Table 6-2
AVERAGE GROUNDWATER VELOCITIES FOR NEWMARK PLUME

Velocity (ft/day)	Velocity (ft/yr)
Newmark Well Area (Area 1)	
0.51	186
Middle Area (Area 2)	
1.57	573
Lower Two-thirds of Newmark Plume (Area 3)	
0.85	310
Average Groundwater Velocity	
0.98	358

- The lower two-thirds of the Newmark plume is an area where the project flow model was calibrated with the most confidence. The observed water elevations (see Sections 2.5 and 2.8, Appendix J) matched the observed water elevations calculated in this area. Consequently, the average calculated groundwater velocity of 358 ft/yr for the entire plume appears to be fairly consistent with the groundwater velocity estimated with some supporting data for the lower two-thirds of the Newmark plume (310 ft/yr).

6.4.4 Retarded Velocities of TCE and PCE in the Groundwater

The previous section discussed movement of the Newmark plume assuming that the dissolved contaminant particles moved at the velocity of the groundwater. However, as discussed in Section 6.3, TCE and PCE are subject to retardation factors. Consequently, TCE and PCE are expected to migrate at rates somewhat slower than the velocity of the groundwater itself.

The retarded velocities of TCE and PCE in the groundwater are estimated in this section. The parameters and properties necessary to calculate the site specific velocities of TCE and PCE in the groundwater include the following:

- Groundwater velocity
- Porosity of the soil medium
- Soil particle density
- Organic carbon content of the soil medium (f_{oc})
- Adsorption or distribution coefficient of an organic chemical between soil surfaces and water (K_d)
- Partition coefficient of an organic chemical between organic carbon and water (K_{oc})
- Partition coefficient of an organic chemical between octanol (an organic liquid) and water (K_{ow})

The porosity of the soil medium, the soil particle density, f_{oc}, K_d, K_{oc}, and K_{ow}, used to estimate the velocities of TCE and PCE in the groundwater at the Newmark site, were discussed in Section 6.3. The average groundwater velocity for the Newmark plume was estimated in Subsection 6.4.3.

Retardation Factors and Velocities of TCE and PCE in the Groundwater

Based on the results of this focused RI, it is assumed that chemical and physical processes other than adsorption (e.g., volatilization, biodegradation) that retard or attenuate PCE or TCE do not occur at appreciable rates in the Newmark plume. Therefore, the estimated velocities of TCE and PCE will be based solely on the contaminants relative sorption potentials and tendency to partition between the water and adjoining soil (i.e., K_d).

Organic chemicals present in groundwater systems tend to travel at retarded velocities, compared to the groundwater velocities due to the adsorption processes discussed in Section 6.3 that slow or delay their movement. The retardation factor (R_f) that is used to express the velocity of an organic chemical relative to the groundwater velocity was determined previously by equation (6.6):

$$R_f = V_w / V_c = 1 + [(1 - n) / n] \rho_s K_d$$

where: V_w, the velocity of the groundwater, or the estimated average groundwater velocity calculated in Subsection 6.4.3, is equal to 358 ft/yr; V_c, the velocity of the organic compound (PCE or TCE), is equal to V_w/R_f; n, the porosity of the soil medium in the model area, based on Domenico and Schwartz (1990) is estimated to be 30 percent; ρ_s, the soil particle density, based on Domenico and Schwartz (1990) is estimated to be 2.65 g/ml ; and K_d, the soil/water distribution coefficient, based on the values calculated in Subsection 6.3.1 is equal to 0.283 ml/g for PCE and 0.148 ml/g for TCE.

The estimated R_f and average velocities (V_c) of TCE and PCE in the groundwater are presented in Table 6-3. Since the velocity of PCE in the groundwater is estimated to be the lowest of the two contaminants, it is used to estimate remediation times for the Newmark plume. The estimated remediation times under several other extraction scenario conditions are discussed further in Subsection 13.1.11.

Table 6-3

ESTIMATED RETARDATION FACTORS (R_f) AND VELOCITIES OF TCE AND PCE IN THE GROUNDWATER

Average Groundwater Velocity (ft/yr)	TCE R_f	PCE R_f	Average TCE Velocity (ft/yr)	Average PCE Velocity (ft/yr)
358	1.91	2.75	187	130

It should be noted that contaminant migration cannot be accurately estimated using only average groundwater velocity and retardation factor. The dispersive characteristics (e.g., frictional forces, varying pore sizes, path length, velocity gradients) of the aquifer can result in substantial contaminant spreading and dilution. Consequently, the spreading plume front can arrive at a given location well in advance of the time estimated solely on the basis of the average flow velocity and retardation factor (Mackay et al. 1985).

7.0 SUMMARY AND CONCLUSIONS

7.1 SUMMARY

The remedial investigation focused on the soils within the area suspected of being the source of groundwater contamination (suspected source area) and the groundwater across the site suspected of being contaminated (plume area).

7.1.1 Nature and Extent of Contamination

Groundwater and soils within Newmark were analyzed for a broad scope of contaminants, including volatile organic compounds, semi-volatile (base, neutral, acid extractable) organic compounds, PCBs, pesticides, and metals.

The contaminants of concern at the Newmark Groundwater Contamination Superfund Site were selected as those contaminants which exceed their individual MCLs for drinking water. These contaminants are summarized in Table 7-1. Concentrations of other volatile organics and metals were detected in the groundwater associated with this project and are presented in Section 5.0 of this report. Elevated concentrations of aluminum and chromium were detected above MCLs in some monitoring wells. These concentrations are considered to be artifacts of the construction and subsequent development of the monitoring wells. Any concern over these concentrations should be addressed through additional rounds of future water quality sampling. All metals concentrations from the municipal supply wells sampled, with the exception of one sample taken from the 17th Street number 2 well, were below the detection limits set by the State of California for the protection of public health. Iron was detected at 701 µg/L in the 17th Street well. This value is attributed to the fact that the well was recently installed using a steel casing. No contaminants of concern were detected in the soils analyzed from the suspected source area.

Table 7-1

CONTAMINANTS OF CONCERN

Matrix	Contaminant of Concern	Maximum Concentration
Groundwater	Trichloroethylene (TCE) Perchloroethylene (PCE)	7 μg/L 36 μg/L

Suspected Source Area

Results of chemical analyses of soil samples collected during the construction of monitoring wells (MW02A/B through MW06A/B) in the suspected source area do not indicate the presence of any residual soil contamination resulting from past disposal activities. This does not mean that contaminants of concern were not disposed within the suspected source area, specifically the Cat pit, but indicates that the Cat pit may no longer be contributing to groundwater contamination.

