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P & D ENVIRONMENTAL
A Division of Paul H. King, Inc.
4020 Panama Court
Oakland, CA 94611
(510) 658-6916

November 26, 2002
Work Plan 0047.W4

Mr. Scott Seery
Alameda County Department of Environmental Health
1131 Harbor Bay Parkway
Alameda, CA 94502

SUBJECT: CORRECTIVE ACTION PLAN
VIP Service
3889 Castro Valley Boulevard
Castro Valley, CA

Dear Mr. Seery:

P&D Environmental, a division of Paul H. King, Inc. (P&D), is pleased to present this corrective action plan (CAP) for cost-effective cleanup for the petroleum hydrocarbon contaminant plume in the vicinity of the subject site. The following three remedial technologies are considered:

- Excavation,
- Vapor Extraction
- Vapor Extraction in conjunction with air sparging and groundwater pumping.

Remedial action is required to reduce petroleum hydrocarbon soil vapor concentrations detected in soil during a soil gas survey adjacent to the slab-on-grade structure immediately adjacent to and down gradient of the subject site. The results of the most recent subsurface soil and groundwater investigation in the vicinity of the subject site identified an area of elevated benzene concentrations in groundwater immediately downgradient of the subject site, and an area of elevated benzene concentrations in shallow soil (at a depth of 4.0 feet below the ground surface) adjacent to the offsite slab-on-grade structure located immediately adjacent to and down gradient of the subject site.

This CAP is prepared in accordance with California Code of Regulations, Title 23, Division 3, Chapter 16, Article 11. The CAP addresses the following elements.

- An assessment of the impacts from the contaminants,
- Feasibility study, and
- Cleanup levels.

BACKGROUND

It is P&D's understanding that the subject site was purchased by VIP Service in December, 1984. Prior to purchase of the property by VIP Service, the site was operated as a retail gasoline station for an undetermined period of time. The site was operated as a retail gasoline station from the time of purchase by VIP Service until the tanks were removed by Accutite on April 26, 1993.

The site is presently operated as an automotive repair facility.

The subject site is currently paved, with one slab-on-grade structure which is used for automotive repair. The adjacent trailer park (located to the west and downgradient from the subject site) is predominantly paved, with the exception of several planters and trailer parking locations. One slab-on-grade structure is located on the adjacent trailer park, immediately adjacent to Castro Valley Boulevard.

The underground tank system at the subject site consisted of three 10,000 gallon capacity gasoline tanks, two dispenser islands, and one 550 gallon waste oil tank. It is P&D's understanding that the fuel tanks contained leaded and unleaded gasoline while in use by VIP Service. In addition, VIP Service reported that diesel fuel was not stored at the site at any time.

It is P&D's understanding that at the time of tank removal, eight soil samples were collected from the sidewalls of the fuel tank pit, and one soil sample was collected from the waste oil tank pit. Groundwater was reported to have been encountered in the fuel tank pit at a depth of approximately 11 feet. One water sample was collected from the water in the fuel tank pit. On April 28, 1993 Accutite returned to the site and collected seven soil samples from beneath the dispenser islands.

All of the samples were analyzed at Sequoia Analytical in Redwood City, California for Total Petroleum Hydrocarbons as Gasoline (TPH-G); Benzene, Toluene, Ethylbenzene and Xylenes (BTEX); and for Total Lead. In addition, the samples from the waste oil tank were analyzed for Total Petroleum Hydrocarbons as Diesel (TPH-D); Total Oil and Grease (TOG); Halogenated Volatile Organic Compounds using EPA Method 8010; Semi-Volatile Organic Compounds using EPA Method 8270; and for the metals cadmium, chromium, lead, nickel and zinc.

The results of the soil samples collected from the fuel tank pit showed TPH-G concentrations ranging from 120 to 6,200 parts per million (ppm), and total lead results ranging from not detected to 13 ppm. The results of the water sample from the fuel tank pit showed 140 ppm TPH-G, and 0.095 ppm total lead.

The results of the soil samples collected from beneath the fuel dispensers showed TPH-G values ranging from not detected to 4.7 ppm, and total lead values ranging from not detected to 7.6 ppm.

The results of the sample collected from the waste oil tank pit showed 670 ppm TPH-G; 410 ppm TPH-D; 1,300 ppm TOG; 0.023 ppm 1,2-Dichloroethane and 0.0094 ppm Tetrachloroethene in the EPA Method 8010 analysis; 2.7 ppm 2-Methylnapthalene and 3.8 ppm Naphthalene in the EPA Method 8270 analysis; and various metals concentrations, none of which exceeded ten times their respective STLC values. The laboratory identified the TPH-D results as being a "non-diesel mix," and indicated that the compounds reported as diesel were diesel-range gasoline and diesel-range oil compounds.

Between August 27 and November 1, 1993 P&D personnel collected stockpiled soil samples for stockpiled soil disposal characterization and oversaw the excavation of approximately 680 cubic yards of soil from the vicinity of the fuel tank pit in an effort to remove petroleum hydrocarbon-impacted soil. In addition, during this time the soil which was stockpiled by Accutite during the tank removal activities and during the subsequent soil excavation activities was disposed of at an appropriate disposal facility, and the tank pit backfilled and compacted. A total of eight confirmation soil samples were collected from the sidewalls of the tank pit on November 19, 1993 at a depth of 10 feet after over-excavation and prior to backfilling. The analytical results of the samples ranged from 33 to 3,200 ppm TPH-G. The sample collection locations are shown on the attached Site Plan, Figure 3, and the sample results are summarized in Table 1, attached. Documentation of excavation, stockpiled soil characterization and disposal, and backfilling of the pit are provided in P&D's report 0047.R1 dated January 24, 1994. The sample results associated with the removal of the tanks by Accutite are also summarized in P&D's report 0047.R1.

On November 10, 1993 P&D personnel oversaw the installation of three groundwater monitoring wells, designated as MW1 through MW3, and one exploratory soil boring, designated as B1, at the subject site. The wells were developed on November 12 and sampled on November 16, 1993. The results of the water samples showed that TPH-G was not detected in wells MW1 and MW2, and that BTEX was not detected in MW2. In well MW1, 0.0022 ppm of benzene was detected. In well MW3, TPH-G was detected at 12 ppm; benzene was detected at 3.3 ppm; TRPH was not detected; EPA Method 8010 compounds were not detected except for 0.027 ppm 1,2-Dichloroethane; and EPA Method 8270 compounds were not detected except for 0.009 ppm Phenol, 0.006 ppm Benzyl Alcohol, 0.006 2-Methylphenol, 0.007 ppm 2,4-Dimethylphenol, 0.088 ppm Benzoic Acid, 0.042 ppm Naphthalene, and 0.015 2-Methylnapthalene.

Documentation of the monitoring well and soil boring installation and associated sample results are presented in P&D's report 0047.R2 dated January 24, 1994. The locations of the monitoring wells are shown in Figure 2.

In response to a letter dated March 18, 1994 from Mr. Scott Seery of the ACDEH addressed to VIP Service which commented upon the results of the initial groundwater sampling associated with the installation of the monitoring wells, a quarterly groundwater monitoring and sampling program was initiated.

On June 9, 1995, P&D personnel hand augered 5 offsite exploratory boreholes designated as boreholes P1 through P5 in the downgradient direction from the subject site. The locations of the soil borings are shown in Figure 2. The results of the groundwater grab samples showed that no gasoline or BTEX were detected in borehole P4. Gasoline and BTEX were detected in boreholes P1, P2, P3 and P5. Documentation of the soil boring installation and associated sample results are presented in P&D's report 0047.R8 dated July 14, 1995. Based upon the sample results, Mr. Scott Seery of the ACDEH requested that further investigation be performed.

On November 17, 1995, P&D personnel hand augered 5 offsite exploratory boreholes designated as boreholes P6 through P10 for the collection of groundwater grab samples. The locations of the soil borings are shown in Figure 2. The results of the groundwater grab samples showed that no gasoline or BTEX were detected in boreholes P6, P8, and P10. Gasoline and BTEX were detected in boreholes P7, and P9. Documentation of the soil boring installation and associated sample results are presented in P&D's report 0047.R11 dated December 27, 1995. Based upon the sample results, Mr. Scott Seery of the ACDEH requested in a letter dated January 10, 1996 that further investigation be performed.

On August 8 and 9, 1996, P&D personnel hand augered 5 offsite exploratory boreholes designated as boreholes P11 through P15 for the collection of groundwater grab samples. The locations of the soil borings are shown in Figure 2. The results of the groundwater grab samples showed that no gasoline or BTEX were detected in boreholes P11, P13, P14, and P15. Gasoline was detected in borehole P12. Documentation of the soil boring installation and associated sample results are presented in P&D's report 0047.R15 dated October 9, 1996.

Based upon the sample results, Mr. Scott Seery of the ACDEH met with Mr. Patel of VIP Service and Paul king of P&D Environmental on November 8, 1996 to discuss corrective actions. In a letter dated November 8, 1996 Mr. Seery requested that a risk-based corrective action evaluation to be performed and that an underground utility survey be performed to identify utility trenches which could be potential conduits for petroleum hydrocarbon vapors.

On February 7, 2001 Mr. Scott Seery of the ACDEH, Mr. Chuck Headlee of the Regional Water Quality Control Board, San Francisco Bay Region, and Mr. Paul King of P&D met at the ACDEH offices. During the meeting, it was agreed that additional soil and groundwater grab samples would be collected to increase the density of information available for delineation of petroleum hydrocarbons in soil and groundwater in the immediate vicinity of the site. In a letter dated April 16, 2001 Mr. Seery requested a work plan for additional subsurface investigation.

P&D's Subsurface Investigation Work Plan (Work Plan 0047.W3, dated June 1, 2001) was subsequently approved in a letter from the ACDEH. Documentation of the drilling of 12 exploratory borings, designated as P16 through P27, for the collection of soil and groundwater grab samples in the vicinity of the subject site was provided in P&D's Subsurface Investigation Report (P16 – P27) dated July 2, 2002 (P&D Report 0047.R28).

Figures 1, 2, 3, 8, 9, 11, 14, and 15 from the most recent Subsurface Investigation Report are attached with this report. The figures show benzene concentrations on site plans and geologic cross sections in the immediate vicinity of the site.

In a letter dated September 4, 2002, the ACDEH requested a Corrective Action Plan for cost-effective cleanup objectives for the entire contaminant plume.

ASSESSMENT OF IMPACTS

In accordance with CAP requirements, the following elements are addressed for an assessment of impact from the contaminants.

- Physical and chemical characteristics of the contaminants,
- Hydrogeologic characteristics of the site and surrounding area,
- The proximity and quality of nearby surface water or groundwater, and the potential beneficial uses of these waters,
- The potential effects of residual contamination on nearby surface water and groundwater.

Physical and Chemical Characteristics

The contaminants of concern (COCs) are petroleum hydrocarbons (gasoline). The components of gasoline that are addressed in this CAP are as follows.

- Methyl t-Butyl Ether (MTBE)
- Benzene,
- Toluene,
- Ethylbenzene,
- Xylenes

Physical Characteristics

The physical characteristics of the COCs are summarized in Appendix A.

Toxicity

The toxic characteristics of the COCs are summarized in Appendix A.

Persistence

The characteristics associated with persistence of the COCs are summarized in Appendix A.

Potential For Migration

The characteristics associated with the potential for migration of the COCs are summarized in Appendix A.

Hydrogeologic Characteristics

Review of soil boring logs and geologic cross sections for the site shows that in general, the site is underlain by fine-grained material (clay and silty clay), which is in turn underlain by coarse-grained material (silty sand or sand) at a depth of approximately 8 to 14 feet below the ground surface. The depth at which the sand layer is encountered generally appears to become shallower in the westward direction. This sand layer is interpreted to be continuous beneath the subject site and the area of the offsite groundwater quality investigation.

Based upon review of the historical quarterly groundwater monitoring data for the subject site, the groundwater flow direction at the subject site has historically been predominantly westerly, with little change in the flow direction. Groundwater was first encountered in boreholes during subsurface investigations at depths ranging from 7.5 to 12.0 feet below the ground surface. Historically, the measured depth to water in the three monitoring wells at the subject site has ranged from approximately from 6 to 10 feet below the ground surface.

Proximity and Beneficial Uses of Surface and Groundwater

Review of the US Geological Survey 7.5 Minute Hayward, Calif quadrangle dated 1959 (photorevised 1980) shows surface water bodies in the vicinity of the site as follows. A copy of the map is attached as Figure 1.

- Crow Creek (located 2,200 feet to the east of the subject site),
- San Lorenzo Creek (located 2,500 feet to the east and southeast of the subject site),
- Unnamed tributary to San Lorenzo Creek (located 1,000 feet to the west of the subject site),

All of the creeks trend in a north-south direction in the vicinity of the site. Review of the June 21, 1995 San Francisco Bay Basin (Region 2) Water Quality Control Plan (the Basin Plan) identified potential beneficial uses of these surface water bodies as follows.

- Crow Creek:
  - See San Lorenzo Creek
- San Lorenzo Creek:
  - Cold freshwater habitat,
  - Freshwater replenishment,
  - Groundwater recharge,
  - Fish migration,
  - Municipal and domestic supply,
  - Water contact recreation,
  - Noncontact water recreation,
  - Fish spawning,
  - Warm freshwater habitat,

  - Wildlife habitat.
- Unnamed tributary to San Lorenzo Creek:
  - See San Lorenzo Creek.

As discussed in the hydrogeologic characteristics section above, groundwater is encountered at depths ranging from 6 to 10 feet below the ground surface at and near the site. Review of the Basin Plan identified potential beneficial uses of the groundwater at and near the site as follows.

- Agricultural supply,
- Industrial service supply,
- Municipal and domestic supply, and
- Industrial process supply.

A detailed explanation and discussion of each of the beneficial uses is provided in Appendix B.

Potential Effects of Residual Contamination

The maximum extent of the petroleum hydrocarbon groundwater plume is approximately 300 feet from the downgradient side of the site (see Figure 2). Based on the distance of the surface water bodies from the site (Figure 1), it is not anticipated that residual contamination will affect surface water quality. In addition to the contaminant plume not having extended to any of the surface water bodies, the bed of the unnamed tributary to San Lorenzo Creek located to the west of the subject site is lined with concrete in the general vicinity of the site.

