SAMPLED IN JUNE 1983 BY HARGIS & MONTGOMERY (H&M). SOIL SAMPLES COLLECTED AT DEPTHS RANGING FROM 0.6 TO 1.6 FEET BELOW LAND SURFACE (FT BLS).
- S010/S010A — SOIL BORING SAMPLED IN JUNE 1983 BY H&M. SOIL SAMPLES WERE COLLECTED IN AUGUST 1983 AT ADDITIONAL DEPTHS RANGING FROM 2.4 TO 5 FT BLS.
- S029 — ADDITIONAL SOIL BORINGS SAMPLED IN AUGUST 1983 BY H&M. SOIL SAMPLES WERE COLLECTED AT DEPTHS RANGING FROM 0.6 TO 5.1 FT BLS.
- S201 — SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- 230 — SOIL BORING SAMPLED IN JUNE 1995 BY METCALF & EDDY, INC. FOR EPA
- FB-SB1 — SOIL BORING SAMPLED IN AUGUST 1994 BY McLAREN/HART
- LF31 — SOIL BORING SAMPLED IN MARCH 1995 BY LEVINE FRICKE INC.
- 10-81-4 — SOIL SAMPLES COLLECTD BY MONTROSE IN OCTOBER 1981- RESULTS NOT FOUND (MONTROSE, 1981c)
- *11 — SOIL BORING SAMPLED IN MAY 1981 BY MONTROSE, JONES CHEMICAL, AND DHS SOIL SAMPLES COLLECTED AT 0, 0.5, 1.0, 1.5, AND 2.0 FT BLS.
- PROPERTY BOUNDARY

NOTE: THIS FIGURE DOES NOT INCLUDE ON-PROPERTY SOIL SAMPLING LOCATIONS, PRE-GRADING 1983 NOR MORE DISTANT NEIGHBORHOOD AND BACKGROUND SOIL SAMPLING LOCATIONS.

LADWP = LOS ANGELES DEPARTMENT OF WATER AND POWER

0 135 270

FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

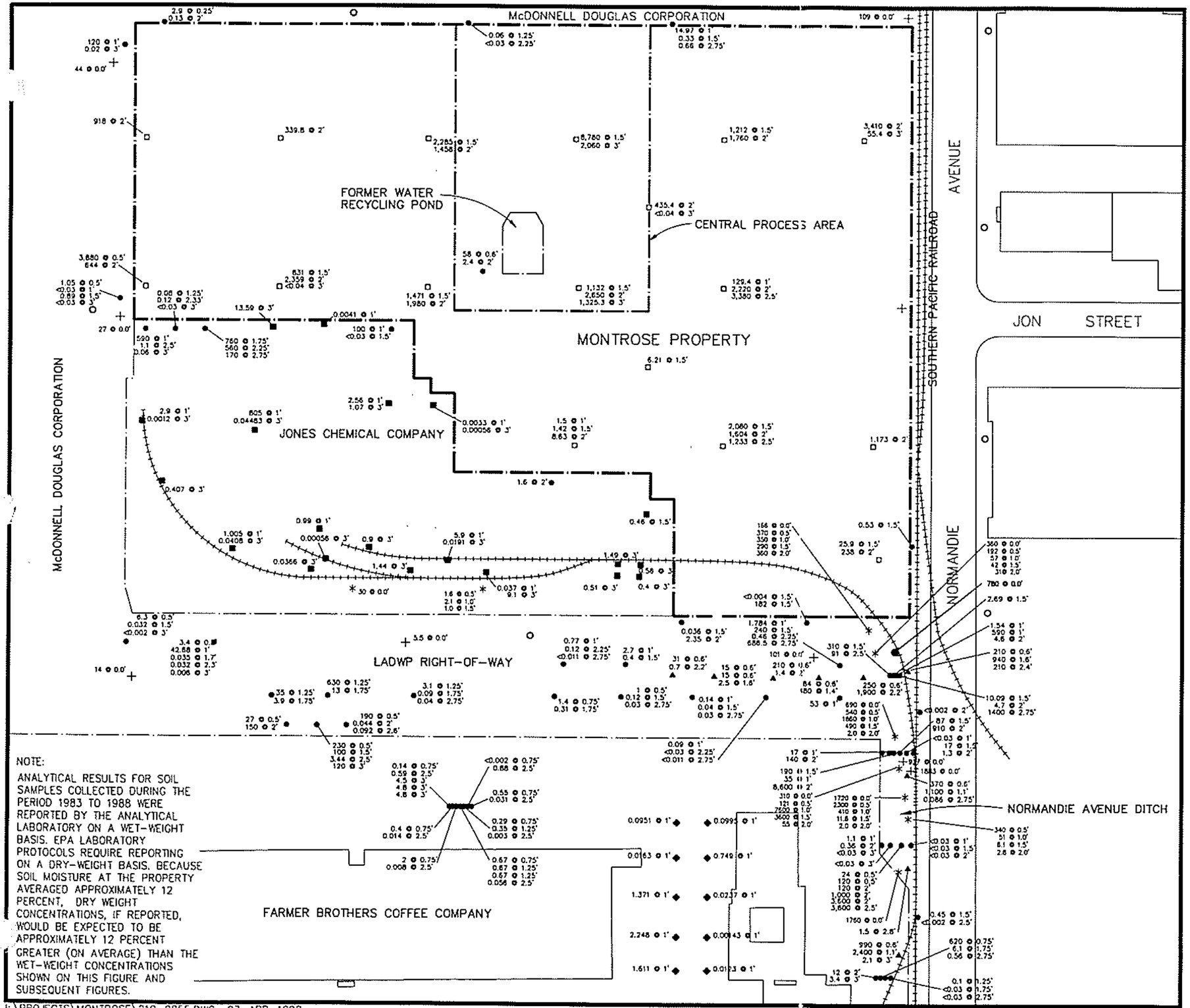
ON-PROPERTY POST GRADING AND NEAR OFF-PROPERTY SOIL BORING LOCATIONS 1981-1995

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.4

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 410-1772 | E



NOTE:

ANALYTICAL RESULTS FOR SOIL SAMPLES COLLECTED DURING THE PERIOD 1983 TO 1988 WERE REPORTED BY THE ANALYTICAL LABORATORY ON A WET-WEIGHT BASIS. EPA LABORATORY PROTOCOLS REQUIRE REPORTING ON A DRY-WEIGHT BASIS. BECAUSE SOIL MOISTURE AT THE PROPERTY AVERAGED APPROXIMATELY 12 PERCENT, DRY WEIGHT CONCENTRATIONS, IF REPORTED, WOULD BE EXPECTED TO BE APPROXIMATELY 12 PERCENT GREATER (ON AVERAGE) THAN THE WET-WEIGHT CONCENTRATIONS SHOWN ON THIS FIGURE AND SUBSEQUENT FIGURES.

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EXPLANATION

- * SOIL BORING SAMPLED IN MAY 1981 BY MONTROSE, JONES CHEMICAL, AND DHS SOIL SAMPLES COLLECTED AT 0, 0.5, 1.0, 1.5, AND 2.0 FT BLS.
- \+ SURFACE SOIL SAMPLES COLLECTED IN AUGUST 1981 BY MONTROSE (MONTROSE, 1981c).
- ▲ SOIL BORING SAMPLED IN 1983 BY HARGIS & MONTGOMERY, INC.
- ● SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- □ SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- ◆ SOIL BORING SAMPLED IN AUGUST 1994 BY McLAREN/HART
- ■ SOIL BORING SAMPLED IN MARCH 1995 BY LEVINE FRICKE INC.
- 210 @ 0.6' LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF TOTAL DICHLORODIPHENYLTRICHLOROETHANE (TOTAL DDT) IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE.
- ● SURFACE SOIL SAMPLES COLLECTED IN NOVEMBER 1981 BY MONTROSE (MONTROSE, 1981f).
- ○ SOIL SAMPLES COLLECTD BY MONTROSE IN OCTOBER 1981– RESULTS NOT FOUND (MONTROSE, 1981e)
- < = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:

SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

0 135 270

FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

TOTAL DDT IN SOIL
0 TO 3 FEET BLS

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.5

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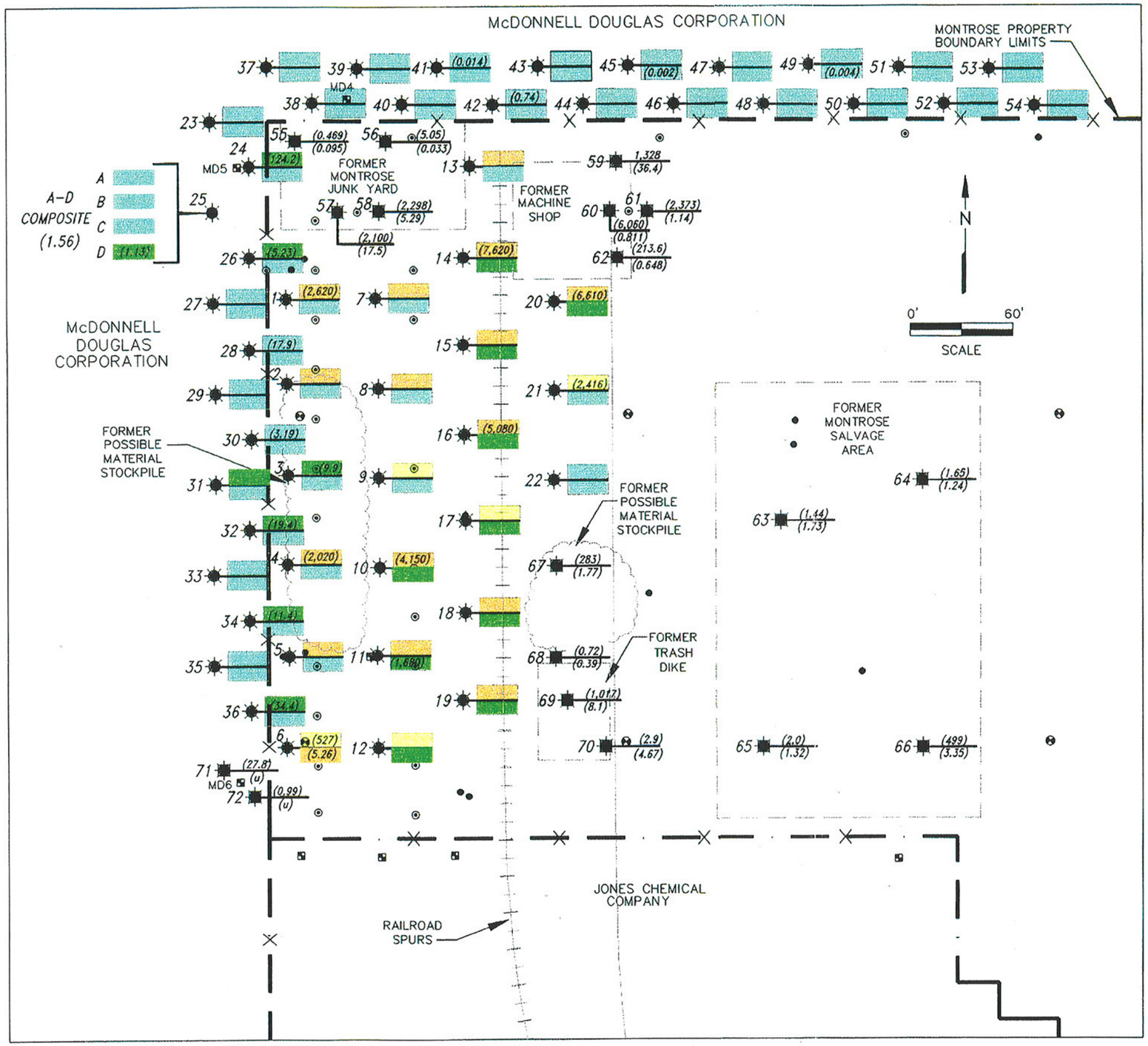

LEGEND

- STAUFFER CHEMICALS – 1983 SAMPLE/BORING NUMBER
- HARGIS & MONTGOMERY, INC. – 1983 SAMPLE/BORING
- METCALF & EDDY – 1985 SAMPLE/BORING LOCATIONS
- HARGIS + ASSOCIATES, INC. – 1986 SAMPLE/BORING
- MARCH, 1997 SAMPLING LOCATION (GRID POINT), McLAREN/HART
- MARCH, 1997 SAMPLING LOCATION (BIASED POINT), McLAREN/HART

NOTE: ONLY DATA ASSOCIATED WITH NORTHWEST CORNER OF PROPERTY IS PLOTTED ON THIS FIGURE.

NUMBER ADJACENT TO SOIL SAMPLE LOCATION REFERS TO SOIL BORING NUMBER (63 REFERS TO SB-63 ETC.)

Range of DDT Immunoassay (mg/kg)

- 0–10
- >10–200
- >200–1000
- >1000

Sample Location: 22 — Shallow (27.8) / Subsurface — CLP Pesticides (mg/kg)

(u) Compound was not detected above reported detection limits

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

PRELIMINARY RESULTS CLP-PESTICIDES AND DDT IMMUNOASSAY NORTHWEST CORNER OF MONTROSE PROPERTY

FIGURE 5-5A

PREP BY _____ PREP BY _____ APT NO. _____ | xxxxxxxxx | K

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McDONNELL DOUGLAS CORPORATION

FORMER WATER RECYCLING POND

CENTRAL PROCESS AREA

MONTROSE PROPERTY

JONES CHEMICAL COMPANY

LADWP RIGHT-OF-WAY

FARMER BROTHERS COFFEE COMPANY

NORMANDIE AVENUE DITCH

SOUTHERN PACIFIC RAILROAD

JON STREET

NORMANDIE AVENUE

McDONNELL DOUGLAS CORPORATION

EXPLANATION

- ▲ SOIL BORING SAMPLED IN 1983 BY HARGIS & MONTGOMERY, INC.
- ● SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- □ SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- ■ SOIL BORING SAMPLED IN MARCH 1995 BY LEVINE FRICKE INC.
- 0.063 ● 4' ▲ LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF TOTAL DICHLORODIPHENYLTRICHLOROETHANE (TOTAL DDT) IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE.
- < = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

TOTAL DDT IN SOIL
3 TO 6 FEET BLS

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.6

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 210-0856 | B

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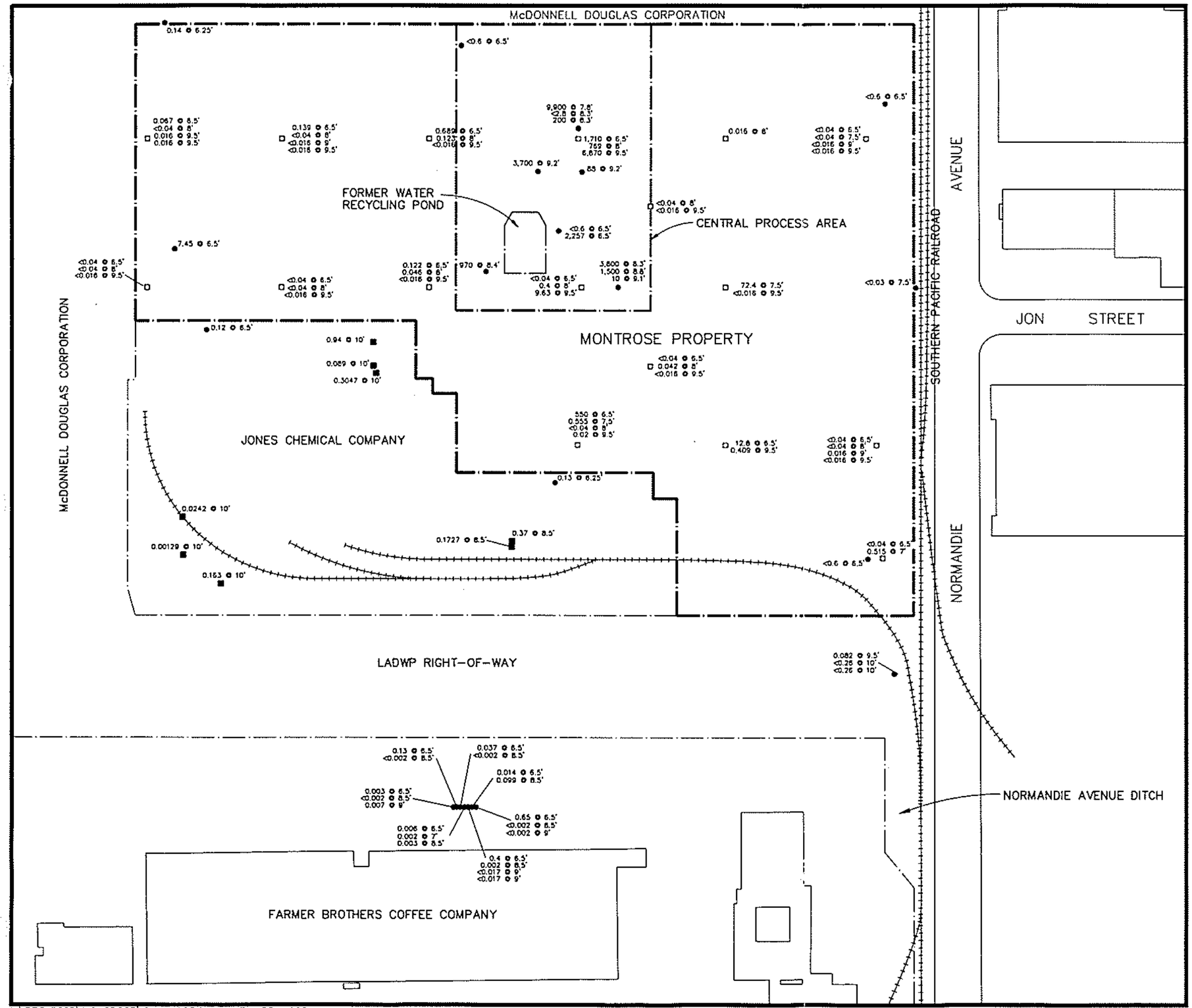

EXPLANATION

- ● SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- □ SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- ■ SOIL BORING SAMPLED IN MARCH 1995 BY LEVINE FRICKE INC.
- 72.4 ● 7.5' LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF TOTAL DICHLORODIPHENYLTRICHLOROETHANE (TOTAL DDT) IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE.
- < = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

TOTAL DDT IN SOIL
6 TO 10 FEET BLS

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.7

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 210-0857 | B

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McDONNELL DOUGLAS CORPORATION

CENTRAL PROCESS AREA

FORMER WATER RECYCLING POND

MONTROSE PROPERTY

JONES CHEMICAL COMPANY

LADWP RIGHT-OF-WAY

FARMER BROTHERS COFFEE COMPANY

McDONNELL DOUGLAS CORPORATION

SOUTHERN PACIFIC RAILROAD

AVENUE

JON STREET

NORMANDIE

NORMANDIE AVENUE DITCH

EXPLANATION

- ● SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- □ SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- ■ SOIL BORING SAMPLED IN MARCH 1995 BY LEVINE FRICKE INC.
- <0.04 ● 11' / □ LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF TOTAL DICHLORODIPHENYLTRICHLOROETHANE (TOTAL DDT) IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE.
- < = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

N

0 135 270

FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

TOTAL DDT IN SOIL
10 TO 70 FEET BLS

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.8

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 210-0858 | B

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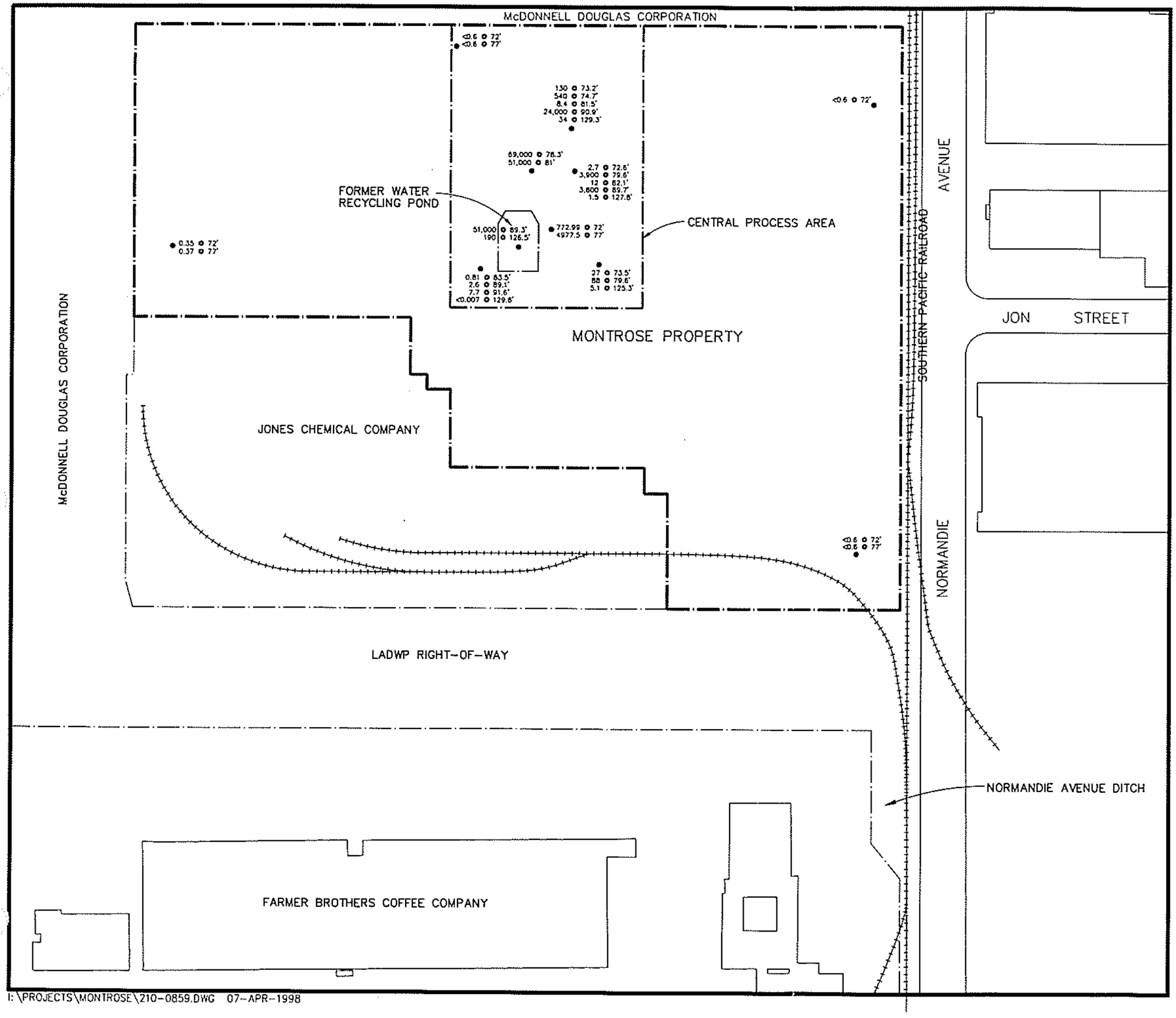


I:\PROJECTS\MONTROSE\210-0859.DWG 07-APR-1998

EXPLANATION

- • SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- 88 @ 79.6' • LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF TOTAL DICHLORODIPHENYLTRICHLOROETHANE (TOTAL DDT) IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE.
- < = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

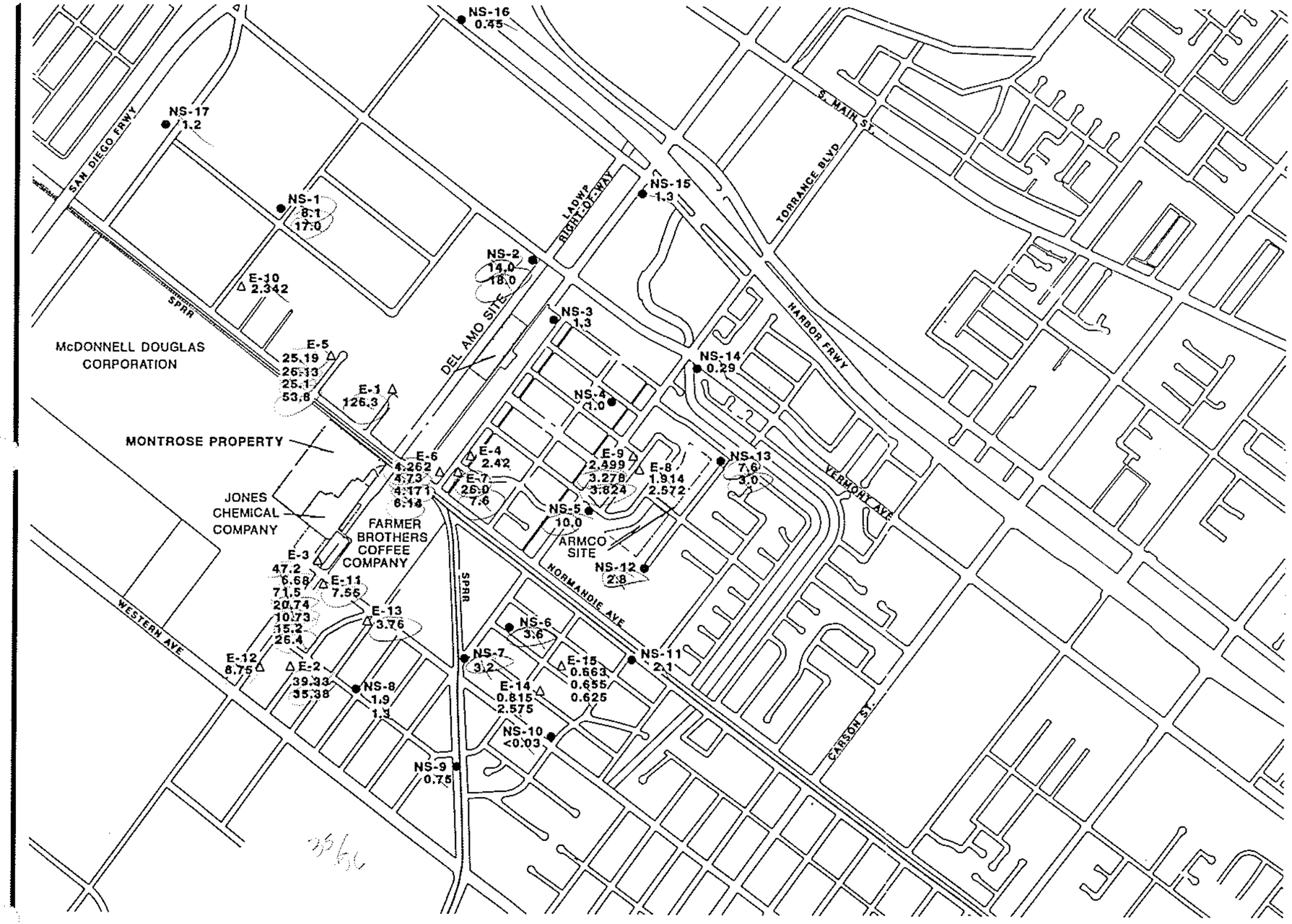
TOTAL DDT IN SOIL GREATER THAN 70 FEET BLS

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

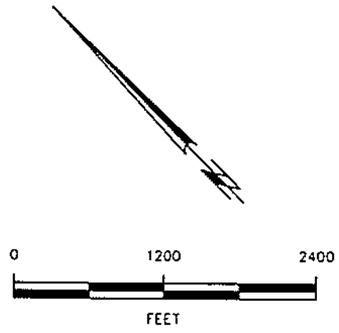
FIGURE 5.9

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 210-0859 | B



EXPLANATION

NS-14 ●	MONTROSE NEIGHBORHOOD OFF-PROPERTY SOIL SAMPLE ORIGINAL AND FIELD DUPLICATE SAMPLE
E-4 △	ECOLOGY AND ENVIRONMENT, INC. NEIGHBORHOOD OFF-PROPERTY SOIL SAMPLE, MULTIPLE SAMPLES COLLECTED AT EACH LOCATION
NS-14 ● 0.29	TOTAL DDT CONCENTRATION IN MILLIGRAMS PER KILOGRAM
##########	RAILROAD TRACKS
SPRR	SOUTHERN PACIFIC RAILROAD
LADWP	LOS ANGELES DEPARTMENT OF WATER AND POWER
	(<) = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS



MONTROSE CHEMICAL CORPORATION
OF CALIFORNIA
TORRANCE, CALIFORNIA

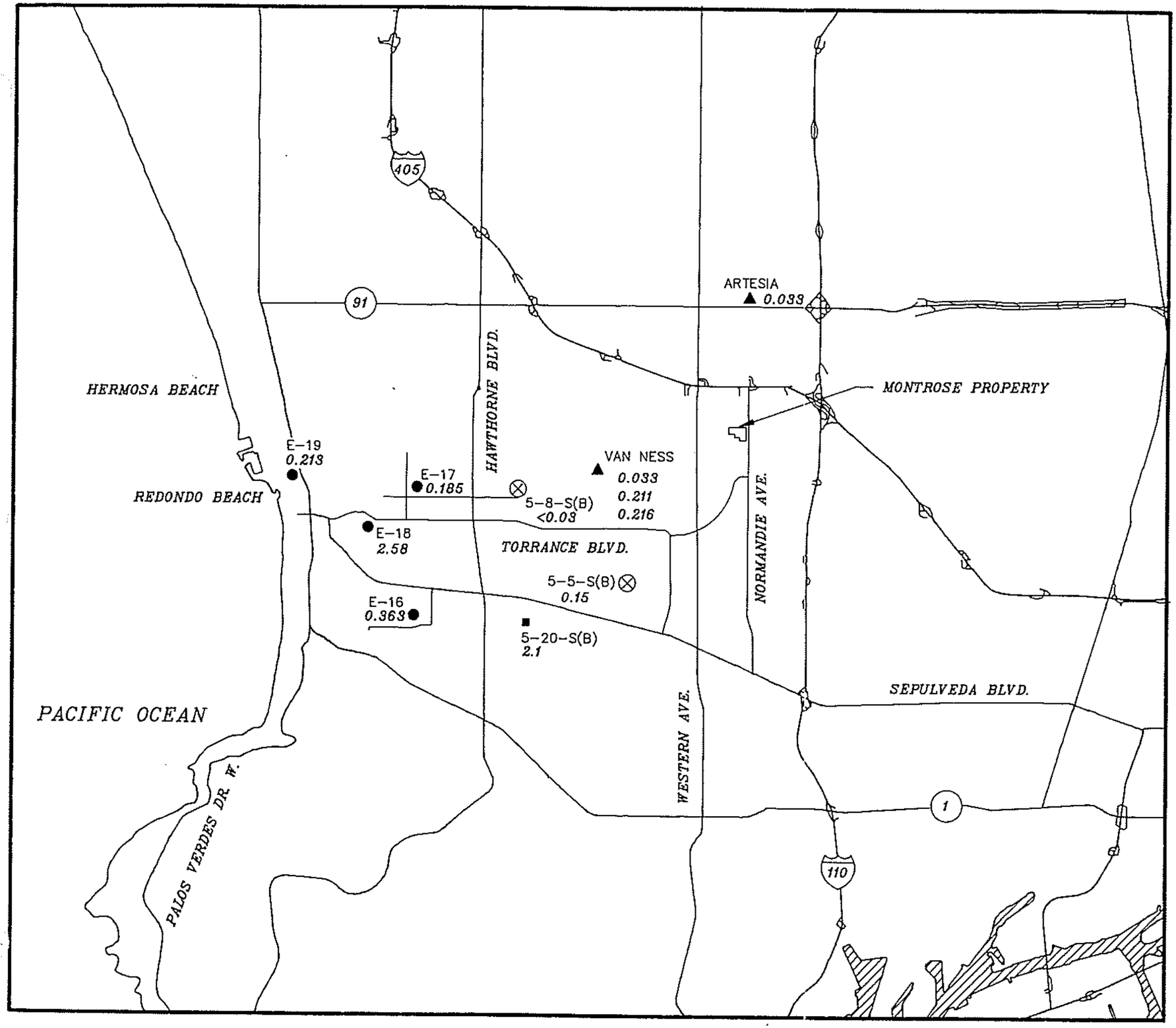
TOTAL DDT
NEIGHBORHOOD SOIL SAMPLES

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

2/97

FIGURE 5.10

PREP BY _____ REV BY _____ RPT NO. 218.544 | R1504-5\F05-11 | A



EXPLANATION

VAN NESS ▲ — METCALF & EDDY, INC., BACKGROUND SOIL SAMPLE TO 1985 ON-PROPERTY INVESTIGATION, MULTIPLE SAMPLES COLLECTED AT ONE LOCATION.

5-5-S(B) ⊗ — MONTROSE BACKGROUND SOIL SAMPLE TO 1986 OFF-PROPERTY SOIL INVESTIGATION

5-20-S(B) ■ — MONTROSE BACKGROUND SOIL SAMPLE TO 1986 SURFICIAL SOIL INVESTIGATION

E-18 ● — ECOLOGY AND ENVIRONMENT, INC., ADDITIONAL SOIL SAMPLE TO 1986 SURFICIAL SOIL INVESTIGATION

E-18 ● 2.58 — TOTAL DDT CONCENTRATION IN MILLIGRAMS PER KILOGRAM

(<) = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS

BASE MAP FROM: USGS DLG 7.5 QUADRANGLES

0 6,000 12,000
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

TOTAL DDT BACKGROUND SOIL SAMPLES

HARGIS+ASSOCIATES, INC. 10/92

FIGURE 5.11

PREP BY JMP REV BY K.S.M. RPT NO. 218.544 | R1504-5\F05-12 | A

McDONNELL DOUGLAS CORPORATION

McDONNELL DOUGLAS CORPORATION

FORMER WATER RECYCLING POND

CENTRAL PROCESS AREA

MONTROSE PROPERTY

JONES CHEMICAL COMPANY

LADWP RIGHT-OF-WAY

FARMER BROTHERS COFFEE COMPANY

SOUTHERN PACIFIC RAILROAD

AVENUE

JON STREET

NORMANDIE

NORMANDIE AVENUE DITCH

I:\PROJECTS\MONTROSE\210-0780.DWG 07-APR-1998

EXPLANATION

- ● SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- ▫ SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- ◆ SOIL BORING SAMPLED IN AUGUST 1994 BY McLAREN/HART
- ■ SOIL BORING SAMPLED IN MARCH 1995 BY LEVINE FRICKE INC.
- 210 ● 0.6' LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF TOTAL HEXACHLOROCYCLOHEXANE (TOTAL BHC) IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE.
- < = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

TOTAL BHC IN SOIL
0 TO 3 FEET BLS

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.12

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 210-0780 | C

McDONNELL DOUGLAS CORPORATION

FORMER WATER RECYCLING POND

CENTRAL PROCESS AREA

MONTROSE PROPERTY

SOUTHERN PACIFIC RAILROAD

AVENUE

JON STREET

McDONNELL DOUGLAS CORPORATION

JONES CHEMICAL COMPANY

LADWP RIGHT-OF-WAY

NORMANDIE

NORMANDIE AVENUE DITCH

FARMER BROTHERS COFFEE COMPANY

I:\PROJECTS\MONTROSE\210-0781.DWG 07-APR-1998

EXPLANATION

- ● SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- □ SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- ■ SOIL BORING SAMPLED IN MARCH 1995 BY LEVINE FRICKE INC.
- <0.01 ● 3.25' LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF TOTAL HEXACHLOROCYCLOHEXANE (TOTAL BHC) IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE.
- < = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

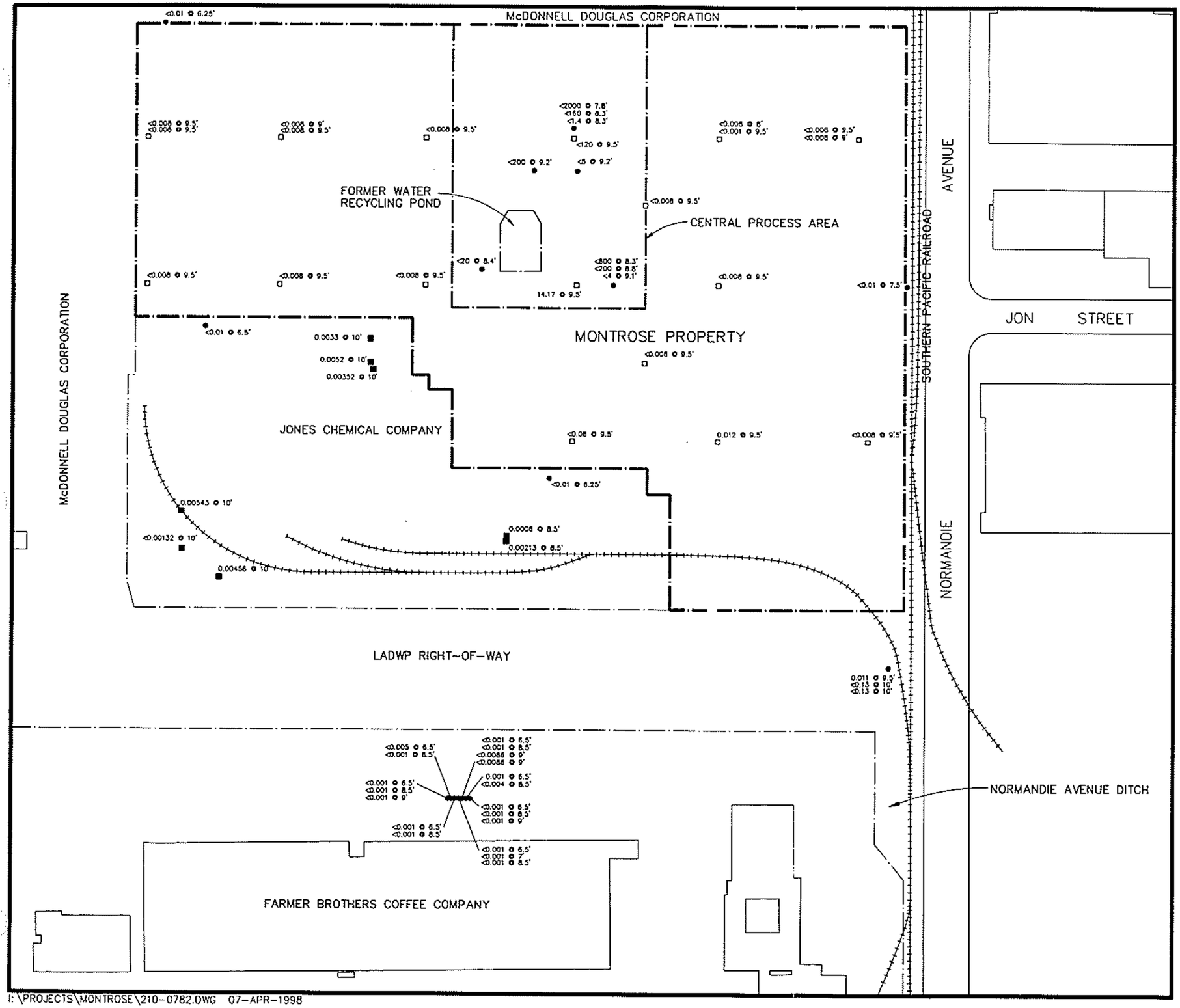
TOTAL BHC IN SOIL
3 TO 6 FEET BLS

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.13

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 210-0781 | C



EXPLANATION

- ● SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- □ SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- ■ SOIL BORING SAMPLED IN MARCH 1995 BY LEVINE FRICKE INC.
- ●/□/■ <0.01 @ 6.5' — LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF TOTAL HEXACHLOROCYCLOHEXANE IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE.
- < = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

TOTAL BHC IN SOIL
6 TO 10 FEET BLS

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

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FIGURE 5.14

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 210-0782 | B

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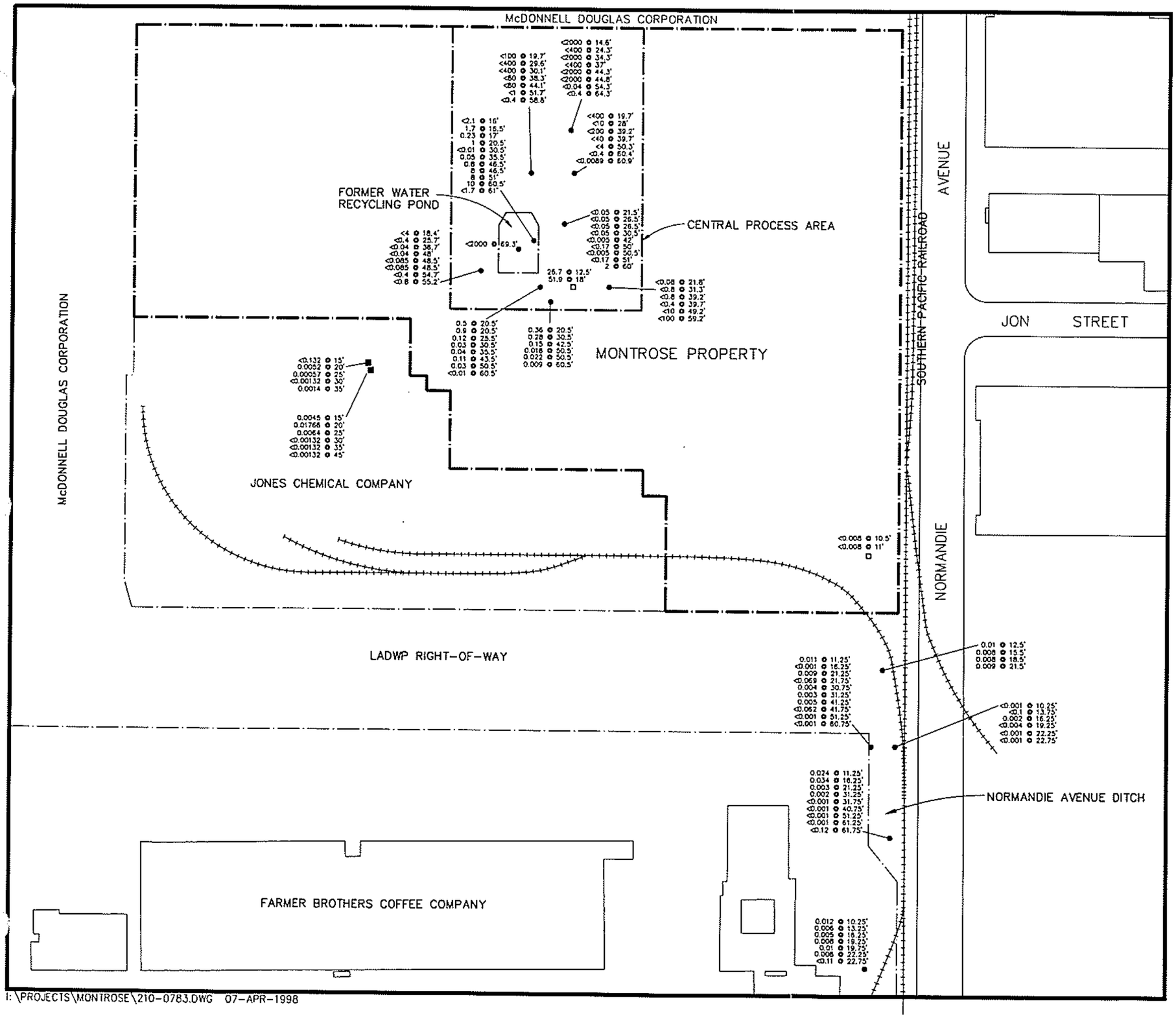

EXPLANATION

- ● SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- □ SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- ■ SOIL BORING SAMPLED IN MARCH 1995 BY LEVINE FRICKE INC.
- <0.4 ● 58.8' LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF TOTAL HEXACHLOROCYCLOHEXANE IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE.
- < = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

N

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

TOTAL BHC IN SOIL
10 TO 70 FEET BLS

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.15

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 210-0783 | B

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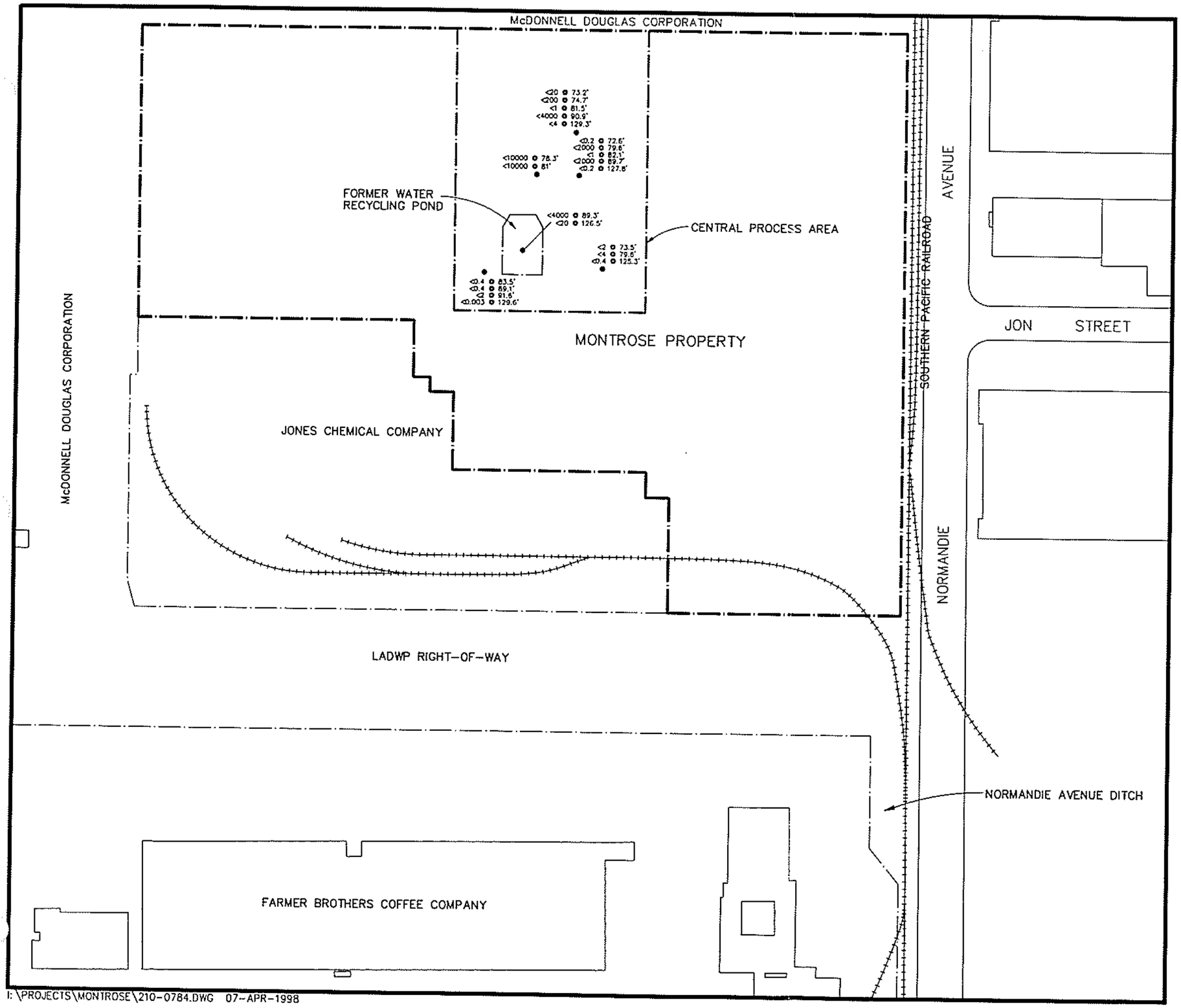

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EXPLANATION

<0.4 @ 125.3' — LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF TOTAL HEXACHLOROCYCLOHEXANE (TOTAL BHC) IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE.

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS

LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

N

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

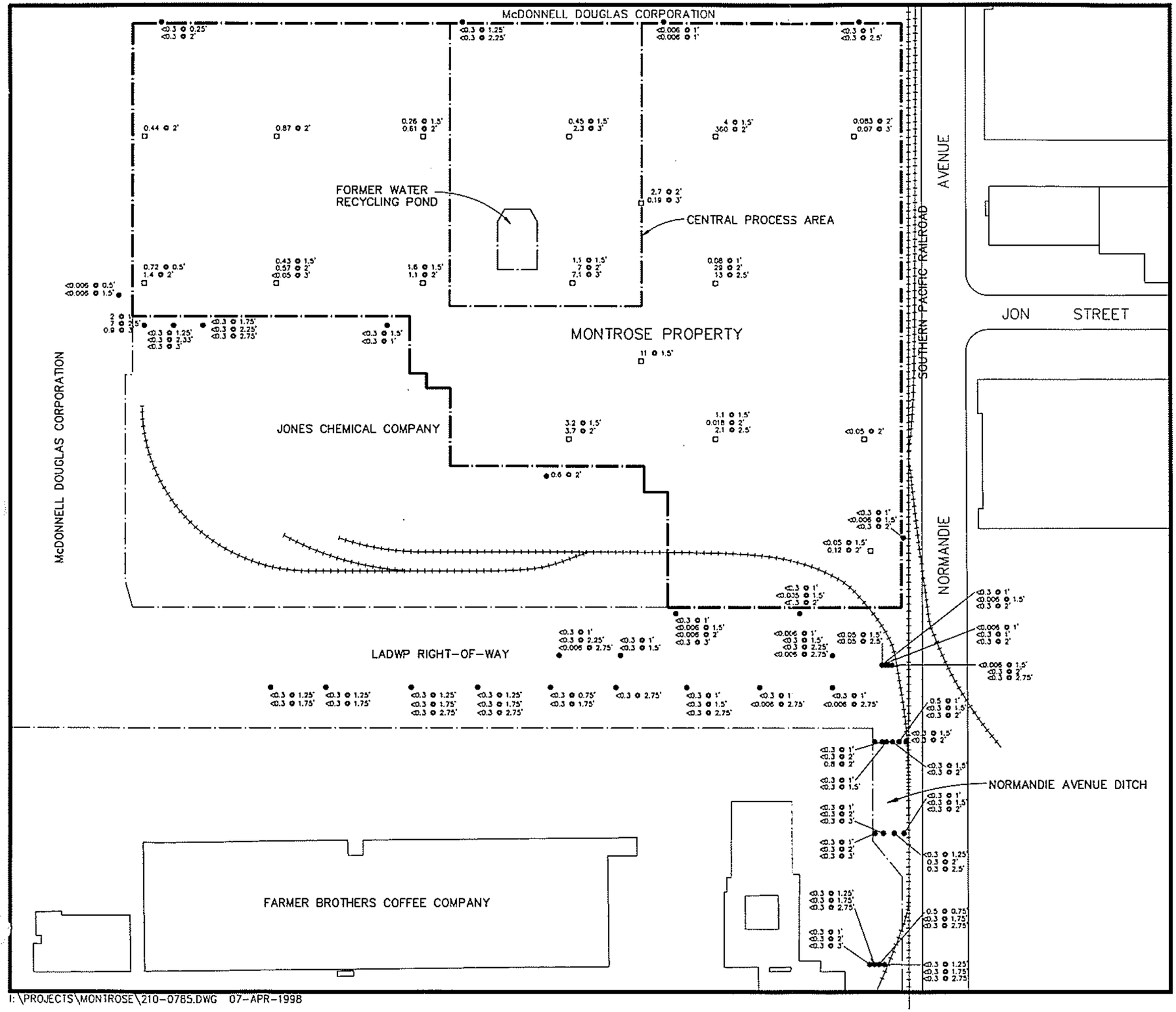
TOTAL BHC IN SOIL GREATER THAN 70 FEET BLS

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.16

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 210-0784 | B



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EXPLANATION

- ● SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- □ SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- 0.87 ○ 2' LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF CHLOROBENZENE IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE.
- < = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

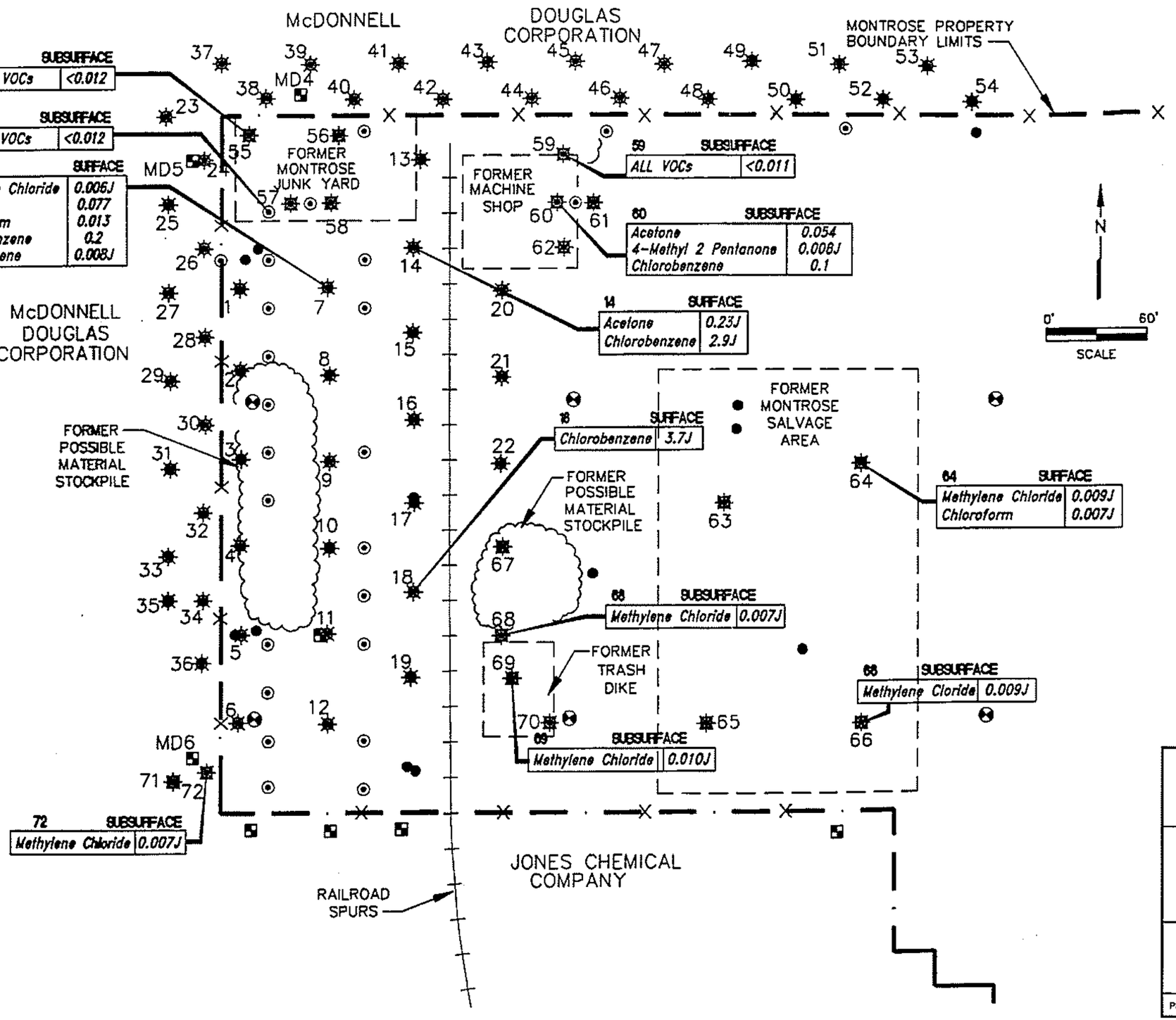
CHLOROBENZENE IN SOIL
0 TO 3 FEET BLS

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.17

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 210-0785 | B



LEGEND

- STAUFFER CHEMICALS – 1983 SAMPLE/BORING NUMBER
- HARGIS & MONTGOMERY, INC. – 1985 SAMPLE/BORING
- METCALF & EDDY – 1985 SAMPLE/BORING LOCATIONS
- HARGIS + ASSOCIATES, INC. – 1986 SAMPLE/BORING
- MARCH, 1997 SAMPLING LOCATION (GRID POINT), McLAREN/HART
- MARCH, 1997 SAMPLING LOCATION (BIASED POINT), McLAREN/HART

NOTE: CLP VOLATILE SAMPLING ONLY OCCURRED AT LOCATIONS WHERE DATA ARE SHOWN ONLY DATA ASSOCIATED WITH NORTHWEST CORNER OF PROPERTY IS PLOTTED ON THIS FIGURE.

NUMBER ADJACENT TO SOIL SAMPLE LOCATION REFERS TO SOIL BORING NUMBER (63 REFERS TO SB-63 ETC.)