Results from analyses of groundwater samples collected from the suspected source area (monitoring wells MW02A/B through MW08A/B) indicate the presence of an upgradient source of contaminated groundwater that appears to be entering the suspected source area through the topographic low formed between Shandin Hills and Wiggins Hill (see Plate 1). Results from MW08B, recorded the highest levels of PCE, 25 μg/L found in the suspected source area. The non-detectable results from MW06A/B are assumed to represent background concentrations for the site. Because of the non-detectable results for TCE and PCE found in the Devils Canyon 1 and 2 supply wells and MW06A/B, it is concluded that no contaminants are entering the suspected source area from the Devils Canyon area.

Table 7-2
Concentrations of Contaminants of Concern in Groundwater
Newmark Operable Unit RI/FS Report

Sample Number	Concentration (mg/L) Trichloroethylene (2)	Concentration (mg/L) Perchloroethylene (2)
WMW01 A - J	ND	ND
WMW02A-01C	ND	0.3 J
WMW02B-01C	3	16
WMW03A-01C	ND	0.2 J
WMW03B-01C	4	19
WMW04A-01C	ND	ND
WMW04B-01C	1 J	10
WMW05A-01C	ND	0.4 J
WMW05B-01C	6	22
WMW06A-01C	ND	ND
WMW06B-01C	ND	ND
WMW07A-01C	4	16
WMW07B-01C	3	16
WMW07B-02C	3	16
WMW08A-01C	ND	0.3 J
WMW08B-01C	3	25
Newmark #4, Muni 03	2	12

Notes: Sample specific quantitation limits are shown in parentheses.
ND = Not Detected.
Values followed by the qualifier J are estimated quantities and useful for qualitative purposes only.

Table 7-2 (continued)
Concentrations of Contaminants of Concern in Groundwater
Newmark Operable Unit RI/FS Report

Sample Number	Concentration (mg/L) Trichloroethylene (2)	Concentration (mg/L) Perchloroethylene (2)
Newmark #1, Muni 05	2	9
Newmark #3, Muni 06	2	15
Electric Ave. #1 W1-1, Muni 08	ND	ND
Electric Ave. #2 W2-3, Muni 09	5	22
Parkdale Schl. W3-2, Muni 11	7	32
Parkdale Schl. W3-3, Muni 12	3	15
Waterman Ave., Muni 13	4	21
31st. & Mt. View, Muni 13	5	20
30th. St. & Mt. View, Muni 15	5	18
Leroy, Muni 16	7	36
27th St., Muni 18	0.2 J	0.5 J
North E St., Muni 19	0.4 J	0.7 J
23rd. St., Muni 20	ND	0.3 J
17th. St., Muni 22	2	3
16th. St., Muni 23	2	3
Maximum Contaminant Levels (MCLs)	2	3

Notes: Sample specific quantitation limits are shown in parentheses.
ND = Not detected.
Values followed by the qualifier J are estimated quantities and useful for qualitative purposes only.

Plume Area

TCE and PCE were detected above the MCLs in 15 of the 25 samples from municipal and previously installed monitoring wells, and 11 of the 15 newly installed monitoring wells. Based upon these results, a contamination plume area was mapped (see Plate 1) and its concentrations are presented in Table 7-2. Based upon the sampling results from source area monitoring wells MW02A/B through MW05A/B, MW07A/B, and MW08A/B, the majority of the contaminants appear to be located within the lower 200 feet of the aquifer in the vicinity of the suspected source area (see Figures 5-1 and 5-2). Further south at monitoring well MW01 results from samples collected taken from 10 discrete depths in the aquifer were all non-detectable for the contaminants of concern. Because only one sampling of MW01 has occurred and because of the presence of TCE and PCE contamination both upgradient and downgradient of MW01 it is believed at this time that contamination is present. Additional sampling will be necessary to verify the absence or presence of contamination and to adequately delineate vertical distribution within the plume in the vicinity of MW01. Lithologic data collected during the installation of MW01 did not indicate the presence of a confined layer in this portion of the plume.

The greatest concentrations of TCE and PCE were identified in the Leroy well sample (PCE: 36 μg/L and TCE: 7 μg/L) and the Parkdale School well (W3-2) sample (TCE: 7 μg/L). Historical sampling of the impacted municipal well supply indicates the highest concentration of TCE (36.8 μg/L) was found in samples collected from Newmark #4 in 1987, and the highest concentration of PCE, 166 μg/L, was found in samples collected from the same well in 1986. However, since the mid-1980s, a general decrease in concentrations of TCE and PCE has been observed in the Newmark Wellfield wells (Newmark #1 through #4) (see Figure 5-1), while a general increase has been noted downgradient of the Newmark Wellfield, 30th and Mountain View, 31st and Mountain View, Leroy, and Waterman Avenue wells (see Figure 5-1).

7.1.2 Fate and Transport

The contaminants of concern, TCE and PCE, are highly volatile chlorinated hydrocarbons that are relatively insoluble in water. Although exhibiting only low to moderate mobility in soil, these common groundwater contaminants can percolate fairly rapidly through sandy soils to reach underlying groundwater.

The movement of TCE and PCE in groundwater is principally affected by their moderately low solubility in water and their sorption potential or tendency to adsorb onto solid organic matter in the aquifer [commonly defined by the organic carbon partition coefficient (K_{oc}); and the soil/water distribution coefficient (K_d)]. Most chlorinated hydrocarbons, such as TCE and PCE, tend to migrate at rates substantially lower than the velocity of the groundwater. This is a result of the retardation resulting from the compounds' sorption and hydrophobicity. The extent of the retardation, which is mathematically expressed as a retardation factor, can be calculated for a specific compound if certain site-specific soil parameters are known. The velocity of the contaminant is equal to the average groundwater velocity divided by the retardation factor. The calculated retardation factors for TCE and PCE are 1.91 and 2.75, respectively. Therefore, TCE and PCE are expected to migrate at rates of 52 percent and 36 percent of the velocity of the groundwater in the Newmark model area.

Numerous studies have determined that TCE and PCE can be biologically transformed or degraded by acclimated microorganisms present within an aquifer. Based on the data generated during this RI, however, there is no conclusive evidence suggesting that biotransformation may be significantly reducing or contributing to the attenuation of either contaminant in the Newmark plume.