Based on the known land use in the vicinity of the site, it does not appear that groundwater within or near the petroleum hydrocarbon contaminant plume is used for any of the potential beneficial uses identified in the Basin Plan. Domestic water supply in the vicinity of the site is obtained through a municipal provider. No known municipal water supplies are located within the vicinity of the petroleum hydrocarbon contaminant plume. Residual groundwater contamination at and near the site may result in petroleum hydrocarbon exposure to sensitive receptors (humans) if groundwater is used from within the groundwater contaminant plume.

FEASIBILITY STUDY

Review of Figure 8 shows that elevated benzene concentrations are encountered in soil at a depth of 4.0 feet at borehole P26. Review of Figure 11 shows that benzene concentrations in groundwater exceeding 10 ppm are located in an area immediately west of the site. The area of elevated groundwater benzene concentrations corresponds to elevated benzene, toluene, ethylbenzene and xylenes (BTEX) concentrations. Review of Figures 14 and 15 show that elevated benzene concentrations have migrated vertically upward a limited distance from the underlying sand layer. The remedial objectives are to reduce BTEX concentrations to below an acceptable Risk Based Screening Level (RBSL) for sensitive receptors located at the slab-on-grade structure immediately downgradient of the subject site.

Evaluation of effectiveness and limitations of remedial technologies to abate petroleum hydrocarbons in both soil and groundwater at and near the subject site is provided below. This evaluation assumes that reduction of BTEX concentrations in soil at a depth of 4.0 feet in the vicinity of borehole P26 and reduction of elevated groundwater BTEX concentrations immediately downgradient of the subject site (within the 10 ppm groundwater benzene contour as shown on Figure 11) will be adequate to affect the desired remedial objectives. The reduction of groundwater BTEX concentrations is desired to eliminate the BTEX in the groundwater as an on-going source for soil contamination.

The area within the 10 ppm benzene contour on Figure 11 can be approximated as an area 40 feet wide and extending 100 feet in a southerly direction from the curb on Castro Valley Boulevard. Remedial action should be effected to a depth of approximately 14 feet, corresponding to the base of the sand layer that appears to be continuous throughout the affected area.

Excavation

The proposed area for remediation corresponds to the only entrance to the trailer park located adjacent to the subject site. Although excavation may effectively remove contamination quickly, the following mitigating circumstances make excavation not feasible.

- Buried PG&E utility mains enter the site within the area of remediation.
- Two existing mobile homes are located within the area of remediation and would need to be re-located.
- The facility manager has identified unlimited and unimpeded access to emergency vehicles as a requirement for elderly residents located at the facility. Excavation would eliminate the only access to the site.

Vapor Extraction

Vapor extraction of the proposed affected area (if feasible) would allow remediation to occur without the disruptions to site services and site access associated with excavation. Limitations associated with vapor extraction include the following.

- Silty clay in the vicinity of borehole P21 may be too impermeable for adequate flow associated with vapor extraction.
- The water table makes access to the sand layer that is interpreted to be continuous beneath the affected area not feasible with vapor extraction alone.

Vapor Extraction, Air Sparging and Groundwater Pumping

In addition to the absence of disruptions to site services and site access, the addition of groundwater pumping may enhance remedial effectiveness by reducing the water table in the sand

layer to facilitate vapor extraction of petroleum hydrocarbons from the sand layer. Air sparging in the sand layer in the vicinity of the locations where groundwater pumping and vapor extraction are performed may enhance the biodegradation of petroleum hydrocarbons and volatilization of petroleum hydrocarbons into the areas of vapor extraction. Limitations associated with this remedial alternative include the following.

- Limitations identified for vapor extraction, above.

CLEANUP LEVELS

The Basin Plan states that the following parameters have water quality objectives that apply to all surface waters within the region.

- Bacteria
- Bioaccumulation
- Biostimulatory
- Color
- Dissolved Oxygen
- Floating Material
- Oil and Grease
- Population and Community Ecology
- PH
- Salinity
- Sediment
- Settleable Material
- Suspended Material
- Sulfide
- Tastes and odors
- Temperature
- Toxicity
- Tubidity
- Un-ionized ammonia
- Objectives for specific chemical constituents
- Constituents of concern for municipal and agricultural water supplies
- Radioactivity

Similarly, parameters with water quality objectives for groundwater are as follows.

- Bacteria
- Organic and inorganic constituents
- Radioactivity
- Taste and odor

The specific limits for each parameter are summarized in tables in Appendix C. As discussed above, it is not anticipated that surface water will be affected by the petroleum hydrocarbon plume. Review of the list of parameters for groundwater water quality objectives shows that the two applicable parameters are as follows.

- Organic and inorganic constituents
- Taste and odor

Review of Table 3.5 in Appendix C identifies water quality objectives for municipal supply (in mg/L) as follows.

- Benzene 0.001
- Toluene 0.15
- Ethylbenzene 0.7
- Xylenes 1.75
- Odor 3.0

The water quality objectives for benzene, toluene, ehtylbenzene and xylenes correspond to Maximum Contaminant Levels (MCLs) as specified in the California Code of Regulations, and the water quality objective for odor corresponds to the secondary MCL in the California Code of Regulations.

DISCUSSION AND RECOMMENDATIONS

Beneficial uses of surface water and groundwater that may be impacted by the petroleum hydrocarbon groundwater plume at and near the subject site appear to be limited to groundwater. Review of applicable water quality objectives shows that the applicable parameters are benzene, toluene, ethylbenzene, xylenes and odor. The water quality objectives for these parameters for municipal supply correspond with the respective MCLs for these parameters (in addition to the secondary MCL for odor). However, it does not appear that municipal water supplies will be affected by the petroleum hydrocarbon plume.

P&D recommends that elevated BTEX concentrations in soil at a depth of 4.0 feet in the vicinity of borehole P26 and elevated groundwater BTEX concentrations immediately downgradient of the subject site (within the 10 ppm groundwater benzene contour as shown on Figure 11) be reduced to below an acceptable RBSL for sensitive receptors located at the slab-on-grade structure immediately downgradient of the subject site.

P&D recommends that vapor extraction probes and air sparging probes be installed within the area defined by the 10 ppm benzene groundwater plume and that a vapor extraction and air sparging feasibility study be performed.

Should you have any questions, please do not hesitate to contact us at (510) 658-6916.

Sincerely,

P&D Environmental

Paul H. King
President
California Registered Geologist
Registration No. : 5901
Expires: 12/31/03

Attachments:
Site Location Map (Figure 1)
Site Vicinity Map (Figure 2)
Site Vicinity Map Showing Previous Investigation Borehole Locations (Figure 3)
Site Vicinity Map Showing Benzene in Soil at 4.0 Foot Depth (Figure 8)
Site Vicinity Map Showing Benzene in Groundwater (Figure 11)
Geologic Cross Sections A-A', B-B', C-C' Benzene Isoconcentration Contrours (Figure 14)
Geologic Cross Sections D-D', E-E', F-F' Benzene Isoconcentration Contrours (Figure 15)
Appendix A
Appendix B
Appendix C

cc: Mr. Lalji Patel & Mr. Pawan Gupta, VIP Service

PHK
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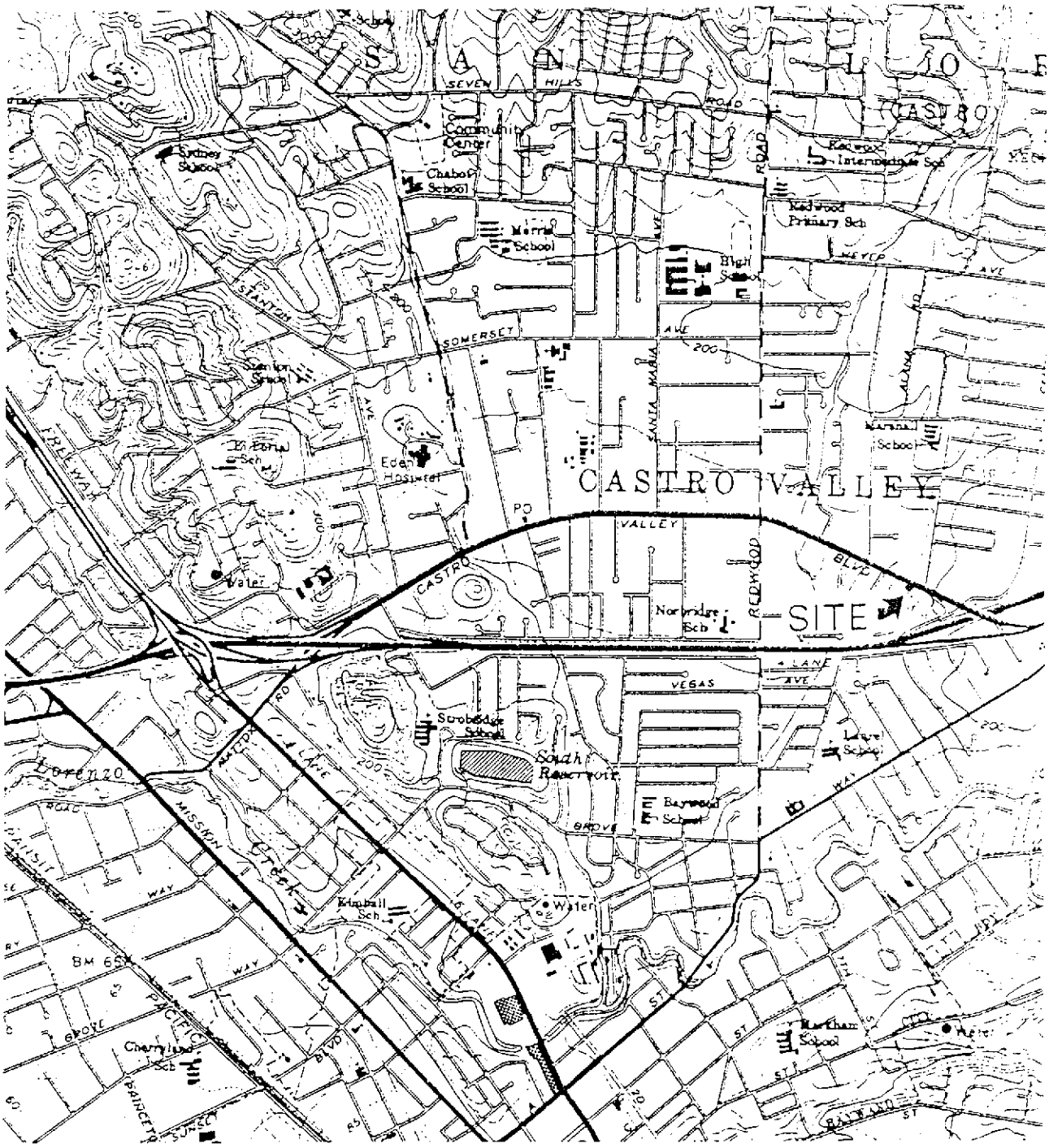


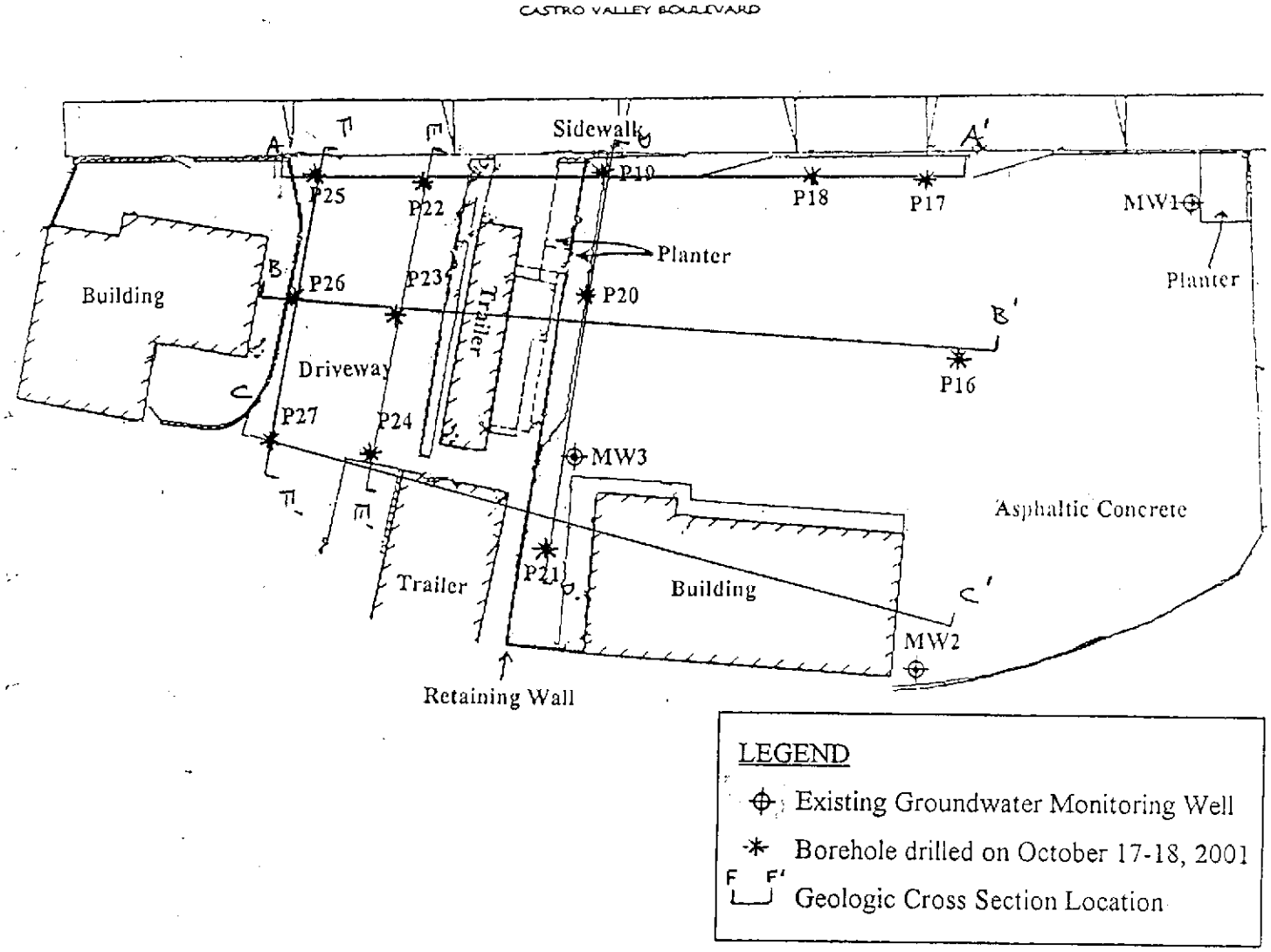
Base Map From
U.S. Geological Survey
Hayward, Calif.
7.5 Minute Quadrangle
Photorevised 1980

