5.0 BASELINE HUMAN HEALTH RISK ASSESSMENT

This section evaluates human health risks associated with potential exposures to chemicals in soil, groundwater, and air (organic compounds only) at Group 2 SWMUs 3, 5, 8, 9, 30, and 31. The analysis is based on the RFI-Phase II analytical results presented in Section 4.0, combined with pertinent environmental setting and land-use information. Both current use and hypothetical future use (residential) exposure pathways are quantitatively evaluated.

5.1 METHODOLOGY

All methods used in this evaluation are in general accordance with guidelines presented in the State of Utah Hazardous Waste Management Rules (USHWCB 1994), the Proposed EPA Guidance for RCRA RFIs (EPA 1989c), and Risk Assessment Guidance for Superfund (RAGS) (EPA 1989d). Consistent with these guidelines, the baseline human health risk assessment was developed as follows:

1. Identify the chemicals of concern (COCs).
2. Assess the potential exposures.
3. Assess the toxicity of the COCs, including carcinogenic and noncarcinogenic constituents.
4. Characterize the potential risk.

These steps are described in Sections 5.1.1 through 5.1.4, so that the SWMU-specific risk evaluations presented in Sections 5.2 through 5.7 may be focused on the salient aspects of the analysis and the risk assessment results.

5.1.1 Identification of Chemicals of Concern

COCs are those chemicals that are to be evaluated in the risk assessment process. The general methods used in selecting COCs for all SWMUs are discussed below for soil (Section 5.1.1.1), groundwater (Section 5.1.1.2), and air (Section 5.1.1.3).

5.1.1.1 Soil Chemicals of Concern

Soil COCs were selected on the basis of the three following primary factors:

- Frequency of detection—Chemicals detected at frequencies less than 5 percent were excluded from further evaluation.

- Toxicity—Chemicals with negligible toxicity to humans (e.g., calcium) were excluded from further consideration.

- Comparison to the background levels—Inorganic constituents with maximum concentrations below the site-specific background levels determined in Section 2.3 were not selected as COCs.

Other factors were considered in selecting the COCs, as was professional judgement, which is implicit in the risk assessment process. For example, if a chemical exceeded background in several samples, but the magnitude of the exceedance was very slight and there were no other indications that its presence was related to the site, it was not identified as a soil COC. In addition, certain organic constituents (e.g., phthalates and hydrocarbons) are typically ubiquitous in the environment, particularly in industrial areas. However, site-specific background data are not available for organic compounds, precluding exclusion as a COC on that basis. Therefore, at some SWMUs, certain organic constituents were not selected as COCs even though, in other instances, the above-listed criteria would have alone warranted their selection as COCs. Detailed rationales for soil COC selection (and exclusion) are provided in the SWMU-specific risk evaluations (Section s 5.2 through 5.7).

For some SWMUs, elevated concentrations of certain constituents were limited to specific sample locations or areas of the site, whereas concentrations in remaining samples were less than site-specific background levels. In these cases, the constituents were not selected as SWMU-wide COCs, but were considered sample- or area-specific COCs. The reason for this distinction is two-fold. First, it focuses the analysis on an area of the site potentially requiring further evaluation. Second it prevents the masking or dilution of elevated concentrations that might occur were the chemical evaluated as SWMU-wide COCs. For example, if for a given chemical the majority of detections area at low concentrations (i.e., well below background), the exposure point concentration (EPC) derived to represent a SWMU-wide reasonable maximum exposure (RME) could be much lower than the levels detected in a localized area. It is important to note that identification of a constituent as a sample-specific COC does not necessarily imply that its presence at elevated levels is limited to that location; it indicates, rather, that its presence in the samples was limited to that location.

5.1.1.2 Groundwater Chemicals of Concern

Groundwater monitoring was conducted at SWMUs 3, 5, and 9. Groundwater COCs identified for each of these SWMUs were selected on the basis of the following two factors:

- Comparison of inorganic chemical concentrations with upgradient (background) groundwater levels— Constituents detected at concentrations less than the site-specific background level were not selected as COCs.

- Toxicity— Chemicals with negligible toxicity to humans (e.g., calcium and other common nutrients) were excluded from further consideration.

Frequency of detection could not be used as a criterion for selecting groundwater COCs given the limited number of groundwater samples collected. For example, only three wells were installed at SWMU 3—a single detection therefore equates to a 33 percent frequency (far exceeding a 5 or 10 percent criterion). In addition, although groundwater analytical results were compared with drinking water standards (e.g., MCLs), the presence of a chemical at a level below an MCL did not necessarily warrant its exclusion as a COC, since the potential cumulative effects associated with exposure to multiple constituents also had to be considered. Therefore, if a constituent was detected in groundwater at a SWMU at a level or levels exceeding background, and toxicity criteria were available, it was generally considered a groundwater COC and thus carried through the quantitative future-use groundwater pathway evaluation.

As discussed previously, the groundwater analytical results (particularly the metals results) should be interpreted with caution. High turbidity was observed in groundwater samples from all well locations. Because the samples were not filtered, the presence of elevated levels of metals suggests that natural conditions (i.e., colloids, suspended particulates, adsorbed metals, etc.) may be responsible for the observed concentrations, not SWMU-related activities. In addition, at SWMUs 3, 5 and 9, maximum concentrations of inorganic constituents were generally detected at what are apparent upgradient well locations, providing further evidence that the elevated detection levels may not be related to either SWMU. The results of the groundwater pathway risk evaluations should therefore be interpreted in light of these findings.

5.1.1.3 Air Chemicals of Concern

Air COCs for organic constituents were selected based on results of the ambient air sampling and meteorological monitoring conducted at TEAD-S from September 11, 1993 to October 3, 1993 (Appendix I). In general, a constituent was selected as an air COC if detected concentrations significantly exceeded levels reported for the background (BK) monitoring location. Air COCs were not selected for metals because monitoring results were considered invalid due to media and laboratory problems. Inhalation pathway(s) for inorganic constituents were therefore evaluated based on the exposure point concentrations determined for soil COCs.

5.1.2 Exposure Assessment

The following sections document the general methods used to identify the exposure pathways (Section 5.1.2.1), estimate chemical intakes (Section 5.1.2.2), and determine exposure point concentrations (Section 5.1.2.3) for each SWMU-specific risk evaluation.

5.1.2.1 Identification of Exposure Pathways

According to EPA RAGS (EPA 1989d), an exposure pathway consists of the following elements:

- A source and mechanism of chemical release to the environment
- An environmental transport medium
- A point of contact with the medium (the exposure point)
- An exposure route at the contact point (e.g., ingestion, dermal contact, inhalation)

Exposure pathways for Group 2 SWMUs were identified based on the following information: land and groundwater use on and surrounding TEAD-S, the potential chemical release mechanisms and transport processes, and data regarding the current activity patterns of on-site workers obtained through interviews with facility personnel. The exposure pathways quantitatively addressed in this assessment are identified in the SWMU-specific risk evaluations (Sections 5.2 through 5.7). Table 5.1-1 summarizes those pathways that were not quantified; the 3rationales presented in this table apply to all Group 2 SWMUs and are not repeated in subsequent sections.

5.1.2.2 Estimation of Chemical Intakes

To calculate chemical intakes (and corresponding risks), the following factors must be estimated:

- Constituent concentration in the medium (i.e., the exposure point concentration [EPC]) to which an individual is exposed.
- Amount of constituent taken up by the body via ingestion, dermal absorption, and/or inhalation

Table 5.1-1 Summary of Pathways Excluded from Quantitative Evaluation for Group 2 SWMUs

Exposure Medium	Potential Receptor(s)	Receptor Location(s)	Potential Exposure Route(s)	Reason for Exclusion of Pathway from Quantitative Evaluation
CURRENT-USE SOIL EXPOSURE PATHWAYS				
Surface Soil	Trespassers (e.g., child)	All SWMU Locations	Ingestion, Dermal Contact, and Inhalation Soil Exposure Pathways	The nearest residence is located approximately 1 mile west of the TEAD-S border. However, given the general inaccessibility of the TEAD-S facility and round-the-clock security, combined with the isolated location of most Group 2 SWMUs, trespassing is extremely unlikely.
Resuspended Surface Soil Particulates	Nearby Residents	Nearby Towns	Inhalation of Resuspended Soil Particulates Transferred to these Areas via Wind Dispersion	The evaluation of potential worker inhalation exposures within the TEAD-S boundary (either within each SWMU or at nearby receptor locations) is assumed to represent a worst-case analysis of the risks/hazards associated with exposure to Group 2 SWMU soil COCs. Inhalation risks associated with potential dispersion of soil COCs to off-post residential areas would therefore be less than those quantified for TEAD-S workers. Consequently, off-post residential exposure pathways were not evaluated quantitatively for any of the Group 2 SWMUs.
Subsurface Soil	Site Workers	SWMU Location	Ingestion, Dermal Contact, and Inhalation Soil Exposure Pathways	Digging may occur within certain areas in SWMU 30 only. Contamination of subsurface soil at this SWMU was limited to two local samples, therefore, the current-use analysis for these locations uses both surface and subsurface soil data. Digging is not expected at any other of the Group 2 SWMUs, so the current-use analysis for all SWMUs, except SWMU 30, makes use of surface soil data only.
FUTURE-USE SOIL EXPOSURE PATHWAYS				
Surface and Subsurface Soils (all Group 2 SWMUs)	Future Site Workers	SWMU Location	Ingestion, Dermal Contact, and Inhalation Soil Exposure Pathways	Potential future uses of the Group 2 SWMUs have yet to be defined. At this time, potential future industrial uses are assumed to be the same as those assumed for the current-use evaluation. (Hypothetical future residential use pathways were quantitatively evaluated, however.)

Exposure Medium	Potential Receptor(s)	Receptor Location(s)	Potential Exposure Route(s)	Reason for Exclusion of Pathway from Quantitative Evaluation
Surface and Subsurface Soils (all Group 2 SWMUs)	Future Residents	SWMU Location	Food-Chain (Bioconcentration) Exposure Pathways Associated with Future Agricultural Uses (e.g., grazing)	Were TEAD-S to be developed for future residential uses, agricultural-related pathways (e.g., consumption of contaminated food products) would also be likely under this scenario. These pathways were not quantified for Group 2 SWMUs, however, for the following reasons. First, plant- and bio-uptake data are not available for most of the COCs evaluated (which are predominantly metals); when available, these data are highly uncertain. Second, future residential-use exposure risks were calculated using very conservative assumptions (Appendix Tables K.2-1 through K.2-4). Therefore, in general (and assuming data availability), food-pathway risks would add only a small increment to the residential-use risk already calculated. Given the hypothetical nature of the residential-use scenario (such use is not expected), and the fact that soil types at Group 2 SWMUs are not suitable for most agricultural uses, agricultural-related pathways were not quantitatively evaluated.
GROUNDWATER AND SURFACE WATER EXPOSURE PATHWAYS				
Shallow Groundwater (Current Uses)	On-Post Workers, Off-Post Residents	Downgradient Wells Screened in the Shallow Aquifer	Ingestion	Shallow groundwater is not used for drinking water at the TEAD-S facility. Also, due to the clay-rich nature of site sediments and discontinuous and perched nature of water-bearing zones at the site, the production capacity of the shallow aquifer would likely be insufficient (i.e., the wells would not produce enough water).
Shallow Groundwater (Current and Future Uses)	On-Post Workers, Off-Post Residents	On- and Off-Post Downgradient Shallow Wells	Non-Potable Uses (e.g., irrigation)	On-post supply wells, which are used as the drinking water supply at TEAD-S, are located at the extreme upgradient (northern) edge of TEAD-S. Therefore, any constituents present in these wells would not be attributable to the (downgradient) Group 2 SWMUs. The nearest downgradient off-post well is the Stookey well, located south of the southern TEAD-S boundary (approximately 1500 ft south of SWMU 25 well S-95-92). This off-post well is permitted for stock watering; however, there is no evidence that it is still in use.

Exposure Medium	Potential Receptor(s)	Receptor Location(s)	Potential Exposure Route(s)	Reason for Exclusion of Pathway from Quantitative Evaluation
Shallow Groundwater (Current and Future Uses), Cont.				As indicated in the SWMU-specific groundwater summary tables, exceedances of background concentrations and/or MCLs were identified for selected constituents. However, given the low groundwater-flow rate and long travel time, combined with contaminant-specific half-life data, the presence of significant levels of any groundwater COC in the Stookey well or any other downgradient well is not expected.
Deep Groundwater (Current and Future Uses)	Not Known	Downgradient Wells Screened in the Deep Aquifer	Ingestion and Other Uses	The deeper aquifer is hundreds of feet below the shallow aquifer characterized in this investigation and the aquifers are separated by a thick sequence of fine-grained deposits. Consequently, migration of shallow groundwater constituents to this deeper aquifer is not expected.
Surface Water	Site Workers, Trespassers	Group 2 SWMU Pits and Trenches	Dermal Contact, Incidental Ingestion of Surface Water	Following spring snowmelt or large rainfall events, surface water may pond locally in existing trenches and pits. However, the presence of water in these features is ephemeral as much is lost due to climatic factors (low precipitation and high evaporation) and infiltration. Furthermore, even when surface water is present, exposure to this medium is not expected given either limited access (characteristic of SWMUs 3, 8, 9, and 31) and/or reasonable assumptions regarding human behavior (e.g., workers are not expected to wade in or contact standing surface water). Also, as discussed above, trespassing at TEAD-S is not expected. Surface water samples were collected at SWMU 31, and potential surface water COCs were identified (Table 5.7-2). However, given the factors discussed above, exposure to COCs in surface water at SWMU 31 is not expected under current site conditions. Exposures under a future-use scenario are also not expected because the SWMU 31 craters will be decommissioned and filled with dirt upon unit closure.

- Frequency and duration of exposures

The factors listed above are incorporated in a term referred to as the chronic daily intake (CDI), which represents an estimated average daily dose received via direct contact (soil ingestion or dermal contact) and/or inhalation pathways. CDIs are expressed in units of milligrams of chemical per kilogram of body weight per day (mg/kg/day), and are calculated using the pathway-specific equations summarized in Appendix Table K.1-1. The EPCs used in these equations were derived using the general methods described below (Section 5.1.2.3). Human exposure parameters (e.g., the assumed frequency and duration of exposure, soil ingestion and dermal contact rates, etc.) differ according to site use and thus are presented in the SWMU-specific risk evaluations. Resulting CDI values were then combined with toxicity factors (Section 5.1.3) to calculate cancer risks and noncancer hazard indices using the methods discussed in Section 5.1.4. The SWMU-specific sections and associated tables documenting the assumptions used to estimate all exposure variables referred to above are detailed in Appendix Table K.1-1.

5.1.2.3 Determination of Exposure Point Concentrations

An EPC is the chemical concentration to which an individual is assumed to be exposed. General assumptions used in determining EPCs for soil, groundwater, and air are summarized below. More detailed information is provided in the EPC summary tables developed for individual SWMUs (Section 5.2).

Soil Exposure Point Concentrations

EPCs for constituents evaluated as SWMU-wide soil COCs were developed using the 95 percent upper confidence limit (UCL) of their mean surface soil concentrations under the current-use setting, and using the 95 percent UCL of their mean surface and subsurface soils (concentrations combined) under the future-use setting. These EPCs, considered to represent reasonable maximum exposure (RME) estimates in accordance with EPA guidance (1991a), were calculated after substituting values equal to one-half the detection limit for all nondetections in the database.

For constituents evaluated as sample- or location-specific soil COCs, EPCs are essentially the maximum concentration detected either in a sample or at a sample location that exhibits a localized, elevated presence. They are used to calculate potential risks for both the current- and future-use exposure scenarios. For example, to adequately account for potential cumulative risks or hazards at just two sampling SWMU 3 locations (e.g., 3-TRN-1 and 3-TRN-2), concentrations of SWMU-wide COCs detected at these locations had to be included in corresponding risk calculations (Table 5.2-3, Table 5.2-5).

In accordance with EPA Region VIII protocols, this analysis assumes that 10 percent of the detected (total) chromium is in the hexavalent (carcinogenic) form; the remaining 90 percent is assumed to be trivalent (noncarcinogenic). As discussed in Section 5.8 (Identification of Uncertainties), this assumption is likely to be conservative.

Groundwater Exposure Point Concentrations

Given the limited number of groundwater samples collected (three at SWMU 3, six at SWMU 5, and four at SWMU 9), and given that maxima for most constituents (metals, in particular) were often detected at the same well location (see Tables 5.2-2, 5.3-2, and 5.5-2), groundwater EPCs are the maximum detected groundwater COC concentration.

Air Exposure Point Concentrations Estimated for Non-Volatile Soil COCs

Inhalation of soil COCs adsorbed to respirable particulates (PM_{10}) was assessed using a particulate emission factor (PEF) equal to 8.62×10^8 m^3/kg. This factor relates the chemical concentration in soil with the concentration of respirable particulates in the air resulting from fugitive dust emissions, and was adapted from the default PEF value of 4.63×10^9 m^3/kg recommended in Part B of EPA Risk Assessment Guidance for Superfund (EPA 1991b). The rationale supporting this modified approach is explained below.

The default PEF value recommended in EPA guidance corresponds to a respirable dust (PM_{10}) concentration from the contaminated source of 0.216 $\mu g/m^3$ (which is the inverse of the 4.63×10^9 m^3/kg value). However, PM_{10} data from a TEAD-S monitoring station located centrally within the Group 2 SWMUs indicate a yearly average PM_{10} concentration of 11.6 $\mu g/m^3$ (54 times higher than the respirable dust concentration assumed for EPA's default value). Given this finding, a more conservative value of 8.62×10^8 m^3/kg was applied in this assessment. This value accounts for site-specific respirable dust concentrations and assumes that 10 percent of the respirable dust at a SWMU originates from contaminated soils. [The 8.62×10^8 m^3/kg value is equal to 10 times the inverse of the reported 11.6 $\mu g/m^3$ annual mean PM_{10} concentration.]

The 8.62×10^8 m^3/kg PEF factor used to calculate air EPCs is considered conservative, particularly given the physical characteristics of the SWMUs evaluated in this assessment (e.g., surface vegetation, which was observed at all SWMUs, and at SWMU 3, the hardpan texture of the soil surface). Air EPCs were not estimated for the hypothetical future-use evaluation because risks for this scenario were calculated on the basis of soil concentrations only.

Exposure Point Concentrations for Volatile Air COCs

Air EPCs for organic constituents were selected based on results of the ambient air sampling conducted at TEAD-S from September 11, 1993 to October 3, 1993. Given the availability of these monitoring data, and given the fact that at most Group 2 SWMUs volatile organic compounds were either not detected or were present at low levels in soil, no modeling was performed for organic soil COCs. Rather, the air monitoring data are considered to supersede any modeled estimates (derived on the basis of soil VOC or SVOC concentrations). The analysis uses the average VOC concentrations reported in Appendix I (Table 8), which were applied in the current-use pathway evaluation only. (As discussed previously, air COCs were not selected for metals because monitoring results were considered invalid due to media and laboratory problems).

5.1.3 Toxicity Assessment

For risk assessment purposes, COCs are separated into two categories of chemical toxicity: carcinogenic and noncarcinogenic effects. As defined below, this distinction assumes that the biological mechanism of action for each category is different. Appendix Tables K.1-2 through K.1-5 list chemical-specific toxicity values developed for evaluating carcinogenic and noncarcinogenic endpoints. These values, which were applied in all SWMU-specific risk evaluations, were combined with CDIs (See Section 5.1.2) to calculate risks (Section 5.1.4). Toxicity profiles for the COCs are provided in Appendix H.1.

5.1.3.1 Toxicity Information for Potential Carcinogenic Effects

As described in EPA guidance (1989d), a small number of molecular events can cause changes in a single cell or a small number of cells that can lead to the formation of tumors. This mechanism is described as a no-threshold mechanism because it is assumed that there is no threshold level of exposure to a carcinogen that will not result in some finite possibility of causing the disease. Evaluation of carcinogenic effects is a two-step process involving weight-of-evidence determination and calculation of slope factors. These steps are described below.

Weight-of-evidence classifications are assigned to account for the likelihood that an agent is a human carcinogen. Using this system, chemicals are classified as either Group A, Group B1, Group B2, Group C, Group D, or Group E. Group A chemicals (human carcinogens) are agents for which there is sufficient evidence to support the causal association between human exposures and cancer. Group B1 and B2 chemicals (probable human carcinogens) are agents for which there is limited (B1) or inadequate (B2) evidence of carcinogenicity from human studies, but for which there is sufficient evidence of carcinogenicity from animal studies. Group C chemicals (possible human carcinogens) are agents for which there is limited evidence of carcinogenicity in animals and no human data. Group D chemicals, which are not classified as to human carcinogenicity, are agents for which data are inadequate to evaluate either animal or human carcinogenicity. Group E chemicals (evidence of noncarcinogenicity in humans) are agents for which there is no evidence of carcinogenicity in adequate human or animal studies. In this risk assessment, chemicals with weight-of-evidence classifications A, B, and C are considered carcinogens. Chemicals with unknown carcinogenicity (Class D) are treated as noncarcinogens.

Based on the weight-of-evidence determinations described above, EPA calculates a slope factor that quantitatively defines the relationship between dose and response. This factor is expressed in units of $(mg/kg/day)^{-1}$. Slope factors are derived from the results of human epidemiological studies or, in many cases, chronic animal bioassays. These animal studies are usually conducted using relatively high doses to detect possible adverse effects. Because humans are expected to be exposed to lower doses than those used in animal studies, animal data are adjusted by using mathematical models and applying an inter-species scaling factor to derive a comparable low-dose slope factor for humans. Therefore, the use of these slope factors typically results in an upper-bound estimate of the probability of an individual to develop cancer as a result of exposure to a given level of a potential carcinogen. It should be noted that the actual risks are not likely to be higher than risks estimated using these slope factors, and could in fact be considerably lower.

Appendix Table K.1-2 lists slope factors for the oral exposure pathway and related toxicity information developed for each carcinogenic COC. Appendix Table K.1-3 provides this information for the inhalation exposure pathway.

In accordance with EPA guidance (1992c), the oral slope factors listed in Appendix Table K.1-2 were also used to calculate dermal exposure pathway risks. Oral slope factors were not adjusted for dermal exposures given the uncertainties in the chemical-specific absorption data, and given the fact that adjustment using default absorption factors often yields anomalous results. For example, using a default absorption factor for inorganic compounds may indicate that for inorganic compounds the dermal pathway drives the calculation of risk, when in fact the inhalation of contaminant-laden dust may be more a pathway of concern, given site related use considerations.

5.1.3.2 Toxicity Information for Potential Noncarcinogenic Effects
For chemicals that cause noncarcinogenic effects, exposed organisms are assumed to have protective mechanisms that must be overcome before the toxic endpoint is manifested. This view holds that a range of exposures from just above zero to some finite threshold value can be tolerated by the organism without appreciable risk of an adverse effect (EPA 1989d).

Health criteria for chemicals exhibiting noncarcinogenic effects are generally developed using reference doses (RfDs). The RfD, expressed in units of mg/kg/day, is an estimate of the daily exposure that a human population (including sensitive subpopulations) can sustain that is not likely to present an unacceptable risk of deleterious effects during a lifetime (EPA 1989d). RfDs are generally developed by the EPA RfD Work Group. Alternative sources include Health Effects Assessments (HEAs) and Office of Drinking Water criteria documents that support health-based drinking water standards. These values are usually derived from animal studies and in some cases, from human studies involving occupational exposures. These experimental or epidemiological data are then adjusted using a range of uncertainty factors. The RfDs thereby provide a benchmark to which chemical intakes by other routes (e.g., via exposure to environmental media) may be compared. Appendix Table K.1-4 lists the RfDs developed for noncarcinogenic effects of COCs for oral routes of exposure; these values were also used to evaluate hazards associated with the dermal exposure route. Appendix Table K.1-5 lists the RfDs developed for inhalation exposure routes.

5.1.3.3 Chemicals For Which No Toxicity Values Are Available

<u>Lead</u>
Currently, EPA toxicity factors are not available for lead. EPA (1991b) recommends using the Uptake Biokinetic (UBK) Model to predict blood lead levels in the most sensitive population (i.e., children 0 to 6 years old) exposed to lead in air, dust, and soil. However, given the age of the exposed population at this Group 2 SWMUs (i.e., adult rather than child), the UBK model was not used in the current-use evaluation. It was also not applied in the future-use evaluation, given the hypothetical nature of this scenario. Rather, the on-site soil concentrations were compared to EPA's screening level value of 400 μg/g (EPA 1994b). This level was developed for sites characterized as residential, so use of this guidance to evaluate potential exposures to lead at Group 2 SWMUs for current site uses is conservative.

MPA and PETN

Toxicity criteria are also not available for two other constituents identified as potential soil COCs–MPA and PETN. The extent to which these COCs can be addressed in the risk assessment is limited to a qualitative discussion.

A chronic oral reference dose is not available for MPA, but a review of its chemical structure and reactivity indicate that IMPA is the chemical most similar to MPA. Based on a study for site closure at Dugway Proving Ground (Montgomery Watson 1997), IMPA will be used as a surrogate to assess the toxicity of MPA present in the Group 2 units. IMPA and MPA are only reactive at the oxygen atoms of each molecule. Where MPA can lose a hydrogen to become the reactive anion MPA^{-}, IMPA is similar because it can lose an isopropyl group and becomes a molecule identical to MPA^{-}. At this point the two chemicals have identical toxicity and the isopropyl group that leaves IMPA is expected to have low toxicity analogous to similar compounds such as isopropanol and isopropane. If this expectation is incorrect, IMPA could be equal or more toxic than MPA, thus IMPA is a conservative surrogate. A noncarcinogenic risk-based screening concentration (RBC) of 7,800 mg/kg for IMPA was established by EPA Region III based on the oral reference dose for IMPA of 0.1 mg/kg/day. This RBC is the soil concentration of IMPA that corresponds to a nocarcinogenic risk of 1, which is the risk threshold below which no action is required by UAC. The RBC for IMPA exceeds concentrations of MPA and IMPA detected in soil at SWMUs 3 and 9 by a factor of up to 500.

PETN is used with TNT for loading small caliber projectiles and in the manufacturing of detonating fuses. PETN has very low toxicity (NIOSH 1996). In fact, PETN is used as a drug to treat congestive heart failure and to prevent angina (chest pain). The typical human dosage is 10–20 mg, three to four times per day. Any potential exposure to the PETN in soil at SWMUs 8 and 30 would be well below this prescribed dose.

5.1.4 Risk Characterization

This section presents the methods used in the quantitative risk assessment that apply to all SWMU-specific evaluations. Section 5.1.4.1 describes the mathematical methods used to calculate cancer risks and noncancer hazard indices for current-use exposure scenarios. Section 5.1.4.2 describes the methods used to calculate risks for hypothetical future-use exposure pathways.

5.1.4.1 Risk Calculation Methodology for Current-Use Pathways

Carcinogenic Endpoints

Excess cancer risks associated with exposures to known or potentially carcinogenic COCs are calculated by multiplying the slope factor (SF) by the estimated average lifetime dose, or CDI. "Excess" cancer risks are risks in excess of the normal cancer "burden" in a population and represent the upper-bound probability that an individual exposed to a given level of contaminant over a lifetime will develop cancer as a result of those exposures. A 10^{-6} upper-bound excess lifetime cancer risk, for example, is an increase of 1 in 1 million in the probability that an exposed individual would develop cancer.

In equation form, risk is defined as follows:

$$\textbf{Risk} = (\textbf{SF}) * (\textbf{CDI}) \qquad \textbf{(5-1)}$$

where:

where:	Risk	=	A unitless probability that an individual will develop cancer attributable to the assumed exposure scenario
	SF	=	Slope factor, expressed in $(mg/kg/day)^{-1}$
	CDI	=	Chronic daily intake averaged over 70 years (mg/kg/day)

Noncarcinogenic Endpoints

Potential noncarcinogenic effects associated with exposures to COCs are evaluated using RfDs. As discussed in Section 5.1.3, these criteria are estimates of the daily chemical exposures that present an acceptably low risk of adverse effects to an individual over a specified exposure duration. In the absence of any information on the specific chemical mixture in question, the mixture is assessed by means of a hazard index (HI). The HI is defined as the sum of the ratios of the CDI to the RfD for each noncarcinogenic chemical, as in the following equation:

$$\textbf{HI} = \textbf{CDI}_1 / \textbf{RfD}_1 + \textbf{CDI}_2 / \textbf{RfD}_2 + \ldots \textbf{CDI}_i / \textbf{RfD}_i \qquad \textbf{(5-2)}$$

where:	HI	=	Hazard Index
	CDI_i	=	Chronic daily intake for the i^{th} chemical in mg/kg/day
	RfD_i	=	Chronic reference dose for the i^{th} chemical in mg/kg/day

The ratio of the chemical-specific CDI to the RfD incorporated in Equation (5-2) is referred to as the hazard quotient (HQ). Any single chemical with an exposure level (or CDI) greater than the RfD would cause both the chemical-specific HQ and the cumulative HI to exceed unity, indicating potential health risks of concern. For multiple chemical exposures, the HI can exceed the 1.0 target criterion even if no single chemical exceeds its corresponding reference dose (i.e., if no HQ exceeds 1.0). However, the assumption of additivity reflected in the HI equation is most properly applied to compounds that induce the same effect by the same mechanism. Consequently, applying this equation to compounds that are not expected to induce the same type of effects could overestimate the potential for adverse health effects.

5.1.4.2 Risk Calculation Methodology for Future-Use Pathways

Risks for hypothetical future-use pathways were calculated using risk-based screening levels (RBSLs). RBSLs are chemical- and medium-specific concentrations that are considered protective of human health given a defined set of exposure and toxicity assumptions. For carcinogens, RBSLs are defined as concentrations protective of human health at a cancer risk level of 10^{-6}. For noncarcinogens, RBSLs are defined as concentrations unlikely to pose adverse health effects based on a hazard index of 1.0. Table 5.1-2 lists the soil and groundwater RBSLs developed for Group 2 SWMU future-use evaluations.

The methods used to calculate risks using RBSLs are slightly different from those described in Section 5.1.4.1 for the current-use evaluations. However, the basic premise is the same in that both current- and future-use risk calculations incorporate CDI (dose) and toxicity (SF and/or RfD) parameters for multiple exposure routes. The reason for using this alternative (RBSL) approach to calculate future-use hazards and risks is twofold. First, because the exposure assumptions used in the risk calculations are the same for all SWMUs, it results in a more streamlined assessment (i.e., it eliminates redundancy in summarizing exposure assumptions and CDI/risk calculations). Second, it provides a worst-case screening level point of reference, against which observed concentrations of soil and groundwater COCs can be compared. The following paragraphs summarize the methods used to develop RBSLs and calculate associated risks; Appendix K.2 provides supporting documentation.

RBSL Development

Soil RBSLs for carcinogenic and noncarcinogenic endpoints were calculated using the equations and assumptions presented in Appendix Tables K.2-1 and K.2-2, respectively. These equations incorporate factors that quantify the assumed intakes for soil ingestion, dermal absorption (semivolatile organic compounds only), and vapor or particulate inhalation pathways.

Appendix Tables K.2-3 and K.2-4 document the equations and assumptions used to calculate carcinogenic and noncarcinogenic groundwater RBSLs. These equations account for both water ingestion and vapor inhalation (VOCs only) exposures.

For both soil and groundwater pathways, the exposure and toxicity assumptions used to develop RBSL equations follow standard EPA guidance for residential exposures (EPA 1989b, 1991a). For example, soil RBSLs for carcinogenic endpoints were calculated assuming that exposure occur to a 70-kilogram adult 350 days a year for 30 years and at a soil ingestion rate of 100 mg/day (Appendix Table K.1-1). Alternatively, soil RBSLs for noncarcinogenic endpoints were calculated assuming exposure to a 15-kilogram child at a soil ingestion rate of 200 mg/day (Appendix Table K.1-2). (Averaging time is not relevant for evaluation of noncarcinogenic endpoints). Groundwater RBSLs were calculated assuming the same exposure frequency and duration as that defined above for soil pathways, at a daily water ingestion rate of 2 liters per day (Appendix Tables K.2-3 and K.2-4).