CONCENTRATIONS IN mg/kg

J QUALIFIER CODE "J" AFTER CONCENTRATION INDICATES RESULT IS CONSIDERED SEMI-QUANTITATIVE. QA/QC PARAMETERS ARE SLIGHTLY OUTSIDE THE CONTROL LIMITS

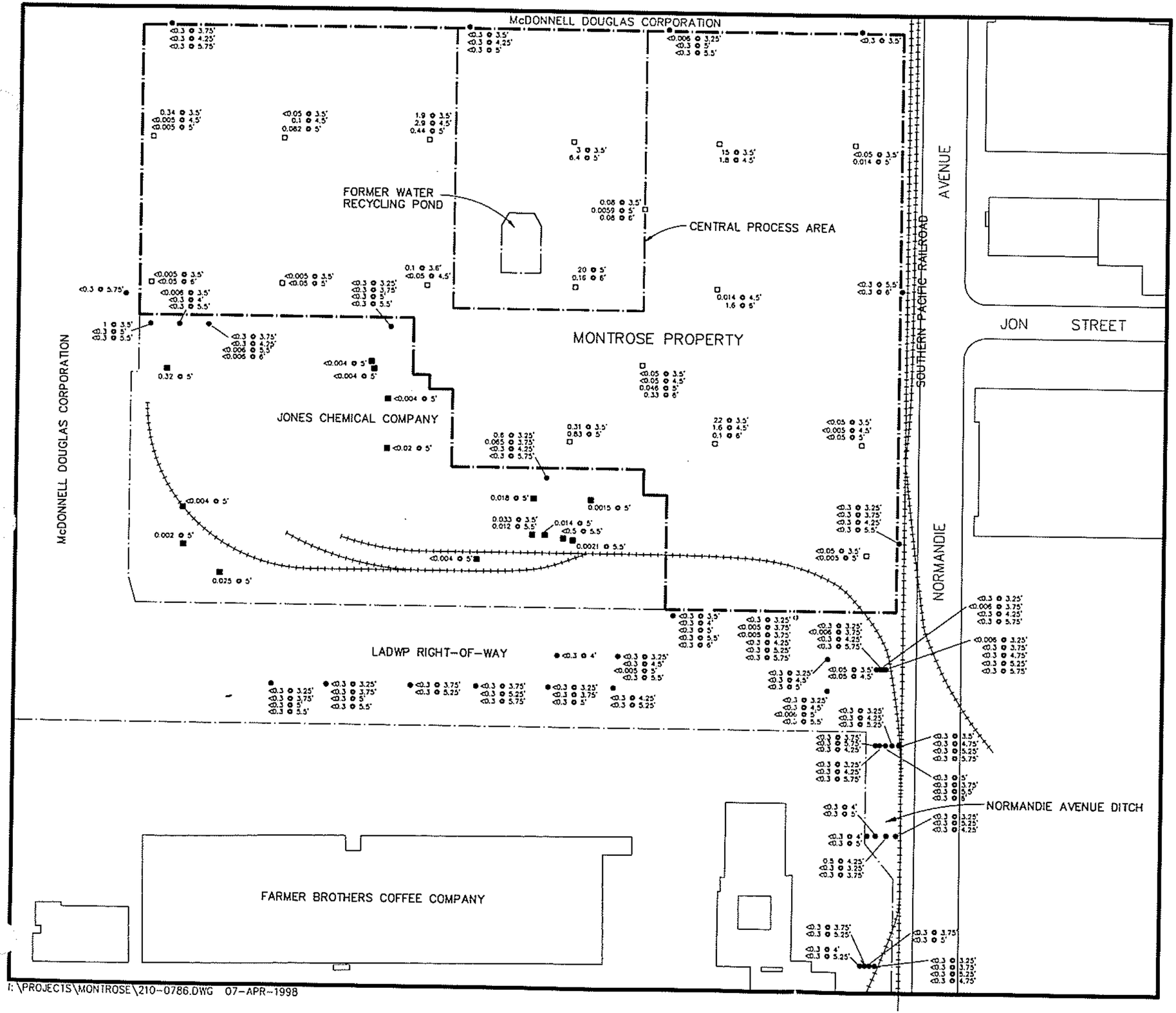
MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

SOIL ANALYTICAL RESULTS, CLP VOLATILES, NORTHWEST CORNER OF MONTROSE PROPERTY

FIGURE 5-17A

PREP BY _____ PREP BY _____ APT NO. _____ xxxxxxxxx K

p102573.17.01 SOIL FH 1/98



EXPLANATION

- ● SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- □ SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- ■ SOIL BORING SAMPLED IN MARCH 1995 BY LEVINE FRICKE INC.
- <0.05 ● 3.5' — LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF CHLOROBENZENE IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE.
- < = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

N

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

CHLOROBENZENE IN SOIL
3 TO 6 FEET BLS

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.18

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 210-0786 | B

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McDONNELL DOUGLAS CORPORATION

McDONNELL DOUGLAS CORPORATION

FORMER WATER RECYCLING POND

CENTRAL PROCESS AREA

MONTROSE PROPERTY

JONES CHEMICAL COMPANY

LADWP RIGHT-OF-WAY

FARMER BROTHERS COFFEE COMPANY

SOUTHERN PACIFIC RAILROAD

AVENUE

JON STREET

NORMANDIE

NORMANDIE AVENUE DITCH

EXPLANATION

- ● SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- □ SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- ■ SOIL BORING SAMPLED IN MARCH 1995 BY LEVINE FRICKE INC.
- ◆ <0.005 @ 9.5' LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF CHLOROBENZENE IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE.
- < = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

0 135 270
FEET

I:\PROJECTS\MONTROSE\210-0787.DWG 07-APR-1998

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

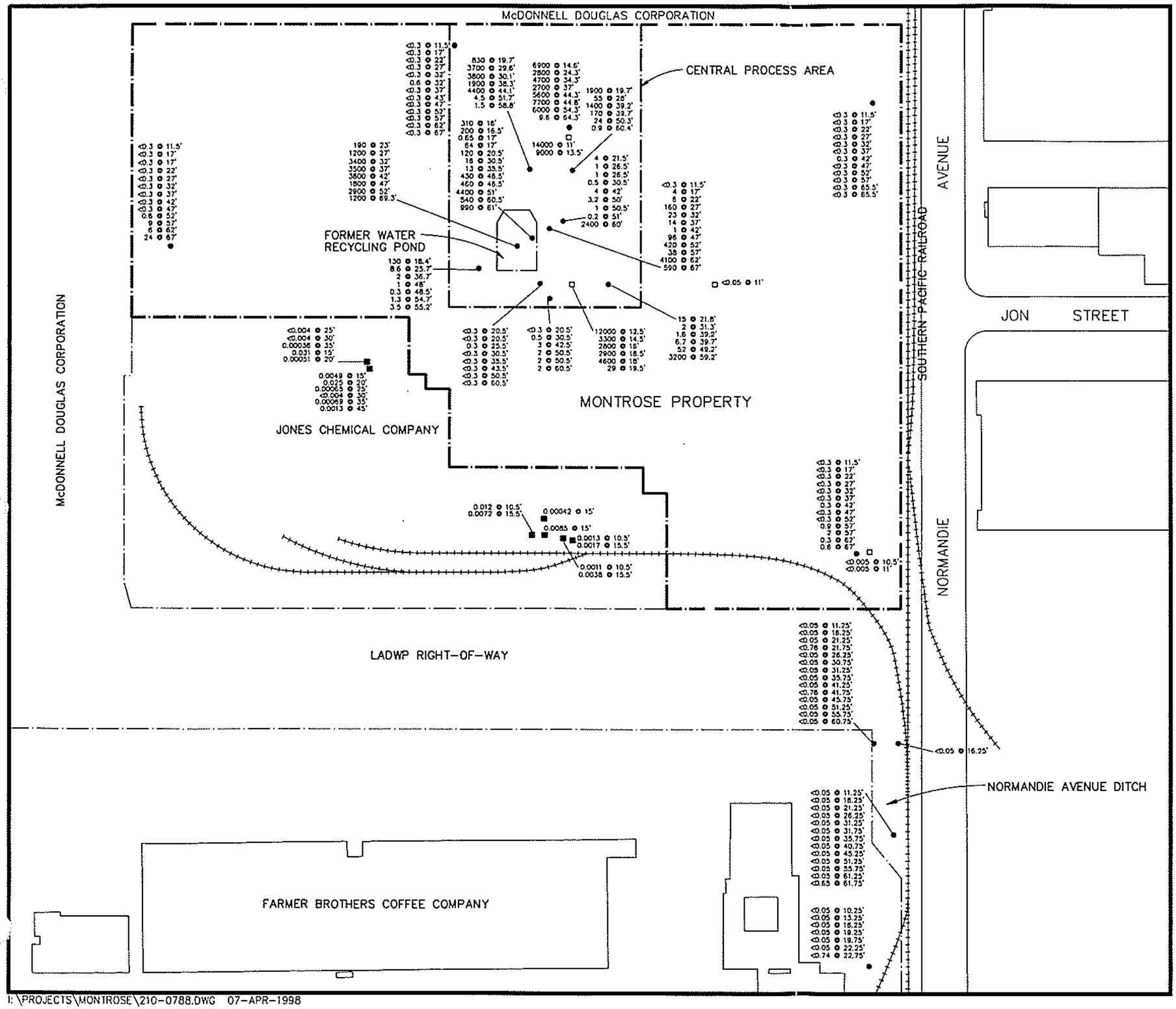
CHLOROBENZENE IN SOIL
6 TO 10 FEET BLS

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.19

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 210-0787 | B



EXPLANATION

- ● SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- □ SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- ■ SOIL BORING SAMPLED IN MARCH 1995 BY LEVINE FRICKE INC.
- ●/□/■ <0.005 ○ 11' — LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF CHLOROBENZENE IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE.
- < = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

N

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

CHLOROBENZENE IN SOIL
10 TO 70 FEET BLS

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.20

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 210-0788 | D

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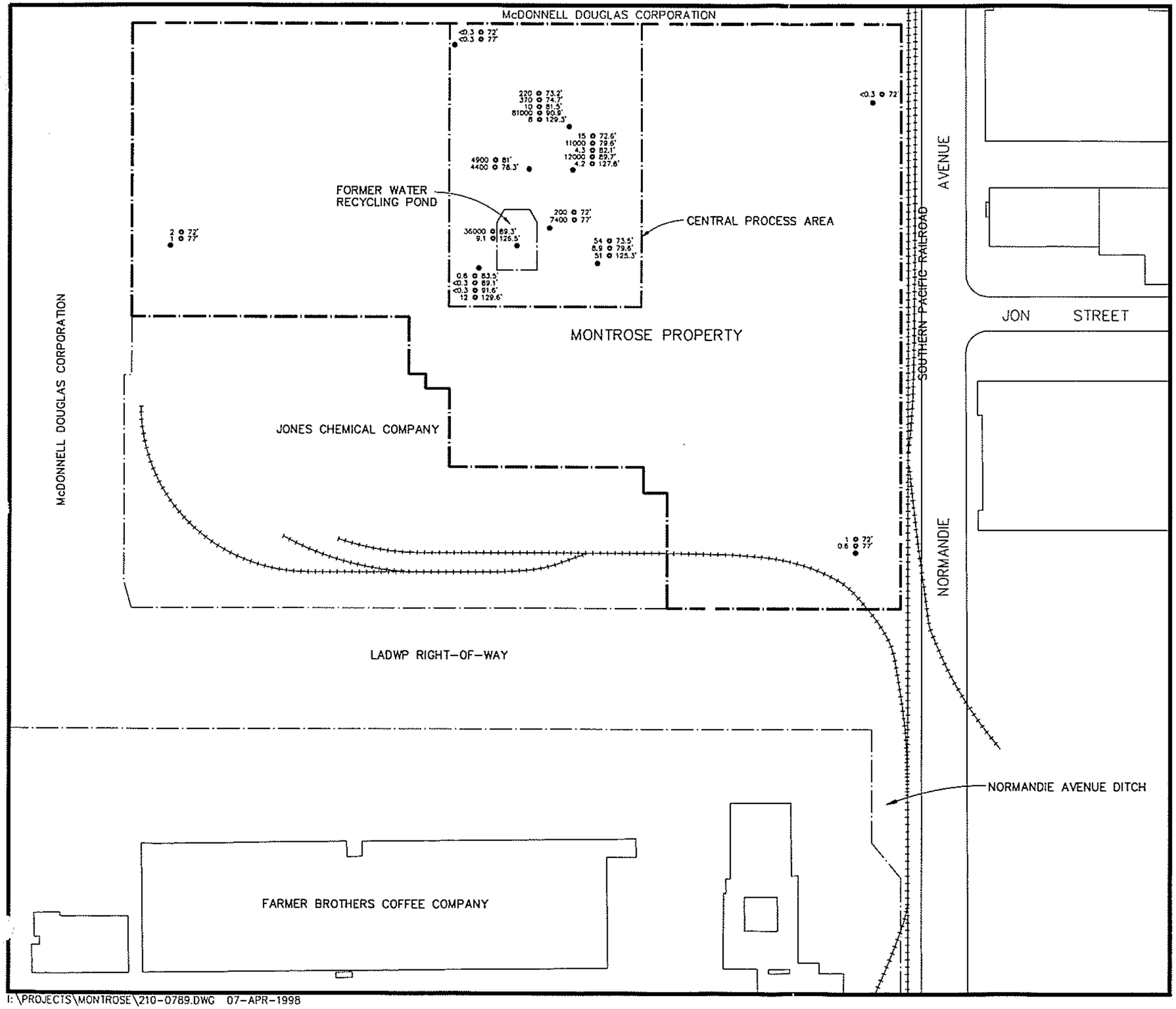

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EXPLANATION

- ● SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- 54 @ 73.5' ● LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF CHLOROBENZENE IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE.
- < = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

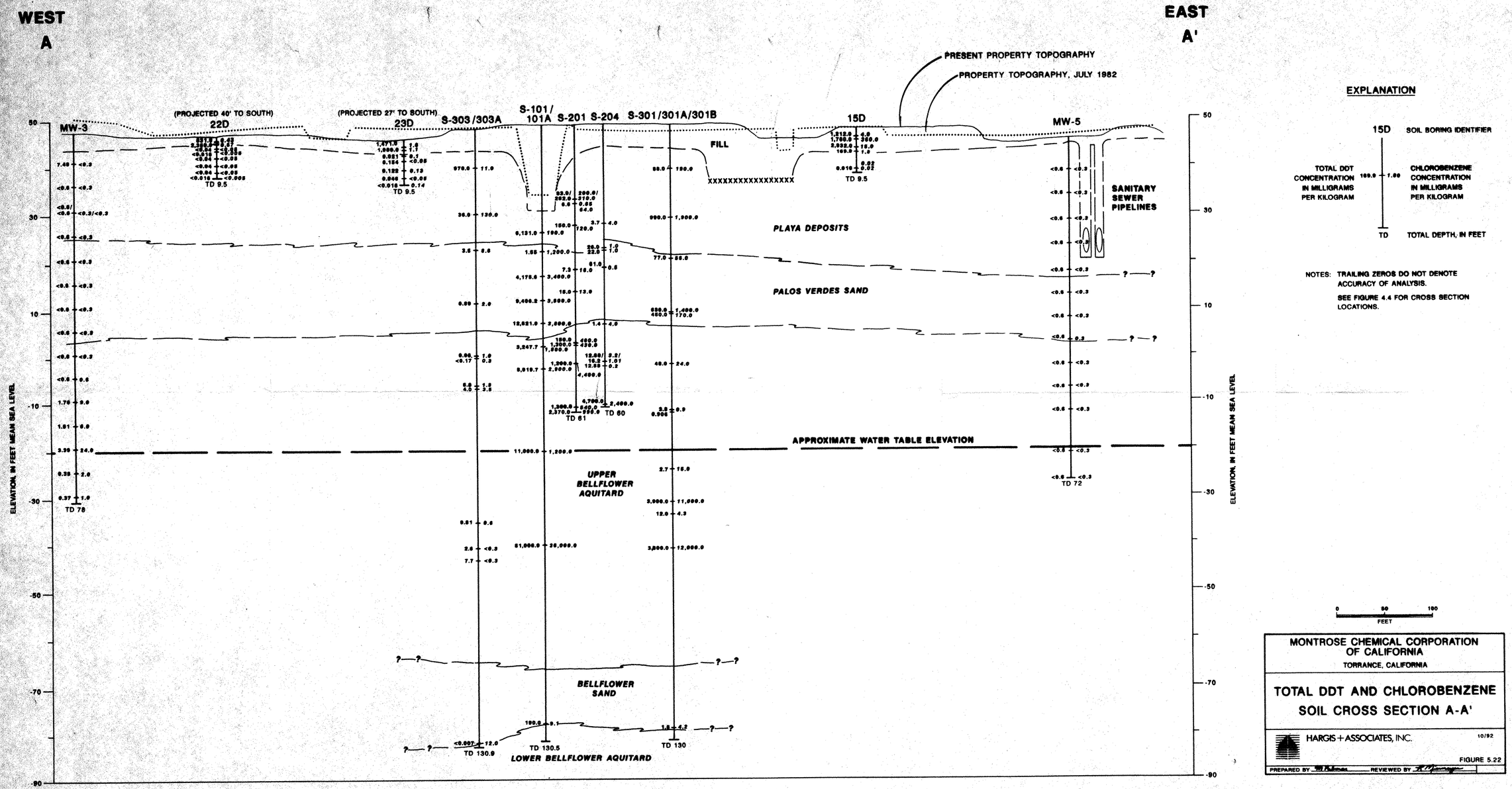
CHLOROBENZENE IN SOIL GREATER THAN 70 FEET BLS

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.21

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 210-0789 | B



EXPLANATION

15D — SOIL BORING IDENTIFIER

TOTAL DDT CONCENTRATION IN MILLIGRAMS PER KILOGRAM — 169.9 / 1.00 — CHLOROBENZENE CONCENTRATION IN MILLIGRAMS PER KILOGRAM

TD — TOTAL DEPTH, IN FEET

NOTES: TRAILING ZEROS DO NOT DENOTE ACCURACY OF ANALYSIS.

SEE FIGURE 4.4 FOR CROSS SECTION LOCATIONS.

0 50 100
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

TOTAL DDT AND CHLOROBENZENE SOIL CROSS SECTION A-A'

HARGIS + ASSOCIATES, INC. 10/92

FIGURE 5.22

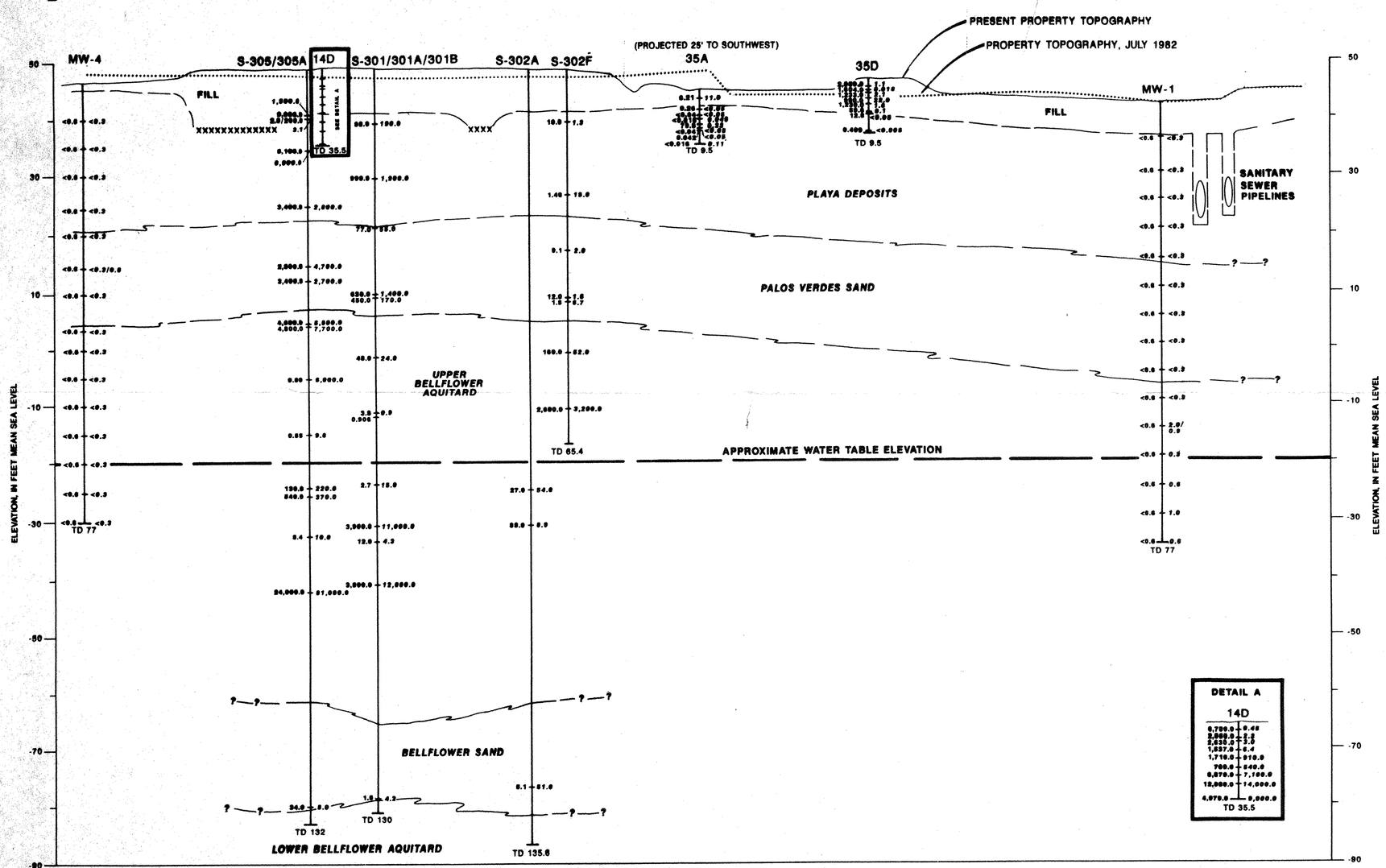
PREPARED BY _____ REVIEWED BY _____

NORTHWEST

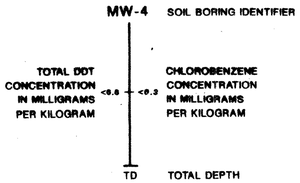
B

SOUTHEAST

B'



EXPLANATION



NOTES: TRAILING ZEROS DO NOT DENOTE ACCURACY OF ANALYSIS.

SEE FIGURE 4.4 FOR CROSS SECTION LOCATIONS.

0 50 100
FEET

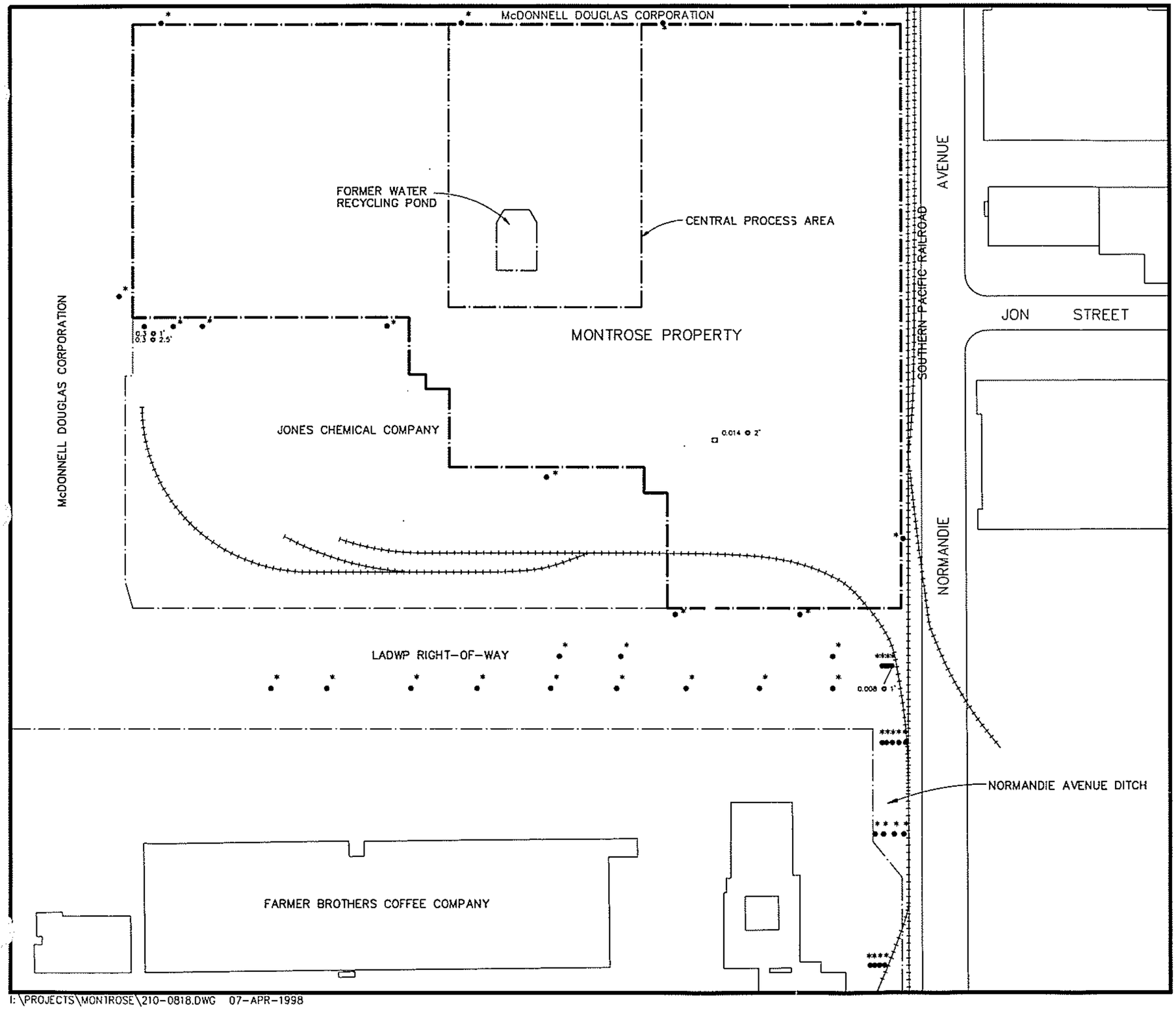
MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

TOTAL DDT AND CHLOROBENZENE SOIL CROSS SECTION B-B'

HARGIS + ASSOCIATES, INC. 10/92

FIGURE 5.23

PREPARED BY _____ REVIEWED BY _____



EXPLANATION

- ● SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- □ SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- * 0.014 @ 2' / □ LOCATION OF SOIL SAMPLE SHOWING CONCETRATION OF CHLOROFORM IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE. ASTERISK INDICATES ADDITIONAL SOIL SAMPLES ANALYZED FOR COMPOUND WHERE COMPOUND WAS NOT DETECTED.
- * / □ LOCATIONS OF SOIL SAMPLES ANALYZED FOR COMPOUND WHERE COMPOUND WAS NOT DETECTED IN ANY SOIL SAMPLES.
- ——·—— LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

N

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

CHLOROFORM IN SOIL
0 TO 3 FEET BLS

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.24

PREP BY	REV BY	RPT NO. 218.1103	210-0818	D

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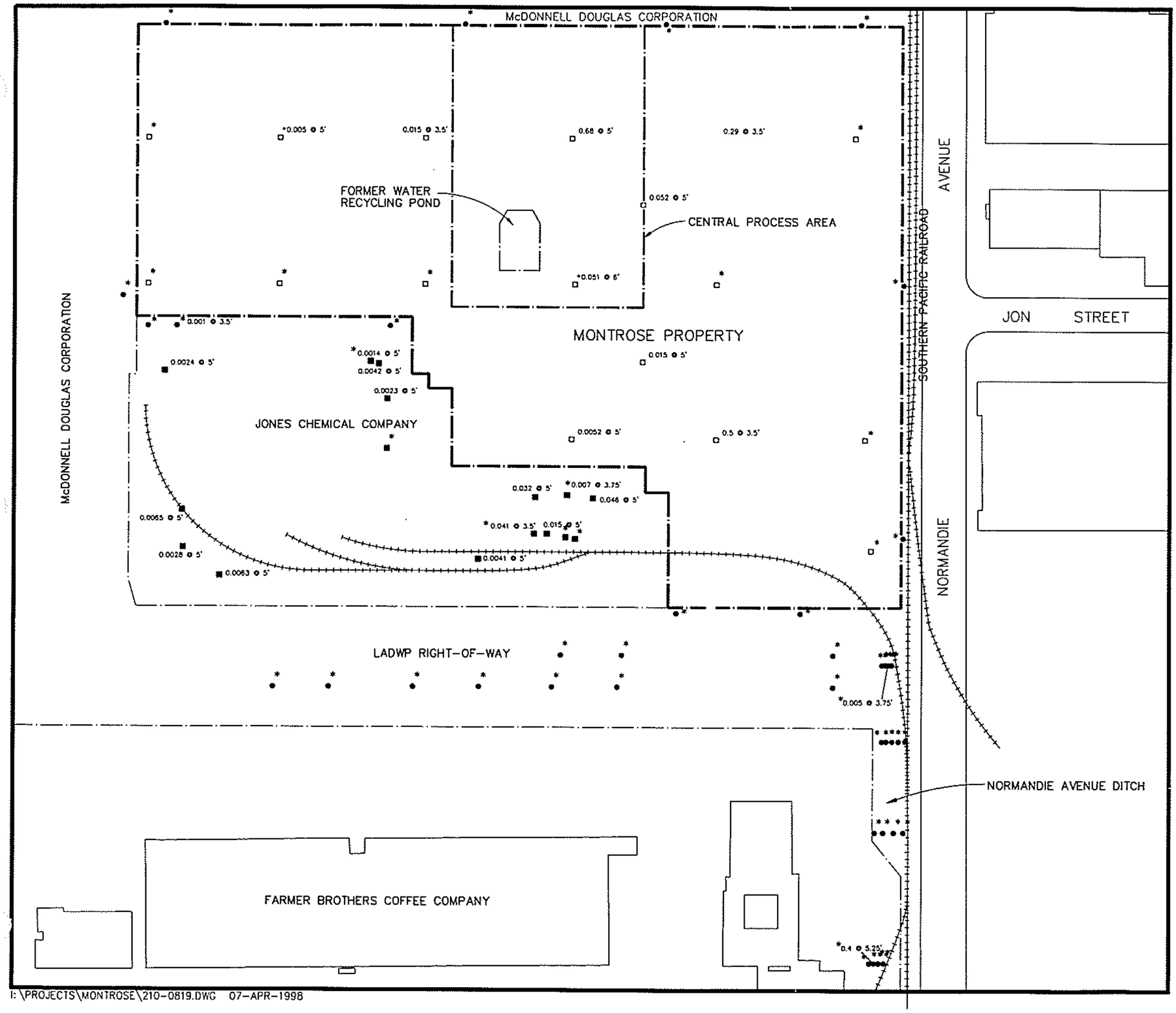

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EXPLANATION

- ● SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- □ SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- *0.68 @ 5' □ LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF CHLOROFORM IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE. ASTERISK INDICATES ADDITIONAL SOIL SAMPLES ANALYZED FOR COMPOUND WHERE COMPOUND WAS NOT DETECTED.
- * □ LOCATIONS OF SOIL SAMPLES ANALYZED FOR COMPOUND WHERE COMPOUND WAS NOT DETECTED IN ANY SOIL SAMPLES.
- ■ SOIL BORING SAMPLED IN MARCH 1995 BY LEVINE FRICKE INC.
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

CHLOROFORM IN SOIL
3 TO 6 FEET BLS

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.25

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 210-0819 | D

McDONNELL DOUGLAS CORPORATION

McDONNELL DOUGLAS CORPORATION

FORMER WATER RECYCLING POND

CENTRAL PROCESS AREA

MONTROSE PROPERTY

JONES CHEMICAL COMPANY

LADWP RIGHT-OF-WAY

FARMER BROTHERS COFFEE COMPANY

SOUTHERN PACIFIC RAILROAD

AVENUE

JON STREET

NORMANDIE

NORMANDIE AVENUE DITCH

0.005 @ 9.5'
0.005 @ 9.5'
72 @ 9.5'
0.018 @ 8.5'
0.059 @ 9.5'
0.0088 @ 9.5'
0.021 @ 9.5'
0.7 @ 9.1'
1.8 @ 8.6'
2 @ 8.3'
0.023 @ 9.5'
0.029 @ 9.5'
0.0082 @ 9.5'
0.015 @ 10'
0.0015 @ 10'
0.0037 @ 10'
0.053 @ 10'
0.014 @ 6.5'
0.25 @ 10'
0.0036 @ 10'
0.033 @ 10'
0.041 @ 10'
0.066 @ 10'
0.017 @ 10'
0.015 @ 10'
0.00056 @ 10'
0.029 @ 10'

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EXPLANATION

- SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- SOIL BORING SAMPLED IN MARCH 1995 BY LEVINE FRICKE INC.
- *0.018 @ 8' — LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF CHLOROFORM IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE. ASTERISK INDICATES ADDITIONAL SOIL SAMPLES ANALYZED FOR COMPOUND WHERE COMPOUND WAS NOT DETECTED.
- * — LOCATIONS OF SOIL SAMPLES ANALYZED FOR COMPOUND WHERE COMPOUND WAS NOT DETECTED IN ANY SOIL SAMPLES.
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

N

0 135 270

FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

CHLOROFORM IN SOIL
6 TO 10 FEET BLS

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.26

PREP BY _____ REV BY _____ APT NO. 218.1103 | 210-0820 | D

McDONNELL DOUGLAS CORPORATION

McDONNELL DOUGLAS CORPORATION

FORMER WATER RECYCLING POND

CENTRAL PROCESS AREA

MONTROSE PROPERTY

JONES CHEMICAL COMPANY

LADWP RIGHT-OF-WAY

FARMER BROTHERS COFFEE COMPANY

SOUTHERN PACIFIC RAILROAD

AVENUE

JON STREET

NORMANDIE

NORMANDIE AVENUE DITCH

*0.001 ⊙ 20'
*0.0036 ⊙ 20'
0.0036 ⊙ 15'

0.043 ⊙ 15'
0.028 ⊙ 10.5'
0.0037 ⊙ 10.5'
0.011 ⊙ 15.3'
0.0043 ⊙ 10.5'
0.0058 ⊙ 13.5'
0.078 ⊙ 15'
0.016 ⊙ 14.5'

*4 ⊙ 28'
*0.6 ⊙ 42'
0.14 ⊙ 50'
*0.9 ⊙ 30.5'
*0.4 ⊙ 20.5'
*0.4 ⊙ 25.5'
0.4 ⊙ 33.5'
*2.7 ⊙ 21.8'
0.4 ⊙ 39.7'
*1 ⊙ 20.5'
1 ⊙ 42.5'
0.5 ⊙ 50.5'

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EXPLANATION

- SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- SOIL BORING SAMPLED IN MARCH 1995 BY LEVINE FRICKE INC.
- *0.4 ⊙ 39.7' LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF CHLOROFORM IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE. ASTERISK INDICATES ADDITIONAL SOIL SAMPLES ANALYZED FOR COMPOUND WHERE COMPOUND WAS NOT DETECTED.
- * LOCATIONS OF SOIL SAMPLES ANALYZED FOR COMPOUND WHERE COMPOUND WAS NOT DETECTED IN ANY SOIL SAMPLES.
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

N

0 135 270

FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

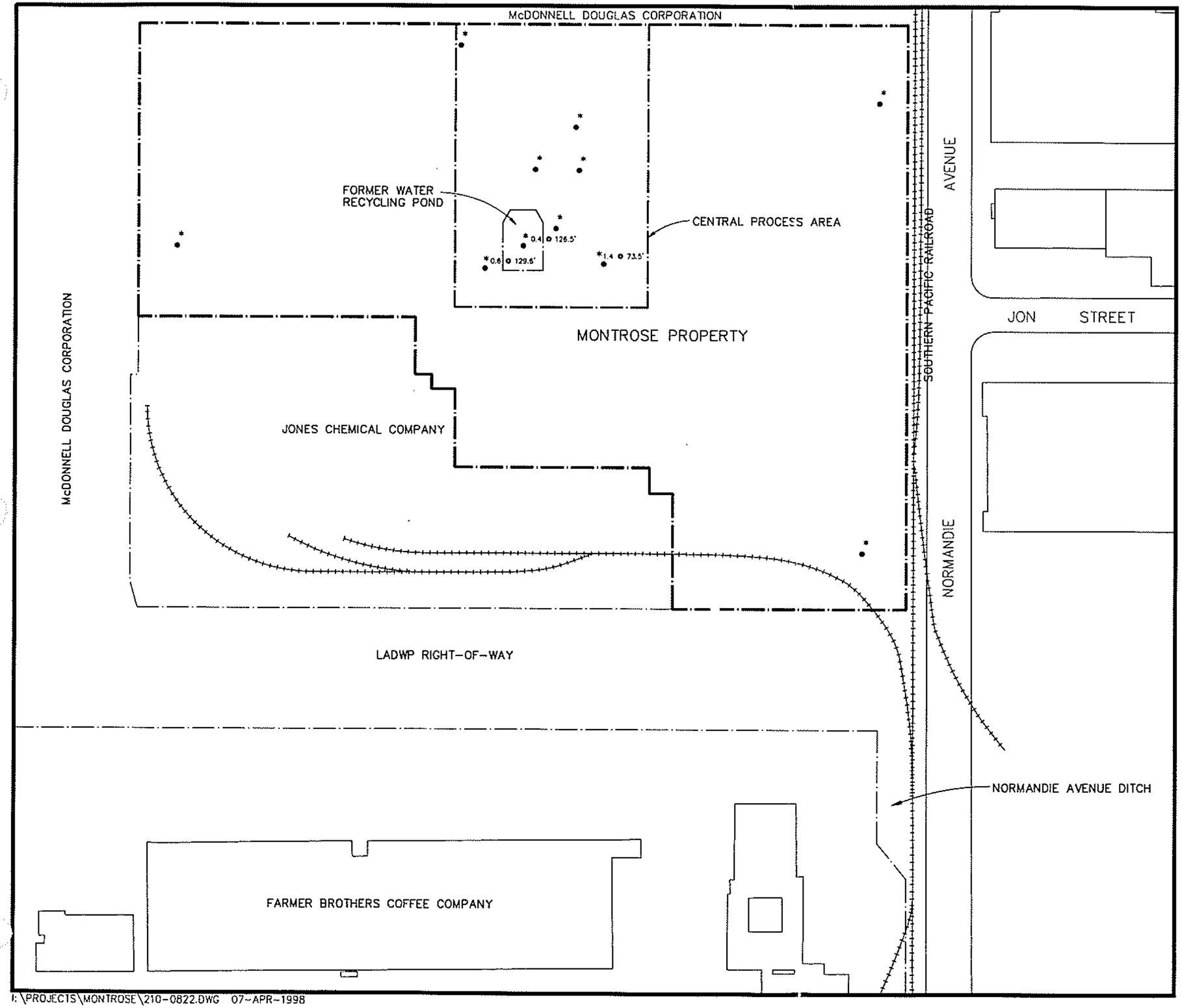
CHLOROFORM IN SOIL
10 TO 70 FEET BLS

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.27

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 210-0821 | D



EXPLANATION

- ● SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- *1.4 ⊙ 73.5' ● LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF CHLOROFORM IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE. ASTERISK INDICATES ADDITIONAL SOIL SAMPLES ANALYZED FOR COMPOUND WHERE COMPOUND WAS NOT DETECTED.
- * ● LOCATIONS OF SOIL SAMPLES ANALYZED FOR COMPOUND WHERE COMPOUND WAS NOT DETECTED IN ANY SOIL SAMPLES.
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

CHLOROFORM IN SOIL GREATER THAN 70 FEET BLS

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.28

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 210-0822 | C

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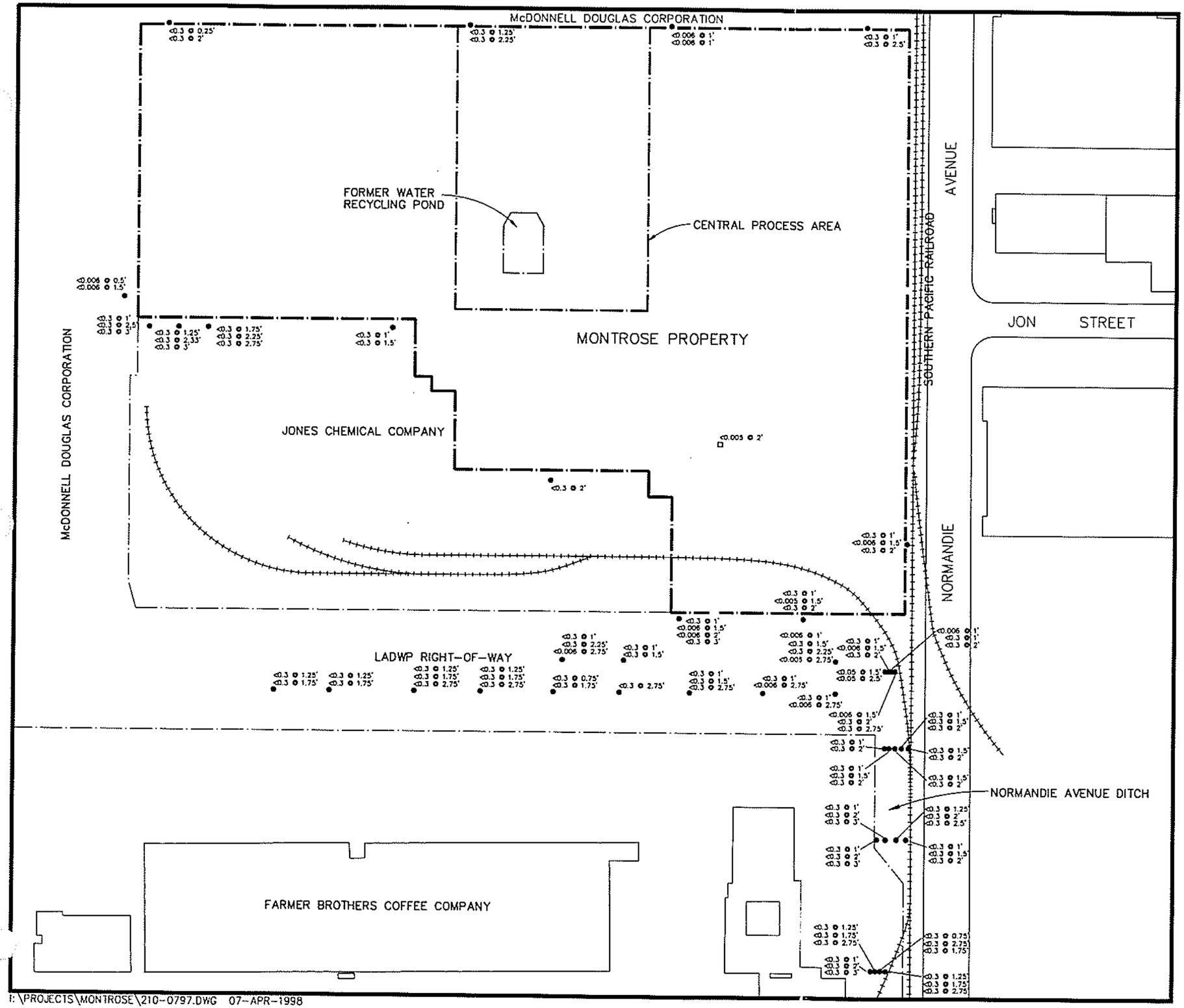

EXPLANATION

- ● SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- □ SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- <0.005 ● 1.5' LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF BENZENE IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE.
- < = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

BENZENE IN SOIL
0 TO 3 FEET BLS

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

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FIGURE 5.29

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 210-0797 | B

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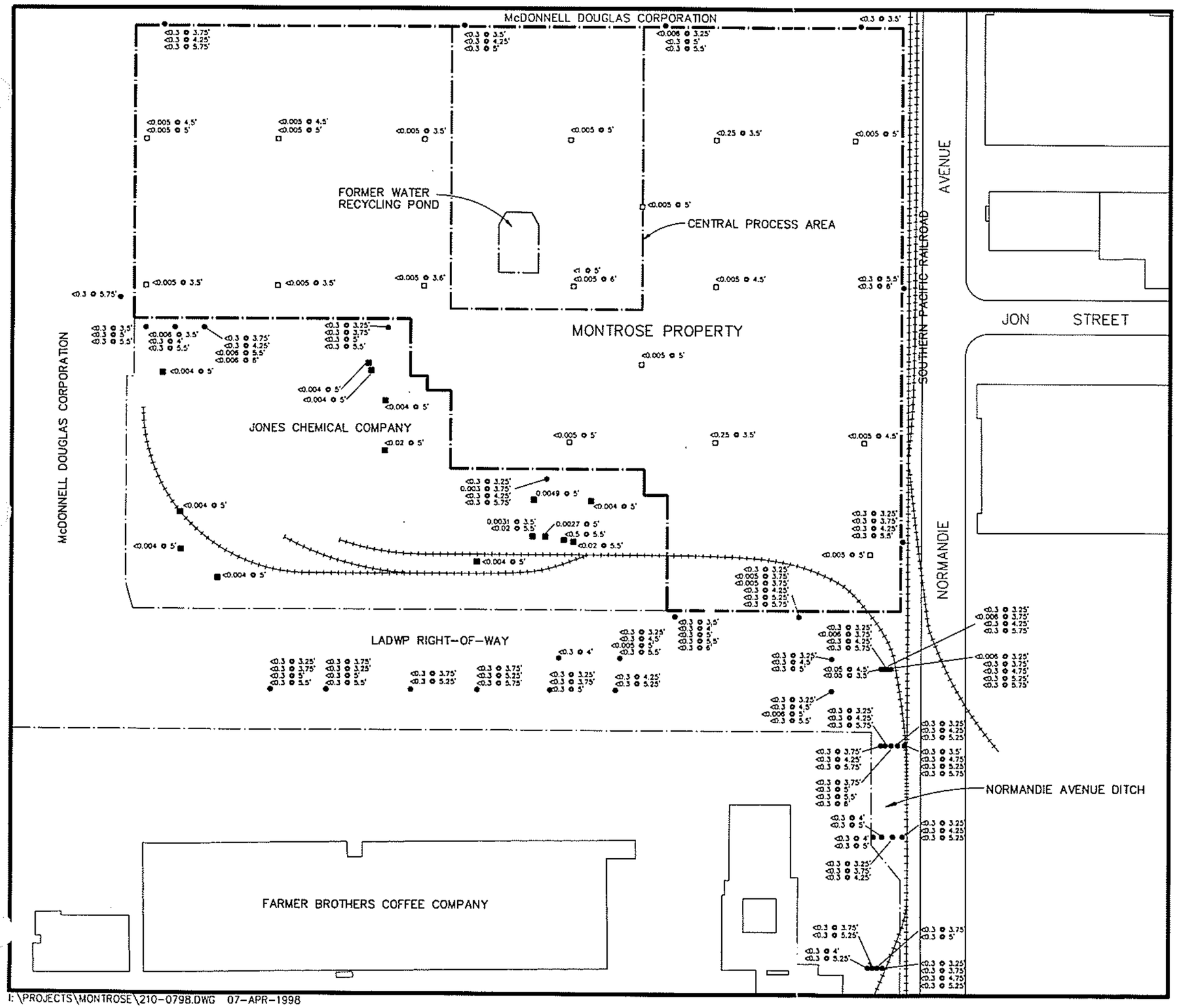

EXPLANATION

- ● SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- □ SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- ■ SOIL BORING SAMPLED IN MARCH 1995 BY LEVINE FRICKE INC.
- <0.005 ● 5' LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF TOTAL HEXACHLOROCYCLOHEXANE IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE.
- < = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

N

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION
OF CALIFORNIA
TORRANCE, CALIFORNIA

BENZENE IN SOIL
3 TO 6 FEET BLS

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.30

PREP BY ____ REV BY ____ RPT NO. 218.1103 | 210-0798 | C

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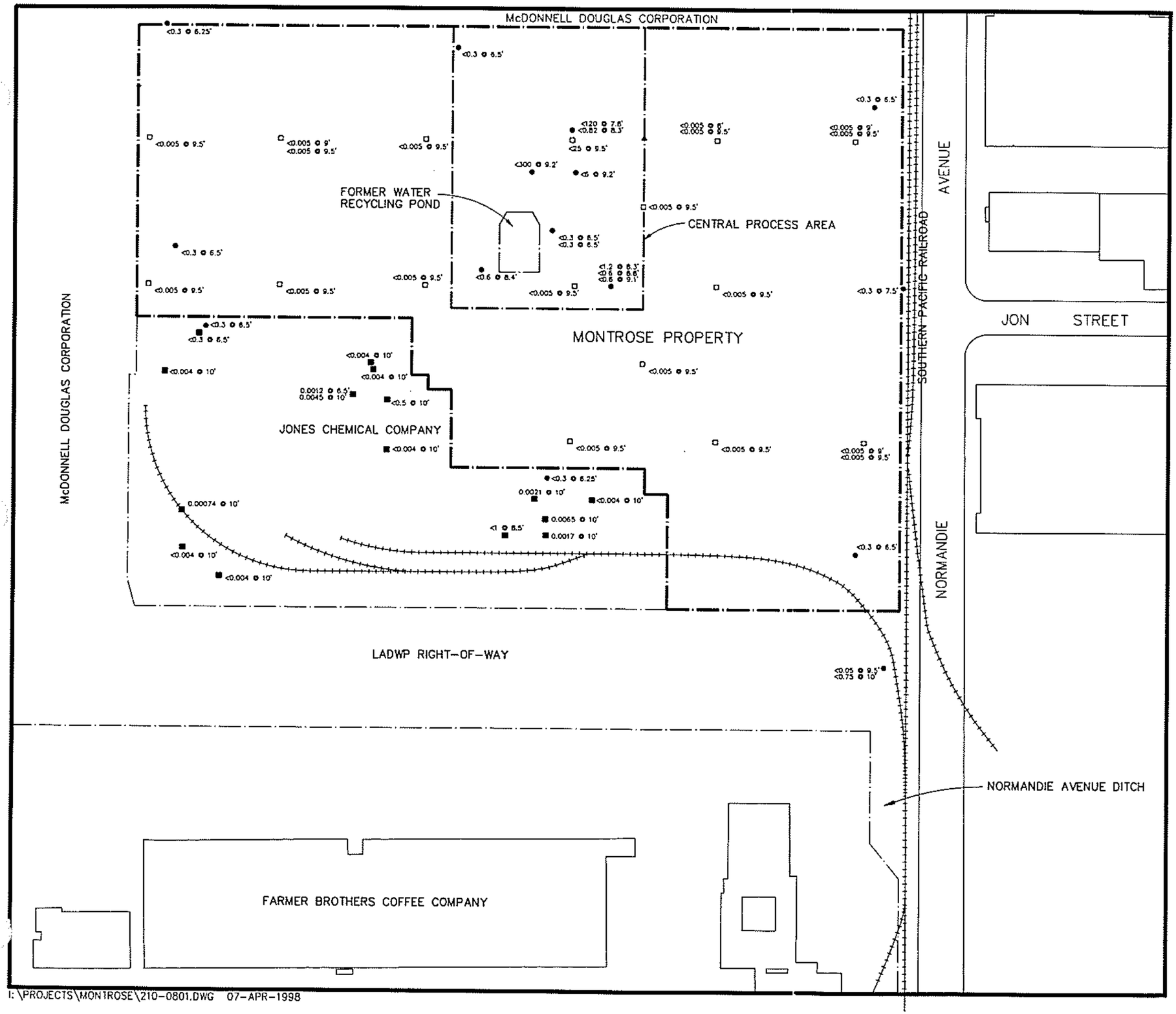

EXPLANATION

- ● SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- □ SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- ■ SOIL BORING SAMPLED IN MARCH 1995 BY LEVINE FRICKE INC.
- <0.005 ● 9.5' LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF BENZENE IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE.
- < = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

N

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

BENZENE IN SOIL
6 TO 10 FEET BLS

HARGIS+ASSOCIATES, INC. 7/97
Hydrogeology/Engineering

FIGURE 5.31

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 210-0801 | B

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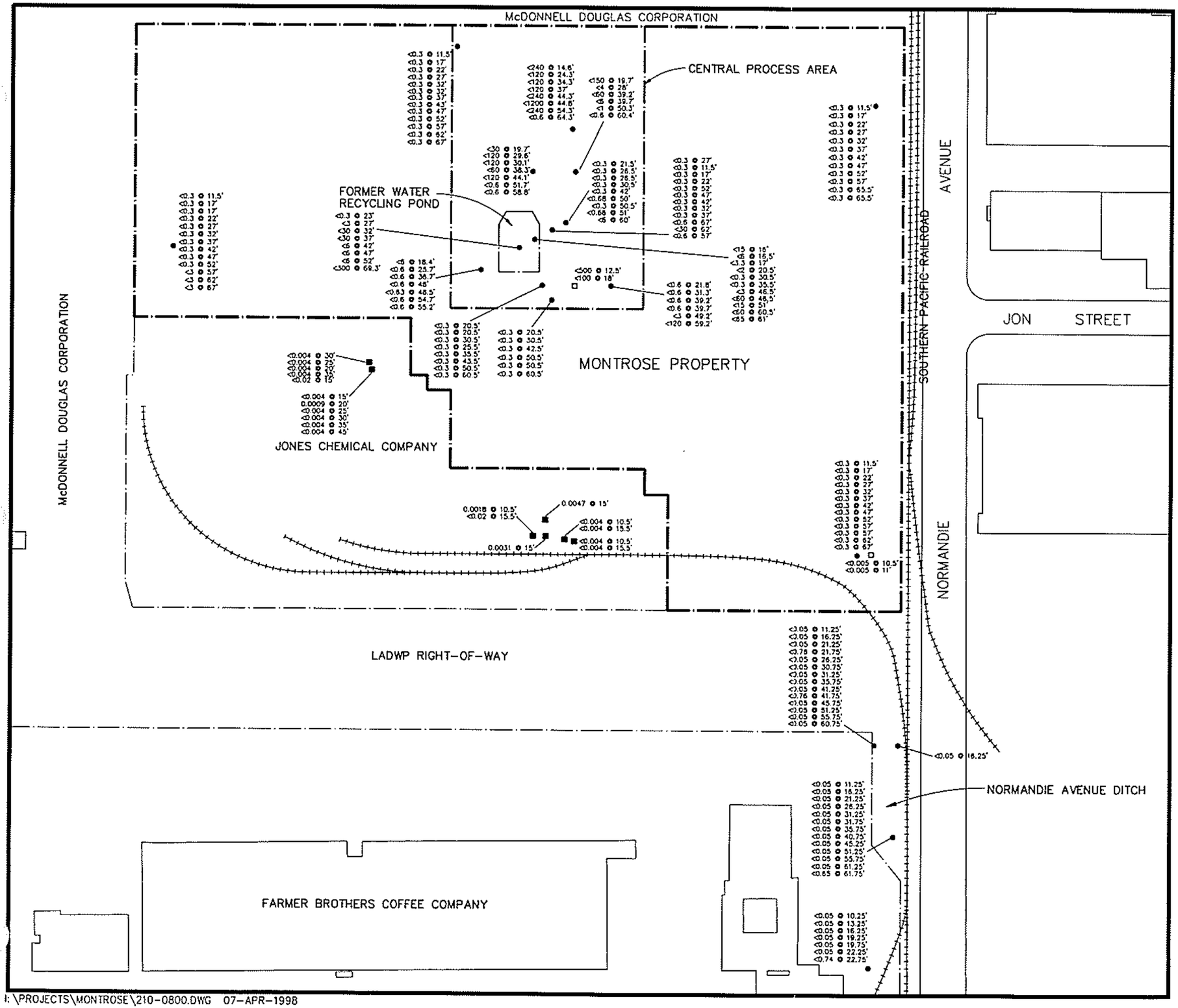

EXPLANATION

- ● SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- □ SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- ■ SOIL BORING SAMPLED IN MARCH 1995 BY LEVINE FRICKE INC.
- <0.05 ● 16.25' LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF BENZENE IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE.
- < = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

BENZENE IN SOIL
10 TO 70 FEET BLS

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.32

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 210-0800 | B

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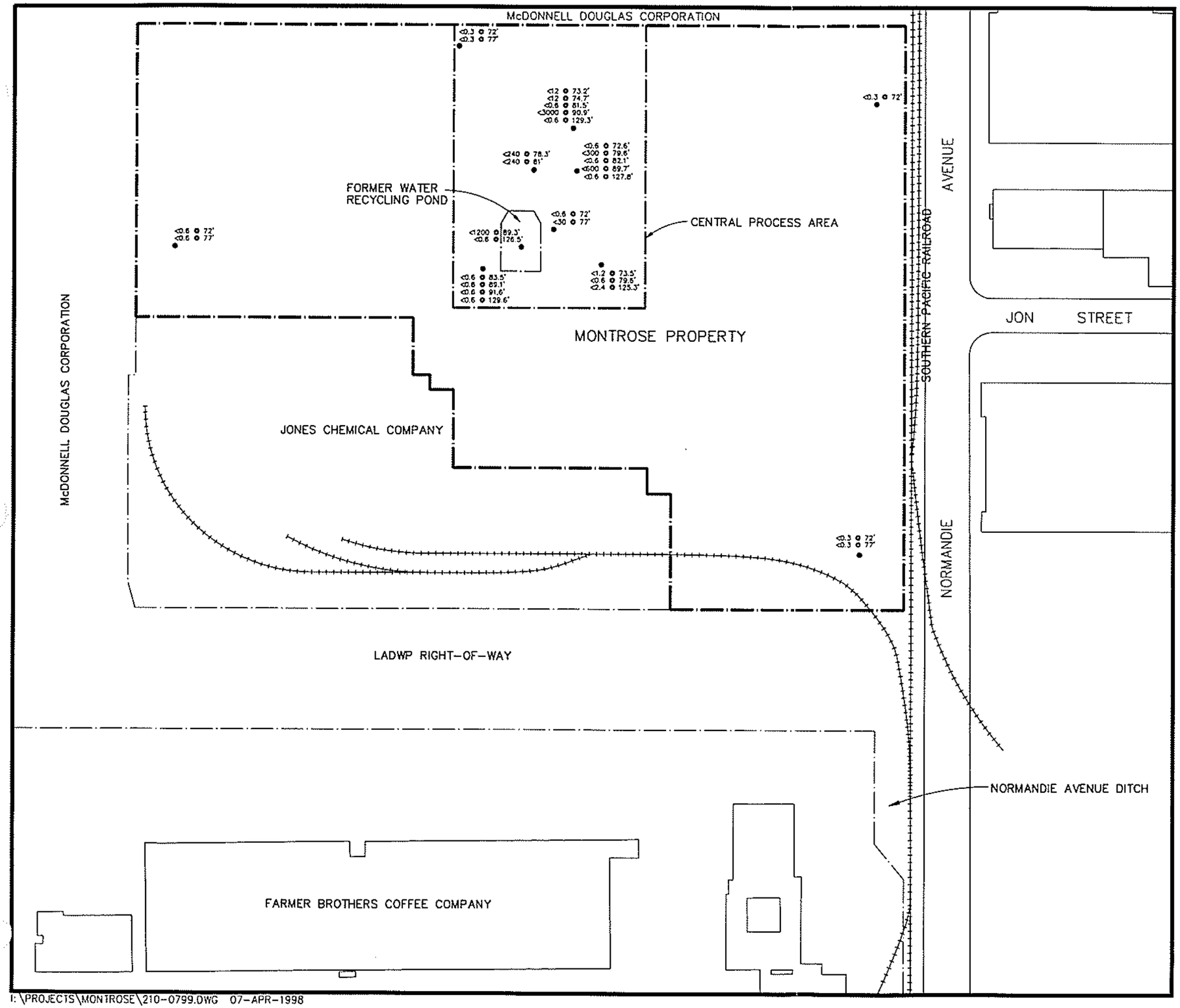

EXPLANATION

- ● SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- <1.2 ● 73.5' LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF BENZENE IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE.
- < = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

BENZENE IN SOIL
GREATER THAN 70 FEET BLS

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.33

PREP BY ____ REV BY ____ RPT NO. 218.1103 | 210-0799 | B

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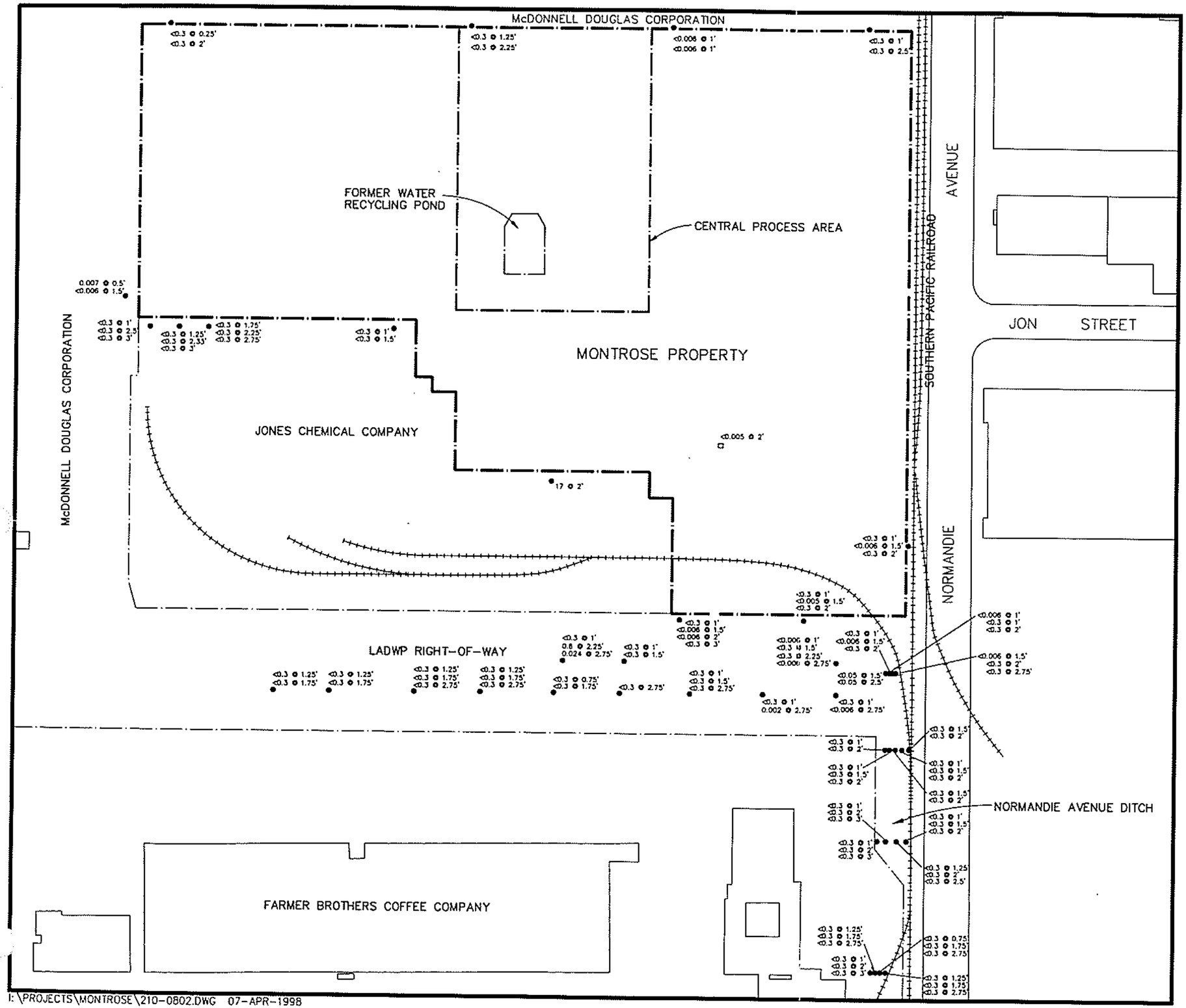

EXPLANATION

- ● SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- □ SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- <0.3 ● 2' LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF TETRACHLOROETHYLENE (PCE) IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE.
- < = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

N

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

PCE IN SOIL
0 TO 3 FEET BLS

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.34

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 210-0802 | C

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McDONNELL DOUGLAS CORPORATION

McDONNELL DOUGLAS CORPORATION

FORMER WATER RECYCLING POND

CENTRAL PROCESS AREA

MONTROSE PROPERTY

JONES CHEMICAL COMPANY

LADWP RIGHT-OF-WAY

FARMER BROTHERS COFFEE COMPANY

SOUTHERN PACIFIC RAILROAD

AVENUE

JON STREET

NORMANDIE

NORMANDIE AVENUE DITCH

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EXPLANATION

- ● SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- □ SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- ■ SOIL BORING SAMPLED IN MARCH 1995 BY LEVINE FRICKE INC.
- <0.3 ● 4.75' LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF TETRACHLOROETHYLENE (PCE) IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE.
- < = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:

SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

0 135 270

FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

PCE IN SOIL
3 TO 6 FEET BLS

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.35

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 210-0803 | B

McDONNELL DOUGLAS CORPORATION

McDONNELL DOUGLAS CORPORATION

FORMER WATER RECYCLING POND

CENTRAL PROCESS AREA

MONTROSE PROPERTY

JONES CHEMICAL COMPANY

LADWP RIGHT-OF-WAY

FARMER BROTHERS COFFEE COMPANY

SOUTHERN PACIFIC RAILROAD

NORMANDIE AVENUE

JON STREET

NORMANDIE AVENUE DITCH

EXPLANATION

- ● SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- □ SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- ■ SOIL BORING SAMPLED IN MARCH 1995 BY LEVINE FRICKE INC.
- ●/□/■ <0.75 @ 10' — LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF TETRACHLOROETHYLENE (PCE) IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE.
- < = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

