RECORD OF DECISION

TELEDYNE SEMICONDUCTOR AND SPECTRA-PHYSICS, INC.

JOINT SUPERFUND SITES

MOUNTAIN VIEW, CALIFORNIA

MARCH 22, 1991

U.S. ENVIRONMENTAL PROTECTION AGENCY

REGION 9

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1.0 SITE NAME AND LOCATION

Teledyne Semiconductor, Inc.
1300 Terra Bella Avenue
Mountain View, California 94043

Spectra-Physics, Inc.
1250 West Middlefield Road
Mountain View, California 94043

2.0 STATEMENT OF BASIS AND PURPOSE

This Record of Decision ("ROD") presents the selected remedial actions for the Teledyne and Spectra-Physics Superfund sites in Mountain View, California. This document was developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), 42 U.S.C. Section 9601 et. seq., and in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan, 40 C.F.R. Section 300 et. seq., ("NCP"). The attached administrative record index (Attachement A) identifies the documents upon which the selection of the remedial action is based.

3.0 ASSESSMENT OF THE SITE

Actual or threatened release of hazardous substances from these sites, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

4.0 DESCRIPTION OF THE REMEDY

The selected remedy for the Teledyne and Spectra-Physics sites consists of:

- Soil vapor extraction for soil cleanup;
- Groundwater extraction and treatment for groundwater cleanup;
- Shallow zone, intermediate zone, and deep aquifer groundwater monitoring as well as soil monitoring.

These remedial actions address the principal threat remaining at the Teledyne and Spectra-Physics sites by removing and permanently destroying the contaminants from soils and removing the contaminants from ground water, thereby significantly reducing the the toxicity, mobility or volume of hazardous substances in both media. These response actions will greatly reduce the possibility of contamination of existing potable water supplies and potential future water supplies.

5.0 DECLARATION

The selected remedy is protective of human health and the environment, complies with federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

Because the remedy will result in hazardous substances remaining on-site above health-based levels, a five-year review, pursuant to CERCLA Section 121, 42 U.S.C. Section 9621, will be conducted at least once every five years after initiation of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

John Wise

John Wise
Deputy Regional Administrator

3.22.91
Date

II. RECORD OF DECISION

DECISION SUMMARY

This Decision Summary provides an overview of the problems posed by the Spectra-Physics/Teledyne Superfund sites ("the Study Area"), the remedial alternatives, and the analysis of the remedial alternatives. This Decision Summary explains the rationale for the remedy selection and how the selected remedy satisfies the statutory requirements.

1.0 SITE NAME, LOCATION, AND DESCRIPTION

1.1 SITE NAME AND LOCATION

The Study Area (Figure 1) has been divided into the following three areas based on the sources of contamination, the extent of contamination in the ground water and geographic location:

Teledyne Semiconductor, Inc., 1300 Terra Bella Avenue, Mountain View California

Teledyne Semiconductor, Inc. (Teledyne) has owned and operated a semiconductor manufacturing facility at 1300 Terra Bella Avenue since 1962, (Figure 2). The southern half of the facility was built in 1962 and the northern half of the building was added in 1966.

Spectra-Physics, Inc., 1250 West Middlefield Road, Mountain View California

Spectra-Physics is an active manufacturer of lasers and associated components which has operated two of its divisions, Laser Products and Optics, in the City of Mountain View since 1961. Seven of the nine buildings in Spectra-Physics' Mountain View facility are bounded by West Middlefield Road, Terra Bella Avenue, and Shoreline Boulevard (formerly Stierlin Road) (Figure 2). The other two buildings are on the north side of Terra Bella Avenue.

Teledyne/Spectra-Physics Combined Study Area

The Teledyne/Spectra-Physics Combined Study Area (the "Study Area") encompasses the full extent of the groundwater plume and is generally bounded by Permanente Creek to the west, the City of Mountain View dewatering trench to the north, Armand Avenue to the east, and Teledyne and Spectra-Physics facilities to the south (Figure 1).

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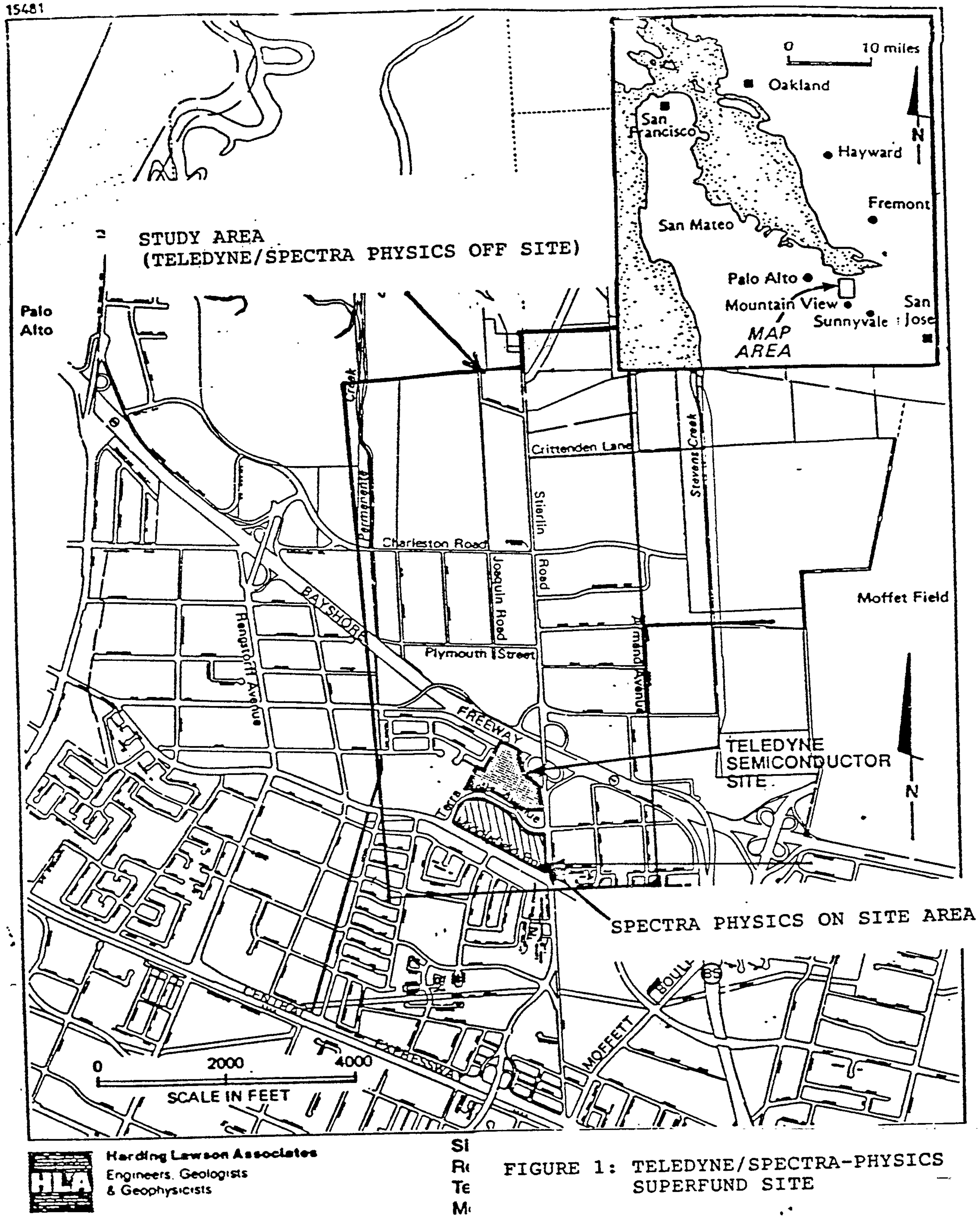

FIGURE 1: STUDY AREA

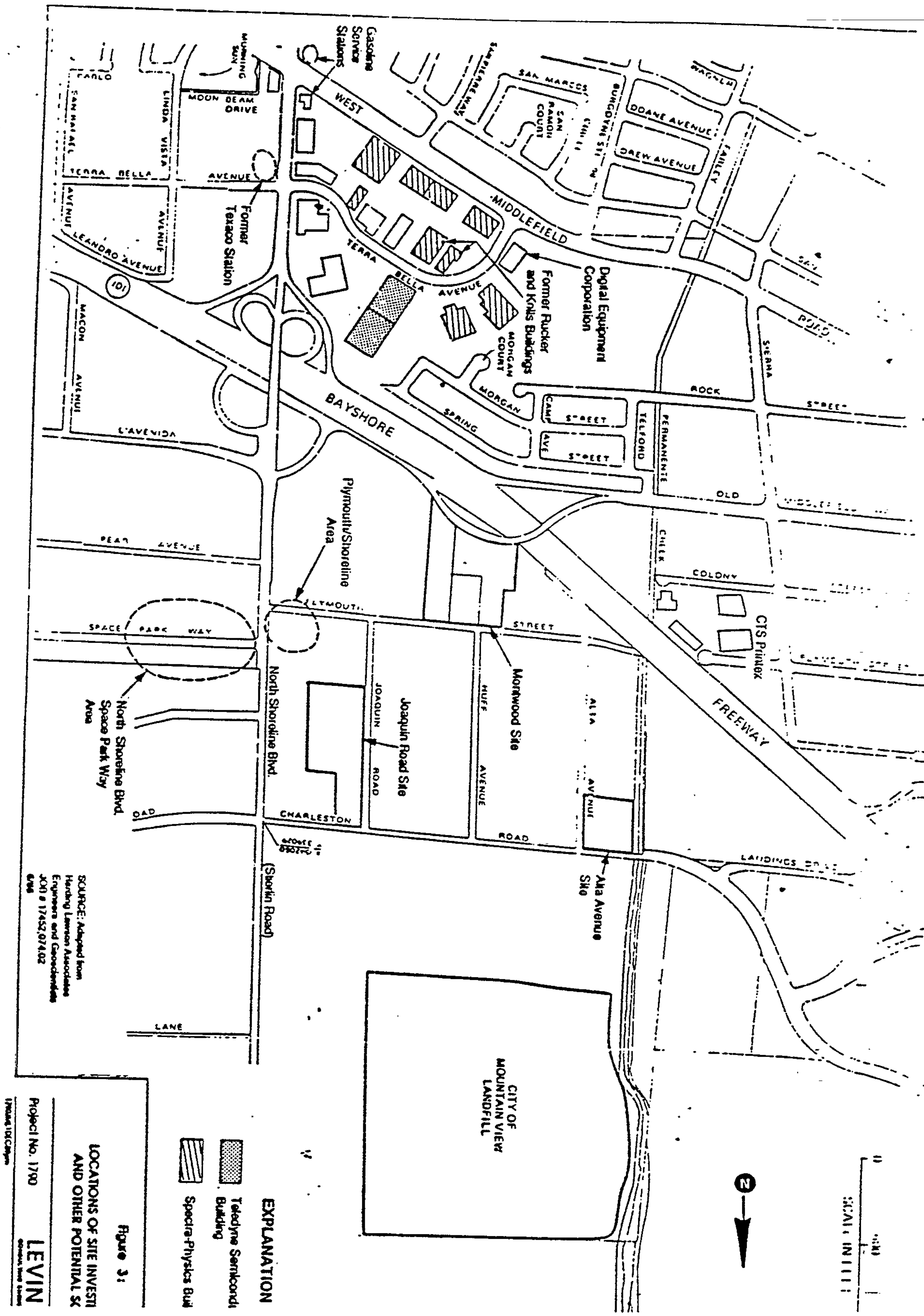

FIGURE 2: TELEDYNE SEMICONDUCTOR AND SPECTRA-PHYSICS ON-SITE AREAS

1.2 REGIONAL TOPOGRAPHY

The Study Area is located in the Santa Clara Valley which is a gently-sloping alluvial plain, flanked by the Diablo Range to the east-southeast and the Santa Cruz Mountains to the west-southwest. The Study Area is located toward the center of the valley. The Santa Cruz Mountains are located several miles southwest of the Study Area. The San Francisco Bay is located approximately 3 miles north of the Study Area.

1.3 ADJACENT LAND USE

The Study Area consists of a mixture of commercial/industrial buildings (about 57 percent), residential land use (about 8 percent), and public buildings and land uses (about 35 percent). The Study Area contains a network of paved streets with sidewalks and landscaping. There are two open spaces within the Study Area: one is the playground and softball field associated with Crittenden Middle School immediately west of the on-site areas, and the other is the open space adjacent to the present City of Mountain View Landfill and Shoreline Amphitheater.

1.4 HISTORICAL LAND USE

Historical aerial photographs show that historical land use within the Study Area was agricultural, dating back to 1937 and possibly further. The Study Area was developed as an industrial area during the period from 1961 to 1973. Companies historically located in the vicinity of the Study Area were involved in a wide range of manufacturing activities, including the manufacturing of amusement park equipment, laser devices, printed circuit boards, electrical test equipment, and semiconductors. In addition to commercial and agriculture use, the Study Area includes residential use.

1.5 HYDROGEOLOGY

Ground water zones at the Study Area are divided into an Upper Aquifer Zone and a Deep Aquifer Zone (Figure 3). The Upper Aquifer Zone is divided into the Shallow Zone and the Intermediate Zone. The Shallow Zone is about 10 feet thick, and generally occurs between the depths of 10 to about 30 feet below ground surface. The Intermediate Zone is about 10 to 15 feet thick, generally occurring between the depths of 35 to 70 feet below ground surface. The Upper Aquifer Zone and the Deep Aquifer Zone are separated by a Confining Zone composed primarily of silt which varies in thickness from about 50 to 150 feet. The Deep Aquifer Zone is generally more than 150 feet below ground surface. Groundwater elevations in the Study Area indicate a northerly flow direction in the Upper Aquifer Zone.

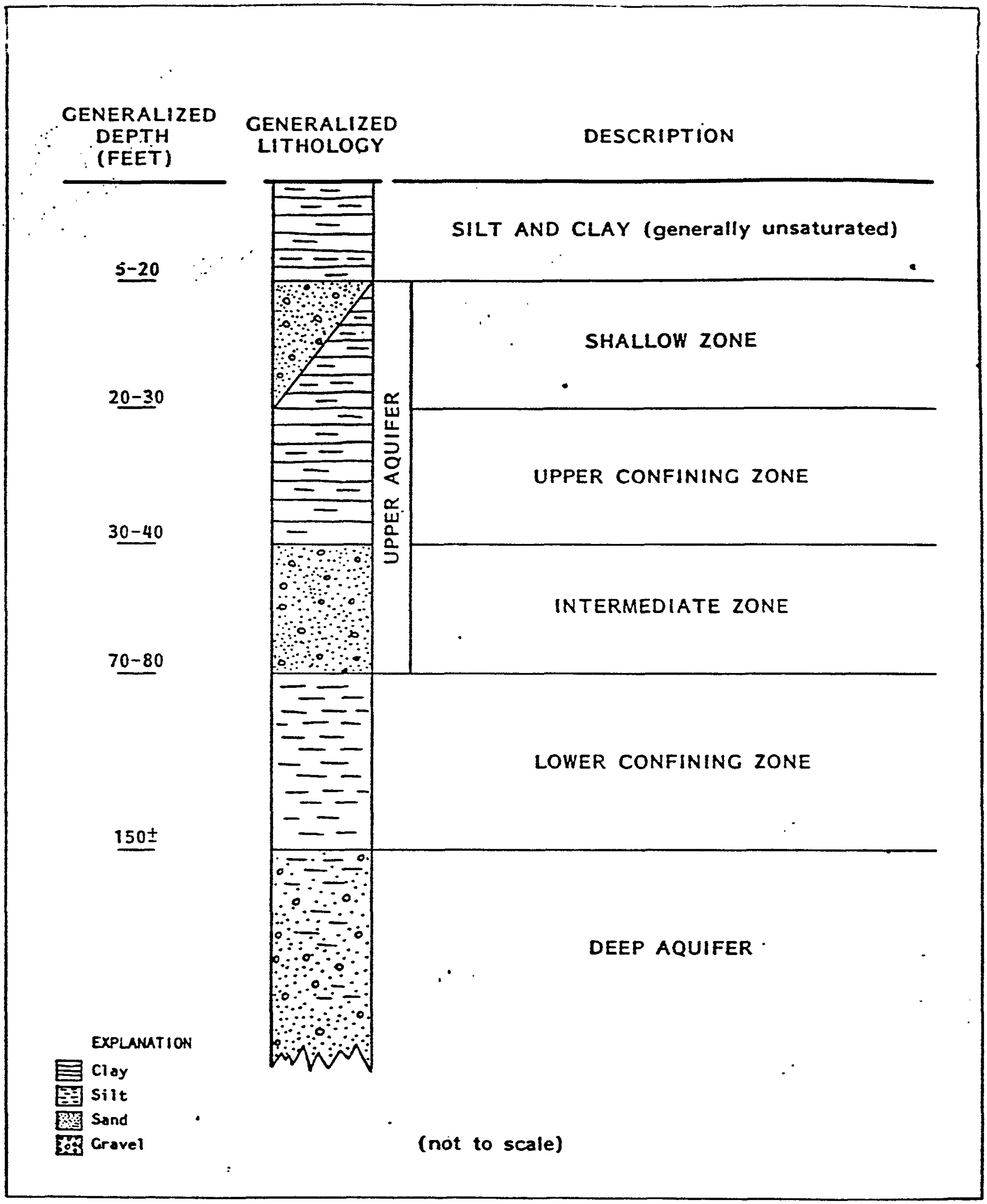

Figure 8 : GENERALIZED STRATIGRAPHIC COLUMN

FIGURE 3: HYDROGEOLOGIC PROFILE

Elevations in the Shallow and Intermediate Zone sediments demonstrate an upward hydraulic gradient between the two zones. Groundwater elevations within the Study Area also show an upward hydraulic gradient from the Deep Aquifer to the Upper Aquifer.

1.6 WATER USE

Historical ground water use in the Study Area includes private water-supply wells for homes and agriculture prior to the construction of public water connections and sewer connections in 1984. A review of data on active, abandoned and closed wells within the Study Area identified 174 registered wells, including former private water-supply wells. Of these, 120 are equal to or greater than 65 feet deep, or of unknown depth. Of the 120 wells, 13 are active, seven are inactive, 31 are destroyed, and 69 are abondoned. Based on the results of this investigation, wells identified in the North Bayshore Area which exceed 80 feet in depth and contained VOCs were closed as a precautionary measure.

1.7 SURFACE AND SUBSURFACE STRUCTURES

Teledyne used two double staged equalization sumps to separate TCE from waste discharge, sumps B/C and D (Figure 4). Teledyne also used a 2000 gallon underground tank, Tank A, to store waste solvents, i.e. isopropyl alcohol, xylene, and acetone. An above ground storage tank was used to store unused TCE, Tank B.