Table 5.1-2 Summary of RBSLs for Soil and Groundwater: Hypothetical Residential Future-Use Pathways[1]

Chemical of Concern	Soil RBSL [2] (µg/g)	Groundwater RBSL (µg/l)
Aluminum	78,200	--
Antimony	31.3	14.6[4]
Arsenic*	0.97[4]	0.05[4]
Barium	5,480	2,560
Beryllium*	0.4[4]	--
Cadmium	78.2	--
Carbon tetrachloride*	--	0.22
Chloroform*	--	0.21
Chromium, hexavalent*	175	--
Chromium, total -- assuming 10% is hexavalent*	1,750	--
Chromium, trivalent	78,200	--
Cobalt	No Tox Data	No Tox Data
Copper	2,900	--
Cyanide	1,560	--
Ethylbenzene	--	2,430
Lead	400 [3]	15[3,4]
Manganese	10,900	--
Mercury	23.5	--
Methylene chloride*	--	5.42
Nickel	1,560	--
Selenium	--	183
Silver	391	--
Thallium	6.3[4]	2.92
Toluene	--	7,300
Vanadium	548	256
Zinc	23,500	--

Notes:

1 The equations and assumptions used to calculate the soil and groundwater RBSLs listed here are provided in Appendix Tables K.2-1 through K.2-4. COCs followed by an asterisk represent constituents for which the soil and/or groundwater RBSL reflects the carcinogenic endpoint corresponding to a 10^{-6} risk level goal.

2 For soil COCs for which both carcinogenic and noncarcinogenic endpoints were evaluated, the soil RBSLs listed above are the lowest (most conservative) of the values derived for both endpoints. For example, the soil RBSL for arsenic reflects the carcinogenic endpoint (the noncarcinogenic RBSL is 23.5 µg/g). However, the RBSLs for cadmium and nickel reflect the noncarcinogenic endpoint. (The higher carcinogenic RBSLs for these compounds stem from the small contribution of inhalation pathway risks and/or low cancer slope factors.)

3 No toxicity data are available for lead, precluding calculation of a soil RBSL. The value of 400 µg/g listed above is the screening level for lead in soil recommended by EPA for residential sites (EPA 1994, OSWER directive #9355.4-12). The value of 15µg/l for groundwater listed above for lead is the MCL.

4 The soil RBSLs listed above for arsenic, beryllium, and thallium are lower than corresponding background levels (27.3µg/g, 0.89 µg/g, and 49.9 µg/g, respectively). Therefore, any exceedances of risk-based criteria identified for these constituents should be interpreted with caution. Additionally, for arsenic, an RBSL of 9.7µg/g might be more appropriate than the 0.97µg/g (10^{-6} risk-based) value cited above, given the following conclusion drawn in a recent memorandum by the Administrator of the EPA: "The uncertainties associated with ingested inorganic arsenic are such that estimates could be modified downwards by as much as an order of magnitude, relative to risk estimates associated with most other carcinogens" (IRIS 1994). For water COCs, the RBSLs listed above for antimony, arsenic, and lead are lower than corresponding background levels (65.8 µg/l, 420 µg/l, and 24 µg/l, respectively).

-- Not applicable or not evaluated.

Characterization of Cancer Risks and Noncancer HIs Using RBSLs

Cancer risks for the future-use pathway evaluations were calculated using the following equation:

$$Risk_i = \frac{EPC_i}{RBSL_i} * RL \qquad (5\text{-}3)$$

where:

$Risk_i$	=	Cancer risk for chemical i
EPC_i	=	Exposure point concentration for chemical i (µg/g or µg/L)
$RBSL_i$	=	Risk based screening level for chemical i (µg/g or µg/L)
RL	=	Reference risk level (10^{-6})

The 10^{-6} reference risk level included in this equation accounts for the fact that the RBSL term was originally calculated assuming a 10^{-6} risk level. This approach to calculating risk is basically equivalent to that used for the current-use evaluations, in that risk is estimated as the product of the exposure point concentration, the intake rate, and the cancer slope factor (Section 5.1.4.1, Equation 5-1). The term "1/RBSL * RL" in Equation 5-3 is equivalent to the product of the intake rate and the slope factor; thus the two approaches yield the same result. The total cancer risk for residential exposures is then calculated by adding the chemical-specific risks.

As defined in Section 5.1.4.1 (Equation 5-2), noncancer HIs are calculated by summing the chemical-specific HQs. For the future-use risk evaluations, HQs are calculated by dividing the chemical-specific (soil or groundwater) EPC by the RBSL (i.e, the chemical concentration for which no adverse health effect is anticipated). An HQ is computed separately for each COC as shown below (Equation 5-4):

$$HQ_i = \frac{EPC_i}{RBSL_i} \qquad (5\text{-}4)$$

Where:

HQ_i	=	Hazard quotient for chemical i
EPC	=	Exposure point concentration for chemical i (µg/g or µg/L)
$RBSL_i$	=	Risk based screening level for chemical i (µg/g or µg/L)

This calculation is equivalent to calculating an HQ as the ratio of the chronic daily intake rate to the reference dose (Equation 5-2). The total (additive) noncancer health threat is then estimated by the hazard index, which is equal to the sum of the chemical-specific HQs.

5.1.4.3 Interpretation of Risk Assessment Results

Guidance specified in the State of Utah Hazardous Waste Management Rules (USHWCB 1994) states that the site management plan must contain procedures for corrective action if the level of risk present at a site is greater than 10^{-4} for carcinogens, or the hazard index is greater than 1.0 for noncarcinogens. If the level of risk present at a site is less than 10^{-4} for the risk assessment conducted for actual or potential land use conditions (based on applicable zoning and future land use planning considerations), or greater than 10^{-6} for the risk assessment conducted for future residential uses, the site management plan may contain, but is not required to contain, procedures for corrective action. However, the site management plan in this case must include provision for site controls to limit exposure and must also include post-closure care. If the level of risk present at a site is below 10^{-6} for carcinogens and a hazard index of less than one for noncarcinogens, the site management plan may contain a no further action option.

Given the State of Utah guidelines cited above, this report defines cancer risk estimates between 10^{-6} and 10^{-4} as being within the range of risks requiring only site controls. This interpretation is similar to that which has been established by the EPA for the Superfund Program under the National Contingency Plan (NCP, 1990). This federal guidance states that the target risk range for carcinogens is a 10^{-6} to 10^{-4} incremental cancer risk, and that for noncarcinogens, where the HI exceeds unity (1.0), assumed exposures may present a health hazard and therefore warrant further evaluation.

5.2 BASELINE HUMAN HEALTH RISK ASSESSMENT FOR SWMU 3

5.2.1 Identification of Chemicals of Concern

Using the criteria defined in Section 5.1.1, Tables 5.2-1 and 5.2-2 detail the COC selection process for SWMU 3 soil and groundwater samples, respectively. Table 5.2-3 summarizes the COCs selected for all media, including the air COCs that were selected based on the air monitoring results.

Only lead was selected as a SWMU-wide soil COC for SWMU 3. Chromium, copper, and zinc were identified as location-specific soil COCs for two sample locations at the southern end of the

Table 5.2-1 Identification of COCs for SWMU 3 Soil

Parameter	Detection Frequency [1]	Minimum	Maximum [6] (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
INORGANIC CONSTITUENTS								
Aluminum (Al)	24/24 (100%)	3,150	21,400 (3-GRT-1, 0-2")	12,862	25,200	Yes	No	The maximum concentration is less than the site-specific background level.
Antimony (Sb)	2/24 (8.3%)	10.7	15.3 (3-BLD-5, 0-2")	4.36	11.9	Yes	No	Antimony was detected in only two samples. Only the maximum (15.3 µg/g) concentration exceeds the 11.9 µg/g background level, and not by a significant amount.
Arsenic (As)	24/24 (100%)	9.57	500 (3-TRN-6, 0-2")	123	482.0	Yes	No	The maximum concentration is less than the site-specific background level.
Barium (Ba)	24/24 (100%)	63.8	526 (3-TRN-6, 0-2")	265	537	Yes	No	The maximum barium concentration is below the site-specific background value.
Beryllium (Be)	21/24 (87.5%)	0.35	1.22 (3-GRT-1, 0-2")	0.67	1.21	Yes	No	The maximum (1.22 µg/g) concentration is essentially equal to the 1.21 µg/g background value. The ore-grade beryllium deposits in surrounding mountains may be a potential source of the beryllium detected on site.
Cadmium (Cd)	9/24 (37.5%)	0.54	2.0 (3-TRN-1, 0-2")	0.56	0.98	Yes	No	Cadmium concentrations exceed the 0.98 µg/g background level in only two samples, and not by a significant amount. The maximum (2.0 µg/g) concentration was detected in sample 3-TRN-1, coinciding with the location of the metal boxes. The second highest concentration (1.2 µg/g in surface soil sample 3-BLD-3) is just slightly higher than the background value.
Calcium (Ca)	24/24 (100%)	44,800	180,000 (3-BLD-3, 0-2")	87,508	250,000	No	No	The maximum concentration is less than the site-specific background level. Calcium is a naturally-occurring essential human nutrient with negligible toxicity. It is also abundant as caliche deposits in the Utah desert.

Parameter	Detection Frequency [1]	Minimum	Maximum [6] (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Chromium (Cr)	**24/24 (100%)**	**7.14**	**117.0 (3-TRN-1, 0-2")**	**22.2**	**48.5**	**Yes**	**Yes* (3-TRN-1)**	**Only the maximum (117 µg/g) concentration exceeds the 48.5 µg/g background value; remaining detections are ≤ 31.0 µg/g. As observed for other metals, the maximum chromium concentration was detected in sample 3-TRN-1, coinciding with the location of the scrap metal boxes.[6] Chromium could be considered a sample-specific COC, but not a SWMU-wide COC given that all other detections are below background (see Note 4).**
Cobalt (Co)	24/24 (100%)	1.51	8.89 (3-TRN-1, 0-2")	5.78	8.6	No	No	The maximum (8.89 µg/g) concentration just slightly exceeds the 8.6 µg/g site-specific background; remaining cobalt concentrations are ≤ 8.4 µg/g.
Copper (Cu)	**24/24 (100%)**	**9.28**	**61.2 (3-TRN-1, 0-2")**	**16.6**	**27.6**	**Yes**	**Yes* (3-TRN-1)**	**The only detection exceeding background (27.6 µg/g) occurs in the 3-TRN-1 sample; remaining detections are ≤ 26.2 µg/g. As discussed for chromium (see above), copper could be considered a sample-specific COC, but not a SWMU-wide COC.[6] Consideration as even a sample-specific COC may be conservative because copper is widely distributed in nature and is an essential element.**
Cyanide (Cyn)	1/24 (4.2%)	1.73	1.73 (3-BLD-7, 0-2")	0.51	ND	Yes	No	Frequency of detection < 5%.
Iron (Fe)	24/24 (100%)	4,430	30,800 (3-TRN-1, 0-2")	14,091	24,300	No	No	Exceeds background in the 3-TRN-1 (0-2") sample only; remaining concentrations are ≤ 20,800 µg/g.[6] Iron is a naturally-occurring essential human nutrient with negligible toxicity, and is very abundant in the native geologic materials.

Parameter	Detection Frequency [1]	Minimum	Maximum [6] (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Lead (Pb)	**24/24 (100%)**	**7.74**	**170 (3-BLD-2, 0-2")**	**31.1**	**35.0**	**Yes**	**Yes**	**100% frequency of detection; exceeds background (35 µg/g) in 6 (25%) of the 24 samples; potential toxicity. The maximum lead concentration was detected at the location of the mustard spill site.**
Magnesium (Mg)	24/24 (100%)	9,370	23,500 (3-BLD-3, 0-2")	12,906	16,150	No	No	Exceeds background in 5 (21%) of the 24 samples. However, magnesium was not selected as a COC because it is a naturally-occurring essential human nutrient with negligible toxicity, and is widely abundant the native geologic materials.
Manganese (Mn)	24/24 (100%)	130	737 (3-GRT-1, 0-2")	438	658	Yes	No	Manganese concentrations exceed background in only three samples: 3-GRT-1 (metal grating location—737 µg/g, 12% higher than the background value); 3-TRN-1 (location of metal boxes—673 µg/g, 2% higher); and 3-BLD-5 (truck decon area—669 µg/g, 2% higher). These background exceedances are not notable, and likely reflect the surface features of the sample locations. Manganese is a ubiquitous mineral in desert soils, and it is also an essential element present in all living organisms. The principal portion of human intake is derived from food; vegetables, grains, fruits, and nuts are rich in manganese.
Mercury (Hg)	24/24 (100%)	0.037	2.8 (3-BLD-5, 0-2")	0.573	22.1	Yes	No	The maximum concentration is less than the site-specific background level.
Nickel (Ni)	24/24 (100%)	5.6	27.4 (3-TRN-1, 0-2")	15.9	27.9	Yes	No	The maximum nickel concentration is less than the site-specific background value.

Parameter	Detection Frequency [1]	Minimum	Maximum [6] (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Potassium (K)	24/24 (100%)	1,480	10,100 (3-GRT-1, 0-2")	4,329	7,940	No	No	Only the maximum concentration (detected at the metal grating location) exceeds background; remaining detections are ≤ 7,920 µg/g. Also, potassium is a naturally-occurring essential human nutrient with negligible toxicity, and is widely abundant in the native geologic materials.
Sodium (Na)	24/24 (100%)	424	3,780 (3-BLD-2, 2-3')	1,635	5,610	No	No	The maximum concentration is less than the site-specific background level. Also, sodium is naturally occurring and has negligible toxicity.
Thallium (Tl)	28/28 (100%)	16.7	54.9 (3-TRN-1)	31.7	49.9	Yes	No	Only the maximum (3-TRN-1) concentration exceeds background; this exceedance (54.9 µg/g vs. 49.9 µg/g) is not notable.[6] Remaining thallium detections are ≤ 45.6 µg/g.
Vanadium (V)	24/24 (100%)	4.77	51.7 (3-GRT-1, 2-3')	26.3	62.6	Yes	No	The maximum vanadium concentration is less than the site-specific background value.
Zinc (Zn)	**24/24 (100%)**	**40.2**	**820 (3-TRN-2, 0-2")**	**115**	**144**	**Yes**	**Yes* (3-TRN-2, 3-TRN-1)**	**Exceeds background (144 µg/g) in only 2 (8%) of the 24 samples: 3-TRN-2 (820 µg/g) and 3-TRN-1 (511 µg/g). The higher zinc levels observed in these trench samples are not unexpected given the surface features of this area.[6] Also, zinc is a naturally-occurring essential human nutrient that is widely abundant in the native geologic materials. Zinc-ore was mined in Ophir, and is present in most ore-grade districts of the Oquirrh mountains, so consideration as even an area-specific COC may be conservative.**

Parameter	Detection Frequency [1]	Minimum	Maximum [6] (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
ORGANIC CONSTITUENTS								
Di-n-butylphthalate (DNBP)	1/24 (4.2%)	10.0	10.0 (3-TRN-2, 0-2")	--	ND	Yes	No	Single, isolated occurrence (detection frequency <5%). Also, DNBP is a ubiquitous pollutant due to its widespread use as a plasticizer. Its presence in this sample could also reflect laboratory or sample container contamination.
Fluoranthene (FANT)	1/24 (4.2%)	0.12	0.12 (3-BLD-1, 0-2")	--	ND	Yes	No	Single detection at low concentration (frequency <5%). Potential sources of fluoranthene (and other polycyclic aromatic hydrocarbons [PAHs]) include natural sources (e.g., forest fires), products of incomplete combustion, and car exhaust.
Methylene chloride (CH2CL2)	3/24 12.5%	0.005	0.006 (3-GRT-1, 0-2", 3-BLD-5, 0-2")	--	ND	Yes	No	Although the detection frequency exceeds the 5% criterion, all three detections are in the low ppb range and are well below one half the CRL.
Methylphosphonic acid (MPA, = agent breakdown product)	**2/24 (8.3%)**	**2.94**	**10.8 (3-BLD-2, 2-3')**	**--**	**ND**	**Yes [7]**	**Yes* (3-BLD-2, 3-BLD-1)**	**MPA was detected at only two locations: 3-BLD-2, coinciding with the location of the mustard spill site, and 3-BLD-1. It is a hydrolysis product of the agents Sarin (GB) and VX (but is not a documented breakdown product of mustard). MPA is discussed qualitatively in Section 5.2.3.1.**
PCB 1254 (PCB254)	2/24 (8.3%)	0.118	0.331 (3-BLD-2, 0-2")	--	ND	Yes	No	The detection frequency exceeds the 5% criterion. However, concentrations are below EPA's 0.5 to 1.0 ppm PCB cleanup criterion developed for sites with unrestricted (i.e., residential) access (EPA 1990). A range of 10 to 25 ppm PCBs is considered protective for sites with limited access, including industrial sites (EPA 1990).

Parameter	Detection Frequency [1]	Minimum	Maximum [6] (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
PCB 1260 (PCB260)	1/24 (4.2%)	0.193	0.193 (3-BLD-2, 0-2")	--	ND	Yes	No	Single, isolated occurrence at low concentration; detection frequency < 5% (also, see above).
Pyrene (PYR)	1/24 (4.2%)	0.083	0.083 (3-BLD-1, 0-2")	--	ND	Yes	No	Single detection at low concentration (frequency <5%). See rationale presented for exclusion of fluoranthene.
NON-TARGET ANALYTES								
Clionasterol (GSITOS)	2/24 (8.3%)	0.64	1.0 (3-GRT-2, 0-2")	--	ND	No	No	No toxicity data; low concentrations (≤ 1 µg/g). Clionasterol is a steroid compound that may be naturally derived from plants and their degradation products in soil.
Diethylene glycol (DEGLYC)	2/24 (8.3%)	0.44	0.59 (3-BLD-4, 2-3')	--	ND	No	No	The detection frequency exceeds the 5% criterion; however, concentrations are low (< 1 µg/g). Also, diethylene glycol is widely used—in cosmetics, in antifreeze formulations, in lubricants, and as a softening agent. Given this widespread industrial use, the fact that both DEGLYC detections correspond to building locations is not unexpected.
Hydrocarbons, long-chain (C16A, C17, C27, and C29)	1/24 (4.2%)	0.35	1.3 (C17, 3-BLD-5)	--	ND	No	No	Detection frequency < 5%; negligible toxicity. Note, however, that the 4.2% detection frequency applies to each hydrocarbon, i.e., C16A, C17, etc. were detected only once. Their presence in samples may reflect naturally occurring long-chain hydrocarbons present in the organic carbon in soil.

Parameter	Detection Frequency [1]	Minimum	Maximum [6] (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Octadecamethyl-cyclo-nonasiloxane (OMCTSX)	2/24 (8.3%)	0.005	0.01 (3-BLD-1, 2-3')	--	ND	No	No	A search of several toxicological/medical databases yielded no toxicity data for this compound. Also, OMCTSX was detected in low concentrations at only two locations (3-BLD-1 and 3-BLD-6).

NOTES:

ND Not Determined
-- Not Calculated
All units in μg/g (ppm).
Bold print indicates the chemical was selected as a soil COC for SWMU 3.

1 The summaries provided in this table apply to both surface and subsurface soil (i.e., data for both soil depth profiles were merged to derive detection frequencies, means, etc.). Distinctions regarding the vertical distribution of constituents are made only if warranted by the data. In general, such distinctions are left to the quantitative risk assessment, for which current-use risks are calculated using surface soil data (only), and future-use risks are calculated using the merged (surface and subsurface) database.

2 Means were calculated assuming that nondetects are equivalent to one-half the MDL. Average concentrations are not reported for most organic and non-target analytes, however, because the low detection frequencies and high MDL values result in artificially elevated means (that often exceed reported maxima). Thus, the average was not considered to be a meaningful estimator for these constituents.

3 Site-specific background values were derived as the maximum detected concentration of each metal in background samples collected for the Group 2 SWMUs (Section 2.3).

4 "Yes" is indicated in this column when toxicity criteria are available that allow quantitative evaluation of a given compound (e.g., carcinogenic slope factors and/or noncarcinogenic RfDs from IRIS or HEAST).

5 When "Yes" is followed by an asterisk (*) in this column, it indicates that the constituent was not selected as a site-wide COC, but may be a potential sample- or area-specific COC (for example, see Note 6 below).

6 Maximum concentrations of seven metal constituents (cadmium, chromium, cobalt, copper, iron, nickel, and thallium) were detected in trench sample 3-TRN-1 (0-2"), coinciding with the location of the metal boxes and other metallic surface debris. For chromium, cobalt, copper, iron, and thallium, the only detection exceeding background occurred in this (3-TRN-1) sample. Concentrations of cadmium, cobalt, and thallium detected in sample 3-TRN-1 only slightly exceeded background, and the nickel detection was less than background. However, background exceedances were notable for chromium (117 μg/g maximum vs. 48.5 μg/g background), copper (61.2 μg/g vs. 27.6 μg/g), and iron (30,800 μg/g vs. 24,300 μg/g). Thus, chromium and copper could be considered sample-specific COCs (i.e., for [3-TRN-1]), but not as SWMU-wide COCs because remaining detections were less than background. Iron has negligible toxicity, and thus was not considered a COC despite presence at high levels relative to background.

7 Toxicity information does not exist for MPA, but for reasons presented in Section 5.1.3.3, IMPA will be used as a conservative surrogate in order to assess risk due to the presence of MPA in soil at SWMU 3.

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Octadecamethyl-cyclo-nonasiloxane (OMCTSX)	2/24 (8.3%)	0.005	0.01 (3-BLD-1, 2-3')	--	ND	No	No	A search of several toxicological/medical databases yielded no toxicity data for this compound. Also, OMCTSX was detected in low concentrations at only two locations (3-BLD-1 and 3-BLD-6).

NOTES:

1 The summaries provided in this table apply to both surface and subsurface soil (i.e., data for both soil depth profiles were merged to derive detection frequencies, means, etc.). Distinctions regarding the vertical distribution of constituents are made only if warranted by the data. In general, such distinctions are left to the quantitative risk assessment, for which current-use risks are calculated using surface soil data (only), and future-use risks are calculated using the merged (surface and subsurface) database.

2 Means were calculated assuming that nondetects are equivalent to one-half the MDL. Average concentrations are not reported for most organic and non-target analytes, however, because the low detection frequencies and high MDL values result in artificially elevated means (that often exceed reported maxima). Thus, the average was not considered to be a meaningful estimator for these constituents.

3 Background values were determined using the methods and assumptions described in Section 2.3.

4 "Yes" is indicated in this column when toxicity criteria are available that allow quantitative evaluation of a given compound (e.g., carcinogenic slope factors and/or noncarcinogenic RfDs from IRIS or HEAST).

5 When "Yes" is followed by an asterisk (*) in this column, it indicates that the constituent was not selected as a site-wide COC, but may be a potential sample- or area-specific COC (for example, see Note 6 below).

6 Maximum concentrations of seven metal constituents (cadmium, chromium, cobalt, copper, iron, nickel, and thallium) were detected in trench sample 3-TRN-1 (0-2"), coinciding with the location of the metal boxes and other metallic surface debris. For chromium, cobalt, copper, iron, and thallium, the only detection exceeding background occurred in this (3-TRN-1) sample. Concentrations of cadmium, cobalt, and thallium detected in sample 3-TRN-1 only slightly exceeded background, and the nickel detection was less than background. However, background exceedances were notable for chromium (117 μg/g maximum vs. 48.5 μg/g background), copper (61.2 μg/g vs. 27.6 μg/g), and iron (30,800 μg/g vs. 24,300 μg/g). Thus, chromium and copper could be considered sample-specific COCs (i.e., for [3-TRN-1]), but not as SWMU-wide COCs because remaining detections were less than background. Iron has negligible toxicity, and thus was not considered a COC despite presence at high levels relative to background.

ND Not Determined
-- Not Calculated

All units in μg/g (ppm).
Bold print indicates the chemical was selected as a soil COC for SWMU 3.

Parameter (No Detects)	Minimum [1]	Maximum (Location) [1]	Background Level [2]	MCL/ Criteria	Toxicity Data? [3]	Selected as Potential COC? [4]	Rationale for Selection or Exclusion as Potential Groundwater COC
INORGANIC CONSTITUENTS							
Aluminum (3/3)	10,900	310,000 (S-61-90)	14,200	200	Yes	Yes*	Two of the three detections exceed background (the maximum by more than an order of magnitude). The highest concentration (310,000 µg/l) was detected in the most upgradient well. (Note, however, that this background level was determined on the basis of only one well sample [Table 2.3-3].) Although aluminum is a ubiquitous component of aluminosilicate materials, no MCL is available for comparison, nor was aluminum selected as a soil COC for this SWMU (Table 5.2-1). Therefore, selection as a groundwater COC is likely to be conservative.
Arsenic (3/3)	**35.4**	**310 (S-61-90)**	**35.5**	**50**	**Yes**	**Yes**	**Two of the three detections exceed both background and the 50 µg/l MCL. The highest concentration (310 µg/l) was detected in the most upgradient well. Arsenic was also considered a soil COC for this SWMU. Note, however, that arsenic concentrations reported in the RFI Phase I investigation for <u>filtered</u> samples were 9.1 µg/l (S-61-90), 9.3 µg/l (S-62-90), and 12 µg/l (S-63-90), each of which is well below the 50 µg/l MCL.**
Barium (3/3)	181	2,220 (S-61-90)	200	2,000	Yes	Yes*	Two of the three detections exceed background. The maximum concentration, which was detected in the most upgradient well, exceeds the 2,000 µg/l MCL, but remaining concentrations are ≤ 418 µg/l. Also, barium was not selected as a soil COC so selection as a groundwater COC may be conservative.
Beryllium (1/3)	**15.1**	**15.1 (S-61-90)**	**0.805**	**4.0**	**Yes**	**Yes**	**The single detection exceeds background by a factor of almost 19, and the MCL by a factor of approximately 5. This lone detection occurred in the most upgradient well.**

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Parameter (No Detects)	Minimum [1]	Maximum (Location) [1]	Background Level [2]	MCL/ Criteria	Toxicity Data? [3]	Selected as Potential COC? [4]	Rationale for Selection or Exclusion as Potential Groundwater COC
Cadmium (3/3)	3.6	10.4 (S-61-90)	10.7	5.0	Yes	No	The maximum cadmium concentration exceeds the MCL, but is less than the site-specific background level. The highest concentration, like other metals, was detected in the most upgradient well.
Chromium (3/3)	**24.9**	**329 (S-61-90)**	**35.5**	**100**	**Yes**	**Yes**	**Two of the three detections exceed background; the maximum concentration exceeds background by almost an order of magnitude, and is more than three times greater than the MCL. As with other metals, the highest concentration of chromium occurred in the most upgradient well. Also, chromium was selected as a sample-specific soil COC for the nearby 3-TRN-1 sample. Note, however, that chromium concentrations reported in the RFI Phase I investigation for filtered samples were 8.6 μg/l (S-61-90), 9.7 μg/l (S-62-90), and 15 μg/l (S-63-90), each of which is well below the 100 μg/l MCL.**
Cobalt (3/3)	18.3	110 (S-61-90)	ND	NA	No	No	Cobalt was analyzed for in only one of the four background wells (S-50-90), where it was not detected (Table 2.3-3). Therefore, comparison of detected levels to this single background observation may not be meaningful. The highest cobalt concentration occurred in the most upgradient well. Cobalt was not selected as a soil COC, and neither toxicity data nor groundwater criteria (e.g., an MCL) are available for its quantitative evaluation. Consequently, cobalt was not selected as a groundwater COC.
Copper (3/3)	18.0	253 (S-61-90)	47.7	1,000	Yes	Yes*	The (maximum) concentration in well S-61-90, the most upgradient well, is more than five times greater than background, so copper was selected as a sample-specific soil COC for the nearby 3-TRN-1 sample. However, the remaining two groundwater detections are less than background. Also, all copper concentrations are well below the 1,000 μg/l secondary MCL (SMCL), so selection as a COC may be conservative.

Parameter (No Detects)	Minimum [1]	Maximum (Location) [1]	Background Level [2]	MCL/ Criteria	Toxicity Data? [3]	Selected as Potential COC? [4]	Rationale for Selection or Exclusion as Potential Groundwater COC
Lead (3/3)	**9.22**	**210 (S-61-90)**	**57.7**	**15**	**Yes**	**Yes**	**The (maximum) lead concentration in well S-61-90, the most upgradient well, greatly exceeds both background and the MCL (15 µg/l). Also, lead was selected as a site-wide COC for SWMU 3. (Lead concentrations in the remaining two wells, however, were less than background.)**
Mercury (1/3)	1.15	1.15 (S-61-90)	<0.243	2.0	Yes	Yes*	The single mercury detection exceeds background, but does not exceed the MCL, so selection as a COC may be conservative. The detection occurred in the most upgradient well. However, mercury was selected as a site-wide soil COC.
Nickel (3/3)	**21.0**	**340 (S-61-90)**	**45.1**	**100**	**Yes**	**Yes**	**Two of the three nickel detections exceed background; however, only the S-61-90 detection exceeds the MCL (100 µg/l). This highest concentration occurred in the most upgradient well. Nickel concentrations in SWMU 3 soil, however, were all less than background (Table 5.2-1).**
Thallium (1/3)	**10.9**	**10.9 (S-62-90)**	**<7.0**	**2**	**Yes**	**Yes**	**The single thallium detection exceeds both background and the MCL. However, thallium was not identified as a soil COC for this SWMU.**
Vanadium (3/3)	28.4	437 (S-61-90)	27.1	ND	Yes	Yes*	All three detections exceed background, the maximum by over a factor of 16. The highest concentration (437 µg/l) was detected in the most upgradient well. Note, however, that the 27.1 µg/l background level was determined on the basis of only two well samples (Table 2.3-3). Also, vanadium concentrations in SWMU 3 soils were all less than background (Table 5.2-1), so selection as a groundwater COC may be conservative.

Parameter (No Detects)	Minimum [1]	Maximum (Location) [1]	Background Level [2]	MCL/ Criteria	Toxicity Data? [3]	Selected as Potential COC? [4]	Rationale for Selection or Exclusion as Potential Groundwater COC
Zinc (3/3)	57.5	1,110 (S-62-90)	1,100	5,000	Yes	No	The maximum (1,110 µg/l) zinc concentration is essentially equal to the 1,100 µg/l background value. Remaining detections are less than background, and all concentrations are well below the 5,000 µg/l secondary MCL (SMCL).

Parameter (No Detects)	Minimum [1]	Maximum (Location) [1]	Background Level [2]	MCL/ Criteria	Toxicity Data? [3]	Selected as Potential COC? [4]	Rationale for Selection or Exclusion as Potential Groundwater COC
ORGANIC CONSTITUENTS							
Methylene chloride (2/3)	1.15	3.4 (S-62-90)	ND	5.0	Yes	Yes*	Background data are not available to determine whether detected concentrations are attributable to upgradient water quality. Both detections are less than the 5.0 µg/l MCL, and methylene chloride was detected in low parts per billion (ppb) concentrations in SWMU 3 soils. However, it was conservatively selected as a groundwater COC because it is a potential human carcinogen. It should also be noted that methylene chloride is a common laboratory contaminant.

NOTE: All units in µg/l (ppb). Detection frequencies are not listed in this table, as only three groundwater samples were collected. With the exception of thallium and methylene chloride, maximum concentrations for all constituents were detected in well S-61-90. Bold print indicates groundwater COCs whose presence may be attributable to previous SWMU 3 activities. Other constituents identified as groundwater COCs were conservatively selected given the reasons stated in Note 4 of this table.
ND=Not Determined; NA=Not Available.

1 Reported groundwater concentrations reflect results of unfiltered groundwater sample analyses. Results for anions, cations, and commonly-occurring constituents with negligible toxicity (e.g, calcium, iron, magnesium, manganese, potassium, and sodium) are not addressed in this table, but are reported in Table 4.1-3.

2 Background levels for groundwater were determined using the methods and assumptions described in Section 2.3.

3 "Yes" is indicated in this column when toxicity criteria are available that allow quantitative evaluation of a given compound.

4 As discussed in Section 5.1.1.2, given the small number of groundwater samples collected at each SWMU (there were three wells at SWMU 3), detection frequency could not be used as a criterion for COC selection. Therefore, in general, if a constituent was detected in groundwater at the SWMU at a level or levels exceeding background, and toxicity criteria were available, it was considered a groundwater COC (even if an MCL was not exceeded), and thus carried through the quantitative future-use groundwater pathway evaluation. When "Yes" is followed by an asterisk (*) in this column, it indicates that the constituent was selected as a groundwater COC based on these conservative assumptions (i.e., exceedance of background), but there is insufficient evidence that its presence is attributable to site-related activities and/or poses a health risk. For example, given the high turbidity of groundwater samples from SWMU 3 wells, the presence of elevated levels of metals suggests that natural conditions (i.e., colloids, suspended particulates, adsorbed metals, etc.) may be responsible for the observed concentrations, not SWMU-related activities.

Table 5.2-3 Summary of COCs Selected for SWMU 3 Media

SWMU-Wide Soil COCs [1]	Sample- or Area-Specific Soil COCs [1]	Location	Air COCs [2]	Groundwater COCs [3]
	Chromium	trench sample 3-TRN-1	Chloroform	Aluminum* Arsenic
Lead	Copper	trench sample 3-TRN-1	Methylene chloride	Barium* Beryllium
	Zinc	trench samples 3-TRN-2 and 3-TRN-1	Tetrachloro-ethene	Chromium Copper* Lead
	MPA [4]	3-BLD-2 and 3-BLD-1	Tetrachloro-ethene	Mercury* Nickel Thallium Vanadium*
				Methylene Chloride*

MPA Methylphosphonic acid

NOTES:

1 As indicated in Table 5.2-1 (Note 5), for certain constituents elevated concentrations were only detected in localized areas of the SWMU. Concentrations at remaining sample locations were less than site-specific background levels. Therefore, these constituents were not selected as site-wide COCs, but are considered sample- or area-specific COCs.