N

Scale in Feet
0 1000 2000 3000

Figure 1
SITE LOCATION MAP
VIP Service
3889 Castro Valley Blvd.
Castro Valley, California

P & D ENVIRONMENTAL
A Division of Paul H. King, Inc.
4020 Panama Court
Oakland, CA 94611
(510) 658-6916



LEGEND

- Existing Groundwater Monitoring Well
- Borehole drilled on October 17-18, 2001
- F F' Geologic Cross Section Location

North

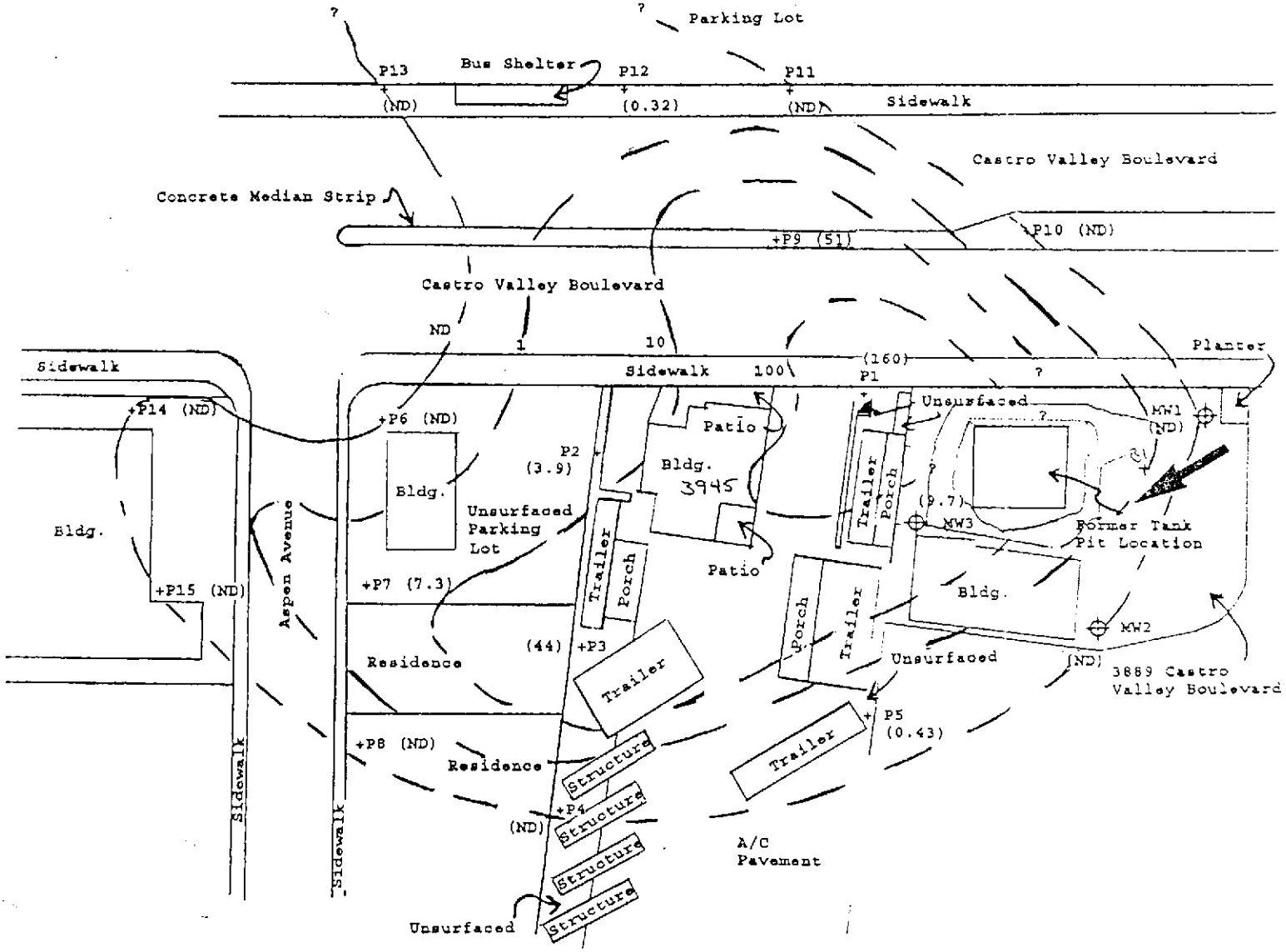
0 30 60

Scale in Feet

Base Map From
Kier & Wright
Pleasanton, CA
October 2001

Figure 2
Site Vicinity Map
VIP Service
3889 Castro Valley Blvd.
Castro Valley, CA

P & D Environmental
A Division of Paul H. King, Inc.
4020 Panama Court
Oakland, CA 94611
(510) 658-6916



LEGEND

(9.7) ⊕ Existing Groundwater Monitoring Well and TPH-Gasoline Concentration in ppm on April 23, 1996.

(160) + Groundwater Grab Sample Collection Location and TPH-Gasoline Concentration on June 9, 1995 (P1-P5), November 17, 1995 (P6-P10), and August 8 and 9, 1996 (P11-P15)

Groundwater Isoconcentration Contour for TPH-Gasoline in ppm

Groundwater Flow Direction on April 23, 1996

North

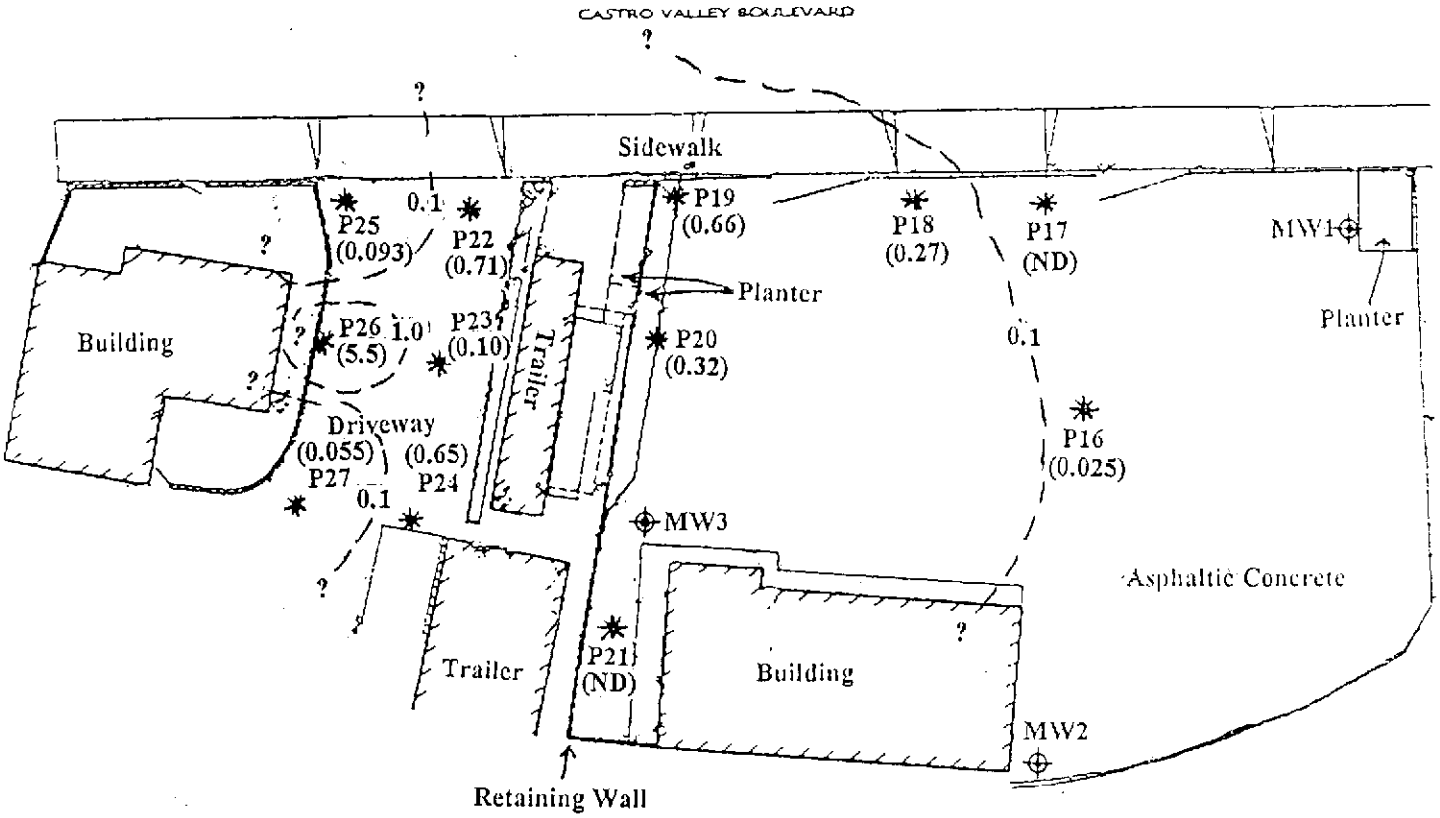
0 30 60

Scale in Feet

Base Map From
P&D Environmental
October, 1993
January, 1995
June, 1995
Prepared Using a
Rolatape

Figure 3
SITE VICINITY MAP
VIP Service
3889 Castro Valley Blvd.
Castro Valley, California

P & D ENVIRONMENTAL
A Division of Paul H. King, Inc.
4020 Panama Court
Oakland, CA 94611
(510) 658-6916



LEGEND

- ⊕ Existing Groundwater Monitoring Well
- ✳ (0.27) Soil Sample Collection Location and Benzene Concentration in ppm at 4.0 foot depth on October 17-18, 2001
- Soil Isoconcentration Contour for Benzene in ppm

North

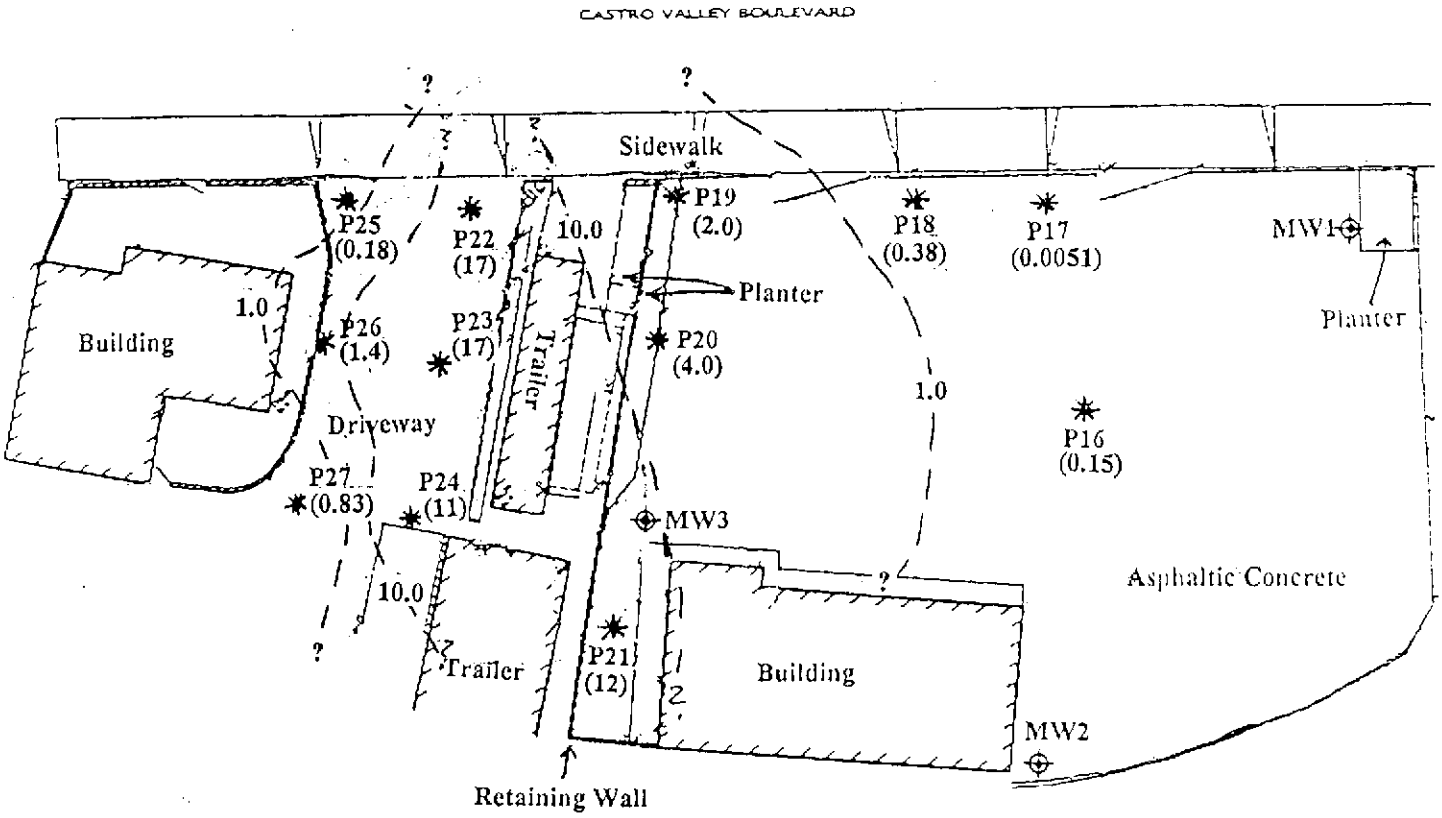
0 30 60

Scale in Feet

Base Map From
Kier & Wright
Pleasanton, CA
October 2001

Figure 8
BENZENE IN SOIL AT
4.0 FOOT DEPTH
VIP Service
3889 Castro Valley Blvd.
Castro Valley, CA

