3.0 BASELINE RISK ASSESSMENT FOR SITES 2 AND 12

The BRA for Sites 2 and 12 is presented in this section. Site 2 is the former Main Garrison Sewage Treatment Plant (MGSTP). Site 12 comprises four areas: the Lower Meadow, the former Directorate of Logistics (DOL) Automotive Yard, the former Cannibalization Yard and the associated industrial area, and a portion of the Southern Pacific Railroad (SPRR) spur. This BRA follows the methodology presented in Section 2.0. Any deviations from the methods described in Section 2.0 are noted.

3.1 Site Background

This section describes the physical settings, past and planned land uses, and local demographics for the sites.

3.1.1 Physical Setting

Both sites are in the northwest portion of Fort Ord. Site 2 is west of Highway 1; Site 12 is in the Main Garrison east of Highway 1 (Plate 3.1).

3.1.1.1 Site 2

Site 2 encompasses approximately 50 acres bounded by Indian Head Beach to the west, Range Road to the east, Trainfire Range No. 9 to the north, and Stilwell Hall to the south. The site is at an approximate elevation of 80 feet MSL. Much of Site 2 is covered with stabilized dune sand vegetated primarily with ice plant.

3.1.1.2 Site 12

The four areas of investigation at Site 12 are described below.

The Lower Meadow

This area is a grass field comprising less than 1 acre east of Highway 1, west of the DOL Automotive Yard, and south of the Twelfth Street Gate. The site is lined on two sides by Monterey cypress. The elevation of the Lower Meadow is approximately 65 feet MSL, about 5 feet lower than the DOL Automotive Yard, from which it historically received runoff. Several drain pipes extend from the DOL Yard into the Lower Meadow.

The DOL Automotive Yard

This 8-acre paved area northeast of the SPRR spur and south of Twelfth Street houses several buildings formerly used for automotive repair. Wooden barracks are located north and east of the yard. This area is approximately 70 feet above sea level and slopes gently to the west, toward the Lower Meadow.

The Cannibalization Yard

This approximately 1/2-acre paved area is located within an 18-1/2 acre industrial area separated from the DOL Automotive Yard to the north by the SPRR spur. A former baseball field lies to the east, and Tenth Street and wooden barracks are to the south. This area is approximately 80 feet above sea level.

The SPRR Spur

This area of less than 1 acre consists of the right of way along a portion of the railroad spur that curves east from the SPRR track through an industrial complex and between the DOL Automotive Yard and the Cannibalization Yard. The area is mostly unpaved except for areas adjacent to the former loading docks.

3.1.1.3 Geology

At Sites 2 and 12, older dune deposits consisting of predominately well-sorted to silty sand extend from the surface to approximately 120 to 150 feet bgs, where a sandy silt to sandy clay is encountered. Well-sorted sand to silty sand of the Valley Fill deposits is present beneath the silt to at least 300 feet bgs, the maximum depth investigated in the RI. The Salinas Valley Aquiclude, present through much of Fort Ord, is absent at both sites.

3.1.1.4 Hydrogeology

Sites 2 and 12 are located in the Salinas Basin. Two aquifer units were investigated as part of the RI, the Upper 180-foot aquifer and the Lower 180-foot aquifer. The sandy silt present at approximately 70 to 80 feet below MSL acts as a confining unit between the two aquifer units. Depth to water ranges from approximately 40 to 60 feet at Site 2 to about 70 feet at Site 12. Localized groundwater flow in the Upper 180-foot aquifer is generally from Site 12 westward toward Site 2 and Monterey Bay. Flow in the Lower 180-foot aquifer is primarily inland toward the Salinas Valley.

Groundwater quality at Sites 2 and 12 is characterized by total dissolved solids (TDS) content ranging from 295 to 998 mg/l for wells screened in the upper part of the Upper 180-foot aquifer at Site 2, and from 227 to 713 mg/l (with a mean of 375 mg/l) through the entire Upper 180-foot aquifer at Site 12. Saltwater intrusion has occurred in the lower part of the Upper 180-foot aquifer at Site 2 as far inland as the Sewage Treatment Plant, as evidenced by TDS values of up to 26,900 mg/l in Monitoring Well MW-02-07-180, which is screened in the bottom 20 feet of the Upper 180-foot aquifer. Groundwater underlying Site 12 is considered potable, but groundwater at Site 2 that has been subject to saltwater intrusion and is therefore generally not potable.

3.1.2 Land Use

This section discusses both past and planned future land uses for Sites 2 and 12.