2 Air COCs for organic constituents were selected based on results of the ambient air sampling and meteorological monitoring conducted at TEAD-S from September 11, 1993 to October 3, 1993. In general, a constituent was selected as an air COC if detected concentrations significantly exceeded levels reported for the background (BK) monitoring location. Air COCs were not selected for metals because monitoring results were considered invalid due to media and laboratory problems.

3 The list of chemicals selected as groundwater COCs is rather extensive relative to that identified for soil (for metals, in particular); the latter reflects the conservatism used in the groundwater COC selection process described in Table 5.2-2 (Note 4). Constituents followed by an asterisk (*) were selected as groundwater COCs based on conservative assumptions. However, there is insufficient evidence that their presence is attributable to site-related activities and/or poses a health risk.

4 No toxicity data are available for MPA, so this constituent will be addressed only qualitatively in the risk assessment.

open portion of the disposal trench (3-TRN-1 and 3-TRN-2 [zinc only]). MPA was also identified as a location-specific COC for two sample locations on the gravel pad (3-BLD-2 and 3-BLD-1). Although MPA could not be quantitatively evaluated it is discussed qualitatively in Section 5.2.3.1. Detailed rationales for soil COC selection and designations (as SWMU-wide or location-specific COCs) are provided in Tables 5.2-1 and 5.2-3.

Air COCs selected on the basis of the air monitoring results include chloroform, methylene chloride, tetrachloroethene, and trichloroethene. These constituents were identified as air COCs because ambient concentrations detected at SWMU 3 exceeded levels reported for the background monitoring location (Table 5.2-3).

Constituents identified as SWMU 3 groundwater COCs include aluminum, arsenic, barium, beryllium, chromium, copper, lead, mercury, nickel, thallium, vanadium, and methylene chloride (Table 5.2-2). Of these constituents, arsenic, beryllium, chromium, lead, and nickel are considered the primary COCs. For the remaining constituents, there is insufficient evidence that their presence is attributable to SWMU-related activities and/or poses a health risk (Table 5.2-3).

5.2.2 Exposure Assessment

Table 5.2-4 summarizes the current- and future-use exposure pathways at SWMU 3 that were quantified in the risk assessment. (Table 5.1-1 presents rationales for excluding pathways from quantitative evaluation.) Table 5.2-5 lists the soil and air EPCs used in the risk calculations; groundwater EPCs are the maximum COC concentrations listed in Table 5.2-2. Table 5.2-6 summarizes the pathway-specific exposure parameters, along with supporting references, assumptions, and rationales. The values listed in Tables 5.2-5 and 5.2-6 were applied using the methods outlined in Section 5.1.2, and the CDI equations listed in Appendix Table K.1-1. (CDI calculation documentation specific to SWMU 3 is provided in Appendix Tables K.3-1 through K.3-5.)

5.2.3 Risk Characterization

This section quantifies risks for the SWMU 3 exposure pathways identified in Table 5.2-4. Section 5.2.3.1 presents the results of the risk assessment for current-use soil exposure scenarios. Sections 5.2.3.2 and 5.2.3.3 present the risk assessment results for hypothetical future-use exposures to soil and groundwater, respectively. In accordance with EPA Region VIII protocols, this analysis assumes that 10 percent of the detected (total) chromium is in the hexavalent form; the remaining 90 percent is assumed to be trivalent. As discussed in Section 5.1.2.3

Exposure Medium	Potential Receptor(s)	Receptor Location(s)	Potential Exposure Route(s)	Pathway Quantitatively Evaluated?[1]	Reason for Selection or Exclusion
CURRENT-USE EXPOSURE PATHWAYS					
Current-Use Exposure Scenarios 1a and 1b: SWMU 3 Receptor					
Surface (0-2") Soils	Site Environmental Management Personnel	Within SWMU 3	**1(a)** Incidental Ingestion, Dermal Contact, and Inhalation Soil Exposure Pathways **(1b)** Inhalation of volatile organic air COCs (Table 5.2-3)	YES	SWMU 3 is currently inactive and security patrols do not enter the site. However, Environmental Management staff do access the SWMU twice per year for semi-annual groundwater monitoring. Therefore, potential exposures to soil and air COCs were quantitatively evaluated assuming workers enter the SWMU twice per year for collection of groundwater samples (4 hours per exposure) and another two times (within a given year) for inspection of the grounds.
Current-Use Exposure Scenario 2: Site Security Personnel Receptor					
Resuspended Surface Soil Particulates	Site Security Personnel	Along Perimeter of SWMU 3	Inhalation of Resuspended Soil Particulates	YES	The SWMU 3 location is very isolated. Also, the general wind direction is northwest to southeast, so no downwind worker receptors are apparent. The only possible exception might be site security personnel who drive by SWMU 3 to inspect the grounds. According to TEAD Chemical Surety staff, there are three security shifts per day, so a given worker makes only one circuit of a SWMU per day. Each circuit (i.e., the drive around the SWMU perimeter) takes approximately 15 minutes. A conservative scenario involving one 30-minute inspection circuit per shift per day (250 days per year) was therefore evaluated using a worst-case (screening level) estimate of COC concentrations in resuspended surface soils. These assumptions are based on SWMUs that are regularly patrolled (e.g., SWMUs 1 and 25) and therefore, given the remote location of SWMU 3, are very conservative.

Table 5.2-4 Potential Pathways of Exposure to COCs at SWMU 3

Exposure Medium	Potential Receptor(s)	Receptor Location(s)	Potential Exposure Route(s)	Pathway Quantitatively Evaluated?[1]	Reason for Selection or Exclusion
FUTURE USE EXPOSURE PATHWAYS					
Surface and Subsurface Soil	Future Residents	Within SWMU 3	Ingestion, Dermal Contact, and Inhalation Soil Exposure Pathways Associated with Hypothetical Future Residential Use of SWMU 3	YES	Future residential use of TEAD-S is not expected. Nonetheless, in accordance with state and federal risk assessment guidelines, this hypothetical future use pathway was quantitatively evaluated using the exposure assumptions outlined in Section 5.1 and in Appendix K.2. This assessment is considered to represent a worst-case screening level evaluation of risks associated with potential exposures to SWMU 3 soil COCs.
Shallow Groundwater (Future Uses)	Future Residents	SWMU 3 Wells Screened in the Shallow Aquifer	Ingestion, and Inhalation of Volatile COCs while Showering or Washing	YES	Future use of shallow groundwater underlying SWMU 3 is not expected. However, as discussed above, this pathway was nonetheless quantitatively evaluated in the baseline risk assessment, and represents a worst-case screening level evaluation of risks associated with potential exposures to COCs in SWMU 3 shallow groundwater.

COC- Chemical of Concern

[1] For pathways that were quantitatively evaluated, exposure assumptions are summarized in Table 5.2-6. These pathways were quantified for both SWMU-wide and location-specific risk evaluations (Tables 5.2-7 and 5.2-8).

Table 5.2-5 EPCs Used to Evaluate SWMU 3 Exposure Pathways[1]

	SWMU-Wide Risk Evaluation [2,3]				Location-Specific Risk Evaluation [4]		
	Current-Use Pathways		Future-Use Pathways		Current- and Future-Use Pathways		
Chemical of Concern	Surface Soil EPC (µg/g)	Corresponding Air EPC (mg/m^3)	Surface/Subsurface Soil EPC (µg/g)	Corresponding Air EPC (mg/m^3)	Soil EPC (µg/g)	Basis (Location) Trench Area	Corresponding Air EPC (mg/m^3)
Chromium*	--	--	--	--	117	3-TRN-1 (0-2")	3.51E-07
Copper*	--	--	--	--	61.2	3-TRN-1 (0-2")	1.84E-07
Lead	63.9	1.92E-07	44.6	--	130	3-TRN-2 (0-2")	3.90E-07
Zinc*	--	--	--	--	820	3-TRN-2 (0-2")	2.46E-06
Chloroform	--	5.50E-03	--	--	--	--	--
Methylene chloride	--	1.15E-03	--	--	--	--	--
Tetrachloroethene	--	4.34E-03	--	--	--	--	--
Trichloroethene	--	1.39E-03	--	--	--	--	--

NOTES:

-- Not applicable or not evaluated.

* Sample- or area-specific COC.

1 This table lists soil and air EPCs only. Given that only three groundwater samples were collected, and that maxima for most constituents (metals, in particular) were detected at the same sample location (well S-61-90), groundwater EPCs are the maximum concentrations listed in Table 5.2-2.

2 For current use pathways, soil EPCs are the 95% UCL of the mean surface soil concentration. These EPCs, considered to represent RME estimates, were calculated assuming nondetections are equal to one-half the method detection limit value. Soil EPCs for the future residential use pathway evaluation are the 95% UCL of the mean COC concentration in surface and subsurface soil (combined).

3 Inhalation of soil COCs adsorbed to respirable particulates (PM10) was assessed using a PEF equal to 8.62×10^8 m^3/kg. This factor relates the contaminant concentration in soil with the concentration of respirable particulates in the air due to fugitive dust emissions from contaminated soils (EPA, 1991), and was derived using the methods described in Section 5.1.2. This PEF factor is considered conservative, particularly given the hardpan-like texture of the soil surface. Air EPCs were not estimated for the hypothetical future use pathway because risks were calculated on the basis of soil concentrations only (see Table 5.1-3 and Appendix K.2).

Air EPCs for organic constituents were selected based on results of the ambient air sampling conducted at TEAD-S from September 11, 1993 to October 3, 1993 (Table 5.2-3). Given the availability of these monitoring data, no modeling was performed for organic soil COCs (which, for SWMU 3, were generally not detected). Rather, the air monitoring data are considered to supersede any modeled estimates (derived on the basis of soil VOC or SVOC concentrations). The analysis uses the average concentrations (Appendix I, Table 8), which were applied to the current use pathway evaluation only. (As discussed previously, no air COCs were selected for metals because monitoring results were considered invalid due to media and laboratory problems.)

4 EPCs for sample- or area-specific soil COCs are essentially the maximum concentration detected at the sample location listed in the table above (e.g., the 3-TRN-1 surface soil sample). These EPCs were applied in both the current- and future-use risk evaluations. To adequately account for potential cumulative risks or hazards in the specified areas, location-specific EPCs are also listed for site-wide COCs (arsenic, lead, and mercury) that correspond to the 3-TRN-1 and 3-TRN-2 sample locations.

Table 5.2-6 Assumptions Used to Evaluate SWMU 3 Current-Use Exposure Pathways

PARAMETER	ASSUMED VALUE: Site EM Personnel	ASSUMED VALUE: Site Security Personnel	SOURCE/RATIONALE
General Exposure Parameters			
Age During Exposure	Adult	Adult	-
Average Body Weight	70 kg	70 kg	EPA 1991a. Standard default.
Lifetime Exposure Duration	25 years	25 years	EPA 1991a. Standard default.
Exposure Frequency	4 days/year	250 days/year	Professional judgement based on site-specific factors (see Table 5.2-4).
Direct Contact Parameters			
Soil Ingestion Rate	100 mg/day[1]	NA	EPA 1991 (See Note 1).
Soil Adherence Rate	1.0 mg/cm^2	NA	EPA 1992c. Upper bound default.
Surface Area Exposed	4,100 cm^2	NA	EPA 1992c (See Note 2).
Dermal Absorption Rate	Metals: 0.1% Organics: 10%	NA NA	EPA 1992c
Inhalation Exposure Parameters			
Hours per Day	4 hours	0.5 hours	Professional judgement based on site-specific factors (Table 5.2-4).
Inhalation Rate	2.5 m^3/hour	2.5 m^3/hour	EPA 1991a. Assumes moderate activity for both receptor groups.
Particulate Emission Factor	8.62 x 10^8 m^3/kg	8.62 x 10^8 m^3/kg	Site-specific particulate emission factor (PEF); see Section 5.1.2 for derivation.

Notes:

1 Although EPA guidance (1991a) recommends a soil ingestion rate of 50 mg/day for workers, a more conservative value of 100 mg/day is used in this assessment to account for potentially higher exposures possible at TEAD-S for an outdoor work environment.

2 The skin surface area of 4,100 cm^2 is for an adult male, and represents a 95th percentile value for the hands, forearms, and head (EPA 1992c).

(Determination of Exposure Point Concentrations), this assumption is likely to be conservative. Section 5.2.3.4 summarizes the results of the current- and future-use risk evaluations developed for SWMU 3.

5.2.3.1 Current-Use Risks

SWMU-Wide Risk Evaluation

Table 5.2-7 summarizes the cancer risks and HIs calculated for SWMU 3 current-use SWMU-wide exposure scenarios. The cancer risk and HI calculated for site Environmental Management (EM) personnel receptors (exposure scenario 1) are will below the corrective action criteria. There is no cancer risk for site security personnel receptors (exposure scenario 2) since there are no carcinogenic COCs to be evaluated. The HI calculated for this scenario is zero because toxicity criteria are not available to quantify hazards associated with lead. However, the maximum value of lead detected in SWMU 3 soil (170 µg/g) is well below the USEPA Screening Level for lead (400 µg/g).

Location-Specific Risk Evaluation

Table 5.2-8 summarizes the cancer risks and hazard indices calculated for SWMU 3 current-use location-specific exposure scenarios–trench samples 1 and 2. The cancer risks and HIs calculated for both the EM personnel receptors and the site security personnel receptors are well below corrective action criteria. MPA, although selected as a COC, was not quantitatively evaluated because chronic exposure toxicity data are not available for this compound. As presented in Section 5.1.3.3, MPA is chemically similar to IMPA, thus IMPA has been evaluated as a conservative surrogate for MPA in the evaluation of risk at SWMU 3. Using IMPA as a surrogate, associated future risk calculated for MPA indicates corrective action criteria are not exceeded. Exposure to the part-per-million levels of MPA that were measured in SWMU 3 soil are not expected to cause any other perceptible effects under either the current use or hypothetical residential use scenarios. Therefore, no action is required to limit exposures to the trace levels of MPA detected at SWMU 3.

5.2.3.2 Potential Future-Use Soil Exposure Risks

Table 5.2-9 summarizes the results of the risk assessment developed for hypothetical future-use exposures to SWMU 3 surface and subsurface soils. Cancer risks and noncancer HIs presented in this table were calculated using RBSLs (Table 5.1-2) in accordance with the methods, (Determination of Exposure Point Concentrations), this assumption is likely to be conservative. Section 5.2.3.4 summarizes the results of the current- and future-use risk evaluations developed for SWMU 3.

5.2.3.1 Current-Use Risks

SWMU-Wide Risk Evaluation

Table 5.2-7 summarizes the cancer risks and HIs calculated for SWMU 3 current-use SWMU-wide exposure scenarios. The cancer risk and HI calculated for site Environmental Management (EM) personnel receptors (exposure scenario 1) are well below the corrective action criteria. There is no cancer risk for site security personnel receptors (exposure scenario 2) since there are no carcinogenic COCs to be evaluated. The HI calculated for this scenario is zero because toxicity criteria are not available to quantify hazards associated with lead. However, the maximum value of lead detected in SWMU 3 soil (170 μg/g) is well below the USEPA Screening Level for lead (400 μg/g).

Location-Specific Risk Evaluation

Table 5.2-8 summarizes the cancer risks and hazard indices calculated for SWMU 3 current-use location-specific exposure scenarios—trench samples 1 and 2. The cancer risks and HIs calculated for both the EM personnel receptors and the site security personnel receptors are well below corrective action criteria. MPA, although selected as a COC, was not quantitatively evaluated because chronic exposure toxicity data are not available for this compound. However, this compound is readily metabolized to phosphorus acid and methanol. Both of these products are water soluble and are easily excreted. At sufficient concentrations, phosphorous acid and methanol are each irritants to the eyes, upper respiratory tract, and skin. However, exposure to the part-per-million levels of MPA that were measured in SWMU 3 soil are not expected to cause either these or any other perceptible effects under either the current use or hypothetical residential use scenarios. Therefore, no action is required to limit exposures to the trace levels of MPA detected at SWMU 3.

5.2.3.2 Potential Future-Use Soil Exposure Risks

Table 5.2-9 summarizes the results of the risk assessment developed for hypothetical future-use exposures to SWMU 3 surface and subsurface soils. Cancer risks and noncancer HIs presented in this table were calculated using RBSLs (Table 5.1-2) in accordance with the methods,

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Table 5.2-7 Cancer Risks and Hazard Indices Calculated for SWMU 3 Current-Use SWMU-Wide Exposure Pathways[1]

Current-Use Exposure Scenario			Results of Cancer Risk (CR) Calculations		Results of Hazard Index (HI) Calculations	
Receptor	Pathway(s)	COCs Evaluated	CR	Driving COC(s) and Pathway	HI	Driving COC(s) and Pathway
Current-Use Exposure Scenario 1a: Receptor Location—Within SWMU 3						
Site EM Personnel	SI/DC/INH (Appendix Table K.3-1)	SWMU-wide COC: lead[2]	0	None	NE	Lead is below the EPA screening level[2]
Current-Use Exposure Scenario 1b: Receptor Location—Within SWMU 3						
Site EM Personnel	INH[3] (Appendix Table K.3-2)	VOCs, based on air monitoring data (Table 5.2-3)	2.6×10^{-7}	chloroform—accounts for 96% of the CR; CRs for remaining air COCs are less than 10^{-8} (see Note 4)	2×10^{-6}	methylene chloride
Scenario 1 Total Current-Use Risk (1a+1b):			**3×10^{-7}**	**chloroform**	**2×10^{-6}**	**Methylene chloride**
Current-Use Exposure Scenario 2: Receptor Location—SWMU 3 Perimeter						
Site Security Personnel	N/A (Appendix Table K.3-3)	SWMU-wide COC: lead	0	None	NE	Lead is below the EPA screening level[2]

Interpretation: *The cancer risk calculated for current-use exposure scenario 1 (direct contact and inhalation exposures to soil COCs and VOCs in air at SWMU 3 by site EM personnel) is below the risk level requiring site controls as stated in State of Utah rules. This risk is attributable primarily to direct contact exposures to arsenic, which occurred at elevated levels (130-500 ug/g) in 8 of 24 soil samples. Results of risk calculations for the remaining current use pathway scenarios are all well below the corrective action criteria (for carcinogens and noncarcinogens).*

COC - Chemical of Concern
SI - Soil Ingestion Pathway
DC - Dermal Contact Pathway
INH - Inhalation Pathway
CR - Cancer Risk
HI - Hazard Index
NE - No exceedance based on the USEPA soil screening level for lead. Potential human health risks are not likely to occur following chronic exposure.

1 Tables 5.2-3 and 5.2-4 detail the COC and exposure pathway selection process; Tables 5.2-5 and 5.2-6 summarize the chemical-specific exposure point concentrations (EPCs) and exposure assumptions used in the risk calculations. Appendix Tables K.3-1 through K.3-3 provide detailed cancer risk and HI calculation documentation.

2 Although lead was identified as a site-wide soil COC for SWMU 3, toxicity criteria are not available with which to quantify associated hazards or risks. Currently, as set forth by OSWER directive #9355.4-12, EPA recommends a screening level for lead in soil of 400 ug/g, assuming residential land use (EPA, 1994). The maximum detected lead concentration in SWMU 3 soils, 170 μg/g (Table 5.2-1), is well below this level.

3 Risks associated with inhalation of VOCs are presented separately given: (1) differences in source data—VOCs were identified as air COCs based on the air monitoring results, but were not detected in soil; and (2) the differences in EPC determination—EPCs for the site-wide soil COCs are the 95% UCL of the mean soil COC concentration (RME estimates), whereas EPCs for VOCs in air are based on monitoring results, and are the average VOC concentration reported in Appendix I (Table 8).

Table 5.2-8 Cancer Risks and Hazard Indices Calculated for SWMU 3 Current-Use Location-Specific Exposure Pathways[1]

Current-Use Exposure Scenario			Results of Cancer Risk (CR) Calculations		Results of Hazard Index (HI) Calculations	
Receptor	Pathway(s)	COCs Evaluated	CR	Driving COC(s) and Pathway	HI	Driving COC(s) and Pathway
Current-Use Exposure Scenario 1: Source Location—Trench Samples 1 and 2 Receptor Location—Within SWMU 3						
Site EM Personnel	INH (Appendix Table K.3-4)	Sample-specific COCs (Cr, Cu, Zn)	3×10^{-10}	Chromium; inhalation dominates	7×10^{-5}	Zinc accounts for 61% of the HI, copper accounts for 37%; soil ingestion pathway dominates
Current-Use Exposure Scenario 2: Source Location—Trench Samples 1 and 2 Receptor Location—SWMU 3 Perimeter						
Site Security Personnel	INH (Appendix Table K.3-5)	Sample-specific COCs (Cr, Cu, Zn)	3×10^{-9}	Chromium (assuming 10% of the total Cr is in hexavalent form) accounts for the inhalation cancer risk	0	RfD values are not available for these COCs

Interpretation: *The cancer risk calculated for current use exposure scenario 1—direct contact and inhalation exposures to soil COCs at the SWMU 3 trench locations by site EM personnel—is well below the risk level requiring site controls as stated in State of Utah rules. As identified for the SWMU-wide risk evaluation (Table 5.2-7), this risk is attributable primarily to direct contact exposures to arsenic, which occurred at elevated levels in trench soil samples. Results of risk calculations for the remaining location-specific (current-use) pathway scenarios are all well below the corrective action criteria (for carcinogens and noncarcinogens).*

COC - Chemical of Concern
SI - Soil Ingestion Pathway
DC - Dermal Contact Pathway
INH - Inhalation Pathway
CR - Cancer Risk
HI - Hazard Index

1 Tables 5.2-3 and 5.2-4 detail the COC and exposure pathway selection process; Tables 5.2-5 and 5.2-6 summarize the chemical-specific exposure point concentrations (EPCs) and exposure assumptions used in the risk calculations. Appendix Tables K.3-4 and K.3-5 provide detailed cancer risk and HI calculation documentation for the SWMU 3 location-specific evaluation.

Table 5.2-9 Cancer Risks and Hazard Indices Calculated for SWMU 3 Hypothetical Future-Use Soil Exposure Pathways

Chemical of Concern	Carcinogenic RBSL (mg/kg)	Soil EPC (μg/g)	Cancer Risk	(Percent of Total Risk)	Noncarcinogenic RBSL (μg/g)	Soil EPC (μg/g)	Hazard Quotient	Percent of Total HI)
SWMU-WIDE RISK EVALUATION								
Lead		44.6			400	44.6	NE	
	Total Cancer Risk:		0.0E+00		Total Hazard Index (HI):		0.0E+00	
LOCATION-SPECIFIC RISK EVALUATION: 3-TRN-1 and 3-TRN-2 LOCATIONS								
Chromium	175	117	6.7E-07	100%	391	117	3.0E-01	84%
Copper		61.2			2,902	61.2	2.1E-02	6%
Lead		130			400	130	NE	
Zinc		820			23,464	820	3.5E-02	<1%
	Total Cancer Risk:		6.7E-07		Total Hazard Index (HI):		3.6E-01	

NOTE: NE = No Exceedance based on the USEPA Soil Screening Level for lead. Potential human health risks are not likely to occur following chronic exposure.

equations, and assumptions outlined in Section 5.1.4.1 and Appendix K.2. The cancer risks and the HIs calculated for both the SWMU-wide and location-specific future-use scenarios are well below corrective action criteria, assuming residential use of the site.

5.2.3.3 Potential Future-Use Groundwater Exposure Risks

Table 5.2-10 summarizes the results of the risk assessment developed for hypothetical future-use exposures to COCs in groundwater underlying SWMU 3. Cancer risks and noncancer HIs presented in this table were calculated using the groundwater RBSLs listed in Table 5.1-2. These RBSLs were calculated as described in Section 5.1.4.2 and Appendix K.2, and correspond to a risk level goal of 10^{-6} for carcinogenic endpoints and an HI of 1.0 for noncarcinogenic endpoints. Of the groundwater COCs evaluated, arsenic and beryllium exceed the corresponding RBSL for carcinogenic endpoints (risks are 6.4×10^{-3} and 7.6×10^{-4}, respectively). Aluminum, arsenic, chromium, lead, thallium, and vanadium exceed the corresponding RBSL for noncarcinogenic endpoints (Table 5.2-10). The total cancer risk and HI calculated for groundwater exposures under a hypothetical future-use scenario are 7.2×10^{-3} and 46, respectively. Both values exceed risk levels requiring corrective action, assuming potable use of underlying shallow groundwater under a future residential-use scenario.

As discussed previously (Section 4.1.3), the groundwater analytical results, in particular the metals results, should be interpreted with caution. Given the high turbidity of groundwater samples from SWMU 3 well locations, and given the fact that samples were not filtered, the presence of elevated levels of metals suggests that natural conditions (i.e., colloids, suspended particulates, adsorbed metals, etc.) may be responsible for the observed concentrations, not SWMU-related activities. The results of the future-use groundwater pathway risk assessment should therefore be interpreted in light of these findings. Also, maxima for all inorganic constituents were detected in well S-61-90, which is an upgradient location (Table 5.2-2). In addition, background levels of SWMU 3 groundwater COCs (assuming concentrations are collocated) correspond to a cancer risk of 7.7×10^{-4} and an HI of 6.8 (Appendix Table K.2-6), which also exceed State of Utah target risk criteria.

The cumulative risk for the hypothetical future residential-use scenario, reflecting both soil and groundwater exposure pathways, is 7×10^{-3}. The cumulative HI is 46 (Tables 5.2-9 and 5.2-10). Both of these values exceed corresponding State of Utah target risk criteria for residential site uses.

Table 5.2-10 Cancer Risks and Hazard Indices Calculated for SWMU 3 Hypothetical Future-Use Groundwater Exposure Pathways

Chemical of Concern	Carcinogenic RBSL (μg/l)	GW EPC (μg/l)	Cancer Risk	(Percent of Total Risk)	Noncarcinogenic RBSL (μg/l)	GW EPC (μg/l)	Hazard Quotient	(Percent of Total HI)
Aluminum					**36,500**	**310,000**	**8.5E+00**	**19%**
Arsenic	**0.05**	**310**	**6.4E-03**	**89%**	**11**	**310**	**2.8E+01**	**62%**
Barium					2,560	2,200	8.6E-01	2%
Beryllium	**0.02**	**15.1**	**7.6E-04**	**11%**	183	15.1	8.3E-02	<1%
Chromium					**183**	**329**	**1.8E+00**	**4%**
Copper					1,350	253	1.9E-01	<1%
Lead					**15**	**210**	**E**	
Mercury					11	1.15	1.0E-01	<1%
Methylene chloride	5.42	3.4	6.3E-07	<1%	1,620	3.4	2.1E-03	<1%
Nickel					730	340	4.7E-01	1%
Thallium					**2.92**	**10.90**	**3.7E+00**	**8%**
Vanadium					**256**	**437**	**1.7E+00**	**4%**
		Total Cancer Risk:	**7.2E-03**			**Total Hazard Index (HI):**	**4.6E+01**	

NOTE: Bolded COCs/values reflect exceedances of either a 1.0E-04 cancer risk and/or a hazard quotient (HQ) of 1.0
E = Exceedance based on MCL for lead. Potential human health risk may occur following chronic exposure.

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5.2.3.4 Summary of SWMU 3 Human Health Risk Assessment Results

The results obtained for all current-use exposure scenarios (carcinogenic and noncarcinogenic endpoints) are all well below respective State of Utah corrective action criteria. (Groundwater was not quantitatively evaluated for current site uses given the lack of an exposure pathway (Table 5.1-1).)

The results of the future-use evaluation indicate no exceedances of soil RBSLs. Groundwater RBSLs were exceeded for aluminum, arsenic, beryllium, chromium, lead, thallium, and vanadium. The results of the future-use risk evaluation should be interpreted in light of the following: (1) the hypothetical nature of the future-residential-use pathway, (2) the extent to which background levels of COCs contribute to the cancer risk and HI estimates (Appendix Tables K.2-5 and K.2-6), and (3) the caveats identified in Section 4.1.3 (and above) for the groundwater analytical results.

5.3 BASELINE HUMAN HEALTH RISK ASSESSMENT FOR SWMU 5

5.3.1 Identification of Chemicals of Concern

Tables 5.3-1 and 5.3-2 detail the COC selection process as defined in Section 5.1.1, for SWMU 5 soil and groundwater samples, respectively. Table 5.3-3 summarizes the COCs selected for all media, including the single air COC (methylene chloride) that was selected based on the air monitoring results.

Six constituents were selected as SWMU-wide soil COCs for SWMU 5: cadmium, chromium, copper, lead, zinc, and 1,1,2-trichloro-1,2,2-trifluoroethane. Antimony, nickel, and silver were identified as location-specific soil COCs for the pond area, where maximum concentrations of several soil constituents were detected. Mercury and vanadium were identified as location-specific COCs for sample locations 5-BLD-10 and 5-BLD-14/-15, respectively (Tables 5.3-1 and 5.3-3). Detailed rationales for soil COC selection and designations (as SWMU-wide or location-specific COCs) are provided in Tables 5.3-1 and 5.3-3.

Methylene chloride was selected as the single air COC for SWMU 5 because the air sampling results indicated ambient concentrations exceeding levels reported for the background monitoring location (Table 5.3-3).