P & D Environmental
A Division of Paul H. King, Inc.
4020 Panama Court
Oakland, CA 94611
(510) 658-6916



LEGEND

- Existing Groundwater Monitoring Well
- Groundwater Grab Sample Collection Location and Benzene Concentration in ppm on October 17-18, 2001
- Groundwater Isoconcentration Contour for Benzene in ppm

North

0 30 60

Scale in Feet

Base Map From
Kier & Wright
Pleasanton, CA
October 2001

Figure 11
BENZENE IN GROUNDWATER
VIP Service
3889 Castro Valley Blvd.
Castro Valley, CA

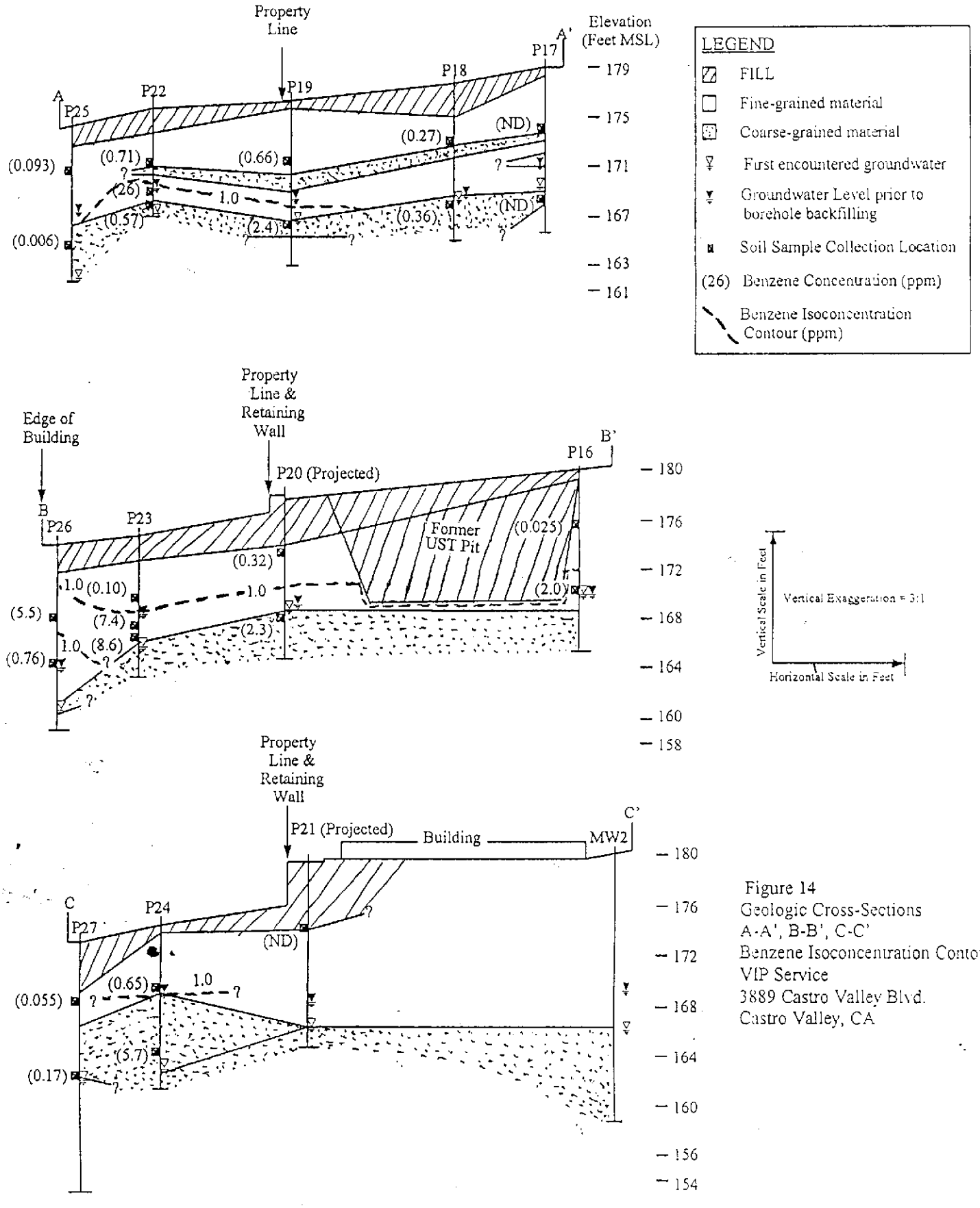
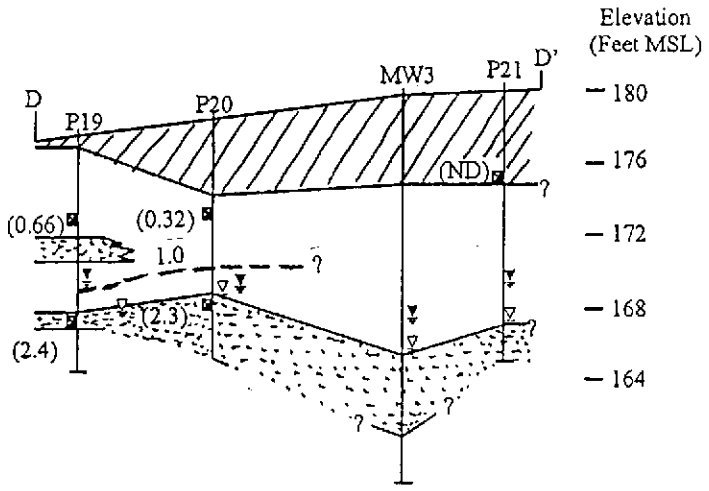
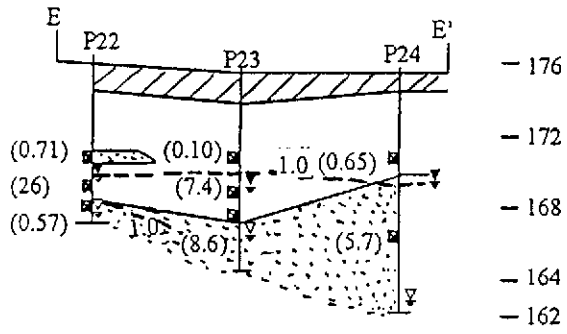


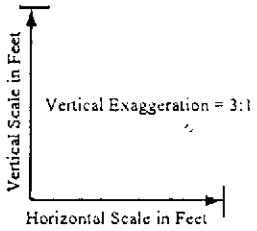
Figure 14
Geologic Cross-Sections
A-A', B-B', C-C'
Benzene Isoconcentration Contours
VIP Service
3889 Castro Valley Blvd.
Castro Valley, CA



LEGEND

- FILL
- Fine-grained material
- Coarse-grained material
- First encountered groundwater
- Groundwater Level prior to borehole backfilling
- Soil Sample Collection Location
- (26) Benzene Concentration (ppm)
- Benzene Isoconcentration Contour (ppm)





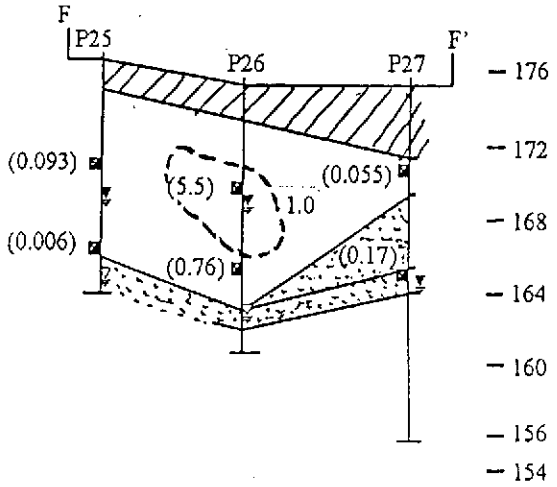


Figure 15
Geologic Cross-Sections
D-D', E-E', F-F'
Benzene Isoconcentration Contours
VIP Service
3889 Castro Valley Blvd.
Castro Valley, CA

APPENDIX A

PHYSICAL AND CHEMICAL PARAMETERS

RBCA CHEMICAL DATABASE

Toxicity Data

CAS Number	Constituent	Reference Dose (mg/kg/day) Oral RfD_oral	ref	Inhalation RfD_inhal	ref	Slope Factors 1/(mg/kg/day) Oral SF_oral	ref	Inhalation SF_inhal	ref	EPA Weight of Evidence	Is Constituent Carcinogenic ?
71-43-2	Benzene	-		1.70E-03	R	2.90E-02	A	2.90E-02	A	A	TRUE
100-41-4	Ethylbenzene	1.00E-01	A	2.86E-01	A	-		-		D	FALSE
1634-04-4	Methyl t-Butyl Ether	5.00E-03	R	8.57E-01	R	-		-			FALSE
108-88-3	Toluene	2.00E-01	A,R	1.14E-01	A,R	-		-		D	FALSE
1330-20-7	Xylene (mixed isomers)	2.00E+00	A,R	2.00E+00	A	-		-		D	FALSE

RBCA CHEMICAL DATABASE

Physical Property Data

CAS Number	Constituent	type	Molecular Weight (g/mole) MW	ref	Diffusion Coefficients in air (cm2/s) Dair	ref	in water (cm2/s) Dwat	ref	log (Koc) or log(Kd) (@ 20 - 25 C) log(l/kg)	ref	Henry's Law Constant (@ 20 - 25 C) (atm-m3) mol	(unitless)	ref	Vapor Pressure (@ 20 - 25 C) (mm Hg)	ref	Solubility (@ 20 - 25 C) (mg/L)	ref	acid pKa	base pKb	ref
71-43-2	Benzene	A	78.1	5	9.30E-02	A	1.10E-05	A	1.58	A	5.29E-03	2.20E-01	A	9.52E+01	4	1.75E+03	A			
100-41-4	Ethylbenzene	A	106.2	5	7.60E-02	A	8.50E-06	A	1.98	A	7.69E-03	3.20E-01	A	1.00E+01	4	1.52E+02	5			
1634-04-4	Methyl t-Butyl Ether	O	88.146	5	7.92E-02	6	9.41E-05	7	1.08	A	5.77E-04	2.40E-02		2.49E+02		4.80E+04	A			
108-88-3	Toluene	A	92.4	5	8.50E-02	A	9.40E-06	A	2.13	A	6.25E-03	2.60E-01	A	3.00E+01	4	5.15E+02	29			
1330-20-7	Xylene (mixed isomers)	A	106.2	5	7.20E-02	A	8.50E-06	A	2.38	A	6.97E-03	2.90E-01	A	7.00E+00	4	1.98E+02	5			

RBCA CHEMICAL DATABASE

Miscellaneous Chemical Data

CAS Number	Constituent	Maximum Contaminant Level MCL (mg/L)	reference	Permissible Exposure Limit PEL/TLV (mg/m3)	ref	Relative Absorption Factors Oral	Dermal	Detection Limits Groundwater (mg/L)	ref	Soil (mg/kg)	ref	Half Life (First-Order Decay) (days) Saturated	Unsaturated	ref
71-43-2	Benzene	5.00E-03	52 FR 25690	3.20E+00	OSHA	1	0.5	0.002	C	0.005	S	720	720	H
100-41-4	Ethylbenzene	7.00E-01	56 FR 3526 (30 Jan 91)	4.34E+02	ACGIH	1	0.5	0.002	C	0.005	S	228	228	H
1634-04-4	Methyl t-Butyl Ether			1.44E+02	ACGIH	1	0.5					360	180	H
108-88-3	Toluene	1.00E+00	56 FR 3526 (30 Jan 91)	1.47E+02	ACGIH	1	0.5	0.002	C	0.005	S	28	28	H
1330-20-7	Xylene (mixed isomers)	1.00E+01	56 FR 3526 (30 Jan 91)	4.34E+02	ACGIH	1	0.5	0.005	C	0.005	S	360	360	H

2 BENEFICIAL USES

INTRODUCTION

State policy for water quality control in California is directed toward achieving the highest water quality consistent with maximum benefit to the people of the state. Aquatic ecosystems and underground aquifers provide many different benefits to the people of the state. The beneficial uses described in detail in this chapter define the resources, services, and qualities of these aquatic systems that are the ultimate goals of protecting and achieving high water quality. The Regional Board is charged with protecting all these uses from pollution and nuisance that may occur as a result of waste discharges in the region. Beneficial uses of surface waters, groundwaters, marshes, and mudflats presented here serve as a basis for establishing water quality objectives and discharge prohibitions to attain this goal.

DEFINITIONS OF BENEFICIAL USES

The following definitions (in *italic*) for beneficial uses are applicable throughout the entire state. A brief description of the most important water quality requirements for each beneficial use follows each definition (in alphabetical order by abbreviation).

(AGR) AGRICULTURAL SUPPLY

Uses of water for farming, horticulture, or ranching, including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.

The criteria discussed under municipal and domestic water supply (MUN) also effectively protect farmstead uses. To establish water quality criteria for livestock water supply, the Regional Board must consider the relationship of water to the total diet, including water freely drunk, moisture content of feed, and interactions between irrigation water quality and feed quality. The University of California Cooperative Extension has developed threshold and limiting concentrations for livestock and irrigation water.

Continued irrigation often leads to one or more of four types of hazards related to water quality and the nature of soils and crops. These hazards are (1) soluble salt accumulations, (2) chemical changes in the soil, (3) toxicity to crops, and (4) potential disease transmission to humans through reclaimed water use. Irrigation water classification systems, arable soil classification systems, and public health criteria related to reuse of wastewater have been developed with consideration given to these hazards.

(ASBS) AREAS OF SPECIAL BIOLOGICAL SIGNIFICANCE

Areas designated by the State Water Resources Control Board.

These include marine life refuges, ecological reserves, and designated areas where the preservation and enhancement of natural resources requires special protection. In these areas, alteration of natural water quality is undesirable. The areas that have been designated as ASBS in this region are depicted in Figure 2-1. The State Ocean Plan (see Chapter 5) requires wastes to be discharged at a sufficient distance from these areas to assure maintenance of natural water quality conditions.

