DEVELOPMENT OF PRESIDIO-WIDE CLEANUP LEVELS FOR SOIL, SEDIMENT, GROUNDWATER, AND SURFACE WATER

PRESIDIO OF SAN FRANCISCO, CALIFORNIA

Prepared for:

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LIST OF ACRONYMS/ABBREVIATIONS

§	Section
1,2-DCA	1,2-dichloroethane
2,4-D	2,4-dichlorophenoxyacetic acid
AA	graphite furnace atomic absorption
ABS	absorption factor
ACM	asbestos-containing material
AF	soil adherence factor
ARAR	Applicable or Relevant and Appropriate Requirement
Army	United States Department of Defense, Department of the Army
Army FS	*Final Feasibility Study Report, Presidio Main Installation, Presidio of San Francisco*, prepared by Dames & Moore, 1997
AT	averaging time
ATSDR	United States Department of Health and Human Services, Agency for Toxic Substances and Disease Registry
AUF	area use factor
BAAQMD	Bay Area Air Quality Management District
BAF	bioaccumulation factor
BAT	Best Available Technology
bgs	below ground surface
BRAC	Base Realignment and Closure Act
BTAG	U.S. EPA Region IX Biological Technical Advisory Group
BTEX	benzene, toluene, ethylbenzene, and xylenes
BW	body weight
CCR	California Code of Regulations
CCME	Canadian Council of Ministers of the Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CF	conversion factor
CFR	Code of Federal Regulations
COC	chemical of concern
Contd	continued
Cr(III)	trivalent chromium
Cr(VI)	hexavalent chromium

LIST OF ACRONYMS/ABBREVIATIONS

CTR	California Toxics Rule
DEH	Directorate of Engineering and Housing
dicamba	3,6-dichloro-2-methoxybenzoic acid
DIR	total dietary ingestion rate
DOD	United States Department of Defense
DOE	United States Department of Energy
DTSC	California Environmental Protection Agency, Department of Toxic Substances Control
EBEP	SWRCB *California Enclosed Bays and Estuaries Plan, Water Quality Control Plan for Enclosed Bays and Estuaries of California*, dated 11 April 1991
Eh	oxidation-reduction potential
EKI	Erler & Kalinowski, Inc.
EqP	equilibrium partitioning
EPC	exposure point concentration
FD	field duplicate
FPALDR	Montgomery Watson *Fuel Product Action Level Development Report*, dated October 1995
FS	Feasibility Study
gm	gram
GMPA	NPS *General Management Plan Amendment*, dated July 1994
HEAST	Health Effects Assessment Summary Tables
HI	hazard index
HQ	hazard quotient
ICP	inductively coupled plasma
$Intake_i$	Intake (or dose) from pathway *i*
IRIS	Integrated Risk Information System
ISQG	interim sediment quality guideline
ISWP	SWRCB *California Inland Surface Waters Plan, Water Quality Control Plan for Inland Surface Waters of California*, dated 11 April 1991
IT Corporation	International Technology Corporation
kg	kilogram

LIST OF ACRONYMS/ABBREVIATIONS

L	liter
LOAEL	lowest-observed-adverse-effect level
LOEC	lowest-observed-effects-concentration
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MCPP	2-(4-chloro-*o*-to(yl)oxy)propionic acid
µg	microgram
µg/dl	micrograms per deciliter
µg/kg	microgram/kilogram
µg/L	microgram per liter
mg	milligram
mg/kg	milligram per kilogram
mg/L	milligram per liter
mV	millivolt
NCEA	National Center for Environmental Assessment
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEIC	U.S. EPA National Enforcement Investigations Center
NOAA	National Oceanic and Atmospheric Administration
NOAEL	no-observed-adverse-effect-level
NOEC	no-observed-effects-concentration
NPS	United States Department of the Interior, National Park Service
OEHHA	California Environmental Protection Agency, Office of Environmental Health Hazard Assessment
ORNL	Oak Ridge National Laboratory, U.S. Department of Energy
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
PA	Preliminary Assessment
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCOC	potential chemical of concern
PEA	Preliminary Endangerment Assessment

LIST OF ACRONYMS/ABBREVIATIONS

PEC	probable effects concentration
PEL	probable effect level
PHGs	Drinking Water Public Health Goals
PHSH	Public Health Service Hospital
Presidio	Presidio of San Francisco
Presidio soil	serpentinite, Colma Formation, and beach/dune sand
PRG	Preliminary Remediation Goal
PRG_c	PRG based on carcinogenic effects
PRG_{nc}	PRG based on non-carcinogenic effects
Proposition 65	Safe Drinking Water and Toxic Enforcement Act
PTMP	*Presidio Trust Management Plan, Land Use Policies for Area B of the Presidio of San Francisco*, dated May 2002 (presents Trust's vision for use of Area B of the Presidio)
RAB	Restoration Advisory Board
RAO	Remedial Action Objective
RAP	Remedial Action Plan
RBSL	Risk-based Screening Level
RCRA	Resource Conservation and Recovery Act
Revised Final FS Report	*Revised Final Feasibility Study Report for Main Installation Sites*
RfD	Reference Dose
RI	Remedial Investigation
RME	reasonable maximum exposure
ROD	Record of Decision
RTECS	Registry of Toxic Effects of Chemical Substances, National Institute for Occupational Safety and Health
RWQCB	California Environmental Protection Agency, Regional Water Quality Control Board, San Francisco Bay Region
SA	surface area
SDWA	Safe Drinking Water Act
SF	slope factor
Soil Lead Guidance	*Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities*, U.S. EPA, 14 July 1994

LIST OF ACRONYMS/ABBREVIATIONS

soil/sed	soil and sediment
SQB	sediment quality benchmark
SQC	sediment quality criterion
Superfund	collectively refers to CERCLA and SARA
SVOC	semivolatile organic compound
SWRCB	California Environmental Protection Agency, State Water Resources Control Board
TBV	Toxicity benchmark value
TCE	trichloroethene
TEC	threshold effects concentration
TIC	tentatively identified compound
TPH	total petroleum hydrocarbons
TOXNET	National Library of Medicine Toxicity Data Network
Trust	The Presidio Trust
TSCA	Toxic Substances Control Act
U.S. EPA	United States Environmental Protection Agency
VOC	volatile organic compound
VMP	NPS and Trust *Vegetation Management Plan and Environmental and Assessment for the Presidio of San Francisco*, dated May 2001

1. EXECUTIVE SUMMARY

1. EXECUTIVE SUMMARY

The Presidio Trust ("Trust") is in the process of transforming the Presidio of San Francisco ("Presidio") from an Army base to a financially self-sufficient National Park. To successfully complete the conversion, some remedial activities must be performed to address environmental issues from previous land uses and activities. This document presents the approach to develop cleanup levels and the framework to apply these cleanup levels to chemical release sites at the Presidio. These cleanup levels are anticipated to be applied to new decision documents at the Presidio.

The Trust has been working to develop cleanup levels with representatives of the Department of the Interior, National Park Service ("NPS"), California Environmental Protection Agency, Department of Toxic Substances Control ("DTSC"), United States Environmental Protection Agency ("U.S. EPA"), California Environmental Protection Agency, Regional Water Quality Control Board, San Francisco Bay Region ("RWQCB"), and community members of the Restoration Advisory Board ("RAB"). This document summarizes the derivation of human health and ecological cleanup levels for soil, sediment, groundwater, and surface water at the Presidio, and the development of background metal concentrations at the Presidio. This document presents for approval by regulatory agencies the proposed methodology for determining Presidio-specific cleanup levels based on the protection of human health and ecological receptors for a wide range of chemicals that may potentially be encountered in soil, sediment, and water at the Presidio.

The Presidio-specific cleanup levels presented in this document are based on site-specific preliminary remediation goals ("PRGs") calculated for the Presidio, and chemical-specific Applicable or Relevant and Appropriate Requirements ("ARARs") for potential chemicals of concern ("PCOCs") detected in various media at the Presidio. Chemical-specific ARARs and site-specific PRGs are compared to naturally occurring or background concentrations of metals in soil to establish cleanup levels for use at all areas of the Presidio. Also presented in this document are the procedures to determine which specific cleanup levels are applicable to a given chemical release site.

The cleanup levels developed in this document are anticipated to be applied to new decision documents at the following Presidio Operable Units ("OUs"): the Main Installation, Firing Ranges, Miscellaneous Sites, Basewide Cumulative Effects, as well as any unknown sites encountered in the future, and lead-based paint in soil. Petroleum program sites are technically covered by RWQCB Site Cleanup Requirements specified in Order No. 96–070, as described in Section 3. However, the cleanup levels presented in this document comply with Order No. 96–070, so this cleanup level document also applies to petroleum program sites and petroleum sites with CERCLA components.

2. INTRODUCTION

2. INTRODUCTION

This document presents the development and application of cleanup levels at chemical release sites at the Presidio. To develop cleanup levels, the Trust has been working with representatives of the NPS, DTSC, U.S. EPA, and RWQCB, and RAB community members. This document summarizes the derivation of human health and ecological cleanup levels for soil, sediment, groundwater, and surface water at the Presidio, and the development of background metal concentrations at the Presidio. The Presidio-specific cleanup levels are based on site-specific PRGs calculated for the Presidio, and chemical-specific ARARs for PCOCs detected in various media at the Presidio. Chemical-specific ARARs and site-specific PRGs are compared to naturally occurring or background concentrations of metals in soil to establish cleanup levels for use at all areas of the Presidio.

ARARs are laws, requirements, or other cleanup standards that pertain to the chemical release at a site. Chemical-specific ARARs for PCOCs identified at the Presidio are discussed in Section 3 and have been adopted as cleanup levels, when available and greater than naturally occurring or background concentrations of metals in soil and water. In the absence of such ARARs, Presidio-specific risk-based PRGs derived in Sections 4 and 5 are used as cleanup levels if the PRGs are greater than background concentrations of metals. Background concentrations of metals need to be considered in establishing cleanup levels because it is impracticable to remediate releases of metals to less than naturally occurring concentrations. Background concentrations of metals in soil and water are addressed in Section 6.

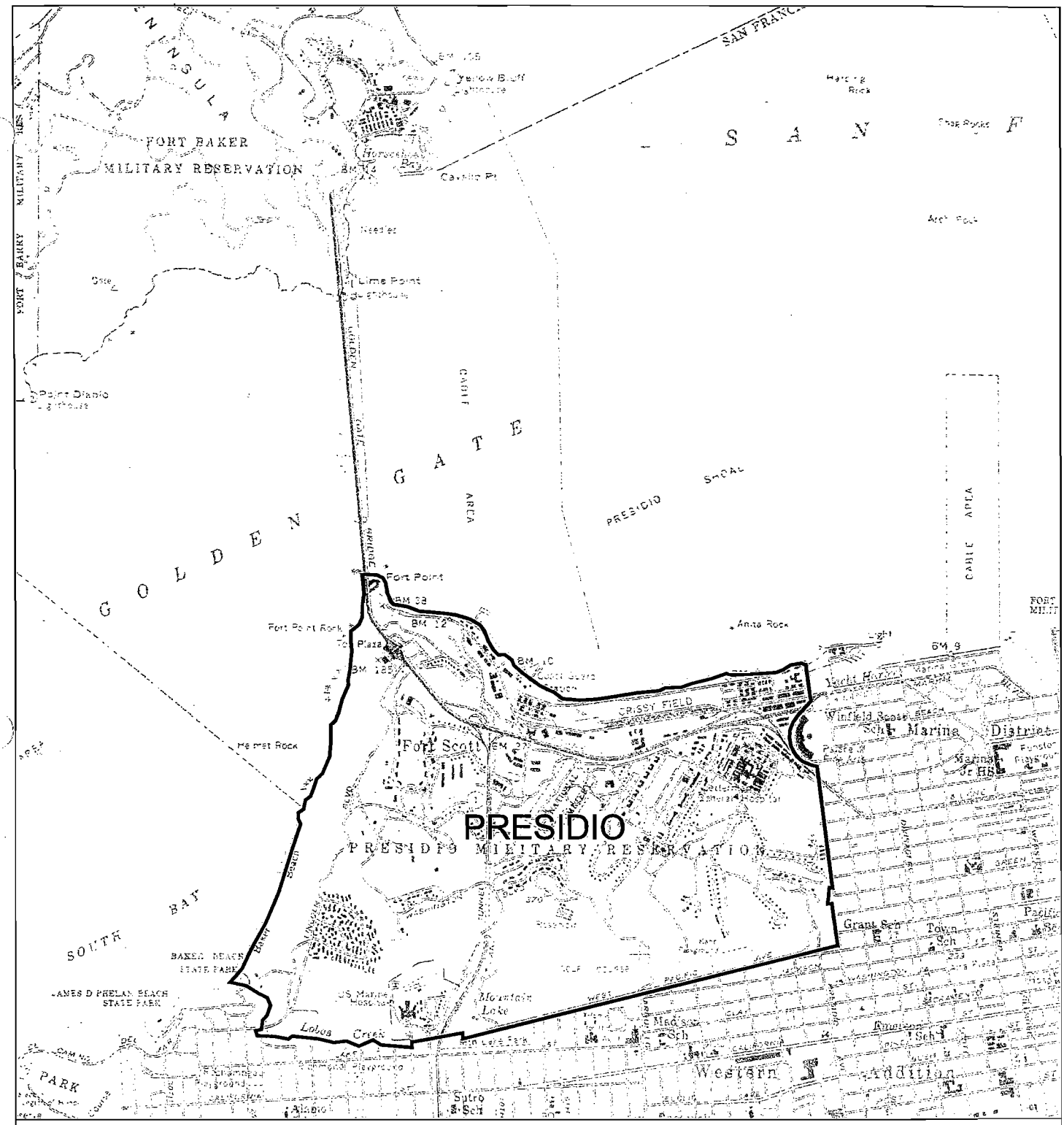
As part of its environmental restoration efforts, the Trust retained Erler & Kalinowski, Inc. ("EKI") to prepare a Revised Final Feasibility Study Report for Main Installation sites ("Revised Final FS Report") at the Presidio. In the process of preparing the Revised Final FS Report, the Trust identified a need to establish cleanup levels for soil, sediment, and groundwater at identified sites to determine if remediation is required, and if so, to what level. This Presidio-wide Cleanup Level Document presents the steps taken to create cleanup levels for Main Installation sites as well as other sites at the Presidio. Figure 2-1 is a vicinity map showing the location of the Presidio; Figure 2-2 shows known CERCLA sites within the Presidio. The list of PCOCs included in this document is based on the chemicals detected in soil, sediment, groundwater, and surface water samples collected at Main Installation and Public Health Service Hospital sites, as included in the database given to the Trust by the Army and as augmented with analytical data collected by the Trust.[1] This list of PCOCs also includes chemicals that have been detected at the Firing Ranges and at petroleum release sites.

[1] Data that were excluded from the database used to create the PCOC list include the following: (a) results from non-representative media (e.g., wipe samples), (b) tentatively identified compounds (TICs), (c) surrogates added by the laboratory during analysis, (d) inorganic chemicals unrelated to chemical releases (e.g., major elements in the earth's crust), (e) common water quality parameters (e.g., hardness), (f) phthalates, which were determined to be laboratory contaminants, and (g) unreliable or rejected data.

The key factors that are used to develop cleanup levels are background metal concentrations, human health exposure, and ecological exposure. Background metals concentrations are based on the predominant soil lithologies encountered within the Presidio. Thus, for any given site, the applicable cleanup level incorporates the planned land use (residential, recreational, institutional, or commercial/industrial), the predominant soil or sediment lithology, and potential ecological species present (including the presence of special-status species). In addition, some cleanup levels, particularly for petroleum hydrocarbons and related constituents, are determined by Presidio-wide Site Cleanup Requirements as adopted in RWQCB Order No. 96–070 ("Order"). The Order allows varying cleanup levels depending on the existing and future use, depth to groundwater, and the Presidio drainage basin.

Chemical-specific ARARs, Presidio-specific risk-based PRGs, and background metals concentrations are combined in Section 7 to develop the Presidio-wide cleanup levels. Also presented in Section 7 is the framework used to identify the specific cleanup levels that will apply to a given Presidio site based on the specific characteristics of an individual site (e.g., human land use, presence of sensitive ecological species, predominant lithology). These site-specific cleanup levels can then be used to identify chemicals of concern ("COCs"), followed by an assessment of required remedial actions.

FIGURES



Reference: U.S.G.S. Topographic Maps, San Francisco North and Point Bonita, Photorevised 1973.

Note:

1. All locations are approximate.

N

0 1/2 1

(Approximate Scale in Miles)

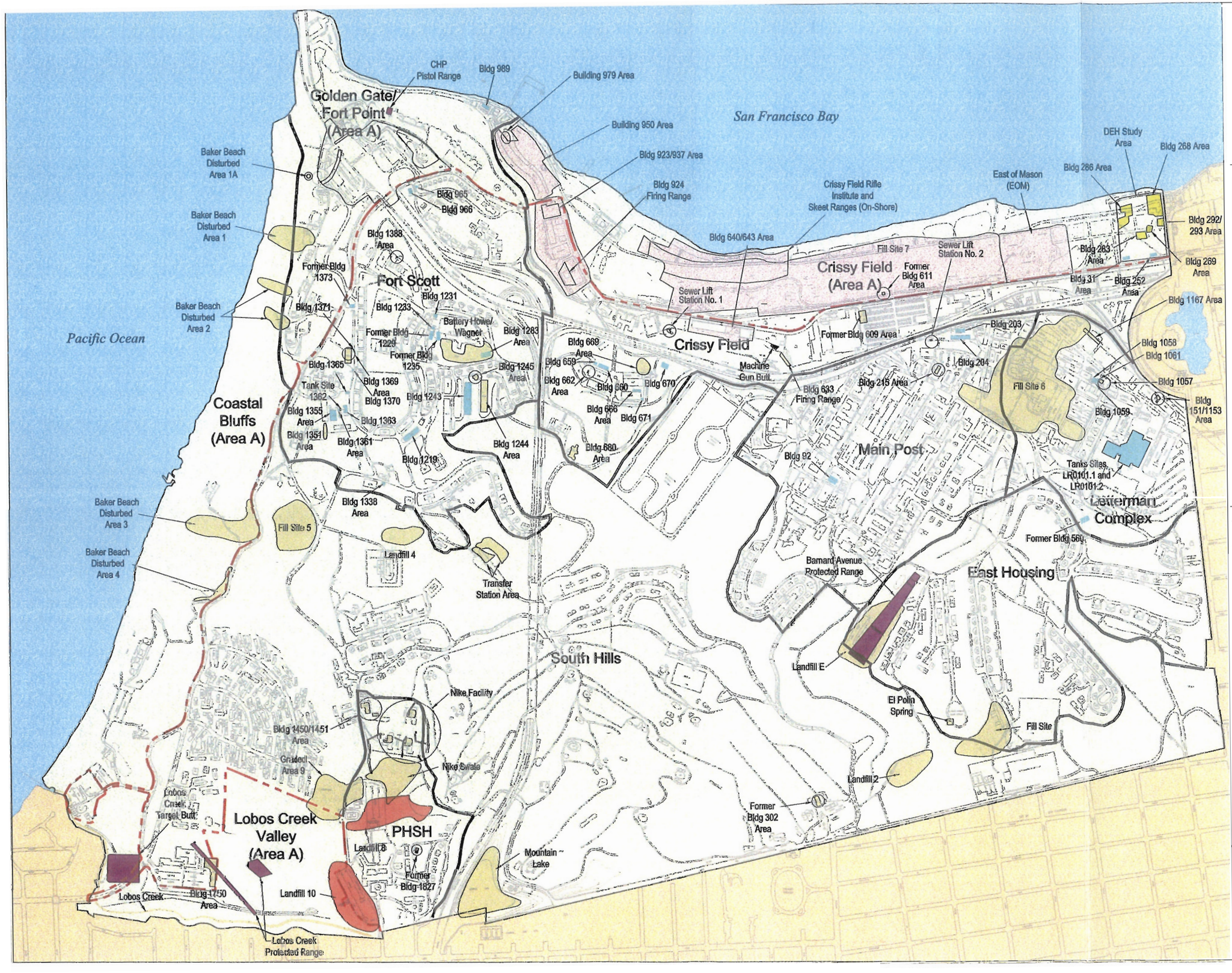
Erler & Kalinowski, Inc.

Vicinity Map

THE PRESIDIO TRUST

Presidio Trust
San Francisco, CA
September 2002
EKI A000003.04

Figure 2–1



Notes:

1. All locations are approximate.
2. Basemap developed from site plan provided by the Presidio Trust.
3. PHSH is the Public Health Service Hosiptal.
4. "OU" is an "Operable Unit".
5. Site boundaries are approximate. For individual tank sites or smaller sites, the associated building is shaded.
6. The Army identified 35 additional potential chemical release sites. These sites are mapped in OU6, but need a site inspection to determine their status.

Erler & Kalinowski, Inc.

Operable Units being Addressed by The Presidio Trust

Presidio Trust
San Francisco, CA
October 2002
EKI A000003.04

Figure 2-2

3. CHEMICAL-SPECIFIC ARARS

3. CHEMICAL-SPECIFIC ARARS

This section identifies some potential chemical-specific ARARs that may be applicable to some Presidio sites. This discussion is not intended to be a complete evaluation of all potential ARARs for all sites at the Presidio; such an evaluation will be included in future decision documents. However, ARARs warrant discussion because the National Oil and Hazardous Substances Pollution Contingency Plan ("NCP") at 40 CFR §300.430(f)(1)(i)(A) provides that releases of hazardous substances at a site be cleaned up to meet ARARs, unless circumstances for a waiver exist. ARARs are used in conjunction with risk-based cleanup goals to establish cleanup levels as part of Remedial Action Objectives ("RAOs") for a site. According to U.S. EPA (1991b), "ARARs represent the minimum that a remedy must attain; it may sometimes be necessary, where there are multiple contaminants with potentially cumulative and synergistic effects, to go beyond what ARARs require to ensure that a remedy is protective."

If available, chemical–specific ARARs were used to establish cleanup levels for water and soil for protection of human health and the environment. Table 3-1 provides a summary of numerical values of potential chemical-specific ARARs for Presidio sites. Not all of these requirements will be an ARAR at every site; other location- or action-specific ARARs may also apply, and, in fact, may be more stringent than the chemical-specific ARARs listed. Section 3.1 addresses potential ARARs in water, seeps, and groundwater, and Section 3.2 addressees potential ARARs in soil. RWQCB Order 96-070 is a specific ARAR for petroleum sites that addresses petroleum hydrocarbons and related constituents in both soil and water; therefore ARARs for petroleum hydrocarbons are presented in Section 3.3. In the development of future decision documents, additional chemical-specific ARARs may be identified and used as cleanup levels.

3.1 POTENTIAL CHEMICAL-SPECIFIC ARARS FOR WATER

For groundwater and surface water, promulgated Maximum Contaminant Levels ("MCLs") or published action levels have been adopted as cleanup levels to protect human health due to groundwater ingestion (U.S. EPA, 2000d). These are listed in Table 3-1. Maximum Contaminant Level Goals ("MCLGs") are the level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals. MCLGs are also listed in Table 3-1. MCLs are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration.

The California Environmental Protection Agency's Office of Environmental Health Hazard Assessment ("OEHHA") has prepared Drinking Water Public Health Goals ("PHGs") for many contaminants in drinking water. In February 1999 OEHHA prepared a PHG for chromium in drinking water, setting a goal of 2.5 µg/L. In November 2001, the chromium PHG was withdrawn by OEHHA because the PHG was calculated using a

study that was determined to have flawed data and should not be used as a basis for health risk assessments. According to OEHHA's webpage, there is uncertainty regarding the carcinogenicity by the oral route. OEHHA is in the process of developing a PHG for hexavalent chromium ("Cr(VI)"). Like MCLGs, PHGs are not enforceable.

Promulgated water quality criteria were applied to existing and planned freshwater surface bodies, and groundwater that recharges surface water or emerges as seeps. Existing surface water bodies at the Presidio include Mountain Lake, Crissy Field wetlands, and Lobos Creek. In addition, Tennessee Hollow and Dragonfly Creek are recognized surface water resources of the Presidio and will be treated as such in applying cleanup levels. Water quality criteria adopted as cleanup levels for surface water and groundwater that recharges surface water at the Presidio are intended to protect freshwater aquatic organisms, marine organisms, and humans who may drink the water and consume fish or other organisms inhabiting the water bodies from chronic exposure to PCOCs. Water quality criteria adopted as cleanup levels for freshwater seeps at the Presidio are intended to protect freshwater aquatic organisms from chronic exposure to PCOCs. Seeps observed at the Presidio are not considered potential habitat that would support fish or other organisms that could be consumed by humans. Water quality criteria used to establish surface water, groundwater recharge to surface water, and seep cleanup levels are listed in Table 3-1 and were obtained from the following sources:

- RWQCB Water Quality Control Plan, San Francisco Bay Basin, ("Basin Plan") amended 16 April 1997.

- Title 40 of the Code of Federal Regulations ("CFR") §131.38, *Establishment of Numerical Criteria for Priority Toxic Pollutants for the State of California*, also known as the California Toxics Rule ("CTR").

3.2 POTENTIAL CHEMICAL-SPECIFIC ARARS FOR SOIL

Chemical-specific ARARs for soil are available for only a limited number of contaminants. Cleanup levels for lead, polychlorinated biphenyls ("PCBs"), and volatile organic compounds ("VOCs") in soil are based on the more stringent of ARARs and risk-based PRGs. Cleanup levels for petroleum hydrocarbons and related constituents in soil and water at the Presidio are derived from ARARs as described below. Cleanup levels for remaining PCOCs in soil are risk-based PRGs or, in the case of metals, background concentrations if naturally occurring levels of metals in soil are greater than PRGs. Background concentrations of metals in serpentinite, chert/shale, Colma Formation, and beach/dune sand are described in Section 6. Serpentinite, Colma Formation, and beach/dune sand are the main lithologies encountered at the Presidio. Chert/shale is believed to have been imported to the Presidio by the Army for use as fill material.

In its *Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities* (U.S. EPA, 1994), U.S. EPA recommends using a screening level of 400 mg/kg of lead in soil for residential scenarios. The 5 January 2001 *Federal Register*

stated that effective 6 March 2001, the Toxic Substance Control Act ("TSCA") was amended to establish a hazard standard of 400 mg/kg lead in bare residential soil. A cleanup level of 400 mg/kg of lead in soil is being used as a not-to-exceed value for residential areas at the Presidio.[2]

Requirements governing cleanup of PCB-containing soil and wastes were broadened by amendments to TSCA in 1998. As part of these amendments, U.S. EPA added 40 CFR §761.61 to Subpart D of TSCA, which provides cleanup and disposal provisions for PCB-containing soil and other types of remediation wastes. This section of Subpart D sets cleanup levels for high occupancy areas (e.g., residence) at 1 mg/kg of PCBs in soil. The TSCA value of 1 mg/kg for PCBs in soil is compared with the Presidio-specific human health PRGs for PCBs (see Section 4). The more stringent of the ARAR of 1 mg/kg or the Presidio-specific human health PRGs for PCBs is being used as the human health cleanup level.

In December 2001 RWQCB (2001a) released interim final soil and groundwater risk-based screening levels ("RBSLs") for over 100 chemicals commonly found at sites where releases of hazardous substances have occurred. RBSLs are generally not cleanup levels. RBSLs are used to evaluate whether a chemical release may pose a risk at the site that warrants further investigation. In addition, RBSLs can be used, if appropriate, as cleanup levels if site-specific cleanup levels are not available.

For VOCs, the RBSLs were used to incorporate potential risks due to vapor intrusion into indoor air and protection of groundwater due to leaching to groundwater, in addition to direct contact with soil which is addressed by the Presidio-specific human health PRGs developed in Section 4. RBSL values for VOCs for indoor air and potential leaching to groundwater are summarized in Table 3-2.

3.3 POTENTIAL CHEMICAL-SPECIFIC ARARS FOR PETROLEUM HYDROCARBONS

RWQCB issued Order No. 96-070 - *Site Cleanup Requirements for the Cleanup of Petroleum Impacted Soil* to the Army in 1996 (RWQCB, 1996). In this order, the Tennessee Hollow riparian corridor, the Crissy Field wetlands, and a 150-foot buffer zone along the Crissy Field shoreline were identified as sensitive habitats requiring more stringent petroleum hydrocarbon cleanup levels than elsewhere on the Presidio. The area where more stringent cleanup levels apply to the Tennessee Hollow riparian corridor is designated as the freshwater ecological protection zone. The area where more stringent cleanup levels apply to the Crissy Field wetlands and shoreline is designated as the saltwater ecological protection zone.

[2] A Presidio-specific Preliminary Remediation Goal ("PRG") for lead in soil at residential sites has been developed in Section 4. This Presidio-specific PRG will be used as the maximum average lead concentration in soil at residential sites.

The Army conducted several studies and worked closely with RWQCB to develop cleanup levels for petroleum hydrocarbons and related constituents at the Presidio. Human health and ecological cleanup levels for soil and groundwater were developed by Montgomery Watson and presented in its *Fuel Product Action Level Development Report* ("FPALDR"), (Montgomery Watson, 1995). Soil cleanup levels in the FPADLR were subsequently adopted by the RWQCB in Order No. 96-070 for all areas of the Presidio except the freshwater and ecological protection zones. The RWQCB requested that the Army conduct bioassay studies to develop cleanup levels for the saltwater ecological protection zone. International Technology ("IT") Corporation (1997) conducted these studies on behalf of the Army and proposed saltwater and sediment cleanup levels for protection of marine organisms. The Army worked collaboratively with RWQCB to develop cleanup levels for the freshwater protection zone. RWQCB conducted bioassay studies, and Montgomery Watson (1999b) interpreted the results and reviewed toxicological data published in scientific literature, which led to the proposal of freshwater and sediment cleanup levels for protection of freshwater aquatic organisms. Cleanup levels for petroleum hydrocarbons and related constituents developed in connection with Order No. 96-070 have been adopted for the Presidio, and are listed in Table 3-3.

TABLES

TABLE 3-1
NUMERIC VALUES OF POTENTIAL CHEMICAL-SPECIFIC ARARs
FOR WATER AT PRESIDIO SITES (a)

Presidio of San Francisco, California

Potential Chemical of Concern	Clean Water Act					Safe Drinking Water Act		
	RWQCB Basin Plan Surface Water Quality Objectives		California Toxics Rule			Drinking Water Standards		
	Salinity Greater than 5 parts-per-thousand (µg/L); (b)	Salinity Less than 5 parts-per-thousand (µg/L); (b)	Freshwater (µg/L); (c)	Saltwater (µg/L); (c)	Human Health Risk (µg/L); (c)	Maximum Contaminant Levels ("MCLs") (µg/L); (d)	Maximum Contaminant Level Goals ("MCLGs") (µg/L); (d)	Secondary MCLs (µg/L); (d)
Inorganic Chemicals								
Antimony	- (e)	-	-	-	14	6	6	-
Arsenic	36	190	190	36	-	10	-	-
Barium	-	-	-	-	-	1,000	-	-
Beryllium	-	-	-	-	-	4	4	-
Cadmium	9.3	1.1 (f)	1.1 (f)	9.3	-	5	5	-
Trivalent Chromium	-	-	180	-	-	-	-	-
Hexavalent Chromium	50	11	11	50	-	-	-	-
Total Chromium	50	11	11	50	-	50 (g)	-	-
Cobalt	-	-	-	-	-	-	-	-
Copper	4.9	11.8 (f)	7	2.9	1,300	1,300 (h)	-	1,000
Cyanide	5	5.2	5	5.2	700	200	200	-
Lead	5.6	3.2 (f)	3.2 (f)	5.6	-	15 (h)	0	-
Tetraethyl lead	-	-	-	-	-	-	-	-
Mercury	0.025	0.025 (i)	0.025 (i)	0.025	0.05	2	2	-
Molybdenum	-	-	-	-	-	-	-	-
Nickel	8.3	158 (f)	56	7.1	610	100	-	-
Selenium	-	-	5	71	-	50	50	-
Silver	2.3	4.1 (f)	1.2	2.3	-	50 (m)	-	100
Thallium	-	-	-	-	1.7	2	0.5	-
Vanadium	-	-	-	-	-	-	-	-
Zinc	58	106 (f, j)	58	58	-	-	-	5,000
Semivolatile Organic Compounds								
Acenaphthene	-	-	-	-	1,200	-	-	-
Acenaphthylene	-	-	-	-	-	-	-	-
Anthracene	-	-	-	-	9,600	-	-	-
Benzo(a)anthracene	-	-	-	-	0.0044	0.1 (k)	0 (k)	-
Benzo(a)pyrene	-	-	-	-	0.0044	0.2	0	-
Benzo(b)fluoranthene	-	-	-	-	0.0044	0.2 (k)	0 (k)	-
Benzo(g,h,i)perylene	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	-	-	-	-	0.0044	-	-	-
Benzyl alcohol	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	1.8	4	0	-
Chrysene	-	-	-	-	0.0044	-	-	-
Dibenzo(a,h)anthracene	-	-	-	-	0.0044	-	-	-
Dibenzofuran	-	-	-	-	-	-	-	-

TABLE 3-1
NUMERIC VALUES OF POTENTIAL CHEMICAL-SPECIFIC ARARs FOR WATER AT PRESIDIO SITES (a)

Presidio of San Francisco, California

Potential Chemical of Concern	Clean Water Act					Safe Drinking Water Act		
	RWQCB Basin Plan Surface Water Quality Objectives		California Toxics Rule			Drinking Water Standards		
	Salinity Greater than 5 parts-per-thousand (µg/L); (b)	Salinity Less than 5 parts-per-thousand (µg/L); (b)	Freshwater (µg/L); (c)	Saltwater (µg/L); (c)	Human Health Risk (µg/L); (c)	Maximum Contaminant Levels ("MCLs") (µg/L); (d)	Maximum Contaminant Level Goals ("MCLGs") (µg/L); (d)	Secondary MCLs (µg/L); (d)
emivolatile Organic ompounds								
luoranthene	-	-	-	-	300	-	-	-
luorene	-	-	-	-	1,300	-	-	-
ideno(1,2,3-c,d)-pyrene	-	-	-	-	0.0044	-	-	-
-methylnaphthalene	-	-	-	-	-	-	-	-
-methylphenol (p-Cresol)	-	-	-	-	-	-	-	-
aphthalene	-	-	-	-	-	-	-	-
-doctriacontane	-	-	-	-	-	-	-	-
-hentriacontame	-	-	-	-	-	-	-	-
-nitrosodiphenylamine	-	-	-	-	5	-	-	-
-triacontane	-	-	-	-	-	-	-	-
entachlorophenol	-	-	15	7.9	0.28	1	0	-
henanthrene	-	-	-	-	-	-	-	-
henol	-	-	-	-	21,000	1 (m)	-	-
olycyclic aromatic ydrocarbons	0.031	0.031	-	-	-	-	-	-
yrene	-	-	-	-	960	-	-	-
'olatile Organic 'ompounds								
.cetone	-	-	-	-	-	-	-	-
romodichloromethane	-	-	-	-	0.56	80	0	-
-butanone (MEK)	-	-	-	-	-	-	-	-
'arbon disulfide	-	-	-	-	-	-	-	-
'arbon tetrachloride	-	-	-	-	0.25	0.5	0	-
'hlorodibromomethane	-	-	-	-	0.401	80	60	
'hloroform	-	-	-	-	-	80	0	
'hloromethane	-	-	-	-	-	-	-	-
,4-dichlorobenzene	-	-	-	-	400	5	5	5
,2-dichloroethane	-	-	-	-	0.38	0.5	0	-
,1-dichloroethene	-	-	-	-	0.057	6	6	-
-Isopropyltoluene (p-cymene)	-	-	-	-	-	-	-	-
'ethylene chloride	-	-	-	-	4.7	5	0	-
'etrachloroethene	-	-	-	-	0.8	5	0	-
,2,3-trichlorobenzene	-	-	-	-	-	-	-	-
,2,4-trichlorobenzene	-	-	-	-	-	70	70	-
'richloroethene	-	-	-	-	2.7	5	0	-
,1,1-trichloroethane	-	-	-	-	-	200	200	-
'richlorofluoromethane	-	-	-	-	-	150	-	-

TABLE 3-1
NUMERIC VALUES OF POTENTIAL CHEMICAL-SPECIFIC ARARs
FOR WATER AT PRESIDIO SITES (a)

Presidio of San Francisco, California

Potential Chemical of Concern	Clean Water Act					Safe Drinking Water Act		
	RWQCB Basin Plan Surface Water Quality Objectives		California Toxics Rule			Drinking Water Standards		
	Salinity Greater than 5 parts-per-thousand (µg/L); (b)	Salinity Less than 5 parts-per-thousand (µg/L); (b)	Freshwater (µg/L); (c)	Saltwater (µg/L); (c)	Human Health Risk (µg/L); (c)	Maximum Contaminant Levels ("MCLs") (µg/L); (d)	Maximum Contaminant Level Goals ("MCLGs") (µg/L); (d)	Secondary MCLs (µg/L); (d)
PCBs, Pesticides, and Herbicides								
PCBs	-	-	0.014	0.03	0.00017	0.5	0	-
Aldrin	-	-	-	-	0.00013	-	-	-
Chlordane	-	-	0.0043	0.09	0.00057	0.1	0	-
2,4-D	-	-	-	-	-	70	70	-
4,4'-DDD	-	-	-	-	0.00083	-	-	-
4,4'-DDE	-	-	-	-	0.00059	-	-	-
4,4'-DDT	-	-	0.001	0.001	0.00059	-	-	-
Dicamba	-	-	-	-	-	-	-	-
Dieldrin	-	-	0.056	0.0019	0.00014	-	-	0.5 (l)
Endosulfan	-	-	0.056	0.0087	110	-	-	-
Endosulfan Sulfate	-	-	-	-	-	-	-	-
Endrin	-	-	0.036	0.0023	0.76	2	2	-
Endrin Aldehyde	-	-	-	-	-	-	-	-
Endrin Ketone	-	-	-	-	-	-	-	-
Heptachlor	-	-	0.0038	0.0036	0.00021	0.01	0	-
Heptachlor Epoxide	-	-	0.0038	0.0036	0.0001	0.01	0	-
Isodrin	-	-	-	-	-	-	-	-
gamma-BHC (Lindane)	-	-	-	-	0.019	0.2	0.2	-
MCPP	-	-	-	-	-	-	-	-
Methoxychlor	-	-	-	-	-	40	40	-
Petroleum Hydrocarbons and Constituents								
Total TPH	-	-	-	-	-	-	-	-
TPH (as diesel)	-	-	-	-	-	-	-	-
TPH (as gasoline)	-	-	-	-	-	-	-	-
TPH (as fuel oil)	-	-	-	-	-	-	-	-
Benzene	-	-	-	-	1.2	1	0	-
Ethylbenzene	-	-	-	-	3,100	700	700	30 (k)
Toluene	-	-	-	-	6,800	150	-	40 (k)
Total xylenes	-	-	-	-	-	1,750	-	20 (k)
Methyl t-butyl ether (MTBE)	-	-	-	-	-	13	5	-

TABLE 3-1
NUMERIC VALUES OF POTENTIAL CHEMICAL-SPECIFIC ARARs
FOR WATER AT PRESIDIO SITES (a)

Presidio of San Francisco, California

es:

Numeric values for chemical-specific ARARs and TBCs are listed in this table.

µg/L = microgram per liter
mg/L = milligram per liter

Water quality objectives for surface waters are from Table 3-3 and 3-4 of RWQCB *Water Quality Control Plan, San Francisco Bay Basin*, amended 16 April 1997 ("Basin Plan"). Values are for chronic toxicity to aquatic organisms, except for polycyclic aromatic hydrocarbon criteria which are for protection of human health, based on setting the acceptable lifetime risk for cancer to one-in-a-million.

California Toxic Rule water quality criteria listed are freshwater and saltwater aquatic toxicity standards, using 4 days of continuous exposure. Human health standards are for one-in-a-million risk for consumption of water and organisms. Values are from 40 CFR §131.38, *Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California.*

MCLs, MCLGs, and secondary MCLs are obtained from *U.S. EPA Drinking Water Standards and Health Advisories Table*, Region IX, Drinking Water Office, dated February 2001. If California MCLs are more stringent than federal MCLs, the California values are shown.

Hyphen indicates no value is provided in the reference.

Value listed is a function of hardness. Value shown is based on a hardness of 100 mg/L as calcium carbonate. Hardness concentrations at the Presidio have ranged from 93 to 772 mg/L, with an average of 325 mg/L. The use of 100 mg/L results in conservative values for these metals.

According to the California Environmental Protection Agency's Office of Environmental Health Hazard Assessment ("OEHHA"), there is uncertainty regarding the carcinogenicity of chromium by the oral route.

Values for lead and copper are action levels that require treatment of drinking water.

U.S. EPA water quality criterion for mercury is 0.012 µg/L, which is below typical analytical method reporting limit of 0.025 µg/L. An objective of 0.012 ug/L is desirable.

Zinc value revised in 1997 amendments to RWQCB Basin Plan.

Proposed MCL.

Value corresponds to the California action level.

) Value corresponds to the RWQCB Basin Plan water quality objective for municipal supply.

TABLE 3-2
RISK-BASED SCREENING LEVELS FOR VOCS
AT PRESIDIO SITES (a)

Presidio of San Francisco, California

Potential Chemical of Concern	RWQCB Risk-Based Screening Levels ("RBSLs")			
	Vapor Intrusion		Groundwater Protection (Soil Leaching)	
	Residential Land Use Permitted (mg/kg); (b)	Industrial/ Commercial Land Use (mg/kg); (b)	Residential Land Use Permitted (mg/kg); (c)	Industrial/ Commercial Land Use (mg/kg); (c)
Volatile Organic Compounds				
Acetone	43	140	0.24	0.24
Bromodichloromethane	0.025	0.098	2.7	2.7
2-butanone (MEK)	- (d)	-	3.8	3.8
Carbon disulfide	-	-	-	-
Carbon tetrachloride	0.021	0.074	0.11	0.11
Chlorodibromomethane	-	-	8.3	8.3
Chloroform	0.17	0.58	0.88	0.88
Chloromethane	0.49	1.7	0.42	0.42
1,4-dichlorobenzene	0.13	0.49	0.59	0.59
1,2-dichloroethane	0.04	0.14	0.006	0.006
1,1-dichloroethene	0.018	0.062	1	1
p-Isopropyltoluene (p-cymene)	-	-	-	-
Methylene chloride	0.89	3.1	0.076	0.076
Tetrachloroethene	0.15	0.53	0.8	0.8
1,2,3-trichlorobenzene	-	-	-	-
1,2,4-trichlorobenzene	87	280	15	15
Trichloroethene	0.44	1.5	0.4	0.4
1,1,1-trichloroethane	76	220	8	8
Trichlorofluoromethane	-	-	-	-

Notes:

(a) Numeric values for volatile organic compounds ("VOCs") presented in this table are from *Application of Risk-Based Screening Levels and Decision Making to Sites with Impacted Soil and Groundwater ("RBSLs")*, Regional Water Quality Control Board, San Francisco Bay Region, Interim Final, December 2001. As stated in the text, RBSLs were used only for VOCs to consider leaching to groundwater (groundwater protection) and vapor intrusion into indoor air, in addition to direct contact with soil.

mg/kg = milligram per kilogram

(b) Vapor Intrusion RBSLs represent the soil concentration corresponding to the risk due to vapor intrusion of VOCs from soil into indoor air. Values obtained from Table E-1a from Volume II of the RBSLs. The values assume coarse grain soils.

(c) Groundwater Protection RBSLs are soil cleanup levels based on protection of drinking water resources via the leaching pathway. Values were obtained from Tables A-1 and A-2 from Volume II of the RBSLs. The listed value is from the Groundwater Protection (soil leaching) column, assuming groundwater is a drinking water resource.

(d) Hyphen indicates no value is provided in the reference.

TABLE 3-3
SITE CLEANUP REQUIREMENTS FOR PETROLEUM HYDROCARBONS AND RELATED CONSTITUENTS AT PRESIDIO SITES (a)

Presidio of San Francisco, California

Potential Chemical of Concern	Protection of Human Health			Protection of Ecological Receptors	Soil Cleanup Levels for Crissy Field	
	Residential (mg/kg); (b)	Maintenance (mg/kg); (b)	Recreational (mg/kg); (b)	Terrestrial Receptors (mg/kg); (b)	Greater than 5 feet above Groundwater (mg/kg); (b)	Less than 5 feet above Groundwater (mg/kg); (b)
Inorganic Chemicals						
Lead	- (c)	-	-	50	-	-
Semivolatile Organic Compounds						
Acenaphthene	-	-	-	-	-	-
Acenaphthylene	-	-	-	-	-	-
Anthracene	5,900	17,800	13,800	-	-	1,120
Benzo(a)anthracene	0.43	1.5	1	-	-	23
Benzo(a)pyrene	0.04	0.15	0.1	0.3	-	9
Benzo(b)fluoranthene	0.43	1.5	1	-	-	64
Benzo(g,h,i)perylene	620	1,700	1,400	-	-	19,500
Benzo(k)fluoranthene	0.43	1.5	1	-	-	64
Benzyl alcohol	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-
Chrysene	4.3	15	10	-	-	151
Dibenzo(a,h)anthracene	-	-	-	-	-	-
Dibenzofuran	-	-	-	-	-	-
Fluoranthene	820	2,300	1,900	-	-	1,160
Fluorene	770	2,300	1,800	-	-	220
Indeno(1,2,3-c,d)-pyrene	-	-	-	-	-	-
2-methylnaphthalene	-	-	-	-	-	-
4-methylphenol (p-Cresol)	-	-	-	-	-	-
Naphthalene	480	2,300	1,100	-	-	140
n-doctriacontane	-	-	-	-	-	-
n-hentriacontame	-	-	-	-	-	-
n-nitrosodiphenylamine	-	-	-	-	-	-
n-triacontane	-	-	-	-	-	-
Pentachlorophenol	-	-	-	-	-	-
Phenanthrene	600	1,700	1,400	-	-	410
Phenol	-	-	-	-	-	-
Polycyclic aromatic hydrocarbons	-	-	-	-	-	-
Pyrene	620	1,700	1,400	-	-	910

TABLE 3-3
SITE CLEANUP REQUIREMENTS FOR PETROLEUM HYDROCARBONS AND RELATED CONSTITUENTS AT PRESIDIO SITES (a)

Presidio of San Francisco, California

Potential Chemical of Concern	Protection of Human Health			Protection of Ecological Receptors	Soil Cleanup Levels for Crissy Field	
	Residential (mg/kg); (b)	Maintenance (mg/kg); (b)	Recreational (mg/kg); (b)	Terrestrial Receptors (mg/kg); (b)	Greater than 5 feet above Groundwater (mg/kg); (b)	Less than 5 feet above Groundwater (mg/kg); (b)
Petroleum Hydrocarbons and Constituents						
Total TPH	-	-	-	-	-	-
TPH (as diesel)	1,380	6,700	3,200	700	15,000	1,950
TPH (as gasoline)	1,030	5,900	2,400	610	5,000	1,690
TPH (as fuel oil)	1,900	9,400	4,500	980	15,000	2,730
Benzene	0.6	5	1.5	40	140	1
Ethylbenzene	840	6,600	1,900	125	60	19
Toluene	530	12,800	1,200	270	420	14
Total xylenes	1,080	109,000	2,500	55	180	4,340
Methyl t-butyl ether (MTBE)	-	-	-	-	-	-

TABLE 3-3
SITE CLEANUP REQUIREMENTS FOR PETROLEUM HYDROCARBONS AND RELATED CONSTITUENTS AT PRESIDIO SITES (a)

Presidio of San Francisco, California

Potential Chemical of Concern	Protection of Water Quality at Detectable Levels		Protection of Water Quality to Drinking Water Standards		Groundwater Quality Goals for Fuel Chemicals (µg/L); (d)
	Greater than 5 feet above Groundwater (mg/kg); (b)	Less than 5 feet above Groundwater (mg/kg); (b)	Greater than 5 feet above Groundwater (mg/kg); (b)	Less than 5 feet above Groundwater (mg/kg); (b)	
Inorganic Chemicals					
Lead	-	-	-	-	-
Semivolatile Organic Compounds					
Acenaphthene	-	-	-	-	-
Acenaphthylene	-	-	-	-	-
Anthracene	-	0.05	-	308	770
Benzo(a)anthracene	-	0.2	-	8	2
Benzo(a)pyrene	-	0.8	-	3	0.2
Benzo(b)fluoranthene	-	0.6	-	23	2
Benzo(g,h,i)perylene	-	2	-	5,040	150
Benzo(k)fluoranthene	-	0.6	-	23	2
Benzyl alcohol	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-
Chrysene	-	0.3	-	54	20
Dibenzo(a,h)anthracene	-	-	-	-	-
Dibenzofuran	-	-	-	-	-
Fluoranthene	-	0.05	-	316	300
Fluorene	-	0.05	-	60	300
Indeno(1,2,3-c,d)-pyrene	-	-	-	-	-
2-methylnaphthalene	-	-	-	-	-
4-methylphenol (p-Cresol)	-	-	-	-	-
Naphthalene	-	0.05	-	9	300
n-doctriacontane	-	-	-	-	-
n-hentriacontame	-	-	-	-	-
n-nitrosodiphenylamine	-	-	-	-	-
n-triacontane	-	-	-	-	-
Pentachlorophenol	-	-	-	-	-
Phenanthrene	-	0.05	-	86	230
Phenol	-	-	-	-	-
Polycyclic aromatic hydrocarbons	-	-	-	-	-
Pyrene	-	0.09	-	241	230

TABLE 3-3
SITE CLEANUP REQUIREMENTS FOR PETROLEUM HYDROCARBONS AND RELATED CONSTITUENTS AT PRESIDIO SITES (a)

Presidio of San Francisco, California

Potential Chemical of Concern	Protection of Water Quality at Detectable Levels		Protection of Water Quality to Drinking Water Standards		Groundwater Quality Goals for Fuel Chemicals (µg/L); (d)
	Greater than 5 feet above Groundwater (mg/kg); (b)	Less than 5 feet above Groundwater (mg/kg); (b)	Greater than 5 feet above Groundwater (mg/kg); (b)	Less than 5 feet above Groundwater (mg/kg); (b)	
Petroleum Hydrocarbons and Constituents					
Total TPH	-	-	-	-	-
TPH (as diesel)	15,000	7	15,000	115	880
TPH (as gasoline)	5,000	7	5,000	100	770
TPH (as fuel oil)	15,000	10	15,000	160	1,200
Benzene	140	0.005	140	0.005	1
Ethylbenzene	60	0.009	60	13	700
Toluene	420	0.005	420	1	150
Total xylenes	180	0.009	180	33	1,750
Methyl t-butyl ether (MTBE)	-	-	-	-	-

TABLE 3-3
SITE CLEANUP REQUIREMENTS FOR PETROLEUM HYDROCARBONS AND RELATED CONSTITUENTS AT PRESIDIO SITES (a)

Presidio of San Francisco, California

Potential Chemical of Concern	Point of Compliance Concentration for Marine Sediment "Saltwater Ecological Protection Zone" (mg/kg); (e)	Point of Compliance Concentrations for Seawater (µg/L); (e)	Point of Compliance Concentrations for Freshwater Sediment "Freshwater Ecological Protection Zone" (mg/kg); (f)	Point of Compliance Concentration for Freshwater (µg/L); (f)
Inorganic Chemicals				
Lead	-	-	-	-
Semivolatile Organic Compounds				
Acenaphthene	-	-	-	-
Acenaphthylene	-	-	-	-
Anthracene	-	-	-	-
Benzo(a)anthracene	-	-	-	-
Benzo(a)pyrene	-	-	-	-
Benzo(b)fluoranthene	-	-	-	-
Benzo(g,h,i)perylene	-	-	-	-
Benzo(k)fluoranthene	-	-	-	-
Benzyl alcohol	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-
Chrysene	-	-	-	-
Dibenzo(a,h)anthracene	-	-	-	-
Dibenzofuran	-	-	-	-
Fluoranthene	-	-	-	-
Fluorene	-	-	-	-
Indeno(1,2,3-c,d)-pyrene	-	-	-	-
2-methylnaphthalene	-	-	-	-
4-methylphenol (p-Cresol)	-	-	-	-
Naphthalene	-	-	-	-
n-doctriacontane	-	-	-	-
n-hentriacontame	-	-	-	-
n-nitrosodiphenylamine	-	-	-	-
n-triacontane	-	-	-	-
Pentachlorophenol	-	-	-	-
Phenanthrene	-	-	-	-
Phenol	-	-	-	-
Polycyclic aromatic hydrocarbons	-	-	-	-
Pyrene	-	-	-	-

TABLE 3-3
SITE CLEANUP REQUIREMENTS FOR PETROLEUM HYDROCARBONS AND RELATED CONSTITUENTS AT PRESIDIO SITES (a)

Presidio of San Francisco, California

Potential Chemical of Concern	Point of Compliance Concentration for Marine Sediment "Saltwater Ecological Protection Zone" (mg/kg); (e)	Point of Compliance Concentrations for Seawater (µg/L); (e)	Point of Compliance Concentrations for Freshwater Sediment "Freshwater Ecological Protection Zone" (mg/kg); (f)	Point of Compliance Concentration for Freshwater (µg/L); (f)
Petroleum Hydrocarbons and Constituents				
Total TPH	-	-		
TPH (as diesel)	-	-	-	-
TPH (as gasoline)	11.6	1,200	140	443
TPH (as fuel oil)	144	2,200	-	-
Benzene	50	510	0.79	463
Ethylbenzene	5	43	15	845
Toluene	260	1,000	3	490
Total xylenes	22	130	5.7	318
Methyl t-butyl ether (MTBE)	190	4,400	-	-

TABLE 3-3
SITE CLEANUP REQUIREMENTS FOR PETROLEUM HYDROCARBONS AND RELATED CONSTITUENTS AT PRESIDIO SITES (a)

Presidio of San Francisco, California

tes:

) Numeric values for chemical-specific ARARs and TBCs are listed in this table.

µg/L = microgram per liter
mg/kg = milligram per kilogram

) Values are from Tables 1 through 5 of RWQCB Order No. 96-070, *Site Cleanup Requirements for the Cleanup of Petroleum Impacted Soils, U.S. Army, Presidio of San Francisco, California*, dated 15 May 1996.

) Hyphen indicates no value is provided in the reference.

) Values from Table E-12 of Montgomery Watson *Final Fuel Product Action Level Development Report, Presidio of San Francisco, San Francisco, California,* dated October 1995. Residential exposure scenario was used to determine groundwater cleanup levels listed.

) Values from Table 16 of IT Corporation *Petroleum Hydrocarbon Bioassay and Point-of-Compliance Concentration Determinations*, *Saltwater Ecological Protection Zone, Presidio of San Francisco, California*, dated December 1997.

) Values from Tables 5 and 6 of Montgomery Watson *Development of Point of Compliance Concentrations ("POCCs") for Gasoline in Surface Waters and Sediments of the Proposed Freshwater Stream*, dated May 1999.

4. HUMAN HEALTH RISK-BASED PRGS FOR SOIL

4. HUMAN HEALTH RISK-BASED PRGS FOR SOIL

According to U.S. EPA (1991a), under the NCP, there are two sources that can be used to establish cleanup levels that remedial actions must achieve under a Record of Decision ("ROD") or RAP. These sources consist of chemical-specific ARARs and risk-based PRGs. Chemical-specific ARARs are discussed in Section 3. In the absence of such ARARs, risk-based PRGs have been derived that take into account existing and planned uses at the Presidio. This section presents risk-based human health PRGs for PCOCs. Section 5 presents risk-based ecological PRGs for PCOCs.

4.1 PURPOSE OF RISK-BASED PRGs

U.S. EPA (1991a) defines PRGs as "concentration goals for individual chemicals for specific medium and land use combinations at CERCLA sites." In other words, PRGs are potential cleanup levels that are derived specifically for a site. PRGs take into account the PCOCs that have been identified, the media that have been impacted, most likely future land use where PCOCs have been detected, and the pathways and conditions under which exposure may occur.

Chemical-specific ARARs generally do not exist that adequately consider the scenarios under which humans may be exposed to PCOCs in soil, and ecological receptors may be exposed to PCOCs in soil and sediment at the Presidio. Consequently, site-specific PRGs for protection of human health and the environment to PCOCs in soil and sediment have been derived in this document. The methods used to derive human health and ecological PRGs incorporate comments made by DTSC (2001, 2000b, 2000d) RWQCB (verbal), and other key stakeholders.

4.2 HUMAN HEALTH PRGs FOR SOIL

Chronic exposure to PCOCs may cause non-carcinogenic and carcinogenic effects in humans. PRGs are calculated by establishing an acceptable or target risk level that will protect individuals from the non-carcinogenic and carcinogenic effects of PCOCs. The procedures and assumptions used to derive human health PRGs for soil are discussed in Sections 4.2.1 through 4.2.10.

4.2.1 Potentially Exposed Populations

Children and adults comprise the populations that may be potentially exposed to PCOCs at the Presidio. Children may be exposed through residential or recreational activities. In addition to residential and recreational activities, adults may be exposed as a result of commercial or industrial activities at the Presidio. The recreational or commercial/industrial exposure scenarios should also be protective of populations with short-term exposures, such as tourists or construction workers, respectively. For

example, subsurface utility repairs and earthwork construction typically take a few weeks to one year. Although the ingestion rate for construction and utility workers is commonly assumed to be 480 mg/day (compared with 50 mg/day assumed for the commercial/industrial population), the lifetime soil exposure is significantly lower for the construction worker because the exposure duration is so much shorter (e.g., a few weeks to one year compared with 25 years). Therefore, the PRGs developed for the commercial/industrial exposure scenario should be protective of construction workers and other workers with shorter-term exposures to soil.

Section 7.1.1 discusses the areas of the Presidio where residential, recreational, and commercial/industrial uses are likely to occur and identifies the appropriate cleanup levels based upon anticipated activity patterns that will protect the most sensitive individuals using these areas.

4.2.2 Potential Human Health Exposure Pathways

Metals and polycyclic aromatic hydrocarbons ("PAHs") are the predominant non-petroleum PCOCs in soil at chemical release sites at the Presidio. As shown on Figure 4-1 and discussed in Table 4-1, individuals that come in contact with soil at Presidio sites are likely to be exposed to PCOCs as a result of inadvertently ingesting impacted soil or absorbing chemicals from soil that becomes stuck to their skin. Inhalation of PCOCs is not considered to be a significant exposure pathway. Metals and PAHs are not volatile and inhalation of chemical-containing soil or dust is estimated to result in less than 3 percent of the potential total exposure to PCOCs when compared with the ingestion and dermal absorption pathways.[3] For VOCs, volatilization and vapor intrusion into indoor air is a potentially significant exposure pathway (i.e., for residential and commercial/industrial populations only).

Other potential exposure pathways include consumption of produce grown in gardens at the Presidio, leaching of chemicals in soil to groundwater, and ingestion, inhalation, or absorption of PCOCs that may be present in groundwater or surface water. Of these pathways, leaching to groundwater, ingestion of groundwater, and ingestion of water and fish or other organisms inhabiting surface bodies at the Presidio are considered to be a potentially significant exposure pathways.

The process of chemicals in soil leaching to groundwater is chemical-specific. Metals generally bind strongly to soil and are not prone to significant leaching unless conditions are very acidic. For petroleum compounds and related constituents (including benzene, toluene, ethylbenzene, xylenes, and PAHs), the cleanup levels established in RWQCB Order 96-070 (and as presented in Tables 3-3 and 7-5) include protection of groundwater

[3] EKI calculated the residential PRG for several compounds including and excluding the inhalation pathway. Arsenic was used as a conservative test case because it is significantly more toxic via the inhalation route compared with the oral route (i.e., slope factor of 12 $(mg/kg\text{-}day)^{-1}$ for inhalation versus 1.5 $(mg/kg\text{-}day)^{-1}$ for ingestion). Assuming a fugitive dust concentration of 0.05 mg/m^3 and breathing rates of 10 and 20 m^3/day for children and adults, respectively, the inhalation pathway accounts for 3 percent of the total exposure. For other compounds where the ingestion and inhalation slope factors are the same, the inhalation pathway comprises less than 1 percent of the exposure.

resources via the leaching pathway. Therefore, cleanup levels that consider leaching were derived for VOCs and petroleum compounds and related constituents.

As discussed in Section 7.3.4, the water ingestion and fish or other aquatic organism ingestion pathways are taken into account by adoption of chemical-specific ARARs as cleanup levels. The ARARs being used as cleanup levels include MCLs and aquatic criteria for protection of human health, where applicable. Although MCLs are not explicitly risk-based numbers like MCLGs, they are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. The aquatic criteria for protection of human health are risk-based values that include ingestion of water and consumption of aquatic organisms.

Exposure to PCOCs in homegrown produce, and dermal contact with surface water and seeps are not considered to be significant exposure pathways. Landscaping at the Presidio is maintained by the Trust, and residents and commercial tenants are not permitted to plant vegetation. Consequently, most produce grown at the Presidio would be restricted to plants in containers or in community gardens at locations specifically approved for such use by the Trust. Similarly, no appreciable dermal contact with PCOCs in surface water is expected. Swimming and wading are not allowed in Mountain Lake, Crissy Field wetlands, or Lobos Creek, and it is anticipated that these activities will be restricted in the proposed riparian corridor associated with Tennessee Hollow. Swimming and wading are prohibited in these areas because of possible damage to critical and sensitive habitats, and the need to protect potable supply in the case of Lobos Creek. Although residential and recreational users of the Presidio may have contact with water at seeps, the exposure frequency and duration are anticipated to be very limited.

4.2.3 Non-carcinogen Target Risk Level

As defined by U.S. EPA (1989a), non-carcinogenic effects are organ-specific and are manifested only after reaching a certain chemical dose. As a result, a range of exposures exists from zero to some finite value that can be tolerated with essentially no chance of adverse effects. The upper bound on this tolerance range or "safe dose" is identified as a reference dose ("RfD").

U.S. EPA (1989a) estimates the potential for non-carcinogenic effects by comparing a chronic exposure level (i.e., greater than 7 years) over a specified time period with a reference dose derived for a similar exposure period. This ratio of exposure to toxicity is called the hazard index ("HI"). Consistent with the NCP at 40 CFR §300.430(e)(2)(i)(A)(1), U.S. EPA (1991a) established the standard default non-carcinogenic target risk level to correspond to a HI of unity (i.e., 1). This target risk level is equivalent to the degree of chemical exposure from all significant exposure pathways in a given medium below which it is unlikely for even sensitive populations to experience adverse health effects. A target HI of 1 was used to derive PRGs for soil at the Presidio based upon non-carcinogenic effects.

4.2.4 Carcinogen Target Risk Level

Carcinogenesis, unlike non-carcinogenic effects, is generally thought to be a phenomenon for which risk evaluation based on presumption of a threshold is inappropriate (U.S. EPA, 1989a). For carcinogens, U.S. EPA assumes that a small number of molecular events can evoke changes in a single cell that can lead to uncontrolled cellular proliferation and eventually to a clinical state of disease. This hypothesized mechanism for carcinogenesis is referred to as "non-threshold" because there is not believed to be a level of exposure to such a chemical that does not pose a finite probability, however small, of generating a carcinogenic response. No dose is thought to be risk-free. Therefore, in evaluating cancer risks, a safe dose cannot be estimated.

For carcinogenic effects, U.S. EPA uses a two-part evaluation. In the first part of this evaluation, the chemical is assigned a weight-of-evidence classification, which is related to how convincingly the scientific studies demonstrate that the chemical is carcinogenic to humans. In the second part of this evaluation, a slope factor ("SF") is calculated, which is a measure of the chemical's potency. U.S. EPA (1989a) estimates risks as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the potential carcinogen. This probability is defined as the incremental or excess lifetime cancer risk. The SF is the 95 percent upper confidence limit on the slope of the low-dose linear portion of the dose-response curve as estimated by the multistage linear model.

The SF directly relates the incremental risk of cancer over a lifetime (i.e., 70 years) to the degree of chemical exposure averaged over a lifetime. U.S. EPA (1991a) established the standard default carcinogenic target risk level to correspond to a one-in-one million (i.e., 10^{-6}) incremental risk of an individual developing cancer over a lifetime as a result of exposure to the potential carcinogen from all significant exposure pathways for a given medium. Consistent with the NCP at 40 CFR §300.430(e)(2)(i)(A)(2), U.S. EPA (1991c) strives for cleanup of Superfund sites that attain a 10^{-4} to 10^{-6} target risk range. A target risk of 10^{-6} was used to derive PRGs for soil at the Presidio based upon carcinogenic effects.

4.2.5 Lead Target Risk Level

Ingested or inhaled lead is distributed primarily to the blood, soft tissue (e.g., bone marrow, liver, and brain), and mineralizing tissue (e.g., bones and teeth) of the body. Lead interferes with normal cell function and with a number of physiologic processes, including damage to the central nervous system, inhibition of the body's ability to make hemoglobin, disruption of the endocrine system that may lead to impaired tooth and bone development, and damage to the kidneys (California Department of Health Services, 1997). The United States Department of Health and Human Services, Agency for Toxic Substances and Disease Registry ("ATSDR") also indicates that lead readily crosses the placenta. According to ATSDR (1995), lead not only affects the viability of the fetus, but development as well. Development consequences of prenatal exposure to low levels of lead include reduced birth weight and premature birth. Reports have shown

lead to be a teratogen and carcinogen in animals. However, studies in humans have failed to show a relationship between lead concentrations and congenital malformations, and the association of lead levels and cancer observed in humans remains uncertain (ATSDR, 1995).

Blood lead concentration is an integrated measure of internal dose resulting from the total exposure of releases of lead at a site and naturally occurring concentrations of lead in the environment. The DTSC has established that the concentration of concern for lead in blood is 10 micrograms per deciliter ("µg/dl") at the 99th percentile, i.e., a one percent chance that blood lead concentrations will be greater than 10 µg/dl (DTSC, 1996). The 99th percentile is believed to be protective because it establishes an upper bound level for lead exposure that is akin to U.S. EPA's reasonable maximum exposure ("RME") approach (U.S. EPA, 1989a).

4.2.6 Human Health Toxicity Values

Following the hierarchy established in DTSC's Preliminary Endangerment Assessment ("PEA") Guidance Manual, toxicity values used to calculate human health PRGs were obtained from the following references in the order listed:

- Carcinogenic slope factors were obtained from California Environmental Protection Agency, Office of Environmental Health Hazard Assessment ("OEHHA") website table entitled *California Cancer Potency Factors*, dated December 2000.

- U.S. EPA's computerized Integrated Risk Information System ("IRIS").

- U.S. EPA's Health Effects Assessment Summary Tables ("HEAST"), dated July 1997.

- U.S. EPA's National Center for Environmental Assessment ("NCEA"), Draft Risk Assessment Issue Papers for individual chemicals.

OEHHA's technical documents and website represent the agency's most current stance on non-carcinogenic and carcinogenic toxicity values. U.S. EPA maintains the IRIS computerized database. Toxicity values on IRIS have undergone review and verification by U.S. EPA program offices prior to publication. Toxicity values were obtained from HEAST if none were available from OEHHA or IRIS. HEAST is not updated as regularly as IRIS and may contain interim toxicity values. NCEA was the final information source consulted. Toxicity values obtained from NCEA have not been verified by U.S. EPA and are considered provisional. The sources for chemical-specific toxicity values used to calculate human health PRGs are presented on the tables in which PRGs are calculated.

No published toxicity values were found for copper, acenaphthylene, benzo(g,h,i)perylene, 2-(4-chloro-o-to(yl)oxy)propionic acid ("MCPP"), phenanthrene,

and 2-methylnaphthalene. Consequently, human health PRGs for these PCOCs could not be calculated. For VOCs and pesticides, which have no published toxicity values, surrogates were used to calculate human health PRGs. The values for 1,2,4-trichlorbenzene were used as a surrogate for 1,2,3-trichlorbenzene, and the values for isopropyl benzene were used as a surrogate for p-isopropyltoluene (also known as p-cymene). The values for endosulfan were used as a surrogate for endosulfan sulfate, the values for endrin were used as a surrogate for endrin aldehyde and endrin ketone, the values for heptachlor were used as a surrogate for heptachlor epoxide, and the values for aldrin were used as a surrogate for isodrin because isodrin is an isomer of aldrin.

4.2.7 Calculation of Human Health PRGs for PCOCs Other than Lead in Soil

Except for lead, PRGs were calculated for PCOCs using the hazard and risk equations based on those presented in DTSC's PEA guidance. PRGs for lead were calculated as described in Section 4.2.10 due to the different toxicological behavior of lead. For other PCOCs, PRGs based on non-carcinogenic effects ("PRG_{nc}") were calculated using the following equation:

$$PRG_{nc} = \frac{RfD \times \text{Target HI of 1}}{\left(\text{Ingestion}_{child} + \text{Dermal}_{child}\right)}$$

PRGs based on carcinogenic effects ("PRG_cs") were calculated using the following equation:

$$PRG_c = \frac{\text{Target Risk Level of } 10^{-6}}{SF \times \left(\text{Ingestion}_{child} + \text{Dermal}_{child} + \text{Ingestion}_{adult} + \text{Dermal}_{adult}\right)}$$

Ingestion_{child}, Dermal_{child}, Ingestion_{adult}, and Dermal_{adult} (i.e., direct contact) are estimates of exposure that may result from swallowing and absorbing PCOCs through the skin of a child and adult, respectively. Exposure to PCOCs for various children and adult populations at the Presidio were estimated by use of the equations listed below:

where:

$$\text{Ingestion}_{child} = \frac{IR_{child} \times FI \times EF \times ED \times 10^{-6}\,kg/mg}{BW_{child} \times AT_c}$$

$$\text{Dermal}_{child} = \frac{SA_{child} \times AF_{child} \times ABS \times EF \times ED \times 10^{-6}\,kg/mg}{BW_{child} \times AT_c}$$

$$\text{Ingestion}_{adult} = \frac{IR_{adult} \times FI \times EF \times ED \times 10^{-6}\,kg/mg}{BW_{adult} \times AT_c}$$

$$\text{Dermal}_{\text{adult}} = \frac{\text{SA}_{\text{adult}} \times \text{AF}_{\text{adult}} \times \text{ABS} \times \text{EF} \times \text{ED} \times 10^{-6}\,\text{kg/mg}}{\text{BW}_{\text{adult}} \times \text{AT}_{\text{c}}}$$

Definitions of the terms or exposure parameters within the equations are presented in Table 4-2.

For VOCs under the residential and commercial/industrial exposure scenarios, the PRGs also incorporate potential risks due to vapor intrusion into indoor air. Carcinogenic and non-carcinogenic PRGs based on the vapor intrusion pathway ("$\text{PRG}_{\text{c-inh}}$" and "$\text{PRG}_{\text{nc-inh}}$") were obtained from Table E-1a of the RWQCB's RBSLs (RWQCB, 2001b).[4] For compounds that do not have tabulated RBSLs, inhalation PRGs were calculated using the Johnson and Ettinger model (Version 2.3, dated March 2001) with the default exposure assumptions and soil parameters used to calculate the RBSLs. The printouts from the Johnson and Ettinger model runs are included in Appendix E.

The PRGs accounting for the direct contact exposure pathways (i.e., dermal contact and ingestion) were combined with those for inhalation using the following equations:

$$\text{PRG}_{\text{c-combined}} = \frac{\text{PRG}_{\text{c}} \times \text{PRG}_{\text{c-inh}}}{\text{PRG}_{\text{c}} + \text{PRG}_{\text{c-inh}}}$$

$$\text{PRG}_{\text{nc-combined}} = \frac{\text{PRG}_{\text{nc}} \times \text{PRG}_{\text{nc-inh}}}{\text{PRG}_{\text{nc}} + \text{PRG}_{\text{nc-inh}}}$$

PRGs for VOCs also need to consider leaching to groundwater ("Groundwater Protection PRGs"). As discussed further in Section 4.2.9, Groundwater Protection PRGs were also obtained from the RWQCB's RBSL document (Table A-1of Volume II) (RWQCB, 2001b).

4.2.8 Human Health Exposure Parameters

In accordance with DTSC PEA Guidance Manual, the same exposure parameter values were used to calculate non-carcinogenic and carcinogenic PRGs except for the averaging time ("AT"). Regarding this parameter, DTSC (1999) states the following:

> AT is 70 yr for cancer risk, but is set equal to 6 years for non-carcinogenic hazard to be consistent with the exposure duration for non-carcinogenic hazards. Thus, all non-carcinogenic exposures are estimated for a child, which are the receptors with the greatest estimated exposures.

[4] The RBSLs generally use default values from the Johnson and Ettinger model. One exception is the indoor air exchange rate. The RBSLs use a residential air exchange rate of 2 per hour, instead of the default of 0.45 per hour, because air exchange rates are anticipated to be higher in the San Francisco Bay Area (i.e., temperate climate and houses with limited insulation). Due to the linear relationship between the calculated soil concentration and the air exchange rate, the difference is only a factor of 4.

As shown in Table 4-2, where available, exposure parameters are default factors obtained from U.S. EPA or DTSC guidance for residential, recreational, and commercial/industrial populations, or are calculated based on published values. Recreational exposure frequency is the only parameter where a default factor does not exist and professional judgement had to be used to estimate a value. The exposure frequency, or number of days per year that an individual may engage in recreational activities (e.g., sightseeing, hiking, picnicking, or participating in athletic or cultural events) at the Presidio is assumed to be 150 days per year (i.e., 3 days per week).

4.2.9 Human Health PRGs for PCOCs Other than Lead in Soil

Tables 4-3, 4-4, and 4-5 summarize the non-carcinogenic and carcinogenic PRGs for residential, recreational, and commercial/industrial exposure at the Presidio, respectively. PRGs proposed as cleanup levels are the lower values of the PRG_{nc} and PRG_c for each potential chemical of concern.

For VOCs, the non-carcinogenic and carcinogenic direct contact PRGs calculated in Tables 4-3, 4-4, and 4-5 are carried forward to Table 4-6. In Table 4-6, the indoor air exposure soil concentrations are factored into the PRG_{nc} and PRG_c using the formulas described above to account for potential risks due to vapor intrusion into indoor air. The values for $PRG_{nc\text{-}inh}$ and $PRG_{c\text{-}inh}$ (Vapor Intrusion PRGs) were obtained from Table E-1a of the RBSLs, or the Johnson and Ettinger model (Appendix E). The Combined PRGs calculated in Table 4-6 are carried forward to Table 4-7.

In Table 4-7, the Combined PRGs for VOCs are compared to the respective Groundwater Protection PRGs obtained from Tables A-1 or A-2 of the RWQCB's RBSL document (RWQCB, 2001b). The Groundwater Protection PRGs are soil cleanup levels based on protection of drinking water resources via the leaching to groundwater pathway. For VOCs for which groundwater protection numbers are not listed in the RBSL document, Groundwater Protection PRGs were calculated using formulas within the RBSL document. The lower of the Combined PRG or the Groundwater Protection PRG is retained as the human health PRG for the respective VOC for each land use.

As noted above, the Vapor Intrusion PRGs and Groundwater Protection PRGs are from the RWQCB's RBSL document and are not site-specific. Therefore, if VOCs are found at a Presidio site, VOC cleanup levels may be re-calculated to be site-specific. Site-specific factors that could affect the calculation include the type of soil, depth to groundwater, presence of buildings, and the number and types of VOCs present in soil. Any recalculation of PRGs for VOCs would be conducted in conjunction with discussions with regulatory agencies. Other identified COCs at the Presidio generally are not mobile or volatile (e.g., metals, PCBs, and pesticides); therefore, Vapor Intrusion PRGs and Groundwater Protection PRGs were not developed for these other chemical classes.

4.2.10 Human Health PRGs for Lead in Soil

PRGs for residential, recreational and commercial/industrial users of the Presidio were calculated using the DTSC Lead Spread Version 7.0 computer model. PRGs were established such that the lead concentration in the blood of these potentially exposed individuals was less than 10 µg/dl at the 99th percentile, taking into account the intake of lead from releases at Presidio sites, and lead naturally occurring in air, water, food, and soil.

DTSC default factors of 0.028 µg/m^3 and 1.1 kg food/day (at 3.1 µg lead/kg food) were used to account for lead naturally occurring in air and food, respectively, for all populations at the Presidio. The concentration of lead in tap water was established as 2.4 µg/L for residential populations at the Presidio and 15 µg/L for recreational and commercial/industrial users. A value of 2.4 µg/L is the 95 percent upper confidence limit of the average lead concentration measured in tap water at Presidio residences in 1998, 1999, and 2000. The tap water data are included in Appendix A. A value of 15 µg/L is the DTSC default factor, which is based on the Action Level for lead in drinking water.[5] The dietary source of lead assumes that residential, recreational, and commercial/industrial users will not consume produce, if any, grown at impacted sites.[6] A site-specific background concentration of 66 mg/kg of lead was assumed for soil at the Presidio. This concentration reflects the naturally occurring concentration of lead found in serpentinite soil at the Presidio. Naturally occurring or background concentrations of metals in soil and water at the Presidio are discussed in Section 6.

The frequency that residential and recreational users are exposed to naturally occurring or background concentrations of lead in air, water, and food was assumed to be equivalent to the concentrations identified above for 7 days per week. For recreational users, the exposure frequency to background concentrations of lead in soil was assumed to occur 4 days per week (i.e., when those users are assumed to be off-site). Consistent with the assumptions used to calculate PRGs for PCOCs with non-carcinogenic and carcinogenic effects, the exposure frequency to lead in soil and fugitive dust while at the Presidio was taken to be 3 days per week (i.e., 150 days per year) for recreational users and 7 days per week for residential populations. The lead PRG for commercial/industrial users was calculated assuming an exposure frequency of 5 days per week, as specified by DTSC (1996). Exposures of commercial/industrial users to background concentrations of lead in air, water, and food were assumed to be equivalent DTSC default factors. Consistent with the assumptions used to calculate PRGs for other PCOCs, the exposure frequency to lead in soil and fugitive dust while at the Presidio was taken to be 5 days per week for commercial/industrial users.

Table 4-8 summarizes the lead intakes for residential, recreational and commercial/industrial users. As shown in this table, lead concentrations of 370 mg/kg,

[5] The background level of lead in drinking water for recreational and commercial/industrial users was not established as the site-specific value of 2.4 µg/L because a significant portion of their daily drinking water may come from off-site sources.

[6] Use restrictions prohibiting the in-ground planting of home grown produce are already in place at the Presidio.

500 mg/kg and 3,500 mg/kg in soil at the Presidio potentially cause blood lead to increase to 10 µg/dl in residential, recreational, and commercial/industrial users, respectively, based upon the values of exposure parameters and frequencies assumed. Copies of computer spreadsheets used to calculate PRGs for lead in soil are included in Appendix A. Recreational and commercial/industrial PRGs have been established at 500 mg/kg and 3,500 mg/kg for lead in soil. The residential cleanup level for lead in soil has been established as a not-to-exceed value of 400 mg/kg, based on the chemical-specific ARARs discussed in Section 3.2, and a maximum average concentration of 370 mg/kg, based on the site-specific PRG.

TABLES

TABLE 4-1
EXPOSED POPULATIONS AND EXPOSURE PATHWAYS USED TO DEVELOP PRGs

Presidio of San Francisco, California

Potentially Exposed Populations and Significant Exposure Pathways	Rationale
Residential Use (Children & Adults)	
• Ingestion of Soil • Dermal Contact with Soil	Residential children and adults may be directly exposed to residual chemicals in soil in backyards and areas near houses. Thus, ingestion of soil and dermal contact with soil are considered potentially complete exposure pathways. Ingestion of chemicals in homegrown produce is not considered a significant pathway for residents because landscaping at the Presidio is maintained by the Trust. Residents are not permitted to plant vegetation. Consequently, most produce grown at the Presidio would be in community gardens at locations specifically designated by the Trust.
• Inhalation of VOCs in Indoor Air	The primary non-petroleum potential chemicals of concern ("PCOCs") at the Presidio are metals and polycyclic aromatic hydrocarbons. Inhalation of PCOCs on soil particulates accounts for only 1 to 2 percent of total exposure to PCOCs. Therefore, inhalation of chemicals is not considered to be a significant exposure pathway for non-volatile PCOCs and is not included in the development of preliminary remediation goals ("PRGs"). Inhalation of VOCs via the vapor intrusion pathway is considered a complete pathway.
• Ingestion of Water (Addressed through MCLs as Cleanup Levels)	Exposure to chemicals of concern in groundwater through drinking water is considered a potentially complete pathway and will be addressed by adopting Maximum Contaminant Levels ("MCLs") or action levels as cleanup levels. Swimming and wading are prohibited in Mountain Lake, Crissy Field wetlands, and Lobos Creek. Dermal contact with or incidental ingestion of surface water and sediment is not considered to be a significant exposure pathway for residents. Residents may have periodic contact with water at seeps; however, the exposure is anticipated to be limited because the seeps generally are small and shallow, and difficult to access. Some of the seeps are ephemeral. Contact with water at seeps is not considered to be a significant exposure pathway.

TABLE 4-1
EXPOSED POPULATIONS AND EXPOSURE PATHWAYS USED TO DEVELOP PRGs

Presidio of San Francisco, California

Potentially Exposed Populations and Complete Exposure Pathways	Rationale
Recreational Use (Children & Adults)	
• Ingestion of Soil • Dermal Contact with Soil	Children and adults recreating in open areas of the Presidio may be directly exposed to residual PCOCs. Thus, ingestion of soil and dermal contact with soil are considered potentially complete exposure pathways. The primary non-petroleum PCOCs at the Presidio are metals and polycyclic aromatic hydrocarbons. Inhalation of PCOCs on soil particulates accounts for only 1 to 2 percent of total exposure to PCOCs. Inhalation of non-volatile PCOCs is not considered to be a significant exposure pathway. In addition, recreational users of the Presidio are assumed to be primarily outdoors. Therefore, vapor intrusion of VOCs to indoor air is considered to be an incomplete pathway.
• No Significant Water Exposure Pathways Identified	Swimming and wading are prohibited in Mountain Lake, Crissy Field wetlands, and Lobos Creek. Dermal contact with or incidental ingestion of surface water and sediment is not considered to be a significant exposure pathway for recreational users. Recreational users of the Presidio may have periodic contact with water at seeps; however, the exposure is anticipated to be limited because the seeps generally are small and shallow, and difficult to access. Some of the seeps are ephemeral. Contact with water at seeps is not considered to be a significant exposure pathway.

TABLE 4-1
EXPOSED POPULATIONS AND EXPOSURE PATHWAYS USED TO DEVELOP PRGs

Presidio of San Francisco, California

Potentially Exposed Populations and Complete Exposure Pathways	Rationale
Commercial/Industrial Use (Adults)	
• Ingestion of Soil • Dermal Contact with Soil	Commercial/industrial workers may be directly exposed to residual chemicals at the Presidio. Thus, ingestion of soil and dermal contact with soil are considered potentially complete exposure pathways.
• Inhalation of VOCs in Indoor Air	Inhalation of PCOCs on soil particulates accounts for only 1 to 2 percent of total exposure to PCOCs. Therefore, inhalation of non-volatile PCOCs is not considered a significant exposure pathway. Vapor intrusion of VOCs to indoor air is also considered a complete pathway.
• Ingestion of Water (Addressed through MCLs as Cleanup Levels)	Exposure to PCOCs in groundwater through drinking water is considered a potentially complete exposure pathway and will be addressed by adopting MCLs or action levels as cleanup levels. Commercial/industrial workers are not anticipated to be contacting surface water at the Presidio. Thus, dermal contact with or incidental ingestion of surface water and sediment is not considered to be a complete exposure pathway.

TABLE 4-2
EXPOSURE FACTORS USED TO CALCULATE HUMAN HEALTH PRELIMINARY REMEDIATION GOALS FOR SOIL

Presidio of San Francisco, California

Exposure Parameter	Units	Default or Assumed Value	Reference (a)
Averaging Time (AT)			
Carcinogenic	days	27,375	U.S. EPA, 1997
Non-carcinogenic			
Residential/Recreational	days	2,190	U.S. EPA, 1991; DTSC, 1996
Commercial/Industrial	days	9,125	U.S. EPA, 1991; DTSC, 1996
Exposure Frequency (EF)			
Residential	days/year	350	U.S. EPA, 1991; DTSC, 1996
Recreational	days/year	150	Professional Judgment
Commercial/Industrial	days/year	250	U.S. EPA, 1991; DTSC, 1996
Exposure Duration (ED)			
Residential/Recreational			
Carcinogenic	years	6 (child) + 24 (adult)	U.S. EPA, 1991; DTSC, 1996
Non-carcinogenic	years	6 (child)	U.S. EPA, 1991; DTSC, 1996
Commercial/Industrial			
Carcinogenic and Non-carcinogenic	years	25	U.S. EPA, 1991; DTSC, 1996
Body Weight (BW)			
Adult	kg	70	U.S. EPA, 1991; DTSC, 1996
Child	kg	15	U.S. EPA, 1991; DTSC, 1996
Soil Ingestion Rate (IR)			
Adult - Residential/Recreational	mg/day	100	U.S. EPA, 1997; DTSC, 1996
Child - Residential/Recreational	mg/day	200	U.S. EPA, 1997; DTSC, 1996
Adult - Commercial/Industrial	mg/day	50	U.S. EPA, 1997
Fraction of Soil Ingested (FI)	-	1	U.S. EPA, 1989; DTSC, 1996
Skin Surface Area			
Adult - Residential/Recreational	cm^2/day	5,800 (b)	DTSC, 1999
Child - Residential/Recreational	cm^2/day	2,900 (c)	U.S. EPA, 1998
Adult - Commercial/Industrial	cm^2/day	3,400 (d)	U.S. EPA, 1997
Soil-to-Skin Adherence Factor (AF)	-		
Adult - Residential/Recreational	mg/cm^2	0.23 (e)	U.S. EPA, 1998
Child - Residential/Recreational	mg/cm^2	0.30	U.S. EPA, 1998
Adult - Commercial/Industrial	mg/cm^2	0.12 (f)	U.S. EPA, 1998

TABLE 4-2
EXPOSURE FACTORS USED TO CALCULATE HUMAN HEALTH PRELIMINARY REMEDIATION GOALS FOR SOIL

Presidio of San Francisco, California

Exposure Parameter	Units	Default or Assumed Value	Reference (a)
Skin Absorption Factor (ABS)			
Metals	-	0.01	DTSC, 1999
Arsenic	-	0.03	DTSC, 1999
Cadmium	-	0.001	DTSC, 1999
Polycyclic Aromatic Hydrocarbons	-	0.15	DTSC, 1999
Volatile Organics	-	0.10	DTSC, 1999
Polychlorinated Biphenyls	-	0.15	DTSC, 1999
Pesticides	-	0.05	DTSC, 1999

Notes:

(a) References for exposure parameter values are as follows:

- U.S. EPA. 25 March 1991. *Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual, Supplemental Guidance, Standard Default Exposure Factors.* Interim Final. OSWER Directive 9285.6-03.
- U.S. EPA. December 1989. *Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part A).* Interim Final. Office of Emergency and Remedial Response. EPA/540/1-89/002.
- U.S. EPA. August 1997. *Exposure Factors Handbook Volume I General Factors: Principles and Applications.* Office of Research and Development. EPA 600/P-95/002F.
- U.S. EPA. May 1998. *Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual, Supplemental Guidance Dermal Risk Assessment.* Interim Guidance. Office of Emergency Response. NCEA-W-0364.
- DTSC. August 1996. *Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities.*
- DTSC. June 1999. *Preliminary Endangerment Assessment Guidance Manual.* Second Printing.

(b) Average skin exposure for men and women's heads, forearms, hands, and lower legs to chemicals of concern in soil while participating in recreational activities. Exposure factor assumes residential and recreational users at the Presidio wear short-sleeved shirts and shorts.

(c) Skin exposure for children's heads, forearms, hands, lower legs, and feet to chemicals of concern in soil. Exposure factor assumes children at the Presidio wear short-sleeved shirts, shorts, and are bare footed.

(d) Average skin exposure for men and women's heads, forearms, and hands to chemicals of concern in soil while performing commercial/industrial activities. Exposure factor assumes workers at the Presidio wear short-sleeved shirts and long pants.

(e) Average of the soil-to-skin adherence factors given for rugby player in wet soil and in dry soil.

(f) Average soil-to-skin adherence factor given for grounds keeper, landscaper, irrigation installer, gardener, archaeologist construction worker, utility worker and heavy equipment operator.

TABLE 4-3
HUMAN HEALTH PRELIMINARY REMEDIATION GOALS FOR SOIL BASED ON RESIDENTIAL USE

Presidio of San Francisco, California

Potential Chemical of Concern	Carcinogenic Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Slope Factor (a)	Non-carcinogenic Oral Reference Dose (mg/kg-day)	Reference Dose (b)	Dermal Absorption Factor (c)	Carcinogenic Risk Based PRG (mg/kg); (d)	Non-carcinogenic Risk Based PRG (mg/kg); (d)	Proposed PRG (mg/kg); (e)
Inorganic Chemicals								
Antimony	- (f)	-	0.0004	IRIS	0.01	-	29	29
Arsenic	1.5	OEHHA	0.0003	IRIS	0.03	0.36	20	0.36
Barium	-	-	0.07	IRIS	0.01	-	5,000	5,000
Beryllium	-	-	0.002	IRIS	0.01	-	140	140
Cadmium	0.38	OEHHA	0.0005	IRIS	0.001	1.7	37	1.7
Chromium (Cr(VI) and Cr(III))	5.3E-04	OEHHA (g)	2	IRIS	0.01	1,200	140,000	1,200
Cobalt	-	-	0.06	NCEA	0.01	-	4,000	4,000
Copper	-	-	(h)	(h)	-	-	-	-
Cyanide	-	-	0.02	IRIS	0.10	-	1,000	1,000
Lead (i)	-	-	-	-	-	-	-	400
Tetraethyl Lead	-	-	0.0000001	IRIS	0.10	-	0.0052	0.0052
Mercury	-	-	0.0003	IRIS	0.01	-	20	20
Molybdenum	-	-	0.0050	IRIS	0.01	-	360	360
Nickel	-	-	0.02	IRIS	0.01	-	1,400	1,400
Selenium	-	-	0.005	IRIS	0.01	-	360	360
Silver	-	-	0.005	IRIS	0.01	-	360	360
Thallium	-	-	0.00008	IRIS (j)	0.01	-	5.7	5.7
Vanadium	-	-	0.009	IRIS	0.01	-	650	650
Zinc	-	-	0.3	IRIS	0.01	-	22,000	22,000
Semivolatile Organic Compounds								
Acenaphthene	-	-	0.06	IRIS	0.15	-	2,700	2,700
Acenaphthylene	-	-	-	-	-	-	-	-
Anthracene	-	-	0.3	IRIS	0.15	-	14,000	14,000
Benzo(a)anthracene	1.2	OEHHA	-	-	0.15	0.27	-	0.27
Benzo(a)pyrene	12	OEHHA	-	-	0.15	0.027	-	0.027

TABLE 4-3
HUMAN HEALTH PRELIMINARY REMEDIATION GOALS FOR SOIL BASED ON RESIDENTIAL USE

Presidio of San Francisco, California

Potential Chemical of Concern	Carcinogenic Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Slope Factor (a)	Non-carcinogenic Oral Reference Dose (mg/kg-day)	Reference Dose (b)	Dermal Absorption Factor (c)	Carcinogenic Risk Based PRG (mg/kg); (d)	Non-carcinogenic Risk Based PRG (mg/kg); (d)	Proposed PRG (mg/kg); (e)
Semivolatile Organic Compounds (cont.)								
Benzo(b)fluoranthene	1.2	OEHHA	-	-	0.15	0.27	-	0.27
Benzo(g,h,i)perylene	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	1.2	OEHHA	-	-	0.15	0.27	-	0.27
Benzyl Alcohol	-	-	0.3	HEAST	0.15	-	14,000	14,000
Chrysene	0.12	OEHHA	-	-	0.15	2.7	-	2.7
Dibenzo(a,h)anthracene	4.1	OEHHA	-	-	0.15	0.078	-	0.078
Dibenzofuran	-	-	0.02	IRIS	0.15	-	910	910
Fluoranthene	-	-	0.04	IRIS	0.15	-	1,800	1,800
Fluorene	-	-	0.04	IRIS	0.15	-	1,800	1,800
Indeno(1,2,3-c,d)pyrene	1.2	OEHHA	-	-	0.15	0.27	-	0.27
2-methylnaphthalene	-	-	-	-	-	-	-	-
4-methylphenol (p-Cresol)	-	-	0.005	HEAST	0.10	-	260	260
Naphthalene	-	-	0.02	IRIS	0.15	-	910	910
n-Nitrosodiphenylamine	0.009	OEHHA	-	-	0.10	43	-	43
Pentachlorophenol	0.081	OEHHA	0.03	IRIS	0.10	5	1,600	5
Phenanthrene	-	-	-	-	-	-	-	-
Phenol	-	-	0.6	IRIS	0.15	-	27,000	27,000
Pyrene	-	-	0.03	IRIS	0.15	-	1,400	1,400
Volatile Organic Compounds (k)								
Acetone	-	-	0.1	IRIS	0.10	-	5,200	See Table 4-6
2-butanone (MEK)	-	-	0.6	IRIS	0.10	-	31,000	See Table 4-6
Carbon disulfide	-	-	0.1	IRIS	0.10	-	5,200	See Table 4-6
1,4-dichlorobenzene	0.0054	OEHHA	0.03	HEAST	0.10	71	1,600	See Table 4-6
p-Isopropyltoluene (p-cymene)	-	-	0.1	IRIS (l)	0.1	-	5,200	See Table 4-6
Methylene Chloride	0.014	OEHHA	0.06	IRIS	0.10	27	3,100	See Table 4-6

TABLE 4-3
HUMAN HEALTH PRELIMINARY REMEDIATION GOALS FOR SOIL BASED ON RESIDENTIAL USE

Presidio of San Francisco, California

Potential Chemical of Concern	Carcinogenic Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Slope Factor (a)	Non-carcinogenic Oral Reference Dose (mg/kg-day)	Reference Dose (b)	Dermal Absorption Factor (c)	Carcinogenic Risk Based PRG (mg/kg); (d)	Non-carcinogenic Risk Based PRG (mg/kg); (d)	Proposed PRG (mg/kg); (e)
Volatile Organic Compounds (cont.)								
1,2,3-trichlorobenzene	0.0036	(m)	0.01	(m)	0.1	110	520	See Table 4-6
1,2,4-trichlorobenzene	0.0036	OEHHA	0.01	IRIS	0.1	110	520	See Table 4-6
Trichlorofluoromethane	-	-	0.30	IRIS	0.10	-	16,000	See Table 4-6
1,1,1-trichloroethane	-	-	0.29	NCEA (n)	0.10	-	15,000	See Table 4-6
PCBs, Pesticides, and Herbicides								
PCBs (Aroclor 1254)	2	OEHHA (o)	0.00002	IRIS	0.15	0.16	1.0	0.16
Aldrin	17	OEHHA	0.00003	IRIS	0.05	0.029	1.8	0.029
alpha-BHC	2.7	OEHHA	-	-	0.05	0.180	-	0.18
beta-BHC	1.5	OEHHA	-	-	0.05	0.32	-	0.32
delta-BHC	2.7	(p)	-	-	0.05	0.180	-	0.18
Chlordane	1.3	OEHHA	0.0005	IRIS	0.05	0.37	31	0.37
2,4-D	-	-	0.01	IRIS	0.05	-	620	620
Dicamba	-	-	0.03	IRIS	0.05	-	1,800	1,800
4,4'-DDD	0.24	OEHHA	-	-	0.05	2.0	-	2.0
4,4'-DDE	0.34	OEHHA	-	-	0.05	1.4	-	1.4
4,4'-DDT	0.34	OEHHA	0.0005	IRIS	0.05	1.4	31	1.4
Dieldrin	16	OEHHA	0.00005	IRIS	0.05	0.030	3.1	0.030
Endosulfan	-	-	0.006	IRIS	0.05	-	370	370
Endosulfan Sulfate	-	-	0.006	(q)	0.05	-	370	370
Endrin	-	-	0.0003	IRIS	0.05	-	18	18
Endrin Aldehyde	-	-	0.0003	(q)	0.05	-	18	18
Endrin Ketone	-	-	0.0003	(q)	0.05	-	18	18
gamma-BHC (Lindane)	1.1	OEHHA	0.0003	IRIS	0.05	0.44	18	0.44
Heptachlor	4.1	OEHHA	0.0005	IRIS	0.05	0.12	31	0.12
Heptachlor Epoxide	5.5	OEHHA	0.00001	IRIS	0.05	0.088	1	0.088

TABLE 4-3
HUMAN HEALTH PRELIMINARY REMEDIATION GOALS FOR SOIL BASED ON RESIDENTIAL USE

Presidio of San Francisco, California

Potential Chemical of Concern	Carcinogenic Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Slope Factor (a)	Non-carcinogenic Oral Reference Dose (mg/kg-day)	Reference Dose (b)	Dermal Absorption Factor (c)	Carcinogenic Risk Based PRG (mg/kg); (d)	Non-carcinogenic Risk Based PRG (mg/kg); (d)	Proposed PRG (mg/kg); (e)
PCBs, Pesticides, and Herbicides (cont.)								
Isodrin	17	(r)	0.00003	(r)	0.05	0.029	-	0.029
MCPP	-	-	-	-	-	-	-	-
Methoxychlor	-	-	0.005	IRIS	0.05	-	310	310

Notes:

(a) Carcinogenic slope factors were obtained from California Environmental Protection Agency, Office of Environmental Health Hazard Assessment ("OEHHA") website table entitled *California Cancer Potency Factors*, dated March 2001. U.S. EPA Integrated Risk Information System ("IRIS") was used as a secondary reference.