Relatively insoluble organic liquids that are denser than groundwater, such as TCE and PCE, can form a dense non-aqueous phase liquid (DNAPL) that sinks through the aquifer and forms a contaminant pool on top of an underlying aquitard. The possible presence of a DNAPL in the Newmark plume downgradient of the suspected source area was considered, but was not supported by the data gathered during this RI. Monitoring wells MW02B through MW05B were installed at the bedrock contact in the vicinity of the Cat Pit and had the highest likelihood of encountering elevated levels of TCE or PCE indicative of DNAPL's. If DNAPL's were present it would be expected that levels of TCE or PCE approaching 1% of their solubility limits would have seen, or that dissolved levels would increase in the upgradient direction as DNAPL's were approached and then rapidly drop off. However, this does not preclude the possibility of a DNAPL contaminant pool in the areas of the aquifer outside the investigation area.

The project flow model, developed to screen the remedial alternatives, was used to estimate groundwater flow and contaminant movement in the Newmark plume. The model employed MODFLOW, a computer program developed by the U.S. Geological Survey to simulate groundwater flow, and several post-processors to create contours, simulate contaminant pathlines, delineate capture-zones and produce graphics. The model was only capable of simulating the advection processes and thus the simulations do not reflect the effects of other processes, such as dispersion, retardation, and transformation.

The existing Newmark plume is 12,500 feet in length measured from the northeast edge of Shandin Hills, and 6000 feet wide at its widest point. Within 35 years the plume is projected to migrate approximately 7,500 feet resulting in a plume approximately 20,000 feet long and 6,500 feet wide at its widest point.

To estimate the remediation times and rate of migration at the calculated retarded velocities of the contaminants, the average groundwater velocity for an area of the Newmark plume was estimated. Based on this estimated average groundwater velocity (358 ft/yr) and the literature derived retardation factors for the two contaminants, it was estimated that TCE and PCE would migrate at a rate of 187 ft/yr and 130 ft/yr, respectively. The actual contaminant migration is likely to be somewhat faster due to the effects of dispersion.

7.2 DATA LIMITATIONS AND RECOMMENDATIONS FOR FUTURE WORK

The data and subsequent interpretation presented in this RI report are based largely upon a single groundwater sampling event taken from existing well locations which were not located for this type of data collection. Consequently, some uncertainties exist regarding the concentrations of contaminants found in the groundwater samples and the exact distribution of the contaminants in the groundwater within the Newmark plume.

7.2.1 Groundwater

The findings of the elevated levels of total aluminum and total chromium found in the newly installed suspected source area monitoring wells MW03A/B, MW05A, MW06B and MW01 respectively were not anticipated. It is recommended that all of the suspected source area monitoring wells be resampled and that samples collected for metals be field filtered prior to submission for analysis to determine if these elevated aluminum and chromium levels are the result of suspended solids from the drilling fluids and sealing material.

The lateral and vertical distribution of contaminants should be further evaluated prior to completion of the final remedial action. This is required in order to optimize the placement of extraction wells and the pumping interval of these extraction wells. Aquifer parameters developed by the groundwater model (see Appendices J and M) need to be field verified during development of a final remedial action. This is necessary to more accurately predict the response of the aquifer to the final aquifer pumping scenario (see Section 13.0 and Appendix M).

7.2.2 Source Area

A source area was not found nor identified during the course of this investigation, although a potential off-site upgradient source is indicated. Further refinement of the source area should be undertaken prior to finalization of any remedial actions. Additionally, a more complete picture of the bedrock elevations within the suspected source area needs to be developed. This is necessary to more accurately predict where the upgradient contaminants are entering, and how they are moving within the suspected source area.

8.0 REMEDIAL ACTION OBJECTIVES

8.1 IDENTIFICATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND OTHER CRITERIA OR GUIDELINES TO BE CONSIDERED

Applicable or relevant and appropriate requirements (ARARs) are federal environmental and state environmental and facility siting requirements with which a remedial action at a Superfund site must comply. The Comprehensive Environmental Response, Compensation and Liability Act of 1980 as amended by the Superfund Amendments and Reauthorization Act of 1986 (Collectively, CERCLA), and the National Contingency Plan (NCP) require compliance with ARARs. Only state requirements that are more stringent than federal ARARs, and are legally enforceable and consistently enforced statewide may be ARARs.

Pursuant to Section 121(d) of CERCLA, the on-site portion of a remedial action selected for a Superfund site must comply with all applicable or relevant and appropriate requirements (ARARs). Off-site, all requirements legally applicable at the time the action is carried out must be met.

8.1.1 Definition of ARARs and Other Criteria or Guidelines to be Considered (TBCs)

An ARAR may be either "applicable", or "relevant and appropriate", but not both. According to the NCP (40 CFR Section 300), "applicable", "relevant and appropriate", and "to be considered" are defined as follows:

- Applicable requirements are those cleanup standards, standards of control, or other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable.

- <u>Relevant and appropriate requirements</u> are those cleanup standards, standard of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and that are more stringent than federal requirements may be relevant and appropriate.

- <u>Advisories, criteria, guidance or proposed standards to-be-considered (TBC)</u> consist of advisories, criteria, or guidance that were developed by EPA, other federal agencies, or states that may be useful in developing CERCLA remedies. The TBC values and guidelines may be used as EPA deems appropriate.

8.1.2 Identification of ARARs

Neither SARA nor the NCP provides across-the-board standards for determining whether a particular remedy will affect an adequate cleanup at a particular site. Rather, the process recognizes that each site will have unique characteristics that must be evaluated and compared to those requirements that apply under the given circumstances. Therefore, identification of ARARs is done on a site-specific basis.

The ARARs are identified and considered at the following steps in the remedial process:

- As part of the RI/FS scoping
- During the site characterization phase of the RI
- During development of remedial alternatives
- During detailed analysis of the remedial alternatives
- When an alternative is selected
- During the remedial design.

There are several different types of requirements that CERCLA actions may have to comply with: chemical-specific, location-specific, and action-specific. Each type is explained in the following subsections.

Chemical-Specific ARARs

Chemical-specific ARARs are health- or risk-based concentration limits or methodologies for various environmental media (i.e., groundwater, surface water, air, and soil) that are established for a specific chemical that may be present in a specific media at the site, or that may be discharged to the site during remedial activities. A remedy for the Newmark Operable Unit has not been selected. As a result, all chemical-specific ARARs identified in this remedial investigation report are preliminary. ARARs used in remedy selection will be further specified during the feasibility study. A final determination of ARARs for the Newmark OU will be included in EPA's Record of Decision (ROD). In addition, since the remedial action established by the Newmark OU ROD will be an interim action, chemical-specific requirements or clean-up levels that must be achieved in the aquifer by the selected remedial action will not be ARARs for the Newmark OU (See 55 Fed. Reg. 8755.)