(COLD) COLD FRESHWATER HABITAT

Uses of water that support cold water ecosystems, including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Cold freshwater habitats generally support trout and may support the anadromous salmon and steelhead fisheries as well. Cold water habitats are commonly well-oxygenated. Life within these waters is relatively intolerant to environmental stresses. Often, soft waters feed cold water habitats. These waters render fish more susceptible to toxic metals, such as copper, because of their lower buffering capacity.

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(COMM) OCEAN, COMMERCIAL, AND SPORT FISHING

Uses of water for commercial or recreational collection of fish, shellfish, or other organisms in oceans, bays, and estuaries, including, but not limited to, uses involving organisms intended for human consumption or bait purposes.

To maintain ocean fishing, the aquatic life habitats where fish reproduce and seek their food must be protected. Habitat protection is under descriptions of other beneficial uses.

(EST) ESTUARINE HABITAT

Uses of water that support estuarine ecosystems, including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds), and the propagation, sustenance, and migration of estuarine organisms.

Estuarine habitat provides an essential and unique habitat that serves to acclimate anadromous fishes (salmon, striped bass) migrating into fresh or marine water conditions. The protection of estuarine habitat is contingent upon (1) the maintenance of adequate Delta outflow to provide mixing and salinity control; and (2) provisions to protect wildlife habitat associated with marshlands and the Bay periphery (i.e., prevention of fill activities). Estuarine habitat is generally associated with moderate seasonal fluctuations in dissolved oxygen, pH, and temperature and with a wide range in turbidity.

(FRSH) FRESHWATER REPLENISHMENT

Uses of water for natural or artificial maintenance of surface water quantity or quality.

(GWR) GROUNDWATER RECHARGE

Uses of water for natural or artificial recharge of groundwater for purposes of future extraction, maintenance of water quality, or halting saltwater intrusion into freshwater aquifers.

The requirements for groundwater recharge operations generally reflect the future use to be made of the water stored underground. In some cases, recharge operations may be conducted to prevent seawater intrusion. In these cases, the quality of recharged waters may not directly affect quality at the wellfield being protected. Recharge operations are often limited by excessive suspended sediment or turbidity that can clog the surface of recharge pits, basins, or wells.

Under the state Antidegradation Policy, the quality of some of the waters of the state is higher than established by adopted policies. It is the intent of this policy to maintain that existing higher quality to the maximum extent possible.

Requirements for groundwater recharge, therefore, shall impose the Best Available Technology (BAT) or Best Management Practices (BMPs) for control of the discharge as necessary to assure the highest quality consistent with maximum benefit to the people of the state. Additionally, it must be recognized that groundwater recharge occurs naturally in many areas from streams and reservoirs. This recharge may have little impact on the quality of groundwaters under normal circumstances, but it may act to transport pollutants from the recharging water body to the groundwater. Therefore, groundwater recharge must be considered when requirements are established.

(IND) INDUSTRIAL SERVICE SUPPLY

Uses of water for industrial activities that do not depend primarily on water quality, including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, and oil well repressurization.

Most industrial service supplies have essentially no water quality limitations except for gross constraints, such as freedom from unusual debris.

(MAR) MARINE HABITAT

Uses of water that support marine ecosystems, including, but not limited to, preservation or enhancement of marine habitats, vegetation such as kelp, fish, shellfish, or wildlife (e.g., marine mammals, shorebirds).

In many cases, the protection of marine habitat will be accomplished by measures that protect wildlife habitat generally, but more stringent criteria may be necessary for waterfowl marshes and other habitats, such as those for shellfish and marine fishes. Some marine habitats, such as important intertidal zones and kelp beds, may require special protection.

(MIGR) FISH MIGRATION

Uses of water that support habitats necessary for migration, acclimatization between fresh water and salt water, and protection of aquatic organisms that are temporary inhabitants of waters within the region.

The water quality provisions acceptable to cold water fish generally protect anadromous

fish as well. However, particular attention must be paid to maintaining zones of passage. Any barrier to migration or free movement of migratory fish is harmful. Natural tidal movement in estuaries and unimpeded river flows are necessary to sustain migratory fish and their offspring. A water quality barrier, whether thermal, physical, or chemical, can destroy the integrity of the migration route and lead to the rapid decline of dependent fisheries.

Water quality may vary through a zone of passage as a result of natural or human-induced activities. Fresh water entering estuaries may float on the surface of the denser salt water or hug one shore as a result of density differences related to water temperature, salinity, or suspended matter.

(MUN) MUNICIPAL AND DOMESTIC SUPPLY

Uses of water for community, military, or individual water supply systems, including, but not limited to, drinking water supply.

The principal issues involving municipal water supply quality are (1) protection of public health; (2) aesthetic acceptability of the water; and (3) the economic impacts associated with treatment- or quality-related damages.

The health aspects broadly relate to: direct disease transmission, such as the possibility of contracting typhoid fever or cholera from contaminated water; toxic effects, such as links between nitrate and methemoglobinemia (blue babies); and increased susceptibility to disease, such as links between halogenated organic compounds and cancer.

Aesthetic acceptance varies widely depending on the nature of the supply source to which people have become accustomed. However, the parameters of general concern are excessive hardness, unpleasant odor or taste, turbidity, and color. In each case, treatment can improve acceptability although its cost may not be economically justified when alternative water supply sources of suitable quality are available.

Published water quality objectives give limits for known health-related constituents and most properties affecting public acceptance. These objectives for drinking water include the U.S. Environmental Protection Agency Drinking Water Standards and the California State Department of Health Services criteria.

(NAV) NAVIGATION

Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.

(PRO) INDUSTRIAL PROCESS SUPPLY

Uses of water for industrial activities that depend primarily on water quality.

Water quality requirements differ widely for the many industrial processes in use today. So many specific industrial processes exist with differing water quality requirements that no meaningful criteria can be established generally for quality of raw water supplies. Fortunately, this is not a serious shortcoming, since current water treatment technology can create desired product waters tailored for specific uses.

(RARE) PRESERVATION OF RARE AND ENDANGERED SPECIES

Uses of waters that support habitats necessary for the survival and successful maintenance of plant or animal species established under state and/or federal law as rare, threatened, or endangered.

The water quality criteria to be achieved that would encourage development and protection of rare and endangered species should be the same as those for protection of fish and wildlife habitats generally. However, where rare or endangered species exist, special control requirements may be necessary to assure attainment and maintenance of particular quality criteria, which may vary slightly with the environmental needs of each particular species. Criteria for species using areas of special biological significance should likewise be derived from the general criteria for the habitat types involved, with special management diligence given where required.

(REC1) WATER CONTACT RECREATION

Uses of water for recreational activities involving body contact with water where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, whitewater activities, fishing, and uses of natural hot springs.

Water contact implies a risk of waterborne disease transmission and involves human health; accordingly, criteria required to protect this use are more stringent than those for more casual water-oriented recreation.

Excessive algal growth has reduced the value of shoreline recreation areas in some cases, particularly for swimming. Where algal growths exist in nuisance proportions, particularly bluegreen algae, all recreational water uses, including fishing, tend to suffer.

One criterion to protect the aesthetic quality of waters used for recreation from excessive algal growth is based on chlorophyll a.

(REC2) NONCONTACT WATER RECREATION

Uses of water for recreational activities involving proximity to water, but not normally involving contact with water where water ingestion is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tide pool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

Water quality considerations relevant to noncontact water recreation, such as hiking, camping, or boating, and those activities related to tide pool or other nature studies require protection of habitats and aesthetic features. In some cases, preservation of a natural wilderness condition is justified, particularly when nature study is a major dedicated use.

One criterion to protect the aesthetic quality of waters used for recreation from excessive algal growth is based on chlorophyll a.

(SHELL) SHELLFISH HARVESTING

Uses of water that support habitats suitable for the collection of crustaceans and filter-feeding shellfish (e.g., clams, oysters, and mussels) for human consumption, commercial, or sport purposes.

Shellfish harvesting areas require protection and management to preserve the resource and protect public health. The potential for disease transmission and direct poisoning of humans is of considerable concern in shellfish regulation. The bacteriological criteria for the open ocean, bays, and estuarine waters where shellfish cultivation and harvesting occur should conform with the standards described in the National Shellfish Sanitation Program, Manual of Operation.

Toxic metals can accumulate in shellfish. Mercury and cadmium are two metals known to have caused extremely disabling effects in humans who consumed shellfish that concentrated these elements from industrial waste discharges. Other elements, radioactive isotopes, and certain toxins produced by particular plankton species also concentrate in shellfish tissue. Documented cases of paralytic shellfish poisoning are not uncommon in California.

(SPWN) FISH SPAWNING

Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.

Dissolved oxygen levels in spawning areas should ideally approach saturation levels. Free movement of water is essential to maintain well-oxygenated conditions around eggs deposited in sediments. Water temperature, size distribution and organic content of sediments, water depth, and current velocity are also important determinants of spawning area adequacy.

(WARM) WARM FRESHWATER HABITAT

Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

The warm freshwater habitats supporting bass, bluegill, perch, and other panfish are generally lakes and reservoirs, although some minor streams will serve this purpose where stream flow is sufficient to sustain the fishery. The habitat is also important to a variety of nonfish species, such as frogs, crayfish, and insects, which provide food for fish and small mammals. This habitat is less sensitive to environmental changes, but more diverse than the cold freshwater habitat, and natural fluctuations in temperature, dissolved oxygen, pH, and turbidity are usually greater.

(WILD) WILDLIFE HABITAT

Uses of waters that support wildlife habitats, including, but not limited to, the preservation and enhancement of vegetation and prey species used by wildlife, such as waterfowl.

The two most important types of wildlife habitat are riparian and wetland habitats. These habitats can be threatened by development, erosion, and sedimentation, as well as by poor water quality.

The water quality requirements of wildlife pertain to the water directly ingested, the aquatic habitat itself, and the effect of water quality on the production of food materials. Waterfowl habitat is particularly sensitive to changes in water quality. Dissolved oxygen, pH, alkalinity, salinity, turbidity, settleable

matter, oil, toxicants, and specific disease organisms are water quality characteristics particularly important to waterfowl habitat.

Dissolved oxygen is needed in waterfowl habitats to suppress development of botulism organisms; botulism has killed millions of waterfowl. It is particularly important to maintain adequate circulation and aerobic conditions in shallow fringe areas of ponds or reservoirs where botulism has caused problems.

PRESENT AND POTENTIAL BENEFICIAL USES

SURFACE WATERS

Surface waters in the region consist of freshwater rivers, streams, and lakes (collectively described as inland surface waters), estuarine waters, and coastal waters. Estuarine waters are comprised of the Bay system from the Golden Gate to the regional boundary near Pittsburg and the lower portions of streams flowing into the Bay, such as the Napa and Petaluma rivers in the north and Coyote and San Francisquito creeks in the south.

Inland surface waters support or could support most of the beneficial uses described above. The specific beneficial uses for inland streams include municipal and domestic supply, agricultural supply, industrial process supply, groundwater recharge, water contact recreation, noncontact water recreation, wildlife habitat, cold freshwater habitat, warm freshwater habitat, fish migration, and fish spawning. The San Francisco Bay Estuary supports estuarine habitat, industrial service supply, and navigation in addition to all of the uses supported by streams.

Coastal waters' beneficial uses include water contact recreation; noncontact water recreation; industrial service supply; navigation; marine habitat; shellfish harvesting; ocean, commercial and sport fishing; and preservation of rare and endangered species. In addition, the California coastline within the San Francisco Bay Basin is endowed with exceptional scenic beauty.

Beneficial uses of each significant water body have been identified and are organized according to the seven major watersheds within the region (Figure 2-2). The maps locating each water body (Figures 2-3 through 2-9) and tables keyed to each map (Tables 2-1 through 2-7) describing associated present and potential beneficial uses were produced using a geographical information system (GIS) at the Regional Board. More detailed representations of each location can be created using this computerized version.

The beneficial uses of any specifically identified water body generally apply to all its tributaries. In some cases a beneficial use may not be applicable to the entire body of water, such as navigation in Calabazas Creek or shellfish harvesting in the Pacific Ocean. In these cases, the Regional Board's judgment regarding water quality control measures necessary to protect beneficial uses will be applied.

GROUNDWATERS

Groundwater is defined as subsurface water that occurs beneath the water table in soils and geologic formations that are fully saturated. Where groundwater occurs in a saturated geologic unit that contains sufficient permeable thickness to yield significant quantities of water to wells and springs, it can be defined as an aquifer. A groundwater basin is defined as a hydrogeologic unit containing one large aquifer or several connected and interrelated aquifers.

Water-bearing geologic units occur within groundwater basins in the region that do not meet the definition of an aquifer. For instance, there are shallow, low permeability zones throughout the region that have extremely low water yields. Groundwater may also occur outside of currently identified basins. Therefore, for basin planning purposes, the term "groundwater" includes all subsurface waters, whether or not these waters meet the classic definition of an aquifer or occur within identified groundwater basins.

The areal extent of groundwater basins in the region has been evaluated by the Department of Water Resources (DWR) (Bulletin 118, 1980). Of special importance to the region are the 31 groundwater basins classified by DWR that produce, or potentially could produce, significant amounts of groundwater. Table 2-8 summarizes the hydrogeologic characteristics of basins depicted in Figure 2-10. This computer groundwater mapping GIS system was developed by the Regional Board and has the capacity to present information on each basin at a much higher level of resolution.

Existing and potential beneficial uses applicable to groundwater in the region include municipal and domestic water supply (MUN), industrial water supply (IND), industrial process water supply (PROC), agricultural water supply (AGR), and freshwater replenishment to surface waters (FRESH). Table 2-9 lists the 31 identified groundwater basins located in the region and their existing and potential beneficial uses.