(b) Chronic reference doses were obtained from IRIS, U.S. EPA's Health Effects Assessment Summary Tables ("HEAST"), dated July 1997, and U.S. EPA's National Center for Environmental Assessment ("NCEA") Draft Risk Assessment Issue Papers for individual chemicals.

(c) Soil absorption factors obtained from California Environmental Protection Agency, Department of Toxic Substances Control ("DTSC"), *Endangerment Assessment Guidance Manual*, dated June 1999.

(d) Exposure factors used to calculate carcinogenic and non-carcinogenic preliminary remediation goals ("PRGs") are summarized in Table 4-2. PRGs are based upon a carcinogenic target risk level of one-in-one million (i.e., 10^{-6}) incremental risk of an individual developing cancer over a lifetime, and a non-carcinogenic target risk level that corresponds to a hazard index of 1.

(e) Where both carcinogenic and non-carcinogenic PRGs are available, the proposed PRG is the lesser of the two values.

(f) Hyphen indicates that a value is not available or cannot be calculated.

(g) At the Presidio, Cr(VI) comprises 0.0055 to 0.28 percent of the total chromium in serpentinite (Montgomery Watson, 1999). By analogy to the U.S. EPA PRG tables (U.S. EPA, October 2000), OEHHA's oral slope factor of 0.19 $(mg/kg\text{-}d)^{-1}$ for hexavalent chromium was reduced by a factor of 0.0028.

(h) According to HEAST, the toxicity data for copper are inadequate for calculation of an RfD.

(i) The residential cleanup level for lead in soil has been established as a not-to-exceed value of 400 mg/kg, based on chemical-specific ARARs and a maximium average concentration of 370 mg/kg, based on the site-specific PRG. Refer to text for discussion of methodology used to derive the human health PRG for lead.

(j) Reference dose for thallium chloride was used.

TABLE 4-3
HUMAN HEALTH PRELIMINARY REMEDIATION GOALS FOR SOIL BASED ON RESIDENTIAL USE

Presidio of San Francisco, California

Notes (contd):

(k) PRGs for VOCs are adjusted in Tables 4-6 and 4-7, respectively, to account for potential risks due to vapor intrusion into indoor air and potential leaching to groundwater.

(l) Oral reference dose not available for p-isopropyltoluene. The value for isopropylbenzene was used as a surrogate.

(m) Oral slope factors and reference doses not available for 1,2,3-trichlorobenzene. The values for 1,2,4-trichlorobenzene were used as a surrogate.

(n) In the absence of an oral chronic reference dose or oral slope factor, the respective inhalation value was used.

(o) OEHHA's California Cancer Potency Factor table lists a slope factor of 5 $(mg/kg\text{-}day)^{-1}$ for PCBs. However, OEHHA's Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values (dated 13 September 2001) and IRIS list the oral slope factor for PCBs as 2 $(mg/kd\text{-}day)^{-1}$. Based on discussions with Laurie Monserrat and David Siegel with OEHHA, the oral slope factor of 2 $(mg/kg\text{-}day)^{-1}$ is the most current value and would be accepted in risk assessments reviewed by OEHHA.

(p) An oral slope factor was not available for delta-BHC. The respective slope factor for alpha-BHC is used.

(q) Oral reference doses were not available for Endosulfin Sulfate, Endrin Aldehyde, or Endrin Ketone. The respective reference doses for Endosulfin is used for Endosulfin Sulfate, and Endrin is used for Endrin Aldehyde and Endrin Ketone.

(r) Isodrin is an isomer of aldrin. Oral slope factor and reference dose for aldrin were used to calculate isodrin PRGs.

TABLE 4-4
HUMAN HEALTH PRELIMINARY REMEDIATION GOALS FOR SOIL BASED ON RECREATIONAL USE

Presidio of San Francisco, California

Potential Chemical of Concern	Carcinogenic Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Slope Factor (a)	Non-carcinogenic Oral Reference Dose (mg/kg-day)	Reference Dose (b)	Dermal Absorption Factor (c)	Carcinogenic Risk Based PRG (mg/kg); (d)	Non-carcinogenic Risk Based PRG (mg/kg); (d)	Proposed PRG (mg/kg); (e)
Inorganic Chemicals								
Antimony	- (f)	-	0.0004	IRIS	0.01	-	70	70
Arsenic	1.5	OEHHA	0.0003	IRIS	0.03	0.88	48	0.88
Barium	-	-	0.07	IRIS	0.01	-	12,000	12,000
Beryllium	-	-	0.002	IRIS	0.01	-	350	350
Cadmium	0.38	OEHHA	0.0005	IRIS	0.001	4.2	91	4.2
Chromium (Cr(VI) and Cr(III))	5.3E-04	OEHHA (g)	2	IRIS	0.01	2,800	350,000	2,800
Cobalt	-	-	0.06	NCEA	0.01	-	10,000	10,000
Copper	-	-	(h)	(h)	-	-	-	-
Cyanide	-	-	0.02	IRIS	0.10	-	2,500	2,500
Lead (i)	-	-	-	-	-	-	-	500
Tetraethyl Lead	-	-	0.0000001	IRIS	0.10	-	0.013	0.013
Mercury	-	-	0.0003	IRIS	0.01	-	52	52
Molybdenum	-	-	0.0050	IRIS	0.01	-	870	870
Nickel	-	-	0.02	IRIS	0.01	-	3,500	3,500
Selenium	-	-	0.005	IRIS	0.01	-	870	870
Silver	-	-	0.005	IRIS	0.01	-	870	870
Thallium	-	-	0.00008	IRIS (j)	0.01	-	14	14
Vanadium	-	-	0.009	IRIS	0.01	-	1,600	1,600
Zinc	-	-	0.3	IRIS	0.01	-	52,000	52,000
Semivolatile Organic Compounds								
Acenaphthene	-	-	0.06	IRIS	0.15	-	6,600	6,600
Acenaphthylene	-	-	-	-	-	-	-	-
Anthracene	-	-	0.3	IRIS	0.15	-	33,000	33,000
Benzo(a)anthracene	1.2	OEHHA	-	-	0.15	0.65	-	0.65
Benzo(a)pyrene	12	OEHHA	-	-	0.15	0.065	-	0.065

TABLE 4-4
HUMAN HEALTH PRELIMINARY REMEDIATION GOALS FOR SOIL BASED ON RECREATIONAL USE

Presidio of San Francisco, California

Potential Chemical of Concern	Carcinogenic Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Slope Factor (a)	Non-carcinogenic Oral Reference Dose (mg/kg-day)	Reference Dose (b)	Dermal Absorption Factor (c)	Carcinogenic Risk Based PRG (mg/kg); (d)	Non-carcinogenic Risk Based PRG (mg/kg); (d)	Proposed PRG (mg/kg); (e)
Semivolatile Organic Compounds (cont.)								
Benzo(b)fluoranthene	1.2	OEHHA	-	-	0.15	0.65	-	0.65
Benzo(g,h,i)perylene	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	1.2	OEHHA	-	-	0.15	0.65	-	0.65
Benzyl Alcohol	-	-	0.3	HEAST	0.10	-	38,000	38,000
Chrysene	0.12	OEHHA	-	-	0.15	6.5	-	6.5
Dibenzo(a,h)anthracene	4.1	OEHHA	-	-	0.15	0.19	-	0.19
Dibenzofuran	-	-	0.02	IRIS	0.15	-	2,200	2,200
Fluoranthene	-	-	0.04	IRIS	0.15	-	4,400	4,400
Fluorene	-	-	0.04	IRIS	0.15	-	4,400	4,400
Indeno(1,2,3-c,d)pyrene	1.2	OEHHA	-	-	0.15	0.65	-	0.65
2-methylnaphthalene	-	-	-	-	-	-	-	-
4-methylphenol (p-Cresol)	-	-	0.005	HEAST	0.10	-	640	640
Naphthalene	-	-	0.02	IRIS	0.15	-	2,200	2,200
n-nitrosodiphenylamine	0.009	OEHHA	-	-	0.10	104	-	104
Pentachlorophenol	0.081	OEHHA	0.03	IRIS	0.10	12	3,800	12
Phenanthrene	-	-	-	-	-	-	-	-
Phenol	-	-	0.60	IRIS	0.10	-	76,000	76,000
Pyrene	-	-	0.03	IRIS	0.15	-	3,300	3,300
Volatile Organic Compounds (k)								
Acetone	-	-	0.1	IRIS	0.10	-	13,000	See Table 4-6
2-butanone (MEK)	-	-	0.6	IRIS	0.10	-	76,000	See Table 4-6
Carbon disulfide	-	-	0.1	IRIS	0.10	-	13,000	See Table 4-6
1,4-dichlorobenzene	0.0054	OEHHA	0.03	HEAST	0.10	173	3,800	See Table 4-6
p-Isopropyltoluene (p-cymene)	-	-	0.1	IRIS (l)	0.1	-	13,000	See Table 4-6
Methylene Chloride	0.014	OEHHA	0.06	IRIS	0.10	67	7,600	See Table 4-6

TABLE 4-4
HUMAN HEALTH PRELIMINARY REMEDIATION GOALS FOR SOIL BASED ON RECREATIONAL USE

Presidio of San Francisco, California

Potential Chemical of Concern	Carcinogenic Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Slope Factor (a)	Non-carcinogenic Oral Reference Dose (mg/kg-day)	Reference Dose (b)	Dermal Absorption Factor (c)	Carcinogenic Risk Based PRG (mg/kg); (d)	Non-carcinogenic Risk Based PRG (mg/kg); (d)	Proposed PRG (mg/kg); (e)
Volatile Organic Compounds (cont.)								
1,2,3-trichlorobenzene	0.0036	(m)	0.01	(m)	0.1	260	1,300	See Table 4-6
1,2,4-trichlorobenzene	0.0036	OEHHA	0.01	IRIS	0.1	260	1,300	See Table 4-6
Trichlorofluoromethane	-	-	0.30	IRIS	0.10	-	38,000	See Table 4-6
1,1,1-trichloroethane	-	-	0.29	NCEA (n)	0.10	-	37,000	See Table 4-6
PCBs, Pesticides, and Herbicides								
PCBs (Aroclor 1254)	2	OEHHA (o)	0.00002	IRIS	0.15	0.39	2.2	0.39
Aldrin	17	OEHHA	0.00003	IRIS	0.05	0.07	4.5	0.07
alpha-BHC	2.7	OEHHA	-	-	0.05	0.44	-	0.44
beta-BHC	1.5	OEHHA	-	-	0.05	0.79	-	0.79
delta-BHC	2.7	(p)	-	-	0.05	0.44	-	0.44
Chlordane	1.3	OEHHA	0.0005	IRIS	0.05	0.91	75	0.91
2,4-D	-	-	0.01	IRIS	0.05	-	1,500	1,500
Dicamba	-	-	0.03	IRIS	0.05	-	4,500	4,500
4,4'-DDD	0.24	OEHHA	-	-	0.05	4.9	-	4.9
4,4'-DDE	0.34	OEHHA	-	-	0.05	3.5	-	3.5
4,4'-DDT	0.34	OEHHA	0.0005	IRIS	0.05	3.5	75	3.5
Dieldrin	16	OEHHA	0.00005	IRIS	0.05	0.074	7.5	0.074
Endosulfan	-	-	0.006	IRIS	0.05	-	900	900
Endosulfan Sulfate	-	-	0.006	(q)	0.05	-	900	900
Endrin	-	-	0.0003	IRIS	0.05	-	45	45
Endrin Aldehyde	-	-	0.0003	(q)	0.05	-	45	45
Endrin Ketone	-	-	0.0003	(q)	0.05	-	45	45
gamma-BHC (Lindane)	1.1	OEHHA	0.0003	IRIS	0.05	1.1	45	1.1
Heptachlor	4.1	OEHHA	0.0005	IRIS	0.05	0.29	75	0.29
Heptachlor Epoxide	5.5	OEHHA	0.00001	IRIS	0.05	0.21	2	0.21

TABLE 4-4
HUMAN HEALTH PRELIMINARY REMEDIATION GOALS FOR SOIL BASED ON RECREATIONAL USE

Presidio of San Francisco, California

Potential Chemical of Concern	Carcinogenic Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Slope Factor (a)	Non-carcinogenic Oral Reference Dose (mg/kg-day)	Reference Dose (b)	Dermal Absorption Factor (c)	Carcinogenic Risk Based PRG (mg/kg); (d)	Non-carcinogenic Risk Based PRG (mg/kg); (d)	Proposed PRG (mg/kg); (e)
PCBs, Pesticides, and Herbicides (cont.)								
Isodrin	17	(r)	0.00003	(r)	0.05	0.069	4	0.069
MCPP	-	-	-	-	-	-	-	-
Methoxychlor	-	-	0.005	IRIS	0.05	-	750	750

Notes:

(a) Carcinogenic slope factors were obtained from California Environmental Protection Agency, Office of Environmental Health Hazard Assessment ("OEHHA") website table entitled *California Cancer Potency Factors*, dated March 2001. U.S. EPA Integrated Risk Information System ("IRIS") was used as a secondary reference.

(b) Chronic reference doses were obtained from IRIS, U.S. EPA's Health Effects Assessment Summary Tables ("HEAST"), dated July 1997, and U.S. EPA's National Center for Environmental Assessment ("NCEA") Draft Risk Assessment Issue Papers for individual chemicals.

(c) Soil absorption factors obtained from California Environmental Protection Agency, Department of Toxic Substances Control ("DTSC"), *Endangerment Assessment Guidance Manual*, dated June 1999.

(d) Exposure factors used to calculate carcinogenic and non-carcinogenic preliminary remediation goals ("PRGs") are summarized in Table 4-2. PRGs are based upon a carcinogenic target risk level of one-in-one million (i.e., 10^{-6}) incremental risk of an individual developing cancer over a lifetime, and a non-carcinogenic target risk level that corresponds to a hazard index of 1.

(e) Where both carcinogenic and non-carcinogenic PRGs are available, the proposed PRG is the lesser of the two values.

(f) Hyphen indicates that a value is not available or cannot be calculated.

(g) At the Presidio, Cr(VI) comprises 0.0055 to 0.28 percent of the total chromium in serpentinite (Montgomery Watson, 1999). By analogy to the U.S. EPA PRG tables (U.S. EPA, October 2000), OEHHA's oral slope factor of 0.19 $(mg/kg\text{-}d)^{-1}$ for hexavalent chromium was reduced by a factor of 0.0028.

(h) According to HEAST, the toxicity data for copper are inadequate for calculation of an RfD.

(i) PRG calculated through use of DTSC Lead Spread Version 7.0 (beta test version) computer model.

(j) Reference dose for thallium chloride was used.

TABLE 4-4
HUMAN HEALTH PRELIMINARY REMEDIATION GOALS FOR SOIL BASED ON RECREATIONAL USE

Presidio of San Francisco, California

Notes (contd):

(k) PRGs for VOCs are adjusted in Tables 4-6 and 4-7, respectively, to account for potential risks due to vapor intrusion into indoor air and potential leaching to groundwater.

(l) Oral reference dose not available for p-isopropyltoluene. The value for isopropylbenzene was used as a surrogate.

(m) Oral slope factors and reference doses not available for 1,2,3-trichlorobenzene. The values for 1,2,4-trichlorobenzene were used as a surrogate.

(n) In the absence of an oral chronic reference dose or oral slope factor, the respective inhalation value was used.

(o) OEHHA's California Cancer Potency Factor table lists a slope factor of 5 $(mg/kg\text{-}day)^{-1}$ for PCBs. However, OEHHA's Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values (dated 13 September 2001) and IRIS list the oral slope factor for PCBs as 2 $(mg/kd\text{-}day)^{-1}$. Based on discussions with Laurie Monserrat and David Siegel with OEHHA, the oral slope factor of 2 $(mg/kg\text{-}day)^{-1}$ is the most current value and would be accepted in risk assessments reviewed by OEHHA.

(p) An oral slope factor was not available for delta-BHC. The respective slope factor for alpha-BHC is used.

(q) Oral reference doses were not available for Endosulfin Sulfate, Endrin Aldehyde, or Endrin Ketone. The respective reference doses for Endosulfin is used for Endosulfin Sulfate, and Endrin is used for Endrin Aldehyde and Endrin Ketone.

(r) Isodrin is an isomer of aldrin. Oral slope factor and reference dose for aldrin were used to calculate isodrin PRGs.

TABLE 4-5
HUMAN HEALTH PRELIMINARY REMEDIATION GOALS FOR SOIL BASED ON COMMERCIAL/INDUSTRIAL USE

Presidio of San Francisco, California

Potential Chemical of Concern	Carcinogenic Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Slope Factor (a)	Non-carcinogenic Oral Reference Dose (mg/kg-day)	Reference Dose (b)	Dermal Absorption Factor (c)	Carcinogenic Risk Based PRG (mg/kg); (d)	Non-carcinogenic Risk Based PRG (mg/kg); (d)	Proposed PRG (mg/kg); (e)
Inorganic Chemicals								
Antimony	- (f)	-	0.0004	IRIS	0.01	-	760	760
Arsenic	1.5	OEHHA	0.0003	IRIS	0.03	3.3	490	3.3
Barium	-	-	0.07	IRIS	0.01	-	130,000	130,000
Beryllium	-	-	0.002	IRIS	0.01	-	3,800	3,800
Cadmium	0.38	OEHHA	0.0005	IRIS	0.001	16	1,000	16
Chromium (Cr(VI) and Cr(III))	5.3E-04	OEHHA (g)	2	IRIS	0.01	11,000	3,800,000	11,000
Cobalt	-	-	0.06	NCEA	0.01	-	110,000	110,000
Copper	-	-	(h)	(h)	-	-	-	-
Cyanide	-	-	0.02	IRIS	0.10	-	23,000	23,000
Lead (i)	-	-	-	-	-	-	-	3,500
Tetraethyl Lead	-	-	0.0000001	IRIS	0.10	-	0.11	0.11
Mercury	-	-	0.0003	IRIS	0.01	-	570	570
Molybdenum	-	-	0.0050	IRIS	0.01	-	9,400	9,400
Nickel	-	-	0.02	IRIS	0.01	-	38,000	38,000
Selenium	-	-	0.005	IRIS	0.01	-	9,400	9,400
Silver	-	-	0.005	IRIS	0.01	-	9,400	9,400
Thallium	-	-	0.00008	IRIS (j)	0.01	-	150	150
Vanadium	-	-	0.009	IRIS	0.01	-	17,000	17,000
Zinc	-	-	0.3	IRIS	0.01	-	570,000	570,000
Semivolatile Organic Compounds								
Acenaphthene	-	-	0.06	IRIS	0.15	-	55,000	55,000
Acenaphthylene	-	-	-	-	-	-	-	-
Anthracene	-	-	0.3	IRIS	0.15	-	280,000	280,000
Benzo(a)anthracene	1.2	OEHHA	-	-	0.15	2.3	-	2.3
Benzo(a)pyrene	12	OEHHA	-	-	0.15	0.23	-	0.23

TABLE 4-5
HUMAN HEALTH PRELIMINARY REMEDIATION GOALS FOR SOIL BASED ON COMMERCIAL/INDUSTRIAL USE

Presidio of San Francisco, California

Potential Chemical of Concern	Carcinogenic Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Slope Factor (a)	Non-carcinogenic Oral Reference Dose (mg/kg-day)	Reference Dose (b)	Dermal Absorption Factor (c)	Carcinogenic Risk Based PRG (mg/kg); (d)	Non-carcinogenic Risk Based PRG (mg/kg); (d)	Proposed PRG (mg/kg); (e)
Semivolatile Organic Compounds (cont.)								
Benzo(b)fluoranthene	1.2	OEHHA	-	-	0.15	2.3	-	2.3
Benzo(g,h,i)perylene	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	1.2	OEHHA	-	-	0.15	2.3	-	2.3
Benzyl Alcohol	-	-	0.3	HEAST	0.15	-	280,000	280,000
Chrysene	0.12	OEHHA	-	-	0.15	23	-	23
Dibenzo(a,h)anthracene	4.1	OEHHA	-	-	0.15	0.67	-	0.67
Dibenzofuran	-	-	0.02	IRIS	0.15	-	18,000	18,000
Fluoranthene	-	-	0.04	IRIS	0.15	-	37,000	37,000
Fluorene	-	-	0.04	IRIS	0.15	-	37,000	37,000
Indeno(1,2,3-c,d)pyrene	1.2	OEHHA	-	-	0.15	2.3	-	2.3
2-methylnaphthalene	-	-	-	-	-	-	-	-
4-methylphenol (p-Cresol)	-	-	0.005	HEAST	0.10	-	5,600	5,600
Naphthalene	-	-	0.02	IRIS	0.15	-	18,000	18,000
n-nitrosodiphenylamine	0.009	OEHHA	-	-	0.10	380	-	380
Pentachlorophenol	0.081	OEHHA	0.03	IRIS	0.10	42	34,000	42
Phenanthrene	-	-	-	-	-	-	-	-
Phenol	-	-	0.6	IRIS	0.15	-	550,000	550,000
Pyrene	-	-	0.03	IRIS	0.15	-	28,000	28,000
Volatile Organic Compounds (k)								
Acetone	-	-	0.1	IRIS	0.10	-	110,000	See Table 4-6
2-butanone (MEK)	-	-	0.6	IRIS	0.10	-	680,000	See Table 4-6
Carbon disulfide	-	-	0.1	IRIS	0.10	-	110,000	See Table 4-6
1,4-dichlorobenzene	0.0054	OEHHA	0.03	HEAST	0.10	630	34,000	See Table 4-6
p-Isopropyltoluene (p-cymene)	-	-	0.1	IRIS (l)	0.1	-	110,000	See Table 4-6
Methylene Chloride	0.014	OEHHA	0.06	IRIS	0.10	240	68,000	See Table 4-6

TABLE 4-5
HUMAN HEALTH PRELIMINARY REMEDIATION GOALS FOR SOIL BASED ON COMMERCIAL/INDUSTRIAL USE

Presidio of San Francisco, California

Potential Chemical of Concern	Carcinogenic Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Slope Factor (a)	Non-carcinogenic Oral Reference Dose (mg/kg-day)	Reference Dose (b)	Dermal Absorption Factor (c)	Carcinogenic Risk Based PRG (mg/kg); (d)	Non-carcinogenic Risk Based PRG (mg/kg); (d)	Proposed PRG (mg/kg); (e)
Volatile Organic Compounds (cont.)								
1,2,3-trichlorobenzene	0.0036	(m)	0.01	(m)	0.1	940	11,000	See Table 4-6
1,2,4-trichlorobenzene	0.0036	OEHHA	0.01	IRIS	0.1	940	11,000	See Table 4-6
Trichlorofluoromethane	-	-	0.30	IRIS	0.10	-	338,000	See Table 4-6
1,1,1-trichloroethane	-	-	0.29	NCEA (n)	0.10	-	330,000	See Table 4-6
PCBs, Pesticides, and Herbicides								
PCBs (Aroclor 1254)	2	OEHHA (o)	0.00002	IRIS	0.15	1.4	18	1.4
Aldrin	17	OEHHA	0.00003	IRIS	0.05	0.26	44	0.26
alpha-BHC	2.7	OEHHA	-	-	0.05	1.6	-	1.6
beta-BHC	1.5	OEHHA	-	-	0.05	2.9	-	2.9
delta-BHC	2.7	(p)	-	-	0.05	1.6	-	1.6
Chlordane	1.3	OEHHA	0.0005	IRIS	0.05	3.4	730	3.4
2,4-D	-	-	0.01	IRIS	0.05	-	15,000	15,000
Dicamba	-	-	0.03	IRIS	0.05	-	44,000	44,000
4,4'-DDD	0.24	OEHHA	-	-	0.05	18	-	18
4,4'-DDE	0.34	OEHHA	-	-	0.05	13	-	13
4,4'-DDT	0.34	OEHHA	0.0005	IRIS	0.05	13	730	13
Dieldrin	16	OEHHA	0.00005	IRIS	0.05	0.27	73	0.27
Endosulfan	-	-	0.006	IRIS	0.05	-	8,700	8,700
Endosulfan Sulfate	-	-	0.006	(q)	0.05	-	8,700	8,700
Endrin	-	-	0.0003	IRIS	0.05	-	440	440
Endrin Aldehyde	-	-	0.0003	(q)	0.05	-	440	440
Endrin Ketone	-	-	0.0003	(q)	0.05	-	440	440
gamma-BHC (Lindane)	1.1	OEHHA	0.0003	IRIS	0.05	4.0	440	4.0
Heptachlor	4.1	OEHHA	0.0005	IRIS	0.05	1.1	730	1.1
Heptachlor Epoxide	5.5	OEHHA	0.00001	IRIS	0.05	0.79	19	0.79

TABLE 4-5
HUMAN HEALTH PRELIMINARY REMEDIATION GOALS FOR SOIL BASED ON COMMERCIAL/INDUSTRIAL USE

Presidio of San Francisco, California

Potential Chemical of Concern	Carcinogenic Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Slope Factor (a)	Non-carcinogenic Oral Reference Dose (mg/kg-day)	Reference Dose (b)	Dermal Absorption Factor (c)	Carcinogenic Risk Based PRG (mg/kg); (d)	Non-carcinogenic Risk Based PRG (mg/kg); (d)	Proposed PRG (mg/kg); (e)
PCBs, Pesticides, and Herbicides (cont.)								
Isodrin	17	(r)	0.00003	(r)	0.05	0.26	44	0.26
MCPP	-	-	-	-	-	-	-	-
Methoxychlor	-	-	0.005	IRIS	0.05	-	7,300	7,300

Notes:

(a) Carcinogenic slope factors were obtained from California Environmental Protection Agency, Office of Environmental Health Hazard Assessment ("OEHHA") website table entitled *California Cancer Potency Factors*, dated March 2001. U.S. EPA Integrated Risk Information System ("IRIS") was used as a secondary reference.

(b) Chronic reference doses were obtained from IRIS, U.S. EPA's Health Effects Assessment Summary Tables ("HEAST"), dated July 1997, and U.S. EPA's National Center for Environmental Assessment ("NCEA") Draft Risk Assessment Issue Papers for individual chemicals.

(c) Soil absorption factors obtained from California Environmental Protection Agency, Department of Toxic Substances Control ("DTSC"), *Endangerment Assessment Guidance Manual*, dated June 1999.

(d) Exposure factors used to calculate carcinogenic and non-carcinogenic preliminary remediation goals ("PRGs") are summarized in Table 4-2. PRGs are based upon a carcinogenic target risk level of one-in-one million (i.e., 10^{-6}) incremental risk of an individual developing cancer over a lifetime, and a non-carcinogenic target risk level that corresponds to a hazard index of 1.

(e) Where both carcinogenic and non-carcinogenic PRGs are available, the proposed PRG is the lesser of the two values.

(f) Hyphen indicates that a value is not available or cannot be calculated.

(g) At the Presidio, Cr(VI) comprises 0.0055 to 0.28 percent of the total chromium in serpentinite (Montgomery Watson, 1999). By analogy to the U.S. EPA PRG tables (U.S. EPA, October 2000), OEHHA's oral slope factor of 0.19 $(mg/kg\text{-}d)^{-1}$ for hexavalent chromium was reduced by a factor of 0.0028.

(h) According to HEAST, the toxicity data for copper are inadequate for calculation of an RfD.

(i) PRG calculated through use of DTSC Lead Spread Version 7.0 (beta test version) computer model.

(j) Reference dose for thallium chloride was used.

TABLE 4-5
HUMAN HEALTH PRELIMINARY REMEDIATION GOALS FOR SOIL BASED ON COMMERCIAL/INDUSTRIAL USE

Presidio of San Francisco, California

Notes (contd):

(k) PRGs for VOCs are adjusted in Tables 4-6 and 4-7, respectively, to account for potential risks due to vapor intrusion into indoor air and potential leaching to groundwater.

(l) Oral reference dose not available for p-isopropyltoluene. The value for isopropylbenzene was used as a surrogate.

(m) Oral slope factors and reference doses not available for 1,2,3-trichlorobenzene. The values for 1,2,4-trichlorobenzene were used as a surrogate.

(n) In the absence of an oral chronic reference dose or oral slope factor, the respective inhalation value was used.

(o) OEHHA's California Cancer Potency Factor table lists a slope factor of 5 $(mg/kg\text{-}day)^{-1}$ for PCBs. However, OEHHA's Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values (dated 13 September 2001) and IRIS list the oral slope factor for PCBs as 2 $(mg/kd\text{-}day)^{-1}$. Based on discussions with Laurie Monserrat and David Siegel with OEHHA, the oral slope factor of 2 $(mg/kg\text{-}day)^{-1}$ is the most current value and would be accepted in risk assessments reviewed by OEHHA.

(p) An oral slope factor was not available for delta-BHC. The respective slope factor for alpha-BHC is used.

(q) Oral reference doses were not available for Endosulfin Sulfate, Endrin Aldehyde, or Endrin Ketone. The respective reference doses for Endosulfin is used for Endosulfin Sulfate, and Endrin is used for Endrin Aldehyde and Endrin Ketone.

(r) Isodrin is an isomer of aldrin. Oral slope factor and reference dose for aldrin were used to calculate isodrin PRGs.

TABLE 4-6
DEVELOPMENT OF HUMAN HEALTH PRELIMINARY REMEDIATION GOALS FOR VOLATILE ORGANIC COMPOUNDS IN SOIL AT THE PRESIDIO OF SAN FRANCISCO (INCLUDES VAPOR INTRUSION PATHWAY)

Presidio of San Francisco, California

CARCINOGENIC	Carcinogenic Direct Contact PRGs (a)			Carcinogenic Vapor Intrusion PRGs ($PRG_{c\text{-}inh}$) (b)		Combined Carcinogenic PRGs (c)		
Potential Chemical of Concern	Residential (mg/kg)	Recreational (mg/kg)	Comm./Indust. (mg/kg)	Residential (mg/kg)	Comm./Indust. (mg/kg)	Residential (mg/kg)	Recreational (mg/kg)	Comm./Indust. (mg/kg)
Acetone	-	-	-	-	-	-	-	-
2-butanone (MEK)	-	-	-	-	-	-	-	-
Carbon disulfide	-	-	-	-	-	-	-	-
1,4-dichlorobenzene	71	173	630	0.13	0.49	0.13	173	0.49
p-Isopropyltoluene (p-cymene)	-	-	-	-	-	-	-	-
Methylene Chloride	27	67	240	0.89	3.1	0.86	67	3.1
1,2,3-trichlorobenzene (d)	110	260	940	87	280	49	260	216
1,2,4-trichlorobenzene	110	260	940	87	280	49	260	216
Trichlorofluoromethane	-	-	-	-	-	-	-	-
1,1,1-trichloroethane	-	-	-	-	-	-	-	-

NON-CARCINOGENIC	Non-carcinogenic Direct Contact PRGs (a)			Non-carcinogenic Vapor Intrusion PRGs ($PRG_{nc\text{-}inh}$) (e)		Combined Non-carcinogenic PRGs (c)		
Potential Chemical of Concern	Residential (mg/kg)	Recreational (mg/kg)	Comm./Indust. (mg/kg)	Residential (mg/kg)	Comm./Indust. (mg/kg)	Residential (mg/kg)	Recreational (mg/kg)	Comm./Indust. (mg/kg)
Acetone	5,200	13,000	110,000	43	140	43	13,000	140
2-butanone (MEK)	31,000	76,000	680,000	596	1,980	585	76,000	1,974
Carbon disulfide	5,200	13,000	110,000	266	676	253	13,000	672
1,4-dichlorobenzene	1,600	3,800	34,000	485	1,580	372	3,800	1,510
p-Isopropyltoluene (p-cymene)	5,200	13,000	110,000	533	848	483	13,000	842
Methylene Chloride	3,100	7,600	68,000	1,140	3,320	958	7,600	3,165
1,2,3-trichlorobenzene (d)	520	1,300	11,000	462	1,520	245	1,300	1,335
1,2,4-trichlorobenzene	520	1,300	11,000	462	1,520	245	1,300	1,335
Trichlorofluoromethane	16,000	38,000	338,000	40	116	40	38,000	116
1,1,1-trichloroethane	15,000	37,000	330,000	76	220	76	37,000	220

TABLE 4-6
DEVELOPMENT OF HUMAN HEALTH PRELIMINARY REMEDIATION GOALS FOR VOLATILE ORGANIC COMPOUNDS IN SOIL AT THE PRESIDIO OF SAN FRANCISCO (INCLUDES VAPOR INTRUSION PATHWAY)

Presidio of San Francisco, California

Notes:

(a) Direct Contact Preliminary Remediation Goals ("PRGs") for volatile organic compounds ("VOCs") were calculated in Tables 4-3, 4-4, and 4-5 for residential, recreational, and commercial/industrial human health land use, respectively. The direct contact PRGs do not include potential risks due to vapor intrusion into indoor air.

(b) Carcinogenic Vapor Intrusion PRGs represent the soil concentration corresponding to a lifetime incremental cancer risk of 10^{-6} due to vapor intrusion of VOCs from soil into indoor air. Values obtained from Table E-1a from Volume II, of *Application of Risk-Based Screening Levels and Decision Making to Sites with Impacted Soil and Groundwater ("RBSLs")*, Regional Water Quality Control Board, San Francisco Bay Region, Interim Final, December 2001. The value assumes coarse grained soils. Recreational populations are assumed to be outdoors; this pathway is assumed to be incomplete for recreational users.

(c) Combined carcinogenic and non-carcinogenic PRGs incorporating the Vapor Intrusion PRGs were calculated using the formula shown in the text. These values are carried forward for use in calculation of final human health PRGs in subsequent tables. Vapor intrusion of VOCs into indoor air is not anticipated for recreational land uses. Therefore, the recreational PRGs were not modified to account for vapor intrusion.

(d) Values for 1,2,4-trichlorobenzene were used as a surrogate for 1,2,3-trichlorobenzene.

(e) Non-carcinogenic Vapor Intrusion PRGs represent the soil concentration corresponding to a hazard index of 1 due to vapor intrusion of VOCs from soil into indoor air. Values obtained from Table E-1a from Volume II of the RBSLs. The value assumes coarse grained soils. RBSLs were not available for 2-butanone, carbon disulfide, 1,4-dichlorobenzene (non-carcinogenic), p-isopropyltoluene, trichloroflouromethane, and 1,2,4-trichlorobenzene (non-carcinogenic). Vapor Intrusion PRGs for these VOCs were calculated using the Johnson & Ettinger model (Version 2.3, March 2001), with the same exposure assumptions and soil parameters as used for the development of the RBSLs. Recreational populations are assumed to be outdoors; this pathway is assumed to be incomplete for recreational users.

TABLE 4-7
HUMAN HEALTH PRELIMINARY REMEDIATION GOALS FOR VOLATILE ORGANIC COMPOUNDS IN SOIL AND SEDIMENT AT THE PRESIDIO OF SAN FRANCISCO

Presidio of San Francisco, California

Potential Chemical of Concern	Combined Carcinogenic PRGs (a)			Combined Non-carcinogenic PRGs (a)			Groundwater Protection PRGs for Surface Soil (b)		Proposed Human Health PRGs (c)		
	Residential (mg/kg)	Recreational (mg/kg)	Comm./Indust. (mg/kg)	Residential (mg/kg)	Recreational (mg/kg)	Comm./Indust. (mg/kg)	Residential (mg/kg)	Comm./Indust. (mg/kg)	Residential (mg/kg)	Recreational (mg/kg)	Comm./Indust. (mg/kg)
Acetone	-	-	-	43	13,000	140	0.24	0.24	0.24	0.24	0.24
2-butanone (MEK)	-	-	-	585	76,000	1,974	3.8	3.8	3.8	3.8	3.8
Carbon disulfide	-	-	-	253	13,000	672	200	200	200	200	200
1,4-dichlorobenzene	0.13	173	0.49	372	3,800	1,510	0.59	0.59	0.13	0.59	0.49
p-Isopropyltoluene (p-cymene)	-	-	-	483	13,000	842	133	133	133	133	133
Methylene Chloride	0.86	67	3.1	958	7,600	3,165	0.076	0.076	0.076	0.076	0.076
1,2,3-trichlorobenzene (d)	49	260	216	245	1,300	1,335	15	15	15	15	15
1,2,4-trichlorobenzene	49	260	216	245	1,300	1,335	15	15	15	15	15
Trichlorofluoromethane	-	-	-	40	38,000	116	80	80	40	80	80
1,1,1-trichloroethane	-	-	-	76	37,000	220	8.0	8.0	8.0	8.0	8.0

Notes:

(a) Combined carcinogenic and non-carcinogenic Preliminary Remediation Goals ("PRGs") for volatile organic compounds ("VOCs") are carried forward from Table 4-6. The PRGs for residential and commercial/industrial human health land use incorporate potential risks due to vapor intrusion into indoor air. Vapor intrusion of VOCs into indoor air is not anticipated for recreational uses.

(b) Groundwater Protection PRGs are soil cleanup levels based on protection of drinking water resources via the leaching pathway. Values were obtained from Tables A-1 and A-2 from Volume II of the *Application of Risk-Based Screening Levels and Decision Making to Sites with Impacted Soil and Groundwater ("RBSLs")*, Regional Water Quality Control Board, San Francisco Bay Region, Interim Final, December 2001. The listed value is from the Groundwater Protection (soil leaching) column, assuming groundwater is a drinking water resource. Groundwater protection RBSLs were not available for carbon disulfide, p-isopropyltoluene, or trichlorofluoromethane; groundwater protection values were calculated for these compounds using formulas in the RBSL guidance. For these calculations, the common maximum contaminant level ("MCL") for trichlorofluoromethane and toluene (as a surrogate for p-isopropyltoluene) of 150 µg/L was used as the target groundwater concentration for both chemicals. The U.S. EPA tap water PRG (November 2000) was used as the target groundwater concentration for carbon disulfide (1,000 µg/L), as no target groundwater concentration is identified in Table 7-6. Because the Vapor Intrusion and Groundwater Protection PRGs are not site-specific, if VOCs are found at Presidio sites, VOC cleanup levels may be re-calculated to be site-specific. Such values would be calculated in conjunction with discussions with regulatory agencies.

(c) The proposed PRG is the more stringent (smallest) of the applicable values in each land use category. Although the RWQCB's RBSL document does not provide numbers for leaching to groundwater under a recreational land use scenario, the protection of groundwater resources in recreational areas is appropriate. Therefore, the Groundwater Protection PRGs are retained as the proposed PRGs for recreational land uses since these values are more stringent than the other human health values and are appropriate for protecting groundwater resources in recreational areas of the Presidio.

(d) Values for 1,2,4-trichlorobenzene were used as a surrogate for 1,2,3-trichlorobenzene.

TABLE 4-8
LEAD INTAKE SUMMARY FOR RESIDENTIAL, RECREATIONAL, AND COMMERCIAL/INDUSTRIAL USERS (a)

Presidio of San Francisco, California

Potentially Exposed Population	Exposure Frequency (days/week)	Exposure Media/Lead Concentration					Blood Lead (f) (µg/dl)
		Air (b) (µg/m^3)	Water (b) (µg/L)	Food Intake (c) (kg/day)	Background Soil (d) (mg/kg)	Presidio Soil (e) (mg/kg)	
Residential (child)	7 (Presidio)	0.028	2.4	1.9	0	**370**	10
Recreational (child)	7 (Background)	0.028	15	1.1	0	0	4.6
	4 (Background)	0	0	0	66	0	0.8
	3 (Presidio)	0	0	0	0	**500**	4.6
							10
Commercial/Industrial (adult)	5 (Presidio)	0.028	15	1.9	0	**3,500**	10

Notes:

(a) Lead concentration in blood calculated using California Environmental Protection Agency, Department of Toxic Substances Control ("DTSC") Lead Spread Version 7.0 (beta test version) computer model.

(b) Air, water and food intake concentrations are based on DTSC default factors, except for lead in residential tap water. A value of 2.4 ug/L is based on the 95% upper confidence limit of the average lead concentration measured in residential tap water at the Presidio in 1998, 1999, and 2000 (see data in Appendix A).

(c) Food intake is based on DTSC default factor. The lead concentration in food is assumed to be 3.1 µg/kg, which is also a DTSC default factor.

(d) Background concentrations of lead in soil at the Presidio are used for background in Lead Spread. A value of 66 mg/kg of lead corresponds to the background concentration in serpentinite, which is the maximum background concentration calculated by EKI for the four lithologies at the Presidio.

TABLE 4-8
LEAD INTAKE SUMMARY FOR RESIDENTIAL, RECREATIONAL, AND COMMERCIAL/INDUSTRIAL USERS (a)

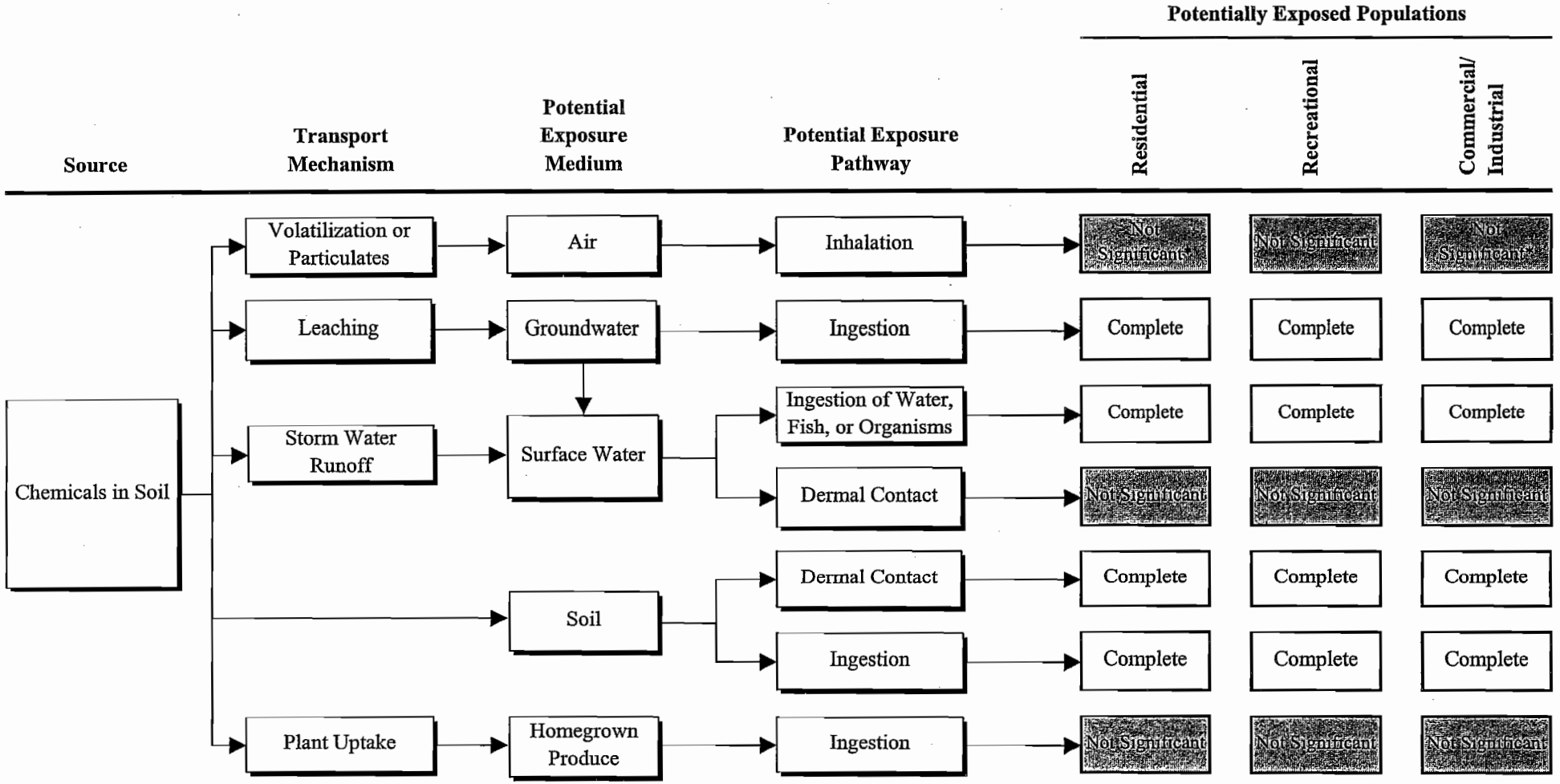
Presidio of San Francisco, California

Notes (continued):

(e) The concentration of lead in Presidio soil corresponds to the value that results in a cumulative blood lead concentration of 10 µg/dl. This value is the proposed cleanup level for the scenario indicated.

(f) See Appendix A for the computer spreadsheets in which blood lead concentration is calculated.

FIGURES



Legend

Complete / Complete — Pathway Complete or Potentially Complete. Pathway Has Been Quantitatively Evaluated.

Not Significant — Pathway Complete or Potentially Complete; Exposure is Not Considered Significant. Pathway Has Not Been Evaluated Quantitatively.

Not Complete — Pathway is Not Considered Complete.

*For volatile organic compounds, volatilization to indoor air is considered to be a complete pathway. For non-volatile compounds this pathway is not signficant.

Potential Human Health Exposure Pathways

Presidio of San Francisco, California

Erler & Kalinowski, Inc.

October 2002

Figure 4-1

5. ECOLOGICAL PRGS FOR SOIL AND SEDIMENT

5. ECOLOGICAL PRGS FOR SOIL AND SEDIMENT

Human health PRGs for PCOCs in soil were developed in Section 4. This section presents the development of ecological PRGs for PCOCs in soil and sediment. As discussed in Section 5.10, the Trust received comments from DTSC on the ecological PRGs for soil, as developed in Sections 5.1 through 5.8. These sections present the methodology used by the Trust to develop ecological PRGs for PCOCs other than lead. Section 5.10 presents the selection of the final ecological PRGs for soil based on DTSC's comments.

5.1 DERIVATION OF ECOLOGICAL PRGs FOR SOIL AND SEDIMENT

Derivation of ecological cleanup levels or performance of ecological risk assessments differ from their human health counterparts in that the objectives of ecological cleanup levels are site-specific. In contrast, the goals of human health cleanup levels are prescribed (i.e., reduce incremental carcinogenic risk to 10^{-6} to 10^{-4} and limit the non-carcinogenic HI below 1). The numerical values of human health cleanup levels change only as a result of varying activities that may be performed at a given site. Recognizing this important distinction between ecological and human health cleanup levels and risk assessments, U.S. EPA (1998b) states the following:

> The wide use and important advantages of ecological risk assessments do not mean they are the sole determinants of management decisions; risk managers consider many factors. Legal mandates and political, social, and economic considerations may lead risk managers to make decisions that are more or less protective. Reducing risk to the lowest level may be too expensive or not technically feasible. Thus, although ecological risk assessments provide critical information to risk managers, they are only part of the environmental-decision making process.

The resources to be protected and the objectives of ecological cleanup levels must be clearly established to ensure that remedial actions implemented at identified sites truly benefit the ecosystems found at the Presidio. For example, overly conservative ecological cleanup levels may cause greater harm than less stringent criteria if the cleanup levels result in remedial actions that destroy or substantially alter the habitats of the plants and wildlife that the cleanup levels are attempting to preserve. Ecological PRGs for soil and sediment at the Presidio have been derived independently of potential remedial actions to accomplish the following objectives:

- Maintain and permit enhancement of habitats as described in the *General Management Plan Amendment*, ("GMPA") (NPS, 1994), the *Vegetation Management Plan,* ("VMP") (NPS and Trust, 2001), and the *Presidio Trust*

Management Plan, Land Use Policies for Area B of the Presidio of San Francisco, ("PTMP") (Trust, 2002).

- Sustain populations of plants and soil fauna, wildlife, and aquatic life present at the Presidio.

- Protect individual plants and animals of rare, or threatened or endangered ("special status") species.

These objectives are consistent with the goals of remedial actions performed under Superfund. U.S. EPA (1999a) states the following regarding cleanup measures intended to protect the environment:

> Superfund remedial actions generally should not be designed to protect organisms on an individual basis (the exception being designated protected status resources, such as listed or candidate threatened and endangered species or treaty-protected species that could be exposed to site releases), but to protect local populations and communities of biota. Levels that are expected to protect local populations and communities can be estimated by extrapolating from effects on individuals and groups of individuals using a lines-of-evidence approach.

The Army conducted an ecological risk assessment as part of the RI (Dames & Moore, 1997b) and the results obtained were used to develop ecological PRGs for PCOCs in the FS (Dames & Moore, 1997a). Concerns expressed by regulatory agencies, organizations, and individuals regarding the manner in which the Army performed its ecological risk assessment caused the Trust to reexamine risks to ecological receptors and recalculate PRGs building upon the work completed by the Army.

Ms. Bridgette DeShields, formerly of Harding ESE and currently with Blasland, Bouck and Lee, Inc., was retained to review the Army's ecological risk assessment and to derive ecological PRGs for soil and sediment at the Presidio. The approach employed by Harding ESE to derive ecological PRGs paralleled the method used to derive PRGs in the Army's FS. For PCOCs other than lead, this method involved conducting the following two major steps:

(1) Develop toxicity benchmark values ("TBVs") that represent a range of potential adverse effects to indicator plant and wildlife species that may be exposed to PCOCs.

(2) Adopt these TBVs as acceptable concentrations or PRGs for PCOCs in soil and sediment, or use the TBVs in standard risk equations to calculate PRGs that are protective of indicator plant and wildlife species.

Multiple PRGs for PCOCs at Presidio sites were obtained because a range of TBVs was developed and more than one indicator species was considered. PRGs were further

assessed to obtain a single value for each PCOC to safeguard non-special status species and a single value for each PCOC to safeguard special status species. Non-special status species PRGs were selected to protect populations of ecological receptors, whereas special status species PRGs were chosen to protect individuals. PRGs for lead were evaluated differently because the widely varying toxicity values for lead do not lend themselves well to derivation of PRGs by the method used for other PCOCs. PRGs for lead were recalculated by use of the Monte Carlo method as was done by the Army.

Although PRGs were derived employing similar methods to those of the Army, the methods were revised to address comments made by DTSC, U.S. EPA and other regulatory agencies and organizations. Special status species were considered separately, toxicity values and exposure factors were updated to reflect more recent guidance and published literature, and errors in calculations performed by the Army were corrected. Procedures and assumptions used by Harding ESE to derive ecological PRGs for soil and sediment are discussed in Sections 5.2 through 5.9.

5.2 POTENTIALLY EXPOSED SPECIES

The Presidio has both higher quality habitat areas (e.g., native plant communities, forests, Mountain Lake, Lobos Creek, Crissy Field wetlands) and lower quality habitat areas (e.g., paved streets and parking lots or designed landscapes such as lawns and ornamental plantings). Generally, plants and animals requiring protection are associated with higher quality habitat areas. These higher quality habitat areas include both terrestrial and aquatic habitats.

5.2.1 Plants

The GMPA recognized the need for a plan to address vegetation at the Presidio. In response to this need, the Trust and NPS prepared the VMP, dated May 2001. The purpose of the VMP is to provide a management framework for protecting, enhancing, restoring, and rehabilitating native and planted vegetation at the Presidio. Members of the California Native Plant Society (Skinner and Pavlik, 1994), NPS (1995), and biologists retained by NPS (Jones & Stokes Associates, Inc., 1997) have identified the following twelve (12) native plant communities:

- Foredune
- Bluff scrub
- Coastal scrub
- Serpentine chaparral
- Live oak riparian forest
- Riparian scrub
- Dune scrub
- Coastal prairie
- Serpentine grassland
- Freshwater marsh and seep
- Arroyo willow riparian forest
- Live oak woodland

Table 5–1 summarizes special status plant species identified in the VMP as being present at the Presidio. Section 7.1.2 describes the Presidio sites where special status plant species have been observed or may be reintroduced under the VMP. Figure 7-3 identifies planned vegetation types at the Presidio, based on the VMP and PTMP.

5.2.2 Wildlife

A number of avian and mammalian species, as well as invertebrates, amphibians, and reptiles, utilize the higher quality habitat areas within the Presidio. Special status animal species considered by the Army in the RI were obtained from Jones & Stokes Associates, Inc. *Presidio of San Francisco Forest Management Plan*, dated 1994. Jones & Stokes Associates identified potential occurring special status animal species based upon the wildlife that are associated with varying types of habitats found at the Presidio. Table 5–2 summarizes special status animal species that may exist at the Presidio. Potential special status animal species are generally limited to birds.

5.2.3 Indicator Plant and Wildlife Species

Indicator species are routinely selected to conduct an ecological risk assessment. The reason for choosing a subset of potentially occurring species to determine risk at or PRGs for a site is to avoid repetition in the analysis that would make the ecological risk assessment or derivation of PRGs more difficult to perform and understand.

Indicator species are chosen to represent various ecological trophic levels (e.g., primary producer, primary consumer, and higher level consumer) to provide for complete food chain modeling. Species considered more likely to be exposed to site-related chemicals are selected over other species to represent receptors throughout the entire trophic levels. Availability of published exposure factors (e.g., body weight, surface area, dietary ingestion rate, soil ingestion rate) and toxicological information are also considered in determining indicator species. In some instances, more than one species is selected from a receptor group to adequately represent trophic levels. In the case of certain receptor groups, such as plants, soil invertebrates, aquatic plants and invertebrates, amphibians, and fish, indicator species are not identified; rather, an indicator group is selected. For example, aquatic life represents aquatic plants and invertebrates, amphibians, and fish.

5.2.3.1 Non-special Status Indicator Species

The following receptors were chosen as indicator species for non-special status species at the Presidio based on the criteria presented in Section 5.2.3, procedures followed by the Army in selecting its indicator species (Dames & Moore, 1997b), review of U.S. EPA (1992c, 1997a, 1998b) guidance, and discussions with regulatory agency staff:

- Terrestrial habitats:
  - ◊ Plants and soil fauna (e.g., soil invertebrates)
  - ◊ American robin (insectivorous bird)

- ◊ Mourning dove (herbivorous bird)
- ◊ Western harvest mouse (omnivorous mammal)
- ◊ Valley pocket gopher (herbivorous mammal)
- ◊ Raccoon (carnivorous mammal)
- ◊ Peregrine falcon (carnivorous bird that ingests birds)
- ◊ Red-tailed hawk (carnivorous bird that ingests mammals)

- Aquatic habitats:
  - ◊ Aquatic life (e.g., aquatic plants and invertebrates, amphibians, and fish)
  - ◊ Mallard duck (herbivorous, dabbling duck)
  - ◊ Western sandpiper (insectivorous, wading bird)

5.2.3.2 Special Status Indicator Species

The following receptors were chosen as indicator species for special status species at the Presidio:

- Terrestrial habitats:
  - ◊ Plants and soil fauna
  - ◊ Peregrine falcon
  - ◊ Red-tailed hawk
- Aquatic habitats:
  - ◊ Mallard duck
  - ◊ Western sandpiper

Potential ecological exposure pathways to PCOCs for both non-special status and special status species in terrestrial and aquatic habitats at Presidio sites are discussed in Section 5.3.

5.3 POTENTIAL ECOLOGICAL EXPOSURE PATHWAYS

Figures 5-1 and 5-2 illustrate the complete and potentially complete exposure pathways for each of the receptor types for terrestrial and aquatic habitats at the Presidio. Aquatic habitat includes both freshwater and marine (or estuarine) areas. Some complete or potentially complete pathways may be considered less significant due to: (1) low levels of contaminants, (2) low exposure frequency, or (3) low contribution to the overall risks in comparison to other pathways. According to U.S. EPA (1997a), complete or potentially complete exposure pathways should be evaluated quantitatively. Pathways considered less significant and that require more uncertain assumptions to be made do not warrant further evaluation.

5.3.1 Terrestrial Habitats

For plants and soil fauna (i.e., soil invertebrates), one or more complete exposure pathways are shown on Figure 5-1. Route-specific exposures shown on Figure 5-1 are not directly quantified for these species in an ecological risk assessment. Published TBVs for exposure of plants and soil fauna to PCOCs are expressed as concentrations, as opposed to doses, and generally encompass all potential exposure pathways. Therefore, exposures of plants and soil fauna to PCOCs are taken into account by use of published TBVs and not through the quantification of route-specific exposures.

For birds and mammals, pathways considered complete include ingestion of contaminated soil and food items, dermal contact with PCOCs, and inhalation of particulates and VOCs. Dermal contact and inhalation pathways are considered less significant than ingestion pathways. U.S. EPA (2000c) has examined the contributions that dermal contact of PCOCs, inhalation of particulates, and inhalation of VOCs make to chemical doses received by birds and mammals. Dermal contact and inhalation of particulate pathways have been found to contribute less than 1 percent (and often less than 0.001 percent) of the total dose. Similarly, U.S. EPA (2000c) has determined that inhalation of VOCs typically represents 1 percent of the total dose, but may contribute more under certain circumstances. Although VOCs are PCOCs at some Presidio sites, VOCs are infrequently detected at low concentrations that do not meet the conditions under which evaluation of this pathway is recommended (e.g., broadly distributed VOCs in soil and groundwater within areas where animals are burrowing). Consequently, inhalation of particulates and VOCs are not included in derivation of ecological PRGs for Presidio sites. Ecological PRGs consider ingestion of contaminated soil and food items, and dermal contact of PCOCs. The dermal contact pathway was retained, not because it is believed that this pathway contributes significantly to total dose, but due to the fact that this pathway was quantitatively evaluated in the risk assessment presented in the Army's RI (Dames & Moore, 1997b).

5.3.2 Aquatic Habitats

For aquatic life, one or more complete exposure pathways are shown on Figure 5-2. As is the case of plants and soil fauna, route-specific exposures shown on Figure 5-2 are not directly quantified for aquatic life in an ecological risk assessment; rather, risks are assessed through use of TBVs or sediment quality criteria. Exposures of wildlife to PCOCs in surface water are also not directly quantified. Aquatic life TBVs and sediment quality criteria are generally considered protective of wildlife exposures to PCOCs in surface water as well.

Ecological PRGs for birds and mammals were calculated by quantitatively evaluating ingestion of contaminated soil and food items, and dermal contact of PCOCs. Inhalation exposure pathways are not routinely assessed for aquatic habitats because VOCs do not generally bind to sediments and half-lives of these compounds are generally short in surface water. In addition, as discussed in Section 5.3.1, inhalation pathways generally do not significantly contribute to the overall risk.

5.4 ECOLOGICAL TARGET RISK LEVEL

Ecological PRGs developed for Presidio sites are intended to maintain and permit enhancement of habitats at the Presidio that will support local communities of biota. As such, the PRGs for non-special status species have been chosen to protect wildlife populations that may occur at the Presidio. While recognizing DTSC's (2000b) comment that studies of population dynamics have not been made, the objective to safeguard non-special status species populations, as opposed to individuals, is supported by U.S. EPA guidance (1999a).

Upon identifying TBVs that pose no significant risk to ecological receptors under consideration, the "safe" dose from all complete exposure pathways is the dose that results in a hazard quotient ("HQ") of unity (i.e., 1):

$$HQ = \frac{Dose}{TBV}$$

In contrast to ecological PRGs for non-special status species, ecological PRGs for special status species are intended to protect individual plants and animals of rare, or threatened or endangered species. The toxicity values for developing PRGs for both non-special status and special status species are discussed in Section 5.5.

5.5 ECOLOGICAL TOXICITY VALUES

For non-special status species, ecological PRGs for PCOCs other than lead have been derived through adoption of published TBVs and sediment quality guidelines, or calculation of risk-based concentrations that are judged to be protective of non-special status species. The ecological PRGs for lead for non-special status and special status species were derived using the Monte Carlo method, as explained in Section 5.9. Ecological PRGs for special status species were determined by evaluating reported no-observed-effects-concentrations ("NOECs") and TBV values for the indicator species and employing professional judgment to select those values that will reasonably safeguard special status species that have been observed or may exist at the Presidio.

TBVs were developed from toxicity values presented in the Army's RI, and the results of a recent literature search and the application of safety or uncertainty factors, where appropriate. The Army developed both low and high toxicity values because its review of scientific literature returned numerous toxicity values for each PCOC and indicator species evaluated.

The most conservative (i.e., lowest) value for a given chemical and indicator species was termed the TBV_{low}. TBV_{low} values are based on no-observed-adverse-effect-levels ("NOAELs") or NOEC if reported. Uncertainty factors were applied to toxicity data for

PCOCs for which NOAELs and NOECs were unavailable in an effort to estimate doses that pose no risk to individuals or populations. Exposure concentrations or doses at or below the TBV_{low} are considered to result in no significant adverse effects to the indicator species.

According to the Army, the TBV_{high} was developed to represent the upper bound of "acceptable or safe daily intakes". Where BTAG high toxicity values (PRC, 1997) were used, the TBV_{high} is considered a level of high concern to regulatory agencies and natural resource trustees. Because the TBV_{high} was often a lowest-observed-adverse-effect level ("LOAEL"), it is more correct to indicate that exposure doses below the TBV_{high} may be within the acceptable range. Exposure concentrations at or above the TBV_{high} may result in significant adverse effects on individuals or populations of ecological receptors.

The range of values between the TBV_{low} and the TBV_{high} is considered a "gray zone" where risks are possible but significant risks are unlikely. Toxicity values presented in the Army's RI were used to derive PRGs by the Trust with the following exceptions:

- Updated TBVs for plants, soil invertebrates, and aquatic life were obtained from the references consulted by the Army.
- A literature review was performed and more current TBVs were used for wildlife indicator species if warranted.
- Errors in the calculation of TBVs for wildlife, mostly due to transcription errors or misapplication of uncertainty factors, were corrected.
- Additional uncertainty factors were applied to TBVs based on studies of mortality endpoints that were used in the Army's RI.
- TBVs were developed for chemicals not considered in the Army's RI.

Summarized in Tables 5–3 and 5–4 are TBVs and uncertainty factors for chemicals not considered in the Army's RI. Revised TBV_{low} and TBV_{high} values for non-special status indicator species are listed in Table 5–5 for plants and Table 5–6 for wildlife.

5.5.1 Plants and Soil Fauna

The United States Department of Energy ("DOE") Oak Ridge National Laboratory ("ORNL") documents are the primary references consulted by both the Army and Trust for plant and invertebrate TBVs. The recommended benchmark values in the ORNL documents were used as the TBV_{low} values in the Army's RI. The lowest lowest-observed-effects-concentration ("LOEC") values in the ORNL documents were adopted as the TBV_{high} values in the Army's RI. The Trust reviewed current versions of the ORNL documents (Efroymson, 1997) and updated TBVs as appropriate. TBVs in Tables 5–5 and 5–6 that are boxed and shown in bold are updated values, or values for chemicals not considered in the Army's RI. Updated values do not vary greatly from the

original values. For example, TBV_{low} for cadmium increased from 3 to 4 mg/kg. The TBV_{low} of 5 mg/kg for chromium was chosen based on toxicity tests using different forms of chromium reported in the ORNL documents. Toxicity values for plants and invertebrates were unavailable for many PCOCs, including several chemicals not considered in the Army's RI. The majority of the chemicals without plant and invertebrate TBVs are VOCs, SVOCs, and pesticides. These chemicals are most often not highly toxic to plants. Although some VOCs, SVOCs, and pesticides have been shown to be toxic to invertebrates, risks from these chemicals are typically governed by wildlife receptors for which TBVs are generally available.

5.5.2 Wildlife

A variety of references were used to develop TBVs for wildlife species in the Army's RI including the following:

- Toxicity values listed in governmental computerized databases, such as the National Library of Medicine Toxicity Data Network ("TOXNET") and the National Institute for Occupational Safety and Health Registry of Toxic Effects of Chemical Substances ("RTECS").

- Laboratory toxicology studies for various chemicals reported by U.S. EPA and ORNL, or published in *Environmental Toxicology and Chemistry*.

- U.S. EPA's Great Lakes Water Quality Initiative Criteria Documents for the Protection of Wildlife: DDT, Mercury, 2,3,7,8 TCDD, and PCBs, dated 1995.

- Donker, M.H., H.E. van Capelleveen, and N.M. van Straalen. 1993. *Metal Contamination Affects Size-structure and Life-history Dynamics in Isopod Field Populations*. Ecotoxicology of Metals in Invertebrates.

- U.S. EPA Region IX Biological Technical Advisory Group ("BTAG") draft TBVs, which have since been formalized (PRC Environmental Management, 1997).

Extensive effort was put forth by the Army to gather toxicity information and to develop TBVs for wildlife. Updating TBVs for wildlife in the Army's RI involved comparing the values in the Army's RI to more recently published TBVs, correcting errors, and reevaluating the Army's values that were based upon mortality endpoints. Errors in the calculation of TBVs for wildlife, mostly due to transcription errors or misapplication of uncertainty factors, were minor and had little effect on TBV values used to calculate risk-based PRGs by the Trust. For example, using the correct uncertainty factors for the red-tailed hawk changed the TBV_{low} for mercury from 0.04 to 0.08 mg/kg-day. Uncertainty factors ("UFs") developed by the Army are shown in the table below. UFs were used to convert all toxicity endpoints to chronic NOAELs based on sensitive endpoints (e.g., growth, reproduction, development). TBV_{low} and TBV_{high} values that were based on mortality endpoints were divided by an additional uncertainty factor of 10.

TBV_{high} values derived by the Army for silver, thallium, chlordane, and gamma-BHC (i.e., lindane) were divided by this additional uncertainty factor.

Uncertainty Factors Used in the Calculation of TBV_{low} values (a)

Type of UF	UF	Comments
Study Duration	5	Converts acute to chronic
	2	Converts subchronic to chronic
Endpoint	2	Converts from less to more sensitive endpoint
	5	Converts LOAEL to NOAEL
	10	Converts LD50 to NOAEL (Army)
	10	Additional factor 10 for mortality endpoints (LD50s) was applied to both the TBV_{low} and TBV_{high} by the Trust
Intertaxon	3	Converts between species in same family, different genus
	4	Converts between species in same order, different families
	5	Converts between species in different orders
	10	Converts between species in different orders with an additional factor of 2 for special-status species (raptors)

(a) Uncertainty factors were those developed by the Army, except where noted.

TBV_{low} and TBV_{high} values were developed for chemicals not considered in the Army RI using similar methods, including application of uncertainty factors used in the Army's RI, as appropriate. Chemicals not considered in the Army's RI for which TBVs were derived consist of tetraethyl lead, 4-methylphenol, n-nitrosodiphenylamine, pentachlorophenol, phenol, acetone, 2-butanone, 1,4-dichlorobenzene, carbon disulfide, methylene chloride, 1,1,1-trichloroethane, toluene (which was used as a surrogate for p-isopropyltoluene), and methoxychlor. Additionally, mammalian data were added for heptachlor/heptachlor epoxide, which was not included in the Army's RI.

The Army also did not consider acenaphthene, acenapthylene, benzo(a)anthracene, benzo(b)fluoranthene, dibenzofuran, benzo(k)fluoranthene, benzo(g,h,i)perylene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, 2-methylnaphthalene, phenanthrene, and pyrene, which are PAHs. Because only one set of toxicity values is available for PAHs, this same set was applied to each of these PAHs. Similarly, the TBV for endosulfan was used as a surrogate for endosulfan sulfate, the TBV for endrin was used

as a surrogate for endrin aldehyde and endrin ketone, the TBV for heptachlor was used as a surrogate for heptachlor epoxide, the TBV for beta-BHC was used as a surrogate for alpha- and delta-BHC, and the TBV for aldrin was used as a surrogate for isodrin because isodrin is an isomer of aldrin. Only studies on mortality endpoints were available to calculate TBV_{high} values for benzyl alcohol, aldrin, chlordane, gamma-BHC, heptachlor, heptachlor epoxide, isodrin, and methoxychlor. TBV_{high} values for these chemicals were divided by an additional uncertainty factor of 10, consistent with the revisions made to TBV_{high} values derived by the Army based upon mortality endpoints.

No published toxicity values were found for trichlorofluoromethane, 2,4-D, dicamba, and MCPP. Consequently, ecological PRGs for these PCOCs could not be calculated.

5.5.3 Aquatic Life

TBVs for aquatic life were developed for both freshwater and marine aquatic habitats. Aquatic life TBVs are based upon sediment quality guidelines. Potentially relevant sediment quality guidelines for freshwater sediments include the following:

- **Canadian Sediment Quality Guidelines**: The Canadian Council of Ministers of the Environment (1999) has issued interim sediment quality guidelines ("ISQGs") and probable effect levels ("PELs") for chemicals in sediment. These levels have been developed employing the approach that NOAA (1999) used to derive sediment criteria in its *Screening Quick Reference Tables*. Chemical concentrations in sediment below the LEL are unlikely to result in adverse effects, concentrations between the LEL and PEL may result in adverse effects, and concentrations above the PEL are likely to result in adverse effects.

- **Consensus-Based Threshold Effects Concentration ("TEC") and Probable Effects Concentration ("PEC"):** MacDonald et al. (2000) developed freshwater sediment quality guidelines for 28 chemicals. These guidelines reflect the toxicity of chemicals in sediment when they occur in mixtures with other chemicals and provide a basis for classifying sediment as potentially harmful. For each chemical considered by MacDonald et al., a TEC and PEC have been developed. Similar to the Canadian sediment quality guidelines, chemical concentrations in sediment below the TEC are unlikely to result in adverse effects, concentrations between the TEC and PEC may result in adverse effects, and concentrations above the PEC are likely to result in adverse effects.

- **U.S. EPA Sediment Quality Criteria ("SQC") and Sediment Quality Benchmarks ("SQB"):** U.S. EPA (1996a, 1995a) developed SQC and SQB values based on the equilibrium partitioning ("EqP") method. These values are considered protective of aquatic life.

Sediment quality guidelines for marine sediments include the following:

- **NOAA Effects Range Low (ER-L) and Effects-Range Median (ER-M):** NOAA (Long et al., 1995) developed effects-based screening benchmarks using data for chemical concentrations in coastal marine and estuarine environments collected throughout the United States annually. Concentrations observed or predicted from these studies associated with biological effects are ranked; the lower 10^{th} percentile values are the ER-Ls and the median values are the ER-Ms.
- **U.S. EPA SQC and SQB**: (U.S. EPA (1996a, 1995a) developed SQC and SQB values based on the EqP method. These values are considered protective of aquatic life.

Sediment quality criteria or PRGs for aquatic life are summarized in Tables 5–7 and 5–8, respectively, for freshwater and marine habitats.

5.6 CALCULATION OF ECOLOGICAL PRGS FOR PCOCS OTHER THAN LEAD IN SOIL AND SEDIMENT

As discussed in Section 5.3, PRGs for plants, soil fauna, and aquatic life are not calculated. PRGs for these receptor groups are instead based upon published TBVs or sediment quality guidelines for the PCOCs under consideration that encompass all exposure pathways. To calculate wildlife PRGs for Presidio sites, standard risk equations were rearranged to solve for the concentration term. The general equation employed to calculate PRGs for protection of wildlife species at the Presidio is as follows:

$$PRG = \frac{\text{Target HQ of } 1 \times TBV \times BW}{Intake_{soil/sed\ ingestion} + Intake_{food\ ingestion} + Intake_{dermal}}$$

where:

HQ	=	Hazard quotient equal to 1
TBV	=	Toxicity benchmark value (mg/kg-day)
BW	=	Body weight (kg)
$Intake_i$	=	Intake (or dose) from pathway *i* (kg/day)

The intake from soil and sediment ("soil/sed") ingestion is equivalent to the total dietary ingestion rate multiplied by the fraction of soil and sediment in the diet:

$$Intake_{soil/sed\ ingestion} = DIR \times F_{soil/sed}$$

where:

DIR	=	Daily ingestion rate (kg/day)
$F_{soil/sed}$	=	Fraction of soil and sediment in diet (unitless)

The intake from food ingestion is the sum of the ingestion for each food item, which is estimated by multiplying the dietary ingestion rate by the fraction of the diet that consists of the particular food item and by the bioaccumulation factor of the food item:

$$\text{Intake}_{\text{food ingestion}} = \Sigma \text{ DIR} \times F_i \times \text{BAF}_i$$

where:

F_i	=	Fraction of diet that consists of food item *i* (unitless)
BAF_i	=	Bioaccumulation factor for food item *i* (unitless)

Intake from dermal contact is expressed as follows:

$$\text{Intake}_{\text{dermal}} = \text{SA} \times \text{AF} \times \text{ABS} \times \text{CF}$$

where:

SA	=	Surface area of species (cm^2)
AF	=	Soil adherence factor (mg/cm^2)
ABS	=	Absorption factor (chemical-specific)
CF	=	Conversion factor (converts units from mg to kg)

The Army used the above general equations to create formulas for calculating PRGs for specific wildlife species. Formulas for terrestrial habitat indicator species (i.e., American robin, mourning dove, western harvest mouse, valley pocket gopher, raccoon, peregrine falcon, red-tailed hawk) and aquatic habitat indicator species (i.e., mallard duck, western sandpiper) are included in Appendix B of the Army's FS (Dames & Moore, 1997a). The formulas in Appendix B of the Army's FS were modified by the Trust to recalculate ecological PRGs for Presidio sites. Modifications to the formulas involved adjusting the ingestion of food items pathway to be consistent with the exposure pathways described in Section 5.3, and removing the area use factors ("AUFs"). The AUF is the ratio of the area of the site to the area of the home range of the species evaluated. AUFs were removed because the PRGs developed apply to all Presidio sites and do not correspond to the area of a specific site. Modified formulas used by the Trust to recalculate ecological PRGs for Presidio sites are listed in Table 5–9.

5.7 ECOLOGICAL EXPOSURE PARAMETERS

Table 5–10 summarizes the factors assumed for the exposure parameters in the formulas used to recalculate PRGs. Home ranges in Table 5–10 are presented for information only. Exposure factors are identical to those presented in the Army's FS except for adjustment to some dietary ingestion rates as noted below. When available, upper-bound (i.e., 95th percentile) values were used to be protective.

- **Body weight (BW):** 95th percentile values assumed by the Army were used. These values were compared to values in DTSC (2000a) Ecotox computerized database and were found to be comparable.

- **Surface area (SA):** 95th percentile values assumed by the Army were used.

- **Dietary ingestion rate (DIR):** 95th percentile values assumed by the Army were used except that values previously expressed on a wet weight basis (i.e., American robin, western harvest mouse, and red-tailed hawk) were converted to a dry weight basis. This conversion was necessary because all other exposure factors (e.g., fraction of soil in diet, BAF) are expressed on a dry weight basis. Dietary ingestion rates were converted using the equation $DIR_{dry} = DIR_{wet} \times (1 - \text{percent water content in food})$ and average moisture contents from Sample and Suter (1994).

Values assumed for dietary composition and bioaccumulation factors ("BAF") are discussed in Sections 5.7.1 and 5.7.2.

5.7.1 Dietary Composition

The formulas for recalculating PRGs for specific wildlife species are based upon the following dietary fractions:

- American robin: 100 percent of diet is invertebrates ($F_{inv} = 1$)

- Mourning dove: 100 percent of diet is plants ($F_{plant} = 1$)

- Western harvest mouse: 50 percent of diet is plants ($F_{plant} = 0.5$) and 50 percent is invertebrates ($F_{inv} = 0.5$)

- Valley pocket gopher: 100 percent of diet is plants ($F_{plant} = 1$)

- Raccoon: 50 percent of diet is invertebrates ($F_{inv} = 0.5$) and 50 percent is herbivorous birds ($F_{bird} = 0.5$)[7]

- Peregrine falcon: 50 percent of diet is herbivorous birds ($F_{bird1} = 0.5$) and 50 percent is insectivorous birds ($F_{bird2} = 0.5$)

- Red-tailed hawk: 50 percent of diet is herbivorous mammals ($F_{mam1} = 0.5$) and 50 percent is insectivorous mammals ($F_{mam2} = 0.5$)

[7] Although raccoons are more likely to ingest plant material and some small mammals, the use of the herbivorous bird BAF (BAF for plants times BAF for birds) is conservative and encompasses a similar magnitude of exposure.

- Mallard duck: 100 percent of diet is plants ($F_{plant} = 1$)
- Western sandpiper: 100 percent of diet is invertebrates ($F_{inv} = 1$).

5.7.2 Bioaccumulation Factors

Metals, PCBs, pesticides, and herbicides are recognized to be bioaccumulative. BAFs used by the Trust to recalculate ecological PRGs are summarized in Table 5–11. If available, BAFs for PCOCs were obtained from ORNL documents (Bechtel Jacobs Company L.L.C, 1998; Sample, et al., 1998a, 1998b). U.S. EPA generally accepts BAFs from ORNL for use in performing ecological risk assessments. ORNL BAFs for plants, soil invertebrates, and wildlife were available for most bioaccumulative PCOCs. If no BAFs from ORNL were available for PCOCs, BAFs included in the Army's RI were assumed instead. The BAF for lead was used as a surrogate for tetraethyl lead. The BAF for dieldrin was used as a surrogate for aldrin and isodrin. The BAF for heptachlor was used as a surrogate for heptachlor epoxide, and 4,4'-DDT was used as a surrogate for 4,4'-DDD and 4,4'-DDE. For pesticides and herbicides that do not have reported BAFs, assumptions were made for these values based on the magnitude of BAFs reported in literature for other pesticides and herbicides.

Plants do not bioaccumulate pesticides and herbicides to any significant extent. Therefore, the BAF was assumed to be zero for plants without pesticide and herbicide literature-reported values. Pesticide and herbicide BAFs were assumed to be 3 for invertebrates, 1 for birds, and 0.5 and 0.1 for omnivorous and herbivorous mammals based on the range of literature-reported values for chlordane, dieldrin, heptachlor, and 4,4'-DDT.

5.8 ECOLOGICAL PRGS FOR PCOCS OTHER THAN LEAD IN SOIL AND SEDIMENT

Ecological PRGs for PCOCs other than lead in soil and sediment for non-special status species and special status species are described in Sections 5.8.1 and 5.8.2. PRGs for lead in soil and sediment for non-special status species and special status species are described in Section 5.9.

5.8.1 Non-special Status Species PRGs

PRGs for soil based on TBV_{low} and TBV_{high} values are presented in Tables 5-12 and 5-13, respectively. Potential ecological PRGs for soil are compiled in Table 5-14. For each PCOC, Table 5-14 contain the PRG_{low} and PRG_{high} values for plants and soil fauna, and the lowest wildlife PRGs recalculated using the TBV_{low} from Table 5–5 and TBV_{high} from Table 5–6. The arithmetic means of the PRGs for plants and soil fauna, and the arithmetic mean PRGs for wildlife were computed for each PCOC. Selecting the lower of the arithmetic means of plants and soil fauna PRGs, and wildlife PRGs determined the soil PRG proposed to safeguard populations of non-special status species. The arithmetic

means are considered protective because they are computed from PRG_{low} and PRG_{high} values that are based on TBVs that span the range of no significant adverse effects to the upper bound of acceptable or safe daily intakes, as discussed in Section 5.5.

A similar approach to that used to develop ecological PRGs for soil was used to derive ecological PRGs for sediment. Sediment quality criteria were compared to risk-based PRGs calculated for the mallard duck and western sandpiper to determine whether sediment quality criteria or risk-based PRGs should be proposed as cleanup levels for PCOCs. Mallard duck and western sandpiper are considered representative species for both freshwater and marine aquatic areas onsite. Although mallard duck is more of a freshwater species, it is similar to diving ducks that may be present in marine aquatic areas (e.g., scoters, lesser scaup, etc.). Sediment quality criteria for aquatic life are presented in Tables 5–7 and 5–8. Potential PRGs for sediment calculated from the TBV_{low} and TBV_{high} values for the mallard duck and western sandpiper are summarized in Table 5-15. The PRGs for aquatic life, and the mallard duck, and western sandpiper were considered together to select potential sediment PRGs for each PCOC. The lowest values defining the range of PRGs developed for these indicator species (i.e., aquatic life, mallard duck, western sandpiper) of aquatic habitats are presented in Tables 5-16 and 5-17, respectively, for freshwater and marine habitats. The arithmetic mean of these lowest values was computed for each PCOC and is the proposed sediment PRG for protection of non-special status species.

5.8.2 Special Status Species PRGs

As described in Section 5.8.1, proposed PRGs in Tables 5-14, 5-16, and 5-17 are anticipated to be protective of populations of ecological receptors. However, these PRGs may not be protective of individual special status species, especially where the difference between the PRG_{low} and PRG_{high} values used to calculate the mean is great. For PCOCs where the difference between the TBV_{low} and TBV_{high} values for the species governing the level of cleanup is greater than one order of magnitude, a separate evaluation was conducted to develop alternate PRGs that are intended to safeguard special status species. For plants, special status species PRGs had to be developed for several metals. For raptors and shorebirds, which serve as wildlife indicator species for terrestrial and aquatic habitats, special status species PRGs had to be developed for several metals, as well as pesticides, and herbicides. The non-special status species PRGs for all other PCOCs and indicator species (i.e., aquatic life) are considered protective of special status species.

For plants, NOECs were compiled from the references consulted for non-special status plant species. However, the low and high values used to develop special status species PRGs encompassed the entire range of NOECs and excluded LOECs. The 5^{th}, 10^{th}, and 25^{th} percentiles, and arithmetic means of the NOEC values were computed, as summarized in Table 5-18. The 25^{th} percentile of NOECs for each metal is proposed as the alternate special status species PRG because this percentile includes NOECs obtained from studies on a variety of soil types and species, including species that are taxonomically similar to those at the Presidio.

The alternate special status species PRGs for raptors and shorebirds are established from the PRGs for the peregrine falcon and western sandpiper, respectively, because the PRGs for these birds are the lowest of the special status indicator species evaluated for terrestrial and aquatic habitats. PRG_{low} and PRG_{high} values were computed from TBVs compiled from the references consulted for non-special status wildlife species. The 5^{th}, 10^{th}, and 25^{th} percentiles, and arithmetic means of the PRG_{low} and PRG_{high} values were calculated for each metal, pesticide, and herbicide that a special status species PRG needed to be derived. Tables 5-19 and 5-20 summarize these statistics and the toxicity endpoints of the studies on which the computed PRGs are founded. The following hierarchy was used to select the proposed PRG for special status raptors:

- The 5^{th} percentile was used where the difference between PRG_{low} and PRG_{high} values for non-special status species is two orders of magnitude or greater.

- The 10^{th} percentile was used where the difference between PRG_{low} and PRG_{high} values for non-special status species is between one and two orders of magnitude.

Except for 4,4'-DDT, no further adjustment was required to calculate special status PRGs because TBVs obtained from studies of mortality endpoints had previously been divided by an uncertainty factor of 10 to calculate PRGs for non-special status species. TBV_{low} and TBV_{high} values for 4,4'-DDT were adjusted based upon TBVs developed from studies on eggshell thinning.

Soil PRGs for special status plant (Table 5-18) and wildlife species (Table 5-19) were compared to soil PRGs proposed for non-special status plant and wildlife species (Table 5-14). This comparison is presented in Table 5-21. Special status species PRGs that are lower than non-special status PRGs are proposed as soil PRGs for special status species. Non-special status PRGs may be lower for some of the PCOCs evaluated because (1) the non-special status species evaluated may have higher exposure to chemicals than the special status species (e.g., American robin vs. peregrine falcon), or (2) the toxicity value for a non-special status species for a particular chemical is lower (e.g., mammal vs. bird toxicity values). For these PCOCs, no value is presented in Table 5-21 for the alternate PRG for special status species.

Similarly, sediment PRGs for special status wildlife species (Table 5-20) were compared to sediment PRGs proposed for non-special status aquatic life and wildlife species (Table 5-16). These comparisons are presented in Tables 5-22 and 5-23, respectively, for freshwater and marine habitats. Special status species PRGs that are lower than non-special status PRGs are proposed as sediment PRGs for special status species.

5.9 ECOLOGICAL PRGS FOR LEAD IN SOIL AND SEDIMENT

The Army evaluated separately the potential ecological risks of lead in Appendix U of the Army's RI. Available plant and wildlife toxicity information for lead varies up to five orders of magnitude. In fact, inserting U.S. EPA Region IX BTAG lead toxicity values

(PRC, 1997) in the formulas listed in Table 5–9 generates an ecological PRG that is considerably less than naturally occurring lead concentrations in Presidio soil based upon BTAG's low toxicity value, and generates an ecological PRG greater than 2,000 mg/kg based upon BTAG's high toxicity value. Therefore, establishing an ecological PRG for lead by computing the arithmetic mean of PRGs derived from TBV_{low} and TBV_{high} values may not be appropriate.

The Army used a probabilistic approach to derive a cleanup level for lead. The approach used is often termed the Monte Carlo method because of the type of computer modeling employed. The Monte Carlo method takes into account the variability of toxicity values and exposure factors. Instead of using single point estimates for TBVs and exposure factors (e.g., body weight, dietary ingestion rate), the entire distributions of values are input into a computer simulation model. The model randomly selects each of these distributions for values to be incorporated into the risk equations, thereby generating a distribution of acceptable concentrations or PRGs.

The Army performed the Monte Carlo method for plants and the American robin. Plants were selected because of the need to protect special status plant species at the Presidio. The American robin was chosen because the robin has some of the lowest PRGs of the wildlife indicator species evaluated. DTSC (2000b) provided comments to the Trust on the manner in which the Army performed the Monte Carlo method to derive PRGs for lead. In response to these comments, the Trust made the following modifications to the Monte Carlo method to recalculate ecological PRGs for lead in soil at the Presidio:

- For plants, only toxicity data for non-mortality endpoints (e.g., reduction in shoot or root growth) were used and the data were fitted to a distribution.

- For the American robin, exposure factors were revised, as discussed in Section 5.7, updated TBVs for lead from U.S. EPA Region IX BTAG were used (PRC, 1997), the gastrointestinal tract absorption of lead was changed from 10 to 26 percent, and a dermal absorption factor of 0.01 for lead was used, as suggested by DTSC (2000b).

- A total of 10,000 iterations was used in each Monte Carlo computer model simulation instead of 1,000 iterations used by the Army.

- The 50^{th} percentile lead concentrations to safeguard plants and the American Robin were compared to determine the proposed PRG for lead in soil to protect non-special status species as opposed to the 90^{th} percentile values used by the Army.

- The 25^{th} percentile lead concentration to safeguard plants is proposed as the PRG for lead in soil to protect special status species.

Crystal Ball™ was used to perform the Monte Carlo method computer simulations. Copies of input parameters and Monte Carlo method output using Crystal Ball™ are included as Appendix B.

5.9.1 Non-special Status Species PRGs

The Monte Carlo method produced 50th percentile concentrations of 324 mg/kg of lead to protect plants and 297 mg/kg of lead to protect the American robin. Consequently, a PRG of 300 mg/kg for lead in soil is proposed for protection of both non-special status plant and animal species.

PRGs of 82 and 132 mg/kg for lead in sediment from freshwater and marine habitats, respectively, are proposed for protection of non-special status aquatic life and wildlife species. For freshwater habitats, this concentration is based upon the arithmetic mean of the lowest sediment quality value for aquatic life of 35.7 mg/kg and the highest sediment quality value of 128 mg/kg for lead (Table 5–7). For marine habitats, this concentration is based on the arithmetic mean of the lowest sediment quality value for aquatic life of 46.7 mg/kg and the highest sediment quality value of 218 mg/kg for lead (Table 5–8). The Monte Carlo method was not conducted for indicator wildlife species of aquatic habitats because the range of values of sediment quality value for lead varied by less than an order of magnitude and because of the fact that sediment quality value for aquatic life are generally considered protective of wildlife exposures to PCOCs in surface water as well.

5.9.2 Special Status Species PRGs

A PRG of 160 mg/kg for lead in soil is proposed for protection of both special status plant and animal species based upon the 25th percentile concentration of 157 mg/kg of lead to protect plants generated by the Monte Carlo method. The PRGs of 82 and 132 mg/kg for lead in sediment are believed to be protective of special status aquatic life and wildlife species as well as non-special status species.

5.10 DTSC REVIEW OF ECOLOGICAL PRGS FOR SOIL

The DTSC reviewed the ecological PRGs developed using the protocol described above and provided the Trust with written comments in October 2001 (DTSC, 2001) and verbal comments during the first few months of 2002. The DTSC was primarily concerned that (1) the special status species PRGs for soil developed by the Trust may not be fully protective of special status species and (2) when there was a large difference between the PRG_{low} and PRG_{high}, the arithmetic mean PRG may not be fully protective of non-special status species. Based on discussions with the DTSC, the Trust made the following changes to the ecological cleanup levels:

- The areas of the Presidio where non-special status species PRGs would be applied were renamed "buffer zone" areas because these areas are generally adjacent to

special status species areas and developed areas of the Presidio where ecological PRGs are not applicable (see Section 7.1.2 and Figure 7-2). Proposed soil PRGs for these buffer zone areas were redefined as the lowest value of (1) the special status species PRG identified in Table 5-21, (2) the arithmetic mean of the PRG_{low} and PRG_{high} for plant and soil fauna, (3) the arithmetic mean of the PRG_{low} and PRG_{high} wildlife PRGs, or (4) 5 mg/kg for pesticides or herbicides for which not enough toxicological data exists to calculate a PRG_{low} and PRG_{high} (i.e., 2,4-D, Dicamba, and MCPP).

- Special status species PRGs were redefined as the lower value of (1) the PRG_{low} for plant and soil fauna or (2) the PRG_{low} for wildlife, unless the PRG_{low} is less than the laboratory method detection limit as specified in the *Presidio-wide Quality Assurance Project Plan, Sampling and Analysis Plan* ("QAPP/SAP") (TTEMI, 2001). In such cases, the method detection limit was established as the special status species PRG. If no PRG could be calculated for pesticides or herbicides due to a lack of toxicological data (i.e., 2,4-D, Dicamba, and MCPP), the special status species PRG was established as the method detection limit. For mercury, the special status species PRG was established as two times the typical method detection limit.

These revised ecological PRGs are shown in Table 5-24, which summarizes the ecological PRGs for PCOCs in soil at the Presidio. These PRGs are incorporated into the selection of applicable cleanup levels at the Presidio, as described in Section 7.

TABLES

TABLE 5-1
SPECIAL STATUS PLANT SPECIES AT THE PRESIDIO OF SAN FRANCISCO (a)

Presidio of San Francisco, California

Common Name	Scientific Name	Basis for Special Status Listing
Coast rock cress	*Arabis blepharophylla*	List 4 Species: Plants of Limited Distribution (b)
Raven's manzanita	*Arctostaphylos hookeri* var. *ravenii*	Federal and California Endangered Species (c); (d); List 1B Species: Rare, Threatened, or Endangered Species in California or Elsewhere (b)
San Francisco spineflower	*Chorizanthe cuspidata* var. *cuspidata*	List 1B Species: Rare, Threatened, or Endangered Species in California or Elsewhere (b)
Franciscan thistle	*Cirsium andrewsii*	Proposed List 1B Species: Rare, Threatened, or Endangered Species in California or Elsewhere (b)
Presidio clarkia	*Clarkia franciscana*	Federal and California Endangered Species (c); (d); List 1B Species: Rare, Threatened, or Endangered Species in California or Elsewhere (b)
San Francisco wallflower	*Erysimum franciscanum*	List 4 Species: Plants of Limited Distribution (b)
Dune gilia	*Gilia capitata* ssp. *chamissonis*	Proposed List 1B Species: Rare, Threatened, or Endangered Species in California or Elsewhere (b)
San Francisco gum plant	*Grindelia hirsutula* var. *maritima*	List 1B Species: Rare, Threatened, or Endangered Species in California or Elsewhere (b)
Marin dwarf flax	*Hesperolinon congestum*	Federal and California Threatened Species (c); (d); List 1B Species: Rare, Threatened, or Endangered Species in California or Elsewhere (b)
San Francisco lessingia	*Lessingia germanorum* var. *germanorum*	Federal and California Endangered Species (c); (d); List 1B Species: Rare, Threatened, or Endangered Species in California or Elsewhere (b)
San Francisco campion	*Silene verecunda* ssp. *verecunda*	List 1B Species: Rare, Threatened, or Endangered Species in California or Elsewhere (b)
San Francisco owl's clover	*Tryphysaria floribunda*	List 1B Species: Rare, Threatened, or Endangered Species in California or Elsewhere (b)
California sea-blight	*Suaeda californica*	Federal and California Endangered Species (c)

TABLE 5-1
SPECIAL STATUS PLANT SPECIES AT THE PRESIDIO OF SAN FRANCISCO (a)

Presidio of San Francisco, California

Notes:

(a) Special status plant species identified at the Presidio of San Francisco are compiled from Department of Interior, National Park Service and Presidio Trust *Vegetation Management Plan and Environmental and Assessment Staff Report,* dated October 2000, finalized May 2001.

(b) Skinner, M.W. and B.M. Pavlik. 1994. *Inventory of Rare and Endangered Vascular Plants of California*. 5th Edition. California Native Plant Society.

(c) Title 50 of Code of Federal Regulations §17.12.

(d) California Department of Fish and Game. September 1995. *Endangered, Threatened, or Rare Plants of California*. Natural Heritage Division, Plant Conservation Program, Sacramento, California.