PCE IN SOIL
6 TO 10 FEET BLS

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.36

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 210-0804 | C

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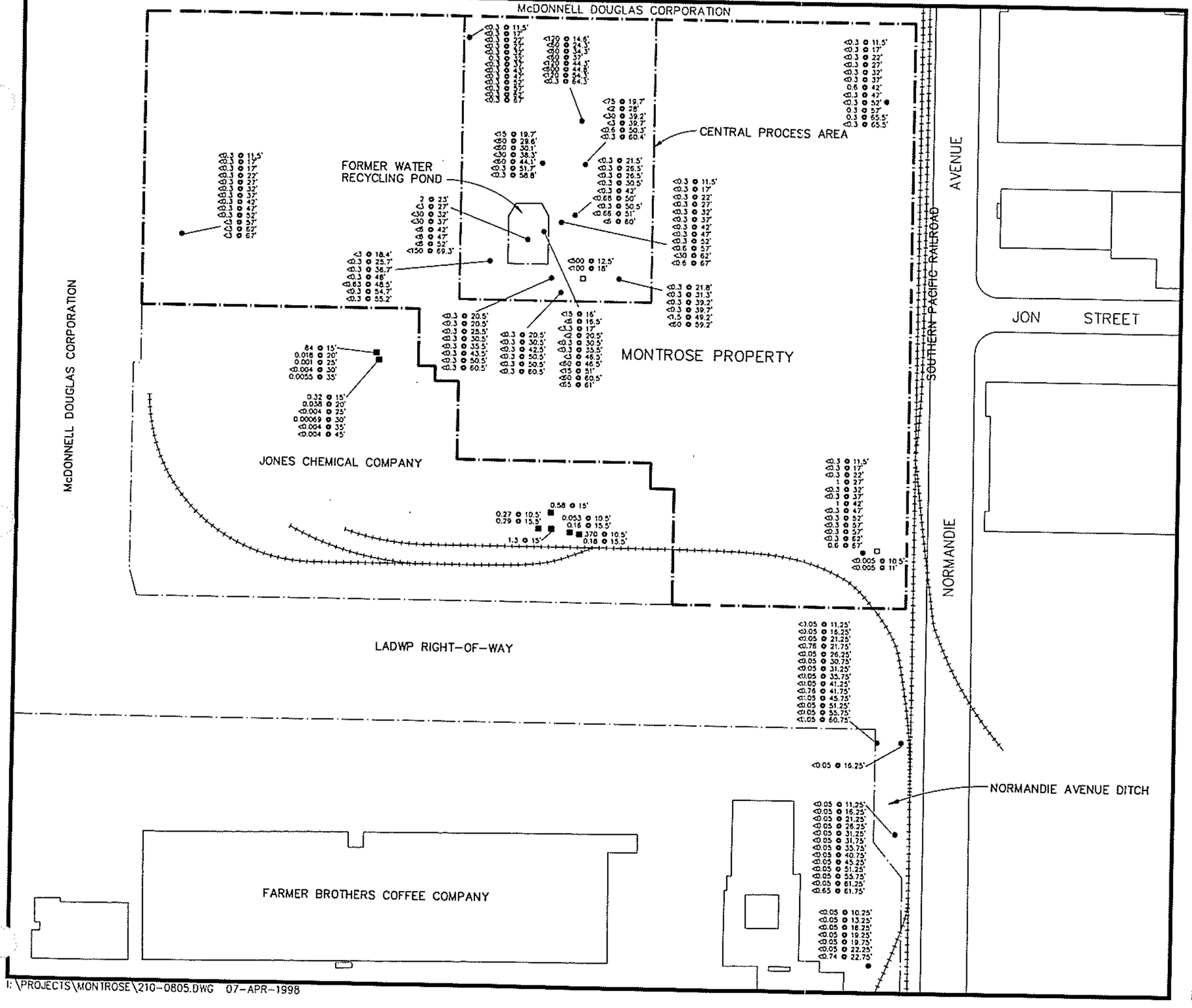

EXPLANATION

- ● SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- □ SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- ■ SOIL BORING SAMPLED IN MARCH 1995 BY LEVINE FRICKE INC.
- <0.05 ● 31.75' LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF TETRACHLOROETHYLENE (PCE) IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE.
- < = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

PCE IN SOIL
10 TO 70 FEET BLS

HARGIS + ASSOCIATES, INC. 7/97
Hydrogeology/Engineering

FIGURE 5.37

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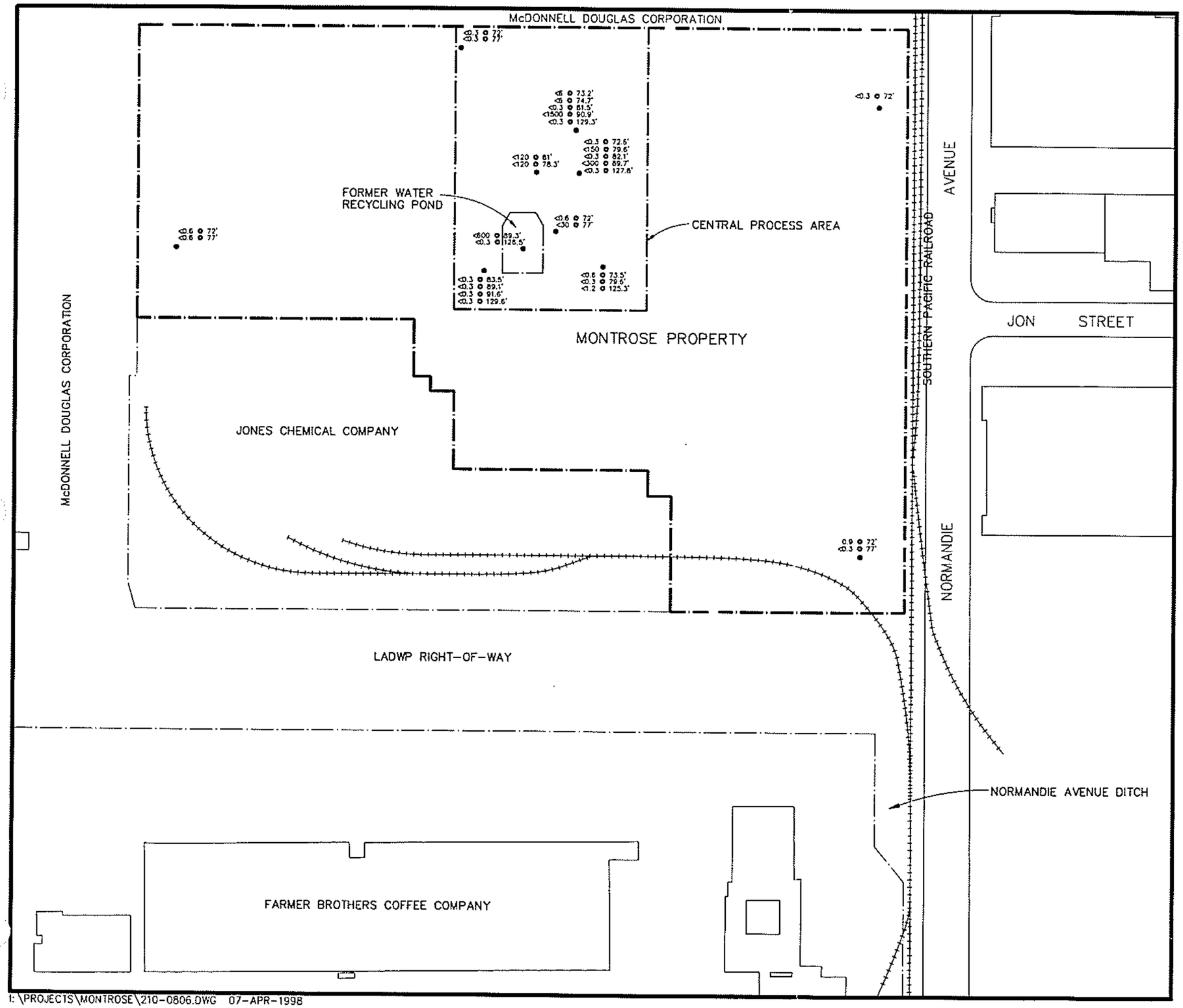

EXPLANATION

- ● SOIL BORING SAMPLED DURING APRIL 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- ●<0.3 ○ 77' LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF TETRACHLOROETHYLENE (PCE) IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE.
- < = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

N

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

PCE IN SOIL
GREATER THAN 70 FEET BLS

HARGIS+ASSOCIATES, INC. 7/97
Hydrogeology/Engineering

FIGURE 5.38

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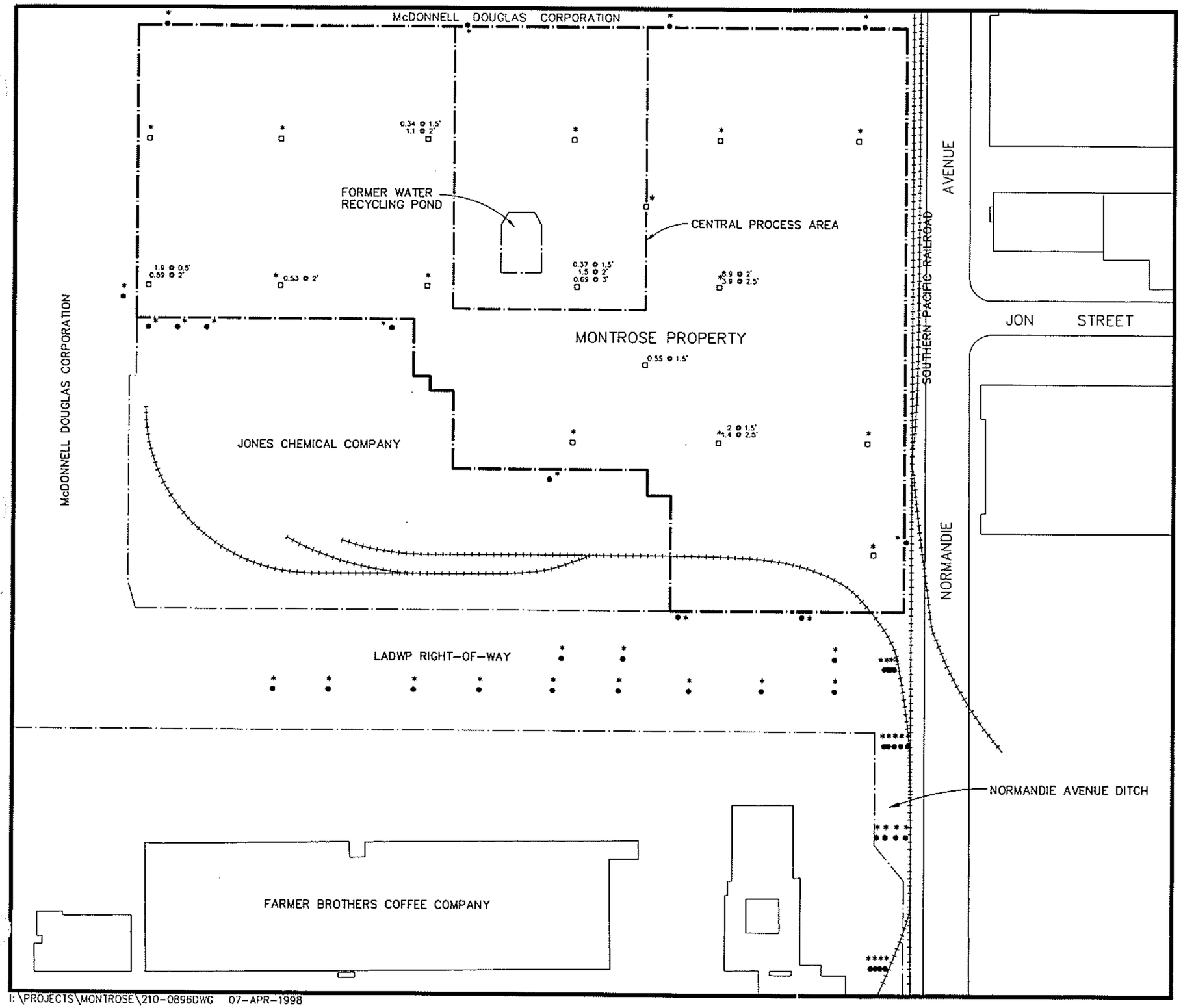

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EXPLANATION

- SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- *0.34 o 1.5' — LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF TOTAL DICHLOROBENZENE (TOTAL DCB) IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE. ASTERISK INDICATES ADDITIONAL SOIL SAMPLES ANALYZED FOR COMPOUND WHERE COMPOUND WAS NOT DETECTED.
- * — LOCATIONS OF SOIL SAMPLES ANALYZED FOR COMPOUND WHERE COMPOUND WAS NOT DETECTED IN ANY SOIL SAMPLES.
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

0 135 270
FEET

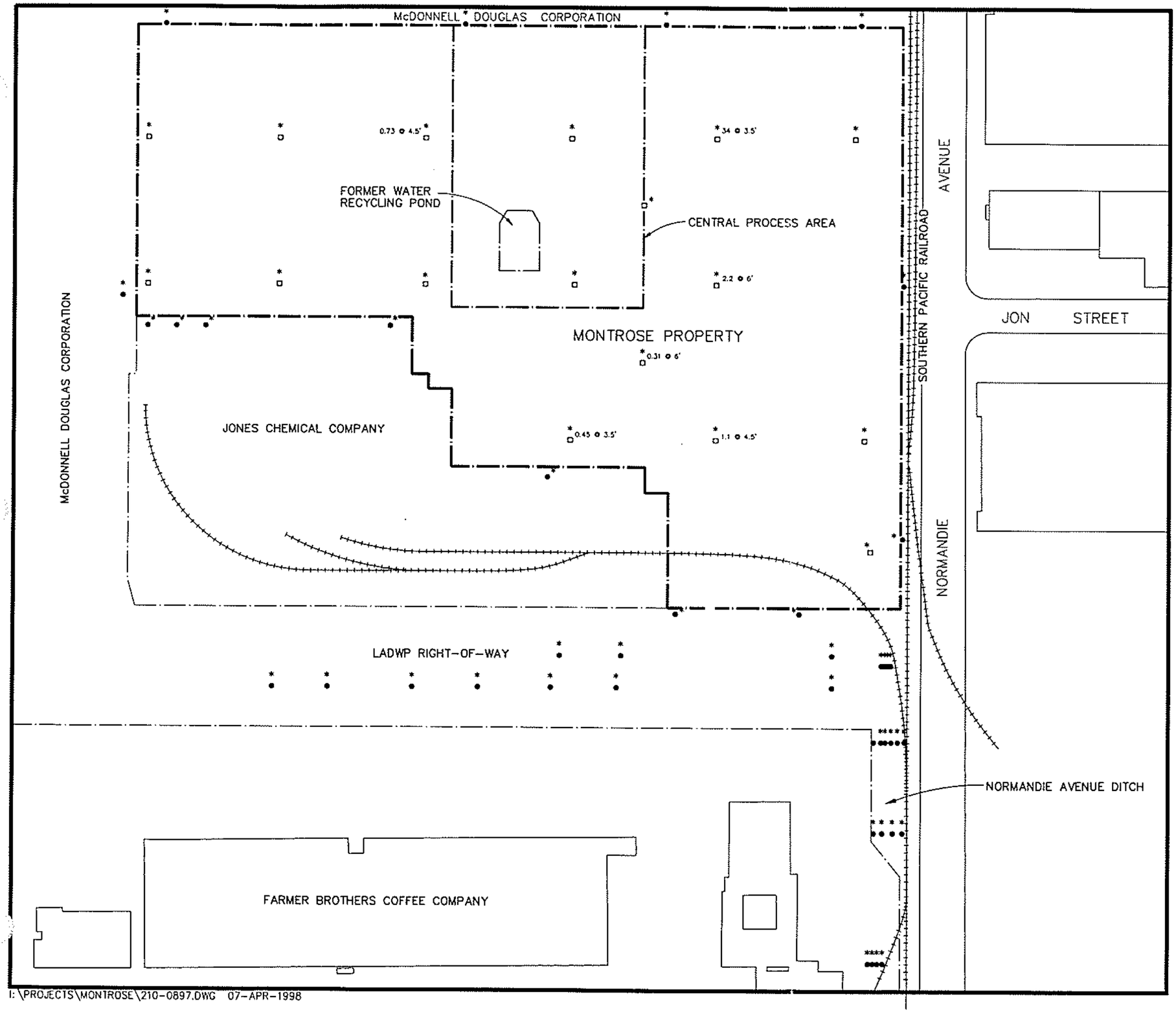
MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

TOTAL DICHLOROBENZENE IN SOIL
0 TO 3 FEET BLS

HARGIS+ASSOCIATES, INC. 7/97
Hydrogeology/Engineering

FIGURE 5.39

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 210-0896 | F



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EXPLANATION

- SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- *34 @ 3.5' — LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF TOTAL DICHLOROBENZENE (TOTAL DCB) IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE. ASTERISK INDICATES ADDITIONAL SOIL SAMPLES ANALYZED FOR COMPOUND WHERE COMPOUND WAS NOT DETECTED.
- * — LOCATIONS OF SOIL SAMPLES ANALYZED FOR COMPOUND WHERE COMPOUND WAS NOT DETECTED IN ANY SOIL SAMPLES.
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

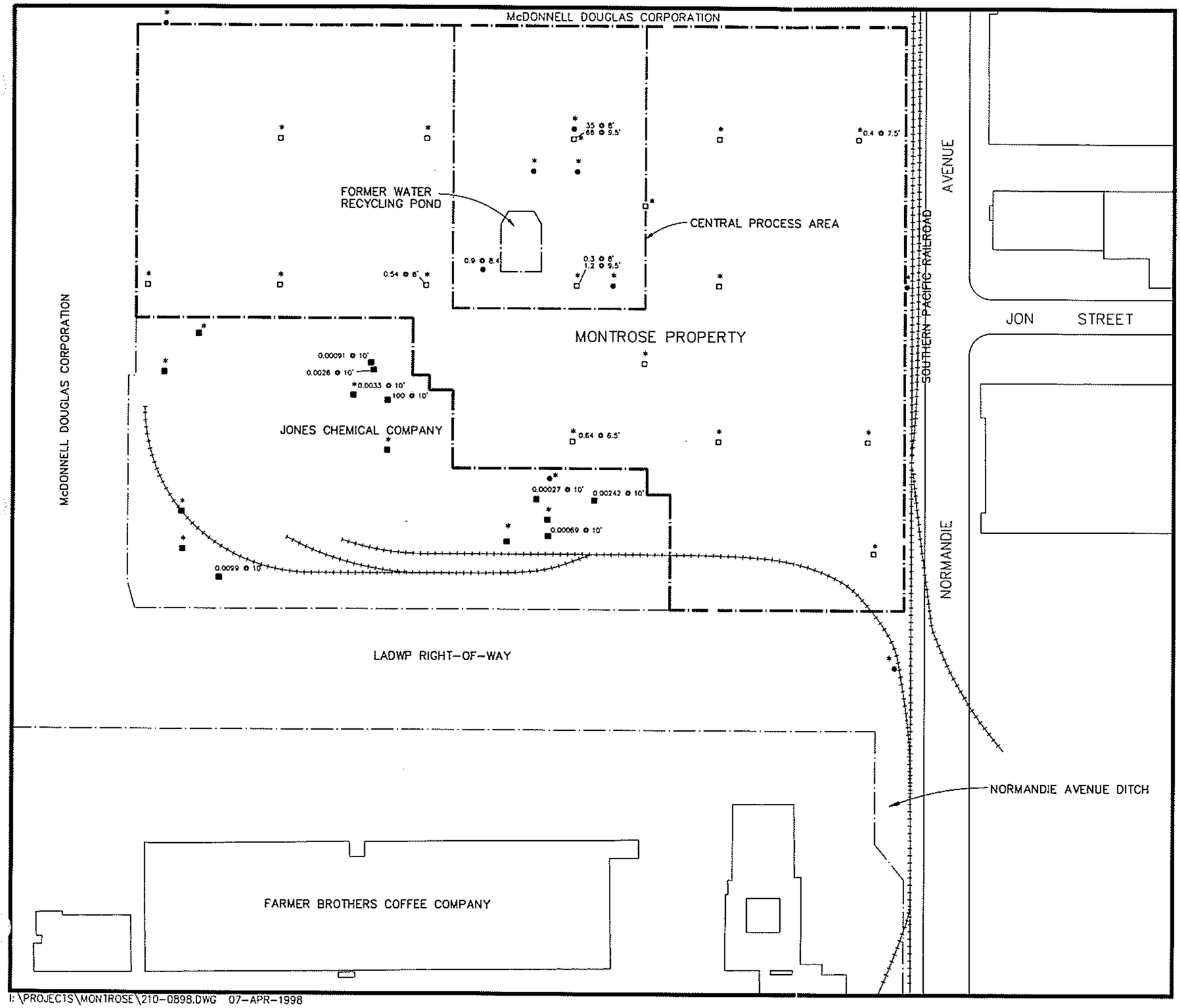
TOTAL DICHLOROBENZENE IN SOIL
3 TO 6 FEET BLS

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.40

PREP BY ____ REV BY ____ RPT NO. 218.1103 | 210-0897 | F



EXPLANATION

- ● SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- □ SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- ■ SOIL BORING SAMPLED IN MARCH 1995 BY LEVINE FRICKE INC.
- *0.4 @ 7.5' / □ LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF TOTAL DICHLOROBENZENE (TOTAL DCB) IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE. ASTERISK INDICATES ADDITIONAL SOIL SAMPLES ANALYZED FOR COMPOUND WHERE COMPOUND WAS NOT DETECTED.
- * / □ LOCATIONS OF SOIL SAMPLES ANALYZED FOR COMPOUND WHERE COMPOUND WAS NOT DETECTED IN ANY SOIL SAMPLES.
- ——— LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

TOTAL DICHLOROBENZENE IN SOIL 6 TO 10 FEET BLS

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.41

PREP BY	REV BY	RPT NO. 218.1103	210-0898	F

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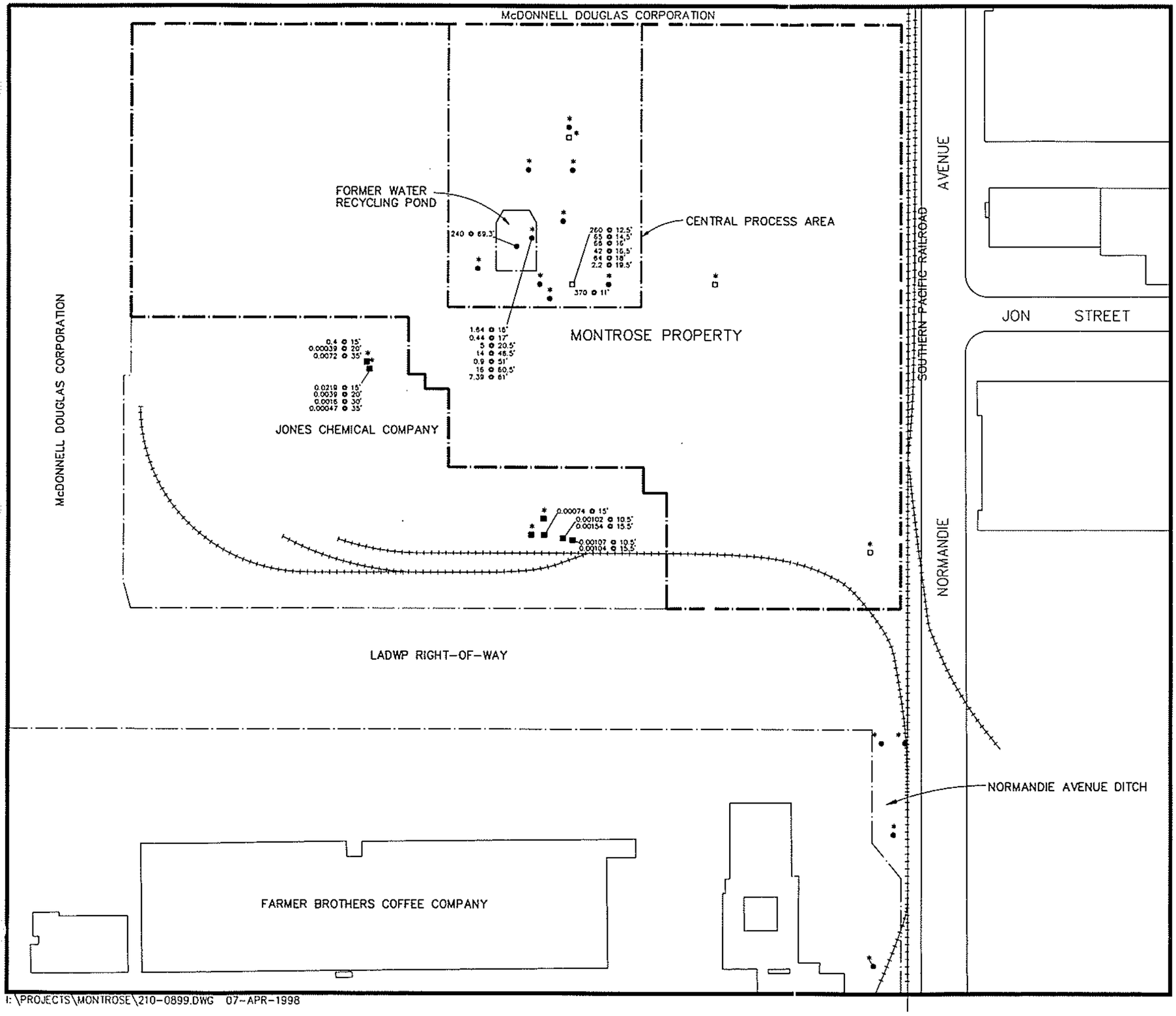

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EXPLANATION

- ● SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- □ SOIL BORING SAMPLED IN 1985 BY METCALF & EDDY, INC. (M&E) FOR EPA
- ■ SOIL BORING SAMPLED IN MARCH 1995 BY LEVINE FRICKE INC.
- * 66 @ 16' / □ LOCATION OF SOIL SAMPLE SHOWING CONCENTRATION OF TOTAL DICHLOROBENZENE (TOTAL DCB) IN MILLIGRAMS PER KILOGRAM (mg/kg) AND SAMPLE DEPTH IN FEET BELOW LAND SURFACE. ASTERISK INDICATES ADDITIONAL SOIL SAMPLES ANALYZED FOR COMPOUND WHERE COMPOUND WAS NOT DETECTED.
- * / □ LOCATIONS OF SOIL SAMPLES ANALYZED FOR COMPOUND WHERE COMPOUND WAS NOT DETECTED IN ANY SOIL SAMPLES.
- ——— LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

N

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

TOTAL DICHLOROBENZENE IN SOIL 10 TO 70 FEET BLS

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

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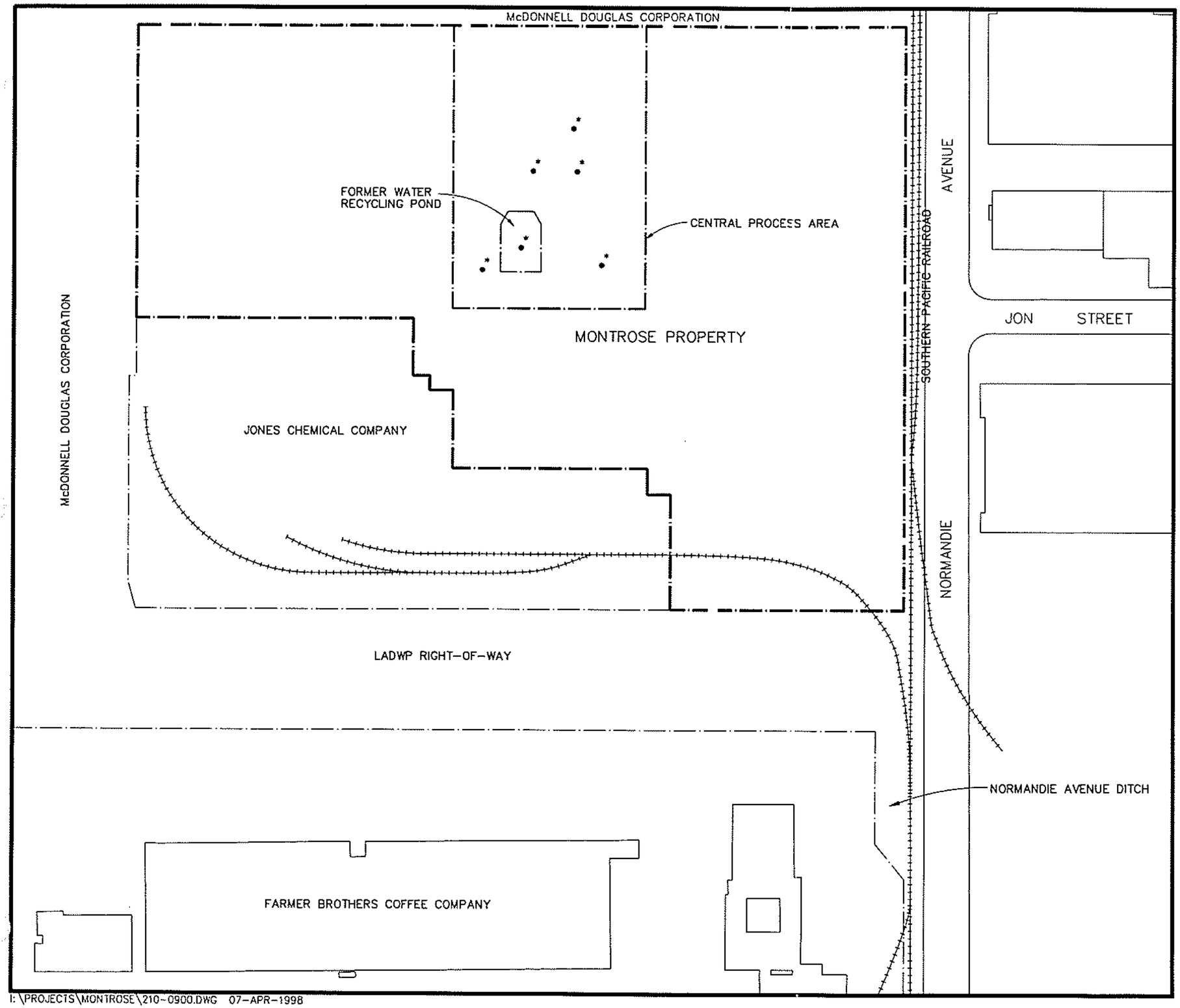
FIGURE 5.42

PREP BY _____ REV BY _____ APT NO. 218.1103 | 210-0899 | F



EXPLANATION

- SOIL BORING SAMPLED DURING 1985 TO 1988 BY HARGIS + ASSOCIATES, INC.
- LOCATION OF SOIL SAMPLE ANALYZED FOR TOTAL DICHLOROBENZENE (TOTAL DCB) WHERE COMPOUND WAS NOT DETECTED IN ANY SOIL SAMPLES ANALYSED
- LOCATION OF MONTROSE PROPERTY BOUNDARY

NOTES:
SEE FIGURE 5.4 FOR SOIL BORING IDENTIFIERS
SEE TABLE 5.1 AND APPENDIX H FOR TABULATED RESULTS

0 135 270
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

TOTAL DICHLOROBENZENE IN SOIL GREATER THAN 70 FEET BLS

HARGIS+ASSOCIATES, INC.
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FIGURE 5.43

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 210-0900 | E

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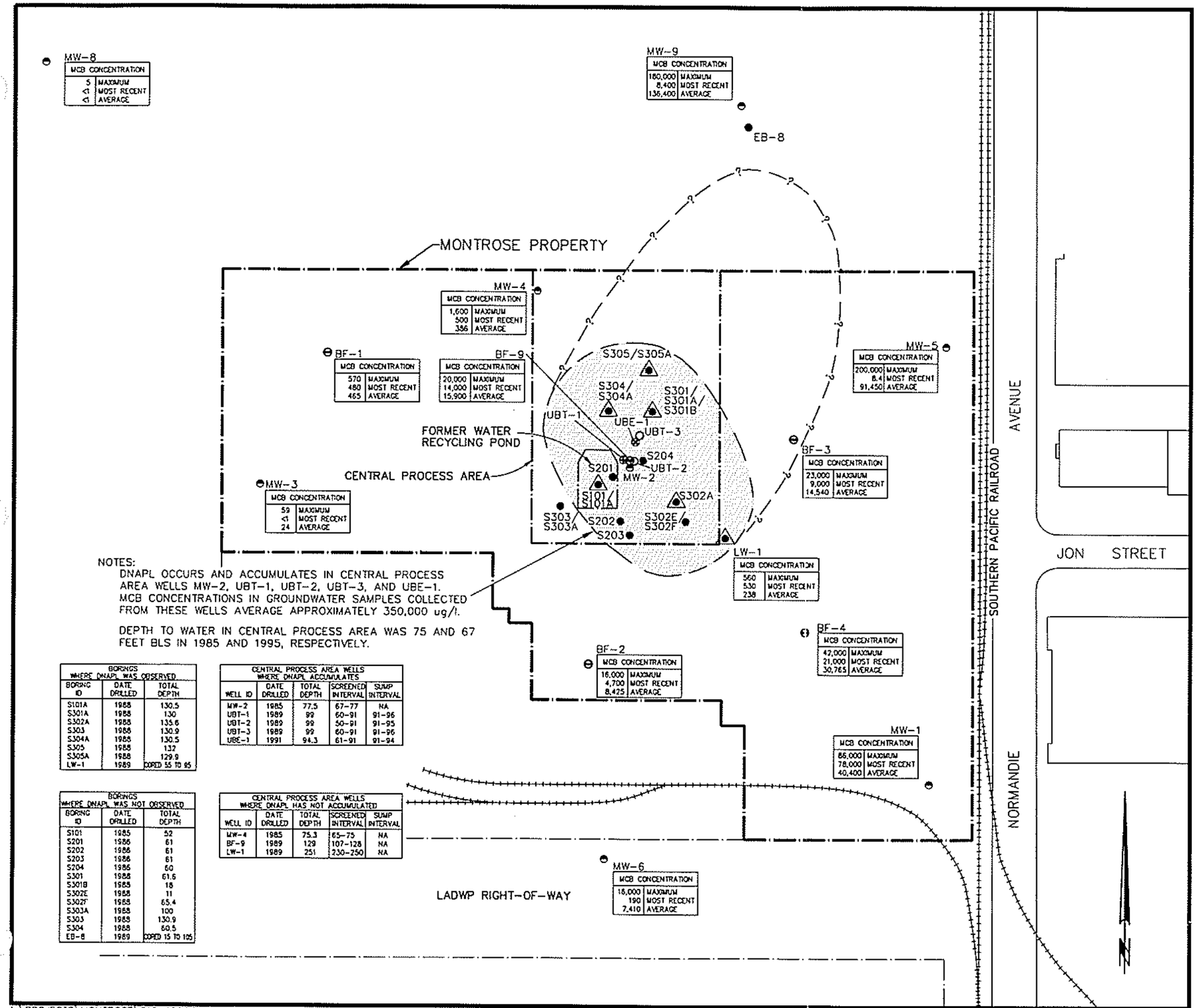

NOTES:

DNAPL OCCURS AND ACCUMULATES IN CENTRAL PROCESS AREA WELLS MW-2, UBT-1, UBT-2, UBT-3, AND UBE-1. MCB CONCENTRATIONS IN GROUNDWATER SAMPLES COLLECTED FROM THESE WELLS AVERAGE APPROXIMATELY 350,000 ug/l.

DEPTH TO WATER IN CENTRAL PROCESS AREA WAS 75 AND 67 FEET BLS IN 1985 AND 1995, RESPECTIVELY.

BORINGS WHERE DNAPL WAS OBSERVED

BORING ID	DATE DRILLED	TOTAL DEPTH
S101A	1988	130.5
S301A	1988	130
S302A	1988	135.6
S303	1988	130.9
S304A	1988	130.5
S305	1988	132
S305A	1988	129.9
LW-1	1989	CORED 55 TO 95

CENTRAL PROCESS AREA WELLS WHERE DNAPL ACCUMULATES

WELL ID	DATE DRILLED	TOTAL DEPTH	SCREENED INTERVAL	SUMP INTERVAL
MW-2	1985	77.5	67-77	NA
UBT-1	1989	99	60-91	91-96
UBT-2	1989	99	50-91	91-95
UBT-3	1989	99	60-91	91-96
UBE-1	1991	94.3	61-91	91-94

BORINGS WHERE DNAPL WAS NOT OBSERVED

BORING ID	DATE DRILLED	TOTAL DEPTH
S101	1985	52
S201	1986	61
S202	1986	61
S203	1986	61
S204	1986	60
S301	1988	61.6
S301B	1988	18
S302E	1988	11
S302F	1988	65.4
S303A	1988	100
S303	1988	130.9
S304	1988	60.5
EB-8	1989	CORED 15 TO 105

CENTRAL PROCESS AREA WELLS WHERE DNAPL HAS NOT ACCUMULATED

WELL ID	DATE DRILLED	TOTAL DEPTH	SCREENED INTERVAL	SUMP INTERVAL
MW-4	1985	75.3	65-75	NA
BF-9	1989	129	107-128	NA
LW-1	1989	251	230-250	NA

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EXPLANATION

S305/S305A — BORING WHERE DNAPL WAS OBSERVED IN SOIL SAMPLES

S201 — BORING WHERE DNAPL WAS NOT OBSERVED IN SOIL SAMPLES

MW-2 — UPPER BELLFLOWER AQUITARD EXTRACTION WELL

UBT-1 — UPPER BELLFLOWER AQUITARD TEST WELL

UBT-3 — UPPER BELLFLOWER AQUITARD OBSERVATION WELL

UBE-1 — UPPER BELLFLOWER AQUITARD EXTRACTION WELL

BF-9 — BELLFLOWER SAND MONITOR WELL (NOTE: DNAPL HAS NOT BEEN OBSERVED IN BELLFLOWER SAND OR DEEPER MONITOR WELLS)

PROPERTY BOUNDARY

MCB CONCENTRATION
200,000 MAXIMUM
8.4 MOST RECENT
91,450 AVERAGE

MAXIMUM, MOST RECENT*, AND AVERAGE CONCENTRATION OF CHLOROBENZENE (MCB) DETECTED IN GROUNDWATER SAMPLES IN MICROGRAMS PER LITER, (*AS OF 4TH QUARTER 1995)

AREA WHERE VISUAL OBSERVATIONS OF SOIL SAMPLES INDICATED THE OCCURENCE OF DNAPL AND WHERE DNAPL OCCURS IN UPPER BELLFLOWER AQUITARD MONITOR, TEST, OBSERVATION AND EXTRACTION WELLS

AREA WHERE DNAPL OCCURRENCE IS UNCERTAIN BUT MAY BE INFERRED BASED ON HISTORICAL WATER QUALITY DATA

0 140 280
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

AREA OF OBSERVED DNAPL OCCURRENCE

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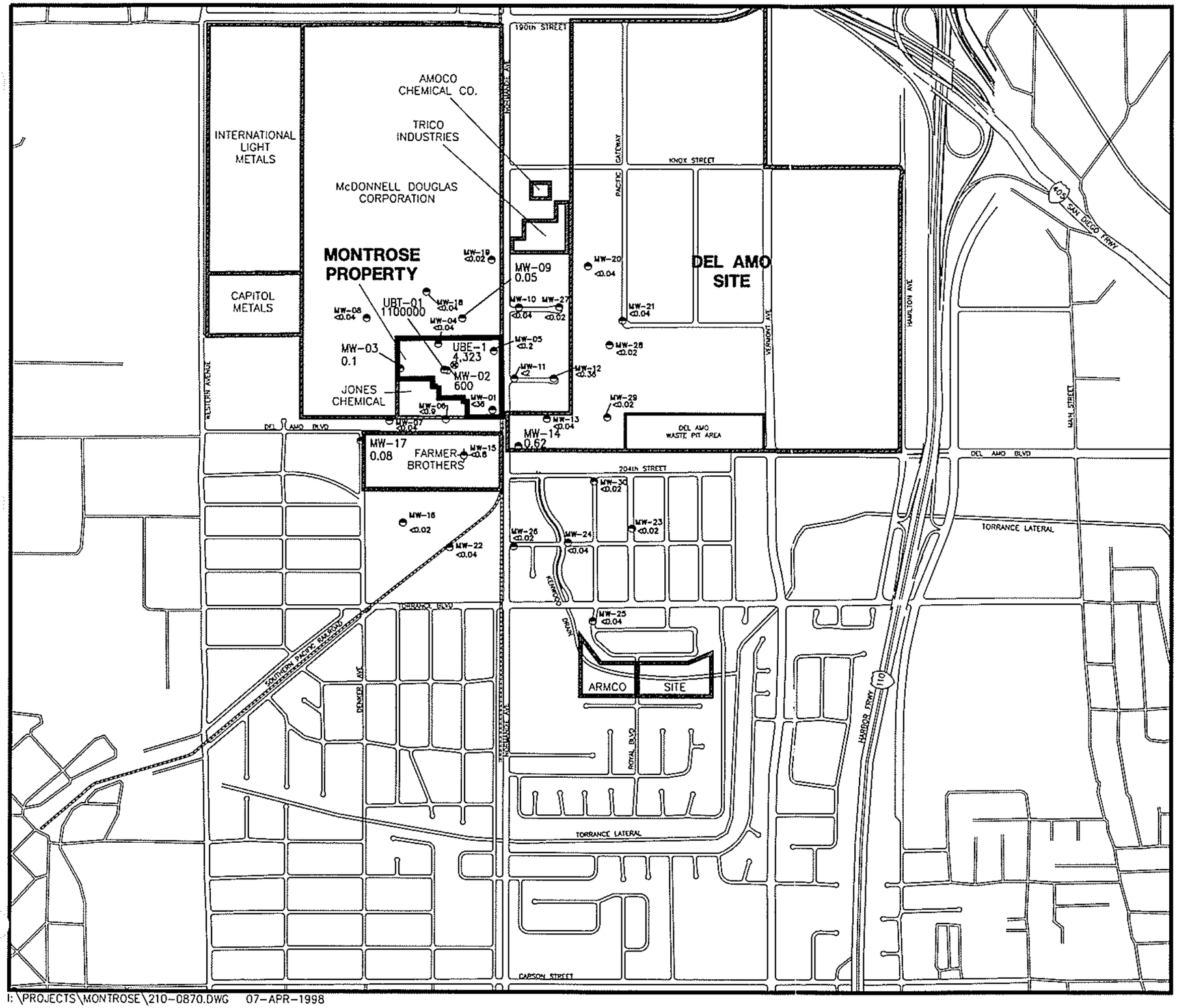
FIGURE 5.44

PREP BY _____ REV BY _____ RPT NO. 218.1103 | 210-1008 | G



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EXPLANATION

MW-02 ◓ 600	UPPER BELLFLOWER AQUITARD MONITOR WELL CONCENTRATION IN MICROGRAMS PER LITER
UBE-1 ⊗ 4,323	UPPER BELLFLOWER AQUITARD EXTRACTION WELL
MW-15 ⊕ <0.8	DESTROYED WELL
NA	NOT AVAILABLE
< =	LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY. WITH THE EXCEPTION OF MONTROSE MONITOR WELL MW-2, SAMPLE DATES RANGE FROM APRIL 1990 TO DECEMBER 1995. SAMPLE DATES AND A SAMPLE RESULTS SUMMARY FOR MONTROSE WELLS ARE PROVIDED IN TABLE 5.5. ANALYTICAL RESULTS FOR ALL ANALYSES FOR MONTROSE WELLS ARE PROVIDED IN APPENDIX G. ANALYTICAL METHODS ARE PROVIDED IN APPENDIX B.

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

TOTAL DDT IN GROUNDWATER
UPPER BELLFLOWER AQUITARD

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

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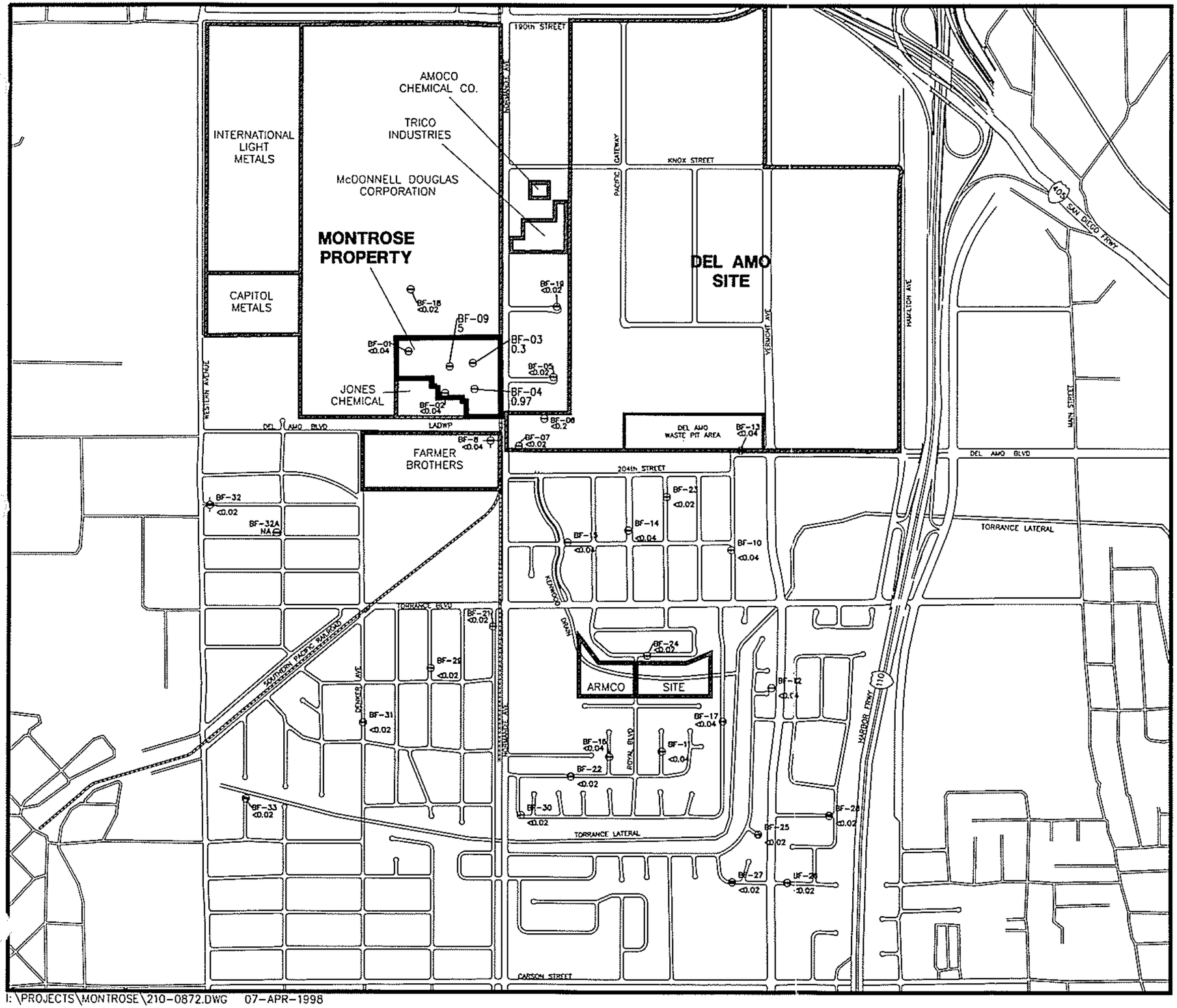
FIGURE 5.45

PREP BY	REV BY	RPT NO. 218.11.3	210-0870	B



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EXPLANATION

BF-06 ⊖ <0.2	BELLFLOWER SAND MONITOR WELL CONCENTRATION IN MICROGRAMS PER LITER
BF-32 ⊕	DESTROYED WELL
NA	NOT AVAILABLE
< =	LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY. SAMPLE DATES RANGE FROM APRIL 1990 TO DECEMBER 1995. SAMPLE DATES AND A SAMPLE RESULTS SUMMARY FOR MONTROSE WELLS ARE PROVIDED IN TABLE 5.5. ANALYTICAL RESULTS FOR ALL ANALYSES FOR MONTROSE WELLS ARE PROVIDED IN APPENDIX G. ANALYTICAL METHODS ARE PROVIDED IN APPENDIX B.

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MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

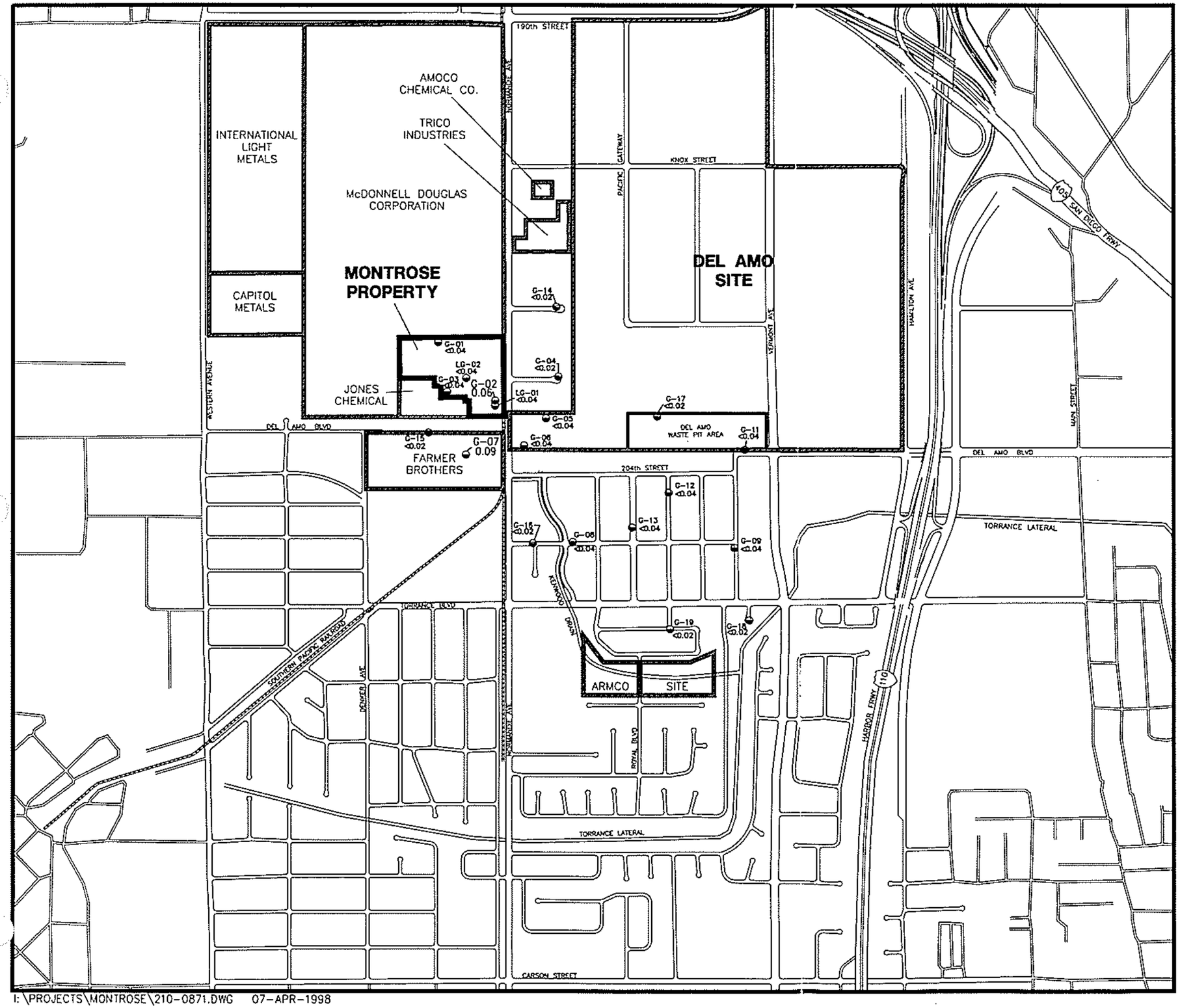
TOTAL DDT IN GROUNDWATER BELLFLOWER SAND

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.46

PREP BY	REV BY	RPT NO. 218.11.3	210-0872	B



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EXPLANATION

G-05 — GAGE AQUIFER MONITOR WELL

<0.04 — CONCENTRATION IN MICROGRAMS PER LITER

G-07 — DESTROYED WELL

LG-01 — LOWER GAGE AQUIFER MONITOR WELL

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY. SAMPLE DATES RANGE FROM APRIL 1990 TO DECEMBER 1995. SAMPLE DATES AND A SAMPLE RESULTS SUMMARY FOR MONTROSE WELLS ARE PROVIDED IN TABLE 5.5. ANALYTICAL RESULTS FOR ALL ANALYSES FOR MONTROSE WELLS ARE PROVIDED IN APPENDIX C. ANALYTICAL METHODS ARE PROVIDED IN APPENDIX B.

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MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

TOTAL DDT IN GROUNDWATER GAGE AQUIFER

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

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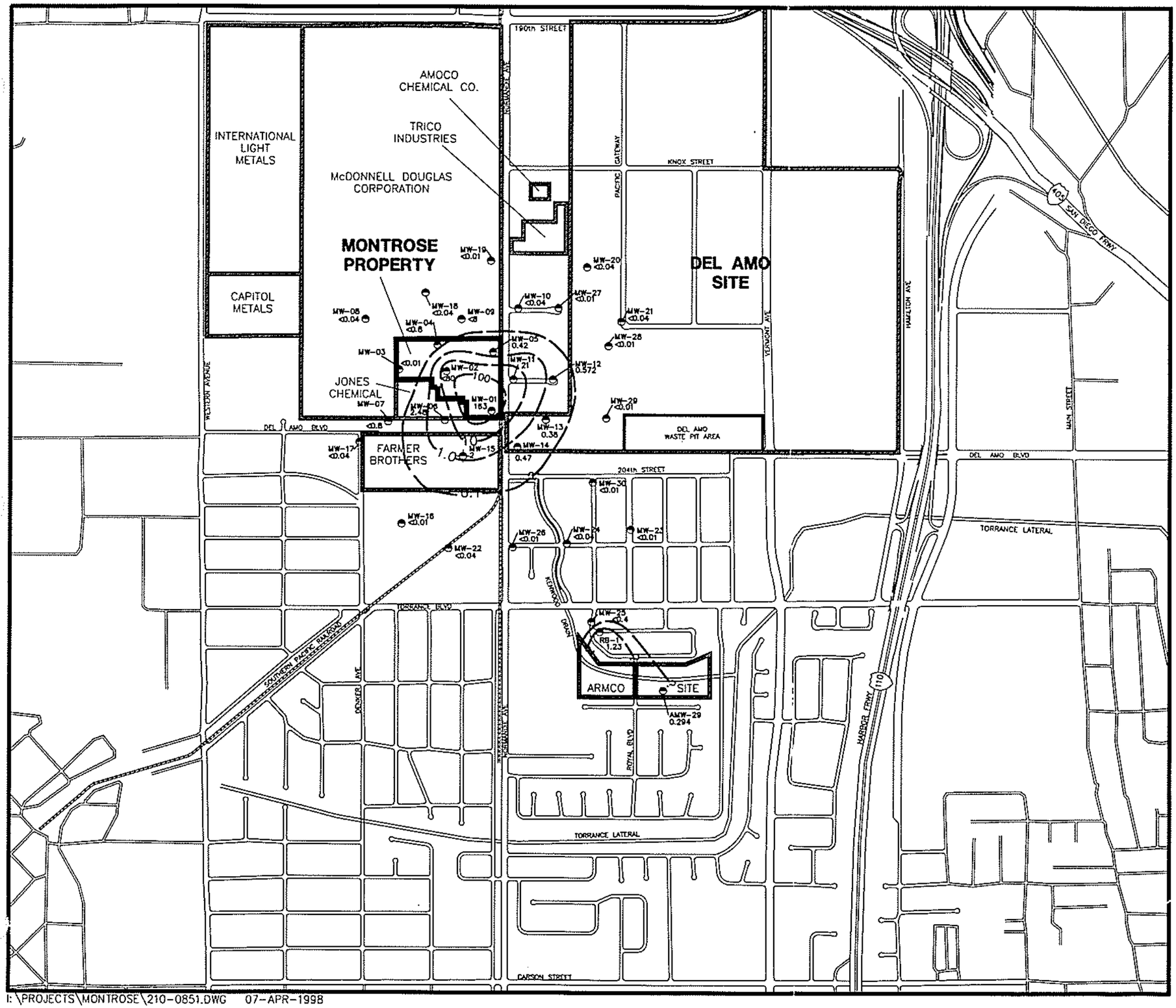
FIGURE 5.47

PREP BY _____ REV BY _____ RPT NO. 218.11.3 | 210-0871 | B



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EXPLANATION

MW-03 — UPPER BELLFLOWER AQUITARD MONITOR WELL

<0.01 — CONCENTRATION IN MICROGRAMS PER LITER

MW-15 — DESTROYED WELL

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

?——100——?

CONTOUR LINE OF EQUAL CONCENTRATION OF TOTAL BHC IN MICROGRAMS PER LITER
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995 DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY. WITH THE EXCEPTION OF MONTROSE MONITOR WELL MW-2, SAMPLE DATES RANGE FROM APRIL 1990 TO DECEMBER 1995. SAMPLE DATES AND A SAMPLE RESULTS SUMMARY FOR MONTROSE WELL ARE PROVIDED IN TABLE 5.5. ANALYTICAL RESULTS FOR ALL ANALYSES FOR MONTROSE WELLS ARE PROVIDED IN APPENDIX G. ANALYTICAL METHODS ARE PROVIDED IN APPENDIX B.

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MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

TOTAL BHC IN GROUNDWATER UPPER BELLFLOWER AQUITARD

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

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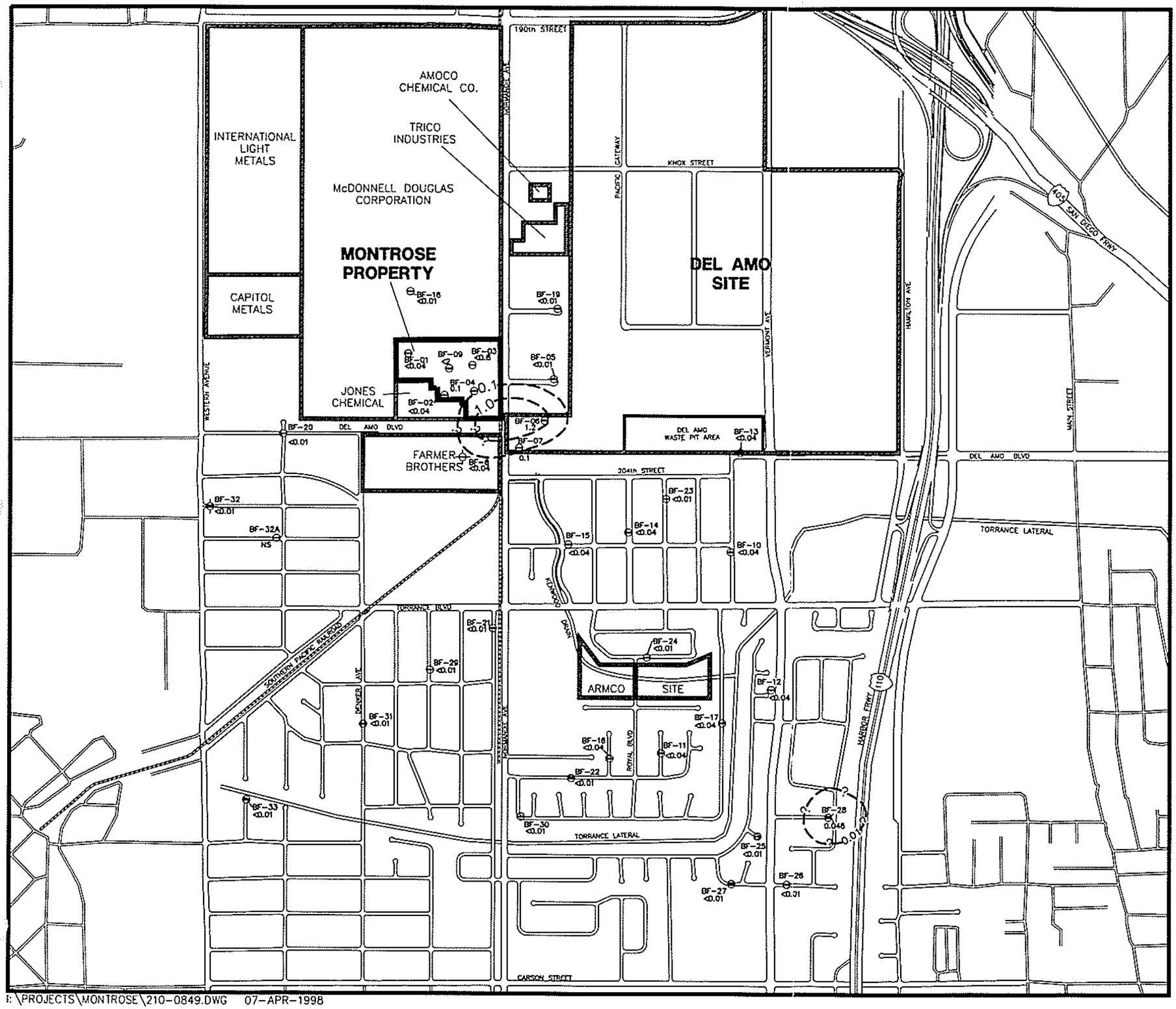
FIGURE 5.48

PREP BY _____ REV BY _____ RPT NO. 218.11.3 | 210-0851 | d



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EXPLANATION

BF-28 ⊖ 0.046 — BELLFLOWER SAND MONITOR WELL; CONCENTRATION IN MICROGRAMS PER LITER

BF-8 ⊖ — DESTROYED WELL

?——1.0——?

CONTOUR LINE OF EQUAL CONCENTRATION OF TOTAL BHC IN MICROGRAMS PER LITER
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

NS = NOT SAMPLED

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY. SAMPLE DATES RANGE FROM APRIL 1990 TO DECEMBER 1995. SAMPLE DATES AND A SAMPLE RESULTS SUMMARY FOR MONTROSE WELLS ARE PROVIDED IN TABLE 5.5. ANALYTICAL RESULTS FOR ALL ANALYSES FOR MONTROSE WELLS ARE PROVIDED IN APPENDIX G. ANALYTICAL METHODS ARE PROVIDED IN APPENDIX B.