3.1.2.1 Site 2

Site 2 is the former Main Garrison Sewage Treatment Plant (MGSTP) site. The MGSTP was the primary sewage treatment facility for Fort Ord from the late 1930s until May 1990. Five buildings, two large trickling filter facilities, three inactive unlined sewage ponding areas, and 10 inactive asphalt-lined sludge drying beds associated with the MGSTP remain on the southern portion of the parcel. The northwest edge of the site was used as a firing range (*HLA, 1993*). Effluent from the plant was discharged under a National Pollutant Discharge Elimination System (NPDES) permit to a storm drain that emptied into Indian Head Beach during low tide and into Monterey Bay at high tide.

The proposed development for Site 2 (Polygon 13) includes outdoor and indoor aquaculture facilities for raising fish and shellfish, with additional research facilities proposed to support oceanographic studies (*FORG, 1994*).

3.1.2.2 Site 12

Past land uses in the four Site 12 areas are described below.

Lower Meadow

This area was used as a waste disposal site. Suspected wastes include scrap metal, oil, and batteries. Construction waste, scrap metal, and evidence of hydrocarbon staining have been identified in fill at depths of up to 21 feet in areas of the Lower Meadow. The Lower Meadow has historically received runoff from the Automotive Yard via drain pipes.

DOL Automotive Yard

This area includes several buildings previously used for automobile repair, degreasing, engine testing, auto steam cleaning/washing, petroleum and oil storage, and auto painting. A formerly buried muffler near Building 2719 was used to store liquid waste (e.g., solvents and petroleum products). Underground storage tanks (USTs), primarily for gasoline storage, were present throughout the area, but all have been removed. Chemical releases from this area may have occurred as a result of accidental discharge of waste solvents, paints, and battery acid directly into soil, drains, or sewers.

Cannibalization Yard

The Cannibalization Yard was used from 1964 until the present to dismantle decommissioned military vehicles and other old equipment. Several buildings remain, including a former machine shop and a former furniture shop.

USTs that held diesel, kerosene, Stoddard solvent, and waste oil have been removed. Ten USTs containing motor vehicle fuel remain southeast of the MGSTP at Building 2042. One oil/water separator is located on the eastern border of the yard.

SPRR Spur

The portion of the SPRR spur described in Section 3.1.1.2 is considered as part of Site 12 because oil or fuel may have been sprayed in this area for dust control. The remainder of the SPRR spur is included in Site 13.

Future Use

Development planned for Site 12 includes a central business district, light industrial areas, a high-tech business park, a transit center, retail businesses, medium- to high-density residential areas, and a school (*FORG, 1994*).

3.1.3 Nearby Populations

The current and potential future residential population is nearest Site 2 approximately 1 mile north of the site in the city of Marina. It is not anticipated that these populations would have contact with chemicals detected at Site 2.

For Site 12, the nearest current residential and occupational receptors are individuals living and/or working at Fort Ord approximately 1 mile north to northeast of Site 12.

3.2 Data Evaluated

Data considered in the BRA were derived from soil and groundwater sampling conducted by HLA from 1991 to 1994 as part of the RI. Data obtained from site investigation(s) conducted by EA (*1990*) were also considered.

The sampling activities and the methods used to evaluate analytical data are discussed in Section 2.1.1.5 and summarized here. Soil data were segregated by depth as follows: surface soil (0 to 2 feet bgs), subsurface soil (2 to 10.5 feet bgs), and deep soil (greater than 10.5 feet gs). Statistical summaries for chemicals detected at Sites 2 and 12 are presented in Tables 3.1a, b, and c and 3.2a, b, and c (soil) and Tables 3.3 and 3.4 (groundwater). The frequency of detection, minimum and maximum concentrations, arithmetic mean concentration, and standard deviation and the 95 percent upper confidence limit (UCL) of the arithmetic mean are presented for each detected chemical.

Hexavalent chromium was not detected at either Site 2 or 12. A total of 31 soil samples were analyzed for hexavalent chromium at Site 2(4) and Site 12(27); detection limits for these samples ranged from 0.10 to 5.00 mg/kg for Sites 2 and 12. Detected concentrations of total chromium are therefore assumed to represent trivalent chromium.

3.2.1 Site 2

Twenty-seven soil samples were collected from eight soil borings and analyzed for one or more of the following: VOCs, SOCs, pesticides/PCBs, and priority pollutant metals (Tables 3.1a, b, and c).

The following 13 metals were detected in at least one surface soil sample (0 2 feet bgs): antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc. No organic compounds were detected in surface samples (Table 3.1a). Six metals were detected in at least one subsurface soil sample (2 to 10.5 feet bgs): arsenic, chromium, copper, lead, nickel, and zinc. No organic compounds were detected in subsurface soil (Table 3.1b). Chemicals detected in at least one deep soil sample (>10.5 feet bgs) were: acetone, bis (2-ethylhexyl)phthalate, antimony, arsenic, beryllium, chromium, copper, lead, nickel, and zinc (Table 3.1c).