TABLE 5-2
POTENTIAL OCCURRING SPECIAL STATUS WILDLIFE SPECIES AT THE PRESIDIO OF SAN FRANCISCO (a)

Presidio of San Francisco, California

Common Name	Scientific Name	Basis for Special Status Listing
Double-crested cormorant	*Phalacrocorax auritus*	California Species of Concern (c)
Western snowy plover	*Charadrius alexandrius nivosus*	Federal Threatened Species (b); California Species of Concern (c)
Loggerhead shrike	*Lanius ludovicianus*	California Species of Concern (c)
Long-billed curlew	*Numenius americanus*	Federal and California Species of Concern (b); (c)
California gull	*Larus californicus*	California Species of Concern (c)
Saltmarsh common yellowthroat	*Geothylpos trichas sinuosa*	Federal and California Species of Concern (b); (c)
Elegant tern	*Sterna elegans*	California Species of Concern (c)
California least tern	*Sterna antillarum browni*	Federal and California Endangered Species (b); (c)
Vaux's swift	*Chaetura vauxi*	California Species of Concern (c)
California yellow warbler	*Dendroica petechia brewsteri*	California Species of Concern (c)
Willow flycatcher	*Empidonax trailli*	California Endangered Species (c)
White-tailed kite	*Elanus caeruleus*	California Fully Protected Species (c)
Bald eagle	*Haliaeetus leucocephalus*	Proposed Delisting from Federal Endangered Species Act (b); California Endangered and Fully Protected Species (c)
Northern harrier	*Circus cyaneus*	California Species of Concern (c)
Sharp-shinned hawk	*Accipiter striatus*	California Species of Concern (c)
Northern goshawk	*Accipiter gentilis*	California Species of Concern (c)

POTENTIAL OCCURRING SPECIAL STATUS WILDLIFE SPECIES AT THE PRESIDIO OF SAN FRANCISCO (a)

Presidio of San Francisco, California

Common Name	Scientific Name	Basis for Special Status Listing
Swainson's hawk	*Buteo swainsoni*	California Threatened Species (c)
Ferruginous hawk	*Buteo regalis*	Federal and California Species of Concern (b); (c)
Golden eagle	*Aquila chrysaetos*	California Fully Protected Species (c)
Prairie falcon	*Falco mexicanus*	California Species of Concern (c)
Cooper's hawk	*Accipiter cooperi*	California Species of Concern (c)
Merlin	*Falco columbarius*	California Species of Concern (c)
Peregrine falcon	*Falco peregrinus anatum*	Delisted from Federal Endangered Species Act (b); California Endangered Species (c)
Common loon	*Gavia inmer*	California Species of Concern (c)
American white pelican	*Pelecanus erythrorhynchos*	California Species of Concern (c)
California brown pelican	*Pelecanus occidentalis californicus*	Federal and California Endangered Species (b); (c)
Harlequin duck	*Histrionicus histrionicus*	California Species of Concern (c)
Osprey	*Pandion haliaetus*	California Species of Concern (c)
Marbled murrelet	*Brachyramphus marmoratus*	Federal Threatened Species (b); California Endangered Species (c)
Yuma myotis	*Myotis yumanensis*	Federal and California Species of Concern (b); (c)

Notes:

(a) Potential occurring special status animal species identified at the Presidio of San Francisco are compiled from Jones & Stokes Associates, Inc. *Draft Presidio of San Francisco Forest Management Plan*, dated 1994. Jones & Stokes Associates identified potential occurring special status animal species based upon the animals that are associated with varying types of habitats found at the Presidio.

(b) Title 50 of Code of Federal Regulations §1711-12

(c) California Fish and Game Code §§3511, 4700, 5050, and 3503.5.

TABLE 5-3
DEVELOPMENT OF TOXICITY BENCHMARK VALUES FOR CHEMICALS NOT INCLUDED IN ARMY REMEDIAL INVESTIGATION (a)

Presidio of San Francisco, California

Potential Chemical of Concern	TBV-Low (mg/kg-day)	TBV-high (mg/kg-day)	Species	Study Endpoint UF	Study Duration UF	NOAEL (mg/kg-day)	LOAEL (mg/kg-day)	Study Description	Reference	Comment
Inorganic Chemicals										
Beryllium	48.5	485	poultry	5	2	- (b)	485	Caused ricketts in poultry and other livestock at 0.5% of diet. Use 0.097 kg/kg-day from Wiseman (1987) to convert.	Friberg et al, 1979.	Study used in Army RI.
	21.3	42.5	rat	2	1	-	42.5	Mild weight loss, 2 year study. Estimated with 0.085 gm/gm-day (Groton, et al, 1991.)	WHO, 1999.	Long term study; clear endpoint; study used in Army RI.
Cyanide	68.7	-	rat	1	1	68.7	-	Chronic, gestation and lactation; reproduction, oral in diet.	Sample et al, 1996.	Used potassium cyanide.
Molybdenum	3.5	35.3	poultry	1	1	3.5	35.3	LOAEL reduced embryonic viability; 21 day study	Sample et al., 1996	Reproductive endpoint.
	0.26	2.6	mouse	1	1	0.26	2.6	LOAEL for reduced reproductive success; 3 generation study	Sample et al, 1996.	Long-term study.
Tetraethyl Lead	12	170	rat	1	1	12	170	NOAEL for mortality and growth.	Azar et al, 1973.	Study used in Army RI.
	1.13	11.3	quail	1	1	1.13	11.3	Egg hatching success.	Sample et al, 1996.	Long-term study.

DEVELOPMENT OF TOXICITY BENCHMARK VALUES FOR CHEMICALS NOT INCLUDED IN ARMY REMEDIAL INVESTIGATION (a)

Presidio of San Francisco, California

Potential Chemical of Concern	TBV-Low (mg/kg-day)	TBV-high (mg/kg-day)	Species	Study Endpoint UF	Study Duration UF	NOAEL (mg/kg-day)	LOAEL (mg/kg-day)	Study Description	Reference	Comment
Semi Volatile Oragnic Compounds										
Benzyl Alcohol	2	100	bird	10	5	-	100	LD_{50} study.	RTECS, 1996.	Study used in Army RI.
	20.8	1,040	rabbit	10	5	-	1,040	LD_{50} study.	RTECS, 1996.	Study used in Army RI.
4-methylphenol (p-Cresol)	219.2	-	mink	1	1	219.2	-	6 months, reproduction, oral in diet.	Sample et al, 1996.	Used o-cresol.
n-nitrosodiphenylamine	200	-	rat	1	1	200	-	100 week, systemic.	ATSDR, 1999.	
Pentachlorophenol	0.24	2.4	rat	1	1	-	-	Reduction in survival and growth during gestation.	Sample et al, 1996.	Study used in Army RI.
Phenol	30	-	rat	2	1	60	-	NOAEL, chronic, oral study demonstrating decreased fetal weight.	U.S. EPA, 2000.	
Volatile Organic Compounds										
Acetone	100	500	rat	1	1	100	500	90 day NOAEL & LOAEL; liver & kidney damage; oral intubation.	Sample et al, 1996.	Study used in Army RI.
2-butanone (MEK)	50	100	rat	1	1	50	-	NOAEL for methyl isobutyl ketone for body weight, food consumption, organ weight, histopathology, morbidity, clinical chemistry, hematology for 13 week study.	WHO, 1990.	Study used in Army RI.

TABLE 5-3
DEVELOPMENT OF TOXICITY BENCHMARK VALUES FOR CHEMICALS NOT INCLUDED IN ARMY REMEDIAL INVESTIGATION (a)

Presidio of San Francisco, California

Potential Chemical of Concern	TBV-Low (mg/kg-day)	TBV-high (mg/kg-day)	Species	Study Endpoint UF	Study Duration UF	NOAEL (mg/kg-day)	LOAEL (mg/kg-day)	Study Description	Reference	Comment
Volatile Organic Compounds (cont.)										
Carbon disulfide	11	110	rat	1	1	11	110	NOAEL for fetal toxicty/malformations; entire gesation period (22 days).	IRIS, 2001.	Calculated from oral dose.
1,4-dichlorobenzene	25	50	mouse, rat	1	1	25	50	NOEL, subchronic oral study, endpoints of body weight, survival, histopathology, hematology, organ weight range from 25-125 mg/kg bw/d.	CEPA, 1993.	Less extrapolation than using the inhalation study from Army RI.
Methylene Chloride	5.85	50	rat	1	1	5.85	50	Histological effects on liver.	Sample et al, 1996.	
Toluene (as a surrogate for p-isopropyltoluene)	26	260	mouse	1	1	26	260	LOAEL for reduced fetal weights; dosed during	Sample et al, 1996.	
1,1,1-trichloroethane	114	5,700	rabbit, rat, guinea pig	10	5	-	5,700	LD_{50} study.	CEPA, 1993.	Study used in Army RI.
PCBs, Pesticides, and Herbicides										
Aldrin	0.5	5	mallard duck	5	2	-	5	LOAEL for mortality in a 30-day study.	Hudson et al, 1984.	Study used in Army RI.
	0.2	1	rat	1	1	0.2	1	Reproduction, duration less than 1year, oral in diet.	Sample et al, 1996.	Study used in Army RI.
alpha-BHC	0.563	2.25	japanese quail	1	1	0.563	2.25	Chronic, 90-day, reproduction, oral in diet	Sample et al, 1996.	Used beta-BHC.

TABLE 5-3
DEVELOPMENT OF TOXICITY BENCHMARK VALUES FOR CHEMICALS NOT INCLUDED IN ARMY REMEDIAL INVESTIGATION (a)

Presidio of San Francisco, California

Potential Chemical of Concern	TBV-Low (mg/kg-day)	TBV-high (mg/kg-day)	Species	Study Endpoint UF	Study Duration UF	NOAEL (mg/kg-day)	LOAEL (mg/kg-day)	Study Description	Reference	Comment
PCBs, Pesticides, and Herbicides (cont.)										
alpha-BHC	4	20	rat	1	1	4	20	13 weeks; growth, blood chemistry, organ histology, oral in diet.	Sample et al, 1996.	Used beta-BHC.
beta-BHC	0.563	2.25	japanese quail	1	1	0.563	2.25	Chronic, 90-day, reproduction, oral in diet	Sample et al, 1996.	Study used in Army RI.
	4	20	rat	1	1	4	20	13 weeks (subchronic); growth, blood chemistry, organ histology, oral in diet.	Sample et al, 1996.	Study used in Army RI.
delta-BHC	0.563	2.25	japanese quail	1	1	0.563	2.25	Chronic, 90-day, reproduction, oral in diet.	Sample et al, 1996.	Used beta-BHC.
	4	20	rat	1	1	4	20	13 weeks; growth, blood chemistry, organ histology, oral in diet.	Sample et al, 1996.	Used beta-BHC.
Endosulfan / Endosulfan Sulfate	10	-	gray partridge	1	1	10	-	4 weeks, chronic; reproduction; oral in diet.	Sample et al, 1996.	Study used in Army RI.
	1.5	-	rat	1	1	1.5	-	30 days; reproduction, blood chemistry; oral intubation.	Sample et al, 1996.	Study used in Army RI.

TABLE 5-3
DEVELOPMENT OF TOXICITY BENCHMARK VALUES FOR CHEMICALS NOT INCLUDED IN ARMY REMEDIAL INVESTIGATION (a)

Presidio of San Francisco, California

Potential Chemical of Concern	TBV-Low (mg/kg-day)	TBV-high (mg/kg-day)	Species	Study Endpoint UF	Study Duration UF	NOAEL (mg/kg-day)	LOAEL (mg/kg-day)	Study Description	Reference	Comment
PCBs, Pesticides, and Herbicides (cont.)										
Endrin / Endrin Aldehyde / Endrin Ketone	0.032	0.2	mallard duck	1	1	0.0315	0.189	NOAEL for reproductive effects in a 12 week study; dietary level 0.5 ppm. 3 ppm decreased embryo survival, and decreased male body weight by 4.5%; convert with 0.063 g/g -day from U.S. EPA (1993).	Roylance et al, 1985.	Long term study; relates to assessment endpoints; study used in Army RI.
	0.184	0.92	mouse	5	1	-	0.92	120 days, chronic; reproduction; oral in diet.	Sample et al, 1996.	Study used in Army RI.
Heptachlor / Heptachlor Epoxide	0.2	1	mink	5	1	-	1	181 days, chronic; reproduction; oral in diet.	Sample et al, 1996.	Mammal data.
Isodrin	0.5	5	mallard duck	5	2	-	5	LOAEL for mortality in a 30-day study.	Hudson et al., 1984	Used aldrin.
	0.2	1	rat	1	1	0.2	1	Reproduction, duration less than 1year, oral in diet.	Sample et al, 1996.	Used aldrin.
Methoxychlor	40	2,000	mallard duck, sharp tailed grouse, California quail	10	5	-	200	LD_{50} exceeded 2,000 mg/kg bw for all species.	Hudson et al., 1984	
	4	8	rat	1	1	4	8	11 month, chronic, reproduction; oral in diet.	Sample et al, 1996.	Study used in Army RI.

DEVELOPMENT OF TOXICITY BENCHMARK VALUES FOR CHEMICALS NOT INCLUDED IN ARMY REMEDIAL INVESTIGATION (a)

Presidio of San Francisco, California

Notes:

(a) Abbreviations used in this table are as follows:

ATSDR	Agency for Toxic Substances and Disease Registry
CEPA	Canada Environmental Protection Agency
IRIS	Integrated Risk Information System
LOAEL	lowest-observed-adverse-effect-level
mg/kg-day	milligrams per kilogram body weight per day
NOAEL	no-observed-adverse-effect-level
ORNL	Oak Ridge National Laboratory
RI	Remedial Investigation
RTECS	Registry of Toxic Effects of Chemical Substances
TBV	toxicity benchmark value
UF	uncertainty factor
U.S. EPA	United States Environmental Protection Agency
WHO	World Health Organization

(b) Hyphen indicates information was not available.

(c) References listed in this table are as follows:

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- Sample, B.E., D.M. Opresko, and G.W. Suter I.I. June 1996. *Toxicological Benchmarks for Wildlife: 1996 Revision*. Oak Ridge National Laboratory.

TABLE 5-3
DEVELOPMENT OF TOXICITY BENCHMARK VALUES FOR CHEMICALS NOT INCLUDED IN ARMY REMEDIAL INVESTIGATION (a)

Presidio of San Francisco, California

Notes:

- United States Department of Health and Human Services. 1999. *Toxicological Profile for N-Nitrosodiphenylamine*. Agency for Toxic Substances and Disease Registry.
- U.S. EPA. 2000. Integrated Risk Information System Computerized Database. www.epa.gov/ngispgm3/iris/subst/.
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TABLE 5-4

UNCERTAINTY FACTORS USED FOR CHEMICALS NOT INCLUDED IN ARMY REMEDIAL INVESTIGATION

Presidio of San Francisco, California

Potential Chemical of Concern	Toxicity Data (a)			Uncertainty Factors (Dimensionless); (a)								
	Species Data are Based	TBV_{low} (mg/kg-day)	TBV_{high} (mg/kg-day)	American Robin	Mourning Dove	Western Harvest Mouse	Valley Pocket Gopher	Raccoon	Peregrine Falcon	Red-tailed Hawk	Mallard Duck	Western Sandpiper
Inorganic Chemicals												
Beryllium	poultry	48.5	485	5	5	- (b)	-	-	10	5	5	5
	rat	21.3	42.5	-	-	3	4	5	-	-	-	-
Cyanide	rat	68.7	68.7	-	-	3	4	5	-	-	-	-
Molybdenum	poultry	3.5	35.3	5	5	10	5	5	5	-	-	-
	mouse	0.26	2.6	-	-	-	-	-	-	3	4	5
Tetraethyl Lead	rat	12	170	-	-	3	4	5	-	-	-	-
	quail	1.13	11.3	5	5	-	-	-	10	5	5	5
Semivolatile Organic Compounds												
Benzyl Alcohol	bird	2	100	5	5	-	-	-	10	5	5	5
	rabbit	20.8	1,040	-	-	5	5	5	-	-	-	-
4-methylphenol (p-Cresol)	mink	219.2	219.2	-	-	5	5	4	-	-	-	-
n-nitrosodiphenylamine	rat	200	200	-	-	3	4	5	-	-	-	-
Pentachlorophenol	rat	0.24	2.4	-	-	3	4	5	-	-	-	-
Phenol	rat	30	30	-	-	3	4	5	-	-	-	-
Volatile Organic Compounds												
Acetone	rat	100	500	-	-	3	4	5	-	-	-	-
2-butanone (MEK)	rat	50	100	-	-	3	4	5	-	-	-	-

TABLE 5-4
UNCERTAINTY FACTORS USED FOR CHEMICALS NOT INCLUDED IN ARMY REMEDIAL INVESTIGATION

Presidio of San Francisco, California

Potential Chemical of Concern	Toxicity Data (a)			Uncertainty Factors (Dimensionless); (a)								
	Species Data are Based	TBV_{low} (mg/kg-day)	TBV_{high} (mg/kg-day)	American Robin	Mourning Dove	Western Harvest Mouse	Valley Pocket Gopher	Raccoon	Peregrine Falcon	Red-tailed Hawk	Mallard Duck	Western Sandpiper
Volatile Organic Compounds (cont.)												
1,4-dichlorobenzene	mouse, rat	25	50	-	-	3	4	5	-	-	-	-
Carbon disulfide	rat	11	110	-	-	3	4	5	-	-	-	-
Methylene Chloride	rat	5.85	50	-	-	3	4	5	-	-	-	-
Toluene (as a surrogate for p-isopropyltoluene)	mouse	26	260	-	-	3	4	5	-	-	-	-
1,1,1-trichlorothane	rabbit rat, guinea pig	114	5,700	-	-	3	4	5	-	-	-	-
PCBs, Pesticides, and Herbicides												
Aldrin	mallard duck	0.5	5	5	5	-	-	-	10	5	1	5
	rat	0.2	1	-	-	3	4	5	-	-	-	-
alpha-BHC	japanese quail	0.563	2.25	5	5	-	-	-	10	5	5	5
	rat	4	20	-	-	3	4	5	-	-	-	-
beta-BHC	japanese quail	0.563	2.25	5	5	-	-	-	10	5	5	5
	rat	4	20	-	-	3	4	5	-	-	-	-

TABLE 5-4
UNCERTAINTY FACTORS USED FOR CHEMICALS NOT INCLUDED IN ARMY REMEDIAL INVESTIGATION

Presidio of San Francisco, California

Potential Chemical of Concern	Toxicity Data (a)			Uncertainty Factors (Dimensionless); (a)								
	Species Data are Based	TBV_{low} (mg/kg-day)	TBV_{high} (mg/kg-day)	American Robin	Mourning Dove	Western Harvest Mouse	Valley Pocket Gopher	Raccoon	Peregrine Falcon	Red-tailed Hawk	Mallard Duck	Western Sandpiper
PCBs, Pesticides, and Herbicides (cont.)												
delta-BHC	japanese quail	0.563	2.25	5	5	-	-	-	10	5	5	5
	rat	4	20	-	-	3	4	5	-	-	-	-
	rat	1.5	1.5	-	-	3	4	5	-	-	-	-
Endrin / Endrin Aldehyde / Endrin Ketone	mallard duck	0.032	0.2	5	5	-	-	-	10	5	1	5
	mouse	0.184	0.92	-	-	3	4	5	-	-	-	-
Heptachlor/Heptachlor Epoxide	mink	0.2	0.5	-	-	5	5	4	-	-	-	-
Isodrin	mallard duck	0.5	5	5	5	-	-	-	10	5	1	5
	rat	0.2	1	-	-	3	4	5	-	-	-	-
Methoxychlor	mallard duck, sharp tailed grouse, California quail	40	2,000	5	5	-	-	-	10	5	1	5
	rat	4	8	-	-	3	4	5	-	-	-	-

Notes:

(a) Toxicity values are obtained from studies described in Table 5-3; uncertainty factors are discussed in Section 5.5.

(b) Hyphen indicates information was not available.

TABLE 5-5
LOW TOXICITY BENCHMARK VALUES FOR NON-SPECIAL STATUS PLANT AND WILDLIFE SPECIES

Presidio of San Francisco, California

Potential Chemical of Concern	Plants and Soil Fauna TBV_{low} (mg/kg)	Wildlife TBV_{low} (mg/kg-day); (a)								
		American Robin	Mourning Dove	Western Harvest Mouse	Valley Pocket Gopher	Raccoon	Peregrine Falcon	Red-tailed Hawk	Mallard Duck	Western Sandpiper
Inorganic Chemicals										
Antimony	5	- (b)	-	0.59	0.45	0.36	-	-	-	-
Arsenic	10	2.8	2.8	1.27	0.95	0.76	1.4	2.8	14	2.8
Barium	500	19.4	19.4	11.9	8.9	7.12	9.7	19.4	19.4	19.4
Beryllium	**10**	**9.7**	**9.7**	**7.1**	**5.33**	**4.26**	**4.85**	**9.7**	**9.7**	**9.7**
Cadmium	**4**	0.08	0.08	0.06	0.06	0.06	0.04	0.08	0.4	0.08
Chromium	**5**	0.26	0.26	4	4	5	0.13	0.26	0.26	0.32
Cobalt	20	101	101	0.8	0.6	0.48	50.4	101	252	101
Copper	50	11.1	11.1	26.7	26.7	1.97	5.53	11.1	11.1	11.1
Cyanide	-	-	-	**22.9**	**17.2**	**13.7**	-	-	-	-
Lead (c)										
Tetraethyl Lead	-	**0.23**	**0.23**	**4**	**3**	**19.8**	**0.11**	**0.23**	**0.23**	**0.23**
Mercury	0.3	0.0	0.0	0.26	0.2	0.16	0.04	**0.1**	**0.1**	**0.1**
Molybdenum	-	**0.7**	**0.7**	**0.087**	**0.065**	**0.052**	**0.35**	**0.7**	**0.7**	**0.7**
Nickel	**30**	3.49	3.49	10.5	7.9	3	1.75	3.49	3.49	3.49
Selenium	1	0.13	0.13	0.04	0.03	0.02	0.07	0.13	0.13	0.13
Silver	2	**0.349**	**0.349**	21.7	16.3	13	**0.175**	**0.349**	**0.349**	**0.349**
Thallium	1	**0.009**	**0.009**	0.1	0.08	0.06	**0.005**	**0.009**	**0.009**	**0.009**
Vanadium	2	0.1	0.1	0.02	0.01	0.01	0.05	0.1	0.1	0.1
Zinc	50	7.56	7.56	56.7	42.5	34	3.78	7.56	37.8	7.56

TABLE 5-5

LOW TOXICITY BENCHMARK VALUES FOR NON-SPECIAL STATUS PLANT AND WILDLIFE SPECIES

Presidio of San Francisco, California

Potential Chemical of Concern	Plants and Soil Fauna TBV_{low} (mg/kg)	Wildlife TBV_{low} (mg/kg-day); (a)								
		American Robin	Mourning Dove	Western Harvest Mouse	Valley Pocket Gopher	Raccoon	Peregrine Falcon	Red-tailed Hawk	Mallard Duck	Western Sandpiper
Semivolatile Organic Compounds										
Acenaphthene	**30**	-	-	**0.33**	**0.25**	**0.20**	-	-	-	-
Acenaphthylene	**30**	-	-	**0.33**	**0.25**	**0.20**	-	-	-	-
Anthracene	30	-	-	0.33	0.25	0.2	-	-	-	-
Benzo(a)anthracene	**30**	-	-	**0.33**	**0.25**	**0.20**	-	-	-	-
Benzo(a)pyrene	**30**	-	-	**0.33**	**0.25**	**0.20**	-	-	-	-
Benzo(b)fluoranthene	**30**	-	-	**0.33**	**0.25**	**0.20**	-	-	-	-
Benzo(g,h,i)perylene	**30**	-	-	**0.33**	**0.25**	**0.20**	-	-	-	-
Benzo(k)fluoranthene	**30**	-	-	**0.33**	**0.25**	**0.20**	-	-	-	-
Benzyl Alcohol	-	**0.04**	**0.04**	**0.416**	**0.416**	**0.416**	**0.02**	**0.04**	**0.04**	**0.04**
Chrysene	30	-	-	0.33	0.25	0.2	-	-	-	-
Dibenzo(a,h)anthrancene	**30**	-	-	**0.33**	**0.25**	**0.20**	-	-	-	-
Dibenzofuran	-	-	-	-	-	-	-	-	-	-
Fluoranthene	30	-	-	0.33	0.25	0.2	-	-	-	-
Fluorene	30	-	-	0.33	0.25	0.2	-	-	-	-
Ideno(1,2,3-cd)pyrene	**30**	-	-	**0.33**	**0.25**	**0.20**	-	-	-	-
2-methylnaphthalene	**30**	-	-	**0.33**	**0.25**	**0.20**	-	-	-	-
4-methylphenol (p-Cresol)	**50**	-	-	**43.8**	**43.8**	**54.8**	-	-	-	-
Naphthalene	30	-	-	0.33	0.25	0.2	-	-	-	-
n-nitrosodiphenylamine	**20**	-	-	**66.7**	**50**	**40**	-	-	-	-
Pentachlorophenol	**3**	-	-	**0.08**	**0.06**	**0.05**	-	-	-	-
Phenanthrene	**30**	-	-	**0.33**	**0.25**	**0.20**	-	-	-	-
Phenol	**30**	-	-	**10**	**7.5**	**6**	-	-	-	-
Pyrene	**30**	-	-	**0.33**	**0.25**	**0.20**	-	-	-	-

TABLE 5-5
LOW TOXICITY BENCHMARK VALUES FOR NON-SPECIAL STATUS PLANT AND WILDLIFE SPECIES

Presidio of San Francisco, California

Potential Chemical of Concern	Plants and Soil Fauna TBV_{low} (mg/kg)	Wildlife TBV_{low} (mg/kg-day); (a)								
		American Robin	Mourning Dove	Western Harvest Mouse	Valley Pocket Gopher	Raccoon	Peregrine Falcon	Red-tailed Hawk	Mallard Duck	Western Sandpiper
Volatile Organic Compounds										
Acetone	-	-	-	**33.3**	**25**	**20**	-	-	-	-
2-Butanone (MEK)	-	-	-	**16.7**	**12.5**	**10**	-	-	-	-
Carbon disulfide	-	-	-	**3.67**	**2.75**	**2.20**	-	-	-	-
1,4-dichlorobenzene	**20**	-	-	**8.33**	**6.25**	**5**	-	-	-	-
p-isopropyltoluene (p-cymene) (d)	**200**	-	-	**8.7**	**6.5**	**5.20**	-	-	-	-
Methylene Chloride	-	-	-	**1.67**	**1.25**	**1.00**	-	-	-	-
1,2,3-trichlorobenzene	**20**	-	-	-	-	-	-	-	-	-
1,2,4-trichlorobenzene	**20**	-	-	-	-	-	-	-	-	-
Trichlorofluoromethane	-	-	-	-	-	-	-	-	-	-
1,1,1-trichloroethane	-	-	-	**38**	**28.5**	**22.8**	-	-	-	-
PCBs, Pesticides, and Herbicides										
PCBs (Aroclor 1254)	40	0.04	0.04	0.11	0.09	0.07	0.02	0.04	0.04	0.04
Aldrin	-	**0.01**	**0.01**	**0.07**	**0.05**	**0.04**	**0.005**	**0.01**	**0.05**	**0.01**
alpha-BHC	-	**0.113**	**0.113**	**1.33**	**1**	**0.8**	**0.0563**	**0.113**	**0.113**	**0.113**
beta-BHC	-	**0.113**	**0.113**	**1.33**	**1**	**0.8**	**0.0563**	**0.113**	**0.113**	**0.113**
delta-BHC	-	**0.113**	**0.113**	**1.33**	**1**	**0.8**	**0.0563**	**0.113**	**0.113**	**0.113**
Chlordane	-	**0.027**	**0.021**	0.24	0.24	0.24	**0.011**	**0.021**	**0.021**	**0.021**
2,4-D	-	-	-	-	-	-	-	-	-	-
Dicamba	-	-	-	-	-	-	-	-	-	-
4,4'-DDD	40	0.06	0.06	2.83	2.13	1.7	0.04	0.1	0.06	0.06
4,4'-DDE	40	0.12	0.12	2.83	2.13	1.7	0.06	0.12	0.12	0.12
4,4'-DDT	40	0.01	0.01	2.83	2.13	1.7	**0.04**	**0.1**	**0.06**	**0.06**
Dieldrin	50	0.1	0.1	0.09	0.07	0.01	0.05	0.1	0.1	0.1
Endosulfan	-	**2**	**2**	**0.5**	**0.375**	**0.3**	**1**	**2**	**2**	**2**
Endosulfan Sulfate (e)	-	**2**	**2**	**0.5**	**0.375**	**0.3**	**1**	**2**	**2**	**2**

LOW TOXICITY BENCHMARK VALUES FOR NON-SPECIAL STATUS PLANT AND WILDLIFE SPECIES

Presidio of San Francisco, California

Potential Chemical of Concern	Plants and Soil Fauna TBV_{low} (mg/kg)	Wildlife TBV_{low} (mg/kg-day); (a)								
		American Robin	Mourning Dove	Western Harvest Mouse	Valley Pocket Gopher	Raccoon	Peregrine Falcon	Red-tailed Hawk	Mallard Duck	Western Sandpiper
PCBs, Pesticides, and Herbicides (cont.)										
Endrin	-	**0.0064**	**0.0064**	**0.06**	**0.046**	**0.0368**	**0.0032**	**0.0064**	**0.032**	**0.0064**
Endrin Aldehyde (e)	-	**0.0064**	**0.0064**	**0.06**	**0.046**	**0.0368**	**0.0032**	**0.0064**	**0.032**	**0.0064**
Endrin Ketone (e)	-	**0.0064**	**0.0064**	**0.06**	**0.046**	**0.0368**	**0.0032**	**0.0064**	**0.032**	**0.0064**
gamma-BHC (Lindane)	-	**0.019**	**0.019**	**2.7**	**2.0**	**1.6**	**0.01**	**0.019**	**0.019**	**0.019**
Heptachlor	-	**0.019**	**0.019**	**0.04**	**0.04**	**0.05**	**0.01**	**0.019**	**0.019**	**0.019**
Heptachlor Epoxide	-	**0.019**	**0.019**	**0.04**	**0.04**	**0.05**	**0.01**	**0.019**	**0.019**	**0.019**
Isodrin (f)	-	**0.01**	**0.01**	**0.067**	**0.05**	**0.04**	**0.005**	**0.01**	**0.05**	**0.01**
MCPP	-	-	-	-	-	-	-	-	-	-
Methoxychlor	-	**0.8**	**0.8**	**1.33**	**1**	**0.8**	**0.4**	**0.8**	**4**	**0.8**

Notes:

(a) Toxicity values that are boxed and shown in bold have been updated and differ from those assumed by the Army in Dames & Moore, *Final Feasibility Study Report, Presidio Main Installation*, dated May 1997. Updated values have been obtained from United States Department of Energy Oak Ridge National Laboratory documents prepared by R.A. Efroymson, M.E. Will, G.W. Suter II, and A.C. Wooten entitled T*oxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants, 1997 Revision*, dated November 1997. Low toxicity values incorporate uncertainty factors, as discussed in Section 5.5.

(b) Hyphen indicates information was not available.

(c) United States Environmental Protection Agency Region IX Biological Technical Advisory Group toxicity benchmark values for lead vary up to five orders of magnitude. As described in the text, the Preliminary Remediation Goals for lead in soil were developed by use of the Monte Carlo method.

(d) Values for toluene were used for isopropyltoluene.

(e) Values for Endosulfan were used for Endosulfan Sulfate. Values for Endrin were used for Endrin Aldehyde and Endrin Ketone.

(f) Isodrin is an isomer of Aldrin. Values for Aldrin were used for Isodrin.

TABLE 5-6
HIGH TOXICITY BENCHMARK VALUES FOR NON-SPECIAL STATUS PLANT AND WILDLIFE SPECIES

Presidio of San Francisco, California

Potential Chemical of Concern	Plants and Soil Fauna TBV_{high} (mg/kg)	Wildlife TBV_{high} (mg/kg-day); (a)								
		American Robin	Mourning Dove	Western Harvest Mouse	Valley Pocket Gopher	Raccoon	Peregrine Falcon	Red-tailed Hawk	Mallard Duck	Western Sandpiper
Inorganic Chemicals										
Antimony	5	- (b)	-	1.78	1.78	1.78	-	-	-	-
Arsenic	224	42	42	22.5	22.5	22.5	42	42	42	42
Barium	500	194	194	71.2	71.2	71.2	194	194	194	194
Beryllium	**10**	**485**	**485**	**42.5**	**42.5**	**42.5**	**485**	**485**	**485**	**485**
Cadmium	100	2	2	24.3	24.3	24.3	2	2	2	2
Chromium	200	2.56	2.56	40	40	40	2.56	2.56	2.56	2.56
Cobalt	75	2,520	2,520	12	12	12	2,520	2,520	2,520	2,520
Copper	400	72.7	72.7	40	40	13	72.7	72.7	72.7	72.7
Cyanide	-	-	-	**68.7**	**68.7**	**68.7**	-	-	-	-
Lead (c)										
Tetraethyl Lead	-	**11.3**	**11.3**	**170**	**170**	**170**	**11.3**	**11.3**	**11.3**	**11.3**
Mercury	10	12.5	12.5	3.9	3.9	3.9	12.5	12.5	12.5	12.5
Molybdenum	-	**35.3**	**35.3**	**2.6**	**2.6**	**2.6**	**35.3**	**35.3**	**35.3**	**35.3**
Nickel	500	87.3	87.3	158	158	158	87.3	87.3	87.3	87.3
Selenium	70	1.32	1.32	0.57	0.57	0.57	1.32	1.32	1.32	1.32
Silver	2	**8.73**	**8.73**	130	130	130	**8.73**	**8.73**	**8.73**	**8.73**
Thallium	1	**2.37**	**2.37**	3	3	3	**2.37**	**2.37**	**2.37**	**2.37**
Vanadium	20	0.485	0.485	20	20	20	0.485	0.485	0.485	0.485
Zinc	864	189	189	340	340	340	189	189	189	189

TABLE 5-6
HIGH TOXICITY BENCHMARK VALUES FOR NON-SPECIAL STATUS PLANT AND WILDLIFE SPECIES

Presidio of San Francisco, California

Potential Chemical of Concern	Plants and Soil Fauna TBV_{high} (mg/kg)	Wildlife TBV_{high} (mg/kg-day); (a)								
		American Robin	Mourning Dove	Western Harvest Mouse	Valley Pocket Gopher	Raccoon	Peregrine Falcon	Red-tailed Hawk	Mallard Duck	Western Sandpiper
Semivolatile Organic Compounds										
Acenaphthene	**50**	-	-	**10**	**10**	**10**	-	-	-	-
Acenaphthylene	**50**	-	-	**10**	**10**	**10**	-	-	-	-
Anthracene	50	-	-	10	10	10	-	-	-	-
Benzo(a)anthracene	**50**	-	-	**10**	**10**	**10**	-	-	-	-
Benzo(a)pyrene	50	-	-	10	10	10	-	-	-	-
Benzo(b)fluoranthene	**50**	-	-	**10**	**10**	**10**	-	-	-	-
Benzo(g,h,i)perylene	**50**	-	-	**10**	**10**	**10**	-	-	-	-
Benzo(k)fluoranthene	**50**	-	-	**10**	**10**	**10**	-	-	-	-
Benzyl Alcohol	-	**10**	**10**	**104**	**104**	**104**	**10**	**10**	**10**	**10**
Chrysene	50	-	-	10	10	10	-	-	-	-
Dibenzo(a,h)anthrancene	**50**	-	-	**10**	**10**	**10**	-	-	-	-
Dibenzofuran	-	-	-	-	-	-	-	-	-	-
Fluoranthene	50	-	-	10	10	10	-	-	-	-
Fluorene	50	-	-	10	10	10	-	-	-	-
Indeno(1,2,3-cd)pyrene	**50**	-	-	**10**	**10**	**10**	-	-	-	-
2-methylnaphthalene	**50**	-	-	**10**	**10**	**10**	-	-	-	-
4-methylphenol (p-Cresol)	**50**	-	-	**219**	**219**	**219**	-	-	-	-
Naphthalene	50	-	-	10	10	10	-	-	-	-
n-nitrosodiphenylamine	**109**	-	-	**200**	**200**	**200**	-	-	-	-
Pentachlorophenol	**4**	-	-	**2.4**	**2.4**	**2.4**	-	-	-	-
Phenanthrene	**50**	-	-	**10**	**10**	**10**	-	-	-	-
Phenol	**188**	-	-	**30**	**30**	**30**	-	-	-	-
Pyrene	**50**	-	-	**10**	**10**	**10**	-	-	-	-

TABLE 5-6
HIGH TOXICITY BENCHMARK VALUES FOR NON-SPECIAL STATUS PLANT AND WILDLIFE SPECIES

Presidio of San Francisco, California

Potential Chemical of Concern	Plants and Soil Fauna TBV_{high} (mg/kg)	Wildlife TBV_{high} (mg/kg-day); (a)								
		American Robin	Mourning Dove	Western Harvest Mouse	Valley Pocket Gopher	Raccoon	Peregrine Falcon	Red-tailed Hawk	Mallard Duck	Western Sandpiper
Volatile Organic Compounds										
Acetone	-	-	-	**500**	**500**	**500**	-	-	-	-
2-Butanone (MEK)	-	-	-	**100**	**100**	**100**	-	-	-	-
Carbon disulfide	-	-	-	**110**	**110**	**110**	-	-	-	-
1,4-dichlorobenzene	**128**	-	-	**50**	**50**	**50**	-	-	-	-
p-isopropyltoluene (p-cymene) (d)	**1,000**	-	-	**87**	**65**	**52**	-	-	-	-
Methylene Chloride	-	-	-	**125**	**125**	**125**	-	-	-	-
1,2,3-trichlorobenzene	**115**	-	-	-	-	-	-	-	-	-
1,2,4-trichlorobenzene	**127**	-	-	-	-	-	-	-	-	-
Trichlorofluoromethane	-	-	-	-	-	-	-	-	-	-
1,1,1-trichloroethane	-	-	-	**5,700**	**5,700**	**5,700**	-	-	-	-
PCBs, Pesticides, and Herbicides										
PCBs (Aroclor 1254)	240	1.8	1.8	1.7	1.7	1.7	1.8	1.8	1.8	1.8
Aldrin	-	**0.5**	**0.5**	**1**	**1**	**1**	**0.5**	**0.5**	**0.5**	**0.5**
alpha-BHC	-	**20**	**20**	**2.25**	**2.25**	**2.25**	**20**	**20**	**20**	**20**
beta-BHC	-	**20**	**20**	**2.25**	**2.25**	**2.25**	**20**	**20**	**20**	**20**
delta-BHC	-	**20**	**20**	**2.25**	**2.25**	**2.25**	**20**	**20**	**20**	**20**
Chlordane	-	**0.213**	**0.213**	10.4	10.4	10.4	**0.213**	**0.213**	**0.213**	**0.213**
2,4-D	-	-	-	-	-	-	-	-	-	-
Dicamba	-	-	-	-	-	-	-	-	-	-
4,4'-DDD	200	3	3	43	43	43	**3**	3	3	3
4,4'-DDE	200	3	3	43	43	43	3	3	3	3
4,4'-DDT	200	3	3	43	43	43	**3**	3	3	3
Dieldrin	100	1.25	1.25	0.31	0.31	2.6	1.25	1.25	1.25	1.25
Endosulfan	-	**10**	**10**	**1.5**	**1.5**	**1.5**	**10**	**10**	**10**	**10**
Endosulfan Sulfate (e)	-	**10**	**10**	**1.5**	**1.5**	**1.5**	**10**	**10**	**10**	**10**

TABLE 5-6

HIGH TOXICITY BENCHMARK VALUES FOR NON-SPECIAL STATUS PLANT AND WILDLIFE SPECIES

Presidio of San Francisco, California

Potential Chemical of Concern	Plants and Soil Fauna TBV_{high} (mg/kg)	Wildlife TBV_{high} (mg/kg-day); (a)								
		American Robin	Mourning Dove	Western Harvest Mouse	Valley Pocket Gopher	Raccoon	Peregrine Falcon	Red-tailed Hawk	Mallard Duck	Western Sandpiper
PCBs, Pesticides, and Herbicides (cont.)										
Endrin	-	**0.92**	**0.92**	**2**	**2**	**2**	**0.92**	**0.92**	**0.92**	**0.92**
Endrin Aldehyde (e)	-	**0.92**	**0.92**	**2**	**2**	**2**	**0.92**	**0.92**	**0.92**	**0.92**
Endrin Ketone (e)	-	**0.92**	**0.92**	**2**	**2**	**2**	**0.92**	**0.92**	**0.92**	**0.92**
gamma-BHC (Lindane)	-	**3**	**3**	**8**	**8**	**8**	**3**	**3**	**3**	**3**
Heptachlor	-	**208**	**208**	**1**	**1**	**1**	**208**	**208**	**208**	**208**
Heptachlor Epoxide	-	**208**	**208**	**1**	**1**	**1**	**208**	**208**	**208**	**208**
Isodrin (f)	-	**0.5**	**0.5**	**1**	**1**	**1**	**0.5**	**0.5**	**0.5**	**0.5**
MCPP	-	-	-	-	-	-	-	-	-	-
Methoxychlor	-	**200**	**200**	**8**	**8**	**8**	**200**	**200**	**200**	**200**

Notes:

(a) Toxicity values that are boxed and shown in bold have been updated and differ from those assumed by the Army in Dames & Moore, *Final Feasibility Report, Presidio Main Installation*, dated May 1997. Updated values have been obtained from United States Department of Energy Oak Ridge National Laboratory documents prepared by R.A. Efroymson, M.E. Will, G.W. Suter II, and A.C. Wooten entitled T*oxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants, 1997 Revision*, dated November 1997.
With the exception of the factor of 10 used for toxicity values based on mortality endpoints, high toxicity values do not incorporate the use of uncertainty factors (see Section 5.5).

(b) Hyphen indicates information was not available.

(c) United States Environmental Protection Agency Region IX Biological Technical Advisory Group toxicity benchmark values vary up to five orders of magnitude. As described in the text, the Preliminary Remediation Goals for lead in soil were developed by use of the Monte Carlo method.

(d) Values for toluene were used for isopropyltoluene.

(e) Values for Endosulfan were used for Endosulfan Sulfate. Values for Endrin were used for Endrin Aldehyde and Endrin Ketone.

(f) Isodrin is an isomer of Aldrin. Values for Aldrin were used for Isodrin.

TABLE 5-7
SEDIMENT QUALITY CRITERIA FOR AQUATIC LIFE (FRESHWATER)

Presidio of San Francisco, California

Potential Chemical of Concern	Sediment Quality Criteria (mg/kg)							
	CCME ISQG (a)	CCME PEL (a)	Consensus Based TEC (b)	Consensus Based PEC (b)	U.S. EPA SQC (c)	U.S. EPA SQB (c)	Lowest Criterion	Highest Criterion
Inorganic Chemicals								
Antimony	- (d)	-	-	-	-	-	-	-
Arsenic	5.9	17	9.79	33	-	-	5.9	33
Barium	-	-	-	-	-	-	-	-
Beryllium	-	-	-	-	-	-	-	-
Cadmium	0.6	3.5	0.99	4.98	-	-	0.6	4.98
Chromium	37.3	90	43.4	111	-	-	37.3	111
Cobalt	50 (e)	-	-	-	-	-	50	50
Copper	35.7	197	31.6	149	-	-	31.6	197
Cyanide	0.0001 (e)	-	-	-	-	-	0.0001	0.0001
Lead	35.7	91.3	35.8	128	-	-	35.7	128
Tetraethyl Lead	-	-	-	-	-	-	-	-
Mercury	0.17	0.486	0.18	1.06	-	-	0.17	1.06
Molybdenum	-	-	-	-	-	-	-	-
Nickel	16 (e)	75 (e)	22.7	48.6	-	-	16	75
Selenium	-	-	-	-	-	-	-	-
Silver	0.5 (e)	-	-	-	-	-	0.5	0.5
Thallium	-	-	-	-	-	-	-	-
Vanadium	-	-	-	-	-	-	-	-
Zinc	123	315	121	459	-	-	121	459

SEDIMENT QUALITY CRITERIA FOR AQUATIC LIFE (FRESHWATER)

Presidio of San Francisco, California

Potential Chemical of Concern	Sediment Quality Criteria (mg/kg)							
	CCME ISQG (a)	CCME PEL (a)	Consensus Based TEC (b)	Consensus Based PEC (b)	U.S. EPA SQC (c)	U.S. EPA SQB (c)	Lowest Criterion	Highest Criterion
Semivolatile Organic Compounds								
Acenaphthene	0.00671	0.0889	-	-	0.62	-	0.00671	0.62
Acenaphthylene	0.00587	0.128	-	-	-	-	0.00587	0.128
Anthracene	0.0469	0.245	0.0572	0.845	-	-	0.0469	0.845
Benzo(a)anthracene	0.0317	0.385	0.108	1.05	-	-	0.0317	1.05
Benzo(a)pyrene	0.0319	0.782	0.15	1.45	-	-	0.0319	1.45
Benzo(b)fluoranthene	0.24 (e,f)	1.34 (e,f)	-	-	-	-	0.24	1.34
Benzo(g,h,i)perylene	0.17 (e)	0.32 (e)	-	-	-	-	0.17	0.32
Benzo(k)fluoranthene	0.24 (f)	1.34 (f)	-	-	-	-	0.24	1.34
Benzyl Alcohol	-	-	-	-	-	-	-	-
Chrysene	0.0571	0.862	0.166	1.29	-	-	0.0571	1.29
Dibenzo(a,h)anthrancene	0.00622	0.135	0.033	-	-	-	0.00622	0.135
Dibenzofuran	-	-	-	-	-	2	2	2
Fluoranthene	0.111	2.355	0.423	2.23	2.9	-	0.111	2.9
Fluorene	0.0212	0.144	0.0774	0.536	-	0.54	0.0212	0.54
Indeno(1,2,3-cd)pyrene	0.2	0.32	-	-	-	-	0.2	0.32
2-methylnaphthalene	0.0202	0.201	-	-	-	-	0.0202	0.201
4-methylphenol (p-Cresol)	-	-	-	-	-	-	-	-
Naphthalene	0.0346	0.391	0.176	0.561	-	0.48	0.0346	0.561
n-nitrosodiphenylamine	-	-	-	-	-	-	-	-
Pentachlorophenol	-	-	-	-	-	-	-	-
Phenanthrene	0.0419	0.515	0.204	1.17	0.85	-	0.0419	1.17
Phenol	-	-	-	-	-	-	-	-
Pyrene	0.053	0.875	0.195	1.52	-	-	0.053	1.52

TABLE 5-7
SEDIMENT QUALITY CRITERIA FOR AQUATIC LIFE (FRESHWATER)

Presidio of San Francisco, California

Potential Chemical of Concern	Sediment Quality Criteria (mg/kg)							
	CCME ISQG (a)	CCME PEL (a)	Consensus Based TEC (b)	Consensus Based PEC (b)	U.S. EPA SQC (c)	U.S. EPA SQB (c)	Lowest Criterion	Highest Criterion
Volatile Organic Compounds								
Acetone	-	-	-	-	-	-	-	-
2-Butanone (MEK)	-	-	-	-	-	-	-	-
Carbon disulfide	-	-	-	-	-	-	-	-
p-isopropyltoluene (p-cymene)	-	-	-	-	-	-	-	-
1,4-dichlorobenzene	-	-	-	-	-	0.35	0.35	0.35
Methylene Chloride	-	-	-	-	-	-	-	-
1,2,3-trichlorobenzene	-	-	-	-	-	-	-	-
1,2,4-trichlorobenzene	-	-	-	-	-	-	-	-
Trichlorofluormethane	-	-	-	-	-	-	-	-
1,1,1-trichloroethane	-	-	-	-	-	0.17	0.17	0.17
PCBs, Pesticides, and Herbicides								
PCBs (Arochlor 1254)	0.06	0.34	0.0598	0.676	-	-	0.0598	0.676
Aldrin	0.002 (e)	0.008 (e)	-	-	-	-	0.002	0.008
alpha-BHC	0.006 (e)	0.01 (e)	-	-	-	-	0.006	0.01
beta-BHC	0.005 (e)	0.021 (e)	-	-	-	-	0.005	0.021
delta-BHC	0.003 (e)	0.012 (e)	-	-	-	-	0.003	0.012
Chlordane	0.0045	0.00887	0.00324	0.0176	-	-	0.00324	0.0176
2,4-D	-	-	-	-	-	-	-	-
Dicamba	-	-	-	-	-	-	-	-
4,4'-DDD	0.00354	0.00851	0.00488	0.028	-	-	0.00354	0.028
4,4'-DDE	0.00142	0.00675	0.00316	0.0313	-	-	0.00142	0.0313
4,4'-DDT	0.00119	0.00477	0.00416	0.0629	-	-	0.00119	0.0629
Dieldrin	0.00285	0.00667	0.0019	0.0618	0.052	-	0.0019	0.0618
Endosulfan	-	-	-	-	-	0.0054	0.0054	0.0054
Endosulfan Sulfate (g)	-	-	-	-	-	0.0054	0.0054	0.0054

SEDIMENT QUALITY CRITERIA FOR AQUATIC LIFE (FRESHWATER)

Presidio of San Francisco, California

Potential Chemical of Concern	Sediment Quality Criteria (mg/kg)							
	CCME ISQG (a)	CCME PEL (a)	Consensus Based TEC (b)	Consensus Based PEC (b)	U.S. EPA SQC (c)	U.S. EPA SQB (c)	Lowest Criterion	Highest Criterion
PCBs, Pesticides, and Herbicides (cont.)								
Endrin	0.00267	0.0624	0.00222	0.207	0.02	-	0.00222	0.207
Endrin Aldehyde (g)	0.00267	0.0624	0.00222	0.207	0.02	-	0.00222	0.207
Endrin Ketone (g)	0.00267	0.0624	0.00222	0.207	0.02	-	0.00222	0.207
gamma-BHC (Lindane)	0.00094	0.00138	0.00237	0.00499	-	0.0037	0.00094	0.00499
Heptachlor	0.0006	0.00274	0.00247	0.016	-	-	0.0006	0.016
Heptachlor Epoxide	0.0006	0.00274	0.00247	0.016	-	-	0.0006	0.016
Isodrin	0.002 (h)	0.008 (h)	-	-	-	-	0.002	0.008
MCPP	-	-	-	-	-	-	-	-
Methoxychlor	-	-	-	-	-	0.019	0.019	0.019

Notes:

(a) Unless otherwise noted, interim sediment quality guidelines ("ISQG") and probable effect levels ("PELs") obtained from Canadian Council of Ministers of the Environment *Canadian Sediment Quality Guidelines for the Protection of Aquatic Life*, dated 1999.

(b) Consensus-based threshold effects concentrations ("TECs") and probable effects concentrations ("PECs") obtained from MacDonald, D.M., C.G. Ingersoll, and T.A. Berger *Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems*, dated 2000.

(c) Sediment quality criteria ("SQC") and sediment quality benchmarks ("SQB") obtained from U.S. EPA *Ecotox Thresholds*, dated 1996 and U.S. EPA. *Ecological Screening Values*, dated 1995.

(d) Hyphen indicates sediment quality criterion not found.

(e) Value from Persuad, D., R. Jaagumagi, and A. Hayton *Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario*, dated August 1993 or U.S. EPA (1996).

(f) Value for benzo(k)fluoroanthene obtained from Persuad, et al (1993). Value for benzo(k)fluoroanthene used for benzo(b)fluoroanthene.

(g) Values for Endosulfan were used for Endosulfan Sulfate. Values for Endrin were used for Endrin Aldehyde and Endrin Ketone.

(h) Isodrin is an isomer of aldrin. Value listed is for aldrin.

TABLE 5-8
SEDIMENT QUALITY CRITERIA FOR AQUATIC LIFE (MARINE)

Presidio of San Francisco, California

Potential Chemical of Concern	Sediment Quality Criteria (mg/kg)					
	ER-L (a)	ER-M (a)	U.S. EPA SQC (b)	U.S. EPA SQB (b)	Lowest Criterion	Highest Criterion
Inorganic Chemicals						
Antimony	2	25	- (c)	-	2	25
Arsenic	8.2	70	-	-	8.2	70
Barium	-	-	-	-	-	-
Beryllium	-	-	-	-	-	-
Cadmium	1.2	9.6	-	-	1.2	9.6
Chromium	81	370	-	-	81	370
Cobalt	-	-	-	-	-	-
Copper	34	270	-	-	34	270
Cyanide	-	-	-	-	-	-
Lead	46.7	218	-	-	46.7	218
Tetraethyl Lead	-	-	-	-	-	-
Mercury	0.15	0.71	-	-	0.15	0.71
Molybdenum	-	-	-	-	-	-
Nickel	20.9	51.6	-	-	20.9	51.6
Selenium	-	-	-	-	-	-
Silver	1	3.7	-	-	1	3.7
Thallium	-	-	-	-	-	-
Vanadium	-	-	-	-	-	-
Zinc	150	410	-	-	150	410

TABLE 5-8

SEDIMENT QUALITY CRITERIA FOR AQUATIC LIFE (MARINE)

Presidio of San Francisco, California

Potential Chemical of Concern	Sediment Quality Criteria (mg/kg)					
	ER-L (a)	ER-M (a)	U.S. EPA SQC (b)	U.S. EPA SQB (b)	Lowest Criterion	Highest Criterion
Semivolatile Organic Compounds						
Acenaphthene	0.016	0.5	0.62	-	0.016	0.62
Acenaphthylene	0.044	0.64	-	-	0.044	0.64
Anthracene	0.0853	1.1	-	-	0.0853	1.1
Benzo(a)anthracene	0.261	1.6	-	-	0.261	1.6
Benzo(a)pyrene	0.43	1.6	-	-	0.43	1.6
Benzo(b)fluoranthene	-	-	-	-	-	-
Benzo(g,h,i)perylene	-	-	-	-	-	-
Benzo(k)fluoranthene	-	-	-	-	-	-
Benzyl Alcohol	-	-	-	-	-	-
Chrysene	0.384	2.8	-	-	0.384	2.8
Dibenzo(a,h)anthrancene	0.0634	0.26	-	-	0.0634	0.26
Dibenzofuran	-	-	-	2	2	2
Fluoranthene	0.6	5.1	2.9	-	0.6	5.1
Fluorene	0.019	0.54	-	0.54	0.019	0.54
Indeno(1,2,3-cd)pyrene	-	-	-	-	-	-
2-methylnaphthalene	0.07	0.67	-	-	0.07	0.67
4-methylphenol (p-Cresol)	-	-	-	-	-	-
Naphthalene	0.16	2.1	-	0.48	0.16	2.1
n-nitrosodiphenylamine	-	-	-	-	-	-
Pentachlorophenol	-	-	-	-	-	-
Phenanthrene	0.24	1.5	0.85	-	0.24	1.5
Phenol	-	-	-	-	-	-
Pyrene	0.665	2.6	-	-	0.665	2.6

TABLE 5-8
SEDIMENT QUALITY CRITERIA FOR AQUATIC LIFE (MARINE)

Presidio of San Francisco, California

Potential Chemical of Concern	Sediment Quality Criteria (mg/kg)					
	ER-L (a)	ER-M (a)	U.S. EPA SQC (b)	U.S. EPA SQB (b)	Lowest Criterion	Highest Criterion
Volatile Organic Compounds						
Acetone	-	-	-	-	-	-
2-Butanone (MEK)	-	-	-	-	-	-
Carbon disulfide	-	-	-	-	-	-
1,4-dichlorobenzene	-	-	-	0.35	0.35	0.35
p-isopropyltoluene (p-cymene) (d)	-	-	-	0.67	0.67	0.67
Methylene Chloride	-	-	-	-	-	-
1,2,3-trichlorobenzene (e)	-	-	-	9.2	9.2	9.2
1,2,4-trichlorobenzene	-	-	-	9.2	9.2	9.2
Trichlorofluormethane	-	-	-	-	-	-
1,1,1-trichloroethane	-	-	-	0.17	0.17	0.17
PCBs, Pesticides, and Herbicides						
PCBs (Arochlor 1254)	0.0227 (f)	0.18 (f)	-	-	0.0227	0.18
Aldrin	-	-	-	-	-	-
alpha-BHC	0.00032 (g,h)	0.00099 (g,h)	-	-	0.00032	0.00099
beta-BHC	0.00032 (g,h)	0.00099 (g,h)	-	-	0.00032	0.00099
delta-BHC	0.00032 (g,h)	0.00099 (g,h)	-	-	0.00032	0.00099
Chlordane	0.0005	0.006	-	-	0.0005	0.006
2,4-D	-	-	-	-	-	-
Dicamba	-	-	-	-	-	-
4,4'-DDD	0.002	0.02	-	-	0.002	0.02
4,4'-DDE	0.0022	0.027	-	-	0.0022	0.027
4,4'-DDT	0.001	0.007	-	-	0.001	0.007
Dieldrin	0.00002	0.008	0.052	-	0.00002	0.052
Endosulfan	-	-	-	0.0054	0.0054	0.0054
Endosulfan Sulfate (i)	-	-	-	0.0054	0.0054	0.0054

TABLE 5-8
SEDIMENT QUALITY CRITERIA FOR AQUATIC LIFE (MARINE)

Presidio of San Francisco, California

Potential Chemical of Concern	Sediment Quality Criteria (mg/kg)					
	ER-L (a)	ER-M (a)	U.S. EPA SQC (b)	U.S. EPA SQB (b)	Lowest Criterion	Highest Criterion
PCBs, Pesticides, and Herbicides (cont.)						
Endrin	0.00002	0.045	0.02	-	0.00002	0.045
Endrin Aldehyde (i)	0.00002	0.045	0.02	-	0.00002	0.045
Endrin Ketone (i)	0.00002	0.045	0.02	-	0.00002	0.045
gamma-BHC (Lindane)	0.00032 (g)	0.00099 (g)	-	0.0037	0.00032	0.0037
Heptachlor	-	-	-	-	-	-
Heptachlor Epoxide	-	-	-	-	-	-
Isodrin	-	-	-	-	-	-
MCPP	-	-	-	-	-	-
Methoxychlor	0.019	-	-	0.019	0.019	0.019

Notes:

(a) Effects Range-Low ("ER-L") and Effects Range-Medium ("ER-M") obtained from U.S. EPA *Sediment Classification Methods Compendium*, dated 1992; except where noted.

(b) Sediment quality criteria ("SQC") and sediment quality benchmarks ("SQB") obtained from U.S. EPA *Ecotox Thresholds*, dated *1996 and U.S. EPA. Ecological Screening Values*, dated 1995.

(c) Hyphen indicates sediment quality criterion not found.

(d) Values for toluene were used for isopropyltoluene.

(e) Values for 1,2,4-trichlorobenzene were used for 1,2,3-trichlorobenzene.

(f) Value listed is for total PCBs.

(g) Florida Department of Environmental Protection Threshold Effects Level (TEL) and Probable Effects Level (PEL) (MacDonald, 1994). dated 1990 and normalized to 1 percent total organic carbon.

(h) Value listed is for gamma-BHC.

(i) Values for Endosulfan were used for Endosulfan Sulfate. Values for Endrin were used for Endrin Aldehyde and Endrin Ketone.

TABLE 5-9
FORMULAS FOR CALCULATION OF WILDLIFE PRELIMINARY REMEDIATION GOALS FOR SOIL AND SEDIMENT AT THE PRESIDIO OF SAN FRANCISCO

Presidio of San Francisco, California

$$PRG_{\text{American robin}} = \frac{HQ \times TBV \times BW}{(F_{soil/sed} \times DIR) + (CF \times SA \times AF \times ABS) + (BAF_{inv} \times DIR)}$$

$$PRG_{\text{Mourning dove}} = \frac{HQ \times TBV \times BW}{(F_{soil/sed} \times DIR) + (CF \times SA \times AF \times ABS) + (BAF_{pl} \times DIR)}$$

$$PRG_{\text{Western harvest mouse}} = \frac{HQ \times TBV \times BW}{(F_{soil/sed} \times DIR) + (CF \times SA \times AF \times ABS) + (((BAF_{pl} \times 0.5) + (BAF_{inv} \times 0.5)) \times DIR)}$$

$$PRG_{\text{Pocket gopher}} = \frac{HQ \times TBV \times BW}{(F_{soil/sed} \times DIR) + (CF \times SA \times AF \times ABS) + (BAF_{pl} \times DIR)}$$

$$PRG_{\text{Red-tailed hawk}} = \frac{HQ \times TBV \times BW}{(F_{soil/sed} \times DIR) + (CF \times SA \times AF \times ABS) + ((BAF_{mam} \times BAF_{pl} \times 0.5) + (BAF_{mam} \times BAF_{inv} \times 0.5)) \times DIR)}$$

TABLE 5-9

FORMULAS FOR CALCULATION OF WILDLIFE PRELIMINARY REMEDIATION GOALS FOR SOIL AND SEDIMENT AT THE PRESIDIO OF SAN FRANCISCO

Presidio of San Francisco, California

$$PRG_{\text{Peregrine falcon}} = \frac{HQ \times TBV \times BW}{(F_{soil/sed} \times DIR) + (CF \times SA \times AF \times ABS) + (((BAF_{bird} \times BAF_{pl} \times 0.5) + (BAF_{bird} \times BAF_{inv} \times 0.5)) \times DIR)}$$

$$PRG_{\text{Raccoon}} = \frac{HQ \times TBV \times BW}{(F_{soil/sed} \times DIR) + (CF \times SA \times AF \times ABS) + (((BAF_{bird} \times BAF_{pl} \times 0.5) + (BAF_{inv} \times BAF_{inv} \times 0.5)) \times DIR)}$$

$$PRG_{\text{Mallard duck}} = \frac{HQ \times TBV \times BW}{(F_{soil/sed} \times DIR) + (CF \times SA \times AF \times ABS) + (BAF_{pl} \times DIR)}$$

$$PRG_{\text{Western sandpiper}} = \frac{HQ \times TBV \times BW}{(F_{soil/sed} \times DIR) + (CF \times SA \times AF \times ABS) + (BAF_{inv} \times DIR)}$$

TABLE 5-9
FORMULAS FOR CALCULATION OF WILDLIFE PRELIMINARY REMEDIATION GOALS FOR SOIL AND SEDIMENT AT THE PRESIDIO OF SAN FRANCISCO

Presidio of San Francisco, California

where:

ABS = Absorption factor (chemical-specific)

AF = Soil adherence factor (mg/cm^2)

BAF_{inv} = Bioaccumulation factor for invertebrates (unitless)

BAF_{pl} = Bioaccumulation factor for plants (unitless)

BW = Body weight (kg)

CF = Conversion factor (converts units from mg to kg)

DIR = Dietary ingestion rate (kg/day)

$F_{soil/sed}$ = Fraction of soil and sediment in diet (unitless)

HQ = Hazard quotient equal to 1

PRG = Preliminary remediation goal

SA = Surface area (cm^2)

TBV = Toxicity benchmark value (mg/kg-day)

TABLE 5-10
WILDLIFE EXPOSURE FACTORS (a)

Presidio of San Francisco, California

Receptor	Surface Area (cm^2)	Body Weight (kg)	Normalized Dietary Ingestion Rate (kg/kg-day)	Dietary Ingestion Rate (kg/day)	Basis of Dietary Ingestion Rate	Converted Dietary Ingestion Rate (kg/day); (b)	Soil Ingestion (Fraction of Diet)	Soil Ingestion Rate (kg/day)	Home Range (hectares)
American Robin	206	0.085	1.457	0.1235	weight weight	0.0499	0.103	0.00514	0.4
Mourning Dove	385	0.166	0.200	0.0332	dry weight	0.0332	0.103	0.00342	0.24
Western Harvest Mouse	93	0.029	0.372	0.0108	weight weight	0.0044	0.024	0.00010	0.4
Valley Pocket Gopher	161	0.306	0.061	0.0187	dry weight	0.0187	0.024	0.00044	0.1
Raccoon	3979	7.264	0.017	0.1235	dry weight	0.1235	0.094	0.01161	2122
Peregrine Falcon	279	0.135	0.290	0.0392	dry weight	0.0392	0.028	0.00110	192
Red-tailed Hawk	1208	1.231	0.109	0.1342	weight weight	0.0426	0.028	0.00119	1663
Mallard Duck	1205	1.243	0.053	0.0659	dry weight	0.0659	0.033	0.00217	608
Western Sandpiper	140	0.047	0.122	0.0057	dry weight	0.0057	0.282	0.00160	0.25

Notes:

(a) Unless otherwise noted, wildlife exposure factors are the same as those assumed by the Army in Dames & Moore, *Final Feasibility Study Report, Presidio Main Installation*, dated May 1997.

(b) Dietary ingestion rates were converted to a dry weight basis using the equation DIRdry = DIRwet x (1 - percent water in food) and average moisture contents from Sample, B.E. and G.W. Suter, I.I. 1994. *Estimating Exposure of Terrestrial Wildlife to Contaminants*. Oak Ridge National Laboratory, United States Department of Energy. ES/ER/TM-125.

TABLE 5-11
PLANT AND WILDLIFE BIOACCUMULATION FACTORS

Presidio of San Francisco, California

Potential Chemical of Concern	Bioaccumulation Factor (unitless); (a)				
	Plant	Soil Invertebrate	Bird	Mammal	
				Omnivore	Herbivore
Inorganic Chemicals					
Cadmium	**0.586**	**7.708**	0.002	**0.1217**	**0.1258**
Copper	**0.124**	**0.515**	0.001	**0.1272**	**0.1086**
Lead	**0.0389**	**0.266**	0.0003	**0.0659**	**0.0522**
Mercury	**0.652**	**1.693**	1.214	**0.0543**	**0.0239**
Selenium	**0.672**	**0.985**	0.013	**0.2062**	**0.155**
Zinc	**0.366**	**3.201**	0.001	0.55772	**0.50429**
Semivolatile Organic Compounds					
Polycyclic Aromtaic Hydrocarbons	0	0	0	0	0
PCBs, Pesticides, and Herbicides					
PCBs	0.01	**6.667**	0.227	1.43	1.43
Aldrin	**0.03**	**4.29**	**0.477**	**0.02**	**0.02**
alpha-BHC (b)	**0**	**3**	**1**	**0.5**	**0.1**
beta-BHC (b)	**0**	**3**	**1**	**0.5**	**0.1**
delta-BHC (b)	**0**	**3**	**1**	**0.5**	**0.1**
Chlordane	0.02	5	0.352	0.04	0.04
Dicamba (b)	**0**	**3**	**1**	**0.5**	**0.1**
4,4'-DDD	**0.01**	**1.98**	**0.905**	**0.45**	**0.45**
4,4'-DDE	**0.01**	**1.98**	**0.905**	**0.45**	**0.45**
4,4'-DDT	0.01	1.98	0.905	0.45	0.45
Dieldrin	0.03	4.29	0.477	0.02	0.02
Endosulfan (b)	**0**	**3**	**1**	**0.5**	**0.1**
Endosulfan Sulfate (b)	**0**	**3**	**1**	**0.5**	**0.1**
Endrin (b)	**0**	**3**	**1**	**0.5**	**0.1**
Endrin Aldehyde (b)	**0**	**3**	**1**	**0.5**	**0.1**
Endrin Ketone (b)	**0**	**3**	**1**	**0.5**	**0.1**
gamma-BHC (b)	**0**	**3**	**1**	**0.5**	**0.1**
Heptachlor	0.086	1.67	2.25	0.11	0.11
Heptachlor Epoxide	**0.086**	**1.67**	**2.25**	**0.11**	**0.11**
Isodrin (c)	**0.03**	**4.29**	**0.477**	**0.02**	**0.02**
MCPP (b)	**0**	**3**	**1**	**0.5**	**0.1**
Methoxychlor (b)	**0**	**3**	**1**	**0.5**	**0.1**

TABLE 5-11
PLANT AND WILDLIFE BIOACCUMULATION FACTORS

Presidio of San Francisco, California

ıtes:

) Unless otherwise noted, bioaccumulation factors that are boxed and shown in bold have been updated and differ from those assumed by the Army in Dames & Moore, *Final Feasibility Study Report, Presidio Main Installation*, dated May 1997. Updated values have been obtained from the following United States Department of Energy Oak Ridge National Laboratory documents:

- Bechtel Jacobs Company L.L.C. September 1998. *Empirical Models for Uptake of Inorganic Chemicals from Soil to Plants.* United States Department of Energy Oak Ridge National Laboratory. BJC/OR-133.
- Sample, B.E., et al. February 1998. *Development and Validation of Bioaccumulation Models for Earthworms*. Energy. ES/ER/TM-220.
- Sample, B.E., et al. February 1998. *Development and Validation of Bioaccumulation Models for Small Mammals*. United States Department of United States Department of Energy ES/ER/TM-219.

Calculation of BAFs for chemicals without literature based BAFs

	Bioaccumulation Factor (unitless)				
		Soil		Mammal	
Potential Chemical of Concern	Plant	Invertebrate	Bird	Omnivore	Herbivore
Pesticides/herbicides with BAFs					
Dieldrin	0.03	4.29	0.477	0.02	0.02
Chlordane	0.02	5	0.352	0.04	0.04
4,4'-DDT	0.01	1.98	0.905	0.45	0.45
Heptachlor	0.086	1.67	2.25	0.11	0.11
Statistics					
Range	0.01-0.09	1.67-5	0.35-2.25	0.02-0.45	0.02-0.45
Median	0.025	3.135	0.691	0.075	0.075
Assumed BAFs (for chemicals with no literature BAF)	**0 (a)**	**3 (b)**	**1 (c)**	**0.5 (d)**	**0.1 (e)**

(a) Assumed to be 0 based on BAFs for other pesticides all below 0.1.
(b) Assumed to be 3 based on median BAF for other pesticides of 3.1.
(c) Assumed to be 1 based on median BAF for other pesticides of 0.7.
(d) Assumed to be 0.5 based on median BAF for other pesticides of 0.075 and conservative assumption that omnivores should have a higher BAF.
(e) Assumed to be 0.1 based on median BAF for other pesticides of 0.075.

) No literature-reported bioaccumulation factors were found. Bioaccumulation factors listed for potential chemical of concern are assumed values based on the range of literature-reported values for chlordane, dieldrin, heptachlor, and 4,4'-DDT.

) Isodrin is an isomer of Aldrin. Values for Aldrin were used for Isodrin.

TABLE 5-12
SOIL PRELIMINARY REMEDIATION GOALS FOR NON-SPECIAL STATUS PLANT AND WILDLIFE SPECIES BASED ON LOW TOXICITY BENCHMARK VALUES

Presidio of San Francisco, California

Potential Chemical of Concern	Plants and Soil Fauna PRG_{low} (mg/kg)	Soil Preliminary Remediation Goal for Protection of Wildlife (mg/kg)							
		American Robin	Mourning Dove	Western Harvest Mouse	Valley Pocket Gopher	Raccoon	Peregrine Falcon	Red-tailed Hawk	Wildlife Minimum PRG Value
Inorganic Chemicals									
Antimony	5	- (a)	-	162	309	225	-	-	162
Arsenic	10	46	135	343	647	471	171	2,804	46
Barium	500	320	940	3,264	6,109	4,440	1,192	19,819	320
Beryllium	10	160	470	1,953	3,655	2,657	596	9,910	160
Cadmium	4	0.017	0.58	0.1	2	0.89	4	4	0.017
Chromium	5	4	13	1,100	2,746	3,118	16	266	4
Cobalt	20	1,663	4,886	220	412	299	6,191	102,977	220
Copper	50	30	243	517	2,957	329	672	4,715	30
Cyanide	-	-	-	6,298	11,789	8,569	-	-	6,298
Lead (b)	-	-	-	-	-	-	-	-	-
Tetraethyl Lead	-	1	8	151	783	5,111	13	175	1
Mercury	0.3	0.038	0.26	1.45	4.85	7.04	0.095	28.18	0.038
Molybdenum	-	12	34	24	44	32	43	701	12
Nickel	30	58	169	2,896	5,422	1,871	215	3,565	58
Selenium	1	0.2	0.84	0.31	0.71	2	6	21	0.2
Silver	2	6	17	5,960	11,154	8,107	21	357	6
Thallium	1	0.15	0.44	28	55	37	1	9	0.15
Vanadium	2	2	5	6	7	6	6	102	2
Zinc	50	4	81	209	1,787	1,180	437	216	4

TABLE 5-12

SOIL PRELIMINARY REMEDIATION GOALS FOR NON-SPECIAL STATUS PLANT AND WILDLIFE SPECIES BASED ON LOW TOXICITY BENCHMARK VALUES

Presidio of San Francisco, California

Potential Chemical of Concern	Plants and Soil Fauna PRG_{low} (mg/kg)	Soil Preliminary Remediation Goal for Protection of Wildlife (mg/kg)							
		American Robin	Mourning Dove	Western Harvest Mouse	Valley Pocket Gopher	Raccoon	Peregrine Falcon	Red-tailed Hawk	Wildlife Minimum PRG Value
Semivolatile Organic Compounds									
Acenaphthene	30	-	-	84	166	121	-	-	84
Acenaphthylene	30	-	-	84	166	121	-	-	84
Anthracene	30	-	-	84	166	121	-	-	84
Benzo(a)anthracene	30	-	-	84	166	121	-	-	84
Benzo(a)pyrene	30	-	-	84	166	121	-	-	84
Benzo(b)fluoranthene	30	-	-	84	166	121	-	-	84
Benzo(g,h,i)perylene	30	-	-	84	166	121	-	-	84
Benzo(k)fluoranthene	30	-	-	84	166	121	-	-	84
Benzyl Alcohol	-	0.66	2	106	277	252	2	37	0.66
Chrysene	30	-	-	84	166	121	-	-	84
Dibenzo(a,h)anthrancene	30	-	-	84	166	121	-	-	84
Dibenzofuran	-	-	-	-	-	-	-	-	-
Fluoranthene	30	-	-	84	166	121	-	-	84
Fluorene	30	-	-	84	166	121	-	-	84
Indeno(1,2,3-cd)pyrene	30	-	-	84	166	121	-	-	84
2-methylnaphthalene	30	-	-	84	166	121	-	-	84
4-methylphenol (p-Cresol)	50	-	-	11,167	29,145	33,156	-	-	11,167
Naphthalene	30	-	-	84	166	121	-	-	84
n-nitrosodiphenylamine	20	-	-	16,981	33,240	24,202	-	-	16,981
Pentachlorophenol	3	-	-	22	41	30	-	-	22
Phenanthrene	30	-	-	84	166	121	-	-	84
Phenol	30	-	-	2,547	4,986	3,630	-	-	2,547
Pyrene	30	-	-	84	166	121	-	-	84

TABLE 5-12
SOIL PRELIMINARY REMEDIATION GOALS FOR NON-SPECIAL STATUS PLANT AND WILDLIFE SPECIES BASED ON LOW TOXICITY BENCHMARK VALUES

Presidio of San Francisco, California

Potential Chemical of Concern	Plants and Soil Fauna PRG_{low} (mg/kg)	Soil Preliminary Remediation Goal for Protection of Wildlife (mg/kg)							
		American Robin	Mourning Dove	Western Harvest Mouse	Valley Pocket Gopher	Raccoon	Peregrine Falcon	Red-tailed Hawk	Wildlife Minimum PRG Value
Volatile Organic Compounds									
Acetone	-	-	-	8,490	16,620	12,101	-	-	8,490
2-Butanone (MEK)	-	-	-	4,245	8,310	6,050	-	-	4,245
Carbon disulfide	-	-	-	934	1,828	1,331	-	-	934
1,4-dichlorobenzene	20	-	-	2,123	4,155	3,025	-	-	2,123
p-isopropyltoluene (p-cymene) (d)	200	-	-	2,207	4,321	3,146	-	-	2,207
Methylene Chloride	-	-	-	459	858	624	-	-	459
1,2,3-trichlorobenzene	20	-	-	-	-	-	-	-	-
1,2,4-trichlorobenzene	20	-	-	-	-	-	-	-	-
Trichlorfluoromethane	-	-	-	-	-	-	-	-	-
1,1,1-trichloroethane	-	-	-	9,679	18,947	13,795	-	-	9,679
PCBs, Pesticides, and Herbicides									
PCBs (Aroclor 1254)	40	0.01	2	0.22	43	1	0.09	0.24	0.01
Aldrin	-	0.004	0.37	0.2	15	1	0.02	4	0.004
alpha-BHC	-	0.062	5	6	665	29	0.13	18	0.062
beta-BHC	-	0.062	5	6	665	29	0.13	18	0.062
delta-BHC	-	0.062	5	6	665	29	0.13	18	0.062
Chlordane	-	0.009	0.85	0.63	88	5	0.04	5	0.009
2,4-D	-	-	-	-	-	-	-	-	-
Dicamba	-	-	-	-	-	-	-	-	-
4,4'-DDD	40	0.049	3	18	1,007	92	0.14	6	0.049
4,4'-DDE	40	0.098	5	18	1,007	92	0.22	7	0.098
4,4'-DDT	40	0.008	0.44	18	1,007	92	0.14	6	0.008
Dieldrin	50	0.039	4	0.27	21	0.26	0.16	39	0.039
Endosulfan	-	1.1	96	2	249	11	2	320	1.1
Endosulfan Sulfate (d)	-	1.1	96	2	249	11	2	320	1.1

TABLE 5-12

SOIL PRELIMINARY REMEDIATION GOALS FOR NON-SPECIAL STATUS PLANT AND WILDLIFE SPECIES BASED ON LOW TOXICITY BENCHMARK VALUES

Presidio of San Francisco, California

Potential Chemical of Concern	Plants and Soil Fauna PRG_{low} (mg/kg)	Soil Preliminary Remediation Goal for Protection of Wildlife (mg/kg)							
		American Robin	Mourning Dove	Western Harvest Mouse	Valley Pocket Gopher	Raccoon	Peregrine Falcon	Red-tailed Hawk	Wildlife Minimum PRG Value
PCBs, Pesticides, and Herbicides (cont.)									
Endrin	-	0.004	0.31	0.3	31	1	0.007	1	0.004
Endrin Aldehyde (d)	-	0.004	0.31	0.3	31	1	0.007	1	0.004
Endrin Ketone (d)	-	0.004	0.31	0.3	31	1	0.007	1	0.004
gamma-BHC (Lindane)	-	0.010	0.91	12	1,330	59	0.023	3	0.010
Heptachlor	-	0.018	0.50	0.29	6	3	0.017	4	0.017
Heptachlor Epoxide	-	0.018	0.5	0.29	6	3	0.017	4	0.017
Isodrin	-	0.004	0.37	0.2	15	1	0.016	4	0.004
MCPP	-	-	-	-	-	-	-	-	-
Methoxychlor	-	0.44	38	6	665	29	0.9	128	0.44

Notes:

(a) Hyphen indicates that Preliminary Remediation Goal ("PRG") could not be calculated due to lack of toxicity information.

(b) PRG for lead was calculated through use of the Monte Carlo method. Refer to text for discussion of methodology used to derive the PRG for lead.

(c) Values for toluene were used for isopropyltoluene.

(d) Values for Endosulfan were used for Endosulfan Sulfate. Values for Endrin were used for Endrin Aldehyde and Endrin Ketone.

TABLE 5-13
SOIL PRELIMINARY REMEDIATION GOALS FOR NON-SPECIAL STATUS PLANT AND WILDLIFE SPECIES BASED ON HIGH TOXICITY BENCHMARK VALUES

Presidio of San Francisco, California

Potential Chemical of Concern	Plants and Soil Fauna PRG_{high} (mg/kg)	Soil Preliminary Remediation Goal for Protection of Wildlife (mg/kg)							
		American Robin	Mourning Dove	Western Harvest Mouse	Valley Pocket Gopher	Raccoon	Peregrine Falcon	Red-tailed Hawk	Wildlife Minimum PRG Value
Inorganic Chemicals									
Antimony	5	- (a)	-	490	1,222	1,110	-	-	490
Arsenic	224	692	2,031	6,080	15,333	13,937	5,133	42,064	692
Barium	500	3,200	9,404	19,581	48,870	44,403	23,831	198,190	3,200
Beryllium	10	8,000	23,510	11,688	29,171	26,505	59,578	495,476	8,000
Cadmium	100	0.44	15	38.80	653	362	190	108	0.44
Chromium	200	42	124	11,001	27,455	24,946	314	2,615	42
Cobalt	75	41,567	122,156	3,300	8,237	7,484	309,559	2,574,431	3,300
Copper	400	200	1,599	775	4,435	2,173	8,824	30,975	200
Cyanide	-	-	-	18,894	47,154	42,844	-	-	18,894
Lead (b)	-	-	-	-	-	-	-	-	-
Tetraethyl Lead	-	52	398	6,408	44,391	43,989	1,386	8,578	52
Mercury	10	12	83	22	95	172	30	4,402	12
Molybdenum	-	582	1,710	703	1,770	1,610	4,310	35,400	582
Nickel	500	1,440	4,232	43,453	108,448	98,536	10,724	89,186	1,440
Selenium	70	2	9	4	13	57	117	210	2
Silver	2	144	423	35,752	89,230	81,074	1,072	8,919	144
Thallium	1	39	115	825	2,059	1,871	291	2,421	39
Vanadium	20	8	24	5,500	13,728	12,473	60	495	8
Zinc	864	97	2,014	1,253	14,297	11,799	21,830	5,390	97

TABLE 5-13

SOIL PRELIMINARY REMEDIATION GOALS FOR NON-SPECIAL STATUS PLANT AND WILDLIFE SPECIES BASED ON HIGH TOXICITY BENCHMARK VALUES

Presidio of San Francisco, California

Potential Chemical of Concern	Plants and Soil Fauna PRG_{high} (mg/kg)	Soil Preliminary Remediation Goal for Protection of Wildlife (mg/kg)							
		American Robin	Mourning Dove	Western Harvest Mouse	Valley Pocket Gopher	Raccoon	Peregrine Falcon	Red-tailed Hawk	Wildlife Minimum PRG Value
Semivolatile Organic Compounds									
Acenaphthene	50	-	-	2,547	6,648	6,050	-	-	2,547
Acenaphthylene	50	-	-	2,547	6,648	6,050	-	-	2,547
Anthracene	50	-	-	2,547	6,648	6,050	-	-	2,547
Benzo(a)anthracene	50	-	-	2,547	6,648	6,050	-	-	2,547
Benzo(a)pyrene	50	-	-	2,547	6,648	6,050	-	-	2,547
Benzo(b)fluoranthene	50	-	-	2,547	6,648	6,050	-	-	2,547
Benzo(g,h,i)perylene	50	-	-	2,547	6,648	6,050	-	-	2,547
Benzo(k)fluoranthene	50	-	-	2,547	6,648	6,050	-	-	2,547
Benzyl Alcohol	-	164	480	26,490	69,139	62,924	1,201	9,371	164.36
Chrysene	50	-	-	2,547	6,648	6,050	-	-	2,547
Dibenzo(a,h)anthrancene	50	-	-	2,547	6,648	6,050	-	-	2,547
Dibenzofuran	-	-	-	-	-	-	-	-	-
Fluoranthene	50	-	-	2,547	6,648	6,050	-	-	2,547
Fluorene	50	-	-	2,547	6,648	6,050	-	-	2,547
Indeno(1,2,3-cd)pyrene	50	-	-	2,547	6,648	6,050	-	-	2,547
2-methylnaphthalene	50	-	-	2,547	6,648	6,050	-	-	2,547
4-methylphenol (p-Cresol)	50	-	-	55,782	145,591	132,504	-	-	55,782
Naphthalene	50	-	-	2,547	6,648	6,050	-	-	2,547
n-nitrosodiphenylamine	109	-	-	50,942	132,960	121,008	-	-	50,942
Pentachlorophenol	4	-	-	660	1,647	1,497	-	-	660
Phenanthrene	50	-	-	2,547	6,648	6,050	-	-	2,547
Phenol	188	-	-	7,641	19,944	18,151	-	-	7,641
Pyrene	50	-	-	2,547	6,648	6,050	-	-	2,547

TABLE 5-13
SOIL PRELIMINARY REMEDIATION GOALS FOR NON-SPECIAL STATUS PLANT AND WILDLIFE SPECIES BASED ON HIGH TOXICITY BENCHMARK VALUES

Presidio of San Francisco, California

Potential Chemical of Concern	Plants and Soil Fauna PRG_{high} (mg/kg)	Soil Preliminary Remediation Goal for Protection of Wildlife (mg/kg)							
		American Robin	Mourning Dove	Western Harvest Mouse	Valley Pocket Gopher	Raccoon	Peregrine Falcon	Red-tailed Hawk	Wildlife Minimum PRG Value
Volatile Organic Compounds									
Acetone	-	-	-	127,356	332,399	302,520	-	-	127,356
2-Butanone (MEK)	-	-	-	25,471	66,480	60,504	-	-	25,471
Carbon disulfide	-	-	-	28,018	73,128	66,554	-	-	28,018
1,4-dichlorobenzene	128	-	-	12,736	33,240	30,252	-	-	12,736
p-isopropyltoluene (p-cymene) (c)	1,000	-	-	22,075	43,212	31,462	-	-	22,075
Methylene Chloride	-	-	-	34,377	85,798	77,956	-	-	34,377
1,2,3-trichlorobenzene	115	-	-	-	-	-	-	-	-
1,2,4-trichlorobenzene	127	-	-	-	-	-	-	-	-
Trichlorfluoromethane	-	-	-	-	-	-	-	-	-
1,1,1-trichloroethane	-	-	-	1,451,858	3,789,347	3,448,730	-	-	1,451,858
PCBs, Pesticides, and Herbicides									
PCBs (Aroclor 1254)	240	0.45	79	3	812	29	8	10.83	0.45
Aldrin	-	0.19	19	3	300	26	2	195	0.19
alpha-BHC	-	11	960	10	1,496	83	45	740	10
beta-BHC	-	11	960	10	1,496	83	45	740	10
delta-BHC	-	11	960	10	1,496	83	45	740	10
Chlordane	-	0.071	9	27	3,818	235	0.81	47	0.071
2,4-D	-	-	-	-	-	-	-	-	-
Dicamba	-	-	-	-	-	-	-	-	-
4,4'-DDD	200	2	131	280	20,339	2,317	11	181	2
4,4'-DDE	200	2	131	280	20,339	2,317	11	181	2
4,4'-DDT	200	2	131	280	20,339	2,317	11	181	2
Dieldrin	100	0.48	47	0.94	93	68	4	488	0.48
Endosulfan	-	5	480	7	997	55	23	370	5
Endosulfan Sulfate (d)	-	5	480	7	997	55	23	370	5

TABLE 5-13

SOIL PRELIMINARY REMEDIATION GOALS FOR NON-SPECIAL STATUS PLANT AND WILDLIFE SPECIES BASED ON HIGH TOXICITY BENCHMARK VALUES

Presidio of San Francisco, California

Potential Chemical of Concern	Plants and Soil Fauna PRG_{high} (mg/kg)	Soil Preliminary Remediation Goal for Protection of Wildlife (mg/kg)							
		American Robin	Mourning Dove	Western Harvest Mouse	Valley Pocket Gopher	Raccoon	Peregrine Falcon	Red-tailed Hawk	Wildlife Minimum PRG Value
PCBs, Pesticides, and Herbicides (cont.)									
Endrin	-	0.50	44	9	1,330	74	2	34	0.50
Endrin Aldehyde (d)	-	0.50	44	9	1,330	74	2	34	0.50
Endrin Ketone (d)	-	0.50	44	9	1,330	74	2	34	0.50
gamma-BHC (Lindane)	-	2	144	35	5,318	295	7	111	2
Heptachlor	-	199	5,467	7	148	57	358	47,169	7
Heptachlor Epoxide	-	199	5,467	7	148	57	358	47,169	7
Isodrin (e)	-	0.19	19	3	300	26	2	195	0.19
MCPP	-	-	-	-	-	-	-	-	-
Methoxychlor	-	110	9,598	35	5,318	295	451	7,401	35

Notes:

(a) Hyphen indicates that Preliminary Remediation Goal ("PRG") could not be calculated due to lack of toxicity information.

(b PRG for lead was calculated through use of the Monte Carlo method. Refer to text for discussion of methodology used to derive the PRG for lead.

(c) Values for toluene were used for isopropyltoluene.

(d Values for Endosulfan were used for Endosulfan Sulfate. Values for Endrin were used for Endrin Aldehyde and Endrin Ketone.

(e) Isodrin is an isomer of Aldrin. Values for Aldrin were used for Isodrin.

TABLE 5-14
SOIL PRELIMINARY REMEDIATION GOALS FOR NON-SPECIAL STATUS PLANT AND WILDLIFE SPECIES

Presidio of San Francisco, California

Potential Chemical of Concern	Summary of Plant and Soil Fauna PRGs (mg/kg); (a)			Summary of Wildlife PRGs (mg/kg); (a)			Proposed Soil PRG (mg/kg); (b)
	PRG_{low}	PRG_{high}	Arithmetic Mean	PRG_{low}	PRG_{high}	Arithmetic Mean	
Inorganic Chemicals							
Antimony	5	5	5	162	490	326	5
Arsenic	10	224	117	46	692	369	120
Barium	500	500	500	320	3,200	1,760	500
Beryllium	10	10	10	160	8,000	4,080	10
Cadmium	4	100	52	0.017	0.44	0.23	0.23
Chromium	5	200	103	4	42	23	23
Cobalt	20	75	48	220	3,300	1,760	48
Copper	50	400	225	30	200	115	120
Cyanide	- (c)	-	-	6,298	18,894	12,596	13,000
Lead (d)							300
Tetraethyl Lead	-	-	-	1	52	27	27
Mercury	0.3	10	5.15	0.038	12	6	5.2
Molybdenum	-	-	-	11.5	582	297	300
Nickel	30	500	265	58	1,440	749	270
Selenium	1	70	35.5	0.20	2	1	1.1
Silver	2	2	2	6	144	75	2
Thallium	1	1	1	0.15	39	20	1
Vanadium	2	20	11	2	8	5	5
Zinc	50	864	457	4	97	51	50

TABLE 5-14
SOIL PRELIMINARY REMEDIATION GOALS FOR NON-SPECIAL STATUS PLANT AND WILDLIFE SPECIES

Presidio of San Francisco, California

Potential Chemical of Concern	Summary of Plant and Soil Fauna PRGs (mg/kg); (a)			Summary of Wildlife PRGs (mg/kg); (a)			Proposed Soil PRG (mg/kg); (b)
	PRG_{low}	PRG_{high}	Arithmetic Mean	PRG_{low}	PRG_{high}	Arithmetic Mean	
Semivolatile Organic Compounds							
Acenaphthene	30	50	40	84	2,547	1,316	40
Acenaphthylene	30	50	40	84	2,547	1,316	40
Anthracene	30	50	40	84	2,547	1,316	40
Benzo(a)anthracene	30	50	40	84	2,547	1,316	40
Benzo(a)pyrene	30	50	40	84	2,547	1,316	40
Benzo(b)fluoranthene	30	50	40	84	2,547	1,316	40
Benzo(g,h,i)perylene	30	50	40	84	2,547	1,316	40
Benzo(k)fluoranthene	30	50	40	84	2,547	1,316	40
Benzyl Alcohol	-	-	-	1	164	83	83
Chrysene	30	50	40	84	2,547	1,316	40
Dibenzo(a,h)anthrancene	30	50	40	84	2,547	1,316	40
Dibenzofuran	-	-	-	-	-	-	-
Fluoranthene	30	50	40	84	2,547	1,316	40
Fluorene	30	50	40	84	2,547	1,316	40
Indeno(1,2,3-cd)pyrene	30	50	40	84	2,547	1,316	40
2-methylnaphthalene	30	50	40	84	2,547	1,316	40
4-methylphenol (p-Cresol)	50	50	50	11,167	55,782	33,474	50
Naphthalene	30	50	40	84	2,547	1,316	40
n-nitrosodiphenylamine	20	109	65	16,981	50,942	33,962	65
Pentachlorophenol	3	4	3.5	22	660	341	3.5
Phenanthrene	30	50	40	84	2,547	1,316	40
Phenol	30	188	109	2,547	7,641	5,094	109
Pyrene	30	50	40	84	2,547	1,316	40

TABLE 5-14
SOIL PRELIMINARY REMEDIATION GOALS FOR NON-SPECIAL STATUS PLANT AND WILDLIFE SPECIES

Presidio of San Francisco, California

Potential Chemical of Concern	Summary of Plant and Soil Fauna PRGs (mg/kg); (a)			Summary of Wildlife PRGs (mg/kg); (a)			Proposed Soil PRG (mg/kg); (b)
	PRG_{low}	PRG_{high}	Arithmetic Mean	PRG_{low}	PRG_{high}	Arithmetic Mean	
Volatile Organic Compounds							
Acetone	-	-	-	8,490	127,356	67,923	68,000
2-butanone (MEK)	-	-	-	4,245	25,471	14,858	15,000
Carbon disulfide	-	-	-	934	28,018	14,476	14,476
1,4-dichlorobenzene	20	128	74	2,123	12,736	7,429	74
p-isopropyltoluene (p-cymene) (e)	200	1000	600	2,207	22,075	12,141	600
Methylene Chloride	-	-	-	459	34,377	17,418	17,000
1,2,3-trichlorobenzene	20	115	67.5	-	-	-	67.5
1,2,4-trichlorobenzene	20	127	73.5	-	-	-	73.5
Trichlorofluoromethane	-	-	-	-	-	-	-
1,1,1-trichloroethane	-	-	-	9,679	1,451,858	730,768	730,000
PCBs, Pesticides, and Herbicides							
PCBs (Arochlor 1254)	40	240	140	0.010	0.45	0.23	0.23
Aldrin	-	-	-	0.0039	0.19	0.1	0.1
alpha-BHC	-	-	-	0.062	10	4.9	4.9
beta-BHC	-	-	-	0.062	10	4.9	4.9
delta-BHC	-	-	-	0.062	10	4.9	4.9
Chlordane	-	-	-	0.0090	0.071	0.04	0.04
2,4-D	-	-	-	-	-	-	-
Dicamba	-	-	-	-	-	-	-
4,4'-DDD	40	200	120	0.049	2	1.2	1.2
4,4'-DDE	40	200	120	0.098	2	1.3	1.3
4,4'-DDT	40	200	120	0.0082	2	1.2	1.2
Dieldrin	50	100	75	0.039	0.48	0.26	0.26
Endosulfan	-	-	-	1.1	5.5	3.3	3.3
Endosulfan Sulfate (f)	-	-	-	1.1	5.5	3.3	3.3

TABLE 5-14
SOIL PRELIMINARY REMEDIATION GOALS FOR NON-SPECIAL STATUS PLANT AND WILDLIFE SPECIES

Presidio of San Francisco, California

Potential Chemical of Concern	Summary of Plant and Soil Fauna PRGs (mg/kg); (a)			Summary of Wildlife PRGs (mg/kg); (a)			Proposed Soil PRG (mg/kg); (b)
	PRG_{low}	PRG_{high}	Arithmetic Mean	PRG_{low}	PRG_{high}	Arithmetic Mean	
PCBs, Pesticides, and Herbicides							
Endrin	-	-	-	0.004	0.50	0.25	0.25
Endrin Aldehyde (f)	-	-	-	0.004	0.50	0.25	0.25
Endrin Ketone (f)	-	-	-	0.004	0.50	0.25	0.25
gamma-BHC (Lindane)	-	-	-	0.010	2	0.83	0.83
Heptachlor	-	-	-	0.017	7	3.7	3.7
Heptachlor Epoxide	-	-	-	0.017	7	3.7	3.7
Isodrin (g)	-	-	-	0.0039	0.19	0.1	0.1
MCPP	-	-	-	-	-	-	-
Methoxychlor	-	-	-	0.44	35	18	18

Notes:

(a) Listed in this table are the low and high Preliminary Remediation Goals ("PRGs") values for plants and soil fauna, and the lowest wildlife PRGs recalculated using TBV_{low} values from Table 5-12 and TBV_{high} values from Table 5-13.

(b) The soil PRG proposed for protection of non-special status species is the lower of the arithmetic means of plants and soil fauna PRGs, and wildlife PRGs.