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

TOTAL BHC IN GROUNDWATER
BELLFLOWER SAND

HARGIS + ASSOCIATES, INC.
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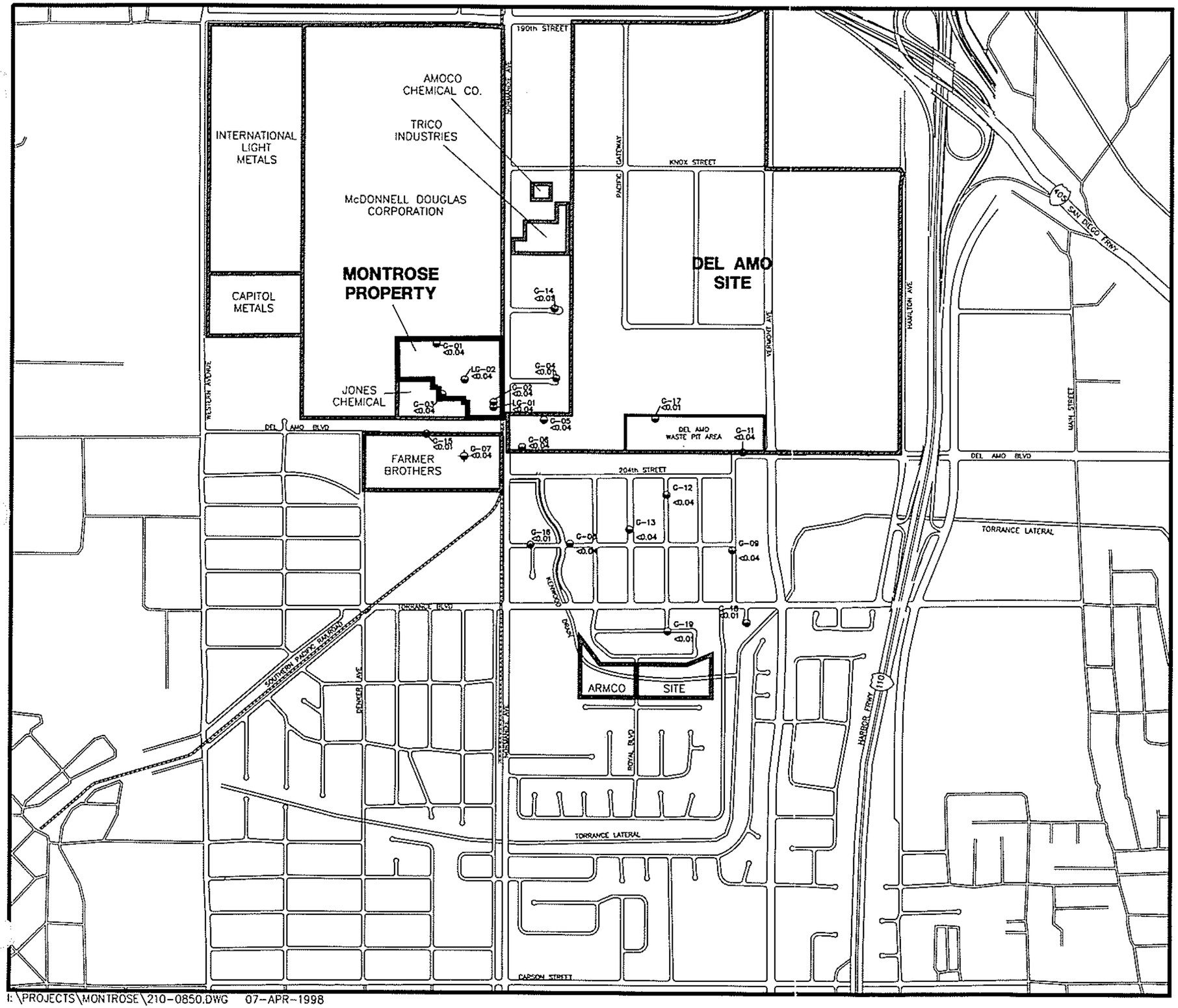
FIGURE 5.49

PREP BY _____ REV BY _____ RPT NO. 218.11.3 | 210-0849 | A



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EXPLANATION

G-11 — GAGE AQUIFER MONITOR WELL
<0.04 — CONCENTRATION IN MICROGRAMS PER LITER

LG-02 — LOWER GAGE AQUIFER MONITOR WELL
<0.04 — CONCENTRATION IN MICROGRAMS PER LITER

G-07 — DESTROYED WELL
<0.04

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

NOTE:
WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY. SAMPLE DATES RANGE FROM APRIL 1990 TO DECEMBER 1995. SAMPLE DATES AND A SAMPLE RESULTS SUMMARY FOR MONTROSE WELLS ARE PROVIDED IN TABLE 5.5. ANALYTICAL RESULTS FOR ALL ANALYSES FOR MONTROSE WELLS ARE PROVIDED IN APPENDIX G. ANALYTICAL METHODS ARE PROVIDED IN APPENDIX B.

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MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

TOTAL BHC IN GROUNDWATER GAGE AQUIFER

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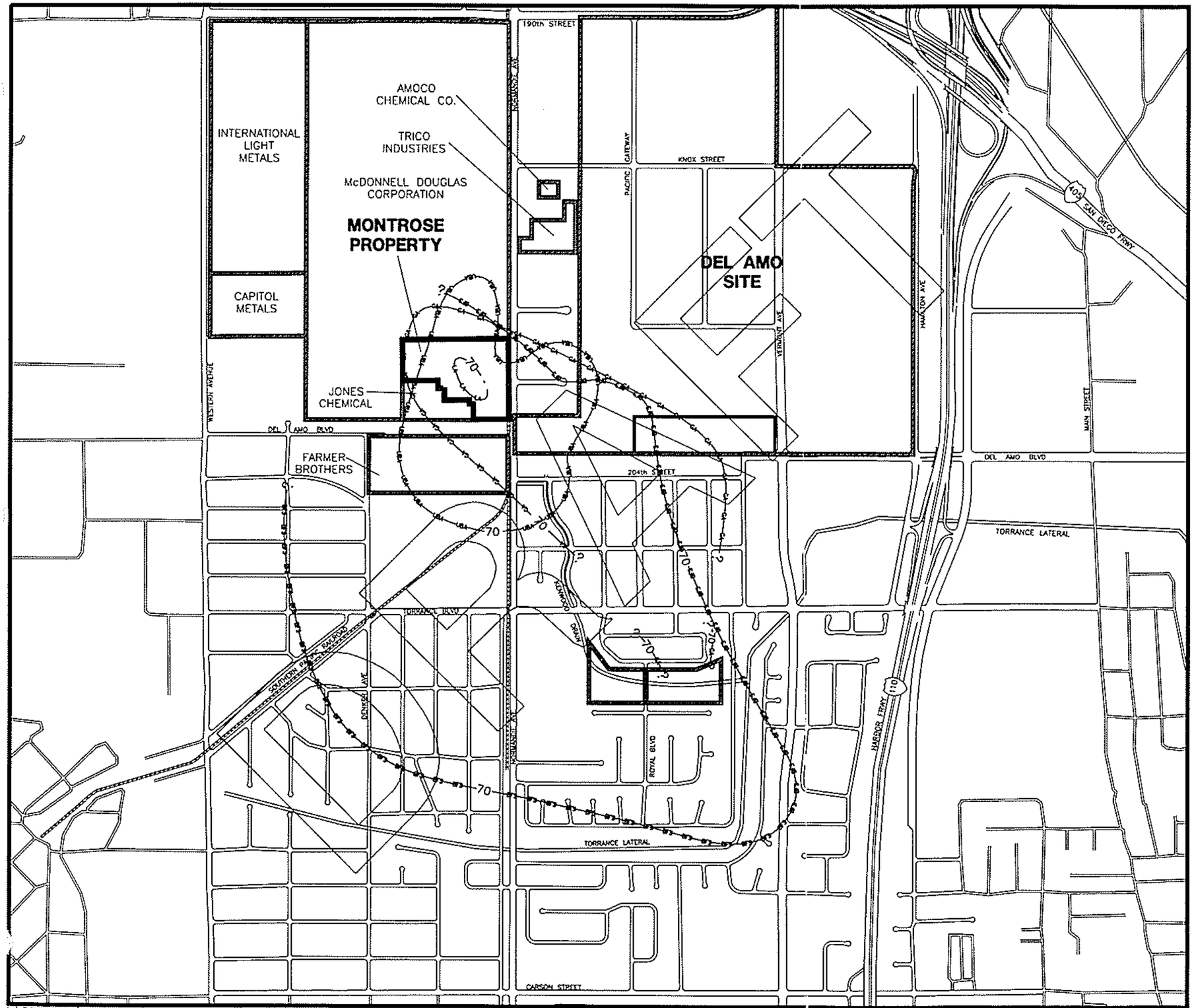
FIGURE 5.50

PREP BY _____ REV BY _____ RPT NO. 218.11.3 | 210-0850 | D



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EXPLANATION

?——— 70 ——— ———?

CONTOUR LINE OF EQUAL CONCENTRATION OF CHLOROBENZENE IN MICROGRAMS PER LITER
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

NOTE:
THIS FIGURE ILLUSTRATES THE APPROXIMATE LATERAL EXTENT OF CHLOROBENZENE IN GROUNDWATER WHICH OCCURS IN EACH HYDROSTRATIGRAPHIC UNIT AT CONCENTRATIONS EXCEEDING THE MAXIMUM CONTAMINANT LEVEL (MCL) FOR DRINKING WATER AT 70 MICROGRAMS PER LITER

—UBA—UBA— UPPER BELLFLOWER AQUITARD
—BFS—BFS— BELLFLOWER SAND
—GA—GA— GAGE AQUIFER
—LA—LA— LYNWOOD AQUIFER

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MONTROSE CHEMICAL CORPORATION
OF CALIFORNIA
TORRANCE, CALIFORNIA

EXTENT OF CHLOROBENZENE IN GROUNDWATER AT CONCENTRATIONS GREATER THAN THE MCL FOR DRINKING WATER

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

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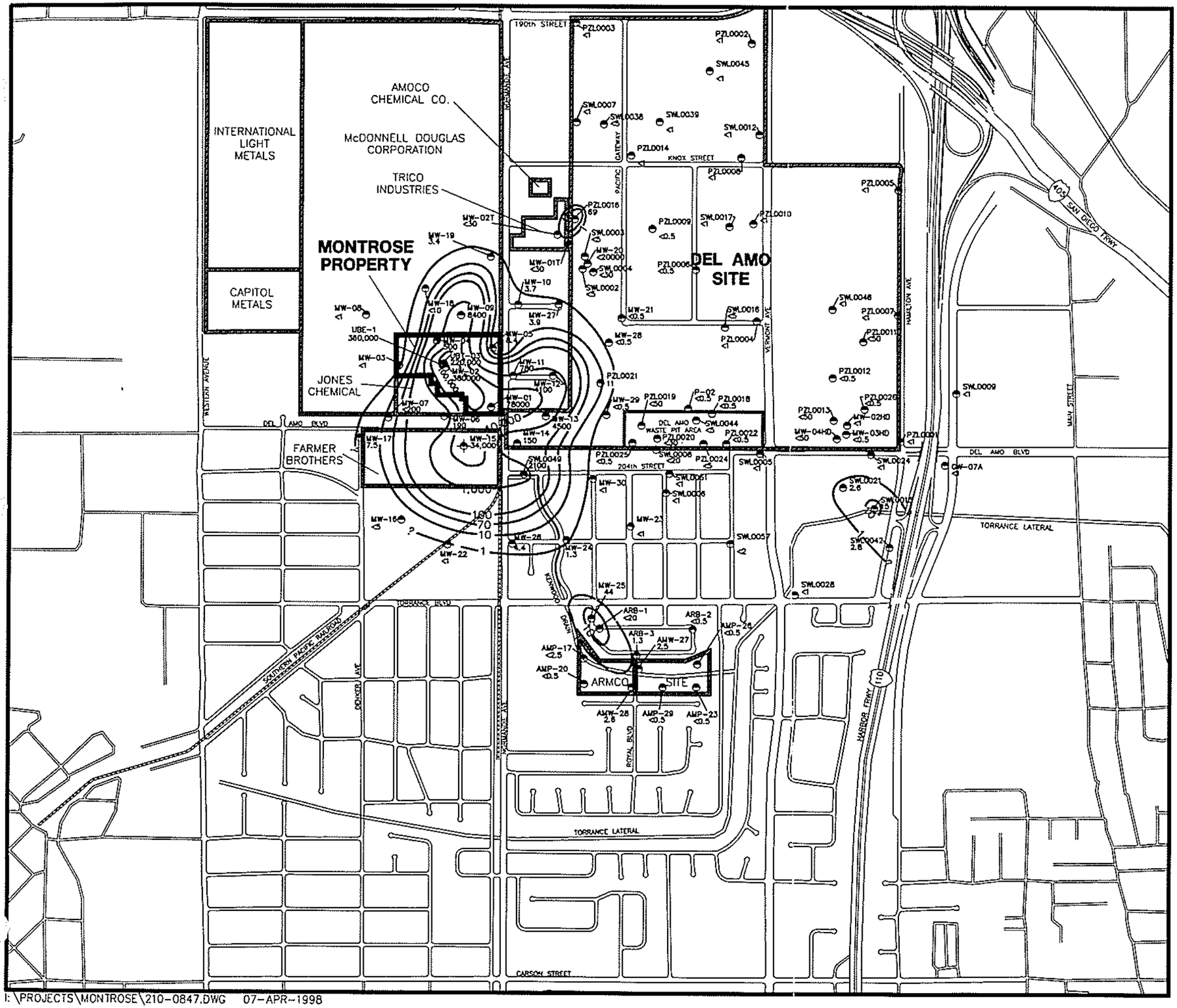
FIGURE 5.51

PREP BY	REV BY	RPT NO. 218.11.3	210-0901	C



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EXPLANATION

MW-10 / 3.7 — UPPER BELLFLOWER AQUITARD MONITOR WELL; CONCENTRATION IN MICROGRAMS PER LITER

MW-15 — DESTROYED WELL

NA — NOT AVAILABLE

?——1,000——?

CONTOUR LINE OF EQUAL CONCENTRATION OF CHLOROBENZENE IN MICROGRAMS PER LITER DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

WELL IDENTIFIER NOTES:
MW = MONTROSE MONITOR WELLS
SWL, PZL, GW, P, AND MW-_HD = DEL AMO MONITOR WELLS
AMW, AMP, AND ARB = ARMCO MONITOR WELLS

NOTE: CONCENTRATION DATA FOR DEL AMO MONITOR WELLS PROVIDED BY DEL AMO IN JUNE 1996

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY. WITH THE EXCEPTION OF MONTROSE MONITOR WELL MW-2, SAMPLE DATES RANGE FROM APRIL 1990 TO DECEMBER 1995. SAMPLE DATES AND A SAMPLE RESULTS SUMMARY FOR MONTROSE WELLS ARE PROVIDED IN TABLE 5.5. ANALYTICAL RESULTS FOR ALL ANALYSES FOR MONTROSE WELLS ARE PROVIDED IN APPENDIX C. ANALYTICAL METHODS ARE PROVIDED IN APPENDIX B.

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MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

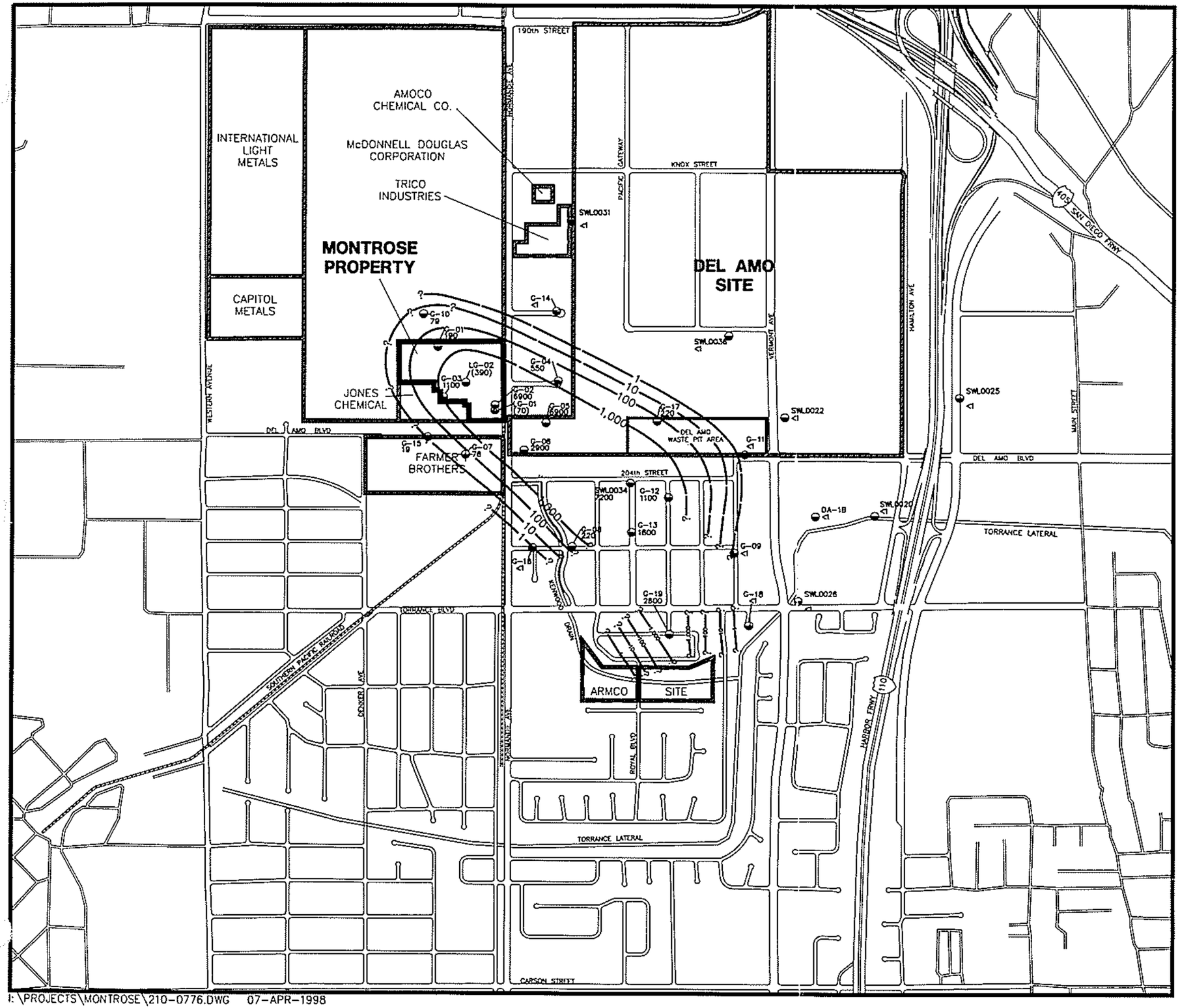
CHLOROBENZENE IN GROUNDWATER UPPER BELLFLOWER AQUITARD

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.52

PREP BY _____ REV BY _____ RPT NO. 218.11.3 | 210-0847 | C



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EXPLANATION

G-02 — GAGE AQUIFER MONITOR WELL

6900 — CONCENTRATION IN MICROGRAMS PER LITER

G-07 — DESTROYED WELL

LG-02 — LOWER GAGE AQUIFER MONITOR WELL

(309) — CONCENTRATION IN MICROGRAMS PER LITER (CONCENTRATION NOT CONTOURED)

?——100——?

CONTOUR LINE OF EQUAL CONCENTRATION OF CHLOROBENZENE IN MICROGRAMS PER LITER DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

WELL IDENTIFIER NOTES:
G AND LG = MONTROSE MONITOR WELLS
DA AND SWL = DEL AMO MONITOR WELLS

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY. SAMPLE DATES RANGE FROM APRIL 1990 TO DECEMBER 1995. SAMPLE DATES AND A SAMPLE RESULTS SUMMARY FOR MONTROSE WELLS ARE PROVIDED IN TABLE 5.5. ANALYTICAL RESULTS FOR ALL ANALYSES FOR MONTROSE WELLS ARE PROVIDED IN APPENDIX G. ANALYTICAL METHODS ARE PROVIDED IN APPENDIX B.

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MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

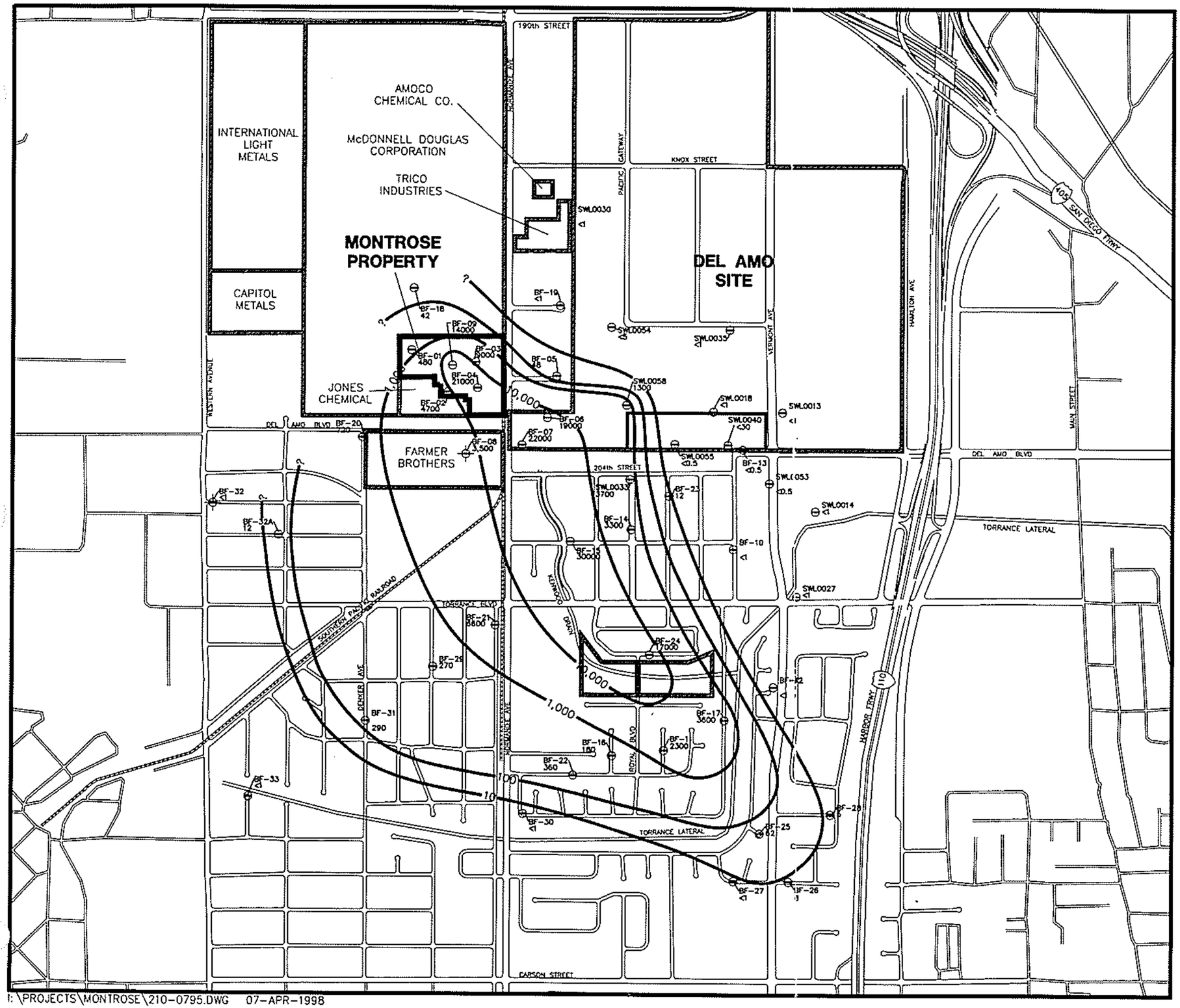
CHLOROBENZENE IN GROUNDWATER GAGE AQUIFER

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.54

PREP BY _____ REV BY _____ RPT NO. 218.11.3 | 210-0776 | D



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EXPLANATION

BF-19 ⊖ <1 — BELLFLOWER SAND MONITOR WELL; CONCENTRATION IN MICROGRAMS PER LITER

BF-08 ⊘ — DESTROYED WELL

?——100——?
CONTOUR LINE OF EQUAL CONCENTRATION OF CHLOROBENZENE IN MICROGRAMS PER LITER
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

WELL IDENTIFIER NOTES:
BF = MONTROSE MONITOR WELLS
SWL = DEL AMO MONITOR WELLS

NOTE:
WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY. SAMPLE DATES RANGE FROM APRIL 1990 TO DECEMBER 1995. SAMPLE DATES AND A SAMPLE RESULTS SUMMARY FOR MONTROSE WELLS ARE PROVIDED IN TABLE 5.5. ANALYTICAL RESULTS FOR ALL ANALYSES FOR MONTROSE WELLS ARE PROVIDED IN APPENDIX G. ANALYTICAL METHODS ARE PROVIDED IN APPENDIX B.

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MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

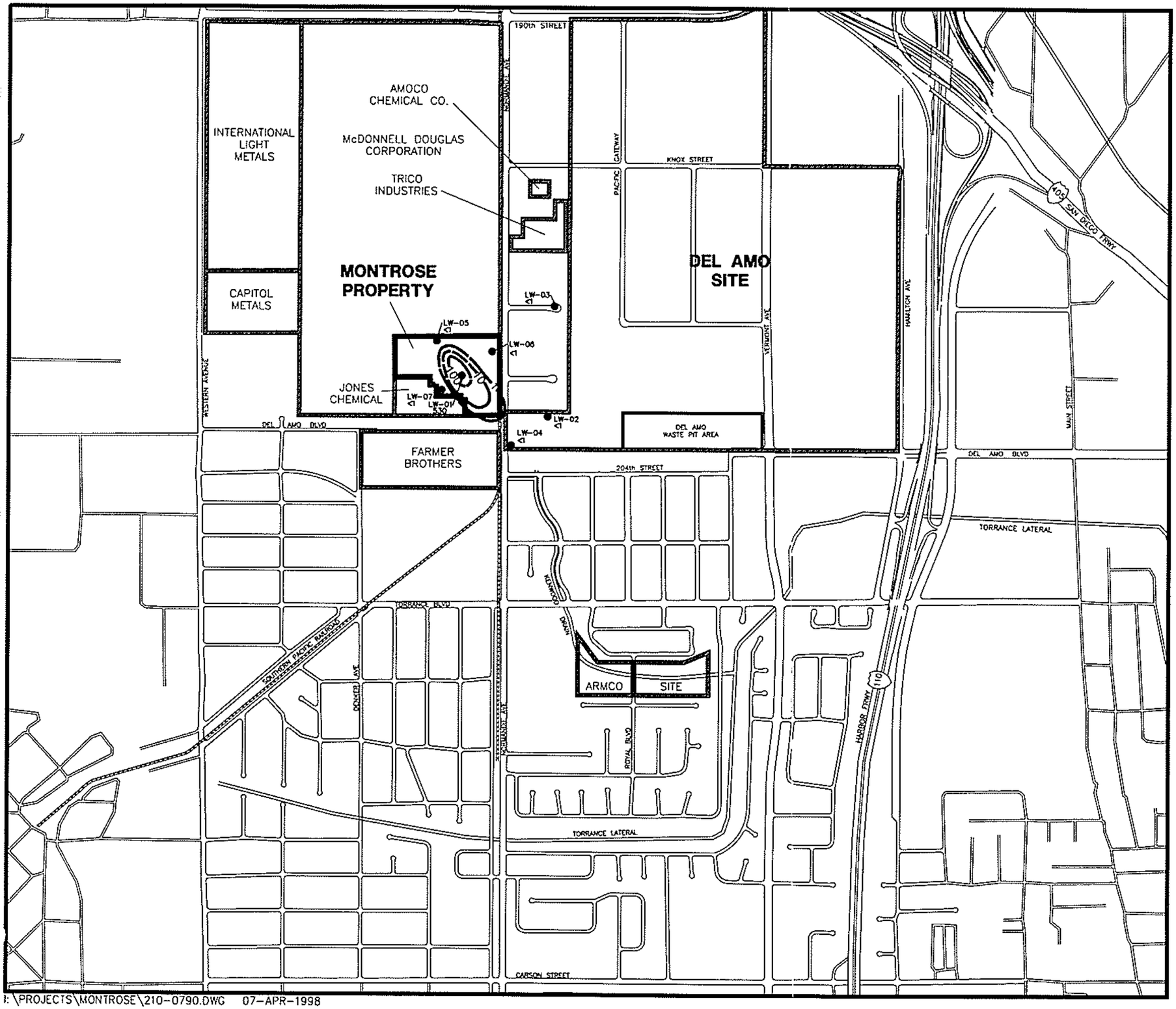
CHLOROBENZENE IN GROUNDWATER BELLFLOWER SAND

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

7/97

FIGURE 5.53

PREP BY _____ REV BY _____ APT NO. 218.11.3 | 210-0795 | C



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EXPLANATION

LW-04 — LYNWOOD AQUIFER MONITOR WELL

<1 — CONCENTRATION IN MICROGRAMS PER LITER

?——100——?

CONTOUR LINE OF EQUAL CONCENTRATION OF CHLOROBENZENE IN MICROGRAMS PER LITER DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY. SAMPLE DATES RANGE FROM APRIL 1990 TO DECEMBER 1995. SAMPLE DATES AND A SAMPLE RESULTS SUMMARY FOR MONTROSE WELLS ARE PROVIDED IN TABLE 5.5. ANALYTICAL RESULTS FOR ALL ANALYSES FOR MONTROSE WELLS ARE PROVIDED IN APPENDIX G. ANALYTICAL METHODS ARE PROVIDED IN APPENDIX B.

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MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

CHLOROBENZENE IN GROUNDWATER LYNWOOD AQUIFER

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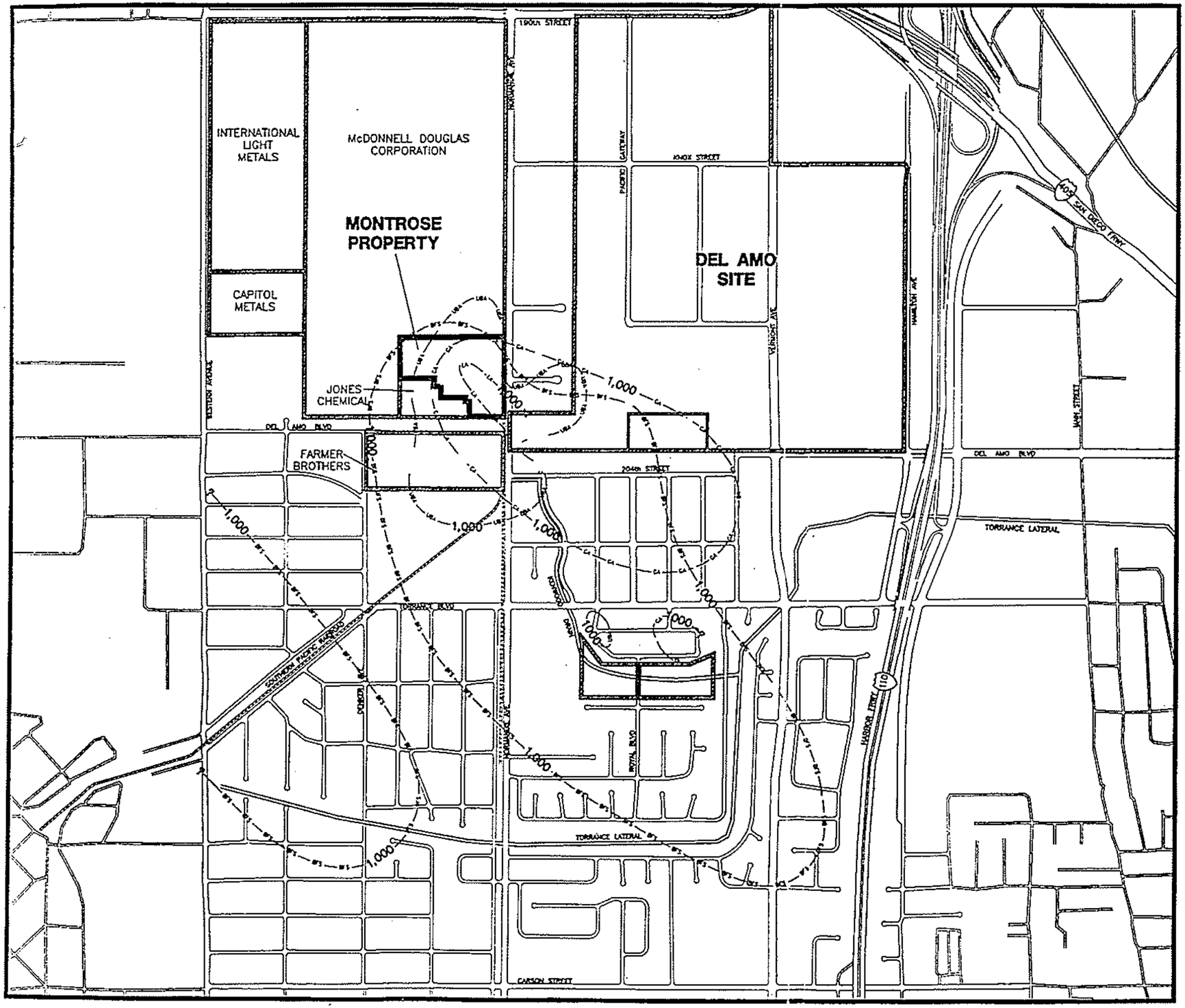
FIGURE 5.55

PREP BY _____ REV BY _____ RPT NO. 218.11.3 | 210-0790 | C



EXPLANATION

?——1,000——?

CONTOUR LINE OF EQUAL CONCENTRATION OF PCBSA IN MICROGRAMS PER LITER
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

NOTE:
THIS FIGURE ILLUSTRATES THE APPROXIMATE LATERAL EXTENT OF PCBSA IN GROUNDWATER WHICH OCCURS IN EACH HYDROSTRATIGRAPHIC UNIT AT CONCENTRATIONS EXCEEDING 1,000 MICROGRAMS PER LITER (µg/L).
THERE ARE NO WATER QUALITY STANDARDS FOR PCBSA IN DRINKING WATER. RWQCB HAS RECOMMENDED AN AQUIFER INJECTION STANDARD OF 25,000 µg/L FOR PCBSA AT THE SITE.

—UBA—UBA— UPPER BELLFLOWER AQUITARD
—BF3—BF3— BELLFLOWER SAND
—GA—GA— GAGE AQUIFER
—LA—LA— LYNWOOD AQUIFER

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MONTROSE CHEMICAL CORPORATION
OF CALIFORNIA
TORRANCE, CALIFORNIA

EXTENT OF PCBSA IN GROUNDWATER AT CONCENTRATIONS GREATER THAN 1,000 MICROGRAMS PER LITER

FIGURE 5.56

PREP BY _____ PREP BY_____ APT NO. _____ | 210-0903 | a

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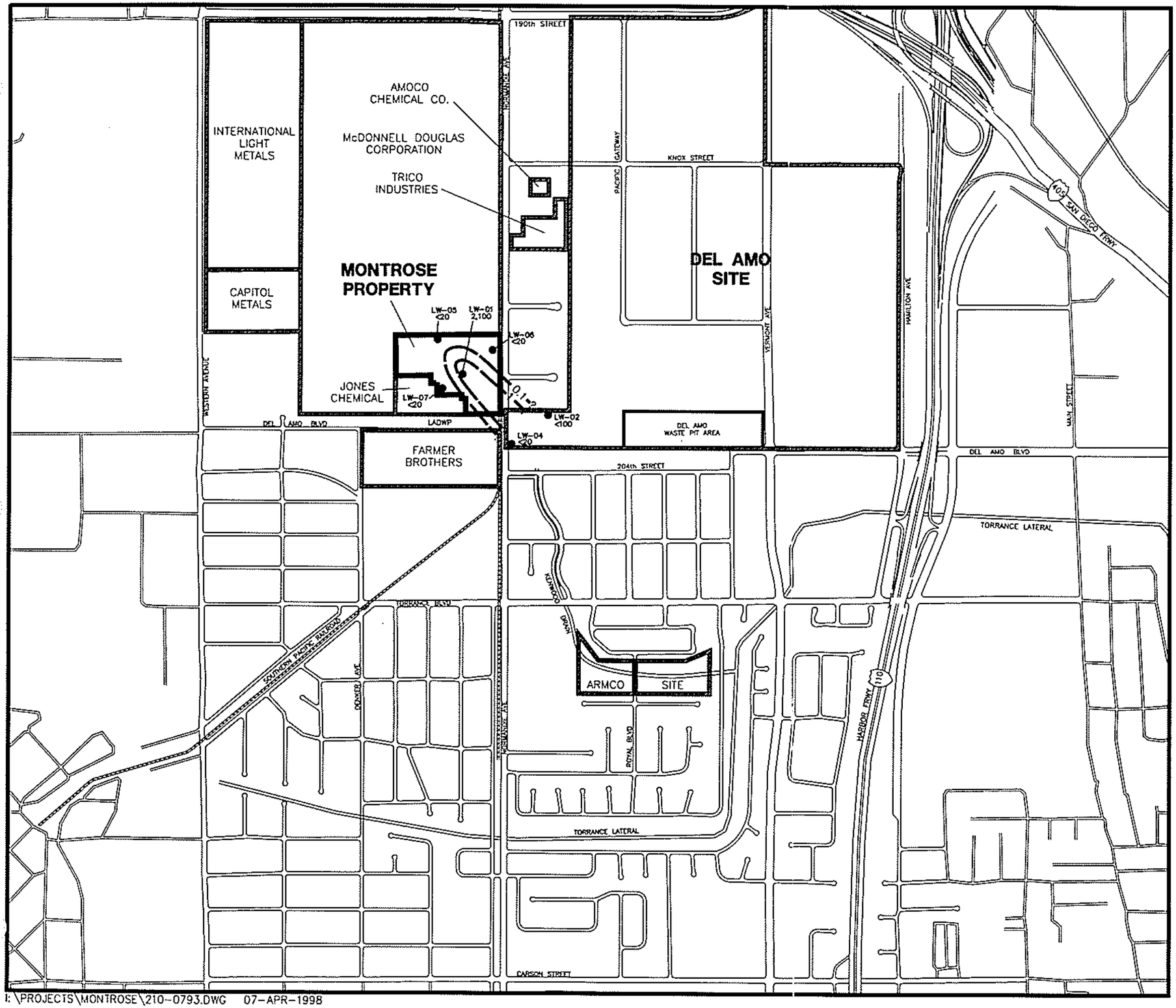

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EXPLANATION

LW-06 ● <20 — LYNWOOD AQUIFER MONITOR WELL; CONCENTRATION IN MICROGRAMS PER LITER

?——1 ——?

CONTOUR LINE OF EQUAL CONCENTRATION OF PCBSA IN MILLIGRAMS PER LITER
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY. SAMPLE DATES RANGE FROM APRIL 1990 TO DECEMBER 1995. SAMPLE DATES AND A SAMPLE RESULTS SUMMARY FOR MONTROSE WELLS ARE PROVIDED IN TABLE 5.5. ANALYTICAL RESULTS FOR ALL ANALYSES FOR MONTROSE WELLS ARE PROVIDED IN APPENDIX G. ANALYTICAL METHODS ARE PROVIDED IN APPENDIX B.

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MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

PCBSA IN GROUNDWATER LYNWOOD AQUIFER

HARGIS + ASSOCIATES, INC.
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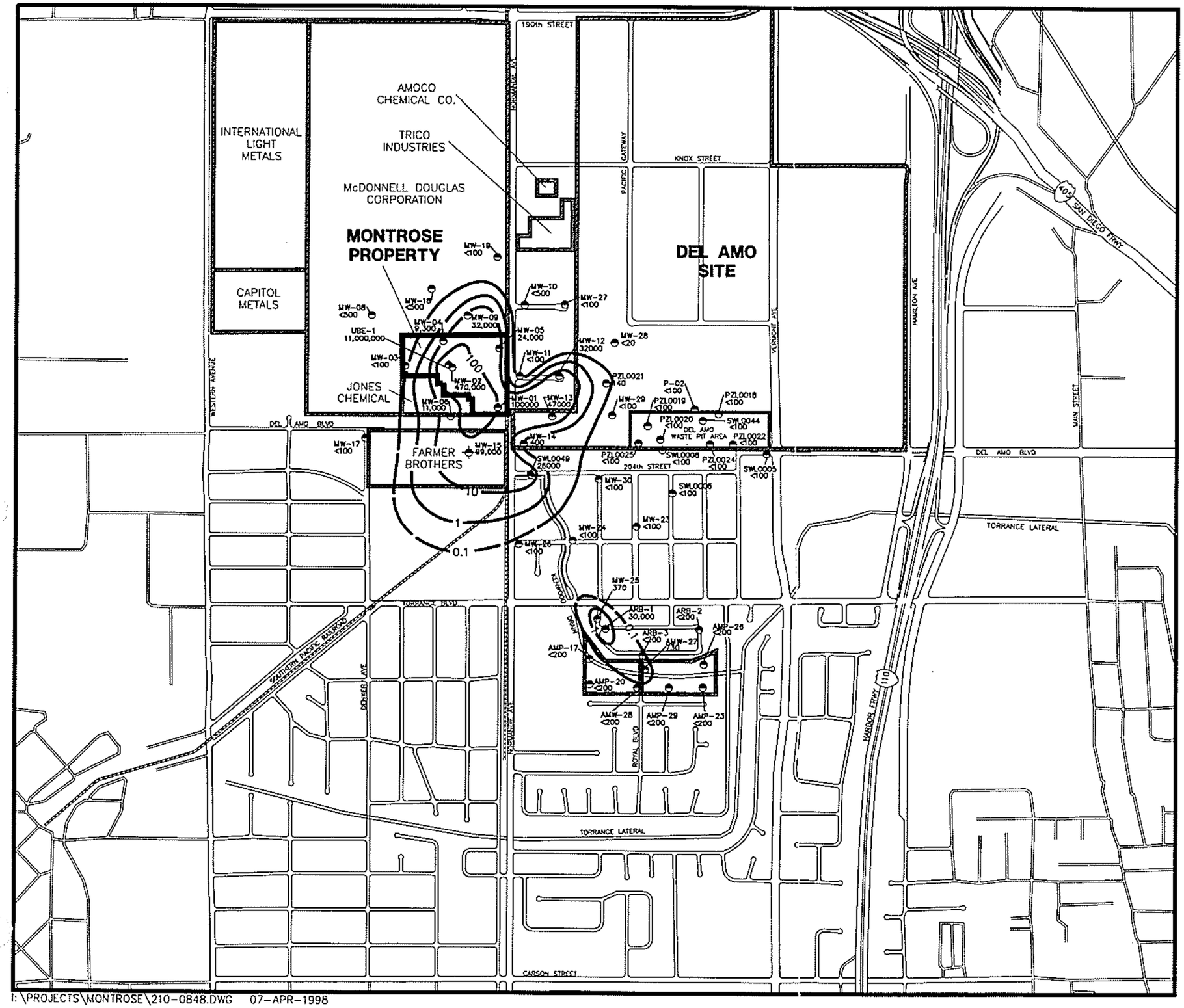
FIGURE 5.60

PREP BY _____ REV BY _____ RPT NO. 218.11.3 | 210-0793 | B



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EXPLANATION

MW-28 — UPPER BELLFLOWER AQUITARD MONITOR WELL

<20 — CONCENTRATION IN MICROGRAMS PER LITER

MW-15 — DESTROYED WELL

?——— 1 ——— ? CONTOUR LINE OF EQUAL CONCENTRATION OF PCBSA IN MILLIGRAMS PER LITER
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

WELL IDENTIFIER NOTES:
MW AND BF = MONTROSE MONITOR WELLS
SWL, PZL, AND P = DEL AMO MONITOR WELLS
AMW, AMP, AND ARB = ARMCO MONITOR WELLS

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY. WITH THE EXCEPTION OF MONTROSE MONITOR WELL MW-2, SAMPLE DATES RANGE FROM APRIL 1990 TO DECEMBER 1995. SAMPLE DATES AND A SAMPLE RESULTS SUMMARY FOR MONTROSE WELLS ARE PROVIDED IN TABLE 5.5. ANALYTICAL RESULTS FOR ALL ANALYSES FOR MONTROSE WELLS ARE PROVIDED IN APPENDIX G. ANALYTICAL METHODS ARE PROVIDED IN APPENDIX B.

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MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

PCBSA IN GROUNDWATER
UPPER BELLFLOWER AQUITARD

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

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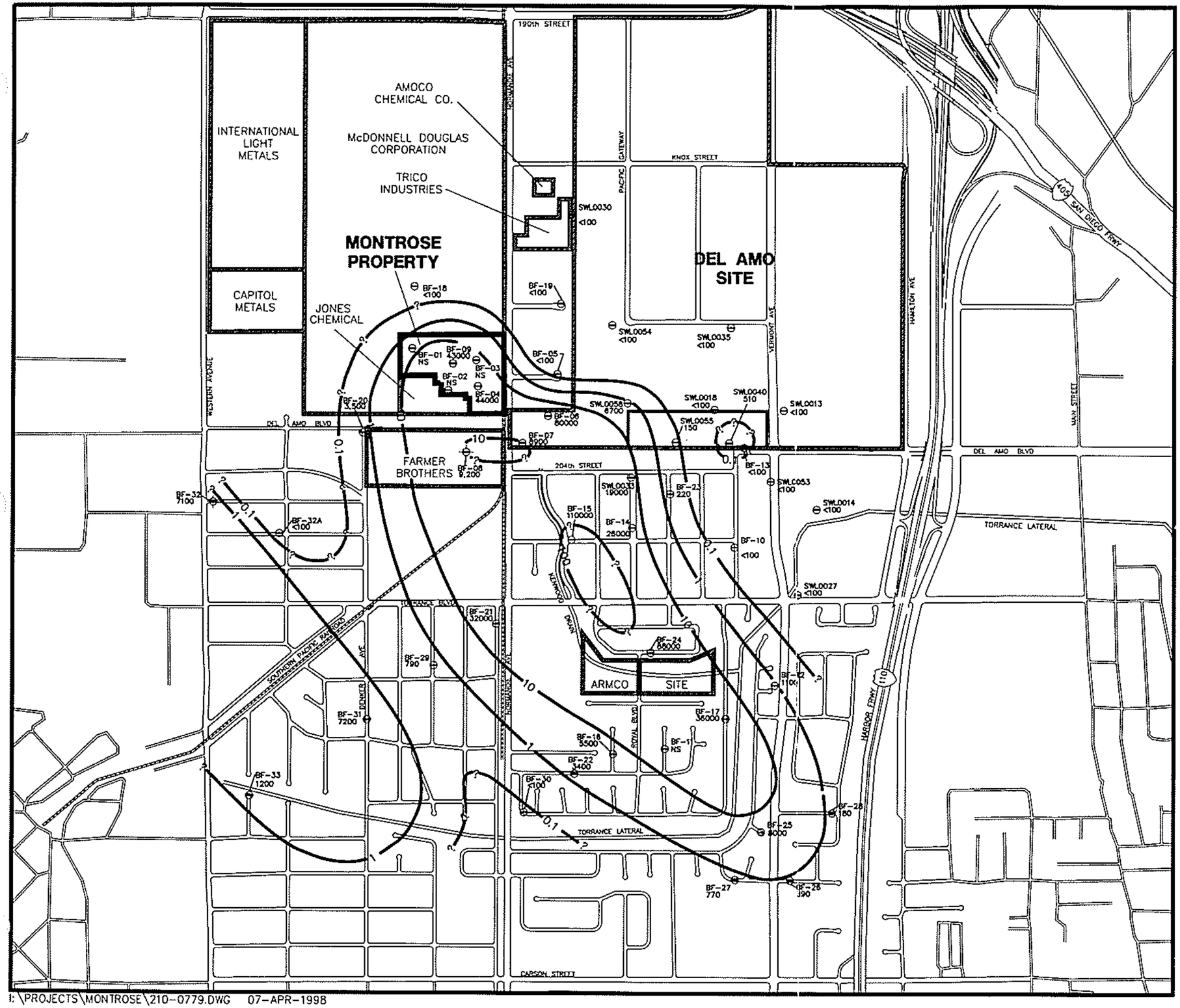
FIGURE 5.57

PREP BY _____ REV BY _____ RPT NO. 218.11.6 | 210-0848 | E



EXPLANATION

BF-05 ⊖ <100 — BELLFLOWER SAND MONITOR WELL; CONCENTRATION IN MICROGRAMS PER LITER

BF-32 ⊖ — DESTROYED WELL

?——1——?

CONTOUR LINE OF EQUAL CONCENTRATION OF PCBSA IN MILLIGRAMS PER LITER
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

NS = NOT SAMPLED

WELL IDENTIFIER NOTES:
BF = MONTROSE MONITOR WELLS
SWL = DEL AMO MONITOR WELLS

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY. SAMPLE DATES RANGE FROM APRIL 1990 TO DECEMBER 1995. SAMPLE DATES AND A SAMPLE RESULTS SUMMARY FOR MONTROSE WELLS ARE PROVIDED IN TABLE 5.5. ANALYTICAL RESULTS FOR ALL ANALYSES FOR MONTROSE WELLS ARE PROVIDED IN APPENDIX C. ANALYTICAL METHODS ARE PROVIDED IN APPENDIX B.

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

PCBSA IN GROUNDWATER BELLFLOWER SAND

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FIGURE 5.58

PREP BY _____ REV BY _____ RPT NO. 218.11.3 | 210-0779 | E

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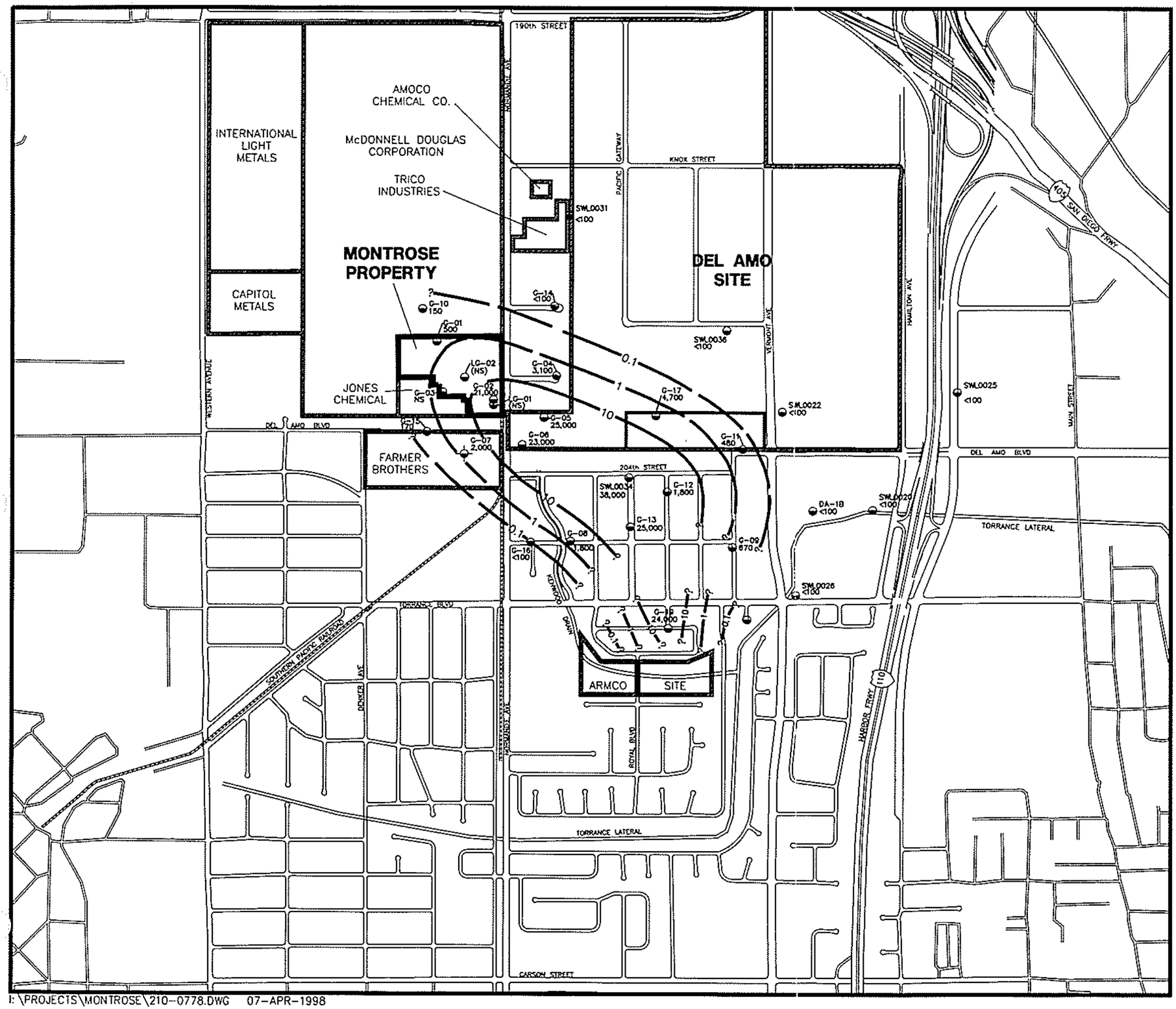

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EXPLANATION

G-09 — GAGE AQUIFER MONITOR WELL

670 — CONCENTRATION IN MICROGRAMS PER LITER

G-07 — DESTROYED WELL

LG-02 — LOWER GAGE AQUIFER MONITOR WELL

?——10——?

CONTOUR LINE OF EQUAL CONCENTRATION OF PCBSA IN MILLIGRAMS PER LITER
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

(NS) = NOT SAMPLED

WELL IDENTIFIER NOTES:
G AND LG = MONTROSE MONITOR WELLS
DA AND SWL = DEL AMO MONITOR WELLS

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY. SAMPLE DATES RANGE FROM APRIL 1990 TO DECEMBER 1995. SAMPLE DATES AND A SAMPLE RESULTS SUMMARY FOR MONTROSE WELLS ARE PROVIDED IN TABLE 5.5. ANALYTICAL RESULTS FOR ALL ANALYSES FOR MONTROSE WELLS ARE PROVIDED IN APPENDIX G. ANALYTICAL METHODS ARE PROVIDED IN APPENDIX B.

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MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

PCBSA IN GROUNDWATER GAGE AQUIFER

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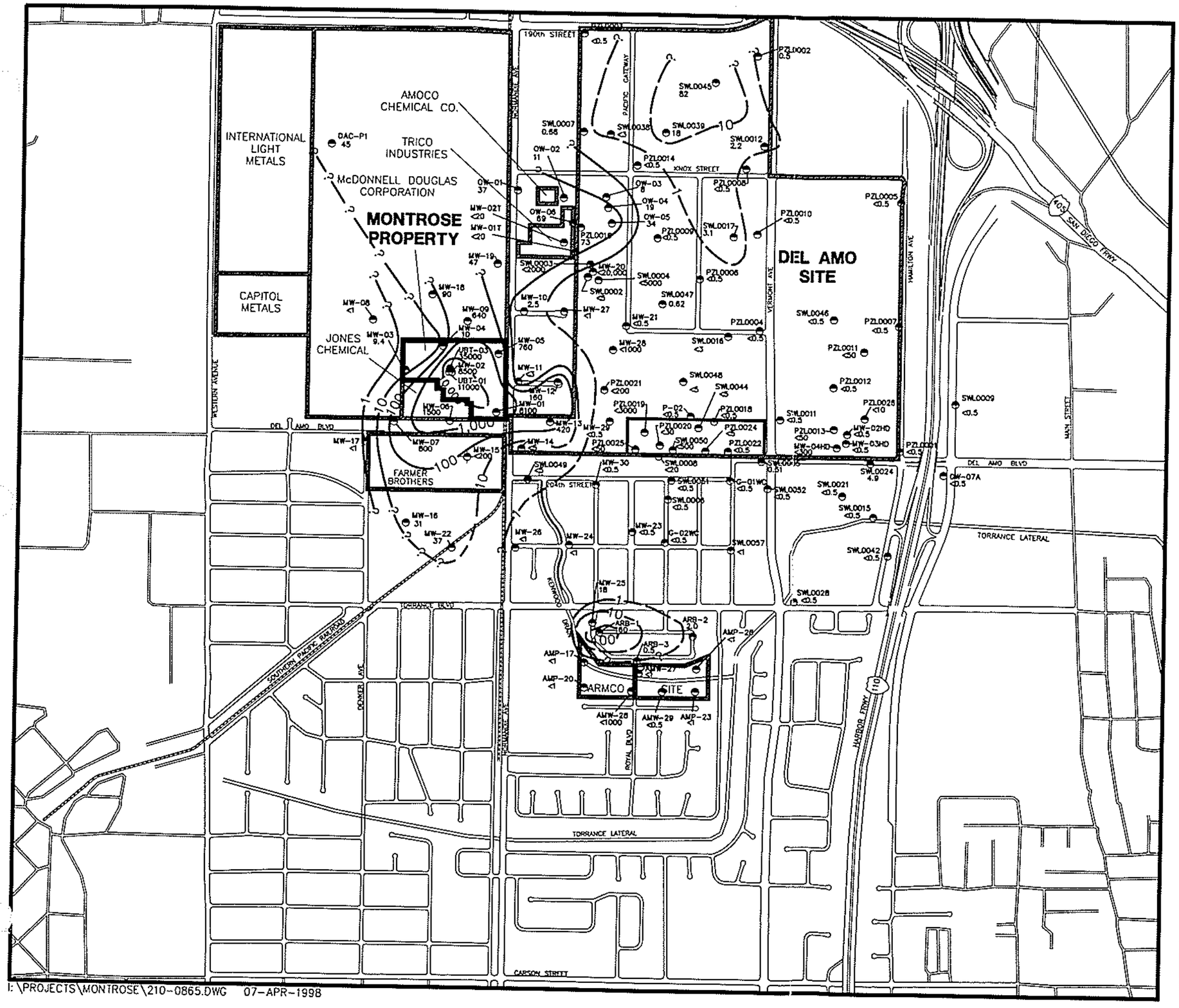
FIGURE 5.59

PREP BY _____ REV BY _____ RPT NO. 218.11.6 | 210-0778 | N



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EXPLANATION

MW-03 / 9.4 — UPPER BELLFLOWER AQUITARD MONITOR WELL; CONCENTRATION IN MICROGRAMS PER LITER

MW-15 — DESTROYED WELL

?——100——?
CONTOUR LINE OF EQUAL CONCENTRATION OF CHLOROFORM IN MICROGRAMS PER LITRE
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

WELL IDENTIFIER NOTES:
- MW = MONTROSE MONITOR WELLS
- WCC AND DAC = McDONNELL DOUGLAS MONITOR WELLS
- SWL, PZL, GW, AND P = DEL AMO MONITOR WELLS
- AMW, ARB, AND AMP = ARMCO MONITOR WELLS
- OW = AMOCO MONITOR WELLS

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY. WITH THE EXCEPTION OF MONTROSE MONITOR WELL MW-2, SAMPLE DATES RANGE FROM APRIL 1990 TO DECEMBER 1995. SAMPLE DATES AND A SAMPLE RESULTS SUMMARY FOR MONTROSE WELLS ARE PROVIDED IN TABLE 5.5. ANALYTICAL RESULTS FOR ALL ANALYSES FOR MONTROSE WELLS ARE PROVIDED IN APPENDIX G. ANALYTICAL METHODS ARE PROVIDED IN APPENDIX B.

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TORRANCE, CALIFORNIA

CHLOROFORM IN GROUNDWATER UPPER BELLFLOWER AQUITARD

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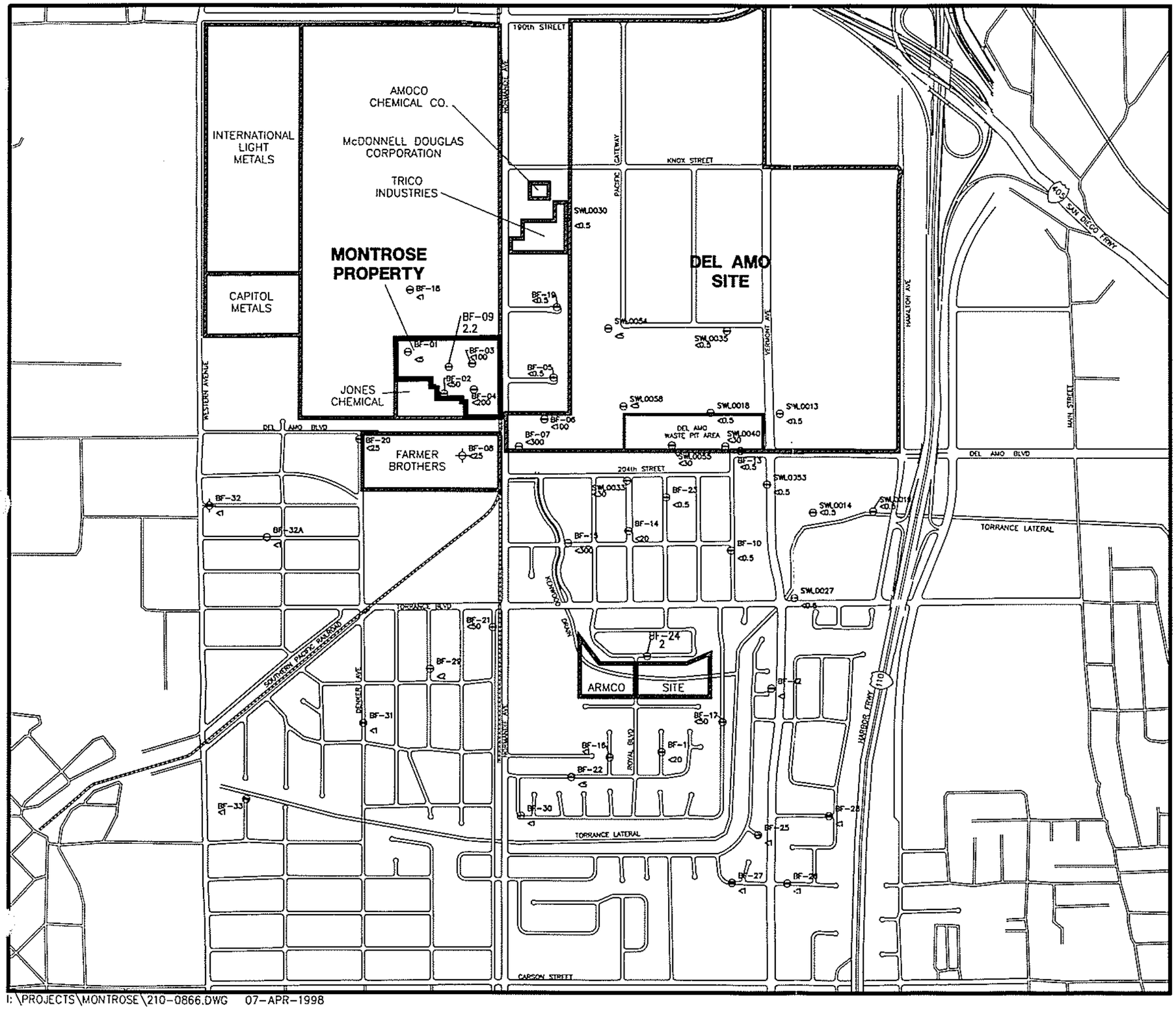
FIGURE 5.61

PREP BY _____ REV BY _____ RPT NO. 218.11.3 | 210-0865 | D



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EXPLANATION

BF-23 ⊖ <0.5 — BELLFLOWER SAND MONITOR WELL; CONCENTRATION IN MICROGRAMS PER LITER

BF-08 ⊖ — DESTROYED WELL

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

WELL IDENTIFIER NOTES:
BF = MONTROSE MONITOR WELLS
SWL = DEL AMO MONITOR WELLS

NOTE:
WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY. SAMPLE DATES RANGE FROM APRIL 1990 TO DECEMBER 1995. SAMPLE DATES AND A SAMPLE RESULTS SUMMARY FOR MONTROSE WELLS ARE PROVIDED IN TABLE 5.5. ANALYTICAL RESULTS FOR ALL ANALYSES FOR MONTROSE WELLS ARE PROVIDED IN APPENDIX G. ANALYTICAL METHODS ARE PROVIDED IN APPENDIX B.