Parameter	Detection Frequency [1]	Minimum µg/g	Maximum (Location) µg/g	Mean [2] µg/g	Site-Specific Background Level [3] µg/g	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
INORGANIC CONSTITUENTS								
Aluminum (Al)	74/74 (100%)	3,910	27,700 (5-BLD-15, 2-3')	13,156	25,200	Yes	No	Only one (1.4%) of the detections exceeds the site-specific background level. The maximum (27,700 µg/g) concentration exceeds the 25,200 µg/g background level by a negligible amount. Also, aluminum is a ubiquitous component of aluminosilicate minerals, a common constituent of most clays.
Antimony (Sb)	**4/74 (5.4%)**	**12.4**	**57.6 (5-PND-2, 2-3')**	**4.9**	**11.9**	**Yes**	**Yes* (5-PND-2)**	**Antimony was detected at only two sample locations, 5-PND-2 and 5-PND-1, both of which were located in the former pond area. Antimony concentrations at the 5-PND-2 location were 25.5 µg/g, 57.6 µg/g (the maximum), and 12.4 µg/g for the 0-2", 2-3', and 4-5' depths, respectively. Antimony was also detected in sample 5-PND-1 (2-3') at 16.3 µg/g. Only the two highest concentrations (detected in the surface and 2-3' 5-PND-2 samples) are considered to significantly exceed the 11.9 µg/g background level. Given these findings, antimony was not selected as a SWMU-wide COC. However, *it* is considered to be a *potential* COC for the former pond area, in particular the 5-PND-2 location.**

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
INORGANIC CONSTITUENTS								
Aluminum (Al)	74/74 (100%)	3,910	27,700 (5-BLD-15, 2-3')	13,156	25,200	Yes	No	Only one (1.4%) of the detections exceeds the site-specific background level. The maximum (27,700 µg/g) concentration exceeds the 25,200 µg/g background level by a negligible amount. Also, aluminum is a ubiquitous component of aluminosilicate minerals, a common constituent of most clays.
Antimony (Sb)	**4/74 (5.4%)**	**12.4**	**57.6 (5-PND-2, 2-3')**	**4.9**	**11.9**	**Yes**	**Yes* (5-PND-2)**	**Antimony was detected at only two sample locations, 5-PND-2 and 5-PND-1, both of which were located in the former pond area. Antimony concentrations at the 5-PND-2 location were 25.5 µg/g, 57.6 µg/g (the maximum), and 12.4 µg/g for the 0-2", 2-3', and 4-5' depths, respectively. Antimony was also detected in sample 5-PND-1 (2-3') at 16.3 µg/g. Only the two highest concentrations (detected in the surface and 2-3' 5-PND-2 samples) are considered to significantly exceed the 11.9 µg/g background level. Given these findings, antimony was not selected as a SWMU-wide COC. However, it is considered to be a potential COC for the former pond area, in particular the 5-PND-2 location.**

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Arsenic (As)	74/74 (100%)	2.0	50.0 (5-DCH-3, 2-3')	7.0	40.0	Yes	No	Only the maximum concentration exceeds the site-specific background value (40 µg/g); this exceedance is not considered notable. Remaining arsenic concentrations are ≤ 22 µg/g.
Barium (Ba)	74/74 (100%)	47.9	792 (5-PND-2, 0-2")	193	537	Yes	No	A single detection exceeds background, but is less than the RBSL for hypothetical future residential use (5,480 µg/g) as shown in Table 5.1-2).
Beryllium (Be)	54/74 (73.0%)	0.3	1.74 (5-BLD-15, 2-3')	0.60	1.2	Yes	No	Only three samples (4% of the total) have beryllium concentrations exceeding background: 5-BLD-15 (1.74 µg/g, 2-3' sample); 5-BLD-14 (1.6 µg/g, 2-3'); and 5-PND-3 (1.4 µg/g, 0-2"). None of these exceedances is considered notable, given that the concentrations are all within 0.5 µg/g of the 1.2 µg/g background value.
Cadmium (Cd)	**47/74 (63.5%)**	**0.45**	**22.5 (5-PND-2, 0-2")**	**1.45**	**0.98**	**Yes**	**Yes**	**Detection frequency >5%; potential toxicity; exceeds background in 26 (35%) of the 74 soil samples. The highest cadmium concentrations correspond to samples collected in the former pond (5-PND-2, 5-PND-1, and 5-PND-4) and the nearby ditch (5-DCH-2).**

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Calcium (Ca)	74/74 (100%)	10,800	220,000 (5-BLD-16, 0-2")	115,831	250,000	No	No	The maximum concentration is less than the site-specific background level. Also, calcium is a naturally-occurring essential human nutrient with negligible toxicity.
Chromium (Cr)	**74/74 (100%)**	**11.0**	**1,680 (5-PND-2, 2-3')**	**96.3**	**48.5**	**Yes**	**Yes**	**Detection frequency 100%; potential toxicity; 15 (20%) of the 74 samples have chromium concentrations exceeding the site-specific background value (48.5 µg/g). As observed for other constituents (e.g., cadmium), the highest chromium concentrations were detected in samples collected from the former pond.**
Cobalt (Co)	74/74 (100%)	2.2	12.2 (5-PND-2, 0-2")	5.3	8.6	No	No	Detection frequency 100%; however, cobalt concentrations exceed the 8.6 µg/g background level in only 3 (4%) of the 74 samples: 5-PND-2 (12.2 µg/g); 5-BLD-18 (10.4 µg/g); and 5-BLD-19 (10.2 µg/g). These background exceedances are not considered notable. Cobalt is an essential component of vitamin B_{12}, which is required for the production of red blood cells.
Copper (Cu)	**74/74 (100%)**	**6.2**	**170 (5-PND-2, 0-2")**	**21.5**	**27.6**	**Yes**	**Yes**	**Detection frequency 100%; potential toxicity; exceeds background in 10 (14%) of the 74 soil samples. Copper is widely distributed in nature and is an essential element, so selection as a COC is conservative.**

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Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Cyanide (CYN)	6/74 (8.1%)	0.28	3.13 (5-PND-2, 0-2")	--	ND	Yes	No	Although the detection frequency exceeds the 5% criterion, 5 of the 6 detections are below one half the CRL and thus highly uncertain.
Iron (Fe)	74/74 (100%)	6,220	73,200 (5-PND-2, 0-2")	14,672	24,300	No	No	Only 4 (5%) of the 74 detections exceed the site-specific background level. Also, iron is a naturally-occurring essential human nutrient with negligible toxicity (as evidenced by the lack of toxicity criteria for this constituent).
Lead (Pb)	**74/74 (100%)**	**4.7**	**750.0 (5-PND-2, 0-2")**	**74.9**	**35.0**	**Yes**	**Yes**	**Detection frequency 100%; potential toxicity; exceeds background in 27 (36%) of the 74 soil samples. As observed for other metals, the highest lead concentrations were detected in samples collected in the former pond (in particular, samples 5-PND-2 and 5-PND-1). Lead concentrations highly elevated relative to background were also detected in samples 5-BLD-15 (0-2", 460 µg/g) and 5-BLD-18 (0-2", 410 µg/g), the later underlying the sump in Building 600. It should be noted that the lead concentration reported for the 5-BK-2 surficial soil sample (located approximately 30 feet West of 5-BLD-15) was 160 µg/g. This concentration was not used to determine the lead soil background level because it was considered a statistical outlier (see Section 2.3).**

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Magnesium (Mg)	74/74 (100%)	7,330	32,200 (5-BLD-4, 0-2")	13,108	16,150	No	No	Magnesium was not selected as a COC because it is a naturally-occurring essential human nutrient with negligible toxicity. Additionally, concentrations exceed background in only 6 (8%) of the 74 samples.
Manganese (Mn)	74/74 (100%)	145.0	1,160 (5-DCH-3, 2-3')	376.4	658.0	Yes	No	Manganese concentrations exceed background in only 3 (4%) of the 74 samples. Other than the maximum, these exceedances are not considered notable. (Second- and third-rank detections were 744 μg/g and 663 μg/g, respectively.) Furthermore, manganese is a ubiquitous mineral in desert soil and is also an essential element present in all living organisms.
Mercury (Hg)	**40/74 (54.1%)**	**0.029**	**1.8 (5-BLD-10, 0-2")**	**0.069**	**0.143**	**Yes**	**Yes* (5-BLD-10)**	**Mercury concentrations exceed the 0.14 μg/g background level in only 4 (5%) of the 74 samples: 5-BLD-10 (0-2", 1.8 μg/g); 5-PND-2 (0-2", 0.29 μg/g); 5-BLD-12 (0-2", 0.27 μg/g); and 5-PND-1 (2-3', 0.21 μg/g). Other than the maximum, these exceedances are not considered notable. Mercury was selected as a COC for location 5-BLD-10, but not as a SWMU-wide COC.**
Nickel (Ni)	**74/74 (100%)**	**6.8**	**172 (5-PND-2, 2-3')**	**23.1**	**27.9**	**Yes**	**Yes* (Pond Area)**	**Nickel concentrations exceed background in 11 samples; all exceedances occur in pond area ("PND") samples. Consequently, nickel was selected as a COC for this area, but is not considered a SWMU-wide COC.**

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Potassium (K)	74/74 (100%)	878	7,590 (5-SS-4, 0-2")	3,831	7,940	No	No	The maximum concentration is less than the site-specific background value.
Silver (Ag)	**8/74 (10.8%)**	**0.98**	**78.0 (5-PND-2, 0-2")**	**2.0**	**0.435**	**Yes**	**Yes* (Pond Area, 5-DCH-2)**	**All 8 silver detections exceed background, and all correspond to samples collected in the former pond (5-PND-2, 5-PND-1, and 5-PND-4) and the nearby ditch (5-DCH-2). Consequently, silver was selected as a COC for this area, but is not considered a SWMU-wide COC.**
Sodium (Na)	74/74 (100%)	394.0	3,630 (5-BLD-17, 2-3')	1,095	5,610	No	No	The maximum concentration is well below the site-specific background value.
Thallium (Tl)	46/74 (62.2%)	4.74	34.0 (5-BLD-15, 0-2")	13.0	49.9	Yes	No	The maximum thallium concentration is less than the site-specific background value.
Vanadium (V)	**74/74 (100%)**	**6.7**	**103 (5-BLD-14, 2-3')**	**27.2**	**62.6**	**Yes**	**Yes* (5-BLD-14, 5-BLD-15)**	**Vanadium concentrations exceed the 62.6 µg/g background level in only 4 (5%) of the 74 samples: 5-BLD-14 (2-3', 103 µg/g); 5-BLD-15 (2-3', 94 µg/g); 5-BLD-18 (0-2", 72.8 µg/g); and 5-BLD-19 (0-2", 66 µg/g). Only the first- and second-rank concentrations are considered significantly elevated relative to background. Consequently, vanadium is a potential COC for these samples taken near the wooden loading dock, but is not considered a SWMU-wide COC.**

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Zinc (Zn)	**74/74 (100%)**	**30.5**	**2,950 (5-PND-2, 0-2")**	**192**	**144**	**Yes**	**Yes**	**Detection frequency 100%; potential toxicity; exceeds background in 18 (24%) of the 74 soil samples. As observed for many other metals, the highest zinc concentrations were detected in pond samples.**
<u>ORGANIC CONSTITUENTS</u>								
Acetone	1/46 (2.2%)	0.028	0.028 (5-BLD-8, 2-3')	--	ND	No	No	Detection frequency <5%; presence in the single detection could also reflect laboratory or sample-container contamination.
Dibenzofuran (DBZFUR)	1/44 (2.3%)	0.11	0.11 (5-BLD-12, 0-2")	--	ND	No	No	Single detection at low concentration (frequency <5%); no toxicity data.
Diethyl phthalate (DEP)	1/44 (2.3%)	0.47	0.47 (5-BLD-10, 0-2")	--	ND	Yes	No	Single detection at low concentration (frequency <5%). Also, DEP is widely used in manufacturing and plastics processing.
Di-n-butylphthalate (DNBP)	1/44 (2.3%)	0.92	0.92 (5-BLD-1, 0-2")	--	ND	Yes	No	Single detection at low concentration (frequency <5%).
Methylene chloride (CH2CL2)	4/46 (8.6%)	0.005	0.010 (5-UST-1, 9-10')	--	ND	Yes	No	Detection frequency exceeds the 5% criterion; however, only low concentrations (0.005 µg/g to 0.01 µg/g) were detected.
2-Methylnaphthalene (2MNAP)	2/44 (4.5%)	0.094	0.48 (5-BLD-12, 0-2")	--	ND	No	No	Detection frequency <5%; low concentrations (0.094 µg/g and 0.48 µg/g).

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Naphthalene (NAP)	3/44 (6.8%)	0.064	0.6 (5-BLD-4, 0-2")	--	ND	Yes	No	The detection frequency slightly exceeds the 5% criterion. However, concentrations are low (< 1 µg/g), and there were only single detections in isolated (0-2") building soil samples (5-BLD-4, 5-BLD-12, and 5-BLD-6). Common sources of naphthalene are fugitive emissions and exhaust connected with production and use of fuel oil and gasoline. Thus, naphthalene's presence in the building surface soil samples is not unexpected.
PCB 1260 (PCB260)	2/46 (4.3%)	0.157	0.213 (5-BLD-19, 2-3')	--	ND	Yes	No	Detection frequency <5%. Also, concentrations are below EPA's 0.5 to 1.0 ppm PCB cleanup criterion developed for sites with unrestricted (residential) access (EPA 1990).
Phenanthrene (PHANTR)	2/44 (4.3%)	0.043	0.13 (5-BLD-12, 0-2")	--	ND	Yes	No	Detection frequency <5%; low concentrations. Potential sources of phenanthrene and other PAHs include natural sources, products of incomplete combustion, and car exhaust.
Trichlorofluoro-methane (CCL3F)	1/46 (2.2%)	0.015	0.015 (5-BLD-16, 2-3')	--	ND	Yes	No	Single isolated detection at a low concentration (frequency < 5%).
Toluene (MEC6H5)	2/46 (4.3%)	0.001	0.008 (5-BLD-1, 0-2")	--	ND	Yes	No	Detection frequency <5%; low concentrations (0.001 µg/g and 0.008 µg/g).

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
NON-TARGET ANALYTES								
2-Cyclohexen-1-one (2CHE10)	1/74 (1.4%)	0.41	0.41 (5-BLD-1, 0-2")	--	ND	No	No	Single detection at low concentration (frequency <5%); no toxicity data.
Hydrocarbons, long-chain (C25, C27, C28, and C29)	1/46 (C25) 4/46 (C27) 1/46 (C28) 7/46 (C29)	0.42 0.30 0.42 0.43	0.42 1.2 0.42 2.3	-- -- -- --	ND ND ND ND	No No No No	No No No No	Low prevalence; negligible toxicity. Presence in samples may reflect naturally- occurring long-chain hydrocarbons present in the organic carbon in soil.
Clionasterol (GSITOS)	4/46 (8.7%)	0.71	0.92 (5-BLD-1, 0-2")	--	ND	No	No	The detection frequency slightly exceeds the 5% criterion. However, clionasterol is a steroid compound that may be naturally derived from plants and their degradation products in soil. Concentrations are low, and no toxicity data are available.
1-Methylnaphthalene (1MNAP)	1/46 (2.2%)	0.47	0.47 (5-BLD-12, 0-2")	--	ND	No	No	Detection frequency <5%; no toxicity data.
Phthalic anhydride (PHTHAN)	2/46 (4.3%)	0.4	11.0 (5-BLD-15, 0-2")	--	ND	Yes	No	Detection frequency <5%. Phthalic anhydride is widely used in the manufacture of many materials including plasticizers, synthetic fibers, dyes, and pharmaceuticals.

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
2-Propanol (2PROL)	1/46 (2.2%)	0.027	0.027 (5-BLD-18, 0-2")	--	ND	No	No	Single detection at low concentration (frequency <5%); no toxicity data.
2,6,10,14-Tetra-methylpentadecane (2TMPD)	3/46 (6.5%)	0.52	2.3 (5-BLD-12, 0-2")	--	ND	No	No	The detection frequency slightly exceeds the 5 percent criterion. However, no toxicity data are available and there were only single detections in isolated building surface soil samples (5-BLD-12, 5-BLD-7, and 5-BLD-6) on the east side of Building 600.
1,1,2-Trichloro-1,2,2-trifluoroethane (TCLTFE)	**11/46 (23.9%)**	**0.005**	**0.010 (5-BLD-2, 2-3')**	**--**	**ND**	**Yes**	**Yes**	**Detection frequency > 5%; potential toxicity.**
Octadecamethyl-cyclo-nonasiloxane (OMCTSX)	7/46 (15.2%)	0.010	0.11 (5-BLD-9, 2-3')	--	ND	No	No	The detection frequency exceeds the 5% criterion. However, a search of numerous medical and toxicological databases yielded no toxicity information for this compound, precluding both quantitative and qualitative evaluations.

NOTES:

ND Not detected.
All units in µg/g (ppm).
Bold print indicates the chemical was selected as a soil COCs for SWMU 5.

1 The summaries provided in this table apply to both surface and subsurface soil (i.e., data for both soil depth profiles were merged to derive detection frequencies, means, etc.). Distinctions regarding the vertical distribution of constituents are made only if warranted by the data. In general, such distinctions are left to the quantitative risk assessment, for which current-use risks are calculated using surface soil data (only), and future-use risks are calculated using the merged (surface and subsurface) database.

2 Means were calculated assuming that nondetects are equivalent to one-half the MDL. Average concentrations are not reported for most organic and non-target analytes, however, because the low detection frequencies and high MDL values result in artificially elevated means (that often exceed reported maxima). Thus, the average was not considered to be a meaningful estimator for these constituents.

3 Site-specific background values were derived as the maximum detected concentration of each metal in background samples collected for the Group 2 SWMUs (Section 2.3).

4 "Yes" is indicated in this column when toxicity criteria are available that allow quantitative evaluation of a given compound (e.g., carcinogenic slope factors and/or noncarcinogenic RfDs from IRIS or HEAST).

5 When "Yes" is followed by an asterisk (*) in this column, it indicates that the constituent was not selected as a site-wide COC, but may be a potential sample- or area-specific COC.

Table 5.3-2 Identification of Potential COCs for SWMU 5 Groundwater Samples

Parameter (No. Detects/No. samples)	Minimum [1]	Maximum (Location) [1]	Background Level [2]	MCL/ Criteria	Toxicity Data? [3]	Selected as Potential COC? [4]	Rationale for Selection or Exclusion as Potential Groundwater COC
INORGANIC CONSTITUENTS							
Aluminum (6/6)	14,200	79,900 (S-2)	14,200	200	Yes	Yes*	Four of the five detections exceed background. However, the background level was determined on the basis of only one well sample. The highest concentration was detected in an apparent upgradient well. Given these factors, combined with the fact that aluminum was not selected as a soil COC for this SWMU, selection as a groundwater COC may be conservative.
Antimony (1/6)	**28.9**	**28.9 (S-109-93)**	**4.54**	**6.0**	**Yes**	**Yes (for area downgradient of pond)**	**The single detection in well S-109-93 exceeds both background and the MCL. This observation may be attributable to antimony's presence at elevated levels in pond area soils. (Well S-109-93 is located 700 feet downgradient of the SWMU 5 pond.)**
Arsenic (6/6)	6.72	47.4 (S-2)	35.5	50	Yes	No	Only two concentrations (47 μg/l and 38 μg/l) exceed the 35.5 μg/l background level; these exceedances are not considered notable. The highest arsenic concentration was detected in an apparent upgradient well. Remaining detections are ≤17.1 μg/l. No concentrations exceed the 50 μg/l MCL, and arsenic was not identified as a soil COC. Note that the arsenic concentrations reported in the RFI-Phase I investigation for filtered samples were 15 μg/l (S-2), 7.9 μg/l (S-53-90), and < 2.5 μg/l (wells S-50-90 and S-51-90); all are well below the background and MCL.
Barium (6/6)	173	602 (S-2)	200	2,000	Yes	Yes*	Three detections exceed background; however, the maximum concentration is well below the 2,000 μg/l MCL. The highest concentration was detected in an apparent upgradient well. Also, barium was not identified as a soil COC, so selection as a groundwater COC is conservative.

Parameter (No. Detects/No. samples)	Minimum [1]	Maximum (Location) [1]	Background Level [2]	MCL/ Criteria	Toxicity Data? [3]	Selected as Potential COC? [4]	Rationale for Selection or Exclusion as Potential Groundwater COC
Beryllium (1/6)	4.09	4.09 (S-2)	0.805	4.0	Yes	Yes*	The single detection exceeds background, but is essentially equal to the MCL. This detection occurred in an apparent upgradient well. Also, beryllium was not identified as a soil COC, so selection as a groundwater COC is likely conservative.
Cadmium (4/6)	2.1	6.7 (S-2)	10.7	5.0	Yes	No	The maximum cadmium concentration exceeds the MCL, but is less than the site-specific background level. The highest cadmium concentration occurred in an apparent upgradient well. Remaining concentrations are ≤ 5 µg/l.
Chromium (6/6)	**23.9**	**112 (S-2)**	**35.5**	**100**	**Yes**	**Yes**	**Three concentrations exceed background; the maximum also exceeds the MCL. The maximum concentration was detected in an apparent upgradient well. Chromium was also identified as a site-wide soil COC for this SWMU. Note that the chromium concentrations reported in the RFI-Phase I investigation for filtered samples were 27 µg/l (S-2), 10 µg/l (S-50-90), 12 µg/l (S-51-90), and 19 µg/l (S-53-90).**
Cobalt (1/6)	24.9	24.9 (S-2)	ND	NA	No	No	Cobalt was analyzed for in only one of the four background wells. Therefore, comparison of the single (25 µg/l) detection levels to the single (nondetected) background observation may not be meaningful. The highest cobalt detection occurred in an apparent upgradient well. Cobalt was not selected as a soil COC, and neither toxicity data nor groundwater criteria are available for its quantitative evaluation.

Parameter (No. Detects/No. samples)	Minimum [1]	Maximum (Location) [1]	Background Level [2]	MCL/ Criteria	Toxicity Data? [3]	Selected as Potential COC? [4]	Rationale for Selection or Exclusion as Potential Groundwater COC
Copper (6/6)	12.4	66.8 (S-2)	47.7	1,000	Yes	No	Only one detection exceeds background; this detection occurred in an apparent upgradient well. Remaining concentrations are ≤ 19.3 μg/l. Also, all copper concentrations are well below the 1,000 μg/l Secondary MCL (SMCL).
Lead (6/6)	**17.6**	**89.0 (S-2)**	**57.7**	**15**	**Yes**	**Yes**	**All detections exceed the 15 ug/l MCL. Two detections (the maximum in well S-2, an apparent upgradient well, and 87 μg/l in well S-109-93) exceed background concentrations. Additionally, lead was selected as a site-wide soil COC. Note that the lead concentrations reported in the RFI-Phase I investigation for filtered samples were 15 μg/l (S-2, although lead was also detected in corresponding method blank), 2.0 μg/l (S-50-90), 2.3 μg/l (S-51-90), and 17 μg/l (S-53-90).**
Mercury (1/6)	0.35	0.35 (S-53-90)	<0.243	2.0	Yes	Yes*	The single detection exceeds background, but does not exceed the MCL. Mercury was identified as a soil COC for the upgradient 5-BLD-10 sample location, so it was conservatively selected as a groundwater COC.
Nickel (4/6)	20.8	104 (S-2)	45.1	100	Yes	No	Only the maximum concentration exceeds background and the 100 μg/l MCL; this detection occurred in an apparent upgradient well. Remaining detections are ≤ 34.9 μg/l. The S-2 well location is essentially upgradient of SWMU 5, so the presence of nickel in this well may not be related to the site.

Parameter (No. Detects/No. samples)	Minimum [1]	Maximum (Location) [1]	Background Level [2]	MCL/ Criteria	Toxicity Data? [3]	Selected as Potential COC? [4]	Rationale for Selection or Exclusion as Potential Groundwater COC
Vanadium (6/6)	**27.1**	**145 (S-2)**	**27.1**	**ND**	**Yes**	**Yes**	**Five of the six detections exceed background, the maximum by over a factor of 5. The highest concentration occurred in an apparent upgradient well. Also, vanadium was identified as a soil COC for building sample locations.**
Zinc (6/6)	64.8	688 (S-2)	1,100	5,000	Yes	No	All six detections are less than background and are well below the 5,000 µg/l Secondary MCL (SMCL). The highest concentration occurred in an apparent upgradient well.
ORGANIC CONSTITUENTS							
Bromodichloromethane (1/6)	**0.72**	**0.72 (S-53-90)**	**ND**	**0.27 (TBC value)**	**Yes**	**Yes**	**No background data are available for organic constituents, but the single detection does exceed the 0.27 µg/l TBC criterion. Therefore, it was quantitatively evaluated to account for potential cumulative effects (given presence of other organic constituents in the S-53-90 well sample). Note that in the RFI-Phase I investigation, bromodichloromethane was detected in the upgradient S-2 well sample (1.2 µg/l), but not in S-53-90 (LT 1.6 µg/l).**

Parameter (No. Detects/No. samples)	Minimum [1]	Maximum (Location) [1]	Background Level [2]	MCL/ Criteria	Toxicity Data? [3]	Selected as Potential COC? [4]	Rationale for Selection or Exclusion as Potential Groundwater COC
Chloroform (1/6)	1.4	1.4 (S-53-90)	ND	5.7 (TBC value)	Yes	Yes*	The single detection is less than the 5.7 µg/l TBC criterion. However, given the rationale stated above for bromodichloromethane (re: cumulative effects), chloroform was selected as a potential groundwater COC. The chloroform concentration reported for well S-53-90 in the RFI-Phase I investigation was comparable (1.6 µg/l). It should be noted as well that chloroform is a common laboratory contaminant, or may be formed as a degradation product of chlorinated water reacting with naturally occurring organic compounds.
Trichloroethene (2/6)	**1.9**	**7.6 (S-53-90)**	**ND**	**5.0**	**Yes**	**Yes**	**The maximum concentration exceeds the 5 µg/l MCL; see rationale stated above for bromodichloromethane. Note that the TCE concentration reported for well S-53-90 in the RFI Phase I investigation was comparable (8.2 µg/l).**

<u>NOTES:</u>

All units in μg/l (ppb). Except for antimony and mercury, maxima for inorganic constituents were detected in well S-2 (which is essentially an upgradient well location). Organics detections were generally limited to well S-53-90. Bolded print indicates groundwater COCs whose presence may be attributable to previous SWMU 5 activities. Other constituents identified as groundwater COCs were conservatively selected given the reasons stated in Note 4.
ND=Not Determined; NA=Not Available.

[1] Reported groundwater concentrations reflect results of unfiltered groundwater sample analyses. Results for anions, cations, and commonly-occurring constituents with negligible toxicity (e.g, calcium, iron, magnesium, manganese, potassium, and sodium) are not addressed in this table, but are reported in Table 4.2-3.

[2] Background levels for groundwater were determined using the methods and assumptions described in Section 2.3.

[3] "Yes" is indicated in this column when toxicity criteria are available that allow quantitative evaluation of a given compound.

[4] Given that only six groundwater samples were collected at SWMU 5, detection frequency could not be used as a criterion for COC selection. Therefore, if a constituent was detected in groundwater at a level or levels exceeding background, and its toxicity criteria were available, it was generally considered a groundwater COC (even if an MCL was not exceeded), and thus carried through the quantitative future-use groundwater pathway evaluation. When "Yes" is followed by an asterisk (*) in this column, it indicates that the constituent was selected as a groundwater COC based on these conservative assumptions (i.e., exceedance of background), although there is insufficient evidence that its presence is attributable to site-related activities and/or poses a health risk. For example, given the high turbidity of groundwater samples from SWMU 5 well locations, the presence of elevated levels of metals suggests that natural conditions (i.e., colloids, suspended particulates, adsorbed metals, etc.) may be responsible for the observed concentrations, not SWMU-related activities.

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Table 5.3-3 Summary of COCs Selected for SWMU 5 Media

SWMU-Wide Soil COCs[1]	Sample- or Area- Specific Soil COCs [1]	Location	Air COCs [2]	Groundwater COCs [3]
Cadmium	Antimony	Pond Area	Methylene chloride	Aluminum*
Chromium	Mercury	5-BLD-10 sample		Antimony
Copper	Nickel	Pond Area		Barium*
Lead	Silver	Pond Area, Ditch		Beryllium*
Zinc	Vanadium	5-BLD-14, 5-BLD-15		Chromium
1,1,2-Trichloro-1,2,2-trifluoroethane (TCLTFE)				Lead Mercury* Vanadium
				Bromodichloro-methane Chloroform* Trichloroethene

NOTES:

1 As indicated in Table 5.3-1 (Note 5), for certain constituents elevated concentrations were only detected in localized areas of the SWMU. Concentrations at remaining sample locations were less than site-specific background levels. Therefore, these constituents were not selected as site-wide COCs, but are considered sample- or area-specific COCs.

2 Air COCs for organic constituents were selected based on results of the ambient air sampling and meteorological monitoring conducted at TEAD-S from September 11, 1993 to October 3, 1993. In general, a constituent was selected as an air COC if detected concentrations significantly exceeded levels reported for the background (BK) monitoring location. Air COCs were not selected for metals because monitoring results were considered invalid due to media and laboratory problems.

3 The list of chemicals selected as groundwater COCs is rather extensive relative to that identified for soil; the latter reflects the conservatism used in the groundwater COC selection process described in Table 5.3-2 (Note 4). Constituents followed by an asterisk (*) were selected as groundwater COCs based on conservative assumptions. However, there is insufficient evidence that their presence is attributable to site-related activities and/or poses a health risk.

Constituents identified as SWMU 5 groundwater COCs include aluminum, antimony, barium, beryllium, chromium, lead, mercury, nickel, vanadium, bromodichloromethane, chloroform, and trichloroethene (Tables 5.3-2 and 5.3-3). Of these constituents, antimony, chromium, lead, vanadium, bromodichloromethane, and trichloroethene are considered the primary COCs. For the remaining constituents, there is insufficient evidence that their presence is attributable to SWMU-related activities and/or poses a health risk (Table 5.3-3).

5.3.2 Exposure Assessment

Table 5.3-4 summarizes the current- and future-use exposure pathways at SWMU 5 that were quantified in the risk assessment. Table 5.3-5 lists the soil and air EPCs used in the risk calculations; groundwater EPCs are the maximum COC concentrations listed in Table 5.3-2. Given the spatial trends for soil COCs identified in Tables 5.3-1 and 5.3-3, soil EPCs were determined for three distinct subareas of SWMU 5: pond area sample locations, ditch/surficial soil sample locations, and remaining sample locations (Table 5.3-5). Table 5.3-6 summarizes the pathway-specific exposure parameters, along with supporting references, assumptions and rationales. (CDI calculation documentation specific to SWMU 5 is provided in Appendix Tables K.4-1 through K.4-5.)

5.3.3 Risk Characterization

This section quantifies risks for the SWMU 5 exposure pathways identified in Table 5.3-4. Section 5.3.3.1 presents the results of the risk assessment for current-use soil exposure scenarios. Sections 5.3.3.2 and 5.3.3.3 present the risk assessment results for hypothetical future-use exposures to soil and groundwater, respectively. Section 5.3.3.4 summarizes the results of the current- and future-use risk evaluations developed for SWMU 5.

5.3.3.1 Current-Use Risks

Table 5.3-7 summarizes the cancer risks and HIs calculated for SWMU 5 current-use exposure scenarios. Pathway-specific cancer risks calculated for all scenarios—the three SWMU subarea evaluations (for the former pond, ditch/surficial soil, and remaining sample locations) and the downwind demilitarization area receptor—range between 2×10^{-9} and 2×10^{-7}. Noncancer HIs range between 1.9×10^{-5} and 0.0018. These levels are all well below respective State of Utah corrective action criteria for carcinogens and noncarcinogens.

Table 5.3-4 Potential Pathways of Exposure to COCs at SWMU 5[1]

Exposure Medium	Potential Receptor(s)	Receptor Location(s)	Potential Exposure Route(s)	Pathway Quantitatively Evaluated?[2]	Reason for Selection or Exclusion
CURRENT-USE EXPOSURE PATHWAY					
Current-Use Exposure Scenario 1: SWMU 5 Receptor					
Surface (0-2") Soil	Site Environmental Management Personnel	Within SWMU 5	Incidental Ingestion, Dermal Contact, and Inhalation Soil Exposure Pathways, and Inhalation of Methylene chloride (the only air COC identified)	YES	SWMU 5 is not currently active; however, similar to the scenario described for SWMU 3, Environmental Management staff might access SWMU 5 twice per year for semiannual groundwater monitoring. Therefore, potential exposures to surface soil were quantitatively evaluated assuming workers enter the site twice per year for collection of groundwater samples (4 hours per exposure), and another two times (within a given year) for inspection of the grounds.
Current-Use Exposure Scenario 2: Nearest On-Post Receptor					
Resuspended Surface Soil Particulates	Demilitarization Area Workers	Southeast of SWMU 5 (Downwind)	Inhalation of Resuspended Soil Particulates Transferred off SWMU 5 via Wind Dispersion	YES	The nearest on-post receptors for a chronic exposure scenario would be demilitarization area workers working downwind of SWMU 5. These individuals drive through SWMU 5 to access SWMU 31 approximately 4 times per day, 4 days per week. Additionally, the demilitarization area workers remain downwind in close proximity to SWMU 5 during detonation operations. Given these factors, this analysis assumes an exposure frequency of 9 months per year, 4 days per week, 8 hours per day, for 25 years.

Table 5.3-4 Potential Pathways of Exposure to COCs at SWMU 5[1]

Exposure Medium	Potential Receptor(s)	Receptor Location(s)	Potential Exposure Route(s)	Pathway Quantitatively Evaluated?[2]	Reason for Selection or Exclusion
FUTURE USE EXPOSURE PATHWAYS					
Surface and Subsurface Soil	Future Residents	Within SWMU 5	Ingestion, Dermal Contact, and Inhalation Soil Exposure Pathways Associated with Hypothetical Future Residential Use of SWMU 5	YES	Future residential use of TEAD-S is not expected. Nonetheless, in accordance with state and federal risk assessment guidelines, this hypothetical future use pathway was quantitatively evaluated using the exposure assumptions outlined in Section 5.1 and in Appendix K.2. This assessment is considered to represent a worst-case screening level evaluation of risks associated with potential exposures to SWMU 5 soil COCs.
Shallow Groundwater (Future Uses)	Future Residents	SWMU 5 Wells Screened in the Shallow Aquifer	Ingestion, and Inhalation of Volatile COCs while Showering or Washing	YES	Future use of shallow groundwater underlying SWMU 5 is not expected. However, as discussed above, this pathway was nonetheless quantitatively evaluated and represents a worst-case, screening-level evaluation of risks associated with potential exposures to COCs in SWMU 5 shallow groundwater.

NOTES:

1 Given the spatial trends identified for soil COCs (Tables 5.3-1 and 5.3-3), three distinct subareas were identified for SWMU 5: the pond area (encompassing the PND-1 through PND-4 sample locations), ditch (DCH-1 through -3) and surface soil samples, and remaining SWMU 5 sample locations. Although the same (current- and future-use) exposure assumptions were applied to all subarea risk evaluations, exposures in the former pond are expected to be negligible given that this area is dry, covered with sagebrush, and in an approximate 10 ft depression. Consequently, the analysis of potential risks in the former pond area is considered very conservative.

2 For pathways that were quantitatively evaluated, exposure assumptions are summarized in Table 5.3-6. These pathways were quantified for the three subareas identified above (Note 1) and in Table 5.3-3.