Ten monitoring wells were installed at Site 2 between 1990 and 1994. Groundwater samples from these wells have been analyzed for VOCs, SOCs, and priority pollutant metals (Table 3.3). Results of analyses conducted since September 1993 indicate the presence of the following chemicals in groundwater from at least one of the 10 monitoring wells: bromodichloromethane, chloroform, dibromochloromethane, 1,1-dichloroethane (1,1-DCA), 1,1-dichloroethene (1,1-DCE), 1,2-dichloroethene (total) (total 1,2-DCE), tetrachloroethene (PCE), 1,1,1-trichloroethane (1,1,1-TCA), trichloroethene (TCE), vinyl chloride, bis(2-ethylhexyl)phthalate, pentachlorophenol, antimony, arsenic, chromium, copper, iron, magnesium, manganese, mercury, nickel, potassium, thallium, zinc, calcium, chloride, nitrate as N, orthophosphate as P, sodium, and sulfate.

3.2.2 Site 12

Soil samples were collected in all four areas of Site 12 to characterize potential source areas. These areas were first investigated as potential source areas for the solvents identified in groundwater during an initial characterization of the Cannibalization Yard (*EA, 1990*). This investigation included drilling of four soil borings and installation and sampling of three monitoring wells. HLA conducted a remedial investigation at Site 12 between 1991 and 1994. This consisted of two phases and included the following activities: geophysical surveys; soil gas surveys for screening purposes; drilling of 38 soil borings and 4 pilot borings; collection of hydropunch samples to evaluate the extent of potential groundwater contamination and select monitoring well locations; installation of 7, and sampling of 10, monitoring wells; tidal influence monitoring; and aquifer testing. The results of soil sampling activities are summarized below followed by a summary of the groundwater sampling results. Soil sampling summaries are presented for Site 12 as a whole, consistent with how the data were employed in the exposure assessment (Table 3.2).

A total of 147 soil samples were collected from 42 soil borings, 6 test pits, and 5 surface locations at Site 12 and analyzed for one or more of the following: VOCs, SOCs, pesticides/PCBs, PAHs, and priority pollutant metals. The following chemicals were detected in at least one soil sample at Site 12 at depths of 0 to 2 feet bgs: acetone, PCE, toluene, TCE, 4,4'-DDT, di-n-butylphthalate, diethyl phthalate, bis(2-ethylhexyl)phthalate, total carcinogenic PAH, benzo(a)pyrene toxic equivalents (B(a)P-TE), pyrene, antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, and zinc (Table 3.2a). Most of these chemicals and the following chemicals were also detected at depths below 2 feet: carbon disulfide, 1,1-DCA, 1,2-DCA, total 1,2-DCE, 1,2-dichloropropane, methyl ethyl ketone (MEK), methylene chloride, 1,1,2-trichloroethane (1,1,2-TCA), 2-methylnaphthalene, pentachlorophenol, and xylenes (Tables 3.2b and 3.2c).

Groundwater samples from the 10 monitoring wells at Site 12 (seven installed by HLA and three by EA) have been analyzed for VOCs, SOCs, and metals on a regular basis from 1992 to 1994. Results of analyses conducted since September 1993 indicate the presence of the following chemicals in groundwater from at least one of the monitoring wells: 1,2-DCA, 1,1-DCE, total 1,2-DCE, methylene chloride, PCE, toluene, 1,1,1-TCA, TCE, antimony, chromium, copper, iron, magnesium, manganese, mercury, nickel, potassium, zinc, calcium, chloride, nitrate as N, orthophosphate as P, sodium, and sulfate (Table 3.4).

Results of physical testing of soil samples from Sites 2 and 12 are summarized Appendix C, RI Volume II, Sites 2 and 12.

3.3 Selection of Chemicals of Potential Concern (COPCs)

This section describes the selection of COPCs for soil and groundwater at Sites 2 and 12. All chemicals positively identified in at least one sample were subjected to the COPC selection screening described in Section 2.1.2.

3.3.1 Soil

For direct contact pathways, COPCs were identified based on soil analytical data at 0 to 2 feet bgs. The maximum concentration of each metal was first compared to the depth-specific Fort Ord NQTP soil background concentration for that metal. Metals whose concentrations did not exceed background concentrations were eliminated as COPCs. A toxicity screen, described in Section 2.1.2.4 and Appendix C, was performed for the remainder of the detected chemicals. Chemicals with a screening cancer risk of less than 1×10^{-8} or a screening hazard quotient less than 0.01 were eliminated.