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CHLOROFORM IN GROUNDWATER BELLFLOWER SAND

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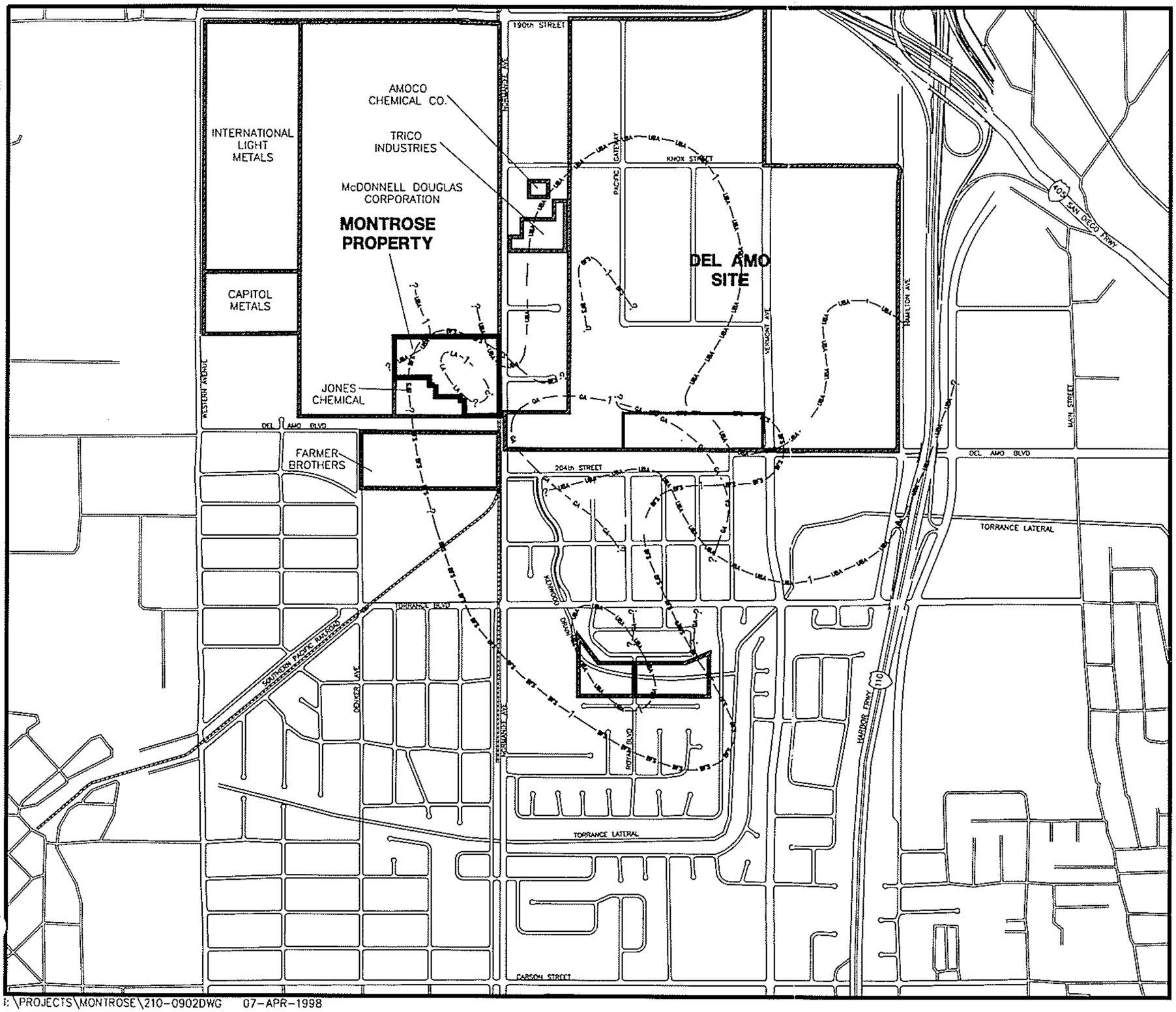
FIGURE 5.62

PREP BY _____ REV BY _____ RPT NO. 218.11.6 | 210-0866 | E



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EXPLANATION

?———— 1 ———— ——?

CONTOUR LINE OF EQUAL CONCENTRATION OF BENZENE IN MICROGRAMS PER LITER
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

—UBA—UBA— UPPER BELLFLOWER AQUITARD

—BF3—BF3— BELLFLOWER SAND

—GA—GA— GAGE AQUIFER

—LA—LA— LYNWOOD AQUIFER

NOTE:

THIS FIGURE ILLUSTRATES THE APPROXIMATE LATERAL EXTENT OF BENZENE IN GROUNDWATER WHICH OCCURS IN EACH HYDROSTRATIGRAPHIC UNIT AT CONCENTRATIONS EXCEEDING THE MAXIMUM CONTAMINANT LEVEL (MCL) FOR DRINKING WATER OF 1 MICROGRAM PER LITER.

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MONTROSE CHEMICAL CORPORATION
OF CALIFORNIA
TORRANCE, CALIFORNIA

EXTENT OF BENZENE IN GROUNDWATER-GREATER THAN THE MCL FOR DRINKING WATER

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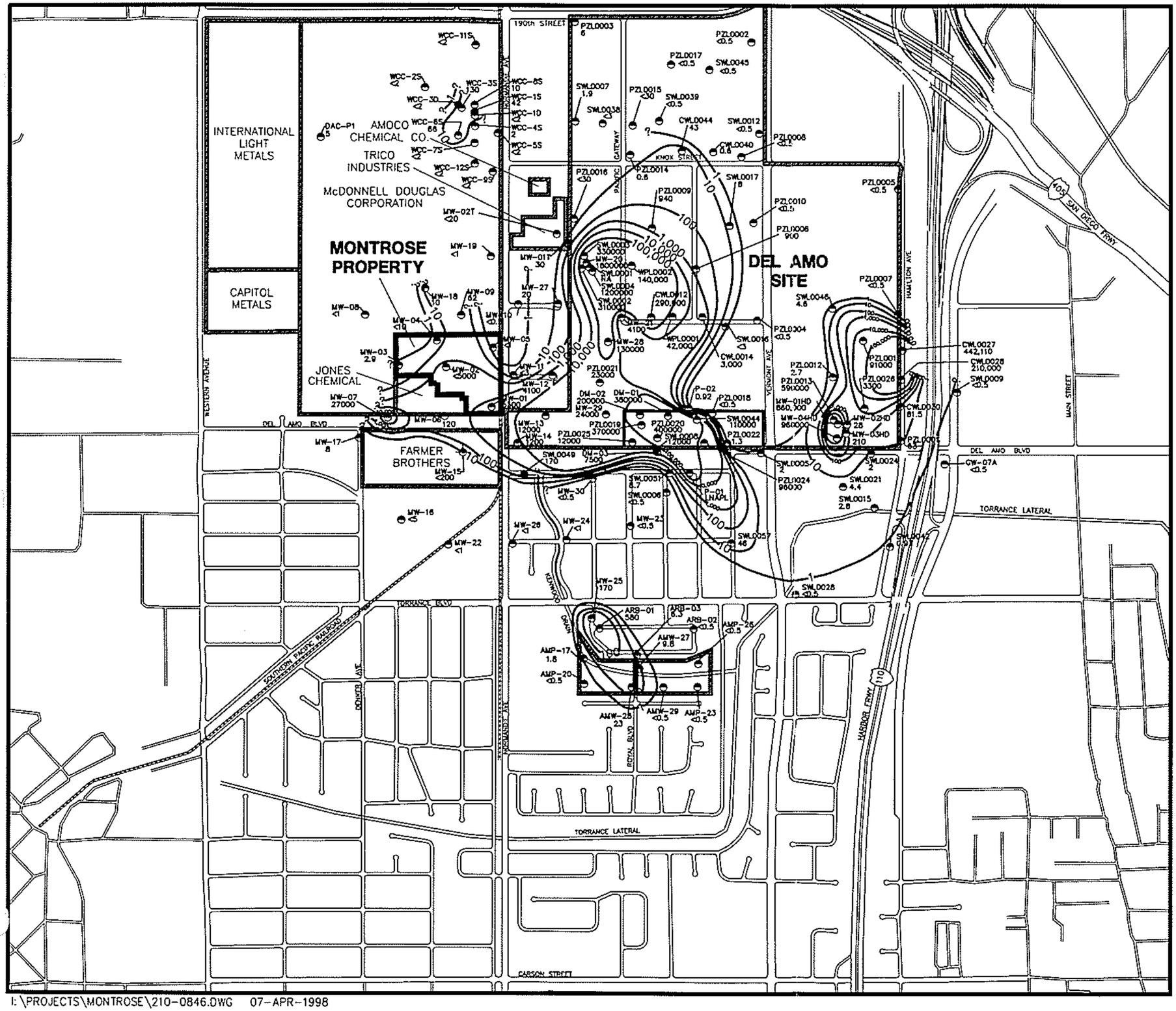
FIGURE 5.63

PREP BY _____ REV BY _____ RPT NO. 218.11.3 | 210-0902 | D



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EXPLANATION

MW-14 — UPPER BELLFLOWER AQUITARD MONITOR WELL

1200 — CONCENTRATION IN MICROGRAMS PER LITER

MW-15 — DESTROYED WELL

NA — NOT AVAILABLE

?——10,000——?
CONTOUR LINE OF EQUAL CONCENTRATION OF BENZENE IN MICROGRAMS PER LITER
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY. WITH THE EXCEPTION OF MONTROSE MONITOR WELL MW-2 AND DEL AMO MONITOR WELLS DM-01 AND DM-03, SAMPLE DATES RANGE FROM APRIL 1990 TO DECEMBER 1995. DEL AMO MONITOR WELLS DM-01 AND DM-03 WERE SAMPLED IN DECEMBER 1988. SAMPLE DATES AND A SAMPLE RESULTS SUMMARY FOR MONTROSE WELL ARE PROVIDED IN TABLE 5.5. ANALYTICAL RESULTS FOR ALL ANALYSES FOR MONTROSE WELLS ARE PROVIDED IN APPENDIX G. ANALYTICAL METHODS ARE PROVIDED IN APPENDIX B.

WELL IDENTIFIER NOTES:

MW = MONTROSE MONITOR WELLS
WCC AND DAC = McDONNELL DOUGLAS MONITOR WELLS
CWL, SWL, PZL AND GW = DEL AMO, OR OTHER MONITOR WELLS
P, MW-_T AND MW-_HD = DEL AMO, OR OTHER MONITOR WELLS
AMW, ARB, AND AMP = ARMCO MONITOR WELLS

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TORRANCE, CALIFORNIA

BENZENE IN GROUNDWATER UPPER BELLFLOWER AQUITARD

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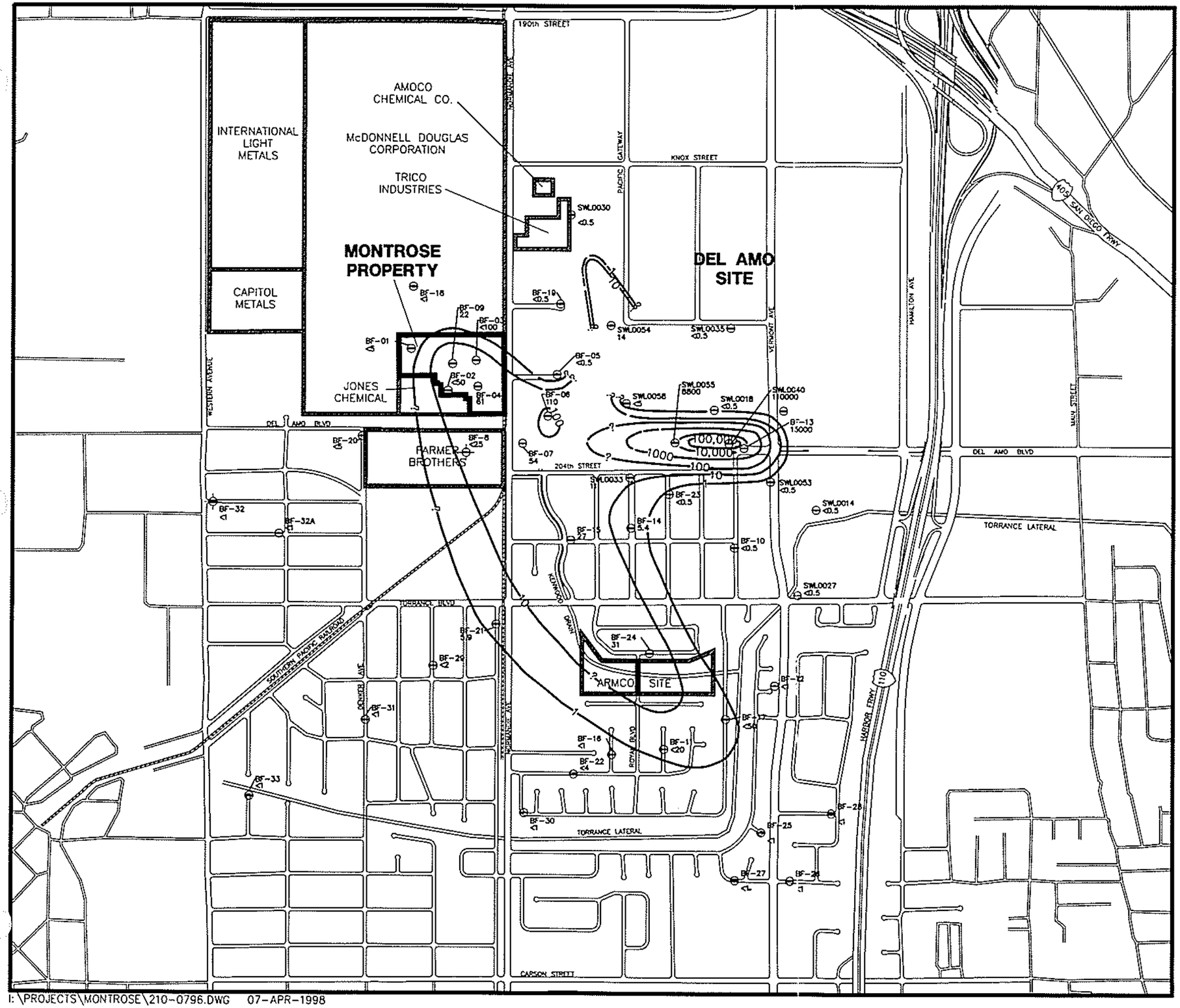
FIGURE 5.64

PREP BY _____ REV BY _____ RPT NO. 218.11.6 | 210-0846 | D



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EXPLANATION

BF-18 ⊖ — BELLFLOWER SAND MONITOR WELL

<1 — CONCENTRATION IN MICROGRAMS PER LITER

BF-8 ⊘ — DESTROYED WELL

?——1——? CONTOUR LINE OF EQUAL CONCENTRATION OF BENZENE IN MICROGRAMS PER LITER
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

WELL IDENTIFIER NOTES:
BF = MONTROSE MONITOR WELLS
SWL = DEL AMO MONITOR WELLS

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY. SAMPLE DATES RANGE FROM APRIL 1990 TO DECEMBER 1995. SAMPLE DATES AND A SAMPLE RESULTS SUMMARY FOR MONTROSE WELLS ARE PROVIDED IN TABLE 5.5. ANALYTICAL RESULTS FOR ALL ANALYSES FOR MONTROSE WELLS ARE PROVIDED IN APPENDIX C. ANALYTICAL METHODS ARE PROVIDED IN APPENDIX B.

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MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

BENZENE IN GROUNDWATER BELLFLOWER SAND

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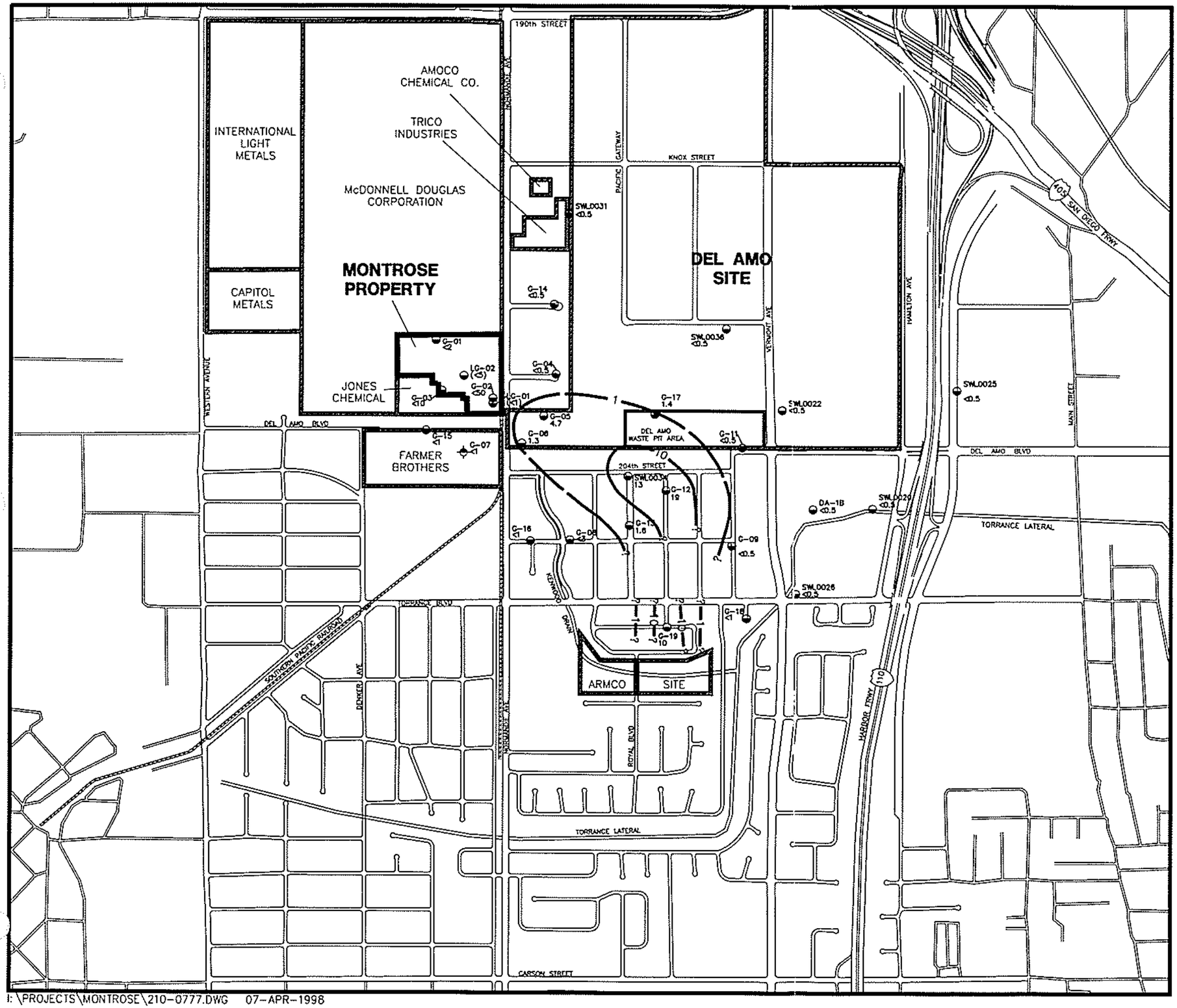
FIGURE 5.65

PREP BY _____ REV BY _____ RPT NO. 218.11.3 | 210-0796 | D



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EXPLANATION

G-11 — GAGE AQUIFER MONITOR WELL

<0.5 — CONCENTRATION IN MICROGRAMS PER LITER

LG-01 — LOWER GAGE AQUIFER MONITOR WELL

(<1) — CONCENTRATION IN MICROGRAMS PER LITER (CONCENTRATION NOT CONTOURED)

G-07 — DESTROYED WELL

?——10——?

CONTOUR LINE OF EQUAL CONCENTRATION OF BENZENE IN MICROGRAMS PER LITER
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

WELL IDENTIFIER NOTES:
G AND LG = MONTROSE MONITOR WELLS
DA AND SWL = DEL AMO MONITOR WELLS

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY. SAMPLE DATES RANGE FROM APRIL 1990 TO DECEMBER 1995. SAMPLE DATES AND A SAMPLE RESULTS SUMMARY FOR MONTROSE WELLS ARE PROVIDED IN TABLE 5.5. ANALYTICAL RESULTS FOR ALL ANALYSES FOR MONTROSE WELLS ARE PROVIDED IN APPENDIX G. ANALYTICAL METHODS ARE PROVIDED IN APPENDIX B.

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MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

BENZENE IN GROUNDWATER GAGE AQUIFER

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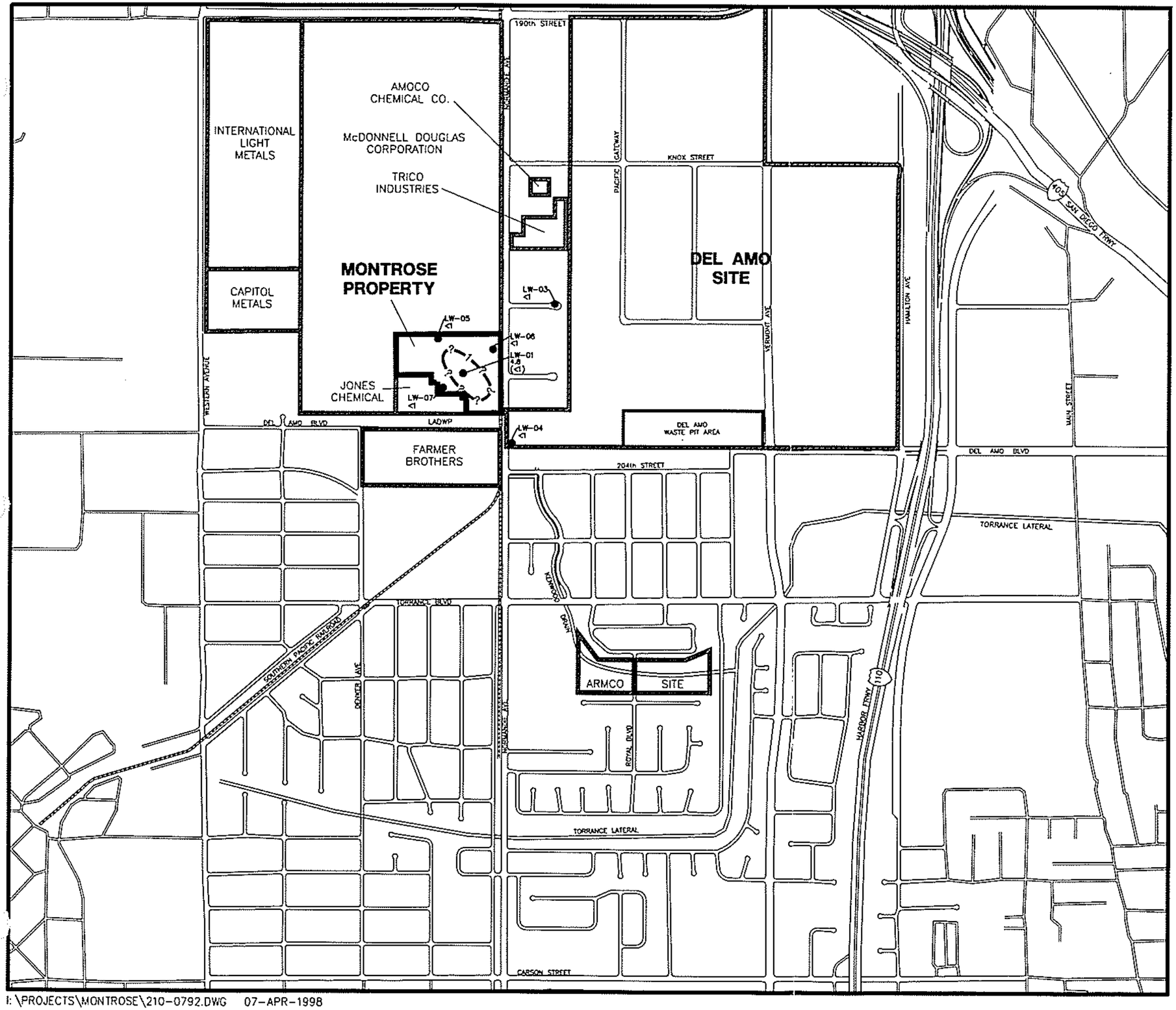
FIGURE 5.66

PREP BY _____ REV BY _____ RPT NO. 218.11.6 | 210-0777 | C



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EXPLANATION

LW-04 ● — LYNWOOD AQUIFER MONITOR WELL

<1 — CONCENTRATION IN MICROGRAMS PER LITER

(<1) — CONCENTRATION IN MICROGRAMS PER LITER IN LABORATORY SPLIT SAMPLE

?——1——?

CONTOUR LINE OF EQUAL CONCENTRATION OF BENZENE IN MICROGRAMS PER LITER
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

< - LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY. SAMPLE DATES RANGE FROM APRIL 1990 TO DECEMBER 1995. SAMPLE DATES AND A SAMPLE RESULTS SUMMARY FOR MONTROSE WELLS ARE PROVIDED IN TABLE 5.5. ANALYTICAL RESULTS FOR ALL ANALYSES FOR MONTROSE WELLS ARE PROVIDED IN APPENDIX G. ANALYTICAL METHODS ARE PROVIDED IN APPENDIX B.

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TORRANCE, CALIFORNIA

BENZENE IN GROUNDWATER LYNWOOD AQUIFER

HARGIS + ASSOCIATES, INC. 7/97
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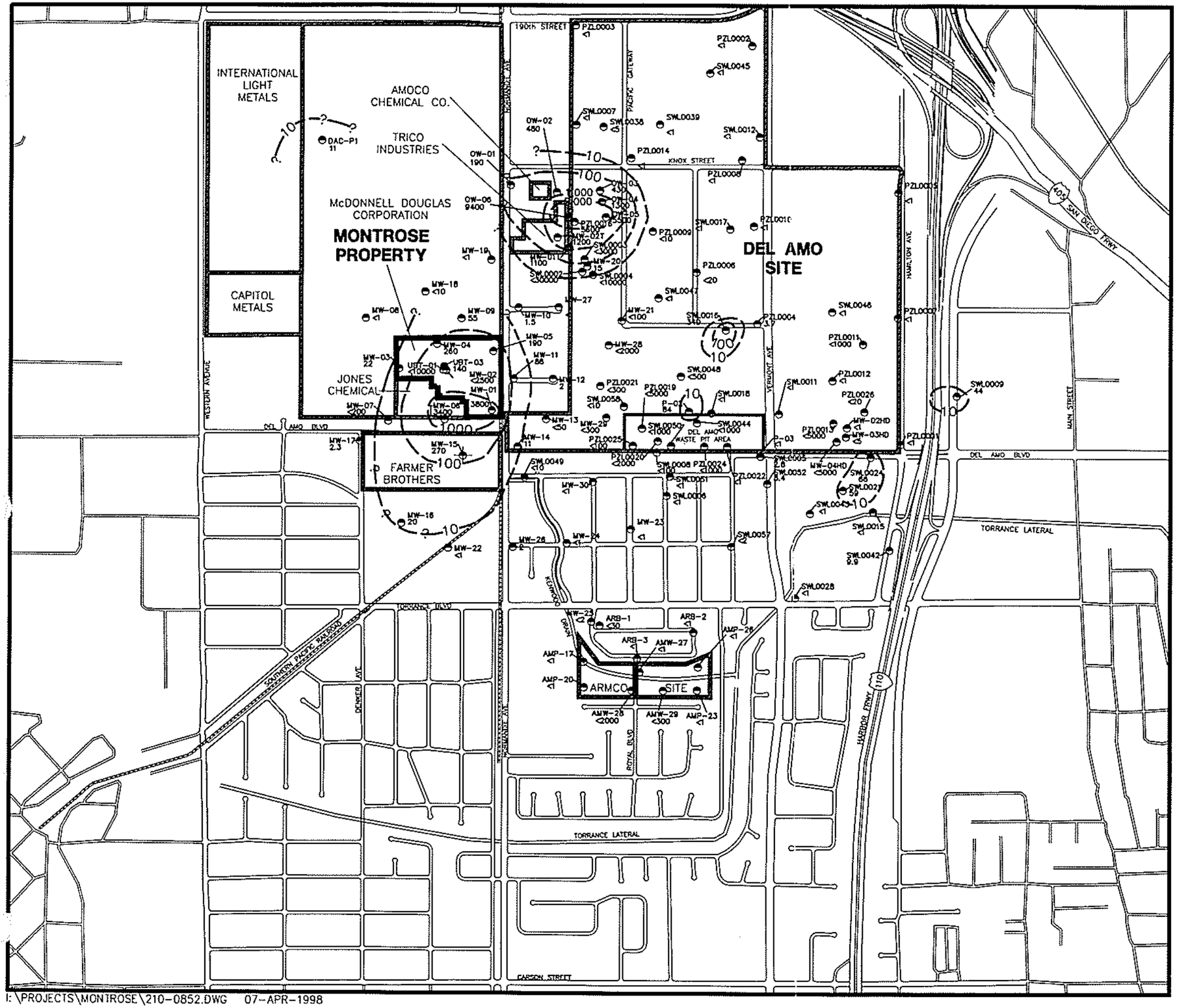
FIGURE 5.67

PREP BY _____ REV BY _____ RPT NO. 218.11.3 | 210-0792 | E



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EXPLANATION

MW-05 — UPPER BELLFLOWER AQUITARD MONITOR WELL

190 — CONCENTRATION IN MICROGRAMS PER LITER

MW-15 — DESTROYED WELL

? —— 100 —— ? — CONTOUR LINE OF EQUAL CONCENTRATION OF TETRACHLOROETHYLENE IN MICROGRAMS PER LITRE DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY. WITH THE EXCEPTION OF MONTROSE MONITOR WELL MW-2, SAMPLE DATES RANGE FROM APRIL 1990 TO DECEMBER 1995. SAMPLE DATES AND A SAMPLE RESULTS SUMMARY FOR MONTROSE WELLS ARE PROVIDED IN TABLE 5.5. ANALYTICAL RESULTS FOR ALL ANALYSES FOR MONTROSE WELLS ARE PROVIDED IN APPENDIX G. ANALYTICAL METHODS ARE PROVIDED IN APPENDIX B.

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

WELL IDENTIFIER NOTES:

MW/UBT/UBE	= MONTROSE MONITOR WELLS
DAC	= McDONNELL DOUGLAS MONITOR WELLS*
SWL, PZL, GW, P, AND MW	= DEL AMO MONITOR WELLS
AMP, ARB AND AMW	= ARMCO
OW	= AMOCO

* NOTE: CONCENTRATIONS OF PCE DETECTED IN McDONNEL DOUGLAS MONITOR WELLS NOT SHOWN ON THIS MAP, WERE ALL NON DETECT AT A DETECTION LIMIT OF 2 ug/l

N

0 1000 2000

FEET

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TETRACHLOROETHYLENE IN GROUNDWATER UPPER BELLFLOWER AQUITARD

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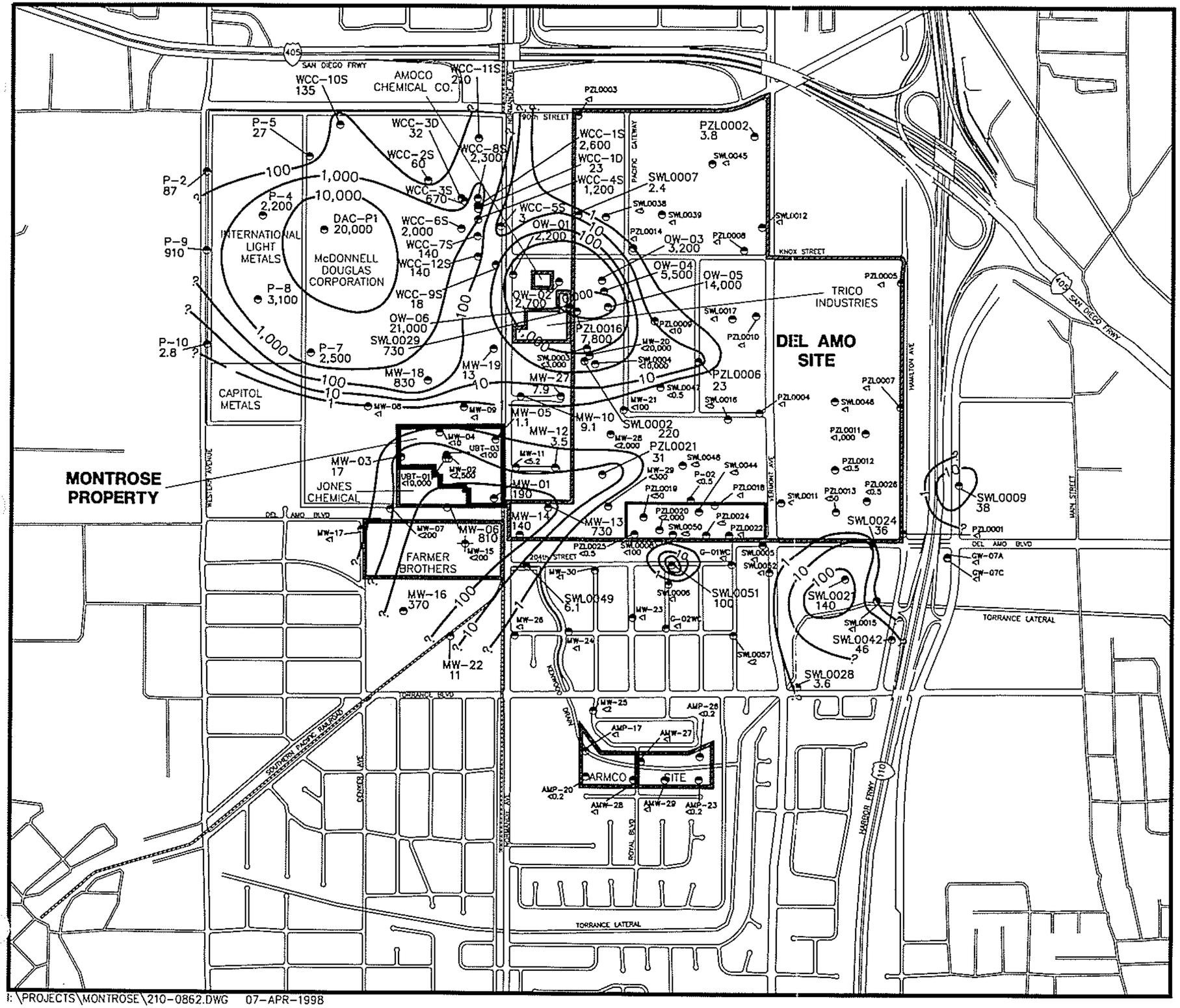
FIGURE 5.6B

PREP BY _____ REV BY _____ RPT NO. 218.11.3 | 210-0852 | D



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EXPLANATION

MW-4 — UPPER BELLFLOWER AQUITARD MONITOR WELL

<10 — CONCENTRATION IN MICROGRAMS PER LITER

MW-15 — DESTROYED WELL

?——100——?

CONTOUR LINE OF EQUAL CONCENTRATION OF TRICHLOROETHYLENE IN MICROGRAMS PER LITRE
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY. WITH THE EXCEPTION OF MONTROSE MONITOR WELL MW-2, SAMPLE DATES RANGE FROM APRIL 1990 TO DECEMBER 1995. SAMPLE DATES AND A SAMPLE RESULTS SUMMARY FOR MONTROSE WELLS ARE PROVIDED IN TABLE 5.5. ANALYTICAL RESULTS FOR ALL ANALYSES FOR MONTROSE WELLS ARE PROVIDED IN APPENDIX C. ANALYTICAL METHODS ARE PROVIDED IN APPENDIX B.

WELL IDENTIFIER NOTES:

MW, UBE, AND UBT = MONTROSE MONITOR WELLS
WCC, DAC, AND P = McDONNELL DOUGLAS MONITOR WELLS
SWL, PZL, GW, P, AND MW = DEL AMO MONITOR WELLS
OW = AMOCO MONITOR WELLS
AMP AND AMW = ARMCO MONITOR WELLS

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

TRICHLOROETHYLENE IN GROUNDWATER UPPER BELLFLOWER AQUITARD

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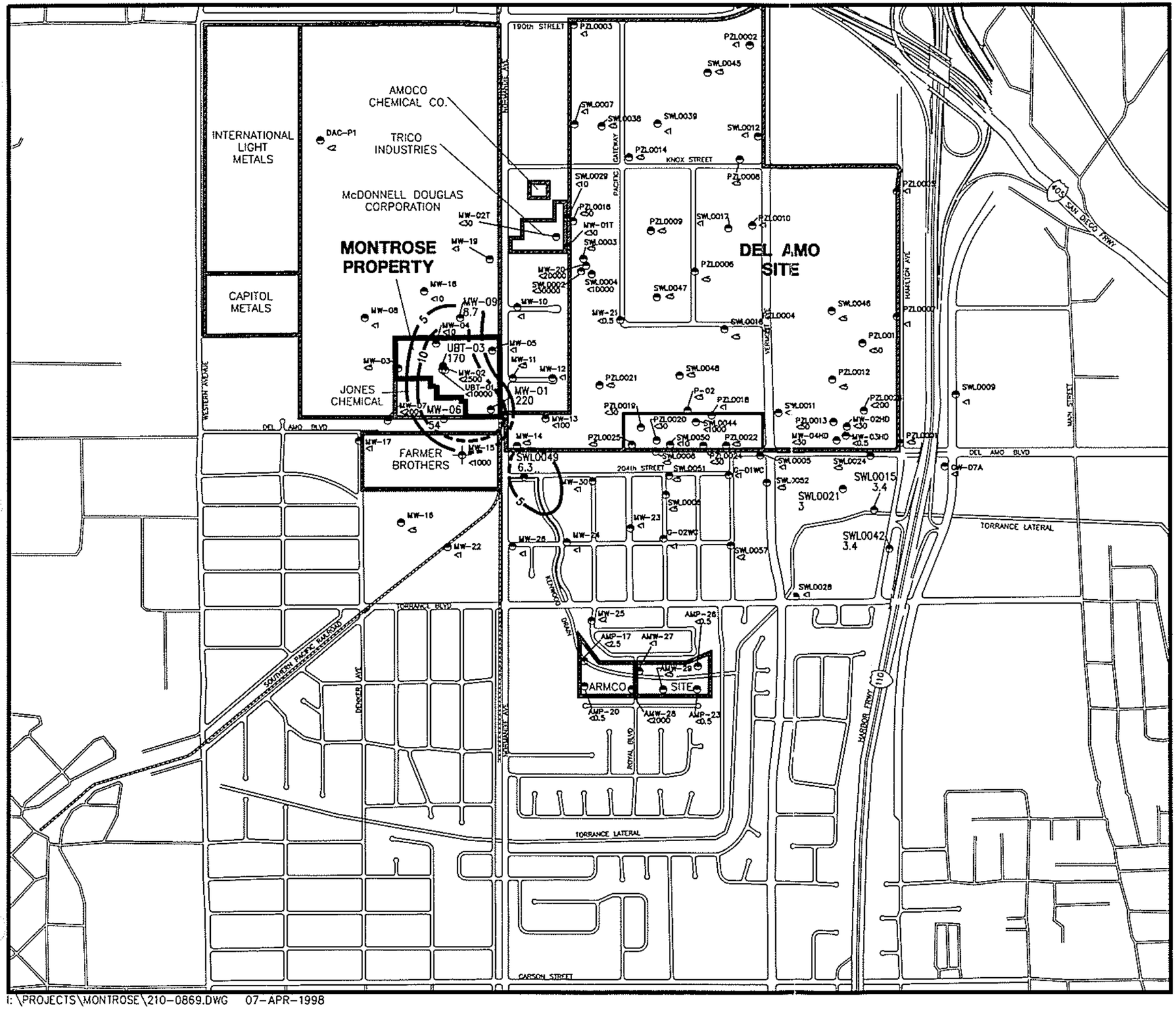
FIGURE 5.69

PREP BY	REV BY	RPT NO. 218.11.3	210-0862	E



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EXPLANATION

MW-12 — UPPER BELLFLOWER AQUITARD MONITOR WELL

<1 — CONCENTRATION IN MICROGRAMS PER LITER

MW-15 — DESTROYED WELL

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY. WITH THE EXCEPTION OF MONTROSE MONITOR WELL MW-2, SAMPLE DATES RANGE FROM APRIL 1990 TO DECEMBER 1995. SAMPLE DATES AND A SAMPLE RESULTS SUMMARY FOR MONTROSE WELLS ARE PROVIDED IN TABLE 5.5. ANALYTICAL RESULTS FOR ALL ANALYSES FOR MONTROSE WELLS ARE PROVIDED IN APPENDIX G. ANALYTICAL METHODS ARE PROVIDED IN APPENDIX B.

WELL IDENTIFIER NOTES:

MW = MONTROSE MONITOR WELLS
DAC = McDONNELL DOUGLAS MONITOR WELLS
SWL, PZL, GW, P, MW-_T, AND MW-_HD = DEL AMO MONITOR WELLS
AMP AND AMW = ARMCO MONITOR WELLS

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TORRANCE, CALIFORNIA

1,4-DICHLOROBENZENE IN GROUNDWATER UPPER BELLFLOWER AQUITARD

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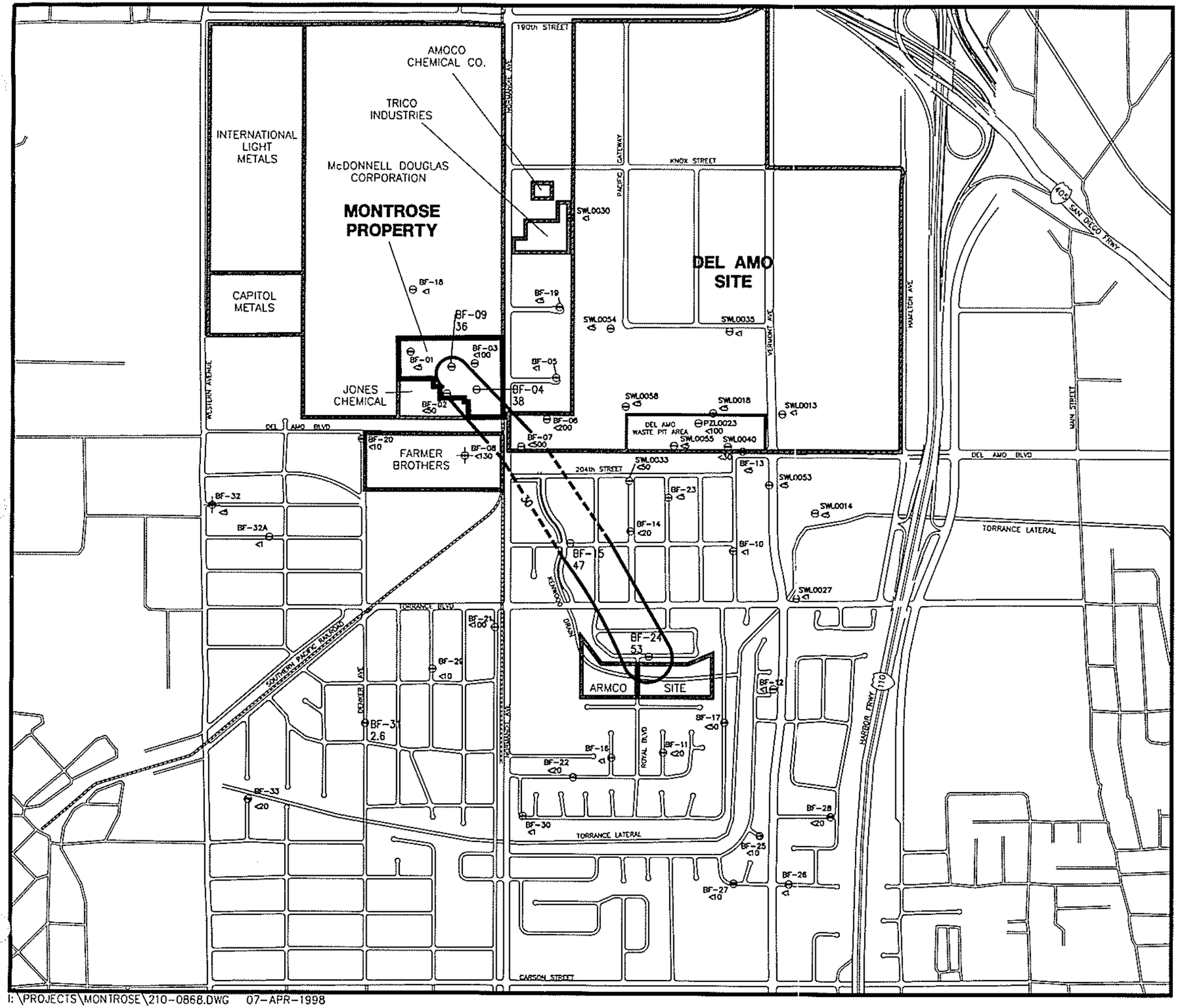
FIGURE 5.70

PREP BY _____ REV BY _____ RPT NO. 218.11.3 | 210-0869 | D



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EXPLANATION

BF-19 ⊖ — BELLFLOWER SAND MONITOR WELL

<5 — CONCENTRATION IN MICROGRAMS PER LITER

BF-08 ⊕ — DESTROYED WELL

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY. SAMPLE DATES RANGE FROM APRIL 1990 TO DECEMBER 1995. SAMPLE DATES AND A SAMPLE RESULTS SUMMARY FOR MONTROSE WELLS ARE PROVIDED IN TABLE 5.5. ANALYTICAL RESULTS FOR ALL ANALYSES FOR MONTROSE WELLS ARE PROVIDED IN APPENDIX G. ANALYTICAL METHODS ARE PROVIDED IN APPENDIX B.

WELL IDENTIFIER NOTES:
BF = MONTROSE MONITOR WELLS
PZL, SWL = DEL AMO MONITOR WELLS

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1,4-DICHLOROBENZENE IN GROUNDWATER BELLFLOWER SAND

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FIGURE 5.71

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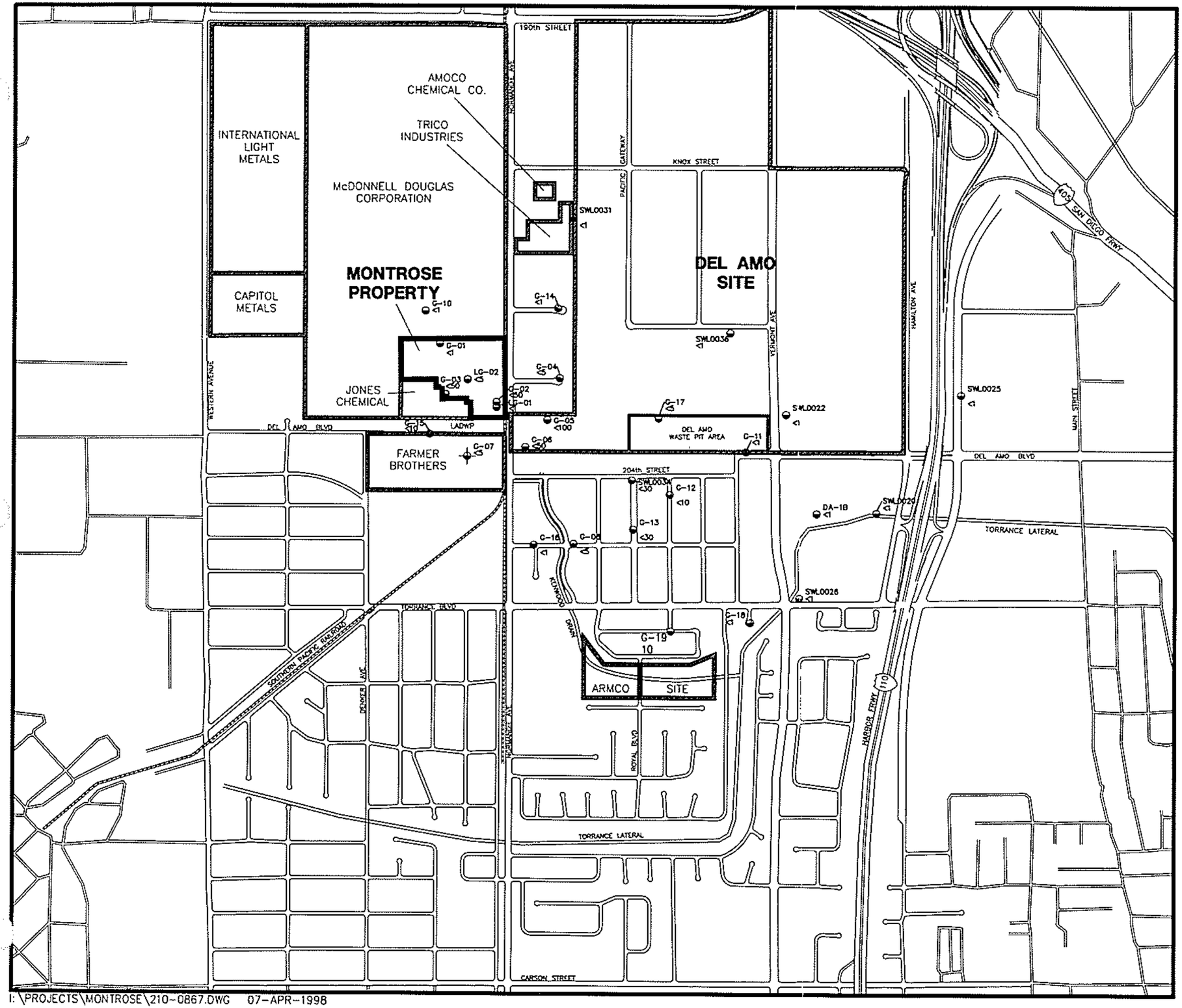

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EXPLANATION

G-04 — GAGE AQUIFER MONITOR WELL

<5 — CONCENTRATION IN MICROGRAMS PER LITER

G-07 — DESTROYED WELL

LG-02 — LOWER GAGE AQUIFER MONITOR WELL

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

WELL IDENTIFIER NOTES:
G AND LG = MONTROSE MONITOR WELLS
DA AND SWL = DEL AMO MONITOR WELLS

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY. SAMPLE DATES RANGE FROM APRIL 1990 TO DECEMBER 1995. SAMPLE DATES AND A SAMPLE RESULTS SUMMARY FOR MONTROSE WELLS ARE PROVIDED IN TABLE 5.5. ANALYTICAL RESULTS FOR ALL ANALYSES FOR MONTROSE WELLS ARE PROVIDED IN APPENDIX G. ANALYTICAL METHODS ARE PROVIDED IN APPENDIX B.