Chemical of Concern	Pond Area Samples Surface Soil EPC (μg/g)	Pond Area Samples Corresponding Air EPC (mg/m³)	Ditch/SS- Samples Surface Soil EPC (μg/g)	Ditch/SS- Samples Corresponding Air EPC (mg/m³)	Remaining Sample Locations Surface Soil EPC (μg/g)	Remaining Sample Locations Corresponding Air EPC (mg/m³)	SWMU-Wide Air EPCs Based on Monitoring Data (mg/m³)
Current-Use Pathways							
Antimony*	21.95	2.55E-08	3.57	4.14E-09	3.57	4.14E-09	--
Cadmium	19.40	2.25E-08	1.47	1.71E-09	1.09	1.26E-09	--
Chromium	958.9	1.11E-06	29.46	3.42E-08	34.74	4.03E-08	--
Copper	148.4	1.72E-07	25.89	3.00E-08	31.88	3.70E-08	--
Lead	741.8	8.61E-07	50.88	5.90E-08	130.44	1.51E-07	--
Mercury*	0.264	3.06E-10	0.075	8.70E-11	0.27	3.13E-10	--
Nickel*	80.47	9.34E-08	14.25	1.65E-08	16.08	1.87E-08	--
Silver*	65.98	7.65E-08	0.295	3.42E-10	0.295	3.42E-10	--
Vanadium*	25.73	2.98E-08	21.61	2.51E-08	31.23	3.62E-08	--
Zinc	2,567	2.98E-06	318.26	3.69E-07	175.5	2.04E-07	--
TCLTFE	ND	--	ND	--	0.008	9.28E-12	--
Methylene chloride	--	--	--	--	--	--	1.56E-03
Future-Use Pathways							
Antimony*	20.04	--	3.57	--	3.57	--	--
Cadmium	8.22	--	1.86	--	0.83	--	--
Chromium	725.4	--	54.73	--	28.12	--	--
Copper	65.45	--	22.48	--	21.31	--	--
Lead	363.8	--	38.92	--	66.7	--	--
Mercury*	0.14	--	0.062	--	0.138	--	--
Nickel*	86.2	--	18.55	--	15.65	--	--
Silver*	21.69	--	2.12	--	0.295	--	--
Vanadium*	23.29	--	25.87	--	34.83	--	--
Zinc	1,087	--	210.43	--	112.1	--	--

Chemical of Concern	Pond Area Samples: Surface Soil EPC (µg/g)	Pond Area Samples: Corresponding Air EPC (mg/m^3)	Ditch/SS- Samples: Surface Soil EPC (µg/g)	Ditch/SS- Samples: Corresponding Air EPC (mg/m^3)	Remaining Sample Locations: Surface Soil EPC (µg/g)	Remaining Sample Locations: Corresponding Air EPC (mg/m^3)	SWMU-Wide Air EPCs Based on Monitoring Data (mg/m^3)
TCLTFE	ND	--	ND	--	0.008	--	--
Methylene chloride	--	--	--	--	--	--	--

NOTES:

TCLTFE 1,1,2-Trichloro-1,2,2-trifluoroethane
-- Not Applicable/Not Evaluated
* Sample- or area-specific soil COCs identified in Table 5.3-3
ND Not Detected

1 This table lists soil and air EPCs only; groundwater EPCs used to calculate potential future-use risks are the maximum COC concentrations listed in Table 5.3-2. Maximum concentrations were chosen for analysis of the (hypothetical) groundwater exposure pathway given the limited number of groundwater samples, and the fact that maxima for most constituents (primarily metals) were detected at the same well location (S-53-90).

2 Given the spatial trends for soil COCs identified in Tables 5.3-1 and 5.3-3, soil EPCs were determined for three distinct subareas of SWMU 5: pond area samples (5-PND-1 through 5-PND-4), ditch/surface soil samples (all 5-SS- samples, 5-DCH-1, 5-DCH-2, and 5-DCH-3), and remaining sample locations (all "BLD" sample locations, both "UST" locations, and 5-DCH-4). For current-use pathways, soil EPCs are the 95% UCL of the mean surface soil concentration calculated for each subarea (calculated assuming nondetections are equal to one-half the method detection limit value). Soil EPCs for the future residential use pathway evaluation are the 95% UCL of the mean COC concentration in surface and subsurface soil (combined). Air EPCs were derived using the methods described in Section 5.1.2 and in Table 5.2-5.

Table 5.3-6 Assumptions Used to Evaluate SWMU 5 Current-Use Exposure Pathways

PARAMETER	ASSUMED VALUE		SOURCE/RATIONALE
	Site EM Personnel	Demil. Area Worker	
General Exposure Parameters			
Age During Exposure	Adult	Adult	-
Average Body Weight	70 kg	70 kg	EPA 1991a. Standard default.
Lifetime Exposure Duration	25 years	25 years	EPA 1991a. Standard default.
Exposure Frequency	4 days/year	150 days/year	Professional judgement based on site-specific factors.
Direct Contact Parameters			
Soil Ingestion Rate	100 mg/day	NA	EPA 1991a (See Note 1).
Soil Adherence Rate	1.0 mg/cm^2	NA	EPA 1992c. Upper bound default.
Surface Area Exposed	4,100 cm^2	NA	EPA 1992c (See Note 2).
Dermal Absorption Rate	Metals: 0.1%	NA	EPA 1992c
	Organics: 10%	NA	
Inhalation Exposure Parameters			
Hours per Day	4 hours	8 hours	Professional judgement based on site-specific factors (Table 5.3-4).
Inhalation Rate	2.5 m^3/hour	2.5 m^3/hour	EPA 1991a. Assumes moderate activity for both receptor groups.
Particulate Emission Factor	8.62 x 10^8 m^3/kg	8.62 x 10^8 m^3/kg	Site-specific particulate emission factor (PEF); see Section 5.1.2 for derivation.

Notes:

1 Although EPA guidance (1991a) recommends a soil ingestion rate of 50 mg/day for workers, a more conservative value of 100 mg/day is used in this assessment to account for potentially higher exposures possible at TEAD-S for an outdoor work environment.

2 The skin surface area of 4,100 cm^2 is for an adult male, and represents a 95th percentile value for the hands, forearms, and head (EPA 1992c).

Table 5.3-7 Cancer Risks and Hazard Indices Calculated for SWMU 5: Current-Use Location-Specific Soil Exposure Pathways[1, 2]

Current-Use Exposure Scenario			Results of Cancer Risk (CR) Calculations		Results of Hazard Index (HI) Calculations	
Receptor	Pathway(s)	COCs Evaluated	CR	Driving COC(s) and Pathway	HI	Driving COC(s) and Pathway
Current-Use Exposure Scenario 1: Source Location—Former Pond Subarea Receptor Location—Within SWMU 5						
Site EM Personnel	SI/DC/INH[3] (Appendix Table K.4-1)	All soil COCs identified in Table 5.3-3, using EPCs listed in Table 5.3-5	3×10^{-8}	Chromium (10% assumed hexavalent) and methylene chloride; INH is the only relevant carcinogenic endpoint for the carcinogenic COCs evaluated	0.0018	antimony (50%) and cadmium (18%); SI dominates
Current-Use Exposure Scenario 1: Source Location—Ditch/SS Sample Location Subarea Receptor Location—Within SWMU 5						
Site EM Personnel	SI/DC/INH[3] (Appendix Table K.4-3)	All soil COCs, using EPCs derived for ditch/SS locations (Table 5.3-5)	2×10^{-9}	methylene chloride	2.7×10^{-4}	Antimony and vanadium account for 55% and 19% of the HI, respectively; SI dominates
Current-Use Exposure Scenario 1: Source Location—Remaining Sample Locations (Non-Pond, Non-Ditch areas) Receptor Location—Within SWMU 5						
Site EM Personnel	SI/DC/INH[3] (Appendix Table K.4-4)	All soil COCs, using EPCs derived for remaining sample locations	2×10^{-9}	methylene chloride	2.9×10^{-4}	Antimony and vanadium account for 50% and 25% of the HI, respectively; SI dominates
Current-Use Exposure Scenario 2: Source Location—Soil in Former Pond Subarea *(assumed to be the worst-case source location at SWMU 5)* **Receptor Location—Southeast (Downwind) of SWMU 5**						
Demil. Area Workers	INH[4] (Appendix Table K.4-2)	All soil COCs, using EPCs derived for former pond area	2×10^{-7}	chromium (10% assumed hexavalent)—94%	1.9×10^{-5}	cadmium (98%)

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***Interpretation:** The cancer risks and HIs calculated for all SWMU 5 current-use exposure scenarios (for all three SWMU subareas, as well as the downwind receptor scenario) are all well below corrective action criteria for carcinogens and noncarcinogens as stated in State of Utah rules.*

COC	Chemical of Concern	SI	Soil Ingestion Pathway
DC	Dermal Contact Pathway	INH	Inhalation Pathway
CR	Cancer Risk	HI	Hazard Index
SS	Surface Soil		

1 Tables 5.3-3 and 5.3-4 detail the COC and exposure pathway selection process; Tables 5.3-5 and 5.3-6 summarize the chemical-specific exposure point concentrations (EPCs) and exposure assumptions used in the risk calculations. Appendix Tables K.4-1 through K.4-5 provide detailed cancer risk and HI calculation documentation for each SWMU 5 current-use exposure scenario summarized above.

2 Toxicity criteria are not available with which to quantify hazards or risks associated with exposures to lead. Currently, as set forth by OSWER directive #9355.4-12, EPA recommends a screening level for lead in soil of 400 $\mu g/g$, assuming residential land use (EPA, 1994). This 400 $\mu g/g$ screening level value is exceeded in only five SWMU 5 soil samples, three of which were collected in the former pond area: 5-PND-2, 0-2" (750 $\mu g/g$); 5-PND-1, 0-2" (500 $\mu g/g$); 5-PND-1, 2-3' (490 $\mu g/g$); 5-BLD-15, 0-2" (460 $\mu g/g$); and 5-BLD-18, 0-2" (410 $\mu g/g$).]

3 The total cancer risks and HIs calculated for current use exposure scenario 1 (for all three subareas) also incorporate the SWMU-wide risk/HI stemming from inhalation exposures to methylene chloride, the only volatile organic air COC identified (Table 5.3-3). The cancer risk and HI calculated for inhalation exposures to methylene chloride are 1.4×10^{-9} and 2.8×10^{-6}, respectively (Appendix Table K.4-5).

4 Current-use exposure scenario 2 represents a worst-case, screening-level evaluation of potential risks associated with chronic inhalation of SWMU 5 soil contaminants at the nearest (off-SWMU) downwind receptor location (Tables 5.3-4 and 5.3-5). This analysis was conducted assuming the soil contaminant source is the former pond area, where concentrations of most soil COCs were highest. The 2×10^{-7} risk level calculated for this scenario is considered very conservative given that the pond contamination lies in an approximate 10 ft deep depression and is covered with sagebrush. (The inhalation risk for demilitarization area workers associated with soil COC concentrations in the ditch/SS or remaining SWMU 5 sample locations would probably be one to two orders of magnitude lower than that calculated assuming the pond area as a source.)

5.3.3.2 Potential Future-Use Soil Exposure Risks

Table 5.3-8 summarizes the results of the risk assessment developed for hypothetical future-use exposures to SWMU 5 surface and subsurface soil. Cancer risks and noncancer HIs were calculated for the three subareas identified in Section 5.3.2 (pond, ditch/surficial soil, and remaining sample locations) using the soil RBSLs listed in Table 5.1-2, in accordance with the methods, equations, and assumptions outlined in Section 5.1.4.1 and Appendix K.

The total cancer risk and HI calculated for the evaluation of soil in the former pond subarea soil are 4.2×10^{-6} and 2.8, respectively (Table 5.3-8). The cancer risk estimate is above the level requiring site controls for residential site uses; the HI exceeds the 1.0 target HI criterion. For this scenario, only chromium (10 percent of which was assumed to be hexavalent) exceeds corresponding soil RBSLs for cancer and noncancer endpoints. Cancer risks and HIs calculated for the remaining subareas of SWMU 5 (the ditch area and remaining sample locations) are all less than corresponding State of Utah risk criteria (Table 5.3-8).

5.3.3.3 Potential Future-Use Groundwater Exposure Risks

Table 5.3-9 summarizes the results of the risk assessment developed for hypothetical future-use exposures to COCs in groundwater underlying SWMU 5. Cancer risks and noncancer HIs presented in this table were calculated using the groundwater RBSLs listed in Table 5.1-2, which correspond to a risk level goal of 10^{-6} for carcinogenic endpoints and a hazard index of 1.0 for noncarcinogenic endpoints.

The total cancer risk and HI calculated for groundwater exposures under a hypothetical future-use scenario are 2.3×10^{-4} and 5.3, respectively. Both values exceed risk levels requiring corrective action, assuming potable use of underlying shallow groundwater under a future residential-use scenario. Beryllium accounts for the majority (92 percent) of the total cancer risk. Chloroform and trichlorothene also exceed the groundwater RBSL for the carcinogenic endpoint. For noncancer endpoints, lead, aluminum, and antimony all exceed corresponding RBSLs, and aluminum and antimony account for the majority of the HI (41 percent and 27 percent, respectively). (Note: Cumulative risks, reflecting both soil and groundwater exposures, were not determined for SWMU 5 given that soil exposure risks were calculated only for specific subareas of the SWMU.)

Table 5.3-8 Cancer Risks and Hazard Indices Calculated for SWMU 5 Hypothetical Future-Use Soil Exposure Pathways

Chemical of Concern	Carcinogenic RBSL (mg/kg)	Soil EPC (μg/g)	Cancer Risk	(Percent of Total Risk)	Noncarcinogenic RBSL (μg/g)	Soil EPC (μg/g)	Hazard Quotient	(Percent of Total HI)
Risk Calculations for Former Pond Subarea								
Antimony					31.3	20.04	6.4E-01	23%
Cadmium	1,170	8.22	7.0E-09	<1%	78.2	8.22	1.1E-01	4%
Chromium, hexavalent	175	725.4	4.1E-06	99%	**391**	**725.4**	**1.9E+00**	**66%**
Copper					2,902	65.45	2.3E-02	1%
Lead					400	363.8	NE	
Mercury					23.5	0.14	6.0E-03	<1%
Nickel	4,370	86.2	2.0E-08	<1%	1,564	86.2	5.5E-02	2%
Silver					391.1	21.69	5.5E-02	2%
Vanadium					547.5	23.29	4.3E-02	2%
Zinc					23,464	1,087	4.6E-02	2%
	Total Cancer Risk:		4.2E-06		**Total Hazard Index (HI):**		**2.8E+00**	
Risk Calculations for Ditch/SS Sample Location Subarea								
Antimony					31.3	3.57	1.1E-01	32%
Cadmium	1,170	1.86	1.6E-09	<1%	78.2	1.86	2.4E-02	7%
Chromium, hexavalent	175	54.7	3.1E-07	98%	391	54.7	1.4E-01	39%
Copper					2,902	22.48	7.7E-03	2%
Lead					400	38.9	NE	
Mercury					23.5	0.06	2.6E-03	<1%
Nickel	4,370	18.6	4.2E-09	1%	1,564	18.6	1.2E-02	3%
Silver					391.1	2.12	5.4E-03	1%
Vanadium					547.5	25.87	4.7E-02	13%
Zinc					23,464	210	9.0E-03	2%
	Total Cancer Risk:		3.2E-07		**Total Hazard Index (HI):**		3.6E-01	

Table 5.3-8 Cancer Risks and Hazard Indices Calculated for SWMU 5 Hypothetical Future-Use Soil Exposure Pathways

Chemical of Concern	Carcinogenic RBSL (mg/kg)	Soil EPC (µg/g)	Cancer Risk	(Percent of Total Risk)	Noncarcinogenic RBSL (µg/g)	Soil EPC (µg/g)	Hazard Quotient	(Percent of Total HI)
Risk Calculations for Remaining Sample Locations								
Antimony					31.3	3.57	1.1E-01	39%
Cadmium	1,170	0.83	7.1E-10	<1%	78.2	0.83	1.1E-02	4%
Chromium, hexavalent	175	28.1	1.6E-07	97%	391	28.1	7.2E-02	25%
Copper					2,902	21.3	7.3E-03	3%
Lead					400	66.7	NE	
Mercury					23.5	0.14	5.9E-03	2%
Nickel	4,370	15.7	3.6E-09	2%	1,564	15.7	1.0E-02	3%
Silver					391.1	0.30	7.5E-04	<1%
Vanadium					547.5	34.8	6.4E-02	22%
Zinc					23,464	112	4.8E-03	2%
TCLTFE					410	0.008	2.0E-05	<1%
	Total Cancer Risk:		1.6E-07		**Total Hazard Index (HI):**		2.9E-01	

TCLTFE 1,1,2-Trichloro-1,2,2-fluoroethane

Note:
Bolded COCs/values reflect exceedances of either a 1.0E-04 cancer risk and/or a hazard quotient (HQ) of 1.0.
NE = No Exceedance based on the USEPA Soil Screening Level for lead. Potential human health risks are not likely to occur following chronic exposure.

Table 5.3-9 Cancer Risks and Hazard Indices Calculated for SWMU 5 Hypothetical Future-Use Groundwater Exposure Pathways

Chemical of Concern	Carcinogenic RBSL (μg/l)	GW EPC (μg/l)	Cancer Risk	(Percent of Total Risk)	Noncarcinogenic RBSL (μg/l)	GW EPC (μg/l)	Hazard Quotient	(Percent of Total HI)
Aluminum					**36,500**	**79,900**	**2.2E+00**	**41%**
Antimony					**14.6**	**28.9**	**2.0E+00**	**27%**
Barium					2,560	602	2.4E-01	4%
Beryllium	**0.02**	**4.09**	**2.1E-04**	**92%**	183	4.09	2.2E-02	<1%
Bromodichloromethane	1.37	0.72	5.2E-07	<1%	730	0.72	9.9E-04	<1%
Chloroform	0.21	1.4	6.7E-06	3%	365	1.4	3.8E-03	<1%
Chromium					183	23.90	1.3E-01	2%
Lead					**15**	**89**	E	
Mercury					11	0.35	3.2E-02	1%
Nickel					730	104	1.4E-01	3%
Trichloroethene	2.04	7.6	3.7E-06	2%				<1%
Vanadium					256	145	5.7E-01	11%
	Total Cancer Risk:		**2.3E-04**		**Total Hazard Index (HI):**		**5.3E+00**	

NOTE: Bolded COCs/values reflect exceedances of either a 1.0E-04 cancer risk and/or a hazard quotient (HQ) of 1.0.
E = Exceedance based on MCL for lead. Potential human health risks may occur following chronic exposure.

5.3.3.4 Summary of SWMU 5 Human Health Risk Assessment Results

The results of the current-use evaluation indicate no potential health threats from exposure to SWMU 5 soil or air COCs. Cancer risks and HIs calculated for all scenarios—the three SWMU subarea evaluations (for the former pond, ditch/surficial soil, and remaining smaple locations) and the downwind demilitarization area receptor—are all well below respective State of Utah corrective action criteria for carcinogens and noncarcinogens.

The results of the future-use evaluation indicate exceedances of soil RBSLs (and thus target risks and HIs) for chromium only. Groundwater RBSLs were exceeded for aluminum, antimony, beryllium, chloroform, lead, and trichloroethene. The results of the future-use risk evaluation should be interpreted in light of following: (1) the hypothetical nature of the future-residential-use pathway, (2) the extent to which background levels of COCs contribute to the cancer risk and HI estimates (Appendix Tables K.2-5 and K.2-6), and (3) the caveats identified previously for the groundwater analytical results.

5.4 BASELINE HUMAN HEALTH RISK ASSESSMENT FOR SWMU 8

5.4.1 Identification of Chemicals of Concern

Table 5.4-1 details the COC selection process, as defined in Section 5.1.1, for SWMU 8 soil samples. Table 5.4-2 lists the soil COCs selected and identifies corresponding SWMU-wide and location-specific designations. Six constituents were identified as SWMU-wide soil COCs for SWMU 8: cadmium, copper, lead, mercury, zinc, and trichlorofluoromethane (CCL3F). Chromium and nickel were identified as location-specific soil COCs for the west trench and drop tower areas.

5.4.2 Exposure Assessment

Table 5.4-3 summarizes the current- and future-use exposure pathways at SWMU 8 that were quantified in the risk assessment. Table 5.4-4 lists the soil EPCs used in the SWMU-wide and location-specific risk calculations, and Table 5.4-5 summarizes the pathway-specific exposure parameters. The values listed in Tables 5.4-4 and 5.4-5 were applied using the methods outlined in Section 5.1.2, and the CDI equations listed in Appendix Table K.1-1. (CDI calculation documentation specific to SWMU 8 is provided in Appendix Tables K.5-1 through K.5-4.)

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
<u>INORGANIC CONSTITUENTS</u>								
Aluminum (Al)	40/40 (100%)	4,200	19,200 (8-NTR-2, 4-5')	12,191	25,200	Yes	No	The maximum concentration is less than the site-specific background level.
Antimony (Sb)	1/40 (2.5%)	25.5	25.5 (8-GS-3, 0-2")	4.1	11.9	Yes	No	Detection frequency < 5%. The single detection exceeds background, but this concentration is not expected to present a health risk for either current or potential future use scenarios. (This finding is based on comparison with the 31.3 µg/g RBSL listed in Table 5.1-3, which was developed for a hypothetical future residential-use scenario.)
Arsenic (As)	40/40 (100%)	3.2	25.0 (8-DCH-2, 0-2")	8.5	40.0	Yes	No	The maximum arsenic concentration is below the site-specific background value.
Barium (Ba)	40/40 (100%)	83.2	4,300 (8-WTR-2, 0.5')	357	537	Yes	No	Three detections exceed background, but are less than the RBSL for hypothetical future residential use (5,480 µg/g) as shown in Table 5.1-2).
Beryllium (Be)	27/40 (67.5%)	0.32	0.90 (8-NTR-1, 4-5')	0.50	1.2	Yes	No	The maximum beryllium concentration is below the site-specific background level.
Cadmium (Cd)	**17/40 (42.5%)**	**0.42**	**6.43 (8-GS-2, 0-2")**	**1.02**	**0.98**	**Yes**	**Yes**	**Detection frequency > 5%; potential toxicity; exceeds background in 10 (25%) of the 40 soil samples. All background exceedances occur in the surface (0-2") soil samples.**

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Calcium (Ca)	40/40 (100%)	28,300	190,000 (8-GS-5, 2-3')	111,615	250,000	No	No	The maximum concentration is less than the site-specific background level.
Chromium (Cr)	**40/40 (100%)**	**8.95**	**75.8 (8-WTR-2, 0.5')**	**20.5**	**48.5**	**Yes**	**Yes* (west trench and drop tower site areas)**	**Detection frequency > 5%; potential toxicity. Chromium concentrations exceed background in only 2 (5%) of the 40 soil samples: west trench sample 8-WTR-2 (75.0 µg/g, 0.5'), and drop tower site sample 8-GS-2 (59.2 µg/g, 0-2"). All other detections are ≤ 43.5 µg/g. Consequently, chromium is not considered a site-wide COC, but is a potential COC for the west trench and drop tower site areas.**
Cobalt (Co)	40/40 (100%)	3.1	8.35 (8-NTR-2, 4-5')	5.4	8.6	No	No	The maximum cobalt concentration is less than the site-specific background level.
Copper (Cu)	**40/40 (100%)**	**5.5**	**557 (8-WTR-2, 0.5')**	**59.3**	**27.6**	**Yes**	**Yes**	**Detection frequency 100%; potential toxicity; exceeds background in 12 (30%) of the 40 soil samples. Most (9) of the background exceedances occur in surface (0-2") soil samples. Selection as a COC is conservative given copper's wide distribution in the environment, and the fact that it is an essential element.**
Cyanide (CYN)	4/40	0.41	0.70	--	0.0	Yes	No	Although the detection frequency exceeds the

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Table 5.4-1 Identification of COCs for SWMU 8 Soil

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
	(10%)		(8-GS-2, 0-2")					5% criterion, all four detections are below one half the CRL and thus highly uncertain.
Iron (Fe)	40/40 (100%)	5,810	22,100 (8-WTR-2, 0.5')	12,618	24,300	No	No	The maximum concentration is less than the site-specific background level.
Lead (Pb)	**40/40 (100%)**	**7.12**	**240.0 (8-GS-7, 0-2")**	**26.6**	**35.0**	**Yes**	**Yes**	**Detection frequency 100%; potential toxicity; exceeds background in 6 (15%) of the 40 soil samples. All lead background exceedances occur in samples collected at surface (0-2") or shallow subsurface (0.5') depths.**
Magnesium (Mg)	40/40 (100%)	9,930	58,000 (8-WTR-2, 0.5')	16,216	16,150	No	No	Exceeds background in 16 (40%) of the 40 samples. However, magnesium was not selected as a COC because it is a naturally-occurring essential human nutrient with negligible toxicity.
Manganese (Mn)	**40/40 (100%)**	159.0	634.0 (8-NTR-1, 0-2")	406.1	658.0	Yes	No	**The maximum concentration is less than the site-specific background level.**
Mercury (Hg)	**26/40 (65%)**	**0.029**	**0.591 (8-GS-3, 0.5')**	**0.077**	**0.143**	**Yes**	**Yes**	**Detection frequency 100%; potential toxicity; exceeds background in 6 (15%) of the 40 soil samples. With the exception of the maximum, all background exceedances occur in ditch ("DCH") samples. The magnitude of the background exceedances is not considered notable, so selection as a COC is conservative.**

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Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Nickel (Ni)	**40/40 (100%)**	**11.3**	**57.9 (8-WTR-2, 0.5')**	**19.2**	**27.9**	**Yes**	**Yes* (west trench and drop tower site areas)**	**Detection frequency 100%; potential toxicity. As observed for chromium, nickel concentrations exceed background in only 2 (5%) of the 40 soil samples: west trench sample 8-WTR-2 (57.9 µg/g, 0.5'), and drop tower site sample 8-GS-2 (42 µg/g, 0-2"). All other detections are ≤26.6 µg/g. Consequently, nickel is not considered a site-wide COC, but is a potential COC for the west trench and drop tower site areas.**
Potassium (K)	40/40 (100%)	1,000	7,400 (8-GS-6, 0-2")	3,764	7,940	No	No	The maximum concentration is less than the site-specific background value.
Silver (Ag)	3/40 (7.5%)	0.45	0.84 (8-GS-7, 0-2")	0.32	0.435	Yes	No	The detection frequency slightly exceeds the 5% criterion, but silver concentrations are well below the 391 µg/g risk-based screening level (Table 5.1-3).
Sodium (Na)	40/40 (100%)	250.0	5,730 (8-NTR-2, 4-5')	1,544	5,610	No	No	Only the maximum concentration exceeds the site-specific background value; remaining detections are ≤ 5,460 µg/g. Also, sodium is naturally occurring and has negligible toxicity.
Thallium (Tl)	29/40 (72.5%)	20.7	35.2 (8-WTR-2, 6-7')	21.6	49.9	Yes	No	The maximum thallium concentration is less than the site-specific background value.
Vanadium (V)	40/40	11.2	38.4	21.2	62.6	Yes	No	The maximum vanadium concentration is less

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
	(100%)		(8-NTR-1, 4-5')					than the site-specific background value.
Zinc (Zn)	**40/40 (100%)**	**30.5**	**2,820 (8-GS-3, 0-2")**	**238**	**144**	**Yes**	**Yes**	**Detection frequency 100%; potential toxicity; exceeds background in 10 (25%) of the 40 soil samples. All background exceedances occur in surface (0-2") or shallow subsurface (0.5') soil samples. Zinc is a nutritionally essential metal that is widely abundant in the native geologic materials (it is present in most ore-grade districts of the Oquirrh mountains), so selection as a COC may be conservative.**
ORGANIC CONSTITUENTS								
Benzene (C6H6)	1/40 (2.5%)	0.005	0.005 (8-GS-6, 0-2")	--	ND	Yes	No	Detection frequency < 5%; single, isolated occurrence at low concentration, which is less than the MDL (1.5 µg/g).
1,3-Dinitrobenzene (13DNB) (Explosive)	**1/40 (2.5%)**	0.233	**0.233 (8-GS-1, 0-2")**	--	ND	Yes	No	**Detection frequency < 5%; single isolated occurrence at low concentration (<1 µg/g).**
Cyclotetramethyl-enetetranitramine (HMX) (Explosive)	1/40 (2.5%)	2.52	2.52 (8-GS-2, 0-2")	--	ND	No	No	Detection frequency < 5%; single, isolated occurrence coincides with detection of 24DNT, another explosive compound (see below).
2,4,6-Trinitrotoluene (246TNT)	1/40 2.5%	0.456	0.456 (8-GS-1, 0-2")	--	ND	Yes	No	Detection frequency < 5%; single isolated occurrence at low concentration (<1 µg/g).

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
(Explosive)								
2,4-Dinitrotoluene (24DNT) (Explosive)	2/40 (5%)	0.053	2.31 (8-GS-2, 0-2")	--	ND	Yes	No	Detection frequency 5%; the minimum concentration is below one half the CRL and thus is highly uncertain. [The maximum coincides with the detection of HMX, another explosive compound (see above).]
Pentaerythritol tetranitrate (PETN)	8/40 (20%)	2.6	2.64 (8-WTR-2)	--	ND	No	No	Detection frequency >5%, however, PETN has very low toxicity. When used to treat congestive heart failure and prevent angina (chest pain), the typical human dosage is 10–20 mg, three to four times per day. Any potential exposure to the PETN detected in soil at SWMU 8 would be well below this prescribed dose.
Phenanthrene (PHANTR)	1/40 (2.5%)	0.082	0.082 (8-GS-3, 0-2")	--	ND	Yes	No	Detection frequency < 5%; single, isolated occurrence at low concentration (< 1 µg/g).
Trichlorofluoro-methane (CCL3F)	**6/40 (15%)**	**0.006**	**0.008 (8-GS-7, 2-3')**	**--**	**ND**	**Yes**	**Yes**	**Detection frequency > 5%; potential toxicity. Concentrations are low, however, and the range is narrow (0.006-0.008 µg/g). Selection as a COC may therefore be conservative.**
Toluene (MEC6H5)	1/40 (2.5%)	0.002	0.002 (8-WTR-1, 1-2')	--	ND	Yes	No	Single detection at a low concentration (frequency < 5%).

Table 5.4-1 Identification of COCs for SWMU 8 Soil

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
NON-TARGET ANALYTES								
Hydrocarbons, long-chain (C16A, C27, and C29)	1/40 (C16A) 2/40 (C27) 5/40 (C29)	1.2 0.32 0.43	1.2 0.34 1.0	-- -- --	ND ND ND	No No No	No No No	Presence in samples may reflect naturally-occurring, long-chain hydrocarbons present in the organic carbon in soil; negligible toxicity.
Octadecamethyl-cyclo-nonasiloxane (OMCTSX)	2/40 (5.0%)	0.043	0.059 (8-WTR-1, 1-2')	--	ND	No	No	Low detection frequency (= 5%) at low concentrations; no toxicity data available.

NOTES:

All units in μg/g (ppm).
Bold print indicates the chemical was selected as a soil COC for SWMU 8.

1 The summaries provided in this table apply to both surface and subsurface soil (i.e., data for both soil depth profiles were merged to derive detection frequencies, means, etc.). Distinctions regarding the vertical distribution of constituents are made only if warranted by the data. In general, such distinctions are left to the quantitative risk assessment, for which current-use risks are calculated using surface soil data (only), and future-use risks are calculated using the merged (surface and subsurface) database.

2 Means were calculated assuming that nondetects are equivalent to one-half the MDL. Average concentrations are not reported for most organic and non-target analytes, however, because the low detection frequencies and high MDL values result in artificially elevated means (that often exceed reported maxima). Thus, the average was not considered to be a meaningful estimator for these constituents.

3 Site-specific background values were derived as the maximum detected concentration of each metal in background samples collected for the Group 2 SWMUs (Section 2.3).

4 "Yes" is indicated in this column when toxicity criteria are available that allow quantitative evaluation of a given compound (e.g., carcinogenic slope factors and/or noncarcinogenic RfDs from IRIS or HEAST).

5 When "Yes" is followed by an asterisk (*) in this column, it indicates that the constituent was not selected as a site-wide COC, but may be a potential sample- or area-specific COC.

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
NON-TARGET ANALYTES								
Hydrocarbons, long-chain (C16A, C27, and C29)	1/40 (C16A)	1.2	1.2	--	ND	No	No	Presence in samples may reflect naturally-occurring, long-chain hydrocarbons present in the organic carbon in soil; negligible toxicity.
	2/40 (C27)	0.32	0.34	--	ND	No	No	
	5/40 (C29)	0.43	1.0	--	ND	No	No	
Octadecamethyl-cyclo-nonasiloxane (OMCTSX)	2/40 (5.0%)	0.043	0.059 (8-WTR-1, 1-2')	--	ND	No	No	Low detection frequency (= 5%) at low concentrations; no toxicity data available.

All units in µg/g (ppm).
Bold print indicates the chemical was selected as a soil COC for SWMU 8.