Maximum lead concentrations were compared against a Health Based Screening Level (HBSL) of 240 mg/kg. Essential nutrients were considered and eliminated as appropriate, as discussed in Appendix B.

3.3.1.1 Site 2

Based on the exposure pathways identified for Site 2 (Section 3.4.3), only surface soil was evaluated for COPCs. Beryllium and nickel were eliminated because detected concentrations did not exceed background. Based on the essential nutrient evaluation (Appendix B), the estimated expected daily dose (EDD) of zinc is 0.31 mg/kg. This value is well below the Food and Drug Administration's (FDA's) recommended daily allowance (RDA) of 5 to 10 mg/day (*NRC, 1989*). For this reason, zinc was eliminated as a COPC. Chromium and selenium were eliminated based on results of the toxicity screen. The results of the toxicity screen are presented in Table C1 of Appendix C. Lead was eliminated because its maximum concentration was less than the HBSL.

The chemicals retained as COPCs in soil for Site 2 were: antimony, arsenic, cadmium, copper, mercury, silver, and thallium. The results of the selection process are presented in Table 3.5.

3.3.1.2 Site 12

Based on the exposure pathways identified for Site 12 (Section 3.4.3), only surface soil was evaluated for COPCs. Nickel was eliminated because the maximum concentration did not exceed background. Zinc was eliminated as an essential nutrient because its EDD of 0.10 mg/day was well below the FDA's RDA of 5 to 10 mg/day (*NRC, 1989*).

Acetone, beryllium, chromium, copper, 4,4'-DDT, di-n-butylphthalate, diethyl phthalate, mercury, pyrene, selenium, PCE, TCE, and toluene, were eliminated based on the results of the toxicity screen. The results of the toxicity screen are presented in Table C2 of Appendix C.

The chemicals that were retained as COPCs in soil for Site 12 were: antimony, arsenic, B(a)P-TE, beryllium, bis (2-ethylhexyl)phthalate, cadmium, lead, and Total carcinogenic PAH. Summaries of these COPCs and results of the selection process are presented in Table 3.6.

3.3.2 Groundwater

COPCs in groundwater were identified for Site 12 using a toxicity screen similar to that applied in the determination of COPCs in soil. COPCs were not selected for groundwater at Site 2, because ingestion of groundwater underlying Site 2 is not a complete pathway as residential land use is not planned for this site. In addition, groundwater below Site 2 has been subject to salt water intrusion, and is therefore generally not potable.

The toxicity screen evaluation was performed using a groundwater ingestion rate of 1 l/day, the maximum groundwater concentration within the last year, and the appropriate cancer slope factor or reference dose. Chemicals with a screening cancer risk of less than 1×10^{-8} or a screening hazard quotient less than 0.01 were eliminated on the basis of insignificant contribution. The results of the COPC screening analysis for groundwater are presented in Tables 3.7.

For groundwater at Site 12, the EDDs of calcium, iron, magnesium, and zinc were below their respective RDAs: for calcium 56.5 vs. 400 to 800 mg/day, for iron 0.14 vs. 6 to 10 mg/day, for magnesium 29.5 mg/day vs. 40 to 120 mg/day, and for zinc 0.10 vs. 5 to 10 mg/day. These chemicals were therefore, eliminated as COPCs.

The following chemicals were eliminated on the basis of the toxicity screen: chromium, toluene, and 1,1,1-TCA. The results of the toxicity screen are presented in Table C3 of Appendix C. EPA and Cal/EPA have not developed toxicity values for chloride, potassium, sodium, or sulfate. As a result, these chemicals could not be quantitatively evaluated in this BRA and were eliminated as COPCs.

The following chemicals were, therefore, retained as COPCs: antimony, copper, 1,1-DCE, 1,2-DCA, total 1,2-DCE, manganese, mercury, methylene chloride, nickel, nitrate (as N), PCE, and TCE (Table 3.7).

3.4 Exposure Assessment

The general methods used to identify potential exposure scenarios for Sites 2 and 12 are described in detail in Section 2.2. The following section provides a discussion of the nature and degree of the potential exposure to the COPCs that may occur at Sites 2 and 12. The sources and potential chemical migration routes for the COPCs, potential hypothetical receptors and the pathways by which exposure to COPCs may occur, exposure point concentrations, and the dose estimation for each chemical are presented in the following sections.