The compounds listed in Table 8-1 represent those detected or tentatively detected in groundwater in the Newmark OU. Those compounds that were included in the laboratory analysis but not detected are not listed in the table. The promulgated state and federal chemical-specific standards are listed for those contaminants that have actual standards. Each standard is described below.

EPA has established Maximum Contaminant Levels (MCLs) (40 CFR Section 141) under the Safe Drinking Water Act (SDWA) to protect public health from contaminants that may be found in drinking water sources. MCLs are standards that are enforceable. These requirements are applicable at the tap for water provided directly to 25 or more people or will be supplied to 15 or more service connections. The MCLs are applicable to any water that would be served as drinking water. Under the SDWA, EPA has also designated more stringent requirements for drinking water than MCLs, called Maximum Contaminant Level Goals (MCLGs) (40 CFR Section 141) which are potential ARARs. These standards may be needed in special circumstances where multiple contaminants in groundwater or multiple pathways of exposure present unacceptable health risks.

Table 8-1

POTENTIAL STATE AND FEDERAL CHEMICAL-SPECIFIC ARARs FOR THE NEWMARK OPERABLE UNIT (DECEMBER, 1992)

Chemical	USEPA MCL	USEPA MCLG	Cal EPA (DTSC) MCL
VOCs (μg/l)			
Butene	--	--	--
Carbon Tetrachloride	5	0	0.5
Chloroform	100	--	--
1,1-Dichloroethane	--	--	5
cis-1,2-Dichloroethene	70	70	6
Dichlorofluoromethane	--	--	--
1,2-Dichloropropane	5	0	5
Methylene Chloride	5	0	--
Tetrachloroethene (PCE)	5	0	5
Toluene	1000	1000	--
1,1,1-Trichloroethane	200	200	200
Trichloroethene (TCE)	5	0	5
Trichlorofluoromethane	--	--	150
Metals and Inorganics (μg/l)			
Aluminum	--	--	1000
Arsenic	50	--	50
Barium	2000	2000	1000
Calcium	--	--	--

Table 8-1 (Cont'd.)

POTENTIAL STATE AND FEDERAL CHEMICAL-SPECIFIC ARARs FOR THE NEWMARK OPERABLE UNIT (DECEMBER, 1992)

Chemical	USEPA MCL	USEPA MCLG	Cal EPA (DTSC) MCL
Chromium	100	100	50
Cobalt	--	--	--
Copper	--	--	--
Iron	--	--	--
Lead	15	0	50
Magnesium	--	--	--
Manganese	--	--	--
Mercury	2	2	2
Nickel	100	100	--
Metals and Inorganics (µg/l)			
Potassium	--	--	--
Selenium	50	50	10
Sodium	--	--	--
Thallium	2	0.5	--
Vanadium	--	--	--
Zinc	--	--	--

NOTES:

Source: USEPA, Region 9, Drinking Water Standards and Health Advisories Tables, Updated December, 1992.
MCL = Maximum Contaminant Level
MCLG = Maximum Contaminant Level Goal (40 CFR 141)
MCL for Lead is the Action Level at which Treatment and Public Notification is triggered.
"--" indicates that no MCL or MCLG has been promulgated.

California has also established drinking water standards for sources of public drinking water, under the California Safe Drinking Water Act of 1976, California Code of Regulations, Title 22 ("22 CCR"), Sections 64401 et seq.. In some instances, state MCLs are more stringent than federal MCLs. In these cases, the more stringent state MCLs would be ARARs. There are also some chemicals where state MCLs exist but there are no federal MCLs. These state MCLs are ARARs. A final determination will be made during preparation of the ROD.

The State of California has been authorized to enforce its own hazardous waste regulations (California Hazardous Waste Control Act) in lieu of the federal Resource Conservation and Recovery Act (RCRA) program administered by the EPA. State regulations (in 22 CCR, Division 4.5) are now cited as ARARs instead of the federal RCRA regulations. Spent solvents used in degreasing are listed hazardous wastes (F001) pursuant to 22 CCR Section 66261.31 if the solvent mixture contains a total of 10 percent or more (by volume) of certain halogenated solvents, including tetrachloroethene (PCE). Since the total percent solvent by volume used by potential sources in the Newmark OU is not known, RCRA regulations concerning groundwater are not applicable but may be relevant and appropriate. If the groundwater in the Newmark OU is treated so it no longer contains a hazardous waste, the RCRA regulations no longer apply.

The land disposal restrictions (LDR), 22 CCR Section 66268 will be relevant and appropriate to discharges of contaminated groundwater to land. The remedial alternatives presented do not include land disposal of untreated groundwater, except as may occur through purging monitoring wells. Purge water must be treated to MCLs prior to discharge.

The storage requirements in 22 CCR Sections 66264.170 -.178 will be ARARs for the storage of contaminated groundwater. Air stripping towers are miscellaneous RCRA units. Therefore, the substantive requirements of 22 CCR Sections 66264.600 - .603 may be ARARs for the Newmark OU. The 22 CCR Section 66264.100 corrective action regulations may be TBC for the Newmark OU.

Groundwater monitoring requirements under 22 CCR Section 66264.90 -.98 are applicable if the CERCLA remedial action involves creation of a new disposal unit, when remedial actions are undertaken at existing RCRA units, or where disposal of RCRA hazardous wastes occurs as part of the remedial action. None of these are contemplated at the Newmark OU; therefore, the groundwater monitoring requirements are not applicable but may be relevant and appropriate.

The federal RCRA, passed by Congress in 1976 and amended by the Hazardous and Solid Waste Amendments of 1984, contains several provisions that may be ARARs for the Newmark OU. The EPA's "contained in" principle provides that any non-waste material that contains a listed hazardous waste must be managed as if it were a hazardous waste as long as it continues to contain the listed hazardous waste. RCRA Section 3020 is applicable to reinjection of treated contaminated groundwater into or above a formation which contains an underground source of drinking water.

<u>Location-Specific ARARs</u>

Federal and state location-specific ARARs are restrictions placed on the concentration of a contaminant or the activities to be conducted because they are in a specific location. Examples of special locations possibly requiring ARARs may include flood plains, wetlands, historic places, and sensitive ecosystems or habitants.