Unless otherwise designated by the Regional Board, all groundwaters are considered

TABLE 2-9 EXISTING AND POTENTIAL BENEFICIAL USES OF GROUNDWATER IN IDENTIFIED BASINS

GROUNDWATER BASIN	COUNTY	DWR BASIN NO.	MUN[1]	PROC[2]	IND[3]	AGR[4]	FRESH[5]
Alameda Creek (Niles Cone)	Alameda	2 - 9.01	E[6]	E	E	E	
Castro Valley	Alameda	2 - 8	P[7]	P	P	P	
East Bay Plain	Alameda	2 - 9.01	E	E	E	E	
Livermore Valley	Alameda	2 - 10	E	E	E	E	
Sunol Valley	Alameda	2 - 11	E	E	E	E	
Arroyo Del Hambre Valley	Contra Costa	2 - 31	P	P	P	P	
Clayton Valley	Contra Costa	2 - 5	E	P	P	P	
Pittsburg Plain	Contra Costa	2 - 4	P	P	P	P	
San Ramon Valley	Contra Costa	2 - 7	E	P	P	E	
Ygnacio Valley	Contra Costa	2 - 6	P	P	P	P	
Novato Valley	Marin	2 - 30	P	P	P	P	
Sand Point Area	Marin	2 - 27	E	P	P	P	
San Rafael	Marin	2 - 29	P	P	P	P	
Ross Valley	Marin	2 - 28	E	P	P	E	
Napa Valley	Napa	2.2 & 2 - 2.01	E	E	E	E	
Islais Valley	San Francisco	2 - 33	P	E	E	P	
Merced Valley (North)	San Francisco	2 - 35	P	P	P	E	
San Francisco Sands	San Francisco	2 - 34	E	P	P	E	
Visitation Valley	San Francisco	2 - 32	P	E	E	P	
Half Moon Bay Terrace	San Mateo	2 - 22	E	P	P	E	
Merced Valley (South)	San Mateo	2 - 35A	E	P	P	E	
Pescadero Valley	San Mateo	2 - 26	E	P	P	E	
San Gregorio Valley	San Mateo	2 - 24	E	P	P	E	
San Mateo Plain	San Mateo	2 - 9A	E	E	E	P	
San Pedro Valley	San Mateo	2 - 36	P	P	P	P	
Santa Clara Valley (& Coyote)	Santa Clara	2 - 9B	E	E	E	E	
Suisun/Fairfield Valley	Solano	2 - 3	E	E	E	E	
Kenwood Valley	Sonoma	2 - 19	E	P	P	E	
Petaluma Valley	Sonoma	2 - 1	E	P	P	E	
Sebastopol-Merced Fm. Highlands	Sonoma	2 - 25	E	P	P	E	
Sonoma Valley	Sonoma	2 - 2.022	E	P	P	E	

NOTES:
(1) MUN = Municipal and domestic water supply.
(2) PROC = Industrial process water supply.
(3) IND = Industrial service water supply.
(4) AGR = Agricultural water supply.
(5) FRESH = Freshwater replenishment to surface water. (Designation will be determined at a later date; for the interim, a site-by-site determination will be made).
(6) E = Existing beneficial use; based on available information (see references listed in Table 2-8).
(7) P = Potential beneficial use; based on available information. There is no known use of the basin for this category; however, the basin could be used for this purpose (see references listed in Table 2-8).

APPENDIX C

BASIN PLAN
WATER QUALITY OBJECTIVES

Objectives for Surface Waters

Bacteria	Numeric: See tables 3-1 and 3-2
Bioaccumulation	See narrative, page 3-2
Biostimulatory Substances	See narrative, page 3-2
Color	See narrative, page 3-3
Dissolved Oxygen	Numeric: Cold water habitat = 7.0 mg/l min., warm water habitat = 5.0 mg/l min.
Floating Material	See narrative, page 3-3
Oil and Grease	See narrative, page 3-3
Population and Community Ecology	See narrative, page 3-3
pH	Numeric: 6.5<pH<8.5, see narrative, page 3-3
Salinity	See narrative, page 3-3
Sediment	See narrative, page 3-3
Settleable Material	See narrative, page 3-3
Suspended Material	See narrative, page 3-3
Sulfide	See narrative, page 3-3
Tastes and odors	See narrative, page 3-4
Temperature	Numeric: water temperature cannot be increased by> 5 degrees, See narrative, page 3-4
Toxicity	Numeric: See narrative, page 3-4
Turbidity	Numeric: See narrative, page 3-4
Un-ionized ammonia	Numeric: See narrative, page 3-4
Objectives for specific chemical constiuents	Numeric: See tables 3-3 and 3-4
Constituents of concern for municipal and agricultural water supplies	Numeric: See tables 3-5 and 3-6, see narrative, page 3-5
Radioactivity	Numeric: See table 3-5

Objectives for Groundwaters

Bacteria	Numeric: See narrative, page 3-6
Organic and inorganic constiutents	Numeric: See table 3-5
Radioactivity	Numeric: See table 3-5
Taste and odor	Numeric: See table 3-5

3 WATER QUALITY OBJECTIVES

INTRODUCTION

The overall goals of water quality regulation are to protect and maintain thriving aquatic ecosystems and the resources those systems provide to society and to accomplish these in an economically and socially sound manner. California's regulatory framework uses water quality objectives both to define appropriate levels of environmental quality and to control activities that can adversely affect aquatic systems.

WATER QUALITY OBJECTIVES

There are two types of objectives: narrative and numerical. Narrative objectives present general descriptions of water quality that must be attained through pollutant control measures and watershed management. They also serve as the basis for the development of detailed numerical objectives.

Historically, numerical objectives were developed primarily to limit the adverse effect of pollutants in the water column. Two decades of regulatory experience and extensive research in environmental science have demonstrated that beneficial uses are not fully protected unless pollutant levels in all parts of the aquatic system are also monitored and controlled. The Regional Board is actively working towards an integrated set of objectives, including numerical sediment objectives, that will ensure the protection of all current and potential beneficial uses.

Numerical objectives typically describe pollutant concentrations, physical/chemical conditions of the water itself, and the toxicity of the water to aquatic organisms. These objectives are designed to represent the maximum amount of pollutants that can remain in the water column without causing any adverse effect on organisms using the aquatic system as habitat, on people consuming those organisms or water, and on other current or potential beneficial uses (as described in Chapter 2).

The technical bases of the region's water quality objectives include extensive biological, chemical, and physical partitioning information reported in the scientific literature, national water quality criteria, studies conducted by other agencies, and information gained from local environmental and discharge monitoring (as described in Chapter 6). The Regional Board recognizes that limited information exists in some cases, making it difficult to establish definitive numerical objectives, but the Regional Board believes its conservative approach to setting objectives has been proper. In addition to the technical review, the overall feasibility of reaching objectives in terms of technological, institutional, economic, and administrative factors is considered at many different stages of objective derivation and implementation of the water quality control plan.

Together, the narrative and numerical objectives define the level of water quality that shall be maintained within the region. In instances where water quality is better than that prescribed by the objectives, the state Antidegradation Policy applies (State Board Resolution 68-16: Statement of Policy With Respect to Maintaining High Quality of Waters in California). This policy is aimed at protecting relatively uncontaminated aquatic systems where they exist and preventing further degradation.

When uncontrollable water quality factors result in the degradation of water quality beyond the levels or limits established herein as water quality objectives, the Regional Board will conduct a case-by-case analysis of the benefits and costs of preventing further degradation. In cases where this analysis indicates that beneficial uses will be adversely impacted by allowing further degradation, then the Regional Board will not allow controllable water quality factors to cause any further degradation of water quality. Controllable water quality factors are those actions, conditions, or circumstances resulting from human activities that may influence the quality of the waters of the state and that may be reasonably controlled.

QUICK INDEX PAGE

The Regional Board establishes and enforces waste discharge requirements for point and nonpoint source of pollutants at levels necessary to meet numerical and narrative water quality objectives. In setting waste discharge requirements, the Regional Board will consider, among other things, the potential impact on beneficial uses within the area of influence of the discharge, the existing quality of receiving waters, and the appropriate water quality objectives.

In general, the objectives are intended to govern the concentration of pollutant constituents in the main water mass. The same objectives cannot be applied at or immediately adjacent to submerged effluent discharge structures. Zones of initial dilution within which higher concentrations can be tolerated will be allowed for such discharges.

For a submerged buoyant discharge, characteristic of most municipal and industrial wastes that are released from submerged outfalls, the momentum of the discharge and its initial buoyancy act together to produce turbulent mixing. Initial dilution in this case is completed when the diluting wastewater ceases to rise in the water column and first begins to spread horizontally.

For shallow water submerged discharges, surface discharges, and nonbuoyant discharges, characteristic of cooling water wastes and some individual discharges, turbulent mixing results primarily from the momentum of discharge. Initial dilution, in these cases, is considered to be completed when the momentum-induced velocity of the discharge ceases to produce significant mixing of the waste, or the diluting plume reaches a fixed distance from the discharge to be specified by the Regional Board, whichever results in the lower estimate for initial dilution.

Compliance with water quality objectives may be prohibitively expensive or technically impossible in some cases. The Regional Board will consider modification of specific water quality objectives as long as the discharger can demonstrate that the alternate objective will protect existing beneficial uses, is scientifically defensible, and is consistent with the state Antidegradation Policy. This exception clause properly indicates that the Regional Board will conservatively compare benefits and costs in these cases because of the difficulty in quantifying beneficial uses.

These water quality objectives are considered necessary to protect the present and potential beneficial uses described in Chapter 2 of this Plan and to protect existing high quality waters of the state. These objectives will be achieved primarily through establishing and enforcing waste discharge requirements and by implementing this water quality control plan.

OBJECTIVES FOR OCEAN WATERS

The provisions of the State Board's "Water Quality Control Plan for Ocean Waters of California" (Ocean Plan) and "Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California" (Thermal Plan) and any revision to them will apply to ocean waters. These plans describe objectives and effluent limitations for ocean waters.

OBJECTIVES FOR SURFACE WATERS

The following objectives apply to all surface waters within the region, except the Pacific Ocean.

BACTERIA

Table 3-1 provides a summary of the bacterial water quality objectives and identifies the sources of those objectives. Table 3--2 summarizes U.S. EPA's water quality criteria for water contact recreation based on the frequency of use a particular area receives. These criteria will be used to differentiate between pollution sources or to supplement objectives for water contact recreation.

BIOACCUMULATION

Many pollutants can accumulate on particles, in sediment, or bioaccumulate in fish and other aquatic organisms. Controllable water quality factors shall not cause a detrimental increase in concentrations of toxic substances found in bottom sediments or aquatic life. Effects on aquatic organisms, wildlife, and human health will be considered.

BIOSTIMULATORY SUBSTANCES

Waters shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect beneficial uses. Changes in chlorophyll a and associated phytoplankton communities follow complex dynamics that are sometimes associated with a discharge of biostimulatory substances. Irregular and extreme levels of chlorophyll a

or phytoplankton blooms may indicate exceedance of this objective and require investigation.

COLOR

Waters shall be free of coloration that causes nuisance or adversely affects beneficial uses.

DISSOLVED OXYGEN

For all tidal waters, the following objectives shall apply:

In the Bay:

Downstream of
Carquinez Bridge.....5.0 mg/l minimum

Upstream of
Carquinez Bridge.....7.0 mg/l minimum

For nontidal waters, the following objectives shall apply:

Waters designated as:

Cold water habitat.....7.0 mg/l minimum

Warm water habitat.....5.0 mg/l minimum

The median dissolved oxygen concentration for any three consecutive months shall not be less than 80 percent of the dissolved oxygen content at saturation.

Dissolved oxygen is a general index of the state of the health of receiving waters. Although minimum concentrations of 5 mg/l and 7 mg/l are frequently used as objectives to protect fish life, higher concentrations are generally desirable to protect sensitive aquatic forms. In areas unaffected by waste discharges, a level of about 85 percent of oxygen saturation exists. A three-month median objective of 80 percent of oxygen saturation allows for some degradation from this level, but still requires a consistently high oxygen content in the receiving water.

FLOATING MATERIAL

Waters shall not contain floating material, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect beneficial uses.

OIL AND GREASE

Waters shall not contain oils, greases, waxes, or other materials in concentrations that result in a visible film or coating on the surface of the water or on objects in the water, that cause nuisance, or that otherwise adversely affect beneficial uses.

POPULATION AND COMMUNITY ECOLOGY

All waters shall be maintained free of toxic substances in concentrations that are lethal to or that produce significant alterations in population or community ecology or receiving water biota. In addition, the health and life history characteristics of aquatic organisms in waters affected by controllable water quality factors shall not differ significantly from those for the same waters in areas unaffected by controllable water quality factors.

pH

The pH shall not be depressed below 6.5 nor raised above 8.5. This encompasses the pH range usually found in waters within the basin. Controllable water quality factors shall not cause changes greater than 0.5 units in normal ambient pH levels.

SALINITY

Controllable water quality factors shall not increase the total dissolved solids or salinity of waters of the state so as to adversely affect beneficial uses, particularly fish migration and estuarine habitat.

SEDIMENT

The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.

Controllable water quality factors shall not cause a detrimental increase in the concentrations of toxic pollutants in sediments or aquatic life.

SETTLEABLE MATERIAL

Waters shall not contain substances in concentrations that result in the deposition of material that cause nuisance or adversely affect beneficial uses.

SUSPENDED MATERIAL

Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.

SULFIDE

All water shall be free from dissolved sulfide concentrations above natural background levels. Sulfide occurs in Bay muds as a result of bacterial action on organic matter in an anaerobic environment.

Concentrations of only a few hundredths of a milligram per liter can cause a noticeable odor or be toxic to aquatic life. Violation of the sulfide objective will reflect violation of dissolved oxygen objectives as sulfides cannot exist to a significant degree in an oxygenated environment.

TASTES AND ODORS

Waters shall not contain taste- or odor-producing substances in concentrations that impart undesirable tastes or odors to fish flesh or other edible products of aquatic origin, that cause nuisance, or that adversely affect beneficial uses.

TEMPERATURE

Temperature objectives for enclosed bays and estuaries are as specified in the "Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays of California," including any revisions to the plan.

In addition, the following temperature objectives apply to surface waters:

- The natural receiving water temperature of inland surface waters shall not be altered unless it can be demonstrated to the satisfaction of the Regional Board that such alteration in temperature does not adversely affect beneficial uses.
- The temperature of any cold or warm freshwater habitat shall not be increased by more than 5°F (2.8°C) above natural receiving water temperature.