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0 1000 2000

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MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

1,4-DICHLOROBENZENE IN GROUNDWATER GAGE AQUIFER

HARGIS+ASSOCIATES, INC.
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FIGURE 5.72

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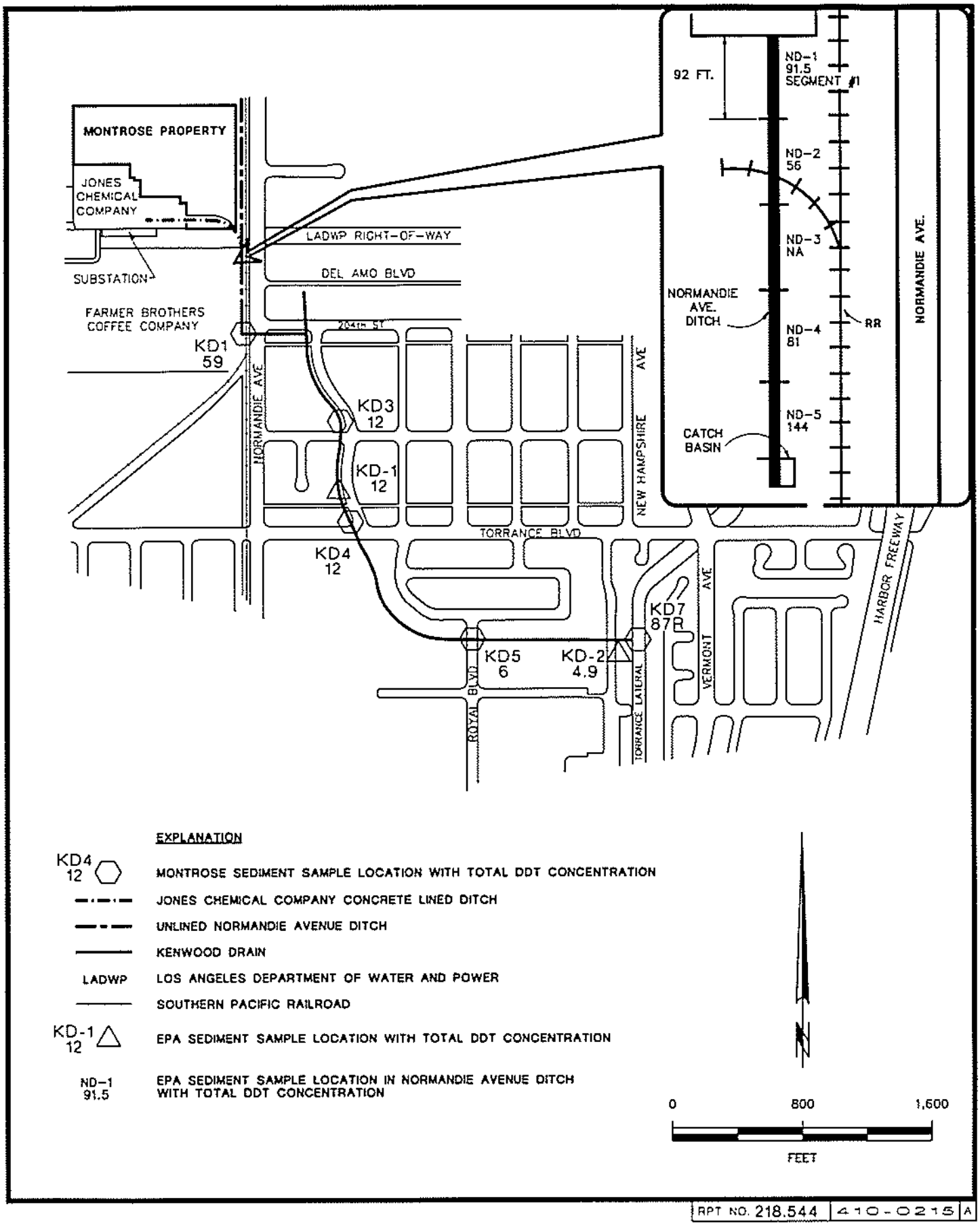

RPT NO. 218.544 | 410-0215 | A

FIGURE 5.73
TOTAL DDT IN SEDIMENT, NORMANDIE AVE. DITCH AND KENWOOD DRAIN

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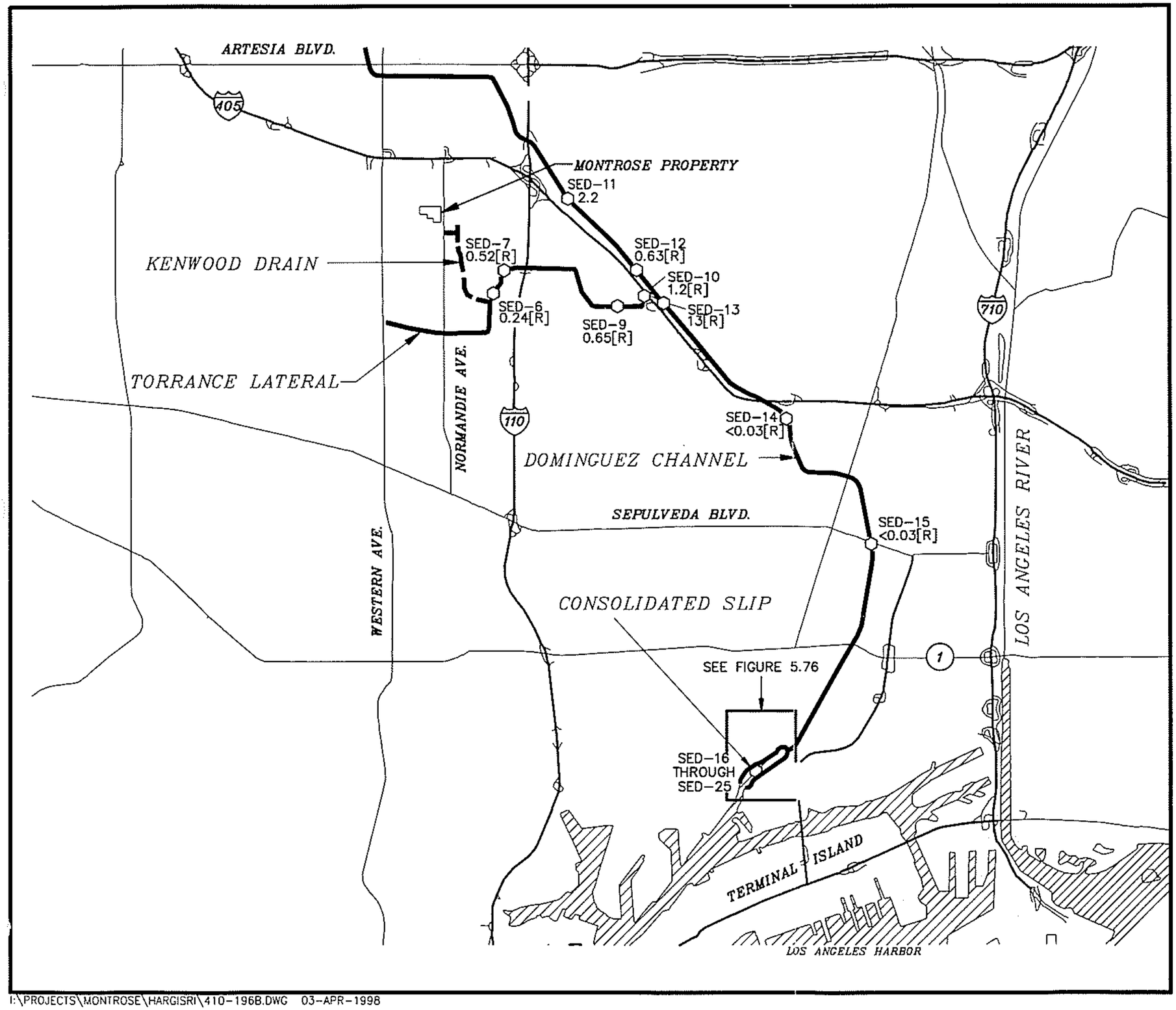

EXPLANATION

SED-11 ⬡	SEDIMENT SAMPLE LOCATION
13	CONCENTRATION OF TOTAL DDT IN mg/kg
(<)	LESS THAN: NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.
[R]	QUALIFIED BY EPA AS UNUSABLE FOR ANY PURPOSE

BASE MAP FROM: USGS DLG 7.5 MINUTE QUADRANGLES

0 5,000 10,000

FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

TOTAL DDT IN SEDIMENT, TORRANCE LATERAL AND DOMINGUEZ CHANNEL, MONTROSE SAMPLING 1986

7/97

FIGURE 5.74

PREP BY _____ REV BY _____ RPT NO. 218.544 | 410-196B | 8

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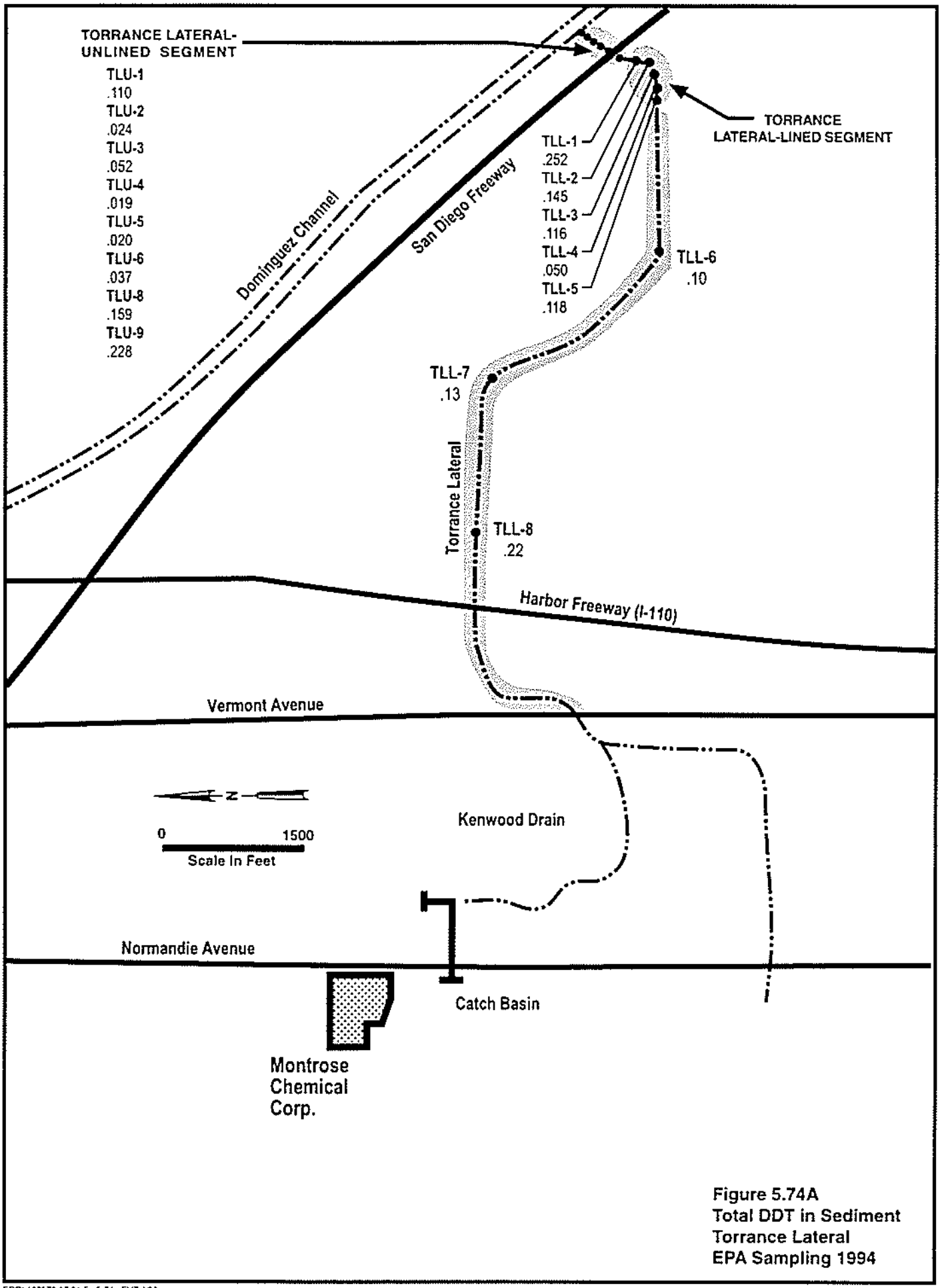
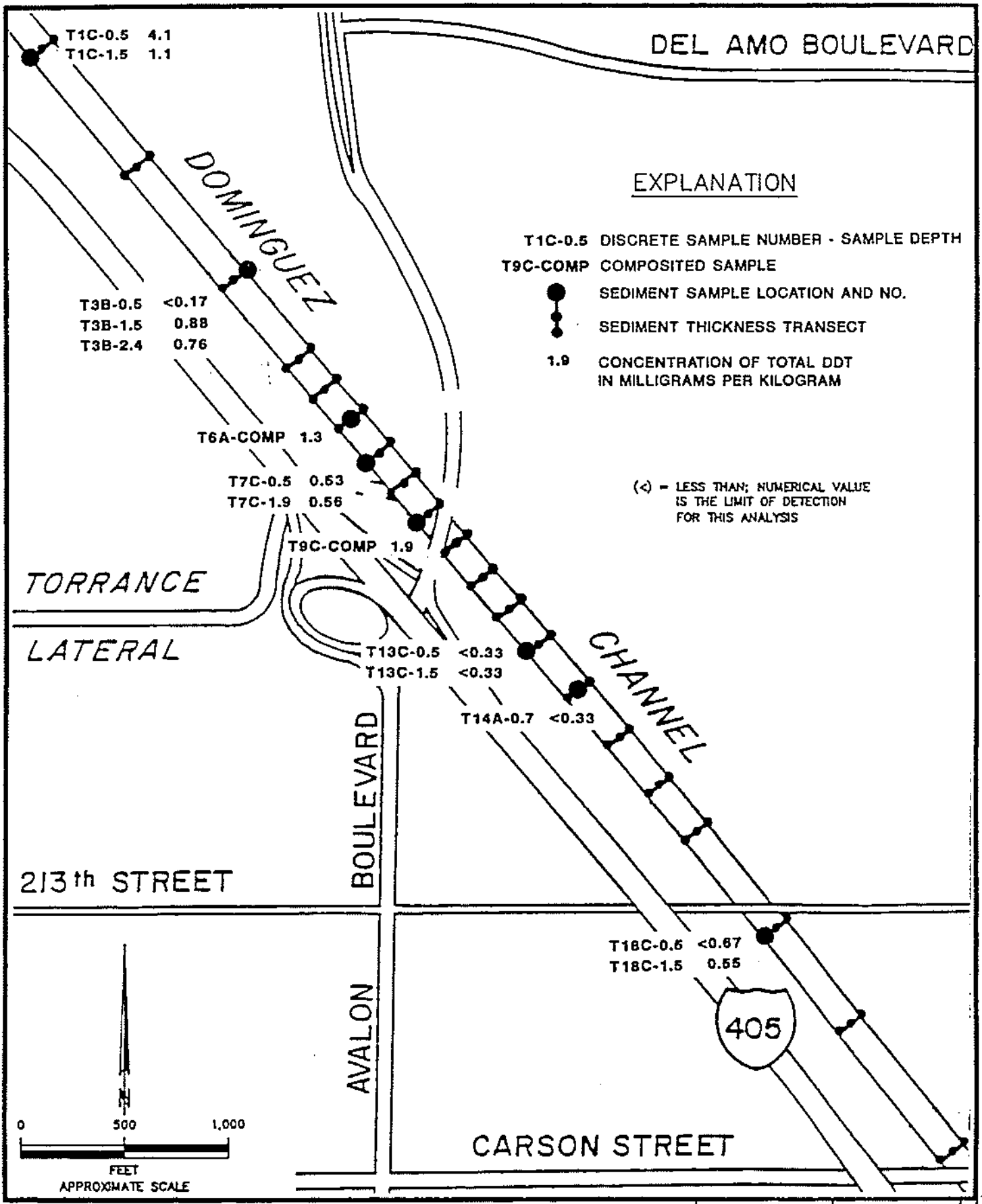


Figure 5.74A
Total DDT in Sediment
Torrance Lateral
EPA Sampling 1994

SCOb102573 17 01 Fig5-74a FH7 4-98



SCOh102573.17.01 F5.75.cdr 4/98

FIGURE 5.75 TOTAL DDT IN SEDIMENT, DOMINGUEZ CHANNEL, MONTROSE SAMPLING 1988

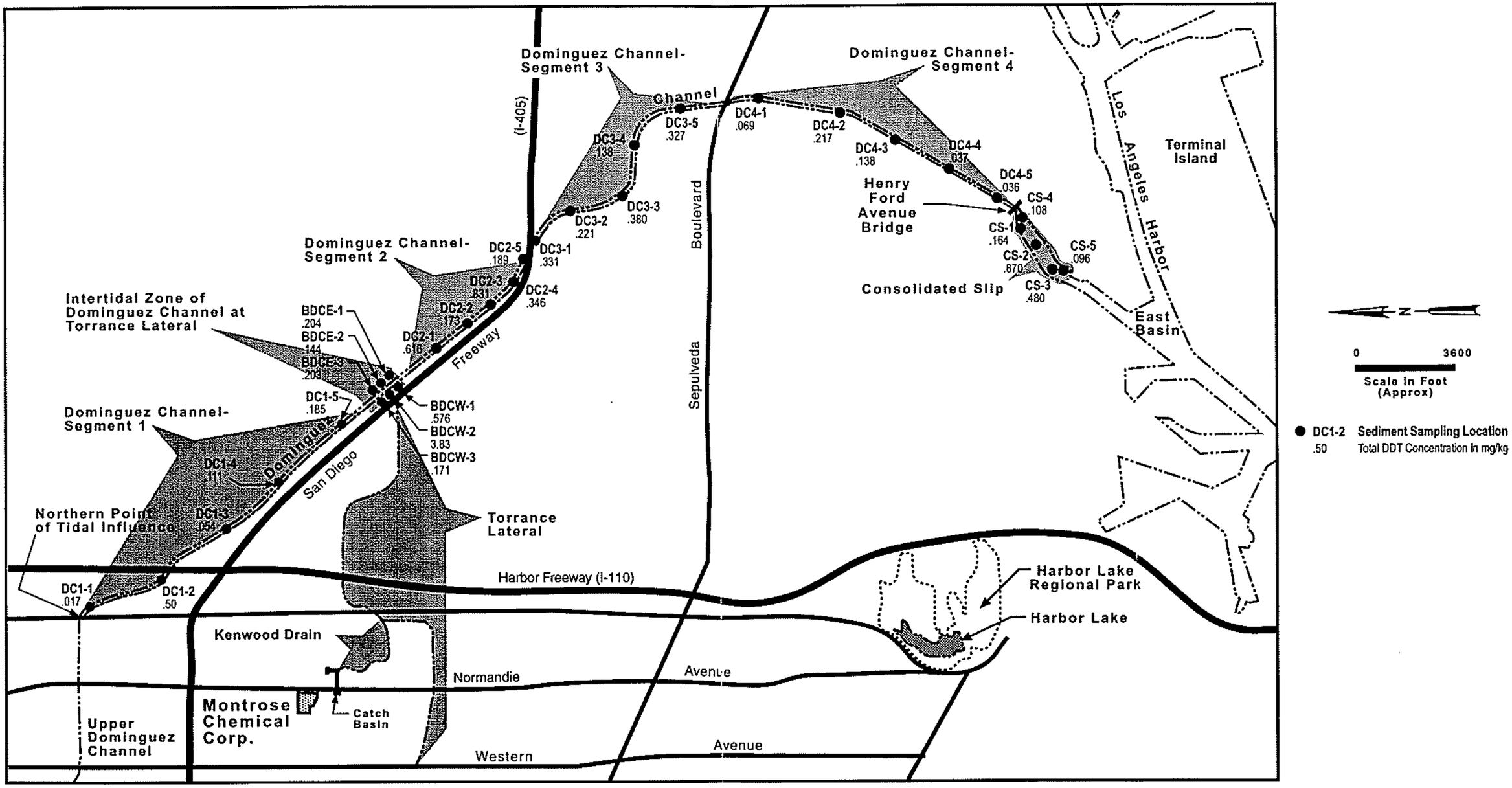
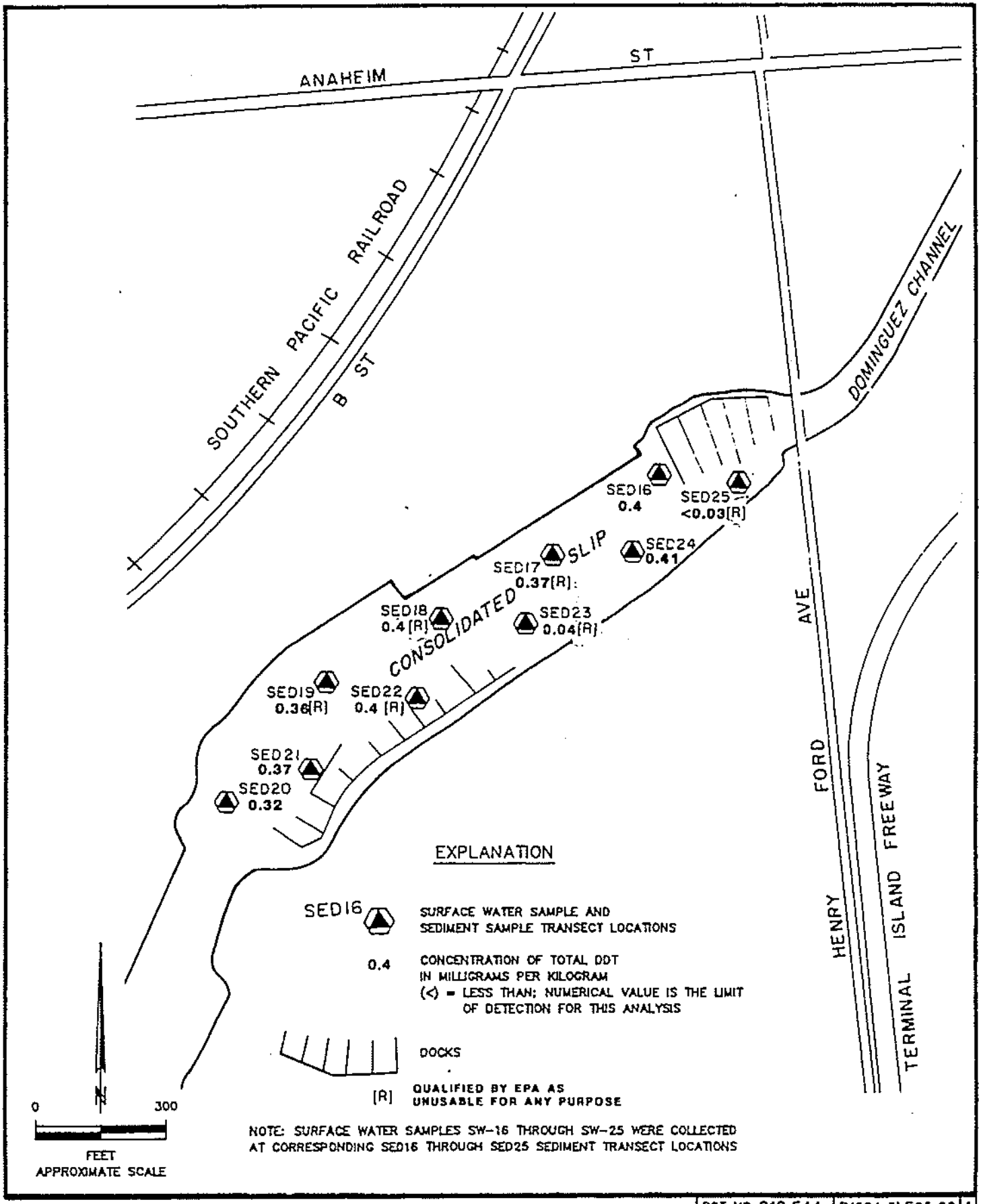


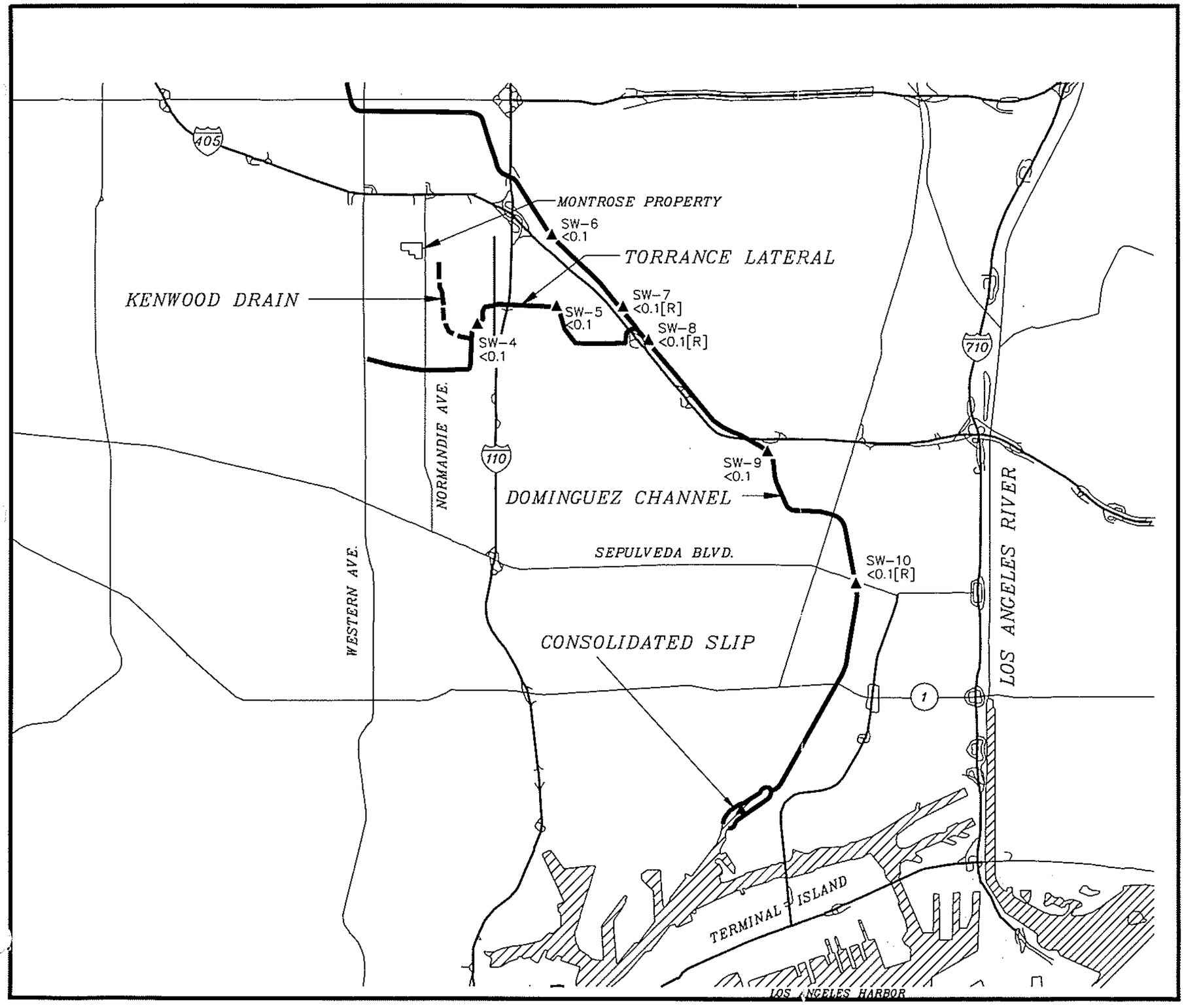
Figure 5.75A
Total DDT in Sediment
Dominguez Channel
and Consolidated Slip
EPA Sampling 1994



RPT NO. 218.544 | R1504-5\F05-32 | A

SCOh102573 17.01 F5 76 cdr 4/98

FIGURE 5.76 TOTAL DDT IN SEDIMENT, CONSOLIDATED SLIP, MONTROSE SAMPLING 1986



EXPLANATION

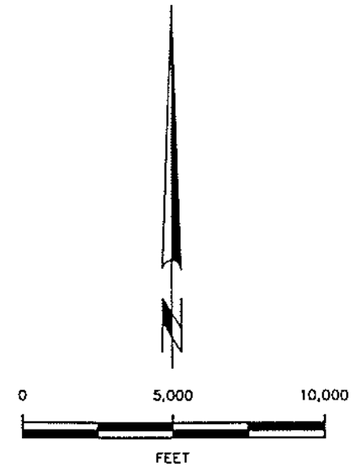
SW-6 ▲ DRY WEATHER SURFACE WATER SAMPLE LOCATION

<0.1 CONCENTRATION OF TOTAL DDT IN MICROGRAMS PER LITER

[R] QUALIFIED BY EPA AS UNUSABLE FOR ANY PURPOSE

NOTE: SAMPLES WERE ANALYZED UNFILTERED

BASE MAP FROM: USGS DLG 7.5 MINUTE QUADRANGLES



MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

TOTAL DDT IN DRY WEATHER SURFACE WATER SAMPLES, TORRANCE LATERAL AND DOMINGUEZ CHANNEL, MONTROSE SAMPLING 1986

7/97

FIGURE 5.77

PREP BY	REV BY	RPT NO. 218.544	410-2008	B

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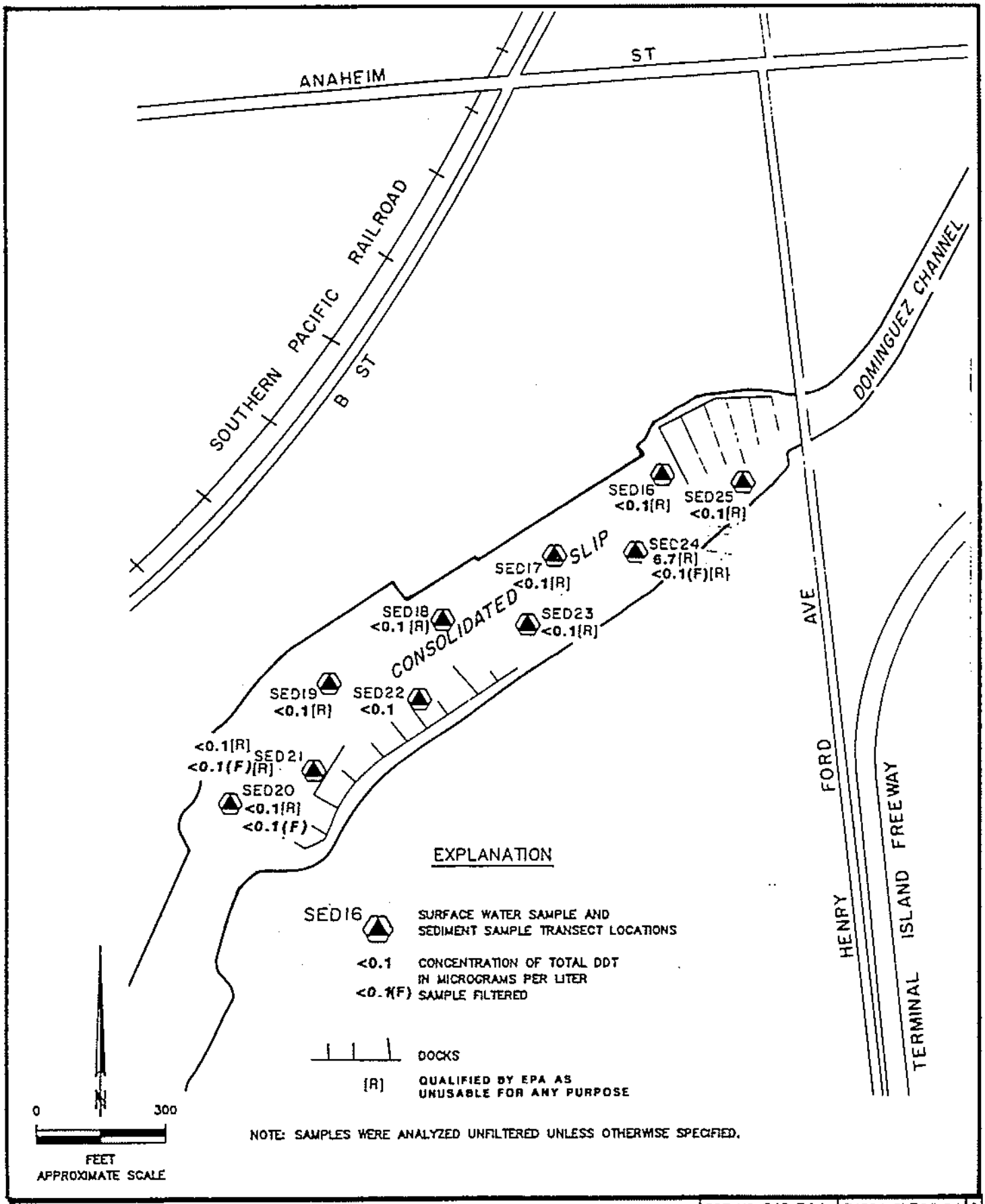
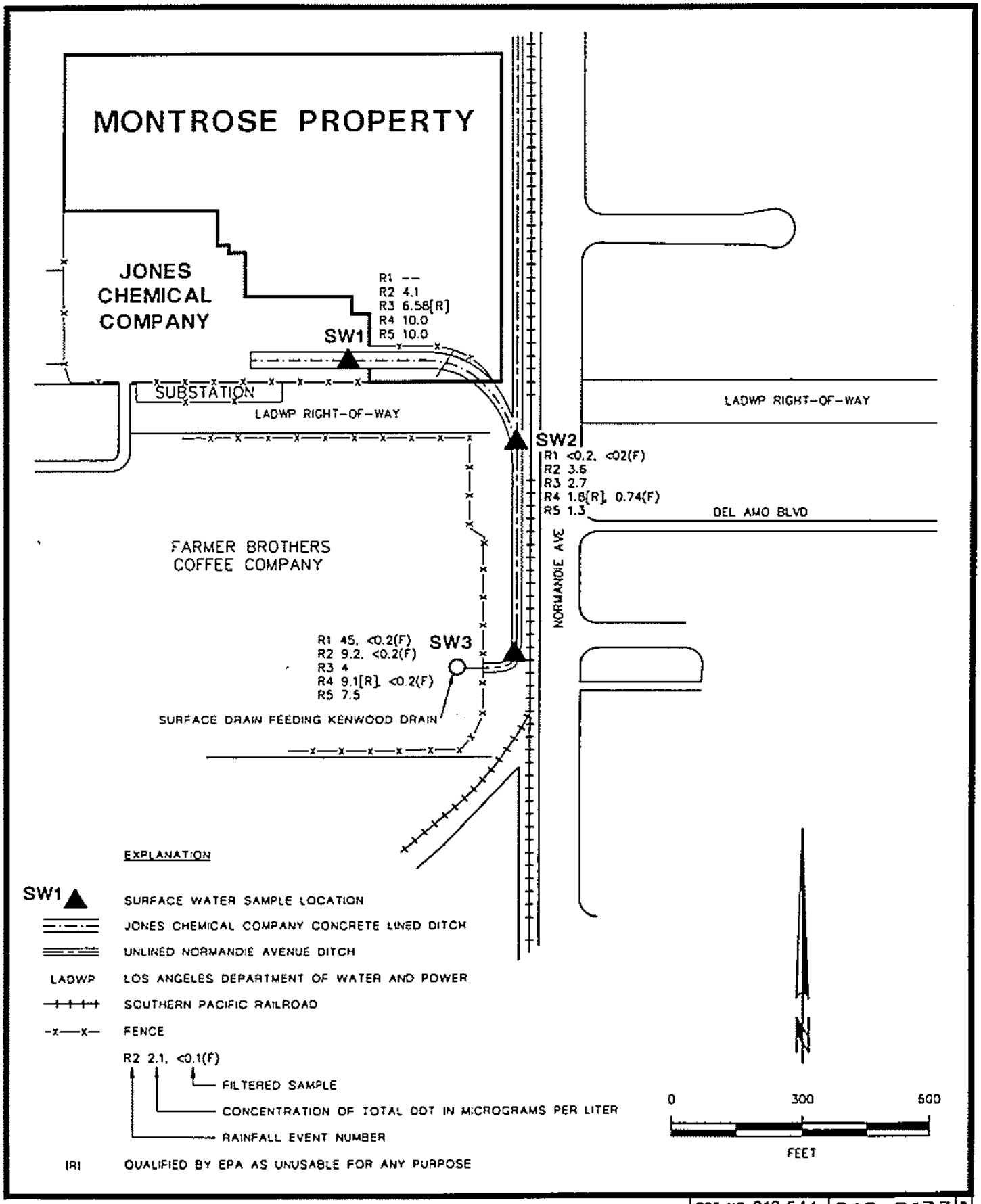


SCOh102573 17.01 F5.78 cdr 4/98

RPT NO. 218.544 | R1504-5\F05-34 | A

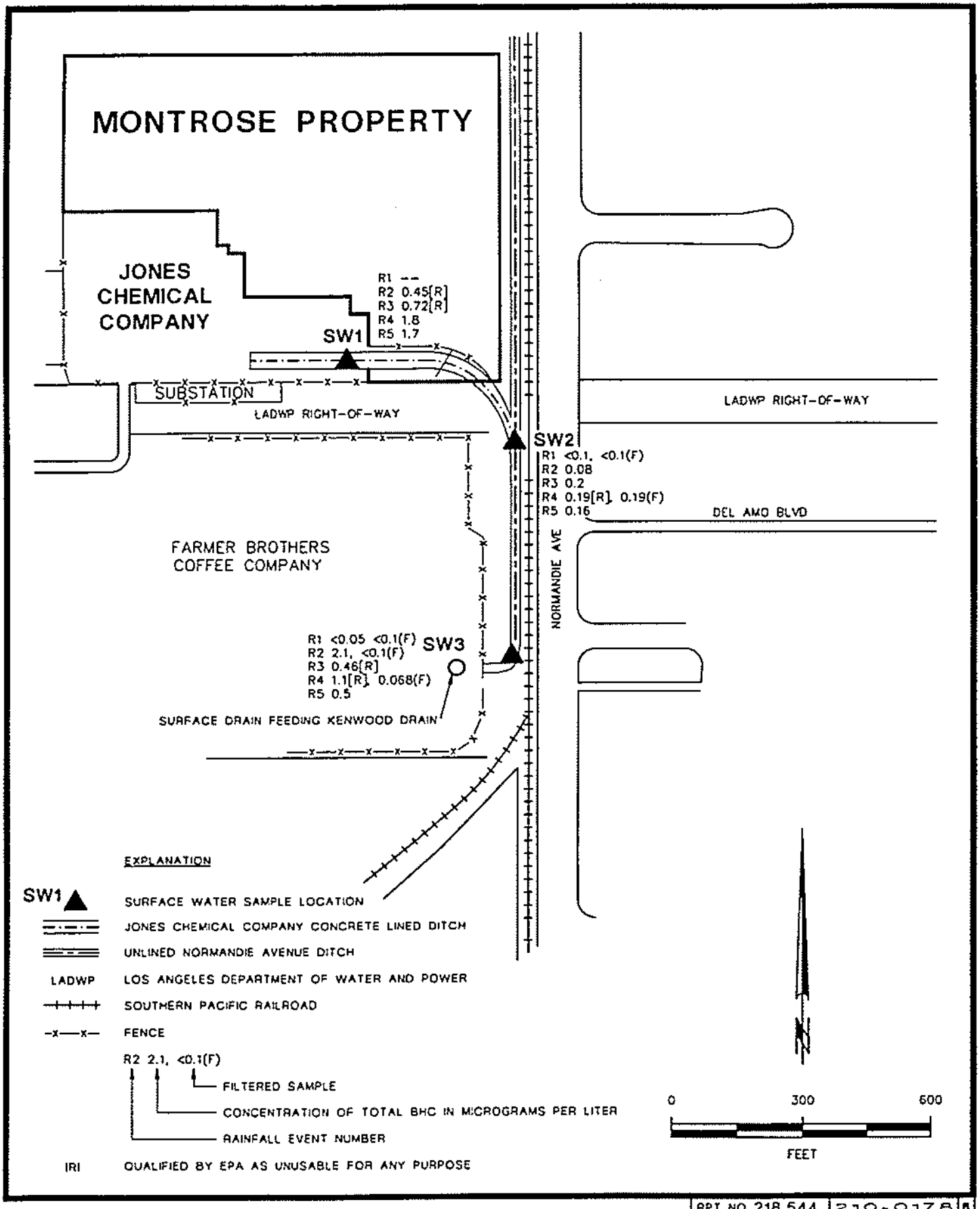
FIGURE 5.78 TOTAL DDT IN DRY WEATHER SURFACE WATER SAMPLES
CONSOLIDATED SLIP, MONTROSE SAMPLING 1986



RPT NO. 218.544 | 210-0177 | B

SCOh102573.17.01 FS 79 cdr 4/98

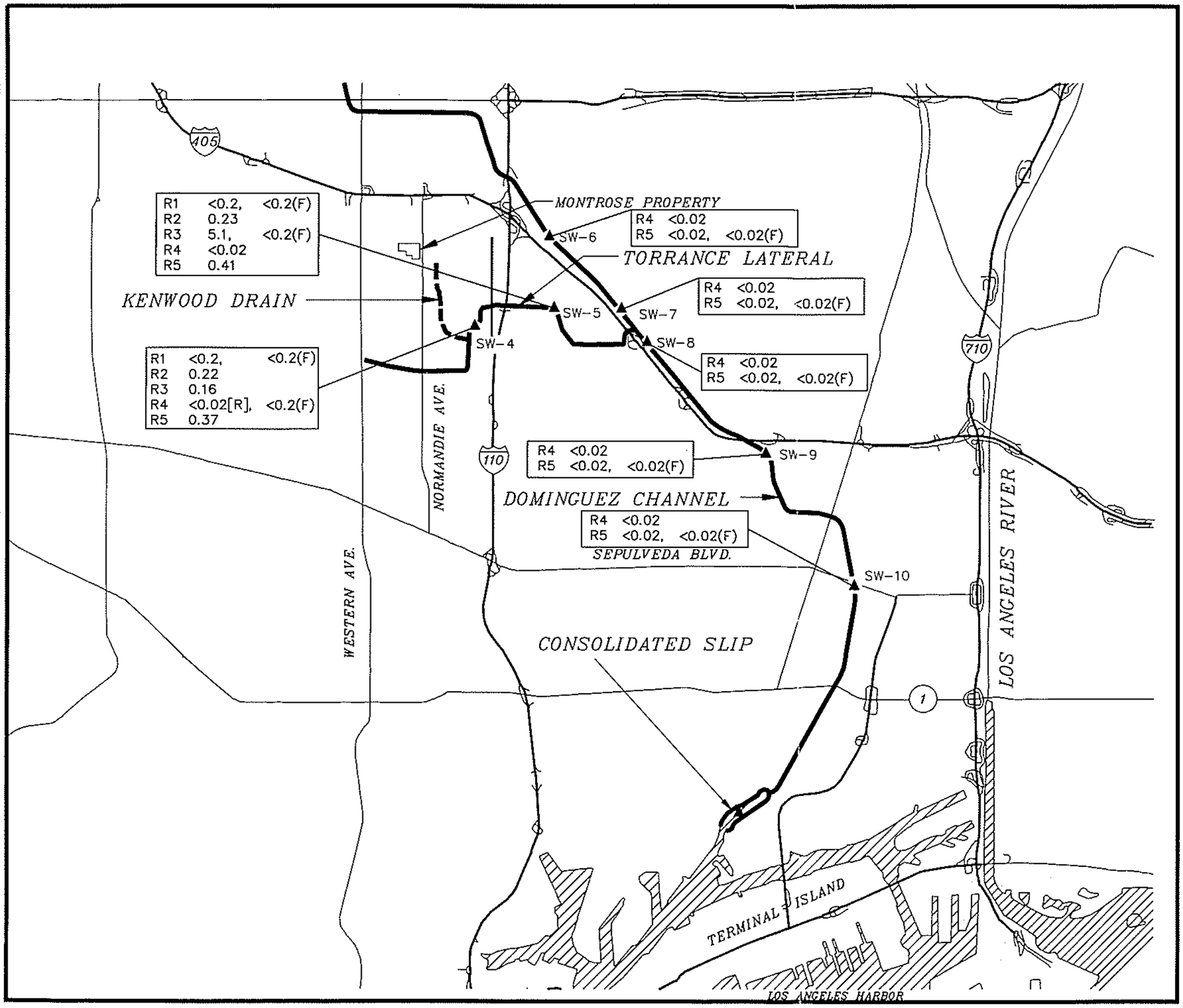
FIGURE 5.79 TOTAL DDT IN WET WEATHER SURFACE WATER SAMPLES NEAR PROPERTY, MONTROSE SAMPLING 1986-1987



SCOh102573 17.01 F5 80 cdr 4/98

RPT NO. 218.544 210-0178 B

FIGURE 5.80 TOTAL BHC IN WET WEATHER SURFACE WATER SAMPLES NEAR PROPERTY, MONTROSE SAMPLING 1986-1987



EXPLANATION

SW-6 ▲ WET WEATHER SURFACE WATER SAMPLE LOCATION

R4 <0.02
R5 <0.02 <0.02(F)

- FILTERED SAMPLE CONCENTRATION OF TOTAL DDT
- RAINFALL EVENT NUMBER

[R] QUALIFIED BY EPA AS UNUSABLE FOR ANY PURPOSE

BASE MAP FROM: USGS DLG 7.5 MINUTE QUADRANGLES

0 5,000 10,000
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

TOTAL DDT IN WET WEATHER SURFACE WATER SAMPLES, TORRANCE LATERAL AND DOMINGUEZ CHANNEL, MONTROSE SAMPLING 1986-1987

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FIGURE 5.81

PREP BY _____ REV BY _____ RPT NO. 218.544 | 410-200C | B

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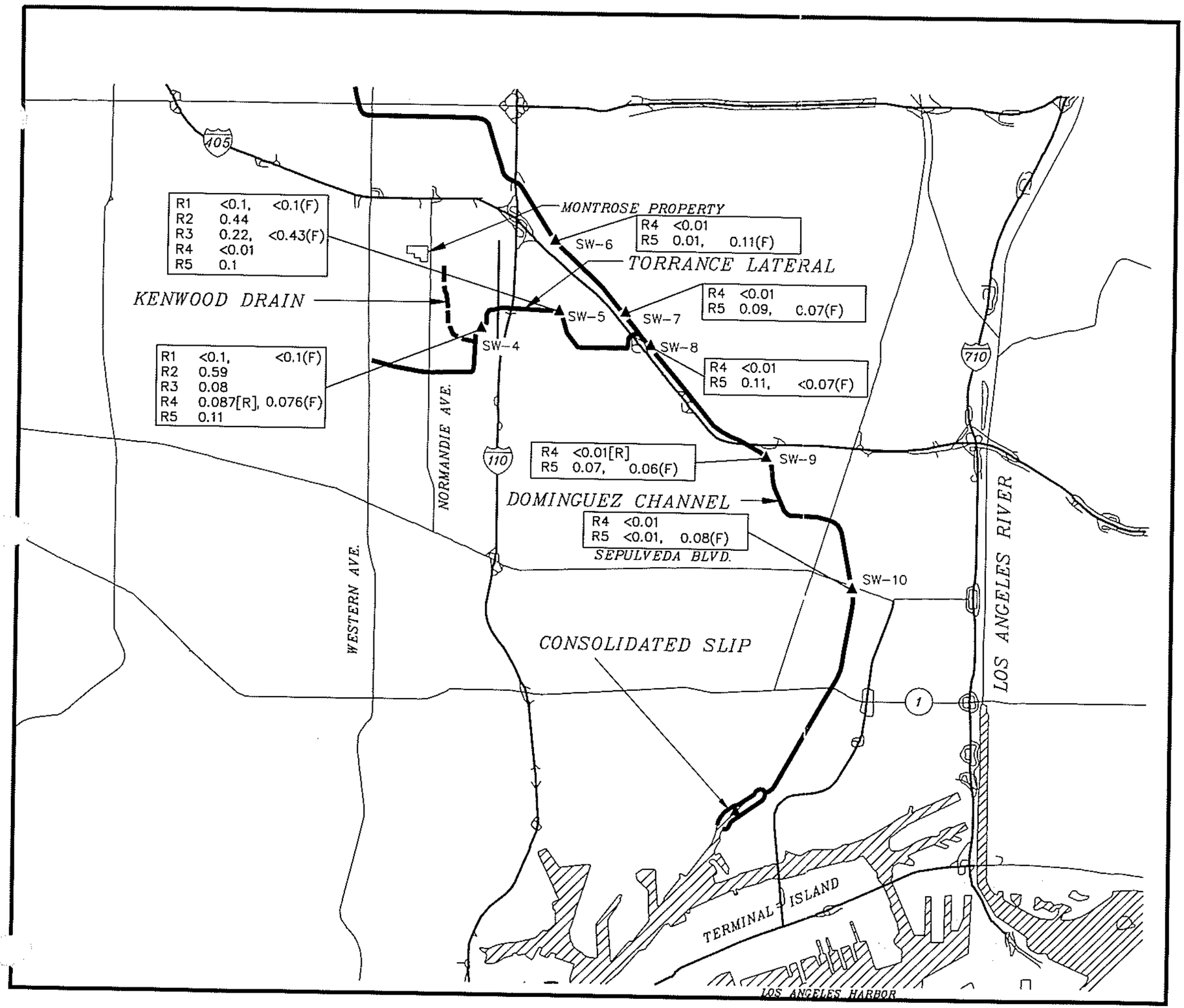

EXPLANATION

SW-6 — WET WEATHER SURFACE WATER SAMPLE LOCATION

R4 <0.02
R5 <0.02 <0.01(F)

- FILTERED SAMPLE CONCENTRATION OF TOTAL DDT
- RAINFALL EVENT NUMBER

[R] — QUALIFIED BY EPA AS UNUSABLE FOR ANY PURPOSE

BASE MAP FROM: USGS DLG 7.5 MINUTE QUADRANGLES

0 5,000 10,000
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

TOTAL BHC IN WET WEATHER SURFACE WATER SAMPLES, TORRANCE LATERAL AND DOMINGUEZ CHANNEL, MONTROSE SAMPLING 1986-1987

7/97

FIGURE 5.82

PREP BY _____ REV BY _____ RPT NO. 218.544 | 410-200D | B

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6. Contaminant Fate and Transport

The objective of this section is to evaluate the fate and transport of chemicals of concern (COCs) at the Montrose Site, and to identify the potential contaminant migration pathways within which transport of COCs could occur. The understanding of the potential contaminant migration pathways is required for the design and implementation of an adequate remedy for the Montrose Site and to prevent further migration of COCs. In general, the use of the term COC in this report refers to chemicals detected in samples collected at the Montrose Site.

The fate and transport of COCs at the Montrose Site is controlled by a number of physical, chemical, and biological processes that are briefly described in Section 6.1. The degree to which a particular COC is affected by these processes is discussed in Section 6.2 based on the COC-specific physical and chemical properties. A general description of the potential contaminant migration pathways is presented in Section 6.3. Section 6.4 presents a conceptual model of the Montrose Site that is focused on the potential contaminant migration pathways for COCs. The potential contaminant migration pathways for the COCs are evaluated based on: (1) the degree to which COCs or groups of COCs are affected by the physical, chemical, and biological processes as discussed in Section 6.2, (2) COCs distribution at the Montrose Site described in Section 5, and (3) site-specific conditions described in Section 4.

6.1 Fate and Transport Processes

The fate and transport of the COCs in the environment is primarily dependent on the mobility and persistence of these constituents given the site-specific conditions. A general description of the processes affecting the mobility and persistence of the COCs is presented below.

6.1.1 Processes Affecting Mobility

Processes that affect the mobility of the COCs include sorption/desorption (retardation), dissolution, and volatilization. Each of these processes is briefly described below.

6.1.1.1 Sorption/Desorption

Sorption is the process by which certain compounds partition (redistribute) between the solid and liquid phases. Sorption refers to the process whereby dissolved COCs are attracted and bind to solid particles. Desorption refers to the detachment of COCs from the solid particles back into the aqueous phase. Solid particles in the environment include the soil matrix, the aquifer matrix, and surface sediment. The amount of contaminant sorbed onto solid particles and the corresponding amount of desorption is a function of the organic content and mineralogy of the soil material, and the chemical characteristics of the contaminant.

Organic compounds with strong sorption characteristics are relatively immobile in the subsurface soil and groundwater environments (Letey and Farmer, 1974). The net effect of

sorption of an organic compound in an aquifer is retardation, which acts to slow or retard an average rate of contaminant migration.

6.1.1.2 Dissolution

Dissolution is the process by which compounds dissolve in liquid. This process depends on the solubility of chemical compounds. The solubility of a compound (the solute) is the maximum amount of the solute that will dissolve in a liquid (the solvent) expressed as the mass of solute per unit volume of the solvent at a specific temperature and pressure. The solubility of a compound will vary based on the composition of the dissolving liquid. The solubility of a compound in water (the aqueous solubility) is affected by the pH, temperature, and salinity of the water, and the presence of other dissolved compounds (Verschueren, 1983). Low solubility reduces the mobility of chemical compounds in the subsurface environment by limiting their ability to migrate with infiltrating water and groundwater. High solubility increases the mobility of chemical compounds by allowing the compounds to more readily dissolve into and migrate with the infiltrating water in the unsaturated soil and to dissolve into and be transported with the groundwater.

6.1.1.3 Volatilization

An organic compound in the liquid or solid phase is converted to the vapor phase by the process of volatilization. Volatilization of a compound that is adsorbed to soil may occur as the compound partitions from the adsorbed solid phase into the soil moisture and from the soil moisture into the vapor phase (Guenzi and Beard, 1974). Volatilization of the chemical compound is primarily controlled by desorption, solubility, and vapor pressure.

Vapor pressure is the pressure, usually expressed in millimeters of mercury (mm Hg), exerted by the vapor phase of a pure compound under the equilibrium condition with the solid or liquid phase at a given temperature.

The volatility of a compound can be evaluated in terms of its partitioning coefficient, the Henry's Law Constant (H_c). The H_c for a particular compound is a measure of that compound's tendency to partition into the vapor phase from the aqueous phase. The larger the H_c, the greater the tendency for the compound to volatilize from the aqueous phase into the vapor phase. Chemicals with an H_c greater than 4.6×10^{-3} atmosphere-meters cubed per mole ($atm \times m^3/mol$) are considered to have high volatility (Smith et al. 1980).

Factors that affect volatilization of organic compounds from the soil include the concentration of the organic compound in the soil, the composition of the soil, and atmospheric conditions (Guenzi and Beard, 1974). Atmospheric conditions that affect volatilization from the soil into the atmosphere include wind speed, temperature, turbulence, and relative humidity. Volatilization is reduced in soils composed of clays and organic matter, which enhance sorption. Soil moisture and temperature also affect compound volatility.

6.1.2 Persistence

Persistence refers to the tendency of a compound to remain in the environment. Processes that influence the persistence of an organic compound in the environment include bioaccumulation, biotransformation, and chemical transformation. Compounds that are chemically stable and/or not easily biologically degraded are considered to be persistent.

These chemical and biological factors can influence the amount of a compound available for environmental transport and potential exposure to human receptors.

6.1.2.1 Bioaccumulation

Organic compounds present in the environment can accumulate in living organisms by means of bioaccumulation. Bioaccumulation of a contaminant can occur by ingestion of the contaminant through the food chain or by direct uptake from ingestion of water, dermal contact, or respiration. The net result of bioaccumulation is an increase in organic compound concentration in the organism.

The microorganism-water partition coefficient (K_b) is a measure of a compound's tendency to bioaccumulate in aquatic organisms. K_b is used to evaluate the partitioning of a chemical between microorganisms and water in a water column and is in part a function of the compound's K_{ow}.

Bioaccumulation is controlled in part by the organic compound concentration in the solid media and in part by the solubility of the compound (Litwin et al. 1983; Nash, 1974). Compounds with lower solubility in water tend to bioaccumulate.

6.1.2.2 Biodegradation

Biodegradation is the process whereby organic compounds are biologically degraded to other compounds, usually by microorganisms. The process by which intrinsic microbial metabolism or co-metabolism by indigenous microorganisms within the subsurface results in a chemical or biological transformation of contaminants, and a corresponding reduction of contaminant mass, is called "intrinsic biodegradation." The microorganisms break down the organic compound into different chemical components. Biodegradation may also cause conversion of organic compounds to inorganic compounds. This process is termed mineralization.

Biodegradation within the various media occurs through the action of microorganisms present within that media. Microorganisms in an aquifer are either attached to, or suspended between, aquifer solids (Kobayashi and Rittman, 1982). Shallow water table aquifers and associated regions of the unsaturated soil are known to provide habitats for microorganisms (Wilson and McNabb, 1983). The upper 14 cm of soil contain the greatest number of microorganisms because more nutrients and oxygen are available at this depth than at lower depths.

Biodegradation rates are highly variable. Biodegradation rates are affected in part by the concentration of the organic compound; the types and number of organisms present; the presence of other compounds; the presence of oxygen; the oxidation-reduction potential (Eh); soil moisture content; temperature, pH, salinity, and composition of the soil; and the quantity and quality of nutrients in the soil (Weed and Weber, 1974; Kobayashi and Rittman, 1982; Verschueren, 1983; Cheng and Koskinen, 1986).

6.1.2.3 Chemical Transformation

Chemical transformation processes that could potentially affect the fate of COCs include oxidation/reduction, hydrolysis, and photolysis.

Oxidation/reduction reactions involve the transfer of electrons from one compound to another. A compound is oxidized if electrons are donated from the compound and the oxidation state of the compound is increased. A compound is reduced if electrons are accepted by the compound and the oxidation state is decreased. During any electron transfer reaction, one of the compounds is oxidized while the other is reduced. Therefore these reactions are commonly referred to as oxidation/reduction or "redox" reactions.

A reaction in which a water molecule (or hydroxide ion) substitutes for another atom or group of atoms present in an organic molecule is commonly called a hydrolysis reaction. In a hydrolysis reaction, the compound is transformed into more polar products that may have quite different fate and transport properties.

Organic compounds can undergo chemical transformation in the atmosphere through photolysis. Photolysis occurs through direct and indirect exposure to solar energy. Direct photolysis can occur when a compound absorbs light and reacts to form a different compound. The absorbed light does not necessarily result in a reaction (Swann and Eschenroeder, 1983). Less than 5 percent of the light absorbed by a compound during this process results in chemical transformation (Lyman et al. 1982). Indirect photolysis requires an intermediate substance such as humic material to absorb light and transfer energy to the compound (Swann and Eschenroeder, 1983). Indirect photolysis at the Montrose Site is not considered to be dominant transformation process On-Property, but may occur Off-Property along the surface water pathway.

6.2 Mobility and Persistence of COCs

This section discusses the mobility and persistence of contaminants detected in soil or groundwater at the Montrose Site based on the contaminant-specific physical, chemical, and biological properties. As discussed in Section 5, the following groups of COCs were detected at the Montrose Site. This list focuses on the chemicals of primary concern for the purpose of analysis; not all chemicals detected at the Montrose Site are included.

Pesticides	Volatile Organic Compounds	Other Compounds
DDT	Chlorobenzene	p-CBSA
BHC	Benzene	
	Toluene	
	Ethylbenzene	
	Xylenes	
	Carbon tetrachloride	
	PCE	
	TCE	
	Chloroform	
	1,2-DCA	
	1,2- DCB	
	1,3-DCB	
	1,4-DCB	

The mobility and persistence of the COCs at the Montrose Site is evaluated based on the degree to which the COCs are affected by the corresponding physical, chemical, or

biological processes discussed in Section 6.1 given the COC-specific properties. These physical and chemical properties are similar for COCs within the groups listed above. Therefore, the discussion in this section will be focused on the groups of COCs rather than individual COCs. The mobility and persistence of each group of COCs, such as pesticides, VOCs, and p-CBSA are discussed below.

In addition to the COCs listed above, DNAPL has been encountered at the site, beneath the Central Process Area. The mobility and persistence of DNAPL is also discussed in this section based on the DNAPL-specific properties.

6.2.1 Pesticides

The mobility and persistence of pesticides of concern at the Montrose Site can be evaluated based on their physical and chemical properties, as well as their observed distribution given the conditions of the site. A complete listing of chemical properties discussed in this section including the chemical formula, molecular weight, melting point, boiling point, vapor pressure, solubility in water, specific gravity, Log K_{ow} (the octanol water partition coefficient), Log K_{oc} (the organic carbon partition coefficient), H_c (Henry's Law Constant), and log K_o (microorganism-water partition coefficient) are provided in Table 6.1. In addition, selected portions of this data are provided in the in-text Tables 6.2a through 6.2d and Tables 6.3a through 6.3d.

6.2.1.1 Mobility of Pesticides

As discussed in Section 6.1, sorption, dissolution, and volatility are the primary processes that control the mobility of COCs. The effects of these processes on pesticides of concern are discussed below.

Sorption of Pesticides. The tendency for an organic compound to adsorb to solid particles can be evaluated in terms of two partition coefficients: the octanol-water partition coefficient (K_{ow}) and the organic carbon partition coefficient (K_{oc}). K_{ow} and K_{oc} are commonly expressed as logarithms because of their wide range of values. K_{ow} is defined as the ratio of the concentration of the organic compound in octanol to its concentration in water. K_{oc} is defined as the ratio of the quantity of a compound adsorbed per unit weight of organic carbon in the solid media to the concentration of that organic compound in solution. Organic compounds with high K_{oc} values will exhibit stronger sorption characteristics than organic compounds with lower K_{oc} values.

Published values of Log K_{ow} and Log K_{oc} for pesticides detected at the Montrose Site are presented in Table 6.3a. Compounds with a Log K_{ow} greater than 4 are considered strongly hydro-phobic (i.e., do not readily dissolve in water, and have a great tendency to sorb to the solid phase) (Lyman et al. 1982). Based on data presented in Table 6.3a, most of the pesticides of concern, such as the isomers of DDT and its metabolites DDD, DDE, and delta-BHC, have Log K_{ow} greater than 4, and therefore, have a great tendency to sorb onto the soil particles.

TABLE 6.2a
The Octanol Water Partition Coefficient (K_{OW}) and Organic Carbon Partition Coefficient (K_{OC}) for Pesticides of Concern

Pesticides	Log K_{OW}	Log K_{OC}
p,p-DDT	6.19, 6.91	6.59
o,p-DDT	—	—
p,p-DDD	6.20	5.89
o,p-DDD	6.08	—
p,p-DDE	6.96	6.64
o,p-DDE	5.78	—
a-BHC	3.89	3.58
b-BHC	3.89	3.58
d-BHC	4.15	3.82
g-BHC	3.89	3.58

Solubility of Pesticides. Published solubilities of pesticides of concern are presented in Table 6.2b. As shown in Table 6.2b, the DDT-isomers and metabolites are relatively insoluble in water, with solubilities of less than 0.1 mg/L at standard temperature and pressure (STP). The concentrations of p,p-DDT in groundwater from monitoring wells that are located within the Central Process Area at the Montrose Property approached or exceeded the solubility levels of this constituent (Section 5.5.1.4). These high concentrations of p,p-DDT are caused by the presence of DNAPL beneath the Central Process Area that contains an average of 40 percent DDT and 36 percent chlorobenzene (Section 5.5.1.2). The very high concentrations of DDT in DNAPL are due to the fact that the solubility of DDT in chlorobenzene (74,000 mg/L chlorobenzene) is much higher than that of water.

Solubilities of the BHC-isomers are also low, and range from 0.24 to 31.4 mg/L at STP based on published values (Table 6.2b). Concentrations of BHC detected in groundwater samples collected at the Montrose Site were below the solubility levels of this constituent.

The low solubility of the pesticides of concern decreases the ability of these contaminants to dissolve in surface water and groundwater. The observed limited distribution of pesticides in groundwater at the Montrose Site further demonstrates that the ability of these contaminants to migrate with groundwater is low.

TABLE 6.2b
Aqueous Solubilities of Pesticides of Concern

Pesticides	Aqueous Solubility (mg/L)
p,p-DDT	0.0055 to 0.025 (25°C)
o,p-DDT	0.026 to 0.085 (25°C)
p,p-DDD	0.02 to 0.09 (25°C)
o,p-DDD	0.10 (25°C)
p,p-DDE	0.04 (20°C) to 0.014 (25°C)
o,p-DDE	0.140 (20°C)
a-BHC	1.63 (25°C)
b-BHC	0.24 (25°C)
d-BHC	31.4 (25°C)
g-BHC	7.8 (25°C)

Volatility of Pesticides. As mentioned previously, the volatility of a particular contaminant depends on its vapor pressure and the Henry's Law Constant H_c. Published values of vapor pressure and H_c for the pesticides of concern are summarized in Table 6.2c. Generally, low vapor pressures and low values of H_c result in the low volatility of the corresponding constituent.

TABLE 6.2c
Vapor Pressure and Henry's Law Constant (Hc) for Pesticides of Concern

Pesticides of Concern	Vapor Pressure (Vp) at 20°C (Mm Hg)	Henry's Law Constant (H_C) at 20°C (Atm × M^3/Mol)
p,p-DDT	1.9 x 10-7	1.58 x 10-5 (25°C)
o,p-DDT	5.5 x 10-6 (30°C)	---
p,p-DDD	10.2 x 10-7 (30°C)	2.2 x 10-8
o,p-DDD	1.89 x 10-6 (30°C)	---
p,p-DDE	6.5 x 10-6	6.8 x 10-5
o,p-DDE	6.2 x 10-6	—
a-BHC	2.5 x 10-5	6.0 x 10-6
b-BHC	2.8 x 10-7	4.5 x 10-7
d-BHC	1.7 x 10-5	2.07 x 10-7
g-BHC	1.6 x 10-4	7.8 x 10-6

Based on Table 6.2c, the volatility of pesticides of concern is limited by the low vapor pressures and H_c of these contaminants.

It is important to note that the ability of contaminants to volatilize is closely related to their sorption potential, which in turn depends on the sorption characteristics of the contaminant as well the characteristics of the soil matrix. Volatilization of pesticides of concern is more

likely in soils with low organic carbon content and high moisture content, because these soil characteristics will decrease the sorption potential for these contaminants. Therefore, very limited volatilization of pesticides potentially could occur at the site, where subsurface materials have low organic carbon content and high moisture content. However, it must be emphasized that the potential for volatilization of the pesticides of concern at the Montrose Site is very low.

6.2.1.2 Persistence of Pesticides

As discussed previously, the persistence of pesticides depends on the processes of bioaccumulation, biodegradation, and chemical transformation. The effects of these processes on the pesticides of concern are discussed below.

Bioaccumulation of Pesticides. The microorganism-water partition coefficient (K_b) is a measure of a compound's tendency to bioaccumulate in aquatic organisms. K_b is used to evaluate the partitioning of a chemical between microorganisms and water in a water column and is in part a function of the compound's K_{ow}.

Bioaccumulation is controlled in part by the organic compound concentration in the solid media and in part by the solubility and hydrophobicity of the compound (Litwin et al. 1983; Nash, 1974). Pesticides of concern tend to bioaccumulate due to their low solubility in water and high hydrophobicity. Estimated K_b values for the pesticides of concern are summarized in Table 6.2d based on published values.

TABLE 6.2d
Microorganism-Water Partition Coefficient (K_b) for Pesticides of Concern

Pesticides of Concern	Log K_b [(µg/g) (mg/L)$^{-1}$]
p,p-DDT	6.90
o,p-DDT	—
p,p-DDD	5.26
o,p-DDD	---
p,p-DDE	5.95
o,p-DDE	---
a-BHC	3.18
b-BHC	3.18
d-BHC	3.54
g-BHC	3.18

DDT and its metabolites are more prone to bioaccumulation than BHC based on their K_b values (Table 6.2d). K_b for p,p-DDT and its metabolites are two to three orders of magnitude greater than K_b for the BHC-isomers. Bioaccumulation of DDT and its metabolites in the environment is a well documented problem (EPA, 1979). EPA banned all uses of DDT in the United States in 1972 due in part to the levels of DDT accumulating in the environment (ATSDR, 1989).

Biodegradation of Pesticides. Based on the literature data, biodegradation of DDT-isomers occurs more readily under anaerobic conditions, when oxygen is absent, as compared to

aerobic conditions, when oxygen is present (EPA, 1979R). The DDT-isomers have been shown to biodegrade to DDD-isomers under anaerobic conditions and to DDE-isomers under aerobic conditions (Figure 6.1). DDE is expected to be less susceptible to further biodegradation than DDD. Biodegradation studies indicate that DDT biodegradation does not occur readily, is highly dependent on environmental conditions, and may require a variety of microorganisms (EPA, 1986R). It is not possible to accurately estimate site-specific rates of biodegradation of DDT with a high degree of certainty due to insufficient published literature regarding this process and limitations of the currently available technology. Extensive field work is needed to confirm in-situ biodegradation. The presence of both DDD and DDE in soil samples collected from the Montrose Site indicates that there is potential for the occurrence of biological degradation of DDT at the Montrose Site. However, other processes, such as photolysis or hydrolysis, may also be factors.

Gamma-BHC has been shown to biodegrade under aerobic conditions by several microorganisms (EPA, 1979R). Gamma-BHC may biodegrade to alpha-BHC and to a lesser extent to the beta- and delta-isomers. Estimates of the half-life for gamma-BHC undergoing biodegradation range from several days to years (EPA, 1979R; Laskowski et al. 1983). Little information is available on the biodegradation of alpha-, beta-, and delta-isomers of BHC. The BHC isomers reportedly biodegrade in the following order: gamma-BHC > alpha-BHC > beta-BHC > delta-BHC (EPA, 1979R). It is not possible to estimate site-specific rates of biodegradation of BHC due to insufficient published literature regarding this process and limitations of the currently available technology.

Chemical Transformation of Pesticides. Although experiments show that indirect photolysis of DDT does occur, the relationship of these studies to photolysis rates of DDT in natural aquatic systems is unknown (EPA, 1979R). Based on laboratory experiments, the indirect photolytic half-life for DDT has been estimated to range from several hours to 7 days. However, the majority of the DDT at the Montrose Site occurs within subsurface soil, where exposure to sunlight does not occur. Published information regarding the chemical transformation of DDT by oxidation and hydrolysis in natural systems is limited. Experimental data have shown that the chemical reduction of DDT and DDD is facilitated by high organic carbon content in soils (EPA, 1979R).

Hydrolysis, photolysis, reduction, and oxidation do not appear to be important fate processes for the BHC-isomers (EPA, 1979R and 1982R). Experimental data have demonstrated the reduction of gamma-BHC in anaerobic environments (EPA, 1979R).