The portion of the City of San Bernardino in the vicinity of the Newmark OU has been classified by the Federal Emergency Management Association (FEMA) as an area of "minimal flood hazard", where no part of the community would be inundated by a base flood (see (Figure 2-1). Since the locations addressed in the remedial action alternatives (see Section 10) are outside the floodplain, the Newmark OU is not considered to be in a flood plain and no further consideration of flood plains in remedial planning is necessary.

The requirements of the National Historic Preservation Act will be ARARs for the Newmark OU if the remedy impacts any historic sites protected under the Act. However, at this stage of the Superfund process, no historic preservation ARARs have been identified that would be triggered by potential remedial activities in the Newmark OU.

The California Department of Fish and Game is the implementing agency for the California State Endangered Species Act of 1970 (California Fish and Game Code, Division 3, Chapter 1.5) . This act is similar in layout and scope to the Federal Endangered Species Act of 1973. Although the area affected by the Newmark OU is a developed urban community, the requirements of both of these Acts will be ARARs for the Newmark OU if the remedy impacts any federal or state threatened or endangered species protected under either Act. Division 6, Chapter 2, of the California Fish and Game Code prohibits water pollution with substances that may be deleterious to fish, plants or birds. If any options include direct discharges to surface water, this chapter may become an ARAR. A final determination of these ARARs will be made during preparation of the ROD.

Action-Specific ARARs

Action-specific ARARs are usually technology- or activity-based requirements for remedial activities. The action-specific ARARs presented in this RI/FS report are intended to cover the potential remedial alternatives that may be applied to the Newmark OU. Examples of potential remedial alternatives for groundwater cleanup for the Newmark OU may include groundwater extraction, treatment of the groundwater to remove VOCs (e.g., air stripping with emission control or other approved methods), and reuse of treated water (e.g., distribution as potable water), reinjection within the basin, or disposal to a Publicly Owned Treatment Works (POTW).

An additional action-specific requirement that may be an ARAR for the Newmark OU is treatment of VOCs by techniques such as air stripping, whereby the volatiles are emitted to the atmosphere. The South Coast Air Quality Management District (SCAQMD) has adopted rules that limit air emissions of identified toxics and contaminants. SCAQMD Rule 1401 also requires that best available control technology for toxics (T-BACT) be employed for new stationery operating equipment, so the cumulative carcinogenic impact from air toxics does not exceed the maximum individual cancer risk limit of ten in one million (1×10^{-5}). This T-BACT rule may be an ARAR for the Newmark OU because compounds such as PCE and TCE are present in groundwater, and release of these compounds to the atmosphere may pose health risks exceeding SCAQMD requirements. The SCAQMD Regulation XIII, comprising rules 1301 through 1313, on new source review may also be an ARAR for the Newmark OU.

The SCAQMD also has rules to limit the visible emissions from a point source (Rule 401), which prohibits discharge of material that is odorous or causes injury, nuisance or annoyance to the public (Rule 402), and limits down-wind particulate concentrations (Rule 403). These are potential ARARs for the Newmark OU.

The Regional Water Quality Control Board (RWQCB) has prescribed waste discharge requirements for any recharge of treated water into the basin. These requirements state that, at a minimum, any treated water returned to the basin would have to meet RWQCB Basin Plan objectives for all pollutants identified, such as VOCs, general minerals and metals. These requirements are potential ARARs for the Newmark OU.

For any reinjection that occurs, the reinjected water must meet all action-specific ARARs for such reinjection. ARARs applicable to the reinjected water include the following:

- The Santa Ana Regional Water Quality Control Board's Water Quality Control Plan, which incorporates State Water Resources Control Board Resolution No. 68-16, "Statement of Policy with Respect to Maintaining High Quality of Waters in California."

- The Resource Conservation and Recovery Act (RCRA) Section 3020. This section of RCRA provides that the ban on the disposal of hazardous waste into a formation which contains an underground source of drinking water (set forth in Section 3020(a)) shall not apply to the injection of contaminated groundwater into the aquifer if: (i) such injection is part of a response action under CERCLA; (ii) such contaminated groundwater is treated to substantially reduce hazardous constituents prior to such injection; and (iii) such response action will, upon completion, be sufficient to protect human health and the environment. RCRA Section 3020(b).

In order to comply with these ARARs, any water to be reinjected into the aquifer will have to meet the current MCLs for drinking water for contaminants that are hazardous substances (as defined in CERCLA). In other aquifers in California and other parts of the Bunker Hill Basin, nitrate from agricultural or domestic sources have degraded the water quality. If nitrate values rise above drinking water standards in water extracted by the Newmark OU, the concentration of nitrate in the water to be reinjected would have to be similar to the levels of nitrate concentration in the area of the aquifer where the reinjection will occur. The quality and quantity of the water to be reinjected, as well as the duration of the project, will be considered with respect to the existing water quality. After the remedial alternatives are screened during the feasibility study, EPA will identify the action-specific ARARs.

8.1.3 Identification of Other Guidance and Criteria To-Be-Considered

Other standards, criteria or guidance to-be-considered (TBCs) are federal, state or local advisories or guidance that do not have the status of potential ARARs. If there are no specific federal or state ARARs for a particular chemical or remedial action, or if existing ARARs are not considered sufficiently protective, then guidance or advisory criteria should be identified and used to ensure public health and environmental protection. TBCs may provide health effects information with a high degree of credibility, technical information on performing or evaluating site investigations or remedial actions, and useful policies for dealing with hazardous substances.

Proposed federal MCLs and MCLGs are considered potential TBCs. EPA has also developed Secondary MCLs (SMCLs) (40 CFR Section 143) which are non-enforceable limits designed to establish minimum aesthetic qualities in drinking water. SMCLs and proposed MCLs (Table 8-2) are potential TBCs for the Newmark OU if the remedy includes serving treated groundwater as drinking water. A final determination will be made by EPA during preparation of the ROD.

The state also has Secondary Drinking Water Standards (SDWS - see Table 8-2). SDWSs may be TBCs to the Newmark OU if the remedy includes serving treated groundwater as drinking water. A final determination will be made during preparation of the ROD. The California DHS has established numerical criteria as State Action Levels (SALs) for selected chemicals in drinking water for which state MCLs have not yet been established. DHS has established a policy by which any water system not meeting the SALs is required to take corrective action. SALs may be TBCs for the Newmark OU.