Spectra-Physics has no record of using underground facilities to store hazardous substances on their site. However, there are records of two underground gasoline tanks and five underground sumps. Spectra-Physic's records indicate that two 3,000-gallon underground gasoline tanks, used by prior occupants, previously were located on the Spectra-Phyiscs site. The records do not show use of the tanks for anything but gasoline storage. The gasoline tanks were removed in 1985. Until 1987, the waste streams to the sanitary sewer from Buildings 2, 3, 4, 4A and 5 passed through underground neutralization sumps (Figure 5).

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 HISTORY OF SITE ACTIVITIES

Teledyne has operated a semiconductor manufacturing facility at its Mountain View facility since approximately 1963. Teledyne installed two 1400 gallon below-grade sumps at their site in 1962 and 1966, respectively. Prior to 1980, the sumps were used for acid neutralization and waste TCE collection. Neither sump has contained TCE since 1980 and the two sumps are no longer in service. A 2,000 gallon underground waste flammable solvent tank

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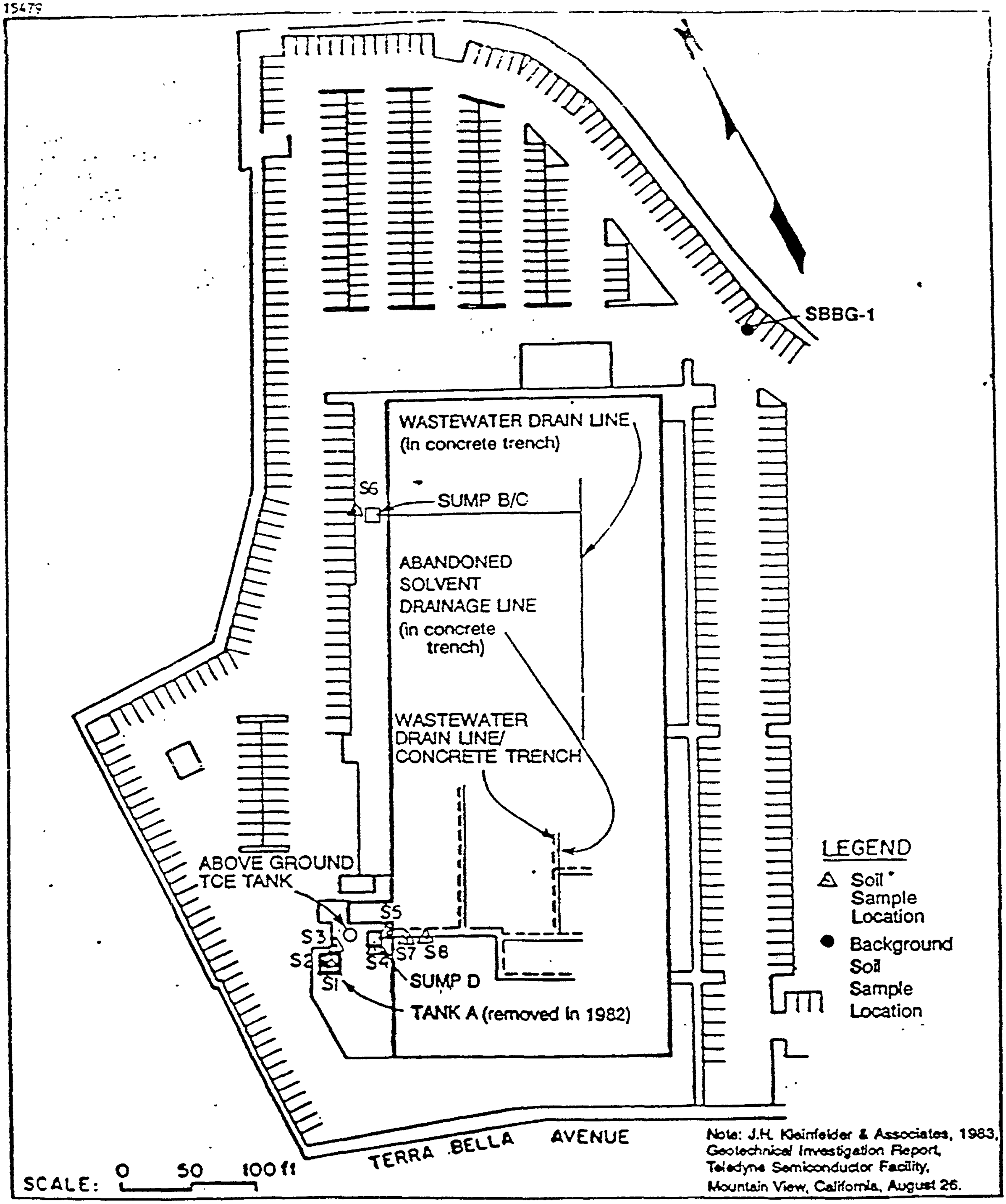

Harding Lawson Associates
Engineers and Geoscientists

Locations of Sumps, Drain Lines, and 1983 Soil Samples
Remedial Investigation/Feasibility Study
Teledyne Semiconductor
Mountain View, California

PLATE
B3

FIGURE 4: LOCATION OF TELEDYNE WASTE STORAGE FACILITIES

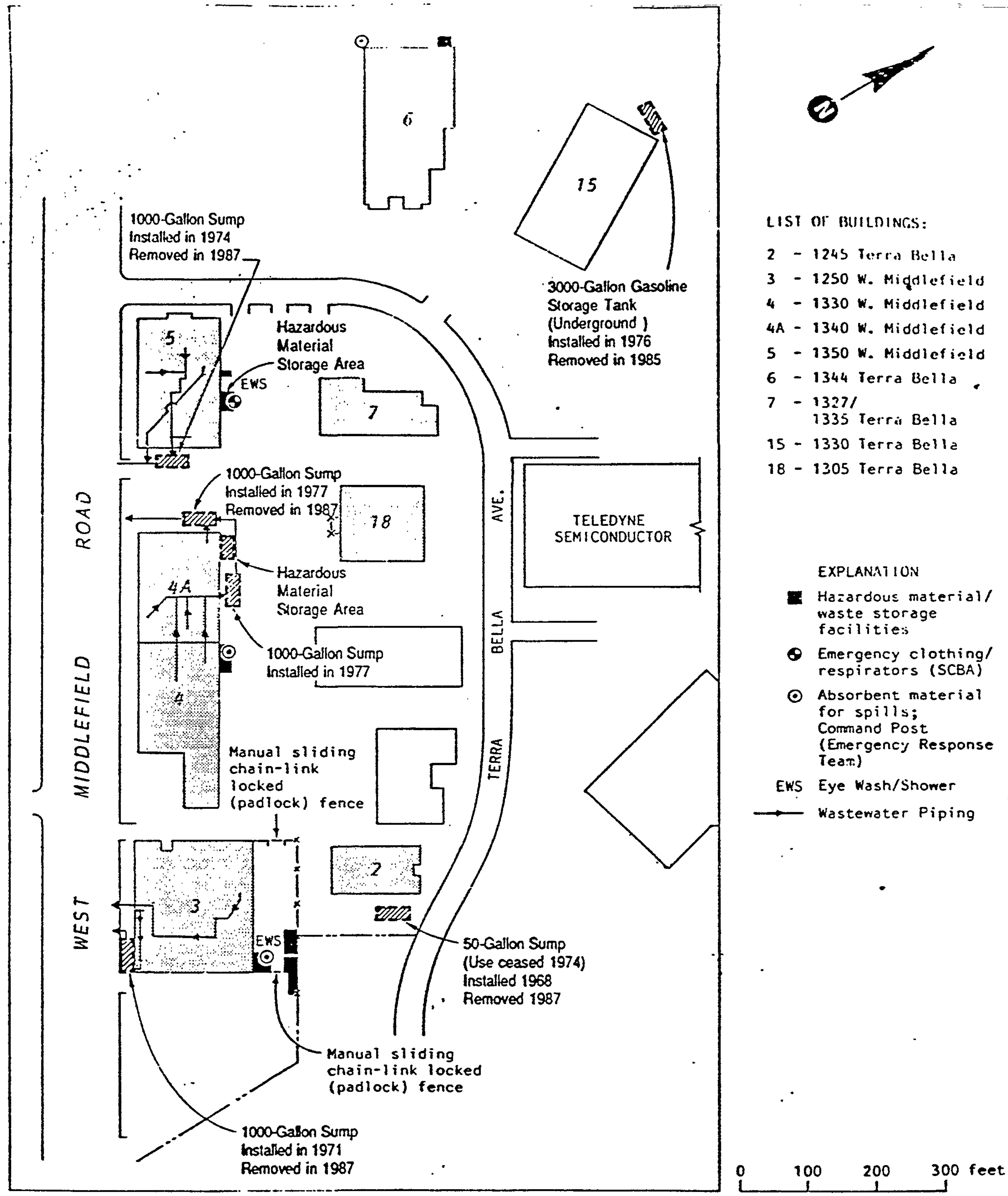

Figure C-1: DETAILED SITE PLAN

FIGURE 5: LOCATION OF SPECTRA-PHYSICS WASTE STORAGE FACILITIES

(Tank A) was installed in 1975 and removed in 1982. It was used to store waste isopropyl alcolhol, xylene and acetone. Teledyne also used TCA and other VOCs at the facility. All underground solvent handling activities were discontinued in 1980 and all chemicals are currently stored above-ground.

Since approximately 1963, Spectra-Physics has manufactured lasers and associated components at its Mountain View facility. Spectra-Physics previously used five underground sumps as part of its industrial wastewater disposal system (see Section 1.7). One 50 gallon and four 1000 gallon underground sumps were installed between 1968 and 1977. Rinsewaters were discharged through these sumps to the sanitary sewer for the primary purpose of pH and flow equalization. All but one of the sumps were removed in 1987. The remaining sump is primarily used for settlement of solids. Spectra-Physics used TCE, TCA, Freon-113 and other volatile organic compounds (VOCs) in its manufacturing processes.

2.2 HISTORY OF SITE INVESTIGATIONS

In 1982, Teledyne and Spectra-Physics submitted Facility Questionnaires to the California Regional Water Quality Control Board (RWQCB) staff describing their underground neutralization systems, sumps, and tanks. Based on these submittals, staff required the initiation of a remedial investigation (RI) at Teledyne in 1982 and Spectra-Physics in 1984. The RI has been ongoing for the last eight years. Sampling results from these investigations are described in Section 5.2. Teledyne and Spectra-Physics have jointly and separately implemented interim remedial actions since remedial investigations were initiated. These interim actions are described in Section 4.1.

2.3 HISTORY OF ENFORCEMENT ACTIONS

Teledyne and Spectra-Physics are on the National Priorities List (NPL). The sites have been regulated by the RWQCB Orders since 1986. The summary of enforcement history for each of the sites is as follows:

<u>Teledyne</u>

- February 1986 - Order No. 86-9, Waste Discharge Requirements
- June 1986 - Teledyne Semiconductor site is added to the NPL
- September 1986 - Cleanup and Abatement Order No. 86-011
- January 1987 - Cleanup and Abatement Order No. 87-002
- January 1989 - Order No. 89-019, Site Cleanup Requirements

<u>Spectra-Physics</u>

- February 1986 -Order No. 86-10, Waste Discharge Requirements
- September 1986 - Cleanup and Abatement Order No. 86-012
- January 1987 - Cleanup and Abatement Order No. 87-003

- o June 1988 - Spectra-Physics site proposed for NPL
- o January 1989 - Order No. 89-020, Site Cleanup Requirements

3.0 COMMUNITY RELATIONS

The RWQCB has maintained an aggressive Community Relations program for the Teledyne and Spectra-Physics sites. The RWQCB published a notice in the The View (Mountain View Newspaper) on November 1, 1990, announcing the proposed final Remedial Action Plan (RAP) and announcing the public meeting held on November 14, 1990. A presentation of the final cleanup plan was made at the November 14, 1990 public meeting. The comment period for the proposed cleanup plan was from November 14, 1990 to December 28, 1990. The Responsiveness Summary for the comments received during this period are included as Part III of this document.

Fact sheets were mailed to interested residents, local government officials, and media representatives. Fact sheet # 1, mailed in August 1989, summarized the pollution problem, the results of investigations to date, and the interim remedial actions. Fact sheet # 2, mailed in November 1990, described the cleanup alternatives evaluated, explained the proposed final RAP, announced opportunities for public comment at the Regional Board Hearing of November 14, 1990 in Oakland and the Public Meeting of November 14, 1990 in Mountain View, and described the availability of further information at the Information Respository at the Mountain View Public Library. Fact sheet # 3, mailed in March 1991, explains the final Cleanup and Abatement Order adopted by the RWQCB.

4.0 SCOPE AND ROLE OF THE RESPONSE ACTION

4.1 SCOPE OF THE RESPONSE ACTION

The remedy selected and described in this ROD includes existing interim remedial actions as well as additional remedial actions selected for the Teledyne and Spectra-Physics sites. The interim remedial actions include the removal of leaking underground sumps and tanks, excavation of contaminated soil, three groundwater extraction systems, the operation of the City of Mountain View dewatering trench, and a soil vapor extraction system. The additional remedial actions include the expansion of existing groundwater extraction systems and the soil vapor extraction system and additional ground water and soil monitoring.

Spectra-Physics removed four sumps suspected of leaking at its site. In 1987, the sumps were removed and six feet of soil surrounding the sumps was excavated to a depth of two feet below the bottom of the sumps. As a result of an investigation in February 1986, Spectra-Physics was ordered to remove four of their five sumps. Listed below and shown in Figure 5 are the sumps the RWCQB ordered Spectra-Physics to remove in order to eliminate potential sources of contamination:

- Three-stage equalization sump, 1250 West *Middlefield* Road, Building 3 installed in 1971 and removed in December 1987;

- Three-stage equalization at 1340 West Middlefield Road, Building 4A installed in 1977 and removed in December 1987;

- Four-stage equalization sump at 1340 West Middlefield Road, Building 4A installed in 1977 and currently in use;

- Four-stage equalization sump at 1350 West Middlefield Road, Building 5 installed in 1974 and removed in December 1987;

- One-stage equalization sump at 1245 Terra Bella Road, Building 2 installed in 1968 and removed in April 1987.

The sump remaining at Building 4A is used primarily for solids settlement, and is secondarily contained.

Teledyne removed Tank A and excavated the surrounding contaminated soils in August 1982. Teledyne ceased using sumps B/C and D in 1987 when a new above ground, double-contained, acid neutralization system was put on line. Sumps B/C and D were not removed from the subsurface.

Three groundwater extraction systems were installed on the Teledyne site and in the combined Teledyne and Spectra-Physics Study Area. Teledyne has an extraction system operating on their site which consists of a Shallow Zone extraction well and an Intermediate Zone extraction well. This extraction system has been operating since October 1986. In addition, Teledyne and Spectra-Physics have installed groundwater extraction systems along Spring Street and in the North Bayshore area (Figure 6). The Spring Street Extraction System (SSES), consists of three Shallow Zone and two Intermediate Zone extraction wells and was developed to capture concentraions of VOCs greater than 0.1 ppm. This extraction system has not yet started operating. The North Bayshore Extraction System (NBES) consists of eleven Shallow Zone and six Intermediate Zone extraction wells. The system started operating on January 4, 1990 and the entire NBES was operating continuously as of March 13, 1990. The NBES was designed to capture VOCs in concentrations greater than 5 ppb in the Upper Aquifer Zone. Extracting ground water from the Upper Aquifer Zone minimizes the risk of VOCs migrating downward by enhancing the upward gradients between the Deep and Upper Aquifer. The operating extraction systems are currently discharging extracted water to the sanitary sewer system under permit.

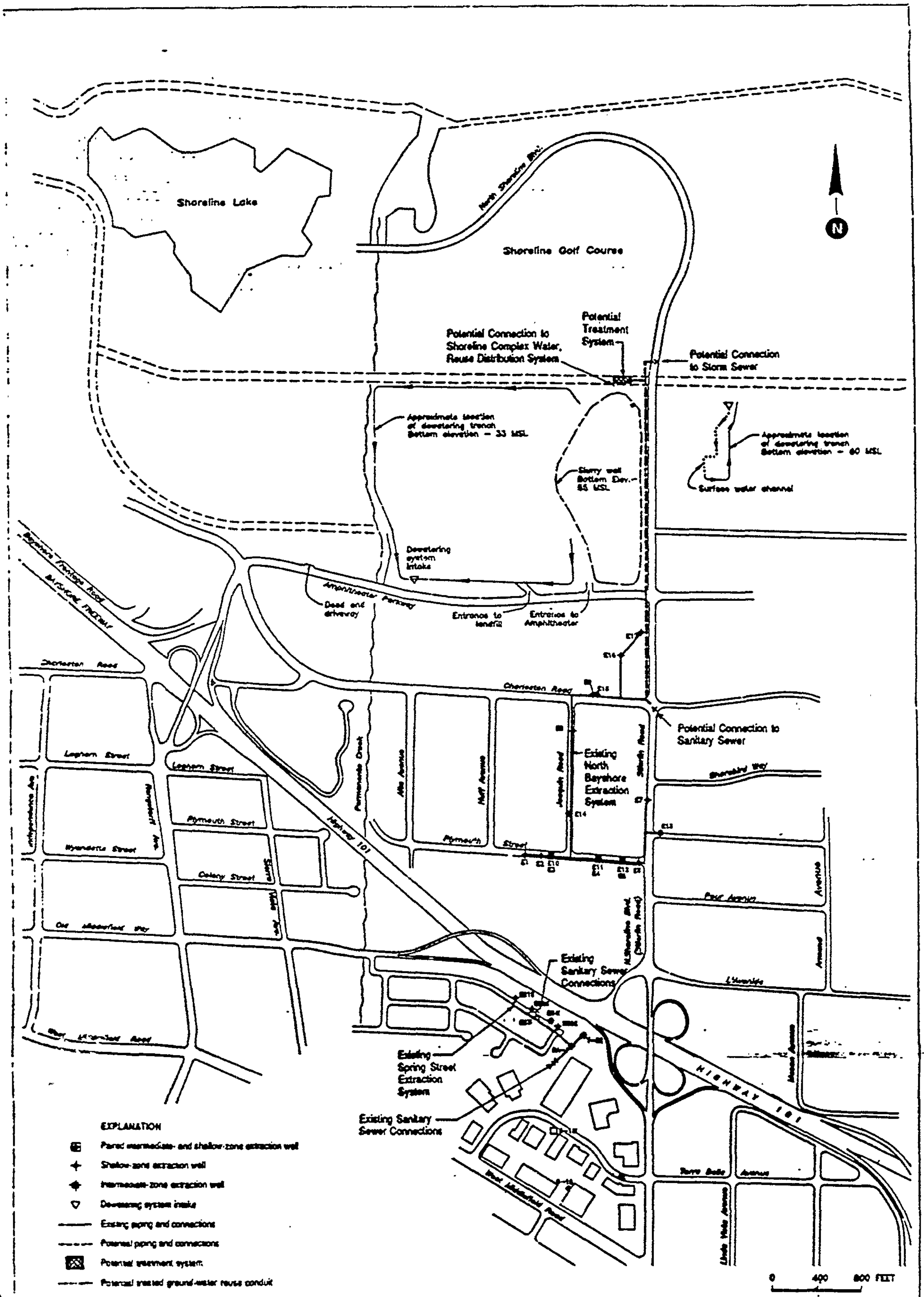

FIGURE 6: LOCATION OF EXTRACTION SYSTEMS

The 150-acre parcel of the City of Mountain View landfill was excavated below sea level during construction in 1978. A dewatering trench was installed to dewater the excavation until the refuse was filled above sea level. The landfill dewatering trench, which borders the landfill parcel located directly north of Amphitheatre Parkway between Permanente Creek and North Shoreline Blvd. (Figure 6), has been and continues to be operated by the City of Mountain View on a voluntary basis to assist in keeping ground water in the Upper Aquifer under hydraulic control until the NBES is completed. The NBES will be designed to remediate the groundwater plume once the trench is turned off. The SSES was installed to shorten the overall remediation time by removing a higher concentration of VOCs.