6.2.2 Volatile Organic Compounds

The potential mobility and persistence of the VOCs of concern are evaluated in this section based on their physical and chemical properties.

6.2.2.1 Mobility of VOCs

As discussed in Section 6.1, sorption, dissolution, and volatility are the primary processes that control the mobility of COCs. The effects of these processes on VOCs of concern are discussed below.

Sorption of VOCs. As discussed previously, the tendency for an organic compound to adsorb to solid particles can be evaluated in terms of two partition coefficients, K_{ow} and K_{oc}.

The logarithms of K_{ow} and K_{oc} for the VOCs of concern are presented in Table 6.3a based on published values.

TABLE 6.3a
Logarithms of Kow and Koc for VOCs of Concern

VOCs	Log K_{OW}	Log K_{OC}
Chlorobenzene	2.84	2.52
Benzene	2.13	1.81
Toluene	2.69, 2.79	2.48
Xylenes	2.77, 3.15, 3.20	2.11, 2.31, 3.20
Ethylbenzene	3.15, 3.34	3.04
Carbon Tetrachloride	2.64, 2.96	2.64
PCE	2.6, 2.88	2.56
TCE	2.42	2.10
Chloroform	1.96, 1.97	1.64
1,2-DCA	1.48	1.15
1,2-DCB	3.38	2.27
1,3-DCB	3.38	2.23
1,4-DCB	3.39	2.20

Based on data in Table 6.3a, the VOCs of concern are more hydrophilic (i.e., tend to dissolve in water and less readily sorb onto solid particles) than the pesticides. Ethylbenzene and the dichlorobenzenes (1,2-DCB, 1,3-DCB, and 1,4-DCB) tend to be the most hydrophobic VOCs of concern (i.e., have the highest sorption potential) and 1,2-DCA tends to be the most hydrophilic VOC of concern (i.e., has the lowest sorption potential).

Solubility of VOCs. Aqueous solubilities of the VOCs of concern significantly exceed those of pesticides (Table 6.3b). The solubilities of the VOCs of concern range from 12.3 mg/L for 1,2-DCB to 8,690 mg/L for 1,2-DCA.

The single component aqueous solubility of chlorobenzene, the VOC that occurs in the highest concentrations at the Montrose Site, is approximately 500 mg/L at 20°C (Table 6.3b). Given the composition of DNAPL at the Montrose Site (Section 5), the aqueous solubility of chlorobenzene from DNAPL is expected to be somewhat less than its single component solubility. Based on an estimated chlorobenzene to DDT ratio of 60 percent to 40 percent by weight, the estimated mole fraction of chlorobenzene in the DNAPL would be approximately 83 percent. Assuming ideal behavior, the estimated effective aqueous solubility of chlorobenzene from DNAPL would be about 410 mg/L (410,000 µg/L). Chlorobenzene has been detected in groundwater samples collected from Upper Bellflower Aquitard monitoring wells located in the Central Process Area at concentrations approaching its effective aqueous solubility, from 200,000 to 400,000 µg/L (200 to 400 mg/L). These high chlorobenzene concentrations in groundwater are associated with the occurrence of DNAPL in the subsurface.

TABLE 6.3b
Aqueous Solubilities of VOCs of Concern

Volatile Organic Compounds	Aqueous Solubility (mg/L)
Chlorobenzene	500 (20°C)
Benzene	1,780 (20°C)
Toluene	515 (20°C)
Xylenes	175 (20°C), 173 to 198 (25°C)
Ethylbenzene	152 (20°C)
Carbon Tetrachloride	785 (20°C)
PCE	200 (20°)
TCE	1,100 (20°C)
Chloroform	8,000 (20°C)
1,2-DCA	8,690 (20°C)
1,2-DCB	14.5 (25°C)
1,3-DCB	12.3 (25°C)
1,4-DCB	79 (25°C)

Volatility of VOCs. Published vapor pressures and H_c for the VOCs of concern are summarized in Table 6.3c.

TABLE 6.3c
Vapor Pressure (Vp) and Henry's Law Constant (Hc) for VOCs of Concern

VOCs of Concern	Vp at 20°C (mm Hg)	H_C at 20°C (atm × m^3/mol)
Chlorobenzene	8.8	3.58 x 10-3
Benzene	76	5.5 x 10-3 (25°C)
Toluene	22	6.66 x 10-3
Xylenes	5 - 6.5	5.3 - 6.3 x 10-3 (25°C)
Ethylbenzene	7	6.6 x 10-3
Carbon Tetrachloride	90	2.3 x 10-2
PCE	14	1.53 x 10-2
TCE	60	9.1 x 10-3
Chloroform	160	2.88 x 10-3
1,2-DCA	61	9.14 x 10-4
1,2-DCB	1	2.4 X 10-3 (25°C)
1,3-DCB	2.3 (25°)	4.7 X 10-3 (25°C)
1,4-DCB	0.6	4.45 X 10-3 (25°C)

The VOCs of concern detected at the Montrose Site are much more volatile than the pesticides as shown by the vapor pressures and values of H_c presented in Table 6.3c. VOCs with an H_c greater than 4.6×10^{-3} atmosphere-meters cubed per mole ($atm \times m^3/mol$) are considered to have high volatility (Smith et al. 1980). The vapor pressure of mixture of a solvent and solute is proportional to the mole fraction of the solvent within the mixture. Therefore, the vapor pressure of chlorobenzene from the Montrose DNAPL which is composed of approximately 40 percent DDT and 60 chlorobenzene by weight, would be less than that for pure chlorobenzene.

6.2.2.2 Persistence of VOCs

As discussed previously, the persistence of VOCs depends on the processes of bioaccumulation, biodegradation, and chemical transformation. The effects of these processes on the VOCs of concern are discussed below.

Bioaccumulation of VOCs. The value of K_b, which is a measure of a compound's tendency to bioaccumulate in aquatic organisms, is presented in Table 6.3d for the VOCs of concern based on published values.

TABLE 6.3d
Log of Microorganism-Water Partition Coefficient (K_b) for VOCs of Concern

VOCs of Concern	Log K_b [(µg/g) (mg/L)$^{-1}$]
Chlorobenzene	2.21
Benzene	1.57
Toluene	2.17
Xylenes	---
Ethylbenzene	2.67
Carbon Tetrachloride	2.32
PCE	2.40
TCE	1.99
Chloroform	1.41
1,2-DCA	1.0
1,2-DCB	2.86
1,3-DCB	2.86
1,4-DCB	2.86

VOCs of concern are not expected to bioaccumulate readily based on low K_b values for these contaminants (Howard, 1989).

Biodegradation of VOCs. Non-chlorinated VOCs, such as benzene, toluene, ethylbenzene, and xylenes, are generally more readily biodegraded than chlorinated VOCs (EPA, 1979R). Some species of soil bacteria can use benzene as a sole source of organic carbon, but benzene is more likely to biodegrade if it is combined with an additional organic carbon source. Toluene reportedly provides an additional organic carbon source for benzene

biodegradation under aerobic conditions (Gibson et al. 1968). Studies also indicate that benzene can be mineralized (EPA, 1979R).

There is a considerable body of evidence in the literature for the active biodegradation of benzene by indigenous soil microorganisms at a number of sites under a variety of conditions. These conditions include both aerobic and anaerobic environments, (Scow, 1982; Barker et al. 1987; Rifai et al. 1988; Chiang et al. 1989; Cozzarelli et al. 1990; Baedecker et al. 1992, 1993; Bennett et al. 1993; Daniel, 1993; Eganhouse et al. 1993; Salanitro, 1993; Cozzarelli et al. 1994; NRC, 1994; Borden et al. 1995; McNab and Narasimhan, 1995). These papers suggest that intrinsic degradation of benzene is somewhat ubiquitous and is likely to occur under most conditions normally encountered. Although hydrogeologic, geochemical, and microbiological properties of a particular site could affect the rate at which intrinsic degradation of benzene might occur, the literature suggests that this phenomenon could be prevalent under a multitude of site conditions, including those conditions observed at the Montrose Site.

Chlorinated VOCs, such as chlorobenzene, are more difficult to biodegrade than nonchlorinated VOCs due to their chemical structure. The presence of the chlorine on the benzene ring in chlorobenzene makes this compound more persistent than benzene in the environment (Gibson et al. 1968).

Chlorinated ethenes such as PCE and TCE may biodegrade via a number of different pathways (Figure 6.2). Reductive dehalogenation may occur under anaerobic conditions which results in daughter compounds containing fewer chlorines. Biodegradation via direct or cometabolic oxidation may occur under aerobic conditions which results in complete mineralization. Reductive dehalogenation occurs at faster rates for more highly chlorinated compounds and may stall for the lesser chlorinated compounds depending on the supply of primary organic carbon or electron donor.

Chlorinated aromatics such as the dichlorobenzenes biodegrade similarly to the chlorinated ethenes. Based on the existing published laboratory information, chlorobenzene is potentially biodegradable both aerobically and anaerobically, although the degree of evidence differs between the two processes. The majority of existing studies demonstrates that chlorobenzene can be biodegraded aerobically in the laboratory (e.g., Reineke and Knackmuss, 1984; Heigler et al. 1992; Nishino et al. 1992; Burback and Perry, 1993; Oh and Bartha, 1993; Fries et al. 1994; Yadav et al. 1995; Zaitsev et al. 1995). Under aerobic conditions chlorobenzene could be potentially mineralized to CO2 (Figure 6.3).

In contrast, very few examples of anaerobic degradation of chlorobenzene exist in the literature. The results of these studies are usually not conclusive, and indicate the need for further assessment. Of the three known studies that show anaerobic degradation, two report limited chlorobenzene degradation under highly specific conditions: (1) Bouwer (1993) reports anaerobic chlorobenzene degradation by nitrate reduction, but such degradation is inhibited by the presence of other organic compounds, and (2) Nowak et al. (1996) reports very limited chlorobenzene degradation by reductive dechlorination under methanogenic conditions, only in the presence of tri- or di-chlorobenzene, and only when chlorobenzene concentrations are above approximately 100 mg/L. A third study, Masunaga et al. (1996), reports chlorobenzene degradation by reductive dechlorination under methanogenic conditions and provides a relatively short half-life, but does not present experimental chlorobenzene degradation data or provide a description of

chlorobenzene degradation other than the presentation of a half-life. In addition to these studies, there are numerous studies in which chlorobenzene did not degrade anaerobically at all, but, in fact, accumulated when other chlorobenzenes (e.g., hexa-, penta-, tetra-, di- or tri-chlorobenzenes) were reductively dechlorinated under anaerobic conditions (e.g., Ramanand, 1993). Finally, a study by Wilson, et al. at EPA's Kerr Research Lab, used chlorobenzene as a positive control (unpublished results). While this study presents some indications of chlorobenzene degradation, the results of the study are not conclusive because the study did not focus on chlorobenzene.

Chlorobenzene degradation by nitrate-reducing bacteria has been demonstrated in only one identified study (Bouwer and Trizinsky, 1993). However, according to this study, the conditions at the joint site, such as the presence of more easily degraded substances (e.g., benzene) would be expected to inhibit chlorobenzene degradation by nitrate-reducing bacteria. It is notable that Fries et al. (1994), showed that 10 isolates that degraded toluene under denitrifying conditions failed to degrade chlorobenzene under the same conditions. Again, the evidence for the degradability of chlorobenzene by nitrate reducers is tenuous; and there is also evidence of its recalcitrance to such degradation.

To summarize, while it could be concluded that chlorobenzene is potentially biodegradable, the degree of supporting laboratory evidence, and the understanding of the metabolic chemical processes within the scientific community, is still limited, particularly for anaerobic degradation. Based on the above, it is more likely that chlorobenzene is degradable aerobically rather than anaerobically.

In a manner similar to the chlorinated ethenes, the more highly chlorinated benzenes are more readily biodegraded by the reductive dechlorination pathway. This process may result in formation of lower chlorinated daughter products such as dichlorobenzenes or chlorobenzene.

Chemical Transformation of VOCs. Abiotic oxidation, reduction, hydrolysis, and photolysis are expected to have only minor impacts on the environmental fate and transport of the VOCs of concern.

6.2.3 p-CBSA

The potential mobility and persistence of para-chlorobenzene sulfonic acid (p-CBSA) is evaluated in this section based on the physical and chemical properties of this constituent.

6.2.3.1 Mobility of p-CBSA

The widespread occurrence of p-CBSA in the hydrogeologic units at the Montrose Site demonstrates the relatively greater mobility of this compound as compared to pesticides, chlorobenzene, and other VOCs (see Section 5 for the nature and extent of contamination). The high solubility, low adsorption, and low volatility of p-CBSA results in high mobility of this compound in groundwater. p-CBSA is an ionic compound that appears to completely dissociate in solution. Its fate and transport properties appear to reflect its ionic nature. As discussed in Section 6.1, sorption, dissolution, and volatility are the primary processes that control the mobility of COCs. The effects of these processes on p-CBSA are discussed below. In addition, the surfactant properties of p-CBSA and the co-solvency of p-CBSA are also discussed in this section.

Sorption of p-CBSA. Published literature regarding the transport properties of p-CBSA is not available. The sorptive properties of p-CBSA are minimal due to the weak polar nature of this compound and its high solubility in water.

Solubility of p-CBSA. Published literature indicates that p-CBSA is very soluble in water (Verschueren, 1983). The solubility of the sodium salt of p-CBSA is approximately 150,000 mg/L (15 percent by weight) at 25°C (EPA, 1978). p-CBSA has been detected at concentrations approaching approximately 10 percent of the aqueous solubility in a groundwater sample collected from Upper Bellflower Aquitard Extraction Monitoring Well UBE-1 located in the CPA.

p-CBSA is a byproduct from the manufacture of DDT. p-CBSA is nearly insoluble in benzene, but is apparently soluble in chlorobenzene at elevated temperatures (Merck Index, 1989). Heated chlorobenzene was reportedly used by Montrose to extract p-CBSA from the spent acid (Section 1). Because of its high aqueous solubility, p-CBSA, if present in DNAPL, is expected to readily partition from DNAPL into groundwater.

Volatility of p-CBSA. Published literature regarding the volatile properties of p-CBSA is not available. Based on the high boiling point (148°C at 25 mm Hg) and ionic nature, p-CBSA is expected to be essentially non-volatile (Budaveri, 1989).

Surfactant Properties. p-CBSA is not a surfactant and is not expected to form micelles. Surfactant molecules are composed of a polar end group and a non-polar tail. Surfactant molecules form micelles in aqueous solution in response to the polar nature of the surrounding water molecules. These micelles are aggregates of surfactant molecules in which the polar end groups are oriented toward the outside of the aggregates and the non-polar tails are oriented toward the inside of the aggregates. Non-polar organic molecules are generally at a lower energy state in non-polar solvents, which the insides of these micelles represent. Therefore, surfactant micelles will tend to attract non-polar organic molecules from solution. Because the outsides of the micelles are composed of polar end groups, they are generally mobile within an aqueous solution. Hence, surfactant micelles can increase the apparent solubility and mobility of dissolved organic chemicals.

When surfactants are in solution at low concentrations in which micelles do not readily form (i.e. the Critical Micelle Concentration [CMC]), they can exhibit some co-solvency properties. Co-solvency is the phenomenon where a miscible organic solvent, at high concentrations, affects the energetic structure of water and increases the solubility and mobility of organic chemicals. p-CBSA may have mild co-solvent properties at concentrations below the CMC due to its weak polar structure.

A study conducted by Kirk and Chiou (1989) has shown that surfactants can increase the aqueous solubility of DDT at concentrations both above and below CMC. Solubility enhancement at concentrations below the CMC were limited to heterogeneous mixtures of non-ionic surfactants. Single specie ionic surfactants did not significantly increase the aqueous solubility of DDT when present below the CMC.

This research suggests that, because p-CBSA is characterized as a single specie, ionic, and not expected to form micelles, it is likely that any increase in the aqueous solubility of DDT or reduction in sorption due to the presence of p-CBSA would be minor.

Enhanced Mobility and Cosolvency. The presence of p-CBSA is not expected to significantly enhance the mobility of other COCs in groundwater due to co-solvency. Enhanced mobility related to co-solvency occurs when organic solvents which are completely miscible in water, such as acetone or methanol, are present at cosolvent fractions of greater than about 5 percent by volume (Pankow and Cherry, 1996). p-CBSA is only partially miscible in water and has been detected at a maximum concentration of about 1 percent by weight in groundwater beneath the Central Process Area. Given that: (1) p-CBSA is an ionic compound and has salt, rather than solvent properties, (2) p-CBSA is not completely miscible, and (3) the relatively low fraction of p-CBSA in water outside the Central Process Area, enhanced mobility of other COCs related to co-solvency with p-CBSA is not expected to be significant.

6.2.3.2 Persistence of p-CBSA

The effects of bioaccumulation, biodegradation, and chemical transformation on p-CBSA are discussed below.

Bioaccumulation of p-CBSA. Published literature regarding the bioaccumulation of p-CBSA is not available; however, given the high aqueous solubility, bioaccumulation of p-CBSA is not expected to be a significant fate process.

Biodegradation of p-CBSA. p-CBSA has been shown to biodegrade under aerobic conditions in a laboratory study (MacKay, et al. 1990). The isolated organism was capable of growth utilizing p-CBSA as a sole carbon and energy source. p-CBSA was completely degraded from an initial concentration of 400 ppm within 2 days and was accompanied by the release of sulfate and chloride ions. The organism was reportedly capable of both ortho- and meta-ring cleavage.

Chemical Transformation of p-CBSA. Published information regarding the chemical transformation of p-CBSA is not available.

6.2.4 DNAPL

6.2.4.1 Mobility of DNAPL

Sorption, dissolution, and volatilization from DNAPL depends on the chemical composition of DNAPL. As discussed in Section 5, the DNAPL is assumed to be composed of approximately 60 percent chlorobenzene and 40 percent DDT by weight. Therefore, the properties of these COCs that are discussed in the previous sections will control their ability to sorb, dissolve, and volatilize from the DNAPL. As discussed in Section 6.2.2, the aqueous solubility and vapor pressure of chlorobenzene from the DNAPL is less than that for pure chlorobenzene. DNAPL can flow and migrate in the subsurface as a separate liquid phase, as discussed in Section 6.4.4. DNAPL migration in the unsaturated soil is primarily influenced by gravity and lithology. However, transport of the DNAPL components by groundwater flow is controlled by the properties of the individual chemicals.

6.2.4.2 Persistence of DNAPL

Direct biodegradation of DNAPL is not expected to occur due to the toxic effects of pure phase compounds.

6.3 Potential Contaminant Migration Pathways and Processes

The primary pathways for the migration of contaminants in the environment include the atmosphere, surface water runoff, unsaturated soil, and groundwater. COCs can potentially migrate in the vapor phase, dissolved aqueous phase, separate liquid phase (DNAPL), or solid phase. Transport and transformation processes may alter the quantity of COCs as they travel along each migration pathway. These pathways, and the processes potentially affecting the COCs as they move along these pathways, are described below.

6.3.1 Atmosphere

Organic compounds can migrate through the atmosphere as vapors, attached to solids, or as particulates. Vapor transport can occur through volatilization from the surface of liquids and solids exposed to the atmosphere. Vapor transport can also occur through diffusion in response to the concentration gradient between the exposed media and the atmosphere, or through advection with the moving air. Environmental factors that affect volatilization from soil include soil composition and moisture content, and ambient atmospheric conditions, such as temperature, humidity, and wind speed (Guenzi and Beard, 1974).

Volatilization from Surface Water. Volatilization of organic compounds to the atmosphere from surface water can occur and is dependent on the solubility and volatility of the organic compound, and on the flow velocity, turbulence, and sediment content of the surface water. Volatilization decreases with increasing depth of surface water and increases with turbulence or eddy motion. Atmospheric conditions that can affect volatilization are wind speed and turbulence (Lyman et al. 1982).

Solid Phase Transport. Organic compounds can migrate through the atmosphere as particulate matter or adsorbed to soil particles. Once released to the air, airborne particulates are simultaneously subjected to advection and turbulent dispersion transport processes, as well as to transformation, deposition, and depletion processes.

Advection, which is transport along with moving air in the downwind direction; and dispersion, which is mixing and spreading in the cross wind and vertical directions due to atmospheric turbulence and, to a lesser extent, diffusion along concentration gradients, are affected by meteorological, topographic, and source conditions. Atmospheric turbulence results in the mixing and dilution of chemical compounds entering the air.

Atmospheric Dispersion. Atmospheric dispersion of contaminants is in large part controlled by meteorological conditions, such as wind speed and direction, atmospheric stability, and the height of an inversion layer. The predominant direction of contaminant movement is strongly influenced by the relative directional wind frequencies at a site.

The extent of offsite migration and the locations where maximum ground-level concentrations of an airborne particulate occur is affected by wind speeds and atmospheric stability. In general, low wind speed and high stability result in higher airborne concentrations close to the source; moderate wind speed and high stability result in moderate concentrations over a larger downwind area; and high wind speed and low stability generally lead to lower concentrations over larger areas surrounding a source.

Source variables, such as release height, exit velocity, exit temperature, and plume density relative to air, affect the transport and dispersion of airborne releases. Dominant

downwash structures in the vicinity of a release, such as a building or wall of a height similar to that of the source height, can also have a significant impact on ground-level concentrations of near sources.

Deposition and Depletion Processes. Particulates are also subject to dry deposition and depletion processes. Particles tend to settle at a rate that is a function of their diameter, shape, and density relative to the wind speed. Low wind speeds and high stability may lead to a faster, more concentrated deposition of particles closer to the source than high winds. Larger particles will settle more rapidly than finer, submicron particles resulting in decreasing airborne concentrations with distance from the source.

Gravitational settling or "fallout" plays an important role in particles of greater than 20 or 30 microns in diameter. Particles of a few microns in diameter can be transported large distances but are also subject to gravitational effects.

Wet deposition or "washout," occurs when particles are swept out by falling rain drops or incorporated into various forms of precipitation. Wet deposition can deplete airborne particulate concentrations. Depletion of airborne particulate concentrations also occurs as particles are removed from the air and deposited by contact with vegetation, soils, and water bodies.

Resuspension. Deposited particulates can be subjected to resuspension due to wind erosion, especially when wind speeds exceed approximately 15 to 20 miles per hour. The degree to which deposited particles can be resuspended is generally a function of particle size, wind speed, surface roughness, vegetative ground cover, and cohesiveness. The predictability of particle resuspension is poor, and air sampling is usually the most direct method of estimating wind blown erosion if it is expected to be significant.

6.3.2 Surface Water Runoff

Dissolved compounds, compounds adsorbed to sediment, and compounds occurring as particulates can be transported with surface water runoff. Migration of chemical compounds in surface water runoff is dominated and controlled by the properties of solubility, volatility, and sorption. Dissolved compounds will be transported principally by mass flow with the surface water.

Surface water runoff may transport chemical compounds adsorbed to suspended sediment and chemical compounds which occur as particulates. The mobility of chemical compounds transported in the surface water runoff will be affected by sediment particle size (Karickhoff et al. 1979). Sediment may show a nonuniform distribution of adsorbed organic compounds due to the functional dependence of sorption on particle size (Karickhoff et al. 1979).

6.3.3 Unsaturated Soil

Organic compounds can migrate through unsaturated soil in the vapor phase, dissolved aqueous phase, or as a separate liquid phase. The concentration of an organic compound present in the unsaturated soil is a function of its partitioning among the solid particles, soil moisture, separate liquid phase, and soil vapor.

Vapor phase transport can occur through advective movement in response to a pressure gradient or by molecular diffusion in response to the chemical concentration gradient.

Dissolved aqueous phase transport can occur as organic compounds dissolve into and are transported with soil moisture. Separate liquid phase transport can occur as liquid product (i.e., DNAPL) migrates through the unsaturated soil under the influence of gravity.

Vapor Phase Migration. Vapor phase compounds will migrate within the vadose zone by molecular diffusion under a chemical concentration gradient. Soil vapors will migrate from areas of high soil vapor concentration toward areas of low soil vapor concentration until equilibrium conditions are approached. Partitioning between the soil vapor, soil moisture, and organic carbon and solid particles will tend to retard the diffusion of compounds in the vapor phase.

Migration of vapor phase compounds is generally greater in coarse-grained deposits than in fine-grained deposits because of the greater air permeability and potentially lower moisture and organic carbon content of the coarse-grained deposits. Diffusion of vapor phase compounds into the fine-grained deposits is expected to be very slow.

Infiltration and Leaching. Migration of organic compounds through unsaturated soil can occur as the compounds dissolve into and are transported with soil moisture. Solubility and sorption are dominant factors that affect the ability of organic compounds to leach from the soil into soil moisture. Organic compounds within the soil can migrate to the water table if surface water infiltration is sustained enough to induce deep percolation. Infiltration and deep percolation of soil moisture through the vadose zone where organic compounds exist as a vapor phase may also result in the flushing of VOCs to the water table.

The potential for deep percolation of surface water is affected by the variably saturated permeability of unsaturated soil. Unsaturated soil permeability is a function of moisture content. As moisture content increases, soil permeability increases. Dry soil will tend to retain infiltrating water until the moisture content increases to the point where gravitational forces exceed capillary forces and downward percolation continues.

Transport as DNAPL in Unsaturated Media. Transport as DNAPL was probably the primary transport mechanism for movement of DDT and chlorobenzene into and through the unsaturated soil beneath the Central Process Area at the Montrose Site.

6.3.4 Groundwater

Organic compounds migrate in groundwater principally in the dissolved phase. Solubility and sorption are the most important processes that control organic compound mobility in groundwater. The groundwater quality parameters pH, temperature, and salinity, and the presence of other organic compounds affect organic compound solubility in groundwater. DNAPL can also migrate in the saturated zone as a separate liquid phase.

Dissolved Transport. Contaminant transport in groundwater is controlled by the groundwater flow velocity; and chemical, biological, and physical processes including advection, dispersion, retardation caused by contaminant sorption onto aquifer material, and biodegradation.

Advection is the process by which dissolved chemicals within the groundwater (solutes) are transported by the movement of the flowing groundwater. Advective transport of solute occurs in the direction of groundwater flow at a rate equal to the average linear velocity of

the groundwater flow. The velocity of groundwater flow depends primarily on the hydraulic gradient, hydraulic conductivity, and effective porosity of the aquifer, and is generally much lower in lower permeability units such as the Upper Bellflower Aquitard compared to velocities in the more permeable sediments of the Bellflower Sand and the Gage and Lynwood Aquifers.

Hydrodynamic dispersion is the component of physical transport that results from mechanical mixing of solute and molecular diffusion. Longitudinal dispersion occurs in the direction of the average linear groundwater flow, and transverse dispersion occurs in the direction perpendicular to the average linear flow. Transverse dispersion occurs both horizontally and vertically.

The mechanical mixing component of dispersion results from variations in groundwater flow velocity in the porous media caused by frictional forces, variation in pore geometry, tortuosity of groundwater flow paths within the aquifer matrix, and heterogeneity of the aquifer matrix, causing local fluctuations in flow direction. Mechanical mixing occurs on a large scale, primarily due to aquifer heterogeneities, and on a microscopic scale, due to velocity variations in aquifer pore spaces.

Dispersivity, measured in units of length, is the parameter that relates the component of hydrodynamic dispersion due to mechanical mixing. Hydrodynamic dispersion that is dominated by mechanical mixing is generally much less in the horizontal and vertical transverse directions than in the longitudinal direction (Freeze and Cherry, 1979).

Molecular diffusion is the process by which dissolved solutes move from an area of higher concentration to an area of lower concentration. Molecular diffusion operates on a small scale within the pores between the grains of the aquifer or aquitard matrix. The process of molecular diffusion can have long-term impacts on organic compound concentrations in groundwater due to the slow rates at which molecular diffusion occurs. Remediation of groundwater by pumping can be hindered as a result of the slow rate of diffusion of organic compounds out of low permeability units.

Molecular diffusion is generally believed to comprise a minor component of the total dispersion in coarse-grained aquifer materials with relatively high groundwater flow velocities (Newsom, 1985). In finer-grained geologic material, such as clay and silt, that typically have lower groundwater flow velocities, diffusion may become the dominant dispersion mechanism (Freeze and Cherry, 1979).

Retardation (sorption of contaminants onto aquifer material and desorption of contaminants from the aquifer material into groundwater) acts to slow or retard an average rate of contaminant migration. The amount of contaminant sorbed onto aquifer materials and the corresponding amount of desorption is a function of the organic content of the aquifer; bulk density, porosity, and mineralogy of the aquifer material; and the physical and chemical properties of the contaminant (Section 6.1).

Retardation can be affected by the presence of co-solvents or surfactants. However, co-solvency effects that are typically associated with completely miscible compounds do not appear to be a significant transport mechanism at the Montrose Site.

Chemical and biological reactions can significantly affect the transport of some contaminants in groundwater. As discussed previously, the process by which intrinsic

microbial metabolism or co-metabolism results in a chemical or biological transformation of dissolved or residual contaminants, and a corresponding reduction of contaminant mass in the aquifer, is called *intrinsic biodegradation.*

Transport as DNAPL in Saturated Media. Lateral and vertical migration of DNAPL in saturated porous media is one of the mechanisms for movement of DDT and chlorobenzene in the subsurface. The factors that control DNAPL migration in the saturated media are discussed in Section 6.2.

6.4 Site Conceptual Model

This section evaluates the potential migration pathways and fate and transport processes described in Section 6.3 with respect to the transport of COCs detected at the Montrose Site. The potential COC migration pathways are evaluated based on: (1) the degree to which COCs or groups of COCs are affected by the physical, chemical, and biological processes discussed in Sections 6.2 and 6.3, (2) distribution of COCs at the Montrose Site described in Section 5, and (3) site-specific conditions described in Section 4. The evaluation of the potential migration pathways for the COCs is important for understanding the means by which these COCs may be transported to human and environmental receptors, and is required for the development of an appropriate remedy for the Montrose Site. Figure 6.4 summarizes the conceptual site model for the Montrose Site including sources of contaminants, contaminant release mechanisms and transport pathways, exposure routes, and potential receptors (both human and environmental).

The observed distribution of COCs relative to the known or suspected sources is indicative of the historic migration pathways for these COCs. While the evaluation of the historic migration pathways can be used to a certain degree to predict the future migration of the COCs, contaminant migration through some historical migration pathways has been significantly reduced as a result of the closure of the Montrose plant about 15 years ago, and by the subsequent grading and paving of the Property conducted 12 years ago. These changes have: (1) stopped the influx of additional DNAPL and dissolved contaminants to the subsurface soil beneath the Montrose Site that occurred as a result of plant operations, and (2) greatly reduced the transport of dissolved contaminants from the vadose zone to the groundwater as a result of surface water infiltration. Contamination of groundwater, however, still occurs by the contact of flowing groundwater with the DNAPL and dissolved/adsorbed contaminants beneath the Montrose Site. Surface water run-off is now contained in lined channels, thereby reducing the potential for percolation of COCs to groundwater.

It appears that the groundwater pathway is the primary migration pathway by which contaminants may migrate to human or environmental receptors. However, some potential for migration of contaminants through other pathways such as soil, surface water, atmosphere, and as DNAPL does remain. The potential contaminant migration pathways are described below for each group of COCs including pesticides, VOCs, and p-CBSA. This section also discusses the potential migration of DNAPL including DNAPL transport in the unsaturated and saturated media, operational considerations for DNAPL extraction, and containment of groundwater in the DNAPL impacted areas.

6.4.1 Potential Migration Pathways for Pesticides

The pesticides of concern, such as DDT and BHC, were detected in all environmental media investigated as part of this RI, including soil, surface water, and groundwater. The highest concentrations of these pesticides were detected at and in the immediate vicinity of the Montrose Property. Concentrations of the pesticides of concern decrease rapidly with distance away from the Property.

Data on historical aerial dispersion of DDT to areas off-Property are not provided in this RI Report; however, EPA is considering conducting an investigation to assess this pathway. Descriptions of dust emissions from the former DDT grinding, formulating, and packaging operations at the Property are provided in Section 1.3.7.

Based on the history of operations (Section 1.3) and the distribution of the pesticides of concern discussed in Section 5, the primary sources of the pesticides are located at the Montrose Property. The primary sources of DDT reside beneath the Central Process Area, where DDT was manufactured as part of the facility operations. Because the Montrose plant has been decommissioned and most facilities that caused contaminant leaks to the environment have been removed, DNAPL (consisting of 40 to 60 percent of DDT) and residual DDT soil contamination underneath the Central Process Area appears to be the primary source of DDT at the Montrose Site. The BHC contamination at the Montrose Site appears to be associated with the former Stauffer BHC plant located at the Montrose Property.

The assessment of offsite sources and historic migration pathways for the pesticides of concern is complicated by the difficulties associated with differentiating between DDT related to the former Montrose plant operations and low concentrations of DDT in Off-Property areas caused by the extensive and widespread domestic, commercial, and other use of DDT.

Based on the limited vertical and lateral extent of DDT and BHC, it appears that the pesticides of concern have limited mobility in groundwater. This low mobility of pesticides could be explained by their strong sorptive properties, low aqueous solubilities, and low vapor pressures (Section 6.2). DDT is slightly less mobile than BHC because of its lower aqueous solubilities and greater hydrophobicity.

This section describes the potential migration pathways for the pesticides of concern from both: (1) sources at the Montrose Property, and (2) areas with contaminated soil, surface water, and groundwater.

6.4.1.1 Transport of Pesticides in the Atmosphere and Surface Water Runoff

Volatilization into Atmosphere and Dissolution in Surface Water. Significant transport of DDT and BHC into the atmosphere as vapors, or as dissolved phase in surface water runoff is not likely because of the low volatilities and low solubilities of these contaminants (Section 6.2). Volatilization of pesticides from surface water in downstream drainages is also expected to be minimal due to the low volatility of pesticides (Section 6.2).

Solid Transport in Atmosphere and Surface Water; Atmospheric Dispersion and Deposition. The potential for DDT and BHC to be transported into the atmosphere and surface water with solid particles or as particulates is high because these contaminants occur as particulates, and also could easily sorb on solid particles due to their high sorptive capacity.

DDT and BHC detected in soil and groundwater Off-Property could be partially related to the transport of these contaminants as solid particles or adsorbed to particulates from the Montrose Property, where the primary sources reside, in the surface water runoff or through the atmosphere

The aerial dispersion and transport of particulate DDT is reported to have occurred from operations at the Formulating and Grinding Plant, south of the Central Process Area. During the 1960s and 1970s, Montrose received several citations from the Los Angeles County Air Pollution Control District for violating the California Health and Safety Code, including one citation for the release of particulate matter. In 1975, the existing buildings were extended to enclose more of the dust plant. Prior to this time, records indicate that during windy weather, finely ground DDT was being released to the atmosphere from open bins. The quantity of DDT that was released to the atmosphere during operation of the Montrose Plant is difficult to estimate.

Many factors may influence the atmospheric migration and deposition of solid particles including particle size, wind direction and speed, atmospheric turbulence, meteorological and topographic conditions, and physical characteristics of the source area. The migration with the surface water runoff and deposition also depends on many factors such as the amount of surface recharge, former site topography, and sediment particle size. However, since 1985, the atmospheric and surface water transport of pesticides from the Montrose Property has been significantly mitigated by the asphalt pavement, which limits the exposure of On-Property soil and sediment to the atmosphere and surface water migration pathways. The atmospheric and surface water transport and subsequent deposition of the pesticides of concern may still actively occur in unpaved areas of the Montrose Site.

Resuspension. It is important to note that the deposited particulates of pesticides (or solid particles with sorbed pesticides) can potentially be subjected to resuspension and transported via the atmosphere to human and environmental receptors. Prior to the installation of the asphalt cap over the Montrose Property, wind resuspension of DDT rework piles likely occurred during periods dry and windy weather. As discussed in Section 6.3, the predictability of resuspension is poor, and air sampling is the most direct method of evaluating this process.

6.4.1.2 Transport of Pesticides in Unsaturated Soil

Vapor Phase Migration. As discussed previously, the potential for the pesticides of concern to partition into the soil vapor is low due to the low volatility (vapor pressure and Henry's Law Constant) of these contaminants (Section 6.2).

Infiltration and Leaching. The potential for the pesticides of concern to dissolve into infiltrating water is also low due to their strong sorptive properties and low aqueous solubility. This is confirmed by the current distribution of the pesticides of concern. As discussed in Section 5, DDT is detected in soil at only relatively shallow depths of less than about 6 feet bls in most areas at the Montrose Site with the exception of the Central Process Area. The downward migration of DDT at the Central Process Area at depths greater than at other areas is facilitated by the presence of DNAPL (see Transport as DNAPL). At the Central Process Area, DDT also occurs at greater depths of up to 10 feet bls in areas where excavation and backfill operations may have mixed pre-existing shallow soil contamination into subsequent backfill soil.

Concentrations of chlorobenzene in groundwater close to the solubility limit, as occurs beneath the Central Process Area, may increase the solubility of DDT. This may potentially explain why DDT has been detected infrequently in groundwater from the Gage Aquifer.

Although BHC has a slightly greater leaching potential than DDT due to its greater aqueous solubility, BHC transport in unsaturated soil is also expected to be minimal due to the strong sorptive properties and low solubility of this pesticide (Section 6.2).

Transport as DNAPL in Unsaturated Media. The mobility of DDT in the unsaturated soil below the Central Process Area is much greater as a DNAPL than as dissolved DDT. The solubility of DDT is many orders of magnitude greater in an organic solvent, such as chlorobenzene, than it is in water. DDT dissolved in chlorobenzene has migrated as DNAPL through the unsaturated soil beneath the Central Process Area to the saturated portion of the Upper Bellflower Aquitard and perhaps deeper into the underlying Bellflower Sand and the Gage Aquifer (Section 5). It is likely that residual as well as mobile DNAPL is present beneath the Central Process Area. As discussed in Section 6.2, vertical migration of mobile DNAPL in the unsaturated media can occur rapidly, and is primarily influenced by gravity and lithology.

Soil core data collected at the Montrose Site do not suggest some lateral spreading of DNAPL in the unsaturated soil beneath the Central Process Area. However, the presence of the low permeability units within the Upper Bellflower Aquitard could inhibit the downward migration of DNAPL and cause the DNAPL to spread laterally.

DDT is not expected to partition readily from the DNAPL into the soil vapor or soil moisture due to the strong sorptive properties and low aqueous solubility and volatility of this pesticide. Mobilization of DDT in the unsaturated soil by dissolution from DNAPL into groundwater as a result of the rising water table is not expected to be significant due to the low aqueous solubility and strong sorptive properties of this pesticide.

Because DDT appears to be present in the DNAPL at or near its solubility level in chlorobenzene, precipitation of DDT from DNAPL into the soil matrix and sorption onto soil particles can occur as chlorobenzene is mobilized from the residual DNAPL by partitioning into soil vapor and/or soil moisture. This precipitation of DDT is further supported by field observations. When DNAPL is brought to the surface using a Teflon bailer, a whitish precipitate immediately begins to form on the sides of the bailer upon exposure to the atmosphere. This precipitate adheres very strongly to the Teflon and is difficult to remove by physical means. This observed behavior is consistent with the expected precipitation of DDT from the DNAPL as the chlorobenzene fraction of the DNAPL begins to volatilize.

6.4.1.3 Transport of Pesticides in Groundwater

Dissolved Transport. DDT has been detected at low concentrations in groundwater samples collected from the Upper Bellflower Aquitard and, to a lesser extent, the Bellflower Sand and Gage Aquifer in the immediate vicinity of the Central Process Area (Section 5). The occurrence of DDT in groundwater may be an indication of the presence or former presence of DNAPL.

BHC has been detected in groundwater samples collected from the Upper Bellflower Aquitard primarily near the southeast corner of the Property. Total BHC has also been

detected sporadically in groundwater samples collected from the underlying Bellflower Sand and Gage Aquifer.

The rate of migration of total DDT and total BHC in groundwater is strongly retarded with respect to the estimated average linear groundwater flow velocities of the hydrogeologic units at the Montrose Site. The strong retardation of these contaminants limits the mobility of the pesticides of concern in groundwater. The low mobility of these pesticides in groundwater is also demonstrated by their limited extent as compared to other contaminants (such as chlorobenzene and p-CBSA) and the average linear groundwater flow velocities estimated for the various hydrogeologic units. Retardation of DDT and BHC in groundwater will likely limit the further migration of these contaminants dissolved in groundwater.

As discussed in Section 6.2.1, biodegradation of DDT and BHC can not be quantitatively evaluated due to insufficient published literature regarding this process, and limitations of the currently available technology to measure biodegradation of the pesticides of concern in the field. It is known, however, that DDT biodegradation does not occur readily and is highly dependent on environmental conditions.

Transport as DNAPL in Saturated Media. DNAPL containing DDT has been observed in soil core samples collected from below the water table to approximately the base of the Upper Bellflower Aquitard in the Central Process Area (Section 5). As discussed earlier, significant partitioning of DDT dissolved in DNAPL into groundwater is not likely because the aqueous solubility of DDT is much lower than the solubility of DDT in an organic solvent (chlorobenzene). As chlorobenzene dissolves from the DNAPL into the groundwater, DDT is expected to precipitate out of DNAPL and sorb onto the solid particles. DDT may dissolve into groundwater at low concentrations, although the aqueous solubility of the DDT, DDD, and DDE isomers is low (5 to 140 µg/L), as discussed in Section 6.2.1.1. The subsequent migration of DDT in groundwater will also be limited due to the retardation caused by the strong sorptive properties of this contaminant.

6.4.2 Potential Migration Pathways for VOCs

The VOCs of concern were detected primarily in soil and groundwater. Only limited amount of surface water samples indicated the presence of some VOCs of concern (Section 5). VOCs are more mobile in the environment than pesticides due to their relatively greater solubilities and volatilities (Section 6.2). VOCs do not adsorb to sediment, soil, or aquifer matrix as readily as pesticides, and are not expected to bioaccumulate. Some VOCs are susceptible to biodegradation under certain environmental conditions.

A list of the VOCs of concern is presented in Section 6.2. A detailed discussion on the distribution and sources of these VOCs is presented in Section 5. This section presents a brief summary of the distribution and sources for the most prevalent VOCs of concern. The potential migration pathways for the VOCs of concern are discussed in this section based on their sources and distribution, and the mobility and persistence of VOCs described in Section 6.2. The potential migration of the VOCs of concern can occur from both: (1) sources of VOCs at and near the Montrose Property [primary sources], and (2) areas of soil and groundwater contamination [secondary sources].

Chlorobenzene is the most prevalent VOC detected in soil and groundwater at the site. Based on the historic operations at the Montrose Property (Section 1.3), and the

chlorobenzene distribution discussed in Section 5, the sources of chlorobenzene appear to reside beneath the Central Process Area at the Montrose Property, where chlorobenzene was stored, processed, and disposed. Because the Montrose plant has been decommissioned and the surface facilities that resulted in contaminant leaks to groundwater have been removed, DNAPL (consisting of 40 to 60 percent of chlorobenzene) and residual soil contamination underneath the Central Process Area appears to be the primary source of chlorobenzene at the Montrose Site.

The lateral extent of soil chlorobenzene contamination is limited to the proximity of the Montrose Property. Similar to DDT, the highest concentrations of chlorobenzene in soil samples were detected beneath the Central Process Area (Section 5). Off-Property, chlorobenzene was detected in soil samples at Jones Chemical and in the Normandie Avenue Ditch. Because the chlorobenzene has a significant lateral extent in groundwater, the chlorobenzene plume within the Bellflower Sand extends approximately 1 mile downgradient from the source at the Montrose Property. The vertical extent of dissolved chlorobenzene is about 400 feet, from the Upper Bellflower Aquitard through the Lynwood Aquifer.

Benzene and other BTEX constituents (toluene, ethylbenzene, and xylenes) detected in groundwater in the vicinity of the Montrose Site occur in the highest concentrations within the Upper Bellflower Aquifer. Benzene dissolved in groundwater has a relatively large lateral extent with the highest concentrations east and south of the Montrose Property (Section 5). Similar to chlorobenzene, dissolved benzene extends vertically from the Upper Bellflower Aquitard through the Lynwood Aquifer.

A significant offsite source of benzene is the Del Amo site, located directly east of the Montrose Site, which has documented benzene LNAPL. Potential leakage from pipelines that extend through the LADWP right-of-way adjacent to the Jones Chemical Property has also been identified as a potential source of benzene to groundwater. In addition, the former BHC plant located at the Montrose Property, and the Montrose chlorobenzene feedstock containing about 0.3 percent of benzene as an impurity, remain possible contributors of benzene found in the saturated zone. The plumes of benzene within the Bellflower Sand and the Gage Aquifer are similar to the plume of chlorobenzene, suggesting a common source from the Montrose Property.

While benzene was detected in soil samples in the vicinity of the property, soil samples collected On-Property did not indicate detectable concentrations of benzene. The absence of benzene in soil and presence of benzene in groundwater may be the result of more rapid benzene degradation within the comparably more oxidized environment of the vadose zone.

TCE and PCE were also detected in soil and groundwater at the Montrose Site. The highest concentrations and greatest frequency of detection of PCE and TCE in soil samples were for samples collected at and in the vicinity of the Jones Chemical Property. The sources of TCE and PCE are likely located at Jones Chemical, which is a known and consistent user of chlorinated solvents such as TCE and PCE. Because Jones Chemical may have used the Montrose recycle pond for the wastes, TCE and PCE could have also been released to the subsurface from the Montrose Property. Other known sources of TCE and PCE are located northwest, north, and northeast of the Montrose Property (Section 5.4.6). Sales records from

Jones Chemical indicate that Montrose purchased a variety of chemical from Jones Chemicals between 1968 and 1973 including PCE and TCE (Gaffney, 1992).

The highest concentrations of TCE and PCE in groundwater samples were also detected in the vicinity of the Jones Chemical property. The distribution of dissolved TCE and PCE is centered Off-Property, beneath the Amoco Chemical and Jones Chemical (Section 5). Dissolved TCE and PCE contamination extends vertically from the Upper Bellflower Aquitard through the Gage Aquifer.

Chloroform was also detected in soil and groundwater at the site. In soil, chloroform was detected On-Property as well as Off-Property, at Jones Chemical and in the Normandie Avenue Ditch (Section 5). The highest concentrations in soil were observed beneath the Montrose Site. Chloroform was mostly detected in unsaturated soil, with the exception of few locations beneath the CPA, where it was detected below the water table. The plume of chloroform dissolved in groundwater is centered on the Montrose Property (Section 5). The highest concentrations occur within the Upper Bellflower Aquitard (over 10,000 µg/L). Vertically, the distribution of dissolved chloroform extends from the Upper Bellflower Aquitard through the Lynwood Aquifer, although the presence of detectable chloroform in the deeper hydrogeologic units is difficult to assess due to elevated detection limits for the VOC analyses. The primary source of chloroform appears to be located On-Property. Additional sources are indicated in the northern portion of the Del Amo Site. A more detailed discussion of the extent of chloroform contamination in soil and groundwater is provided in Sections 5.4.4 and 5.6.5, respectively.

Dichlorobenzenes (1,2-DCB, 1,3-DCB, and 1,4-DCB) were detected in unsaturated soil On-Property, primarily within Central Process Area , and Off-Property, near the Jones Chemical (Sections 5.2.9 and 5.4.10). Dissolved DCB was also detected in groundwater, in On- and Off- property monitoring wells. The vertical distribution of DCB extends from the Upper Bellflower Aquitard through the Lynwood Aquifer. The soil and groundwater data indicate that Montrose is the likely source of the groundwater plume.

6.4.2.1 Transport of VOCs in Atmosphere

Volatilization from Soil and Surface Water. The VOCs of concern at the Montrose Site may be transported into the atmosphere as vapors. Vapor transport can occur through diffusion in response to the concentration gradient between the exposed media and the atmosphere, or through advection with the moving air. Volatilization of the VOCs of concern can occur from contaminated shallow soil and surface water runoff. The asphalt cover at the Montrose Site, where it is present, limits the exposure of VOC vapors in the unsaturated soil pores to the atmosphere or surface water. Lateral subsurface migration of VOC vapor may continue to occur in response to concentration gradients.

Solid Phase Transport. The VOCs of concern are not likely to be transported into the atmosphere with soil or sediment particles because they do not readily adsorb to soil or sediment due to their generally low sorption potential (Section 6.2). Therefore, the transport of the VOCs of concern via atmospheric dispersion, deposition, and resuspension is not likely. As mentioned previously, ethylbenzene and DCB have the highest sorption potential of all the VOCs of concern.

6.4.2.2 Transport of VOCs with Surface Water Runoff

VOCs can easily dissolve in water and travel with the surface water runoff as the dissolved phase. The VOCs of concern are not likely to be transported with soil or sediment particles in the surface water runoff because they do not readily adsorb to soil or sediment. The asphalt cover, where it is present, limits the exposure of contaminated soil to the surface water runoff. The potential for the transport of VOCs with the surface water runoff is also limited by the volatile properties of these contaminants that cause volatilization of VOCs into the atmosphere from the surface water. Nonetheless, VOCs were detected in surface water runoff from the Montrose Site.

Wet weather samples collected between September 1996 and March 1987 from Sampling Location SW-1 in the Jones Chemical Ditch (Figure 5.80) contained VOCs in 9 of 14 unfiltered samples (Table 5.15). Chloroform and toluene were the most commonly detected VOCs and chloroform occurred in the highest concentrations (77 to 550 µg/L). Chloroform occurs in concentrations up to 35,000 µg/L in groundwater within the Upper Bellflower Aquitard. Therefore, the source of chloroform in surface water at the Jones Chemical Ditch may originate from the Montrose Site or Jones Chemical contamination. Chloroform was also detected at Sampling Location SW-3, a surface drain feeding the Kenwood Drain at a concentration of 4 µg/L at the adjacent Farmers Brothers Coffee Company facility, but was not detected further downstream in the Torrance Lateral and Dominguez Channel. This is consistent with the expectation that the VOCs would be rapidly volatilized and diluted.

6.4.2.3 Transport of VOCs in Unsaturated Soil

Vapor Phase Migration. Vapor phase transport is one of the primary migration pathways for the VOCs of concern due to their volatility. VOCs may partition into soil vapor from infiltrating surface water, contaminated soil and sediments, surface water, and, in the case of chlorobenzene, from DNAPL. The VOCs of concern may also volatilize from the groundwater at the capillary fringe. The VOC concentration present in soil vapor directly above the capillary fringe can be approximated by Henry's Law Constant using the groundwater concentrations (Kerfoot, 1988). Vapor diffusion from the groundwater can only occur if there is a sufficient chemical concentration gradient at the capillary fringe.

Chlorobenzene present in the dissolved aqueous phase or as DNAPL in the unsaturated soil will potentially volatilize into the soil vapor. Other VOCs of concern will also potentially volatilize into the soil vapor in areas where elevated concentrations of these compounds are present in the unsaturated soil. Chlorobenzene and other VOCs of concern may also volatilize to a limited extent from groundwater at the capillary fringe.

Vapor phase transport in the unsaturated soil is dominated by the process of molecular diffusion. The VOC of concern that is expected to be present to the greatest extent and in the highest concentrations in soil vapor at the Property is chlorobenzene. Chlorobenzene in the vadose zone will tend to volatilize into the air-filled pores. The chlorobenzene vapors will migrate away from high concentration areas into lower concentration areas due to molecular diffusion. The highest concentrations of chlorobenzene in soil vapor are expected to occur On-Property at and in the vicinity of the Central Process Area (Figure 6.5).

Vapor phase chlorobenzene will migrate in the unsaturated soil pores predominantly under a chemical concentration gradient. Vapor phase transport will decrease as the vapor

concentration gradient decreases and equilibrium conditions are approached. Partitioning of chlorobenzene between the soil vapor, the soil moisture, and the organic carbon in the soil will further retard the vapor diffusion of chlorobenzene.

Migration of chlorobenzene vapors at the Montrose Site is expected to be greater in the coarse-grained units than in the fine-grained units (Figure 6.5). The upper 25 feet of soil beneath the Property is predominantly fine-grained. Vapor phase migration of VOCs is expected to be greatest in the underlying Palos Verdes Sand due to the potentially greater air-filled porosity of this relatively coarse-grained unit. Vapor phase transport in the Upper Bellflower Aquitard above the water table is expected to be greatest in the sandy portions of this unit. Vapor phase transport in the unsaturated zone is expected to be predominantly horizontal due to the observed lithologic stratification. Chlorobenzene has a relative vapor density in moist air of 1.035 (Cohen et al. 1995) indicating that soil vapor, even if saturated with chlorobenzene, will have only a slight tendency to sink downward in the subsurface due to gravity.

Vapor transport of VOCs from the groundwater will occur where there is a sufficient chemical concentration gradient between groundwater at the capillary fringe and the overlying soil vapor (Figure 6.5). The rate of partitioning and vapor transport from groundwater is typically limited due to the slow rate of diffusion within the shallow groundwater.

Infiltration and Leaching. Although the historical timing and amount of infiltration at the Property are unknown, the current potential for surface water infiltration into the unsaturated soil on the Property is limited because the Property was covered with asphalt in 1985. The Property was also graded and paved to drain surface water runoff into the now lined Normandie Avenue Ditch. Some infiltration of surface water can occur through cracks in the asphalt covering and around the edges of the asphalt where rain falls on bare soil. Some of this water could be held in the shallow fine-grained soil and returned to the atmosphere via evaporation during the following dry periods.

Presently, the asphalt covering on the Montrose Property is expected to minimize surface water infiltration onsite; however, a greater degree of infiltration of surface water may occur in unpaved Off-Property areas. Based on the calibration of the Joint Montrose-Del Amo groundwater model, an average infiltration rate of 1 inch per year is expected in the vicinity of the Montrose Site. Infiltration which occurs locally in areas that are paved or underlain at shallow depths by low permeability clayey soils such as in the immediate vicinity of the Montrose Property, however, could be lower than 1 inch per year. Three areas of potentially increased infiltration (18 to 30 inches per year) were identified during construction and calibration of the Joint Montrose-Del Amo groundwater model. These areas are located about 1,500 feet or more northeast of the Montrose Property and appear to be associated with leaking pipelines or excess irrigation at a freeway interchange. These areas of increased infiltration appear to be too far away from the Montrose Site to effect contaminant transport of Montrose-related compounds.

Leakage from active sewer lines which cross beneath the eastern portion of the Property may be a potential source of percolation. These sewer lines, buried at depths of about 20 feet bls, may extend through the clayey near-surface soil into sandier material at depth.

The amount of chlorobenzene available for leaching is greater than that of other VOCs of concern, particularly in the Central Process Area. Chlorobenzene present in the sorbed

phase, vapor phase, or liquid phase as DNAPL has the potential to dissolve into the soil moisture. The lateral extent of chlorobenzene soil vapor is unknown. Any residual drainage of soil moisture that may still be occurring beneath the Central Process Area would likely contain chlorobenzene. Therefore, this drainage provides a continuous source of chlorobenzene to groundwater.

Between 1985 and 1995, the water table at the Montrose Site rose at an average rate of approximately 1 foot per year. The VOCs of concern adsorbed to the deep unsaturated soil, or present as DNAPL in the vadose zone in the Central Process Area are expected to desorb and dissolve into the groundwater if the water table continues to rise. Chlorobenzene is the primary COC that may dissolve from DNAPL that resides in the vadose zone as well as desorb from the contaminated soil into the rising groundwater. In the areas where the occurrence of VOCs in soil is limited primarily to shallow depths, leaching of VOCs into groundwater will not likely to be affected by the rising water table.

Transport as DNAPL in Unsaturated Media. Chlorobenzene is the VOC of concern included within DNAPL detected at the Montrose Site. Therefore, chlorobenzene migrates as DNAPL within the unsaturated soil. Vertical migration of DNAPL in the unsaturated soil occurs rapidly under the influence of gravity (Section 6.2). Relatively low permeability units within the Upper Bellflower Aquitard inhibit the vertical migration of DNAPL in some areas, and cause lateral spreading of DNAPL.

Chlorobenzene can dissolve from the DNAPL into the soil moisture. As discussed in Section 6.2, the effective aqueous solubility of chlorobenzene from DNAPL is about 410 mg/L. Chlorobenzene can also volatilize from DNAPL into the soil vapors, and into the atmosphere in the areas where DNAPL and contaminated soil resides at shallow depths.

6.4.2.4 Transport of VOCs in Groundwater

Dissolved Transport. Advection and dispersion appear to be the primary transport mechanism for the observed migration of VOCs in groundwater at the site. The distribution of the chlorobenzene plume, for example, suggests that the transport of this contaminant is primarily governed by the processes of advection and dispersion, which have resulted in the large lateral extent and gradual decrease in concentrations with increasing distance from the source. The advective transport of VOCs depends on the average linear velocity of groundwater flow, which in turn depends on the hydraulic conductivity and gradients of the aquifer. Therefore, the horizontal extent of VOCs of concern, including chlorobenzene, in the hydrogeologic units at the Montrose Site appears to be related to the relative magnitudes of the horizontal hydraulic gradients and horizontal hydraulic conductivities of these units. For example, chlorobenzene has migrated farther from the source in the Bellflower Sand than in the other hydrogeologic units at the Montrose Site. This more elongated downgradient extent of chlorobenzene in the Bellflower Sand is the result of the high groundwater flow velocities in the Bellflower Sand relative to the other hydrogeologic units.

Vertically, most VOCs of concern have migrated from the Upper Bellflower Aquitard through the Gage and Lynwood Aquifers. The vertical migration of dissolved VOCs is likely caused by the downward hydraulic gradients between the hydrogeologic units at the site and the vertical migration of DNAPL.

The further lateral and vertical advective transport and dispersion of the VOCs of concern are expected to continue under the natural flow conditions. This transport will occur from the potential sources described in Section 5, and from the areas of the dissolved contamination in groundwater.

Retardation of VOCs, primarily due to sorption and biological transformation, may limit the mobility of the VOCs of concern in groundwater. The rate of migration of the VOCs of concern in the hydrogeologic units at the Montrose Site is expected to be lower than the estimated linear groundwater flow velocities of these units due to retardation. The retardation factors for the VOCs of concern will vary based on heterogeneities in the aquifer matrix, variations in the fractional organic carbon content of the aquifer matrix, and the relative hydrophobicity of these compounds.

The values of f_{oc} have been calculated from TOC values for soil samples collected at the Montrose Site. These samples averaged at $2.0x10^{-5}$ for the Upper Bellflower Aquitard, $5.1x10^{-4}$ for the Bellflower Sand, $1.6x10^{-3}$ for the Lower Bellflower Aquitard, $1.0x10^{-3}$ for the Gage Aquifer, $2.8x10^{-3}$ for the Gage/Lynwood Aquitard, and $2.0x10^{-4}$ for the Lynwood Aquifer (Section 4.2.1). Elevated f_{oc} values potentially associated with wood and charcoal fragments observed in the aquifer/aquitard matrix samples were removed from the data set prior to calculating average f_{oc}. These values of f_{oc} were used to estimate the retardation coefficients for benzene, chlorobenzene, and TCE. Based on these estimates, the retardation coefficients for benzene range from 1.01 in the Upper Bellflower Aquifer to 1.48 in the Gage Aquifer, and in aquitards from 1.78 in the Lower Bellflower Aquitard to 2.33 in the Gage/Lynwood Aquitard. The retardation coefficients for chlorobenzene in aquifers range from approximately 1.2 in the Lynwood Aquifer to 2.0 in the Gage Aquifer, and in aquitards from approximately 1.02 in the Upper Bellflower Aquitard to 3.8 in the Gage/Lynwood Aquitard. The retardation coefficients for TCE range from 1.01 in the Upper Bellflower Aquitard to 3.01 in the Gage/Lynwood Aquitard.

Biodegradation of contaminants dissolved in groundwater could be indicated by the following: (1) spatial characteristics of the plume, (2) geochemical/microbiological indicators, and (3) level of understanding of degradation mechanisms for a certain contaminant.

As discussed previously, the contaminants migrate in groundwater by the processes of advection (with groundwater flow) and dispersion (mixing and diffusion), which cause lateral spreading of contaminants from the contaminant sources in a pattern characterized by the gradual decrease in concentrations with increased distances from the source. When microorganisms are actively degrading organic contaminants, concentration gradients at the edges of the contaminant plume tend to be steep (i.e., change rapidly over a short distance) because the low concentration portions of the plume biodegrade to nondetectable levels. The contaminant plume reaches an equilibrium condition when the rate of biodegradation at the edges of the plume is similar to the rate of the contaminant migration. When the plume reaches the equilibrium condition, it typically tends not to migrate beyond a particular distance from the source. If the rate of biodegradation exceeds the rate of the contaminant migration from the source, the extent of the contaminant plume could decrease in size.

The chlorobenzene plume distribution pattern does not support the presence of dependable intrinsic biodegradation. The chlorobenzene plume has migrated more than 1 mile

downgradient in the Bellflower Sand and 2,500 feet in the Gage Aquifer (Section 5.4.3). The chlorobenzene plume has also migrated vertically to a depth of several hundred feet bgs, and is currently found in both the Gage and Lynwood Aquifers. The plume is characterized by gradual changes in concentrations toward the edges of the plume, which is typical for contaminant distributions controlled primarily by advection and dispersion, and not influenced by intrinsic biodegradation.