Table 8-2

POTENTIAL STATE AND FEDERAL CHEMICAL-SPECIFIC TBCs FOR THE NEWMARK OPERABLE UNIT (DECEMBER, 1992)

Chemical	USEPA		Cal EPA (DTSC)	
	SMCL	Proposed SMCL	SDWS	SAL
VOCs (μg/l				
Butene	--	--	--	--
Carbon Tetrachloride	--	--	--	--
Chloroform	--	--	--	--
1,1-Dichloroethane	--	--	--	--
cis-1,2-Dichloroethene	--	--	--	--
Dichlorofluoromethane	--	--	--	--
1,2-Dichloropropane	--	--	--	--
Methylene Chloride	--	--	--	40
Tetrachloroethene (PCE)	--	--	--	--
Toluene	--	40	--	100
1,1,1-Trichloroethane	--	--	--	--
Trichloroethene (TCE)	--	--	--	--
Trichlorofluoromethane	--	--	--	150
Metals and Inorganics (μg/l)				
Aluminum	50/ 200	--	1000	--
Arsenic	--	--	--	--
Barium	--	--	--	--
Calcium	--	--	--	--

Table 8-2 (Cont'd.)

POTENTIAL STATE AND FEDERAL CHEMICAL-SPECIFIC TBCs
FOR THE NEWMARK OPERABLE UNIT (DECEMBER, 1992)

Chemical	USEPA		Cal EPA (DTSC)	
	SMCL	Proposed SMCL	SDWS	SAL
Chromium	--	--	--	--
Cobalt	--	--	--	--
Copper	1300	--	--	--
Iron	300	--	--	--
Lead	--	--	--	--
Magnesium	--	--	--	--
Manganese	50	--	--	--
Mercury	--	--	--	--
Metals and Inorganics (μg/l)				
Nickel	--	--	--	--
Potassium	--	--	--	--
Selenium	--	--	--	--
Sodium	--	--	--	--
Thallium	--	--	--	--
Vanadium	--	--	--	--
Zinc	5000	--	--	--
Other USEPA Secondary MCLs				
Color	15 Color Units			
Odor	3 (TON)			
pH	6.5-8.5 pH Units			
Total Dissolved Solids	500 mg/l			

Table 8-2 (Cont'd.)

POTENTIAL STATE AND FEDERAL CHEMICAL-SPECIFIC TBCs FOR THE NEWMARK OPERABLE UNIT (DECEMBER, 1992)

NOTES:

Source: USEPA, Region 9, Drinking Water Standards and Health Advisories Tables, Updated December, 1992.
"--" indicates that no level or standard has been established
SMCL = Secondary Maximum Contaminant Level
SDWS = State of California Secondary Drinking Water Standard
SAL = State of California Action Level

EPA has developed TBC guidance through their Health Effects Advisories (HEAs) for chemicals that may provide the best available standard for a particular chemical where no binding standard exists. As previously stated, TBC standards are not legally binding. Reference doses (RfDs) and cancer potency factors (CPFs) have also been developed for many chemicals. These may be TBCs for the Newmark OU. EPA will make a final determination when the ROD is signed.

The California DHS has developed Applied Action Levels (AALs) intended to be used on the risk appraisal process, not as levels for cleanup. AALs are developed according to procedures outlined in The California Site Mitigation Decision Tree Manual (DHS, 1986). AALs are not ARARs because they are not promulgated. The AALs may be TBCs for the Newmark OU to establish a protective level for those contaminants not having an ARAR or if the ARAR does not establish a protective level. These values are based on maximum acceptable exposure of biological receptors to substances associated with hazardous waste sites and facilities. AALs are derived by considering health effects without dealing with technical feasibility, economic concerns, or other factors. Since AALs are entirely health-based, they are different from standards developed by other agencies and divisions of DHS on both a criterion and use basis.

8.1.4 Summary of ARARs and TBCs

A summary of the ARARs identified for the Newmark OU are listed on Table 8-3. Other standards, guidance, or TBCs have also been identified, and are also included on Table 8-3. A final list of requirements will be identified prior to completion of the ROD for the remedial action that is selected.

8.2 PRELIMINARY BASELINE RISK ASSESSMENT

The EPA, in accordance with the National Contingency Plan (NCP) (40 CFR Part 300), prepared a baseline risk assessment (RA) for the Newmark OU to support the selection of an interim remedial action. The baseline RA is included as Appendix P of this RI/FS. The baseline RA evaluated the potential health effects of the No Action Alternative under an unlikely scenario in which federal and state drinking water standards would not be enforced and residents within the area of the Newmark site would be supplied with contaminated groundwater.

Table 8-3

SUMMARY OF POTENTIAL ARARs AND TBCs for the NEWMARK OPERABLE UNIT

Potential ARARs

Federal Safe Drinking Water Act (SDWA)
- 40 CFR Section 141, Maximum Contaminant Levels (MCLs)
- 40 CFR Section 141, Maximum Contaminant Level Goals (MCLGs)

California Safe Drinking Water Act
- California Code of Regulations, Title 22 ("22 CCR"), Sections 64401 et seq., State MCLs

California Hazardous Waste Control Act [22 CCR, Division 4.5)] :
- 22 CCR Section 66261.31 (definition of listed hazardous waste)
- 22 CCR Section 66264.90 -.97 (groundwater monitoring for new disposal units)
- 22 CCR Section 66264.170 -.178 (storage of contaminated water)
- 22 CCR 264.600 - .603 (Substantive requirements for miscellaneous units - air-stripping towers and GAC units)
- 22 CCR Section 66268 (land disposal restrictions (LDR))

California Fish and Game Code
- Division 3, Chapter 1.5 (endangered species)
- Division 6, Chapter 2 (protecting fish, plants and birds from water pollution)

South Coast Air Quality Management District (SCAQMD)
- SCAQMD Rule 401 (limit the visible emissions from a point source)
- SCAQMD Rule 402 (discharge of material that is odorous or causes injury, nuisance or annoyance to the public)
- SCAQMD Rule 403 (limits down-wind particulate concentrations)
- SCAQMD Regulation XIII, comprising rules 1301 through 1313 (substantive requirements for new source review)
- SCAQMD Rule 1401 (best available control technology for toxics (T-BACT) for new stationery operating equipment)

The Santa Ana Regional Water Quality Control Board's Water Quality Control Plan, (incorporating State Water Resources Control Board Resolution No. 68-16) (maintaining high quality of waters in Bunker Hill Basin)

Federal Resource Conservation and Recovery Act (RCRA) Section 3020 (reinjection of treated contaminated groundwater as part of a response action under CERCLA treated to protect human health and the environment)

Federal Endangered Species Act of 1973

National Historic Preservation Act

Potential TBCs

Proposed federal MCLs and MCLGs

Secondary MCLs (SMCLs) (40 CFR Section 143)

Table 8-3 (Cont'd.)