Spectra-Physics installed a soil vapor extraction system (SVES) near Building 3 (Figure 7) to reduce the concentration of VOCs in the soils. The SVES consists of three extraction wells which penetrate 12 feet into the soil. A partial vacuum is applied to the wells which extracts vapors containing VOCs and passes the vapors through activated carbon cannisters.

The selected remedy for the sites consists of:

- Groundwater extraction and treatment for groundwater cleanup;
- Soil vapor extraction and treatment for soil cleanup;
- Shallow zone, intermediate zone and deep aquifer groundwater monitoring and vadose zone monitoring.

The selected remedy for the Teledyne site consists of continuing the current groundwater extraction system, treating contaminated water with an air stripper, and discharging under NPDES permit to the storm drain. The air stripper will include air emission control with vapor phase carbon if emissions exceed levels permitted by the Bay Area Air Quality Management Board.

The selected remedy for the Spectra-Physics site consists of expanding the soil vapor extraction system to include soil vapor extraction in four additional areas. Groundwater remediation will be provided by the Teledyne On-Site extraction and treatment system.

The selected remedy for the Study Area consists of continuing operation of the current groundwater extraction systems with a contingency for additional extraction wells if complete capture is not achieved when the City of Mountain View landfill dewatering system pump is turned off. Ground water extracted from the NBES will be discharged under permit to the city sewer system. Ground water extracted from the SSES will either be treated with the air stripper unit at the Teledyne facility and discharged under NPDES permit to the storm drain or discharged under permit to the city sewer system.

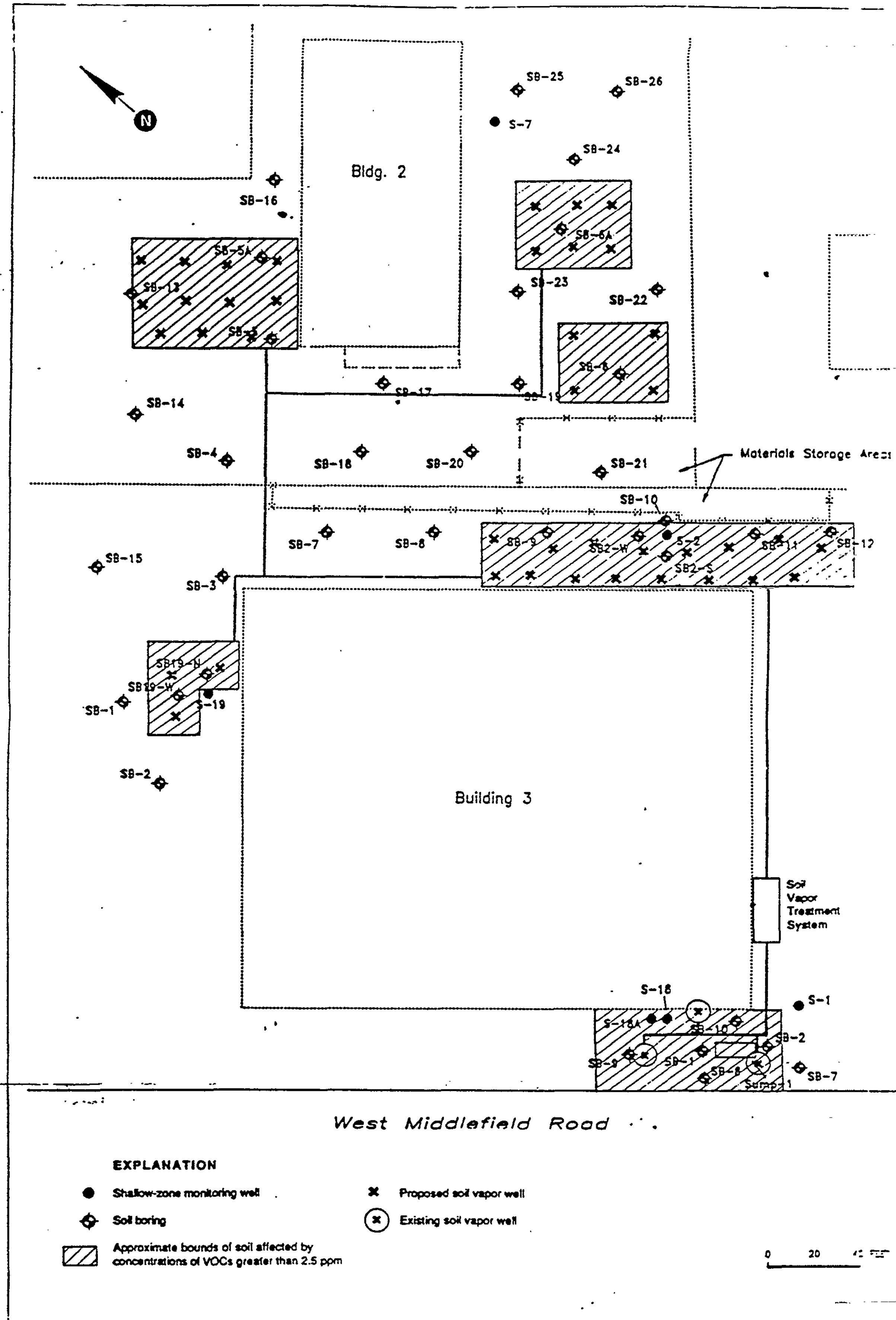

FIGURE 7: SOIL VAPOR EXTRACTION SYSTEM

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4.2 ROLE OF THE RESPONSE ACTION

The selected remedy addresses the principal threats posed by the contamination in soils and ground water in the the Upper Aquifer Zone. These principal threats are: further lateral migration of the plume emanating from the Teledyne and Spectra-Physics sites; potential vertical migration of contaminated ground water into the Deep Aquifer Zone; ingestion and inhalation of contaminants in the ground water from the Upper Aquifer Zone; ingestion and inhalation of contaminants in the contaminated soil; and inhalation of chemicals volatalized from contaminated ground water.

The objective of the selected remedy is to remove and permanently destroy the contaminants from both soils and ground water or significantly reduce the toxicity, mobility or volume of hazardous substances in both media. These response actions will greatly reduce the possibility of contamination of current and potential water supplies.

5.0 SUMMARY OF SITE CHARACTERISTICS

5.1 SOURCES OF CONTAMINATION

In its waste management process, Teledyne used two double staged equalization sumps to separate TCE from its waste discharge, sumps B/C and D. Teledyne also used a 2000 gallon underground tank, Tank A, to store waste solvents, i.e. isopropyl alcohol, xylene, and acetone. An above ground storage tank was used to store unused TCE, Tank B. The location of the sumps and tanks are shown in Figure 4. Soil investigations conducted during 1982 through 1983 and 1988 through 1989 detected the release of chemicals from sumps B/C and D and former Tank A.

Spectra-Physics managed solvent wastes by discharging waste water to buried equalization sumps which discharged into the sanitary sewer. A series of soil investigations conducted since 1984 have shown that a release of chemicals has occurred at the Spectra-Physics site. As a result of an investigation in February 1986; Spectra-Physics was ordered to remove four of its five sumps. Removal of the sumps revealed that a tree root had punctured a drainage line a few feet upstream of the sump at Building 3. Soil investigations further concluded that almost all contamination originated at the punctured drainage line.

The contamination in the combined study area is primarily in the Shallow Zone and partially in the Intermediate Zone of the Upper Aquifer. This comingled groundwater plume is attributed to Teledyne and Spectra-Physics because of the releases of chemicals from their waste handling facilities.

5.2 DESCRIPTION OF CONTAMINATION

5.2.1 SOIL INVESTIGATIONS

Soil investigations conducted at the Teledyne facility identified volatile organic compounds (VOCs) in the soils. Samples collected at the former location of Tank A (Figure 4) were found to contain 1,2-dichloroethylene (1,2-DCE), trichloroethene (TCE), and toluene. The maximum concentrations detected were 18 parts per billion (ppb) of 1,2-DCE, 79 ppb TCE, and 21 ppb toluene. Samples collected from the location of Sump D were found to contain toluene, TCE, 1,2-dichloroethane (1,2-DCA), and 2-butanone. Maximum concentrations of VOCs detected were 14 ppb toluene, 40 ppb TCE, 5.7 ppb 1,2-DCA, and 23 ppb 2-butanone. Samples collected from the location of Sump B/C detected 2-butanone, TCE, tetrachlorethylene (PCE) and toluene. The maximum concentrations detected in soil samples at Sump B/C were 32 ppb 2-butanone, 160 ppb TCE, 5.7 ppb PCE, and 46 ppb toluene. Further analyses of these soil samples determined that the priority pollutant metal concentrations in soils are generally within the range of expected background levels. The results of soils investigations conducted at the Teledyne facility are summarized in Table 1.

LOCATION	1,2-DCA	TCE	TOLUENE (ppb)	2-BUTANONE	1,2-DCA	PCE
TANK A	18	79	21	**	**	**
SUMP D	**	40	14	23	5.7	**
SUMP B/C	**	160	46	32	**	5.7

TABLE 1: Soil Contamination at the Teledyne On-Site Area

Since 1984, soil samples were collected from more than 68 boreholes drilled on the Spectra-Physics site. Additionally, soil samples were collected from the side and bottoms of the pits which remained after the four former sumps were removed, and a soil gas survey was conducted during 1989 in the vicinity of Building 2 and 3 in order to assess the lateral extent of soils containing VOCs in the area. The primary volatile organic compounds detected in soil are TCE and 1,2-DCE. Soil samples collected from an area adjacent to the sump near Building 3 were found to contain up to 18 parts per million (ppm) TCE and up to 1 ppm toluene. TCE is found in the highest concentrations and over the greatest area. Concentrations of TCE in soils in excess of 2.5 ppm have been detected in soils in the loading dock area, soils in a small area east of Building 2, soils in a small area west of Building 2, and soils below the former Building 3 sump. Figure 7 indicates where VOC concentrations in soils exceed 2.5 ppm within the Spectra-Physics On-Site area.

5.2.2 GROUNDWATER INVESTIGATIONS

To evaluate the distribution of VOCs in ground water immediately adjacent to the Teledyne facility, 21 Shallow Zone monitoring wells, 10 Intermediate Zone monitoring wells, and 1 vertical extent well were installed. The distribution of TCE in the Upper Aquifer is described in Figures 8 and 9. Seven VOCs have been regularly detected in the Shallow Zone since monitoring started in 1982: TCE; 1,2-DCE; TCA; 1,1-DCE; 1,1-DCA; Freon 113; PCE; and vinyl chloride. TCE has been found at more sampling points and at generally higher concentrations than the other chemicals. TCE in the Shallow Zone ground water at and immediately downgradient of Teledyne has ranged from less than 1 ppb to 9800 ppb. TCE concentrations in the Intermediate Zone has ranged from less than 1 ppb to 9800 ppb. A vertical extent well detected TCE at 60 feet below ground surface at concentrations ranging from less than 0.5 ppb to 9.6 ppb in September 1988, however, no VOCs have been detected in this well since that date. Table 2 summarizes the range of contaminant levels in the Upper Aquifer at the Teledyne On-Site area.

Spectra-Physics has installed 17 shallow zone monitoring wells and three intermediate zone monitoring wells within their property boundaries to assess the lateral and vertical extent of contaminants. Five VOCs have been regularly detected during previous studies in Upper Aquifer ground water: TCE; trans-1,2-DCE; 1,1,1-trichloroethane (1,1,1-TCA); 1,1-dichloroethane (1,1-DCA); and 1,1-dichloroethylene (1,1-DCE). TCE has been found at more sampling points and at generally higher concentrations than the other chemicals. TCE in Shallow Zone ground water at and immediately downgradient of Spectra-Physics has ranged from less than 1 ppb to 2700 ppb. TCE concentrations in Intermediate Zone ground water has been at or near non-detectable concentrations, but have recently increased at one well to 1 ppb. Also in the Shallow Zone, concentrations of trans-1,2-DCE have ranged from less than 5 ppb to 286 ppb. Freon 112 has been detected at concentrations ranging from 1 ppb to 16 ppb. Concentrations of 1,1-DCA have ranged from less than 5 ppb to 270 ppb and concentrations of 1,1-DCE have ranged from less than 5 ppb to 240 ppb. The highest concentrations of VOCs in ground water at the Spectra-Physics facility generally occur in the area of the former Building 3 sump. Table 3 summarizes the ground water data for the Spectra-Physics site.

Aquifer Zone	Contaminants (ppb) TCE	12-DCE	111-TCA	11-DCA	11-DCE
Shallow	ND - 9800	ND - 4200	ND - 10	ND - 0.7	ND - 4.9
Upper Int.	ND - 9800	ND	ND	ND	ND
Lower Int.	ND - 550	ND	ND	ND	ND

Aquifer Zone	Contaminants (ppb) FREON 113	PCE	VINYL CHLORIDE
Shallow	ND - 200	ND - 100	ND - 770
Upper Int.	ND - 110	ND - 5	ND
Lower Int.	ND - 5	ND - 36	ND

TABLE 2: Groundwater Contaminants at the Teledyne On-Site Area

Aquifer Zone	Contaminants (ppb) TCE	t12-DCE	111-TCA	11-DCA	11-DCE
Shallow	5 - 2700	5 - 286	ND	5 - 270	5 - 2400
Upper Int.	ND	ND	ND	ND	ND
Lower Int.	ND	ND	ND	ND	ND

TABLE 3: Ground Water Contaminants at the Spectra-Physics On-Site Area

To assess the lateral and vertical extent of contamination in the ground water extending beyond the boundaries of the facilities, Teledyne and Spectra-Physics installed over 100 shallow and intermediate zone monitoring and extraction wells, two deep aquifer monitoring wells, and three vertical extent monitoring wells. The horizontal extent of contamination in the Upper Aquifer Zone is defined to the north at approximately the City of Mountain View dewatering trench, to the east and west at approximately Armand Avenue and Permanente Creek, respectively. The vertical extent of groundwater pollution extends approximately to the top of the regional aquitard. Figures 8 and 9 illustrate the boundaries of the TCE plume in the Shallow and Intermediate zones.

6.0 SUMMARY OF SITE RISKS

6.1 TOXICITY ASSESSMENT

Nine indicator chemicals were identified from approximately 30 chemicals detected in the Study Area. The nine indicator chemicals are as follows:

1,1-dichloroethane (1,1-DCA)
1,1-dichloroethylene (1,1-DCE)
1,2-dichloroethylene (1,2-DCE)
tetrachloroethylene (PCE)
toluene
1,2,4-trichlorobenzene (1,2,4-TCB)
1,1,1-trichloroethane (1,1,1-TCA)
trichloroethylene (TCE)
vinyl chloride (VC)

The rational for selecting the listed chemicals as indicator chemicals is as follows:

<u>1,1-Dichloroethane (1,1-DCA)</u>

- 1,1-DCA has been detected in wells throughout the Study Area in both the Shallow Zone and the Intermediate Zone;
- 1,1-DCA was detected in 8.1% of the soil samples collected within the Study Area;
- 1,1-DCA possesses physiochemical properties (relatively high water solubility and relatively low soil sorption) which tend to promote its dispersion in ground water;
- 1,1-DCA was identified by EPA as a probable human carcinogen (Group B2) based on available laboratory animal data.