The geochemical conditions of the chlorobenzene plume have been evaluated to define a line of evidence that could potentially support the occurrence of chlorobenzene biodegradation. The results of this evaluation are:

- Reliable data on the geochemical indicators, including data on dissolved oxygen or oxidation/reduction (redox) conditions within the chlorobenzene plume, are not available.
- Conditions in the aquifers, where most chlorobenzene contamination occurs, such as the Bellflower Sand and Gage Aquifer, are suspected to be anaerobic primarily because of the presence of other organic compounds that are expected to exert an oxygen demand due to their degradability and the significant depth at which these aquifers occur, which would limit oxygen diffusion from the atmosphere. Because the published information suggests that aerobic biodegradation of chlorobenzene is more likely than anaerobic biodegradation, and the existing data suggest that anaerobic conditions within the chlorobenzene plumes are present, it is not likely that substantial intrinsic biodegradation of the chlorobenzene is occurring at the Montrose Site.
- There is one bit of information that could potentially suggest intrinsic biodegradation of chlorobenzene at the Montrose Site. The low concentrations of benzene that are commingled with chlorobenzene could be an indication of reductive dechlorination of chlorobenzene. However, much of the existing published data do not support the hypothesis of the reductive dechlorination of chlorobenzene. On the contrary, some literature evidence suggests that chlorobenzene can inhibit the activity of other bacteria, particularly those bacteria that degrade BTEX (e.g., Burback and Perry, 1993; Oh and Bartha, 1993; Zaitsev et al. 1995). As a result, the occurrence of benzene within the chlorobenzene plume can also be explained by the potential for benzene-degrading organisms to be inhibited by the presence of chlorobenzene, which would enable benzene to migrate from upgradient source areas without being retarded by intrinsic biodegradation (Ramanand et al, 1993). Although the low benzene concentrations commingled with the chlorobenzene could potentially result from the biodegradation of chlorobenzene, on balance this mechanism appears unlikely.

In addition, while the scientific community has accumulated a significant body of information and experience regarding intrinsic biodegradation of certain constituents, the biodegradation mechanisms for chlorobenzene under certain conditions are not currently fully understood (Section 6.2). While based on the existing published laboratory information, chlorobenzene is potentially biodegradable, the degree of supporting laboratory evidence, and the understanding of the metabolic chemical processes within the scientific community, is still limited, particularly for anaerobic degradation. Based on the above, it is more likely that chlorobenzene is degradable aerobically rather than anaerobically, and it is likely that anaerobic conditions exist in the Bellflower Sand and Gage Aquifer. Although benzene could potentially form from the biodegradation within

the subsurface, on balance it appears unlikely. This adds to the relative uncertainty in attempting to use intrinsic biodegradation as a dependable remedial mechanism, especially at a site where anaerobic conditions are expected to exist in the aquifers.

While the data on the dissolved TCE and PCE plumes are not sufficient to determine if these VOCs of concern biodegrade at the Montrose Site, TCE and PCE biodegradation under anaerobic conditions is documented in the literature, particularly if other organic compounds are available. In the case of the Montrose Site, other organic compounds could be used as electron donors while TCE and PCE could be used as electron acceptors and could be reductively dechlorinated under methanogenic conditions.

As discussed in Section 6.2, non-chlorinated VOCs, such as benzene, toluene, ethylbenzene, and xylenes (BTEX), are more readily biodegraded than chlorinated VOCs due to their weaker chemical structure (EPA, 1979R). An extensive body of evidence exists in the literature that benzene is actively biodegraded by indigenous soil microorganisms at a number of sites under a variety of conditions. Although it appears that BTEX has been biodegraded within the vadose zone and partially within the Upper Bellflower Aquitard, degradation of benzene in groundwater does not appear to be occurring as rapidly where it is commingled with chlorobenzene (i.e. within the Bellflower Sand, Gage Aquifer, and Lynwood chlorobenzene plume).

Transport as DNAPL in Saturated Media. As discussed above, chlorobenzene is the VOC of concern included within the DNAPL detected at the Montrose Site. Chlorobenzene has previously migrated as DNAPL within the saturated media laterally as well as vertically (Section 6.2). Significant additional lateral migration of DNAPL is not anticipated. Additional vertical migration could potentially occur in response to changing hydrogeologic conditions. Chlorobenzene also dissolves from the DNAPL into groundwater. As discussed in Section 6.2, the effective aqueous solubility of chlorobenzene from DNAPL is about 410 mg/L.

6.4.3 Potential Migration Pathways for p-CBSA

p-CBSA, a by-product of the manufacture of DDT, is the most widespread organic compound detected in groundwater at the Montrose Site, and occurs in the highest concentrations (Section 5.4.4). p-CBSA has been detected in groundwater samples collected from the Upper Bellflower Aquitard, the Bellflower Sand, the Gage Aquifer, and the Lynwood Aquifer. Little published information regarding the fate and transport of p-CBSA is available.

p-CBSA in groundwater most likely originated as a dissolved constituent in wastewater released to surface and subsurface pathways. Potential sources for release of wastewater to the subsurface include the water recycling pond and sewer lines associated with the Montrose Site (Figure 6.5). Concentrations of p-CBSA in wastewater may have been about 1 percent, based on maximum groundwater concentrations detected at the Montrose Site. Wastewater volumes released from the pond may have resulted in subsequent mounding of the water table beneath the Central Process Area. Such mounding may have induced radial flow away from the Central Process Area in the underlying unsaturated and saturated hydrogeologic units. This may explain the elevated concentrations of p-CBSA detected historically in Monitoring Wells BF-30, BF-32 and MW-9, located in cross-gradient and up-gradient directions from the site. p-CBSA has not been analyzed in soil, sediment, and

surface water samples at the Montrose Site; therefore, the concentrations in these media and potential transport can not be evaluated.

6.4.3.1 Atmospheric Transport of p-CBSA

As discussed in Section 6.2, the published information on volatile properties of p-CBSA is not available. Based on the high boiling point, the volatility of p-CBSA is expected to be low, if any. Therefore, the volatilization of p-CBSA into the atmosphere is unlikely. Because of the low sorption potential, p-CBSA will not likely migrate in the atmosphere with soil particles.

6.4.3.2 Transport of p-CBSA with Surface Water Runoff

The historic p-CBSA migration pathways were via wastewater release to the surface and subsurface. As discussed in Section 6.2, p-CBSA is very soluble in water. Therefore, this contaminant has a high potential to travel as dissolved phase in the surface water runoff.

Because of the low sorption potential, p-CBSA will not likely migrate with the surface water runoff sorbed onto soil particles.

No data are available to assess the prior transport of p-CBSA in surface water; however, if it did occur, p-CBSA would be expected to flush relatively rapidly from the surface water drainage due its high solubility and low sorptive properties.

6.4.3.3 Transport of p-CBSA in Unsaturated Soil

Because of its high aqueous solubility, p-CBSA, if present in DNAPL, is expected to readily partition from DNAPL into soil moisture and leach to groundwater. The potential for volatilization of p-CBSA from DNAPL into the soil vapor is low due to the low volatility of this contaminant.

6.4.3.4 Transport of p-CBSA in Groundwater

Dissolved Transport. *Advection and dispersion* appear to be the primary transport mechanisms for the observed migration of p-CBSA in groundwater at the site. The distribution of the p-CBSA plume suggests that the transport of this contaminant is primarily governed by the processes of advection and dispersion, which have resulted in the large lateral extent and gradual decrease in concentrations with the distance from the source. As discussed previously, the advective transport depends on the average linear velocity of groundwater flow, which in turn depends on the hydraulic conductivity and gradients of the aquifer (Section 6.3). Therefore, the large downgradient extent of p-CBSA in the Bellflower Sand and the Gage Aquifer is the result of the high groundwater flow velocities in these units relative to the Upper Bellflower Aquitard.

p-CBSA has migrated vertically from the Upper Bellflower Sand to the Gage and Lynwood Aquifers. This vertical migration of dissolved p-CBSA is likely caused by the downward vertical hydraulic gradients between the hydrogeologic units at the site. If present in DNAPL, the significant vertical extent of p-CBSA could also be caused by the vertical migration of DNAPL.

The further lateral and vertical advective transport and dispersion of p-CBSA is expected to continue under the natural groundwater flow conditions. This transport will occur from

the apparent source area at the Montrose Property, and from the areas of the dissolved contamination in groundwater.

Retardation of p-CBSA dissolved in groundwater is not likely due to the low sorption potential of this contaminant (Section 6.2). This is further confirmed by the significant extent of p-CBSA in groundwater at the site.

Biodegradation does not appear to significantly impact the migration of p-CBSA in groundwater at the Montrose Site based on the significant lateral and vertical extent of dissolved p-CBSA. Although p-CBSA has been shown to biodegrade under aerobic conditions in a laboratory (Mackay, et al. 1990), there are insufficient data to determine whether biodegradation of p-CBSA is occurring at the Montrose Site. A bench-scale study of ex-situ groundwater treatment with an aerobic bioreactor showed that p-CBSA was highly biodegradable under the aerobic conditions in the bioreactor (McLaren/Hart, 1997a). Field data are not available to evaluate if the same conditions exist in the groundwater as in the bioreactor and to assess if biodegradation of p-CBSA is occurring in the field.

Surfactant properties of p-CBSA are mild due to its weak polar structure (Section 6.2). A study conducted by Kirk and Chiou (1989) suggests that because p-CBSA is: (1) a single specie, (2) ionic, and (3) not expected to form micelles, it is likely that any increase in the aqueous solubility of DDT or reduction in sorption due to the presence of p-CBSA would be minor.

Co-solvency due to the presence of p-CBSA is not expected to significantly enhance the mobility of other COCs in groundwater (Section 6.2). As discussed previously, enhanced mobility related to co-solvency occurs when co-solvents which are completely miscible in water, such as acetone or methanol, are present at co-solvent fractions of greater than about 5 percent by volume (Pankow and Cherry, 1996). p-CBSA is only partially miscible in water and has been detected at a maximum concentration of about 1 percent by weight in groundwater beneath the Central Process Area. Given that p-CBSA is not completely miscible and the relatively low fraction of p-CBSA in water outside the Central Process Area, enhanced mobility, if any, that may be due to co-solvency is not expected to be significant.

Transport as DNAPL. As discussed previously, DNAPL can migrate vertically and laterally in the saturated zone (Section 6.2). p-CBSA, if present in DNAPL, is expected to readily partition from DNAPL into groundwater.

6.4.4 Potential Migration Pathways for DNAPL

The most significant finding of this RI has been the occurrence of DNAPL in the subsurface beneath the Property. The occurrence of DNAPL has facilitated the vertical transport of DDT and chlorobenzene downward from sources located On-Property in the Central Process Area through the 70-foot-thick unsaturated soil zone to the water table and to some depth below the water table (Figure 6.5). The magnitude, extent, and chemical composition of this DNAPL present challenging and complex technical issues that will need to be addressed during the evaluation and selection of remedial measures that may be required for soil and groundwater. DNAPL in the subsurface may represent a continuing source of DDT and chlorobenzene to soil and groundwater, and is a key element in the consideration of potential remedial measures.

The principal source area for DNAPL to the subsurface is the Central Process Area (Figure 6.5). The former unlined surface water recycle pond appears to be a specific area within the Central Process Area which may have facilitated the downward vertical migration of DNAPL. This pond penetrated a substantial percentage of the more clayey near-surface soil, and the fluid level within this pond probably provided the driving hydraulic head for infiltration and percolation of fluids (including DNAPL) into the subsurface.

Chemical composition of DNAPL is difficult to determine because of the required dilution factors for chemical analysis and limitations of the analytical methodologies. Although subject to error, the results of laboratory analysis conducted to date do indicate that DDT and chlorobenzene comprise the principal components of the DNAPL.

DDT, which is a solid at normal temperature and pressure, dissolves readily into chlorobenzene. The reported solubility of DDT in chlorobenzene is 740 g/L, which is equivalent to about 40 percent on a weight to weight basis (Budavari, S., editor, 1989; Montgomery and Welkom, 1990). Results of laboratory analyses of DNAPL obtained from the subsurface beneath the Central Process Area have indicated DDT to chlorobenzene ratios of approximately 40 to 50 percent DDT, indicating the DNAPL is at or near saturation with respect to DDT.

Occurrence of DNAPL is discussed in Section 5.5.1 and is summarized in this section. DNAPL residing in the vadose zone beneath the Central Process Area most likely occurs primarily as isolated, immobile residual globules held in the pore spaces by capillary forces which resist DNAPL entry into smaller pore openings (Figure 6.5). Elevated concentrations of DDT detected in soil samples collected from the deeper portions of the vadose zone may be indicative of residual DNAPL, sorbed DDT, or precipitated DDT as a solid phase.

The potential presence of DNAPL in soil or aquifer matrix samples can be inferred based on equilibrium partitioning between the vapor phase, the sorbed phase, and dissolved phase (Feenstra et al. 1991). Soil partitioning theory was used to compute preliminary screening concentrations which may indicate the presence of DNAPL in soil samples. Screening criteria were based on the concentration of chlorobenzene detected in soil samples collected from the vadose zone and the saturated zone assuming that the concentration of chlorobenzene in the soil pore water was equal to the effective aqueous solubility of chlorobenzene in contact with DNAPL. The DNAPL was assumed to be composed of 60 percent chlorobenzene and 40 percent DDT by weight. The following soil and chemical properties shown in Table 6.4 were assumed in calculating screening level concentrations for vadose zone and saturated zone soil samples.

Assuming average concentrations of total organic carbon and moisture contents for vadose zone soil, concentrations of chlorobenzene in vadose zone soil samples exceeding about 180 mg/kg may indicate the presence of DNAPL. Approximately 49 of all soil samples collected from the vadose zone exceeded this concentration. With the exception of a near surface soil sample collected from Boring 15D in 1985, these samples were collected from borings located in the Central Process Area. Boring 15D is located approximately 120 feet east of the Central Process Area. The concentration of chlorobenzene detected in the soil sample collected from Boring 15D at a depth of 2 feet bls was 360 mg/kg.

TABLE 6.4
Soil and Chemical Properties Used to Calculate Screening Level Concentrations for Vadose Zone and Saturated Zone Soil Samples

Chemical Properties of Chlorobenzene and DDT	
Chlorobenzene Molecular Weight (grams per mole)	112.56
DDT Molecular Weight (grams per mole)	354.5
Chlorobenzene Mole Fraction in DNAPL	0.8253
Chlorobenzene Single Component Aqueous Solubility	500 mg/L
Chlorobenzene Effective Aqueous Solubility from DNAPL	412.7 mg/L
Chlorobenzene Log K_{OW}	2.84
Chlorobenzene Henry's Constant (unitless)	0.149
Soil Properties	
Total porosity	0.411
Dry Bulk Density (grams per cubic centimeter)	1.58
Average Fraction of Organic Carbon of Vadose Zone Samples	0.000894
Average Fraction of Organic Carbon of Saturated Zone Samples	0.000853
Vadose Zone Soil Moisture Content (weight basis)	0.118
Vadose Zone Soil Volumetric Moisture Content	0.186
Saturated Zone Soil Volumetric Moisture Content	0.411

Within the saturated zone beneath the Central Process Area, DNAPL was observed to occur as thin layers that are heterogeneously distributed. The potential presence of DNAPL in aquifer matrix samples can also be inferred based on the results of laboratory analysis of soil samples. Total concentrations of chlorobenzene in saturated zone soil samples exceeding about 230 mg/kg may indicate the presence of DNAPL. Approximately 8 of the 25 aquifer matrix samples collected below the water table in the Central Process Area exceeded this concentration (Figure 5.21). These samples were collected at depths ranging from 75 feet bls to about 90 feet bls. Concentrations of chlorobenzene detected in 5 soil samples collected from 3 borings outside the Central Process Area ranged from less than 0.3 mg/kg to a maximum concentration of 2 mg/kg. Concentrations of chlorobenzene in the five aquifer matrix samples collected beneath the Central Process Area from the Bellflower Sand ranged from 4.2 mg/kg to 51 mg/kg.

6.4.4.1 DNAPL Migration in Unsaturated Soil

As discussed in Section 6.2, DNAPL migration as a separate phase in the unsaturated soil is primarily influenced by gravity and lithology. As DNAPL migrates through the unsaturated soil, the fluid displaces the air in the soil pore spaces and some of the DNAPL becomes trapped due to capillary forces (Schwille, 1988). The trapped DNAPL is termed

residual. The amount of residual DNAPL tends to be inversely proportional to the permeability of the unsaturated soil (Schwille, 1988).

Vertical migration of DNAPL in the unsaturated soil can occur rapidly. Lateral spreading of DNAPL can occur due to capillary forces and/or relative permeability differences. Relatively low permeability units may inhibit the downward migration of DNAPL and cause the DNAPL to spread laterally. DNAPL will penetrate low permeability units if the pressure head on the DNAPL exceeds the capillary pressure barrier of the low permeability unit. DNAPL may also penetrate low permeability units in the unsaturated soil through fractures. If the volume of DNAPL in the unsaturated soil exceeds the retention capacity of the soil, the DNAPL will eventually reach the capillary fringe. If the pressure head of the DNAPL exceeds the capillary pressure barrier between the water and the DNAPL, the DNAPL will penetrate the capillary fringe and continue its downward migration into the groundwater.

6.4.4.2 DNAPL Migration in Saturated Media

Migration of DNAPL in saturated porous media occurs under the influence of gravity and is typically influenced to a lesser extent by the natural hydraulic gradient (Schwille, 1988). DNAPL, which has a greater density than water, will migrate downward through the saturated zone. As DNAPL moves downward through saturated porous media, some portion of groundwater in the soil pores is displaced and replaced in part by the infiltrating liquid (Schwille, 1988).

The dominating factors governing DNAPL migration in saturated media are the interfacial tension, pressure head of the DNAPL, and lithology. Lower permeability units hold water significantly more strongly within their pore-throats because of the greater capillary forces associated with the smaller pore-throat diameters in these finer grained lower permeability units. DNAPL flow can be inhibited by such low-permeability units because the gravitational forces driving the downward migration of DNAPL are not great enough to overcome the capillary forces holding the water in the pore-throats of the fine-grained lower permeability units. In such situations, the downward migration of DNAPL can cease at the upper bounds of these lower permeability units and lateral spreading of DNAPL can occur on the tops of these low permeability units. Lateral spreading of DNAPL will generally continue until residual saturation is reached. Therefore, DNAPL will tend to accumulate over finer-grained strata occupying the available pore space in the overlying coarser-grained strata until the height of the DNAPL (gravitational forces driving DNAPL advection) is sufficient to drive the DNAPL into or around the finer zone. Lateral spreading is controlled in part by the geometry of the contacts between coarse- and fine-grained lithologic zones which can influence the direction and extent of DNAPL migration. Given the complexities of the heterogeneities in lithology observed in the subsurface beneath the Central Process Area, it is very difficult to precisely define the distribution of DNAPL in the subsurface.

Vertical migration of DNAPL in saturated media can also occur through fractures that are commonly present in low permeability units. If the pressure head in the DNAPL overlying an aquitard is high enough, the DNAPL will migrate into the aquitard and, if the quantity of DNAPL is large enough such that residual saturations in the fractures in the lower permeability units are exceeded during this migration, the DNAPL can then potentially migrate to the underlying hydrogeologic unit. DNAPL will continue to dissolve into

infiltrating water and groundwater over long periods of time and may act as a long-term source of groundwater contamination

Most chlorinated solvent DNAPLs are non-wetting on typical aquifer solids with respect to water. Based on observed behavior, DNAPL extracted from Central Process Area monitoring wells at the Montrose Site is non-wetting on glass with respect to water and is likely also non-wetting on aquifer solids. This behavior indicates that it is likely that water preferentially wets the soil particles which makes it more difficult for DNAPL to penetrate small pores associated with fine-grained formations.

Because DNAPL migration in heterogeneous porous media is effected by small scale changes in pore size and geometry which result in a complex and unpredictable DNAPL distribution in the subsurface, estimating total or potentially mobile DNAPL mass is not currently possible. Additional data regarding DNAPL physical and chemical properties will be collected as part of the DNAPL Feasibility Study (FS) for the Montrose Site. The ability to estimate DNAPL mass will be further addressed in the DNAPL FS.

Although current estimates of DNAPL mass are not possible, typical patterns of DNAPL behavior would tend to favor DNAPL accumulation below the water table as opposed to within the vadose zone. Residual saturation of DNAPL in the saturated zone often exceeds that in the vadose zone because: (1) the fluid density ratio (DNAPL:air versus DNAPL:water) favors greater DNAPL drainage in the vadose zone, and (2) DNAPL tends to become trapped in larger pores below the water table whereas in the vadose zone it tends to form thin films with lower overall saturations (Cohen and Mercer, 1993). Field observations were consistent with this behavior as visual evidence of free phase DNAPL beneath the Central Process Area was more common in core samples collected below the water table in the upper Bellflower Aquitard at depths ranging from 70 to 90 feet bls. These observations suggest that the mass of DNAPL below the water table exceeds that occurring in the vadose zone (Figure 6.5). The results of the treatability test during which nearly 300 gallons of DNAPL were also recovered indicates that the mass of mobile phase DNAPL in the saturated zone is probably larger than the mass of mobile phase DNAPL in the overlying vadose zone.

6.4.4.3 Operational Considerations for DNAPL Extraction

The Groundwater Treatability Study (H+A, 1992R-b) demonstrated that DNAPL will accumulate in specially designed monitoring wells and limited quantities can be extracted from the Upper Bellflower Aquitard in the vicinity of the Central Process Area. However, given the tendency of DNAPL to become trapped as residual saturation in the pore space as it migrates, it is expected that only a small percentage of the total DNAPL mass could be recovered using hydraulic enhanced extraction, and that the residual DNAPL will continue to be a near-perpetual source of dissolved chlorobenzene to groundwater. However, the removal of DNAPL using hydraulic enhanced extraction may be enough to reduce or limit DNAPL mobility.

DNAPL recovery was enhanced under pumping conditions when groundwater was being extracted. This is due to the increased hydraulic gradient which occurs in the immediate vicinity of the monitoring well when the monitoring well is pumped. DNAPL recovery from extraction Monitoring Well UBE-1 averaged approximately 10 gallons per day (gpd) during the 28 days when groundwater was being pumped from the monitoring well.

DNAPL recovery from 5 shallow monitoring wells in the Central Process Area under static non-pumping conditions has been generally less than 0.05 gpd in 2 monitoring wells and less than 0.005 gpd in 3 monitoring wells.

Approximately 313 gallons of DNAPL were removed from Extraction Monitoring Well UBE-1 during treatability testing conducted during the period from July 24 to August 21, 1991. An additional 90 gallons of DNAPL have been purged from these 5 upper Bellflower Aquitard monitoring wells located in the Central Process Area since May 1991 during static non-pumping groundwater conditions.

Submersible pump performance during the 28-day aquifer test appears to have degraded as a result of the accumulation of a white, powdery solid in the pump and piping. Analytical results for solids samples collected from the groundwater treatment system have been summarized (Table 6.3). These data indicated that DDT comprised approximately 5 to 13 percent of the solids. The accumulation of the solid in the pump decreased the flow rate capacity of the pump after 15 days of operation. Additional studies are planned to characterize the chemical and physical properties of the accumulated solid precipitate in support of the DNAPL FS.

DNAPL and emulsions were not present in the groundwater extracted from Extraction Monitoring Well UBE-1, based on observations using a separator tank. DNAPL and groundwater appeared to be effectively separated in the monitoring well sump, which allowed DNAPL to be extracted using a bladder pump set near the bottom of the monitoring well.

6.5 Potential for Contamination of Public Water Supply Monitoring Wells

6.5.1 Distance to Public Supply Monitoring Wells

The nearest public water supply monitoring well downgradient from the Montrose Property is Monitoring Well 836A, located approximately 2 miles southeast of the Property (Figure 1.23). The nearest public water supply monitoring well upgradient from the Property is Monitoring Well 792W, located approximately 1.7 miles north of the Property (Figure 1.23). These public supply monitoring wells are screened only in the Silverado Aquifer which is several hundred feet deeper than the hydrogeologic units affected by contaminants from the Montrose Site. There are no public supply monitoring wells located within the area of maximum horizontal extent of chlorobenzene in groundwater at concentrations exceeding MCLs for drinking water. The maximum horizontal extent of chlorobenzene in groundwater investigated at the Montrose Site occurs in the Bellflower Sand. Chlorobenzene was detected in Bellflower Sand monitoring wells located approximately 5,600 feet (1.1 mile) southeast and downgradient from the Montrose Property boundary. Based on the observed lateral and vertical distribution of contaminants in groundwater, the current understanding of the groundwater flow regime, and the monitoring well construction information available for these monitoring wells, it does not appear likely that water quality in water supply monitoring wells located southeast of the Property will be significantly impacted.

6.5.2 Estimated Contaminant Travel Times

Potential arrival times for chlorobenzene in groundwater at concentrations exceeding the MCL of 70 µg/L for drinking water were estimated at the locations of water supply monitoring wells nearest the Property in the east and southeast directions. The three monitoring wells used in these estimates were irrigation Monitoring Well 825, domestic Monitoring Well 818A, and public supply Monitoring Well No. 836A located within approximately 2 miles east and southeast of the Property (Figure 1.23).

The average horizontal groundwater flow velocities for the Bellflower Sand and Gage Aquifer were estimated to be approximately 0.67 ft/day and 0.16 ft/day, respectively, based on RI data and estimates of average horizontal hydraulic conductivities, average horizontal hydraulic gradients, and average effective porosities for these units (Tables 4.4 and 4.6; Sections 4.2.3.2 and 4.2.3.4). The projected travel times derived from these parameters assume advective transport along the shortest distance from the leading edge of the chlorobenzene plume in each unit at concentrations equivalent to the MCL of 70 µg/L for chlorobenzene in drinking water directly toward each monitoring well. These estimates do not account for the effects of sorption, dispersion, diffusion, or chemical and biologic transformation which would result in longer travel times. Monitoring Wells 825, 836A, and 818A are located approximately 3,250 feet east, 5,500 feet southeast, and 4,250 feet south-southeast, respectively, from the leading edge of the chlorobenzene plume in the Bellflower Sand at concentrations exceeding 70 µg/L . The Bellflower Sand is the most transmissive unit encountered beneath the Montrose Site. The downgradient extent of chlorobenzene in Bellflower Sand is the largest and the first arrival, if any, of groundwater containing chlorobenzene would be expected to occur in the Bellflower Sand. The Bellflower Sand is not known to have any beneficial use and is not used to extract drinking water.

Chlorobenzene in the Bellflower Sand at concentrations exceeding the MCL of 70 µg/L for drinking water was projected to arrive at the location of Monitoring Wells 825 and 836A no sooner than approximately 13 and 23 years, respectively. Chlorobenzene in the Gage Aquifer was projected to arrive at the locations of these monitoring wells no sooner than approximately 79 and 136 years, respectively. If groundwater containing chlorobenzene were to arrive in the vicinity of these monitoring wells, however, it would not be expected to impact water quality in groundwater extracted from irrigation Monitoring Well 825 and public water supply Monitoring Well 836A because these monitoring wells produce groundwater from the deeper Silverado Aquifer. The available records for these monitoring wells indicate that they are perforated in the depth intervals from 555 to 676 feet bls, and 504 to 660 feet bls, respectively (Table 1.5). The results of the RI indicate that chlorobenzene in groundwater does not extend vertically deeper than the Lynwood Aquifer which is separated from the underlying Silverado Aquifer by several hundred feet of aquitard material. The Lynwood/Silverado Aquitard is expected to be effective in mitigating the vertical transport of contaminants between these units.

Domestic Monitoring Well 818A, located approximately 9,000 feet southeast of the Property, was drilled to a total depth of 250 feet bls, and although the perforated intervals of this monitoring well are not known, it is likely that this monitoring well produces groundwater directly from the Lynwood Aquifer. Given the previously stated assumptions, chlorobenzene in groundwater in the Bellflower Sand and Gage Aquifer was projected to arrive at the location of domestic Monitoring Well 818A no sooner than approximately 17 and 123 years, respectively. The arrival time for chlorobenzene in the Lynwood Aquifer

from the Property to the location of domestic Monitoring Well No. 818A, was estimated to be approximately 199 years, based on an estimated average horizontal groundwater flow velocity of 0.12 ft/day in the Lynwood Aquifer.

TABLE 6.1
CHEMICAL PROPERTIES OF TARGET COMPOUNDS

TARGET COMPOUND	CHEMICAL FORMULA	MOLECULAR WEIGHT (g/mole)	MELTING POINT (EC)	BOILING POINT (EC)	VAPOR PRESSURE (mm Hg)	SOLUBILITY IN WATER (mg/L)	SPECIFIC GRAVITY	LOG K_{ow}	LOG K_{oc}	H_c	LOG K_b
p,p'-DDT	$C_{14}H_9Cl_5$	354.5	108(A)	185 (a)(B)	1.9×10^{-7} (20EC)(b)(A)	5.5×10^{-3} (25EC)(c)(B)	1.56 (15EC)(C)	6.19(A) 6.91(B)	6.59(B)	1.58×10^{-5} (25EC)(B)	6.90(B)
o,p'-DDT	$C_{14}H_9Cl_5$	354.49	74-74.5 (B)	---	5.5×10^{-6} (30EC)(D)	$2.6\text{-}8.5 \times 10^{-2}$ (25EC)(B)	---	---	---	---	---
p,p'-DDD	$C_{14}H_{10}Cl_4$	320.05	112(d)(B)	193(D)	10.2×10^{-7} (30EC)(e)(B)	0.02 - 0.09 (25EC)(f)(B)	1.476 (20E)(g)(C)	6.20(B)	5.89(B)	2.2×10^{-6} (h)(B)	5.26(B)
o,p'-DDD	$C_{14}H_{10}Cl_4$	320.05	76-78(E)	---	1.89×10^{-6} (30EC)(B)	0.1(25EC)(B)	---	6.08(D)	---	---	---
p,p'-DDE	$C_{14}H_8Cl_4$	318.03	82(B)	---	6.5×10^{-6} (20EC)(B)	0.04(20EC)(B)	---	6.96(B)	6.64(B)	6.8×10^{-5} (20EC)(B)	5.95(B)
o,p'-DDE	$C_{14}H_8Cl_4$	318.03	88-90(D)	---	6.2×10^{-6} (20EC)(B)	0.14(D)	---	5.78(D)	---	---	---
*-BHC	$C_6H_6Cl_6$	290.85	157 (i)(A)	---	2.5×10^{-5} (20EC)(B)	1.63 (25EC)(j)(B)	---	3.89(B)	3.58(B)	6.0×10^{-6} (k)(B)	3.16(B)
$-BHC	$C_6H_6Cl_6$	290.85	297 (l)(A)	---	2.8×10^{-7} (20EC)(B)	0.24(25EC) (m)(B)	1.89 (19EC)(G)	3.89(B)	3.58(B)	4.5×10^{-7} (k)(B)	3.18(B)
*-BHC	$C_6H_6Cl_6$	290.85	138-139 (n)(B)	---	1.7×10^{-5} (20EC)(B)	31.4 (25EC)(o)(B)	---	4.15(B)	3.82(B)	2.07×10^{-7} (k)(B)	3.54(B)
J-BHC	$C_6H_6Cl_6$	290.85	112(A)	---	1.6×10^{-4} (20EC)(B)	7.8(25EC)(B)	1.87 20/4EC(A)	3.89(B)	3.58(B)	7.8×10^{-6} (k)(B)	3.18(B)
Chlorobenzene	C_6H_5Cl	112.56	-45(A)	132(A)	8.8 (20EC)(A)	500(20EC)(A)	1.1066 20/4EC(A)	2.84(A,B)	2.52(B)	3.58×10^{-3} (20EC)(B)	2.21(B)
Benzene	C_6H_6	78.11	5.5(A)	80.1(A)	76(20EC)(A)	1,780(20EC)(A)	0.8786 20/4EC(A)	2.13(A,B)	1.81(B)	5.5×10^{-3} (25EC)(B)	1.57(B)
Chloroform	$CHCl_3$	119.38	-64(A)	62(A)	160 (20EC)(A)	8,000(20EC)(A)	1.489 (20EC)(A)	1.97(A) 1.96(B)	1.64(B)	2.88×10^{-3} (20EC)(B)	1.41(B)
Carbon Tetrachloride	CCl_4(E)	153.82	-23(A)	76.7(A)	90(20EC)(A)	785(20EC)(B) 1,160(25EC)(A)	1.59 (20EC)(A)	2.64(A) 2.96(B)	2.64(B)	0.023(20EC)(B)	2.32(B)
1,2-DCA	$CHCl_2CH_3$ (E)	99	-35.4 (A)	83.5(A)	61(20EC)(A)	8,690(20EC)(A)	1.25 20/4EC(A)	1.48(B)	1.15(B)	9.14×10^{-4} (20EC)(B)	1.0(B)
Ethylbenzene	C_8H_{10}	106.17	-94.97 (A)	136.2 (A)	7(20EC)(A)	140(25EC)(A) 152(20EC)(B)	0.867 20/4EC(A)	3.15(G) 3.34(B)	3.04(B)	6.6×10^{-3} (20EC)(B)	2.67(B)
PCE	C_2Cl_4	165.83	-22.7 (A)	121.4 (A)	14(20EC)(A)	150(25EC)(A) 200(20EC)(B)	1.626 (20EC)(A)	2.6(A) 2.88(B)	2.56(B)	0.0153(20EC)(B)	2.4(B)
TCE	C_2HCl_3	131.5	-87(A)	86.7(A)	60(20EC)(A)	1,100(20EC)(A)	1.46	2.42(B)	2.10(B)	9.1×10^{-3} (20EC)(B)	1.99(B)

NOTE: Refer to page 3 of this table for footnotes

TABLE 6.1 (continued)
CHEMICAL PROPERTIES OF TARGET COMPOUNDS
Page 2 of 3

TARGET COMPOUND	CHEMICAL FORMULA	MOLECULAR WEIGHT (g/mole)	MELTING POINT (EC)	BOILING POINT (EC)	VAPOR PRESSURE (mm Hg)	SOLUBILITY IN WATER (mg/L)	SPECIFIC GRAVITY (20EC)(A)	LOG K_{ow}	LOG K_{oc} 2.29(D)	H_c	LOG K_b
Toluene	C_7H_8	92.1	-95.1 (A)	110.8 (A)	22(20EC)(A)	515(20EC)(A)	0.867 20/4EC(A)	2.69(A) 2.79(B)	2.48(B)	6.66×10^{-3} (20EC)(B)	2.17(B)
p-CBSA (sodium salt)	$C_6H_4ClNaO_3S$	214.60	---	---	---	152,000(25EC) (i)%	---	---	---	---	---
p-CBSA	$C_6H_5ClO_3S$	192.62	68(A)	147/148 (25 mm) (A)	---	13.65(p)%	---	---	---	---	---
o-Xylene	C_8H_{10}	106.17	-25(A)	144.4 (A)	5(20EC)(A)	175(20EC)(A)	0.88 (20EC)(A)	2.77(A)	2.11(H)	5.35×10^{-3} (25EC)(H)	---
m-Xylene	C_8H_{10}	106.16	-48/-53 (G)	139(G)	6(20EC)(G)	173(25EC)	0.864 (20EC)(A)	3.2(A)	3.20(H)	6.3×10^{-3} (25EC)(H)	---
p-Xylene	C_8H_{10}	106.17	13(A)	138.4 (A)	6.5 (20EC)(A)	198(25EC)(A)	0.86 (20EC)(A)	3.15(A)	2.31(H)	6.3×10^{-3} (25EC)(H)	---
1,2-DCB	$C_6H_4Cl_2$	147.01	-16.7/-18 (A)	179(A)	1(20EC)(A)	145(25EC)(A)	1.305 (20/4EC)(A)	3.38(A)	2.27(H)	2.4×10^{-3} (25EC)(H)	2.86(B)
1,3-DCB	$C_6H_4Cl_2$	147.01	-24.8(A)	172(A)	2.3(25EC)(H)	123(25EC)(A)	1.288 (20/4EC)(A)	3.38(A)	2.23(H)	4.7×10^{-3} (25EC)(H)	2.86(B)
1,4-DCB	$C_6H_4Cl_2$	147.01	53(A)	173(A)	0.6(20EC)(A)	79(25EC)(A)	1.458 (20/4EC)(A)	3.39(A)	2.20(H)	4.45×10^{-3} (25EC)(H)	2.86(B)
Acetone	C_3H_6O	58.08	-95.35(H)	56.2(H)	266(20EC)(H)	4.40×10^{5} (25EC)(J)	0.7899 (20/4EC)(J)	-0.24(H)	-0.43(H)	3.97×10^{-5} (25EC)(H)	---

NOTE: Refer to page 3 of this table for footnotes

TABLE 6.1 (continued)
CHEMICAL PROPERTIES OF TARGET COMPOUNDS

FOOTNOTES

SOURCES:

(A) Verschueren, 1983
(B) EPA, R-1982
(C) Weiss, 1986
(D) EPA, R-1979
(E) Sax, 1986
(F) Windholz et al., 1983
(G) Weast, 1985
(H) Montgomery and Welkom, 1990
(I) EPA, 1978
(J) Montgomery, 1991

(a) Boiling point also reported as 260EC (Weast, 1985)
(b) Vapor pressure also reported as 1.7×10^{-7} mm Hg (National Institute for Occupational Safety and Health [NIOSH], 1985)
(c) Solubility in water also reported as 0.1 mg/l (20EC) (NIOSH, 1985), .0031-.0034 mg/l (25EC) (Verschueren, 1983), and 1.2×10^{-3} - 2.5×10^{-2} ppm (Mabey, 1982)
(d) Melting points also reported as 109-110EC (Merck, 1983)
(e) Vapor pressure also reported as 1×10^{-6} mm Hg (30EC) (Sax, 1986)
(f) Solubility is also reported as .160 mg/l (24EC) (Verschueren, 1983)
(g) Specific gravity also given as 1.385 (Sax, 1986)
(h) Calculated using vapor pressure value measured at 30EC and solubility value measured at 25EC
(i) Melting point also reported as 159-160EC (Weast, 1985)
(j) Solubility in water also reported as 10 ppm (Verschueren, 1983)
(k) Calculated using vapor pressure value measured at 20EC and solubility value measured at 25EC
(l) Melting point also reported as 314-315EC (sublimes) (Weast, 1985) and as 309EC (Mabey, 1982)
(m) Solubility in water also reported as 5 ppm (Verschueren, 1983)
(n) Melting point also reported as 141-142EC (Weast, 1985)
(o) Solubility in water also reported as 10 mg/l (Verschueren, 1977)
(p) Solubility in water of p-CBSA based on solubility in water of p-CBSA (sodium salt) and conversion factor listed in the standard operating procedure of the analysis of p-CBSA in water (ATI, 1991)

g/mole = Grams per mole
EC = Degrees Celcius
mm Hg = Millimeters of Mercury
mg/L = Milligrams per liter
Log K_{ow} = Logarithm of octanol-water partition coefficient
Log K_{oc} = Logarithm of organic carbon partition coefficient
H_c = Henry's Law Constant in atmosphere in cubic meters per mole
Log K_b = Logarithm of microorganism-water partition coefficient
(---) = Not available
mm = Millimeters

TABLE 6.2

ESTIMATED CHLOROBENZENE RETARDATION FACTORS

HYDROGEOLOGIC UNIT IDENTIFIER	AVERAGE DRY BULK DENSITY (g/cm3)	AVERAGE TOTAL POROSITY (percent)	GEOMETRIC MEAN FRACTIONAL ORGANIC CARBON (dimensionless)	ESTIMATED DISTRIBUTION COEFFICIENT* (ml/g)	ESTIMATED RETARDATION FACTOR (dimensionless)
UBF	1.49	43.9	0.00002	0.01	1.0
MBFB	1.49	43.3	0.00015	0.05	1.2
MBFM	1.25	52.1	0.00007	0.02	1.1
MBFC	1.59	39.7	0.0005	0.18	1.7
LBA	1.52	42.6	0.0016	0.57	3.1
GAGE	1.53	42.2	0.001	0.35	2.3
GLA	1.51	43.9	0.0028	0.97	4.4
LYNWOOD	1.76	33.7	0.0002	0.07	1.4

NOTE: Hydrogeologic Unit Nomenclature provided in this table was used in the development of the Joint Groundwater Feasibility Study Computer Model for the Montrose and Del Amo Sites. In general, the UBF, MBFB, and MBFM units are equivalent to the Upper Bellflower Aquitard and the MBFC is equivalent to the Bellflower Sand.

*Log Kd = 0.72 log Kow + log foc + 0.5 (after Schwarzenbach and Westall, 1981)
where: Kd = partion distribution coefficient
Kow = octanol-water partition coefficient
foc = fractional organic carbon

log Kow of chlorobenzene = 2.84 (EPA, 1982)

UBF = Upper Bellflower Aquitard
MBFB = Middle Bellflower B Sand
MBFM = Middle Bellflower Mud
MBFC = Middle Bellflower C Sand
LBA = Lower Bellflower Aquitard
GLA = Gage-Lynwood Aquitard

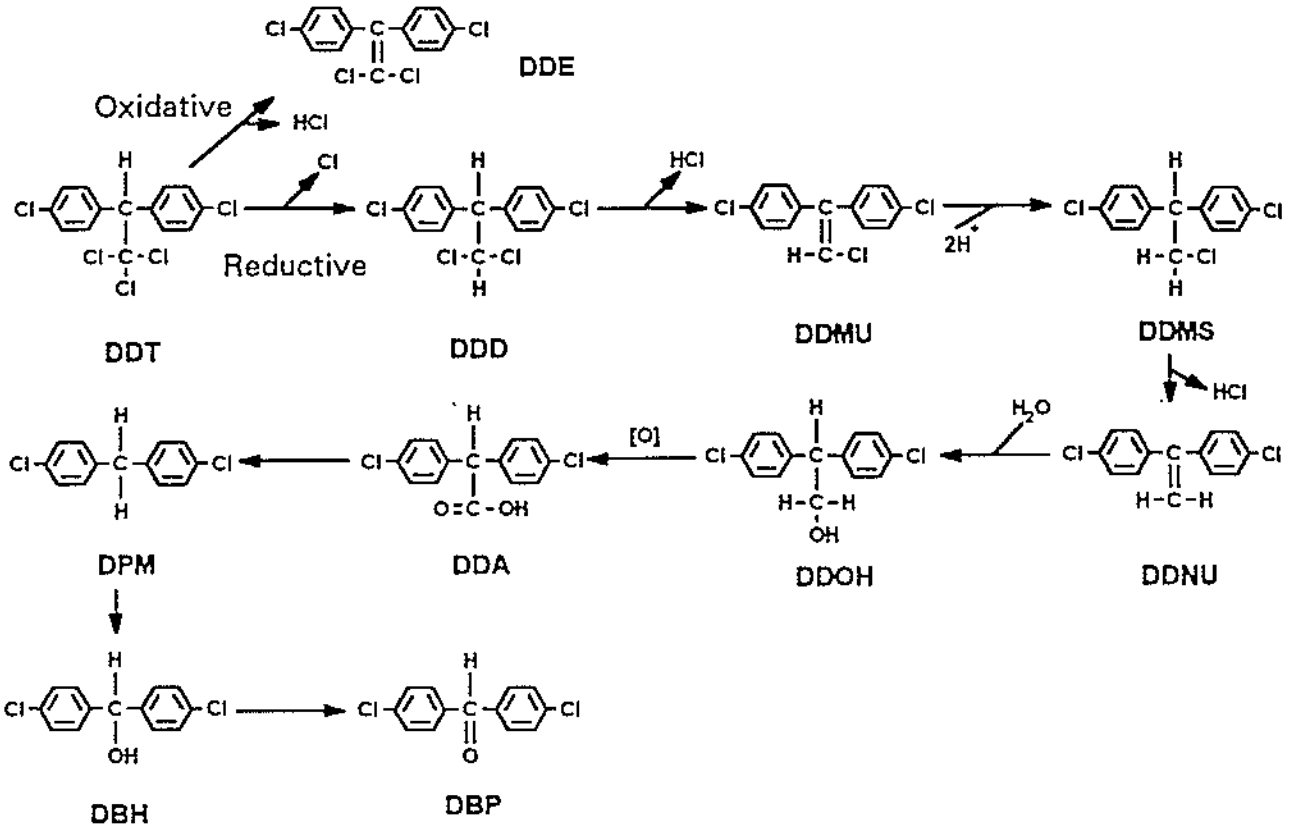
TABLE 6.3

ANALYTICAL RESULTS OF THE SOLIDS SAMPLES COLLECTED
FROM THE GROUNDWATER TREATMENT SYSTEM

...CONCENTRATIONS IN MILLIGRAMS PER KILOGRAM...

DATE SAMPLED	SAMPLE NAME	ORIGIN OF SAMPLE	MAGNESIUM	CALCIUM	SODIUM	TOTAL DDT
08/16/91	PUMP SCALE	Submersible extraction pump	1,980	14,900	3,570	72,550
08/20/91	F02-S	Filter bag	7,000	11,000	24,000	47,280
08/22/91	SEP-5	Separator	600	2,800	1,230	131,500

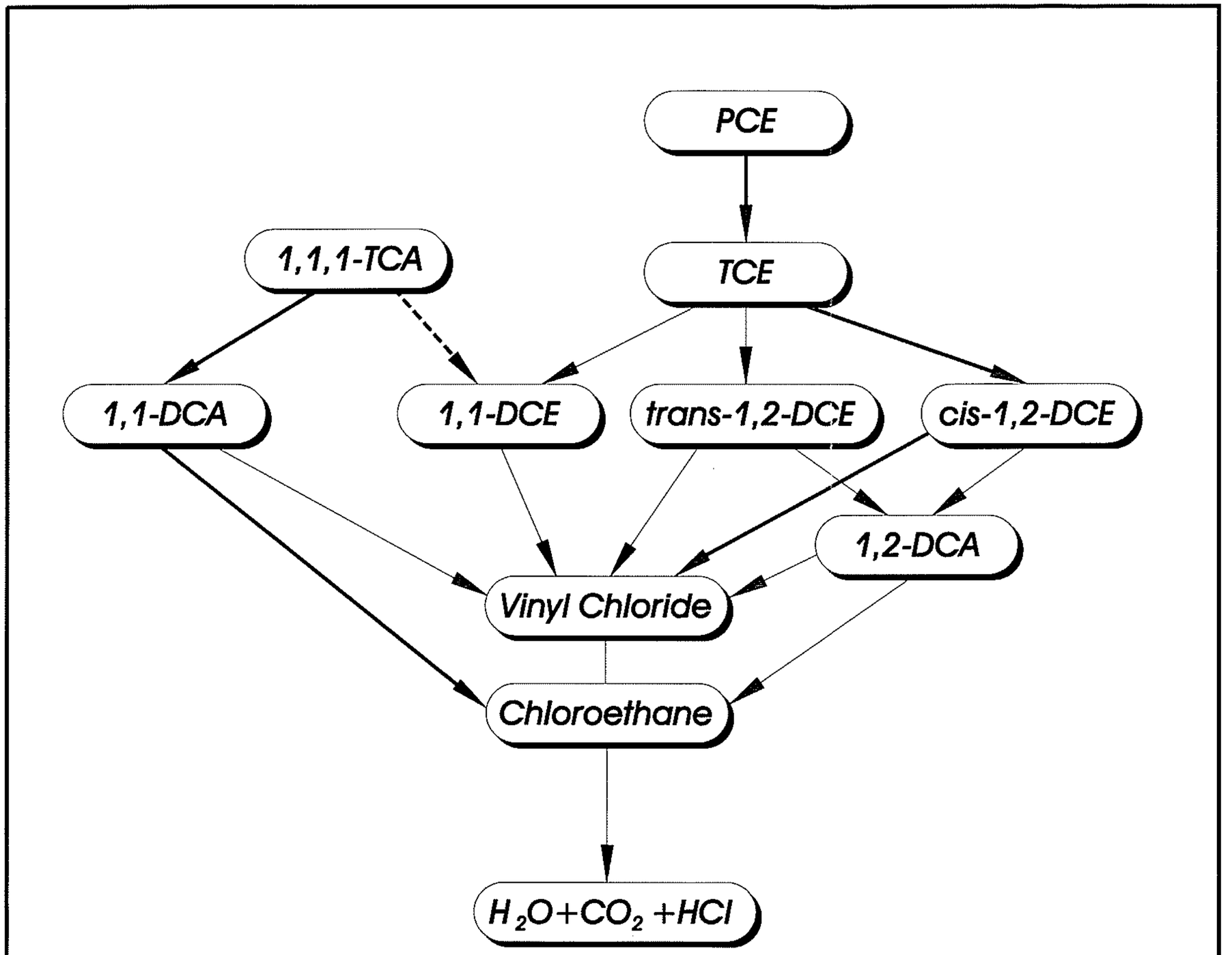
DDT = Dichlorodiphenyltrichloroethane



DDT : 1,1,1-TRICHLORO-2,2-BIS (P-CHLOROPHENYL) ETHANE
DDD : 1,1-DICHLORO-2,2-BIS (P-CHLOROPHENYL) ETHANE
DDMU : 1-CHLORO-2,2-BIS (P-CHLOROPHENYL) ETHYLENE
DDMS : 1-CHLORO-2,2-BIS (P-CHLOROPHENYL) ETHANE
DDNU : UNSYM-BIS (P-CHLOROPHENYL) ETHYLENE
DDOH : 2,2-BIS (P-CHLOROPHENYL) ETHANOL
DDA : DICHLORODIPHENYLACETATE
DPM : DICHLORODIPHENYLMETHANE
DBH : DICHLOROBENZHYDROL
DBP : DICHLOROBENZOPHENONE
DDE : 2,2-BIS (P-CHLOROPHENYL) 1,1-DICHLOROETHYLENE

SOURCE: BIOREMEDIATION OF RECALCITRANT ORGANICS 1995

FIGURE 6.1 BIODEGRADATION FOR DDT



EXPLANATION

DEGRADATION PATHWAY OBSERVED IN FIELD AND LABORATORY STUDIES

NONBIOLOGICAL DEGRADATION PATHWAY

THEORETICAL DEGRADATION PATHWAY

NOTES:

PCE	=	TETRACHLOROETHYLENE
TCE	=	TRICHLOROETHYLENE
TCA	=	TRICHLOROETHANE
DCA	=	DICHLOROETHANE
DCE	=	DICHLOROETHYLENE
H_2O	=	WATER
CO_2	=	CARBON DIOXIDE
HCl	=	HYDROCHLORIC ACID

MODIFIED FROM DRAGUN, 1988

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

PCE, TCE, AND TCA DEGRADATION PATHWAYS

7/97

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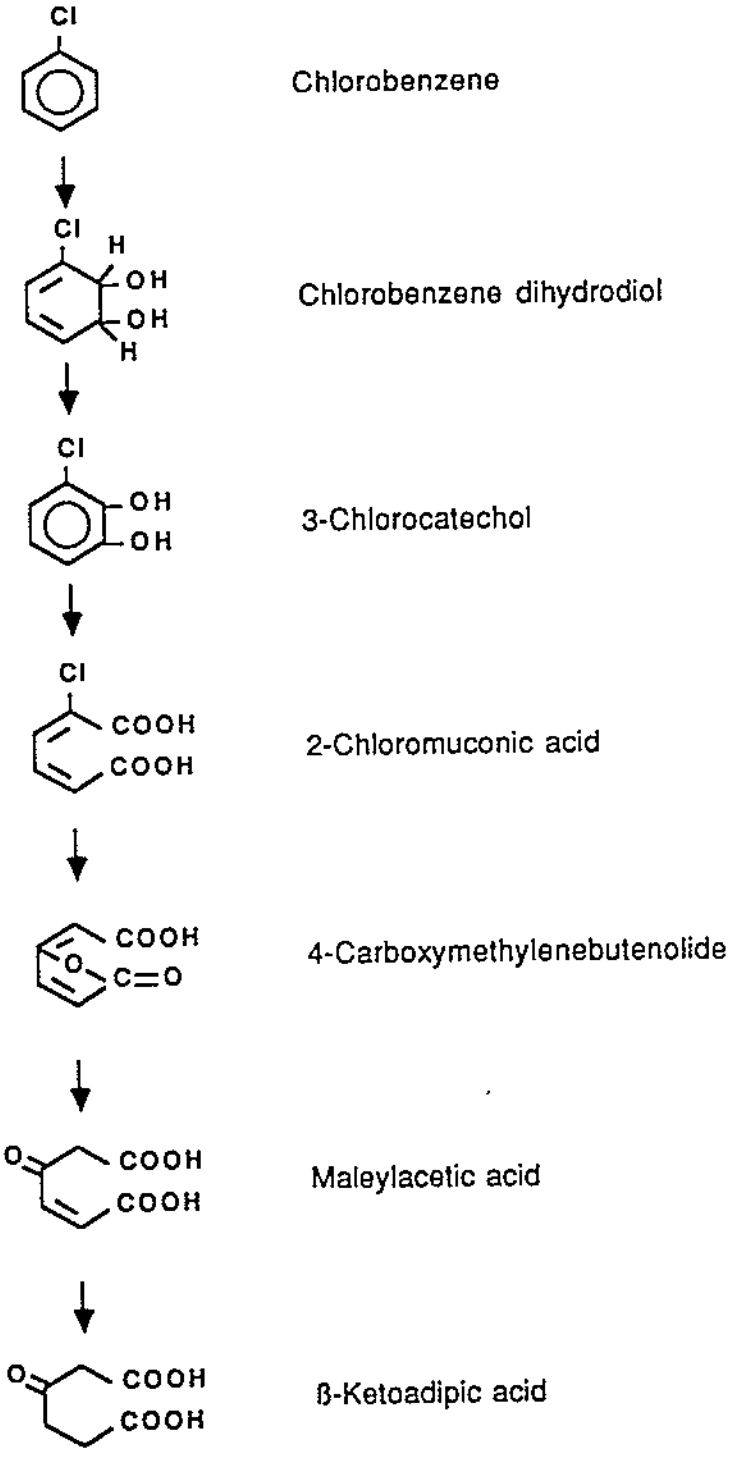
FIGURE 6.2

PREP BY _____ REV BY _____ RPT NO. 857.01 | 620-0281 | B

I:\PROJECTS\DELAMO\HARGISRI\620-0-281



SOURCE: J.C. SPAIN 1990

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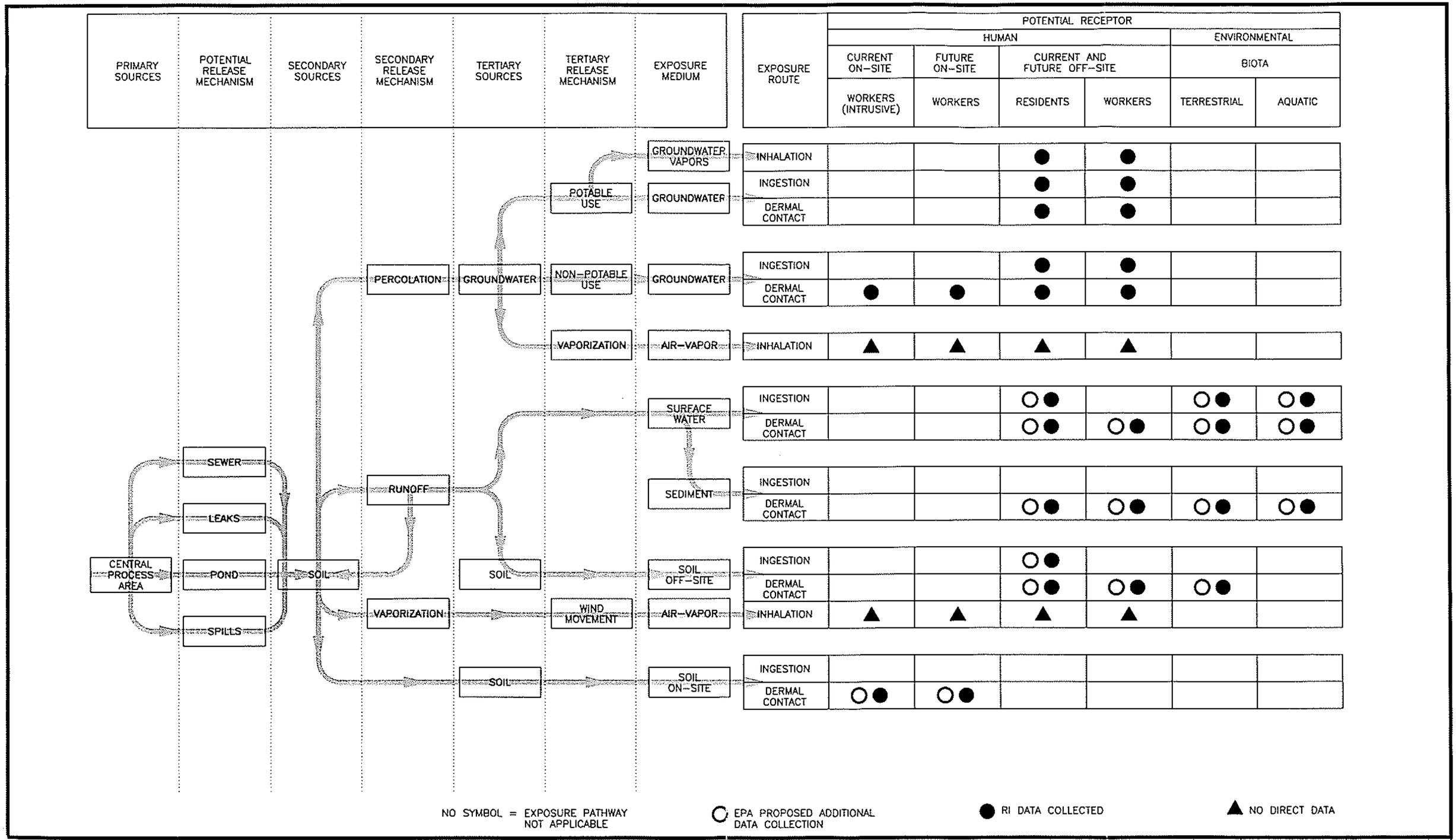
FIGURE 6.3 BIODEGRADATION FOR CHLOROBENZENE



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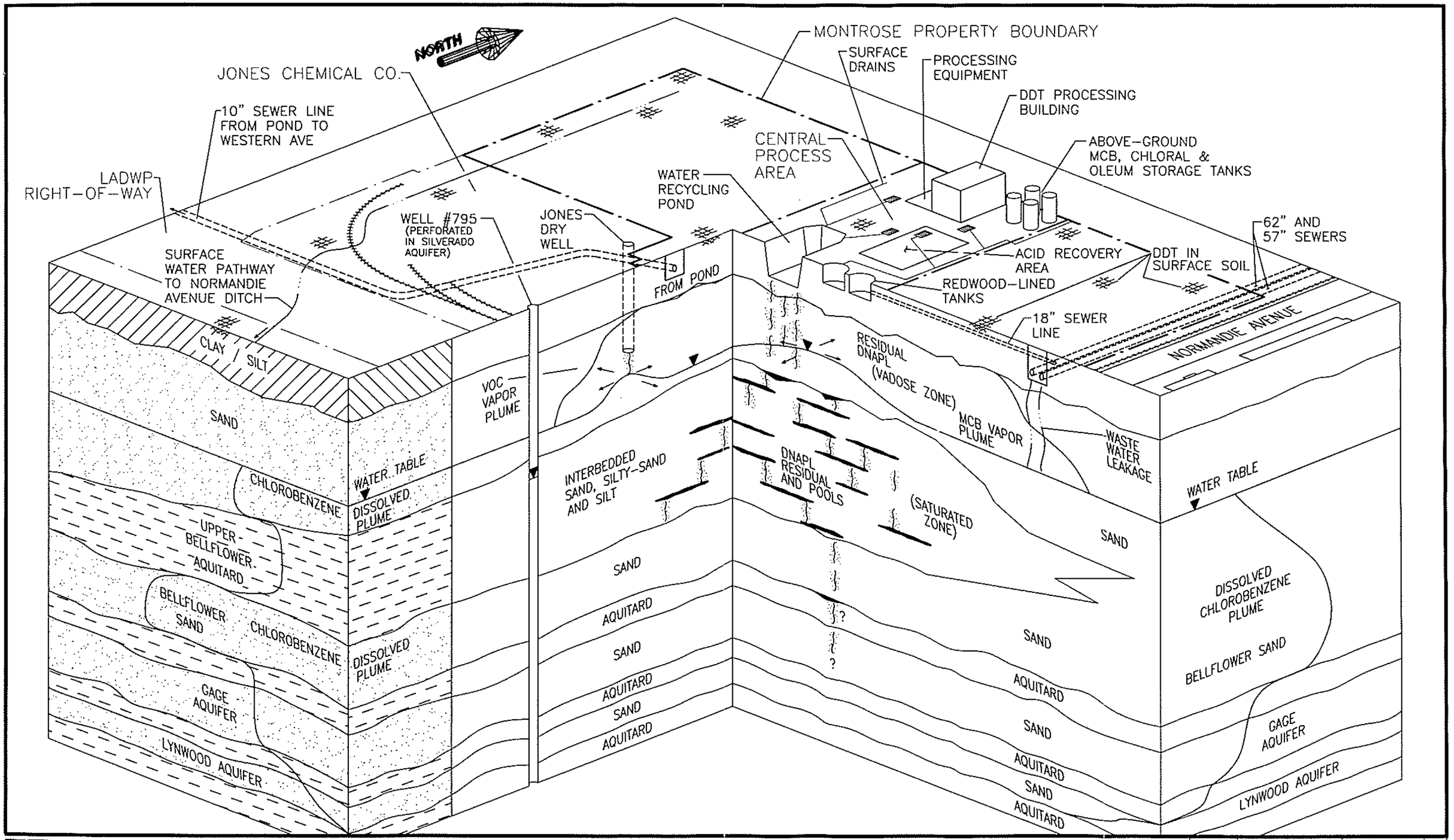
7/97 | RPT NO. 218.1105 | 630-0114 | E

FIGURE 6-4. CONCEPTUAL SITE MODEL FOR INVESTIGATION AREAS AT THE MONTROSE SITE

I:\PROJECTS\MONTROSE\HARGISRI\630-0114.DWG 19-JAN-1998



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7/97 | RPT NO. 218.1103 | 810-1464 | D

FIGURE 6.5 CONCEPTUAL SITE DIAGRAM

I:\PROJECTS\MONTROSE\HARGISRI\810-1464.DWG 19-JAN-1998

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