SUMMARY OF POTENTIAL ARARs AND TBCs for the NEWMARK OPERABLE UNIT

State Secondary Drinking Water Standards (SDWS)

State Action Levels (SALs) numerical criteria

California DHS Applied Action Levels (AALs) (intended to be used on the risk appraisal process)

USEPA Health Effects Advisories (HEAs) (where no binding standard exists for a particular chemical)

USEPA Reference doses (RfDs) and cancer potency factors (CPFs)

California Hazardous Waste Control Act [California Code of Regulations, Title 22 ("22 CCR"), Division 4.5]
- 22 CCR Section 66264.100 corrective action regulations

8.2.1 Background

Potential cancer risks for known or suspected carcinogens are estimated based on the possibility that one additional occurrence of cancer will result from exposure to an individual contaminant or multiple contaminants. A cancer risk estimated at E-06 (one-in-one-million or 10^{-6}) means that for every one million people exposed to the carcinogen(s) throughout their lifetime, the average incidence of cancer is increased by one extra case of cancer. The NCP considers a range of one-in-ten-thousand (E-04) to one-in-one million acceptable at a specific Superfund site, depending upon the site, proposed usage, and chemicals of concern. Within this range, the level of risk which is considered acceptable is a risk management decision and is decided on a case-specific basis.

8.2.2 Chemical Concentrations

Analytical data gathered during the RI were used to identify the chemicals of potential concern (COPCs) and quantify potential exposure levels. The COPCs consisted of nine volatile organic groundwater contaminants: PCE, TCE, cis-1,2-dichloroethene, 1,1,1-trichloroethane, 1,1-dichloroethane, 1,2-dichloropropane, carbon tetrachloride, chloroform, and methylene chloride. Chemical concentrations used to evaluate exposures were based on the arithmetic mean of the groundwater sampling results (see Table 5-3, 5-4, 5-5). For the reasonable maximum exposure (RME) scenario, the upper 95 percent confidence interval on the arithmetic mean was used. Chemical-specific chronic daily intakes (CDIs) were calculated for each COPC by applying the most conservative or upper-bound (95th percentile or maximum) exposure values (e.g., exposure duration, ingestion rate) for both the RME and average exposure scenarios.

8.2.3 Exposure Pathways

Two potential exposure pathways were evaluated: consumption of contaminated drinking water (i.e., oral intake or oral ingestion), and inhalation of airborne vapor-phase contaminants from showering and other exposure-related uses of untreated water (e.g., bathing, washing etc.). The dermal contact exposure pathway was not considered significant, and was not evaluated further or included in the CDI. The inhalation CDI was not specifically calculated, but was conservatively assumed to be equivalent to the daily intake from oral ingestion of 2 liters of the same water.

8.2.4 Quantification of Health Risks

Noncarcinogenic and carcinogenic risks were calculated for each exposure pathway (ingestion, inhalation) and each COPC, and for simultaneous exposure to the aggregate COPCs. A noncarcinogenic effect was determined by comparing the exposure level or intake (CDI) with a reference dose (RfD) derived for a similar exposure. If the CDI/RfD ratio, called the noncancer hazard quotient (HQ) exceeded unity, it was assumed that there may be a concern for potential adverse noncancer health effects.

Noncarcinogenic Risks. For noncarcinogenic effects posed by the aggregate COPCs, a hazard index (HI) approach was used. When the HI, which is equal to the sum of the individual HQs, exceeds unity, is was assumed that there may be a concern for potential health effects.

Carcinogenic Risks. The carcinogenic risks (i.e., the incremental or excess individual lifetime cancer risk) resulting from exposure to the contaminated drinking water were estimated by applying current EPA-approved chemical-and exposure-specific slope factors (SFs). The SF, generally with an upper 95th percentile confidence limit, converts the estimated CDI averaged over a lifetime of exposure to an upper-bound estimated incremental risk of an individual developing cancer. For carcinogenic effects posed by the aggregate COPCs, separate total cancer risks for each exposure pathway were calculated by summing the substance-specific cancer risks.

8.2.5 Estimated Risks - Quantitative Assessment

Noncarcinogenic Health Risks. Exposure levels for both pathways were determined not to exceed the RfDs for any individual COPC (i.e., HQ < 1) or for the sum of all nine COPCs (i.e., HI < 1). For ingestion and inhalation exposures to groundwater contamination equal to the mean COPC concentrations (i.e., average contaminant level), the HI was equal to 0.1 for the ingestion pathway, 0.12 for the inhalation pathway, and 0.22 for both pathways. For the RME scenario, the HI was estimated to be 0.11 for the ingestion pathway and 0.14 for the inhalation pathway. The major contaminant contributing to the noncarcinogenic health risk is PCE.

Carcinogenic Health Risks. The incremental individual excess lifetime cancer risk from ingestion and inhalation exposure to average contaminant levels in the groundwater for all nine COPCs was estimated to be 1.2 E-05, or 1.2 in 100,000, and 3.1 E-06 (3.1 in 1,000,000), respectively. The total cancer risk from exposure to average contaminant levels of all COPCs was estimated at 1.5 E-05 (1.5 in 100,000). The cancer risk from RME to all nine COPCs for the ingestion pathway was estimated to be 1.4 E-05, and 3.3 E-06 for the inhalation pathway, with a total risk of 1.7 E-05, or 1.7 in 100,000. The major contaminant contributing to the cancer risk is PCE.

The total estimated lifetime cancer risk resulting from exposure to groundwater treated to existing federal and state drinking water standards (MCLs) for PCE (5 μg/L) (and applying all other RME exposure values and contaminant levels described above for the other COPCs) was calculated to be 9.4 E-06, or approximately 1 in 100,000.

8.2.6 Ecological Risks

An ecological assessment was conducted to provide a qualitative evaluation of potential risks to the Newmark OU area biota (flora and fauna), or ecological communities, as a result of the contaminated groundwater. The assessment determined that since much of the Newmark OU area is highly developed, there are no significant habitat or wildlife populations (i.e., ecological receptors) present in the area. In addition, there are no indications that the contaminated groundwater reaches the surface or is discharged to surface waters (i.e., no potential pathways).

8.2.7 Conclusions

The current contaminant levels in the Newmark OU aquifer would not meet state or federal drinking water standards (MCLs) if this water were to be delivered directly to local residents without treatment. However, the levels are currently below the concentrations that would pose an unacceptable risk to human health, as defined by CERCLA. Nevertheless, EPA is required to take an action at the Newmark OU in order to meet the MCLs even though the risk levels for the untreated water do not exceed 1 in 10,000.