3.4.1 Chemical Source and Migration Analysis

Section 3.0 of the Introduction to the RI (Volume II) presents a general discussion of chemical fate and transport. Section 3.0 of the Introduction to the RI also includes a table of physical and chemical properties pertaining to environmental fate and transport of chemicals detected at the Fort Ord RI sites, and a discussion of potential chemical migration pathways. Section 5.0 of the Sites 2 and 12 RI presents a site-specific discussion of chemical fate and transport, and identifies potential chemical migration pathways at Sites 2 and 12. The potential migration pathways identified in Section 5.0 of the Sites 2 and 12 RI are discussed in the following sections.

The potential source of chemical release to soil and groundwater at Site 2 is the former sewage treatment plant. Metals are often found in sewage sludge and other sewage treatment byproducts. Metals have been detected in soil at elevated concentrations near the drying ponds at Site 2.

The potential sources of chemical release into soils and groundwater at Site 12 include:

The Lower Meadow

- Waste materials such as scrap metal, oil, batteries, and road construction waste, used as fill
- Runoff from the DOL Automotive Yard.

DOL Automotive Yard

- Former activities associated with automobile repair, degreasing, engine testing, auto steam cleaning/washing, petroleum and oil storage, and auto painting
- USTs used primarily for gasoline storage
- Discharge of waste solvents, paints, and battery acid directly into soil, drains, or sewers.

Cannibalization Yard

- Activities conducted at the former machine and furniture shops
- USTs that held diesel, kerosene, Stoddard solvent, and waste oil, and the oil/water separators on the eastern border of the yard.

SSRR Spur

- Oil or fuel that may have been sprayed in this area for dust control.

Chemicals may be released from soil through volatilization, wind or mechanical erosion, leaching to groundwater, or stormwater runoff. These potential release mechanisms are discussed below for the COPCs identified at Sites 2 and 12.

3.4.1.1 Chemical Vapors

The volatilization of certain chemicals from soil or groundwater can result in the release of chemicals from soil in a vapor phase. Metals were the only chemicals identified as COPCs in soil at Site 2. Metals, PAH and bis(2-ethylhexyl)phthalate were identified as COPCs in soil at Site 12. On the basis of the low vapor pressure of these chemicals, inhalation of vapors from chemicals present in soil at the sites was not assessed. However, as discussed below, volatilization of chemicals identified in groundwater was considered and evaluated as a complete exposure pathway for Site 12.

3.4.1.2 Fugitive Dust

Wind or mechanical erosion can result in the release of chemicals in soil by generation of dust from surface soil. Metals and SOCs, the only chemical classes identified as COPCs in soil at Sites 2 and 12, have been found in the environment adsorbed to suspended particulate matter and are subject to release from contaminated soils via this mechanism. Accordingly, this chemical migration route was included for metals and SOCs at Sites 2 and 12.

3.4.1.3 Stormwater Runoff

Chemicals released from the Automotive Yard may have been transported to adjacent areas within Site 12 (e.g., the Lower Meadow) via runoff through drainage pipes. Soil samples were collected in areas potentially receiving runoff to determine if runoff had occurred. Therefore, it was not necessary to conduct a quantitative migration analysis.

3.4.1.4 Leaching

The potential for chemicals to leach from soil to groundwater depends upon the physical and chemical properties of the chemical, the chemical concentration, soil type, pH, and other site-specific conditions (e.g., surface cover and annual rainfall). The chemicals identified as COPCs in soil at Sites 2 and 12 have limited water solubilities and high soil sorption tendencies. Chemical properties pertaining to chemical fate and transport are presented in Section 3.0 of Volume II of the RI/FS report. The detected concentrations and chemical properties of the organic chemicals detected at Site 12 indicate that the organic COPCs are unlikely to migrate to groundwater. The low detected metal concentrations and generally low mobility of metal cations in soil indicate that the metals detected in soil at Site 12 are unlikely to migrate to groundwater.

The pH of soil at Sites 2 and 12 ranges from 4.2 to 7.8, indicating that there is little potential for metals to leach to groundwater. Further, depth to groundwater is approximately 180 feet at Site 2, and 50 to 70 feet at Site 12. Although elevated concentrations of metals have been detected in at least one monitoring well at Site 2, "clean" soil in subsurface zones and saltwater intrusion at Site 2 indicate that leaching has not been the mechanism. Based on this information, chemical migration of the COPCs in soil to groundwater at Sites 2 and 12 is considered unlikely and was not quantitatively evaluated in the BRA.

3.4.2 Potential Receptors and Exposure Pathways

This section identifies the hypothetical receptors evaluated for Sites 2 and 12, and defines the potential exposure pathways through which the receptors could contact COPCs. Methods used to identify receptors are described in Section 2.2. Site-specific information presented in Section 3.1 was used to develop the exposure assessment.