NOTES/DEFINITIONS:

[1] The summaries provided in this table apply to both surface and subsurface soil (i.e., data for both soil depth profiles were merged to derive detection frequencies, means, etc.). Distinctions regarding the vertical distribution of constituents are made only if warranted by the data. In general, such distinctions are left to the quantitative risk assessment, for which current-use risks are calculated using surface soil data (only), and future-use risks are calculated using the merged (surface and subsurface) database.

[2] Means were calculated assuming that nondetects are equivalent to one-half the MDL. Average concentrations are not reported for most organic and non-target analytes, however, because the low detection frequencies and high MDL values result in artificially elevated means (that often exceed reported maxima). Thus, the average was not considered to be a meaningful estimator for these constituents.

[3] Background values were determined using the methods and assumptions described in Section 2.3.

[4] "Yes" is indicated in this column when toxicity criteria are available that allow quantitative evaluation of a given compound (e.g., carcinogenic slope factors and/or noncarcinogenic RfDs from IRIS or HEAST).

[5] When "Yes" is followed by an asterisk (*) in this column, it indicates that the constituent was not selected as a site-wide COC, but may be a potential sample- or area-specific COC.

Table 5.4-2 Summary of COCs Selected for SWMU 8 Soil [1]

Site-Wide Soil COCs [2]	Sample- or Area- Specific Soil COCs [2]	Location
Cadmium	Chromium	West Trench and Drop Tower Areas
Copper	Nickel	West Trench and Drop Tower Areas
Lead		
Mercury		
Zinc		
Trichlorofluoromethane (CCL3F)		

NOTE:

1 This table summarizes soil COCs only because no groundwater samples were collected, and because evaluation of SWMU 8 air monitoring data did not result in the identification of any groundwater COCs.

2 As indicated in Table 5.4-1 (Note 5), for certain constituents elevated concentrations were only detected in localized areas of the SWMU. Concentrations at remaining sample locations were less than site-specific background levels. Therefore, these constituents were not selected as site-wide COCs, but are considered sample- or area-specific COCs.

Table 5.4-3 Potential Pathways of Exposure to COCs at SWMU 8

Exposure Medium	Potential Receptor(s)	Receptor Location(s)	Potential Exposure Route(s)	Pathway Quantitatively Evaluated?[1]	Reason for Selection or Exclusion
CURRENT-USE EXPOSURE PATHWAYS					
Current-Use Exposure Scenario 1: SWMU 8 Receptor					
Surface (0-2") Soils	Site Environmental Management Personnel	Within SWMU 8	Incidental Ingestion, Dermal Contact, and Inhalation Soil Exposure Pathways	YES	SWMU 8 is not currently active. Security patrols do not enter the site, nor is the evacuation route apparently used. Although exposures to soils in SWMU 8 are not expected, potential risks were evaluated assuming that Environmental Management staff would access the site twice a year (one hour per exposure) to inspect the grounds.
Current-Use Exposure Scenario 2: SWMU 31 Worker Receptor					
Resuspended Surface Soil Particulates	SWMU 31 (Demil. Area Workers)	South of SWMU 8	Inhalation of Resuspended Soil Particulates Transferred off SWMU 8 via Wind Dispersion	YES	The nearest downwind receptors potentially having the longest, most frequent exposures to SWMU 8 soil COCs would be workers in the SWMU 31 demilitarization area, located due south of SWMU 8. The general wind direction is northwest to southeast, so SWMU 31 is not directly downwind of SWMU 8. For this analysis, a demilitarization area worker was assumed to be exposed to screening-level estimates of SWMU 8 soil COC concentrations in airborne particulates for 4 hours per day, 250 days per year. [A 4-hour per day exposure was assumed (e.g., vs. 8 hours) because these workers are expected to be downwind of SWMU 8 only a portion of the day.] Note that this analysis does not account for any possible additional exposures, such as those attributable to SWMU 31 demilitarization activities (see Section 5.7).

Exposure Medium	Potential Receptor(s)	Receptor Location(s)	Potential Exposure Route(s)	Pathway Quantitatively Evaluated?[1]	Reason for Selection or Exclusion
FUTURE-USE EXPOSURE PATHWAYS					
Surface and Subsurface Soils	Future Residents	Within SWMU 8	Ingestion, Dermal Contact, and Inhalation Soil Exposure Pathways Associated with Hypothetical Future Residential Use of SWMU 8	YES	Future residential use of TEAD-S is not expected. Nonetheless, in accordance with state and federal risk assessment guidelines, this hypothetical future-use pathway was quantitatively evaluated using the exposure assumptions outlined in Section 5.1 and in Appendix K.2. This assessment is considered to represent a worst-case, screening-level evaluation of risks associated with potential exposures to SWMU 8 soil COCs.
Shallow Groundwater (Future Uses)	Future Residents	Within SWMU 8	Ingestion and Inhalation of Volatile COCs While Showering or Washing	NO	Future use of shallow groundwater underlying SWMU 8 is not expected. No waste is buried at the unit. Soil sampling confirmed that no contaminants are present at SWMU 8 that would be expected to leach to the underlying shallow groundwater.

1 For pathways that were quantitatively evaluated, exposure assumptions are summarized in Table 5.4-5. These pathways were quantified for both SWMU-wide and location-specific risk evaluations (Tables 5.4-6 and 5.4-7).

Table 5.4-4 EPCs Used to Evaluate SWMU 8 Exposure Pathways

	SWMU-Wide Risk Evaluation				Location-Specific Risk Evaluation		
	Current-Use Pathways		Future-Use Pathways		Current- and Future-Use Pathways		
Contaminant of Concern	Surface Soil EPC (μg/g)	Corresponding Air EPC (mg/m³)	Surface/Subsurface Soil EPC (μg/g)	Corresponding Air EPC (mg/m³)	Soil EPC (μg/g)	Basis (Location)	Corresponding Air EPC (mg/m³)
Cadmium	3.74	4.34E-09	1.41	--	6.43	8-GS-2 (0-2")	7.46E-09
Copper	154.5	1.79E-07	89.3	--	557	8-WTR-2 (0.5')	6.46E-07
Chromium*	--	--	--	--	75.8	8-WTR-2 (0.5')	8.79E-08
Lead	98.9	1.15E-07	38.0	--	73.0	8-GS-2 (0-2")	8.47E-08
Mercury	0.138	1.60E-10	0.11	--	0.591	8-GS-3 (0.5')	6.86E-10
Nickel*	--	--	--	--	57.9	8-WTR-2 (0.5')	6.72E-08
Zinc	1,107	1.28E-06	381	--	2,820	8-GS-3 (0-2")	3.27E-06
Trichlorofluoromethane	0.005	5.80E-12	0.004	--	ND	--	--

<u>Note:</u>

-- Not Applicable/Not Evaluated
ND Not Detected
* Sample- or area-specific soil COCs

1 For current use pathways, soil EPCs are the 95% UCL of the mean surface soil concentration, calculated assuming nondetections are equal to one-half the method detection limit value. Soil EPCs for the future residential-use pathway evaluation are the 95% UCL of the mean COC concentration in surface and subsurface soil (combined). Air EPCs were derived using the methods described in Section 5.1.2 and in Table 5.2-5 (Note 3).

2 EPCs for sample- or area-specific soil COCs are essentially the maximum concentration detected at the sample location listed above. These EPCs were applied in both the current- and future-use risk evaluations. To adequately account for potential cumulative risks or hazards in the specified areas, location-specific EPCs are also listed for the six site-wide COCs that correspond to the west trench (8-WTR-2) and drop tower (8-GS-2 and 8-GS-3) sample locations.

Table 5.4-5 Assumptions Used to Evaluate SWMU 8 Current-Use Exposure Pathways

PARAMETER	ASSUMED VALUE: Site EM Personnel (SWMU 8 Receptor)	ASSUMED VALUE: Demil. Area Worker (SWMU 31 Receptor)	SOURCE/RATIONALE
General Exposure Parameters			
Age During Exposure	Adult	Adult	-
Average Body Weight	70 kg	70 kg	EPA 1991a. Standard default.
Lifetime Exposure Duration	25 years	25 years	EPA 1991a. Standard default.
Exposure Frequency	2 days/year	250 days/year	Professional judgement based on site-specific factors (see Table 5.4-3).
Direct Contact Parameters			
Soil Ingestion Rate	100 mg/day	NA	EPA 1991a (See Note 1).
Soil Adherence Rate	1.0 mg/cm^2	NA	EPA 1992c. Upper bound default.
Surface Area Exposed	4,100 cm^2	NA	EPA 1992c (See Note 2).
Dermal Absorption Rate	Metals: 0.1%	NA	EPA 1992c
	Organics: 10%	NA	
Inhalation Exposure Parameters			
Hours per Day	1 hour	4 hours	Professional judgement.
Inhalation Rate	2.5 m^3/hour	2.5 m^3/hour	EPA 1991a. Assumes moderate activity for both receptor groups.
Particulate Emission Factor	8.62 x 10^8 m^3/kg	8.62 x 10^8 m^3/kg	Site-specific particulate emission factor (PEF); see Section 5.1.2 for derivation.

Notes:

1 Although EPA guidance (1991a) recommends a soil ingestion rate of 50 mg/day for workers, a more conservative value of 100 mg/day is used in this assessment to account for potentially higher exposures possible at TEAD-S for an outdoor work environment.

2 The skin surface area of 4,100 cm^2 is for an adult male, and represents a 95th percentile value for the hands, forearms, and head (EPA 1992c).

5.4.3 Risk Characterization

This section quantifies risks for the SWMU 8 exposure pathways identified in Table 5.4-3. Sections 5.4.3.1 and 5.4.3.2 present the results of the risk assessment for current- and hypothetical future-use soil exposure scenarios, respectively. Section 5.4.3.3 summarizes the results of the current- and future-use risk evaluations.

5.4.3.1 Current-Use Risks

SWMU-Wide Risk Evaluation

Table 5.4-6 summarizes the cancer risks and HIs calculated for the two current-use SWMU-wide exposure scenarios. The cancer risk and HI calculated for site Environmental Management (EM) personnel receptors (exposure scenario 1)—2×10^{-12} and 9.8×10^{-5}, respectively—are well below respective State of Utah corrective action criteria. The cancer risk and the HI calculated for SWMU 31 demilitarization area worker receptors (exposure scenario 2)—1×10^{-9} and 3.2×10^{-6}, are also well below risk levels requiring site controls or corrective action.

Location-Specific Risk Evaluation

Table 5.4-7 summarizes the cancer risks and hazard indices calculated for SWMU 8 current-use location-specific exposure scenarios—west trench and drop tower areas. The cancer risk and HI calculated for site EM personnel receptors (current-use exposure scenario 1)—4×10^{-11} and 2.9×10^{-4}, respectively—are well below respective corrective action criteria. Risk levels calculated for SWMU 31 demilitarization area worker receptors (current-use scenario 2)—2×10^{-8} and 6.0×10^{-6}, respectively, are also well below corrective action criteria.

5.4.3.2 Potential Future-Use Soil Exposure Risks

Table 5.4-8 summarizes the results of the risk assessment developed for hypothetical future-residential-use exposures to SWMU 8 surface and subsurface soil. Cancer risks and noncancer HIs presented in this table were calculated using the soil RBSLs listed in Table 5.1-2 in accordance with the methods, equations, and assumptions outlined in Section 5.1.4.1 and Appendix K.2. For both the SWMU-wide and location-specific (west trench and drop tower area) evaluations, cancer risks (1.2×10^{-9} and 4.5×10^{-7}) and HIs (0.07 and 0.65) are all below State of Utah risk criteria. (Accordingly, assumed chemical-specific soil concentrations (EPCs) are less than corresponding RBSLs.)

Table 5.4-6 Cancer Risks and Hazard Indices Calculated for SWMU 8 Current-Use SWMU-Wide Soil Exposure Pathways[1, 2]

Current-Use Exposure Scenario			Results of Cancer Risk (CR) Calculations		Results of Hazard Index (HI) Calculations	
Receptor	Pathway(s)	COCs Evaluated	CR	Driving COC(s) and Pathway	HI	Driving COC(s) and Pathway
Current-Use Exposure Scenario 1: Receptor Location—Within SWMU 8						
Site EM Personnel	SI/DC/INH (Appendix Table K.5-1)	All soil COCs, using site-wide EPCs (Table 5.4-4)	2×10^{-12}	Cadmium (the only carcinogen evaluated, INH the only relevant pathway)	9.8×10^{-5}	Copper, cadmium, and zinc; SI dominates
Current-Use Exposure Scenario 2: Receptor Location—SWMU 31 Demilitarization Area						
SWMU 31 (Demil. Area) Workers	INH[3] (Appendix Table K.5-2)	All soil COCs, using site-wide EPCs (Table 5.4-4)	1×10^{-9}	Cadmium	3.2×10^{-6}	Cadmium (94%) and mercury (6%)

Interpretation: *The risk levels calculated for the two SWMU 8 current-use exposure scenarios are all well below respective State of Utah corrective action criteria (for carcinogens and noncarcinogens).*

COC Chemical of Concern
SI Soil Ingestion Pathway
DC Dermal Contact Pathway
INH Inhalation Pathway
CR Cancer Risk
HI Hazard Index

1 Tables 5.4-2 and 5.4-3 detail the COC and exposure pathway selection process; Tables 5.4-4 and 5.4-5 summarize the COC-specific exposure point concentrations (EPCs) and exposure assumptions used in the risk calculations. Appendix Tables K.5-1 and K.5-2 provide detailed cancer risk and HI calculation documentation for the two current-use SWMU 8 exposure scenarios summarized above.

2 Although lead was identified as a site-wide soil COC for SWMU 8, toxicity criteria are not available with which to quantify associated hazards or risks. Currently, as set forth by OSWER directive #9355.4-12, EPA recommends a screening level for lead in soil of 400 ug/g, assuming residential land use (EPA, 1994). The maximum detected lead concentration in SWMU 8 soil, 240 μg/g (8-GS-7, 0-2"), is well below this screening level value.

3 This scenario represents a worst-case, screening-level evaluation of potential risks associated with chronic inhalation of SWMU 8 soil COCs at the nearby SWMU 31 demilitarization area location (Table 5.4-3).

Table 5.4-7 Cancer Risks and Hazard Indices Calculated for SWMU 8 Current-Use Location-Specific Soil Exposure Pathways[1]

Current-Use Exposure Scenario			Results of Cancer Risk (CR) Calculations		Results of Hazard Index (HI) Calculations	
Receptor	Pathway(s)	COCs Evaluated	CR	Driving COC(s) and Pathway	HI	Driving COC(s) and Pathway
Current-Use Exposure Scenario 1: Source Location—West Trench and Drop Tower Areas Receptor Location—Within SWMU 8						
Site EM Personnel	SI/DC/INH (Appendix Table K.5-3)	All soil COCs except CCL3F[2], using site-wide EPCs (Table 5.4-4)	4×10^{-11}	chromium, 10% assumed hexavalent (70%) and nickel (21%); INH is the only relevant pathway	2.9×10^{-4}	copper (42%), zinc (26%), and cadmium (18%); SI dominates
Current-Use Exposure Scenario 2: Source Location—West Trench and Drop Tower Areas Receptor Location—SWMU 31 Demilitarization Area						
SWMU 31 (Demil. Area) Workers	INH[3] (Appendix Table K.5-4)	All soil COCs except CCL3F[2], using site-wide EPCs (Table 5.4-4)	2×10^{-8}	chromium and nickel	6×10^{-6}	cadmium (87%) and mercury (13%)

Interpretation: *The cancer risks and HIs calculated for the two SWMU 8 current-use exposure scenarios specific to the west trench and drop tower locations are all well below respective State of Utah corrective action criteria (for carcinogens and noncarcinogens).*

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Table 5.4-7 Cancer Risks and Hazard Indices Calculated for SWMU 8 Current-Use Location-Specific Soil Exposure Pathways[1]

COC Chemical of Concern
SI Soil Ingestion Pathway
DC Dermal Contact Pathway
INH Inhalation Pathway
CR Cancer Risk
HI Hazard Index

1 Tables 5.4-2 and 5.4-3 detail the COC and exposure pathway selection process; Tables 5.4-4 and 5.4-5 summarize the COC-specific exposure point concentrations (EPCs) and exposure assumptions used in the risk calculations. Appendix Tables K.5-3 and K.5-4 provide detailed cancer risk and HI calculation documentation for the two current-use SWMU 8 exposure scenarios summarized above.

2 Trichlorofluoromethane (CCL3F) was not evaluated for the location-specific exposure scenarios because this constituent was not detected in samples collected from the west trench or drop tower areas.

3 This scenario represents a worst-case, screening-level evaluation of potential risks associated with chronic inhalation of SWMU 8 soil COCs at the nearby SWMU 31 demilitarization area location (Table 5.4-3).

Table 5.4-8 Cancer Risks and Hazard Indices Calculated for SWMU 8 Hypothetical Future-Use Soil Exposure Pathways

Chemical of Concern	Carcinogenic RBSL (μg/g)	Soil EPC (μg/g)	Cancer Risk	(Percent of Total Risk)	Noncarcinogenic RBSL (μg/g)	Soil EPC (μg/g)	Hazard Quotient	(Percent of Total HI)
SWMU-WIDE RISK EVALUATION								
Cadmium	1,170	1.41	1.2E-09	100%	78.2	1.41	1.8E-02	26%
Copper		89.3			2,902	89.30	3.1E-02	44%
Lead		38.00			400	38.00	NE	
Mercury		0.11			23.5	0.11	4.7E-03	7%
Trichlorofluoromethane		0.004			410	0.004	9.8E-06	<1%
Zinc		381.00			23,464	381.00	1.6E-02	23%
	Total Cancer Risk:		1.2E-09		**Total Hazard Index (HI):**		7.0E-02	
LOCATION-SPECIFIC RISK EVALUATION: WEST TRENCH (8-WTR-2 AND -1) AND DROP TOWER (8-GS-2 AND -3) SAMPLE LOCATIONS								
Cadmium	1,170	6.43	5.5E-09	1%	78.2	6.43	8.2E-02	13%
Chromium, hexavalent	175	75.8	4.3E-07	96%	391	75.8	1.9E-01	30%
Copper		557.0			2,902	557.0	1.9E-01	30%
Lead		73			400	73	NE	
Mercury		0.59			23.5	0.59	2.5E-02	4%
Nickel	4,370	57.9	1.3E-08	3%	1,564	57.9	3.7E-02	6%
Zinc		2,820			23,464	2,820	1.2E-01	18%
	Total Cancer Risk:		4.5E-07		**Total Hazard Index (HI):**		6.5E-01	

NE = No Exceedance based on the USEPA Soil Screening Level for lead. Potential human health risks are not likely to occur following chronic exposure.

5.4.3.3 Summary of SWMU 8 Human Health Risk Assessment Results

The results of the risk assessment conducted for SWMU 8 indicate no potential health threats associated with exposure to SWMU 8 soil under either the current- or hypothetical future-use scenarios. Total cancer risks calculated for the two current-use scenarios (for both the SWMU-wide and the location-specific evaluation) and the single future-use scenario are all below State of Utah corrective action criteria.

5.5 BASELINE HUMAN HEALTH RISK ASSESSMENT FOR SWMU 9

5.5.1 Identification of Chemicals of Concern

Tables 5.5-1 and 5.5-2 detail the COC selection process for SWMU 9 soil and groundwater samples, respectively. Table 5.5-3 summarizes the COCs selected for all media, including the air COCs that were selected based on the air monitoring results. Only four constituents were selected as SWMU-wide soil COCs for SWMU 9: lead, di-n-butylphthalate (DNBP), toluene, and trichlorofluoromethane (CCL3F). Arsenic and copper were identified as location-specific soil COCs for the 9-A2-11/-12 and 9-BA-1 sample locations, respectively. Tables 5.5-1 and 5.5-3 present detailed rationales for soil COC selection and designations.

Air COCs selected on the basis of the air monitoring results include ethyl benzene, methylene chloride, tetrachloroethene, toluene, and total xylenes. These constituents were identified as air COCs because ambient concentrations detected at SWMU 9 exceeded levels reported for the background monitoring location (Table 5.5-3).

Constituents identified as SWMU 9 groundwater COCs include aluminum, antimony, barium, beryllium, chromium, lead, nickel, vanadium, and methylene chloride (Tables 5.5-2 and 5.5-3). Of these constituents, antimony, lead, nickel, and methylene chloride are considered the primary groundwater COCs. For the remaining constituents, there is insufficient evidence that their presence is attributable to site-related activities and/or poses a health risk (Table 5.5-3).

5.5.2 Exposure Assessment

Table 5.5-4 summarizes the current- and future-use exposure scenarios at SWMU 9 that were quantified in the risk assessment. Table 5.5-5 lists the soil and air EPCs used in the risk calculations; groundwater EPCs are the maximum COC concentrations listed in Table 5.5-2. Table 5.5-6 summarizes the pathway-specific exposure parameters, along with supporting references, assumptions, and rationales. (CDI calculation documentation specific to SWMU 5 is provided in Appendix Tables K.6-1 through K.6-3.)

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
INORGANIC CONSTITUENTS								
Aluminum (Al)	131/131 (100%)	1,400	50,400 (9-BA-1, 0-2")	12,847	25,200	Yes	No	Only one detection (0.8% of the samples) exceeds the site-specific background level; remaining concentrations are ≤22,300 µg/g. Also, aluminum is a ubiquitous component of aluminosilicate minerals.
Antimony (Sb)	6/131 (4.6%)	8.85	13.1 (9-A2-13, 0-2")		11.9	Yes	No	Detection frequency < 5%; two concentrations exceed background, but by a negligible amount.
Arsenic (As)	**131/131 (100%)**	**1.5**	**97.0 (9-A2-11, 0.5')**	**9.8**	**40.0**	**Yes**	**Yes* (sample locations 9-A2-11 and 9-A2-12)**	**Arsenic concentrations exceed background in only 2 (1.5%) of the 131 samples: 9-A2-11 (97 µg/g, 0.5') and 9-A2-12 (85 µg/g, 4-5'). Concentrations in remaining samples are ≤33.0 µg/g. Consequently, arsenic is not considered a site-wide COC, but is a potential COC for the area encompassing the 9-A2-11 and 9-A2-12 sample locations.**
Barium (Ba)	131/131 (100%)	13.8	467 (9-OA2-12, 2-3')	192	11,850	Yes	No	The maximum barium concentration is well below the site-specific background value.

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Table 5.5-1 Identification of COCs for SWMU 9 Soil

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
INORGANIC CONSTITUENTS								
Aluminum (Al)	131/131 (100%)	1,400	50,400 (9-BA-1, 0-2")	12,847	25,200	Yes	No	Only one detection (0.8% of the samples) exceeds the site-specific background level; remaining concentrations are ≤22,300 µg/g. Also, aluminum is a ubiquitous component of aluminosilicate minerals.
Antimony (Sb)	6/131 (4.6%)	8.85	13.1 (9-A2-13, 0-2")		11.9	Yes	No	Detection frequency < 5%; two concentrations exceed background, but by a negligible amount.
Arsenic (As)	**131/131 (100%)**	**1.5**	**97.0 (9-A2-11, 0.5')**	**9.8**	**40.0**	**Yes**	**Yes* (sample locations 9-A2-11 and 9-A2-12)**	**Arsenic concentrations exceed background in only 2 (1.5%) of the 131 samples: 9-A2-11 (97 µg/g, 0.5') and 9-A2-12 (85 µg/g, 4-5'). Concentrations in remaining samples are ≤33.0 µg/g. Consequently, arsenic is not considered a site-wide COC, but is a potential COC for the area encompassing the 9-A2-11 and 9-A2-12 sample locations.**
Barium (Ba)	131/131 (100%)	13.8	467 (9-OA2-12, 2-3')	192	537	Yes	No	**The maximum barium concentration is below the site-specific background value.**

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Beryllium (Be)	117/131 (89.3%)	0.31	1.67 (9-OA2-9, 0.5')	0.65	1.2	Yes	No	Beryllium concentrations exceed background in 15 (11%) of the 131 soil samples. However, none of these exceedances is considered notable, given that the concentrations are all within 0.5 μg/g of the 1.2 μg/g background value. As indicated in Table 5.2-1, the ore-grade beryllium deposits in surrounding mountains may be a potential source of the beryllium detected on site.
Cadmium (Cd)	44/131 (33.6%)	0.41	3.4 (9-A2-14, 0-2")		0.98	Yes	No	Cadmium concentrations exceed the 1.0 μg/g background level in only 3 (2%) of the 131 samples: 9-A2-14 (3.4 μg/g, 0-2"); 9-OA2-8 (1.7 μg/g, 0-2"); and 9-OA2-7 (1.4 μg/g, 0-2"). These exceedances are not considered notable.
Calcium (Ca)	131/131 (100%)	10,100	200,000 (9-A2-1, 0-2")	117,026	250,000	No	No	The maximum calcium concentration is less than the site-specific background level.
Chromium (Cr)	130/131 (99.2%)	6.7	29.2 (9-BA-1, 0-2")	15.8	48.5	Yes	No	The maximum chromium concentration is less than the site-specific background level.

Table 5.5-1 Identification of COCs for SWMU 9 Soil

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Cobalt (Co)	130/131 (99.2%)	1.3	8.9 (9-A2-3, 4-5')	5.4	8.6	No	No	Only the maximum (8.9 µg/g) concentration (less than 1 percent of the samples) exceeds the 8.6 µg/g site-specific background level, and not by a significant amount. Remaining cobalt concentrations are ≤ 8.0 µg/g.
Copper (Cu)	**131/131 (100%)**	**0.8**	**966 (9-BA-1, 0-2")**	**20.8**	**27.6**	**Yes**	**Yes* (9-BA-1 sample only)**	**Copper concentrations exceed background in only 3 (2%) of the 131 samples: 9-BA-1 (966 µg/g, 0-2'"); 9-BA-1 (56.8 µg/g, 2-3'); and 9-TP-4 (39.6 µg/g, 0-2"). Concentrations in remaining samples are ≤26.4 µg/g. Consequently, copper is not considered a site-wide COC, but is a potential COC for the 9-BA-1 sample location. (The background exceedance reported for sample 9-TP-4 is not considered notable.) Consideration as even a sample-specific COC may be conservative because copper is widely distributed in nature and is an essential element.**
Cyanide	1/131 (0.8%)	0.73	0.73 (9-OA2-12, 2-3')	0.73	0	Yes	No	Detection frequency < 5%.

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Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Iron (Fe)	131/131 (100%)	1,760	21,600 (9-A2-3, 4-5')	12,305	24,300	No	No	The maximum iron concentration is less than the site-specific background level.
Lead (Pb)	**131/131 (100%)**	**2.19**	**210.0 (9-A2-12, 0-2")**	**17.8**	**35.0**	**Yes**	**Yes**	**Detection frequency 100%; potential toxicity. Lead concentrations exceed background in only 8 (6%) of the samples, so selection as COC is conservative. (No spatial trend is apparent that would warrant selection as an area-specific COC.) All background exceedances occur in surface soil (0-2") samples.**
Magnesium (Mg)	131/131 (100%)	1,970	24,400 (9-BA-5, 9-10')	13,070	16,150	No	No	Exceeds background in 20 (15%) of the 131 samples. However, magnesium was not selected as a COC because it is a naturally-occurring essential human nutrient with negligible toxicity.

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Manganese (Mn)	131/131 (100%)	35.4	686.0 (9-TP-2A, 0-2")	410.3	658.0	Yes	No	Manganese concentrations exceed background in only 5 (3.8%) of the 131 soil samples. These background exceedances are not considered significant—the maximum (686 µg/g) concentration is only 4% higher than the 658 µg/g background value. Furthermore, manganese is an essential element that is a ubiquitous mineral in desert soils.
Mercury (Hg)	55/131 (42.0%)	0.027	0.36 (9-A2-6, 0.5')	0.069	0.143	Yes	No	Mercury concentrations exceed background in only 2 (1.5%) of the 131 soil samples. These two exceedances are not considered notable—the maximum (0.36 µg/g) concentration is within 0.2 µg/g of the 0.143 µg/g background value, and the second-rank detection (0.147 µg/g) is essentially equal to the background value. Additionally, mercury-containing minerals were mined commercially near Mercur in the Oquirrh mountains, so mercury's presence in site soil samples at these levels is not unexpected.
Nickel (Ni)	131/131 (100%)	1.98	26.0 (9-A2-12, 4-5')	15.3	27.9	Yes	No	

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Potassium (K)	131/131 (100%)	418	8,650 (9-OA2-4, 0.5')	4,046	7,940	No	No	Only the maximum concentration exceeds the site-specific background value, and not by a significant amount. Remaining detections are ≤ 6,730 μg/g. Also, potassium is a naturally-occurring essential human nutrient with negligible toxicity.
Selenium (Se)	2/131 (1.5%)	0.25	0.26 (9-A2-1, 2-3')	0.13	0.21	Yes	No	Selenium was detected in only two soil samples, at concentrations (0.25 μg/g and 0.26 μg/g) just slightly exceeding the 0.21 μg/g background level.
Sodium (Na)	131/131 (100%)	380	4,330 (9-OA2-6, 4-5')	1,378	5,610	No	No	The maximum concentration is less than the site-specific background value.
Thallium (Tl)	82/131 (62.6%)	4.43	33.3 (9-BA-5, 9-10')	13.1	49.9	Yes	No	The maximum thallium concentration is less than the site-specific background value.
Vanadium (V)	131/131 (100%)	5.55	54.5 (9-A2-13, 4-5')	23.8	62.6	Yes	No	The maximum vanadium concentration is less than the site-specific background value.

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Zinc (Zn)	131/131 (100%)	7.0	366 (9-BA-1, 0-2")	57.3	144	Yes	No	Zinc exceeds background in only one sample; remaining concentrations are ≤116 µg/g. Zinc's presence at reported levels is not considered notable given that zinc was mined in Ophir, and is present in most ore-grade districts of the Oquirrh mountains.
ORGANIC CONSTITUENTS								
Acetone	3/131 (2.3%)	0.020	0.022 (9-BA-5, 4-5')	--	ND		No	Detection frequency < 5%. Presence in the three samples may be attributable to laboratory blank or sample container contamination.
Bis(2-ethylhexyl) phthalate (B2EHP)	3/131 (2.3%)	0.98	5.6 (9-OA2-12, 2-3')	--	ND	Yes	No	Detection frequency < 5%. Also, B2EHP is a ubiquitous pollutant due to its widespread use as a plasticizer.

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Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Di-n-butylphthalate (DNBP)	**19/131 (14.5%)**	**0.082**	**10.0 (9-SB-4, 0-2")**	**--**	**ND**	**Yes**	**Yes**	**Detection frequency > 5%; potential toxicity. Only the maximum (10 µg/g) concentration appears elevated; remaining detections are ≤ 0.34 µg/g. Like B2EHP, DNBP is commonly occurring (but no background data are available for comparison), so selection as a COC is conservative.**
Hexachlorobenzene (CL6BZ)	2/131 (1.5%)	0.58	1.1 (9-A2-11, 0-2")	--	ND	Yes	No	Detection frequency < 5%.
Isopropyl methylphosphonic acid (IMPA)	1/131 (0.8%)	15.5	15.5 (9-TP-4, 0-2")	--	ND	Yes	No	Single isolated detection; frequency < 5%.
Methylene Chloride (CH2CL2)	1/131	0.006	0.006 (9-BA-2)	--	ND	Yes	No	Detection frequency < 5%: single isolated occurance at low concentration (<1µg/g).
Methylphosphonic acid (MPA)	**2/131 (1.5%)**	**0.92**	**3.61 (9-OA2-7, 0-2")**	**--**	**ND**	**Yes [6]**	**Yes***	**MPA was selected as a location-specific COC and is discussed qualitatively in Section 5.5.3.1.**

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
PCB 1248 (PCB248)	3/131 (2.3%)	0.15	0.51 (9-A2-8, 0-2")	--	ND	Yes	No	Detection frequency < 5%. Also, concentrations do not exceed EPA's 0.5 to 1.0 ppm PCB cleanup criterion developed for residential sites, and are well below the 10 to 25 ppm range considered protective for industrial site uses.
PCB 1254 (PCB254)	1/131 (0.8%)	0.67	0.67 (9-A2-11, 0-2")	--	ND	Yes	No	Single isolated detection; frequency < 5% (also, see rationale for PCB 1248 above).
Trichlorofluoro-methane (CCL3F)	**14/131 (10.7%)**	**0.006**	**0.011 (9-TP-4, 2-3')**	**0.001**	**ND**	**Yes**	**Yes**	**Detection frequency > 5%; potential toxicity. Concentrations are low, however, so selection as a COC may be conservative.**
Toluene (MEC6H5)	**12/132 (9.1%)**	**0.001**	**1.1 (9-OA2-12, 0-2")**	**--**	**ND**	**Yes**	**Yes**	**Detection frequency > 5%; potential toxicity. With the exception of the maximum, concentrations are in the low ppb range (0.001-0.005 µg/g), so selection as a COC is conservative.**
NON-TARGET ANALYTES								
Dioctyl adipate (DOAD)	1/131 (0.8%)	5.1	5.1 (9-SB-4, 0-2")	--	ND	No	No	Single, isolated detection (frequency < 5%).