Given the absence of potential exposure pathways and ecological receptors, there is no expectation for significant impact to the Newmark OU area biota or sensitive ecological communities. The potential ecological risks to undeveloped areas outside of the Newmark OU were not evaluated in the ecological assessment. Nevertheless, plume containment would avoid potential impacts to biota or sensitive ecological communities that may be present outside the Newmark OU.

8.3 REMEDIAL ACTION OBJECTIVES

The Remedial Action Objectives of this FS focus on the chemical contaminants of concern based on the results of the RI. Contaminants of concern are TCE and PCE.

The Remedial Action Objectives are intended to establish general response actions which are then used to evaluate technologies and processes in Sections 10.0 and 11.0. For the purpose of this FS, the Maximum Contaminant Levels (MCLs) are the performance standards. The Remedial Action Objectives for both human health and environmental protection are typical for Superfund sites similar to Newmark.

The two site-specific remedial action objectives are based upon Safe Drinking Water Act (MCLs). The human health Remedial Action Objective was established by EPA. The second Remedial Action Objective, for environmental protection, was assumed in order to provide a design basis for the screening of technologies and evaluation of remedial alternatives to limit further degradation of groundwater.

1) For Human Health: To prevent ingestion of groundwater having trichloroethylene (TCE) in excess of 5 ppb and perchloroethylene (PCE) in excess of 5 ppb.

2) For Environmental Protection: To contain the plume front.

9.0 GENERAL RESPONSE ACTIONS

General response actions describe those actions that may fulfill the Remedial Action Objectives of the Newmark RI/FS. The general response actions for groundwater are grouped into four categories:

- No Action
- Institutional Actions
- Collection/Treatment/Disposal
- Containment

Table 9-1 summarizes the technologies and processes that were evaluated for each of the general response actions. The technologies and processes are discussed in the following sections.

9.1 NO ACTION

The No Action general response action is included in accordance with the National Contingency Plan (NCP) and is used in the alternative development step of the FS to provide a baseline for comparing with other groundwater remediation alternatives. Although it involves no active clean-up of contaminated groundwater, the No Action response action includes a monitoring program for documenting contaminant movement. This response does not meet the remedial objectives.

9.2 INSTITUTIONAL ACTIONS

Institutional actions are implemented to prevent direct human contact with impacted groundwater by restricting the use and development of the aquifer. This response action will accomplish the human health objective by preventing ingestion of impacted groundwater but does not reduce contamination in the aquifer to the levels specified in the environmental protection objective.

Table 9-1

TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER REMEDIAL ACTION OBJECTIVES

Remedial Action Objectives	General Response Action	Technology	Process Option
For Human Health: Prevent ingestion of water having TCE in excess of 5 ppb and PCE in excess of 5 ppb. For Environmental Protection: Reduce groundwater aquifer below 5 ppb for both TCE and PCE.	No Action	Monitoring	Monitoring
	Institutional Actions	Groundwater use restrictions	Alternate water supply
	Collection/Treatment/Disposal Collection	Extraction	Extraction Wells
			Municipal Production Wells
		Subsurface Drains	French Drain
	Treatment	Biological (On-Site)	Aerobic Oxidation
			Anaerobic Digestion
		Physical/Chemical (On-Site)	Aqueous Granular Activated Carbon (GAC)
			Air Stripping with Vapor Phase GAC Treatment of Off-Gas
			Air Stripping with Advanced Oxidation Off-Gas Treatment
			Air Stripping with Off-Gas Treatment by Incineration
			Advanced Oxidation (Ozone)
			Advanced Oxidation (Ozone/Peroxide)
			Advanced Oxidation (UV)
			Reverse Osmosis
			Ion Exchange
			Precipitation
		Off-site	POTW
			RCRA Facility
		In-situ	Biotreatment
			Aeration

Table 9-1 (Cont'd.)

TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER REMEDIAL ACTION OBJECTIVES

Remedial Action Objectives	General Response Action	Technology	Process Option
For Human Health: Prevent ingestion of water having TCE in excess of 5 ppb and PCE in excess of 5 ppb. For Environmental Protection: Reduce groundwater aquifer below 5 ppb for both TCE and PCE.	Treatment (Cont'd.)	In-situ (Cont'd.)	Permeable Treatment Beds
			Chemical Oxidation
	Disposal	On-site Discharge of Treated Water	Reinjection
			Surface Drainage
		Off-site Discharge of Treated Water	POTW
			Municipal Water Supply
	Containment	Vertical Barrier	Slurry Wall
			Grout Curtain
			Steel Sheet Piling

9.3 COLLECTION/TREATMENT/DISPOSAL

The collection/treatment/disposal general response action encompasses a range of actions described below which are grouped together in order to form a complete response action alternative. This response action has the potential to accomplish both human health and environmental objectives to a varying degree depending on how technologies and processes are combined. The degree to which Remedial Action Objectives are accomplished by selected technical collection/treatment/disposal alternatives is fully evaluated in Section 13.0.

9.3.1 Collection

Contaminated groundwater may be collected from the aquifer by extraction wells or subsurface drains. Extraction wells may either be municipal water production wells or wells specifically sited and designed to capture all or part of the contaminated groundwater plume. Both extraction wells and subsurface drains are evaluated in Section 10.0, which presents the results of initial screening of technologies and process options.

9.3.2 Treatment

Treating contaminated groundwater implements one or more methods of biological, physical, and chemical treatment technologies. Groundwater treatment may be completed on-site, off-site or in-situ. The degree and nature of contamination and the effluent specifications dictate the treatment requirements. Implementability of different treatment technologies and processes is affected by the following factors: type of contamination; contaminant concentration; volume of contaminated groundwater; and flow rate of contaminated groundwater.

9.3.3 Disposal

After collection and treatment, the treated groundwater must be disposed in an appropriate manner. Disposal methods may include reinjection into the aquifer, discharge to a publicly owned treatment works (POTW), discharge to a municipal water supply system, application to the ground surface or disposal to a river or drainage channel. Preferably, the disposal method will incorporate a beneficial end use for the treated groundwater.

9.4 CONTAINMENT

Containment methods utilize physical or hydraulic barriers to prevent contact between contaminated groundwater and potential receptors, and to reduce contaminant migration. Containment methods generally require long-term monitoring of groundwater quality.