3.4.2.1 Site 2

There are no current receptors at or within approximately 1 mile of Site 2. Potential future onsite receptors for Site 2 are adult workers employed at the proposed marine aquaculture and oceanographic research facilities. These receptors may be exposed to chemicals in surface soil as a result of outdoor activities associated with aquaculture and research. Residential receptors were not evaluated because proposed development at Site 2 includes only these facilities (*FORG, 1994*).

Three complete soil exposure pathways at Site 2 were identified: incidental ingestion of soil, dermal contact with soil, and inhalation of fugitive dust. Ingestion of groundwater underlying Site 2 was not considered a complete exposure pathway as residential land use is not planned for this site.

3.4.2.2 Site 12

There are no current receptors at Site 12. The nearest populations live and/or work approximately 1 mile east of the site. Exposure of these individuals to chemicals present at Site 12 is assumed to be negligible based on results of the future onsite scenario and the distance of these individuals from the site.

The potential future onsite receptors for Site 12 are adult workers and child and adult residents (*FORG, 1994*) who may be exposed to chemicals in surface soil as a result of normal activities. Because exposure of future workers would be much less than that of future residents, quantitative risk evaluations were conducted for residential receptors only.

The complete soil exposure pathways at Site 12 are incidental ingestion of soil, dermal contact with soil, and inhalation of fugitive dust. Inhalation of volatile chemicals migrating from groundwater into air was also evaluated for Site 12, although the results of an initial screening evaluation (Appendix D) indicated that this exposure pathway does not contribute significantly to the total exposure. Additionally, ingestion of groundwater underlying Site 12 was evaluated.

3.4.3 Exposure Scenarios

This section presents a discussion of the site-specific information considered in the exposure assessment. To provide a conservative range of potential risks, both average and RME exposure scenarios (defined in Section 2.2.3) were evaluated. The average exposure scenario was evaluated using average (or mean) values for key exposure parameters; the RME scenario was evaluated using upperbound values (e.g., 95th UCL) for key exposure parameters. The pathway-specific assumptions used to evaluate potential exposures of each of the receptors for Sites 2 and 12 are presented in Section 2.2.5.

It was assumed that exposures for future adult workers at Site 2 would occur 8 hours per day, 250 days per year (5 days per week, 50 weeks per year) for 10 years (average exposure) or 25 years (RME). The fraction of intake (FI) was assumed to be 0.5 (average) and 1.0 (RME).

For the future residential scenario at Site 12, it was assumed that exposure would occur 20 hours per day (average exposure) or 24 hours per day (RME), 350 days per year for 9 years (average exposure) or 30 years (RME). The fraction of intake was assumed to be 0.75 (average exposure) or 1.0 (RME).

These assumptions are summarized in Table 3.8.

3.4.4 Exposure Point Concentrations (EPCs)

The methods used to evaluate EPCs are discussed in Section 2.2.7. Site-specific average exposure and RME EPCs were developed for soil and groundwater using the arithmetic mean concentration and the 95 percent upper confidence limit on the mean (95th UCL), respectively. EPCs were developed for particulate-bound chemicals in air by assuming that 100 percent of the airborne, site-specific PM_{10} originated from site soil. Accordingly, the PM_{10} dust concentration was multiplied by the mean and 95th UCL soil concentrations to characterize EPCs in air, as described in Section 2.2.7.

EPCs for volatile chemicals were estimated using the Army/Jury Behavior Assessment Model, discussed in Appendix D. This model estimates vapor flux rates at the soil surface resulting from volatile chemicals present in the dissolved phase in groundwater.

Because no areas of contamination at Site 12 were identified as hot spots, it was not considered necessary to analyze soil data on an area-specific basis for the exposure assessment.

EPCs for soil, air, and groundwater are summarized in Tables 3.9 through 3.11.

3.4.5 Estimation of Exposure (Dose)

The pathway-specific equations and exposure parameters used to estimate average daily doses (noncarcinogens) and lifetime average daily doses (carcinogens) are presented in Sections 2.2.4 and 2.2.5. This approach was applied to all COPCs except lead. For lead, blood lead concentrations were conservatively estimated using the DTSC LEADSPREAD (adults and children from age 6 years) and the EPA UBK (children 0 to 6 years) models. These models are described Section 2.2.9.

3.5 Toxicity Assessment

The toxicity assessment presents the chemical-specific cancer slope factors (SFs) and noncancer reference doses (RfDs) used in the BRA. Where EPA and DTSC have derived different slope factors for a chemical, the more conservative value was used. The EPA RfD, or an appropriate surrogate RfD, was used for all noncarcinogenic endpoints other than lead toxicity. The chemical-specific SFs and RfDs used in the BRA are provided in Table 2.9.