TOXICITY

All waters shall be maintained free of toxic substances in concentrations that are lethal to or that produce other detrimental responses in aquatic organisms. Detrimental responses include, but are not limited to, decreased growth rate and decreased reproductive success of resident or indicator species. There shall be no acute toxicity in ambient waters. Acute toxicity is defined as a median of less than 90 percent survival, or less than 70 percent survival, 10 percent of the time, of test organisms in a 96-hour static or continuous flow test.

There shall be no chronic toxicity in ambient waters. Chronic toxicity is a detrimental biological effect on growth rate, reproduction, fertilization success, larval development, population abundance, community composition, or any other relevant measure of the health of an organism, population, or community. Chronic toxicity generally results from exposures to pollutants exceeding 96 hours. However, chronic toxicity may also be detected through short-term exposure of critical life stages of organisms.

As a minimum, compliance will be evaluated using the bioassay requirements contained in Chapter 4.

The health and life history characteristics of aquatic organisms in waters affected by controllable water quality factors shall not differ significantly from those for the same waters in areas unaffected by controllable water quality factors.

TURBIDITY

Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses. Increases from normal background light penetration or turbidity relatable to waste discharge shall not be greater than 10 percent in areas where natural turbidity is greater than 50 NTU.

UN-IONIZED AMMONIA

The discharge of wastes shall not cause receiving waters to contain concentrations of un-ionized ammonia in excess of the following limits (in mg/l as N):

Annual Median 0.025

Maximum, Central Bay (as depicted in Figure 2-5) and upstream.....0.16

Maximum, Lower Bay (as depicted in Figures 2-6 and 2-7) 0.4

The intent of this objective is to protect against the chronic toxic effects of ammonia in the receiving waters. An ammonia objective is needed for the following reasons:

- Ammonia (specifically un-ionized ammonia) is a demonstrated toxicant. Ammonia is generally accepted as one of the principle toxicants in municipal waste discharges. Some industries also discharge significant quantities of ammonia.
- Exceptions to the effluent toxicity limitations in Chapter 4 of the Plan allow for the discharge of ammonia in toxic amounts. In most instances, ammonia will be diluted or degraded to a nontoxic state fairly rapidly. However, this does not occur in all cases, the South Bay being a notable example. The ammonia limit is recommended in order to preclude any build up of ammonia in the receiving water.

- A more stringent maximum objective is desirable for the northern reach of the Bay for the protection of the migratory corridor running through Central Bay, San Pablo Bay, and upstream reaches.

OBJECTIVES FOR SPECIFIC CHEMICAL CONSTITUENTS

Surface waters shall not contain concentrations of chemical constituents in amounts that adversely affect any designated beneficial use. Water quality objectives for selected toxic pollutants developed in 1986 for surface waters are given in Tables 3-3 and 3-4.

The Regional Board intends to work towards the derivation of site-specific objectives for the Bay-Delta estuarine system. Site-specific objectives to be considered by the Regional Board shall be developed in accordance with the provisions of the federal Clean Water Act, the State Water Code, State Board water quality control plans, and this Plan. These site-specific objectives will take into consideration factors such as all available scientific information and monitoring data and the latest U.S. EPA guidance, and local environmental conditions and impacts caused by bioaccumulation. Copper, mercury, PCBs, and selenium will be the highest priorities in this effort. Pending the adoption of site-specific objectives, the objectives in Tables 3-3 and 3-4 apply throughout the region.

Based on the concerns raised in the Regional Monitoring Program, pilot fish contamination study, cooperative striped bass study, and other studies, water quality objectives for aromatic hydrocarbons are also needed.

The South Bay below the Dumbarton Bridge is a unique, water-quality-limited, hydrodynamic and biological environment that merits continued special attention by the Regional Board. Site-specific water quality objectives are absolutely necessary in this area for two reasons. First, its unique hydrodynamic environment dramatically affects the environmental fate of pollutants. Second, potentially costly nonpoint source pollution control measures must be implemented to attain any objectives for this area. The costs of those measures must be factored into economic impact considerations by the Regional Board in adopting any objectives for this area. Nowhere else in the region will nonpoint source economic considerations have such an impact on the attainability of objectives. Therefore, for this area, the objectives contained in Tables 3-3 and 3-4 will be considered guidance only, and should be used as part of the basis for site-specific objectives. Programs described in Chapter 4 will be used to develop site-specific objectives. Ambient conditions shall be maintained until site-specific objectives are developed.

CONSTITUENTS OF CONCERN FOR MUNICIPAL AND AGRICULTURAL WATER SUPPLIES

At a minimum, surface waters designated for use as domestic or municipal supply (MUN) shall not contain concentrations of constituents in excess of the maximum (MCLs) or secondary maximum contaminant levels (SMCLs) specified in the following provisions of Title 22 of the California Code of Regulations, which are incorporated by reference into this plan: Tables 64431-A (Inorganic Chemicals) and 64431-B (Fluoride) of Section 64431, Table 64444-A (Organic Chemicals) of Section 64444, and Table 64449-A (SMCLs-Consumer Acceptance Limits) and 64449-B (SMCLs-Ranges) of Section 64449. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect. Table 3-5 contains water quality objectives for municipal supply, including the MCLs contained in various sections of Title 22 as of the adoption of this plan.

At a minimum, surface waters designated for use as agricultural supply (AGR) shall not contain concentrations of constituents in excess of the levels specified in Table 3-6.

RADIOACTIVITY

Radionuclides shall not be present in concentrations that result in the accumulation of radionuclides in the food web to an extent that presents a hazard to human, plant, animal, or aquatic life. Waters designated for use as domestic or municipal supply shall not contain concentrations of radionuclides in excess of the limits specified in Table 4 of Section 64443 (Radioactivity) of Title 22 of the California Code of Regulations, which is incorporated by reference into this Plan. This incorporation is prospective, including future changes to the incorporated provisions as the changes take effect (see Table 3-5).

OBJECTIVES FOR GROUNDWATERS

Groundwater objectives consist primarily of narrative objectives combined with a limited number of numerical objectives. Additionally, the Regional Board will establish basin-

and/or site-specific numerical groundwater objectives as necessary. For example, the Regional Board has groundwater basin-specific objectives for the Alameda Creek watershed above Niles to include the Livermore-Amador Valley as shown in Table 3-7.

The maintenance of existing high quality of groundwater (i.e., "background") is the primary groundwater objective.

In addition, at a minimum, groundwaters shall not contain concentrations of bacteria, chemical constituents, radioactivity, or substances producing taste and odor in excess of the objectives described below unless naturally occurring background concentrations are greater.

BACTERIA

In groundwaters with a beneficial use of municipal and domestic supply, the median of the most probable number of coliform organisms over any seven-day period shall be less than 1.1 MPN/100 mL (based on multiple tube fermentation technique; equivalent test results based on other analytical techniques as specified in the National Primary Drinking Water Regulation, 40 CFR, Part 141.21 (f), revised June 10, 1992, are acceptable).

ORGANIC AND INORGANIC CHEMICAL CONSTITUENTS

All groundwaters shall be maintained free of organic and inorganic chemical constituents in concentrations that adversely affect beneficial uses. To evaluate compliance with water quality objectives, the Regional Board will consider all relevant and scientifically valid evidence, including relevant and scientifically valid numerical criteria and guidelines developed and/or published by other agencies and organizations (e.g.,U.S. EPA, the State Water Resources Control Board, California Department of Health Services, U.S. Food and Drug Administration, National Academy of Sciences, Cal/EPA Office of Environmental Health Hazard Assessment, U.S. Agency for Toxic Substances and Disease Registry, Cal/EPA Department of Toxic Substances Control, and other appropriate organizations.)

At a minimum, groundwaters designated for use as domestic or municipal supply (MUN) shall not contain concentrations of constituents in excess of the maximum (MCLs) or secondary maximum contaminant levels (SMCLs) specified in the following provisions of Title 22 of the California Code of Regulations, which are incorporated by reference into this plan: Tables 64431-A (Inorganic Chemicals) and 64431-B (Fluoride) of Section 64431, and Table 64444-A (Organic Chemicals) of Section 64444. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect. (See Table 3-5.)

Groundwaters with a beneficial use of agricultural supply shall not contain concentrations of chemical constituents in amounts that adversely affect such beneficial use. In determining compliance with this objective, the Regional Board will consider as evidence relevant and scientifically valid water quality goals from sources such as the Food and Agricultural Organizations of the United Nations; University of California Cooperative Extension, Committee of Experts; and McKee and Wolf's "Water Quality Criteria," as well as other relevant and scientifically valid evidence. At a minimum, groundwaters designated for use as agricultural supply (AGR) shall not contain concentrations of constituents in excess of the levels specified in Table 3-6.

Groundwaters with a beneficial use of freshwater replenishment shall not contain concentrations of chemicals in amounts that will adversely affect the beneficial use of the receiving surface water.

Groundwaters with a beneficial use of industrial service supply or industrial process supply shall not contain pollutant levels that impair current or potential industrial uses.

To assist dischargers and other interested parties, the Central Valley Regional Board's staff has compiled many numerical water quality criteria from other appropriate agencies and organizations in its staff report, "A Compilation of Water Quality Goals." This staff report is updated regularly to reflect changes in these numerical criteria.

RADIOACTIVITY

At a minimum, groundwaters designated for use as domestic or municipal supply (MUN) shall not contain concentrations of radionuclides in excess of the maximum contaminant levels (MCLs) specified in Table 4 (Radioactivity) of Section 64443 of Title 22 of the California Code of Regulations, which is incorporated by reference into this plan. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect. (See Table 3-5.)

TASTE AND ODOR

Groundwaters designated for use as domestic or municipal supply (MUN) shall not contain taste- or odor-producing substances in concentrations that cause a nuisance or adversely affect beneficial uses. At a minimum, groundwaters designated for use as domestic or municipal supply shall not contain concentrations in excess of the secondary maximum contaminant levels (Secondary MCLs) specified in Tables 64449-A (Secondary MCLs-Consumer Acceptance Limits) and 64449-B (Secondary MCLs-Ranges) of Section 64449 of Title 22 of the California Code of Regulations, which is incorporated by reference into this plan. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect. (See Table 3-5.)

OBJECTIVES FOR THE DELTA AND SUISUN MARSH

The objectives contained in the State Board's "Water Quality Control Plan for the Sacramento-San Joaquin Delta and Suisun Marsh" and any revisions thereto shall apply to the waters of the Sacramento-San Joaquin Delta and Suisun Marsh.

OBJECTIVES FOR ALAMEDA CREEK WATERSHED

The water quality objectives contained in Table 3-7 apply to the surface and groundwaters of the Alameda Creek watershed above Niles.

Wastewater discharges that cause the surface water limits in Table 3-7 to be exceeded may be allowed if they are part of an overall waterwastewater resource operational program developed by those agencies affected and approved by the Regional Board.

TABLE 3-1 WATER QUALITY OBJECTIVES FOR COLIFORM BACTERIA [a]

BENEFICIAL USE	FECAL COLIFORM (MPN /100ML)	TOTAL COLIFORM (MPN/100ML)
Water Contact Recreation	log mean < 200 90th percentile < 400	median < 240 no sample > 10,000
Shellfish Harvesting[b]	median < 14 90th percentile < 43	median < 70 90th percentile < 230[c]
Non-contact Water Recreation[d]	mean < 2000 90th percentile < 4000	
Municipal Supply: - Surface Water[e] - Groundwater	log mean < 20	log mean < 100 < 1.1[f]

NOTES:
a. Based on a minimum of five consecutive samples equally spaced over a 30-day period.
b. Source: National Shellfish Sanitation Program.
c. Based on a five-tube decimal dilution test or 300 MPN/100 ml when a three-tube decimal dilution test is used.
d. Source: Report of the Committee on Water Quality Criteria, National Technical Advisory Committee, 1968.
e. Source: DOHS recommendation.
f. Based on multiple tube fermentation technique; equivalent test results based on other analytical techniques, as specified in the National Primary Drinking Water Regulation, 40 CFR, Part 141.21(f), revised June 10, 1992, are acceptable.

TABLE 3-2 U.S. EPA BACTERIOLOGICAL CRITERIA FOR WATER CONTACT RECREATION[1,2] (IN COLONIES PER 100 ML)

	FRESH WATER		SALT WATER
	ENTEROCOCCI	E. COLI	ENTEROCOCCI
Steady State (all areas)	33	126	35
Maximum at:			
- designated beach	61	235	104
- moderately used area	89	298	124
- lightly used area	108	406	276
- infrequently used area	151	576	500

NOTES:
1. The criteria were published in the Federal Register, Vol. 51, No. 45 / Friday, March 7, 1986 / 8012 - 8016. The Criteria are based on:
(a) Cabelli, V.J. 1983. Health Effects Criteria for Marine Recreational Waters. U.S. EPA, EPA 600/1-80-031, Cincinnati, Ohio, and
(b) Dufour, A.P. 1984. Health Effects Criteria for Fresh Recreational Waters. U.S. EPA, EPA 600/1-84-004, Cincinnati, Ohio.
2. The U.S. EPA criteria apply to water contact recreation only. The criteria provide for a level of protection based on the frequency of usage of a given water contact recreation area. The criteria may be employed in special studies within this region to differentiate between pollution sources or to supplement the current coliform objectives for water contact recreation.