<u>1,1-Dichloroethylene (1,1-DCE)</u>

- 1,1-DCE has been detected in wells throughout the Study Area in both the Shallow Zone and Intermediate Zone;

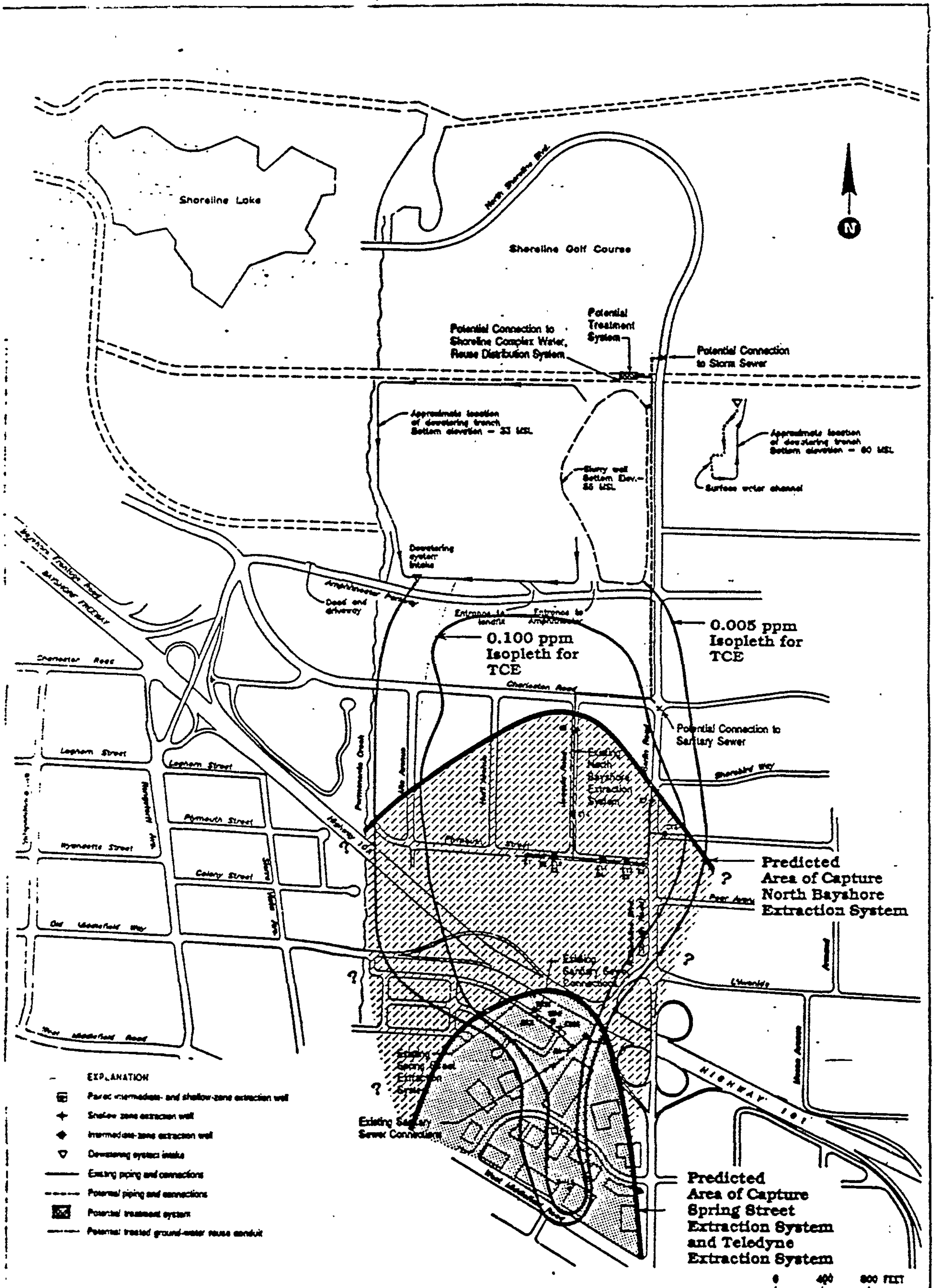

FIGURE 8: TCE PLUME IN SHALLOW ZONE

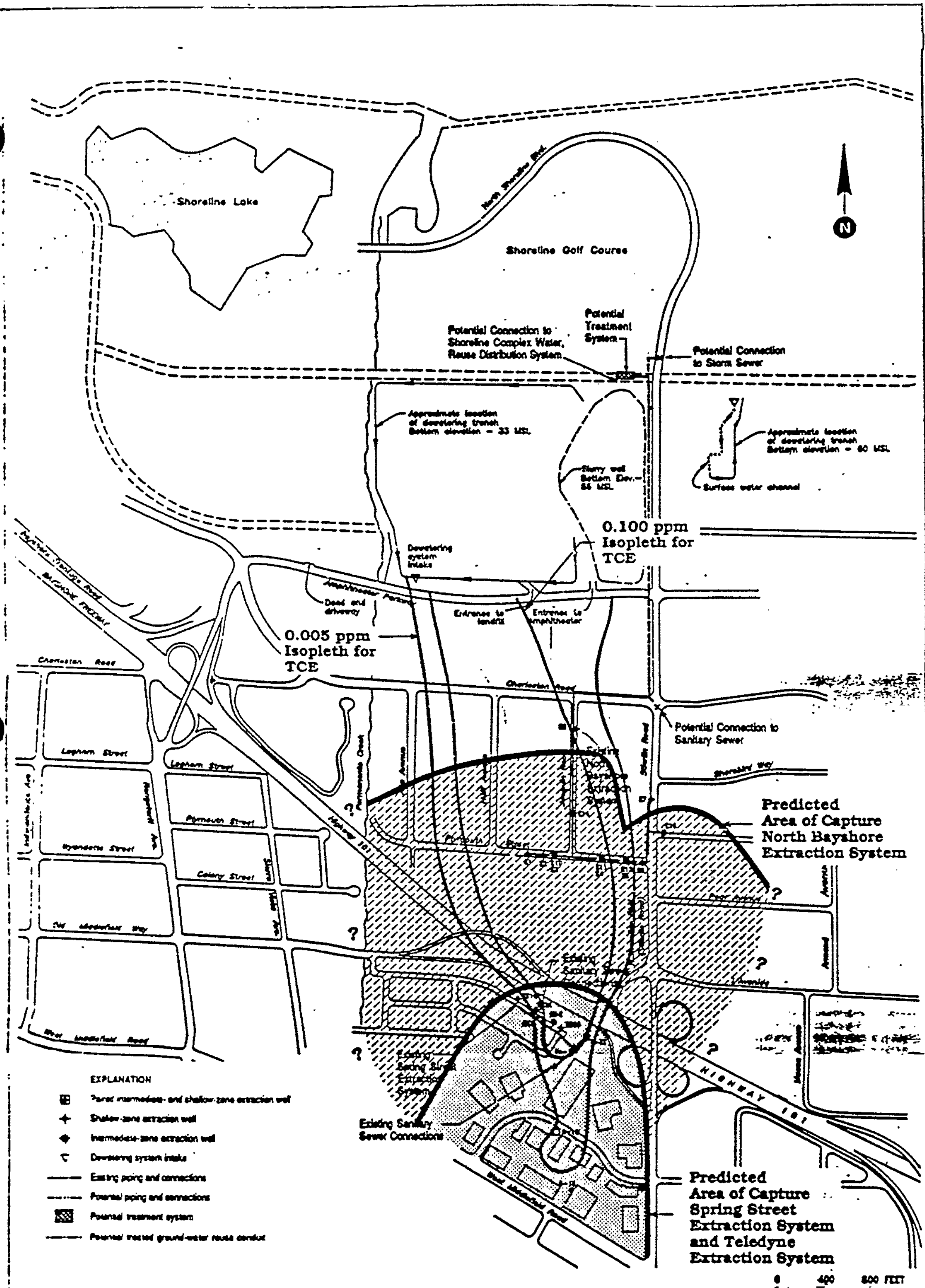

FIGURE 9: TCE PLUME IN INTERMEDIATE ZONE

- 1,1-DCE was detected in 7.0% of the soil samples collected within the Study Area;
- 1,1-DCE possesses physiochemical properties (relatively high water solubility and relatively low soil sorption) which tend to promote its dispersion in ground water;
- 1,1-DCE was identified by EPA as a possible human carcinogen (Group C) based on available laboratory animal data.

1,2-Dichloroethylene (1,2-DCE)

- 1,2-DCE has been consistently detected in wells throughout the Study Area in both the Shallow Zone and Intermediate Zone;
- 1,2-DCE was detected in 21.0% of the soil samples collected within the Study Area;
- 1,2-DCE possesses physiochemical properties (relatively high water solubility and relatively low soil sorption) which tend to promote its dispersion in ground water;

1,1,2,2-Tetrachloroethylene (PCE)

- PCE has been consistently detected in wells throughout the Study Area in both the Shallow Zone and Intermediate Zone;
- PCE was detected in 21.0% of the soil samples collected within the Study Area;
- PCE possesses physiochemical properties (relatively high water solubility and relatively low soil sorption) which tend to promote its dispersion in ground water;
- PCE was identified by EPA as a probable human carcinogen (Group B2) based on available laboratory animal data.

Toluene

- Toluene was detected in 9.7% of the soil samples collected within the Study Area;
- Toluene has a relatively low soil sorption coefficient, therefore, has the potential to leach from soil into groundwater;
- RWQCB requested this chemical be included as an indicator chemical.

1,2,4-Trichlorobenzene (1,2,4-TCB)

- 1,2,4-TCB was 1.1% of the soil samples collected within the

Study Area;

- o RWQCB requested this chemical be included as an indicator chemical.

1,1,1-Trichloroethane (1,1,1-TCA)

- o 1,1,1-TCA has been consistently detected in wells throughout the Study Area in both the Shallow Zone and Intermediate Zone;
- o 1,1,1-TCA was detected in 16.7% of the soil samples collected within the Study Area;
- o PCE possesses physiochemical properties (relatively high water solubility and relatively low soil sorption) which tend to promote its dispersion in ground water;

Trichloroethylene (TCE)

- o TCE has been consistently detected in wells throughout the Study Area in both the Shallow Zone and Intermediate Zone;
- o TCE was detected in 72.6% of the soil samples collected within the Study Area;
- o TCE possesses physiochemical properties (relatively high water solubility and relatively low soil sorption) which tend to promote its dispersion in ground water;
- o TCE was identified by EPA as a probable human carcinogen (Group B2) based on available laboratory animal data.

Vinyl Chloride (VC)

- o Vinyl chloride has been detected infrequently and sporadically throughout the Study Area in both the Shallow Zone and the Intermediate Zone;
- o Vinyl chloride has been detected in one soil sample to date;
- o Vinyl chloride possesses physiochemical properties (relatively high water solubility and relatively low soil sorption) which tend to promote its dispersion in ground water;
- o Vinyl chloride was identified by EPA as a confirmed human carcinogen (Group A) based on evidence in humans; it is also an established animal carcinogen.

6.2 RISK CHARACTERIZATION

Exposure pathways were identified and evaluated for both the current land-use condition and for hypothetical future land-use conditions. Assessment of potential risk under the current land-use scenario was conducted to determine the degree that chemical residues currently present in soil and groundwater in the Study Area may impact the health of humans who currently live or work in the Study Area. Assessment of potential risk under the future land-use scenario was conducted with the assumption that the Study Area, including the location of the facilities, is converted into a typical residential area and the population can use the Upper Aquifer ground water as a domestic potable water supply.

Through a process of identifying and evaluating all of the potential exposure pathways associated with the contamination in the Study Area, those pathways which are complete are identified. A complete exposure pathway is one that has all the necessary components: a source and mechanism of chemical release; an environmental transport medium, a potential human exposure point, and a likely route of exposure. The exposure pathways which were determined to be potentially complete for current land use and future land use are as follows:

- o Possible inhalation of ambient air in the vicinty of the manholes along the sanitary sewer line into which indicator chemicals may have volatilized after discharge of extracted ground water into the sanitary sewer line.

- o Exposure to indicator chemicals due to use (as potable water) of ground water extracted from wells (existing or future installations) screened into the Upper Aquifer; potential exposure pathways include ingestion, dermal contact, and inhalation of vapors (e.g., showering);

- o Possible inhalation of indoor residential air containing indicator chemicals that may have volatilized from contaminated ground water and/or soil.

To assess the potential risk associated with volatilization of indicator chemicals from the sanitary sewer system, air samples were collected at locations in the Study Area where greatest emmissions would occur, "worst case conditions." TCE was the only indicator chemical detected in ambient air, therefore, TCE was the only chemical considered in measuring this risk. The highest 8-hour concentration was 0.430 ppb which was collected at night.

The human receptors most likely to be exposed to TCE volatalized from the sewer line are:

- o utility workers who may periodically enter the manhole;

- o residents in nearby homes.

To judge the potential health implications for each of these groups due to airborne TCE, measured exposure point concentrations were compared with regulatory criteria. For residents, an exposure point concentration of 0.00104 mg/m^3, which was considered the worst case concentration, is about 15% of the health-based California Applied Action Level (AALair) for TCE (0.007 mg/m^3). For the utility worker, the maximum exposure point concentration was estimated to be 0.230 mg/m^3, which is based on the findings of the air sampling study and adjusted using a 100-fold safety factor. This exposure point concentration is only a fraction (0.085%) of OSHA's 8-hour time weighted average for TCE in air, which is 50 ppm or 270 mg/m^3.

Average-case and maximum-case theoretical upperbound carcinogenic risks for both residents and utility workers were estimated. Exposure assumptions were developed for both cases and for both potential receptors in order that chemical intakes (daily dose) could be estimated. Based on the sampling study, the 95% upper bound cancer risk rate for residents was calculated to be 6.5×10^{-10} (average case) and 6.9×10^{-7} (maximum-case). For the utility worker, theoretical upperbound cancer risk rates were estimated to be 7.8×10^{-8} (average case) and 1.1×10^{-6} (maximum -case). These risks are within EPA's target risk range of 1×10^{-4} to 1×10^{-6}.

To assess the potential risk associated with migration of indicator chemicals from ground water into residential air, a study including a combination of field measurements and analytical modeling was conducted on the Study Area. Emission rates were determined using the EPA-recommended surface isolation flux chamber. Gas samples were collected and analyzed for specific indicator chemicals known to be present in ground water. Sampling locations selected to provide worst-case emissions, were above areas where the highest VOC concentrations (1,1,1-TCA and TCE) were detected in ground water.

Soil vapor emission rates were determined and estimates of indoor air VOC concentrations were calculated using a steady-state, single-compartment model. Construction parameters conservatively representative of homes in the off-site area were considered in deriving both hypothetical, average-case and maximum-case indoor air concentration estimates. Using the estimated concentrations (i.e., exposure point concentrations) and assumed exposure factors representative of indoor residential activity, chronic daily intakes (CDIs) were estimated for potentially carcinogenic (TCE) and noncarcinogenic chemicals (1,1,1-TCA and TCE). Hypothetical average-case and maximum-case upperbound carcinogenic risks associated with these emissions were found to be 5.6×10^{-6} and 1.9×10^{-5}, respectively. Hypothetical average-case and maximum-case noncarcinogenic risks were found to be HI=0.18 and HI=0.18, respectively.

For determining the average-case carcinogenic and noncarconinogenic risks associated with the hypothetical use of ground water from the Shallow or Intermediate Zones, domestic usage of Shallow Zone water combined with other less significant exposure pathways (e.g., volatilization of VOCs from soil into ambient air, hypothetical volatilization from ground water into indoor air, and leaching of VOCs from the soil into ground water) were assumed. The chemicals contributing the majority of the risk are 1,1-DCE, TCE, and VC. The noncarcinogenic risks are predominately attributed to 1,2-DCE and TCE. Assuming domestic usage of Intermediate Zone ground water along with other less exposure pathways, TCE accounts for the majority of both the carcinogenic and noncarcinogenic risk.

Maximum-case carcinogenic and noncarcinogenic risks were summed for all exposure pathways and chemicals, which assumes that all of the maximum exposure concentrations occur simultaneously in the same well. Most of the carcinogenic risk associated with hypothetical maximum exposure is attributed to VC, which has been found in only 6 of 115 wells in the Study Area.

Summary of average-case and maximum-case carcinogenic and noncarcinogenic risks associated with current and hypothetical future land-use conditions in the Study Area are given in Tables 4 and 5.

6.3 PRESENCE OF SENSITIVE HUMAN POPULATIONS

Approximately 8% of the Study Area is residential and the majority of the residential area is in the vicinity of Morgan and Spring Street which is located in the southwest corner of the Study Area. Crittenden Middle School (grades 6-8, approximately 420 students) is also located in the southwest corner of the Study Area, directly west of the on-site area. The schoolyard is also used as a public park. There are no hospitals or convalescent homes located in the Study Area.

6.4 PRESENCE OF SENSITIVE ECOLOGICAL SYSTEMS

Two endangered species are reported to use South San Francisco Bay, located approximately 4 miles north of the Study Area. The California clapper rail and the salt marsh harvest mouse are reported to exist in the tidal marshes of the Bay and bayshore. The endangered California brown pelican is occasionally seen in the Bay Area, but does not nest in the South Bay. Ranges of the endangered American peregrine falcon and southern bald eagle include the Bay Area, but these species do not use Bay and bayshore habitats.

The Study Area does not constitute critical habitat for endangered species nor does it include or impact any "wetlands."

SUMMARY OF AVERAGE-CASE AND MAXIMUM-CASE CARCINOGENIC AND NONCARCINOGENIC RISKS ASSOCIATED WITH CURRENT AND HYPOTHETICAL FUTURE LAND-USE CONDITIONS IN THE STUDY AREA

	Lifetime Upperbound Excess Cancer Risk	
Carcinogenic Risk	Average Case	Maximum Case
Current Land-Use Condition	5.6×10^{-6}	2.0×10^{-5}
Future Land-Use Condition		
Shallow Zone	9.4×10^{-5}	1.1×10^{-2}
Intermediate Zone	1.1×10^{-5}	4.3×10^{-4}

	Hazard Indices	
Noncarcinogenic Risk	Average Case	Maximum Case
Current Land-Use Condition	0.18	0.18
Future Land-Use Condition		
Shallow Zone	0.64	16.97
Intermediate Zone	0.51	7.72

TABLE 4: SUMMARY OF CARCINOGENIC AND NON-CARCINOGENIC RISKS FOR STUDY AREA

FUTURE HYPOTHETICAL LAND-USE CONDITION:
SUMMARY OF CARCINOGENIC AND NONCARCINOGENIC
RISK AMONG INDICATOR CHEMICALS

SHALLOW ZONE[a]	Lifetime Upperbound Excess Cancer Risk	
CARCINOGENIC RISK	Average Case	Maximum Case
1,1-DCA	$7.4x10^{-7}$[b] (0.8)[c]	$4.0x10^{-5}$ (0.3)
1,1-DCE	$5.8x10^{-5}$ (61.8)	$4.2x10^{-4}$ (3.7)
PCE	$8.8x10^{-7}$ (0.9)	$2.8x10^{-5}$ (0.2)
TCE	$9.2x10^{-6}$ (9.8)	$6.5x10^{-4}$ (5.8)
VC	$2.5x10^{-5}$ (26.7)	$1.0x10^{-2}$ (90.0)
Total Risk	$9.4x10^{-5}$ (100%)	$1.1x10^{-2}$ (100%)

	CDI: RfD Ratio			
NONCARCINOGENIC RISK	Average Case		Maximum Case	
1,1-DCA	0.0007	(0.1)	0.01	(0.1)
1,1-DCE	0.006	(1.0)	0.10	(0.6)
1,2-DCE	0.05	(8.5)	4.92	(29.0)
PCE	0.02	(3.3)	0.19	(1.1)
1,2,4-TCB	0.07	(0.1)	0.001	(0.1)
1,1,1-TCA	0.002	(0.3)	0.03	(0.2)
TCE	0.55	(86.7)	11.72	(69.0)
Toluene	0.000002	(0.0003)	0.00002	(0.000003)
Total Risk (Hazard Index)	0.64	(100%)	16.97	(100%)

TABLE 5: CHEMICAL SPECIFIC CARCINOGENIC AND NON-CARCINOGENIC RISKS

SUMMARY OF CARCINOGENIC AND NONCARCINOGENIC RISK AMONG INDICATOR CHEMICALS

INTERMEDIATE ZONE[d]	Lifetime Upperbound Excess Cancer Risk			
CARCINOGENIC RISK	Average Case		Maximum Case	
1,1-DCA	2.4×10^{-7}	(2.2)	1.2×10^{-6}	(0.3)
1,1-DCE	2.4×10^{-6}	(21.6)	8.3×10^{-6}	(2.0)
PCE	5.4×10^{-7}	(4.8)	9.7×10^{-6}	(2.3)
TCE	7.9×10^{-6}	(71.4)	4.1×10^{-4}	(95.4)
Total Risk	1.1×10^{-5}	(100%)	4.3×10^{-4}	(100%)

	CDI: RfD Ratio			
NONCARCINOGENIC RISK	Average Case		Maximum Case	
1,1-DCA	0.0002	(0.04)	0.003	(0.04)
1,1-DCE	0.002	(0.4)	0.002	(0.02)
1,2-DCE	0.03	(5.4)	0.30	(3.9)
PCE	0.001	(0.3)	0.07	(0.9)
1,1,1-TCA	0.0003	(0.1)	0.003	(0.04)
TCE	0.48	(93.8)	7.35	(95.1)
Total Risk (Hazard index)	0.51	(100%)	7.73	(100%)

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a Distribution of risk among indicator chemicals under the assumption that water from the Shallow Zone is used for domestic purposes.

b Total risk contributed by a chemical via one or more exposure pathways (water, soil, air) and exposure routes (inhalation, ingestion).

c Percent of total risk contributed by a chemical.

d Distribution of risk among indicator chemicals under the assumption that water from the Intermediate Zone is used for domestic purposes.