(c) Hyphen indicates that PRG could not be calculated due to lack of toxicity information.

(d) Values for toluene were used for isopropyltoluene.

(e) PRG for lead was calculated through use of the Monte Carlo method. Refer to text for discussion of methodology used to derive the PRG for lead.

(f) Values for Endosulfan were used for Endosulfan Sulfate. Values for Endrin were used for Endrin Aldehyde and Endrin Ketone.

(g) Isodrin is an isomer of Aldrin. Values for Aldrin were used for Isodrin.

TABLE 5-15
SEDIMENT PRELIMINARY REMEDIATION GOALS FOR NON-SPECIAL STATUS WILDLIFE SPECIES

Presidio of San Francisco, California

Potential Chemical of Concern	Sediment PRG for Wildlife Based on TBV_{low} (mg/kg); (a)		Sediment PRG for Wildlife Based on TBV_{high} (mg/kg); (a)	
	Mallard Duck	Western Sandpiper	Mallard Duck	Western Sandpiper
Inorganic Chemicals				
Antimony	- (a)	-	-	-
Arsenic	7,874	81	23,621	1,219
Barium	11,031	564	110,309	5,639
Beryllium	5,515	282	275,774	14,097
Cadmium	12	0.082	61	2
Chromium	148	9	1,456	74
Cobalt	143,289	2,930	1,432,886	73,246
Copper	1,328	114	8,721	748
Cyanide	-	-	-	-
Lead (b)				
Tetraethyl Lead	60	3	2,958	169
Mercury	2	0.33	344	52
Molybdenum	394	20.3	19,900	1,020
Nickel	1,984	101	49,639	2,537
Selenium	3	0.84	35	8.5
Silver	198	10	4,964	254
Thallium	5	0.26	1,348	69
Vanadium	57	3	276	14
Zinc	1,787	18	8,933	445
Semivolatile Organic Compounds				
Acenaphthene	-	-	-	-
Acenaphthylene	-	-	-	-
Anthracene	-	-	-	-
Benzo(a)anthracene	-	-	-	-
Benzo(a)pyrene	-	-	-	-
Benzo(b)fluoranthene	-	-	-	-
Benzo(g,h,i)perylene	-	-	-	-
Benzo(k)fluoranthene	-	-	-	-
Benzyl Alcohol	22	1	5,417	288
Chrysene	-	-	-	-
Dibenzo(a,h)anthrancene	-	-	-	-
Dibenzofuran	-	-	-	-
Fluoranthene	-	-	-	-
Fluorene	-	-	-	-

TABLE 5-15
SEDIMENT PRELIMINARY REMEDIATION GOALS FOR NON-SPECIAL STATUS WILDLIFE SPECIES

Presidio of San Francisco, California

Potential Chemical of Concern	Sediment PRG for Wildlife Based on TBV_{low} (mg/kg); (a)		Sediment PRG for Wildlife Based on TBV_{high} (mg/kg); (a)	
	Mallard Duck	Western Sandpiper	Mallard Duck	Western Sandpiper
Semivolatile Organic Compounds (cont.)				
Indeno(1,2,3-cd)pyrene	-	-	-	-
2-methylnaphthalene	-	-	-	-
4-methylphenol (p-Cresol)	-	-	-	-
Naphthalene	-	-	-	-
n-nitrosodiphenylamine	-	-	-	-
Pentachlorophenol	-	-	-	-
Phenanthrene	-	-	-	-
Phenol	-	-	-	-
Pyrene	-	-	-	-
Volatile Organic Compounds				
Acetone	-	-	-	-
2-butanone (MEK)	-	-	-	-
Carbon disulfide	-	-	-	-
1,4-dichlorobenzene	-	-	-	-
p-isopropyltoluene (p-cymene)	-	-	-	-
Methylene Chloride	-	-	-	-
1,2,3-trichlorobenzene	-	-	-	-
1,2,4-trichlorobenzene	-	-	-	-
Trichlorfluoromethane	-	-	-	-
1,1,1-trichloroethane	-	-	-	-
PCBs, Pesticides, and Herbicides				
PCBs (Arochlor 1254)	17	0.047	770	2
Aldrin	15	0.018	146	0.90
alpha-BHC	61	0.28	10,835	50
beta-BHC	61	0.28	10,835	50
delta-BHC	61	0.28	10,835	50
Chlordane	7	0.033	73	0.33
2,4-D	-	-	-	-
Dicamba	-	-	-	-
4,4'-DDD	25	0.22	1,263	11
4,4'-DDE	51	0.43	1,263	11
4,4'-DDT	25	0.22	1,263	11
Dieldrin	29	0.18	364	2
Endosulfan	1,083	5	5,417	25
Endosulfan Sulfate (c)	1,083	5	5,417	25

TABLE 5-15
SEDIMENT PRELIMINARY REMEDIATION GOALS FOR NON-SPECIAL STATUS WILDLIFE SPECIES

Presidio of San Francisco, California

Potential Chemical of Concern	Sediment PRG for Wildlife Based on TBV_{low} (mg/kg); (a)		Sediment PRG for Wildlife Based on TBV_{high} (mg/kg); (a)	
	Mallard Duck	Western Sandpiper	Mallard Duck	Western Sandpiper
PCBs, Pesticides, and Herbicides (cont.)				
Endrin	17	0.016	498	2
Endrin Aldehyde (c)	17	0.016	498	2
Endrin Ketone (c)	17	0.016	498	2
gamma-BHC (Lindane)	10	0.048	1,625	7
Heptachlor	3	0.080	32,480	873
Heptachlor Epoxide	3	0.080	32,480	873
Isodrin (d)	15	0.018	146	0.90
MCPP	-	-	-	-
Methoxychlor	2,167	2	108,349	500

Notes:

(a) Hyphen indicates that Preliminary Remediation Goal ("PRG") could not be calculated due to lack of toxicity information.

(b) Refer to text for discussion of methodology used to derive the the PRG for lead.

(c) Values for Endosulfan were used for Endosulfan Sulfate. Values for Endrin were used for Endrin Aldehyde and Endrin Ketone.

(d) Isodrin is an isomer of Aldrin. Values for Aldrin were used for Isodrin.

TABLE 5-16
SEDIMENT PRELIMINARY REMEDIATION GOALS FOR NON-SPECIAL STATUS AQUATIC LIFE AND WILDLIFE SPECIES (FRESHWATER)

Presidio of San Francisco, California

Potential Chemical of Concern	Range of Sediment PRGs (mg/kg); (a)		Proposed Sediment PRG (b) (mg/kg)
	PRG_{low}	PRG_{high}	
Inorganic Chemicals			
Antimony	- (c)	-	-
Arsenic	6	33	19
Barium	564	5,639	3,100
Beryllium	282	14,097	7,200
Cadmium	0.082	2	1.1
Chromium	9	74	42
Cobalt	50	50	50
Copper	32	197	114
Cyanide	-	-	-
Lead	35.7	128	82
Tetraethyl Lead	3	169	86
Mercury	0.17	1.06	0.62
Molybdenum	20.3	1,020	522
Nickel	16	75	46
Selenium (d)	0.4	38	4.5
Silver	0.5	0.5	0.5
Thallium	0.26	69	35
Vanadium	3	14	9
Zinc	18	445	230
Semivolatile Organic Compounds			
Acenaphthene	0.0067	0.62	0.31
Acenaphthylene	0.0059	0.13	0.067
Anthracene	0.047	0.85	0.45
Benzo(a)anthracene	0.032	1.05	0.54
Benzo(a)pyrene	0.032	1.45	0.74
Benzo(b)fluoranthene	0.24	1.34	0.79
Benzo(g,h,i)perylene	0.17	0.32	0.25
Benzo(k)fluoranthene	0.24	1.34	0.79
Benzyl Alcohol	1	288	145
Chrysene	0.057	1.29	0.67
Dibenzo(a,h)anthrancene	0.0062	0.135	0.071
Dibenzofuran	2	2	2
Fluoranthene	0.11	2.9	1.5
Fluorene	0.021	0.54	0.28

TABLE 5-16
SEDIMENT PRELIMINARY REMEDIATION GOALS FOR NON-SPECIAL STATUS AQUATIC LIFE AND WILDLIFE SPECIES (FRESHWATER)

Presidio of San Francisco, California

Potential Chemical of Concern	Range of Sediment PRGs (mg/kg); (a)		Proposed Sediment PRG (b) (mg/kg)
	PRG_{low}	PRG_{high}	
Semivolatile Organic Compounds (cont.)			
Indeno(1,2,3-cd)pyrene	0.2	0.32	0.26
2-methylnaphthalene	0.02	0.20	0.11
4-methylphenol (p-Cresol)	-	-	-
Naphthalene	0.03	0.56	0.3
n-nitrosodiphenylamine	-	-	-
Pentachlorophenol	-	-	-
Phenanthrene	0.042	1.2	0.61
Phenol	-	-	-
Pyrene	0.053	1.5	0.79
Volatile Organic Compounds			
Acetone	-	-	-
2-butanone (MEK)	-	-	-
Carbon disulfide	-	-	-
1,4-dichlorobenzene	0.35	0.35	0.35
p-isopropyltoluene (p-cymene)	-	-	-
Methylene Chloride	-	-	-
1,2,3-trichlorobenzene	-	-	-
1,2,4-trichlorobenzene	-	-	-
Methylene Chloride	-	-	-
Trichlorfluoromethane	-	-	-
1,1,1-trichloroethane	0.17	0.17	0.17
PCBs, Pesticides, and Herbicides			
PCBs (Arochlor 1254)	0.047	0.68	0.36
Aldrin	0.002	0.008	0.005
alpha-BHC	0.006	0.01	0.008
beta-BHC	0.005	0.021	0.013
delta-BHC	0.003	0.012	0.0075
Chlordane	0.0032	0.018	0.01
2,4-D	-	-	-
Dicamba	-	-	-
4,4'-DDD	0.0035	0.028	0.016
4,4'-DDE	0.0014	0.031	0.016
4,4'-DDT	0.0012	0.063	0.032
Dieldrin	0.0019	0.062	0.032
Endosulfan	0.0054	0.0054	0.0054
Endosulfan Sulfate (e)	0.0054	0.0054	0.0054

TABLE 5-16
SEDIMENT PRELIMINARY REMEDIATION GOALS FOR NON-SPECIAL STATUS AQUATIC LIFE AND WILDLIFE SPECIES (FRESHWATER)

Presidio of San Francisco, California

Potential Chemical of Concern	Range of Sediment PRGs (mg/kg); (a)		Proposed Sediment PRG (b) (mg/kg)
	PRG_{low}	PRG_{high}	
PCBs, Pesticides, and Herbicides (cont.)			
Endrin	0.0022	0.207	0.1
Endrin Aldehyde (e)	0.0022	0.207	0.1
Endrin Ketone (e)	0.0022	0.207	0.1
gamma-BHC (Lindane)	0.0009	0.005	0.003
Heptachlor	0.0006	0.016	0.0083
Heptachlor Epoxide	0.0006	0.016	0.0083
Isodrin (f)	0.002	0.008	0.005
MCPP	-	-	-
Methoxychlor	0.019	0.019	0.019

Notes:

(a) The sediment quality criteria for aquatic life (Table 5-17), and the Preliminary Remediation Goals ("PRGs") for the mallard duck and western sandpiper (Table 5-15) were considered together to select potential sediment PRGs for each potential chemical of concern ("PCOC"). The lowest values defining the range of PRGs developed for these indicator species of aquatic habitats are listed.

(b) Proposed sediment PRG for protection of non-special status species is the arithmetic mean of the range of PRGs listed in this table for aquatic life, and the mallard duck and western sandpiper.

(c) Hyphen indicates that PRG could not be calculated due to lack of toxicity information.

(d) PRG_{low} is the United States Fish and Wildlife Service recommended no-observed-adverse-effect-level developed in Skorupa J.P., S.P. Morman, and J.S. Sefchick-Edwards. March 1996. *Guidelines for Interpreting Selenium Exposures of Biota Associated with Nonmarine Aquatic Habitats*. Sacramento Field Office.

(e) Values for Endosulfan were used for Endosulfan Sulfate. Values for Endrin were used for Endrin Aldehyde and Endrin Ketone.

(f) Isodrin is an isomer of Aldrin. Values for Aldrin were used for Isodrin.

TABLE 5-17
SEDIMENT PRELIMINARY REMEDIATION GOALS FOR NON-SPECIAL STATUS AQUATIC LIFE AND WILDLIFE SPECIES (MARINE)

Presidio of San Francisco, California

Potential Chemical of Concern	Range of Sediment PRGs (mg/kg); (a)		Proposed Sediment PRG (b) (mg/kg)
	PRG_{low}	PRG_{high}	
Inorganic Chemicals			
Antimony	2	25	14
Arsenic	8.2	70	39
Barium	564	5,639	3,100
Beryllium	282	14,097	7,200
Cadmium	1.2	2	1.6
Chromium	9	74	42
Cobalt	2,930	73,246	38,088
Copper	34	270	152
Cyanide	-	-	-
Lead	46.7	218	132
Tetraethyl Lead	3	169	86
Mercury	0.15	0.71	0.43
Molybdenum	20.3	1,020	522
Nickel	20.9	51.6	36
Selenium (d)	0.4	8.5	4.5
Silver	1	3.7	2.4
Thallium	0.26	69	35
Vanadium	3	14	8.5
Zinc	18	410	214
Semivolatile Organic Compounds			
Acenaphthene	0.016	0.62	0.32
Acenaphthylene	0.044	0.64	0.34
Anthracene	0.0853	1.1	0.59
Benzo(a)anthracene	0.261	1.6	0.93
Benzo(a)pyrene	0.43	1.6	1.0
Benzo(b)fluoranthene	-	-	-
Benzo(g,h,i)perylene	-	-	-
Benzo(k)fluoranthene	-	-	-
Benzyl Alcohol	1.2	288	145
Chrysene	0.384	2.8	1.6
Dibenzo(a,h)anthrancene	0.0634	0.26	0.16
Dibenzofuran	2.0	2.0	2.0
Fluoranthene	0.6	5.1	2.9
Fluorene	0.019	0.54	0.28

TABLE 5-17
SEDIMENT PRELIMINARY REMEDIATION GOALS FOR NON-SPECIAL STATUS AQUATIC LIFE AND WILDLIFE SPECIES (MARINE)

Presidio of San Francisco, California

Potential Chemical of Concern	Range of Sediment PRGs (mg/kg); (a)		Proposed Sediment PRG (b) (mg/kg)
	PRG_{low}	PRG_{high}	
Semivolatile Organic Compounds (cont.)			
Indeno(1,2,3-cd)pyrene	-	-	-
2-methylnaphthalene	0.07	0.67	0.37
4-methylphenol (p-Cresol)	-	-	-
Naphthalene	0.16	2.1	1.1
n-nitrosodiphenylamine	-	-	-
Pentachlorophenol	-	-	-
Phenanthrene	0.24	1.5	0.87
Phenol	-	-	-
Pyrene	0.665	2.6	1.6
Volatile Organic Compounds			
Acetone	-	-	-
2-butanone (MEK)	-	-	-
Carbon disulfide	-	-	-
1,4-dichlorobenzene	0.35	0.35	0.35
p-isopropyltoluene (p-cymene) (e)	0.67	0.67	0.67
Methylene Chloride	-	-	-
1,2,3-trichlorobenzene (f)	9.2	9.2	9.2
1,2,4-trichlorobenzene	9.2	9.2	9.2
Methylene Chloride	-	-	-
Trichlorfluoromethane	-	-	-
1,1,1-trichloroethane	0.17	0.17	0.17
PCBs, Pesticides, and Herbicides			
PCBs (Arochlor 1254)	0.0227	0.18	0.10
Aldrin	0.018	0.90	0.46
alpha-BHC	0.00032	0.00099	0.0007
beta-BHC	0.00032	0.00099	0.0007
delta-BHC	0.00032	0.00099	0.0007
Chlordane	0.0005	0.006	0.003
2,4-D	-	-	-
Dicamba	-	-	-
4,4'-DDD	0.002	0.02	0.011
4,4'-DDE	0.0022	0.027	0.015
4,4'-DDT	0.001	0.007	0.004
Dieldrin	0.00002	0.052	0.026
Endosulfan	0.0054	0.0054	0.005
Endosulfan Sulfate (g)	0.0054	0.0054	0.005

TABLE 5-17
SEDIMENT PRELIMINARY REMEDIATION GOALS FOR NON-SPECIAL STATUS AQUATIC LIFE AND WILDLIFE SPECIES (MARINE)

Presidio of San Francisco, California

Potential Chemical of Concern	Range of Sediment PRGs (mg/kg); (a)		Proposed Sediment PRG (b) (mg/kg)
	PRG_{low}	PRG_{high}	
PCBs, Pesticides, and Herbicides			
Endrin	0.00002	0.045	0.023
Endrin Aldehyde (g)	0.00002	0.045	0.023
Endrin Ketone (g)	0.00002	0.045	0.023
gamma-BHC (Lindane)	0.00032	0.0037	0.002
Heptachlor	0.080	873	437
Heptachlor Epoxide	0.080	873	437
Isodrin (h)	0.018	0.90	0.46
MCPP	-	-	-
Methoxychlor	0.019	0.019	0.019

Notes:

(a) The sediment quality criteria for aquatic life (Table 5-8), and the Preliminary Remediation Goals ("PRGs") for the mallard duck and western sandpiper (Table 5-15) were considered together to select potential sediment PRGs for each potential chemical of concern ("PCOC"). The lowest values defining the range of PRGs developed for these indicator species of aquatic habitats are listed.

(b) Proposed sediment PRG for protection of non-special status species is the arithmetic mean of the range of PRGs listed in this table for aquatic life, and the mallard duck and western sandpiper.

(c) Hyphen indicates sediment quality criterion not found.

(d) PRG_{low} is the United States Fish and Wildlife Service recommended no-observed-adverse-effect-level developed in Skorupa J.P., S.P. Morman, and J.S. Sefchick-Edwards. March 1996. *Guidelines for Interpreting Selenium Exposures of Biota Associated with Nonmarine Aquatic Habitats*. Sacramento Field Office.

(e) Values for toluene were used for isopropyltoluene.

(f) Values for 1,2,4-trichlorobenzene were used for 1,2,3-trichlorobenzene.

(g) Values for Endosulfan were used for Endosulfan Sulfate. Values for Endrin were used for Endrin Aldehyde and Endrin Ketone.

(h) Isodrin is an isomer of Aldrin. Values for Aldrin were used for Isodrin.

SOIL PRELIMINARY REMEDIATION GOALS FOR SPECIAL STATUS PLANT SPECIES BASED ON NO-OBSERVED-EFFECTS-CONCENTRATIONS

Presidio of San Francisco, California

Potential Chemical of Concern	Toxicity Benchmarks (a)		No-Observed-Effects-Concentration (mg/kg); (b); (c)						Proposed Alternate PRG for Special Status Plant Species
					Summary Statistics				
	TBV_{low} (mg/kg)	TBV_{high} (mg/kg)	Low	High	5th Percentile	10th Percentile	25th Percentile	Arithmetic Mean	
Inorganic Chemicals									
Arsenic	10	224	10	224	21	31	**64**	117	64
Cadmium	4	100	1	50	3	6	**13**	26	13
Chromium	5	200	1	150	8	16	**38**	76	38
Lead (d)									160
Mercury	0.3	10	0.3	10	0.8	1.3	**2.7**	5.2	3
Nickel	30	500	5	270	18	32	**71**	138	71

Notes:

(a) Preliminary Remediation Goals ("PRGs") may not be protective of individual special status species, especially where the difference between the PRG_{low} and PRG_{high} values used to calculate the mean is great. PRGs for special status plant species were developed for potential chemicals of concern where the difference between the low and high toxicity benchmark values ("TBVs") for the species governing determination of the cleanup levels is more than one order of magnitude. TBV_{low} values from Table 5-12 and TBV_{high} values from Table 5-13 are included for reference.

(b) No-observed-effects-concentrations ("NOECs") were compiled from the references consulted for non-special status plant species. However, the low and high values used to develop special status species PRGs encompassed the entire range of NOECs and excluded lowest-observed-effects-concentrations ("LOECs"). The 5th, 10th, and 25th percentiles, and arithmetic means of the NOEC values were computed, as summarized in this table. The 25th percentile of NOECs for each metal is proposed as the PRG because this percentile includes NOECs obtained from studies on a variety of soil types and species, including species that are taxonomically similar to those at the Presidio.

(c) Values that are boxed and shown in bold are proposed as PRG for rare, or threatened or endangered plant (i.e., special status) species.

(d) Special status species PRG for lead was calculated through use of the Monte Carlo method. Refer to text for discussion of methodology used to derive special status species PRG for lead.

TAB 5-19

SOIL PRELIMINARY REMEDIATION GOALS FOR SPECIAL STATUS WILDLIFE SPECIES BASED ON TOXICITY BENCHMARK VALUES

Presidio of San Francisco, California

Potential Chemical of Concern	PRGs for Peregine Falcon (a)		Summary Statistics for Peregrine Falcon (mg/kg); (b); (c)					Proposed Alternate PRG for Special Status Wildlife Species
	PRG_{low} (mg/kg)	PRG_{high} (mg/kg)	5^{th} Percentile	10^{th} Percentile	25^{th} Percentile	Arithmetic Mean	Toxicity Endpoint of Study	
Inorganic Chemicals								
Arsenic	170	5,130	418	**666**	1,410	2,650	Protective	666
Lead (d)								
Mercury	0.095	29.7	**1.6**	3.1	7.5	15	Protective	1.58
Nickel	215	10,700	**739**	1,264	2,836	5,458	Protective	739
Selenium	6.21	117	**11.7**	17	34	62	Protective	12
Silver	21.5	1,070	**74**	126	284	546	Based on mortality/10	74
Thallium	0.614	291	**15**	30	73	146	Based on mortality/10	15
PCBs, Pesticides, and Herbicides								
PCBs (Aroclor 1254)	0.09	8	**0.490**	0.88	2.1	4.0	Protective	0.49
Aldrin	0.016	2	**0.097**	0.18	0.42	0.82	Based on mortality/10	0.097
alpha-BHC	0.13	45	**2.4**	4.6	11	23	Protective	2.4
beta-BHC	0.13	45	**2.4**	4.6	11	23	Protective	2.4
delta-BHC	0.13	45	**2.4**	4.6	11	23	Protective	2.4
Chlordane	0.04	0.81	0.080	**0.12**	0.23	0.42	Based on mortality/10	0.12
4,4'-DDD	0.14	4	0.34	**0.53**	1.12	2.10	Protective; adjusted for endpoint	0.53
4,4'-DDE	0.22	4	0.42	**0.61**	1.18	2.15	Protective; adjusted for endpoint	0.61
4,4'-DDT	0.14	4	0.34	**0.53**	1.12	2.10	Protective; adjusted for endpoint	0.53
Dieldrin			0.36	**0.55**	1.14	2.12	Low partially based on mortality	0.55
Endrin	0.007	2	**0.11**	0.21	0.5	1.0	Protective	0.11
Endrin Aldehyde (e)	0.007	2	**0.11**	0.21	0.5	1.0	Protective	0.11
Endrin Ketone (e)	0.007	2	**0.11**	0.21	0.5	1.0	Protective	0.11
gamma-BHC	0.023	7	**0.37**	0.72	1.8	3.5	Based on mortality/10	0.37
Heptachlor	0.017	358	**18**	36	90	179	Based on mortality/10	18
Heptachlor Epoxide	0.017	358	**18**	36	90	179	Based on mortality/10	18
Isodrin (f)	0.016	2	**0.097**	0.18	0.42	0.82	Based on mortality/10	0.097
Methoxychlor	0.9	451	**23**	46	113	226	Based on mortality/10	26

BASED ON TOXICITY BENCHMARK VALUES

Presidio of San Francisco, California

Notes:

(a) Soil Preliminary Remediation Goals ("PRGs") for non-special status plant and animal species listed in Table 5-14.

(b) PRGs for special status wildlife species are established from the PRG_{low} and PRG_{high} values for the peregrine falcon because the PRGs for this bird are the lowest of the avian indicator species evaluated for terrestrial habitats. PRG concentrations were computed from TBVs compiled from the references consulted for non-special status wildlife species. The 5^{th} percentile is proposed as the PRG where the difference between PRG_{low} and PRG_{high} values for non-special status species is two orders of magnitude or greater. The 10^{th} percentile is proposed as the PRG where the difference between PRG_{low} and PRG_{high} values for non-special status species is between one and two orders of magnitude.

(c) Values that are boxed and shown in bold are proposed as PRG for rare, or threatened or endangered wildlife (i.e., special status) species.

(d) Special status species PRG for lead was calculated through use of the Monte Carlo method. Refer to text for discussion of methodology used to derive special status species PRG for lead.

(e) Values for Endrin were used for Endrin Aldehyde and Endrin Ketone.

(f) Isodrin is an isomer of Aldrin. Values for Aldrin were used for Isodrin.

TAE 5-20

SEDIMENT PRELIMINARY REMEDIATION GOALS FOR SPECIAL STATUS WILDLIFE SPECIES BASED ON TOXICITY BENCHMARK VALUES

Presidio of San Francisco, California

Potential Chemical of Concern	PRGs for Western Sandpiper (a)		Summary Statistics for Western Sandpiper (mg/kg); (b); (c)					Proposed PRG for Special Status Wildlife Species
	PRG_{low} (mg/kg)	PRG_{high} (mg/kg)	5^{th} Percentile	10^{th} Percentile	25^{th} Percentile	Arithmetic Mean	Toxicity Endpoint of Study	
Inorganic Chemicals								
Arsenic	81	1,220	138	**195**	366	651	Protective	195
Lead (d)								
Mercury	0.33	52	**2.9**	5.5	13.2	26	Protective	2.9
Nickel	101	2,540	223	**345**	711	1,321	Protective	345
Selenium	0.84	9	1.2	**1.6**	3	5	Protective	1.6
Silver	10	254	**22**	34	71	132	Based on mortality/10	22
Thallium	0.26	69	**3.7**	7	17	35	Based on mortality/10	3.7
PCBs, Pesticides, and Herbicides								
PCBs (Aroclor 1254)	0.047	2	**0.14**	**0.24**	0.54	1.0	Protective	0.14
Aldrin	0.018	1	0.061	**0.1**	0.23	0.45	Based on mortality/10	0.1
alpha-BHC	0.28	50	**2.8**	5.3	13	25	Protective	2.8
beta-BHC	0.28	50	**2.8**	5.3	13	25	Protective	2.8
delta-BHC	0.28	50	**2.8**	5.3	13	25	Protective	2.8
Chlordane	0.03	0.33	0.048	**0.062**	0.11	0.18	Based on mortality/10	0.062
4,4'-DDD	0.22	11	0.75	**1.3**	2.9	5.6	Protective; adjusted for endpoint	1.3
4,4'-DDE	0.44	11	0.96	**1.5**	3.1	5.7	Protective; adjusted for endpoint	1.5
4,4'-DDT	0.22	11	0.75	**1.3**	2.9	5.6	Protective; adjusted for endpoint	1.3
Dieldrin	0.179	2	0.28	**0.39**	0.69	1.21	Low partially based on mortality	0.39
Endrin	0.016	2	**0.12**	0.21	0.51	1.0	Protective	0.12
Endrin Aldehyde (e)	0.016	2	**0.12**	0.21	0.51	1.0	Protective	0.12
Endrin Ketone (e)	0.016	2	**0.12**	0.21	0.51	1.0	Protective	0.12
gamma-BHC	0.049	7	**0.4**	0.74	1.8	3.5	Based on mortality/10	0.4
Heptachlor	0.08	873	**44**	87	218	437	Based on mortality/10	44
Heptachlor Epoxide	0.08	873	**44**	87	218	437	Based on mortality/10	44
Isodrin (f)	0.018	1	**0.1**	0.10	0.23	0.45	Based on mortality/10	0.1
Methoxychlor	2	500	**27**	52	127	251	Based on mortality/10	27

SEDIMENT PRELIMINARY REMEDIATION GOALS FOR SPECIAL STATUS WILDLIFE SPECIES BASED ON TOXICITY BENCHMARK VALUES

Presidio of San Francisco, California

Notes:

(a) Sediment Preliminary Remediation Goals ("PRGs") for non-special status plant and animal species listed in Table 5-15.

(b) PRGs for special status wildlife species are established from the PRG_{low} and PRG_{high} values for the western sandpiper because the PRGs for this bird are the lowest of the avian indicator species evaluated for aquatic habitats. PRG concentrations were computed from TBVs compiled from the references consulted for non-special status wildlife species. The 5^{th} percentile is proposed as the PRG where the difference between PRG_{low} and PRG_{high} values for non-special status species is two orders of magnitude or greater. The 10^{th} percentile is proposed as the PRG where the difference between PRG_{low} and PRG_{high} values for non-special status species is between one and two orders of magnitude.

(c) Values that are boxed and shown in bold are proposed as PRG for rare, or threatened or endangered wildlife (i.e., special status) species.

(d) A special status species PRG for lead was not calculated because the sediment quality criteria for aquatic life is protective of aquatic life, including special status species. Refer to text for discussion of methodology used to derive special status species PRG for lead.

(e) Values for Endrin were used for Endrin Aldehyde and Endrin Ketone.

(f) Isodrin is an isomer of Aldrin. Values for Aldrin were used for Isodrin.

TABLE 5-21
COMPARISON OF SOIL PRELIMINARY REMEDIATION GOALS OF NON-SPECIAL STATUS AND SPECIAL STATUS SPECIES

Presidio of San Francisco, California

Potential Chemical of Concern	Plant and Soil Fauna PRGs (mg/kg); (a)		Wildlife PRGs (mg/kg); (b)		Alternate PRGs for Special Status Species (mg/kg); (c)
	Non-Special Status	Special Status	Non-Special Status	Special Status	
Inorganic Chemicals					
Arsenic	117	64	369	666	64
Lead (d)					160
Mercury	5.2	2.7	5.9	1.6	1.6
Nickel	265	71	749	739	71
Selenium	36	- (e)	1.1	12	
Silver	2	-	749	74	
Thallium	1	-	196	15	
PCBs, Pesticides, and Herbicides					
PCBs (Aroclor 1254)	40	240	0.23	0.49	
Aldrin	-	-	0.1	0.097	0.097
alpha-BHC	-	-	4.9	2.4	2.4
beta-BHC	-	-	4.9	2.4	2.4
delta-BHC	-	-	4.9	2.4	2.4
Chlordane	-	-	0.04	0.12	
4,4'-DDD	120	-	1.25	0.53	0.53
4,4'-DDE	120	-	1.27	0.61	0.61
4,4'-DDT	120	-	1.23	0.53	0.53
Dieldrin	75	-	0.26	0.55	
Endrin	-	-	0.25	0.11	0.11
Endrin Aldehyde (f)	-	-	0.25	0.11	0.11
Endrin Ketone (f)	-	-	0.25	0.11	0.11
gamma-BHC	-	-	0.83	0.37	0.37

TABLE 5-21

COMPARISON OF SOIL PRELIMINARY REMEDIATION GOALS OF NON-SPECIAL STATUS AND SPECIAL STATUS SPECIES

Presidio of San Francisco, California

Potential Chemical of Concern	Plant and Soil Fauna PRGs (mg/kg); (a)		Wildlife PRGs (mg/kg); (b)		Alternate PRGs for Special Status Species (mg/kg); (c)
	Non-Special Status	Special Status	Non-Special Status	Special Status	
PCBs, Pesticides, and Herbicides (contd)					
Heptachlor	-	-	3.7	18	
Heptachlor Epoxide	-	-	3.7	18	
Isodrin (g)	-	-	0.1	0.097	0.097
Methoxychlor	-	-	18	26	

Notes:

(a) Preliminary Remediation Goals ("PRGs") for non-special status and special status plant and soil fauna species compiled from Table 5-14 and Table 5-18, respectively.

(b) PRGs for non-special status and special status wildlife species compiled from Table 5-14 and Table 5-19, respectively.

(c) PRGs for special status species that are proposed as soil/sediment Alternate PRGs for special status species. Receptors that are not special status species may have lower PRGs because of higher exposure or different sensitivity to potential chemicals of concern ("PCOCs"). For PCOCs where special status PRGs are not the lowest PRGs no value is presented for the Alternate PRGs for special status species.

(d) Special status species PRG for lead was calculated through use of the Monte Carlo method. Refer to text for discussion of methodology used to derive special status species PRG for lead.

(e) Hyphen indicates that PRG could not be calculated due to lack of toxicity information.

(f) Values for Endrin were used for Endrin Aldehyde and Endrin Ketone.

(g) Isodrin is an isomer of Aldrin. Values for Aldrin were used for Isodrin.

TABLE 5-22
COMPARISON OF SEDIMENT PRELIMINARY REMEDIATION GOALS OF NON-SPECIAL STATUS AND SPECIAL STATUS SPECIES (FRESHWATER)

Presidio of San Francisco, California

Potential Chemical of Concern	Aquatic Life and Wildlife PRGs (mg/kg); (a)		Special Status PRGs Proposed for Use as Cleanup Levels (b) (mg/kg)
	Non-Special Status	Special Status	
Inorganic Chemicals			
Arsenic	19	195	
Lead (c)	82		
Mercury	0.6	2.9	
Nickel	46	345	
Selenium	4.5	1.6	1.6
Silver	1	22	
Thallium	35	3.7	3.7
PCBs, Pesticides, and Herbicides			
PCBs (Aroclor 1254)	0.36	0.14	0.14
Aldrin	0.005	0.1	
alpha-BHC	0.008	2.8	
beta-BHC	0.013	2.8	
delta-BHC	0.0075	2.8	
Chlordane	0.01	0.062	
4,4'-DDD	0.016	1.3	
4,4'-DDE	0.016	1.5	
4,4'-DDT	0.032	1.3	
Dieldrin	0.032	0.39	
Endrin	0.1	0.12	
Endrin Aldehyde (d)	0.1	0.12	
Endrin Ketone (d)	0.1	0.12	
gamma-BHC	0.003	0.4	
Heptachlor	0.0083	44	
Heptachlor Epoxide	0.0083	44	
Isodrin (e)	0.005	0.1	
Methoxychlor	0.019	27	

Notes:

(a) Preliminary Remediation Goals ("PRGs") for non-special status and special status aquatic life and wildlife species compiled from Table 5-16 and Table 5-20, respectively.

(b) PRGs for special status species that are proposed as soil/sediment PRGs for special status species. Receptors that are not special status species may have lower PRGs because of higher exposure or different sensitivity to potential chemicals of concern ("PCOCs"). For PCOCs where special status PRGs are not the lowest PRGs, soil/sediment PRGs for non-special status species will be applied as cleanup levels and considered protective of special status species as well.

(c) Refer to text for discussion of methodology used to derive sediment PRG for lead.

(d) Values for Endrin were used for Endrin Aldehyde and Endrin Ketone.

(e) Isodrin is an isomer of Aldrin. Values for Aldrin were used for Isodrin.

TABLE 5-23
COMPARISON OF SEDIMENT PRELIMINARY REMEDIATION GOALS OF NON-SPECIAL STATUS AND SPECIAL STATUS SPECIES (MARINE)

Presidio of San Francisco, California

Potential Chemical of Concern	Aquatic Life and Wildlife PRGs (mg/kg); (a)		Special Status PRGs Proposed for Use as Cleanup Levels (b) (mg/kg)
	Non-Special Status	Special Status	
Inorganic Chemicals			
Arsenic	39	195	
Lead (c)	132		
Mercury	0.43	2.9	
Nickel	36	345	
Selenium	4.5	1.6	1.6
Silver	2.4	22	
Thallium	35	3.7	3.7
PCBs, Pesticides, and Herbicides			
PCBs (Aroclor 1254)	0.10	0.14	
Aldrin	0.46	0.1	0.1
alpha-BHC	0.0007	2.8	
beta-BHC	0.0007	2.8	
delta-BHC	0.0007	2.8	
Chlordane	0.0033	0.062	
4,4'-DDD	0.011	1.3	
4,4'-DDE	0.015	1.5	
4,4'-DDT	0.004	1.3	
Dieldrin	0.026	0.39	
Endrin	0.023	0.12	
Endrin Aldehyde (d)	0.023	0.12	
Endrin Ketone (d)	0.023	0.12	
gamma-BHC	0.002	0.4	
Heptachlor	437	44	44
Heptachlor Epoxide	437	44	44
Isodrin (e)	0.46	0.1	0.1
Methoxychlor	0.019	27	

Notes:

(a) Preliminary Remediation Goals ("PRGs") for non-special status and special status aquatic life and wildlife species compiled from Table 5-17 and Table 5-20, respectively.

(b) PRGs for special status species that are proposed as soil/sediment PRGs for special status species. Receptors that are not special status species may have lower PRGs because of higher exposure or different sensitivity to potential chemicals of concern ("PCOCs"). For PCOCs where special status PRGs are not the lowest PRGs, soil/sediment PRGs for non-special status species will be applied as cleanup levels and considered protective of special status species as well.

(c) Refer to text for discussion of methodology used to derive sediment PRG for lead.

(d) Values for Endrin were used for Endrin Aldehyde and Endrin Ketone.

(e) Isodrin is an isomer of Aldrin. Values for Aldrin were used for Isodrin.

TABLE 5-24
SUMMARY OF ECOLOGICAL PRELIMINARY REMEDIATION GOALS FOR NON-PETROLEUM COMPOUNDS IN SOIL

Presidio of San Francisco, California

Potential Chemical of Concern	Summary of Plant and Soil Fauna PRGs (mg/kg); (a)			Summary of Wildlife PRGs (mg/kg); (a)			Proposed Alternate PRGs (mg/kg); (b)	Proposed Buffer Zone PRGs (mg/kg); (c)	Proposed Special Status PRGs (mg/kg); (d)
	PRG_{low}	PRG_{high}	Arithmetic Mean	PRG_{low}	PRG_{high}	Arithmetic Mean			
Inorganic Chemicals									
Antimony	5	5	5	162	490	326	- (e)	5	5
Arsenic	10	224	117	46	692	369	64	64	10
Barium	500	500	500	320	3,200	1,760	-	500	320
Beryllium	10	10	10	160	8,000	4,080	-	10	10
Cadmium	4	100	52	0.017	0.44	0.23	-	0.23	0.017
Chromium	5	200	103	4	42	23	-	23	4
Cobalt	20	75	48	220	3,300	1,760	-	48	20
Copper	50	400	225	30	200	115	-	120	30
Cyanide	-	-	-	6,298	18,894	12,596	-	13,000	6,300
Lead (f)	-	-	-	-	-	-	-	300	160
Tetraethyl Lead	-	-	-	1.1	52	27	-	27	1.1
Mercury	0.3	10	5.15	0.038	12	6	1.6	1.6	0.4 (g)
Molybdenum	-	-	-	11.5	582	297	-	300	12
Nickel	30	500	265	58	1,440	749	71	71	30
Selenium	1	70	35.5	0.20	2	1	-	1.1	0.2
Silver	2	2	2	6	144	75	-	2	2
Thallium	1	1	1	0.15	39	20	-	1	0.15
Vanadium	2	20	11	2	8	5	-	5	2
Zinc	50	864	457	4	97	51	-	50	4
Semivolatile Organic Compounds									
Acenaphthene	30	50	40	84	2,547	1,316	-	40	30
Acenaphthylene	30	50	40	84	2,547	1,316	-	40	30
Anthracene	30	50	40	84	2,547	1,316	-	40	30
Benzo(a)anthracene	30	50	40	84	2,547	1,316	-	40	30
Benzo(a)pyrene	30	50	40	84	2,547	1,316	-	40	30

TABLE 5-24

SUMMARY OF ECOLOGICAL PRELIMINARY REMEDIATION GOALS FOR NON-PETROLEUM COMPOUNDS IN SOIL

Presidio of San Francisco, California

Potential Chemical of Concern	Summary of Plant and Soil Fauna PRGs (mg/kg); (a)			Summary of Wildlife PRGs (mg/kg); (a)			Proposed Alternate PRGs (mg/kg); (b)	Proposed Buffer Zone PRGs (mg/kg); (c)	Proposed Special Status PRGs (mg/kg); (d)
	PRG_{low}	PRG_{high}	Arithmetic Mean	PRG_{low}	PRG_{high}	Arithmetic Mean			
Semivolatile Organic Compounds									
Benzo(b)fluoranthene	30	50	40	84	2,547	1,316	-	40	30
Benzo(g,h,i)perylene	30	50	40	84	2,547	1,316	-	40	30
Benzo(k)fluoranthene	30	50	40	84	2,547	1,316	-	40	30
Benzyl Alcohol	-	-	-	1	164	83	-	40 (h)	1
Chrysene	30	50	40	84	2,547	1,316	-	40	30
Dibenzo(a,h)anthracene	30	50	40	84	2,547	1,316	-	40	30
Dibenzofuran	-	-	-	-	-	-	-	-	-
Fluoranthene	30	50	40	84	2,547	1,316	-	40	30
Fluorene	30	50	40	84	2,547	1,316	-	40	30
Indeno(1,2,3-cd)pyrene	30	50	40	84	2,547	1,316	-	40	30
2-methylnaphthalene	30	50	40	84	2,547	1,316	-	40	30
4-methylphenol (p-Cresol)	50	50	50	11,167	55,782	33,474	-	50	50
Naphthalene	30	50	40	84	2,547	1,316	-	40	30
n-nitrosodiphenylamine	20	109	65	16,981	50,942	33,962	-	65	20
Pentachlorophenol	3	4	3.5	22	660	341	-	3.5	3
Phenanthrene	30	50	40	84	2,547	1,316	-	40	30
Phenol	30	188	109	2,547	7,641	5,094	-	109	30
Pyrene	30	50	40	84	2,547	1,316	-	40	30

TABLE 5-24
SUMMARY OF ECOLOGICAL PRELIMINARY REMEDIATION GOALS FOR NON-PETROLEUM COMPOUNDS IN SOIL

Presidio of San Francisco, California

Potential Chemical of Concern	Summary of Plant and Soil Fauna PRGs (mg/kg); (a)			Summary of Wildlife PRGs (mg/kg); (a)			Proposed Alternate PRGs (mg/kg); (b)	Proposed Buffer Zone PRGs (mg/kg); (c)	Proposed Special Status PRGs (mg/kg); (d)
	PRG_{low}	PRG_{high}	Arithmetic Mean	PRG_{low}	PRG_{high}	Arithmetic Mean			
Volatile Organic Compounds									
Acetone	-	-	-	8,490	127,356	67,923	-	68,000	8,500
2-butanone (MEK)	-	-	-	4,245	25,471	14,858	-	15,000	4,200
Carbon disulfide	-	-	-	934	28,018	14,476	-	14,000	934
1,4-dichlorobenzene	20	128	74	2,123	12,736	7,429	-	74	20
p-isopropyltoluene (p-cymene)	200 (i)	1,000 (i)	600 (i)	2,207 (i)	22,075 (i)	12,141 (i)	-	600 (i)	200 (i)
Methylene Chloride	-	-	-	459	34,377	17,418	-	17,000	459
1,2,3-trichlorobenzene (j)	20	115	67.5	-	-	-	-	68	20
1,2,4-trichlorobenzene	20	127	73.5	-	-	-	-	74	20
Trichlorofluoromethane	-	-	-	-	-	-	-	-	-
1,1,1-trichloroethane	-	-	-	9,679	1,451,858	730,768	-	730,000	9,700
PCBs, Pesticides, and Herbicides									
PCBs (Arochlor 1254)	40	240	140	0.010	0.45	0.23	-	0.23	*0.033*
Aldrin	-	-	-	0.0039	0.19	0.1	0.097	0.1	0.0039
alpha-BHC	-	-	-	0.062	9.8	4.9	2.4	2.4	0.062
beta-BHC	-	-	-	0.062	9.8	4.9	2.4	2.4	0.062
delta-BHC	-	-	-	0.062	9.8	4.9	2.4	2.4	0.062
Chlordane	-	-	-	0.0090	0.071	0.04	-	0.04	0.0090
2,4-D	-	-	-	-	-	-	-	5	*0.025*
Dicamba	-	-	-	-	-	-	-	5	*0.01*
4,4'-DDD	40	200	120	0.049	2.4	1.2	0.53	0.53	0.049
4,4'-DDE	40	200	120	0.098	2.4	1.3	0.61	0.61	0.098
4,4'-DDT	40	200	120	0.0082	2.4	1.2	0.53	0.53	0.0082
Dieldrin	50	100	75	0.039	0.48	0.26	-	0.26	0.039
Endosulfan	-	-	-	1.1	5.5	3.3	-	3.3	1.1

TABLE 5-24

SUMMARY OF ECOLOGICAL PRELIMINARY REMEDIATION GOALS FOR NON-PETROLEUM COMPOUNDS IN SOIL

Presidio of San Francisco, California

Potential Chemical of Concern	Summary of Plant and Soil Fauna PRGs (mg/kg); (a)			Summary of Wildlife PRGs (mg/kg); (a)			Proposed Alternate PRGs (mg/kg); (b)	Proposed Buffer Zone PRGs (mg/kg); (c)	Proposed Special Status PRGs (mg/kg); (d)
	PRG_{low}	PRG_{high}	Arithmetic Mean	PRG_{low}	PRG_{high}	Arithmetic Mean			
PCBs, Pesticides, and Herbicides									
Endosulfan Sulfate (j)	-	-	-	1.1	5.5	3.3	-	3.3	1.1
Endrin	-	-	-	0.0035	0.50	0.25	0.11	0.11	*0.004*
Endrin Aldehyde (j)	-	-	-	0.0035	0.50	0.25	0.11	0.11	*0.004*
Endrin Ketone (j)	-	-	-	0.0035	0.50	0.25	0.11	0.11	*0.004*
gamma-BHC (Lindane)	-	-	-	0.010	1.6	0.8	0.37	0.37	0.010
Heptachlor	-	-	-	0.017	7.4	3.7	-	3.7	0.017
Heptachlor Epoxide	-	-	-	0.017	7.4	3.7	-	3.7	0.017
Isodrin (j)	-	-	-	0.0039	0.19	0.1	0.097	0.1	0.0039
MCPP	-	-	-	-	-	-	-	-	*5.0*
Methoxychlor	-	-	-	0.44	35	18	-	18	0.44

Notes:

(a) Listed in these columns are the following: (1) the plant and soil fauna represent the low and high Preliminary Remediation Goals ("PRGs") from Tables 5-12 and 5-13; (2) the wildlife PRG_{low} represents the lowest of the wildlife PRG_{low} from Table 5-12; and (3) the wildlife PRG_{high} represents the lowest of the wildlife PRG_{high} from Table 5-13.

(b) Alternate PRGs for special status species were developed by the Trust for PCOCs which have a large difference (greater than one order of magnitude) between PRG_{low} and PRG_{high}. These values were obtained from Table 5-21.

(c) The buffer zone PRG proposed for protection of non-special status species is the lowest of the arithmetic mean of plant and soil fauna PRGs, the arithmetic mean of wildlife PRGs, the Alternate PRG for special status species, or 5 mg/kg for pesticides or herbicides for which not enough toxicological data exist to calculate a PRG_{low} and PRG_{high} (i.e., 2,4-D, Dicamba, and MCPP).

(d) Values are proposed as soil PRGs for protection of special status species. The special status PRG, as used in this document, is established as the lower value of (1) the PRG_{low} for plant and soil fauna or (2) the PRG_{low} for wildlife, unless the PRG_{low} is less than the laboratory method detection limit. Italics indicates that the laboratory detection limit exceeds the PRG_{low}, and thus the detection limit is selected as the PRG. The laboratory detection limit is also used as the special status PRG for pesticides and herbicides for which not enough toxicological data exist to calculate ecological PRGs.

TABLE 5-24
SUMMARY OF ECOLOGICAL PRELIMINARY REMEDIATION GOALS FOR NON-PETROLEUM COMPOUNDS IN SOIL

Presidio of San Francisco, California

Notes:

(e) Hyphen indicates that PRG could not be calculated due to lack of applicable toxicity data in available literature, or no value is appropriate based on the Trust's assessment of alternate PRGs for special status species.

(f) Ecological PRGs for lead were calculated through use of the Monte Carlo method. Refer to text for discussion of methodology used to derive the ecological PRGs for lead.

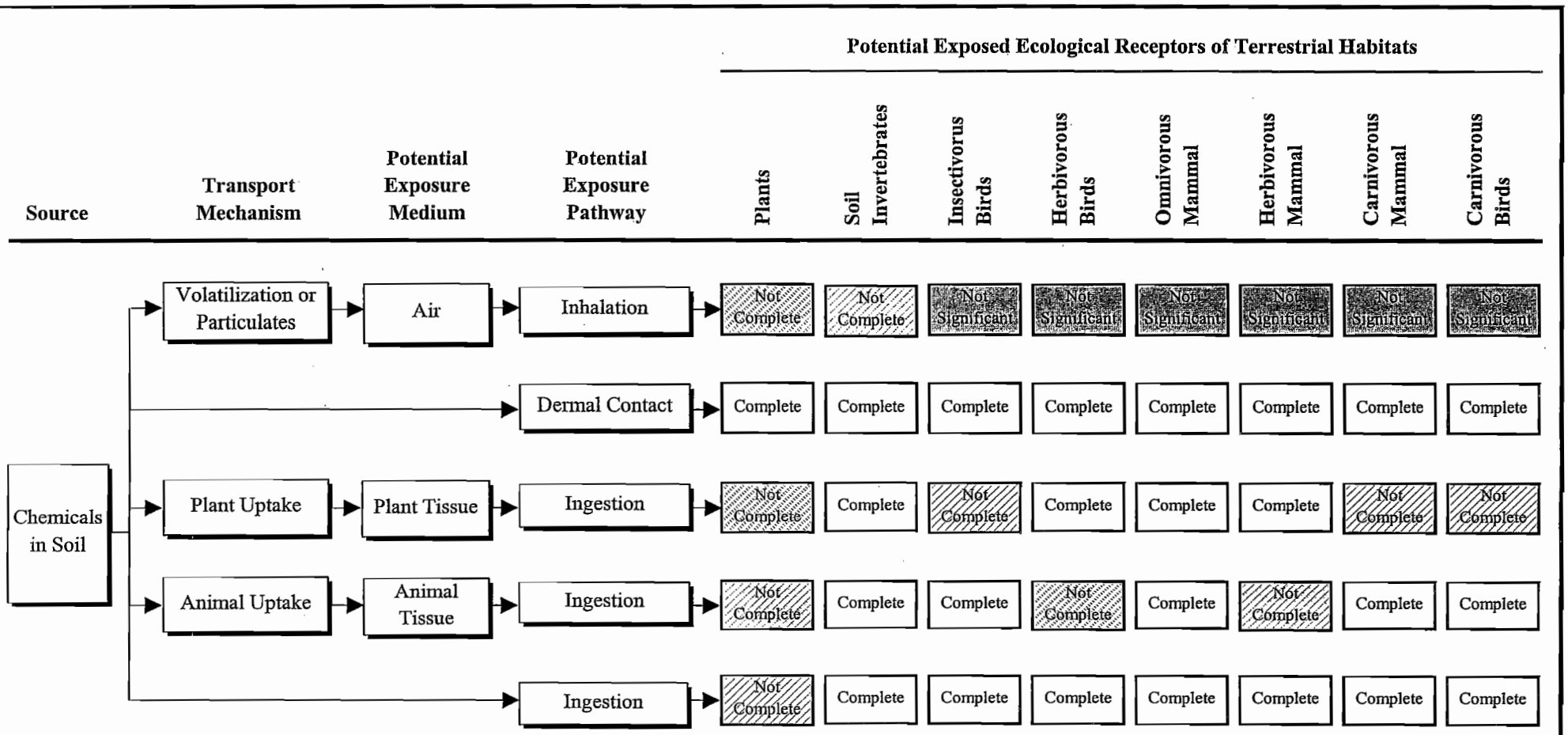
(g) Mercury level for special status species is based on risk management concerns and is established at 2 times the typical method detection limit.

(h) For benzyl alcohol, the buffer zone PRG was decreased from the wildlife arithmetic mean PRG to be more in line with the other semivolatile organic compounds.

(i) Toluene was used as a surrogate for isopropyltoluene.

(j) Values for Endosulfan were used for Endosulfan Sulfate, values for Endrin were used for Endrin Aldehyde and Endrin Ketone.
Isodrin is an isomer of Aldrin; values for Aldrin were used for Isodrin.

FIGURES



Legend

Complete — Pathway Complete or Potentially Complete. Pathway Has Been Quantitatively Evaluated.

Not Significant — Pathway Complete or Potentially Complete; Exposure is Not Considered Significant. Pathway Has Not Been Evaluated Quantitatively.

Not Complete — Pathway is Not Considered Complete.

Harding ESE

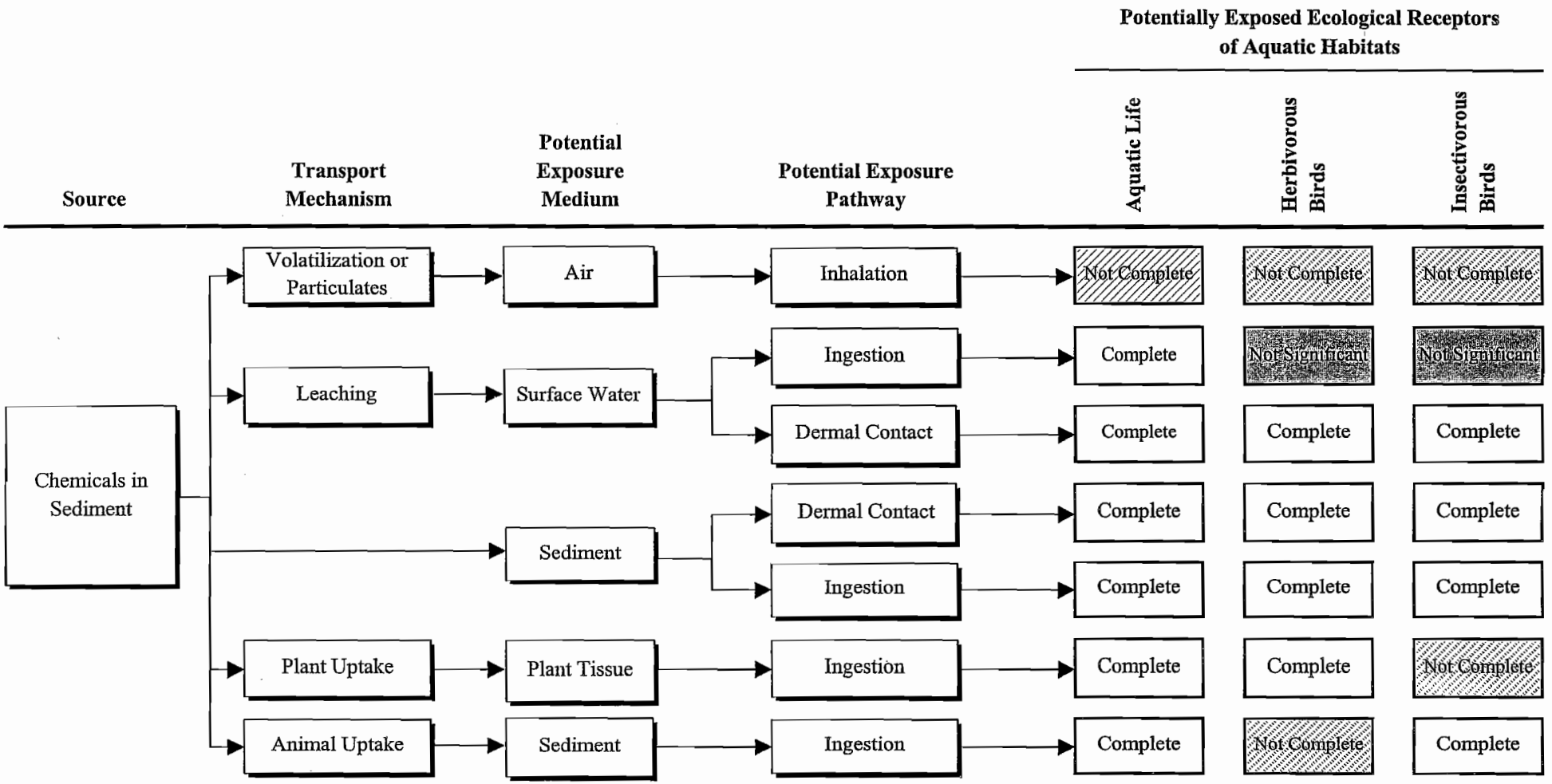
Potential Ecological Chemical Exposure Pathways for Terrestrial Habitats

Presidio of San Francisco, California

Erler & Kalinowski, Inc.

October 2002

Figure 5-1



Potential Ecological Chemical Exposure Pathways for Aquatic Habitats

Presidio of San Francisco, California

Harding ESE

Erler & Kalinowski, Inc.

October 2002

Figure 5-2

6. BACKGROUND CONCENTRATIONS OF METALS IN SOIL AND WATER AT THE PRESIDIO

6. BACKGROUND CONCENTRATIONS OF METALS IN SOIL AND WATER AT THE PRESIDIO

Under 22 CCR §66261.24, DTSC lists seventeen metals (i.e., antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc) that may pose human health and ecological risks if present in waste at sufficiently high concentrations. U.S. EPA (1999b) has established PRGs for these metals in soil and water based upon available toxicological data. However, identification of a release is complicated by the fact that all of these metals are naturally occurring (i.e., at background levels) in soil, sediment, groundwater, and surface water. Background metal concentrations were assessed because it is impractical to remediate releases of metals to less than naturally occurring concentrations. Background concentrations of metals derived in this section have been incorporated into cleanup levels presented in Section 7 to assist in distinguishing between releases of metals at Presidio sites and naturally occurring concentrations of metals in soil and water at the Presidio.

6.1 PRESIDIO GEOLOGY

Studies conducted by the Army (Dames & Moore, 1997b; IT Corporation, 1999; Montgomery Watson, 1999a, 1998a, 1996, 1995; Argonne National Laboratory, 1989) and others (Schlocker, 1974) have identified serpentinite, Colma Formation, and beach/dune sand as the three primary lithologies or soil types at the Presidio. Serpentinite is bedrock unit, part of the Franciscan Formation, whereas the Colma Formation and the beach/dune sands are unconsolidated sediments deposited on top of bedrock. These three primary units were distinguished in borehole logging performed by the Army and considered as distinct geochemically in its assessment of background metals. Based upon mapping performed by the USGS (Schloker, 1974), the generalized surface distribution of serpentinite, Colma Formation, and beach/dune sand is shown on Figure 6-1. This figure is a geological map; each contact has not been field verified at each site. Actual field observations at a particular site will be used to determine site-specific lithology.

Five other secondary geologic units occur at the Presidio in sufficient volumes to be discernible on the 1:24,000-scale USGS geologic map (Schloker, 1974). These units consist of four Franciscan Formation bedrock units (which were not distinguished by the Army in borehole logs nor in the background metals assessment) and Artificial Fill. In detail, the bedrock units are Sheared Rock, Jurassic/Cretaceous Sedimentary Rocks, Greenstone, and Chert/Shale. The Sheared Rock unit is a mixed bedrock unit. It is made up of a soft, highly sheared, clayey matrix of serpentinite, shale, or both, in which occur coherent blocks of Jurassic/Cretaceous Sedimentary Rock and serpentinite. The Jurassic/Cretaceous Sedimentary Rocks is a bedrock unit that is made up of interbedded sandstones, shales, and occasional conglomerates. Greenstone is a bedrock unit made up of dark green meta-basalt that occurs interbedded with the Jurassic/Cretaceous

Sedimentary Rocks and the Chert/Shale. Chert/Shale is a bedrock unit made up of alternating beds of hard, red-brown chert and softer, red-brown shale. It occurs interbedded with greenstone and Jurassic/Cretaceous Sedimentary Rocks. At the Presidio, both Greenstone and Chert/Shale are exposed in minor outcrops only along the Coastal Bluffs. Artificial Fill is an all-inclusive term for unconsolidated material artificially placed for engineering purposes. It includes material probably excavated from local sources at the Presidio as well as material brought in from Fort Baker/Marin Peninsula or dredged from San Francisco Bay.

Although these soil types can be found separately at the Presidio, they are often commingled due to natural events or human activity. As shown on Figure 6-1, landslide deposits and soil reside as fill in ravines at the Fort Scott, Presidio Hill, and Presidio Forest planning areas. These deposits are likely to be derived from any of the three soil types, individually or mixed together. Dames & Moore (1997b) indicates that the landslide deposits and soil in these ravines are generally thin, but may be as thick as 150 feet at some locations. In addition, Artificial Fill is common at the Presidio and may include any or all of the Presidio rock and soil types as well as material brought in from off-site.

The main significance of the secondary geologic units is that, with the exception of Chert/Shale, they have not been characterized geochemically in terms of background metals. Hence, if encountered during remedial activities, these units may have background metals "signatures" that differ from the primary soil types and therefore, can be confused with contamination. For example, Greenstone will typically show higher background levels of chromium, nickel, copper, and vanadium than many other rocks or soils.

The characteristics of the three primary soil types, serpentinite, Colma Formation, and beach/dune sand, are discussed further in Sections 6.1.1 through 6.1.3. Chert/Shale, which have been used as fill and base rock at Crissy Field and other locations at the Presidio, is discussed in Section 6.1.4 because this material is also likely to be encountered during implementation of remedial actions. Greenstone is discussed in Section 6.1.5 because it seems to be present in some fill and, therefore, may be encountered during remedial actions. The actual site-specific lithology will be determined in the field through sampling.

6.1.1 Serpentinite

Serpentinite is an ultramafic rock (i.e., a rock composed mostly of magnesium and iron minerals) that is associated with the Franciscan Formation at the Presidio. It is made up of varying proportions of the three magnesium silicate serpentine minerals, antigorite, chrysotile (a form of asbestos), and lizardite. Serpentinite intrusives and coherent blocks of hard rock in a matrix of intensely sheared shale and serpentinite comprise the outcrops or exposed bedrock observed in the remainder of the Presidio (Schlocker, 1974). Serpentinite is a distinctive greenish gray to bluish gray crumbly rock that tends to form

poorly developed soils with a wide range of grain sizes. It is geochemically distinctive in that it typically contains high concentrations of chromium, nickel, and cobalt.

6.1.2 Colma Formation

The Colma Formation overlies bedrock in the south and southeast portions of the Presidio. The Colma Formation consists of unconsolidated fine to medium sand with moderate amounts of silt and clay. Dames & Moore (1997b) notes that these unconsolidated deposits are generally yellow to reddish brown, but can be gray to black at some locations. Schlocker (1974) reports that the Colma Formation may range in thickness from 75 to 300 feet. The Colma Formation overlies Franciscan Formation lithologies (e.g., serpentinite, Jurassic/Cretaceous Sedimentary Rocks, etc.) and may in turn be covered by geologically younger beach/dune sand. In terms of background metals, the Colma Formation is geochemically very similar to the beach/dune sand.

6.1.3 Beach/Dune Sand

Beach and dune sand comprises the bulk of the exposed deposits in the southwest portion, and along the ocean and bay fronts of the Presidio. These deposits are highly permeable, clean, well-sorted sand that are yellowish brown to light gray in color. Schlocker (1974) reports that the thickness of beach/dune sand deposits are typically on the order of 100 feet. Beach and dune sand overlie the Franciscan and Colma Formations. In terms of background metals, beach/dune sand is very similar to the Colma Formation.

6.1.4 Chert/Shale

Investigations and remedial actions conducted at Crissy Field find that reddish brown chert and shale have been placed as fill in the upper 2 feet of ground throughout much of this area. Chert/shale has also been used as fill and base rock at other areas of the Presidio. As noted by Schlocker (1974), only minor outcrops of chert are present at the Presidio, and only in the relatively inaccessible Coastal Bluffs planning area. Based upon a study conducted for the Army, IT Corporation believes that the chert/shale found at Crissy Field was imported to the Presidio. IT Corporation (1999) states:

> Although the specific source is presently unknown, it is possible that the quickest, easiest and cheapest source was the Marin Peninsula chert, barged in as fill probably for the 1915 Panama-Pacific International Exposition. The similarities between the Presidio chert and shale and the southern Marin Peninsula chert and shale...would tend to support this possibility.

Chert/shale is a dark reddish brown rock with regularly alternating layers of chert and shale. Individual layers of chert and shale observed in outcrops generally vary from a fraction of an inch to several inches thick. These thin layers or bands cause the two rock types to become intimately mixed together when imported and placed as fill. The reddish

brown shale associated with the chert is a distinctly different lithology from the gray-green sheared shale sometimes associated with serpentinite.

6.1.5 Greenstone

Greenstone is a dark greenish gray to gray olive colored basaltic rock found associated with chert/shale and/or Jurassic/Cretaceous sedimentary rocks of the Franciscan Formation. When it occurs as a submarine pillow lava, greenstone can develop curving, slickensided surfaces that resemble serpentinite. It appears to be present in fill at Graded Area 9 and the Transfer Station sites where it has been erroneously logged as serpentinite. The locations of these sites are shown on Figure 2-2. Greenstone is not specifically mapped on Figure 6-1. Greenstone is geochemically similar to serpentinite in that it naturally contains higher concentrations of chromium and nickel than other geologic units at the Presidio. Greenstone is geochemically distinctive relative to serpentinite in that the concentrations of nickel and chromium are in the hundreds of mg/kg instead of thousands of mg/kg and greenstone typically contains several hundred mg/kg vanadium. Schloker (1974) reports greenstone analyses from the northern San Francisco Quadrangle that range from 15 to 300 mg/kg chromium, 150 to 300 mg/kg nickel, and 150 to 300 mg/kg vanadium.

6.2 APPROACH TO DEVELOPING BACKGROUND METALS CONCENTRATIONS IN SOIL

Evaluation of background metals in soil included development of a DTSC-approved approach to evaluate background metals concentrations, evaluation of the existing soil metal data set, determining screening levels of metals in soil, and determining threshold levels of metals in soil. These topics are discussed in Sections 6.2.1 through 6.2.4.

6.2.1 Regulatory Guidelines

During preparation of the Revised Final Feasibility Study for Main Installation Sites, the Trust received feedback from the DTSC regarding the approach for evaluating background metals at the Presidio. The DTSC expressed an interest in promoting consistency among base closure sites throughout California. The principal features of the background metals evaluation approach were as follows:

- The probability of "false negatives", i.e., erroneously concluding that significant contamination is not present when it actually is present, should be made as small as possible.

- Evaluating background metals concentrations at the Presidio should be a two-tiered statistical process involving definition of "screening" levels and "threshold" levels. Screening levels are used to determine PCOCs and threshold levels are used to define COCs.

- Only site-specific background data should be used to determine both screening levels and threshold levels (i.e., regional data would not be appropriate to establish background concentrations).

- For a given metal, there should be separate screening and threshold levels for each of the primary soil types encountered at the Presidio.

- In order to make valid estimates of screening and threshold metals levels, a minimum statistical mass must be present, i.e., there should be at least 20 background samples for each soil type.

- When there are insufficient background samples, i.e., samples specifically collected to be representative of background conditions, selected site sample data may be used to supplement the background data set if the DTSC and other stakeholders concur that the supplemental data represent background.

6.2.2 Background Metals Data Set

The Army compiled limited background soil data as part of its RI (Dames & Moore, 1997b) and subsequent studies (IT Corporation, 1999, Montgomery Watson, 1999a). The U.S. EPA's National Enforcement Investigations Center ("NEIC") (1997b) has also analyzed background soil samples collected at the Presidio. The aggregate suite of background samples included 16 beach/dune sand, 11 Colma Formation, 10 serpentinite, and 49 Chert/Shale samples. These data sets are presented in Appendix C.

According to the DTSC guidelines discussed above, three of the four soil types were not represented by a sufficient number of samples to reasonably estimate background screening or threshold levels. In order to avoid the considerable expense and schedule delay involved in collecting additional samples as part of a supplemental background metals study, the DTSC agreed to the inclusion of selected site data in the background data set. The selection of these additional data is described below.

The Trust searched the RI database provided by the Army/Montgomery Watson and retrieved soil samples classified as beach/dune, Colma Formation, or serpentinite. The retrieved data were then progressively screened according to the following scheme:

- Samples that were grossly misclassified were excluded, e.g., Colma or beach/dune samples with high levels of chromium, nickel, and cobalt.

- Samples with obvious contamination were excluded.

- Samples with suspect analyses or laboratory quality assurance/quality control ("QA/QC") problems were excluded.

- Site samples collected from the surface to 0.5 feet below ground surface ("bgs") were excluded because of the potential for general surface contamination and difficulty in accurately classifying topsoil.

- Samples from landfill sites were excluded unless they were collected at least 2 feet below the bottom of the fill.

- Samples collected from sites with known metals contamination were excluded if the samples were collected from 2 feet bgs or less.

- All Fill Site 7 data were excluded due to the presence of hydraulically placed fill.

- All RI samples from the Building 900's and 600's Series sites were excluded due to possible metals contamination and the presence of mixed soil types (e.g., serpentinite fragments in beach/dune material).

Because of the paucity of serpentinite samples, two small sets of data were added to the serpentinite background data set. One set consisted of five soil samples reported by Montgomery Watson in their *Fuel Product Action Level Development Report* ("FPALDR") (1995) that were unclassified as to soil type but which appeared to be serpentinite on the basis of their chromium and nickel concentrations. The second set consisted of three serpentinite bedrock samples collected by Montgomery Watson during the 1998 excavation for petroleum-impacted soil at the Presidio Golf Course clubhouse and reported in their *Hexavalent Chromium in Serpentinite Bedrock and Groundwater in Upland Areas* study (1999a).

The resulting sets of site-derived background data were combined with the RI background data sets into revised background data sets by soil type. The revised background data sets were then evaluated in a joint meeting of the Trust, DTSC, and other stakeholders. The primary evaluation tool used to check the revised background data sets was the bivariate scatterplot (e.g., Figures 6-2 and 6-3) which showed the relationships between metals that are potential contaminants and major elements which are not considered potential contaminants (e.g., iron, aluminum, magnesium, and manganese). Data that were clearly "outliers" from the main mass or trend of data were eliminated, e.g., a single high barium result shown in Figure 6-2 or the cluster of anomalous cobalt data shown in Figure 6-3. The full set of background metals scatterplots is reported in a Technical Memorandum (EKI, 2001).

The outcome of this process was revised background data sets (shown in Tables C–1 through C–4 in Appendix C) that were agreed to by the stakeholders and which contained sufficient samples for statistically estimating background screening and threshold levels.

6.2.3 Determining Metals Screening (PCOC) Levels

According to the DTSC, the main reason for establishing "screening" levels for metals is to build in an evaluation step that would help prevent "false negatives", i.e., situations

wherein it is concluded that no contamination is present when, in fact, it is present. Phrased another way, the screening level step is meant to answer the question, "Are we at the edge of a plume or release?"

The means for accomplishing this goal was to set the screening level very conservatively in a statistical sense, i.e., at the 95% upper confidence level of 80th percentile of the data distribution[8]. The meaning of this terminology is shown graphically on Figure 6-4. The generic metal concentrations presented on Figure 6-4 are shown with a logarithmic scale because the background metals data are best described by logarithmic distributions. A specific screening level example, i.e., chromium in beach/dune sand, is shown on Figure 6-5.

The 80th percentile method for defining the screening level could not be meaningfully applied in those situations wherein 50% or more of the results for a particular metal were below detection limits, e.g., antimony. For these instances, the screening level was defined as the most commonly encountered detection limit.

The process of defining screening levels summarized above was followed and the results discussed in a meeting of the Trust, DTSC, and other stakeholders. The consensus screening levels agreed to by the stakeholders are summarized for serpentinite, Colma Formation, beach/dune, and chert/shale in Tables 6-1 through 6-4, respectively.

The screening levels presented in Tables 6-1 through 6-4 are used to identify which metals at a given site are PCOCs. In other words, if a metal concentration exceeds the screening level for the soil type at the site, then that metal is retained as a PCOC.

6.2.4 Determining Metals Threshold (COC) Levels

The objective of threshold levels evaluation is to define concentration levels (by metal and soil type) above which soil sample metals results would reasonably be considered indicative of contamination and therefore retained as a chemical of concern for the selected site.

As with the screening levels, the threshold levels were defined statistically. The threshold level for a particular metal and soil type was usually defined as the 95% upper confidence limit of the 95th percentile of the data distribution[9]. The meaning of this terminology is shown graphically on Figure 6-4, and an example showing the threshold level for chromium in beach/dune soil is shown on Figure 6-6.

As with the screening levels, threshold levels could not be derived statistically when there were 50% or more results below detection limits. In these instances, the threshold level

[8] Because of the small number of samples in the background metals data set, the DTSC and the Trust agreed to define the screening and threshold levels for serpentinite soils as the 80th and the 95th percentiles, respectively, of the data distributions (rather than the 95% upper confidence limit of those percentiles).

[9] Because of the small number of samples in the background metals data set, the DTSC and the Trust agreed to define the screening and threshold levels for serpentinite soils as the 80th and the 95th percentiles, respectively, of the data distributions (rather than the 95% upper confidence limit of those percentiles).

was defined as the greater of either the maximum concentration detected or the most common detection limit[10]. Background threshold levels derived as described above were reviewed in a meeting of the Trust, DTSC, and other stakeholders. The consensus threshold levels agreed to by the stakeholders are summarized for serpentinite, Colma Formation, beach/dune, and chert/shale in Tables 6-1 through 6-4, respectively.

The threshold levels presented in Tables 6-1 through 6-4 and summarized in Table 6-5 represent the Trust's best estimate of background metals concentrations based on available data. Additional data collected during Presidio remedial activities may indicate the need to modify these estimates. Furthermore, these threshold levels are not cleanup levels; rather, the threshold should be compared to cleanup levels to determine if a specific cleanup level should be established as the background threshold. In particular, if the PRG is less than the background, the cleanup level is established as the background threshold because it is not practical or possible to clean up to concentrations below background.

6.2.5 Summary of Background Threshold Data

Table 6-5 summarizes the background threshold levels by metal and the soil type at each site. The soil type will be determined in the field based on lithologic logs. In addition, the derivation of each threshold is indicated, i.e., 95% UCL, maximum detection, or common detection limit. To provide a larger frame of reference, background metals data from regional sources are summarized in Table 6–6.

6.3 PRESIDIO HYDROGEOLOGY

The Army evaluated the hydrogeology of the Presidio in detail as part of preparation of the FPALDR (Montgomery Watson, 1995). Three groundwater basins that are hydraulically isolated from each other by the bedrock topography have been identified. As shown on Figure 6-7, these groundwater basins consist of the Lobos Creek, Coastal Bluffs, and Marina Groundwater Basins. The shallow depths to bedrock in the entire Coastal Bluffs Groundwater Basin, and in portions of the Lobos Creek and Marina Groundwater Basins indicate that significant amounts of groundwater are not present in these areas and their use as potable supply is limited. Further, the Crissy Field Groundwater Area in the Marina Groundwater Basin (Figure 6-7) is tidally influenced. Saltwater intrusion restricts groundwater use in this area.

Groundwater with the highest likelihood of being developed as potable supply is found in portions of the Presidio where thick sand deposits enhance the infiltration and storage of water in the subsurface. The Army identified three locations where groundwater may be a significant resource. These areas consist of the Lobos Creek Groundwater Area in the

[10] The "common detection limit" is the reporting limit typically achieved by analytical laboratories that have analyzed soil samples at the Presidio. These common detection limits were identified in a series of meetings with the Trust, DTSC, and other stakeholders.

Lobos Creek Groundwater Basin, and the West Valley and Northeastern Groundwater Areas in the Marina Groundwater Basin, as shown on Figure 6-7.

6.4 BACKGROUND CONCENTRATIONS OF METALS IN SURFACE WATER, SEEPS, AND GROUNDWATER

Low concentrations of metals in surface water, seeps, and groundwater have been identified as PCOCs at several Presidio sites where such samples have been collected. The occurrence of these metals in the majority of surface water, seep, and groundwater monitoring well samples are likely to be naturally occurring. However, except for chromium, background water quality has not been sufficiently characterized to confirm that the metals are naturally occurring. U.S. EPA (1997b, 1997f) and the Army (Montgomery Watson, 1999a, 1998b) conducted studies of chromium in bedrock, and dissolved and hexavalent chromium in surface water and groundwater. The results of these studies indicate that dissolved chromium is widespread at low concentrations in surface water and groundwater throughout the Presidio. This occurrence is suggestive of natural, rather than anthropogenic sources of chromium.

6.4.1 Hypothesis that Serpentinite is a Natural Source of Chromium in Water

Chromium exists in two valence states or forms. One form is trivalent chromium, which can also be expressed as Cr(III), and the other form is hexavalent chromium, which can also be expressed as Cr(VI). Under ambient conditions, such as those found at the Presidio, trivalent chromium is insoluble and not detected in water, but present in soil as a precipitate or solid. In contrast, hexavalent chromium is soluble and found dissolved in water under ambient conditions. The solubility and toxicological properties of hexavalent chromium are the reasons that this form of chromium is of greater environmental concern than trivalent chromium.

Dissolved chromium is a very good surrogate for hexavalent chromium because of the differing solubility of trivalent and hexavalent chromium in water. As such, dissolved chromium can be assumed to be hexavalent chromium. Seep and groundwater monitoring well locations from which water samples were collected and analyzed for dissolved chromium are shown on Figure 6-8.

High, naturally occurring concentrations of chromium are associated with serpentinite (Kreckeberg, 1984). As shown in Table 6-1, the background threshold concentration of chromium in serpentinite has been determined to be 1,700 mg/kg. In comparison, the naturally occurring or background threshold chromium concentration in the Colma Formation and beach/dune sand at the Presidio has been determined to be 140 mg/kg and 120 mg/kg, respectively (Tables 6-2 and 6-3). Given that serpentinite is a natural source of chromium, it has been hypothesized that dissolved chromium (i.e., hexavalent chromium) measured in seeps and groundwater at the Presidio is due to the presence of chromium in serpentinite. The Army performed studies to confirm this hypothesis. Representatives of U.S. EPA, DTSC, San Francisco State University, NPS, Presidio

Trust, and community members of the RAB provided significant input to the development of the studies. Montgomery Watson, on behalf of the Army, conducted these studies in 1998 and 1999 (1999a).

6.4.2 Evidence that Serpentinite is a Natural Source of Chromium in Water

As discussed in Sections 6.4.2.1 through 6.4.2.4, the results of the Army's studies support the hypothesis that chromium measured in groundwater is naturally occurring. Results of these studies are included in Appendix D.

6.4.2.1 Background Groundwater Geochemistry

Five monitoring wells were constructed in upland locations considered representative of background conditions (Montgomery Watson, 1999a). Locations of these wells were selected with input from the agencies and organizations that collaborated on development of the Army's studies. The wells, UBR01GW01, UBR02GW01, UBR02GW02, UBR03GW01, and UBR03GW02 (Figure 6-8), were constructed in locations that are up gradient of the direction of groundwater flow from potential anthropogenic sources of chromium. Groundwater samples collected from the three wells screened within the serpentinite contained dissolved or hexavalent chromium ranging from 25 to 100 µg/L (Appendix D). The groundwater conditions in these wells were alkaline (with measured pH values ranging from 8.3 to 9.1) and oxidizing (with measured Eh values ranging from 308 to 423 mV). These conditions are favorable for producing stable concentrations of hexavalent chromium in upland groundwater created by leaching and/or interaction of groundwater with serpentinite bedrock.

6.4.2.2 Serpentinite Geochemistry

Samples of serpentinite bedrock collected during monitoring well construction in upland locations were analyzed for hexavalent chromium (Montgomery Watson, 1999a). Hexavalent chromium was detected in these samples at concentrations ranging from 0.064 mg/kg to 0.602 mg/kg. In addition, the aqueous extracts of serpentinite bedrock were moderately alkaline (with measured pH values ranging from 8 to 8.5) and oxidizing (with measured Eh values ranging from 421 to 454 mV) (Appendix D). These conditions are favorable for leaching and/or creating hexavalent chromium from serpentinite through interaction with infiltrating surface water or contact with groundwater.

6.4.2.3 Leaching Test Results

Serpentinite samples collected during monitoring well construction in upland locations were subjected to leaching tests to evaluate whether hexavalent chromium could be leached from bedrock under different conditions (Montgomery Watson, 1999a). Hexavalent chromium was measured in leachate from the serpentinite samples (Appendix D).

6.4.2.4 Occurrence of Dissolved Chromium in Groundwater Throughout the Presidio

The occurrence and distribution of hexavalent chromium in groundwater at the Presidio appears to result from the fact that hexavalent chromium is present in serpentinite bedrock at the Presidio and/or can be created from serpentinite through interaction with infiltrating surface water or contact with groundwater. Hexavalent chromium can be leached and/or generated from serpentinite by various complex reactions because the geochemical conditions, including pH and Eh, are favorable for producing stable concentrations of hexavalent chromium in surface water and groundwater. Conversion of dissolved hexavalent chromium to insoluble trivalent chromium likely occurs in areas where geochemical conditions are reducing in nature, either from naturally occurring organic matter (e.g., bay muds at Crissy Field) or anthropogenic organic matter (e.g., petroleum hydrocarbons at Nike Facility). Thus, the presence of serpentinite and oxidizing conditions, and the lack of organic matter, produce conditions whereby hexavalent chromium is stable in groundwater.

Chromium has been measured in groundwater samples, and in some cases, seep samples collected from Building 215, Fill Site 6, Battery Howe/Wagner, Landfill 8, Landfill 10, Landfill E, Fill Site 1, Nike Facility, Landfill 2, Landfill 4 and Fill Site 5 (Table 6-7 and Figure 6-8). In addition, chromium has been detected in groundwater samples collected from other areas of the Presidio, including background locations (UBR monitoring wells) and wells constructed in the Tennessee Hollow, which are situated a significant distant from known chemical release sites. Serpentinite has been observed in at least one monitoring well at each of these sites or areas with the exceptions of Building 215, Fill Site 6, and Landfill 4.

6.4.3 Further Assessment Required to Confirm Other Metals in Water are Naturally Occurring

Based upon the Army's study results, hexavalent chromium in groundwater in upland areas of the Presidio appears to be naturally occurring. In its letter, dated 13 July 2000, DTSC agreed that hexavalent chromium is naturally occurring in areas where groundwater contacts serpentinite. DTSC (2000c) has stated that further assessment of the occurrence of hexavalent chromium is required for areas where serpentinite is not present or is not directly down gradient from the flow of groundwater through serpentinite. DTSC is interested in understanding the background concentrations of chromium in water that result from contact with other soil types, and whether these background chromium concentrations would be expected to be higher than potential cleanup levels, as is the case of chromium concentrations in water that contacts serpentinite.

The findings of investigations and studies conducted by the Army clearly indicate that hexavalent chromium is naturally occurring in surface water and groundwater at Battery Howe/Wagner, Landfill 8, Landfill 10, Landfill E, Fill Site 1, Nike Facility, Landfill 2, and Fill Site 5. Hexavalent chromium in groundwater at the Building 215 Area and Fill Site 6 is also likely to be naturally occurring but further assessment is required due to the

proximity of these areas to Crissy Field. It is probable that groundwater containing hexavalent chromium has migrated through upland serpentinite to the Building 215 Area and Fill Site 6. The Colma and Beach/Dune Formations beneath Fill Site 6 and Building 215 consist largely of sands and other material generally poor in naturally occurring organic material. With the exception of releases of petroleum hydrocarbons at the nearby Building 1065 and Building 1027 Areas, there are no reducing agents in the saturated zone beneath Fill Site 6 and Building 215. Consequently, hexavalent chromium formed at upland locations and transported in groundwater to Fill Site 6 and Building 215 is chemically stable. No sources of hexavalent chromium have been identified at these areas and the chromium concentrations are consistent with this type of transport mechanism.

Similar to hexavalent chromium, low concentrations of other metals, such as barium, cadmium, copper, lead, mercury, nickel, selenium, and zinc, are detected in surface water, seep, and groundwater samples collected at Presidio sites. The low concentrations at which these metals are detected and their distribution in surface water, seeps, and groundwater throughout the Presidio suggest that these metals are also naturally occurring. However, this finding cannot be confirmed based upon available data. Analytical results of background metal concentrations in surface water and groundwater have not been obtained for all Presidio sites. It may be appropriate to collect additional data in the vicinity of sites where metals have been identified as COCs in water to demonstrate that the metals are naturally occurring and do not derive from historic chemical releases.

TABLES

TABLE 6-1
SUMMARY OF BACKGROUND DATA, SCREENING LEVELS, AND THRESHOLD LEVELS -- SERPENTINITE SOIL (a)

Presidio of San Francisco, California

	Background Data Summary			Screening Level (mg/kg)				Threshold Level (mg/kg)				
Metal	Number of Detections	Total Samples	Maximum Detected (mg/kg)	Detection Limit	80th Percentile	95% UCL of 80th Percentile	Trust Screening Level	Detection Limit	Maximum Detected	95th Percentile	95% UCL of 95th Percentile	Trust Threshold Level
Antimony	0	8	NM (b)	3.0	-- (d)	--	3.0	3.0	NA	--	--	3.0
Arsenic	8	12	4.1	NA (c)	2.5	4.7	2.5	NA	NA	5.4	12	5.4
Barium	15	16	149	NA	100	180	100	NA	NA	230	510	230
Beryllium	6	14	1.1	0.50	--	--	0.50	0.50	1.1	--	--	1.1
Cadmium	4	12	1.9	0.80	--	--	0.80	0.80	1.9	--	--	1.9
Chromium	22	22	1700 (e)	NA	1,300	1,500	1,300	NA	NA	1,700	2,200	1,700
Cobalt	18	18	165	NA	140	160	140	NA	NA	170	200	170
Copper	22	22	65	NA	48	68	18	NA	NA	85	140	85
Lead	11	15	77	NA	21	49	21	NA	NA	66	200	66
Mercury	2	9	0.069	0.20	--	--	0.20	0.20	0.069	--	--	0.20
Molybdenum	0	4	NM	2.0	--	--	2.0	2.0	NA	--	--	2.0
Nickel	22	22	4,300	NA	3,100	3,900	3,100	NA	NA	4,500	6,100	4,500
Selenium	0	7	NM	0.5	--	--	0.5	0.5	NA	--	--	0.5
Silver	1	10	1.7	1.0	--	--	1.0	1.0	1.7	--	--	1.7
Thallium	4	8	0.077	1.0	--	--	1.0	1.0	0.077	--	--	1.0
Vanadium	22	22	84	NA	51	64	51	NA	NA	74	100	74
Zinc	22	22	140	NA	86	120	86	NA	NA	160	250	160

Notes:

(a) Column headings have the following meanings:

Detection Limit: A typical detection limit is included when there were insufficient data to calculate an 80th percentile or a 95th percentile (e.g., no detections or fewer than 50% detections).

80th Percentile: The concentration corresponding to the 80th percentile of the lognormal data distribution calculated for data sets with a frequency of detection greater than 50%. Because of the small number of samples in the background data set, DTSC and the Trust agreed to use the 80th percentile to establish screening levels for serpentinite soils.

95% UCL of 80th Percentile: The concentration corresponding to the 95% upper confidence level ("UCL") of the 80th percentile of the lognormal data distribution.

Trust Screening Level: Screening level for classification of corresponding metal as a potential chemical of concern.

Maximum: Maximum concentration detected in background samples of this lithology (threshold level when there are fewer than 50% detections).

95th Percentile: The concentration corresponding to the 95th percentile of the lognormal data distribution calculated for data sets with a frequency of detection greater than 50%. Because of the small number of samples in the background data set, DTSC and the Trust agreed to use the 95th percentile to establish threshold levels for serpentinite soils.

95% UCL of 95th Percentile: The concentration corresponding to the 95% UCL of the 95th percentile of the lognormal data distribution.

Trust Threshold Level: Threshold level for classification of corresponding metal as a chemical of concern.

(b) NM means not measured; there were no data above applicable laboratory reporting limits.

(c) NA means not applicable; there were sufficient data to estimate a data distribution so the detection limit or maximum detected concentration are not screening or threshold levels.

(d) A double hyphen ("--") indicates that there were insufficient data above laboratory reporting limits to estimate a data distribution.

(e) Hexavalent chromium has been measured in serpentinite at the Presidio at concentrations ranging from 0.064 to 0.602 mg/kg (Montgomery Watson, 1999a).

TABLE 6-2
SUMMARY OF BACKGROUND DATA, SCREENING LEVELS, AND THRESHOLD LEVELS -- COLMA FORMATION SOIL (a)

Presidio of San Francisco, California

	Background Data Summary			Screening Level (mg/kg)				Threshold Level (mg/kg)				
Metal	Number of Detections	Total Samples	Maximum Detected (mg/kg)	Detection Limit	80th Percentile	95% UCL of 80th Percentile	Trust Screening Level	Detection Limit	Maximum Detected	95th Percentile	95% UCL of 95th Percentile	Trust Threshold Level
Antimony	0	8	NM (b)	3.0	-- (d)	--	3.0	3.0	NA	--	--	3.0
Arsenic	13	20	5.0	NA (c)	3.1	3.9	3.9	NA	NA	4.5	6.2	6.2
Barium	36	36	180	NA	77	99	99	NA	NA	130	180	180
Beryllium	17	32	0.68	NA	0.33	0.46	0.46	NA	NA	0.64	0.99	0.99
Cadmium	5	28	0.49	0.80	--	--	0.80	0.80	0.49	--	--	0.80
Chromium	36	36	150	NA	81	95	95	NA	NA	110	140	140
Cobalt	36	36	19	NA	14	16	16	NA	NA	18	21	21
Copper	36	36	81	NA	18	24	24	NA	NA	33	49	49
Lead	32	35	8.2	NA	4.5	5.2	5.2	NA	NA	6.1	7.5	7.5
Mercury	3	19	0.12	0.20	--	--	0.20	0.20	0.12	--	--	0.20
Molybdenum	0	0	NM	2.0	--	--	2.0	2.0	NA	--	--	2.0
Nickel	35	35	120	NA	72	83	83	NA	NA	96	110	110
Selenium	2	12	0.46	0.5	--	--	0.5	0.50	0.46	--	--	0.50
Silver	0	12	NM	1.0	--	--	1.0	1.0	NA	--	--	1.0
Thallium	0	6	NM	1.0	--	--	1.0	1.0	NA	--	--	1.0
Vanadium	35	35	85	NA	53	62	62	NA	NA	73	90	90
Zinc	36	36	62	NA	38	43	43	NA	NA	50	60	60

Notes:

(a) Column headings have the following meanings:

Detection Limit: A typical detection limit is included when there were insufficient data to calculate an 80th percentile or a 95th percentile (e.g., no detections or fewer than 50% detections).

80th Percentile: The concentration corresponding to the 80th percentile of the lognormal data distribution calculated for data sets with a frequency of detection greater than 50%.

95% UCL of 80th Percentile: The concentration corresponding to the 95% upper confidence level ("UCL") of the 80th percentile of the lognormal data distribution.

Trust Screening Level: Screening level for classification of corresponding metal as a potential chemical of concern.

Maximum: Maximum concentration detected in background samples of this lithology (threshold level when there are fewer than 50% detections).

95th Percentile: The concentration corresponding to the 95th percentile of the lognormal data distribution calculated for data sets with a frequency of detection greater than 50%.

95% UCL of 95th Percentile: The concentration corresponding to the 95% UCL of the 95th percentile of the lognormal data distribution.

Trust Threshold Level: Threshold level for classification of corresponding metal as a chemical of concern.

(b) NM means not measured; there were no data above applicable laboratory reporting limits.

(c) NA means not applicable; there were sufficient data to estimate a data distribution so the detection limit or maximum detected concentration are not screening or threshold levels.

(d) A double hyphen ("--") indicates that there were insufficient data above laboratory reporting limits to estimate a data distribution.

TABLE 6-3
SUMMARY OF BACKGROUND DATA, SCREENING LEVELS, AND THRESHOLD LEVELS -- BEACH/DUNE SOIL (a)
Presidio of San Francisco, California

	Background Data Summary			Screening Level (mg/kg)				Threshold Level (mg/kg)				
Metal	Number of Detections	Total Samples	Maximum Detected (mg/kg)	Detection Limit	80th Percentile	95% UCL of 80th Percentile	Trust Proposed Screening Level	Detection Limit	Maximum Detected	95th Percentile	95% UCL of 95th Percentile	Trust Proposed Threshold Level
Antimony	0	11	NM (b)	3.0	-- (d)	--	3.0	3.0	NA	--	--	3.0
Arsenic	55	69	6.0	NA (c)	3.4	3.9	3.9	NA	NA	5	5.9	5.9
Barium	63	70	250	NA	43	54	54	NA	NA	87	120	120
Beryllium	37	56	1.3	NA	0.44	0.52	0.52	NA	NA	0.70	0.89	0.89
Cadmium	3	32	1.7	0.80	--	--	0.80	0.80	1.7	--	--	1.7
Chromium	75	75	140	NA	72	81	81	NA	NA	100	120	120
Cobalt	62	71	24	NA	10	11	11	NA	NA	14	16	16
Copper	61	70	57	NA	17	21	21	NA	NA	33	43	43
Lead	66	83	89	NA	16	21	21	NA	NA	39	57	57
Mercury	11	65	0.65 (e)	0.20	--	--	0.20	0.20	0.11	--	--	0.20
Molybdenum	0	1	NM	2.0	--	--	2.0	2.0	NA	--	--	2.0
Nickel	70	70	83	NA	43	48	48	NA	NA	60	70	70
Selenium	5	31	4.3 (e)	0.5	--	--	0.5	0.50	0.75	--	--	0.75
Silver	5	39	0.86	1.0	--	--	1.0	1.0	0.86	--	--	1.0
Thallium	1	19	0.37	1.0	--	--	1.0	1.0	0.37	--	--	1.0
Vanadium	71	71	100	NA	52	59	59	NA	NA	77	92	92
Zinc	61	69	93	NA	37	42	42	NA	NA	55	66	66

Notes:

(a) Column headings have the following meanings:

Detection Limit: A typical detection limit is included when there were insufficient data to calculate an 80th percentile or a 95th percentile (e.g., no detections or fewer than 50% detections).

80th Percentile: The concentration corresponding to the 80th percentile of the lognormal data distribution calculated for data sets with a frequency of detection greater than 50%.

95% UCL of 80th Percentile: The concentration corresponding to the 95% upper confidence level ("UCL") of the 80th percentile of the lognormal data distribution.

Trust Screening Level: Screening level for classification of corresponding metal as a potential chemical of concern.

Maximum: Maximum concentration detected in background samples of this lithology (threshold level when there are fewer than 50% detections).

95th Percentile: The concentration corresponding to the 95th percentile of the lognormal data distribution calculated for data sets with a frequency of detection greater than 50%.

95% UCL of 95th Percentile: The concentration corresponding to the 95% UCL of the 95th percentile of the lognormal data distribution.

Trust Threshold Level: Threshold level for classification of corresponding metal as a chemical of concern.

(b) NM means not measured; there were no data above applicable laboratory reporting limits.

(c) NA means not applicable; there were sufficient data to estimate a data distribution so the detection limit or maximum detected concentration are not screening or threshold levels.

(d) A double hyphen ("--") indicates that there were insufficient data above laboratory reporting limits to estimate a data distribution.

(e) The concentration shown was the maximum detected in the data set. DTSC requested that the second highest concentration be used for evaluating the threshold level.