TABLE 3-3 WATER QUALITY OBJECTIVES FOR TOXIC POLLUTANTS FOR SURFACE WATERS WITH SALINITIES GREATER THAN 5 PPT [a,b]

(ALL VALUES IN UG/L)

COMPOUND	4-DAY AVERAGE [c]	1-HR AVERAGE [c]	24-HR AVERAGED	INSTANTANEOUS MAXIMUM [d]
Arsenic	36.0	69.0		
Cadmium	9.3	43.0		
Chromium (VI)[e]	50.0	1100.0		
Copper		f		
Cyanide		5.0		
Lead	5.6	140.0		
Mercury	0.025	2.1		
Nickel[g]			7.1	140.0
Selenium				
Silver				2.3
Tributyltin[h]				
Zinc			58.0	170.0
PAHs[i]			15.0	

NOTES:

a. These objectives shall apply to all estuarine waters within the region, according to the salinity threshold, except for the South Bay below Dumbarton Bridge.

b. The values reported in this table are derived from the 1980 and 1984 U.S. EPA Ambient Water Quality Criteria for salt water and fresh water (unless otherwise specified) and were adopted by the Board in 1986. In 1992, the Regional Board adopted a more inclusive set of objectives reflecting more recent technical information; this set of objectives had been developed and adopted as part of the statewide Inland Surface Waters and Enclosed Bays and Estuaries Plan and was ruled invalid by a court decision in 1993. The U.S. EPA is expected to promulgate final water quality standards for California in late 1995. The national standards will then apply to all planning, monitoring, NPDES permitting, enforcement, and compliance programs conducted under the Clean Water Act within the state.

c. Source: U.S. EPA 1984.

d. Source: U.S. EPA 1980.

e. This objective may be met as total chromium.

f. The current U.S. EPA criterion is 2.9 ug/l. However, copper toxicity varies with the complexing capacity of specific receiving waters, and background concentrations in the Bay typically vary from 1 to 4 ug/l. The Regional Board conducted scientific studies on Bay waters between 1986 and 1992 and determined that 4.9 ug/l was a more appropriate value for a site-specific objective, given U.S. EPA's derivation method. U.S. EPA is reviewing that method as part of its national rulemaking for California water quality standards. A site-specific criterion for copper is urgently needed.

g. The current U.S. EPA criterion is 8.3 ug/l (4-day average).

h. Tributyltin is a compound used as an antifouling ingredient in marine paints and toxic to aquatic life in low concentrations (<1 ppb). Based on technical information, a value of 0.005 ug/l (30-day average) would be protective of human health.

i. U.S. EPA water quality criteria indicate that 0.031 ug/l in both fresh water and salt water is protective of human health, based on setting the acceptable lifetime risk for cancer at the 10-6 risk level. PAHs are those compounds identified by EPA Method 610.

TABLE 3-4 WATER QUALITY OBJECTIVES FOR TOXIC POLLUTANTS FOR SURFACE WATERS WITH SALINITIES LESS THAN 5 PPT[a,b]

(ALL VALUES IN UG/L)

COMPOUND	4-DAY AVERAGE [c]	1-HR AVERAGE [c]	24-HR AVERAGE [d]	INSTANTANEOUS MAXIMUM [d]
Arsenic	190.0	360.0		
Cadmium	e	e		
Chromium (VI)[f]	11.0	16.0		
Copper[g]	6.5	9.2		
Cyanide	5.2	22.0		
Lead	h	h		
Mercury	0.025[i]	2.4		
Nickel	j	j	56.0	1100.0
Selenium				
Silver[k]				1.2
Tributyltin[l]				
Zinc	m	m	58.0	170.0
PAHs[n]				

NOTES:

a. These objectives shall apply to all estuarine and inland surface waters within the region where the salinity is less than 5 ppt, except for the South Bay below Dumbarton Bridge.

b. The values reported in this table are derived from the 1980 and 1984 U.S. EPA Ambient Water Quality Criteria for salt water and fresh water (unless otherwise specified) and were adopted by the Regional Board in 1986. In 1992, the Regional Board adopted a more inclusive set of objectives reflecting more recent technical information; this set of objectives had been developed and adopted as part of the statewide Inland Surface Waters and Enclosed Bays and Estuaries Plan and was ruled invalid by a court decision in 1993. The U.S. EPA is expected to promulgate final water quality standards for the California in late 1995. The national standards will then apply to all planning, monitoring, NPDES permitting, enforcement, and compliance programs conducted under the Clean Water Act within the state.

c. Source: U.S. EPA 1984.

d. Source: U.S. EPA 1980.

e. The objectives for cadmium and other noted metals are expressed by formulas where H = ln (hardness) as $CaCO_3$ in mg/l: The four-day average objective for cadimium is $e^{(0.7852\,H\,-\,3.490)}$. This is 1.1 µg/l at a hardness of 100 mg/l as $CaCO_3$. The one-hour average objective for cadimium is $e^{(1.128\,H\,-\,3.828)}$. This is 3.9 µg/l at a hardness of 100 mg/l as $CaCO_3$.

f. This limit may be met as total chromium.

g. The U.S. EPA water quality criteria for copper are hardness-dependent. The current objectives are equivalent to these criteria as calculated for 50 mg/l hardness as $CaCO_3$. The four-day average EPA criterion for copper is $e^{(0.8545H\,-1.465)}$; the one-hour average criterion is $e^{(0.9422H+1.464)}$.

h. The four-day average objective for lead is $e^{(1.273H-4.705)}$. This is 3.2 µg/l at at hardness of 100 mg/l as $CaCO_3$. The one-hour average objective for lead is $e^{(1.273H-1.460)}$. This is 81 µg/l at a hardness of 100 mg/l as $CaCO_3$.

i. The U.S. EPA Water Quality Criterion for mercury is 0.012 µg/l, which is below the level of detection of 0.025 µg/l. An objective of 0.012 µg/l is desirable, but attainment can only be determined at the level of detection.

j. The U.S. EPA criteria for nickel are hardness-dependent; the 4-day average criterion is $e^{(0.846\,H+1.1645)}$, which is 158 µg/l at a hardness of 100 mg/l as $CaCO_3$. The 1-hour average is $e^{(0.846H+3.3612)}$, which is 1,419 µg/l at a hardness of 100 mg/l as $CaCO_3$.

k. The U.S. EPA water quality criterion for silver is hardness-dependent. This objective is equivalent to these criteria as calculated for 50 mg/l hardness as $CaCO_3$. The instantaneous maximum EPA criterion is $e^{(1.72H-6.52)}$.

l. Tributyltin is a compound used as an antifouling ingredient in marine paints and toxic to aquatic life in low concentrations (<1 ppb). Based on technical information, values of 0.02 µg/l (4-day average), 0.04 µg/l (24-hour average), and 0.06 µg/l (instantaneous maximum) would be protective of aquatic life.

m. The U.S. EPA criteria for zinc are hardness-dependent: the 4-day average criterion is $e^{(0.8473H-0.7614)}$, which is 23 µg/l at a hardness of 100 mg/l as $CaCO_3$. The 1-hour average is $e^{(0.8473H-0.8604)}$, which is 21 µg/l at a hardness of 100 mg/l as $CaCO_3$.

n. U.S. EPA water quality criteria indicate that 0.031 µg/l in both fresh water and salt water is protective of human health, based on setting the acceptable lifetime risk for cancer at the 10^{-6} risk level. PAHs are those compounds identified by EPA Method 610.

TABLE 3-5 WATER QUALITY OBJECTIVES FOR MUNICIPAL SUPPLY

PARAMETER	OBJECTIVE (IN MG/L)
Physical:	
Color (units)[a]	15.0
Odor (number)[a]	3.0
Turbidity (NTU)[a]	5.0
pH[b]	6.5
TDS[c]	500.0
EC (mmhos/cm)[c]	0.9
Corrosivity	non-corrosive
Inorganic Parameters:	
Aluminum[d]	1.0[d] /0.2[a]
Antimony[d]	0.006
Arsenic[d]	0.05
Asbestos[d]	7 MFL[e]
Barium[d]	1.0
Beryllium[d]	0.004
Chloride[c]	250.0
Cadmium[d]	0.005
Chromium[d]	0.05
Copper[a]	1.0
Cyanide[d]	0.2
Fluoride[f]	0.8-1.7[g]
Iron[a]	0.3
Lead[b]	0.05
Manganese[a]	0.05
Mercury[d]	0.002
Nickel[d]	0.1
Nitrate (as NO_3)[d]	45.0
Nitrate + Nitrite (as N)[d]	10.0
Nitrite (as N)[d]	1.0
Selenium[d]	0.05
Silver[b]	0.05
Sulfate[c]	250.0
Thallium[d]	0.002
Zinc[a]	5.0
Organic Parameters:	
MBAS (Foaming agents)[a]	0.5
Oil and grease[b]	none
Phenols[b]	0.001
Trihalomethanes[b]	0.1
Chlorinated Hydrocarbons:	
Endrin[h]	0.002
Lindane[h]	0.0002
Methoxychlor[h]	0.04
Toxaphene[h]	0.003
2,3,7,8-TCDD (Dioxin)[h]	3×10^{-8}
2,4-D[h]	0.07
2,4,4-TP Silvex[h]	0.05
Synthetics:	
Alachlor[h]	0.002
Atrazine[h]	0.003
Bentazon[h]	0.018
Benzo(a)pyrene[h]	0.0002
Dalapon[h]	0.2
Dinoseb[h]	0.007
Diquat[h]	0.02
Endothall[h]	0.1

PARAMETER	OBJECTIVE (IN MG/L)
Benzene[h]	0.001
Carbon Tetrachloride[h]	0.0005
Carbofuran[h]	0.018
Chlordane[h]	0.0001
1,2-Dibromo-3 -chloropropane[h]	0.0002
1,2-Dichlorobenzene[h]	0.6
1,4-Dichlorobenzene[h]	0.005
1,1-Dichloroethane[h]	0.005
1,2-Dichloroethane[h]	0.0005
cis-1,2-Dichloroethlyene[h]	0.006
trans-1,2-Dichloroethylene[h]	0.01
1,1-Dichloroethylene[h]	0.006
Dichloromethane[h]	0.005
1,2-Dichloropropane[h]	0.005
1,3-Dichloropropene[h]	0.0005
Di (2-ethylhexyl) adipate[h]	0.4
Di(2-ethylhexyl) phthalate[h]	0.004
Ethylbenzene[h]	0.7
Ethylene dibromide[h]	0.00005
Glyphosate[h]	0.7
Heptachlor[h]	0.00001
Heptachlor epoxide[h]	0.00001
Hexachlorobenzene[h]	0.001
Hexachlorocyclopentadiene[h]	0.05
Molinate[h]	0.02
Monochlorobenzene[h]	0.07
Oxamyl[h]	0.2
Pentachlorophenol[h]	0.001
Picloram[h]	0.5
Polychlorinated Biphenyls[h]	0.0005
Simazine[h]	0.004
Styrene[h]	0.1
1,1,2,2-Tetrachloroethane[h]	0.001
Tetrachloroethylene[h]	0.005
Thiobencarb[h]	0.001
1,2,4-Trichlorobenzene[h]	0.07
1,1,1-Trichloroethane[h]	0.2
1,1,2-Trichloroethane[h]	0.005
Trichloroethylene[h]	0.005
Trichlorofluoromethane[h]	0.15
1,1,2-Trichloro-1,2,2-trifluoroethane[h]	1.2
Toluene[h]	0.15
Vinyl chloride[h]	0.0005
Xylenes (single or sum of isomers)[h]	1.75

PARAMETER	OBJECTIVE (IN pCi/l)
Radioactivity:	
Combined Radium-226 and Radium-228[i]	5
Gross Alpha Particle Activity[i]	15[j]
Tritium[i]	20,000
Strontium-90[i]	8
Gross Beta Particle Activity[i]	50
Uranium[i]	20

NOTES:

a. Secondary Maximum Contaminant Levels as specified in Table 64449-A of Section 64449, Title 22 of the California Code of Regulations, as of June 19, 1995.
b. Table III-2, 1986 Basin Plan.
c. Secondary Maximum Contaminant Levels as specified in Table 64449-B of Section 64449, Title 22 of the California Code of Regulations, as of June 19, 1995. (Levels indicated are "recommended" levels. Table 64449-B contains a complete list of upper and short-term ranges.)
d. Maximum Contaminant Levels as specified in Table 64431-A (Inorganic Chemicals) of Section 64431, Title 22 of the California Code of Regulations, as of June 19, 1995.
e. MFL = million fibers per liter; MCL for fibers exceeding 10 µm in length.
f. Flouride objectives depend on temperature.
g. A complete list of optimum and limiting concentrations is specified in Table 64431-B of Section 64431, Title 22 of the California Code of Regulations, as of June 19, 1995.
h. Maximum Contaminant Levels as specified in Table 64444-A (Organic Chemicals) of Section 64444, Title 22 of the California Code of Regulations, as of June 19, 1995.
i. Maximum Contaminant Levels as specified in Table 4 (Radioactivity) of Section 64443, Title 22 of the California Code of Regulations, as of December 22, 1988.
j. Includes Radium-226 but excludes Radon and Uranium.

TABLE 3-6 WATER QUALITY OBJECTIVES FOR AGRICULTURAL SUPPLY [a]

(IN MG/L)

PARAMETER	THRESHOLD	LIMIT	LIMIT FOR LIVESTOCK WATERING
Physical:			
pH	5.5-8.3	4.5-9.0	
TDS			10,000.0
EC (mmhos/cm)		0.2-3.0	
Inorganic Parameters:			
Aluminum	5.0	20.0	5.0
Arsenic	0.1	2.0	0.2
Beryllium	0.1	0.5	
Boron	0.5	2.0	5.0
Chloride	142.0	355.0	
Cadmium	0.01	0.5	0.05
Chromium	0.1	1.0	1.0
Cobalt	0.05	5.0	1.0
Copper	0.2	5.0	0.5
Fluoride	1.0	15.0	2.0
Iron	5.0	20.0	
Lead	5.0	10.0	0.1
Lithium		2.5[b]	
Manganese	0.2	10.0	
Molybdenum	0.01	0.05	0.5
Nickel	0.2	2.0	
$NO_3 + NO_2$ (as N)	5.0	30[c]	100.0
Selenium		0.02	0.05
Sodium adsorption ratio (adjusted)[d]	3.0	9.0	
Vanadium	0.1	1.0	0.1
Zinc	2.0	10.0	25

NOTES:

a. For an extensive discussion of water quality for agricultural puposes, see "A Compilation of Water Quality Goals," Central Valley Regional Water Quality Control Board, May 1993.

b. For citrus irrigation, maximum 0.075 mg/l.

c. For sensitive crops. Values are actually for NO_3-N + NH_4-N.

d. Adjusted SAR = [Na / (Ca+Mg) 1/2][1+(8.4-pHc)] where pHc is a calculated value based on total cations, 2 Ca + Mg+ CO_3 + HCO_3, In me/l. Exact calcuations of pHc can be found in "Guidelines for Interpretation of Water Quality for Agriculture" prepared by the Univ. of Califomla Cooperative Extension.