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Ethanol (ETOH)	3/131 (2.3%)	0.007	0.012 (9-A2-13, 0-2")	--	ND	No	No	Detection frequency < 5%; negligible toxicity; common usage in household and industrial products.
Hydrocarbons, long-chain (C16A, C27, and C29)	2/131 (C16A) 3/131 (C27) 9/131 (C29)	0.33 0.33 0.33	0.51 0.77 1.2	-- -- --	ND ND ND	No No No	No No No	Presence in samples may reflect naturally-occurring long-chain hydrocarbons present in the organic carbon in soil; low toxicity.
17-Pentatriacontene (17PTCE)	1/131 (0.8%)	2.1	2.1 (9-A2-7, 2-3')	--	ND	No	No	Single detection (frequency < 5%).
Tetracosane (TCOS)	1/131 (0.8%)	0.43	0.43 (9-OA2-8, 0-2")	--	ND	No	No	Single detection (frequency < 5%).
1,1,2-Trichloro-1,2,2-trifluoroethane (TCLTFE)	5/131 (3.8%)	0.007	0.011 (9-A2-2, 4-5')	--	ND	Yes	No	Detection frequency < 5%.

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Octadecamethyl-cyclo-nonasiloxane (OMCTSX)	5/131 (3.8%)	0.008	0.054 (9-BA-3, 2-3')	--	ND	No	No	Detection frequency < 5%.

NOTES:

All units in µg/g (ppm).
Bold print indicates chemical was selected as a soil COC for SWMU 9.

1 The summaries provided in this table apply to both surface and subsurface soil (i.e., data for both soil depth profiles were merged to derive detection frequencies, means, etc.). Distinctions regarding the vertical distribution of constituents are made only if warranted by the data. In general, such distinctions are left to the quantitative risk assessment, for which current-use risks are calculated using surface soil data (only), and future-use risks are calculated using the merged (surface and subsurface) database.

2 Means were calculated assuming that nondetects are equivalent to one-half the MDL. Average concentrations are not reported for most organic and non-target analytes, however, because the low detection frequencies and high MDL values result in artificially elevated means (that often exceed reported maxima). Thus, the average was not considered to be a meaningful estimator for these constituents.

3 Site-specific background values were derived as the maximum detected concentration of each metal in background samples collected for the Group 2 SWMUs (Section 2.3).

4 "Yes" is indicated in this column when toxicity criteria are available that allow quantitative evaluation of a given compound (e.g., carcinogenic slope factors and/or noncarcinogenic RfDs from IRIS or HEAST).

5 When "Yes" is followed by an asterisk (*) in this column, it indicates that the constituent was not selected as a site-wide COC, but may be a potential sample- or area-specific COC.

6 Toxicity information does not exist for MPA, but for reasons presented in Section 5.1.3.3, IMPA will be used as a conservative surrogate in order to assess risk due to the presence of MPA in soil at SWMU 9.

Table 5.5-2 Identification of Potential COCs for SWMU 9 Groundwater Samples

Parameter (No. Detects/No. samples)	Minimum [1]	Maximum (Location) [1]	Background Level [2]	MCL/ Criteria	Toxicity Data? [3]	Selected as Potential COC? [4]	Rationale for Selection or Exclusion as Potential Groundwater COC
INORGANIC CONSTITUENTS							
Aluminum (4/4)	16,300	54,950 (S-110-93)	14,200	NA	Yes	Yes*	All four detections exceed background, with the highest concentration detected in the upgradient well. However, the background level was determined on the basis of only one well sample. Also, aluminum is a ubiquitous component of aluminosilicate minerals, a common constituent of most clays. Given these factors, combined with the fact that aluminum was not selected as a soil COC for SWMU 9, selection as a groundwater COC is conservative.
Antimony (3/4)	28.4	38.4 (S-110-93)	4.54	6.0	Yes	Yes	All three detections exceed background and the MCL. The highest concentration was detected in the upgradient well. However, antimony was not identified as a soil COC.
Arsenic (4/4)	8.42	33.2 (S-110-93)	35.5	50	Yes	No	All concentrations are below both background and the MCL.
Barium (4/4)	226	558 (S-110-93)	200	2,000	Yes	Yes*	All four detections exceed background, with the highest concentration detected in the upgradient well. However, the maximum concentration is well below the 2,000 µg/l MCL. Additionally, barium was not identified as a soil COC, so selection as a groundwater COC is conservative.
Beryllium (1/4)	4.21	4.21 (S-110-93)	0.805	4.0	Yes	Yes*	The single detection exceeds background, but is only slightly higher than the MCL. This detection occurred in the upgradient well. Also, since beryllium was not identified as a soil COC, selection as a groundwater COC is likely conservative.

Parameter (No. Detects/No. samples)	Minimum [1]	Maximum (Location) [1]	Background Level [2]	MCL/ Criteria	Toxicity Data? [3]	Selected as Potential COC? [4]	Rationale for Selection or Exclusion as Potential Groundwater COC
Cadmium (4/4)	2.39	4.06 (S-10)	10.7	5.0	Yes	No	The maximum cadmium concentration is less than both background and the MCL.
Chromium (4/4)	21.9	72.9 (S-112-93)	35.5	100	Yes	Yes*	Three detections exceed background, but all are less than the MCL. Additionally, chromium was not identified as a soil COC, so selection as a groundwater COC is conservative.
Cobalt (2/4)	16.5	22.3 (S-110-93)	ND	NA	No	No	Cobalt was analyzed for in only one of the four background wells, so a background comparison may not be meaningful. Cobalt was not selected as a soil COC, and neither toxicity data nor groundwater criteria are available for its quantitative evaluation. The maximum cobalt concentration was detected in the upgradient well.
Copper (4/4)	15	42.2 (S-110-93)	47.7	1,000	Yes	No	The maximum copper concentration, which occurred in the upgradient well, is less than background. Also, all concentrations are well below the 1,000 µg/l Secondary MCL (SMCL).
Lead (4/4)	**17.5**	**70.1 (S-110-93)**	**57.7**	**15**	**Yes**	**Yes**	**The maximum concentration, which was detected in the upgradient well, is the only detection that exceeds background. However, all detections exceed the 15 ug/l MCL. Lead was identified as a site-wide soil COC.**
Nickel (3/4)	31.5	79.7 (S-112-93)	45.1	100	Yes	Yes*	Two detections exceed background; however, all detections are below the 100 ug/l MCL. Also, nickel was not identified as a soil COC, so selection as a groundwater COC is conservative.

Parameter (No. Detects/No. samples)	Minimum [1]	Maximum (Location) [1]	Background Level [2]	MCL/ Criteria	Toxicity Data? [3]	Selected as Potential COC? [4]	Rationale for Selection or Exclusion as Potential Groundwater COC
Vanadium (4/4)	42.2	110 (S-112-93)	27.1	ND	Yes	Yes*	All four detections exceed background, the maximum by a factor of four. Vanadium was not identified as a soil COC, and no groundwater standards are available for comparison, so selection as a groundwater COC may be conservative.
Zinc (4/4)	130	362 (S-10)	1,100	5,000	Yes	No	All four zinc detections are well below both background and the Secondary MCL (SMCL).

Parameter (No. Detects/No. samples)	Minimum [1]	Maximum (Location) [1]	Background Level [2]	MCL/ Criteria	Toxicity Data? [3]	Selected as Potential COC? [4]	Rationale for Selection or Exclusion as Potential Groundwater COC
ORGANIC CONSTITUENTS							
Methylene chloride (1/4)	**300**	**300 (S-112-93)**	**ND**	**5.0**	**Yes**	**Yes**	**Methylene chloride was detected in only one sample at a level greater than 10 times the method blank. This single validated detection may therefore be suspect. This concentration greatly exceeds both background and the 5.0 µg/l MCL. Methylene chloride was detected in SWMU 9 soil but was not identified as a soil COC: it was selected as an air COC (Table 5.5-3).**

NOTES:

All units in µg/l (ppb). In general, maxima for inorganic constituents were detected in well S-110-93 (which is an upgradient well location). Bold print indicates groundwater COCs whose presence may be attributable to previous SWMU 9 activities. Other constituents identified as groundwater COCs were conservatively selected given the reasons stated in Note 4.

ND=Not Determined; NA=Not Available.

[1] Reported groundwater concentrations reflect results of unfiltered groundwater sample analyses. Results for anions, cations, and commonly occurring constituents with negligible toxicity (e.g, calcium, iron, magnesium, manganese, potassium, and sodium) are not addressed in this table, but are reported in Table 4.4-3.

[2] Background levels for groundwater were determined using the methods and assumptions described in Section 2.3.

[3] "Yes" is indicated in this column when toxicity criteria are available that allow quantitative evaluation of a given compound.

[4] Given that only four groundwater samples were collected at SWMU 9, detection frequency could not be used as a criterion for COC selection. Therefore, in general, if a constituent was detected in groundwater at a level or levels exceeding background, and toxicity criteria were available, it was considered a groundwater COC (even if an MCL was not exceeded), and thus carried through the quantitative future-use groundwater pathway evaluation. When "Yes" is followed by an asterisk (*) in this column, it indicates that the constituent was selected as a groundwater COC based on these conservative assumptions (i.e., exceedance of background), but there is insufficient evidence that its presence is attributable to site-related activities and/or poses a health risk. For example, given the high turbidity of groundwater samples at SWMU 9 well locations, the presence of elevated levels of metals suggests that natural conditions (i.e., colloids, suspended particulates, adsorbed metals, etc.) may be responsible for the observed concentrations, not SWMU-related activities.

Table 5.5-3 Summary of COCs Selected for SWMU 9 Media

Site-Wide Soil COCs [1]	Sample- or Area-Specific Soil COCs [1]	Location	Air COCs [2]	Groundwater COCs [3]
Lead	Arsenic	9-A2-11 and 9-A2-12 sample locations	Ethyl Benzene	Aluminum* Antimony
Di-n-butyl-phthalate (DNBP)	Copper	sample 9-BA-1	Methylene chloride	Barium* Beryllium* Chromium*
Toluene	MPA	9-A2-10 and 9-0A2-7	Tetrachloro-ethene	Lead
Trichloro-fluoromethane (CCL3F)			Toluene	Nickel Vanadium* Methylene chloride
			Xylenes	

NOTE:

1 As indicated in Table 5.5-1 (Note 5), for certain constituents elevated concentrations were only detected in localized areas of the SWMU. Concentrations at remaining sample locations were less than site-specific background levels. Therefore, these constituents were not selected as site-wide COCs, but are considered sample- or area-specific COCs.

2 Air COCs for organic constituents were selected based on results of the ambient air sampling and meteorological monitoring conducted at TEAD-S from September 11, 1993 to October 3, 1993. In general, a constituent was selected as an air COC if detected concentrations significantly exceeded levels reported for the background (BK) monitoring location. Air COCs were not selected for metals because monitoring results were considered invalid due to media and laboratory problems.

3 The list of chemicals selected as groundwater COCs is rather extensive relative to that identified for soil; the latter reflects the conservatism used in the groundwater COC selection process described in Table 5.5-2 (Note 4). Constituents followed by an asterisk (*) were selected as groundwater COCs based on conservative assumptions. However, there is insufficient evidence that their presence is attributable to site-related activities and/or poses a health risk.

Table 5.5-4 Potential Pathways of Exposure to COCs at SWMU 9

Exposure Medium	Potential Receptor(s)	Receptor Location(s)	Potential Exposure Route(s)	Pathway Quantitatively Evaluated?[1]	Reason for Selection or Exclusion
CURRENT-USE EXPOSURE PATHWAYS					
Current-Use Exposure Scenarios 1a and 1b: SWMU 9 Receptor					
Surface (0-2") Soils	Site Environmental Management Personnel	Within SWMU 9	**(1a)** Incidental Ingestion, Dermal Contact, and Inhalation Soil Exposure Pathways **(1b)** Inhalation of volatile organic air COCs (Table 5.5-3)	YES	In general, no one accesses SWMU 9. However, similar to the scenario described for SWMUs 3 and 5, Environmental Management staff might access SWMU 9 twice per year for semiannual groundwater monitoring. Therefore, potential exposures to surface soil were quantitatively evaluated assuming workers enter the site twice per year for collection of groundwater samples (4 hours per exposure), and another two times (within a given year) for inspection of the grounds.
Current-Use Exposure Scenario 2: Area 2 Warehouse Receptor					
Resuspended Surface Soil Particulates	Warehouse Workers	Adjacent Area 2 Warehouses	Inhalation of Resuspended Soil Particulates Transferred off SWMU 9 via Wind Dispersion	YES	The nearest receptors potentially having the longest, most frequent exposures to SWMU 9 soil COCs would be individuals working in the adjacent Area 2 Warehouses. Therefore, potential exposures to windblown soil at the warehouses were evaluated to represent a hypothetical worst-case current use scenario. For this analysis, the warehouse worker receptor was assumed to be exposed to screening-level estimates of SWMU 9 soil COC concentrations in airborne particulates for 8 hours per day, 250 days per year. The analysis conservatively assumes that an individual would be outdoors for the specified exposure duration—an unlikely scenario.

Exposure Medium	Potential Receptor(s)	Receptor Location(s)	Potential Exposure Route(s)	Pathway Quantitatively Evaluated?[1]	Reason for Selection or Exclusion
FUTURE-USE EXPOSURE PATHWAYS					
Surface and Subsurface Soils	Future Residents	Within SWMU 9	Ingestion, Dermal Contact, and Inhalation Soil Exposure Pathways Associated with Hypothetical Future Residential Use of SWMU 9	YES	Future residential use of TEAD-S is not expected. Nonetheless, in accordance with state and federal risk assessment guidelines, this hypothetical future use pathway was quantitatively evaluated using the exposure assumptions outlined in Section 5.1 and in Appendix K.2. This assessment is considered to represent a worst-case, screening-level evaluation of risks associated with potential exposures to SWMU 9 soil COCs.
Shallow Groundwater (Future Uses)	Future Residents	SWMU 9 Wells Screened in the Shallow Aquifer	Ingestion and Inhalation of Volatile COCs while Showering or Washing	YES	Future use of shallow groundwater underlying SWMU 9 is not expected. However, as discussed above, this pathway was nonetheless quantitatively evaluated in the baseline risk assessment, and represents a worst-case, screening-level evaluation of risks associated with potential exposures to COCs in SWMU 9 shallow groundwater.

1 **All soil exposure pathways were quantified using maximum soil COC concentrations (Table 5.5-5). Exposure assumptions for the current-use scenarios are summarized in Table 5.5-6.**

Chemical of Concern	Current Use Pathways: RME Soil EPC (μg/g)	Current Use Pathways: Air EPC [2] (mg/m^3)	Future Use Pathways: Surface/Subsurface RME Soil EPC (μg/g)	Future Use Pathways: Corresponding Air EPC (mg/m^3)
Arsenic*	11.5	1.13E-07	11.5	--
Copper*	32.8	1.12E-06	32.8	--
Di-n-butylphthalate	27.7	1.16E-08	27.7	--
Lead	--	--	--	--
Toluene	0.38	8.39E-03	0.38	--
Trichlorofluoromethane	0.001	1.28E-11	0.001	--
Ethyl Benzene	--	8.23E-04	--	--
Methylene chloride	--	1.42E-03	--	--
Tetrachloroethene	--	1.22E-03	--	--
Xylenes	--	4.00E-03	--	--

Note:

-- Not Applicable/Not Evaluated
* Sample-Specific COC

1 This table lists soil and air EPCs only. Given that only four groundwater samples were collected, and that maxima for most constituents (metals, in particular) were detected in the same groundwater sample (well S-110-93, which is essentially an upgradient well), groundwater EPCs are the maximum concentration listed in Table 5.5-2.

2 Air EPCs were derived using the methods described in Section 5.1.2 and in Table 5.2-5 (Note 3). Note, however, that the air EPC listed for toluene for current site uses is based on the air monitoring results, as are the air EPCs listed for the remaining SWMU 9 air COCs (ethyl benzene, methylene chloride, tetrachloroethene, and xylenes (see Table 5.5-3).

Table 5.5-6 Assumptions Used to Evaluate SWMU 9 Current-Use Exposure Pathways

PARAMETER	ASSUMED VALUE		SOURCE/RATIONALE
	SWMU 9 Receptor—Site EM Personnel	Adjacent Area 2 Warehouse Worker	
General Exposure Parameters			
Age During Exposure	Adult	Adult	-
Average Body Weight	70 kg	70 kg	EPA 1991a. Standard default.
Lifetime Exposure Duration	25 years	25 years	EPA 1991a. Standard default.
Exposure Frequency	4 days/year	250 days/year	Professional judgement based on site-specific factors. The inhalation receptor evaluation represents a worst-case screening level analysis of potential inhalation exposures to SWMU 9 soil COCs at the nearby Area 2 Warehouses (Table 5.5-4).
Direct Contact Parameters			
Soil Ingestion Rate	100 mg/day	NA	EPA 1991a (See Note 1).
Soil Adherence Rate	1.0 mg/cm^2	NA	EPA 1992c. Upper bound default.
Surface Area Exposed	4,100 cm^2	NA	EPA 1992c (See Note 2).
Dermal Absorption Rate	Metals: 0.1% Organics: 10%	NA NA	EPA 1992c
Inhalation Exposure Parameters			
Hours per Day	4 hours	8 hours	Professional judgement.
Inhalation Rate	2.5 m^3/hour	2.5 m^3/hour	EPA 1991a. Assumes moderate activity for both receptor groups.
Particulate Emission Factor	8.62 x 10^8 m^3/kg	8.62 x 10^8 m^3/kg	Site-specific particulate emission factor (PEF); see Section 5.1.2 for derivation.

Notes:

1 Although EPA guidance (1991a) recommends a soil ingestion rate of 50 mg/day for workers, a more conservative value of 100 mg/day is used in this assessment to account for potentially higher exposures possible at TEAD-S for an outdoor work environment.

2 The skin surface area of 4,100 cm^2 is for an adult male, and represents a 95th percentile value for the hands, forearms, and head (EPA 1992c).

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5.5.3 Risk Characterization

This section quantifies risks for the SWMU 9 exposure pathways identified in Table 5.5-4. Section 5.5.3.1 presents the results of the risk assessment for current-use soil exposure scenarios. Sections 5.5.3.2 and 5.5.3.3 present the risk assessment results for hypothetical future-use exposures to soil and groundwater, respectively. Section 5.5.3.4 summarizes the results of the current- and future-use risk evaluations developed for SWMU 9.

5.5.3.1 Current-Use Risks

SWMU-Wide Risk Evaluation

Table 5.5-7 summarizes the cancer risks and hazard indices (HIs) calculated for the two SWMU 9 current-use exposure scenarios. Both the cancer risk calculated for site Environmental Management (EM) personnel receptors (exposure scenario 1), 1 x 10^{-7}, and the HI, 6.6 x 10^{-4}, are well below corrective action criteria.

The cancer risk calculated for the Area 2 Warehouse worker receptors (exposure scenario 2), 1 x 10^{-8}, is lower than respective corrective action criteria. (A noncancer HI could not be calculated for this scenario given the lack of inhalation RfDs for SWMU 9 soil COCs.)

Location-Specific Risk Evaluation

MPA, although selected as a COC, was not qualitatively evaluated because chronic exposure toxicity data are not available for this compound. However, this compound is readily metabolized to phosphorous acid and methanol. Both of these products are water soluble and are easily excreted. At sufficient concentrations, phosphorous acid and methanol are each irritants to the eyes, upper respiratory tract, and skin. However, exposure to the part-per-million levels of MPA that were measured in SWMU 9 soil are not expected to cause either these or any other perceptible effects under either the current use or hypothetical residential use scenarios. Therefore, no action is required to limit exposures to the trace levels of MPA detected at SWMU 9.

5.5.3.2 Potential Future-Use Soil Exposure Risks

Table 5.5-8 summarizes the results of the risk assessment developed for hypothetical future-residential-use exposures to SWMU 9 surface and subsurface soil. Cancer risks and noncancer HIs presented in this table were calculated using the soil RBSLs listed in Table 5.1-2 in accordance with the methods, equations, and assumptions outlined in Section 5.1.4.2 and Appendix K.2.

5.5.3 Risk Characterization

This section quantifies risks for the SWMU 9 exposure pathways identified in Table 5.5-4. Section 5.5.3.1 presents the results of the risk assessment for current-use soil exposure scenarios. Sections 5.5.3.2 and 5.5.3.3 present the risk assessment results for hypothetical future-use exposures to soil and groundwater, respectively. Section 5.5.3.4 summarizes the results of the current- and future-use risk evaluations developed for SWMU 9.

5.5.3.1 Current-Use Risks

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Table 5.5-7 summarizes the cancer risks and hazard indices (HIs) calculated for the two SWMU 9 current-use exposure scenarios. Both the cancer risk calculated for site Environmental Management (EM) personnel receptors (exposure scenario 1), 1×10^{-7}, and the HI, 6.6×10^{-4}, are well below corrective action criteria.

The cancer risk calculated for the Area 2 Warehouse worker receptors (exposure scenario 2), 1×10^{-8}, is lower than respective corrective action criteria. (A noncancer HI could not be calculated for this scenario given the lack of inhalation RfDs for SWMU 9 soil COCs.)

Location-Specific Risk Evaluation

MPA, although selected as a COC, was not quantitatively evaluated because chronic exposure toxicity data are not available for this compound. As presented in Section 5.1.3.3, MPA is chemically similar to IMPA, thus IMPA has been evaluated as a conservative surrogate for MPA in the evaluation of risk at SWMU 9. Using IMPA as a surrogate, associated future risk calculated for MPA indicates corrective action criteria are not exceeded. Exposure to the part-per-million levels of MPA that were measured in SWMU 9 soil are not expected to cause any other perceptible effects under either the current use or hypothetical residential use scenarios. Therefore, no action is required to limit exposures to the trace levels of MPA detected at SWMU 9.

5.5.3.2 Potential Future-Use Soil Exposure Risks

Table 5.5-8 summarizes the results of the risk assessment developed for hypothetical future-residential-use exposures to SWMU 9 surface and subsurface soil. Cancer risks and noncancer HIs presented in this table were calculated using the soil RBSLs listed in Table 5.1-2 in accordance with the methods, equations, and assumptions outlined in Section 5.1.4.2 and Appendix K.2.

Table 5.5-7 Cancer Risks and Hazard Indices Calculated for SWMU 9 Current-Use Soil Exposure Pathways[1,2]

Current-Use Exposure Scenario			Results of Cancer Risk (CR) Calculations		Results of Hazard Index (HI) Calculations	
Receptor	Pathway(s)	COCs Evaluated	CR	Driving COC(s) and Pathway	HI	Driving COC(s) and Pathway
Current-Use Exposure Scenario 1a: Receptor Location—Within SWMU 9						
Site EM Personnel	SI/DC/INH (Appendix Table K.6-1)	SWMU-wide COCs	1.2×10^{-7}	Arsenic, the only carcinogen evaluated; SI dominates	6.6×10^{-4}	Arsenic (95%); SI dominates
Current-Use Exposure Scenario 1b: Receptor Location—Within SWMU 9						
Site EM Personnel	INH[3] (Appendix Table K.6-3)	VOCs, based on air monitoring data (Table 5.5-3, Table 5.5-5)	1.3×10^{-9}	Methylene chloride (the only carcinogen of the air COCs identified)	7.1×10^{-6}	Ethyl benzene (64%) and methylene chloride (36%)
Scenario 1 Total Current-Use Risk (1a+1b):			**1×10^{-7}**	**Arsenic**	**6.6×10^{-4}**	**Arsenic**
Current-Use Exposure Scenario 2: Receptor Location—Area 2 Warehouses						
Area 2 Warehouse Workers	INH[4] (Appendix Table K.6-2)	Arsenic, copper	1.4×10^{-8}	Arsenic, the only carcinogen evaluated	--	Inhalation RfDs are not available for SWMU 9 soil COCs

Interpretation: *The cancer risk calculated for both current-use exposure scenarios—the conservative on-SWMU scenario for site EM personnel receptors—are below the lower limit requiring site controls according to State of Utah guidance.*

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COC	Chemical of Concern
SI	Soil Ingestion Pathway
DC	Dermal Contact Pathway
INH	Inhalation Pathway
CR	Cancer Risk
HI	Hazard Index

1 Tables 5.5-3 and 5.5-4 detail the COC and exposure pathway selection process. Exposure point concentrations (EPCs) used in the risk calculations are the maximum concentrations of soil COCs (Table 5.5-5). Table 5.5-6 lists the exposure parameters assumed in the analysis. Appendix Tables K.6-1 through K.6-3 provide detailed cancer risk and HI calculation documentation for the two current-use SWMU 9 exposure scenarios summarized above.

2 Although lead was identified as a site-wide soil COC for SWMU 9, toxicity criteria are not available with which to quantify associated hazards or risks. Currently, as set forth by OSWER directive #9355.4-12, EPA recommends a screening level for lead in soil of 400 μg/g, assuming residential land use (EPA, 1994). The maximum detected lead concentration in SWMU 9 soils, 210 μg/g (detected in sample 9-A2-12, 0-2"), is well below this screening level value.

3 Risks associated with inhalation of VOCs are presented separately given: (1) differences in source data—VOCs were identified as air COCs based on the air monitoring results, but, with the exception of toluene, were not detected in soil; and (2) the differences in EPC determination—EPCs for soil COCs are the maximum detected concentrations, whereas EPCs for VOCs in air are based on monitoring results, and are the average VOC concentrations reported in Appendix I (Table 8).

4 This scenario represents a worst-case screening level evaluation of potential risks associated with chronic inhalation of SWMU 9 soil COCs at the adjacent Area 2 Warehouses (Tables 5.5-4 and 5.5-5).

Table 5.5-8 Cancer Risks and Hazard Indices Calculated for SWMU 9 Hypothetical Future-Use Soil Exposure Pathway

Chemical of Concern	Carcinogenic RBSL (mg/kg)	Soil EPC (ug/g)	Cancer Risk	(% of Total Risk)	Noncarcinogenic RBSL (ug/g)	Soil EPC (ug/g)	Hazard Quotient	(% of Total HI
Arsenic	0.97	11.5	1.2E-05	100%	23.5	11.5	4.9E-01	98%
Copper					2,902	32.8	1.1E-02	2%
Di-n-butylphthalate					3,911	0.247	6.3E-05	<1%
Lead					400	21.2	NE	
Toluene					280	0.023	8.2E-05	<1%
Trichlorofluoromethane					410	0.003	7.3E-06	<1%
	Total Cancer Risk:		**1.2E-05**		**Total Hazard Index (HI):**		**5.0E-01**	

NE = No Exceedance based on the USEPA Soil Screening Level for lead. Potential human health risks are not likely to occur following chronic exposure.

The total cancer risk and HI calculated for soil exposures under a hypothetical future residential-use scenario are 1.2 x 10^{-5} and 0.51, respectively. The cancer risk estimate is within the range of risks requiring site controls (assuming future residential use of the site), and the HI is less than 1.0 (the target HI criterion). Of the soil COCs evaluated, only arsenic exceeds the corresponding RBSL, which assumes a risk-level goal of 10^{-6} (Table 5.5-8). Of note is that the arsenic concentration assumed for the future-use analysis—11.5 µg/g (the 95 percent UCL of the mean in surface and subsurface soil)—is less than the 40 µg/g site-specific background level. (The cancer risk corresponding to the arsenic background level is 4.1 x 10^{-5}.) In light of this finding, potential risks associated with exposure to SWMU 9 soil under a future-use scenario are considered negligible.

5.5.3.3 Potential Future-Use Groundwater Exposure Risks

Table 5.5-9 summarizes the results of the risk assessment developed for hypothetical future-residential-use exposures to COCs in groundwater underlying SWMU 9. The total cancer risk and HI calculated for groundwater exposures under a hypothetical future-use scenario are 2.7 x 10^{-4} and 5.5, respectively. Both values exceed corresponding State of Utah corrective action criteria, assuming potable use of underlying shallow groundwater under a future residential-use scenario. Beryllium accounts for 79 percent of the total cancer risk; methylene chloride accounts for the remaining 21 percent. Aluminum, antimony and lead, all exceed corresponding RBSLs, and aluminum and antimony account for the majority of the HI (27 percent and 48 percent, respectively).

As stated previously for SWMUs 3 and 5, the groundwater analytical results should be interpreted with caution. Given the high turbidity of groundwater samples from SWMU 9 well locations, and given the fact that samples were not filtered, the presence of elevated levels of metals suggests that natural conditions (i.e., colloids, suspended particulates, adsorbed metals, etc.) may be responsible for the observed concentrations, not SWMU-related activities. The results of the future-use groundwater pathway risk assessment should therefore be interpreted in light of these findings. Also, maxima for inorganic constituents were detected in well S-110-93, which is in an upgradient location (Table 5.5-2).

Since methylene chloride is both a common laboratory contaminant and a potential contaminant related to SWMU 9 activities, it is difficult to interpret whether methylene chloride is present in groundwater at SWMU 9 or was introduced during laboratory preparation or analysis. Its presence as an environmental contaminant due to SWMU 9 activities is supported by detections

Table 5.5-9 Cancer Risks and Hazard Indices Calculated for SWMU 9 Hypothetical Future-Use Groundwater Exposure Pathway

Chemical of Concern	Carcinogenic RBSL (ug/l)	GW EPC (ug/l)	Cancer Risk	(% of Total Risk)	Noncarcinogenic RBSL (ug/l)	GW EPC (ug/l)	Hazard Quotient	(% of Total HI
Aluminum					36,500	54,950	**1.5E+00**	27%
Antimony					14.6	38.4	**2.6E+00**	48%
Barium					2,560	558	2.2E-01	4%
Beryllium	0.02	4.21	**2.1E-04**	79%	183	4.21	2.3E-02	<1%
Chromium					183	72.9	4.0E-01	7%
Lead					15	70.1	**E**	
Methylene chloride	5.42	300	5.5E-05	21%	1,620	300	1.9E-01	3%
Nickel					730	79.7	1.1E-01	2%
Vanadium					256	110	4.3E-01	8%
	Total Cancer Risk:		**2.7E-04**		**Total Hazard Index (HI):**		**5.5E+00**	

Note:
Bolded COCs/values reflect exceedances of either a 1.0E-04 cancer risk and/or a hazard quotient (HQ) of 1.0.
E = Exceedance based on MCL for lead. Potential human health risks may occur following chronic exposure.

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in air and soil samples, as well, but it was also found in much lower levels in the laboratory method blank, and therefore may be a result of laboratory contamination. It was evaluated as a COC because the detected concentration was greater than ten times the method blank concentration and it was also detected in soil and air samples collected at this SWMU. If the shallow groundwater in this area is considered for future use, the well should be resampled to confirm the Phase II detection and this risk characterization.

The cumulative risk for the hypothetical future residential-use scenario, reflecting both soil and groundwater exposure pathways, is 3×10^{-4} (sum of 1×10^{-5} and 3×10^{-4}). The cumulative HI is 6 (sum of 0.50 and 5.5) (Tables 5.5-8 and 5.5-9). Both of these values exceed corresponding State of Utah target risk criteria for residential site uses.

5.5.3.4 Summary of SWMU 9 Human Health Risk Assessment Results

The risks calculated for all current-use exposure scenarios (cancer and noncancer endpoints) are all well below State of Utah corrective action criteria.

For the future-use evaluation, only arsenic exceeds the soil RBSL, but this result is less than the risk corresponding to the site-specific background levels. Groundwater RBSLs were exceeded for aluminum, antimony, beryllium, lead, and methylene chloride. The results of the future-use risk evaluation should be interpreted in light of the following: (1) the hypothetical nature of the future-residential-use pathway, (2) the extent to which background levels of COCs contribute to the cancer risk and HI estimates (Appendix Tables K.2-5 and K.2-6), and (3) the caveats identified previously for the groundwater analytical results.

5.6 BASELINE HUMAN HEALTH RISK ASSESSMENT FOR SWMU 30

5.6.1 Identification of Chemicals of Concern

Table 5.6-1 details the COC selection process, as defined in Section 5.1.1, for SWMU 30 soil samples. Table 5.6-2 lists the soil COCs selected and identifies corresponding SWMU-wide and location-specific designations.

Only one constituent was selected as a SWMU-wide soil COC for SWMU 30: 1,1,2-trichloro-1,2,2-trifluoroethane (TCLTFE). Arsenic, cadmium, chromium, copper, lead, nickel, and zinc were identified as location-specific soil COCs for test pit samples 30-TP-1 and 30-TP-2 (Table 5.6-2).