TABLE 6-4

SUMMARY OF BACKGROUND DATA, SCREENING LEVELS, AND THRESHOLD LEVELS -- CHERT/SHALE SOIL (a)

Presidio of San Francisco, California

	Background Data Summary			Screening Level (mg/kg)				Threshold Level (mg/kg)				
Metal	Number of Detections	Total Samples	Maximum Detected (mg/kg)	Detection Limit	80th Percentile	95% UCL of 80th Percentile	Trust Screening Level	Detection Limit	Maximum Detected	95th Percentile	95% UCL of 95th Percentile	Trust Threshold Level
Antimony	0	46	NM (b)	3.0	-- (c)	--	3.0	3.0	NA (d)	--	--	3.0
Arsenic	3	47	15 (e)	2.5	--	--	2.5	NA	3.2	--	--	3.2
Barium	47	47	1100	NA	210	310	310	NA	NA	540	900	900
Beryllium	14	47	0.72	0.20	--	--	0.2	0.20	0.72	--	--	0.72
Cadmium	11	47	1.7	0.80	--	--	0.80	0.80	1.7	--	--	1.7
Chromium	37	47	52	NA	8.7	13	13	NA	NA	24	41	41
Cobalt	33	47	87	NA	9.2	13	13	NA	NA	22	37	37
Copper	47	47	310	NA	90	130	130	NA	NA	220	360	360
Lead	6	47	45	10	--	--	10	10	45	--	--	45
Mercury	1	47	0.036	0.20	--	--	0.20	0.20	0.036	--	--	0.20
Molybdenum	0	46	NM	2.0	--	--	2.0	2.0	NA	--	--	2.0
Nickel	34	47	110	NA	19	27	27	NA	NA	44	71	71
Selenium	0	1 (f)	NM	0.50	--	--	0.5	0.50	NA	--	--	0.50
Silver	0	47	NM	1.0	--	--	1.0	1.0	NA	--	--	1.0
Thallium	0	46	NM	1.0	--	--	1.0	1.0	NA	--	--	1.0
Vanadium	45	47	71	NA	16	23	23	NA	NA	38	61	61
Zinc	43	47	140	NA	27	41	41	NA	NA	73	120	120

Notes:

(a) Column headings have the following meanings:

Detection Limit: A typical detection limit is included when there were insufficient data to calculate an 80th percentile or a 95th percentile (e.g., no detections or fewer than 50% detection

80th Percentile: The concentration corresponding to the 80th percentile of the lognormal data distribution calculated for data sets with a frequency of detection greater than 50%.

95% UCL of 80th Percentile: The concentration corresponding to the 95% upper confidence level ("UCL") of the 80th percentile of the lognormal data distribution.

Trust Screening Level: Screening level for classification of corresponding metal as a potential chemical of concern.

Maximum: Maximum concentration detected in background samples of this lithology (threshold level when there are fewer than 50% detections).

95th Percentile: The concentration corresponding to the 95th percentile of the lognormal data distribution calculated for data sets with a frequency of detection greater than 50%.

95% UCL of 95th Percentile: The concentration corresponding to the 95% UCL of the 95th percentile of the lognormal data distribution.

Trust Threshold Level: Threshold level for classification of corresponding metal as a chemical of concern.

(b) NM means not measured; there were no data above applicable laboratory reporting limits.

(c) NA means not applicable; there were sufficient data to estimate a data distribution so the detection limit or maximum detected concentration are not screening or threshold levels.

(d) A double hyphen ("--") indicates that there were insufficient data above laboratory reporting limits to estimate a data distribution.

(e) The concentration shown was the maximum detected in the data set. DTSC requested that the second highest concentration be used for evaluating the threshold level.

(f) The total number of samples analyzed for selenium was 47. However, 46 of these samples had elevated detection limits and were not considered in the evaluation.

TABLE 6-5
SUMMARY OF BACKGROUND SCREENING AND THRESHOLD DATA, PRESIDIO SOILS

Presidio of San Francisco, California

Metal	Trust Screening and Threshold Levels by Lithology (mg/kg)							
	Serpentinite		Colma		Beach/Dune		Chert/Shale	
	Screening Level	Threshold Level	Screening Level	Threshold Level	Screening Level	Threshold Level	Screening Level	Threshold Level
Antimony	3.0 (DL)	3.0 (DL)	3.0 (DL)	3.0 (DL)	3.0 (DL)	3.0 (DL)	3.0 (DL)	3.0 (DL)
Arsenic	2.5 (80th)	5.4 (95th)	3.9 (UCL80)	6.2 (UCL95)	3.9 (UCL80)	5.9 (UCL95)	2.5 (DL)	3.2 (Max)
Barium	100 (80th)	230 (95th)	99 (UCL80)	180 (UCL95)	54 (UCL80)	120 (UCL95)	310 (UCL80)	900 (UCL95)
Beryllium	0.50 (DL)	1.1 (Max)	0.46 (UCL80)	0.99 (UCL95)	0.52 (UCL80)	0.89 (UCL95)	0.2 (DL)	0.72 (UCL95)
Cadmium	0.80 (DL)	1.9 (Max)	0.80 (DL)	0.8 (DL)	0.80 (DL)	1.7 (Max)	0.80 (DL)	1.7 (Max)
Chromium	1,300 (80th)	1,700 (95th)	95 (UCL80)	140 (UCL95)	81 (UCL80)	120 (UCL95)	13 (UCL80)	41 (UCL95)
Cobalt	140 (80th)	170 (95th)	16 (UCL80)	21 (UCL95)	11 (UCL80)	16 (UCL95)	13 (UCL80)	37 (UCL95)
Copper	18 (80th)	85 (95th)	24 (UCL80)	49 (UCL95)	21 (UCL80)	43 (UCL95)	130 (UCL80)	360 (UCL95)
Lead	21 (80th)	66 (95th)	5.2 (UCL80)	7.5 (UCL95)	21 (UCL80)	57 (UCL95)	10 (DL)	45 (Max)
Mercury	0.2 (DL)	0.2 (DL)	0.2 (DL)	0.2 (DL)	0.2 (DL)	0.2 (DL)	0.2 (DL)	0.2 (DL)
Molybdenum	2.0 (DL)	2.0 (DL)	2.0 (DL)	2.0 (DL)	2.0 (DL)	2.0 (DL)	2.0 (DL)	2.0 (DL)
Nickel	3,100 (80th)	4,500 (95th)	83 (UCL80)	110 (UCL95)	48 (UCL80)	70 (UCL95)	27 (UCL80)	71 (UCL95)
Selenium	0.5 (DL)	0.5 (DL)	0.5 (DL)	0.5 (DL)	0.5 (DL)	0.75 (Max)	0.5 (DL)	0.5 (DL)
Silver	1.0 (DL)	1.7 (Max)	1.0 (DL)	1.0 (DL)	1.0 (DL)	1.0 (DL)	1.0 (DL)	1.0 (DL)
Thallium	1.0 (DL)	1.0 (DL)	1.0 (DL)	1.0 (DL)	1.0 (DL)	1.0 (DL)	1.0 (DL)	1.0 (DL)
Vanadium	51 (80th)	74 (95th)	62 (UCL80)	90 (UCL95)	59 (UCL80)	92 (UCL95)	23 (UCL80)	61 (UCL95)
Zinc	86 (80th)	160 (95th)	43 (UCL80)	60 (UCL95)	42 (UCL80)	66 (UCL95)	41 (UCL80)	120 (UCL95)

Notes:

DL - Detection Limit: A typical detection limit is included when there were insufficient data to calculate a 95% UCL of the 80th and/or the 95th percentiles (e.g., fewer than 50% detections).

Max: Maximum concentration detected in background samples of this lithology (threshold level when there are fewer than 50% detections).

95th: The concentration corresponding to the 95th percentile of the lognormal data distribution calculated for data sets with a frequency of detection greater than 50%. Applied to serpentinite only due to small number of data in background data set.

80th: The concentration corresponding to the 80th percentile of the lognormal data distribution calculated for data sets with a frequency of detection greater than 50%. Applied to serpentinite only due to small number of data in background data set.

UCL95: The concentration corresponding to the 95% UCL of the 95th percentile of the lognormal data distribution.

UCL80: The concentration corresponding to the 95% UCL of the 80th percentile of the lognormal data distribution.

TABLE 6-6
CONCENTRATIONS OF METALS IN REGIONAL BACKGROUND SOIL STUDIES

Presidio of San Francisco, California

Metal	Location and Range of Metal Concentrations Reported											
	N. Santa Clara County (a)		Lawrence Berkeley Lab (b)		California Soils (c)		SF Bay Wetlands (d)		Panoche Creek (e)		Hamilton Air Field (f)	
	150 samples		492 samples		50 samples		14 samples		721 samples		62 samples	
	Minimum Detected (mg/kg)	Maximum Detected (mg/kg)	Minimum Detected (mg/kg)	Maximum Detected (mg/kg)	Minimum Detected (mg/kg)	Maximum Detected (mg/kg)	Minimum Detected (mg/kg)	Maximum Detected (mg/kg)	Minimum Detected (mg/kg)	Maximum Detected (mg/kg)	Minimum Detected (mg/kg)	Maximum Detected (mg/kg)
Antimony	-	-	1	9	0.15	1.95	-	-	-	-	0.06	1.2
Arsenic	0.5	20	0.25	63	0.6	11	5.29	23.7	3.4	21	1.1	25.2
Barium	-	-	0.5	1,300	133	1,400	-	-	12	2,300	26	435
Beryllium	0.25	3.2	0.05	2.7	0.25	2.7	-	-	1	3	0.53	1.68
Cadmium	0.4	14	0.05	16	0.05	1.7	0.14	0.56	-	-	0.41	1.8
Chromium	9.5	170	4.1	478	23	1,579	110	224	11	410	9.6	149
Cobalt	-	-	1.7	39	2.7	46.9	-	-	5	34	5.5	32
Copper	4.6	67	0.3	250	9.1	96.4	24.2	90.6	2	86	5.7	88.7
Lead	3.4	54	0.5	31	12.4	97.1	13.7	85.6	2	96	3.3	85.6
Mercury	0.02	1.3	0.05	2.2	0.1	0.9	0.059	0.515	0.02	2.5	0.07	0.43
Molybdenum	-	-	0.25	63	1	9.6	-	-	2	9	0.28	0.97
Nickel	6	145	6	309	9	509	32.2	145.2	6	380	10	139
Selenium	0.12	4	0.5	28	0.015	0.43	0.14	0.91	0.1	4.5	0.34	0.37
Silver	0.3	4.8	0.2	6.5	0.1	8.3	-	-	-	-	0.1	0.21
Thallium	0.41	3.8	0.5	18 (g)	0.17	1.1	-	-	-	-	5.7	33.7 (i)
Vanadium	-	-	0.5	130	39	288	-	-	30	260	15	136
Zinc	7.8	120	3.8	174	88	236	88.5	166.1	11	230	16.6	232

TABLE 6-6
CONCENTRATIONS OF METALS IN REGIONAL BACKGROUND SOIL STUDIES

Presidio of San Francisco, California

Notes:

(a) Scott, C.M. 1995. *Background Metal Concentrations in Soils in Northern Santa Clara County, California* in Recent Geological Studies in the San Francisco Bay Area, Pacific Section of the Society of Economic Paleontologists and Mineralogists, Volume 76.

(b) Lawrence Berkeley National Laboratory. 1995. *Protocol for Determining Background Concentrations of Metals in Soil at Lawrence Berkeley National Laboratory*. U.S. Department of Energy Contract DE-AC03-76F00098.

(c) Bradford, G.R., et al. 1996. *Background Concentrations of Trace and Major Elements in California Soils*. Kearney Foundation of Soil Science, University of California, Riverside.

(d) Lee, C.R., et al. 1995. *Field Survey of Contaminant Concentrations in Existing Wetlands in the San Francisco Bay Area*. Miscellaneous Paper EL-95, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

(e) Ryder, J.L., et al. 1989. *Analysis of 721 Soil Samples from the Panoche Fan Area of the San Joaquin Valley, California*. USGS Open File Report 89-298.

(f) International Technology Corporation. 27 April 2000. *Draft Human Health and Ecological Risk Assessment, BRAC Property, Hamilton Army Airfield, Novato, California.*

(g) Apparent outliers removed by EKI.

TABLE 6-7
DISSOLVED CHROMIUM AND HEXAVALENT CHROMIUM CONCENTRATIONS IN SURFACE WATER, SEEPS, AND GROUNDWATER (a)

Presidio of San Francisco, California

Site	Surface Water, Seep, or Groundwater Sample Location	Is Monitoring Well Screened in Serpentinite?	Range of Dissolved Chromium (b); (c)		Range of Hexavalent Chromium (b); (c)	
			minimum	maximum	minimum	maximum
Main Post:						
• Building 215 Area	215GW01	no	**17**	**26.8**	**12**	**38**
	215GW02	no	**31.8**	**31.8**	**23.5**	**26**
	215GW03	no	**29.5**	**29.5**	**24.6**	**26**
Fort Scott:						
• Battery Howe/Wagner	HWGW01	yes	**82**	**146**	**120**	**220**
	HWGW04	yes	**7**	**18**	**7.4**	**36.6**
	HWGW05	yes	<1	<10	<0.5	**16.1**
	HWGW100	yes	- (d)	-	**40**	**40**
	HWGW101	yes	-	-	**40**	**40**
	HWSW100	seep	-	-	**10**	**10**
	BHWSP01	seep	**6**	**6**	-	-
	BHWSP02	seep	<3	<3	-	-
Letterman Complex:						
• Fill Site 6	LF6GW100	no	<10	<10	-	-
	LF6GW101	no	**12**	**12**	-	-
	LF6GW102	no	<10	<10	-	-
	LF6GW103	no	**27**	**28**	-	-
Public Health Service Hospital:						
• Landfill 8	LF8GW01	yes	**2.3**	**16 (50.7); (e)**	-	-
	LF8GW02B	yes	**20**	**58.4**	-	-
	LF8GW03	no	**22**	**32.3**	-	-
	LF8GW04	no	**1.9**	**25.4**	-	-
	LF8GW06	no	<10	<10	-	-
• Landfill 10	LF10GW01	yes	**71.5**	**110**	-	-
	LF10GW02	no	<1	<10	-	-
	LF10GW03	yes	**2.1**	**14**	-	-
East Housing:						
• Landfill E	DAEGW03	no	**15**	**30**	-	-
	DAEGW04	no	**10**	**23.4 (130); (e)**	-	-
	DAEGW05	no	<10	**22**	-	-
	DAEGW06	yes (f)	<1	<10	-	-
	DAEGW07	no	<1	<10	-	-
	DAEGW08	no	**1**	**19**	-	-
	DAESP01	seep	<3	**20.4**	-	-
	DAESP02	seep	<10	<50	-	-
	DAESP02A	seep	<3	<3	-	-
	DAESP03	seep	<10	**29.1**	-	-
	DAESP04	seep	<10	<10	-	-

TABLE 6-7
DISSOLVED CHROMIUM AND HEXAVALENT CHROMIUM CONCENTRATIONS IN SURFACE WATER, SEEPS, AND GROUNDWATER (a)

Presidio of San Francisco, California

Site	Surface Water, Seep, or Groundwater Sample Location	Is Monitoring Well Screened in Serpentinite?	Range of Dissolved Chromium (b); (c)		Range of Hexavalent Chromium (b); (c)	
			minimum	maximum	minimum	maximum
East Housing (contd):						
• Fill Site 1	LF1GW01	no	<1	<10	**1.3**	**15.1**
	LF1GW02	no	**11**	**40.4**	**32.1**	**34.5**
	LF1GW03	no	**34**	**49**	**38.3**	**137**
	LF1GW04	yes (f)	**16**	**24**	**18.9**	**82.4**
	LF1GW05	no	**9**	**12**	**2.1**	**102**
	LF1GW06	no	**5**	**22.4**	**10.7**	**31.1**
	LF1GW07	yes (f)	**14**	**29**	<10	**24.7**
	LF1SP01	seep	<3	<10	-	-
	LF1SP02	seep	<3	<10	-	-
• Tennessee Hollow	TH-1	yes (g)	**17.1**	**17.4**	**12**	**14**
	TH-2	no	**20.4**	**23.1**	<10	**19**
	TH-3	no	<10	**16.7**	<10	<10
	TH-4	no	**20.9**	**22.2**	**19**	**26**
• El Polin Spring	EPSP01 (h)	seep	**19**	**29**	**22.4**	**29.7**
Presidio Hill:						
• Nike Facility and Nike Swale	NKGW01	yes	**2.5**	**4.1**	-	-
	NKGW02	yes (f)	**5.9**	**20**	<10	<10
	NKGW03	no	<10	<10	<10	<10
	NKGW04	yes	**4.2**	<10	<10	<10
	NKGW05	yes	**4.8**	**23**	<10	<10
	NSSW100	surface water	-	-	ND (i)	ND
Presidio Forest:						
• Landfill 2	LF2GW01	yes	**6**	**14**	**5**	**29.9**
	LF2GW02	yes	<1	<10	<0.5	**13.7**
	LF2GW04	yes (f)	<1	<10	**0.72**	<10
	LF2SP01	seep	<3	<10	-	-
• Landfill 4	LF4GW03	no	**2**	<10	<10	<10
• Building 1349 Area	1349MW01	yes (j)	-	-	<10	<10
	1349MW02	yes	-	-	**43**	**43**
Coastal Bluffs:						
• Fill Site 5	1349MW03	yes	-	-	**69**	**69**
	LF5GW100	yes	**31**	**31**	**30**	**30**
	LF5GW101	yes	**36**	**38**	**40**	**40**

TABLE 6-7
DISSOLVED CHROMIUM AND HEXAVALENT CHROMIUM CONCENTRATIONS IN SURFACE WATER, SEEPS, AND GROUNDWATER (a)

Presidio of San Francisco, California

Site	Surface Water, Seep, or Groundwater Sample Location	Is Monitoring Well Screened in Serpentinite?	Range of Dissolved Chromium (b); (c)		Range of Hexavalent Chromium (b); (c)	
			minimum	maximum	minimum	maximum
Upland Areas of Presidio:						
Background Locations	UBR01GW01	yes	**25**	**66**	**26.6**	**65.4**
	UBR02GW01	yes	**48**	**49**	**45**	**52.1**
	UBR02GW02	yes	**98**	**100**	**89.2**	**98.3**
	UBR03GW01	no	<10	<10	<0.5	<0.5
	UBR03GW02	no	<10	<10	**0.64**	**0.64**

Notes:

(a) Surface water, seep, and groundwater sample analytical results were obtained from an electronic database assembled by Montgomery Watson, and the following additional sources:

- Montgomery Watson. 1998 and 1999. *Groundwater Monitoring Program. Building 1349 Area.*
- Montgomery Watson. 16 July 1999. *Hexavalent Chromium in Serpentinite Bedrock and Groundwater in Upland Areas.*
- Erler & Kalinowski, Inc. October 2000. *Draft Sampling Results for Selected Main Installation Sites.*

(b) Analytical results of dissolved chromium and hexavalent chromium in groundwater consist of filtered samples and unfiltered samples collected through use of low flow sampling techniques.

(c) Analytical results of unfiltered samples are included for dissolved chromium and hexavalent chromium in surface water and freshwater seeps.

(d) Hyphen indicates sample not analyzed or analytical results are not available.

(e) Concentration in parenthesis is not likely representative of dissolved chromium because high concentrations of other metals in sample indicate filter breakthrough likely occurred.

(f) Screened in serpentinite or Franciscan Formation at the bottom of monitoring well only.

(g) Lithologic log of boring in which monitoring well was constructed indicates greenish clay that is possibly weathered serpentinite.

(h) Seep samples consist of samples identified as EPSP01, EPSPRING, EPSPRING2, and EPSSWO1.

(i) Not detected ("ND"). Chromium was not measured above analytical laboratory reporting limit. Reporting limit value was not provided in reference reviewed.

(j) Monitoring well is screened in melange, which typically contains serpentinite fragments. Lithologic log of boring in which monitoring well was constructed indicates weathered serpentinite at bottom of boring.

FIGURES

N

0 800 1600

(Approximate Scale in Feet)

LEGEND

Quarternary Surficial Deposits

- Qaf — Artificial Fill
- Qb — Modern Beach Deposits
- Qsr — Slope Debris & Ravine Fill
- Qd — Dune Sand
- Ql — Landslide Deposits
- Qu — Undivided Surficial Deposits
- Qob — Older Beach Deposits
- Qc — Colma Formation

Mesozoic Franciscan Formation Bedrock

- Ks — Undifferentiated Sheared Rocks
- KJsp — Serpentinite
- KJc — Radiolarian Chert & Shale
- KJss — Sandstone
- KJs — Undifferentiated Sandstone & Shale

Notes:

1. All locations are approximate.
2. Figure modified from Montgomery Watson, Draft Basewide Groundwater Monitoring Plan, July 1996.

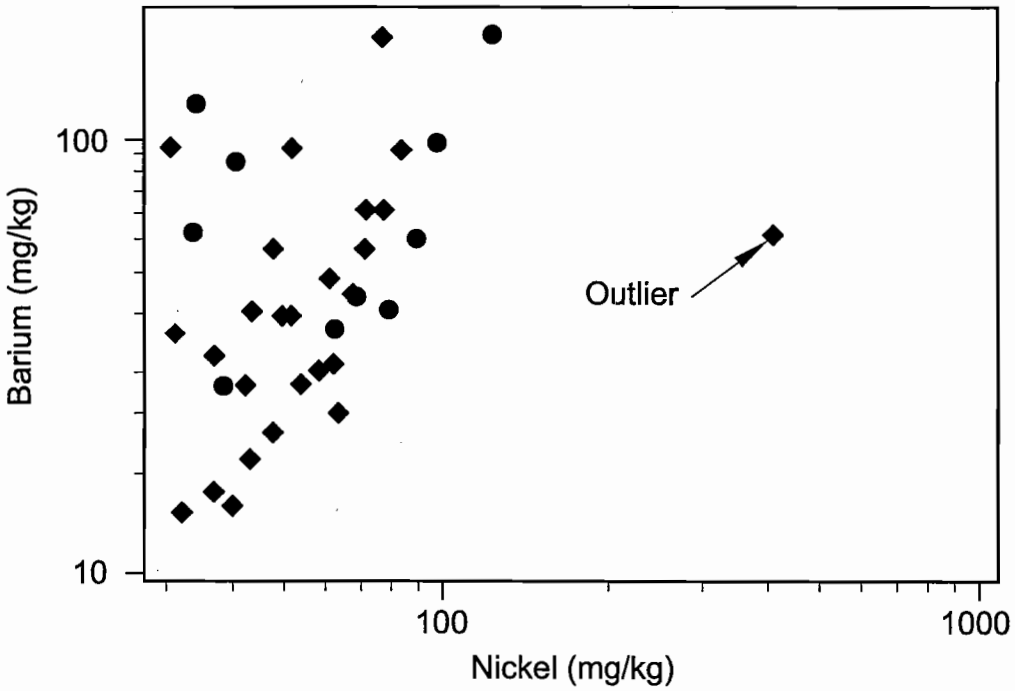
Erler & Kalinowski, Inc.

Surface Deposits at the Presidio

Presidio Trust
San Francisco, CA
October 2002
EKI A000003.04

Figure 6-1

Colma Formation Soils
Outlier Identification



LEGEND:

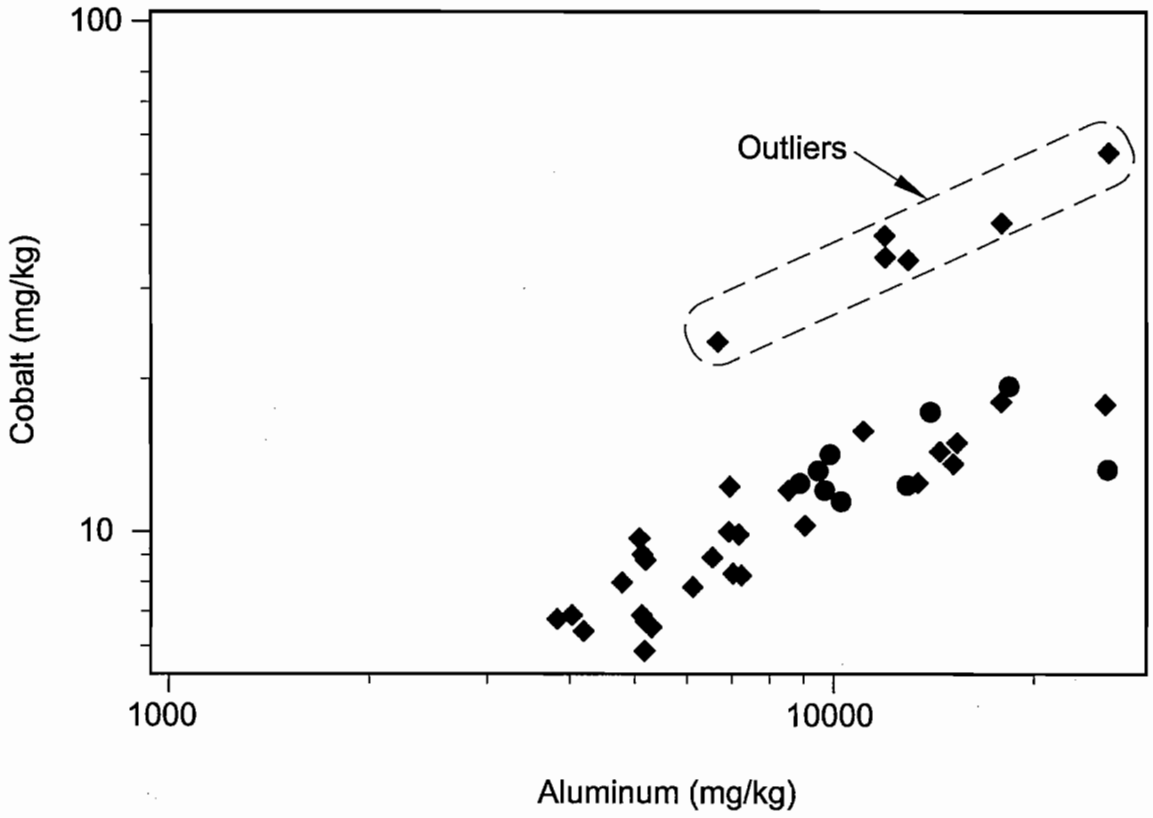
- ● Background
- ◆ Site

Erler & Kalinowski, Inc.

Screening of Individual Outlier from Proposed Colma Background Data Set

Presidio Trust
San Francisco, CA
September 2002
EKI A000003.04

Figure 6-2



LEGEND:

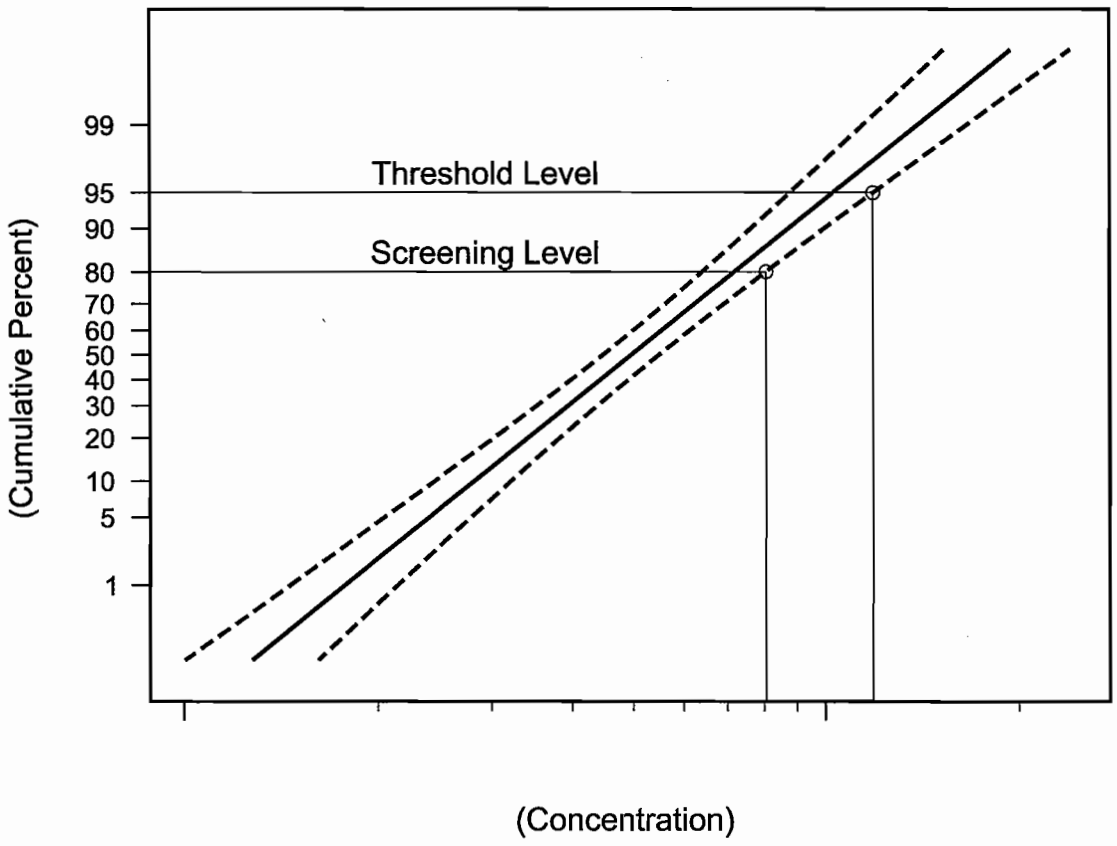
- ● Background
- ◆ Site

Erler & Kalinowski, Inc.

Screening of Outlier Trend from Proposed Colma Background Data Set

Presidio Trust
San Francisco, CA
September 2002
EKI A000003.04

Figure 6-3



LEGEND:

——— Lognormal Metal Population

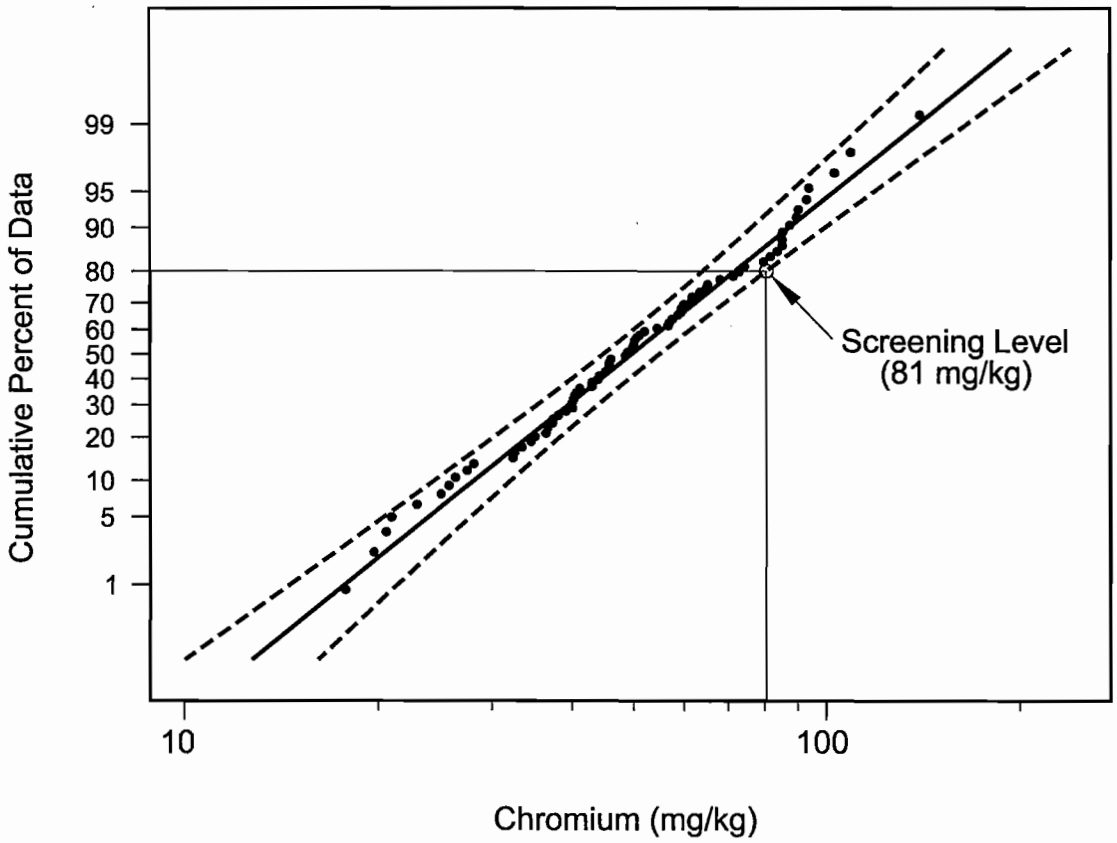
----- 95% Confidence Interval Around Metals Population

Erler & Kalinowski, Inc.

Schematic Data Plot Showing Terminology Used to Define Screening and Threshold Metals Levels

Presidio Trust
San Francisco, CA
September 2002
EKI A000003.04

Figure 6–4



LEGEND:

- 80th Percentile
- 95% Confidence Interval Around Metals Population
- Lognormal Metal Population

Erler & Kalinowski, Inc.

Derivation of Screening Level Concentration for Chromium in Background Beach/Dune Soil

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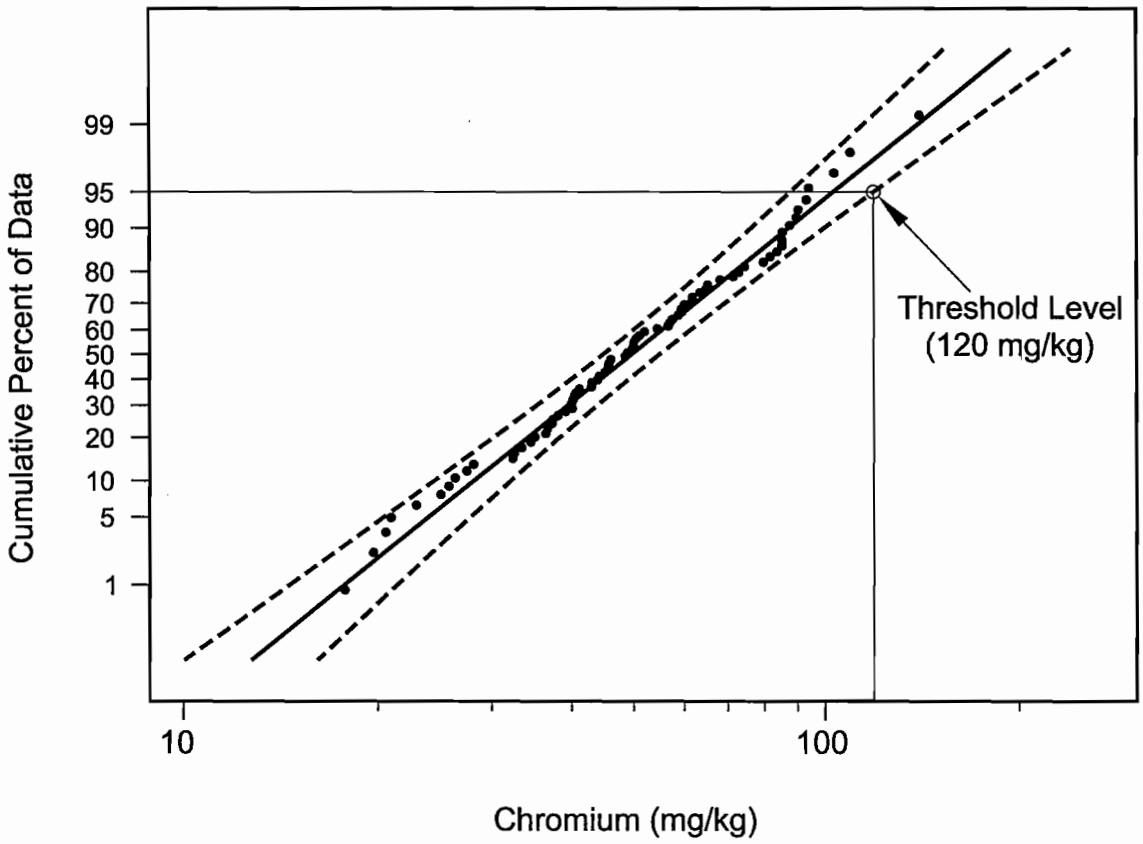
San Francisco, CA
September 2002
EKI A000003.04

Figure 6-5



LEGEND:

- 95th Percentile
- 95% Confidence Interval Around Metals Population
- Lognormal Metal Population

Erler & Kalinowski, Inc.

Derivation of Threshold Level Concentration for Chromium in Background Beach/Dune Soil

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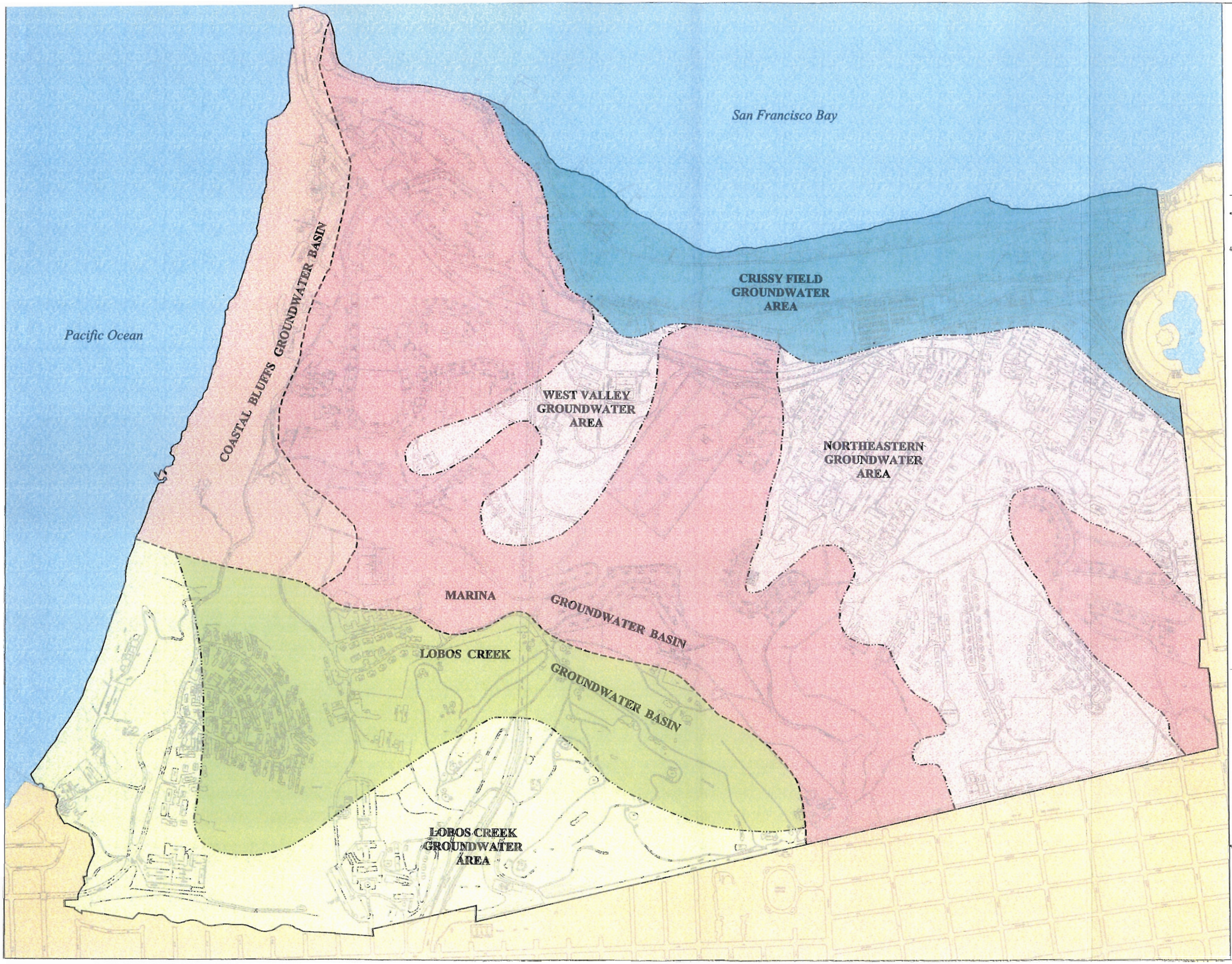
September 2002
EKI A000003.04

Figure 6-6



N

0 800 1600

(Approximate Scale in Feet)

LEGEND

- Groundwater Basin Boundaries
- Groundwater Area Boundaries
- Coastal Bluffs Groundwater Basin
- Lobos Creek Groundwater Basin
- Lobos Creek Groundwater Area
- Marina Groundwater Basin
- West Valley and Northwestern Groundwater Area
- Crissy Field Groundwater Area

Notes:

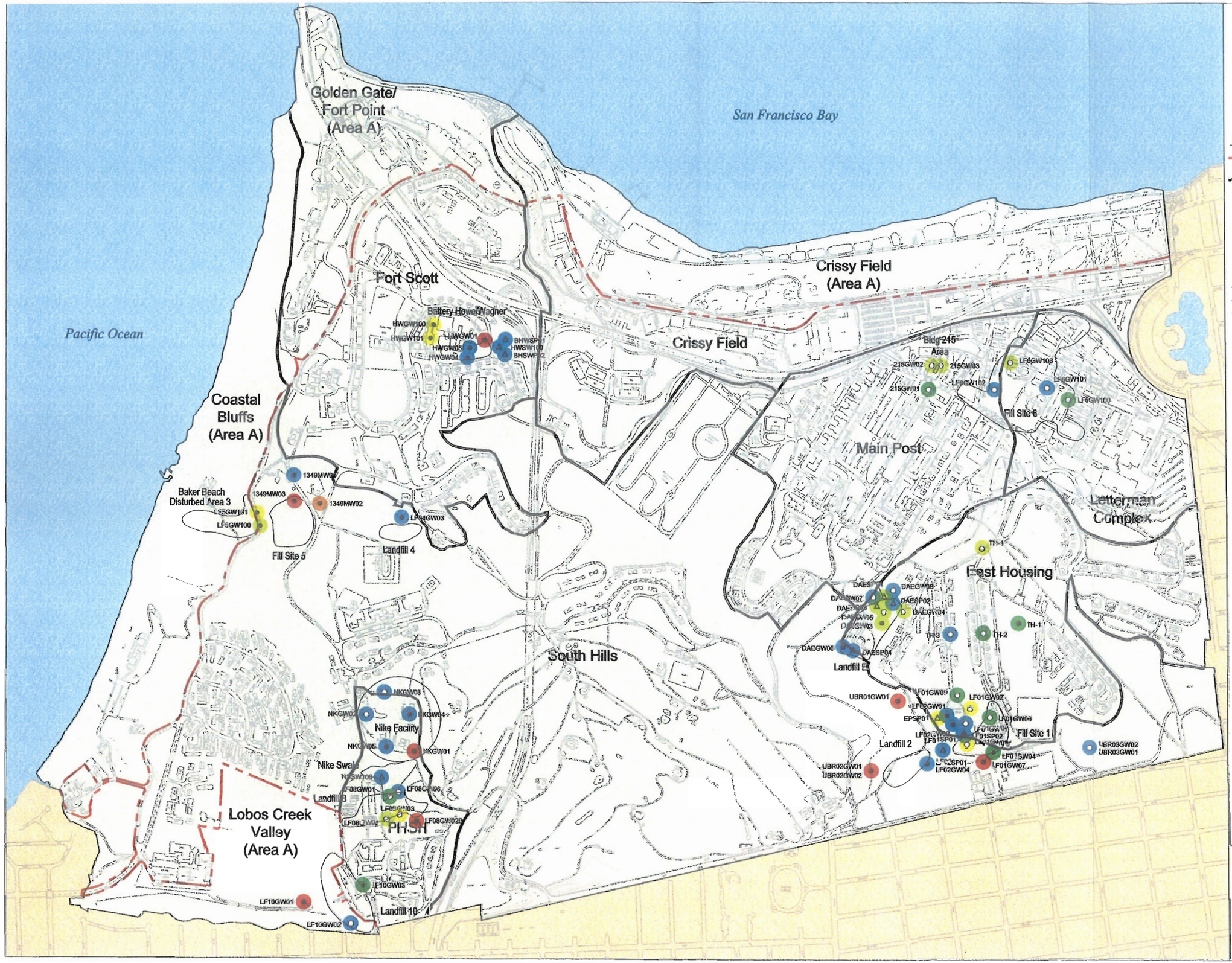
1. All locations are approximate.
2. Figure modified from Montgomery Watson, Draft Basewide Groundwater Monitoring Plan, July 1996.

Erler & Kalinowski, inc.

Groundwater Basins and Areas at the Presidio

Presidio Trust
San Francisco, CA
October 2002
EKI A000003.04

Figure 6-7



N

0 800 1600

(Approximate Scale in Feet)

LEGEND

- Area A/B Boundary
- Presidio Planning Area or District Boundary
- Groundwater Monitoring Well Screened in Serpentinite
- Groundwater Monitoring Well Screened in Other Formations
- Seep or Surface Water Sample

Dissolved Chromium and Hexavalent Chromium Concentrations in µg/L

- 0–10
- 10–20
- 20–30
- 30–40
- 40–50
- >50

Note:

1. All locations are approximate.

References for Groundwater Data:

Analytical Results Obtained from: Draft Sampling Results for Selected Main Installation Sites, Presidio of San Francisco, California, Erler & Kalinowski, Inc., October 2000.

Montgomery Watson, Hexavalent Chromium in Serpentinite Bedrock and Groundwater in Upland Areas, Technical Memorandum, Presidio of San Francisco, 16 July 1999.

Montgomery Watson, Groundwater Monitoring Program, Annual and Quarterly Summary Reports, 1998 and 1999.

U.S. EPA, Analytical Results, Elemental Constituent Results for Groundwater Samples, Presidio Army Base, San Francisco, California, 24 February 1999.

U.S. EPA, Analytical Reports, Inorganic Results for Samples from Presidio Army Base, San Francisco, California, 30 April 1997.

Dames & Moore, Final Remedial Investigation Report, Presidio Main Installation, January 1997.

Erler & Kalinowski, Inc.

Chromium Concentrations in Surface Water, Seeps, and Groundwater

Presidio Trust
San Francisco, CA
October 2002
EKI A000003.04

Figure 6-8

7. DERIVATION OF CLEANUP LEVELS

7. DERIVATION OF CLEANUP LEVELS

Remedial measures should assure protection of human health and the environment. U.S. EPA (1995c, 1991c, 1989a) requires remedies to take into account future land use that is reasonable and that is associated with the most significant risk posed by exposure to COCs. Accordingly, remedial action objectives ("RAOs") for Presidio sites consist of implementing remedies that are cost-effective, and prevent humans and ecological receptors from being exposed to unacceptable concentrations of COCs but still allow the reuse described in the GMPA and PTMP or other planned uses envisioned by the Trust. To determine the appropriate cleanup levels that should be applied to specific areas of the Presidio, future land use and planned water resource use at Presidio sites must be clearly defined. Sections 7.1 and 7.2 describe the planned land and water resource uses at the Presidio. Section 7.3 presents the procedures to determine which specific cleanup levels are applicable to a given site.

7.1 PLANNED LAND USES

Figures 7-1 and 7-2 depict planned human and ecological land use at the Presidio.

7.1.1 Human Land Use

Four broad categories of land use are defined in the GMPA for the Presidio (and are generally maintained in the PTMP). These categories consist of residential, recreational, institutional (education/conference), and industrial uses. The hatch type on Figure 7-1 signifies residential, recreational, institutional, and commercial/industrial areas on the Presidio and the color type depicts the corresponding cleanup levels that will protect people who reside, work, or visit these areas. Suitable cleanup levels are defined by the most sensitive population that is reasonably associated with the planned land use identified for different areas of the Presidio. These soil cleanup levels should be applied to a depth of 10 feet below ground surface, to account for soil disturbance during potential future construction.

7.1.1.1 Residential

Significant portions of the Presidio are designated as residential areas. Residential cleanup levels are applied to those Presidio sites situated in areas that have the following uses:

- **Residential:** Residential use is designated for single family housing and the grounds extending 150 feet from the structures in all directions, as well as playgrounds, and common areas near such housing. For example, it is reasonable to assume that children living in housing next to Fill Site 1 will use the open space at Fill Site 1 for a play area. Similarly, Julius Kahn playground is considered a

"residential" area because adults and children who live adjacent to the Presidio spend considerable time at this playground and use it like a "backyard."

- **Institutional (Educational/Conference):** As described in the GMPA and PTMP, several areas of the Presidio will be used as educational/conference centers. Housing in these areas will provide permanent and temporary lodging for tenant employees and their families, visiting scholars, students, and researchers. While the land use for such areas generally may be described as institutional, the distinction between residential and institutional housing is inconsequential for purposes of selecting appropriate cleanup levels. The potential exposure scenarios for people living in such housing are comparable to those living in single family residences. Accordingly, residential cleanup levels are applied to institutional housing. For example, the GMPA and PTMP indicate Fort Scott may be used for education, research, and training. The barracks would provide residential accommodations for people completing short- and long-term internships.

7.1.1.2 Recreational

Recreational cleanup levels are applied to those Presidio sites situated in areas that have the following land uses:

Commercial/Recreational: Areas and the surrounding open spaces surrounding such places as museums, visitor centers, and park partner buildings will be frequented by recreational users, including children who likely will be picnicking and playing in the areas surrounding the buildings (e.g., the Main Post and Crissy Field). At sites having such mixed or multiple uses, the population having the most significant risk (i.e., the most sensitive user) determines the applicable cleanup levels. For the Presidio, the most sensitive populations frequenting commercial/recreational areas will be recreational users.

Open Spaces: Areas of the Presidio not designated as residential, institutional, commercial/recreational, or industrial use areas are open spaces. Recreational users will frequent open spaces. Accordingly, recreational cleanup levels are applied in such areas.

7.1.1.3 Commercial/Industrial

As shown on Figure 7-1, only a small portion of the Presidio can be considered strictly commercial/industrial. These commercial/industrial areas consist of the water treatment plant area and the park maintenance facilities at Building 1750. Commercial/industrial cleanup levels are applied to these areas.

7.1.2 Ecological Land Use

The planned and existing ecological land use areas depicted on Figure 7-2 encompass most open spaces and recreational areas. Also included on Figure 7-2 are the saltwater and freshwater ecological protection zones defined in Order 96-070 issued by RWQCB in 1996 to the U.S. Army. In this order, the Tennessee Hollow riparian corridor, the Crissy Field wetlands, and Crissy Field shoreline are identified as sensitive habitats requiring more stringent petroleum hydrocarbon cleanup levels than elsewhere on the Presidio. The area where more stringent petroleum cleanup levels apply to the Tennessee Hollow riparian corridor is designated as the freshwater ecological protection zone. The area where more stringent petroleum cleanup levels apply to the Crissy Field wetlands is designated as the saltwater ecological protection zone.

Figure 7-3 indicates the vegetation types to be preserved and rehabilitated at the Presidio. This figure is taken from the VMP. Native plants, including threatened or endangered species, and historic plants are some of the vegetation types to be preserved and their growth enhanced in the future. Also to be preserved and enhanced under the VMP is the historic forest. The historic forest originates from the efforts of Army Major W.A. Jones. In 1883, Major Jones proposed a major tree-planting program to create windbreaks and to visually enhance the ridges, entrances, and perimeters of the Presidio. Planting of the historic forest began in 1886 and continued until the early 1900s.

Arguably, ecological cleanup levels should apply throughout the Presidio since activities at all locations may have some impact on the environment. However, review of the GMPA, VMP, and PTMP suggest that most ecologically sensitive areas and special status species[11] areas encompass land designated for open space and recreational use (e.g., forested areas of South Hills, , Coastal Bluffs, Lobos Creek), and areas designated as ecological protection zones (i.e., Crissy Field wetlands, Crissy Field shoreline, and concomitant drainage area that includes the Tennessee Hollow riparian corridor). Figure 7-2 identifies areas where special status species are assumed to be present and ecological special status cleanup levels are applicable. These areas were established from the VMP and correspond to native plant habitat areas and forested areas. The remaining areas of the Presidio designated as ecological land use areas where special status species are not likely to be present (e.g., the golf course in the South Hills) are established as "buffer zone" ecological areas subject to the less-stringent buffer zone ecological cleanup levels (see Figure 7-2). Areas on Figure 7-2 where ecological cleanup levels are not applicable generally correspond to developed areas of the Presidio.

As described above, in areas where special status species are likely to be present, more stringent cleanup levels are applicable than in buffer zone ecological areas. However, the NPS (in Area A) and the Trust (in Area B), will have the option to assess and modify the applicability of special status cleanup levels on a site-by-site basis. In such cases, the

[11] Special status species include those species that are listed or proposed for listing as threatened or endangered under federal or state Endangered Species Acts, the California Native Plant Protection Act, the Migratory Bird Treaty Act, California Species of Special Concern as defined by the California Department of Fish and Game, or protected by other laws.

Trust or NPS will coordinate with the State or Federal natural resource trustees, as appropriate, to determine if special status species are present at these sites. Such areas could include locations that are not currently identified as ecological land use on Figure 7-2. If an area demarcated as special status species on Figure 7-2 is modified to be a buffer zone ecological area or a non-ecological area (i.e., a less stringent cleanup level would become applicable), then the Trust must obtain approval from the DTSC to change the applicable cleanup level. Where ecological land uses overlap with human land uses, the more stringent cleanup level is the assigned cleanup level upon which remedial actions will be based. The identification of applicable cleanup levels at individual sites is described in more detail in Section 7.3.

7.2 PLANNED WATER RESOURCE USE

U.S. EPA has established in the NCP various expectations regarding the types of remedies that it has determined are consistent with (1) preferences and mandates set forth in Section 121 of CERCLA and (2) its practical experience in complying with such preferences and mandates (Federal Register, 1990). U.S. EPA expects, in part, to return usable groundwater to its beneficial use wherever practicable, within a reasonable time frame. When restoration of groundwater is not practicable, the NCP at 40 CFR §300.430(a)(1)(iii)(F) states that U.S. EPA expects that action will be taken to prevent continued migration of contamination, prevent exposure to the contaminated groundwater, and evaluate further risk reduction. Similar expectations are contained in California's laws, regulations, and policies (e.g., California Water Code §13304 and SWRCB Resolution No. 92-49).

Both the GMPA and RWQCB (1995) recognize that beneficial uses of groundwater at the Presidio include municipal or potable water supply and recharge to streams that enhance ecological and recreational uses. Surface water flow in Lobos Creek has provided most of the potable water at the Presidio. Planned future use of surface water and groundwater at the Presidio includes potable supply (NPS, 1994). As described in the GMPA, potable supply will continue to be provided by on-site sources but reliance on surface water will be reduced in favor of increased use of groundwater. The reasons for this change are that groundwater is less intensive to treat than surface water and that the Lobos Creek ecosystem might benefit if surface water is not diverted (NPS, 1994).

Besides potable supply, beneficial uses of surface water and groundwater that discharges to water bodies at the Presidio include ecological and recreational uses. Areas of the Presidio where ecological and recreational beneficial uses should be protected include, at a minimum, Lobos Creek drainage basin, Tennessee Hollow drainage basin, Nike Swale, Mountain Lake, Crissy Field wetlands, and coastal and shoreline areas.

7.3 PRESIDIO CLEANUP LEVELS APPLICABLE TO SPECIFIC SITES

According to U.S. EPA (1991a), under the NCP, chemical-specific ARARs and risk-based PRGs are the two sources that can be used to establish cleanup levels that remedial actions must achieve under a ROD or RAP. Chemical-specific ARARs identified in Section 3 have been adopted as proposed cleanup levels, if available and greater than naturally occurring or background concentrations of metals in soil and water. In the absence of chemical-specific ARARs, risk-based PRGs derived in Sections 4 and 5 are used as cleanup levels if the PRGs are greater than background concentrations of metals in soil and water.

Naturally occurring metal concentrations should be considered when adopting chemical-specific ARARs and PRGs as cleanup levels for a site because it is not the intent of U.S. EPA (1992b, 1989a) nor DTSC (1999) to have releases of COCs remediated to concentrations below inorganic background levels. To reduce the potential of this event occurring at Presidio sites, chemical-specific ARARs and PRGs were compared to threshold concentrations of metals in soil to determine if the chemical-specific ARARs and PRGs are attainable cleanup levels.

It should also be recognized that chemical-specific ARARs and PRGs derived from toxicological data may be below the range of typical analytical method reporting limits for some PCOCs, such as SVOCs, and PCBs, pesticides, and herbicides in water. The typical analytical method reporting limits range from 0.1 to 10 µg/L for SVOCs by U.S. EPA Methods 8310 and 8270, and from 0.05 to 0.5 µg/L for PCBs, pesticides, and herbicides by U.S. EPA Methods 8081 and 8082 (U.S. EPA, 1997c). For those PCOCs in water, the Trust has selected the chemical-specific ARAR or PRG as the desirable cleanup level, but attainment can only be determined at the standard analytical method reporting limit. For SVOCs, PCBs, pesticides, herbicides and other classes of compounds that may have very low chemical-specific ARARs or PRGs in soil or water, the cleanup levels are established at the typical analytical method reporting limit ranges for these PCOCs assuming no matrix interference. In the event of matrix interference in soil or water samples, actual method reporting limits determining compliance with cleanup levels may be raised.

To allow timely reuse contemplated under the GMPA, the Army addressed chemical release sites at DEH and Crissy Field under separate RAPs. These RAPs (Army and DTSC, 1997 and 1998,) contained cleanup levels specific to sites at DEH and Crissy Field. Cleanup levels in the DEH and Crissy Field RAPs should be used at sites considered under those RAPs to avoid confusion regarding which cleanup levels should be applied in the event that additional contamination is discovered at these areas. The cleanup levels presented in this Presidio-wide Cleanup Level Document are intended for use at all other chemical release sites at the Presidio (e.g., Main Installation sites, the Firing Ranges, and new sites that may be discovered).

Based on chemical-specific ARARs and risk-based PRGs, human health cleanup levels for soil, ecological cleanup levels for soil and sediment, and cleanup levels for surface

water, seeps, and groundwater were developed for the Presidio. Table 7-1 summarizes the process used to identify site-specific cleanup levels applicable to each Presidio site. The table presents the evaluation steps, potential parameters, and reference figures or tables from this document to identify which cleanup level applies to a given site. Fill Site 1 is included in Table 7-1 as an example. Sections 7.3.1 through 7.3.4 discuss the basis for the human health cleanup levels for soil, ecological cleanup levels for soil and sediment, and cleanup levels for surface water, seeps, and groundwater developed for the Presidio and referenced in Table 7-1. Section 7.3.5 revisits Table 7-1 and illustrates how site specific cleanup levels are determined for the Presidio.

7.3.1 Human Health Cleanup Levels for Non-Petroleum Compounds in Soil

Chemical-specific ARARs for soil are available for only a limited number of contaminants. Human health cleanup levels for lead, PCBs, VOCs, and petroleum hydrocarbons in soil and water at the Presidio are generally derived from ARARs (for some receptors, the cleanup levels for these compounds are risk-based). Cleanup levels for remaining PCOCs in soil are risk-based PRGs or, in the case of metals, background concentrations if naturally occurring levels of metals in soil are greater than PRGs. Background concentrations of metals in serpentinite, Colma Formation, beach/dune sand, and chert/shale are derived in Tables 6-1 through 6-4, respectively, and summarized in Table 6-5. These four soil types are the primary lithologies encountered at the Presidio. Chert/shale, believed to be imported from Marin County, has been used as fill and base rock at Crissy Field and other locations at the Presidio and is not necessarily considered chemically-impacted soil material.

The 5 January 2001 *Federal Register* stated that TSCA was amended to establish a hazard standard of 400 mg/kg lead in bare residential soil. A human health cleanup level of 400 mg/kg of lead in soil is being used as a not-to-exceed value for residential areas at the Presidio; the PRG of 370 mg/kg of lead in soil derived in Section 4.2.10 is being used as a maximum average lead concentration in soil at residential sites.

Requirements governing cleanup of PCB-containing soil and wastes were broadened by amendments to TSCA in 1998. As part of these amendments, U.S. EPA added 40 CFR §761.61 to Subpart D of TSCA, which provides cleanup and disposal provisions for PCB-containing soil and other types of remediation wastes. This section of Subpart D sets cleanup levels for high occupancy areas (e.g., residence) at 1 mg/kg of PCBs in soil. However, the human health PRGs for PCBs were calculated in Tables 4-3 through 4-5. For the residential and recreational land uses, the calculated site-specific PRGs for PCBs are less than 1 mg/kg. Therefore, the calculated value is proposed as the cleanup level for those populations. For the commercial/industrial land use, a human health cleanup level of 1 mg/kg of PCBs is proposed to comply with TSCA because the site-specific PRG is greater than the TSCA value. Cleanup levels for petroleum hydrocarbons and related constituents are presented in Section 7.3.3.

Soil cleanup levels for PCOCs other than lead in residential areas, PCBs in commercial/industrial locations, most VOCs, and petroleum hydrocarbons are risk-based

PRGs presented in Section 4. As presented in Sections 4.2.7 and 4.2.9, PRGs for most VOCs were established as the Groundwater Protection RBSL. Table 7-2 includes human health cleanup level values for PCOCs in soil, other than petroleum hydrocarbons and related constituents. Naturally occurring concentrations of metals in soil are also shown on this table, to ensure that the cleanup level used for a given PCOC and specific lithology is not less than background levels. The human health cleanup levels also need to be compared to the ecological cleanup levels in Table 7-2, as appropriate, to identify the lowest applicable cleanup level for the location (Figures 7-1 and 7-2).

7.3.2 Ecological Cleanup Levels for Non-Petroleum Compounds in Soil and Sediment

Figure 7-2 indicates areas of the Presidio where habitat suitable for ecological receptors exists or is planned. Buffer zone and special status ecological cleanup levels pertain to specific areas shown on Figure 7-2. Ecological cleanup levels do not apply to locations that are paved or dominated by designed landscapes (e.g., lawns or ornamental plantings). The NPS (in Area A) and the Trust (in Area B), will have the option to assess and modify the applicability of ecological cleanup levels on a site-by-site basis, with approval from DTSC if the applicable cleanup level is changed to a less stringent value (e.g., modifying a buffer zone ecological area to a non-ecological area).

Table 7-2 lists ecological PRGs that are used for the development of ecological cleanup levels of non-petroleum compounds. The table identifies buffer zone and special status species cleanup levels, which can be compared to background metal and human health cleanup levels to identify the lowest appropriate cleanup level for a location.

Tables 7-3 and 7-4 list ecological cleanup level values for non-petroleum compounds in freshwater and marine sediment at the Presidio, respectively. The tables include cleanup levels for special status species, if available. In the absence of values for special status species, the regular ecological cleanup levels should be used. To account for naturally occurring concentrations of metals in the primary lithologies encountered at the Presidio, ecological cleanup levels for sediments have been developed separately for serpentinite, Colma Formation, beach/dune sand, and chert/shale lithologies.

7.3.3 Human Health and Ecological Cleanup Levels for Petroleum Hydrocarbons and Constituents in Soil and Sediment

Cleanup levels for petroleum hydrocarbons and related constituents developed in connection with Order No. 96-070 are being adopted for areas of the Presidio where releases of petroleum hydrocarbons may have occurred with other types of chemicals. Cleanup levels for petroleum hydrocarbons and related constituents were included in Order No. 96-070 or were developed from subsequent studies required by the order. These studies consisted of performing bioassays and reviewing toxicological data published in scientific literature to develop cleanup levels for the saltwater ecological protection zone (IT Corporation, 1997) and freshwater protection zone (Montgomery Watson, 1999b).

Cleanup level values for petroleum hydrocarbons and related constituents in soil and sediment within the saltwater and freshwater ecological protection zones, and at other areas of the Presidio are summarized in Table 7-5. Figure 7-2 identifies the locations of the saltwater and freshwater ecological protection zones. For sites within these zones, cleanup levels for ecological protection must include not only the values for terrestrial receptors, but also the values for saltwater or freshwater aquatic organisms listed in Table 7-5.

7.3.4 Cleanup Levels for Surface Water, Seeps, and Groundwater

Chemical-specific ARARs were used to establish groundwater and surface cleanup levels for protection of human health and the environment. Promulgated MCLs or published action levels have been adopted as cleanup levels to protect human health due to groundwater ingestion (U.S. EPA, Region IX, 2000d).

Promulgated water quality criteria were applied to existing and planned freshwater surface bodies, and groundwater that recharges surface water or emerges as seeps. Existing surface water bodies at the Presidio include Mountain Lake, Crissy Field wetlands, and Lobos Creek. In addition, Tennessee Hollow and Dragonfly Creek are recognized surface water resources of the Presidio and will be treated as such in applying cleanup levels. Water quality criteria adopted as cleanup levels for surface water and groundwater that recharges surface water at the Presidio are intended to protect freshwater aquatic organisms, and humans who may drink the water and consume fish or other organisms inhabiting the water bodies from chronic exposure to PCOCs. Water quality criteria adopted as cleanup levels for freshwater seeps at the Presidio are intended to protect freshwater aquatic organisms from chronic exposure to PCOCs. Seeps observed at the Presidio are not considered potential habitat that would support fish or other organisms that could be consumed by humans. Water quality criteria used to establish surface water, groundwater recharge to surface water, and seep cleanup levels were obtained from the following references:

- RWQCB *Water Quality Control Plan, San Francisco Bay Basin* or Basin Plan, dated 21 June 1995.

- Title 40 CFR §131.38, *Establishment of Numerical Criteria for Priority Toxic Pollutants for the State of California* or CTR.

Table 7-6 presents cleanup level values for PCOCs in surface water, seeps, and groundwater. Groundwater cleanup level values for PCOCs in Table 7-6 are established as drinking water standards (i.e., MCLs or action levels) unless the site is located near a surface water body (e.g., Mountain Lake, Tennessee Hollow riparian corridor, Lobos Creek) or seep. For sites near surface water bodies, cleanup levels based on water quality criteria for protection of aquatic life or human health are applicable if they are more stringent than relevant MCL or action levels for the PCOC under consideration. For sites near seeps, cleanup levels are based on protection of aquatic life alone.

7.3.5 Site-Specific Cleanup Level Selection Process

Once a site is identified, site-specific cleanup levels for each media must be determined. The process for soil and sediment is presented first in Table 7-1, followed by the process for surface water, seeps and groundwater. The following discussion presents this process for soils and sediments followed by water. The cleanup level selection for Fill Site 1 is also provided as an example of the cleanup level selection process.

- For sites with soil, freshwater sediment, and/or marine sediment, the predominant lithology should be identified based on Figure 6-1 and lithologic logs for the site. For Fill Site 1, the soil lithology is Colma.

- Next, the planned human land use should be determined, as identified on Figure 7-1 and described in Section 7.1.1; for Fill Site 1 residential use is planned. The appropriate human land use and soil lithology columns should be used to select cleanup levels from Table 7-2.

- The site should be evaluated to determine if it is located in an area where buffer zone or special status ecological cleanup levels are applicable, based on Figure 7-2. In addition, NPS or Trust natural resource staff should be consulted to determine if special status species are present. For Fill Site 1, the site is located in an area with significant ecological habitat where special status species may be present. The combination of ecological land use, lithology, and media (soil, freshwater sediment, or marine sediment) is used to select the appropriate column of cleanup levels from Tables 7-2, 7-3, or 7-4. If no values are listed for special status species for the sediments, then the non-special status species values should be used.

- If petroleum hydrocarbons and related constituents are present, cleanup levels are presented on Table 7-5 that are specific to the various human land uses (which will correspond to the same land use from Table 7-2), ecological protection, and groundwater protection. The petroleum hydrocarbon standards are taken directly from Order No. 96-070, Site Cleanup Requirements (RWQCB, 1996). Where cleanup levels for petroleum related constituents, such as PAHs, are presented in both Tables 7-2 through 7-4 and in Table 7-5, the more stringent value should be used for the appropriate land use at a given site. At Fill Site 1, petroleum hydrocarbons and related constituents cleanup levels include the following columns on Table 7-5: protection of residential human health, protection of terrestrial ecological receptors, protection of freshwater aquatic organisms (since Fill Site 1 is with the Freshwater Ecological Protection Zone identified on Figure 7-2), and protection of groundwater resources to maintain drinking water standards in groundwater assuming soil is greater than five feet above groundwater.

- The cleanup level for each PCOC is the minimum cleanup level from the applicable columns of the applicable Tables 7-2 through 7-5. For example, cleanup levels at Fill Site 1 for arsenic, lead, benzo(a)pyrene, and total petroleum hydrocarbons as diesel

("TPHd") would be 6.2 mg/kg (based on Table 7-2), 160 mg/kg (based on Table 7-2), 0.027 mg/kg (based on Table 7-2), and 700 mg/kg (based on Table 7-5), respectively. Any chemical that has been detected at a site at a concentration greater than this minimum cleanup level is identified as a COC for soil or sediment.

The process of screening PCOCs in surface water, seeps and groundwater is similar to that described above for soil and sediment.

- Once the site and type of water resource are identified, the protection level for the water resource must be determined. The cleanup level for freshwater bodies should be used to protect freshwater aquatic organisms, and humans who may drink the water and consume fish or other organisms inhabiting the surface water body. The cleanup level for freshwater seeps should be used to protect only freshwater aquatic organisms within a freshwater seep. The cleanup level for drinking water should be used to protect use of surface water or groundwater as potable supply. The cleanup level for saltwater should protect saltwater aquatic organisms. In some cases, site-specific requirements will include the combination of more than one cleanup level to protection a variety of potential receptors. For Fill Site 1, cleanup levels should consider both protection of drinking water and freshwater aquatic organisms in the seeps.

- The PCOCs should be screened against the lowest water cleanup level. The cleanup level for each PCOC is the minimum cleanup level from the applicable columns of Table 7-6. Any chemical that has been detected at a site at a concentration greater than this minimum cleanup level is identified as a COC for water. Cleanup levels at Fill Site 1 for arsenic, lead, benzo(a)pyrene, and TPHd in groundwater would be 10 µg/L (based on MCLs), 3.2 µg/L (based on freshwater seep water quality criteria), 0.2 µg/L (based on MCLs, since there is no freshwater seep value), and 880 µg/L (based on FPALDR), respectively.

Once cleanup levels are identified, COCs can be determined, and appropriate remedial alternatives, if required, evaluated and selected. In addition, cleanup levels for any chemical, whether or not a PCOC, can be determined through the process described in this section.

7.3.6 Summary

In summary, this document can be used to identify PCOCs and COCs at Presidio sites, and to determine applicable cleanup levels for these chemicals. PCOCs include all organic chemicals detected at a site, assuming these are anthropogenic. In addition, inorganic chemicals detected in soil samples above screening levels identified in Table 6-5 are also included as PCOCs. The screening levels are based on the four main Presidio lithologies (serpentinite, Colma Formation, beach/dune, and chert/shale). The process outlined in Table 7-1 is used to identify the applicable cleanup levels. These cleanup levels are compared with site data to identify the chemicals that are considered COCs at a given site.

Cleanup levels derived from the process and tables presented in this document are intended to be applicable to all Presidio sites that do not have an existing regulatory agency-approved decision document. If new chemicals are identified at a site, the process used herein should be used to derive cleanup levels for those chemicals.

In addition, it is possible that the background metals concentrations developed in this document may not accurately reflect background conditions at all sites throughout the Presidio. If, for example, the Trust is having difficulty meeting cleanup levels during site remediation (when no other indicators for site contamination are present), the Trust may present supporting data to the DTSC and other stakeholders to determine if alternate background concentrations or lithologies may be appropriate for that site, or if other risk management measures should be considered. Similarly, the special status species PRGs developed in Section 5.10 were, in some cases, established as the method detection limit or other low concentration. As a practical matter, it may be difficult to achieve these cleanup levels during remediation. If such cases arise during remediation, the Trust may present the data to the DTSC and other stakeholders to determine alternate ecological cleanup levels at that time or other risk management measures.

TABLES

TABLE 7-1
STEPS TO IDENTIFY SITE-SPECIFIC CLEANUP LEVELS AT THE PRESIDIO

Presidio of San Francisco, California

	Evaluation Process Steps	Potential Parameters	References	Example
Soil and Sediment				
1	Identify Site	--	--	Fill Site 1
2	Identify Media	Soil, freshwater sediment, marine sediment	--	soil
3	Identify Predominant Lithology(ies)	Colma, Serpentinite, Beach/Dune, Chert/Shale	Site-specific lithologic logs, Figure 6-1	Colma
4	Identify Planned Human Land Use and Applicable Cleanup Levels	Residential, Recreational, Commercial/Industrial	Figure 7-1	Residential
5	Identify Applicable Ecological Cleanup Levels	None, buffer zone ecological ("ECO"), ecological special status	Figure 7-2 and NPS or Trust Natural Resource Staff (if ecological special status)	ECO special status
6	Identify Whether Petroleum Hydrocarbons and Related Constituents Present	Petroleum hydrocarbons, BTEX, and PAHs	List of chemicals detected at site	Petroleum hydrocarbons are present
7	If Petroleum Hydrocarbons and Related Constituents Present, Identify Resources to be Protected	Human health, terrestrial ecological receptors, freshwater or saltwater ecological protection zone, soil 5 feet above or below groundwater protected to drinking water standards, soil 5 feet above or below groundwater in Lobos Creek Basin, soil 5 feet above or below groundwater at Crissy Field	Figures 7-1 and 7-2, Table 7-5	Residential, ECO terrestrial, freshwater ECO protection zone, soil greater than 5 feet above groundwater (drinking water standard)
8	Screen Site Chemicals Based on Most Stringent Cleanup Levels from Applicable Tables	• Human Health and Ecological (Non-Petroleum, Soil)	Table 7-2	Colma, residential, ECO special status
		• Ecological (Non-Petroleum, Freshwater Sediment)	Table 7-3	--
		• Ecological (Non-Petroleum, Marine Sediment)	Table 7-4	--
		• Human Health and Ecological (Petroleum Hydrocarbons and Constituents, Soil and Sediment)	Table 7-5	Residential, ECO terrestrial and freshwater, soil >5 feet above groundwater (drinking water standard)

TABLE 7-1
STEPS TO IDENTIFY SITE-SPECIFIC CLEANUP LEVELS AT THE PRESIDIO

Presidio of San Francisco, California

	Evaluation Process Steps	Potential Parameters	References	Example
Surface Water, Seeps, and Groundwater				
1	Identify Site	--	--	Fill Site 1
2	Determine Type of Water	Surface water, seep, groundwater; freshwater or marine	--	Groundwater and seeps
3	Determine Protection Level for Groundwater	Cleanup level to protect aquatic organisms and humans who potentially drink the water or consume fish or other species from surface water ("SW"); cleanup level to protect aquatic organisms in freshwater seep ("FW"); cleanup level to protect marine organisms ("M"); and cleanup level to protect use of water as potable supply ("DW").	Table 7-6	Potential drinking water and freshwater seeps immediately downstream of site
4	Screen Site Chemicals Based on Most Stringent Cleanup Levels from Applicable Table	SW, FW, M, DW	Table 7-6	DW and FW

TABLE 7-2
SUMMARY OF SELECTION OF PRELIMINARY REMEDIATION GOALS AND PROPOSED CLEANUP LEVELS FOR NON-PETROLEUM COMPOUNDS IN SOIL

Presidio of San Francisco, California

	Ecological								Human Health			Lithology				
	Summary of Plant and Soil Fauna PRGs (mg/kg); (a)			Summary of Wildlife PRGs (mg/kg); (a)			Proposed Buffer Zone PRGs (mg/kg); (b)	Proposed Special Status PRGs (mg/kg); (c)	Proposed PRGs (mg/kg); (d)			Presidio Background Metals Concentrations by Lithology (mg/kg); (e)				
Potential Chemical of Concern	PRG_{low}	PRG_{high}	Arithmetic Mean	PRG_{low}	PRG_{high}	Arithmetic Mean			Residential	Recreational	Comm/Ind.	Serpentinite	Colma	Beach/Dune	Chert/Shale	Notes (f)
Inorganic Chemicals																
Antimony	5	5	5	162	490	326	5	5	29	70	760	$3.0^{(DL)}$	$3.0^{(DL)}$	$3.0^{(DL)}$	$3.0^{(DL)}$	1
Arsenic	10	224	117	46	692	369	64 (g)	10	0.36	0.88	3.3	$5.4^{(95th)}$	$6.2^{(UCL95)}$	$5.9^{(UCL95)}$	$3.2^{(Max)}$	2
Barium	500	500	500	320	3,200	1,760	500	320	5,000	12,000	130,000	$230^{(95th)}$	$180^{(UCL95)}$	$120^{(UCL95)}$	$900^{(UCL95)}$	3
Beryllium	10	10	10	160	8,000	4,080	10	10	140	350	3,800	$1.1^{(Max)}$	$0.99^{(UCL95)}$	$0.89^{(UCL95)}$	$0.72^{(UCL95)}$	1
Cadmium	4	100	52	0.017	0.44	0.23	0.23	0.017	1.7	4.2	16	$1.9^{(Max)}$	$0.8^{(DL)}$	$1.7^{(Max)}$	$1.7^{(Max)}$	2
Chromium	5	200	103	4	42	23	23	4	1,200 (h)	2,800 (h)	11,000 (h)	$1,700^{(95th)}$	$140^{(UCL95)}$	$120^{(UCL95)}$	$41^{(UCL95)}$	2
Cobalt	20	75	48	220	3,300	1,760	48	20	4,000	10,000	110,000	$170^{(95th)}$	$21^{(UCL95)}$	$16^{(UCL95)}$	$37^{(UCL95)}$	3
Copper	50	400	225	30	200	115	120	30	- (i)	-	-	$85^{(95th)}$	$49^{(UCL95)}$	$43^{(UCL95)}$	$360^{(UCL95)}$	3
Cyanide	-	-	-	6,298	18,894	12,596	13,000	6,300	1,000	2,500	23,000	-	-	-	-	4
Lead (j)	-	-	-	-	-	-	300	160	400	500	3,500	$66^{(95th)}$	$7.5^{(UCL95)}$	$57^{(UCL95)}$	$45^{(Max)}$	1
Tetraethyl Lead	-	-	-	1.1	52	27	27	1.1	0.0052	0.013	0.11	-	-	-	-	4
Mercury	0.3	10	5.15	0.038	12	6	1.6 (g)	0.4 (k)	20	52	570	$0.2^{(DL)}$	$0.2^{(DL)}$	$0.2^{(DL)}$	$0.2^{(DL)}$	1
Molybdenum	-	-	-	11.5	582	297	300	12	360	870	9,400	$2.0^{(DL)}$	$2.0^{(DL)}$	$2.0^{(DL)}$	$2.0^{(DL)}$	1
Nickel	30	500	265	58	1,440	749	71 (g)	30	1,400	3,500	38,000	$4,500^{(95th)}$	$110^{(UCL95)}$	$70^{(UCL95)}$	$71^{(UCL95)}$	2
Selenium	1	70	35.5	0.20	2	1	1.1	0.2	360	870	9,400	$0.5^{(DL)}$	$0.5^{(DL)}$	$0.75^{(Max)}$	$0.5^{(DL)}$	1
Silver	2	2	2	6	144	75	2	2	360	870	9,400	$1.7^{(Max)}$	$1.0^{(DL)}$	$1.0^{(DL)}$	$1.0^{(DL)}$	1
Thallium	1	1	1	0.15	39	20	1	0.15	5.7	14	150	$1.0^{(DL)}$	$1.0^{(DL)}$	$1.0^{(DL)}$	$1.0^{(DL)}$	2
Vanadium	2	20	11	2	8	5	5	2	650	1,600	17,000	$74^{(95th)}$	$90^{(UCL95)}$	$92^{(UCL95)}$	$61^{(UCL95)}$	2
Zinc	50	864	457	4	97	51	50	4	22,000	52,000	570,000	$160^{(95th)}$	$60^{(UCL95)}$	$66^{(UCL95)}$	$120^{(UCL95)}$	2
Semivolatile Organic Compounds																
Acenaphthene	30	50	40	84	2,547	1,316	40	30	2,700	6,600	55,000	-	-	-	-	1
Acenaphthylene	30	50	40	84	2,547	1,316	40	30	-	-	-	-	-	-	-	1
Anthracene	30	50	40	84	2,547	1,316	40	30	14,000	33,000	280,000	-	-	-	-	1
Benzo(a)anthracene	30	50	40	84	2,547	1,316	40	30	0.27	0.65	2.3	-	-	-	-	4
Benzo(a)pyrene	30	50	40	84	2,547	1,316	40	30	0.027	0.065	0.23	-	-	-	-	4
Benzo(b)fluoranthene	30	50	40	84	2,547	1,316	40	30	0.27	0.65	2.3	-	-	-	-	4
Benzo(g,h,i)perylene	30	50	40	84	2,547	1,316	40	30	-	-	-	-	-	-	-	1
Benzo(k)fluoranthene	30	50	40	84	2,547	1,316	40	30	0.27	0.65	2.3	-	-	-	-	4
Benzyl Alcohol	-	-	-	1	164	83	40 (l)	1	14,000	38,000	280,000	-	-	-	-	1
Chrysene	30	50	40	84	2,547	1,316	40	30	2.7	6.5	23	-	-	-	-	4
Dibenzo(a,h)anthracene	30	50	40	84	2,547	1,316	40	30	0.078	0.19	0.67	-	-	-	-	4
Dibenzofuran	-	-	-	-	-	-	-	-	910	2,200	18,000	-	-	-	-	4
Fluoranthene	30	50	40	84	2,547	1,316	40	30	1,800	4,400	37,000	-	-	-	-	1
Fluorene	30	50	40	84	2,547	1,316	40	30	1,800	4,400	37,000	-	-	-	-	1

TABLE 7-2
SUMMARY OF SELECTION OF PRELIMINARY REMEDIATION GOALS AND PROPOSED CLEANUP LEVELS FOR NON-PETROLEUM COMPOUNDS IN SOIL

Presidio of San Francisco, California

	Ecological								Human Health			Lithology				
	Summary of Plant and Soil Fauna PRGs (mg/kg); (a)			Summary of Wildlife PRGs (mg/kg); (a)			Proposed Buffer Zone PRGs (mg/kg); (b)	Proposed Special Status PRGs (mg/kg); (c)	Proposed PRGs (mg/kg); (d)			Presidio Background Metals Concentrations by Lithology (mg/kg); (e)				
Potential Chemical of Concern	PRG_{low}	PRG_{high}	Arithmetic Mean	PRG_{low}	PRG_{high}	Arithmetic Mean			Residential	Recreational	Comm/Ind.	Serpentinite	Colma	Beach/Dune	Chert/Shale	Notes (f)
Semivolatile Organic Compounds																
Indeno(1,2,3-cd)pyrene	30	50	40	84	2,547	1,316	40	30	0.27	0.65	2.3	-	-	-	-	4
2-methylnaphthalene	30	50	40	84	2,547	1,316	40	30	-	-	-	-	-	-	-	1
4-methylphenol (p-Cresol)	50	50	50	11,167	55,782	33,474	50	50	260	640	5,600	-	-	-	-	1
Naphthalene	30	50	40	84	2,547	1,316	40	30	910	2,200	18,000	-	-	-	-	1
n-nitrosodiphenylamine	20	109	65	16,981	50,942	33,962	65	20	43	104	380	-	-	-	-	5
Pentachlorophenol	3	4	3.5	22	660	341	3.5	3	5	12	42	-	-	-	-	1
Phenanthrene	30	50	40	84	2,547	1,316	40	30	-	-	-	-	-	-	-	1
Phenol	30	188	109	2,547	7,641	5,094	109	30	27,000	76,000	550,000	-	-	-	-	1
Pyrene	30	50	40	84	2,547	1,316	40	30	1,400	3,300	28,000	-	-	-	-	1
Volatile Organic Compounds																
Acetone	-	-	-	8,490	127,356	67,923	68,000	8,500	0.24 (m)	0.24 (m)	0.24 (m)	-	-	-	-	4
2-butanone (MEK)	-	-	-	4,245	25,471	14,858	15,000	4,200	3.8 (m)	3.8 (m)	3.8 (m)	-	-	-	-	4
Carbon disulfide	-	-	-	934	28,018	14,476	14,000	934	200 (m)	200 (m)	200 (m)	-	-	-	-	4
1,4-dichlorobenzene	20	128	74	2,123	12,736	7,429	74	20	0.13 (m)	0.59 (m)	0.49 (m)	-	-	-	-	4
p-isopropyltoluene (p-cymene)	200 (n)	1,000 (n)	600 (n)	2,207 (n)	22,075 (n)	12,141 (n)	600 (n)	200 (n)	130 (m)	130 (m)	130 (m)	-	-	-	-	4
Methylene Chloride	-	-	-	459	34,377	17,418	17,000	459	0.076 (m)	0.076 (m)	0.076 (m)	-	-	-	-	4
1,2,3-trichlorobenzene (o)	20	115	67.5	-	-	-	68	20	15 (m)	15 (m)	15 (m)	-	-	-	-	4
1,2,4-trichlorobenzene	20	127	73.5	-	-	-	74	20	15 (m)	15 (m)	15 (m)	-	-	-	-	4
Trichlorofluoromethane	-	-	-	-	-	-	-	-	40 (m)	80 (m)	80 (m)	-	-	-	-	4
1,1,1-trichloroethane	-	-	-	9,679	1,451,858	730,768	730,000	9,700	8 (m)	8 (m)	8 (m)	-	-	-	-	4
PCBs, Pesticides, and Herbicides																
PCBs (Arochlor 1254)	40	240	140	0.010	0.45	0.23	0.23	*0.033*	0.16	0.39	1 (p)	-	-	-	-	1
Aldrin	-	-	-	0.0039	0.19	0.1	0.1	0.0039	0.029	0.07	0.26	-	-	-	-	5
alpha-BHC	-	-	-	0.062	9.8	4.9	2.4 (g)	0.062	0.18	0.44	1.6	-	-	-	-	5
beta-BHC	-	-	-	0.062	9.8	4.9	2.4 (g)	0.062	0.32	0.79	2.9	-	-	-	-	5
delta-BHC	-	-	-	0.062	9.8	4.9	2.4 (g)	0.062	0.18	0.44	1.6	-	-	-	-	5
Chlordane	-	-	-	0.0090	0.071	0.04	0.04	0.0090	0.37	0.91	3.4	-	-	-	-	1
2,4-D	-	-	-	-	-	-	5	*0.025*	620	1,500	15,000	-	-	-	-	1
Dicamba	-	-	-	-	-	-	5	*0.01*	1,800	4,500	44,000	-	-	-	-	1
4,4'-DDD	40	200	120	0.049	2.4	1.2	0.53 (g)	0.049	2.0	4.9	18	-	-	-	-	1
4,4'-DDE	40	200	120	0.098	2.4	1.3	0.61 (g)	0.098	1.4	3.5	13	-	-	-	-	1
4,4'-DDT	40	200	120	0.0082	2.4	1.2	0.53 (g)	0.0082	1.4	3.5	13	-	-	-	-	1
Dieldrin	50	100	75	0.039	0.48	0.26	0.26	0.039	0.030	0.074	0.27	-	-	-	-	5
Endosulfan	-	-	-	1.1	5.5	3.3	3.3	1.1	370	900	8,700	-	-	-	-	1
Endosulfan Sulfate (o)	-	-	-	1.1	5.5	3.3	3.3	1.1	370	900	8,700	-	-	-	-	1
Endrin	-	-	-	0.0035	0.50	0.25	0.11 (g)	*0.004*	18	45	440	-	-	-	-	1
Endrin Aldehyde (o)	-	-	-	0.0035	0.50	0.25	0.11 (g)	*0.004*	18	45	440	-	-	-	-	1
Endrin Ketone (o)	-	-	-	0.0035	0.50	0.25	0.11 (g)	*0.004*	18	45	440	-	-	-	-	1

TABLE 7-2
SUMMARY OF SELECTION OF PRELIMINARY REMEDIATION GOALS AND PROPOSED CLEANUP LEVELS FOR NON-PETROLEUM COMPOUNDS IN SOIL

Presidio of San Francisco, California

Potential Chemical of Concern	Ecological: Summary of Plant and Soil Fauna PRGs (mg/kg); (a)			Ecological: Summary of Wildlife PRGs (mg/kg); (a)			Ecological: Proposed Buffer Zone PRGs (mg/kg); (b)	Ecological: Proposed Special Status PRGs (mg/kg); (c)	Human Health: Proposed PRGs (mg/kg); (d)			Lithology: Presidio Background Metals Concentrations by Lithology (mg/kg); (e)				Notes (f)
	PRG_{low}	PRG_{high}	Arithmetic Mean	PRG_{low}	PRG_{high}	Arithmetic Mean			Residential	Recreational	Comm/Ind.	Serpentinite	Colma	Beach/Dune	Chert/Shale	
PCBs, Pesticides, and Herbicides																
gamma-BHC (Lindane)	-	-	-	0.010	1.6	0.8	0.37 (g)	0.010	0.44	1.1	4.0	-	-	-	-	5
Heptachlor	-	-	-	0.017	7.4	3.7	3.7	0.017	0.12	0.29	1.1	-	-	-	-	5
Heptachlor Epoxide	-	-	-	0.017	7.4	3.7	3.7	0.017	0.088	0.21	0.79	-	-	-	-	5
Isodrin (o)	-	-	-	0.0039	0.19	0.1	0.1	0.0039	0.029	0.069	0.26	-	-	-	-	5
MCPP	-	-	-	-	-	-	-	*5.0*	-	-	-	-	-	-	-	1
Methoxychlor	-	-	-	0.44	35	18	18	0.44	310	750	7,300	-	-	-	-	1

Notes:

(a) Listed in these columns are the following: (1) the plant and soil fauna represent the low and high Preliminary Remediation Goals ("PRGs") from Tables 5-12 and 5-13; (2) the wildlife PRG_{low} represents the lowest of the wildlife PRG_{low} from Table 5-12; and (3) the wildlife PRG_{high} represents the lowest of the wildlife PRG_{high} from Table 5-13.

(b) The buffer zone PRG proposed for protection of non-special status species is the lowest of the arithmetic mean of plant and soil fauna PRGs, the arithmetic mean of wildlife PRGs, the special status PRGs identified in Table 5-21, or 5 mg/kg for pesticides or herbicides for which not enough toxicological data exist to calculate a PRG_{low} and PRG_{high} (e.g., 2,4-D, Dicamba, and MCPP).

(c) Values are proposed as soil PRGs for special status species. The special status PRG, as used in this document, is established as the PRG_{low}. *Italics* indicates that the laboratory detection limit exceeds the PRGlow, and thus is selected as the cleanup level. The laboratory detection limit is also used as the special status PRG for pesticides and herbicides for which not enough toxicological data exist to calculate ecological PRGs.

(d) The human health PRGs proposed for residential, recreational, and commercial/industrial land use are from Tables 4-3, 4-4, and 4-5, respectively. For VOCs, the human health PRGs are from Table 4-7.

(e) The following abbreviations are used in the Background Metals columns:
DL - Detection Limit: A typical detection limit is included when there were insufficient data to calculate a 95% upper confidence level ("UCL") of the 95th percentile (e.g., fewer than 50% detections).
Max: Maximum concentration detected in background samples of this lithology (threshold level when there are fewer than 50% detections).
95th: The concentration corresponding to the 95th percentile of the lognormal data distribution calculated for data sets with a frequency of detection greater than 50%. Applied to serpentinite only due to small number of data in background data set.
UCL95: The concentration corresponding to the 95% UCL of the 95th percentile of the lognormal data distribution.

(f) In general, the cleanup levels are the minimum of applicable buffer zone ecological, ecological special status, and human health values, above background concentrations. Unless otherwise noted, for a given site, only applicable columns would be used to select the appropriate cleanup level. For example, ecological cleanup levels would not be applied to a site that is classified as only recreational human land use.
1. Cleanup level governed by ecological values.
2. Cleanup level governed by background metals concentrations.
3. Cleanup level governed by ecological values or background metal concentration, depending on lithology.
4. Cleanup level governed by human health values.
5. Cleanup level governed by ecological values or human health values, depending on land use.

(g) For these chemicals, which have a large difference (greater than one order of magnitude) between PRG_{low} and PRG_{high}, alternate PRGs were developed for special status species ("Alternate PRGs"). As discussed in note (c), special status values were ultimately established as the PRG_{low}. For the chemicals indicated, the Alternate PRG was subsequently established as the Buffer Zone PRG, in lieu of the arithmetic mean PRG.

(h) The cleanup levels for chromium are based on the assumption that chromium (VI) comprises up to 0.28 percent of the total chromium in serpentinite at the Presidio (Montgomery Watson, 1999a).

(i) Hyphen indicates that PRG could not be calculated due to lack of applicable toxicity data in available literature, or no value is appropriate.

(j) Ecological PRGs for lead were calculated through use of the Monte Carlo method. The residential cleanup level for lead in soil has been established as a not-to-exceed value of 400 mg/kg, based on chemical-specific ARARs and a maximum average concentration of 370 mg/kg, based on the site-specific PRG. Refer to text for discussion of methodology used to derive the ecological and human health PRGs for lead.

(k) Mercury level for special status species is based on risk management concerns and is established at 2 times the typical method detection limit.

(l) For benzyl alcohol, the buffer zone PRG was decreased from the wildlife arithmetic mean PRG to be more in line with the other semivolatile organic compounds.

TABLE 7-2
SUMMARY OF SELECTION OF PRELIMINARY REMEDIATION GOALS AND PROPOSED CLEANUP LEVELS FOR NON-PETROLEUM COMPOUNDS IN SOIL

Presidio of San Francisco, California

Notes (continued):

(m) For VOCs, human health cleanup levels were calculated using the more stringent of Risk-based Screening Levels based on the protection of groundwater quality, direct contact with soil, or vapor intrusion of VOCs into indoor air. The calculations are described in Section 4.2.9 of this document.

(n) For ecological PRGs only, toluene was used as a surrogate for isopropyltoluene.

(o) For human health PRGs only, values for for 1,2,4-trichlorobenzene were used for 1,2,3-trichlorobenzene. For all PRGs, values for Endosulfan were used for Endosulfan Sulfate, values for Endrin were used for Endrin Aldehyde and Endrin Ketone. Isodrin is an isomer of Aldrin; for all PRGs values for Aldrin were used for Isodrin.

(p) Human health cleanup level of 1 mg/kg for polychlorinated biphenyls in soil obtained from Title 40 of the Code of Federal Regulations §761.61 to Subpart D of Toxic Substances Control Act ("TSCA"). Human health PRGs for PCBs in soil in commercial/industrial land use calculated with the same assumptions as the other chemicals is 1.4 mg/kg, as shown in Table 4-5. The TSCA value of 1 mg/kg is considered protective of human health and conservative, as it corresponds to an estimated lifetime incremental cancer risks of $7x10^{-7}$, which is below U.S. EPA's acceptable risk range of 10^{-4} to 10^{-6}.