3.6 Risk Characterization

The risk characterization integrates the dose estimates and the toxicity assessment to characterize the incremental cancer risks and the noncancer health hazards. Risk characterization methods are discussed in Section 2.4. Estimated incremental cancer risks and noncancer health hazards are presented in Appendix E. The following sections summarize the results of the risk characterization for receptors at Sites 2 and 12. Results are presented with and without corrections for background arsenic levels in surface soil.

3.6.1 Possible Noncancer Health Effects

Noncancer health effects were characterized for future onsite workers at Site 2 and future child and adult residents at Site 12 (Tables 3.12 and 3.13). Hazard quotients were summed to arrive at total hazard indexes (HI) for the average and RME scenarios. This method is considered conservative in that it is more accurate to only sum the hazard quotients of chemicals affecting common target organs ("toxicological endpoints").

3.6.1.1 Site 2

The total multipathway noncarcinogenic HIs for the average exposure and RME scenarios for future onsite workers at Site 2 are 0.01 and 0.1, respectively. These results indicate that noncarcinogenic adverse health effects are not expected for future populations at Site 2.

3.6.1.2 Site 12

Quantitative noncancer hazard evaluations for future residential receptors at Site 12 are discussed below.

Total multipathway HIs for a resident child 0 to 6 years old are 0.4 and 2 for the average exposure and RME scenarios, respectively.

The HI for a child resident 6 to 9 years old (average exposure scenario) is 0.3, and the HI for a child 6 to 18 years old (RME scenario) is 0.7.

The future adult resident noncancer health hazard was evaluated only for the RME scenario, as the average scenario of a 9 year residential tenure was conservatively applied to the childhood years. The HI for the future adult resident, ages 18 to 30, is 1.

The groundwater ingestion pathway accounts for approximately 63 percent (HI = 1.2) and 92 (HI = 1.2) percent of the HI for the child and the adult respectively. The remainder of the HI (0.3 and 0.1 for the child and adult residents, respectively) results from exposure to concentrations of metals, BEHP, and total carcinogenic PAHs in soil.

3.6.2 Possible Cancer Risk

Estimated incremental lifetime cancer risks were characterized for future onsite workers at Site 2 and residents at Site 12. The results are summarized in Tables 3.14 and 3.15 for the worker and resident receptors, respectively.

3.6.2.1 Site 2

Estimated lifetime cancer risks for the future worker at Site 2 are 2×10^{-7} and 3×10^{-6}, for the average and the RME scenarios, respectively. The estimated background RME cancer risk at Site 2 is 2×10^{-6} (Table A1 in Appendix A), which accounts for approximately 89 percent of the site specific RME risk of 3×10^{-6}. When the background related risk is subtracted from the RME site risk, the residual risk is 3×10^{-7}.

3.6.2.2 Site 12

Total cancer risks estimated for the future onsite resident receptor at Site 12 were 5 x 10^{-6} and 6 x 10^{-5}, for the average and RME scenarios, respectively. Nearly all of the cancer risk estimated at Site 12 is due to the presence of 2 metals in soil (arsenic and beryllium) at background concentrations and 5 VOCs in groundwater (1,2 DCA; 1,1 DCE; methylene chloride, PCE; and TCE). Background concentrations of arsenic and beryllium account for approximately 53 percent and 32 percent of the total average and RME cancer risk, respectively. Exposure to VOCs in groundwater accounts for approximately 69 percent (average) and 57 percent (RME) of the total risk estimated at the site. These results are discussed further below.

Total cancer risk estimates associated with exposure to all carcinogenic COPCs in soil (arsenic, beryllium, cadmium, B(a)P-TE, and BEHP) were 2 x 10^{-6} (average) and 2 x 10^{-5} (RME scenario). B(a)P-TE and BEHP account for only 7 percent (1.0 x 10^{-7}; average) and 9 percent (2.0 x 10^{-6}; RME) of this soil-related cancer risk; of this amount B(a)P-TE represents the majority of the risk for both the average (9.6 x 10^{-8}) and the RME scenarios (1.8 x 10^{-6}). B(a)P-TE was detected in only 1 out of 18 soil samples; detection limits ranged from 0.330 to 1.7 mg/kg.

With only one exception, cancer risks due to background levels of arsenic and beryllium (values for cadmium are not available) in soil are greater than the total cancer risk estimate associated with exposure to arsenic, beryllium and cadmium in soil. The total and background cancer risk due to RME concentrations of arsenic was 2 x 10^{-5} and 1 x 10^{-5}, respectively. These results suggest that in general, site-related concentrations of arsenic and beryllium are below naturally occurring background levels. The exceedance of RME arsenic concentrations over background levels may reflect the presence of a hotspot(s) - not extensive contamination throughout the site.