6.5 CONCLUSION

Actual or threatened releases of hazardous substances from the Teledyne and Spectra-Physics Superfund sites, if not addressed by implementing the response action selected in this ROD may present an imminent and substantial endangerment to the public health, welfare or environment. Based on the fact that a variety of the VOCs detected in the Study Area pose significant health risks as carcinogens or as noncarcinogens and complete exposure pathways exist, EPA has determined that remediation is warranted.

7.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

Under Section 121(d)(1) of CERCLA, § 9621, remedial actions must attain a degree of clean-up which assures protection of human health and the environment. Additionally, remedial actions that leave any hazardous substance, pollutant, or contaminant on-site must meet a level or standard of control that at least attains standards, requirements, limitations, or criteria that are "applicable or relevant and appropriate" under the circumstances of the release. These requirements, known as "ARARs", may be waived in certain instances, as stated in Section 121(d)(4) of CERCLA, 42 U.S.C. § 9621(d)(4).

"Applicable" requirements are those clean-up standards, standards of control and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant or contaminant, remedial action, location, or other circumstance at a CERCLA site. "Relevant and appropriate" requirements are clean-up standards, standards of control and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site. For example, requirements may be relevant and appropriate if they would be "applicable" but for jurisdictional restrictions associated with the requirement. See the National Contingency Plan, 40 C.F.R. Section 300.6, 1986).

The determination of which requirements are "relevant and appropriate" is somewhat flexible. EPA and the State may look to the type of remedial actions contemplated, the hazardous substances present, the waste characteristics, the physical characteristics of the site, and other appropriate factors. It is possible for only part of a requirement to be considered relevant and appropriate. Additionally, only substantive requirements need be followed. If no ARAR covers a particular situation, or if an ARAR is not sufficient to protect human health or the environment, then non-promulgated standards, criteria, guidance, and advisories must be used to provide a protective remedy.

7.1 TYPES OF ARARS

There are three types of ARARs. The first type includes "contaminant specific" requirements. These ARARs set limits on concentrations of specific hazardous substance, pollutants, and contaminants in the environment. Examples of this type of ARAR are ambient water quality criteria and drinking water standards. The second type of ARAR includes location-specific requirements that set restrictions on certain types of activities based on site characteristics. These include restriction on activities in wetlands, floodplains, and historic sites. The third type of ARAR includes action-specific requirements. These are technology-based restrictions which are triggered by the type of action under consideration. Examples of action-specific ARARs are Resource Conservation and Recovery Act ("RCRA") regulations for waste treatment, storage, and disposal.

ARARs must be identified on a site-specific basis from information about specific chemicals at the site, specific features of the site location, and actions that are being considered as remedies.

7.2 CONTAMINANT-SPECIFIC ARARS

Section 1412 of the Safe Drinking Water Act, 42 U.S.C. Section 300g-1

Under the authority of Section 1412 of the Safe Drinking Water Act, Maximum Contaminant Levels Goals (MCLGs) that are set at levels above zero, shall be attained by remedial actions for ground or surface water that are current or potential sources of drinking water, where the MCLGs are relevant and appropriate under the circumstances of the release based on the factors in §300.400 (g)(2).

The appropriate remedial goal for each indicator chemical (except toluene and 1,2,4-TCB) in ground water is the MCLG (if not equal to zero), the federal MCL, or the State MCL, whichever is most stringent. The MCLGs and MCLs for the indicator chemicals identified in the Study Area are given in Table 6 .

California Deptartment of Health Services Drinking Water Action Levels (DWALS)

California Department of Health Services (DHS) DWALs are health-based concentration limits set by the DHS to limit public exposure to substances not yet regulated by promulgated standards. They are advisory standards that apply at the tap for public water supplies. The DWAL for toluene is 100 ppb.

California's Resolution 68-16

California's "Statement of Policy With Respect to *Maintaining* High Quality of Waters in California," Resolution 68-16, affects remedial standards. The policy requires maintenance of existing water quality unless it is demonstrated that a change will benefit the people of the State, will not unreasonably affect present or potential uses, and will not result in water quality less that prescribed by other State policies.

State of California Soluble Threshold Limit Concentrations (STLC) and Total Threshold Limit Concentrations (TTLC)

The State of California Soluble Threshold Limit Concentrations (STLC) and Total Threshold Limit Concentrations (TTLC) are applicable as the means of determining whether soils that are excavated consitute a hazardous waste. Of the nine indicator chemicals, only TCE has a STLC and TTLC values. The STLC for TCE is 204 ppm; the TTLC for TCE is 2,040 ppm. Levels of TCE detected in the Study Area exceed these levels.

7.3 ACTION SPECIFIC ARARS AND TBCS

National Pollutant Discharge Elimination System (NPDES)

NPDES substantive permit requirements and/or RWQCB Waste Discharge Requirements (WDRs) are potential ARARs for effluent discharges. The effluent limitations and monitoring requirements of an NPDES permit/WDRs legally apply to point source discharges such as those from a treatment system with an outfall to surface water or storm drains. The RWQCB establishe effluent discharge limitations and permit requirements based on Water Quality Standards set forth in the San Francisco Bay Regional Basin Plan.

City of Mountain View Industrial Waste Ordinance and the Federal Clean Water Act Pretreatment Standards (40 CFR 403.5)

Substantive requirements of the City of Mountain View Industrial Waste Ordinance and the Federal Clean Water Act Pretreatment Standards (40 CFR 403.5) are ARARs for discharges of ground water to the local sanitary sewer system. The Clean Water Act allows municipalities to determine the pretreatment standards for discharges to Publicly Owned Treatment Works (POTWs) within its jurisdiction.

EPA Office of Solid Waste and Emergency Response (OSWER) Directive 9355.0-28

OSWER Directive 9355.0-28 "Control of Air Emissions from Superfund Groundwater Air Strippers at Superfund Groundwater Sites" applies to future remedial decisions at Superfund sites in ozone non-attainment areas. Future remedial decisions include Records of Decisions (RODs), Significant Differences to a ROD and Consent Decrees. Teledyne and Spectra-Physics are in what is considered an ozone non-attainment area. This directive requires such sites to control total volatile organic compound emissions from air

CLEANUP LEVELS FOR GROUND WATER

Chemical	U.S. EPA MCLG (ppb)	U.S. EPA MCL (ppb)	California MCL (ppb)
1,1-DCA	--	--	5
1,2-DCB	600	600	--
1,1-DCE	7	7	6
1,2-DCE	70 (1)	70 (1)	6 (1)
PCE	0	5	5
1,2,4-TCB	9	9	--
1,1,1-TCA	200	200	200
1,1,2-TCA	3	5	32
TCE	0	5	5
Toluene	1000	1000	100 (2)
VC	0	2	0.5
Chloroform	--	100	--

(1) MCL for cis-1,2-DCE
(2) DHS action level

TABLE 6: CHEMICAL SPECIFIC ARARS

strippers and soil vapor extractors to fifteen pounds per day per facility. This directive is what is called a "To Be Considered" or TBC. ARARs with more stringent requirements take precedence over the directive.

Bay Area Air Quality Management District (BAAQMD) Regulation 8, Rule 47

Bay Area Air Quality Management District Board of Directors adopted Regulation 8, Rule 47; "Air Stripping and Soil Vapor Extraction Operations" which applies to new and modified operations. The rule consists of two standards:

- Individual air stripping and soil vapor extraction operations emitting benzene, vinyl chloride, perchloroethylene, methylene chloride and/or trichloroethylene are required to control emissions by at least ninety percent by weight. Operations emitting less than one pound per day of these compounds are exempt from this requirement if they pass a District risk screen.

- Individual air stripping and soil vapor extraction operations emitting greater than fifteen pounds per day of organic compounds other than those listed above are required to control emissions by at least ninety percent by weight.

Regulation 8, Rule 47 is an ARAR for the implementation of the remedy in the Study Area.

Resource Conservation Recovery Act (RCRA) Land Disposal Restrictions

Adsorbents and other materials used for remediation of VOCs, such as activated carbon, chemical-adsorbing resins, or other materials used in the treatment of ground water or air will contain the chemicals after use. RCRA land disposal restrictions are not applicable but are relevant and appropriate to disposal of treatment media due to the presence of constituents which are sufficiently similar to RCRA wastes.

7.4 LOCATION-SPECIFIC ARARS

Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act is an applicable requirement for the locations adjacent to Permanente Creek and other tributary streams and marshes.

8.0 DESCRIPTION OF ALTERNATIVES

Feasibility studies were prepared for the three geographic areas distinguished within the Study Area. The three geographic areas are as follows:

- The Teledyne Semiconductor "On-Site" area which is defined as the area within the property boundaries of Teledyne Semiconductor;

- The Spectra-Physics, Inc., "On-Site" area which is defined as the area within the property boundaries of Spectra-Physics, Inc.;

- The Teledyne Semiconductor and Spectra-Physics, Inc. "Off-Site" area, which is defined as the area outside the property boundaries of the two companies and within the boundaries of the plume.

Please note that the terms "on-site" and "off-site" do not pertain to the boundaries of the Superfund site and therefore are not consistent with the definitions given in the March 8, 1990 National Contingency Plan.

The remediation alternatives evaluated for the Study Area are listed and described herein according to the geophraphical areas described above with the exception of the "No Action" alternative.

Alternative 1 - No Action

The no action alternative was considered for each of the geographical areas as a baseline to compare remedial alternatives. Under the No Action alternative, the existing groundwater and soil vapor extraction and treatment systems would be removed. Groundwater monitoring would continue.

8.1 TELEDYNE SEMICONDUCTOR ON-SITE AREA

Alternative 2 - Existing Groundwater Extraction System

Contaminated ground water with contaminant concentrations in excess of cleanup standards is extracted from the Shallow and Intermediate zones of the Upper Aquifer using the existing extraction wells. The extracted water would continue to be discharged under permit to the sanitary sewer for treatment at the POTW.

Alternative 3 - Existing Groundwater Extraction System with Air Stripping

Ground water from the Shallow and Intermediate Zones would be pumped out using existing extraction wells. The water would then be treated to the cleanup levels listed in Table 6 by an air stripping system that uses a packed bed tower. The treated effluent would be discharged to the storm drain under NPDES permit. The air emitted from the stripper would require subsequent treatment by carbon adsorption to meet local air emission requirements.

Alternative 4 - Existing Groundwater Extraction System with Carbon Adsorption

Ground water from the Shallow and Intermediate Zones would be pumped out using existing extraction wells and the water would be treated the cleanup levels listed in Table 6 with activated carbon. The activated carbon would consist of two packed bed reactors operating in a downflow series mode. One reactor could operate while the carbon in the other reactor is being replaced with regenerated carbon. The treated effluent would be discharged to the storm drain under NPDES permit.

Alternative 5 - Existing Groundwater Extraction System and Treatment to Background Levels

The existing groundwater extraction system would be expanded to capture ground water with VOC concentrations in excess of background concentrations from the Shallow and Intermediate Zones. The extracted groundwater would be treated by carbon adsorption or air stripping until the concentrations of chemicals remaining in the ground water are reduced to background levels. The treated effluent would be discharged to the storm drain under NPDES permit.

8.2 SPECTRA-PHYSICS INC., ON-SITE AREA

Alternative 2 - Institutional Actions

The existing soil-vapor extraction and treatment systems would be shut down and several institutional actions would be implemented. This alternative restricts the future excavation of VOC-affected soils through zoning and/or building permit restrictions, and precludes the future extraction of Upper Aquifer ground water through Santa Clara Valley Water District regulations.

Alternative 3 - Soil Excavation with Existing Groundwater Extraction

Soils containing TCE above 2.5 ppm at the facility would be selected for excavation and disposal at a RCRA-permitted landfill. The Teledyne Semiconductor groundwater extraction system would continue to operate to capture and treat ground water from the Shallow and Intermediate Zones of the Upper Aquifer. Extracted ground water will be treated to the levels listed in Table 6 by either an air stripper or granular activated carbon followed by discharged to the storm drain under NPDES permit.

Alternative 4 - Expansion of Existing Soil Vapor Extraction and Continued Operation of Existing Groundwater Extraction System

The existing soil-vapor extraction and treatment system would be expanded to include additional areas where soil contains TCE in excess of 2.5 ppm. The Teledyne Semiconductor groundwater extraction system would continue to operate to capture and treat ground water from the Shallow and Intermediate Zones of the Upper Aquifer. Extracted ground water will be treated to the levels listed in Table 6 by either an air stripper or granular activated carbon followed by discharged to the storm drain under NPDES permit.

Alternative 5 - Expansion of Existing Soil Vapor Extraction and Additional Groundwater Extraction

The existing soil-vapor extraction and treatment system would be expanded the same as Alternative 4 and two Shallow zone groundwater extraction wells would be installed at the Spectra-Physics facility. Extracted ground water will be treated to the levels listed in Table 6 by either an air stripper or granular activated carbon followed by discharge to the storm drain under NPDES permit.

Alternative 6 - Expansion of Existing Soil Vapor Extraction and Continued Operation of Existing Groundwater System to Achieve Background Levels in Ground Water

The existing soil-vapor extraction and treatment system would be expanded to include additional areas where soil contains TCE in excess of 2.5 ppm. Ground water would continue to be extracted by the Teledyne Semiconductor system until concentrations of chemicals remaining the Upper Aquifer are reduced to background levels. Extracted ground water will either be treated by an air stripper or granular activated carbon followed by discharged to the storm drain under NPDES permit.

8.3 TELEDYNE SEMICONDUCTOR AND SPECTRA-PHYSICS OFF-SITE AREA

Alternative 2 - Institutional Actions

Existing extraction wells, Spring Street Extraction System (SSES) and North Bayshore Extraction System (NBES), would be abandoned and the Santa Clara Valley Water District would institute restrictions preventing the development of the Upper Aquifer. This alternative involves the use of alternate water supplies to Upper Aquifer wells (including wellhead treatment where necessary), a well permit restriction, and the use of groundwater monitoring to document changes in the concentration or area in which ground water contains VOCs.

Alternative 3 - Existing Groundwater Extraction System

The Spring Street Extraction System (SSES) and North Bayshore Extraction (NBES) will continue to extract ground water in the Shallow Zone and Intermediate Zones of the Upper Aquifer. For this alternative, removal of ground water containing contaminants in excess of the levels listed in Table 6 is the objective.

After capture, the ground water would require treatment and disposal. The treatment and discharge subalternatives for Alternative 3 as well as Alternatives 4, 5, and 6 are as follows:

A. Discharge to the sanitary sewer and treatment by Publicly Owned Treatment Works (POTW);

B. Treatment by air stripping with air emission controls and discharge to the storm drain under NPDES permit. Air emission controls considered are:

   - granular activated carbon vapor controls, or

   - co-combustion of vapors with the City of Mountain View Landfill flares;

C. Treatment by aqueous phase granular activated carbon treatment and discharge to the storm drain under NPDES permit;

D. Treatment by photolysis and oxidation and discharge to storm drain under NPDES permit.

Alternative 4 - Limited Existing Groundwater Extraction System

The SSES and the NBES would discontinue using four of the existing extraction wells and the combined captured zone for the Study Area would be reduced. Shallow and Intermediate ground water with TCE concentrations greater than 100 ppb would be captured.

Alternative 5 - Expansion of Existing Groundwater Extraction System

The SSES and the NBES would be expanded by seven additional wells to achieve a larger capture zone in the Study Area. Shallow and Intermediate Zone ground water with VOC concentrations above background levels would be extracted.

Alternative 6 - Existing Groundwater Extraction System and Injection

Alternative 3 would be employed and treated water would be injected back into the subsurface via injection wells located lateral to and downgradient of the affected areas. The injection would provide a hydraulic barrier to prevent further spread of the polluted water.

9.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

This section provides an explaination of the criteria used to select the remedy, and an analysis of the remedial action alternatives in light of those criteria, highlighting the advantages and disadvantages of each of the alternatives.

Criteria

The alternatives were evaluated using nine component criteria. These criteria, which are listed below, are derived from requirements contained in the National Contingency Plan (NCP) and CERCLA Sections 121(b) and 121(c).

1. Overall protection of human health and the environment.
2. Short term effectiveness in protecting human health and the environment.
3. Long-term effectiveness and permanence in protecting human health and the environment.
4. Compliance with ARARs (ARARs are detailed in Section 7.0).
5. Use of treatment to achieve a reduction in the toxicity,mobility or volume of the contaminants.
6. Implementability.
7. State acceptance/Support Agency acceptance.
8. Community acceptance.
9. Cost.

9.1 TELEDYNE SEMICONDUCTOR ON-SITE AREA

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The contamination within the boundaries of the Teledyne Semiconductor On-Site Area is principally groundwater contamination in the Upper Aquifer unit. The groundwater contamination within the boundaries of the Teledyne Semiconductor On-Site Area represents a portion of the defined plume area (Figures 8 and 9).

Alternative 2 provides protection of human health and the environment by reducing the volume of contamination in the Shallow and Intermediate zones of the Upper Aquifer and thereby reducing all risks associated with the presence of VOCs in the ground water. The potential for human exposure to the chemical-containing water still exists via volatilization from sanitary sewer manholes. However, this risk was determined to be within EPA's target risk range. The calculated health risk after the remedial objectives are achieved are estimated to range from 1.6 $x 10^{-6}$ to 2.7 $x 10^{-5}$ for carcinogenic risk with a hazard index of less than 1.0.