TABLE 7-3
ECOLOGICAL CLEANUP LEVELS FOR NON-PETROLEUM COMPOUNDS IN SEDIMENT AT THE PRESIDIO OF SAN FRANCISCO (FRESHWATER)

Presidio of San Francisco, California

Potential Chemical of Concern	Buffer Zone Ecological Cleanup Level (mg/kg)				Special Status Species Cleanup Level (mg/kg); (a)			
	Serpentinite	Colma	Beach/Dune	Chert/Shale	Serpentinite	Colma	Beach/Dune	Chert/Shale
Inorganic Chemicals								
Antimony	3.0 (b)	3.0 (b)	3.0 (b)	3.0 (b)				
Arsenic	19	19	19	19				
Barium	3,100	3,100	3,100	3,100				
Beryllium	7,200	7,200	7,200	7,200				
Cadmium	1.9 (c)	1.1	1.7 (c)	1.7 (c)				
Chromium	1,700 (c)	140 (c)	120 (c)	42				
Cobalt	170 (c)	50	50	50				
Copper	114	114	114	360 (c)				
Cyanide	- (d)	-	-	-				
Lead	82	82	82	82				
Tetraethyl Lead	86	86	86	86				
Mercury	0.62	0.62	0.62	0.62				
Molybdenum	522	522	522	522				
Nickel	4,500 (c)	110 (c)	70 (c)	71 (c)				
Selenium	4.5	4.5	4.5	4.5	1.6	1.6	1.6	1.6
Silver	1.7 (c)	1.0 (c)	1.0 (c)	1.0 (c)				
Thallium	35	35	35	35	3.7	3.7	3.7	3.7
Vanadium	74 (c)	90 (c)	92 (c)	61 (c)				
Zinc	230	230	230	230				

TABLE 7-3
ECOLOGICAL CLEANUP LEVELS FOR NON-PETROLEUM COMPOUNDS IN SEDIMENT AT THE PRESIDIO OF SAN FRANCISCO (FRESHWATER)

Presidio of San Francisco, California

Potential Chemical of Concern	Buffer Zone Ecological Cleanup Level (mg/kg)				Special Status Species Cleanup Level (mg/kg); (a)			
	Serpentinite	Colma	Beach/Dune	Chert/Shale	Serpentinite	Colma	Beach/Dune	Chert/Shale
Semivolatile Organic Compounds								
Acenaphthene	0.31	0.31	0.31	0.31				
Acenaphthylene	0.067	0.067	0.067	0.067				
Anthracene	0.45	0.45	0.45	0.45				
Benzo(a)anthracene	0.54	0.54	0.54	0.54				
Benzo(a)pyrene	0.74	0.74	0.74	0.74				
Benzo(b)fluoranthene	0.79	0.79	0.79	0.79				
Benzo(g,h,i)perylene	0.25	0.25	0.25	0.25				
Benzo(k)fluoranthene	0.79	0.79	0.79	0.79				
Benzyl Alcohol	140	140	140	140				
Chrysene	0.67	0.67	0.67	0.67				
Dibenzo(a,h)anthrancene	0.071	0.071	0.071	0.071				
Dibenzofuran	2	2	2	2				
Fluoranthene	1.5	1.5	1.5	1.5				
Fluorene	0.28	0.28	0.28	0.28				
Indeno(1,2,3-cd)pyrene	0.26	0.26	0.26	0.26				
2-methylnaphthalene	0.11	0.11	0.11	0.11				
4-methylphenol (p-Cresol)	-	-	-	-				
Naphthalene	0.3	0.3	0.3	0.3				
n-nitrosodiphenylamine	-	-	-	-				
Pentachlorophenol	-	-	-	-				
Phenanthrene	0.61	0.61	0.61	0.61				
Phenol	-	-	-	-				
Pyrene	0.79	0.79	0.79	0.79				

TABLE 7-3
ECOLOGICAL CLEANUP LEVELS FOR NON-PETROLEUM COMPOUNDS IN SEDIMENT AT THE PRESIDIO OF SAN FRANCISCO (FRESHWATER)

Presidio of San Francisco, California

Potential Chemical of Concern	Buffer Zone Ecological Cleanup Level (mg/kg)				Special Status Species Cleanup Level (mg/kg); (a)			
	Serpentinite	Colma	Beach/Dune	Chert/Shale	Serpentinite	Colma	Beach/Dune	Chert/Shale
Volatile Organic Compounds								
Acetone	-	-	-	-				
2-Butanone (MEK)	-	-	-	-				
Carbon disulfide	-	-	-	-				
1,4-dichlorobenzene	0.35	0.35	0.35	0.35				
p-Isopropyltoluene (p-cymene)	-	-	-	-				
Methylene Chloride	-	-	-	-				
1,2,3-trichlorobenzene	-	-	-	-				
1,2,4-trichlorobenzene	-	-	-	-				
Trichlorfluoromethane	-	-	-	-				
1,1,1-trichloroethane	0.17	0.17	0.17	0.17				
PCBs, Pesticides, and Herbicides								
PCBs (Arochlor 1254)	0.36	0.36	0.36	0.36	0.14	0.14	0.14	0.14
Aldrin	0.005	0.005	0.005	0.005				
alpha-BHC	0.008	0.008	0.008	0.008				
beta-BHC	0.013	0.013	0.013	0.013				
delta-BHC	0.0075	0.0075	0.0075	0.0075				
Chlordane	0.01	0.010	0.01	0.01				
2,4-D	-	-	-	-				
Dicamba	-	-	-	-				
4,4'-DDD	0.016	0.016	0.016	0.016				
4,4'-DDE	0.016	0.016	0.016	0.016				
4,4'-DDT	0.032	0.032	0.032	0.032				
Dieldrin	0.032	0.032	0.032	0.032				
Endosulfan	0.0054	0.0054	0.0054	0.0054				
Endosulfan Sulfate	0.0054	0.0054	0.0054	0.0054				

TABLE 7-3
ECOLOGICAL CLEANUP LEVELS FOR NON-PETROLEUM COMPOUNDS IN SEDIMENT AT THE PRESIDIO OF SAN FRANCISCO (FRESHWATER)

Presidio of San Francisco, California

Potential Chemical of Concern	Buffer Zone Ecological Cleanup Level (mg/kg)				Special Status Species Cleanup Level (mg/kg); (a)			
	Serpentinite	Colma	Beach/Dune	Chert/Shale	Serpentinite	Colma	Beach/Dune	Chert/Shale
PCBs, Pesticides, and Herbicides (cont.)								
Endrin	0.1	0.1	0.1	0.1				
Endrin Aldehyde	0.1	0.1	0.1	0.1				
Endrin Ketone	0.1	0.1	0.1	0.1				
gamma-BHC (Lindane)	0.003	0.003	0.003	0.003				
Heptachlor	0.0083	0.0083	0.0083	0.0083				
Heptachlor Epoxide	0.0083	0.0083	0.0083	0.0083				
Isodrin	0.005	0.005	0.005	0.005				
MCPP	-	-	-	-				
Methoxychlor	0.019	0.019	0.019	0.019				

Notes:

(a) Buffer zone ecological cleanup levels apply to special status species as well if no special status species cleanup level is listed for a potential chemical of concern ("PCOC").

(b) Cleanup level for this compound and this lithology is based on the background level in soil. Background level for this compound and this lithology is derived from the typical detection limit.

(c) Cleanup level for this compound and this lithology is based on the background level in soil.

(d) Hyphen indicates that a cleanup level cannot be calculated. No published toxicity values for PCOC were found.

TABLE 7-4
ECOLOGICAL CLEANUP LEVELS FOR NON-PETROLEUM COMPOUNDS IN SEDIMENT AT THE PRESIDIO OF SAN FRANCISCO (MARINE)

Presidio of San Francisco, California

Potential Chemical of Concern	Buffer Zone Ecological Cleanup Level (mg/kg)				Special Status Species Cleanup Level (mg/kg); (a)			
	Serpentinite	Colma	Beach/Dune	Chert/Shale	Serpentinite	Colma	Beach/Dune	Chert/Shale
Inorganic Chemicals								
Antimony	14	14	14	14				
Arsenic	39	39	39	39				
Barium	3,100	3,100	3,100	3,100				
Beryllium	7,200	7,200	7,200	7,200				
Cadmium	1.9 (c)	1.6	1.7 (c)	1.7 (c)				
Chromium	1,700 (c)	140 (c)	120 (c)	42				
Cobalt	38,088	38,088	38,088	38,088				
Copper	152	152	152	152				
Cyanide	- (b)	-	-	-				
Lead	132	132	132	132				
Tetraethyl Lead	86	86	86	86				
Mercury	0.43	0.43	0.43	0.43				
Molybdenum	522	522	522	522				
Nickel	4,500 (c)	110 (c)	70 (c)	71 (c)				
Selenium	4.5	4.5	4.5	4.5	1.6	1.6	1.6	1.6
Silver	2.4	2.4	2.4	2.4				
Thallium	35	35	35	35	3.7	3.7	3.7	3.7
Vanadium	74 (c)	90 (c)	92 (c)	61 (c)				
Zinc	214	214	214	214				

TABLE 7-4
ECOLOGICAL CLEANUP LEVELS FOR NON-PETROLEUM COMPOUNDS IN SEDIMENT AT THE PRESIDIO OF SAN FRANCISCO (MARINE)

Presidio of San Francisco, California

Potential Chemical of Concern	Buffer Zone Ecological Cleanup Level (mg/kg)				Special Status Species Cleanup Level (mg/kg); (a)			
	Serpentinite	Colma	Beach/Dune	Chert/Shale	Serpentinite	Colma	Beach/Dune	Chert/Shale
Semivolatile Organic Compounds								
Acenaphthene	0.32	0.32	0.32	0.32				
Acenaphthylene	0.34	0.34	0.34	0.34				
Anthracene	0.59	0.59	0.59	0.59				
Benzo(a)anthracene	0.93	0.93	0.93	0.93				
Benzo(a)pyrene	1.0	1.0	1.0	1.0				
Benzo(b)fluoranthene	-	-	-	-				
Benzo(g,h,i)perylene	-	-	-	-				
Benzo(k)fluoranthene	-	-	-	-				
Benzyl Alcohol	145	145	145	145				
Chrysene	1.6	1.6	1.6	1.6				
Dibenzo(a,h)anthrancene	0.16	0.16	0.16	0.16				
Dibenzofuran	2.00	2.00	2.00	2.00				
Fluoranthene	2.85	2.85	2.85	2.85				
Fluorene	0.28	0.28	0.28	0.28				
Indeno(1,2,3-cd)pyrene	-	-	-	-				
2-methylnaphthalene	0.37	0.37	0.37	0.37				
4-methylphenol (p-Cresol)	-	-	-	-				
Naphthalene	1.1	1.1	1.1	1.1				
n-nitrosodiphenylamine	-	-	-	-				
Pentachlorophenol	-	-	-	-				
Phenanthrene	0.87	0.87	0.87	0.87				
Phenol	-	-	-	-				
Pyrene	1.6	1.6	1.6	1.6				

TABLE 7-4
ECOLOGICAL CLEANUP LEVELS FOR NON-PETROLEUM COMPOUNDS IN SEDIMENT AT THE PRESIDIO OF SAN FRANCISCO (MARINE)

Presidio of San Francisco, California

Potential Chemical of Concern	Buffer Zone Ecological Cleanup Level (mg/kg)				Special Status Species Cleanup Level (mg/kg); (a)			
	Serpentinite	Colma	Beach/Dune	Chert/Shale	Serpentinite	Colma	Beach/Dune	Chert/Shale
Volatile Organic Compounds								
Acetone	-	-	-	-				
2-Butanone (MEK)	-	-	-	-				
Carbon disulfide	-	-	-	-				
1,4-dichlorobenzene	0.35	0.35	0.35	0.35				
p-Isopropyltoluene (p-cymene) (d)	0.67	0.67	0.67	0.67				
Methylene Chloride	-	-	-	-				
1,2,3-trichlorobenzene (e)	9.2	9.2	9.2	9.2				
1,2,4-trichlorobenzene	9.2	9.2	9.2	9.2				
Methylene Chloride	-	-	-	-				
Trichlorfluoromethane	-	-	-	-				
1,1,1-trichloroethane	0.17	0.17	0.17	0.17				
PCBs, Pesticides, and Herbicides								
PCBs (Arochlor 1254)	0.10	0.10	0.10	0.10				
Aldrin	0.46	0.46	0.46	0.46	0.10	0.10	0.10	0.10
alpha-BHC	0.0007	0.0007	0.0007	0.0007				
beta-BHC	0.0007	0.0007	0.0007	0.0007				
delta-BHC	0.0007	0.0007	0.0007	0.0007				
Chlordane	0.0033	0.0033	0.0033	0.0033				
2,4-D	-	-	-	-				
Dicamba	-	-	-	-				
4,4'-DDD	0.011	0.011	0.011	0.011				
4,4'-DDE	0.015	0.015	0.015	0.015				
4,4'-DDT	0.004	0.004	0.004	0.004				
Dieldrin	0.026	0.026	0.026	0.026				
Endosulfan	0.005	0.005	0.005	0.005				
Endosulfan Sulfate	0.005	0.005	0.005	0.005				

TABLE 7-4
ECOLOGICAL CLEANUP LEVELS FOR NON-PETROLEUM COMPOUNDS IN SEDIMENT AT THE PRESIDIO OF SAN FRANCISCO (MARINE)

Presidio of San Francisco, California

Potential Chemical of Concern	Buffer Zone Ecological Cleanup Level (mg/kg)				Special Status Species Cleanup Level (mg/kg); (a)			
	Serpentinite	Colma	Beach/Dune	Chert/Shale	Serpentinite	Colma	Beach/Dune	Chert/Shale
PCBs, Pesticides, and Herbicides (cont.)								
Endrin	0.023	0.023	0.023	0.023				
Endrin Aldehyde	0.023	0.023	0.023	0.023				
Endrin Ketone	0.023	0.023	0.023	0.023				
gamma-BHC (Lindane)	0.002	0.002	0.002	0.002				
Heptachlor	437	437	437	437	44	44	44	44
Heptachlor Epoxide	437	437	437	437	44	44	44	44
Isodrin	0.457	0.457	0.457	0.457	0.10	0.10	0.10	0.10
MCPP	-	-	-	-				
Methoxychlor	0.019	0.019	0.019	0.019				

Notes:

(a) Buffer zone ecological cleanup levels apply to special status species as well if no special status species cleanup level is listed for a potential chemical of concern ("PCOC").

(b) Hyphen indicates that a cleanup level cannot be calculated. No published toxicity values for PCOC were found.

(c) Cleanup level for this compound and this lithology is based on the background level in soil.

(d) Values for toluene were used for isopropyltoluene.

(e) Values for 1,2,4-trichlorobenzene were used for 1,2,3-trichlorobenzene.

TABLE 7-5
HUMAN HEALTH AND ECOLOGICAL CLEANUP LEVELS FOR PETROLEUM HYDROCARBONS AND CONSTITUENTS IN SOIL AND SEDIMENT AT THE PRESIDIO OF SAN FRANCISCO

Presidio of San Francisco, California

	Protection of Human Health			Protection of Ecological Receptors			Protection of Groundwater Resources					
							Cleanup Level for Soil to Maintain Drinking Water Standard in Groundwater		Cleanup Level for Soil to Maintain Non-detectable Concentration in Groundwater in Lobos Creek Basin		Cleanup Level for Soil at Crissy Field	
Potential Chemical of Concern	Residential (mg/kg); (a)	Recreational (mg/kg); (a)	Maintenance (mg/kg); (a)	Terrestrial Receptors (mg/kg); (a)	Freshwater Aquatic Organisms (mg/kg); (b)	Saltwater Aquatic Organisms (mg/kg); (c)	Less than 5 feet Above Groundwater (mg/kg); (a)	Greater than 5 feet Above Groundwater (mg/kg); (a)	Less than 5 feet Above Groundwater (mg/kg); (a)	Greater than 5 feet Above Groundwater (mg/kg); (a)	Less than 5 feet Above Groundwater (mg/kg); (a)	Greater than 5 feet Above Groundwater (mg/kg); (a)
Inorganic Chemicals												
Lead	-	-	-	50 (d)	-	-	-	-	-	-	-	-
Semivolatile Organic Compounds												
Anthracene	5,900	13,800	17,800	-	-	-	308	-	0.05	-	1,120	-
Benzo(a)anthracene	0.43	1	1.5	-	-	-	8	-	0.2	-	23	-
Benzo(a)pyrene	0.04	0.1	0.15	0.3	-	-	3	-	0.8	-	9	-
Benzo(b)fluoranthene	0.43	1	1.5	-	-	-	23	-	0.6	-	64	-
Benzo(g,h,i)perylene	620	1,400	1,700	-	-	-	5,040	-	2	-	19,500	-
Benzo(k)fluoranthene	0.43	1	1.5	-	-	-	23	-	0.6	-	64	-
Chrysene	4.3	10	15	-	-	-	54	-	0.3	-	151	-
Fluoranthene	820	1,900	2,300	-	-	-	316	-	0.05	-	1,160	-
Fluorene	770	1,800	2,300	-	-	-	60	-	0.05	-	220	-
Naphthalene	480	1,100	2,300	-	-	-	9	-	0.05	-	140	-
Phenanthrene	600	1,400	1,700	-	-	-	86	-	0.05	-	410	-
Total Carcinogenic PAHs	5.6	13	19.7	-	-	-	111	-	2.5	-	253	-
Pyrene	620	1,400	1,700	-	-	-	241	-	0.09	-	910	-
Petroleum Hydrocarbons and Constituents												
TPH (as diesel); (e)	1,380	3,200	6,700	700	144 (f); (g)	144 (f)	115	15,000	7	15,000	1,950	15,000
TPH (as gasoline)	1,030	2,400	5,900	610	140	11.6	100	5,000	7	5,000	1,690	5,000
TPH (as fuel oil) (h)	1,900	4,500	9,400	980	144 (g)	144	160	15,000	10	15,000	2,730	15,000
Benzene	0.6	1.5	5	40	0.79	50	0.005	140	0.005	140	1	140
Ethylbenzene	840	1,900	6,600	125	15	5	13	60	0.009	60	19	60
Toluene	530	1,200	12,800	270	3	260	1	420	0.005	420	14	420
Total Xylenes	1,080	2,500	109,000	55	5.7	22	33	180	0.009	180	4,340	180

TABLE 7-5
HUMAN HEALTH AND ECOLOGICAL CLEANUP LEVELS FOR PETROLEUM HYDROCARBONS AND CONSTITUENTS IN SOIL AND SEDIMENT AT THE PRESIDIO OF SAN FRANCISCO

Presidio of San Francisco, California

Notes:

(a) Cleanup level values listed are obtained from Tables 1 through 5 of California Environmental Protection Agency, Regional Water Quality Control Board, San Francisco Bay Region Order No. 96-070, *Site Cleanup Requirements for the Cleanup of Petroleum Impacted Soils, U.S. Army, Presidio of San Francisco, California*, dated 15 May 1996.

(b) Cleanup level values listed are point-of-compliance concentrations for freshwater sediment obtained from Tables 5 and 6 of Montgomery Watson *Development of Point of Compliance Concentrations (POCCs) for Gasoline in Surface Waters and Sediments of the Proposed Freshwater Stream,* dated May 1999. Locations apply to Freshwater Ecological Protection Zones shown on Figure 7-2.

(c) Cleanup level values listed are point-of-compliance concentrations for saltwater sediment obtained from Table 16 of International Technology Corporation *Report of Petroleum Hydrocarbon Bioassay and Point-of-Compliance Concentration Determinations Saltwater Ecological Protection Zone, Presidio of San Francisco,* dated December 1997. Locations apply to Saltwater Ecological Protection Zones shown on Figure 7-2.

(d) According to Order No. 96-070, the value for lead applies only to cleanup of leaded gasoline releases and not from releases from other sources. Order No. 96-070 states that an alternative cleanup level can be derived for protection of ecological receptors from releases of lead other than leaded gasoline. Refer to Tables 7-2 through 7-4 for ecological cleanup level values that apply to releases of lead not from leaded gasoline.

(e) Total petroleum hydrocarbons ("TPH").

(f) Although value is derived for fuel oil, adoption of this cleanup level for TPH (as diesel) has been tentatively approved by RWQCB.

(g) Although value is derived for saltwater aquatic organisms, this cleanup level is also being used for freshwater organisms.

(h) These values also apply to TPH quantified as motor oil.

ble 3.2 Recommended Point of Compliance Concentrat[illegible] (POCCs) for the Freshwater Ecological Protection Zo
Presidio of [illegible]n Francisco
San Francisco, California

Site Designations	TPH-gasoline		TPH-diesel		TPH-fuel oil	
	Soil mg/kg	Water µg/L	Soil mg/kg	Water µg/L	Soil mg/kg	Water µg/L
Building 207/231 CAP Area	11.6	443	144 (115)[a]	443	144	443
Fill Site 6A	11.6	443	144 (115)[a]	443	144	443
Building 1065 CAP Area	TBD[b]	TBD[b]	TBD[b]	TBD[b]	TBD[b]	TBD[b]
Fill Site 6B	TBD[b]	TBD[b]	TBD[b]	TBD[b]	TBD[b]	TBD[b]
Other Areas Within FEPZ Zone of Application	140 (100)[a]	443	140 (115)	443	140	443
Other Areas Outside of FEPZ Zone of Application[c]	see SCRs	770	see SCRs	880	see SCRs	1,200

Inside FEPZ Zone and

TPH	Total petroleum hydrcarbons.
µg/L	Micrograms per liter.
mg/kg	Milligrams per kilogram.
FEPZ	Freshwater ecological protection zone.
SCR	Site Cleanup Requirement.
TBD	To be determined.

Notes:
POCCs adopted from existing POCCs presented in the FPALDR (1995) and RWQCB Order R2-2003-0080 (2003).

[a] Cleanup level shown in parentheses applies if depth to groundwater from TPH contamination in soil is less than 5 feet.

[b] For the Building 1065 CAP Area and Fill Site 6B, the POCCs for the Building 207/231 CAP Area will be used as interim screening levels for the freshwater zone until site-specific POCCs are selected.

[c] POCCs will not apply to areas outside of the FEPZ zone of application. Soil cleanup levels for these areas are based on the SCRs from RWQCB Order R2-2003-0080 (which include SCRs for human health, ecological terrestrial, and groundwater protection). Water cleanup levels for these areas will be drinking water levels.

TABLE 7-6
CLEANUP LEVELS FOR SURFACE WATER, SEEPS, AND GROUNDWATER AT THE PRESIDIO OF SAN FRANCISCO

Presidio of San Francisco, California

Potential Chemical of Concern	Water Quality Criteria									
							Drinking Water Cleanup Level (d);(e) (µg/L)			
	Surface Water (a) (µg/L)	Reference	Freshwater Seep (b) (µg/L)	Reference	Salt Water (c) (µg/L)	Reference	Background Levels	Reference	MCLs or Risk-Based Drinking Water Standards	Reference
Inorganic Chemicals										
Antimony	14	CTR (f)	- (g)	-	-	-	-	-	6	Federal MCL
Arsenic	150 (h, i)	Basin Plan (j)	150 (h, i)	Basin Plan	36 (h, i)	Basin Plan	-	-	10	Federal MCL
Barium	-	-	-	-	-	-	-	-	1,000	California MCL
Beryllium	-	-	-	-	-	-	-	-	4	Federal MCL
Cadmium	1.1 (h, k)	Basin Plan	1.1 (h, k)	Basin Plan	9.3 (h, i)	Basin Plan	-	-	5	Federal MCL
Chloride	-	-	-	-	-	-	-	-	250,000 (l)	Secondary MCL
Chromium (III)	180 (i, k)	NTR (m)	180 (i, k)	NTR	-	-	-	-	50	California MCL
Hexavalent Chromium	11 (h, i)	Basin Plan	11 (h, i)	Basin Plan	50 (h, i)	Basin Plan	-	-	-	-
Chromium (Total)	180 (i, k)	CTR	180 (i, k)	CTR	50 (i)	Basin Plan	-	-	50	California MCL
Cobalt	-	-	-	-	-	-	-	-	-	-
Copper	9.0 (h, i, k)	Basin Plan	9.0 (h, i, k)	Basin Plan	3.1 (h, i)	CTR	-	-	1,000	Secondary MCL
Cyanide	5.2	NTR	5.2	NTR	1	NTR	-	-	150	California MCL
Lead	2.5 (h, i, k)	Basin Plan	2.5 (h, i, k)	Basin Plan	8.1 (h, i)	Basin Plan	-	-	15 (n)	Federal MCL
Mercury	0.012 (o)	Basin Plan	0.012 (o)	Basin Plan	0.025	Basin Plan	-	-	2	Federal MCL
Molybdenum	-	-	-	-	-	-	-	-	-	-
Nickel	52 (h, i, k)	Basin Plan	52 (h, i, k)	Basin Plan	8.2 (h, i)	Basin Plan	-	-	100	California MCL
Selenium	5	NTR	5	NTR	71 (i)	NTR	-	-	50	Federal MCL
Silver	3.4 (h, i, k)	Basin Plan	3.4 (h, i, k)	Basin Plan	1.9 (h, i)	Basin Plan	-	-	50	Basin Plan
Thallium	1.7	CTR	-	-	-	-	-	-	2	Federal MCL
Vanadium	-	-	-	-	-	-	-	-	-	-
Zinc	120 (h, i, k)	Basin Plan	120 (h, i, k)	Basin Plan	81 (h, i)	Basin Plan	-	-	5,000	Secondary MCL

TABLE 7-6
CLEANUP LEVELS FOR SURFACE WATER, SEEPS, AND GROUNDWATER AT THE PRESIDIO OF SAN FRANCISCO

Presidio of San Francisco, California

Potential Chemical of Concern	Water Quality Criteria									
							Drinking Water Cleanup Level (d);(e) (µg/L)			
	Surface Water (a) (µg/L)	Reference	Freshwater Seep (b) (µg/L)	Reference	Salt Water (c) (µg/L)	Reference	Background Levels	Reference	MCLs or Risk-Based Drinking Water Standards	Reference
Semivolatile Organic Compounds										
Acenaphthene	1,200	CTR	-	-	-	-	-	-	-	-
Acenaphthylene	-	-	-	-	-	-	-	-	-	-
Anthracene	9,600	CTR	-	-	-	-	0.05	FPALDR	770	FPALDR (p)
Benzo(a)anthracene	0.0044 (q)	CTR	-	-	-	-	0.05	FPALDR	0.1	Proposed MCL
Benzo(a)pyrene	0.0044 (q)	CTR	-	-	-	-	0.05	FPALDR	0.2	Federal MCL
Benzo(b)fluoranthene	0.0044 (q)	CTR	-	-	-	-	0.05	FPALDR	0.2	Proposed MCL
Benzo(g,h,i)perylene	-	-	-	-	-	-	0.06	FPALDR	150	FPALDR
Benzo(k)fluoranthene	0.0044 (q)	CTR	-	-	-	-	0.05	FPALDR	2	FPALDR
Benzyl Alcohol	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	1.8	CTR	-	-	-	-	-	-	4	California MCL
Chrysene	0.0044 (q)	CTR	-	-	-	-	0.05	FPALDR	20	FPALDR
Dibenzo(a,h)anthracene	0.0044 (q)	CTR	-	-	-	-	-	-	-	-
Dibenzofuran	-	-	-	-	-	-	-	-	-	-
Fluoranthene	300	CTR	-	-	-	-	0.06	FPALDR	300	FPALDR
Fluorene	1,300	CTR	-	-	-	-	0.05	FPALDR	300	FPALDR
Indeno(1,2,3-c,d)-pyrene	0.0044 (q)	CTR	-	-	-	-	-	-	-	-
2-methylnaphthalene	-	-	-	-	-	-	-	-	-	-
2-methylphenol (o-Cresol)	-	-	-	-	-	-	-	-	-	-
Methylphenol (m- and p-Cresol)	-	-	-	-	-	-	-	-	-	-
Naphthalene	-	-	-	-	-	-	0.05	FPALDR	300	FPALDR

TABLE 7-6
CLEANUP LEVELS FOR SURFACE WATER, SEEPS, AND GROUNDWATER AT THE PRESIDIO OF SAN FRANCISCO

Presidio of San Francisco, California

Potential Chemical of Concern	Water Quality Criteria						Drinking Water Cleanup Level (d);(e) (µg/L)			
	Surface Water (a) (µg/L)	Reference	Freshwater Seep (b) (µg/L)	Reference	Salt Water (c) (µg/L)	Reference	Background Levels	Reference	MCLs or Risk-Based Drinking Water Standards	Reference
Semivolatile Organic Compounds (contd)										
n-dotriacontane	-	-	-	-	-	-	-	-	-	-
n-hentriacontane	-	-	-	-	-	-	-	-	-	-
n-nitrosodiphenylamine	5	CTR	-	-	-	-	-	-	-	-
n-triacontane	-	-	-	-	-	-	-	-	-	-
Pentachlorophenol	0.28	CTR	15	CTR	7.9	CTR	-	-	1	Federal MCL
Phenanthrene	-	-	-	-	-	-	0.05	FPALDR	230	FPALDR
Phenol	21,000	CTR	-	-	-	-	-	-	1	Basin Plan
Polycyclic Aromatic Hydrocarbons	0.031 (q)	Basin Plan	-	-	0.031 (q)	Basin Plan	-	-	26 (r)	FPALDR
Pyrene	960	CTR	-	-			0.09	FPALDR	230	FPALDR
Volatile Organic Compounds										
Acetone	-	-	-	-	-	-	-	-	-	-
Bromodichloromethane	0.56	CTR	-	-	-	-	-	-	80	Federal MCL
2-Butanone (MEK)	-	-	-	-	-	-	-	-	-	-
Carbon Disulfide	-	-	-	-	-	-	-	-	-	-
Carbon Tetrachloride	0.25	CTR	-	-	-	-	-	-	0.5	California MCL
Chlorodibromomethane	0.41	CTR	-	-	-	-	-	-	80	Federal MCL
Chlorobenzene	680	CTR	-	-	-	-	-	-	70	California MCL
Chloroform	-	-	-	-	-	-	-	-	80	Federal MCL
Chloromethane	-	-	-	-	-	-	-	-	-	-
1,4-dichlorobenzene	400	CTR	-	-	-	-	-	-	5	California MCL
1,2-dichloroethane	0.38	CTR	-	-	-	-	-	-	0.5	California MCL
1,1-dichloroethene	0.057	CTR	-	-	-	-	-	-	6	California MCL
cis-1,2-dichloroethene	-	-	-	-	-	-	-	-	6	California MCL

TABLE 7-6
CLEANUP LEVELS FOR SURFACE WATER, SEEPS, AND GROUNDWATER AT THE PRESIDIO OF SAN FRANCISCO

Presidio of San Francisco, California

Potential Chemical of Concern	Water Quality Criteria									
							Drinking Water Cleanup Level (d);(e) (µg/L)			
	Surface Water (a) (µg/L)	Reference	Freshwater Seep (b) (µg/L)	Reference	Salt Water (c) (µg/L)	Reference	Background Levels	Reference	MCLs or Risk-Based Drinking Water Standards	Reference
Volatile Organic Compounds (contd)										
p-Isopropyltoluene (p-cymene)	-	-	-	-	-	-	-	-	-	-
Methylene Chloride	4.7	CTR	-	-	-	-	-	-	5	Federal MCL
Tetrachloroethene	0.8	CTR	-	-	-	-	-	-	5	Federal MCL
1,2,3-trichlorobenzene (s)	-	-	-	-	-	-	-	-	5	California MCL
1,2,4-trichlorobenzene	-	-	-	-	-	-	-	-	5	California MCL
1,1,1-trichloroethane	-	-	-	-	-	-	-	-	200	Federal MCL
Trichloroethene	2.7	CTR	-	-	-	-	-	-	5	Federal MCL
Trichlorofluoromethane	-	-	-	-	-	-	-	-	150	California MCL
Petroleum Hydrocarbons and Constituents										
Gasoline Range Hydrocarbons	443	Order (t)	443	Order	1,200	Order	50	FPALDR	770	FPALDR
Diesel Range Hydrocarbons	443 (u)	BBL Study (t)	443 (u)	BBL Study	2,200	Order	50	FPALDR	880	FPALDR
Fuel Oil Range Hydrocarbons (v)	443 (u)	BBL Study	443 (u)	BBL Study	2,200	Order	50	FPALDR	1,200	FPALDR
Benzene	1.2	CTR	463	Order	510	Order	0.5	FPALDR	1	California MCL
Ethylbenzene	845	Order	845	Order	43	Order	0.5	FPALDR	300	California MCL
Toluene	490	Order	490	Order	1,000	Order	0.5	FPALDR	150	California MCL
Tetraethyl Lead	-	-	-	-	-	-	-	-	-	-
Total Xylenes	318	Order	318	Order	130	Order	0.5	FPALDR	1,750	California MCL
Methyl t-butyl ether (MTBE)	-	-	-	-	4,400	Order	-	-	13	California MCL
PCBs, Pesticides, and Herbicides										
Polychlorinated Biphenyls	0.00017 (w, x)	CTR	0.014 (w, x)	CTR	0.03	CTR	-	-	0.5	Federal MCL
Aldrin	0.00013 (x)	CTR	3	CTR	1.3	CTR	-	-	-	-
Chlordane	0.00057 (x)	CTR	0.0043 (x)	CTR	0.004	CTR	-	-	0.1	California MCL

TABLE 7-6
CLEANUP LEVELS FOR SURFACE WATER, SEEPS, AND GROUNDWATER AT THE PRESIDIO OF SAN FRANCISCO

Presidio of San Francisco, California

Potential Chemical of Concern	Water Quality Criteria									
							Drinking Water Cleanup Level (d);(e) (µg/L)			
	Surface Water (a) (µg/L)	Reference	Freshwater Seep (b) (µg/L)	Reference	Salt Water (c) (µg/L)	Reference	Background Levels	Reference	MCLs or Risk-Based Drinking Water Standards	Reference
PCBs, Pesticides, and Herbicides (contd)										
2,4-D	-	-	-	-	-	-	-	-	70	Federal MCL
4,4'-DDD (y)	0.00083 (x)	CTR	0.001 (x)	CTR	0.001 (x)	CTR	-	-	-	-
4,4'-DDE (y)	0.00059 (x)	CTR	0.001 (x)	CTR	0.001 (x)	CTR	-	-	-	-
4,4'-DDT	0.00059 (x)	CTR	0.001 (x)	CTR	0.001 (x)	CTR	-	-	-	-
Dicamba	-	-	-	-	-	-	-	-	-	-
Dieldrin	0.00014 (x)	CTR	0.056 (x)	CTR	0.0019 (x)	CTR	-	-	0.5	Action Level (z)
Endosulfan	0.056 (x)	CTR	0.056 (x)	CTR	0.0087 (x)	CTR	-	-	-	-
Endosulfan Sulfate (s)	0.056 (x)	CTR	0.056 (x)	CTR	0.0087 (x)	CTR	-	-	-	-
Endrin	0.036 (x)	CTR	0.036 (x)	CTR	0.0023 (x)	CTR	-	-	2	Federal MCL
Endrin Aldehyde (s)	0.036 (x)	CTR	0.036 (x)	CTR	0.0023 (x)	CTR	-	-	2	Federal MCL
Endrin Ketone (s)	0.036 (x)	CTR	0.036 (x)	CTR	0.0023 (x)	CTR	-	-	2	Federal MCL
beta-BHC	0.014 (x)	CTR	-	-	-	-	-	-	0.3	Action Level (z)
gamma-BHC (Lindane)	0.019 (x)	CTR	0.95	CTR	0.16	CTR	-	-	0.2	Federal MCL
Heptachlor	0.00021 (x)	CTR	0.0038 (x)	CTR	0.0036 (x)	CTR	-	-	0.01 (x)	California MCL
Heptachlor Epoxide	0.00010 (x)	CTR	0.0038 (x)	CTR	0.0036 (x)	CTR	-	-	0.01 (x)	California MCL
Isodrin (aa)	0.00013 (x)	CTR	3	CTR	1.3	CTR	-	-	-	-
MCPP	-	-	-	-	-	-	-	-	-	-
Methoxychlor	-	-	-	-	-	-	-	-	30	California MCL

TABLE 7-6
CLEANUP LEVELS FOR SURFACE WATER, SEEPS, AND GROUNDWATER AT THE PRESIDIO OF SAN FRANCISCO

Presidio of San Francisco, California

Notes:

(a) Cleanup levels are based upon concentrations of chemicals of concern ("COCs") that result in chronic toxicity to freshwater aquatic organisms, or to humans through consumption of water and fish, whichever is more stringent. Cleanup levels apply to freshwater surface water and groundwater that may exfiltrate directly to surface water, such as Lobos Creek, Mountain Lake, and the Tennessee Hollow Riparian Corridor upon enhancement.

(b) Cleanup levels are based upon concentrations of COCs that result in chronic toxicity to freshwater aquatic organisms. Cleanup levels apply to seeps and to groundwater that emerges as freshwater seeps.

(c) Cleanup levels are based upon concentrations of COCs that result in chronic toxicity to marine organisms. Cleanup levels apply to marine or salt water environments.

(d) Cleanup levels listed in the FPALDR are the Practical Quantitation Limits ("PQLs"). Background levels (i.e., the PQLs) will be used as water quality goals for the Lobos Creek Groundwater Basin.

(e) Cleanup level listed is a promulgated or proposed federal Maximum Contaminant Level ("MCL"), promulgated or proposed MCL or action level specific to the State of California, or a water quality objective for municipal supply as identified in the Basin Plan (California Environmental Protection Agency, Regional Water Quality Control Board, San Francisco Bay Region, Water Quality Control Plan, San Francisco Bay Basin, San Francisco Bay Region ("Basin Plan"), dated 21 June 1995), as updated by Resolution R2-2004-003 dated 21 January 2004. Federal MCLs obtained from U.S. EPA, 2002 Edition of Drinking Water Standards and Health Advisories, dated Summer 2002. California MCLs obtained from Title 22 of the California Code of Regulations, §64431 and §64444. Proposed MCLs and action levels obtained from U.S. EPA Region IX, *Drinking Water Standards and Health Advisories Table,* dated November 2000, revised February 2001. Drinking water cleanup levels apply to groundwater and surface water at the Presidio.

(f) Cleanup level obtained from Title 40 of the Code of Federal Regulations, Part §131.38, *Establishment of Numerical Criteria for Priority Toxic Pollutants for the State of California*, or California Toxics Rule ("CTR"), promulgated 18 May 2000.

(g) Hyphen indicates that a cleanup level is not available.

(h) Cleanup level is expressed as a function of the water-effects ratio, as defined in the CTR.

(i) These objectives for metals are expressed in terms of the dissolved fraction of the metal in the water column.

(j) Cleanup level obtained from the Basin Plan (as defined above).

(k) Cleanup level is a function of hardness. Value shown is based on a hardness of 100 mg/L as calcium carbonate.

TABLE 7-6
CLEANUP LEVELS FOR SURFACE WATER, SEEPS, AND GROUNDWATER AT THE PRESIDIO OF SAN FRANCISCO

Presidio of San Francisco, California

Notes (contd):

(l) Cleanup level listed is a secondary MCL. Secondary MCLs apply to chemicals in drinking water that adversely affect its odor, taste, or appearance and therefore cause people to discontinue using the water.

(m) Cleanup level obtained from Title 40 of the Code of Federal Regulations, Part §131.36, *Establishment of Numerical Criteria for Priority Toxic Pollutants,* or National Toxics Rule ("NTR"), promulgated 22 December 1992, as amended. The Basin Plan indicates values for these chemicals should be obtained from the NTR. The values in the NTR are consistent with those presented in the CTR.

(n) MCL based upon treatment technique. Treatment technique and public notification required at action level of 15 µg/L for lead.

(o) Cleanup level for mercury is 0.012 µg/L. However, this level is below the typical analytical method reporting limit of 0.025 µg/L. A cleanup objective of 0.012 µg/L is desirable, but attainment can only be determined at the analytical method reporting limit.

(p) Cleanup level obtained from Montgomery Watson, *Fuel Product Action Level Development Report, Presidio of San Francisco, California* ("FPALDR"), dated October 1995. Numerical values developed based upon residential exposure to COCs in groundwater through ingestion and inhalation pathways.

(q) This level is below the typical analytical method reporting limit range of 0.1 to 10 µg/L for semivolatile organic compounds. Cleanup level listed is desirable, but attainment can only be determined at the analytical method reporting limit. Cleanup level is established at the typical analytical method reporting limit range for semivolatile organic compounds assuming no matrix interference. In the event of matrix interference, actual method reporting limits determining compliance with cleanup levels may be raised.

(r) The drinking water standard in the FPALDR is for total carcinogenic polyclic aromatic hydrocarbons ("PAHs"). These carcinogenic PAHs include benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, and chrysene.

(s) Values for 1,2,4-trichlorobenzene were used for 1,2,3-trichlorobenzene. Values for Endosulfan were used for Endosulfan Sulfate. Values for Endrin were used for Endrin Aldehyde and Endrin Ketone.

TABLE 7-6
CLEANUP LEVELS FOR SURFACE WATER, SEEPS, AND GROUNDWATER AT THE PRESIDIO OF SAN FRANCISCO

Presidio of San Francisco, California

Notes (contd):

(t) Cleanup levels for TPH-diesel for the saltwater zone are from Order No. R2-2003-0080, *Revised Site Cleanup Requirements and Recision of Order No. 91-082 and Order No. 96-070 for the Property Located at The Presidio of San Francisco, City and County of San Francisco,* issued by the California Regional Water Quality Control Board, 20 August 2003 ("Order").
Cleanup levels for TPH-diesel and TPH-fuel oil for the freshwater ecological protection zone were obtained from Blasland, Bouck, & Lee ("BBL"), *Draft Development of Freshwater TPH-diesel and TPH-fuel oil Point of Compliance Concentration Determinations, Presidio of San Francisco, California,* dated 15 July 2004 ("BBL Study"). This report was approved by the RWQCB on 7 September 2004 in a letter from Bruce H. Wolfe.

(u) The BBL Study developed Point of Compliance Concentrations for areas within the Freshwater Ecological Protection Zone ("FEPZ"). Value is to be used within FEPZ Zone of Application, as discussed in the BBL Study, and in other areas of the Presidio where freshwater cleanup levels may be appropriate (e.g., Lobos Creek).

(v) Fuel oil range hydrocarbons includes motor oil.

(w) Cleanup level applies to total polychlorinated biphenyls ("PCBs").

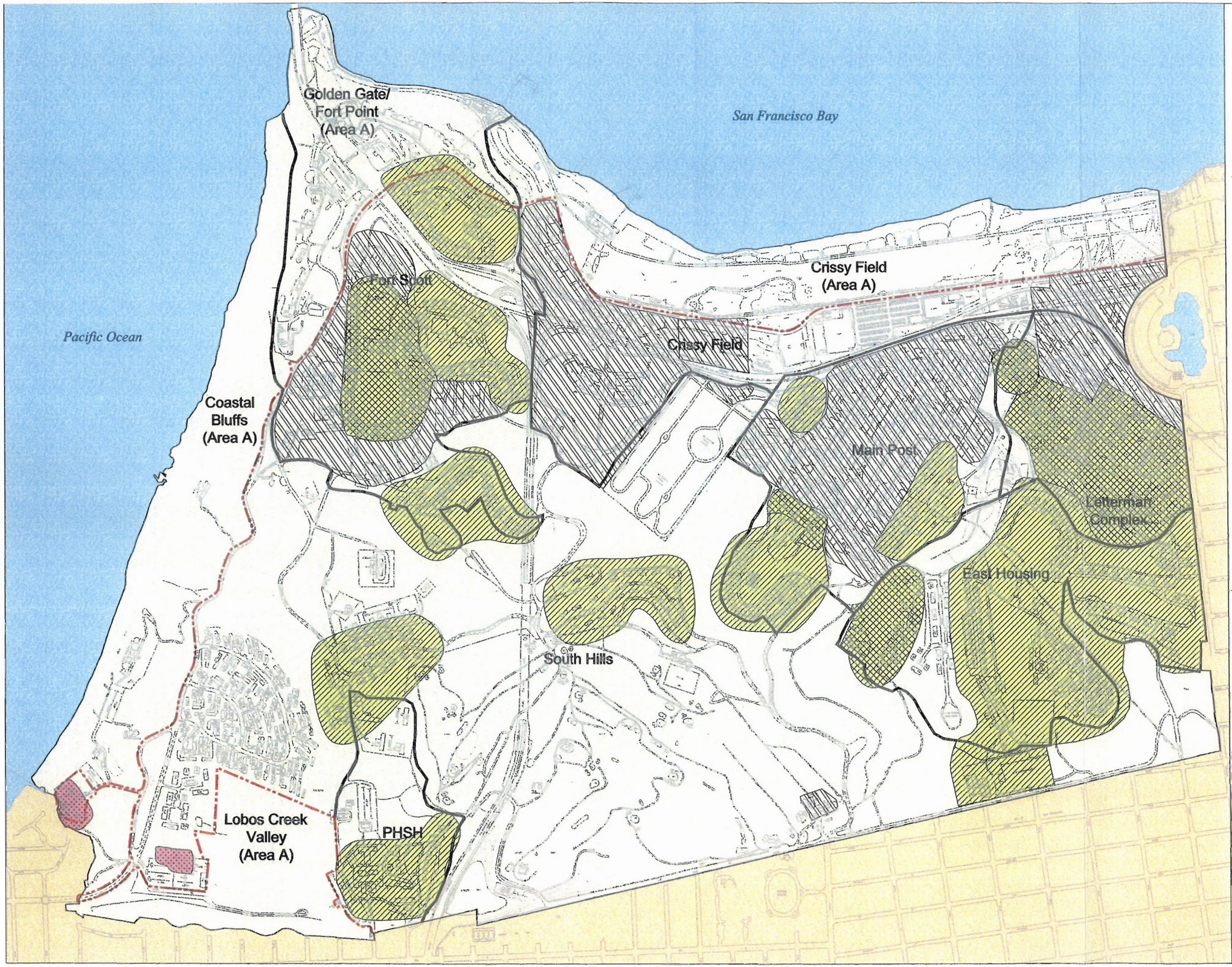
(x) This level is below the typical analytical method reporting limit range of 0.05 to 0.5 µg/L for PCBs and pesticides. Cleanup level listed is desirable, but attainment can only be determined at the analytical method reporting limit.

(y) In the absence of a published value for 4,4'-DDD or 4,4'-DDE, the value for 4,4'-DDT is used.

(z) Cleanup level is State of California action level for drinking water.

(aa) Isodrin is an isomer of Aldrin. Values for Aldrin were used for Isodrin.

FIGURES



N

0 800 1600

(Approximate Scale in Feet)

LEGEND

- Area A/B Boundary
- Presidio Planning Area or District Boundary

Planned Human Land Use (Note 4)

- Planned Residential Use
- Planned Commercial/ Recreational Use
- Planned Institutional Use (Educational/Conference)
- Planned Commercial/ Industrial Land Use

Appropriate Soil Cleanup Level

- Residential Cleanup Level
- Recreational Cleanup Level
- Commercial/Industrial Cleanup Level

Notes:

1. All locations are approximate.
2. Basemap developed from site plan provided by the Presidio Trust.
3. Designated human land use is based on the National Park Service's Final General Management Plan Amendment ("GMPA"), dated July 1994, and Presidio Trust Management Plan ("PTMP") dated May 2002.
4. Planned human land use is recreational if none of the above patterns are shown.
5. Appropriate cleanup levels are based on the most restrictive human land use defined in the GMPA and PTMP.
6. PHSH is the Public Health Service Hospital Planning Area.

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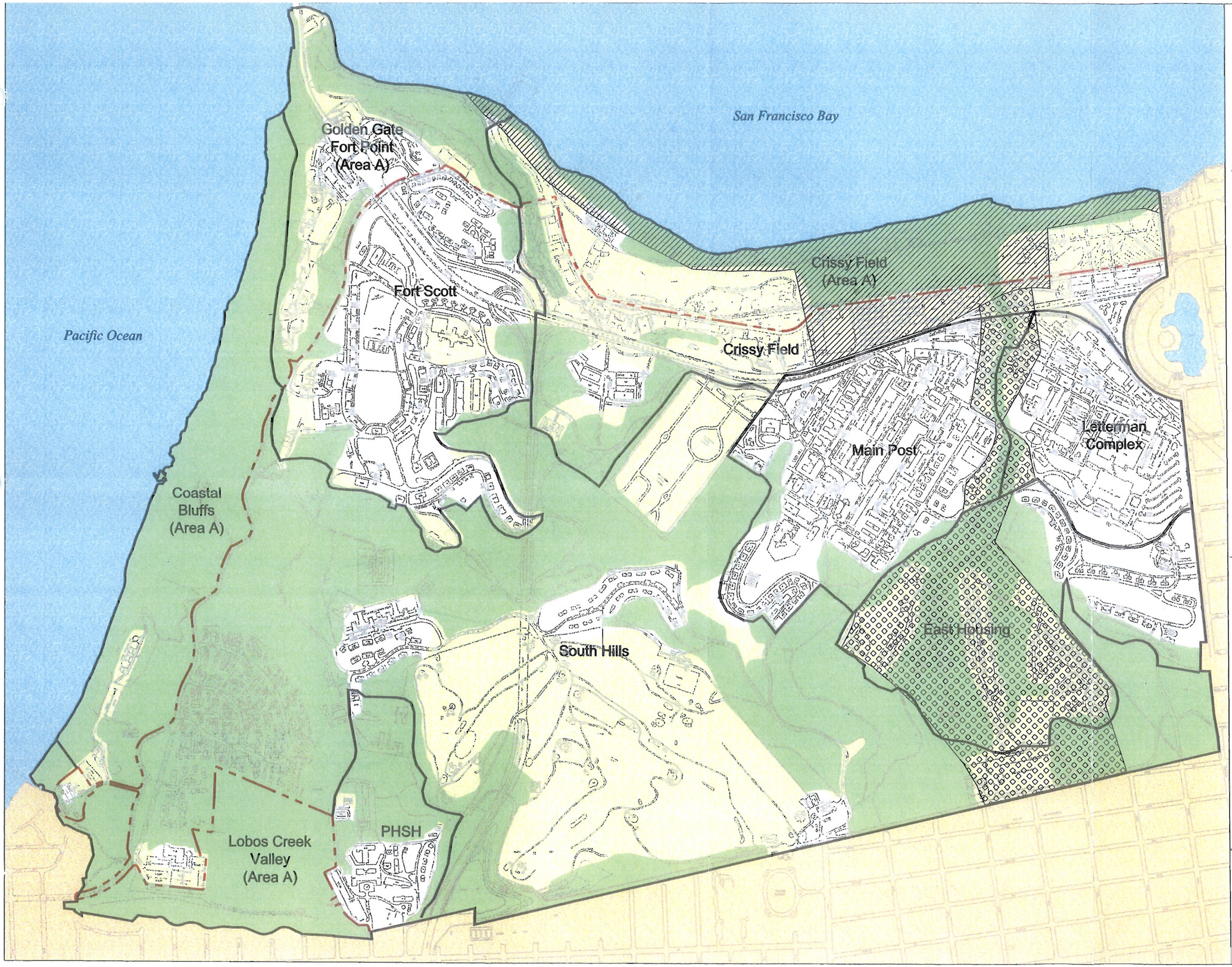
Planned Human Land Use at the Presidio

Presidio Trust
San Francisco, CA
October 2002
EKI A000003.04
Figure 7-1



N

0 800 1600

(Approximate Scale in Feet)

LEGEND

- Area A/B Boundary
- Presidio Planning Area or District Boundary

Ecological Potection Zones (Note 3)

- Saltwater Ecological Protection Zone
- Freshwater Ecological Protection Zone

Appropriate Soil Cleanup Level

- Human Health Cleanup Level (Developed Areas Outside Ecological Protection Zones)
- Buffer Zone Ecological Cleanup Level (Manicured Open Space Areas)
- Special Status Ecological Cleanup Level (See Note 4)

Notes:

1. All locations are approximate.
2. Basemap developed from site plan provided by the Presidio Trust.
3. Ecological Protection Zones are defined in California Regional Water Quality Control Board, Order No. 96-070, dated 15 May 1996.
4. Special Status Ecological Areas include Native Plant Community Zones, Historic Forest Zones, and Special Management Zones identified in the Vegetation Management Plan and Environmental Assessment, NPS and Presidio Trust, December 2001.
5. PHSH is the Public Health Service Hospital Planning Area.

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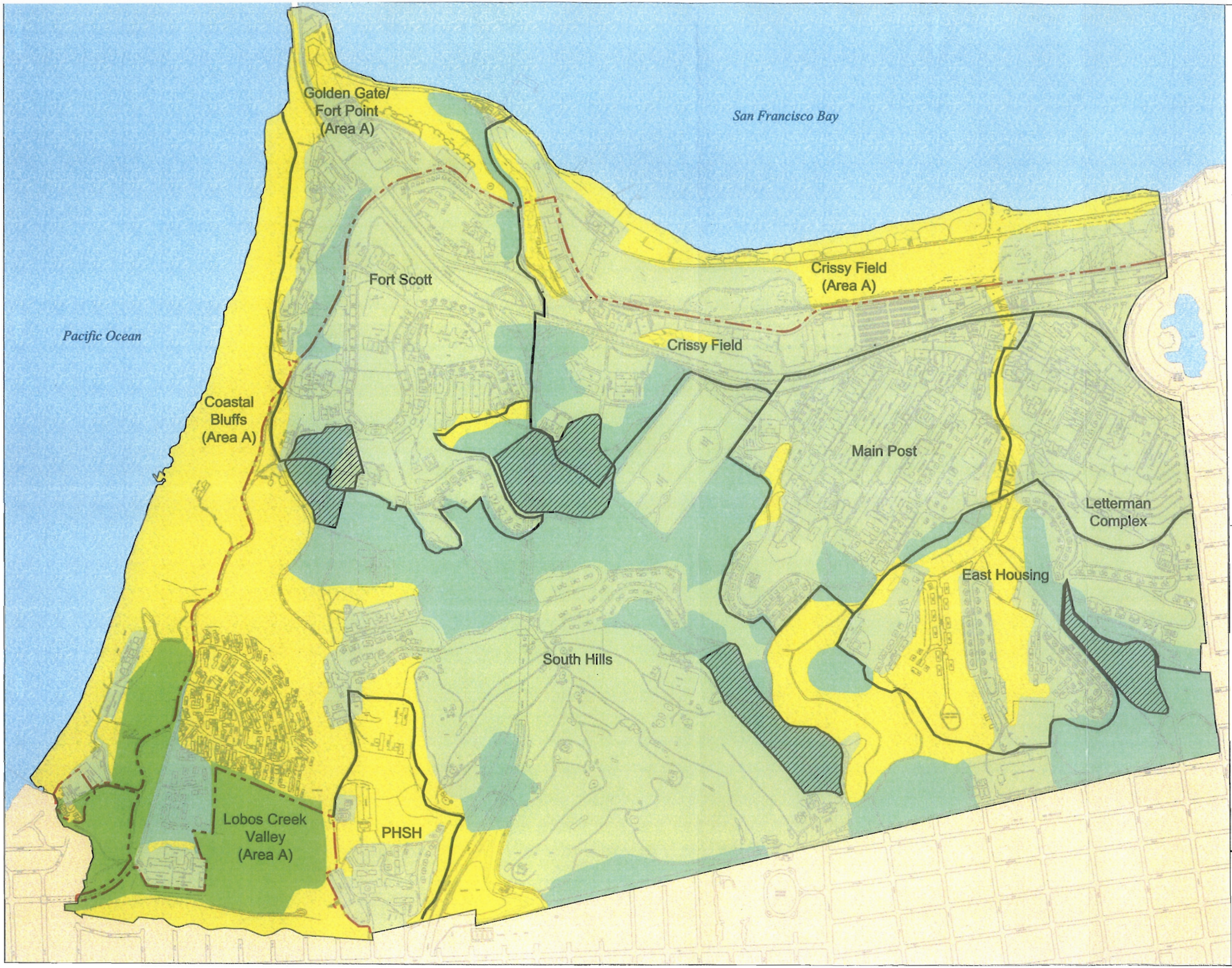
Planned Ecological Land Use at the Presidio

Presidio Trust
San Francisco, CA
October 2002
EKI A000003.04

Figure 7-2



N

0 800 1600

(Approximate Scale in Feet)

LEGEND

- Area A/B Boundary
- Presidio Planning Area or District Boundary
- Native Plant Communities Zone
- Historic Forest Zone
- Landscape Vegetation Zone
- Special Management Zone
- Key Historic Forest Stands

Notes:

1. All locations are approximate.
2. Basemap developed from site plan provided by the Presidio Trust.
3. PHSH is the Public Health Service Hospital Planning Area.
4. Figure taken from Vegetation Management Plan and Environmental Staff Report, NPS and Presidio Trust, October 2000, and Vegetation Management Plan and Environmental Assesment, December 2001.

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Planned Vegetation Types at the Presidio

Presidio Trust
San Francisco, CA
October 2002
EKI A000003.04

Figure 7–3

8. REFERENCES

8. REFERENCES

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APPENDICES

APPENDIX A

LEAD SPREAD VERSION 7.0

COMPUTER SPREADSHEETS

APPENDIX A

LEAD SPREAD VERSION 7.0
COMPUTER SPREADSHEETS

October 2002

TABLE A-1
LEAD INTAKE SUMMARY FOR RESIDENTIAL, RECREATIONAL, AND COMMERCIAL/INDUSTRIAL USERS (a)

Presidio of San Francisco, California

Potentially Exposed Population	Exposure Frequency (days/week)	Exposure Media/Lead Concentration					Blood Lead (f) (µg/dl)
		Air (b) (µg/m^3)	Water (b) (µg/L)	Food Intake (c) (kg/day)	Background Soil (d) (mg/kg)	Presidio Soil (e) (mg/kg)	
Residential (child)	7 (Presidio)	0.028	2.4	1.9	0	**370**	10
Recreational (child)	7 (Background)	0.028	15	1.1	0	0	4.6
	4 (Background)	0	0	0	66	0	0.8
	3 (Presidio)	0	0	0	0	**500**	4.6
							10
Commercial/Industrial (adult)	5 (Presidio)	0.028	15	1.9	0	**3,500**	10

Notes:

(a) Lead concentration in blood calculated using California Environmental Protection Agency, Department of Toxic Substances Control ("DTSC") Lead Spread Version 7.0 (beta test version) computer model.

(b) Air, water and food intake concentrations are based on DTSC default factors, except for lead in residential tap water. A value of 2.4 ug/L is based on the 95% upper confidence limit of the average lead concentration measured in residential tap water at the Presidio in 1998, 1999, and 2000 (see data in Appendix A).

(c) Food intake is based on DTSC default factor. The lead concentration in food is assumed to be 3.1 µg/kg, which is also a DTSC default factor.

(d) Background concentrations of lead in soil at the Presidio are used for background in Lead Spread. A value of 66 mg/kg of lead corresponds to the background concentration in serpentinite, which is the maximum background concentration calculated by EKI for the four lithologies at the Presidio.

TABLE A-1
LEAD INTAKE SUMMARY FOR RESIDENTIAL, RECREATIONAL, AND COMMERCIAL/INDUSTRIAL USERS (a)

Presidio of San Francisco, California

Notes (continued):

(e) The concentration of lead in Presidio soil corresponds to the value that results in a cumulative blood lead concentration of 10 µg/dl. This value is the proposed cleanup level for the scenario indicated.

(f) See Appendix A for the computer spreadsheets in which blood lead concentration is calculated.

BLOOD LEAD CONCENTRATION FOR EXPOSURE OF RESIDENTIAL POPULATIONS TO LEAD IN SOIL AT PROPOSED CLEANUP LEVEL

CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL

USER'S GUIDE to version 7

INPUT	
MEDIUM	LEVEL
Lead in Air (ug/m^3)	0.028
Lead in Soil/Dust (ug/g)	**370.0**
Lead in Water (ug/l)	2.4
% Home-grown Produce	0%
Respirable Dust (ug/m^3)	1.5

OUTPUT							
	Percentile Estimate of Blood Pb (ug/dl)					PRG-99	PRG-95
	50th	90th	95th	98th	99th	(ug/g)	(ug/g)
BLOOD Pb, ADULT	0.8	1.4	1.6	2.0	2.3	3184	4575
BLOOD Pb, CHILD	3.4	6.1	7.3	8.8	**10.0**	368	549
BLOOD Pb, PICA CHILD	6.0	10.9	12.9	15.7	17.8	185	276
BLOOD Pb, OCCUPATIONA	0.4	0.7	0.8	1.0	1.1	#DIV/0!	#DIV/0!

EXPOSURE PARAMETERS			
	units	adults	children
Days per week	days/wk	7	
Days per week, occupational			
Geometric Standard Deviation		1.6	
Blood lead level of concern (ug/dl)		10	
Skin area, residential	cm^2	5700	2900
Skin area occupational	cm^2	2900	
Soil adherence	ug/cm^2	70	200
Dermal uptake constant	(ug/dl)/(ug/day)	0.0001	
Soil ingestion	mg/day	50	100
Soil ingestion, pica	mg/day		200
Ingestion constant	(ug/dl)/(ug/day)	0.04	0.16
Bioavailability	unitless	0.44	
Breathing rate	m^3/day	20	6.8
Inhalation constant	(ug/dl)/(ug/day)	0.082	0.192
Water ingestion	l/day	1.4	0.4
Food ingestion	kg/day	1.9	1.1
Lead in market basket	ug/kg	3.1	
Lead in home-grown produce	ug/kg	166.5	

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PATHWAYS						
ADULTS	Residential			Occupational		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	3.8E-5	0.01	2%	0.0E+0	0.00	0%
Soil Ingestion	8.8E-4	0.33	43%	0.0E+0	0.00	0%
Inhalation, bkgrnd		0.05	6%		0.00	0%
Inhalation	2.5E-6	0.00	0%	0.0E+0	0.00	0%
Water Ingestion		0.13	18%		0.13	37%
Food Ingestion, bkgrnd		0.23	31%		0.23	63%
Food Ingestion	0.0E+0	0.00	0%			0%

CHILDREN	typical			with pica		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	5.6E-5	0.02	1%		0.02	0%
Soil Ingestion	7.0E-3	2.60	78%	1.4E-2	5.21	87%
Inhalation	2.0E-6	0.00	0%		0.00	0%
Inhalation, bkgrnd		0.04	1%		0.04	1%
Water Ingestion		0.15	5%		0.15	3%
Food Ingestion, bkgrnd		0.54	16%		0.54	9%
Food Ingestion	0.0E+0	0.00	0%		0.00	0%

BLOOD LEAD CONCENTRATION FOR EXPOSURE OF CHILDREN TO BACKGROUND LEAD IN AIR, WATER, AND FOOD UNDER A RECREATIONAL SCENARIO

CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL

USER'S GUIDE to version 7

INPUT	
MEDIUM	LEVEL
Lead in Air (ug/m^3)	0.028
Lead in Soil/Dust (ug/g)	0.0
Lead in Water (ug/l)	15
% Home-grown Produce	0%
Respirable Dust (ug/m^3)	1.5

OUTPUT	Percentile Estimate of Blood Pb (ug/dl)					PRG-99	PRG-95
	50th	90th	95th	98th	99th	(ug/g)	(ug/g)
BLOOD Pb, ADULT	1.1	2.0	2.4	2.9	3.3	2417	3809
BLOOD Pb, CHILD	1.5	2.8	3.3	4.0	4.6	255	435
BLOOD Pb, PICA CHILD	1.5	2.8	3.3	4.0	4.6	128	219
BLOOD Pb, OCCUPATIONAL	1.1	2.0	2.4	2.9	3.3	3475	5464

EXPOSURE PARAMETERS	units	adults	children
Days per week	days/wk	7	
Days per week, occupational		5	
Geometric Standard Deviation		1.6	
Blood lead level of concern (ug/dl)		10	
Skin area, residential	cm^2	5700	2900
Skin area occupational	cm^2	2900	
Soil adherence	ug/cm^2	70	200
Dermal uptake constant	(ug/dl)/(ug/day)	0.0001	
Soil ingestion	mg/day	50	100
Soil ingestion, pica	mg/day		200
Ingestion constant	(ug/dl)/(ug/day)	0.04	0.16
Bioavailability	unitless	0.44	
Breathing rate	m^3/day	20	6.8
Inhalation constant	(ug/dl)/(ug/day)	0.082	0.192
Water ingestion	l/day	1.4	0.4
Food ingestion	kg/day	1.9	1.1
Lead in market basket	ug/kg	3.1	
Lead in home-grown produce	ug/kg	0.0	

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PATHWAYS

ADULTS	Residential			Occupational		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	3.8E-5	0.00	0%	1.4E-5	0.00	0%
Soil Ingestion	8.8E-4	0.00	0%	6.3E-4	0.00	0%
Inhalation, bkgrnd		0.05	4%		0.03	3%
Inhalation	2.5E-6	0.00	0%	1.8E-6	0.00	0%
Water Ingestion		0.84	75%		0.84	76%
Food Ingestion, bkgrnd		0.23	21%		0.23	21%
Food Ingestion	0.0E+0	0.00	0%			0%

CHILDREN	typical			with pica		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	5.6E-5	0.00	0%		0.00	0%
Soil Ingestion	7.0E-3	0.00	0%	1.4E-2	0.00	0%
Inhalation	2.0E-6	0.00	0%		0.00	0%
Inhalation, bkgrnd		0.04	2%		0.04	2%
Water Ingestion		0.96	62%		0.96	62%
Food Ingestion, bkgrnd		0.54	35%		0.54	35%
Food Ingestion	0.0E+0	0.00	0%		0.00	0%

BLOOD LEAD CONCENTRATION FOR EXPOSURE OF CHILDREN TO BACKGROUND LEAD IN SOIL UNDER A RECREATIONAL SCENARIO

CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL

USER'S GUIDE to version 7

INPUT	
MEDIUM	LEVEL
Lead in Air (ug/m^3)	0.0
Lead in Soil/Dust (ug/g)	**66.0**
Lead in Water (ug/l)	0.0
% Home-grown Produce	0%
Respirable Dust (ug/m^3)	1.5

OUTPUT							
	Percentile Estimate of Blood Pb (ug/dl)					PRG-99	PRG-95
	50th	90th	95th	98th	99th	(ug/g)	(ug/g)
BLOOD Pb, ADULT	0.3	0.5	0.6	0.7	0.8	5914	8349
BLOOD Pb, CHILD	0.3	0.5	0.6	0.7	**0.8**	825	1141
BLOOD Pb, PICA CHILD	0.5	1.0	1.2	1.4	1.6	414	573
BLOOD Pb, OCCUPATIONAL	0.3	0.5	0.6	0.7	0.8	4830	6819

EXPOSURE PARAMETERS			
	units	adults	children
Days per week	days/wk	4	
Days per week, occupational		5	
Geometric Standard Deviation		1.6	
Blood lead level of concern (ug/dl)		10	
Skin area, residential	cm^2	5700	2900
Skin area occupational	cm^2	2900	
Soil adherence	ug/cm^2	70	200
Dermal uptake constant	(ug/dl)/(ug/day)	0.0001	
Soil ingestion	mg/day	50	100
Soil ingestion, pica	mg/day		200
Ingestion constant	(ug/dl)/(ug/day)	0.04	0.16
Bioavailability	unitless	0.44	
Breathing rate	m^3/day	20	6.8
Inhalation constant	(ug/dl)/(ug/day)	0.082	0.192
Water ingestion	l/day	1.4	0.4
Food ingestion	kg/day	1.9	0.0
Lead in market basket	ug/kg	3.1	
Lead in home-grown produce	ug/kg	29.7	

Click here for REFERENCES

PATHWAYS						
ADULTS	Residential			Occupational		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	2.2E-5	0.00	1%	1.4E-5	0.00	0%
Soil Ingestion	5.0E-4	0.03	12%	6.3E-4	0.04	15%
Inhalation, bkgrnd		0.00	0%		0.00	0%
Inhalation	1.4E-6	0.00	0%	1.8E-6	0.00	0%
Water Ingestion		0.00	0%		0.00	0%
Food Ingestion, bkgrnd		0.23	87%		0.23	85%
Food Ingestion	0.0E+0	0.00	0%			0%

CHILDREN	typical			with pica		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	3.2E-5	0.00	1%		0.00	0%
Soil Ingestion	4.0E-3	0.27	99%	8.0E-3	0.53	100%
Inhalation	1.1E-6	0.00	0%		0.00	0%
Inhalation, bkgrnd		0.00	0%		0.00	0%
Water Ingestion		0.00	0%		0.00	0%
Food Ingestion, bkgrnd		0.00	0%		0.00	0%
Food Ingestion	0.0E+0	0.00	0%		0.00	0%

BLOOD LEAD CONCENTRATION FOR EXPOSURE OF CHILDREN TO LEAD IN SOIL AT PROPOSED CLEANUP LEVEL UNDER A RECREATIONAL SCENARIO

CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL

USER'S GUIDE to version 7

INPUT	
MEDIUM	LEVEL
Lead in Air (ug/m^3)	0.0
Lead in Soil/Dust (ug/g)	**510.0**
Lead in Water (ug/l)	0.0
% Home-grown Produce	0%
Respirable Dust (ug/m^3)	1.5

OUTPUT							
	Percentile Estimate of Blood Pb (ug/dl)					PRG-99	PRG-95
	50th	90th	95th	98th	99th	(ug/g)	(ug/g)
BLOOD Pb, ADULT	0.4	0.8	0.9	1.1	1.3	7885	11133
BLOOD Pb, CHILD	1.6	2.8	3.4	4.1	**4.6**	1100	1521
BLOOD Pb, PICA CHILD	3.1	5.6	6.7	8.1	9.2	552	764
BLOOD Pb, OCCUPATIONAL	0.6	1.0	1.2	1.5	1.7	4830	6819

EXPOSURE PARAMETERS			
	units	adults	children
Days per week	days/wk	3	
Days per week, occupational		5	
Geometric Standard Deviation		1.6	
Blood lead level of concern (ug/dl)		10	
Skin area, residential	cm^2	5700	2900
Skin area occupational	cm^2	2900	
Soil adherence	ug/cm^2	70	200
Dermal uptake constant	(ug/dl)/(ug/day)	0.0001	
Soil ingestion	mg/day	50	100
Soil ingestion, pica	mg/day		200
Ingestion constant	(ug/dl)/(ug/day)	0.04	0.16
Bioavailability	unitless	0.44	
Breathing rate	m^3/day	20	6.8
Inhalation constant	(ug/dl)/(ug/day)	0.082	0.192
Water ingestion	l/day	1.4	0.4
Food ingestion	kg/day	1.9	0.0
Lead in market basket	ug/kg	3.1	
Lead in home-grown produce	ug/kg	229.5	

Click here for REFERENCES

PATHWAYS						
ADULTS	Residential			Occupational		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	1.6E-5	0.01	2%	1.4E-5	0.01	1%
Soil Ingestion	3.8E-4	0.19	44%	6.3E-4	0.32	57%
Inhalation, bkgrnd		0.00	0%		0.00	0%
Inhalation	1.1E-6	0.00	0%	1.8E-6	0.00	0%
Water Ingestion		0.00	0%		0.00	0%
Food Ingestion, bkgrnd		0.23	54%		0.23	42%
Food Ingestion	0.0E+0	0.00	0%			0%

CHILDREN	typical			with pica		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	2.4E-5	0.01	1%		0.01	0%
Soil Ingestion	3.0E-3	1.54	99%	6.0E-3	3.08	100%
Inhalation	8.4E-7	0.00	0%		0.00	0%
Inhalation, bkgrnd		0.00	0%		0.00	0%
Water Ingestion		0.00	0%		0.00	0%
Food Ingestion, bkgrnd		0.00	0%		0.00	0%
Food Ingestion	0.0E+0	0.00	0%		0.00	0%

BLOOD LEAD CONCENTRATION FOR EXPOSURE OF COMMERCIAL/INDUSTRIAL POPULATIONS TO LEAD IN SOIL AT PROPOSED CLEANUP LEVEL

CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL

USER'S GUIDE to version 7

INPUT	
MEDIUM	LEVEL
Lead in Air (ug/m^3)	0.028
Lead in Soil/Dust (ug/g)	3450.0
Lead in Water (ug/l)	15.0
% Home-grown Produce	0%
Respirable Dust (ug/m^3)	1.5

OUTPUT							
	Percentile Estimate of Blood Pb (ug/dl)					PRG-99	PRG-95
	50th	90th	95th	98th	99th	(ug/g)	(ug/g)
BLOOD Pb, ADULT	3.4	6.2	7.3	8.9	10.1	3404	5353
BLOOD Pb, CHILD	19.0	34.7	41.1	50.0	56.9	359	611
BLOOD Pb, PICA CHILD	36.4	66.4	78.6	95.5	108.7	180	307
BLOOD Pb, OCCUPATIONA	3.3	6.1	7.2	8.7	10.0	3475	5464

EXPOSURE PARAMETERS			
	units	adults	children
Days per week	days/wk	5	
Days per week, occupational		5	
Geometric Standard Deviation		1.6	
Blood lead level of concern (ug/dl)		10	
Skin area, residential	cm^2	5700	2900
Skin area occupational	cm^2	2900	
Soil adherence	ug/cm^2	70	200
Dermal uptake constant	(ug/dl)/(ug/day)	0.0001	
Soil ingestion	mg/day	50	100
Soil ingestion, pica	mg/day		200
Ingestion constant	(ug/dl)/(ug/day)	0.04	0.16
Bioavailability	unitless	0.44	
Breathing rate	m^3/day	20	6.8
Inhalation constant	(ug/dl)/(ug/day)	0.082	0.192
Water ingestion	l/day	1.4	0.4
Food ingestion	kg/day	1.9	1.1
Lead in market basket	ug/kg	3.1	
Lead in home-grown produce	ug/kg	1552.5	

Click here for REFERENCES

PATHWAYS

ADULTS	Residential			Occupational		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	2.7E-5	0.09	3%	1.4E-5	0.05	1%
Soil Ingestion	6.3E-4	2.17	64%	6.3E-4	2.17	65%
Inhalation, bkgrnd		0.03	1%		0.03	1%
Inhalation	1.8E-6	0.01	0%	1.8E-6	0.01	0%
Water Ingestion		0.84	25%		0.84	25%
Food Ingestion, bkgrnd		0.23	7%		0.23	7%
Food Ingestion	0.0E+0	0.00	0%			0%

CHILDREN	typical			with pica		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	4.0E-5	0.14	1%		0.14	0%
Soil Ingestion	5.0E-3	17.35	91%	1.0E-2	34.70	95%
Inhalation	1.4E-6	0.00	0%		0.00	0%
Inhalation, bkgrnd		0.03	0%		0.03	0%
Water Ingestion		0.96	5%		0.96	3%
Food Ingestion, bkgrnd		0.54	3%		0.54	1%
Food Ingestion	0.0E+0	0.00	0%		0.00	0%

TABLE A-2
SUMMARY OF LEAD RESULTS FROM SAMPLING IN RESIDENCES

Presidio of San Francisco, California

Street Address / Sample ID	Lead Concentration (µg/L) (a)		
	12/1/98	4/27/99	9/12/00
PR-1	2.8	4.7	NA (b)
PR-2	4.6	3.1	NA
PR-3	1.5	NA	NA
PR-4	-- (c)	1.2	NA
PR-5	10.2	5.9	NA
PR-6	1.1	3.8	NA
PR-7	<1.0	1.7	NA
PR-8	<1.0	<1.0	NA
PR-9	--	3.3	NA
PR-10	2.1	2.4	NA
PR-11	<1.0	<1.0	NA
PR-12	1.2	<1.0	NA
PR-13	--	<1.0	NA
PR-14	--	1.6	NA
PR-15	<1.0	<1.0	NA
PR-16	1.4	1.4	NA
PR-17	--	NA	NA
PR-18	1.1	<1.0	NA
PR-19	1.9	3.3	NA
PR-20	1.5	2.2	NA
PR-21	1.8	NA	NA
PR-22	1.1	NA	NA
PR-23	NA	1.1	NA
PR-28	NA	NA	2.3
PR-29	NA	NA	<1.0
PR-30	NA	NA	1.5
PR-31	NA	NA	<1.0
PR-32	NA	NA	3.6
PR-33	NA	NA	<1.0
PR-34	NA	NA	<1.0
PR-35	NA	NA	27 (d)
PR-36	NA	NA	<1.0
PR-37	NA	NA	<1.0
95% Upper Confidence Limit of the Mean	2.4 µg/L		

Notes:

(a) Samples were collected to comply with the monitoring requirements of the Lead and Copper Rule. Water samples collected by the Trust for lead analysis were from the first draw of the day. For the 12/1/98 and 4/27/99 monitoring events, the Presidio was using 100% Lobos Creek water. For the 9/12/00 monitoring event the Presidio was using 75-80% Lobos Creek water and 20-25% City water.

(b) NA = Not analyzed or no data available.

(c) "--" indicates sample data not valid due to faucet use before sample collection.

(d) It is EKI's understanding that the tap was significantly corroded; tap has been replaced. This data point is not included in statistical analysis of lead data, as it is not considered representative of the actual water.

APPENDIX B

CRYSTAL BALL INPUT PARAMETERS AND MONTE CARLO METHOD OUTPUT

APPENDIX B

CRYSTAL BALL™ INPUT PARAMETERS AND MONTE CARLO METHOD OUTPUT

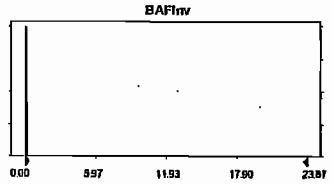
Uncertainty Analysis for Birds Based on Low and High BTAG TRVs
Presidio of San Francisco
San Francisco, California

Assumption: BAFinv **Cell: K2**

Lognormal distribution with parameters:

Mean	0.27
Standard Dev.	18.82

Selected range is from 0.00 to +Infinity
Mean value in simulation was 0.22

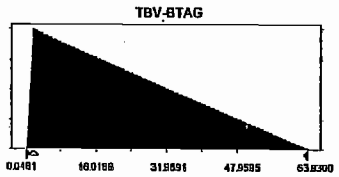


Assumption: TBV-BTAG **Cell: B3**

Triangular distribution with parameters:

Minimum	0.0481
Likeliest	1.7500
Maximum	63.9300

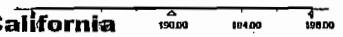
Selected range is from 0.0481 to 63.9300
Mean value in simulation was 21.8493



Uncertainty Analysis for Birds Based on Low and High BTAG TRVs

Presidio of San Francisco

San Francisco, California

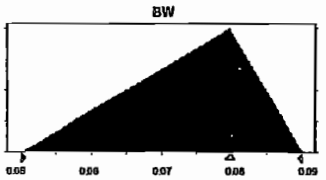


Selected range is from 182.00 to 198.00
Mean value in simulation was 190.02

Assumption: BW **Cell: J2**

Triangular distribution with parameters:

Minimum	0.06
Likeliest	0.08
Maximum	0.09



Selected range is from 0.06 to 0.09
Mean value in simulation was 0.07

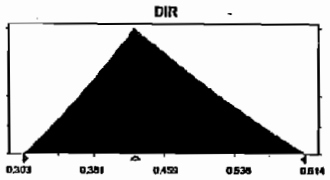
Uncertainty Analysis for Birds Based on Low and High BTAG TRVs
Presidio of San Francisco
San Francisco, California

Assumption: DIR **Cell: D2**

Triangular distribution with parameters:

Minimum	0.303
Likeliest	0.426
Maximum	0.614

Selected range is from 0.303 to 0.614
Mean value in simulation was 0.447

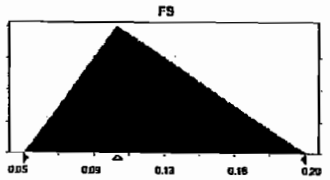


Assumption: FS **Cell: E2**

Triangular distribution with parameters:

Minimum	0.05
Likeliest	0.10
Maximum	0.20

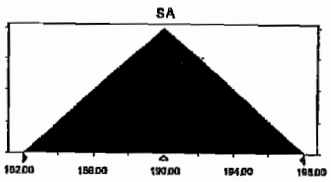
Selected range is from 0.05 to 0.20
Mean value in simulation was 0.12



Assumption: SA **Cell: G2**

Triangular distribution with parameters:

Minimum	182.00
Likeliest	190.00
Maximum	198.00



Uncertainty Analysis for Birds Based on Low and High BTAG TRVs
Presidio of San Francisco
San Francisco, California

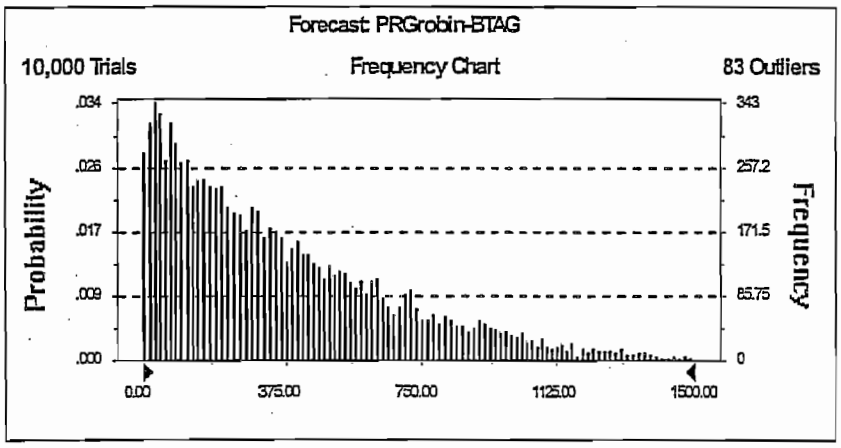
Forecast: PRGrobin-BTAG

Summary:

Display Range is from 0.00 to 1500.00
Entire Range is from 0.08 to 2386.91
After 10,000 Trials, the Std. Error of the Mean is 3.34

Statistics:

	Value
Trials	10,000
Mean	386
Median	297
Mode	---
Standard Deviation	334
Variance	111,420
Skewness	1.35
Kurtosis	5.18
Coeff. of Variability	0.87
Range Minimum	0.08
Range Maximum	2,387
Range Width	2,387
Mean Std. Error	3.34



Percentile	Value	Percentile	Value
0%	0	55%	338
5%	25	60%	385
10%	48	65%	436
15%	73	70%	495
20%	98	75%	559
25%	126	80%	633
30%	156	85%	724
35%	189	90%	853
40%	220	95%	1033
45%	257	100%	2387
50%	297		

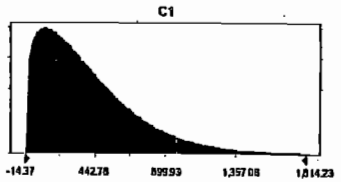
Assumptions for Uncertainty Analysis for Plants
Presidio of San Francisco
San Francisco, California

Assumption: Non-lethal NOECs

Weibull distribution with parameters:

Location	-14.37
Scale	442.21
Shape	1.26122401

Selected range is from -14.37 to +Infinity
Mean value in simulation was 396.27



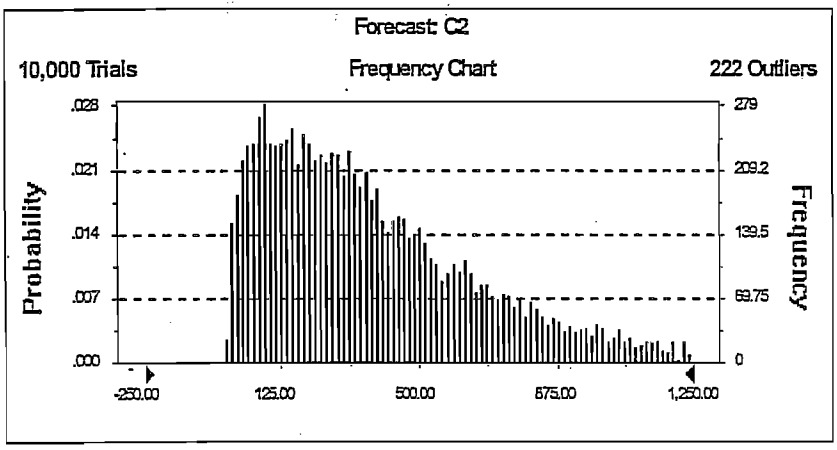
Uncertainty Analysis for Plants
Presidio of San Francisco
San Francisco, California

Forecast: Non-lethal effects on plants

Summary:

Display Range is from 0.00 to 1,250.00
Entire Range is from 0.03 to 2,503.82
After 10,000 Trials, the Std. Error of the Mean is 3.25

Statistics:	Value
Trials	10000
Mean	403.93
Median	324.17
Mode	---
Standard Deviation	325.43
Variance	105,902.02
Skewness	1.33
Kurtosis	5.24
Coeff. of Variability	0.81
Range Minimum	0.03
Range Maximum	2,735.80
Range Width	2,735.80
Mean Std. Error	3.25



Percentile	Value	Percentile	Value
0%	0.03	55%	360.65
5%	33.57	60%	403.57
10%	66.90	65%	452.63
15%	97.89	70%	509.64
20%	128.11	75%	568.32
25%	157.08	80%	644.91
30%	186.04	85%	730.93
35%	219.55	90%	856.43
40%	254.06	95%	1,047.45
45%	289.09	100%	2,735.80
50%	324.17		

APPENDIX C

BACKGROUD MEETALS DATA SETS FOR SERPENTINITE, COLMA FORMATION, BEACH/DUNE AND CHERT/SHALE SAMPLES

APPENDIX C

BACKGROUND METALS DATA SETS FOR SERPENTINITE, COLMA FORMATION, BEACH/DUNE, AND CHERT/SHALE SAMPLES

October 2002

TABLE C-1
BACKGROUND DATA SET - SERPENTINITE LITHOLOGY
Presidio of San Francisco, California

Sample ID	Depth (ft.) (a)	Sample Date	Laboratories (b)	Major Elements (mg/kg)			
				Iron	Aluminum	Magnesium	Manganese
1a	NA (c)	10/16/96	NEIC	78,900	18,100	95,900	1,260
1b	NA	10/16/96	NEIC	72,400	15,900	95,200	1,200
1c	NA	10/16/96	NEIC	73,500	15,600	88,200	1,200
1d	NA	10/16/96	NEIC	80,000	16,800	85,200	1,280
BKGDSB04	0	09/02/92	ED	36,000	5,260	160,000	505
BKGDSB10	18	12/07/94	QA	56,800	7,610	15,300	594
BKGDSB14	1.5	12/08/94	QA	80,700	8,660	89,200	590
BKGDSB15	14.5	12/08/94	QA	73,100	3,500	124,000	2,090
BKGDSB15	20.5	12/08/94	QA	58,300	2,530	179,000	825
BKGSO03A	0.3	11/27/90	UB	52,700	3,560	270,000	791
UBR01SB02	COMP (d)	02/24/99	CALLAB	47,100	7,380	193,000	595
UBR02SB02	COMP (d)	02/25/99	CALLAB	44,700	1,130	213,000	671
1261 WEST	10	06/21/93	UNKNOWN	56,600	NA	NA	3,450
1351SO01B	17	10/26/90	UB	63,000	7,720	140,000	988
1351SO02B	15	10/29/90	UB	94,000	33,100	120,000	1,020
GCEX01	3	10/19/98	QUANT	120,000	20,300	33,500	1,150
GCEX02	3	10/19/98	QUANT	102,000	10,000	72,500	1,330
GCEX03	3	10/19/98	QUANT	71,800	3,520	174,000	1,260
GGSB05	2	08/07/92	ED	54,000	21,000	12,000	811
TRENCH II	1	09/16/93	UNKNOWN	36,700	NA	NA	667
UST 1221.3 EAST	14	09/29/93	UNKNOWN	50,600	NA	NA	1,130
UST 1221.4 EAST	14	09/29/93	UNKNOWN	32,300	NA	NA	452

TABLE C-1
BACKGROUND DATA SET - SERPENTINITE LITHOLOGY
Presidio of San Francisco, California

Sample ID	Title 22 Metals (mg/kg)																
	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vandium	Zinc
1a	<4	NA	63.8	0.15	<0.5	1,380	118	32.3	<1	NA	<0.9	2,590	<6	<1	0.077	29.3	80
1b	<4	NA	63.8	0.11	<0.5	1,310	115	29.9	16	NA	<0.9	2,290	<6	<1	0.064	34.7	85
1c	<4	NA	66.1	<0.09	<0.5	1,520	117	45.2	64	NA	<0.9	2,210	<6	<1	0.069	38.6	109
1d	<4	NA	67.6	0.1	<0.5	1,680	122	33	52	NA	<0.9	2,290	<6	<1	0.067	39.7	114
BKGDSB04	<41.3	1.290	NA	<0.50	<0.515	750	59.8	12.6	NA	<0.027	NA	1,120	<0.25	<0.521	<14.7	27.7	17.7
BKGDSB10	<0.1	<0.250	16.5	<0.10	<0.80	1,290	73.1	64.6	4.48	<0.059	NA	1,940	<0.416	<0.500	<0.162	36.2	42.6
BKGDSB14	<0.1	2.49	92.3	NA	NA	1,050	135	44.2	NA	<0.059	NA	3,670	<0.416	1.67	<0.162	27	20.8
BKGDSB15	<0.1	0.507	62.4	NA	NA	672	140	51.4	NA	<0.059	NA	3,950	<0.416	<0.644	<0.162	40.2	95
BKGDSB15	<0.1	0.320	18.7	<1.0	NA	910	111	17.3	4.01	<0.059	NA	2,530	<0.416	<5.00	<0.162	34.2	50.6
BKGSO03A	<19.6	<2.5	<3.29	<0.427	<1.2	812	85.3	5.08	3.72	<0.05	NA	2,190	<0.449	<0.803	<34.3	11.8	6.64
UBR01SB02	<13.6	NA	30.5	<1.1	0.94	1,160	101	11.1	NA	NA	NA	2,070	<56.7	<2.3	<454	35.2	17
UBR02SB02	<21.6	NA	NA	<1.8	<1.8		97.6	4.6	NA	NA	NA	1,950	<90.1	<3.6	<721	10.4	21.6
1261 WEST	NA	2.9	NA	0.35	1.5	493	NA	59.4	76.8	NA	NA	1,430	NA	NA	NA	50.2	139
1351SO01B	NA	<2.5	56.0	<0.427	NA	753	106	13.3	3.72	0.058	NA	2,600	NA	NA	NA	28.4	33.6
1351SO02B	NA	<2.5	149	0.774	NA	1,270	82.4	41	3.72	<0.05	NA	2,530	NA	NA	NA	56.0	60.5
GCEX01	NA	NA	81.4	NA	NA	1,350	146	29.9	2.6	NA	NA	3,510	NA	NA	NA	48.7	58.3
GCEX02	NA	NA	49.7	NA	NA	1,090	165	21.4	0.67	NA	NA	4,290	NA	NA	NA	28.8	52.5
GCEX03	NA	NA	20.2	NA	NA	586	153	18.5	NA	NA	NA	2,880	NA	NA	NA	25.3	28.4
GGSB05	<41.3	4.09	106	1.07	1.85	556	103	40.50	6.29	0.069	NA	1,020	<0.25	<0.521	NA	84.4	67.2
TRENCH II	NA	NA	NA	NA	0.86	914	NA	45.6	NA	NA	NA	1,430	NA	NA	NA	35.8	45.4
UST 1221.3 EAST	NA	1.2	NA	NA	NA	786	NA	49.4	3.5	NA	NA	882	NA	NA	NA	61	79.3
UST 1221.4 EAST	NA	2.4	NA	NA	NA	527	NA	30.9	11.3	NA	NA	686	NA	NA	NA	54.4	55.8

TABLE C-1
BACKGROUND DATA SET - SERPENTINITE LITHOLOGY
Presidio of San Francisco, California

Abbreviations:

NA	Not Analyzed or Rejected Data

Notes:

a) Depth in feet below ground surface.

b) Laboratory Abbreviations:

CALLAB	Caltest Analytical Laboratory, Napa, California
ED	Environmental Science and Engineering, Inc., Englewood, Colorado
NEIC	U.S. EPA National Enforcement Investigations Center
UB	DataChem, Inc., Salt Lake City, Utah
QA	Quality Assurance Laboratories, San Diego, California
QUANT	Quanterra, Sacramento, California

c) See text for discussion of data.

d) COMP = Composite Sample

TABLE C-2

BACKGROUND DATA SET - COLMA FORMATION LITHOLOGY

Presidio of San Francisco, California

Sample ID	Depth (ft.) (a)	Sample Date	Laboratories (b)	Major Elements (mg/kg)			
				Iron	Aluminum	Magnesium	Manganese
BKGDSB01	2	08/21/92	ED	26,000	14,000	4,220	390
BKGDSB01	5	08/21/92	ED	20,000	9,900	4,230	NA (c)
BKGDSB11	5	12/07/94	QA	31,200	25,900	3,540	270
BKGDSB12	5	12/07/94	QA	14,700	10,300	3,470	227
BKGDSB12	9.5	12/07/94	QA	16,800	9,480	4,060	271
BKGDSB13	5	12/07/94	QA	17,400	13,000	3,910	231
BKGDSB13	9.5	12/07/94	QA	15,400	8,910	4,090	232
LF10BK01	21.5	09/06/94	UNKNOWN	18,800	9,690	2,870	374
LF10BK03	57.5	09/06/94	UNKNOWN	35,600	18,400	7,380	400
LF10BK1BDUP	0	09/06/94	UNKNOWN	NA	NA	NA	NA
CFLSSB01	4	11/18/94	QA	12,300	8,600	2,430	88.1
CFLSSB02	3	11/18/94	QA	12,100	7,010	3,020	227
DAEGW04	8	10/19/92	ED	19,000	9,100	3,310	261
DAESB03	28	08/26/92	ED	17,000	7,200	3,110	243
LF6SB01	20	11/20/94	SU	7,560	4,200	2,640	81.6
LF6SB01	9	11/20/94	SU	20,200	6,160	3,810	224
LF6SB02	20	11/20/94	SU	10,900	4,800	3,160	120
LF6SB02	3	11/20/94	SU	18,100	7,230	3,950	373
LF6SB02	8	11/20/94	SU	14,300	5,170	3,740	154
LF6SB03	20	11/20/94	SU	16,700	6,950	4,310	167
LF6SB03	3	11/20/94	SU	35,500	11,100	4,330	422
LF6SB03	8	11/20/94	SU	16,400	6,540	3,490	207
LF6SB04	20.5	11/20/94	SU	11,400	3,830	3,710	110
LF6SB04	8	11/20/94	SU	9,790	5,170	2,970	132
LF6SB05	20	11/20/94	SU	9,630	4,030	2,580	91.8
LF6SB05	3.5	11/20/94	SU	16,800	6,940	3,470	224
LF6SB05	8.5	11/20/94	SU	11,900	5,290	3,460	216
LF6SB06	20	11/20/94	SU	15,500	5,120	3,810	131
LF6SB06	3	11/20/94	SU	30,200	13,400	4,700	381
LF6SB06	8	11/20/94	SU	34,900	5,130	3,490	164
LF6SO03B	7.5	11/08/90	UB	30,000	15,100	5,250	368
LF8SO02B	19	10/01/90	UB	35,400	25,700	6,500	922

TABLE C-2
BACKGROUND DATA SET - COLMA FORMATION LITHOLOGY
Presidio of San Francisco, California

Sample ID	Depth (ft.) (a)	Sample Date	Table 22 Metals (mg/kg)																
			Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vandium	Zinc
BKGDSB01	2	08/21/92	<41.3	5	100	<0.50	<0.515	100	17	17.3	4.95	0.031	NA	97.5	0.456	<0.521	NA	63.3	36.9
BKGDSB01	5	08/21/92	<41.3	3.27	58.6	<0.50	<0.515	90.2	14	13.9	4.55	<0.027	NA	89.1	0.400	<0.521	<14.7	55.4	33.9
BKGDSB11	5	12/07/94	<0.40	<2.50	121	0.681	<0.80	78.3	13.0	20.9	5.61	<0.059	NA	34.6	<1.66	<0.500	<0.162	64.9	47.3
BKGDSB12	5	12/07/94	<0.50	<2.50	36.9	0.251	<0.80	51.8	11.3	13.0	3.04	<0.059	NA	63.0	<0.416	<0.500	<0.162	37.2	29.1
BKGDSB12	9.5	12/07/94	<0.40	<2.50	43.7	0.256	<0.80	64.6	12.9	80.8	3.84	<0.059	NA	69.3	<0.416	<0.500	<0.162	43.3	61.6
BKGDSB13	5	12/07/94	<0.40	<2.50	41.1	0.301	<0.80	78.4	12.2	10.4	3.99	<0.059	NA	78.5	<0.416	<0.500	<0.162	43.7	29.1
BKGDSB13	9.5	12/07/94	<0.40	<2.50	26.9	0.248	<0.80	67.8	12.3	20.3	3.34	<0.059	NA	38.5	<0.416	<0.500	<0.162	41.6	40.8
LF10BK01	21.5	09/06/94	NA	2.6	61.0	NA	NA	55.6	11.8	11.9	2.9	<0.11	NA	34.1	NA	NA	NA	43.4	27.7
LF10BK03	57.5	09/06/94	NA	2.1	175	NA	NA	103	19.0	28.2	3.4	<0.12	NA	123	NA	NA	NA	49.4	50.4
LF10BK1BDUP	0	09/06/94	NA	3.4	89.4	NA	NA	41.4	9.9	13.5	4.7	<0.12	NA	40.6	NA	NA	NA	42.6	31.9
CFLSSB01	4	11/18/94	<0.40	1.58	35.2	0.207	<0.80	58.0	12.0	9.03	3.94	<0.059	NA	31.2	<0.416	<0.500	<0.162	42.4	22.9
CFLSSB02	3	11/18/94	NA	3.86	55.7	0.178	NA	58.3	8.21	10.9	7.06	<0.059	NA	48.1	<0.416	NA	NA	35.0	25.2
DAEGW04	8	10/19/92	<41.3	3.78	43.8	<0.50	<0.515	96.9	10.2	24.4	3.24	<0.027	NA	67.8	<0.250	<0.521	NA	43.1	33.1
DAESB03	28	08/26/92	<41.3	3.14	29.4	<0.50	<0.515	58.9	9.77	19.5	8.18	<0.027	NA	59.1	<0.250	<0.521	<14.7	40.3	40.6
LF6SB01	20	11/20/94	NA	NA	15.6	0.348	<0.5	24	6.36	3.36	1.8	NA	NA	37.2	NA	<2.76	NA	12	16.8
LF6SB01	9	11/20/94	NA	NA	40.3	0.123	<0.1	43.7	7.73	4.93	2.58	NA	NA	43.7	NA	<7.73	NA	34.7	21.3
LF6SB02	20	11/20/94	NA	NA	18.5	<0.1	<0.1	30.5	7.85	4.03	2.18	NA	NA	43.6	NA	<4.36	NA	19.6	18.5
LF6SB02	3	11/20/94	NA	NA	47.5	0.124	<0.1	49.7	8.14	5.2	2.6	NA	NA	61	NA	<7.01	NA	31.6	22.6
LF6SB02	8	11/20/94	NA	NA	27.5	<0.1	0.22	41.8	8.8	4.62	2.42	NA	NA	53.9	NA	<6.05	NA	27.5	22
LF6SB03	20	11/20/94	<0.5	NA	23.6	<0.1	<0.1	51.5	12.1	5.84	3.06	NA	NA	64	NA	<7.09	NA	29.2	26.4
LF6SB03	3	11/20/94	<0.5	NA	68.8	0.222	0.444	81	15.5	9.54	3.44	NA	NA	72.1	NA	<11.1	NA	49.9	31.1
LF6SB03	8	11/20/94	NA	NA	39.3	0.24	<0.5	50.2	8.83	4.91	2.73	NA	NA	50.2	NA	<7.09	NA	32.7	21.8
LF6SB04	20.5	11/20/94	NA	NA	13.9	<0.1	0.371	41.8	6.73	3.02	1.97	NA	NA	32.5	NA	<6.38	NA	29	17.4
LF6SB04	8	11/20/94	NA	NA	31.9	<0.1	<0.1	26.4	5.83	3.74	2.42	NA	NA	37.4	NA	<3.96	NA	16.5	18.7
LF6SB05	20	11/20/94	NA	NA	14.6	<0.1	0.235	28	6.83	3.47	2.35	NA	NA	40.3	NA	<4.03	NA	19	16.8
LF6SB05	3.5	11/20/94	NA	NA	39.2	0.123	0.493	41.4	9.85	5.82	1.68	NA	NA	51.5	NA	<6.94	NA	29.1	22.4
LF6SB05	8.5	11/20/94	NA	NA	27	<0.1	<0.1	42.1	6.48	4.32	2.48	NA	NA	42.1	NA	<5.08	NA	23.8	20.5
LF6SB06	20	11/20/94	NA	NA	21.4	<0.1	<0.5	36.9	9.64	4.52	2.26	NA	NA	47.6	NA	<6.79	NA	31	20.2
LF6SB06	3	11/20/94	NA	NA	56	0.504	<0.5	91.8	12.3	9.74	3.02	NA	NA	71.7	NA	<12.3	NA	54.9	31.4
LF6SB06	8	11/20/94	NA	3.16	30.5	<0.1	<0.5	52.3	8.94	5.67	1.2	NA	NA	62.2	NA	<9.81	NA	48	20.7
LF6SO03B	7.5	11/08/90	NA	NA	68.8	NA	NA	149	13.5	7.97	3.72	<0.05	NA	77.4	NA	NA	NA	NA	37.2
LF8SO02B	19	10/01/90	<19.6	<2.5	172	<0.427	<1.2	79.2	17.6	22	3.72	<0.05	NA	77	<0.449	<0.803	<34.3	73.1	49.2

TABLE C-2

BACKGROUND DATA SET - COLMA FORMATION LITHOLOGY

Presidio of San Francisco, California

Sample ID	Depth (ft.) (a)	Sample Date	Laboratories (b)	Major Elements (mg/kg)			
				Iron	Aluminum	Magnesium	Manganese
LF8SO03B	19	10/02/90	UB	37,800	17,900	4,870	423
NKSB13	10	12/05/94	QA	10,800	5,130	NA	NA
NKSB14	9.5	12/07/94	QA	16,600	14,500	2,910	589
NKSB15	5	12/07/94	QA	19,000	15,300	4,630	382

TABLE C-2
BACKGROUND DATA SET - COLMA FORMATION LITHOLOGY
Presidio of San Francisco, California

Sample ID	Depth (ft.) (a)	Sample Date	Table 22 Metals (mg/kg)																
			Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vandium	Zinc
LF8SO03B	19	10/02/90	<19.6	<2.5	95.4	<0.427	<1.2	120	17.7	15.7	3.72	0.118	NA	84.2	<0.449	<0.803	<34.3	85	35.9
NKSB13	10	12/05/94	NA	2.20	14.6	0.429	NA	40.2	6.78	3.92	NA	NA	NA	NA	NA	NA	NA	34.1	15.5
NKSB14	9.5	12/07/94	NA	1.49	95.8	0.481	NA	53.6	14.2	24.4	3.97	<0.059	NA	31.2	NA	NA	NA	45.8	39.7
NKSB15	5	12/07/94	NA	2.38	95.8	0.460	NA	53.8	14.7	20.8	5.02	0.104	NA	51.8	NA	NA	NA	44.8	39.5

BACKGROUND DATA SET - COLMA FORMATION LITHOLOGY
Presidio of San Francisco, California

Abbreviations:

NA Not Analyzed or Rejected Data

Notes:

a) Depth in feet below ground surface.

b) Laboratory Abbreviations:

ED	Environmental Science and Engineering, Inc., Englewood, Colorado
QA	Quality Assurance Laboratories, San Diego, California
SU	Superior Precision Analytical, Inc., Maritime, California
UB	DataChem, Inc., Salt Lake City, Utah

c) See text for discussion of data.