Subtracting out the background contribution from the total cancer risk results in a residual risk of 3 x 10^{-6} and 4 x 10^{-5} (rounded to one significant figure) for the average and RME scenarios, respectively. This information is summarized in Table 3.17.

3.6.3 Results of Lead Exposure Evaluation

Lead exposure evaluation was conducted only for Site 12, because lead was not selected as a COPC at Site 2. The UBK model was used to evaluate blood lead levels for children 0 to 6 years old. The highest blood lead levels for this age range were 3.15 μg/dl (average exposure) and 7.29 μg/dl (RME). UBK model output for the child resident receptor is presented in Tables F1 and F2 in Appendix F.

The LEADSPREAD model was used to evaluate resident children 6 to 18 years old and resident adults. The 99th percentile values predicted by the model were 4.46 μg/dl and 7.64 μg/dl, for the average exposure (age 6 to 9) and RME (age 6 to 18), respectively. LEADSPREAD model output for the resident children from age 6 to 18 and adult resident receptors is presented in Tables F3 and F4 in Appendix F.

The average exposure and RME blood lead levels estimated for all future receptors at Site 12 are well below the target 99th percentile blood lead level of 10 μg/dl (Table 3.16).

3.7 Uncertainty Analysis

Section 8.0 presents the uncertainties associated with the BRA that are common to all sites evaluated. Uncertainties associated with the driving component of the cancer risk characterization for Sites 2 and 12 (i.e., ingestion of groundwater) are discussed below.

Factors contributing to the uncertainty in the risks associated with groundwater ingestion include the lack of consideration of the low probability of a home being constructed above the maximally contaminated monitoring well, and lack of consideration of the oral bioavailability (absorption fraction) of ingested chemicals.

3.8 Summary of Baseline Risk Assessment for Sites 2 and 12

This BRA was conducted as part of the Basewide RI/FS for Fort Ord. Sites 2 and 12 were evaluated separately. COPCs for each site were identified for soil and groundwater. The COPCs selected for surface soil at Site 2 were antimony, arsenic, cadmium, copper, mercury, silver, and thallium. The COPCs selected for surface soil at Site 12 were antimony, arsenic, B(a)P-TE, bis(2-ethylhexyl)phthalate, cadmium, lead, and Total cPAH. The following chemicals were selected as COPCs for groundwater at Site 12: antimony, copper, 1,1-DCE, 1,2-DCA, total 1,2-DCE, manganese, mercury, methylene chloride, nickel, nitrate, PCE, and TCE.

There are no current receptors within a 1 mile of either site. The hypothetical future receptors for Site 2 are employees working at the proposed future aquaculture/marine research facility. The hypothetical future receptors at Site 12 are child and adult residents and commercial workers; residents were selected as representative receptors in the quantitative BRA for Site 12.

The results of the BRA for Site 2 indicate that there would be no noncarcinogenic health hazards associated with chemicals present at Site 2 when consideration is given to background levels of arsenic in site soil. Potential average exposure and RME cancer risk for Site 2 were conservatively estimated to be 2×10^{-7} and 3×10^{-6}, respectively. When the RME cancer risk is adjusted to account for local background arsenic levels in soil, the risk is 3×10^{-7}.

The BRA for Site 12 estimated multipathway HIs below 1 for all receptors except for the RME 0 - 6 year old child (HI = 2) and the 18 - 30 year old adult resident (HI = 1). As indicated previously, however, in Section 3.6.1, HIs estimated herein do not account for chemical-specific "toxicological endpoints" (i.e., not all the COPCs will have the identical toxic effect). The groundwater ingestion pathway accounts for approximately 63 percent (HI = 1.2) and 92 (HI = 1.2) percent of the HI for the child and the adult, respectively. The remainder of HI (0.74 and 0.09 for the child and adult, respectively) results from exposure to concentrations of metals, BEHP, and total carcinogenic PAHs in soil.

Potential average exposure and RME cancer risks for Site 12 were conservatively estimated to be 5×10^{-6} and 6×10^{-5}, respectively. The estimated lifetime incremental cancer risks for the future onsite resident (after consideration of local background arsenic and beryllium levels in soil) are 3×10^{-6} and 4×10^{-5} for the average and RME scenarios, respectively.

Of the RME risks, 3×10^{-5} was due to VOCs in groundwater, 2×10^{-5} was due to background metals in soil, and 4×10^{-6} can be attributed to potentially Fort Ord-related compounds in soil.