Alternative 3 provides protection of human health and the environment in the same way as Alternative 2 and also eliminates the risks associated with discharging to the sanitary sewer by including treatment with an air stripper prior to discharging. The BAAQMD will determine if air emission controls are required. The calculated health risks after the remedial objectives are achieved are the same as Alternative 2.

Alternative 4 also provides protection of human health and the environment in the same way as Alternative 2 and also eliminates the risks associated with discharging to the sanitary sewer by including treatment of extracted water with carbon adsorption prior to discharging. The calculated health risks after the remedial objectives are achieved are the same as Alternative 2.

Alternative 5 also provides protection of human health and the environment in the same way as Alternative 2 and also eliminates the risks associated with discharging to the sanitary sewer by including treatment with either carbon adsorption or air stripping prior to discharging. This alternative is designed to extract ground water from the Upper Aquifer containing VOCs in excess of background levels. The calculated health risks after the remedial objectives are achieved are the same as Alternative 2.

The No Action Alternative would provide no protectiveness or risk reduction. The average CRI for the Shallow Zone range from 9.4×10^{-5} to 1.1×10^{-2} and the HI would range from 0.64 to 16.97, respectively.

COMPLIANCE WITH ARARS

The ARARs pertinent to Alternatives 2 - 5 are set forth in Section 7 of this report. All ARARs would be attained by Alternatives 2 - 5. The No Action alternative would not attain all ARARs or provide grounds for a waiver.

REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

Alternatives 2 - 5 will reduce the concentration of VOCs in the Upper Aquifer by extracting contaminated ground water from the aquifer thereby reducing the volume of contamination. Toxicity associated with the presence of VOCs in the Upper Aquifer will also be reduced through the extraction of contaminated ground water from the Upper Aquifer.

Alternative 2 does not provide any treatment other than the volatilization and degradation of VOCs at the POTW. This treatment does not provide complete destruction of chlorinated hydrocarbons.

Alternatives 3, 4, and 5 provide destruction of VOCs by incineration of spent carbon which reduces VOCs to CO_2.

The No Action alterntive does not provide either reduction of toxicity, mobility, or volume through treatment.

LONG-TERM EFFECTIVENESS AND PERMANENCE

Alternatives 2 - 5 include groundwater extraction which is intended to reduce the level of contamination in the Upper Aquifer below action levels for the contaminants described in Section 6.0. Thus, potential risks to the community currently posed by the site in its present condition are minimized. To ensure that the magnitude of residual risks are minimized, the performance of the groundwater extraction system will be carefully monitored on a regular basis and adjusted as warranted by the performance data collected during operation. Modifications may include:

a) discontinuing operation of extraction wells in areas where cleanup standards have been attained;

b) Alternating pumping at wells to eliminate stagnation points;

c) pulse pumping to allow aquifer equilibration and encourage adsorbed contaminants to partition into ground water;

d) installation of additional extraction wells.

Treatment by POTW provided by Alternative 2 is reliable for the complete or near-complete removal of VOCs from the extracted ground water. Treatment residuals are expected to be low, based on the high volatility of the VOCs. The hypothetical health risk is not affected by the treatment alternative.

Treatment by air stripping provided by Alternatives 3 and 5 is reliable for the long-term removal of VOCs from the ground water. Treatment residuals are expected to be negligible based on the high volatility of the compounds present in the ground water.

Treatment by aqueous phase granular activated carbon provided by Alternatives 4 and 5 is reliable for the removal of VOCs from the ground water. Treatment residuals are expected to be negligible based on the high volatility of the compounds present in the ground water.

The No Action alternative provides no long term effectiveness.

SHORT-TERM EFFECTIVENESS

The short-term impact to the health of workers and community will be very minimal for Alternatives 2 - 5 because the groundwater extraction system is already in place at the site. Alternative 2 includes a risk associated with the volatilization of VOCs at the point of discharge to sanitary sewer. This risk, however, was determined to be within the 10^{-4} to 10^{-6} carcinogenic risk range and the hazard index is less than 1.0. Alternatives 3 and 5 would employ an air stripper which would emit VOCs into the air. However, emissions from air stripping towers will be controlled to meet local air district requirements.

The No Action Alternative does not include the implementation of any remedial action, therefore, there are no risks associated with the implementation of a remedy. The risks associated with the contamination of the Upper Aquifer would remain at the site.

IMPLEMENTABILITY

Alternatives 2 - 5 include the same extraction system which is already in place. Alternatives 3, 4 and 5 provide groundwater treatment with either an air stripper or with carbon adsorption. Both methods are proven technologies and there are no technical considerations that prohibit the use of either of these technologies.

There are no technical concerns regarding the implementability of the no action alternative.

COST

The capital cost for Alternative 2 (installation of extraction wells RA1 in 1896 and T32I in 1989) is $58,775 in 1991 dollars with 5% annual inflation rate. Operation and maintenance costs associated with monitoring and sewer disposal fees are estimated to be approximately $105,000/year and the present worth is estimated to be $2,066,725 for a nominal 30-year period using 5 percent interest rate.

The capital cost for Alternative 3 is $248,775, with an operation and maintenance cost of $86,000 per year. The present worth of this alternative is estimated to be $2,000,000 for a nominal 30-year period using 5 percent interest rate.

The capital costs for Alternative 4 is $144,000, with an operation and maintenance cost of $80,000 per year. The present worth cost is estimated to be $1,777,000 for a nominal 30-year period using a 5 percent interest rate.

The capital cost for Alternative 5 would be the same as either Alternative 2, 3 or 4, depending on the selected treatment method. The operation and maintenance would also be consistent with either Alternative 2, 3 or 4, depending on the selected treatment method, therefore, the nominal 30 year present worth will remain the same for each option.

SUPPORT AGENCY ACCEPTANCE

The Feasibility Study and the Proposed Plan Fact Sheet were reviewed by California Regional Water Quality Control Board (RWQCB). The RWQCB concurs with EPA's preferred alternative.

COMMUNITY ACCEPTANCE

The Proposed Plan was presented to the community of Mountain View in a fact sheet and at a public meeting. No technical comments were submitted regarding the alternatives. Other comments received are addressed in the Response Summary.

THE SELECTED REMEDY

The selected remedy for the Teledyne on-site area is Alternative 3. Alternative 3 consists of continuing the current groundwater extraction system to capture ground water containing contaminants in excess of the levels listed in Table 6, treating the extracted water with an air stripper. The air stripper will be equipped with vapor phase GAC treatment if required by BAAQMD and/or EPA OSWER Directive 9355.0-28. Treated water will be discharged under NPDES permit to the storm drain.

Alternative 3 measures evenly against Alternatives 2, 4, and 5 for all of the criteria. The principal advantages of Alternative 3 are that it provides groundwater treatment so water may be considered for reuse at a future date.

9.2 SPECTRA-PHYSICS ON-SITE AREA

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The Spectra-Physics On-Site area represents a portion of the defined VOC plume in the Upper Aquifer and all of the soil contamination known to remain within the boundaries of the Study Area.

Alternative 2 does not reduce nor eliminate the risks associated with contamination of the Upper Aquifer or contamination of the soils. This alternative does not offer any reduction of risk levels so the CRI for the Shallow Zone will range from 9.4×10^{-5} to 1.1×10^{-2} and the HI will range from 0.64 to 16.97.

Alternative 3 provides for excavation of soil that contains TCE above concentrations of 2.5 ppm and continuing groundwater extraction from the wells located at the Teledyne Semiconductor facility. Evaluation of the extraction system at the Teledyne facility is provided in Section 9.1. Removal of VOC-affected soils from the site reduces the total quantity of VOCs present by transferring the material to a Class I landfill. This alternative would provide overall protection of human health and the environment in the long term. However, Alternative 3 may create a greater risk by exposing workers and residents to large volumes of contaminated soils during the period of excavation.

Alternative 4 includes expansion of the the existing soil vapor extraction system for soil remediation and operation of the Teledyne On-Site extraction system for groundwater remediation. The soil vapor extraction system would be designed to remediate

VOCs in the upper ten feet of soils in excess of 2.5 ppm TCE and soils in excess of 0.5 ppm TCE below ten feet. This alternative will reduce the volume of VOCs in the soils and reduce the risks associated with contaminants leaching out of the soils into the ground water. Emissions from the soil vapor extraction system are required to achieve standards enforced by the BAAQMD. The groundwater extraction system discussed in Section 9.1 would provide remediation for contaminated ground water emanating from the Spectra-Physics On-Site area. This alternative would reduce the level of contamination in the Upper Aquifer and in the soils, thus reducing the risks associated with the presence of contamination. Therefore, this alternative provides overall protection to human health and the environment.

Alternative 5 provides soil remediation using the same soil vapor extraction system described for Alternative 4. Groundwater remediation is enhanced by installing two Shallow Zone extraction wells at the Spectra-Physics On-Site area. These groundwater wells would be installed and operated in addition to wells presently operating at the Teledyne Semiconductor On-Site area. This alternative would enhance groundwater remediation by ensuring that contamination emanating from Spectra-Physics is captured within a smaller area. Based on the discussion of Alternative 4, it is determined that Alternative 5 provides overall protection of human health and the environment.

Alternative 6 provides for soil and ground water remediation similar to Alternative 4. However, Alternative 6 requires that VOC levels in the ground water are reduced to background levels (essentially non-detectable). Based on the discussion of Alternative 4, it is determined that Alternative 6 provides overall protection of human health and the environment.

The No Action alternative does not provide overall protection of human health and the environment.

COMPLIANCE WITH ARARS

Alternative 2 does not include any type of soil or ground water remediation. Therefore, contamination is affected only by natural processes and ARARs are not achieved.

Alternative 3 includes groundwater extraction and soil excavation. Soil excavation is subject to a number of ARARs which have been identified in Section 7. Groundwater extraction is intended to capture contaminants in excess of the respective action levels listed in Table 6. This alternative would comply with ARARs.

Alternative 4 includes groundwater extraction and soil vapor extraction. Soil vapor extraction is subject to a number of ARARs which have all been identified in Section 7. Groundwater extraction is intended to capture indicator chemicals in excess of the respective action levels listed in Table 6. This alternative would comply with ARARs.

Alternatives 5 and 6 are expected to comply with ARARs based on the evaluation provided for Alternatives 3 and 4.

The No Action alternative does not comply with ARARs.

REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

Alternative 2 provides no type of groundwater or soil treatment. Therefore, this criterion is not achieved.

Alternative 3 will reduce the total quantity of VOCs at the On-Site area by excavating VOC-contaminated soils and transferring the material to a Class I landfill. Landfilling the material does not provide any reduction of toxicity, mobility, or volume through treatment of the VOCs. Alternative 3 provides groundwater remediation through the operation of the groundwater extraction wells at the Teledyne On-Site Area. The groundwater system and the treatment options all provide reduction of toxicity, mobility, or volume through treatment.

Alternatives 4, 5, and 6 provide soil treatment by expanding the existing soil vapor extraction system. Soil vapor extraction of soils affected by 2.5 ppm or more TCE effectively reduces the volume of VOCs in soils. The captured VOCs are adsorbed to activated carbon and thermal regeneration of carbon will provide permanent destruction of VOCs. In conclusion, soil remediation for Alternatives 4, 5, and 6 will provide reduction of toxicity, mobility, or volume through treatment.

Alternatives 4 and 6 depend on the Teledyne On-Site extraction wells for ground water remediation. The groundwater system and the treatment options all provide reduction of toxicity, mobility, or volume through treatment.

Alternative 5 provides groundwater remediation with the operation of the Teledyne On-Site extraction wells and the addition of two Shallow Zone extraction wells installed at the Spectra-Physics On-Site area. This system has the potential to reduce near source VOC concentrations in the Shallow Zone to action levels. However, it has not been determined if whether VOC concentrations in the Shallow Zone will be reduced quicker by operating extraction systems on both the Teledyne and Spectra-Physics On-Site areas compared to operating only the Teledyne On-Site system. This would be the only added benefit of installing the additional extraction wells. This alternative does provide reduction of toxicity, mobility, or volume through treatment.

The No Action alternative does not provide reduction of toxicity, mobility, or volume through treatment.

LONG-TERM EFFECTIVENESS AND PERMANENCE

Alternative 2 provides no effective measure for remediating groundwater and soil contamination. Therefore, risks associated with the presence of this contamination remain unaffected. Alternative 2 includes the monitoring of untreated soil and ground water contamination. Alternative 2 does not provide long-term effectiveness or permanence.

Alternative 3 provides soil remediation by excavation. Soil removal has the long-term benefit for the Site of removing soils containing VOCs, thus reducing the risks associated with the presence of contamination in the soil. However, because no VOCs are destroyed by treatment, this is not a permanent remedy for VOC-containing soils. The transfer process increases the possibilty of exposure due to loss in transit, and future releases at the disposal site. With this alternative, the long-term health risks associated with soils are carcinogenic risk of 1.7×10^{-7} and a hazard index of 7.4×10^{-4}.

Alternatives 4, 5, and 6 would provide soil remediation by expanding the existing soil vapor extraction system to remediate soils containing TCE in excess of 2.5 ppm in the upper 10 feet and 0.5 ppm below 10 feet. Soil vapor extraction removes the threat of migration or exposure to VOCs in soil. Existing pavement overlying the site area will limit the migration of any residual soil contamination. Soil vapor extraction provides a long-term effective and permanent remedy for soil contamination. By expanding the soil vapor extraction system, the long-term health risks are the same as with Alternative 3.

Alternatives 3, 4, and 6 provide groundwater remediation with the groundwater extraction system operating at the Teledyne On-Site area. The groundwater extraction and treatment systems considered for the Teledyne On-Site area are evaluated in Section 9.1.

Alternative 5 enhances groundwater remediation by adding two additional Shallow Zone extraction wells at the Spectra-Physics On-Site area which will operate in conjuction with the extraction wells at the Teledyne On-Site Area. The objective of this component of Alternative 5 is to reduce the levels of VOCs in the Upper Aquifer to or below action levels. Theoretically, this alternative will achieve chemical specific ARARs in a shorter period of time. However, the long-term health risks associated with the groundwater extraction for this alternative are the same as Alternatives 3, 4, and 6.

The No-Action alternative would result in residual soil and ground water contamination which may create greater risks as the contaminants migrate. The No-Action alternative does not provide long-term effectiveness or permanence.

SHORT-TERM EFFECTIVENESS

Alternative 2 does not increase risk to residents or workers as a result of implementing the remedy. Since Alternative 2 provides no effective measure for remediating groundwater and soil contamination, all risks associated with the presence of this contamination remain unaffected.

Alternative 3 includes excavation which is expedient but also creates the greatest short term potential for adverse human health effects to field personnel, site employees, or nearby residents due to exposure from chemicals in soil during excavation, loading, or transportation. Based on the risks associated with soil excavation, Alternative 3 may increase short-term risks.

Alternatives 4, 5, and 6 include enhancing soil remediation by expanding the existing soil vapor extraction system. Potential, short-term risks associated with expanding the soil vapor extraction system includes exposure to contaminated soil from drilling or trenching, handling excavated material, and any fugitive emissions resulting from the soil vapor extraction system. All of these risks are expected to be minimal and the short-term risk levels are not expected to increase as a result of the installation and operation of the soil vapor extraction system.

Alternatives 3, 4, and 6 provide groundwater remediation with the operation of the Teledyne On-Site area groundwater extraction and treatment system. Short term risks associated with groundwater extraction and treatment systems considered for the Teledyne On-Site area are evaluated in Section 9.1.

Alternative 5 includes the addition of two On-Site, Shallow Zone extraction wells to enhance groundwater remediation. Short-term exposure associated with installation of groundwater extraction systems include exposure of workers or residents to soils and ground water produced in the drilling operations. These potential exposures are fairly minimal and can be easily controlled..

The No Action alternative provides no effective measures for remediating groundwater and soil contamination. Therefore, risks associated with the presence of this contamination remain unaffected. Alternative 2 does not provide short-term effectiveness.

IMPLEMENTABILITY

Alternative 2 is an institutional program which may be implemented. There is no type of construction associated with this alternative.

Alternative 3 may be difficult to implement. It is not known if owners and occupants of properties adjacent to selected locations would grant the access needed for excavation, staging of equipment and stockpiling soils. The 0.37-acre area to be excavated is currently covered with pavement which would have to be removed before excavating. There is limited space available for the operation of heavy equipment. For these reasons, Alternative 3 would be difficult to implement. The groundwater extraction system for Alternative 3 is already implemented.

Alternatives 4 thru 6 are all partially implemented and the construction of additional soil vapor extraction wells and/or groundwater extraction wells is reliable and easily implemented.

The No-Action alternative is implementable.

COST

As a basis for comparison, the cost figures provided for Alternatives 3 thru 6 assumes that the groundwater extraction systems included for each of these alternatives will be discharging under permit to the sanitary sewer for treatment at the POTW.

For Alternative 2, the capital cost is approximately $180,960; the annual operation and maintenance cost is $53,160; and the present worth is $794,811.

For Alternative 3, the capital cost is approximately $4,495,525; the annual operation and maintenance costs are approximately $158,160; and the present worth is approximately $6,723,538.

For Alternative 4, the capital cost is approximately $480,621; the annual operation and maintenance costs are approximately $188,600, and the present worth is approximately $2,729,595.

For Alternative 5, the capital cost is approximately $752,271; the annual operation and maintenance costs are approximately $310,956; and the present worth cost is approximately $4,882,162.

For Alternative 6, the capital cost is $427,871; the annual operation and maintenance costs are approximately $188,600, and the present worth cost is approximately $2,676,845.

SUPPORT AGENCY ACCEPTANCE

The Feasibility Study and the Proposed Plan Fact Sheet were reviewed by California Regional Water Quality Control Board (RWQCB). The RWQCB concurs with EPA's preferred alternative.

COMMUNITY ACCEPTANCE

The Proposed Plan was presented to the community of Mountain View in a fact sheet and at a public meeting. No technical comments were submitted regarding the alternatives. Other comments received are addressed in the Response Summary.

THE SELECTED REMEDY

Alternative 4 is the selected remedial alternative for the Spectra-Physics site. Alternative 4 consists of expanding the soil vapor extraction system and employing the Teledyne On-Site groundwater extraction and treatment system to provide groundwater remediation of the Spectra-Physics On-Site area. The existing soil vapor extraction system of three soil vapor extraction wells at the southeast corner of Building 3 will be expanded to include soil vapor extraction in four additional areas; the northeast and northwest corners of Building 3 and the east and west sides of Building 2 (Figure 7). Emissions from soil vapor extraction system are to be controlled with granular activated carbon.