Table C-3
CHERT/SHALE LITHOLOGY
Presidio of San Francisco, California

Sample ID	Depth (ft.) (a)	Sample Date	Laboratories (b)	Major Elements (mg/kg)			
				Iron	Aluminum	Magnesium	Manganese
950CR	NA (c)	9/24/98	CHROMALA	2,200	460	NA	130
950CT002	NA	10/6/98	CHROMALA	4,500	1,200	NA	4,100
950CT004	NA	10/6/98	CHROMALA	420	160	NA	24
950CT005	NA	10/6/98	CHROMALA	2,400	460	NA	570
950CT006	NA	10/6/98	CHROMALA	1,300	340	NA	100
950CT007	NA	10/6/98	CHROMALA	1,900	360	NA	260
950CT009	NA	10/6/98	CHROMALA	2,900	720	NA	2,200
950CT010	NA	10/6/98	CHROMALA	770	220	NA	700
950CT011	NA	10/15/98	CHROMALA	4,200	1,500	NA	150
950CT012	NA	10/15/98	CHROMALA	18,000	4,600	NA	390
950CT014	NA	10/15/98	CHROMALA	1,300	280	NA	110
950CT015	NA	10/15/98	CHROMALA	3,000	810	NA	180
950CT016	NA	10/15/98	CHROMALA	2,900	390	NA	150
950CT017	NA	10/15/98	CHROMALA	3,700	670	NA	51
950CT018	NA	10/15/98	CHROMALA	7,800	700	NA	150
950CT019	NA	10/15/98	CHROMALA	2,800	650	NA	40
950CT020	NA	10/15/98	CHROMALA	6,600	1,300	NA	1,400
950CT021	NA	10/15/98	CHROMALA	6,400	1,500	NA	600
950CT022	NA	10/15/98	CHROMALA	1,700	240	NA	230
950CT023	NA	10/15/98	CHROMALA	510	220	NA	120
950CT024	NA	10/15/98	CHROMALA	1,100	190	NA	<1.0
950CT025	NA	10/15/98	CHROMALA	1,300	340	NA	1,300
950CT026	NA	10/15/98	CHROMALA	840	240	NA	550
950CT027	NA	10/15/98	CHROMALA	4,400	350	NA	<1.0
950CT028	NA	10/15/98	CHROMALA	880	170	NA	1,000
950CT029	NA	10/15/98	CHROMALA	3,200	530	NA	480
950CT030	NA	10/15/98	CHROMALA	9,700	2400	NA	1,100
950CT031	NA	10/15/98	CHROMALA	2,000	450	NA	630
950CT032	NA	10/15/98	CHROMALA	3,800	500	NA	300

Table C-3

CHERT/SHALE LITHOLOGY

Presidio of San Francisco, California

Sample ID	Depth (ft.) (a)	Sample Date	Title 22 Metals (mg/kg)															
			Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vandium	Zinc
950CR	NA (c)	9/24/98	<3.0	<2.5	36	<0.20	<0.50	2.6	2.0	9.4	<10	<0.21	<2.0	5.4	<25	<1.0	<5.0	2.4	5.4
950CT002	NA	10/6/98	<3.0	<2.5	280	<0.20	<0.50	52	6.3	86	<10	<0.20	<2.0	110	<25	<1.0	<5.0	6.8	16
950CT004	NA	10/6/98	<3.0	<2.5	23	<0.20	<0.50	<1.0	<2.0	3.1	<10	<0.20	<2.0	<4.0	<25	<1.0	<5.0	<1.0	<2.0
950CT005	NA	10/6/98	<3.0	<2.5	96	<0.20	<0.50	1.5	13	20	<10	<0.20	<2.0	<4.0	<25	<1.0	<5.0	2.8	5.5
950CT006	NA	10/6/98	<3.0	<2.5	12	<0.20	<0.50	1.4	<2.0	9.2	<10	<0.20	<2.0	<4.0	<25	<1.0	<5.0	1.2	<2.0
950CT007	NA	10/6/98	<3.0	<2.5	13	<0.20	<0.50	6.9	2.2	24	<10	<0.20	<2.0	4.0	<25	<1.0	<5.0	2.9	2.6
950CT009	NA	10/6/98	<3.0	<2.5	160	<0.20	<0.50	<1.0	2.7	35	<10	<0.20	<2.0	7.0	<25	<1.0	<5.0	3.4	5.3
950CT010	NA	10/6/98	<3.0	<2.5	42	<0.20	<0.50	1.2	<2.0	13	<10	<0.20	<2.0	<4.0	<25	<1.0	<5.0	6.3	2.4
950CT011	NA	10/15/98	<3.0	<2.5	17	<0.20	<0.50	2.4	2.8	12	<10	<0.20	<2.0	<4.0	<25	<1.0	<5.0	11	8.1
950CT012	NA	10/15/98	<3.0	<2.5	96	<0.20	0.61	15	7.8	50	<10	<0.20	<2.0	25	<25	<1.0	<5.0	38	56
950CT014	NA	10/15/98	<3.0	<2.5	13	<0.20	<0.50	<1.0	<2.0	6.1	<10	<0.20	<2.0	<4.0	<25	<1.0	<5.0	2.2	<2.0
950CT015	NA	10/15/98	<3.0	<2.5	31	<0.20	<0.50	1.6	<2.0	26	<10	<0.20	<2.0	4.3	<25	<1.0	<5.0	2.9	7.1
950CT016	NA	10/15/98	<3.0	<2.5	18	<0.20	<0.50	6.3	<2.0	16	<10	<0.20	<2.0	4.2	<25	<1.0	<5.0	3.0	7.9
950CT017	NA	10/15/98	<3.0	<2.5	12	<0.20	<0.50	2.4	<2.0	15	<10	<0.20	<2.0	<4.0	<25	<1.0	<5.0	4.4	3.0
950CT018	NA	10/15/98	<3.0	<2.5	36	<0.20	<0.50	6.2	<2.0	18	<10	<0.20	<2.0	4.4	<25	<1.0	<5.0	7.7	10
950CT019	NA	10/15/98	<3.0	<2.5	12	<0.20	<0.50	2.5	<2.0	11	<10	<0.20	<2.0	<4.0	<25	<1.0	<5.0	3.3	2.7
950CT020	NA	10/15/98	<3.0	<2.5	160	<0.20	<0.51	2.2	9.8	36	<10	<0.20	<2.0	22	<25	<1.0	<5.1	12	8.2
950CT021	NA	10/15/98	<3.0	<2.5	92	<0.20	<0.50	4.3	3.9	26	<10	<0.20	<2.0	5.1	<25	<1.0	<5.0	9.6	4.4
950CT022	NA	10/15/98	<3.0	<2.5	25	<0.20	<0.50	<1.0	<2.0	14	<10	<0.20	<2.0	<4.0	<25	<1.0	<5.0	2.9	<2.0
950CT023	NA	10/15/98	<3.0	<2.5	10	<0.20	<0.50	<1.0	<2.0	3.2	<10	<0.20	<2.0	<4.0	<25	<1.0	<5.0	<1.0	2.0
950CT024	NA	10/15/98	<3.0	<2.5	190	<0.20	<0.50	<1.0	<2.0	4.6	<10	<0.20	<2.0	<4.0	<25	<1.0	<5.0	4.9	4.8
950CT025	NA	10/15/98	<3.0	<2.5	110	<0.20	<0.50	<1.0	2.5	22	<10	<0.20	<2.0	6.2	<25	<1.0	<5.0	2.7	6
950CT026	NA	10/15/98	<3.0	<2.5	46	<0.20	<0.50	<1.0	3.7	13	<10	<0.20	<2.0	4.0	<25	<1.0	<5.0	1.3	3.8
950CT027	NA	10/15/98	<3.0	3.2	250	<0.20	0.64	<1.0	16	140	<10	<0.20	<2.0	33	<25	<1.0	<5.0	7.9	30
950CT028	NA	10/15/98	<3.0	<2.5	31	<0.20	<0.50	<1.0	2.3	15	<10	<0.20	<2.0	6.2	<25	<1.0	<5.0	1.6	14
950CT029	NA	10/15/98	<3.0	<2.5	52	<0.20	<0.50	1.8	2	22	<10	<0.20	<2.0	4.8	<25	<1.0	<5.0	3.6	4.2
950CT030	NA	10/15/98	<3.0	<2.5	120	<0.20	<0.50	4.1	10	52	<10	<0.20	<2.0	9.0	<25	<1.0	<5.0	9.4	16
950CT031	NA	10/15/98	<3.0	<2.5	120	<0.20	<0.50	1.1	5.4	58	<10	<0.20	<2.0	11	<25	<1.0	<5.0	3.7	9
950CT032	NA	10/15/98	<3.0	<2.5	50	<0.20	<0.50	1.9	2.2	25	<10	<0.20	<2.0	5.5	<25	<1.0	<5.0	4.5	4.6

Table C-3
CHERT/SHALE LITHOLOGY
Presidio of San Francisco, California

Sample ID	Depth (ft.) (a)	Sample Date	Laboratories (b)	Major Elements (mg/kg)			
				Iron	Aluminum	Magnesium	Manganese
950CT033	NA	10/15/98	CHROMALA	3,900	970	NA	77
950CT034	NA	10/15/98	CHROMALA	5,800	1,500	NA	400
950SH001	NA	12/21/98	CHROMALA	27,000	7,600	NA	2,000
950SH002	NA	12/21/98	CHROMALA	46,000	7,800	NA	10,000
950SH003	NA	10/15/98	CHROMALA	30,000	6,100	NA	4,600
950SH004	NA	10/15/98	CHROMALA	14,000	5,000	NA	2,600
950SH005	NA	10/15/98	CHROMALA	13,000	3,800	NA	2,900
950SH006	NA	10/15/98	CHROMALA	26,000	4,000	NA	3,300
950SH007	NA	10/15/98	CHROMALA	34,000	3,700	NA	2,300
950SH008	NA	10/15/98	CHROMALA	29,000	3,300	NA	3,000
950SH009	NA	10/15/98	CHROMALA	43,000	3,700	NA	11,000
950SH010	NA	10/15/98	CHROMALA	7,200	2,300	NA	56
950SH011	NA	10/15/98	CHROMALA	34,000	5,200	NA	420
950SH012	NA	10/15/98	CHROMALA	17,000	3,700	NA	1,300
950SH013	NA	10/15/98	CHROMALA	14,000	3,000	NA	340
950SH014	NA	10/15/98	CHROMALA	18,000	4,000	NA	800
950SH015	NA	10/15/98	CHROMALA	14,000	4,400	NA	260
BKGDSB03	0.1	9/2/92	ED	31,000	9,500	4270	853

CHERT/SHALE LITHOLOGY
Presidio of San Francisco, California

Sample ID	Depth (ft.) (a)	Sample Date	Title 22 Metals (mg/kg)															
			Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vandium	Zinc
950CT033	NA	10/15/98	<3.0	<2.5	32	<0.20	<0.50	4.0	<2.0	28	<10	<0.20	<2.0	<4.0	<25	<1.0	<5.0	3.2	5.9
950CT034	NA	10/15/98	<3.0	<2.5	79	0.25	<0.50	3.5	3.1	88	<10	<0.20	<2.0	15	<25	<1.0	<5.0	7.2	20
950SH001	NA	12/21/98	<3.1	<2.6	60	0.31	0.67	12	25	51	<10	<0.21	<2.1	9.2	<26	<1.0	<5.2	25	7.9
950SH002	NA	12/21/98	<3.1	<2.6	210	0.44	1.0	13	87	210	<10	<0.21	<2.0	58	<26	<1.0	<5.1	47	17
950SH003	NA	10/15/98	<3.0	<2.5	190	0.55	0.76	12	22	150	12	<0.21	<2.0	15	<25	<1.0	<5.0	34	10
950SH004	NA	10/15/98	<3.0	<2.5	320	0.27	<0.50	5.9	16	310	<10	<0.21	<2.0	22	<25	<1.0	<5.0	7.6	47
950SH005	NA	10/15/98	<3.0	<2.5	280	<0.20	<0.50	6.9	6.5	110	<10	<0.20	<2.0	18	<25	<1.0	<5.0	14	36
950SH006	NA	10/15/98	<3.0	<2.5	270	0.39	0.96	11	8.2	110	20	<0.21	<2.0	19	<25	<1.0	<5.0	17	51
950SH007	NA	10/15/98	<3.0	<2.5	220	0.53	1.3	7.0	14	110	17	<0.21	<2.0	16	<25	<1.0	<5.0	12	32
950SH008	NA	10/15/98	<3.0	<2.5	250	0.34	1.1	6.7	6.1	110	13	<0.21	<2.0	16	<25	<1.0	<5.0	12	34
950SH009	NA	10/15/98	<3.0	<2.5	1,100	0.72	1.7	6.8	8.7	120	37	<0.20	<2.0	38	<25	<1.0	<5.0	17	140
950SH010	NA	10/15/98	<3.0	NA	50	<0.20	<0.50	4.5	<2.0	39	<10	<0.20	<2.0	<4.0	<25	<1.0	<5.0	15	7.9
950SH011	NA	10/15/98	<3.0	<2.5	170	0.40	0.98	7.2	2.4	76	<10	<0.21	<2.0	4.5	<25	<1.0	<5.1	34	12
950SH012	NA	10/15/98	<3.0	<2.5	400	0.37	<0.51	6.4	8.5	100	<10	<0.21	<2.0	24	<25	<1.0	<5.1	12	39
950SH013	NA	10/15/98	<3.0	<2.5	220	0.32	<0.51	6.4	3.9	140	<10	<0.21	<2.0	16	<25	<1.0	<5.1	7.4	46
950SH014	NA	10/15/98	<3.1	<2.6	280	0.43	0.52	8.8	4.5	160	<10	<0.20	<2.0	18	<26	<1.0	<5.1	12	44
950SH015	NA	10/15/98	<3.1	<2.6	280	0.40	<0.51	9.1	4.5	100	<10	<0.21	<2.0	23	<26	<1.0	<5.1	11	51
BKGDSB03	0.1	9/2/92	<41.3	2.460	229	<0.50	<0.515	48.4	15.3	49.4	45	0.036	NA	32.5	<0.250	<0.521	<14.7	71.3	64.5

Table C-3
CHERT/SHALE LITHOLOGY
Presidio of San Francisco, California

Abbreviations:

NA	Not Analyzed or Rejected Data

Notes:

a) Depth in feet below ground surface.

b) Laboratory Abbreviations:

CHROMALA	ChromaLab, Pleasanton, California
ED	Environmental Science and Engineering, Inc., Englewood, Colorado

c) See text for discussion of data.

TABLE C-4

BACKGROUND DATA SET - BEACH/DUNE LITHOLOGY
Presidio of San Francisco, California

Sample ID	Depth (ft.) (a)	Sample Date	Laboratories (b)	Major Elements (mg/kg)			
				Iron	Aluminum	Magnesium	Manganese
BKGDSB05	5	12/07/94	QA	7,210	3,030	2,040	226
BKGDSB05	9.5	12/07/94	QA	13,100	3,990	1,740	248
BKGDSB06	2	12/07/94	QA	11,400	4,690	3,860	185
BKGDSB06	9.5	12/07/94	QA	10,200	4,640	4,040	171
BKGDSB07	5	12/08/94	QA	18,600	5,480	2,270	180
BKGDSB07	9.5	12/08/94	QA	12,500	5,600	2,480	148
BKGDSB08	5.5	12/08/94	QA	7,580	4,640	1,860	109
BKGDSB08	9.5	12/08/94	QA	14,700	4,670	2,150	151
BKGDSB10	3.5	12/07/94	QA	8,580	5,080	2,140	123
BKGDSB10	7.5	12/07/94	QA	6,030	3,260	1,520	91.5
BKGSO01B	4.5	11/26/90	UB	12,800	5,580	3,680	104
BKGSO02A	0.8	11/27/90	UB	21,800	6,580	2,810	178
BKGSO02B	3.5	11/27/90	UB	19,900	7,660	3,070	176
1065SB02	10	12/14/94	SU	NA	NA	NA	NA
1065SB04	5	01/12/95	SU	NA	NA	NA	NA
1167SB02	6.5	11/19/94	QA	15,800	16,500	5,880	162
1167SB03	10	11/19/94	QA	14,300	11,200	6,320	127
1351SO03B	5	11/29/90	UB	28,000	11,900	2,960	237
1351SO04B	4.5	11/29/90	UB	26,500	16,200	3,280	302
1351SO05B	4.5	11/29/90	UB	31,600	17,400	3,310	588
1351SO06B	4.5	11/29/90	UB	30,800	19,300	3,480	709
231GW04B	6	10/22/90	UB	34,900	25,700	6,740	588
231GW05B	5.5	10/23/90	UB	19,800	10,600	4,305	357
231GW06B	12	10/24/90	UB	29,300	20,000	3,860	440
231GW07B	7	10/25/90	UB	29,800	18,700	7,360	515
231SB16	4	12/06/94	SU	NA	NA	NA	NA
231SB28	4	04/06/95	SU	NA	NA	NA	NA
268SO02	3	12/11/90	UB	32,200	17,800	8,750	432
268SO05	3.5	12/12/90	UB	21,100	10,300	7,030	346
269SB01	2.5	11/19/94	QA	17,700	NA	10,500	174
283SO01B	5	12/10/90	UB	14,900	7,220	4,550	201

TABLE C-4
BACKGROUND DATA SET - BEACH/DUNE LITHOLOGY
Presidio of San Francisco, California

Sample ID	Depth (ft.) (a)	Sample Date	Title 22 Metals (mg/kg)															
			Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vandium	Zinc
BKGDSB05	5	12/07/94	<0.10	<2.50	11.3	0.170	<0.800	19.9	4.75	21.2	1.59	<0.059	NA	19.7	<0.416	<0.500	<0.162	16.4	19.2
BKGDSB05	9.5	12/07/94	<0.10	<2.50	8.12	0.198	<0.800	72.8	6.07	24.1	2.54	<0.059	NA	20.5	<0.416	<0.500	<0.162	42.0	27.5
BKGDSB06	2	12/07/94	<0.10	3.80	22.8	0.201	<0.800	39.5	7.14	16.7	4.87	<0.059	NA	25.3	<0.416	<0.500	<0.162	29.1	25.4
BKGDSB06	9.5	12/07/94	<0.10	5.43	13.2	0.180	<0.800	32.8	7.12	21.2	2.73	<0.059	NA	26.3	<0.416	<0.500	<0.162	23.5	22.9
BKGDSB07	5	12/08/94	<0.10	1.66	13.1	0.202	<0.800	60.3	8.43	12.9	3.96	<0.059	NA	22.9	<0.416	<0.500	<0.162	64.1	26.5
BKGDSB07	9.5	12/08/94	<0.10	2.29	10.5	0.201	<0.800	50.4	7.23	57.2	3.28	<0.059	NA	24.0	<0.416	<0.500	<0.162	39.1	35.6
BKGDSB08	5.5	12/08/94	<0.10	1.78	11.9	0.134	<0.800	27.7	4.95	34.3	1.93	<0.059	NA	21.1	<0.416	<0.500	<0.162	20.6	32.0
BKGDSB08	9.5	12/08/94	<0.10	1.68	11.8	0.208	<0.800	49.5	7.16	46.5	2.83	<0.059	NA	20.6	<0.416	<0.500	<0.162	48.6	40.3
BKGDSB10	3.5	12/07/94	<0.10	<2.50	13.2	0.172	<0.800	28.3	5.73	8.61	2.65	<0.059	NA	15.1	<0.416	<0.500	<0.162	23.2	19.6
BKGDSB10	7.5	12/07/94	<0.10	<2.50	10.8	0.172	<0.800	17.9	3.99	18.4	1.80	<0.059	NA	15.0	<0.416	<0.500	<0.162	15.7	16.2
BKGSO01B	4.5	11/26/90	<19.6	4.18	21.8	<0.427	<1.2	40.8	5.6	4.84	3.72	<0.05	NA	30.1	<0.449	<0.803	<34.3	21.4	17.2
BKGSO02A	0.8	11/27/90	<19.6	2.76	15.5	0.7	<1.2	69.3	7.07	5	11.8	<0.05	NA	24.4	<0.449	<0.803	<34.3	58.9	25.4
BKGSO02B	3.5	11/27/90	<19.6	2.85	14.6	0.646	<1.2	57.4	7.4	4.6	3.72	<0.05	NA	25.3	<0.449	<0.803	<34.3	53.8	19.7
1065SB02	10	12/14/94	NA	NA	NA	NA	NA	NA	NA	NA	4.93	NA	NA	NA	NA	NA	NA	NA	NA
1065SB04	5	01/12/95	NA	NA	NA	NA	NA	NA	NA	NA	4.12	NA	NA	NA	NA	NA	NA	NA	NA
1167SB02	6.5	11/19/94	NA	3.67	31.8	0.389	<0.800	66.2	9.76	NA	17.6	<0.059	NA	64.7	NA	NA	NA	37.4	47.5
1167SB03	10	11/19/94	NA	5.96	17.7	0.297	<0.800	46.2	9.05	14.0	4.18	<0.059	NA	39.7	NA	NA	NA	30.1	38.0
1351SO03B	5	11/29/90	NA	<2.50	54.9	0.720	NA	92.1	11.8	12.5	13.9	<0.050	NA	31.6	NA	NA	NA	68.8	51.7
1351SO04B	4.5	11/29/90	NA	<2.50	81.5	0.914	NA	85.4	9.35	13.7	3.72	<0.050	NA	36.1	NA	NA	NA	61.8	38.1
1351SO05B	4.5	11/29/90	NA	<2.50	103	1.05	NA	89.1	15.8	14.1	3.72	0.059	NA	45.2	NA	NA	NA	77.4	36.0
1351SO06B	4.5	11/29/90	NA	<2.50	132	1.27	NA	91.2	24.2	16.6	3.72	0.063	NA	50.6	NA	NA	NA	68.1	39.2
231GW04B	6	10/22/90	NA	<2.50	251	0.695	NA	95.5	19.5	35.2	52.6	0.646	NA	68.6	NA	<0.803	NA	74.6	62.3
231GW05B	5.5	10/23/90	NA	<2.50	64.6	<0.427	NA	NA	8.84	9.71	20.9	0.070	NA	40.9	NA	<0.803	NA	40.2	49.6
231GW06B	12	10/24/90	NA	<2.50	118	0.738	NA	NA	15	15.6	13.8	0.053	NA	47.7	NA	<0.803	NA	64.0	38.6
231GW07B	7	10/25/90	NA	2.96	111	0.752	NA	NA	15.6	21.9	75.1	0.083	NA	82.9	NA	<0.803	NA	57.2	74.3
231SB16	4	12/06/94	NA	NA	NA	NA	NA	NA	NA	NA	13	NA	NA	NA	NA	NA	NA	NA	NA
231SB28	4	04/06/95	NA	NA	NA	NA	NA	NA	NA	NA	81	NA	NA	NA	NA	NA	NA	NA	NA
268SO02	3	12/11/90	NA	4.57	161	<0.427	<1.20	49.2	14.9	40.6	44.6	0.107	NA	50.6	NA	<0.803	NA	39.8	92.6
268SO05	3.5	12/12/90	NA	2.51	59.7	<0.427	<1.20	142	9.97	24.1	37.4	NA	NA	51.6	NA	<0.803	NA	36.4	36.8
269SB01	2.5	11/19/94	NA	3.01	15.4	0.194	NA	105	15.8	14.2	17.3	NA	NA	80.8	0.532	NA	NA	44.7	32.2
283SO01B	5	12/10/90	NA	2.83	25.3	<0.427	<1.20	64.2	6.76	5.47	3.72	NA	NA	31.1	NA	<0.803	NA	25.7	18.5

TABLE C-4

BACKGROUND DATA SET - BEACH/DUNE LITHOLOGY

Presidio of San Francisco, California

Sample ID	Depth (ft.) (a)	Sample Date	Laboratories (b)	Major Elements (mg/kg)			
				Iron	Aluminum	Magnesium	Manganese
283SO02B	5	12/11/90	UB	15,100	6,920	4,790	178
286SB06	5	12/01/94	QA	64,20	3,200	2,440	86.6
286SB07	5	12/01/94	QA	8,240	3,850	4,570	116
293SB01	2.5	11/15/94	SU	NA	NA	NA	NA
293SB01	4.5	11/15/94	SU	NA	NA	NA	NA
293SB02	4	11/15/94	SU	NA	NA	NA	NA
293SB03	4	11/15/94	SU	NA	NA	NA	NA
30S3R	1	10/11/94	PA	NA	NA	NA	NA
30S3R	1.5	10/11/94	PA	NA	NA	NA	NA
30S3R	2	10/11/94	PA	NA	NA	NA	NA
30S3R	3	10/11/94	PA	NA	NA	NA	NA
60S1R	1.5	10/11/94	PA	NA	NA	NA	NA
60S1R	2	10/11/94	PA	NA	NA	NA	NA
60S1R	3	10/11/94	PA	NA	NA	NA	NA
BBSB11	2	08/05/92	ED	9,500	4,110	3,670	<128
BBSB20	2	08/05/92	ED	12,000	4,900	2,270	<160
BBSB21	2	08/30/92	ED	26,000	13,000	3,210	323
BBSB22	2	08/30/92	ED	24,000	6,900	2,600	<173
CGGW02	2	08/12/92	ED	9,200	3,490	3,680	<131
CGGW02	3.5	08/12/92	ED	11,000	4,030	4,570	<178
CGSO01A	2	11/08/90	UB	14,100	6,230	7,080	171
CGSO02A	1	11/08/90	UB	13,700	5,580	4,650	168
CGSO02B	2	11/08/90	UB	12,800	5,890	5,090	170
CGSO03A	2	11/09/90	UB	12,400	5,080	4,420	151
CGSO03B	3	11/09/90	UB	12,000	5,640	4,700	145
CGSO04A	1	11/14/90	UB	13,600	5,270	4,290	180
CGSO04B	5	11/14/90	UB	13,500	5,480	4,070	152
DEHGW02	5	08/24/92	ED	17,000	6,310	8,310	<214
DEHSB01	3	08/07/92	ED	11,000	4,020	4,510	<139
DEHSB01	5	08/07/92	ED	16,000	4,120	3,740	99.6
EOMSB01	4.5	11/15/94	QA	6,950	3,290	2,330	102
EOMSB02	4.5	11/15/94	QA	9,050	3,690	3,380	118

TABLE C-4
BACKGROUND DATA SET - BEACH/DUNE LITHOLOGY
Presidio of San Francisco, California

Sample ID	Depth (ft.) (a)	Sample Date	Title 22 Metals (mg/kg)																
			Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vandium	Zinc
283SO02B	5	12/11/90	NA	<2.50	18.9	<0.427	1.68	59.5	6.81	4.81	3.72	<0.050	NA	34.4	NA	<0.803	NA	26.1	18.9
286SB06	5	12/01/94	NA	3.16	7.87	0.135	NA	26.6	4.43	11.3	1.60	NA	NA	21.1	NA	<0.500	NA	14.2	18.6
286SB07	5	12/01/94	NA	3.94	9.13	0.149	NA	35.3	5.88	13.0	2.25	NA	NA	36.5	NA	<0.500	NA	16.2	27.5
293SB01	2.5	11/15/94	NA	1.41	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
293SB01	4.5	11/15/94	NA	1.72	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
293SB02	4	11/15/94	NA	1.11	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
293SB03	4	11/15/94	NA	1.72	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
30S3R	1	10/11/94	NA	NA	NA	NA	NA	41	NA	NA	42	NA	NA	NA	NA	NA	NA	NA	NA
30S3R	1.5	10/11/94	NA	NA	NA	NA	NA	40.6	NA	NA	25.1	NA	NA	NA	NA	NA	NA	NA	NA
30S3R	2	10/11/94	NA	NA	NA	NA	NA	45.7	NA	NA	24.4	NA	NA	NA	NA	NA	NA	NA	NA
30S3R	3	10/11/94	NA	NA	NA	NA	NA	50.7	NA	NA	88.7	NA	NA	NA	NA	NA	NA	NA	NA
60S1R	1.5	10/11/94	NA	NA	NA	NA	NA	65.9	NA	NA	44.8	NA	NA	NA	NA	NA	NA	NA	NA
60S1R	2	10/11/94	NA	NA	NA	NA	NA	55	NA	NA	65.9	NA	NA	NA	NA	NA	NA	NA	NA
60S1R	3	10/11/94	NA	NA	NA	NA	NA	37.6	NA	NA	27.4	NA	NA	NA	NA	NA	NA	NA	NA
BBSB11	2	08/05/92	<41.3	2.81	8.1	0.558	<0.515	38.4	8.2	3.605	9.95	<0.027	NA	29.2	<0.25	0.682	NA	30.1	45.4
BBSB20	2	08/05/92	<41.3	2.55	9.0	<0.500	<0.515	44.4	9.75	3.64	21	<0.027	NA	24.2	<0.25	0.805	NA	40.3	31.8
BBSB21	2	08/30/92	<41.3	3.51	94.9	<0.500	<0.515	86.8	11	20.9	16	0.031	NA	56.3	<0.25	<0.521	<14.7	58.4	44.4
BBSB22	2	08/30/92	<41.3	2.73	19.1	<0.500	<0.515	111	9.88	8.64	2.08	<0.027	NA	51.2	<0.25	<0.521	<14.7	62.8	10.4
CGGW02	2	08/12/92	NA	4.48	5.5	<0.500	<0.515	36.8	7.25	3.11	3.95	0.028	NA	35.5	<0.25	<0.521	NA	21	9.75
CGGW02	3.5	08/12/92	NA	5.33	5.4	<0.500	0.690	50.5	8.55	4.68	4.11	<0.027	NA	42.3	<0.25	<0.521	NA	24.3	11.05
CGSO01A	2	11/08/90	NA	NA	22.8	NA	NA	60.2	7.06	6.29	8.26	0.054	NA	50.8	NA	NA	NA	28.1	21.1
CGSO02A	1	11/08/90	NA	NA	15.3	NA	NA	75.4	6.00	5.23	3.72	<0.05	NA	32.5	NA	NA	NA	27.6	18.0
CGSO02B	2	11/08/90	NA	NA	23.3	NA	NA	82.8	6.09	5.04	3.72	<0.050	NA	32.6	NA	<0.803	NA	26.3	19.8
CGSO03A	2	11/09/90	NA	NA	14.7	NA	NA	52.7	5.58	4.53	3.72	<0.050	NA	30.7	NA	NA	NA	23.3	16.9
CGSO03B	3	11/09/90	NA	NA	14.8	NA	NA	51.6	5.31	4.41	3.72	0.098	NA	30.3	NA	NA	NA	22.3	17.2
CGSO04A	1	11/14/90	NA	2.82	20.4	NA	NA	46.3	6.32	5.52	3.72	<0.050	NA	29.0	NA	NA	NA	25.2	20.4
CGSO04B	5	11/14/90	NA	2.72	14.4	NA	NA	34.8	5.97	4.95	3.72	<0.050	NA	27.0	NA	NA	NA	25.2	22.4
DEHGW02	5	08/24/92	<41.3	4.2	28.7	<0.500	<0.515	86.9	10.1	24	23	<0.027	NA	77.8	0.751	<0.521	NA	37.1	42
DEHSB01	3	08/07/92	<41.3	3.52	7.35	<0.500	<0.515	62.5	8.05	5.2	6.33	<0.027	NA	49.8	<0.25	<0.521	NA	24.2	11.4
DEHSB01	5	08/07/92	<41.3	3.52	5.45	<0.500	<0.515	44.7	7.5	5.55	7.01	<0.027	NA	40.2	<0.25	<0.521	NA	23.2	12.25
EOMSB01	4.5	11/15/94	NA	2.64	7.28	0.126	NA	20.7	4.35	4.55	20.9	<0.059	NA	19.3	NA	NA	NA	14.6	12.7
EOMSB02	4.5	11/15/94	NA	3.80	7.18	0.134	NA	23.1	5.77	3.93	2.47	<0.059	NA	25.5	NA	NA	NA	16.2	15.0

TABLE C-4
BACKGROUND DATA SET - BEACH/DUNE LITHOLOGY
Presidio of San Francisco, California

Sample ID	Depth (ft.) (a)	Sample Date	Laboratories (b)	Major Elements (mg/kg)			
				Iron	Aluminum	Magnesium	Manganese
EOMSB03	4.9	11/15/94	QA	9,500	4,140	3,770	205
EOMSB05	4.5	11/16/94	QA	9,400	4,630	3,070	114
HWSB04	22	08/05/92	ED	8,200	3,600	1,820	97.4
LF10BK04	3	07/19/94	UNKNOWN	16,600	6,840	2,480	208
LF10BK05	3.5	07/19/94	UNKNOWN	29,000	7,790	2,750	231
LF10SB02	35	09/02/94	UNKNOWN	15,900	8,390	3,450	244
LF10SB03	29.5	08/27/96	CALLAB	13,000	4,880	3,420	258
LF10SB04	20	08/27/96	CALLAB	18,000	8,960	3,090	243
LF10SB04	25	08/27/96	CALLAB	9,370	4,060	1,620	103
LF3SB03	5	08/25/92	ED	12,000	4,480	2,060	<140
LF3SB04	5	08/25/92	ED	29,000	6,100	2,280	<220
LF4SB03	13	08/19/92	ED	14,000	5,120	1,860	133
LF4SB06	5	12/01/94	SU	NA	NA	NA	NA
LF4SB20	10	04/06/95	SU	NA	NA	NA	NA
LF4SO01	10	10/08/90	UB	14,400	9,780	3,180	172
LF4SO02	10	10/08/90	UB	17,200	10,800	2,990	246
LF8SO01B	19	10/01/90	UB	18,100	7,150	2,850	172
LF9SB01	4	08/19/92	ED	11,000	5,800	2,060	<156
LF9TP102	6	06/20/00	C&T	NA	NA	NA	NA
NKSB11	4.5	11/20/94	QA	7,010	4,090	1,820	106
NKSB12	4.5	11/20/94	QA	9,780	5,230	1,760	156
NKSB12	9	11/20/94	QA	6,110	3,920	1,530	85.9
NKSB13	5	12/05/94	QA	9,960	5,240	NA	NA
NKSB14	5	12/07/94	QA	11,600	5,940	2,270	138

TABLE C-4
BACKGROUND DATA SET - BEACH/DUNE LITHOLOGY
Presidio of San Francisco, California

Sample ID	Depth (ft.) (a)	Sample Date	Title 22 Metals (mg/kg)															
			Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vandium	Zinc
EOMSB03	4.9	11/15/94	NA	3.85	14.5	0.171	NA	50.9	8.94	5.21	3.65	<0.059	NA	32.8	NA	NA	NA	19.7	20.3
EOMSB05	4.5	11/16/94	NA	2.73	29.7	0.166	NA	32.6	5.72	6.98	7.08	<0.059	NA	24.7	NA	NA	NA	19.4	26.3
HWSB04	22	08/05/92	<41.3	2.6	16	<0.500	<0.515	40.6	12.6	6.39	1.53	<0.027	NA	21.8	<0.25	0.864	NA	25	7.45
LF10BK04	3	07/19/94	NA	2.3	23.1	NA	NA	62.4	6.6	4.7	13.9	<0.10	NA	21.1	NA	NA	NA	52.0	26.5
LF10BK05	3.5	07/19/94	NA	2.4	18.7	NA	NA	94.9	9.2	5.2	9.0	<0.10	NA	26.9	NA	NA	NA	98.9	28.7
LF10SB02	35	09/02/94	NA	3.2	33.4	NA	NA	43.4	7.7	6.6	2.8	<0.11	NA	30.4	NA	NA	NA	45.6	23.4
LF10SB03	29.5	08/27/96	NA	3.0	20.2	NA	NA	43.4	5.4	7.3	3.8	<0.11	NA	34.2	NA	NA	NA	31.6	20.2
LF10SB04	20	08/27/96	NA	3.4	57.1	NA	NA	74.4	7.0	10.2	43.0	<0.11	NA	45.4	NA	NA	NA	46.8	30.7
LF10SB04	25	08/27/96	NA	1.8	8.6	NA	NA	33.7	4.1	4.2	1.3	<0.10	NA	17.6	NA	NA	NA	25.6	11.9
LF3SB03	5	08/25/92	NA	2.86	7.0	NA	NA	46.3	2.885	14.1	<1.72	<0.027	NA	21.1	NA	NA	<14.7	37.9	11.65
LF3SB04	5	08/25/92	NA	2.24	36.3	NA	NA	86.7	4.19	6.35	2.15	<0.027	NA	25.1	NA	NA	NA	100	29.8
LF4SB03	13	08/19/92	<41.3	4.61	16.1	0.598	NA	58.2	9	13.3	2.12	<0.027	NA	23.2	0.552	0.814	NA	53.5	25.5
LF4SB06	5	12/01/94	NA	NA	NA	NA	NA	NA	NA	NA	1.17	NA	NA	NA	NA	NA	NA	NA	NA
LF4SB20	10	04/06/95	NA	NA	NA	NA	NA	NA	NA	NA	3.4	NA	NA	NA	NA	NA	NA	NA	NA
LF4SO01	10	10/08/90	NA	NA	29.0	<0.427	NA	46.5	7.08	<2.84	3.72	<0.050	NA	23.3	NA	NA	NA	40.5	NA
LF4SO02	10	10/08/90	NA	<2.50	45.6	<0.427	NA	60.6	6.99	<2.84	3.72	<0.050	NA	18.3	NA	NA	NA	48.8	NA
LF8SO01B	19	10/01/90	<19.6	<2.5	15.4	<0.427	<1.2	57.7	6.75	3.652	3.72	<0.05	NA	22.5	<0.449	<0.803	<34.3	48.7	16.984
LF9SB01	4	08/19/92	NA	2.52	30.9	0.564	NA	40.4	3.785	11.3	2.57	<0.027	NA	22.3	<0.25	0.688	NA	41.3	12.5
LF9TP102	6	06/20/00	<2.9	1.7	52	0.13	0.84	26	4.4	5.3	4	<0.02	<0.98	19	<0.25	<0.25	0.37	20	21
NKSB11	4.5	11/20/94	NA	2.38	9.56	0.165	NA	25.2	4.91	3.12	1.89	<0.059	NA	17.8	NA	NA	NA	19.5	13.5
NKSB12	4.5	11/20/94	NA	1.79	20.8	0.191	NA	37.7	6.08	13.7	3.22	<0.059	NA	16.6	NA	NA	NA	31.4	21.2
NKSB12	9	11/20/94	NA	2.23	10.4	0.129	NA	21.1	4.34	33.5	2.29	<0.059	NA	15.7	NA	NA	NA	15.7	38.6
NKSB13	5	12/05/94	NA	1.25	12.9	0.209	NA	36.9	5.77	3.80	NA	NA	NA	NA	NA	NA	NA	32.0	17.1
NKSB14	5	12/07/94	NA	1.51	16.2	0.275	NA	41.5	6.74	8.45	7.25	<0.059	NA	21.5	NA	NA	NA	37.8	25.8

TABLE C-4
BACKGROUND DATA SET - BEACH/DUNE LITHOLOGY
Presidio of San Francisco, California

Abbreviations:

NA	Not Analyzed or Rejected Data

Notes:

a) Depth in feet below ground surface.

b) Laboratory Abbreviations:

C&T	Curtis & Tompkins, Berkeley, California
CALLAB	Caltest Analytical Laboratory, Napa, California
ED	Environmental Science and Engineering, Inc., Englewood, Colorado
PA	Precision Analytical Labs, Milwaukee, Wisconsin
SU	Superior Precision Analytical, Inc., Martinez, California
QA	Quality Assurance Laboratories, San Diego, California
UB	DataChem, Inc., Salt Lake City, Utah

c) See text for discussion of data.

APPENDIX D

RESULTS OF ARMY'S HEXAVALENT CHROMIUM STUDIES: MONTGOMERY WATSON, HEXAVALENT CHROMIUM IN SERPENTINITE BEDROCK AND GROUNDWATER IN UPLAND AREAS, JULY 1999

APPENDIX D

RESULTS OF ARMY'S HEXAVALENT CHROMIUM STUDIES: MONTGOMERY WATSON, HEXAVALENT CHROMIUM IN SERPENTINITE BEDROCK AND GROUNDWATER IN UPLAND AREAS, JULY 1999

October 2002

TECHNICAL MEMORANDUM

HEXAVALENT CHROMIUM IN SERPENTINITE BEDROCK AND GROUNDWATER IN UPLAND AREAS

PRESIDIO OF SAN FRANCISCO, CALIFORNIA

Contract No. DACW05-98-D-0033

Montgomery Watson Job No. 1212067.011804

Prepared for:

U.S. Army Corps of Engineers
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July 1999

APPENDIX G

ANALYTICAL RESULTS

Analytical data for the Cr(VI) investigation are presented in the following tables:

- **Table G-1:** Summary of Analytes in Bedrock Samples
- **Table G-2:** Summary of Analytes in Groundwater Samples
- **Table G-3:** Summary of Analytes in Leachate
- **Table G-4:** Summary of Analytes in Leached Bedrock

Table G-5 describes the nomenclature used for the sample identification scheme. The analytical results tables present both the sample and the associated duplicate results (i.e., "A" and "B" fractions). Data referenced throughout this technical memorandum are the average value of the "A" and "B" fractions. Table G-6 lists data validation qualifiers reported on the analytical results tables. A more detailed description of the data validation qualifiers is found in Appendix H.

TABLE G-1

SUMMARY OF ANALYTES IN BEDROCK SAMPLES
HEXAVALENT CHROMIUM IN SERPENTINITE BEDROCK AND GROUNDWATER IN UPLAND AREAS
PRESIDIO OF SAN FRANCISCO

Sample Location ID:	UBR01SB01	UBR02SB01	UBR03SB01	UBR01SB01
Sample Date:	2/24/99	2/25/99	2/23/99	2/24/99
Depth (feet):	Composite	Composite	Composite	24.0
Metals (mg/kg)				
Aluminum	7,380	1,130	13,200	NA
Antimony	<13.6 (U9)	<21.6 (U9)	<7.1	NA
Arsenic	<68.1	<108	<35.3	NA
Barium	30.5	<72.1	130	NA
Beryllium	<1.1	<1.8	0.59	NA
Cadmium	0.94	<1.8	0.54 (J28)	NA
Calcium	1,110	1,410 (J28)	2,440	NA
Chromium	1,160	371	83.5	NA
Cobalt	101	97.6	19.9	NA
Copper	11.1	4.6 (J28)	23.4	NA
Iron	47,100	44,700	35,900	NA
Lead	<22.7	<36.1	8.8 (J28)	NA
Magnesium	193,000	213,000	5,400	NA
Manganese	595	671	216	NA
Nickel	2,070	1,950	69.1	NA
Potassium	<1130	<1800	1,520	NA
Selenium	<56.7	<90.1	<29.4	NA
Silicon	178 (J9, J12)	161 (J9, J12)	201	NA
Silver	<2.3	<3.6	<1.2	NA
Sodium	<1130	<1800	<588	NA
Thallium	<454	<721	<235	NA
Titanium	61.6 (J9)	<18.0	551	NA
Vanadium	35.2	10.4 (J28)	64.6	NA
Zinc	17.0	21.6	44.0	NA
Soil Chemistry Parameters (mg/kg)				
Cr(VI) by Alkaline Digestion	0.064	0.463	0.231	0.54
Cr(VI) by DI Leach	0.0102 (J28)	0.0103 (J28)	0.0137	NA
Easily Reducible Manganese	136	102	15	601
Quick Oxidation Test	1.6	1.01	<0.08	3.9
Total Organic Carbon by Walkley-Black	268	253	572	NA
Total Organic Carbon by Method 9060	329	452	897	NA
Miscellaneous Parameters (mV)				
Eh (mV)[a]	454	421	441	NA
pH	8.85	8.0	8.44	NA
Percent Moisture (%)	11.9	16.8	14.9	45.7

TABLE G-1

SUMMARY OF ANALYTES IN BEDROCK SAMPLES
HEXAVALENT CHROMIUM IN SERPENTINITE BEDROCK AND GROUNDWATER IN UPLAND AREAS
PRESIDIO OF SAN FRANCISCO

Sample Location ID:	UBR01SB01	UBR02SB01	UBR02SB01	UBR03SB01
Sample Date:	2/24/99	2/25/99	2/25/99	2/23/99
Depth (feet):	34.0	47.0	48.0	33.0
Metals (mg/kg)				
Aluminum	NA	**230**	**96.1**	**6,730**
Antimony	NA	<13.5	<19.8	<7.1 (U9)
Arsenic	NA	<67.3	<99.0	<35.6
Barium	NA	<44.9	<66.0	**105**
Beryllium	NA	<1.1	<1.6	<0.59
Cadmium	NA	<1.1	<1.6	<0.59
Calcium	NA	**14,100**	<1650	**1,890**
Chromium	NA	**89.5**	**71.0**	**55.6 (J10)**
Cobalt	NA	**108**	**114**	**24.1**
Copper	NA	<5.6	<8.2	**8.1**
Iron	NA	**49,000**	**49,900**	**20,100**
Lead	NA	<22.4	<33.0	<11.9
Magnesium	NA	**203,000**	**235,000**	**2,640**
Manganese	NA	**764**	**751**	**1,040**
Nickel	NA	**2,210**	**2,420**	**59.8**
Potassium	NA	<1120	<1650	**423 (J28)**
Selenium	NA	<56.1	<82.5	<29.7
Silicon	NA	**196**	**251**	**199 (J9)**
Silver	NA	<2.2	<3.3	<1.2
Sodium	NA	<1120	<1650	<593
Thallium	NA	<449	<660	<237
Titanium	NA	<11.2	<16.5	**520**
Vanadium	NA	<11.2	<16.5	**46.4**
Zinc	NA	**25.8**	**29.1**	**23.5**
Soil Chemistry Parameters (mg/kg)				
Cr(VI) by Alkaline Digestion	**0.602**	NA	NA	NA
Cr(VI) by DI Leach	NA	**0.0104 (J28)**	NA	**0.0264**
Easily Reducible Manganese	**1,235**	NA	NA	**891**
Quick Oxidation Test	**13.21**	NA	NA	NA
Total Organic Carbon by Walkley-Black	NA	NA	NA	NA
Total Organic Carbon by Method 9060	NA	NA	NA	**602**
Miscellaneous Parameters (mV)				
Eh (mV)[a]	NA	NA	NA	NA
pH	NA	NA	NA	NA
Percent Moisture (%)	**38.7**	**10.9**	**9.1**	**15.7**

[a] Eh values corrected for reference electrode and temperature
mV - millivolts
% - percent

TABLE G-2

SUMMARY OF ANALYTES IN GROUNDWATER SAMPLES
HEXAVALENT CHROMIUM IN SERPENTINITE BEDROCK AND GROUNDWATER IN UPLAND AREAS
PRESIDIO OF SAN FRANCISCO

Sample Location ID:	UBR01GW01	UBR02GW01	UBR02GW02	UBR03GW01
Sample Date:	3/22/99	3/22/99	3/22/99	3/23/99
Dissolved Metals (µg/l)				
Aluminum	<200	<200	<200	<200
Antimony	<60	<60	<60	<60
Arsenic	<300	<300	<300	<300
Barium	**260**	<200	<200	<200
Beryllium	<5.0	<5.0	<5.0	<5.0
Cadmium	<5.0	<5.0	<5.0	<5.0
Calcium	**35,700**	**12,500**	**27,100**	**40,300**
Chromium	**66**	**49**	**100**	<10
Cobalt	<50	<50	<50	<50
Copper	<25	<25	<25	<25
Iron	<100	<100	<100	<100
Lead	<100	<100	<100	<100
Magnesium	**119,000**	**133,000**	**139,000**	**46,400**
Manganese	**13 (J28)**	<15	**10 (J28)**	**280**
Nickel	<40	<40	<40	<40
Potassium	<5000	<5000	<5000	**5,900**
Selenium	<250	<250	<250	<250
Silicon	**24,300**	**9,100**	**23,600**	**16,800**
Silver	<10	<10	<10	<10
Sodium	**51,200**	**247,000**	**257,000**	**81,300**
Thallium	<2000	<2000	<2000	<2000
Titanium	<50	<50	<50	<50
Vanadium	<50	<50	<50	<50
Zinc	**24**	<20	<20	**11 (J28)**
Hexavalent Chromium	**65.4 (J29)**	**52.1 (J29)**	**98.3 (J29)**	<0.50 (U29)
General Water Chemistry Parameters (µg/l)				
Alkalinity, Total	**491,000**	**323,000**	**347,000**	**260,000**
Bicarbonate	**491,000**	**292,000**	**347,000**	**260,000**
Carbonate	<5000	**31,000**	<5000	<5000
Chloride	**93,600**	**526,000**	**568,000**	**81,900**
Fluoride	<2500	<2500	<2500	<2500
Nitrate	**330 (J29)**	**2,700 (J29)**	**2,700 (J29)**	**11,000**
Nitrite	<250 (U29)	<2500 (U29)	<2500 (U29)	<250
pH	**7.7**	**8.3**	**7.7**	**7.3**
Sulfate	**46,800**	**20,100**	**29,700**	**60,400**
Total Dissolved Solids	**673,000**	**1,180,000**	**1,310,000**	**953,000**
Field Parameters				
Salinity (%)	**0.70**	**1.37**	**1.48**	**0.56**
pH	**8.31**	**9.18**	**8.36**	**7.53**
Temperature (°C)	**15.12**	**14.86**	**14.17**	**16.91**
Specific Conductivity (mS/cm)	**1.384**	**2.625**	**2.839**	**1.132**
Eh (mV)[a]	**423**	**348**	**308**	**464**
Turbidity (NTU)	**12.8**	**0.8**	**2.0**	**945.7**
Dissolved Oxygen (mg/l)	**3.17**	**2.81**	**3.77**	**4.28**

TABLE G-2

SUMMARY OF ANALYTES IN GROUNDWATER SAMPLES
HEXAVALENT CHROMIUM IN SERPENTINITE BEDROCK AND GROUNDWATER IN UPLAND AREAS
PRESIDIO OF SAN FRANCISCO

Sample Location ID:	UBR03GW02	UBR01GW01	UBR01GW01	UBR01GW01
Sample Date:	3/23/99	2/24/99	3/4/99	3/4/99
Dissolved Metals (µg/l)				
Aluminum	<200	120 (J28)	<200	<200
Antimony	<60	<60	<60	<60
Arsenic	<300	<300	<300	<300
Barium	<200	270	260	260
Beryllium	<5.0	<5.0	<5.0	<5.0
Cadmium	<5.0	<5.0	<5.0	<5.0
Calcium	30,000	38,700	34,200	33,600
Chromium	<10	25	66	65
Cobalt	<50	<50	<50	<50
Copper	<25	<25	<25	<25
Iron	<100	140	<100	<100
Lead	<100	<100	<100	<100
Magnesium	42,900	129,000	115,000	112,000
Manganese	59	71	<15	<15
Nickel	<40	27 (J28)	<40	<40
Potassium	<5000	<5000	<5000	<5000
Selenium	<250	<250	<250	<250
Silicon	16,600	25,700	23,900	23,400
Silver	<10	<10	<10	<10
Sodium	50,400	49,500	51,400	50,300
Thallium	<2000	<2000	<2000	<2000
Titanium	<50	<50	<50	<50
Vanadium	<50	<50	<50	<50
Zinc	<20	<20	<20	<20
Hexavalent Chromium	0.64 (J29)	26.6 (J29)	57.9	58.4
General Water Chemistry Parameters (µg/l)				
Alkalinity, Total	172,000	NA	468,000	459,000
Bicarbonate	172,000	NA	468,000	459,000
Carbonate	<5000	NA	<5000	<5000
Chloride	57,500	NA	98,800	98,400
Fluoride	<500	NA	<1000	<1000
Nitrate	6,800	NA	290	290
Nitrite	<250	NA	<250	<250
pH	6.4	NA	8.1	8.2
Sulfate	65,300	NA	48,800	48,000
Total Dissolved Solids	556,000	NA	689,000	699,000
Field Parameters				
Salinity (%)	0.40	NA	0.63	NA
pH	6.62	NA	8.32	NA
Temperature (°C)	15.89	NA	15.10	NA
Specific Conductivity (mS/cm)	0.807	NA	1.252	NA
Eh (mV)[a]	422	NA	-24	NA
Turbidity (NTU)	979.7	NA	1.5	NA
Dissolved Oxygen (mg/l)	0.68	NA	3.46	NA

TABLE G-2

SUMMARY OF ANALYTES IN GROUNDWATER SAMPLES
HEXAVALENT CHROMIUM IN SERPENTINITE BEDROCK AND GROUNDWATER IN UPLAND AREAS
PRESIDIO OF SAN FRANCISCO

Sample Location ID:	UBR02GW01	UBR02GW02
Sample Date:	3/4/99	3/4/99
Dissolved Metals (µg/l)		
Aluminum	<200	<200
Antimony	<60	<60
Arsenic	<300	<300
Barium	<200	<200
Beryllium	<5.0	<5.0
Cadmium	<5.0	<5.0
Calcium	**13,500**	**27,900**
Chromium	**48**	**98**
Cobalt	<50	<50
Copper	<25	<25
Iron	<100	<100
Lead	<100	<100
Magnesium	**130,000**	**143,000**
Manganese	<15	**16**
Nickel	<40	<40
Potassium	<5000	<5000
Selenium	<250	<250
Silicon	**10,300**	**24,100**
Silver	<10	<10
Sodium	**239,000**	**271,000**
Thallium	<2000	<2000
Titanium	<50	<50
Vanadium	<50	<50
Zinc	<20	<20
Hexavalent Chromium	**45.0**	**89.2**
General Water Chemistry Parameters (µg/l)		
Alkalinity, Total	**316,000**	**340,000**
Bicarbonate	**290,000**	**340,000**
Carbonate	**26,600**	<5000
Chloride	**552,000**	**601,000**
Fluoride	<10000	<10000
Nitrate	**2,800**	**2,700**
Nitrite	<1000	<1000
pH	**8.6**	**8.2**
Sulfate	**21,200**	**36,800**
Total Dissolved Solids	**1,140,000**	**1,270,000**
Field Parameters		
Salinity (%)	**1.25**	**1.37**
pH	**9.14**	**8.33**
Temperature (°C)	**14.83**	**14.09**
Specific Conductivity (mS/cm)	**2.420**	**2.638**
Eh (mV)[a]	**-15**	**-33**
Turbidity (NTU)	**1.4**	**0.1**
Dissolved Oxygen (mg/l)	**2.81**	**3.56**

[a] Eh values are corrected for reference electrode and temperature
mg/l - milligrams per liter
mS/cm - millisiemens per centimeter
mV - millivolts
NTU - nephelometric turbidity units
% - percent

TABLE G-3

SUMMARY OF ANALYTES IN LEACHATE
HEXAVALENT CHROMIUM IN SERPENTINITE BEDROCK AND GROUNDWATER IN UPLAND AREAS
PRESIDIO OF SAN FRANCISCO

Sample Location ID:	UBR01T01S01A	UBR01T01S01B	UBR01T01S02A	UBR01T01S02B	UBR01T01S03A	UBR01T01S03B	UBR01T01S04A
Sample Date:	3/16/99	3/16/99	3/16/99	3/16/99	3/17/99	3/17/99	3/23/99
Sampling Interval:	1 hour	1 hour	4 hours	4 hours	24 hours	24 hours	7 days
Dissolved Metals (µg/l)							
Aluminum	<200	<200	NA	NA	NA	NA	NA
Antimony	<60	<60	NA	NA	NA	NA	NA
Arsenic	<300	<300	NA	NA	NA	NA	NA
Barium	<200	<200	NA	NA	NA	NA	NA
Beryllium	<5.0	<5.0	NA	NA	NA	NA	NA
Cadmium	<5.0	<5.0	NA	NA	NA	NA	NA
Calcium	<5000	<5000	NA	NA	NA	NA	NA
Chromium	<10	<10	<10	<10	<10	<10	<10
Cobalt	<50	<50	NA	NA	NA	NA	NA
Copper	<25	<25	NA	NA	NA	NA	NA
Iron	<100	<100	<100	<100	<100	<100	<100
Lead	<100	<100	NA	NA	NA	NA	NA
Magnesium	<5000	<5000	<5000	<5000	<5000	<5000	<5000
Manganese	<15	<15	<15	<15	<15	<15	<15
Nickel	<40	<40	<40	<40	<40	<40	<40
Potassium	<5000	<5000	NA	NA	NA	NA	NA
Selenium	<250	<250	NA	NA	NA	NA	NA
Silicon	<200	<200	NA	NA	NA	NA	NA
Silver	<10	<10	NA	NA	NA	NA	NA
Sodium	<5000	<5000	NA	NA	NA	NA	NA
Thallium	<2000	<2000	NA	NA	NA	NA	NA
Titanium	<50	<50	NA	NA	NA	NA	NA
Vanadium	<50	<50	NA	NA	NA	NA	NA
Zinc	<20	<20	NA	NA	NA	NA	NA
Hexavalent Chromium	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
General Water Chemistry Parameters							
pH	**6.93**	**6.85**	**6.39**	**7.38**	**6.52**	**6.72**	**6.84**
Eh (mV)[a]	**434**	**447**	**464**	**447**	**443**	**421**	**451**

TABLE G-3

SUMMARY OF ANALYTES IN LEACHATE
HEXAVALENT CHROMIUM IN SERPENTINITE BEDROCK AND GROUNDWATER IN UPLAND AREAS
PRESIDIO OF SAN FRANCISCO

Sample Location ID:	UBR01T01S04B	UBR01T01S05A	UBR01T01S05B	UBR01T01S06A	UBR01T01S06B	UBR01T01S07A	UBR01T01S07B
Sample Date:	3/23/99	3/30/99	3/30/99	4/6/99	4/6/99	4/13/99	4/13/99
Sampling Interval:	7 days	14 days	14 days	21 days	21 days	28 days	28 days
Dissolved Metals (µg/l)							
Aluminum	NA	NA	NA	NA	NA	<200	<200
Antimony	NA	NA	NA	NA	NA	<60	<60
Arsenic	NA	NA	NA	NA	NA	<300	<300
Barium	NA	NA	NA	NA	NA	<200	<200
Beryllium	NA	NA	NA	NA	NA	<5.0	<5.0
Cadmium	NA	NA	NA	NA	NA	<5.0	<5.0
Calcium	NA	NA	NA	NA	NA	<5000	<5000
Chromium	<10	<10	<10	<10	<10	<10	<10
Cobalt	NA	NA	NA	NA	NA	<50	<50
Copper	NA	NA	NA	NA	NA	<25	<25
Iron	<100	<100	<100	<100	<100	<100	<100
Lead	NA	NA	NA	NA	NA	<100	<100
Magnesium	<5000	<5000	<5000	<5000	<5000	<5000	<5000
Manganese	<15	<15	<15	<15	**8.8 (J28)**	<15	<15
Nickel	<40	<40	<40	<40	<40	<40	<40
Potassium	NA	NA	NA	NA	NA	<5000	<5000
Selenium	NA	NA	NA	NA	NA	<250	<250
Silicon	NA	NA	NA	NA	NA	**1,600**	**1,100**
Silver	NA	NA	NA	NA	NA	<10	<10
Sodium	NA	NA	NA	NA	NA	<5000	<5000
Thallium	NA	NA	NA	NA	NA	<2000	<2000
Titanium	NA	NA	NA	NA	NA	<50	<50
Vanadium	NA	NA	NA	NA	NA	<50	<50
Zinc	NA	NA	NA	NA	NA	<20	<20
Hexavalent Chromium	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
General Water Chemistry Parameters							
pH	**6.89**	**7.26**	**7.10**	**7.54**	**7.36**	**7.36**	**6.34**
Eh (mV)[a]	**447**	**403**	**442**	**469**	**485**	**454**	**442**

TABLE G-3

SUMMARY OF ANALYTES IN LEACHATE
HEXAVALENT CHROMIUM IN SERPENTINITE BEDROCK AND GROUNDWATER IN UPLAND AREAS
PRESIDIO OF SAN FRANCISCO

Sample Location ID:	UBR01T02S01A	UBR01T02S01B	UBR01T02S02A	UBR01T02S02B	UBR01T02S03A	UBR01T02S03B	UBR01T02S04A
Sample Date:	3/16/99	3/16/99	3/16/99	3/16/99	3/17/99	3/17/99	3/23/99
Sampling Interval:	1 hour	1 hour	4 hours	4 hours	24 hours	24 hours	7 days
Dissolved Metals (µg/l)							
Aluminum	<200	<200	NA	NA	NA	NA	NA
Antimony	<60	<60	NA	NA	NA	NA	NA
Arsenic	<300	<300	NA	NA	NA	NA	NA
Barium	**220**	**210**	NA	NA	NA	NA	NA
Beryllium	<5.0	<5.0	NA	NA	NA	NA	NA
Cadmium	<5.0	<5.0	NA	NA	NA	NA	NA
Calcium	**40,500**	**40,500**	NA	NA	NA	NA	NA
Chromium	**63**	**63**	**62**	**58**	**64**	**56**	**64**
Cobalt	<50	<50	NA	NA	NA	NA	NA
Copper	<25	<25	NA	NA	NA	NA	NA
Iron	<100	<100	<100	<100	<100	<100	<100
Lead	<100	<100	NA	NA	NA	NA	NA
Magnesium	**101,000**	**101,000**	**101,000**	**92,200**	**99,000**	**89,400**	**97,900**
Manganese	<15	<15	<15	<15	<15	<15	<15
Nickel	<40	<40	<40	<40	<40	<40	<40
Potassium	<5000	<5000	NA	NA	NA	NA	NA
Selenium	<250	<250	NA	NA	NA	NA	NA
Silicon	**23,600**	**23,600**	NA	NA	NA	NA	NA
Silver	<10	<10	NA	NA	NA	NA	NA
Sodium	**50,800**	**49,600**	NA	NA	NA	NA	NA
Thallium	<2000	<2000	NA	NA	NA	NA	NA
Titanium	<50	<50	NA	NA	NA	NA	NA
Vanadium	<50	<50	NA	NA	NA	NA	NA
Zinc	<20	<20	NA	NA	NA	NA	NA
Hexavalent Chromium	**69.5**	**67.7**	**63.9**	**62.6**	**69.9**	**70.7**	**66.6**
General Water Chemistry Parameters							
pH	**7.88**	**7.92**	**7.83**	**7.79**	**8.00**	**7.97**	**7.85**
Eh (mV)[a]	**432**	**429**	**458**	**438**	**404**	**407**	**394**

TABLE G-3

SUMMARY OF ANALYTES IN LEACHATE
HEXAVALENT CHROMIUM IN SERPENTINITE BEDROCK AND GROUNDWATER IN UPLAND AREAS
PRESIDIO OF SAN FRANCISCO

Sample Location ID:	UBR01T02S04B	UBR01T02S05A	UBR01T02S05B	UBR01T02S06A	UBR01T02S06B	UBR01T02S07A	UBR01T02S07B
Sample Date:	3/23/99	3/30/99	3/30/99	4/6/99	4/6/99	4/13/99	4/13/99
Sampling Interval:	7 days	14 days	14 days	21 days	21 days	28 days	28 days
Dissolved Metals (µg/l)							
Aluminum	NA	NA	NA	NA	NA	<200	<200
Antimony	NA	NA	NA	NA	NA	<60	<60
Arsenic	NA	NA	NA	NA	NA	<300	<300
Barium	NA	NA	NA	NA	NA	**160 (J28)**	**150 (J28)**
Beryllium	NA	NA	NA	NA	NA	<5.0	<5.0
Cadmium	NA	NA	NA	NA	NA	<5.0	<5.0
Calcium	NA	NA	NA	NA	NA	**28,000**	**27,200**
Chromium	**65**	**64**	**63**	**56 (J33)**	**33 (J33)**	**8.6 (J28)**	**8.4 (J28)**
Cobalt	NA	NA	NA	NA	NA	<50	<50
Copper	NA	NA	NA	NA	NA	<25	<25
Iron	<100	<100	<100	<100	<100	<100	<100
Lead	NA	NA	NA	NA	NA	<100	<100
Magnesium	**97,400**	**94,700**	**96,600**	**80,800**	**90,500**	**83,300**	**82,000**
Manganese	<15	<15	<15	<15	<15	<15	<15
Nickel	<40	<40	<40	<40	<40	<40	<40
Potassium	NA	NA	NA	NA	NA	<5000	<5000
Selenium	NA	NA	NA	NA	NA	<250	<250
Silicon	NA	NA	NA	NA	NA	**24,200**	**23,900**
Silver	NA	NA	NA	NA	NA	<10	<10
Sodium	NA	NA	NA	NA	NA	**47,200**	**47,300**
Thallium	NA	NA	NA	NA	NA	<2000	<2000
Titanium	NA	NA	NA	NA	NA	<50	<50
Vanadium	NA	NA	NA	NA	NA	<50	<50
Zinc	NA	NA	NA	NA	NA	<20	<20
Hexavalent Chromium	**68.8**	**54.7**	**57.1**	**34.9 (J33)**	**19.0 (J33)**	**5.3**	**5.2**
General Water Chemistry Parameters							
pH	**7.83**	**7.86**	**7.87**	**8.09**	**7.93**	**7.86**	**7.96**
Eh (mV)[a]	**393**	**429**	**428**	**464**	**442**	**418**	**424**

TABLE G-3

SUMMARY OF ANALYTES IN LEACHATE
HEXAVALENT CHROMIUM IN SERPENTINITE BEDROCK AND GROUNDWATER IN UPLAND AREAS
PRESIDIO OF SAN FRANCISCO

Sample Location ID:	UBR01T03S01A	UBR01T03S01B	UBR01T03S02A	UBR01T03S02B	UBR01T03S03A	UBR01T03S03B	UBR01T03S04A
Sample Date:	3/16/99	3/16/99	3/16/99	3/16/99	3/17/99	3/17/99	3/23/99
Sampling Interval:	1 hour	1 hour	4 hours	4 hours	24 hours	24 hours	7 days
Dissolved Metals (µg/l)							
Aluminum	<200	<200	NA	NA	NA	NA	NA
Antimony	<60	<60	NA	NA	NA	NA	NA
Arsenic	<300	<300	NA	NA	NA	NA	NA
Barium	<200	<200	NA	NA	NA	NA	NA
Beryllium	<5.0	<5.0	NA	NA	NA	NA	NA
Cadmium	<5.0	<5.0	NA	NA	NA	NA	NA
Calcium	**2,800 (J28)**	**3,300 (J28)**	NA	NA	NA	NA	NA
Chromium	<10	<10	<10	<10	<10	**7.7 (J28)**	<10
Cobalt	<50	<50	NA	NA	NA	NA	NA
Copper	<25	<25	NA	NA	NA	NA	NA
Iron	<100	<100	<100	<100	**110**	<100	<100
Lead	<100	<100	NA	NA	NA	NA	NA
Magnesium	**4,200 (J28)**	**4,800 (J28)**	**6,900**	**6,100**	**6,800**	**6,400**	**8,900**
Manganese	<15	<15	<15	<15	<15	<15	<15
Nickel	<40	<40	<40	<40	<40	<40	<40
Potassium	<5000	<5000	NA	NA	NA	NA	NA
Selenium	<250	<250	NA	NA	NA	NA	NA
Silicon	**9,200**	**9,200**	NA	NA	NA	NA	NA
Silver	<10	<10	NA	NA	NA	NA	NA
Sodium	**7,200**	**6,700**	NA	NA	NA	NA	NA
Thallium	<2000	<2000	NA	NA	NA	NA	NA
Titanium	<50	<50	NA	NA	NA	NA	NA
Vanadium	<50	<50	NA	NA	NA	NA	NA
Zinc	<20	<20	NA	NA	NA	NA	NA
Hexavalent Chromium	**3.5**	**3.3**	**3.7**	**3.3**	**4.1**	**4.2**	**5.2**
General Water Chemistry Parameters							
pH	**8.78**	**8.84**	**8.38**	**8.38**	**8.75**	**8.74**	**8.29**
Eh (mV)[a]	**396**	**389**	**455**	**449**	**416**	**429**	**391**

TABLE G-3

SUMMARY OF ANALYTES IN LEACHATE
HEXAVALENT CHROMIUM IN SERPENTINITE BEDROCK AND GROUNDWATER IN UPLAND AREAS
PRESIDIO OF SAN FRANCISCO

Sample Location ID:	UBR01T03S04B	UBR01T03S05A	UBR01T03S05B	UBR01T03S06A	UBR01T03S06B	UBR01T03S07A	UBR01T03S07B
Sample Date:	**3/23/99**	**3/30/99**	**3/30/99**	**4/6/99**	**4/6/99**	**4/13/99**	**4/13/99**
Sampling Interval:	**7 days**	**14 days**	**14 days**	**21 days**	**21 days**	**28 days**	**28 days**
Dissolved Metals (µg/l)							
Aluminum	NA	NA	NA	NA	NA	<200	<200
Antimony	NA	NA	NA	NA	NA	<60	<60
Arsenic	NA	NA	NA	NA	NA	<300	<300
Barium	NA	NA	NA	NA	NA	<200	<200
Beryllium	NA	NA	NA	NA	NA	<5.0	<5.0
Cadmium	NA	NA	NA	NA	NA	<5.0	<5.0
Calcium	NA	NA	NA	NA	NA	**9,000**	**8,600**
Chromium	**6.7 (J28)**	**9.3 (J28)**	**6.0 (J28)**	**6.7 (J28)**	<10	<10	**5.0 (J28)**
Cobalt	NA	NA	NA	NA	NA	<50	<50
Copper	NA	NA	NA	NA	NA	<25	<25
Iron	**260**	<100	<100	<100	<100	<100	**83 (J28)**
Lead	NA	NA	NA	NA	NA	<100	<100
Magnesium	**8,900**	**11,000**	**8,700**	**10,300**	**10,100**	**11,000**	**10,100**
Manganese	<15	<15	<15	<15	<15	<15	<15
Nickel	<40	<40	<40	<40	<40	<40	<40
Potassium	NA	NA	NA	NA	NA	<5000	<5000
Selenium	NA	NA	NA	NA	NA	<250	<250
Silicon	NA	NA	NA	NA	NA	**18,300**	**17,400**
Silver	NA	NA	NA	NA	NA	<10	<10
Sodium	NA	NA	NA	NA	NA	**7,100**	**7,100**
Thallium	NA	NA	NA	NA	NA	<2000	<2000
Titanium	NA	NA	NA	NA	NA	<50	<50
Vanadium	NA	NA	NA	NA	NA	<50	<50
Zinc	NA	NA	NA	NA	NA	<20	<20
Hexavalent Chromium	**5.2**	**4.4**	**6.4**	**3.4**	**2.3**	**0.36 (J28)**	**2.0**
General Water Chemistry Parameters							
pH	**8.29**	**8.06**	**7.95**	**8.06**	**8.01**	**8.26**	**8.21**
Eh (mV)[a]	**396**	**416**	**425**	**442**	**450**	**403**	**403**

TABLE G-3

SUMMARY OF ANALYTES IN LEACHATE
HEXAVALENT CHROMIUM IN SERPENTINITE BEDROCK AND GROUNDWATER IN UPLAND AREAS
PRESIDIO OF SAN FRANCISCO

Sample Location ID:	UBR01T04S01A	UBR01T04S01B	UBR01T04S02A	UBR01T04S02B	UBR01T04S03A	UBR01T04S03B	UBR01T04S04A
Sample Date:	3/24/99	3/24/99	3/24/99	3/24/99	3/25/99	3/25/99	3/31/99
Sampling Interval:	1 hour	1 hour	4 hours	4 hours	24 hours	24 hours	7 days
Dissolved Metals (µg/l)							
Aluminum	<200	<200	NA	NA	NA	NA	NA
Antimony	<60	<60	NA	NA	NA	NA	NA
Arsenic	<300	<300	NA	NA	NA	NA	NA
Barium	<200	<200	NA	NA	NA	NA	NA
Beryllium	<5.0	<5.0	NA	NA	NA	NA	NA
Cadmium	<5.0	<5.0	NA	NA	NA	NA	NA
Calcium	**4,400 (J28)**	**4,600 (J28)**	NA	NA	NA	NA	NA
Chromium	**79**	**82**	**110**	**110**	**140**	**130**	**180**
Cobalt	<50	<50	NA	NA	NA	NA	NA
Copper	<25	<25	NA	NA	NA	NA	NA
Iron	<100	<100	<100	<100	<100	**96 (J28)**	<100
Lead	<100	<100	NA	NA	NA	NA	NA
Magnesium	**6,300**	**6,700**	**5,400**	**6,000**	**6,600**	**6,100**	**8,900**
Manganese	**59**	**24**	<15	**8.3 (J28)**	**16**	<15	**10 (J28)**
Nickel	<40	<40	<40	<40	<40	<40	<40
Potassium	<5000	<5000	NA	NA	NA	NA	NA
Selenium	<250	<250	NA	NA	NA	NA	NA
Silicon	**8,400**	**8,700**	NA	NA	NA	NA	NA
Silver	<10	<10	NA	NA	NA	NA	NA
Sodium	**4,500 (J28)**	**4,600 (J28)**	NA	NA	NA	NA	NA
Thallium	<2000	<2000	NA	NA	NA	NA	NA
Titanium	<50	<50	NA	NA	NA	NA	NA
Vanadium	**88**	**92**	NA	NA	NA	NA	NA
Zinc	<20	<20	NA	NA	NA	NA	NA
Hexavalent Chromium	**554**	**556**	**108**	**105**	**144**	**132**	**125**
General Water Chemistry Parameters							
pH	**8.59**	**8.57**	**8.68**	**8.61**	**7.98**	**8.39**	**8.30**
Eh (mV)[a]	**333**	**332**	**334**	**336**	**395**	**397**	**431**

TABLE G-3

SUMMARY OF ANALYTES IN LEACHATE
HEXAVALENT CHROMIUM IN SERPENTINITE BEDROCK AND GROUNDWATER IN UPLAND AREAS
PRESIDIO OF SAN FRANCISCO

Sample Location ID:	UBR01T04S04B	UBR01T04S05A	UBR01T04S05B	UBR01T04S06A	UBR01T04S06B	UBR01T04S07A	UBR01T04S07B
Sample Date:	3/31/99	4/7/99	4/7/99	4/14/99	4/14/99	4/21/99	4/21/99
Sampling Interval:	7 days	14 days	14 days	21 days	21 days	28 days	28 days
Dissolved Metals (µg/l)							
Aluminum	NA	NA	NA	NA	NA	<200	<200
Antimony	NA	NA	NA	NA	NA	<60	<60
Arsenic	NA	NA	NA	NA	NA	<300	<300
Barium	NA	NA	NA	NA	NA	<200	<200
Beryllium	NA	NA	NA	NA	NA	<5.0	<5.0
Cadmium	NA	NA	NA	NA	NA	<5.0	<5.0
Calcium	NA	NA	NA	NA	NA	**8,700**	**10,600**
Chromium	**200**	**190 (J33)**	**91 (J33)**	**180**	**190**	**190**	**170**
Cobalt	NA	NA	NA	NA	NA	<50	<50
Copper	NA	NA	NA	NA	NA	<25	<25
Iron	<100	<100	<100	<100	<100	<100	<100
Lead	NA	NA	NA	NA	NA	<100	<100
Magnesium	**9,100**	**9,300**	**10,800**	**10,200**	**10,000**	**11,000**	**12,900**
Manganese	<15	**12 (J28)**	<15	<15	<15	**28**	<15
Nickel	<40	<40	<40	<40	<40	<40	<40
Potassium	NA	NA	NA	NA	NA	<5000	<5000
Selenium	NA	NA	NA	NA	NA	<250	<250
Silicon	NA	NA	NA	NA	NA	**19,400**	**20,400**
Silver	NA	NA	NA	NA	NA	<10	<10
Sodium	NA	NA	NA	NA	NA	**6,700**	**6,800**
Thallium	NA	NA	NA	NA	NA	<2000	<2000
Titanium	NA	NA	NA	NA	NA	<50	<50
Vanadium	NA	NA	NA	NA	NA	<50	<50
Zinc	NA	NA	NA	NA	NA	<20	<20
Hexavalent Chromium	**133**	**139 (J33)**	**67.7 (J33)**	**151**	**152**	**182**	**156**
General Water Chemistry Parameters							
pH	**8.19**	**8.20**	**8.07**	**8.31**	**8.25**	**7.91**	**7.87**
Eh (mV)[a]	**425**	**460**	**450**	**437**	**438**	**399**	**411**

TABLE G-3

SUMMARY OF ANALYTES IN LEACHATE
HEXAVALENT CHROMIUM IN SERPENTINITE BEDROCK AND GROUNDWATER IN UPLAND AREAS
PRESIDIO OF SAN FRANCISCO

Sample Location ID:	UBR01T05S01A	UBR01T05S01B	UBR01T05S02A	UBR01T05S02B	UBR01T05S03A	UBR01T05S03B	UBR01T05S04A
Sample Date:	3/24/99	3/24/99	3/24/99	3/24/99	3/25/99	3/25/99	3/31/99
Sampling Interval:	1 hour	1 hour	4 hours	4 hours	24 hours	24 hours	7 days
Dissolved Metals (µg/l)							
Aluminum	<200	<200	NA	NA	NA	NA	NA
Antimony	<60	<60	NA	NA	NA	NA	NA
Arsenic	<300	<300	NA	NA	NA	NA	NA
Barium	<200	<200	NA	NA	NA	NA	NA
Beryllium	<5.0	<5.0	NA	NA	NA	NA	NA
Cadmium	<5.0	<5.0	NA	NA	NA	NA	NA
Calcium	**3,000 (J28)**	**2,900 (J28)**	NA	NA	NA	NA	NA
Chromium	**22 (J33)**	**14 (J33)**	**7.2 (J28)**	**6.6 (J28)**	**5.0 (J28)**	**5.5 (J28)**	**8.3 (J28)**
Cobalt	<50	<50	NA	NA	NA	NA	NA
Copper	<25	<25	NA	NA	NA	NA	NA
Iron	<100	<100	<100	<100	<100	<100	<100
Lead	<100	<100	NA	NA	NA	NA	NA
Magnesium	**4,200 (J28)**	**4,200 (J28)**	**5,200**	**4,100 (J28)**	**6,300**	**6,200**	**8,500**
Manganese	<15	<15	<15	<15	<15	<15	<15
Nickel	<40	<40	<40	<40	<40	<40	<40
Potassium	<5000	<5000	NA	NA	NA	NA	NA
Selenium	<250	<250	NA	NA	NA	NA	NA
Silicon	**6,200**	**6,200**	NA	NA	NA	NA	NA
Silver	<10	<10	NA	NA	NA	NA	NA
Sodium	**4,300 (J28)**	**4,400 (J28)**	NA	NA	NA	NA	NA
Thallium	<2000	<2000	NA	NA	NA	NA	NA
Titanium	<50	<50	NA	NA	NA	NA	NA
Vanadium	<50	<50	NA	NA	NA	NA	NA
Zinc	<20	<20	NA	NA	NA	NA	NA
Hexavalent Chromium	**4.9**	**4.9**	**4.7**	**4.5**	**5.1**	**5.1**	**4.6**
General Water Chemistry Parameters							
pH	**8.73**	**8.77**	**8.52**	**8.44**	**8.43**	**8.37**	**8.20**
Eh (mV)[a]	**432**	**441**	**373**	**378**	**397**	**407**	**422**

TABLE G-3

SUMMARY OF ANALYTES IN LEACHATE
HEXAVALENT CHROMIUM IN SERPENTINITE BEDROCK AND GROUNDWATER IN UPLAND AREAS
PRESIDIO OF SAN FRANCISCO

Sample Location ID:	UBR01T05S04B	UBR01T05S05A	UBR01T05S05B	UBR01T05S06A	UBR01T05S06B	UBR01T05S07A	UBR01T05S07B
Sample Date:	3/31/99	4/7/99	4/7/99	4/14/99	4/14/99	4/21/99	4/21/99
Sampling Interval:	7 days	14 days	14 days	21 days	21 days	28 days	28 days
Dissolved Metals (µg/l)							
Aluminum	NA	NA	NA	NA	NA	<200	<200
Antimony	NA	NA	NA	NA	NA	<60	<60
Arsenic	NA	NA	NA	NA	NA	<300	<300
Barium	NA	NA	NA	NA	NA	<200	<200
Beryllium	NA	NA	NA	NA	NA	<5.0	<5.0
Cadmium	NA	NA	NA	NA	NA	<5.0	<5.0
Calcium	NA	NA	NA	NA	NA	**11,100**	**10,800**
Chromium	**8.1 (J28)**	**7.5 (J28)**	**7.3 (J28)**	**9.8 (J28, J33)**	**31 (J33)**	**6.2 (J28)**	**7.2 (J28)**
Cobalt	NA	NA	NA	NA	NA	<50	<50
Copper	NA	NA	NA	NA	NA	<25	<25
Iron	<100	<100	<100	<100	<100	<100	<100
Lead	NA	NA	NA	NA	NA	<100	<100
Magnesium	**8,600**	**9,500**	**9,400**	**10,600**	**11,700**	**12,400**	**12,800**
Manganese	<15	<15	<15	<15	<15	<15	<15
Nickel	<40	<40	<40	<40	<40	<40	<40
Potassium	NA	NA	NA	NA	NA	<5000	<5000
Selenium	NA	NA	NA	NA	NA	<250	<250
Silicon	NA	NA	NA	NA	NA	**20,600**	**20,800**
Silver	NA	NA	NA	NA	NA	<10	<10
Sodium	NA	NA	NA	NA	NA	**7,100**	**7,800**
Thallium	NA	NA	NA	NA	NA	<2000	<2000
Titanium	NA	NA	NA	NA	NA	<50	<50
Vanadium	NA	NA	NA	NA	NA	<50	<50
Zinc	NA	NA	NA	NA	NA	<20	<20
Hexavalent Chromium	**4.7**	**5.2**	**5.1**	**5.1**	**6.3**	**4.3**	**6.1**
General Water Chemistry Parameters							
pH	**8.39**	**8.05**	**7.96**	**8.25**	**8.16**	**7.93**	**7.94**
Eh (mV)[a]	**419**	**446**	**449**	**436**	**440**	**418**	**420**

TABLE G-3

SUMMARY OF ANALYTES IN LEACHATE
HEXAVALENT CHROMIUM IN SERPENTINITE BEDROCK AND GROUNDWATER IN UPLAND AREAS
PRESIDIO OF SAN FRANCISCO

Sample Location ID:	UBR01T06S01A	UBR01T06S01B	UBR01T06S02A	UBR01T06S02B	UBR01T06S03A	UBR01T06S03B	UBR01T06S04A
Sample Date:	3/24/99	3/24/99	3/24/99	3/24/99	3/25/99	3/25/99	3/31/99
Sampling Interval:	1 hour	1 hour	4 hours	4 hours	24 hours	24 hours	7 days
Dissolved Metals (µg/l)							
Aluminum	<200	<200	NA	NA	NA	NA	NA
Antimony	<60	<60	NA	NA	NA	NA	NA
Arsenic	<300	<300	NA	NA	NA	NA	NA
Barium	**260**	**210**	NA	NA	NA	NA	NA
Beryllium	<5.0	<5.0	NA	NA	NA	NA	NA
Cadmium	<5.0	<5.0	NA	NA	NA	NA	NA
Calcium	**29,000**	**27,000**	NA	NA	NA	NA	NA
Chromium	**8,600**	**8,700**	**1,800**	**2,100**	**300**	**290**	**210**
Cobalt	**29 (J28)**	<50	NA	NA	NA	NA	NA
Copper	<25	<25	NA	NA	NA	NA	NA
Iron	<100	<100	<100	<100	<100	<100	<100
Lead	<100	<100	NA	NA	NA	NA	NA
Magnesium	**43,100**	**39,000**	**42,600**	**43,300**	**43,600**	**42,000**	**47,600**
Manganese	**780**	**190**	**240**	**130**	**88**	**60**	**29**
Nickel	**97**	**37 (J28)**	**38 (J28)**	**20 (J28)**	**24 (J28)**	<40	<40
Potassium	<5000	<5000	NA	NA	NA	NA	NA
Selenium	<250	<250	NA	NA	NA	NA	NA
Silicon	**5,100**	**4,800**	NA	NA	NA	NA	NA
Silver	<10	<10	NA	NA	NA	NA	NA
Sodium	**7,200**	**6,400**	NA	NA	NA	NA	NA
Thallium	<2000	<2000	NA	NA	NA	NA	NA
Titanium	<50	<50	NA	NA	NA	NA	NA
Vanadium	**33 (J28)**	<50	NA	NA	NA	NA	NA
Zinc	<20	<20	NA	NA	NA	NA	NA
Hexavalent Chromium	**3,590 (J33)**	**210 (J33)**	**117**	**156**	**73.7**	**108**	**147**
General Water Chemistry Parameters							
pH	**5.33**	**5.27**	**5.52**	**5.63**	**6.18**	**6.02**	**7.16**
Eh (mV)[a]	**541**	**459**	**493**	**491**	**443**	**407**	**439**

TABLE G-3

SUMMARY OF ANALYTES IN LEACHATE
HEXAVALENT CHROMIUM IN SERPENTINITE BEDROCK AND GROUNDWATER IN UPLAND AREAS
PRESIDIO OF SAN FRANCISCO

Sample Location ID:	UBR01T06S04B	UBR01T06S05A	UBR01T06S05B	UBR01T06S06A	UBR01T06S06B	UBR01T06S07A	UBR01T06S07B
Sample Date:	3/31/99	4/7/99	4/7/99	4/14/99	4/14/99	4/21/99	4/21/99
Sampling Interval:	7 days	14 days	14 days	21 days	21 day	28 days	28 days
Dissolved Metals (µg/l)							
Aluminum	NA	NA	NA	NA	NA	<200	<200
Antimony	NA	NA	NA	NA	NA	<60	<60
Arsenic	NA	NA	NA	NA	NA	<300	<300
Barium	NA	NA	NA	NA	NA	**150 (J28)**	**130 (J28)**
Beryllium	NA	NA	NA	NA	NA	<5.0	<5.0
Cadmium	NA	NA	NA	NA	NA	<5.0	<5.0
Calcium	NA	NA	NA	NA	NA	**37,900**	**37,300**
Chromium	**240**	**470 (J33)**	**230 (J33)**	**220**	**220**	**190 (J33)**	**120 (J33)**
Cobalt	NA	NA	NA	NA	NA	<50	<50
Copper	NA	NA	NA	NA	NA	<25	<25
Iron	<100	<100	<100	<100	<100	<100	<100
Lead	NA	NA	NA	NA	NA	<100	<100
Magnesium	**48,800**	**48,500**	**47,100**	**47,700**	**48,000**	**47,800**	**48,900**
Manganese	**30**	**51**	**27**	**67**	**22**	**47**	**17**
Nickel	<40	<40	<40	<40	<40	<40	<40
Potassium	NA	NA	NA	NA	NA	<5000	<5000
Selenium	NA	NA	NA	NA	NA	<250	<250
Silicon	NA	NA	NA	NA	NA	**22,600**	**23,500**
Silver	NA	NA	NA	NA	NA	<10	<10
Sodium	NA	NA	NA	NA	NA	**8,700**	**8,600**
Thallium	NA	NA	NA	NA	NA	<2000	<2000
Titanium	NA	NA	NA	NA	NA	<50	<50
Vanadium	NA	NA	NA	NA	NA	<50	<50
Zinc	NA	NA	NA	NA	NA	<20	<20
Hexavalent Chromium	**160**	**344 (J33)**	**169 (J33)**	**184**	**176**	**171 (J33)**	**104 (J33)**
General Water Chemistry Parameters							
pH	**7.04**	**7.25**	**7.08**	**7.31**	**7.24**	**6.93**	**7.07**
Eh (mV)[a]	**421**	**472**	**472**	**463**	**467**	**463**	**453**

[a] Eh values corrected for reference electrode and temperature by adding 244 mV
µg/l - micrograms per liter
mV - millivolts

TABLE G-4

SUMMARY OF ANALYTES IN LEACHED BEDROCK
HEXAVALENT CHROMIUM IN SERPENTINITE BEDROCK AND GROUNDWATER IN UPLAND AREAS
PRESIDIO OF SAN FRANCISCO

Sample ID:	UBR01T02S01A	UBR01T02S01B	UBR01T02S07A	UBR01T02S07B	UBR01T03S01A	UBR01T03S01B
Sample Date:	3/16/99	3/16/99	4/13/99	4/13/99	3/16/99	3/16/99
Sampling Interval:	1 hour	1 hour	28 days	28 days	1 hour	1 hour
Metals (mg/kg)						
Chromium	NA	NA	**592**	**619**	NA	NA
Iron	NA	NA	**29,300**	**30,600**	NA	NA
Magnesium	NA	NA	**128,000**	**133,000**	NA	NA
Manganese	NA	NA	**335**	**364**	NA	NA
Nickel	NA	NA	**1,360**	**1,370**	NA	NA
Soil Chemistry Parameters						
Cr(VI) by Alkaline Digestion (mg/kg)	**0.088**	**0.092**	**0.255**	**0.220**	**0.100**	**0.086**
Easily Reducible Manganese (mg/kg)	**109**	**101**	**94**	**109**	**96**	**94**
Quick Oxidation Test (mg/kg)	**1.34**	**1.31**	**0.24**	**0.24**	**1.60**	**1.73**
Percent Moisture (%)	**23.1**	**21.4**	**26.2**	**24.2**	**18.6**	**21.0**

TABLE G-4

SUMMARY OF ANALYTES IN LEACHED BEDROCK
HEXAVALENT CHROMIUM IN SERPENTINITE BEDROCK AND GROUNDWATER IN UPLAND AREAS
PRESIDIO OF SAN FRANCISCO

Sample ID:	UBR01T03S07A	UBR01T03S07B	UBR01T04S01A	UBR01T04S01B	UBR01T04S07A	UBR01T04S07B
Sample Date:	4/13/99	4/13/99	3/24/99	3/24/99	4/21/99	4/21/99
Sampling Interval:	28 days	28 days	1 hour	1 hour	28 days	28 days
Metals (mg/kg)						
Chromium	827	691	NA	NA	931	686
Iron	32,700	32,100	NA	NA	33,000	32,900
Magnesium	145,000	137,000	NA	NA	139,000	139,000
Manganese	377	359	NA	NA	402	383
Nickel	1,500	1,420	NA	NA	1,420	1,440
Soil Chemistry Parameters						
Cr(VI) by Alkaline Digestion (mg/kg)	0.162	0.148	0.788	1.032	0.315	0.312
Easily Reducible Manganese (mg/kg)	90	111	115	95	88	99
Quick Oxidation Test (mg/kg)	0.72	1.06	0.53	0.56	0.44	0.46
Percent Moisture (%)	24.6	28.6	20.2	20.8	21.9	21.2

TABLE G-4

SUMMARY OF ANALYTES IN LEACHED BEDROCK
HEXAVALENT CHROMIUM IN SERPENTINITE BEDROCK AND GROUNDWATER IN UPLAND AREAS
PRESIDIO OF SAN FRANCISCO

Sample Location ID:	UBR01T05S01A	UBR01T05S01B	UBR01T05S07A	UBR01T05S07B	UBR01T06S01A	UBR01T06S01B
Sample Date:	3/24/99	3/24/99	4/21/99	4/21/99	3/24/99	3/24/99
Sampling Interval:	1 hour	1 hour	28 days	28 days	1 hour	1 hour
Metals (mg/kg)						
Chromium	NA	NA	**908**	**837**	NA	NA
Iron	NA	NA	**31,900**	**33,200**	NA	NA
Magnesium	NA	NA	**132,000**	**148,000**	NA	NA
Manganese	NA	NA	**23,700**	**8,420**	NA	NA
Nickel	NA	NA	**1,430**	**1,420**	NA	NA
Soil Chemistry Parameters						
Cr(VI) by Alkaline Digestion (mg/kg)	**0.163**	**0.151**	**0.173**	**0.114**	**18.15**	**9.615**
Easily Reducible Manganese (mg/kg)	**7,883**	**11,073**	**12,981**	**11,331**	**89**	**106**
Quick Oxidation Test (mg/kg)	**1.88**	**1.97**	**1.27**	**1.65**	**1.92**	**0.35**
Percent Moisture (%)	**18.6**	**23.0**	**21.2**	**21.2**	**21.3**	**19.7**

TABLE G-4

SUMMARY OF ANALYTES IN LEACHED BEDROCK
HEXAVALENT CHROMIUM IN SERPENTINITE BEDROCK AND GROUNDWATER IN UPLAND AREAS
PRESIDIO OF SAN FRANCISCO

Sample Location ID:	UBR01T06S07A	UBR01T06S07B
Sample Date:	4/21/99	4/21/99
Sampling Interval:	28 days	28 days
Metals (mg/kg)		
Chromium	965	909
Iron	28,600	32,600
Magnesium	131,000	144,000
Manganese	316	359
Nickel	1,370	1,480
Soil Chemistry Parameters		
Cr(VI) by Alkaline Digestion (mg/kg)	3.714	3.075
Easily Reducible Manganese (mg/kg)	66	72
Quick Oxidation Test (mg/kg)	0.12	0.09
Percent Moisture (%)	17.9	22.3

mg/kg - milligrams per kilogram

% - percent

TABLE G-5

SAMPLE IDENTIFICATION NOMENCLATURE
HEXAVALENT CHROMIUM IN SERPENTINITE BEDROCK AND GROUNDWATER IN UPLAND AREAS
PRESIDIO OF SAN FRANCISCO

BEDROCK SAMPLE IDs

UBR01SB01	Composite of bedrock samples taken from bedrock core at location UBR01 at 36.5, 40, 44, and 47 feet below ground surface (bgs)
UBR02SB01	Composite of bedrock samples taken from bedrock core at location UBR02 at 22, 27.5, and 32 feet bgs
UBR03SB02	Composite of bedrock samples taken from bedrock core at location UBR03 at 68 and 71 feet bgs

GROUNDWATER SAMPLE IDs

UBR01GW01	groundwater monitoring well at site UBR01
UBR02GW01	deep groundwater monitoring well at site UBR02
UBR02GW02	shallow groundwater monitoring well at site UBR02
UBR03GW01	deep groundwater monitoring well at site UBR03
UBR03GW02	shallow groundwater monitoring well at site UBR03

LEACHATE SAMPLE IDs

Note: Sampling Intervals:	S01 = 1 hour	Test Conditions:	T01 = DI water only
	S02 = 24 hrs		T02 = Bedrock + Groundwater
	S03 = 7 days		T03 = Bedrock + DI water
	S04 = 14 days		T04 = Bedrock + DI water + H_2O_2
	S05 = 21 days		T05 = Bedrock + DI water + MnO_2
	S06 = 28 days		T06 = Bedrock + DI water + $CrCl_3$

Example of leachate sample IDs

UBR01T01S01A	UBR01 = Bedrock composite used , T01 = First test condition, S01 = First sampling interval
UBR01T01S01B	Duplicate of UBR01T01S01
UBR01T01S02A	UBR01 = Bedrock composite used, T01 = First test condition, S02 = Second sampling interval, etc.

TABLE G-6

DATA VALIDATION QUALIFIER SUMMARY
HEXAVALENT CHROMIUM IN SERPENTINITE BEDROCK AND GROUNDWATER IN UPLAND AREAS
PRESIDIO OF SAN FRANCISCO

Data Validation Qualifiers:

J - Qualified as estimated U - Qualified as not detected R - Qualified as rejected

Data Validation Comments:

1 Qualified due to detected concentration in associated method blank sample.
2 Qualified due to detected concentration in associated trip blank sample.
3 Qualified due to detected concentration in associated filter blank sample.
4 Qualified due to detected concentration in associated equipment rinsate blank sample.
5 Qualified as positively biased due to surrogate recoveries above the established acceptance limits.
6 Qualified as negatively biased due to surrogate recoveries below the established acceptance limits.
7 Qualified due to surrogate recoveries outside the established acceptance limits; bias cannot be determined.
8 Qualified as positively biased due to MS/MSD recoveries above the established acceptance limits.
9 Qualified as negatively biased due to MS/MSD recoveries below the established acceptance limits.
10 Qualified due to MS/MSD recoveries outside the established acceptance limits; bias cannot be determined.
11 Qualified as positively biased due to LCS recoveries above the established acceptance limits.
12 Qualified as negatively biased due to LCS recoveries below the established acceptance limits.
13 Qualified due to LCS recoveries outside the established acceptance limits; bias cannot be determined.
14 Qualified as positively biased due to calibration nonconformances.
15 Qualified as negatively biased due to calibration nonconformances.
16 Qualified due to calibration nonconformances; bias cannot be determined.
17 Qualified as negatively biased due to holding time nonconformances.
18 Qualified as negatively biased due to sample receipt nonconformances.
19 Qualified as positively biased due to sample receipt nonconformances.
20 Qualified due to sample receipt nonconformances; bias can not be determined.
21 Qualified as positively biased due to other criteria.
22 Qualified as negatively biased due to other criteria.
23 Qualified due to other criteria; bias cannot be determined.
24 Qualified due to detected concentration in associated source water sample.
25 Qualified due to chromatographic pattern of the sample does not match the calibration pattern.
26 Reported value determined by method of standard addition; bias cannot be determined.
27 Qualified as negatively biased due to post-digest spike recovery between 40% to 85%.
28 Estimated value; result is detected between the method detection limit (MDL) and the reporting limit.
29 Qualified due to holding times exceeded.
30 Qualified as estimated; compound is a common laboratory contaminant.
31 Reported value determined by GC/MS library search; compound is tentatively identified and quantitation is estimated.
32 Qualified data explained further in the report associated with the sampling event.
33 Qualified due to field duplicate RPD outside of established limits; bias cannot be determined.
34 Final purge readings are not representative of site conditions. The reported readings are taken from earlier purge log entries.
35 Questionable field parameter results; readings do not appear to be representative of site conditions.

APPENDIX E

COPIES OF JOHNSON AND ETTINGER MODEL FUNS FOR VOLATILE ORGANIC CHEMICALS

APPENDIX E

COPIES OF JOHNSON AND ETTINGER MODEL RUNS FOR VOLATILE ORGANIC CHEMICALS

DATA ENTRY SHEET

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

SL-ADV
Version 2.3; 03/01

YES [X]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [ ]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
78933		Methyl ethyl ketone

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell D28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
20	15	15	485	15	0	0	S		

MORE ↓

ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
1.5	0.43	0.15	0.006								

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)
15	40	961	961	488	0.1	2

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1
				Used to calculate risk-based soil concentration.	

END

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm \cdot m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
9.18E-02	9.40E-06	5.16E-05	25	7,862	352.75	529.13	3.16E+01	2.85E+05	0.0E+00	5.0E-01	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	**Initial soil concentration used, C_R (µg/kg)**	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
9.46E+08	1	0.280	ERROR	ERROR	0.257	1.01E-07	0.703	7.10E-08	3,844	1.00E+00	2.50E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
9.24E+05	4.16E-04	15	8,775	4.00E-05	1.66E-03	1.78E-04	7.22E-03	0.00E+00	0.00E+00	7.22E-03	1	15

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} (µg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (µg/m^3)	**Finite source β term (unitless)**	**Finite source ψ term $(sec)^{-1}$**	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
1.90E-01	5.74E+00	0.10	6.74E+01	7.22E-03	3.84E+02	1.65E+158	NA	NA	9.99E+01	2.76E-05	5.70E+09	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ (µg/m^3)	Finite source bldg. conc., $C_{building}$ (µg/m^3)	Final finite source bldg. conc., $C_{building}$ (µg/m^3)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
1.52E-04	NA	8.75E-04	8.75E-04	NA	5.0E-01

END

RISK-BASED SOIL CONCENTRATION CALCULATIONS:

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final indoor exposure soil conc., (µg/kg)
NA	5.96E+05	5.96E+05	8.26E+07	5.96E+05

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

SL-ADV
Version 2.3; 03/01

YES [X]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [ ]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
78933		Methyl ethyl ketone

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell D28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
20	15	15	485	15	0	0	5		

MORE ↓

ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
1.5	0.43	0.15	0.006								

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)
15	40	961	961	488	0.1	5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
9.18E-02	9.40E-06	5.16E-05	25	7,862	352.75	529.13	3.16E+01	2.85E+05	0.0E+00	5.0E-01	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	**Initial soil concentration used, C_R** (µg/kg)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.280	ERROR	ERROR	0.257	1.01E-07	0.703	7.10E-08	3,844	1.00E+00	6.26E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm·m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm·s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
9.24E+05	4.16E-04	15	8,775	4.00E-05	1.66E-03	1.78E-04	7.22E-03	0.00E+00	0.00E+00	7.22E-03	1	15

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} (µg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (µg/m^3)	**Finite source β term** (unitless)	**Finite source ψ term** $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
1.90E-01	5.74E+00	0.10	6.74E+01	7.22E-03	3.84E+02	1.65E+158	NA	NA	9.99E+01	2.76E-05	5.70E+09	NO

Finite source indoor attenuation coefficient, <α> (unitless)	Mass limit bldg. conc., $C_{building}$ (µg/m^3)	Finite source bldg. conc., $C_{building}$ (µg/m^3)	Final finite source bldg. conc., $C_{building}$ (µg/m^3)	Unit risk factor, URF $(µg/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
6.43E-05	NA	3.69E-04	3.69E-04	NA	5.0E-01

END

RISK-BASED SOIL CONCENTRATION CALCULATIONS:

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final indoor exposure soil conc., (µg/kg)
NA	1.98E+06	1.98E+06	8.26E+07	1.98E+06

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

SL-ADV
Version 2.3; 03/01

YES [X]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [ ]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
75150		Carbon disulfide

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell D28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
20	15	15	485	15	0	0	S		

MORE ↓

ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
1.5	0.43	0.15	0.006								

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)
15	40	961	961	488	0.1	2

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1

Used to calculate risk-based soil concentration.

END

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm \cdot m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
1.04E-01	1.00E-05	3.02E-02	25	6,391	319.00	552.00	4.57E+01	1.19E+03	0.0E+00	7.0E-01	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	**Initial soil concentration used, C_R** (µg/kg)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
9.46E+08	1	0.280	ERROR	ERROR	0.257	1.01E-07	0.703	7.10E-08	3,844	1.00E+00	2.50E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
9.24E+05	4.16E-04	15	6,604	2.50E-02	1.04E+00	1.78E-04	8.11E-03	0.00E+00	0.00E+00	8.11E-03	1	15

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} (µg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, η (unitless)	Infinite source bldg. conc., $C_{building}$ (µg/m^3)	**Finite source β term** (unitless)	**Finite source ψ term** $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
2.74E-01	1.83E+03	0.10	6.74E+01	8.11E-03	3.84E+02	6.04E+140	NA	NA	1.12E+02	9.88E-03	1.65E+07	YES

Finite source indoor attenuation coefficient, <η> (unitless)	**Mass limit** bldg. conc., $C_{building}$ (µg/m^3)	Finite source bldg. conc., $C_{building}$ (µg/m^3)	Final finite source bldg. conc., $C_{building}$ (µg/m^3)	Unit risk factor, URF $(µg/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	2.75E-03	NA	2.75E-03	NA	7.0E-01

END

RISK-BASED SOIL CONCENTRATION CALCULATIONS:

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final indoor exposure soil conc., (µg/kg)
NA	2.66E+05	2.66E+05	6.76E+05	2.66E+05

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box) | SL-ADV Version 2.3; 03/01

YES | X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES |

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
75150		Carbon disulfide

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_1 (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_1 (cell D28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
20	15	15	485	15	0	0	S		

MORE ↓

ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
1.5	0.43	0.15	0.006								

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)
15	40	961	961	488	0.1	5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
1.04E-01	1.00E-05	3.02E-02	25	6,391	319.00	552.00	4.57E+01	1.19E+03	0.0E+00	7.0E-01	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R (µg/kg)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.280	ERROR	ERROR	0.257	1.01E-07	0.703	7.10E-08	3,844	1.00E+00	6.26E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
9.24E+05	4.16E-04	15	6,604	2.50E-02	1.04E+00	1.78E-04	8.11E-03	0.00E+00	0.00E+00	8.11E-03	1	15

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} (µg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (µg/m^3)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
2.74E-01	1.83E+03	0.10	6.74E+01	8.11E-03	3.84E+02	6.04E+140	NA	NA	1.12E+02	9.88E-03	1.65E+07	YES

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ (µg/m^3)	Finite source bldg. conc., $C_{building}$ (µg/m^3)	Final finite source bldg. conc., $C_{building}$ (µg/m^3)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	1.32E-03	NA	1.32E-03	NA	7.0E-01

END

RISK-BASED SOIL CONCENTRATION CALCULATIONS:

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final indoor exposure soil conc., (µg/kg)
NA	7.75E+05	7.75E+05	6.76E+05	6.76E+05

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

SL-ADV
Version 2.3; 03/01

YES [X]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [ ]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
106467		1,4-Dichlorobenzene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell D28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
20	15	15	485	15	0	0	S		

MORE ↓

ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
1.5	0.43	0.15	0.006								

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)
15	40	961	961	488	0.1	2

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1

Used to calculate risk-based soil concentration.

END

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
6.90E-02	7.90E-06	2.43E-03	25	9,271	447.21	684.75	6.17E+02	7.38E+01	1.1E-05	8.0E-01	S

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R (µg/kg)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
9.46E+08	1	0.280	ERROR	ERROR	0.257	1.01E-07	0.703	7.10E-08	3,844	1.00E+00	2.50E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
9.24E+05	4.16E-04	15	11,140	1.76E-03	7.33E-02	1.78E-04	5.38E-03	0.00E+00	0.00E+00	5.38E-03	1	15

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} (µg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe') (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (µg/m^3)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
3.70E+00	1.92E+01	0.10	6.74E+01	5.38E-03	3.84E+02	1.42E+212	NA	NA	7.48E+01	6.89E-05	2.11E+09	NO

Finite source indoor attenuation coefficient, <α> (unitless)	Mass limit bldg. conc., $C_{building}$ (µg/m^3)	Finite source bldg. conc., $C_{building}$ (µg/m^3)	Final finite source bldg. conc., $C_{building}$ (µg/m^3)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
8.95E-05	NA	1.72E-03	1.72E-03	1.1E-05	8.0E-01

END

RISK-BASED SOIL CONCENTRATION CALCULATIONS: INCREMENTAL RISK CALCULATIONS:

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final indoor exposure soil conc., (µg/kg)	Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
1.29E+02	4.85E+05	1.29E+02	2.82E+05	1.29E+02	NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box) | SL-ADV Version 2.3; 03/01

YES | X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES |

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
106467		1,4-Dichlorobenzene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell D28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
20	15	15	485	15	0	0	S		

MORE ↓

ENTER Stratum A soil dry bulk density, ρb^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B soil dry bulk density, ρb^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C soil dry bulk density, ρb^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
1.5	0.43	0.15	0.006								

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)
15	40	961	961	488	0.1	5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm \cdot m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
6.90E-02	7.90E-06	2.43E-03	25	9,271	447.21	684.75	6.17E+02	7.38E+01	1.1E-05	8.0E-01	S

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	**Initial soil concentration used, C_R** (µg/kg)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.280	ERROR	ERROR	0.257	1.01E-07	0.703	7.10E-08	3,844	1.00E+00	6.26E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
9.24E+05	4.16E-04	15	11,140	1.76E-03	7.33E-02	1.78E-04	5.38E-03	0.00E+00	0.00E+00	5.38E-03	1	15

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} (µg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (µg/m^3)	**Finite source β term** (unitless)	**Finite source ψ term** $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
3.70E+00	1.92E+01	0.10	6.74E+01	5.38E-03	3.84E+02	1.42E+212	NA	NA	7.48E+01	6.89E-05	2.11E+09	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	**Mass limit bldg. conc., $C_{building}$** (µg/m^3)	Finite source bldg. conc., $C_{building}$ (µg/m^3)	Final finite source bldg. conc., $C_{building}$ (µg/m^3)	Unit risk factor, URF $(µg/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.85E-05	NA	7.39E-04	7.39E-04	1.1E-05	8.0E-01

END

RISK-BASED SOIL CONCENTRATION CALCULATIONS:

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final indoor exposure soil conc., (µg/kg)
5.03E+02	1.58E+06	5.03E+02	2.82E+05	5.03E+02

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

SL-ADV
Version 2.3; 03/01

YES [X]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [ ]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
99876		Isopropyltoluene (p-Cymene)

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell D28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
20	15	15	485	15	0	0	S		

MORE ↓

ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
1.5	0.43	0.15	0.006								

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)
15	40	961	961	488	0.1	2

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1

Used to calculate risk-based soil concentration.

END

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
6.01E-02	5.28E-06	9.30E-03	15	9,365	450.00	675.00	5.01E+03	2.80E+01	0.0E+00	8.0E-01	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R (µg/kg)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
9.46E+08	1	0.280	ERROR	ERROR	0.257	1.01E-07	0.703	7.10E-08	3,844	1.00E+00	2.50E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
9.24E+05	4.16E-04	15	11,434	1.31E-02	5.43E-01	1.78E-04	4.69E-03	0.00E+00	0.00E+00	4.69E-03	1	15

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} (µg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (µg/m^3)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
3.01E+01	1.80E+01	0.10	6.74E+01	4.69E-03	3.84E+02	4.16E+243	NA	NA	6.52E+01	5.61E-05	2.52E+09	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ (µg/m^3)	Finite source bldg. conc., $C_{building}$ (µg/m^3)	Final finite source bldg. conc., $C_{building}$ (µg/m^3)	Unit risk factor, URF $(µg/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
8.70E-05	NA	1.56E-03	1.56E-03	NA	8.0E-01

END

RISK-BASED SOIL CONCENTRATION CALCULATIONS:

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final indoor exposure soil conc., (µg/kg)
NA	5.33E+05	5.33E+05	8.48E+05	5.33E+05

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

SL-ADV
Version 2.3; 03/01

YES [X]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [ ]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
99876		Isopropyltoluene (p-Cymene)

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell D28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
20	15	15	485	15	0	0	S		

MORE ↓

ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
1.5	0.43	0.15	0.006								

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)
15	40	961	961	488	0.1	5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1
				Used to calculate risk-based soil concentration.	

END

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm \cdot m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
6.01E-02	5.28E-06	9.30E-03	15	9,365	450.00	675.00	5.01E+03	2.80E+01	0.0E+00	8.0E-01	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R (µg/kg)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.280	ERROR	ERROR	0.257	1.01E-07	0.703	7.10E-08	3,844	1.00E+00	6.26E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm\cdot m^3/mol$)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
9.24E+05	4.16E-04	15	11,434	1.31E-02	5.43E-01	1.78E-04	4.69E-03	0.00E+00	0.00E+00	4.69E-03	1	15

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} (µg/m³)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (µg/m³)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
3.01E+01	1.80E+01	0.10	6.74E+01	4.69E-03	3.84E+02	4.16E+243	NA	NA	6.52E+01	5.61E-05	2.52E+09	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ (µg/m³)	Finite source bldg. conc., $C_{building}$ (µg/m³)	Final finite source bldg. conc., $C_{building}$ (µg/m³)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.74E-05	NA	6.72E-04	6.72E-04	NA	8.0E-01

END

RISK-BASED SOIL CONCENTRATION CALCULATIONS:

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final indoor exposure soil conc., (µg/kg)
NA	1.73E+06	1.73E+06	8.48E+05	8.48E+05

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

SL-ADV
Version 2.3; 03/01

YES [X]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [ ]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
75092		Methylene chloride

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell D28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
20	15	15	485	15	0	0	S		

MORE ↓

ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
1.5	0.43	0.15	0.006								

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm·s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)
15	40	961	961	488	0.1	2

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1

Used to calculate risk-based soil concentration.

END

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm \cdot m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
1.01E-01	1.17E-05	2.19E-03	25	6,706	313.00	510.00	1.17E+01	1.30E+04	4.7E-07	3.0E+00	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	**Initial soil concentration used, C_R (µg/kg)**	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
9.46E+08	1	0.280	ERROR	ERROR	0.257	1.01E-07	0.703	7.10E-08	3,844	1.00E+00	2.50E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
9.24E+05	4.16E-04	15	6,927	1.79E-03	7.46E-02	1.78E-04	7.88E-03	0.00E+00	0.00E+00	7.88E-03	1	15

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} (µg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (µg/m^3)	**Finite source β term (unitless)**	**Finite source ψ term ($sec)^{-1}$**	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
7.02E-02	4.05E+02	0.10	6.74E+01	7.88E-03	3.84E+02	8.64E+144	NA	NA	1.09E+02	2.13E-03	7.60E+07	YES

Finite source indoor attenuation coefficient, <α> (unitless)	**Mass limit bldg. conc., $C_{building}$ (µg/m^3)**	Finite source bldg. conc., $C_{building}$ (µg/m^3)	Final finite source bldg. conc., $C_{building}$ (µg/m^3)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	2.75E-03	NA	2.75E-03	4.7E-07	3.0E+00

END

RISK-BASED SOIL CONCENTRATION CALCULATIONS:

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final indoor exposure soil conc., (µg/kg)
1.88E+03	1.14E+06	1.88E+03	2.39E+06	1.88E+03

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

SL-ADV
Version 2.3; 03/01

YES [X]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [ ]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
75092		Methylene chloride

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell D28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
20	15	15	485	15	0	0	S		

MORE ↓

ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
1.5	0.43	0.15	0.006								

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm \cdot s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)
15	40	961	961	488	0.1	5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
1.01E-01	1.17E-05	2.19E-03	25	6,706	313.00	510.00	1.17E+01	1.30E+04	4.7E-07	3.0E+00	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R (µg/kg)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.280	ERROR	ERROR	0.257	1.01E-07	0.703	7.10E-08	3,844	1.00E+00	6.26E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
9.24E+05	4.16E-04	15	6,927	1.79E-03	7.46E-02	1.78E-04	7.88E-03	0.00E+00	0.00E+00	7.88E-03	1	15

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} (µg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (µg/m^3)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
7.02E-02	4.05E+02	0.10	6.74E+01	7.88E-03	3.84E+02	8.64E+144	NA	NA	1.09E+02	2.13E-03	7.60E+07	YES

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ (µg/m^3)	Finite source bldg. conc., $C_{building}$ (µg/m^3)	Final finite source bldg. conc., $C_{building}$ (µg/m^3)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	1.32E-03	NA	1.32E-03	4.7E-07	3.0E+00

END

RISK-BASED SOIL CONCENTRATION CALCULATIONS:

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final indoor exposure soil conc., (µg/kg)
6.59E+03	3.32E+06	6.59E+03	2.39E+06	6.59E+03

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

SL-ADV
Version 2.3; 03/01

YES [X]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [ ]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
120821		1,2,4-Trichlorobenzene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell D28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
20	15	15	485	15	0	0	S		

MORE ↓

ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
1.5	0.43	0.15	0.006								

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm·s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)
15	40	961	961	488	0.1	2

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1

Used to calculate risk-based soil concentration.

END

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm \cdot m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
3.00E-02	8.23E-06	1.42E-03	25	10,471	486.15	725.00	1.78E+03	3.00E+02	0.0E+00	2.0E-01	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R (µg/kg)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
9.46E+08	1	0.280	ERROR	ERROR	0.257	1.01E-07	0.703	7.10E-08	3,844	1.00E+00	2.50E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm·m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
9.24E+05	4.16E-04	15	13,115	9.73E-04	4.05E-02	1.78E-04	2.34E-03	0.00E+00	0.00E+00	2.34E-03	1	15

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} (µg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (µg/m^3)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
1.07E+01	3.75E+00	0.10	6.74E+01	2.34E-03	3.84E+02	#NUM!	NA	NA	3.31E+01	5.86E-06	2.15E+10	NO

Finite source indoor attenuation coefficient, <α> (unitless)	Mass limit bldg. conc., $C_{building}$ (µg/m^3)	Finite source bldg. conc., $C_{building}$ (µg/m^3)	Final finite source bldg. conc., $C_{building}$ (µg/m^3)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
1.20E-04	NA	4.52E-04	4.52E-04	NA	2.0E-01

END

RISK-BASED SOIL CONCENTRATION CALCULATIONS:

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final indoor exposure soil conc., (µg/kg)
NA	4.62E+05	4.62E+05	3.24E+06	4.62E+05

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

SL-ADV
Version 2.3; 03/01

YES [X]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [ ]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
120821		1,2,4-Trichlorobenzene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell D28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
20	15	15	485	15	0	0	S		

MORE ↓

ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
1.5	0.43	0.15	0.006								

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm·s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)
15	40	961	961	488	0.1	5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm \cdot m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
3.00E-02	8.23E-06	1.42E-03	25	10,471	486.15	725.00	1.78E+03	3.00E+02	0.0E+00	2.0E-01	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R (µg/kg)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.280	ERROR	ERROR	0.257	1.01E-07	0.703	7.10E-08	3,844	1.00E+00	6.26E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm·m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm·s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
9.24E+05	4.16E-04	15	13,115	9.73E-04	4.05E-02	1.78E-04	2.34E-03	0.00E+00	0.00E+00	2.34E-03	1	15

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} (µg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (µg/m^3)	Finite source β term (unitless)	Finite source ψ term ($sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
1.07E+01	3.75E+00	0.10	6.74E+01	2.34E-03	3.84E+02	#NUM!	NA	NA	3.31E+01	5.86E-06	2.15E+10	NO

Finite source indoor attenuation coefficient, <α> (unitless)	Mass limit bldg. conc., $C_{building}$ (µg/m^3)	Finite source bldg. conc., $C_{building}$ (µg/m^3)	Final finite source bldg. conc., $C_{building}$ (µg/m^3)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
5.13E-05	NA	1.92E-04	1.92E-04	NA	2.0E-01

END

RISK-BASED SOIL CONCENTRATION CALCULATIONS:

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final Indoor exposure soil conc., (µg/kg)
NA	1.52E+06	1.52E+06	3.24E+06	1.52E+06

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

SL-ADV
Version 2.3; 03/01

YES [X]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [ ]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
75694		Trichlorofluoromethane

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell D28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
20	15	15	485	15	0	0	S		

MORE ↓

ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
1.5	0.43	0.15	0.006								

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm \cdot s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)
15	40	961	961	488	0.1	2

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1
				Used to calculate risk-based soil concentration.	

END

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm \cdot m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
8.62E-02	9.30E-06	8.21E-02	25	6,805	296.78	445.17	1.46E+02	1.24E+03	0.0E+00	1.1E-01	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R (µg/kg)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
9.46E+08	1	0.280	ERROR	ERROR	0.257	1.01E-07	0.703	7.10E-08	3,844	1.00E+00	2.50E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm \cdot m^3/mol$)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
9.24E+05	4.16E-04	15	6,867	6.74E-02	2.80E+00	1.78E-04	6.73E-03	0.00E+00	0.00E+00	6.73E-03	1	15

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} (µg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe') (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (µg/m^3)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
8.77E-01	1.87E+03	0.10	6.74E+01	6.73E-03	3.84E+02	5.78E+169	NA	NA	9.32E+01	8.37E-03	1.84E+07	YES

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ (µg/m^3)	Finite source bldg. conc., $C_{building}$ (µg/m^3)	Final finite source bldg. conc., $C_{building}$ (µg/m^3)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	2.75E-03	NA	2.75E-03	NA	1.1E-01

END

RISK-BASED SOIL CONCENTRATION CALCULATIONS:

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final indoor exposure soil conc., (µg/kg)
NA	3.98E+04	3.98E+04	1.86E+06	3.98E+04

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box) | SL-ADV Version 2.3; 03/01

YES: X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
75694		Trichlorofluoromethane

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell D28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
20	15	15	485	15	0	0	S		

MORE ↓

ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
1.5	0.43	0.15	0.006								

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm·s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)
15	40	961	961	488	0.1	5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm \cdot m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
8.62E-02	9.30E-06	8.21E-02	25	6,805	296.78	445.17	1.46E+02	1.24E+03	0.0E+00	1.1E-01	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	**Initial soil concentration used, C_R (µg/kg)**	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.280	ERROR	ERROR	0.257	1.01E-07	0.703	7.10E-08	3,844	**1.00E+00**	6.26E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm·m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
9.24E+05	4.16E-04	15	6,867	6.74E-02	2.80E+00	1.78E-04	6.73E-03	0.00E+00	0.00E+00	6.73E-03	1	15

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} (µg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (µg/m^3)	**Finite source β term (unitless)**	**Finite source ψ term $(sec)^{-1}$**	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
8.77E-01	1.87E+03	0.10	6.74E+01	6.73E-03	3.84E+02	5.78E+169	NA	NA	9.32E+01	8.37E-03	1.84E+07	YES

Finite source indoor attenuation coefficient, <α> (unitless)	Mass limit bldg. conc., $C_{building}$ (µg/m^3)	Finite source bldg. conc., $C_{building}$ (µg/m^3)	Final finite source bldg. conc., $C_{building}$ (µg/m^3)	Unit risk factor, URF (µg/m^3)$^{-1}$	Reference conc., RfC (mg/m^3)
NA	1.32E-03	NA	1.32E-03	NA	1.1E-01

END

RISK-BASED SOIL CONCENTRATION CALCULATIONS:

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final indoor exposure soil conc., (µg/kg)
NA	1.16E+05	1.16E+05	1.86E+06	1.16E+05

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

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APPENDIX F

RESPONSES TO COMMENT LETTERS FROM THE DTSC AND RWQCB

APPENDIX F

RESPONSES TO COMMENT LETTERS FROM THE DTSC AND RWQCB

October 2002

30 October 2002

James D. Ponton, R.G.
Regional Water Quality Control Board
1515 Clay Street, Suite 1400
Oakland, California 94612

Subject: Response to RWQCB Comments on *Draft Development of Presidio-wide Cleanup Levels for Soil, Sediment, Groundwater, and Surface Water*
Presidio of San Francisco, California
Regional Water Quality Control Board Letter, dated 22 January 2002

Dear Mr. Ponton:

The Presidio Trust ("Trust") has received draft comments by the Regional Water Quality Control Board ("RWQCB"), in a letter dated 22 January 2002, regarding the document entitled *Draft Development of Presidio-wide Cleanup Levels for Soil, Sediment, Groundwater, and Surface Water*, Presidio of San Francisco, California and dated August 2001. The RWQCB comments have been reproduced in *italics* in this letter.

Comment No. 1 – Table 3-1, reference to Note (l)

Note (l) refers back to Tables 1 through 5 of RWQCB Order No. 96-070, Site Cleanup Requirements of Petroleum Impacted Soils, U.S. Army, Presidio of San Francisco, dated October 1995 (the Order). Regional Board staff have reviewed the Tables 1 through Table 5 of the Order and do not see soil cleanup levels for motor oil as is shown throughout Table 3-1.

Please fix Table 3-1 so that it accurately reflects the petroleum cleanup numbers for soil presented in the Order. It is Regional Board staff's understanding that soil cleanup numbers presented in the Order are for gasoline, diesel and fuel oil range hydrocarbons.

The Trust has revised all tables in this document to reflect the fact that fuel oil, rather than motor oil, is the regulated compound in the RWQCB's Order 96-070. The listing of Site Cleanup Requirements of Petroleum Impacted Soils in former Table 3–1 have been moved to a new Table 3-3 (note b) and the references to motor oil have been changed to fuel oil.

Comment No. 2 – Table 3-1, reference to Note (m)

Note (m) refers back to Table E-12 of the Final Fuel Product Action Level Development Report (FPALDR), Presidio of San Francisco, California, dated October 1995.

Table E-12 presents water quality goals for total petroleum hydrocarbons (TPH) qualified as gasoline, diesel, fuel oil and other specific chemicals. There is no mention of TPH as motor oil as shown on Table 3-1.

Please fix Table 3-1 so that it accurately reflects the water quality goals for hydrocarbons presented in the FPALDR. It is Regional Board staff's understanding that the water quality goals presented in the FPALDR are for gasoline, diesel and fuel oil range hydrocarbons.

As mentioned in response to comment 1, the Trust has revised all tables in this document to reflect the fact that fuel oil, rather than motor oil, is the referenced compound in the FPALDR. The values in new Table 3-3 (note d) have been corrected.

Comment No. 3 – Table 3-1, Note (n)

Note (n) refers back to Table 16 of the Petroleum Hydrocarbon Bioassay and Point-of-Compliance Concentration Determinations, Saltwater Ecological Protection Zone, Presidio of San Francisco, California, dated December 1997. Table 16 presents a summary of the point of compliance concentrations in soil and water for petroleum hydrocarbons, BTEX and MTBE for saltwater ecological protection zone.

Although Table 3-1 lists numeric cleanup values for TPH as diesel, gasoline and motor oil, the point of compliance values on Table 16 list only TPH as gasoline and fuel oil. Furthermore, Table 3-1 does not list MTBE as is shown on Table 16. Please fix Table 3-1 so that it accurately reflects the saltwater ecological protection values presented on Table 16.

Table 3-3 has been revised to accurately reflect the saltwater ecological protection values presented in Table 16 of the *Petroleum Hydrocarbon Bioassay and Point-of-Compliance Concentration Determinations* document. The changes include the values for gasoline, fuel oil, and MTBE. New note (e) reflects the source of these changes.

Verbal Comment

Cleanup levels for volatile organic compounds ("VOCs") should consider the protection of groundwater resources through the leaching pathway.

The soil cleanup levels for VOCs have been modified to reflect the more stringent value based on the protection of human health (through direct contact and volatilization to indoor air pathways) or protection of groundwater resources (leaching to groundwater), as described in Sections 4.2.7 and 4.2.9. The soil cleanup levels for protection of groundwater were obtained from the RWQCB Risk-Based Screening Levels ("RBSLs")

guidance document (December 2001). If a compound was not listed in the RBSL document, then values were calculated using the same assumptions as the compounds included in the guidance document. These values are presented in new Table 4-7 of the revised Cleanup Level Document.

Recognizing that the groundwater protection RBSLs are not site-specific, the text states that if VOCs are found at a Presidio site, VOC cleanup levels may be re-calculated to be site-specific. Factors that could affect a site-specific calculation include the type of soil, depth to groundwater, among others. Any recalculation of cleanup levels for VOCs would be conducted in conjunction with discussions with regulatory agencies.

We trust these revisions address your concerns. If you have any questions, please do not hesitate to call.

Very truly yours,

Craig Cooper

Craig Cooper
THE PRESIDIO TRUST

cc: Brian Ullensvang, P.E., NPS
Robert Boggs, Jr., P.E.
Doug Kern, Presidio RAB
Mark Youngkin, Presidio RAB
Chris Nelson, Presidio Trust
Michelle King, Ph.D., EKI

30 October 2002

THE PRESIDIO TRUST

Mr. Robert Boggs, Jr., P.E.
Department of Toxic Substances Control
700 Heinz, Building F, Suite 200
Berkeley, California 94710-2721

Subject: Response to Comments re: Draft Development of Presidio-Wide Cleanup Levels for Soil, Sediment, Groundwater, and Surface Water
Department of Toxic Substances Control Letters, dated 9 November 2001

Dear Mr. Boggs:

The Presidio Trust ("Trust") has reviewed comments by the Department of Toxic Substances Control ("DTSC"), dated 9 November 2001, regarding the document, entitled *Draft Development of Presidio-Wide Cleanup Levels for Soil, Sediment, Groundwater, and Surface Water* and dated August 2001. The comments consisted of three separate documents: (1) The 9 November 2001 transmittal letter to Sharron Reackhof of the Trust from Robert Boggs; (2) a 26 October 2001 memorandum from James M. Polisini, Ph.D., Human and Ecological Risk Division ("HERD") to Robert Boggs regarding ecological issues; and (3) a 26 October 2001 memorandum from Kimiko Klein, Ph.D., HERD, to Robert Boggs regarding human health issues.

On 12 December 2001, the Trust hosted a meeting and teleconference that included the authors of the comment letters from DTSC, and representatives of the Trust, the National Park Service ("NPS"), Harding ESE, and Erler & Kalinowski, Inc. ("EKI"). Many of the comments were discussed in the course of the meeting. However, several additional meetings and telephone conversations were held to discuss the cleanup levels, including a 4 March 2002 meeting at DTSC's Berkeley office. Through these follow-up meetings and discussions, the Trust and DTSC reached agreements regarding cleanup levels. Although many of the issues presented in this letter have been resolved verbally and through changes in the document, this letter provides responses to address specific DTSC comments, which are printed in italics.

Comments from Mr. Robert Bogg's 9 November 2001 Transmittal Letter

DTSC has concerns regarding the calculation of background metals concentrations. DTSC has been unable to duplicate EKI's calculation for the Serpentinite lithology. In addition, one of our risk assessors has pointed out that some of the "site" data used to calculate background metals concentrations may not be appropriate for use in the calculations.

EKI recalculated the background metals concentrations based on the data set provided in Table C-1 of Appendix C. EKI arrives at the same concentrations presented in Table 6-1. EKI's calculations were performed using MINITAB Version 12, with the program Probability Plot. A lognormal distribution was assumed, as agreed in previous meetings. Based on our telephone discussion on 14 January 2002, we identified the discrepancy between the Trust's and DTSC's calculations, and no changes are proposed for Table 6-1 or the tables in Appendix C.

The site data set was agreed to in a series of 6 meetings and 4 conference calls in the winter and spring of 2001 between the Trust and the DTSC Remediation Project Manager ("RPM"). The Trust understood that the RPM was receiving feedback from appropriate personnel within DTSC regarding the background metals concentrations discussions and analyses.

Comments from Dr. James M. Polisini's Memorandum Dated 26 October 2001

General Comment

Some of the risk-based Ecological Preliminary Remediation Goals ("PRGs") are extremely high. The methodology for evaluation of potential action should include some comparison of a 'background' concentration to the risk-based PRG. For example, if the soil concentration is less than a risk-based concentration, but exceeds the 'background' concentration by some factor (e.g., 2 or 5), then the evaluation area should be more carefully assessed.

Dr. Polisini has commented that some of the Ecological Preliminary Remediation Goals ("PRGs") are extremely high and that the methodology for potential action should include a comparison to background concentrations, or some factor greater than background to determine if additional assessment is required. As discussed in Section 6.2.3 of the Cleanup Level Document, the Trust has developed metals "screening" levels and metals "threshold" levels, as requested by DTSC. All metals data are initially screened against the "screening levels" to identify potential chemicals of concern ("PCOCs"). The PCOC data set is then qualitatively evaluated to determine if a release has potentially occurred, or if we may be at the edge of a release, etc. The next level of screening is for chemicals of concern ("COCs"), which is accomplished by screening against the site-specific cleanup levels that may be based on the background threshold levels, as discussed in the Cleanup Level Document (Section 7). The two-step screening process is intended to identify sites that may require potential action (e.g., additional investigation to better characterize a site), even if the concentrations are less than the site-specific cleanup levels.

Specific Comments

1. *The federal Ambient Water Quality Criterion (AWQC) value for water with salinity less than 5 parts per thousand (Table 3-1) are adjusted for a calcium carbonate concentration of 100 mg/l. Please provide the actual water hardness as calcium carbonate equivalents of the Presidio water surface waters evaluated in this report. Hardness for each particular water source should be used rather than a default value.*

   The Trust reviewed available hardness data, and found that the use of 100 mg/L results in conservative water quality criteria. Hardness concentrations at the Presidio have ranged from 93 to 772 mg/L, with an average of 325 mg/L. A footnote has been added to the table to clarify this point.

2. *HERD does not agree that potential habitat damage due to extensive remedial efforts is an appropriate criterion for selecting the ecological risk level used to develop Ecological RAOs (ERAOs) (Section 5.1, page 5-1 and Section 5.4, page 5-6). Consideration of the potential negative ecological impact of any remedial action is a risk management function, not a risk assessment function. HERD has advised DTSC Risk Managers regarding the potential negative ecological impacts associated with proposed remedial actions at Department of Defense (DoD) sites in California and has sometimes recommended no remedial action.*

   The Trust agrees with DTSC that the negative ecological impacts of implementing a remedial action should be considered as part of risk management. The Ecological PRGs were not adjusted in any way to protect against habitat damage during remediation. Rather, these statements were made in the text to indicate that ultimately habitat damage should be considered in the process (i.e., referenced statement on p. 5-1). The similar statement in Section 5.4 (p. 5-7) has been deleted because it could be interpreted to mean that the Ecological PRGs were somehow modified to reflect potential habitat damage.

3. *We understand the logical argument being made by the Presidio Trust, that protection of populations is the assessment endpoint for species and communities which are not Rare, Threatened or Endangered (RTE) or California Species of Special Concern (CSSC) (Section 5.1, page 5-2). However, no justification for the specific uncertainty factors are supplied, nor have any site-specific studies been proposed or reported and conducted, which document the steady-state population levels of any non-protected, RTE, or CSSC at the Presidio of San Francisco. Please see the subsequent comments regarding the uncertainty factors applied for terrestrial vertebrate species.*

Uncertainty factors used by the Army were carried through to the cleanup level development process. The Army applied uncertainty factors to the Low Toxicity Benchmark Value ("TBV_{low}") only, as agreed to in discussions with the regulatory agencies. An additional factor of 10 was added by the Trust to convert from a LD50 to a No Observed Adverse Effects Level ("NOAEL") (see Response to Comment 5). In assessing RTE species, TBVs were further evaluated (see Sections 5.8.2 and 5.9.2 of the text). A table that describes the uncertainty factors is presented below. This table and the accompanying text have been added to Section 5.5.2 of the document.

Insert for Section 5.5.2, 2nd paragraph, following sentence 4: "Uncertainty factors ("UFs") developed by the Army are shown in the table below. UFs were used to convert all toxicity endpoints to chronic NOAELs based on sensitive endpoints (e.g., growth, reproduction, development)."

Insert for Section 5.5.2, following 2nd paragraph:

"Uncertainty Factors Used in the Calculation of TBV_{low} values (a)

Type of UF	UF	Comments
Study Duration	5	Converts acute to chronic
	2	Converts subchronic to chronic
Endpoint	2	Converts from less to more sensitive endpoint
	5	Converts LOAEL to NOAEL
	10	Converts LD50 to NOAEL (Army)
	10	Additional factor 10 for mortality endpoints (LD50s) was applied to both the TBV_{low} and TBV_{high} by the Trust
Intertaxon	3	Converts between species in same family, different genus
	4	Converts between species in same order, different families
	5	Converts between species in different orders
	10	Converts between species in different orders with an additional factor of 2 for special-status species (raptors)

(a) Uncertainty factors were those developed by the Army, except where noted.

4. *HERD agrees that '...complete or potentially complete exposure pathways should be evaluated quantitatively.' (Section 5.3, page 5-5). We agree that dermal exposure should be evaluated (Section 5.3.1, page 5-6) for terrestrial receptors. Dermal uptake of pesticides has been shown to be significant for raptors in certain exposure scenarios and should be considered for inclusion on a site by site basis.*

   As indicated in Section 5.3.1 and 5.3.2, the dermal contact pathway was included in the development of the ecological PRGs.

5. *HERD will require additional time to evaluate the Toxicity Based Value-High (TBV_{high}) values proposed by the Presidio Trust as cleanup concentrations. Toxicity experiments which reflect a lethal dose for 50 percent of the animals exposed (LD_{50}) are unacceptable to HERD without incorporation of uncertainty factors for definition of areas of ecological concern. For Contaminants of Concern (COCs) where the Biological Technical Assistance Group (BTAG) / Navy Toxicity Reference Values (TRVs) are used, the description of the level of concern is incorrect (Section 5.5, page 5-7). BTAG/NAVY TRV_{high} values are meant to indicate an [sic] dose which would be a high level of concern to regulatory agencies and natural resource trustees.*

   Dr. Polisini was contacted by email several times to request an estimate of when the HERD evaluation will be completed. Given the extent of discussions throughout the winter and spring of 2002 regarding ecological cleanup levels, which culminated in an agreement on the values as presented in Tables 5-24 and 7-2 of the revised Cleanup Level Document, the Trust assumes that no further review of the TBVs is warranted.

   Uncertainty factors used by the Army included a factor of 10 to convert from a LD50 to a NOAEL (see Response to Comment 3). An additional factor of 10 was added by the Trust (see Section 5.5.2 of the text). The Trust added this factor to both the TBV_{low} and TBV_{high}. The text in Section 5.5 that describes the level of concern associated with the TBV_{high} will be revised as follows:

   "According to the Army, the TBV_{high} was developed to represent the upper bound of 'acceptable or safe daily intakes'. Where BTAG high toxicity values (PRC, 1997) were used, the TBV_{high} is considered a level of high concern to regulatory agencies and natural resource trustees."

6. *Please provide the reference for use of an uncertainty factor (UF) of 10 for TBVs based on mortality (Section 5.5.2, page 5-9) to convert the TBV to a Lowest Observable Adverse Effect Level (LOAEL). HERD would normally require a UF*

greater than 10 for adjustment of mortality endpoints unless chemical-specific information is available regarding the dose-response curve.

See Responses to Comments 3 and 5. An additional factor of 10 was added for mortality endpoints (Section 5.5.2), making the total UF 100 for the TBV_{low} and 10 for the TBV_{high}.

7. *Please provide the source of the information used to set the dietary intake factors (Section 5.7.1, page 5-13) for terrestrial vertebrate receptors. If the dietary intake factor is meant to indicate the most conservative assumption, based on best scientific judgement, please indicate that in the text.*

Dietary intake factors developed by the Army were used. These values were 95th percentiles of data presented by USEPA (1993), as indicated in Section 5.7 (first bullet).

8. *Please provide the citations and scientific support for assuming the Bioaccumulation Factor (BAF) of 2 for invertebrates, 1 for birds, 0.5 omnivorous mammals and 0.1 for herbivorous mammals (Section 5.7.2, page 5-14) for pesticide and herbicide COCs without published BAFs.*

Not all chemicals evaluated had BAF values readily available from the literature. For these chemicals, the approach was to assign default BAF values for these chemicals, rather than not evaluating the food chain pathways and documenting uncertainties. Chemicals without BAFs included the following pesticides/herbicides: alpha-, beta-, delta-, and gamma-BHC, dicamba, endosulfan, endosulfan sulfate, endrin, endrin aldehyde, endrin ketone, MCPP, and methoxychlor. To set default values, the median of the available BAFs for pesticides/herbicides was calculated and a default value set based on the results of that calculation as shown in the table below. This table has been added to the footnotes of Table 5-11.

Calculation of BAFs for chemicals without literature based BAFs

Potential Chemical of Concern	Bioaccumulation Factor (unitless)				
		Soil		Mammal	
	Plant	Invertebrate	Bird	Omnivore	Herbivore
Pesticides/herbicides with BAFs					
Dieldrin	0.03	4.29	0.477	0.02	0.02
Chlordane	0.02	5	0.352	0.04	0.04
4,4'-DDT	0.01	1.98	0.905	0.45	0.45
Heptachlor	0.086	1.67	2.25	0.11	0.11
Statistics					
Range	0.01-0.09	1.67-5	0.35-2.25	0.02-0.45	0.02-0.45
Median	0.025	3.135	0.691	0.075	0.075
Assumed BAFs (for chemicals with no literature BAF)	**0 (a)**	**3 (b)**	**1 (c)**	**0.5 (d)**	**0.1 (e)**

(a) Assumed to be 0 based on BAFs for other pesticides all below 0.1.
(b) Assumed to be 3 based on median BAF for other pesticides of 3.1.
(c) Assumed to be 1 based on median BAF for other pesticides of 0.7.
(d) Assumed to be 0.5 based on median BAF for other pesticides of 0.075 and conservative assumption that omnivores should have a higher BAF.
(e) Assumed to be 0.1 based on median BAF for other pesticides of 0.075.

As a result of re-evaluation of these values, the soil invertebrate BAF has been revised from 2 to 3. This change is reflected in the cleanup level derivation tables.

9. *Using the arithmetic mean of the Ecological Preliminary Remediation Goal-Low (PRG_{low}) and the PRG_{high} (Section 5.8.1, page 5-14) for non-RTE species would seem to eliminate information which would be useful to the risk manager. At several Department of Defense (DoD) sites in the San Francisco area, the difference in area considered for remedial action was small when areas based on the PRG_{low} were compared to areas based on the PRG_{high}. The areas identified as areas of concern based on both the PRG_{low} and the PRG_{high} should be presented for evaluation by the risk managers.*

The Trust recognizes the DTSC's rationale for recommending a site-by-site assessment of the PRG_{low} and PRG_{high} as part of the decision making process. To assist in the risk manager's assessment, the Trust has prepared a new Table 7-2 that includes PRG_{low}, PRG_{high}, and PRG_{mean} for both plant and soil fauna and wildlife receptors. This table shows the proposed buffer zone PRGs and proposed special status species PRGs, as well as human health proposed PRGs and background metals concentrations. The Trust feels the risk manager has the necessary data to evaluate cleanup level selection with this table.

In further discussions with the DTSC, the Trust agreed to significantly modify the ecological PRGs originally presented in the Cleanup Level Document, as described in new Section 5.10 of the revised Cleanup Level Document. The modified values are presented in Tables 5-24 and 7-2 and are described below:

- The areas of the Presidio where non-special status species PRGs would be applied were renamed "buffer zone" areas because these areas are generally adjacent to special status species areas and developed areas of the Presidio where ecological PRGs are not applicable (see Section 7.1.2 and Figure 7-2). Proposed soil PRGs for these buffer zone areas were redefined as the lowest value of (1) the special status species PRG identified in Table 5-21, (2) the arithmetic mean of the PRG_{low} and PRG_{high} for plant and soil fauna, (3) the arithmetic mean of the PRG_{low} and PRG_{high} wildlife PRGs, or (4) 5 mg/kg for pesticides or herbicides for which not enough toxicological data exists to calculate a PRG_{low} and PRG_{high} (i.e., 2,4-D, Dicamba, and MCPP).

- Special status species PRGs were redefined as the lower value of (1) the PRG_{low} for plant and soil fauna or (2) the PRG_{low} for wildlife, unless the PRG_{low} is less than the laboratory method detection limit. In such cases, the method detection limit was established as the special status species PRG. If no PRG could be calculated for pesticides or herbicides due to a lack of toxicological data (i.e., 2,4-D, Dicamba, and MCPP), the special status species PRG was established as the method detection limit. For mercury, the special status species PRG was established as two times the typical method detection limit.

10. *The table listing the uncertainty factors (UFs) applied in development of the TBV_{low} and TBV_{high} for vertebrate receptors (Table 5-4) refers to Table 5-9 as the source of the varying uncertainty factors used in footnote a. Table 5-9 provides the formulae for calculation of the PRG, but does not outline the strategy for using differing UFs. The UFs appear to follow a taxonomic pattern. Please provide this information regarding the UFs.*

Footnote (a) has been revised as follows: "Toxicity values are obtained from studies described in Table 5-3; uncertainty factors are discussed in Section 5.5."

11. *The TBV_{low} and TBV_{high} do not appear to follow a similar pattern across the differing taxonomic groups of representative species (Tables 5-5 and 5-6). The TBV_{low} for arsenic, as an example, for the western harvest mouse is 1.27 mg/kg-day and for the valley pocket gopher is 0.95 mg/kg-day. This difference can be arithmetically tracked back to the differing UFs (Table 5-4). The TBV_{high} for these two species is 22.5 mg/kg-day (Table 5-6) respectively. It is difficult to believe that a varying UF is appropriate for the TBV_{low} but not for the TBV_{high}.*

As discussed in Response to Comment 3, the Army applied uncertainty factors to the TBV_{low} only, as agreed to in discussions with the regulatory agencies. The following footnotes have been added to Tables 5-5 and 5-6:

Table 5-5: "Low toxicity values incorporate uncertainty factors, as discussed in Section 5.5."
Table 5-6: "With the exception of the factor of 10 used for toxicity values based on mortality endpoints, high toxicity values do not incorporate the use of uncertainty factors (see Section 5.5)."

12. *The tables comparing the Preliminary Remediation Goals (PRGs) for non-special status species and special status species are somewhat confusing (e.g., Table 5-21). Footnote 'c', which refers to the column labeled 'Special Status PRGS Proposed for Use as Cleanup Levels', states that Non-special status species can be more sensitive to some of the potential chemicals of concern ("PCOCs") evaluated. For PCOCs where special status PRGs are not proposed as cleanup levels, soil PRGs for non-special status species will be applied as cleanup levels for protection of special status species as well." First, HERD does not agree that special status species can be categorized as less sensitive than non-special status species. Toxicological tests are not performed and special status species because of their listing, and therefore an apparent difference in PRGs may be an illusion based on the life history parameters. Second, use of a non-special species PRG as protective of special status species would be appropriate only if it is demonstrated that the range of seed dispersal for plants and the home range for vertebrates could not overlap from the current distribution of special status species onto the area where non-special species PRGs are proposed.*

For some chemicals, non-special status PRGs were lower than those for special status species. For example, for many chemicals, aquatic life toxicity values for sediment (Tables 5-7 and 5-8) were below the sediment PRGs for western sandpiper presented

in Table 5-20. In these cases, the final PRGs were the aquatic life values and not the higher western sandpiper values.

Footnotes [(c) on Table 5-21 and (b) on Tables 5-22 and 5-23] have been revised to clarify as follows: "PRGs for special status species that are proposed as soil/sediment PRGs for special status species. Receptors that are not special status species may have lower PRGs because of higher exposure or different sensitivity to potential chemicals of concern ("PCOCs"). For PCOCs where special status PRGs are not the lowest PRGs, soil/sediment PRGs for non-special status species will be applied as cleanup levels and considered protective of special status species as well."

The text in Section 5.8.2 has also been modified (5th paragraph 4th sentence) as follows: "Non-special status PRGs may be lower for some of the PCOCs evaluated because (1) the non-special status species evaluated may have higher exposure to chemicals than the special status species (e.g., American robin vs. peregrine falcon), or (2) the toxicity value for a non-special status species for a particular chemical is lower (e.g., mammal vs. bird toxicity values)."

The comment also discusses the issue of seed dispersal and the home range of special status species. The concern is the application of non-special status PRGs to sites and whether special status plants or wildlife, although not currently present at the site, be exposed to chemicals there in the future due to seed dispersal or expansion of their home range. It should be noted that most areas surrounding specific sites are not contaminated areas (see new Figure 2-2). Therefore, there is already a "buffer zone" of clean material around most, if not all sites. In addition, Figure 7-2 has been revised to depict areas where special status cleanup levels will be applied. As shown on Figure 7-2, special status species PRGs are applicable to the "undeveloped" areas of the Presidio and areas *planned* for habitat restoration (e.g., near the Baker Beach Apartments). Landscaped areas like the golf course, the cemetery, and the restored airfield at Crissy Field have been established as "buffer zone" ecological areas (Figure 7-2). These delineations on the map coupled with the revised, more stringent cleanup levels (the "buffer zone" PRGs are based on the old special status values) should address the issue of potential seed dispersion and expanded home ranges.

13. *Please indicate whether the figure presenting the surface distribution of the primary soil types of serpentinite, Colma Formation, and beach/dune (Section 6.1, page 6-1), and the five secondary geological units (Figure 6-1) has been 'ground truthed'. By this we mean, have the proposed boundaries between different soil types been checked to determine if the field observations by a registered geologist agree with the figure.*

The boundaries of the map have not been specifically ground-truthed. However, when environmental samples are collected at a Presidio site, the soil lithology is logged under the oversight of a registered geologist. The soil type at a given site may vary spatially, as a function of depth, or due the presence of fill. Figure 6-1 is intended to be used as a starting point to identify the site lithology. The actual field observations are used to determine site lithology. The text has been modified to this effect.

14. *Please identify the Department of Toxic Substance Control (DTSC) document in which it was agreed that selected site data could be included in the 'background' data set (Section 6.2.2, page 6-5) and agreement to the 'background' threshold levels (Section 6.2.4, page 6-7). This reviewer is unable to locate any member of HERD who reviewed the methodology or data used to set the 'background' concentrations.*

The Trust held a series of meetings (6 meetings, 4 conference calls) with the DTSC RPM (Robert Boggs), the RWQCB RPM, a representative of the NPS, and members of the Restoration Advisory Board ("RAB") to identify which site data were appropriate and to develop the methodology for calculating background screening and threshold levels. It was the Trust's understanding that the DTSC RPM was conferring with technical staff at HERD throughout this process. The agreement on the data set and the screening and threshold levels was made verbally during these meetings, after the DTSC had the opportunity to review all data, relevant scatter plots, and tables with results of calculations.

15. *A footnote annotation of '2' appears in the text with no footnote (Section 6.2.3, page 6-6) on the third line of the page. Please include the appropriate footnote referring the 95 percent upper confidence level of the 80th percentile of the data set used for screening levels.*

The footnotes have been renumbered to accurately reflect the item to which they refer.

16. *Please define the term 'common detection limit' as one method of establishing the 'background' threshold levels by soil type (Section 6.2.5, page 6-8).*

The "common detection limit" is the reporting limit typically achieved by analytical laboratories that have analyzed soil samples at the Presidio. During the series of meetings discussed in the response to Comment 14, the Trust, DTSC, and other stakeholders agreed on the "common detection limit" for metals that were generally

not detected above the laboratory reporting limit. A footnote has been added to the text clarifying the meaning of the common detection limit.

17. *The declaration that hexavalent chromium is 'naturally occurring' in groundwater and surface water at the Presidio of San Francisco (Section 6.4, pages 6-9 through 6-12) due to serpentinite soils is unconvincing. This mechanism has not been proposed to explain hexavalent chromium at DoD sites in the San Francisco Bay area. HERD defers to the DTSC Geological Services Unit regarding this explanation for hexavalent chromium in groundwater and surface waters.*

The discussion on the natural occurrence of hexavalent chromium in groundwater is intended to be a summary of available Presidio data that support this hypothesis. These data were presented to Mark Vest and Michael Kenning of DTSC's Geological Services Unit in a May 2000 meeting. Based on the data presented to the DTSC in May 2000 (which are summarized in Section 6.4 of the Cleanup Level Document), the DTSC sent the Trust a letter (dated 13 July 2000) concurring that the hexavalent chromium in groundwater that contacts serpentinite appears to be naturally occurring.

18. *The detection limit of 3.0 mg/kg for antimony (Table 6-1), which is adopted as the screening level and threshold level concentration, appears elevated. In comparison the most recent 'background' soil study, performed for the BRAC Property at Hamilton Army Airfield, lists a minimum detected value of 0.06 mg/kg (Table 6-6) and the California Soils study (Bradford, et al., 1996) achieved detected concentrations of antimony at 0.15 mg/kg. Please explain the reason for the apparently elevated antimony detection limits at the Presidio of San Francisco.*

The actual detection limits for antimony from the Hamilton Field data range from 0.06 to 19.6 mg/kg. EKI contacted Dr. Carla Kagel of KPrime Inc., a consulting and analytical laboratory in Santa Rosa, who indicated that a low detection limit of 0.06 mg/kg for antimony probably reflected a calculation error or could not be supported if the backup data were requested.

The Trust understands that a detection limit of less than 1 mg/kg is not routinely achievable. Under specialized conditions in a research setting, i.e., the conditions under which Bradford generated his California Soils data using ICP-MS, a detection limit of 0.15 mg/kg is likely the best detection limit achievable. For standard, commercial laboratory analyses, these low detection limits are not commonly achieved. This is reflected in the fact that a range of detection limits was produced for the existing data. A detection limit of 3 mg/kg was selected as typically achievable for antimony with the concurrence of representatives from the DTSC, RWQCB, NPS, and RAB.

19. *A bicoordinate plot of barium and manganese concentrations is offered as an example of the data evaluation methods employed to set the 'background' soil concentrations for the differing major and secondary soil types (Figure 6-2). The outlier value for barium and manganese is fairly obvious. However, all of the 'background' samples appear to lie at the lower concentrations of the proposed relationship, while the site-related samples cover the entire range and no 'background' barium or manganese concentrations appear to exceed 20 mg/kg for barium and 300 mg/kg for manganese. Please explain the apparent discrepancy between site-related and 'background' data for whichever soil type of which this is an example.*

    Based on the discussions during the 12 December 2001 teleconference, the Trust understands that DTSC is concerned that this Figure 6-2 does not support the argument the text is trying to make about outliers from the trend. Another figure that more clearly demonstrates outliers has been substituted in its place.

20. *Future land use which is not evaluated based on the residential use scenario (Section 7.1.1, page 7-1) must have a deed restriction in place restricting that area to recreational, institutional or industrial uses.*

    The Trust agrees that residential use is not appropriate for sites that are evaluated and/or remediated based on recreational or commercial/industrial cleanup levels. The Trust anticipates implementing institutional controls at locations where residual chemical concentrations exceed residential cleanup levels or in other cases where residual chemicals are left in place. However, Trust policy does not allow the use of deed restrictions or land use covenants; rather, the Trust adopts and enforces institutional controls through the implementation of land use restrictions. These land use restrictions are incorporated into the Trust's planning documents (e.g., the Presidio Trust Management Plan) and the Trust's leasing documents. For example, the Trust's Rules for Non-Residential Use and Occupancy, which must be followed by tenants at the non-residential buildings, states "Residency in or overnight use and occupancy of any portion of Buildings is strictly prohibited, unless specifically authorized in advance by the Trust."

    In addition, the Trust will prepare a Presidio-wide Institutional Control Management Plan ("ICMP"). A separate Institutional Control Plan ("ICP") will be prepared for each individual site that requires institutional controls. The ICP will include a figure depicting the site location and area and will summarize the specific COCs encountered at a site, the actions taken to remediate the site, and the levels of COCs remaining at the site that required the implementation of ICs. In addition, these ICPs

will discuss unallowed land uses at the site and any special requirements if residual chemicals are left in place in an inaccessible area (e.g., health and safety requirements if the area is disturbed in the future). The individual ICPs will become an attachment to the Trust's ICMP. As such, the ICMP will effectively be a "working document", supplemented with additional information as it becomes available.

21. *Concurrence should be obtained from State and Federal natural resource trustees regarding areas where '... a new site is identified in an area that is not currently designated for ecological cleanup levels on Figure 2...' (Section 7.1.2, page 7-3). Crissy field was once a paved site, prior to conversion to a wetland.*

    The identification of sites that may be classified as buffer zone or special status ecological has been simplified by creating a map (Figure 7-2) that delineates such areas. As discussed above in the response to comment #12, special status species PRGs are applicable to the "undeveloped" areas of the Presidio and areas planned for habitat restoration (e.g., near the Baker Beach Apartments). Landscaped areas like the golf course, the cemetery, and the restored airfield at Crissy Field have been established as "buffer zone" ecological areas (Figure 7-2). This map was developed using the NPS and Trust's Vegetation Management Plan, which identifies zones that correlate to ecological land uses. The Native Plant Communities Zone, Historic Forest Zone, and Special Management Zone were all established as ecological special status species areas. The remaining zone (Landscape Vegetation Zone) was established as either a buffer zone area or as non-ecological, depending on the specific area. In the event that Trust or NPS natural resource staff indicate that a site should be classified differently, State and Federal natural resource trustees will be consulted, as appropriate.

22. *Species listed as California Species of Special Concern by the California Department of Fish and Game should be included in the definition of 'special status species' in footnote 5 (Section 7.1.2, page 7-3).*

    The footnote in Section 7.1.2 has been modified to include California Species of Special Concern as defined by the California Department of Fish and Game; these species are also identified in Table 5-2.

23. *Please insert the word <u>inorganic</u> in the fourth line of the last paragraph to read '... remediated to concentration below <u>inorganic</u> background levels.' (Section 7.3, page 7-4).*

    The text has been modified to include the word "inorganic" in the fourth line of the referenced paragraph.

24. Evaluation of Firing Range sites (Section 7.3, page 7-5) may require evaluation of the percentage of bulk lead pellets in addition to consideration of the lead soil concentration. Please advise HERD of the evaluation of Firing Range sites and the 'discovery' of additional Firing Range sites.

The Trust is planning to work with DTSC staff when it evaluates data from the Firing Range sites. The Trust would not proceed with the evaluation of Firing Ranges without DTSC input.

25. HERD is not concerned about levels set in the Toxic Substance Control Act (TSCA) when assessing risk or hazard (Section 7.3.1, page 7-6). Residential areas with soil concentrations of lead at 370 mg/kg should be deed restricted to exclude the home grown produce/fruit pathway and generation of fugitive dusts. Based on the HERD lead spreadsheet, HERD would recommend a maximum soil lead concentration of approximately 170 mg/kg to 180 mg/kg based on site specific criteria (e.g., tap water lead concentration) for unrestricted use.

The residential lead preliminary remediation goal ("PRG") calculated in Section 4.2.10 accounts for potential exposure to lead in soil, water, air, food, and fugitive dust. The text (Section 4.2.10) has been clarified to say that the calculation includes inhalation of lead in fugitive dust.

With regard to the home grown produce pathway, landscaping at the Presidio is maintained by the Trust; in-ground planting of vegetation by residents and tenants at the Presidio is prohibited in its lease agreements. The Trust and NPS control plantings at the Presidio because of their efforts to restore native plants and maintain historic plantings, as described in the Vegetation Management Plan, (NPS and Trust, May 2001). A copy of the Presidio Trust's planting guidelines for residents is attached. Presidio residents are required to follow these guidelines in accordance with their lease agreements. Thus, land use restrictions preventing in-ground planting of home grown produce are already in place. A footnote has been added to Section 4.2.10 that states: "Use restrictions prohibiting the in-ground planting of home grown produce are already in place at the Presidio."

Accounting for the above comments, the PRG of 370 mg/kg for lead in soil is appropriate for residential sites at the Presidio. Because 370 mg/kg is so close to the TSCA value of 400 mg/kg, the DTSC RPM agreed that from a risk management perspective, it was appropriate to use 400 mg/kg as a not-to-exceed value and 370 mg/kg as the maximum average value for lead at residential sites.

26. The presentation of the multiple HERD spreadsheets regarding the analysis for lead (Appendix A) is confusing. The heading of the second spreadsheet is 'Blood Lead Concentration for Exposure of Children to Background Lead in Air, Water and Food Under a Recreational Scenario'. However, the percent of home-grown produce is set at zero percent. This second spreadsheet cannot present the exposure from home-grown produce. The lead in soil and dust in this second sheet is set at 0.0 µg/g. Lead in soil and dust is included in the third spreadsheet (Appendix A) with a heading of 'Blood Lead Concentration for Exposure of Children to Background Lead Soil Under a Recreational Scenario', but no other pathways are addressed. Please provide a spreadsheet table which sums all the exposure pathways for the recreational scenario.

Multiple spreadsheets are used for lead for the recreational exposure scenario because the calculation cannot be completed on one spreadsheet. Former Table 4-6 (now renumbered as Table 4–8) summarizes all of the exposure pathways for the recreational scenario. This table has been added to Appendix A as new Table A–1 to facilitate review of the appendix. As summarized in Table A-1, the first spreadsheet addresses background exposures of the general population to lead in air, water, and food (which occurs 7 days a week, and is the same whether at the Presidio or in other parts of San Francisco).[1] The second spreadsheet quantifies the blood lead concentration due to background exposure to lead in soil when NOT at the Presidio (i.e., four days per week). As described in Section 4.2.10, a background lead value of 66 mg/kg was derived for serpentinite at the Presidio. This concentration may be found as background in other parts of San Francisco and, therefore, is used for the second spreadsheet. Based on the background exposures calculated in spreadsheets 1 and 2, the total blood lead concentration for background exposures is 5.4 µg/dl. Thus, there is a remaining 4.6 µg/dl blood lead concentration that can be attributed to a potential exposure of recreational users to lead in soil (including ingestion and inhalation of fugitive dust) three days a week at the Presidio. The lead concentration in soil corresponding to a blood lead concentration of 4.6 µg/dl is calculated to be 510 mg/kg in the third spreadsheet.

As described in the response to Comment 25, lead in home grown produce is not applicable to potential exposures to lead at the Presidio. For the recreational use scenario, off-site exposure to lead in food is assumed to be limited to "purchased" food because the majority of the regular recreational users of the Presidio are San Francisco residents. Urban populations are not likely to obtain a significant portion of their diet from homegrown produce.

[1] The lead concentration in tap water was not adjusted to the Presidio value for the recreational user because the recreational user may not drink Presidio water while participating in recreational activities at the Presidio. The lead concentration in tap water for the recreational user was therefore set at the default value of 15 µg/L.

27. *While an example of the outlier testing for 'background' concentrations is provided (Figure 6-2), some of the data sets for 'background' (Appendix D [sic]) contain samples which appear to be outliers for some elements. For example, for the Chert/Shale Lithology (Table C-3) the chromium concentration in sample 950CT002 is 52 mg/kg and BBKGDSB03 is 48.4 mg/kg. The next highest chromium concentration is 11.9 mg/kg at 950SH002 for Chert/Shale. Please identify any samples which were judged to be outliers and eliminated from determination of 'background' concentration in these tables (Tables C-1 through C-4).*

    All outliers were eliminated prior to the compilation of Tables C-1 through C-4. These tables present the data set that was agreed upon by representatives of DTSC, RWQCB, NPS, RAB, and the Trust based on the review of such scatter plots for the fit of the data to multiple chemical distributions, not just that for the range of concentrations of one chemical. Outliers were generally identified when the concentration fell outside the main mass of data or were not on the chemical distribution trend line. The referenced chromium data fall within the data trend lines for chromium and the other metals.

Comments from Dr. Kimiko Klein's Memorandum Dated 26 October 2001

General Comments

The HERD has two editorial comments. First, the numbering of the footnotes in this document is confusing. For example, on page 4-7 of Section 4, there is a footnote designated as footnote "2", but there is apparently no footnote "1". On page 6-7 of Section 6, there is a notation in the text for footnote "2", but there is no explanatory footnote for that notation, and there is no footnote "1" or "4". The numbering of the footnotes should be clarified or corrected. Second, reference is made throughout the text to various study areas, such as "Fill Site 1", "Building 1750", the "Nike facility", etc. However, there is no figure depicting all of these study areas in the document. Such a figure should be included and used as a citation when these study areas are discussed in the text.

The Trust revised the numbering of the footnotes as requested. A new figure, Figure 2-2, has been added to Section 2 that identifies the known sites in the operable units being addressed by the Presidio Trust.

Specific Comments

1. *Page 3-1 Section 3.1 Potential Chemical-Specific ARARS for Water; and Table 3-1 Numeric Values of Potential Chemical-Specific ARARs for Presidio Sites: a) Table 3-1 includes Applicable or Relevant and Appropriate Requirements (ARARs) for water from several different sources. The text summarizes these ARARs. However, the table contains a list of Maximum Contaminant Level Goals (MCLGs) which are not defined or discussed in the text. Since MCLGs are risk-based values, they should be discussed in the text. b) The drinking water standards for copper and lead are listed as MCLs. However, a footnote should be added to each, identifying the values for these metals as "Action Levels". c) A paragraph should be added to Section 3.1 briefly discussing the Public Health Goal for chromium published by the Office of Environmental Health Hazard Assessment (OEHHA) of the California Environmental Protection Agency (Cal/EPA) with regard to the oral carcinogenicity of hexavalent chromium. A footnote should also be included on Table 3-1.*

   (a) A brief discussion of Maximum Contaminant Level Goals ("MCLGs") has been added to the text in Section 3.1. (b) The footnotes to Table 3-1 have been re-organized to better clarify that the copper and lead values are Action Levels. (c) Additional information about the Public Health Goal for chromium has been included in Section 3.1.

2. *Page 4-2 Section 4.2.2 Potential Human Health Exposure Pathways: According to the text, less than two percent of the potential total exposure to potential chemicals of concern, metals and polycyclic aromatic hydrocarbons (PAHs), is via inhalation. Therefore, the inhalation exposure pathway is not included in the estimation of cleanup goals. a) Summarize the supporting documentation for this statement and provide a citation. b) For those areas of the site where large construction projects will occur, the inhalation of the increased dust generated may pose a risk. Therefore, in those areas, inhalation exposure of construction workers may have to be evaluated. c) Inhalation of vapors is an exceedingly important route of exposure for volatile chemicals and must be evaluated for the volatile chemicals listed in the tables of preliminary remediation goals in this section as well as the tables in Section 7.*

   (a) EKI calculated the residential PRG for arsenic including and excluding the inhalation pathway. Arsenic is a conservative test case because it is significantly more toxic via the inhalation route compared with the oral route (i.e., slope factor of 12 $(mg/kg\text{-}day)^{-1}$ for inhalation versus 1.5 $(mg/kg\text{-}day)^{-1}$ for ingestion). Assuming a fugitive dust concentration of 0.05 mg/m^3 and breathing rates of 10 and 20 m^3/day for children and adults, respectively, the inhalation pathway accounts for 3 percent of the total exposure. For other compounds where the ingestion and inhalation slope factors are the same, the inhalation

pathway comprises less than 1 percent of the exposure. The text in Section 4.2.2 has been changed to say that inhalation is estimated to be less than 3 percent of the total exposure to PCOCs and a footnote has been added summarizing the documentation presented above.

(b) EKI agrees that under the construction scenario, inhalation of fugitive dust can play a more significant role in exposure than for the residential and recreational scenarios. However, the residential and recreational cleanup levels being used throughout the Presidio should also be protective of construction workers (i.e., residential and recreational cleanup levels are applicable at all areas where potential future large construction projects would occur; commercial/industrial cleanup levels are only applicable at the water treatment plant and at Building 1750). Using arsenic as the test case, with a fugitive dust concentration of 1 mg/m^3, a soil ingestion rate of 480 mg/day, and a 1-year exposure duration, the inhalation pathway accounts for 20 percent of the total exposure to arsenic. The resulting arsenic PRG for this hypothetical construction scenario is 7.8 mg/kg. The residential and recreational PRGs calculated in the Cleanup Level Document are 0.36 and 0.88 mg/kg, respectively. These are both more stringent than the value calculated above for construction workers. Similarly, for non-carcinogens, such as mercury, the inhalation exposure under the construction scenario described above accounts for approximately 12 percent of the total exposure. The hypothetical construction PRG for mercury is 60 mg/kg, which is less stringent than the respective residential and recreational PRGs of 20 and 52 mg/kg. Based on the evaluation presented herein, no modification to the text or cleanup levels is proposed.

(c) The Trust recognizes the inhalation of vapors is an important exposure route for volatile chemicals. However, as discussed at the 12 December 2001 meeting, VOCs generally have not been detected in soil samples at the Presidio, with the exception of Crissy Field. Therefore, a protective set of screening levels has been added to the Cleanup Level Document to replace the residential and commercial/industrial cleanup levels for VOCs. The screening levels were based on the RWQCB Risk-Based Screening Levels ("RBSLs"), using lookup tables for available chemicals, and calculating values using the same assumptions for chemicals not listed in the RBSL guidance document. Available values came from the RBSL Table E-1a, Vadose-Zone Soil Screening Levels for Protection of Indoor Air Quality, assuming course soils Copies of the Johnson and Ettinger model output (version 2.3, 3/01) are included as a new Appendix E.

In addition, in response to your comment #8 and a request by the RWQCB, the PRGs for VOCs were modified to also consider protection of groundwater

through leaching. The Trust assessed the leaching pathway for VOCs through the use of the RBSLs. Tables 4-3, 4-4, and 4-5 have been revised to direct the reader to new Table 4-6, where potential impacts of indoor air exposures are calculated to generate human health PRGs for VOCs. These values are transferred to new Table 4-7, where the combined direct contact/indoor air PRGs are compared to the RBSLs for groundwater protection. The most stringent values are retained as the human health PRG in Table 4-7 and are carried forward to Table 7-2.

Recognizing that the PRGs calculated for indoor air and groundwater protection are not site-specific, the text states that if VOCs are found at a Presidio site, VOC cleanup levels may be re-calculated to be site-specific. Factors that could affect a site-specific calculation include the type of soil, depth to groundwater, presence of buildings, and number and concentrations of VOCs present in soil, among others. Any recalculation of PRGs for VOCs would be conducted in conjunction with discussions with regulatory agencies.

3. *Page 4-2, Section 4.2.2 Potential Human Health Exposure Pathways: The ingestion of groundwater, surface water, and organisms inhabiting surface water bodies will be accounted for by adoption of chemical-specific ARARs as cleanup levels. The ARARs for ingestion by humans of groundwater or surface water will be MCLs. MCLs are not risk-based levels. As stated in Specific Comment one above, MCLGs are based on risk. MCLGs for specific carcinogens are usually set to zero and for non-carcinogens on a Hazard Index of one. Therefore, a discussion should be added to this section explaining the risk consequences of the application of MCLs and explaining the approach that will be used to clean up to an overall target risk level and/or Hazard Index if the ground or surface water contains multiple chemicals of concern.*

The Trust has added text to state the following: "The ARARs being used as cleanup levels include MCLs and aquatic criteria for protection of human health, where applicable. Although MCLs are not explicitly risk-based numbers like MCLGs, they are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. The aquatic criteria for protection of human health are risk-based values that include ingestion of water and consumption of aquatic organisms."

It should be noted that all of the cleanup levels are based on a target risk level applied to each chemical; the cleanup levels do not directly consider cumulative effects. The target risk levels are discussed in Sections 4.2.3 through 4.2.5 of the Cleanup Level Document. This approach is considered to be protective because there are typically only a few chemicals driving the cleanup at a given site.

4. *Page 4-5, Section 4.2.6 Human Health Toxicity Values: Copper is listed as a chemical for which no published toxicity values were found. However, the US EPA Region 9 office lists a copper oral Reference Dose (RfD) from the Health Effects Assessment Summary Tables (HEAST). This RfD should be used to calculate a human-health-based cleanup level for copper in soil and water. The uncertainty of using this RfD may be discussed in the text.*

   The reference dose for copper (0.037 mg/kg-day) included in the U.S. EPA Region IX PRG tables is reportedly based on a value from HEAST. However, the value in the PRG tables appears to be calculated from the drinking water standard of 1.3 mg/L, which is presented in HEAST. HEAST states that the "toxicity data were inadequate for calculation of an R*f*D for copper." Thus, it seems inappropriate to use the value in HEAST to calculate a PRG for copper. The following footnote has been added to Tables 4-3 through 4-5 to clarify the toxicity information available for copper: "According to HEAST, the toxicity data for copper are inadequate for calculation of an RfD."

   At the 12 December 2002 meeting, the DTSC asked the Trust to review the basis of the copper drinking water standard. If the standard was based on impacts to organolipids, then the DTSC recommended calculating a cleanup level using the approach in the Region IX PRG tables. According to the 18 August 1988 Federal Register that discusses the basis for the Lead and Copper Rule, "acute exposure to high copper levels in test animals and humans can cause gastrointestinal disturbances, liver damage, renal damage, hemolytic anemia, and glucose-6-phosphate dehydrogenase (G6PD) inhibition. Chronic toxicity data are limited." The Federal Register further states that people with Wilson's disease, an inborn error in copper metabolism, and individuals with existing G6PD deficiencies are at risk of experiencing toxic effects from copper exposure. Considering the impacts described in the Federal Register, a cleanup level for copper was not derived.

5. *Page 4-6, Section 4.2.9 Human Health PRGs for Potential Chemicals of Concern (PCOCs) Other than Lead in Soil: This section does not mention how these PRGs will be used at the site. The HERD stresses that human health remediation goals for soil applies to soils to a depth of ten feet below ground surface. Soils contaminated below ten feet may still require remediation based on other objectives, such as, protection of groundwater resources.*

   The Trust agrees that cleanup levels should be applied to a depth of 10 feet below ground surface. The text in Section 7.1.1 has been revised.

6. *Page 4-7, Section 4.2.10 Human Health PRGs for Lead in Soil; Appendix A: a) A sentence should be added to this section stating that the lead PRG chosen represents the 99th percentile value and explaining the protective nature of that value. b) The concentration values used in the DTSC Lead Spread Version 7 model are given in this section, and Appendix A contains the lead results from sampling water from the tap in residences on site. The 95 percent upper confidence level of the mean of these results is used in the lead spreadsheets. However, it is not stated in the text or in the appendix whether the water samples represent the first draw of the day or whether water was allowed to run for a certain length of time before samples were collected. A summary of the method used to collect samples should be included in the appendix. For any future sampling of tap water, first draw of the day should be collected and analyzed separately in order to obtain a worst case estimate of the potential impact of plumbing piping and fixtures on lead levels.*

   (a) Text has been added to the first paragraph of Section 4.2.10 stating that the lead PRGs are based on the 99th percentile. Section 4.2.5 presents a discussion of the target risk level for lead (i.e., 10 mg/dl at the 99th percentile). A sentence has been added to Section 4.2.5 explaining that the protective nature of the 99th percentile. (b) The water samples collected by the Trust for lead analysis were from the first draw of the day. A footnote to this effect has been added to Table A-2.

7. *Table 4-1 Exposed Populations and Exposure Pathways Used to Develop PRGs: Ingestion of homegrown produce is not considered in calculating PRGs for this site, because landscaping at the Presidio is maintained by the Presidio Trust (the Trust), and produce grown at the Presidio would be in "community gardens at locations specifically designated by the Trust". Provide information on the criteria that will be used to choose these locations and what precautions will be taken to ensure that produce will not be grown in soil with elevated levels of on-site contaminants.*

   As discussed in the response to Jim Polisini's comment 25, in-ground planting of vegetation by residents and tenants at the Presidio is prohibited through its lease agreements. The Trust and NPS control plantings at the Presidio because of their efforts to restore native plants and maintain historic plantings, as described in the Vegetation Management Plan, (NPS and Trust, May 2001). A copy of the Presidio Trust's planting guidelines for residents is attached. Presidio residents are required to follow these guidelines in accordance with their lease agreements.

   One community garden is located at the Presidio, near Kobbe Terrace. This community garden is not located at a known chemical release site. Currently, the garden has space available in it. If there were a future need for an additional community garden, the Trust would not locate the garden at a known chemical release site. Moreover, due to the Trust and NPS' efforts to restore native plants at the

Presidio, the community garden would likely be planted in raised beds to limit the propagation of non-native plant species.

8. *Figure 4-1 Potential Human Health Exposure Pathways: As depicted in this figure, chemicals in soil may leach to groundwater. However, nowhere in this document is there any summary discussion on any studies or modeling performed to evaluate the leachability of the chemicals found in soil at the Presidio. A discussion should be added to this section on the concentrations of chemicals that can be left in soil and not impact groundwater at levels above their MCLs.*

   A discussion of potential leaching of chemicals in soil to groundwater has been added to Section 4.2.2. In addition, see response to your comment #2. The human health PRGs for VOCs have been modified to consider protection of groundwater resources through leaching (new Table 4-7).

9. *Page 6-1 Section 6.1 Presidio Geology; Figure 6-1 Surface Deposits at the Presidio: The locations and boundaries of the various lithologies or soil types as described in the text and depicted in Figure 6-1 should be verified either before or during remedial activities. This is particularly important, since a different suite of Threshold Levels for inorganic chemicals will be applied to different areas of the site, depending on the lithology.*

   As discussed above, in the response to Jim Polisini's comment 13, the boundaries of the map have not been specifically ground-truthed. However, when environmental samples are collected at a Presidio site, the soil lithology is logged under the oversight of a registered geologist. The soil type at a given site may vary spatially, as a function of depth, or due the presence of fill. Figure 6-1 is intended to be used as a starting point to identify the site lithology. The actual field observations are used to determine site lithology. The text in Section 6.1 has been modified to clarify this point.

10. *Page 6-2, Section 6.1.1 Serpentinite: As stated in this section, chrysotile is a component of serpentinite. However, it should also be stated that chrysotile is a form of asbestos. If areas with exposed serpentinite are subjected to construction or movement of heavy machinery, asbestos fibers and fine particulates containing elevated metal concentrations may be released into the air. Therefore, it should be stated here and in the summary discussion of this document that any health and safety plan will include protective measures preventing potential exposure to these fibers and particulate matter.*

A parenthetical phrase has been added to Section 6.1.1, after "chrysotile", to indicate that chrysotile is a form of asbestos. The Trust agrees that the health and safety plans for workers performing excavations in areas with serpentinite should describe measures to mitigate potential exposures to asbestos and any associated monitoring that would be performed, unless it is shown that asbestos is not present in the serpentinite at the Presidio. However, the Cleanup Level Document will not be modified to discuss health and safety issues because such matters are outside the purview of this document.

11. *Page 6-4 Section 6.1.5 Greenstone; Figure 6-1 Surface Deposits at the Presidio: The text states that greenstone may be present in fill at Area 9 and the Transfer Station sites. Greenstone has naturally elevated levels of some potentially hazardous metals. However, neither greenstone nor these specific locations are identified in Figure 6-1. The figure should be revised to show the probable locations of greenstone-containing fill.*

A sentence has been added to the text stating that greenstone is not specifically mapped on Figure 6-1; reference is also made to new Figure 2-2 which identifies the locations of the known CERCLA sites at the Presidio. Figure 6-1 has not been modified because the primary greenstone observed at the Presidio is part of the surficial fill, rather than the native soil.

12. *Page 6-7, Section 6.2.3 Determining Metals Screening (PCOC) Levels; Table 6-1 Summary of Background Data, Screening Levels, and Threshold Levels- Serpentinite Soil: The possibility of naturally occurring hexavalent chromium being present in Serpentinite should be addressed either in the text or as a footnote to Table 6-1 with a statement that further discussion appears in Section 6.4.*

A footnote has been added to Table 6-1 that indicates the concentrations of hexavalent chromium detected in serpentinite bedrock samples. These concentrations have also been added to Section 6.4.2.2.

13. *Page 6-10, Section 6.4.2.2 Serpentinite Geochemistry; Section 6.4.2.3 Leaching Test Results: In Section 6.4.2.2, the text states that hexavalent chromium was detected in bedrock samples, but there is no summary of the concentrations found or the fraction of total chromium present in the hexavalent form. This information should be included in the text. In Section 6.4.2.3, the text states that hexavalent chromium was measured in leachate from the serpentinite samples, but, again, there is no summary of the concentrations found in the leachate or the amount of chromium in the serpentinite. These sections should be revised to include this information.*

The hexavalent chromium studies were performed by Montgomery Watson, on behalf of the Army. The results of their studies are included as new Appendix D to the Cleanup Level Document. Sections 6.4.2.2 and 6.4.2.3 have been revised to refer to the results included in this new appendix.

14. *Page 6-10, Section 6.4.2 Evidence that Serpentinite is a Natural Source of chromium in Water: This section relies on a study performed by Montgomery, Watson entitled "Hexavalent Chromium in Serpentinite Bedrock and Groundwater in Upland Areas" (July 1999) to support the hypothesis that the presence of hexavalent chromium in water at this site is a natural consequence of contact with serpentinite. It is recognized in this section that further assessment will be required to determine if other metals found in water are also naturally occurring and if hexavalent chromium found in other areas have been transported by groundwater flow from serpentinite areas. A DTSC geologist should consulted on any future assessment to be performed, particularly with regard to sampling locations and data collection approaches.*

The occurrence of hexavalent chromium in non-upland areas will be discussed on a site-by-site basis in the Revised Final Feasibility Study for Main Installation sites. Additional evaluation of the background occurrence of other metals would likely be performed through the groundwater monitoring program established as part of site remedial actions. Such a groundwater monitoring program would be developed in consultation with a DTSC geologist.

15. *Page 7-4 Section 7.3 Presidio Cleanup Levels Applicable to Specific Sites: This section describes the chemical-specific applicable cleanup levels, and the tables in Section 7 lists those levels. However, the section does not summarize the basis for compilation of the complete list of potential chemicals of concern. The text of this section should be revised to include a summary of the criteria used to compile this list.*

The list of chemicals included in the Cleanup Level Document is based on the chemicals detected in soil, sediment, groundwater, and surface water samples collected at the Main Installation and Public Health Service Hospital sites, as included in the database given to the Trust from the Army. This list also includes chemicals that have been detected at the Firing Ranges and at petroleum release sites. Section 2 of the Cleanup Level Document has been modified to state the source of the list of chemicals.

16. *Table 7-2 Human Health Cleanup Levels for Non-Petroleum Compounds in Soil at the Presidio of San Francisco: There are landfill areas that may be remediated at this site. As mentioned in a previous memorandum from the HERD, dated June 5, 2000, vinyl chloride is often found associated with landfills, but a cleanup goal has not been calculated for this chemical. Explain why vinyl chloride has not been included as a potential chemical of concern.*

    Vinyl chloride was not included as a potential chemical of concern in the Cleanup Level Document because it has not been detected in soil or water samples collected at any of the Main Installation sites. Very few chlorinated VOCs have been detected at Main Installation sites, including landfills. Therefore, based on the available data, vinyl chloride is unlikely to be encountered these sites. As stated in Section 7.3.6, if new chemicals are identified at a site, cleanup levels will be calculated for such chemicals.

If you have any questions, please do not hesitate to call.

Very truly yours,

Craig Cooper

Craig Cooper
THE PRESIDIO TRUST

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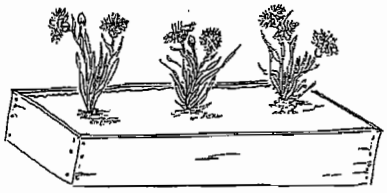

PRESIDIO POTTED PLANT GUIDELINES

(updated Spring 2001)

1. CONTAINERS

- A reasonable number of containers may be placed outside of each unit. The Presidio Trust will, in its sole discretion, determine if inappropriate or an unreasonable number of containers/plants exists. If such a determination is made, the resident will be so notified and asked to remedy the situation.
- Containers must be placed in areas where they will not fall during an earthquake or heavy winds (this includes banisters, railing, etc.) or impede emergency access to buildings.
- Residents are encouraged to grow kitchen herbs and container-sized vegetable plants, since home gardening is an important component of a sustainable community.
- To protect sensitive ecological areas, residents may not discard soil or plant material anywhere on the grounds of the Presidio.
- The use of pesticides or herbicides is prohibited.

2. SUGGESTED PLANTS

Attached is a *partial* list of plants that grow in harmony with the Presidio's native species. Most vegetables and kitchen herbs are also acceptable, since they do not easily cross-pollinate or hybridize with native plants. A more detailed listing of acceptable plants is available at the John Stewart Company leasing offices.

3. PROHIBITED PLANTS

Certain commercial nursery species are difficult to confine to containers since they can spread via seeds or runners. They become aggressive competitors with native species and are difficult to eradicate once established.
Please check the attached list for prohibited plants.

In addition, some commercially available plants labeled "California Native" have the potential to cross-pollinate/hybridize with native plants in natural areas of the Presidio. This is a serious threat to native plants.

PLEASE DO **NOT** BUY PLANTS LABELED "CALIFORNIA NATIVE."

(If you have questions related to plants in the Presidio, please contact the Presidio Trust Natural Resources Program at 415.561.4494 or e-mail us at Nature@presidio.gov.)

SUGGESTED CONTAINER PLANT LIST FOR PRESIDIO RESIDENCES

Scientific name (spp. = species)	**Common Name**
Large Shrubs (>2 m tall)	
Buddleia spp.	butterfly bush
Callistemon citrinus	bottlebrush
Tibouchina semidecandra	princess flower
Small Shrubs (0.5-2 m tall)	
Berberis spp.	Darwin barberry
Fuchsia cultivars	fuchsia
Lavandula spp.	lavender
Nandina domestica	heavenly bamboo
Vines	
Clematis spp., cultivars	clematis
Hardenbergia violacea	hardenbergia
Rosa banksiae	*Lady Banks rose*
Sollya heterophylla	Australian bluebell creeper
Trachelospermum jasminoides	star-jasmine
Wisteria	wisteria
Ferns	
Rumohra adiantiformis	leatherleaf fern
Flowering perennials	
Aquilegia spp.	columbine
Coreopsis spp.	coreopsis
Delphinium spp.	larkspur
Echinacea	echinacea
Lantana spp.	lantana
Penstemon spp., cultivars	beardtongue
Phlox spp.	phlox
Salvia spp., cultivars	sage
Annuals	
Helianthus cultivars	sunflower
Lobelia spp.	lobelia
Salvia spp., cultivars	sage
Viola spp.	violets, pansies
Zinnia	zinnia