Alternative 4 is protective of human health and the environment. Groundwater contamination is treated so that the remaining potential future risks fall within the 10^{-4} to 10^{-6} carcinogenic risk range for acceptable cleanup levels. The remedy complies with ARARs by achieving cleanup federal and State MCLs or RDWALs. Soil is remediated to a level that will protect ground water from future solvent contamination. The remedy is effective in the short-term and in the long-term by virtue of the fact that ARARs are achieved. Alternative 4 provides active, immediate, short-term and long-term reduction of toxicity, mobility, and volume of chemicals in soils and ground water. Alternative 4 is easy to implement, it is accepted by the community of Mountain View and the RWQCB, and is cost effective. Alternative 5 would accelerate On-Site groundwater remediation, however, it is not guaranteed to accelerate the overall remediation of the Study Area. Therefore, Alternative 4 is the selected remedy.

9.3 TELEDYNE SEMICONDUCTOR/SPECTRA-PHYSICS OFF-SITE AREA

OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Alternative 2 provides institutional restrictions preventing the extraction of ground water from Upper Aquifer (minimum depth of 100 feet) in the Study Area. This alternative does not provide any sort of remediation to the Upper Aquifer which would eliminate the future and present, human health and environmental risks associated with the presence of contamination in the Upper Aquifer.

Alternatives 3 and 5 will afford protection to human health and the environment by removing VOCs from the Upper Aquifer through extraction and subsequent treatment and discharge. In addition to removing VOCs from the Upper Aquifer, all of these alternatives will increase the upward hydraulic gradient between the Upper and Deep Aquifers, thus reducing the risk of downward VOC migration. The risks associated with the operation of the respective treatment methods for each alternative are regulated by ARARs identified in Section 7 and are not expected to exceed acceptable risk levels.

Alternative 4 also affords protection to human health and the environment by removing VOCs from the Upper Aquifer. However, this alternative is intended to capture ground water with concentrations of TCE greater than 100 ppb. This will reduce the current level of contamination in the Upper Aquifer as well as reduce the risk of downward migration, however, ARARs for protection of ground water as a drinking water source are not achieved.

Alternative 6 affords protection to human health and the environment by removing VOCs from the Upper Aquifer to the levels listed in Table 6. Following extraction and treatment, part of the effluent would be reinjected into the Upper Aquifer to possibly enhance recovery of VOCs. This action may result in spreading contaminants into unaffected areas as well as create a downward gradient into the Deep Aquifer. Because there are potential risks associated with Alternative 6, this alternative is considered less protective of human health and the environment than Alternatives 3 and 5.

Treatment and disposal subalternatives for Alternatives 3, 4, 5, and 6 do not affect how these alternatives are evaluated according to overall protection of human health and the environment.

The No Action alternative does not afford any protection to human health and the environment.

<u>COMPLIANCE WITH ARARS</u>

Alternative 2 does not provide any sort of remediation for the Upper Aquifer. Therefore, cleanup levels are not acheived. This alternative does not comply with chemical specific ARARs.

Alternatives 3, 4, and 6 would provide extraction of ground water containing indicator chemicals at concentrations greater than the resepective cleanup levels. Therefore, Alternatives 3, 4, and 6 comply with chemical specific ARARs.

Alternative 5 does not extract ground water containing indicator chemicals at concentrations greater than the respective cleanup levels. Therefore, Alternative 5 does not comply with chemical specific ARARs.

Each of the extraction alternatives, except Alternative 6, can be designed to comply with action-specific and location-specific ARARs for extraction, treatment and disposal. Injection of treated ground water may not contribute to the improvement of the quality of the Upper Aquifer ground water and, thus, may be subject to the requirement of California Health Code 25159.10 et seq. for injection wells. These requirements may effectively preclude injection.

Treatment and discharge subalternatives for Alternatives 3 thru 6 do not affect how these alternatives achieve chemical specific ARARs. The pertinent location- and action-specific ARARs for the treatment and discharge subalterantives are described in Section 7. Each of these subalternatives are expected to comply with the pertinent ARARs.

The No Action alternative does not comply with chemical specific ARARs.

REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

Alternative 2 affords no reduction of toxicity, mobility or volume of ground water containing VOCs.

Alternatives 3, 4, and 6 would employ groundwater extraction systems that will reduce the VOC concentrations in the Upper Aquifer to or below cleanup levels. Therefore, Alternatives 3, 4, and 6 will reduce the volume of contaminants in the Upper Aquifer, thereby reducing the toxicity of the ground water.

Alternative 3, 4, and 5 prevents the migration of VOCs in the Upper Aquifer by increasing the upward hydraulic gradient between the Upper and Deep Aquifers, thus reducing the risk of downward migration. In addition, the capture zone created by the operation of the extraction system prevents the lateral migration of VOCs in the Upper Aquifer.

Alternative 4 captures ground water with concentrations of TCE greater than 100 ppb using 18 of the NBES and SSES extraction wells. Therefore, this alternative provides less reduction of toxicity, mobility, or volume than Alternatives 3, 5, and 6.

Alternative 6 will capture ground water in excess of cleanup levels thus reducing the toxicity and volume of contamination. However, by reinjecting treated water into the Upper Aquifer, the upward gradient between the Deep and Upper Aquifer would not be enhanced and would potentially be reversed. In addition, reinjection may result in further spreading of the VOC plume in the Upper Aquifer.
In conclusion, Alternative 6 will provide less reduction of toxicity, mobility, or volume than Alternatives 3 and 5.

All of the treatment and disposal options considered for Alternatives 3 thru 6 will provide reduction of volume, toxicity or mobility through treatment. Treatment by the POTW is the only subalternative that does not provide destruction of VOCs. This subalternative effectively reduces the toxicity of VOCs contained in water, primarily through stripping of VOCs in sewer pipe and in the aeration basins of the POTW.

LONG-TERM EFFECTIVENESS AND PERMANENCE

Alternative 2 does not provide any treatment to reduce the level of contamination in the Upper Aquifer, thus the risk associated with the contamination of the Upper Aquifer would remain. This alternative does not provide a long-term effective and permanent remedy.

Alternatives 3, 4, 5, and 6 employ extraction and treatment technologies that have proven successful in remediating VOC-affected ground water. The North Bayshore and the Spring Street extraction systems would reliably and effectively capture VOC-affected ground water within the Study Area as long as the operation and maintenance of the system is properly managed.

Alternatives 3, 5, and 6 will provide a carcinogenic risk ranging from 2.3×10^{-6} to 1.7×10^{-6} with a hazard index range of approximately 0.034 to 0.028 for the Shallow Zone and the Intermediate Zone, respectively.

Alternative 4 will extract VOC-contaminated ground water containing an excess of 100 ppb TCE. It will, therefore, leave a greater mass of VOCs in the ground water than Alternatives 3, 5, and 6. The long-term health risks associated with the contamination that is not captured with this alterantive range from 3.5×10^{-5} to 2.9×10^{-5} with an estimated hazard index of approximately o.53 to 0.54 for Shalllow Zone and Intermediate Zone ground water, respectively.

The evaluation of long-term effectiveness and permanence for the treatment and discharge subalternatives is as follows:

Air stripping systems are durable, with generally little need for replacement of components with the exception of change-out of vapor phase carbon. Regeneration of spent carbon will not create unacceptable long-term risks. Co-combustion with landfill gases does not create unacceptable long-term risks. Treatment residuals are expected to be negligible. The long-term health risk is not affected by this treatment subalternative.

Treatment by aqueous phase granular activated carbon is reliable for the removal of VOCs from the ground water. Carbon treatment systems are durable, with generally little need for replacements of components. The long-term hypothetical health risk is not affected by this treatment subalternative.

Treatment by photolysis combined with oxidation is reliable for the removal certain VOCs from water. However, the durability of the technology is not established . The long-term hypothetical health risk is not affected by this treatment subalternative.

The No Action alternative does not provide long-term effectiveness and permanence.

SHORT-TERM EFFECTIVENESS

Alternative 2 does not include implementing a remedy, therefore, there is no added risk to workers, site employees, and residents resulting from construction in the Study Area. Since Alternative 2 provides no effective measure for remediating groundwater and soil contamination, all risks associated with the presence of this contamination remain unaffected.

Alternatives 3, 4 and 6 employ the existing groundwater extraction systems without modifications. Therefore, no new risks would result from the installation of new wells. Alternative 3 is expected to achieve cleanup levels in 30 to 160 years. Alternative 4 is expected to achieve the remedial goal of 100 ppb total VOCs is 10 to 80 years. Alternative 6 is expected to achieve cleanup levels in 40 to 200 years.

Alternative 5 includes the expansion of existing the existing groundwater extraction systems. Seven new extraction wells would be installed, and trenching required for installation of piping would not expose VOC-affected soil, but drilling would expose both VOC-contaminated soils and ground water. This would increase the short-term risk associated with implementation. Proper health and safety plans should minimize these risks. The estimated time to achieve background levels in the Upper Aquifer is 40 to 200 years.

The evaluation of the treatment and discharge subalternatives is as follows:

Potential risk resulting from discharging to the sanitary sewer for treatment at the POTW include the risks caused by air emission of VOCs that would be volatilized within the sedimentation and aeration basins and the sanitary sewer. The BPHE determined these risks were insignificant. Time to reach remedial goals is not affected by this subalternative.

Potential risks resulting from employing an air stripper includes overflow of the air stripping tower(s) and emissions from the air stripping tower(s). Controlling emissions from an air stripper with either vapor phase carbon or by co-combustion includes potential risks. Risks associated with managing activated carbon are minimized by employing proper hazardous waste management practices. However, the risks associated with co-combustion are not completely understood. Therefore, short term risks may be greater with this vapor phase control measure. The time to reach remedial goals is not affected by this subalternative.

Potential risks which result from employing activated carbon includes possible dermal contact or injestion of contaminated material. Transportation and disposal or regeneration of spent carbon may involve other risks. These risks may be minimized with proper waste management practices. The time to reach remedial goals is not affected by this treatment alternative.

Potential risk which result from employing a photolysis and oxidation process includes fugitive emissions of ozone. This risk is most easily mitigated by using hydrogen peroxide as an oxidant rather that ozone. The time to reach remedial goals is not affected by this treatment subalternative.

The No Action alternative does not include implementing a remedy, therefore, there is no added risk to workers, site employees, and residents resulting from construction in the Study Area. Since the No Action alternative provides no effective measure for remediating groundwater and soil contamination, all risks associated with the presence of this contamination remain unaffected.

IMPLEMENTABILITY

Alternative 2 is an institutional program which may be implemented. There is no type of construction associated with this alternative.

The groundwater extraction systems for Alternative 3 and 6 are completely implemented. Alternative 4 only requires the closure of existing extraction wells, therefore, this groundwater extraction system may be implemented. Alternative 5 requires the addition of extraction wells in the Study Area which are easily implemented.

The evaluation of the treatment subalternatives is as follows:

Discharging to the POTW requires a connection to the sanitary sewer which is already implemented.

Constructing an air stripping system with vapor controls is easy to achieve. However, the siting is contingent upon having private land owner(s) or City approval for property use. Potential locations for the air stripping system have already been identified. Vapor phase carbon is easy to implement, with high reliability and no identified technical problems associated with this process option. Implementing co-combustion is uncertain and would require a pilot treatment study.

Implementing activated carbon will also depend on available property for staging the system. The use of aqueous phase carbon is implementable, with high reliability and no identified technical problems associated with this process option.

Implementing a photolysis/oxidation system will also depend on available property for staging the system. Construction of a photolysis/oxidation system may require bench and/or pilot testing.

The No Action alternative may be implemented.

COST

As a basis for comparison, the cost figures provided for Alternatives 3 thru 6 assumes that the groundwater extraction systems included in each of these alternatives will be dishcarging under permit to the sanitary sewer for treatment at the POTW.

For Alternative 2, the capitol cost is $124,800; the annual operation and maintenance cost is $198,740, and the present worth for 30 years is $2,498,048.

For Alternative 3, the capitol cost is $0; the annual operation and maintenance cost is $720,739, and the present worth for 30 years is $10,496,757.

For Alternative 4, the capitol cost is $676,475; the annual operation and maintenance cost is $470,390; and the present worth for 30 years is $7,522,902.

For Alternative 5, the capitol cost is $1,141,523; the annual operation and maintenance cost is $548,341; and the present worth for 30 years is $9,334,872.

For Alternative 6, the capitol cost is $1,125,244; the annual operation and maintenance cost is $497,395, and the present worth for 30 years is $8,535,426.

SUPPORT AGENCY ACCEPTANCE

The Feasibility Study and the Proposed Plan Fact Sheet were reviewed by California Regional Water Quality Control Board (RWQCB). The RWQCB concurs with EPA's preferred alternative.

COMMUNITY ACCEPTANCE

The Proposed Plan was presented to the community of Mountain View in a fact sheet and at a public meeting. No technical comments were submitted regarding the alternatives. Other comments received are addressed in the Response Summary.

THE SELECTED REMEDY

The selected remedy for the Off-Site area is Alternative 3. Alternative 3 consists of continuing the current groundwater extraction system. Extracted water will be discharged to the sanitary sewer. The current groundwater extraction system consists of 22 groundwater extraction wells; 14 Shallow Zone and 8 Intermediate Zone extraction wells. The flow rate of the system is approximately 350 gpm.

The extraction systems for Alternatives 3, 5, and 6 were designed to achieve cleanup levels in the Upper Aquifer. The extraction system for Alternative 5 was determined to be more difficult to implement that Alternatives 3 and 6 due to landowner access.

With respect to the treatment and disposal options considered, all options provide essentially the same level of protection of human health and the environment; are equally capable of achieving ARARs; and provide reduction of toxicity, volume, mobility, or volume. Thus the principle differences are feasibility and cost. Discharge to the POTW appears to be the most feasible alternative. It is also the least costly, unless project life extends for an extensive time period. Significant feasibility issues exist for the air stripping/co-combustion option (such as treatment facility siting and the technical feasibilty of co-combustion), although this option could be the most cost-effective for longer project lives, if these issues are resolved in a satisfactory manner.

10.0 STATUTORY DETERMINATIONS

The selected remedies are protective of human health and the environment, comply with federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and are cost-effective. This remedies utilize permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable and satisfy the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

Because the remedies will result in hazardous substances remaining on-site above health-based levels, a five-year review, pursuant to CERCLA Section 121, 42 U.S.C. Section 9621, will be conducted at least once every five years after initiation of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

11.0 DOCUMENTATION OF SIGNIFICANT CHANGES

In the Proposed Plan for Teledyne Semiconductor and Spectra-Physics that was issued in November 1990, the recommended alternatives for the Teledyne On-Site area and the Spectra-Physics On-Site area were not the same alternatives selected in this Record of Decision. An explaination for not selecting the alternatives recommended in the Proposed Plan is provided in this section.

The Proposed Plan recommended Alternative 2 for the Teledyne On-Site area. Alternative 2 provides groundwater extraction from the existing system which discharges under permit to the sanitary sewer system. The remedy selected in this document is Alternative 3 which also provides for groundwater extraction from the existing wells followed by treatment with an air stripping unit. Treated water will be discharged under an NPDES permit to the sanitary sewer or will be reused. Presently, this extraction system is discharging to the sanitary sewer under a permit issued by the City of Mountain View which permits total organics equal to or less than 1 ppm. The Teledyne On-Site area extraction system is not meeting the City of Mountain View discharge requirements. Therefore, a treatment system is required.

The Proposed Plan recommended Alternative 5 for the Spectra-Physics On-Site area. Alternative 5 provides for soil remediation by expanding the existing soil vapor extraction system and provides for groundwater remediation with the addition of two Shallow Zone extraction wells at the Spectra-Physics facility. The remedy selected in this document is Alternative 4 which provides for soil remediation by expanding the existing soil vapor extraction system and provides for groundwater remediation with the Teledyne On-Site extraction system. Alternative 5 was originally proposed for the following reasons:

1. The Spectra-Physics On-Site area may not be adequately captured with the Teledyne On-Site extraction wells;

2. By adding the additional extraction wells, it was estimated that the time to clean up ground water would be reduced by 40% according to Spectra-Physic's groundwater model;

3. Two extraction wells at the Spectra-Physics On-Site area would provide additional source control.

Based on comments provided by Spectra-Physics during public comment period, and a review of information contained in the administrative record for the sites, the RWQCB and EPA have selected Alternative 4 with a requirement that the effectiveness of the system be evaluated in two years, November, 1993.

PART III RESPONSIVENESS SUMMARY

RESPONSIVENESS SUMMARY
TELEDYNE / SPECTRA-PHYSICS
FINAL SITE CLEANUP REQUIREMENTS
January 8, 1991

Introduction / Summary

This responsiveness summary reviews comments and questions received during the 45 day public comment period regarding the proposed final remedy for the Teledyne / Spectra-Physics sites. The remedy is presented in the tentative Site Cleanup Requirements (SCR) for Teledyne and Spectra-Physics, the Teledyne and Spectra-Physics RI/FS and the Regional Board Proposed Plan Fact Sheet. The final public comment period on the SCR was from November 14, 1990 to December 28, 1990. The Board held initial public hearings on the SCR on November 14, 1990 and December 12, 1990. A community meeting was held in Mountain View on November 14, 1990.

Twelve comment letters were received on the SCR. The main issues addressed in the comment letters were: 1) The proposal to delay the nonbinding allocation of responsibility (NBAR) for several months. Staff has agreed with this delay and is planning to bring an NBAR addendum to the SCR back before the Board in June. 2) The requirement for on-site groundwater extraction at Spectra-Physics. Based on the relatively poor performance of the existing interim remedial actions at Teledyne, the significant reduction in cleanup times provided by extraction wells at Spectra-Physics, the additional benefits to public health and the environment, the source control provided by extraction wells at Spectra-Physics, and the cost effectiveness of extraction wells at Spectra-Physics, staff recommends adoption of the Tentative Order requiring on-site groundwater extraction wells at Spectra-Physics. These issues are discussed further below.

During the community meeting that was held in Mountain View, the two main questions asked were: 1) Is the City of Mountain View drinking water safe to drink? Since the deeper aquifer zones which the City uses as a partial supply for its drinking water do not contain pollutants associated with the Teledyne and Spectra-Physics plume, the City's drinking water is safe to drink. 2) Is the groundwater extraction causing land subsidence at a neighboring apartment building? There is currently no evidence that suggests the groundwater extraction system is or will cause land subsidence. These issues are also discussed further below.

The administrative record for the site is available for public review at the Regional Board office. The record contains the basis for the selected remedy and for these responses.

Entities Commenting

The following entities commented in writing on the tentative order:

1. Environmental Protection Agency
2. Santa Clara Valley Water District
3. City of Mountain View
4. Whisman School District
5. Teledyne
6. Spectra-Physics
7. Peery/Arrillaga
8. NTI and John and Liann Davila
9. South Bay Construction and Development Company
10. Silicon Graphics
11. Montwood

Community Relations Activities

The major site specific community relations activities are listed below:

August 1989	Fact Sheet No. 1	(Mailed to local area residents seeking a site-specific mailing list)
November 1990	Fact Sheet No. 2	(Mailed to the Teledyne / Spectra-Physics mailing list)
November 1990	Community Meeting	(At Crittendon School, Mountain View, November 14, 1990.)

Other Superfund community relations activities that included these Superfund sites and other Superfund sites in the South Bay were also conducted in the past five years.

Main SCR Issues

Local Community Concerns and Questions

During the community meeting on November 14, numerous questions were asked about the proposed remedy. All of the significant questions were covered in the Proposed Plan Fact Sheet. The questions were all answered during the community meeting. The two significant questions asked and concerns expressed during the meeting were:

A community member asked if groundwater extraction at the sites could cause land subsidence at an apartment building located across the street from Spectra-Physics, on the south side of West Middlefield Road. It was explained that historical land subsidence in Santa Clara County has been attributed to pumping in the deeper groundwater aquifers, beneath the regional aquitard. Shallow zone groundwater pumping such as at Teledyne and Spectra-Physics has not been attributed as a cause of land subsidence. In addition, groundwater level reductions of several feet caused by shallow zone groundwater extractions are similar in magnitude to natural historical seasonal and annual water level fluctuations. Spectra-Physics has not noticed any land subsidence at its site between the existing groundwater extraction wells and the apartment building.

A community member asked if the City of Mountain View drinking water was safe to drink. The City's drinking water is safe to drink. It was explained that the shallow zones that are polluted are not currently used for drinking water. The shallow zones occur between 10 and 80 feet below ground surface. The City of Mountain View uses the deeper aquifer zones as part of their water supply. The deeper zones occur below a depth of 150 feet and are separated from the shallow zones by a 70 foot thick clay layer that limits downward migration of pollution. The deeper zones in the vicinity of the site do not currently contain chemicals from the Teledyne and Spectra-Physics groundwater pollution.

Nonbinding Allocation of Responsibility

From the list of entities commenting above, Nos. 7 through 11 commented on the proposed nonbinding allocation of responsibility (NBAR). This includes Peery/Arrillaga, NTI and John and Liann Davila, South Bay Construction and Development Company, Silicon Graphics and Montwood. Teledyne and Spectra-Physics also commented on the NBAR. All parties commenting except Silicon Graphics agreed to delay the NBAR for several months while further investigative work is conducted. Silicon Graphics did not address the delay. Silicon Graphics commented that they were neither an owner or operator and therefore should not be listed as a PRP. The current proposed SCR does not list any specific PRP's and the question of who should be listed will be decided after submittal of a revised NBAR. The SCR contains a task for Teledyne and Spectra-Physics to submit a revised NBAR for Board consideration later this spring after the further investigative work is completed.

Teledyne and Spectra-Physics, NTI and John and Liann Davila, and South Bay Construction all proposed language for the NBAR finding. A modification to the Teledyne and Spectra-Physics suggested language is used in the SCR that delays the NBAR for several months while further investigative work is being completed. A revised NBAR report is required to be submitted in April. It is expected that an NBAR addendum to the order will be brought back before the Board in June 1991.

Spectra-Physics On-Site Groundwater Extraction

Spectra-Physics made a presentation at the December 12, 1990 Board meeting objecting to the requirement for on-site groundwater extraction wells at the Spectra-Physics site. Spectra-Physics also submitted separate written comments on this issue dated December 28, 1990. The December 28, 1990 written comments summarized Spectra-Physics verbal comments to the Board and their previous October 12, 1990 comment letter on this same issue. Spectra-Physics states five main reasons why they are contesting the requirement for on-site groundwater extraction:

1) The Spectra-Physics on-site area is already hydraulically captured by the one extraction well at Teledyne.

2) There will be no significant shortening of cleanup times by implementing on-site groundwater extraction at Spectra-Physics.

3) On-site groundwater extraction at Spectra-Physics provides no additional benefit to public health or the environment.

4) On-site groundwater extraction at Spectra-Physics would not provide additional source control and is contrary to groundwater conservation concerns.

5) On-site groundwater extraction at Spectra-Physics is not cost effective.

The responses to each of Spectra-Physics' five points are given below.

1) <u>The on-site area is already hydraulically captured.</u>

Staff does not disagree with this point. However, hydraulically capturing a groundwater plume and effectively cleaning it up are often two completely different design concepts. Simply having one groundwater extraction well at the down gradient edge of a plume may provide a hydraulic barrier to further down gradient migration of the plume but it is certainly not the most effective design for a cleanup system. By designing the on-site cleanup system with only one down gradient hydraulic containment extraction well, all of the distant up gradient mass of chemicals must migrate through the highly irregular shallow zone and traverse over the variable shallow zone / intermediate zone low permeability clay aquitard. The peaks and valleys of the clay aquitard cause the shallow zone to vary in thickness from 28 feet thick to locations where it pinches down to only 5 feet thick. This is shown in the Spectra-Physics RI/FS Figure C-5 and the Teledyne RI/FS Figure B12. As shown in these figures, over a linear distance of about 1800 feet from the upgradient side of Spectra-Physics down to the one on-site shallow extraction well at Teledyne, the shallow zone varies in thickness at the following boring locations with the corresponding shallow zone thicknesses: S-1,10'; S-18A, 15'; S-19, 10'; S-3, 15'; S-15I, 5'; T-15, 18'; S-8S, 5'; T-5I, 28'; RA-1S, 10'. The peaks and valleys in the clay aquitard cause significant barriers to the effectiveness of one groundwater extraction well at the down gradient side of Teledyne. This is a main reason why even though the Spectra-Physics on-site area may be hydraulically contained by the one shallow extraction well at Teledyne, it is not being cleanup up effectively.

Interim Remedial Action Performance Evaluation

Interim remedial action has been on-going at the Teledyne site in the form of one shallow zone groundwater extraction well since October 1986. The following table demonstrates that while interim remedial actions have been ongoing at Teledyne for four full years, concentrations in many on-site Teledyne and Spectra-Physics wells have remained approximately the same or have risen.

TELEDYNE / SPECTRA-PHYSICS ON-SITE AREAS
TOTAL VOC CONCENTRATIONS (ppb)

Well No.	October 1986	September 1990
T-3	756	1589
T-6	4218	4840
T-8	1476	1940
PZ-3	1169	1500
PZ-4	1929(6/87)	3297
PZ-5	3985(6/87)	5480
RA-1	1970	949
S-1	380	292
S-2	700	476
S-3	933	1392
S-18A	194(3/88)	452
S-19	528	695
R-1	245	404

Note: Data taken from Levine-Fricke Groundwater Monitoring Report, November 15,1990, and PES Environmental, Inc. Groundwater Monitoring Report, November 15, 1990.

This demonstrates that simply hydraulically capturing a plume does not mean it is being effectively cleaned up. This also demonstrates that additional on-site shallow zone extraction wells may now be required at the Teledyne site. This will be closely evaluated during the first five year review period. However, the Teledyne site will not achieve cleanup standards in a timely manner if chemicals continue to migrate onto the Teledyne site from Spectra-Physics. Spectra-Physics must be required to implement on-site groundwater extraction prior to requiring additional on-site groundwater extraction wells at Teledyne.

2) Cleanup times will not be significantly shortened by adding extraction wells at Spectra-Physics.

Spectra-Physics' own groundwater cleanup time model contained in their RI/FS estimates cleanup times will be 40 % longer if groundwater extraction is not implemented at the Spectra-Physics site. The upper range of the estimated cleanup times will increase from 50 years to 70 years without on-site groundwater extraction at Spectra-Physics. Spectra-Physics attempts to argue that this 40 % time increase is insignificant and that the two cleanup times are roughly the same. They state that the model is simple and imprecise and shouldn't be used to differentiate cleanup times, and that if the model did take into account the effects of diffusion from low-permeability layers, predicted cleanup times for the two alternatives likely would be the same.

Staff's response is that a 40 % difference in cleanup times is very significant and certainly warrants the installation of on-site groundwater extraction wells at Spectra-Physics. While the groundwater cleanup time model may by relatively simple, it is the best that is available for this site.

At another Superfund site, Siemens, for which the Board recently adopted a final cleanup order, a different cleanup time model[1] was used by the same consultant that wrote Spectra-Physics' RI/FS. This model is more sophisticated in that it calculated the effects that diffusion of TCE out of the clays would have on the cleanup time. This model is also based on the fact that cleanup time for sand zones is directly proportional to the distance from the most distant portion of the groundwater plume to the extraction well. Using the modelling approach that was applied at Siemens for the Spectra-Physics site, it follows that if you cut the distance to the most distant part of the on-site area plume in half by installing groundwater extraction wells at Spectra-Physics, the cleanup times should also correspondingly be reduced by 50 %.

Once cleanup times for the sand zones are estimated, cleanup times for the clay zones must be added. At this point the diffusion portion of the model would be coupled to the cleanup times for the sand zones, as was done for the Siemens site. In the Siemens calculation, approximately one half of the time necessary to remediate the sand zones was then added to the cleanup times to account for the slow diffusion out of the clays. The time modelled for diffusion out of the clays would not make total predicted cleanup times with and without on-site groundwater extraction the same, as Spectra-Physics contends, because the diffusion portion of the time would be added to both alternatives. It follows that by using a more sophisticated model that does account for the effects of diffusion, the cleanup times will still be significantly shorter with additional on-site groundwater extraction wells at Spectra-Physics because the distance to the most distant part of the groundwater plume to the extraction well is cut in half.

3) Additional benefits to Public Health and the Environment

Spectra-Physics argues that there will be no additional benefits to public health and the environment because the remedial objectives, or cleanup standards, will be the same with and without on-site extraction at Spectra-Physics and the cleanup time will be the same for both alternatives. It is true that the cleanup standards will be the same regardless of which alternative is selected. However, by achieving an estimated 40 % difference in cleanup time, significant benefits to public health and the environment are provided by restoring all potential beneficial uses to the aquifers and reducing potential risks as quickly as possible and up to 20 years sooner.

4) Source Control and Water Conservation

Spectra-Physics comments that they do not feel there is a "hot spot" on their site that warrants on-site groundwater extraction and that the additional pumping is not warranted given the current drought conditions and the fact that hydraulic containment is being achieved by the Teledyne extraction well. There are currently 29 Superfund sites in Santa Clara County. Twenty-four out of the 29 sites have on-site groundwater extraction. Of the five sites that do not have on-site groundwater extraction including Spectra-Physics, three have proposed on-site extraction and one is an arsenic soil contamination site. Spectra-Physics is the only Superfund site out of 28 Superfund sites in the County with volatile organic compounds (VOCs) that has not proposed on-site extraction. Many of the other 28 sites are commingled sites, however, they are not relying on their neighbors' systems to remediate their site, they all have their own on-site extraction systems. Spectra-Physics is not significantly different that any of these other 28 sites. Spectra-Physics has on-site groundwater concentrations in the 1,000 part per billion (ppb) TCE range. This is 200 times the cleanup standard of 5 ppb.

It is also inconsistent of Spectra-Physics to argue strenuously for source control for PRPs through the NBAR while refusing to install groundwater source control systems at its own site.

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[1]Levine-Fricke, Feasibility Study Report, Siemens Facility (1990), Appendix A.

Staff has evaluated the tradeoff between the increase in pumping of approximately 20 gallons per minute (gpm) during drought conditions and the reduction in cleanup time with the corresponding greater rate of mass removal in the Teledyne and Spectra-Physics on-site areas. The implementation of on-site groundwater extraction at Spectra-Physics provides the best balance of these two criteria. As more on-site groundwater extraction wells are brought on line, pumping rates will obviously be fine-tuned and optimized to minimize capturing clean water while maximizing the rate of chemical mass removal. This fine tuning process has been completed by Teledyne and Spectra-Physics in the more complex off-site system. With the greater rate of mass removal, groundwater pumping will have to occur over a shorter period of years so that the total cumulative volume of water pumped should be about the same, with no net increase in volume pumped over the lifetime of the project.

5) <u>Cost Effectiveness</u>

Spectra-Physics comments that the installation of on-site groundwater extraction wells at Spectra-Physics is not cost effective. The 30 year present worth cost of the Spectra-Physics cleanup without on-site groundwater extraction is $ 2.7 million. The 30 year present worth cost of the Spectra-Physics cleanup with on-site groundwater extraction ranges from $4.2 million to $4.8 million. This is an increase of between $1.5 million and $2.1 million. The increased costs are due to the increased capital and operating costs of the groundwater extraction system over a 30 year period. The range of the increase in costs is from calculations based on Teledyne and Spectra-Physics sharing a treatment system versus individual treatment systems for each company and from the different costs of disposal to the POTW or installing an on-site air stripping system.

Staff has evaluated the tradeoff between the increased costs of on-site groundwater extraction at Spectra-Physics and the reduction in cleanup times achieved and concludes that the on-site system at Spectra-Physics is warranted and cost-effective. For the alternative without on-site groundwater extraction, a $2.7 million 30 year cost equates to annual payments of $176,000 over a 30 year period using an interest rate of 5%. Similarly, for the alternative with on-site groundwater extraction, a 30 year cost of $4.2 to $4.8 million equates to annual payments of $273,000 to $312,000. This is an increase in annual payments of $97,000 to $136,000. Given the advantages of on-site pumping described above (i.e. more effective and faster cleanup) staff believes these additional costs are warranted. The costs that Spectra-Physics has calculated are typical costs for groundwater extraction and are well within costs of other similar South Bay sites. The 27 out of 28 other Superfund sites in the County with VOC pollution all have reached this same conclusion that on-site groundwater extraction is cost effective at their respective sites.

Summary

Based on the relatively poor performance of the existing interim remedial actions at Teledyne, the significant reduction in cleanup times provided by extraction wells at Spectra-Physics, the additional benefits to public health and the environment, the source control provided by extraction wells at Spectra-Physics, and the cost effectiveness of extraction wells at Spectra-Physics, staff recommends adoption of the Tentative Order requiring on-site groundwater extraction wells at Spectra-Physics.

EPA Comments

EPA commented for further clarification on several technical descriptions and wording changes that do not change the intent of the SCR. All of their comments except one have been incorporated into the SCR and EPA has identified the same remedies for the site that the Regional Board staff have proposed. EPA commented against the use of the word "reasonable" relative to cleanup times. Reasonable was left in the order but defined with respect to cleanup times estimated in the RI/FS.

Santa Clara Valley Water District

The Santa Clara Valley Water District concurs with the proposed cleanup plan.

City of Mountain View

The City of Mountain View comments are mainly wording changes to the SCR that do not change the intent of the SCR. All of the City's comments were incorporated into the SCR except their comment on finding 19 regarding responsibility for chemicals under the landfill. The existing finding 19 language more accurately describes the Regional Board's position that if corrective action is necessary beneath the landfill, the Board will determine who is responsible for the corrective action at the time the corrective action is determined to be necessary.

Whisman School District

The Whisman School District made one comment on the submittal date for a technical report. This comment was incorporated.

Teledyne and Spectra-Physics

Spectra-Physics commented individually on the requirement for on-site groundwater extraction. This issue is addressed separately above. Teledyne and Spectra-Physics commented jointly on other portions of the SCR. The comments are mainly minor wording changes to the SCR for clarification and accuracy that do not change the intent of the SCR. Most of their comments have been incorporated into the SCR.

Teledyne and Spectra-Physics asked that "cleanup standards" or "levels" be changed to "remedial goals". The request is based on the use of remedial goals at several locations in the National Contingency Plan (NCP). This change has not been incorporated based on:
1)EPA's November 7, 1990 letter to Steve Morse which states EPA does not accept the term "goal" in place of "standards" based on the use of "standards" in the NCP.
2)The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) refers to cleanup standards in Sec. 121.
3)Sec. 114 of CERCLA states CERCLA does not preempt a State from imposing additional requirements with respect to the release of hazardous substances. Pursuant to the California Water Code Section 13304 the State may require the cleanup and abatement of waste and in order to do this cleanup standards must be established.

Teledyne and Spectra-Physics requested that Permanente Creek monitoring be deleted. The self-monitoring plan requires semi-annual creek monitoring. In the November 26, 1986 Harding Lawson report entitled, "Further Investigation of Lateral Extent of Chemicals", Table 3 presents water levels in Permanente Creek and nearby wells. During a one month period, the creek fluctuated over a 2.07 foot range and well W4 fluctuated over a 0.60 foot range. The closest that the creek elevation came to the well W4 elevation is 0.82 feet, with the creek elevation always above the groundwater elevation. One page 19 of the text the report states, "However, these measurements were made during only one part of the annual cycle at the end of a long, dry spell, when water levels in the aquifer may have dropped below those in the creek." Due to the fluctuating level in both the creek and the groundwater and the limited data taken after a long dry spell that could have caused lowering in the groundwater elevation, staff believes semi-annual creek monitoring is warranted. This requirement could be reevaluated after several rounds of sampling.

RESPONSIVENESS SUMMARY ADDENDUM
TELEDYNE / SPECTRA-PHYSICS
FINAL SITE CLEANUP REQUIREMENTS
February 11, 1991

This responsiveness summary addendum contains the response to comments received from Board members during the Board meeting on January 16, 1991 and from Spectra-Physics and Teledyne after the Board meeting. Several of the Board members indicated they were not willing to adopt the Order requiring Spectra-Physics to install an on-site extraction system. One Board member indicated that a pilot study may be useful to determine the effectiveness of an on-site extraction system at Spectra-Physics. The Board continued the item until February to allow time for a pilot study to be considered and to try to develop further criteria to judge the performance of the current groundwater extraction system.

Staff met with the companies to evaluate a two year pilot study for groundwater extraction. The two year costs would have been in the range of $190,000 to $250,000. Additional criteria that was agreed to for evaluating the system include average concentration and percentage of mass in the respective captured areas. Because the mass of the plume at Spectra-Physics was calculated to be about 5% of the total plume mass, staff agreed to accept a two year review of the performance of the system and will reevaluate the requirement for on-site groundwater extraction at Spectra-Physics in November, 1993. Alternative No. 4 for Spectra-Physics was chosen based on available information. However, the Board is concerned that these on-site remedies may not be the most effective and expeditious cleanup remedies available. Therefore, the Board is requiring a two year review to evaluate the effectiveness of the selected remedies. November, 1993 was chosen as two years after the startup of the expanded soil vapor extraction system at Spectra-Physics.