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
INORGANIC CONSTITUENTS								
Aluminum (Al)	21/21 (100%)	9,640	22,100 (30-TP-2, 0.5')	15,816	25,200	Yes	No	The maximum concentration is less than the site-specific background level.
Antimony (Sb)	1/21 (4.8%)	10.7	10.7 (30-OSA-3, 0-2")	3.9	11.9	Yes	No	The maximum antimony concentration is less than the site-specific background level; detection frequency < 5%.
Arsenic (As)	**21/21 (100%)**	**6.1**	**540.0 (30-TP-1, 5')**	**41.8**	**40.0**	**Yes**	**Yes* (30-TP-1 location, future-use pathway only)**	**Arsenic exceeds background in only two samples, both of which were collected at the TP-1 location: 30-TP-1, 5' (540 µg/g) and 30-TP-1, 2' (130 µg/g). Remaining detections are ≤ 25 µg/g. Given these findings, arsenic is considered a COC for the 30-TP-1 sample location, but not a SWMU-wide COC given that all other detections are below background. Because arsenic concentrations in the shallow subsurface (0.5') test pit samples and adjacent surface soil samples were all ≤18 µg/g, arsenic was evaluated as a COC for the future residential use pathway only (which assumes exposure to subsurface, as well as surface soil, contaminants).**
Barium (Ba)	21/21 (100%)	129.0	287.0 (30-TP-1, 2-3')	178.3	537	Yes	No	The maximum barium concentration is below the site-specific background value.

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Beryllium (Be)	17/21 (81.0%)	0.49	1.17 (30-TP-3, 4-5')	0.68	1.2	Yes	No	The maximum beryllium concentration is less than the site-specific background level.
Cadmium (Cd)	**13/21 (61.9%)**	**0.92**	**10.1 (30-TP-1, 2-3')**	**1.65**	**0.98**	**Yes**	**Yes* (30-TP-1 and 30-TP-2 locations, future-use pathway only)**	**Exceeds background in 12 samples. However, only the two highest concentrations, 10.1 µg/g and 7.8 µg/g, are considered significantly elevated relative to the 0.98 µg/g background level. These levels were detected in samples 30-TP-1 (2-3') and 30-TP-2 (4-5'), respectively. Cadmium concentrations at remaining sample locations are ≤1.5 µg/g; these levels are not considered notable relative to background. Given these findings, cadmium is considered a COC for the 30-TP-1 and 30-TP-2 sample locations, but not a SWMU-wide COC. As discussed for arsenic (above), cadmium was evaluated as a COC for the future residential use pathway only given the absence of elevated levels in surface or shallow subsurface soils.**
Calcium (Ca)	21/21 (100%)	84,000	130,000 (30-OSA-1, 0-2")	103,333	250,000	No	No	The maximum calcium concentration is well below the site-specific background level.
Chromium (Cr)	**21/21 (100%)**	**12.3**	**104.0 (30-TP-1, 2-3')**	**24.5**	**48.5**	**Yes**	**Yes* (30-TP-1 location, future-use pathway only)**	**Only the maximum concentration exceeds the 48.5 µg/g background level; remaining detections are ≤30.7 µg/g. Therefore, similar to the conclusions drawn for arsenic (see above), chromium is considered a COC for the 30-TP-1 sample location, but not a SWMU-wide COC. Also, given that no**

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
								surface or shallow subsurface soil contamination was identified, potential exposures to chromium were evaluated for the future residential use pathway only.
Cobalt (Co)	21/21 (100%)	3.7	11.0 (30-TP-1, 2-3')	6.3	8.6	No	No	Only the maximum (11.0 µg/g) concentration exceeds the 8.6 µg/g background level. This exceedance is not considered notable (it differs by only 2 µg/g), especially since cobalt is an essential nutrient.
Copper (Cu)	**21/21 (100%)**	**9.7**	**356.0 (30-TP-1, 5')**	**49.6**	**27.6**	**Yes**	**Yes* (30-TP-1 and 30-TP-2 locations, future-use pathway only)**	**Exceeds background in only 5 samples. However, as observed for cadmium (above), copper concentrations are significantly elevated (3 to 13 times higher) relative to background at only two sample locations—30-TP-1 and 30-TP-2—and at subsurface (below 2 ft) depths. Copper concentrations at remaining sample locations are ≤29.7 µg/g. Copper is therefore considered a COC for the 30-TP-1 and 30-TP-2 sample locations, but not a SWMU-wide COC. Also, because no surface or shallow subsurface soil contamination was identified, evaluation as a COC was limited to the future use pathway only.**
Cyanide (CYN)	1/21 (4.8%)	0.98	0.98 (30-TP-3, 2-3')	0.98	0.0	Yes	No	Detection frequency < 5%.
Iron (Fe)	21/21 (100%)	10,100	40,000 (30-TP-2, 4-5')	17,624	24,300	No	No	Only two detections exceed the site-specific background level; remaining concentrations are ≤ 21,100 µg/g. Iron is a naturally- occurring essential human nutrient with negligible toxicity, and is abundant in the native geologic materials.

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Lead (Pb)	**21/21 (100%)**	**9.65**	**850.0 (30-TP-1, 2-3')**	**181**	**35.0**	**Yes**	**Yes* (30-TP-1 location, future-use pathway only)**	**Lead concentrations exceed background in only four samples: 30-TP-1, 2' (850 µg/g); 30-TP-1, 5' (200 µg/g); 30-OSA-1, 0-2" (57 µg/g); and 30-OSA-2, 0-2" (38 µg/g). The 30-TP-1 observations are clearly elevated relative to background, and thus warrant evaluation in the risk assessment. However, lead concentrations at the 30-OSA-1 (57 µg/g) and 30-OSA-2 (38 µg/g) locations are not considered significantly elevated when compared with the 35 µg/g lead background value. Therefore (along with arsenic, cadmium, chromium, and copper), lead is considered a COC for the 30-TP-1 sample location, but not a SWMU-wide COC. Also, because no significant background exceedances were identified in surface or shallow subsurface soil samples, evaluation as a COC was limited to the future use pathway only.**
Magnesium (Mg)	21/21 (100%)	16,900	39,100 (30-SS-6, 0-2")	24,186	16,150	No	No	Exceeds background in all 21 samples. However, magnesium was not selected as a COC because it is a naturally-occurring essential human nutrient with negligible toxicity. It is also abundant in the native geologic materials.
Manganese (Mn)	21/21 (100%)	303.0	657.0 (30-SS-3, 0-2")	484.0	658.0	Yes	No	The maximum manganese concentration is less than the site-specific background level.

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Mercury (Hg)	2/21 (9.5%)	0.040	0.043 (30-TP-1, 2-3')	0.016	0.14	Yes	No	Mercury was detected in only two samples, at concentrations less than the 0.14 µg/g background level.
Nickel (Ni)	**21/21 (100%)**	**11.5**	**41.5 (30-TP-1, 2-3')**	**22.5**	**27.9**	**Yes**	**Yes* (30-TP-1 location, future-use pathway only)**	**Nickel exceeds background in only three samples: 30-TP-1, 2' (41.5 µg/g); 30-TP-2, 2' (29.2 µg/g); and 30-TP-1, 5' (28.7 µg/g). Only the maximum (TP-1) concentration is considered elevated (although not significantly) relative to the 28 µg/g background level. Therefore, nickel is considered a COC for the 30-TP-1 sample location, but not a SWMU-wide COC. Also, because no surface or shallow subsurface soil contamination was identified, evaluation as a COC was limited to the future use pathway only.**
Potassium (K)	21/21 (100%)	3,710	8,860 (30-SS-2, 0-2")	6,998	7,940	No	No	Six detections exceed the site-specific background value, but not by a significant amount. Potassium is a naturally-occurring essential human nutrient with negligible toxicity, and is abundant in the native geologic materials.
Selenium (Se)	1/21 (4.8%)	0.52	0.52 (30-OSA-3, 0-2")	0.14	0.21	Yes	No	Single detection (frequency < 5%) at a low (< 1 µg/g) concentration.
Silver (Ag)	3/21 (14.3%)	0.39	1.27 (30-OSA-3, 0-2")	0.36	0.44	Yes	No	Silver concentrations exceed background in 2 of the 3 samples in which it was detected: 30-OSA-3, 0-2" (1.27 µg/g) and 30-OSA-1, 2' (0.5 µg/g). These exceedances are not considered notable given that the concentrations are within 1 µg/g of the 0.4 µg/g background value.
Sodium (Na)	21/21	1,060	20,400	4,894	5,610	No	No	Only three detections exceed background;

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
	(100%)		(30-SS-2, 0-2")					remaining concentrations are ≤ 5,140 µg/g. Sodium is naturally occurring in geologic materials, is commonly used, and has negligible toxicity. Also, soil at TEAD-S is typically saline.
Thallium (Tl)	14/21 (66.7%)	5.67	47.7 (30-TP-1, 5')	13.5	49.9	Yes	No	The maximum thallium concentration is less than the site-specific background value.
Vanadium (V)	21/21 (100%)	19.7	39.3 (30-TP-3, 4')	27.5	62.6	Yes	No	The maximum vanadium concentration is less than the site-specific background value.
Zinc (Zn)	**21/21 (100%)**	**42.3**	**669 (30-TP-2, 4')**	**183**	**144**	**Yes**	**Yes* (30-TP-1 and 30-TP-2 locations, future-use pathway only)**	**Zinc concentrations exceed background in four samples: 30-TP-2, 4' (669 µg/g); 30-TP-1, 2' (667 µg/g); 30-TP-1, 5' (566 µg/g); and 30-TP-2, 2' (234 µg/g). Remaining detections are ≤ 124 µg/g. Given that background exceedances are limited to 30-TP-1 and 30-TP-2 samples only, zinc is considered a COC for these two locations, but not a SWMU-wide COC. Also, because no surface or shallow subsurface soil contamination was identified, evaluation as a COC was limited to the future use pathway only. Zinc is a nutritionally essential metal, so selection as a COC is conservative.**

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Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
ORGANIC CONSTITUENTS								
Di-n-butylphthalate (DNBP)	10/21 (47.6%)	0.095	0.69 (30-OSA-1, 2-3')	--	ND	Yes	No	The detection frequency exceeds the 5% criterion; however, concentrations are low (< 1 μg/g). (Half the detections occur in the covered test pit samples.) Furthermore, the maximum concentration is over three orders of magnitude less than the 3,910 μg/g risk-based screening level (RBSL) calculated for the future residential use pathway (Table 5.1-3). DNBP is a ubiquitous pollutant due to its widespread use as a plasticizer. Its presence in the samples could also reflect laboratory or sample-container contamination (5 of the 10 detections were qualified in the laboratory report).
1,3-Dinitrobenzene (13DNB)	1/21 (4.8%)	0.31	0.31 (30-TP-2, 2-3')	--	ND	Yes	No	Single detection (frequency < 5%) at a low concentration.
Methylene chloride (CH2CL2)	**3/20 (15.0%)**	**0.008**	**0.015 (30-OSA-3, 0-2")**	--	ND	Yes	No	**Only three detections at low concentrations; occurrence was limited to the open storage area ("OSA") surface soil sample locations. Presence in samples may be attributable to laboratory contamination as presence of VOCs in upper 2 inches of soil is highly improbable given volatilization potential.**
2-Methylnaphthalene (2MNAP)	1/21 (4.8%)	0.10	0.10 (30-TP-1, 5')	--	ND	No	No	Single detection (frequency < 5%) at a low concentration.

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Naphthalene (NAP)	1/21 (4.8%)	0.07	0.07 (30-TP-1, 5')	--	ND	Yes	No	Single detection (frequency < 5%) at a low concentration.
Pentaerythritol tetranitrate (PETN)	12/20 (60%)	2.59	2.74 (30-SS-2)	--	ND	No	No	Detection frequency >5%, however PETN has very low toxicity. When used to treat congestive heart failure and prevent anagina (chest pain), the typical human dosage is 10–20 mg, three to four times per day. Any potential exposure to the PETN detected in soil at SWMU 30 would be well below this prescribed dose.
Phenanthrene (PHANTH)	1/21 (4.8%)	0.046	0.046 (30-TP-1, 2-3')	--	ND	Yes	No	Single detection (frequency < 5%) at a low concentration.
Pyrene (PYR)	1/21 (4.8%)	0.061	0.061 (30-TP-1, 2-3')	--	ND	Yes	No	Single detection (frequency < 5%) at a low concentration.
Trichlorofluoro-methane (CCL3F)	2/20 (10.0%)	0.007	0.009 (30-OSA-2, 0-2")	0.001	ND	Yes	No	Only two detections at low ppb concentrations. **Presence limited to the 30-OSA-1 and 30-OSA-2 surface soil locations, coinciding with methylene chloride detections. CCL3F (also known as Freon 11) is a common refrigerant, and a ubiquitous pollutant due to its global distribution in the atmosphere and long half-life in the atmosphere (52-207 years).** Furthermore, the maximum concentration is orders of magnitude lower than the 410 µg/g RBSL listed in Table 5.1-3.

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Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Toluene (MEC6H5)	2/20 (10.0%)	0.001	0.002 (30-TP-2, 4-5')	--	ND	Yes	No	Only two detections—in the covered center burn trench 30-TP-2 (4-5') sample and nearby surface soil sample 30-SS-6—at very low concentrations (0.001 to 0.002 µg/g). These concentrations are much lower than the 280 µg/g RBSL, considered protective for all site uses (Table 5.1-3).
NON-TARGET ANALYTES								
Cholestane (CHOLA)	1/21 (4.8%)	1.2	1.2 (30-TP-1, 2-3')	--	ND	No	No	Single detection at low concentration (frequency < 5%); no toxicity data. Occurrence coincides with the single detections of PAHs (phenanthrene, pyrene, and naphthalene).
Decahydro-2-methylnaphthalene (DH2MN)	1/21 (4.8%)	20.0	20.0 (30-TP-2, 2-3')	--	ND	No	No	Single detection at low concentration (frequency < 5%); no toxicity data. The (20 µg/g) concentration is high relative to levels **observed for other organic constituents, however. The single occurrence coincides with the single detection of 1,3-dinitrobenzene (0.31 µg/g) and the maximum (0.002 µg/g at 4-5') toluene concentration.**

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Dioctyl adipate (DOAD)	4/21 (19.0%)	0.38	0.67 (30-OSA-1, 0-2")	--	ND	No	No	Low concentrations (< 1.0 µg/g); also, a search of numerous databases yielded no toxicity information for this compound. Occurrence was limited to the open storage area ("OSA") soil sample locations.
Hydrocarbons, long-chain (C12 through C27)	various (1/21 to 3/21)	0.33	100.0	--	ND	No	No	Presence in samples may reflect naturally-occurring long-chain hydrocarbons present in the organic carbon in soil; low toxicity.
2,6,10,14-Tetra-methylpentadecane (2TMPD)	3/21 (14.3%)	0.59	0.79 (30-TP-2, 4-5')	--	ND	No	No	Detection frequency exceeds 5% criterion, but concentrations are low, no toxicity data are available, and all three detections were qualified in the laboratory analytical report. All three detections occur in the covered 30-TP-1 and 30-TP-2 (east and center burn trench) sample locations.

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
1,1,2-Trichloro-1,2,2-trifluoroethane (TCLTFE)	**11/21 (52.4%)**	**0.005**	**0.012 (30-TP-1, 0.5')**	**--**	**ND**	**Yes**	**Yes**	**This constituent detected in more than one-half of the samples, albeit at low concentrations.**

NOTES:

ND Not Determined
-- Not Calculated
All units in µg/g (ppm).
Bold print indicates the chemical was selected as a soil COC for SWMU 30.

1 The summaries provided in this table apply to both surface and subsurface soil (i.e., data for both soil depth profiles were merged to derive detection frequencies, means, etc.). Distinctions regarding the vertical distribution of constituents are made only if warranted by the data. In general, such distinctions are left to the quantitative risk assessment, for which current-use risks are calculated using surface soil data (only), and future-use risks are calculated using the merged (surface and subsurface) database.

2 Means were calculated assuming that nondetects are equivalent to one-half the MDL. Average concentrations are not reported for most organic and non-target analytes, however, because the low detection frequencies and high MDL values result in artificially elevated means (that often exceed reported maxima). Thus, the average was not considered to be a meaningful estimator for these constituents.

3 Site-specific background values were derived as the maximum detected concentration of each metal in background samples collected for the Group 2 SWMUs (Section 2.3).

4 "Yes" is indicated in this column when toxicity criteria are available that allow quantitative evaluation of a given compound (e.g., carcinogenic slope factors and/or noncarcinogenic RfDs from IRIS or HEAST).

5 When "Yes" is followed by an asterisk (*) in this column, it indicates that the constituent was not selected as a site-wide COC, but may be a potential sample- or area-specific COC.

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
1,1,2-Trichloro-1,2,2-trifluoroethane (TCLTFE)	**11/21 (52.4%)**	**0.005**	**0.012 (30-TP-1, 0.5')**	**--**	**ND**	**Yes**	**Yes**	**This constituent detected in more than one-half of the samples, albeit at low concentrations.**

NOTES:

ND Not Determined
-- Not Calculated

/1/ The summaries provided in this table apply to both surface and subsurface soil (i.e., data for both soil depth profiles were merged to derive detection frequencies, means, etc.). Distinctions regarding the vertical distribution of constituents are made only if warranted by the data. In general, such distinctions are left to the quantitative risk assessment, for which current-use risks are calculated using surface soil data (only), and future-use risks are calculated using the merged (surface and subsurface) database.

/2/ Means were calculated assuming that nondetects are equivalent to one-half the MDL. Average concentrations are not reported for most organic and non-target analytes, however, because the low detection frequencies and high MDL values result in artificially elevated means (that often exceed reported maxima). Thus, the average was not considered to be a meaningful estimator for these constituents.

/3/ Background values were determined using the methods and assumptions described in Section 2.3.

/4/ "Yes" is indicated in this column when toxicity criteria are available that allow quantitative evaluation of a given compound (e.g., carcinogenic slope factors and/or noncarcinogenic RfDs from IRIS or HEAST).

/5/ **When "Yes" is followed by an asterisk (*) in this column, it indicates that the constituent was not selected as a site-wide COC, but may be a potential sample- or area-specific COC.**

All units in µg/g (ppm).
Bold print indicates the chemical was selected as a soil COC for SWMU 30.

Table 5.6-2 Summary of COCs Selected for SWMU 30 Soil [1]

Site-Wide Soil COCs [2]	Sample- or Area- Specific Soil COCs [2]	Location
1,1,2-Trichloro-1,2,2-trifluoroethane	Arsenic	Test Pit 30-TP-1
	Cadmium	Test Pits 30-TP-1 and 30-TP-2
	Chromium	Test Pit 30-TP-1
	Copper	Test Pits 30-TP-1 and 30-TP-2
	Lead	Test Pit 30-TP-1
	Nickel	Test Pit 30-TP-1
	Zinc	Test Pits 30-TP-1 and 30-TP-2

NOTE:

1 This table lists soil COCs only because neither groundwater nor air samples were collected at SWMU 30.

2 As indicated in Table 5.6-1 (Note 5), for the constituents identified above as sample-specific COCs, elevated concentrations were limited to subsurface soil samples collected from test pits 30-TP-1 and 30-TP-2 (at depths below 2 ft). Concentrations at remaining sample locations were less than site-specific background levels. Given this finding, inorganic constituents identified as location-specific COCs will be evaluated as a COC for the hypothetical future residential use pathway only.

5.6.2 Exposure Assessment

As indicated in Table 5.6-3, the only current-use scenario quantitatively evaluated for SWMU 30 was limited to the area of the two test pits where the only subsurface soil contamination was detected. Risks associated with a hypothetical future-use scenario were also quantified for these areas within the SWMU.

TCLTFE was not addressed for current site uses because comparison of the maximum soil concentration (0.012 μg/g) with the 410 μg/g soil RBSL (Table 5.1-2) indicates a negligible hazard—the HQ is 2.9×10^{-5}. Because current-use exposures to SWMU 30 soil would not exceed those assumed for future-use exposures (Appendix Table K.2-2), calculation of associated risks or hazards was not considered necessary.

Contamination of SWMU 30 subsurface soil was limited to test pit samples 30-TP-1 and 30-TP-2 (Tables 5.6-1 and 5.6-2). Consequently, risks calculated for the residential-use scenario apply only to these locations. Because this unit is near the CAMDS facility, risk was also assessed for an industrial scenario. This scenario was evaluated using combined data from surface and subsurface soil, since any industrial development or site preparation could result in excavation of subsurface contamination. Corresponding EPCs are the maximum soil COC concentrations (Table 5.6-5, Note 1).

5.6.3 Risk Characterization

As discussed above and in Table 5.6-3, elevated concentrations of soil COCs were limited to subsurface depths at SWMU 30 test pit locations; a potential industrial exposure scenario was quantitatively evaluated for these areas only to calculate risks associated with excavating SWMU 30 soil at or around these test pit locations. Table 5.6-4 summarizes the risks calculated for potential industrial exposures to maximum soil COC concentrations (surface and subsurface soil concentrations combined). The total cancer risk and HI are 1.8×10^{-4} and 0.97, respectively. The cancer risk exceeds corresponding corrective action criteria; the HI is below the corrective action level of 1.0. Table 5.6-5 summarizes the risks calculated for hypothetical residential-use exposures to maximum soil COC concentrations. The total cancer risk and HI are 5.6×10^{-4} and 24, respectively; both values exceed corresponding State of Utah criteria requiring corrective action, assuming future residential use of the site. Of the soil COCs evaluated, only arsenic and lead exceed corresponding RBSLs. As discussed in previous SWMU-specific evaluations, risks calculated for future-use scenarios should be interpreted in light of the contribution of background levels of arsenic.

Table 5.6-3 Potential Pathways of Exposure to COCs at SWMU 30

Exposure Medium	Potential Receptor(s)	Receptor Location(s)	Potential Exposure Route(s)	Pathway Quantitatively Evaluated?	Reason for Selection or Exclusion
Surface (0-2") Soil	Site EM or Security Personnel, and/or adjacent CAMDS Workers	Within SWMU 30, and/or adjacent CAMDS facility (SWMU 13)	**Current Site Uses:** Incidental Ingestion, Dermal Contact, and Inhalation Soil Exposure Pathways	NO	Site Environmental Management personnel might access SWMU 30 occasionally to inspect the grounds and/or to check monitoring wells. Also, site security personnel regularly patrol the perimeter of the adjacent CAMDS (SWMU 13) facility (located north/northeast of SWMU 30). However, with the exception of TCLTFE, which was detected at levels (0.005-0.012 μg/g) well below the RBSL (410 μg/g) developed for future residential use pathways, no surficial contamination was identified at SWMU 30. (The only other exception was PETN, but the lack of toxicity criteria for this compound precludes quantitative evaluation.)
Surface and Subsurface Soil	Site EM or Security Personnel, Industrial (Construction) Workers, and/or adjacent CAMDS Workers	SWMU 30 test pit locations (TP-1 and TP-2) and/or adjacent CAMDS facility (SWMU 13)	Ingestion, Dermal Contact, and Inhalation Soil Exposure Pathways	YES	Construction activities may expose construction personnel, near-by CAMDS personnel, and site EM and security personnel to subsurface soil contaminants brought to the surface during excavation or other construction-related activities. As indicated in Tables 5.6-1 and 5.6-2, elevated concentrations of soil COCs were limited to subsurface depths at test pit locations (30-TP-1 and 30-TP-2). The current-use exposure scenario quantifies risks associated with construction activities at these locations.

Table 5.6-3 Potential Pathways of Exposure to COCs at SWMU 30

Exposure Medium	Potential Receptor(s)	Receptor Location(s)	Potential Exposure Route(s)	Pathway Quantitatively Evaluated?	Reason for Selection or Exclusion
Surface and Subsurface Soil	Future Residents	SWMU 30 test pit locations (TP-1 and TP-2)	**Potential <u>Future Site Uses:</u>** Ingestion, Dermal Contact, and Inhalation Soil Exposure Pathways Associated with Hypothetical Future Residential Use of SWMU 30	YES	Future residential use of TEAD-S is not expected. Nonetheless, this hypothetical future use pathway was quantified to represent a worst-case, screening-level evaluation of risks associated with potential exposures to SWMU 30 soil COCs. With the exception of TCLTFE, this analysis applies to test pit locations TP-1 and TP-2 only (given the localized contamination identified in Tables 5.6-1 and 5.6-2).

TCLTFE 1,1,2-trichloro-1,2,2-trifluoroethane
COC Chemical of Concern

Table 5.6-4 Cancer Risks and Hazard Indices Calculated for SWMU 30 Potential Post-Excavation Industrial Scenario Location Specific Soil Exposure Pathways[1]

Current-Use Exposure Scenario			Results of Cancer Risk (CR) Calculations		Results of Hazard Index (HI) Calculations	
Receptor	Pathway(s)	COCs Evaluated	CR	Driving COC(s) and Pathway	HI	Driving COC(s) and Pathway
Current-Use Exposure Scenario : Receptor Location--Test Pits TP-1 and TP-2						
Industrial workers/CAMDS workers/ Site EM Personnel	SI/DC/INH (Appendix Table K.7-1)	Location-specific COCs and EPCs[2]	1.8×10^{-04}	Arsenic, soil ingestion (SI) pathway dominates	0.97	Arsenic, SI dominates

Interpretation: *The cancer risk level calculated for the SWMU 30 current-use exposure scenario is above State of Utah corrective action criteria.*

COC Chemical of Concern
SI Soil Ingestion Pathway
DC Dermal Contact Pathway
INH Inhalation Pathway
CR Cancer Risk
HI Hazard Index

1 Tables 5.6-2 and 5.6-3 detail the COC and exposure pathway selection process. Appendix Table K.7-1 provides detailed cancer risk and HI calculation documentation for the current-use SWMU 30 exposure scenario summarized above.

2 EPCs for location-specific soil COCs are the maximum concentration detected at the sample locations listed above (See Table 5.6-5).

Location-Specific Evaluation: Test Pits TP-1 and TP-2 (subsurface (below 2 ft) depth) [1]

Chemical of Concern	Carcinogenic RBSL (mg/kg)	Soil EPC (ug/g)	Associated Cancer Risk	(Percent of Total Risk)	Noncarcinogenic RBSL (ug/g)	Soil EPC (ug/g)	Hazard Quotient	(Percent of Total HI)
Arsenic	**0.97**	**540**	**5.6E-04**	**100%**	**23.5**	**540**	**2.3E+01**	**98%**
Cadmium	1,170	10.1	8.6E-09	<1%	78.2	10.1	1.3E-01	<1%
Chromium, hexavalent	175	104	5.9E-07	<1%	391	104	2.7E-01	1%
Copper					2,902	356	1.2E-01	<1%
Lead					400	850	**E**	
Nickel	4,370	41.5	9.5E-09	<1%	1,564	41.5	2.7E-02	<1%
Zinc					23,464	669	2.9E-02	<1%
	Total Cancer Risk:		**5.6E-04**		**Total Hazard Index (HI):**		**2.4E+01**	

Interpretation: *Bolded COCs/values reflect exceedances of either a 1.0E-04 cancer risk and/or a hazard quotient of 1.0. Both the cancer risk and the HI exceed State of Utah risk criteria* ***assuming residential use of the site***.

E - Exceedance based on the USEPA Soil Screening Level for lead. Potential human health risks may occur following chronic exposure.
RBSL - Risk-Based Screening Level
EPC - Exposure Point Concentration
HQ - Hazard Quotient

1 **With the exception of 1,1,2-trichloro-1,2,2-trifluoroethane (TCLTFE), which was selected as a site-wide COC for both current and potential future site uses, no surficial soil contamination was identified at SWMU 30. The only subsurface contamination identified was for the COCs listed above at the test pit (TP-1 and TP-2) locations. [Concentrations at remaining sample locations were below background levels.] Consequently, the results presented above apply to test pit locations for the future residential use scenario only. Soil EPCs assumed in the risk calculations (and listed above) are the maximum concentrations detected at the TP-1/TP-2 locations (Table 5.6-1).**

A comparison of the maximum detected TCLTFE concentration, 0.012 ug/g, with the 410 ug/g RBSL (Table 5.1-3) indicates an HQ of 2.9E-05, a level well below EPA's target hazard index criterion (1.0). Given that such a low HQ was calculated for the future residential use scenario, which uses very conservative assumptions, it was not considered necessary to quantify risks associated with current site uses.

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5.7 BASELINE HUMAN HEALTH RISK ASSESSMENT FOR SWMU 31

5.7.1 Identification of Chemicals of Concern

Table 5.7-1 details the COC selection process, as defined in Section 5.1.1, for SWMU 31 soil samples. Table 5.7-2 summarizes the COCs selected for soil, air, and surface water.

Only two constituents were selected as SWMU-wide soil COCs for SWMU 31: copper and 2,4,6-TNT. No localized contamination was evident, so no constituents were selected as location-specific soil COCs. Air COCs selected on the basis of the air monitoring results include ethyl benzene, methylene chloride, tetrachloroethene, toluene, and total xylenes. These constituents were identified as air COCs because ambient concentrations detected at SWMU 31 exceeded levels reported for the background (BK) monitoring location. Surface water COCs include antimony, the explosive compound RDX, and selenium; these constituents were not quantitatively evaluated, however, given the lack of an exposure pathway (Tables 5.1-2 and 5.7-2).

5.7.2 Exposure Assessment

Similar to the approach used in evaluating risks for SWMU 30, the SWMU 31 evaluation quantifies soil exposure risks for the hypothetical future-residential-use scenario only. Potential current uses were not quantitatively evaluated because maximum concentrations of copper and 246TNT (the only soil COCs identified) are well below corresponding RBSLs developed for future-residential-use pathways (Table 5.7-3). Because the future-use analysis assumes an exposure period that is greater than that associated with current uses of SWMU 3, even accounting for the added soil disturbance associated with demilitarization activities, current-use exposures to these compounds were not quantified. Rather, the exposures/risks estimated for the future-use scenario (Table 5.7-5) are considered to apply to current site uses as well.

Potential inhalation exposures to VOCs in ambient air were quantified, however (Table 5.7-3). Table 5.7-4 lists the soil and air exposure point concentrations used in the quantitative evaluation.

5.7.3 Risk Characterization

Copper and 2,4,6-TNT were the only soil COCs identified; maximum concentrations of both these constituents are well below corresponding RBSLs developed for future residential-use pathways. Because the future-use analysis assumes an exposure period that is greater than that associated with current uses of SWMU 31, even accounting for the added soil disturbance associated with demilitarization activities, current-use risks associated with exposure to these compounds were

Table 5.7-1 Identification of COCs for SWMU 31 Soil

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
INORGANIC CONSTITUENTS								
Aluminum (Al)	16/16 (100%)	10,100	18,100 (31-CS-3, 2-3')	14,369	25,200	Yes	No	The maximum concentration is less than the site-specific background level.
Antimony (Sb)	2/16 (12.5%)	10.2	12.4 (31-CS-1, 0-2")	4.5	11.9	Yes	No	Detected in only two samples; the maximum antimony concentration is essentially equal to the background level.
Arsenic (As)	16/16 (100%)	3.8	20.0 (31-CS-3, 2-3')	11.5	40.0	Yes	No	The maximum arsenic concentration is less than the site-specific background value.
Barium (Ba)	16/16 (100%)	39.2	233.5 (31-DCH-2, 0-2")	120.9	537	Yes	No	The maximum barium concentration is below the site-specific background value.
Beryllium (Be)	16/16 (100%)	0.43	1.15 (31-CS-2, 0.5')	0.88	1.2	Yes	No	The maximum detected beryllium concentration is less than the site-specific background level.
Cadmium (Cd)	14/16 (88%)	0.62	2.4 (31-DCH-2, 0-2")	1.04	0.98	Yes	No	Cadmium concentrations exceed background in 10 (63%) of the 16 soil samples; these exceedances are not considered significant, however. It should be noted that the cadmium concentration reported tor the 31-BK-1 surficial soil sample was 1.78 μg/g. This concentration was not used to determine the cadmium soil background level because it was considered a statistical outlier (see Section 2.3). The maximum differs from background by only a factor of 2.4 (2.4 μg/g vs. 0.98 μg/g); the second rank (31-BK-1, 0-2") concentration is 1.78 μg/g; the third rank (31-DCH-1, 0-2") concentration is 1.6 μg/g. All three detections occurred in

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
								surface soil samples. The remaining eight "exceedances" range between 1.01 µg/g and 1.3 µg/g.
Calcium (Ca)	16/16 (100%)	56,100	230,000 (31-CS-4, 2-3')	11,006	250,000	No	No	The maximum concentration is less than the site-specific background level.
Chromium (Cr)	16/16 (100%)	15.9	24.7 (31-CS-3, 0.5')	19.6	48.5	Yes	No	The maximum chromium concentration is less than the site-specific background value.
Cobalt (Co)	16/16 (100%)	4.3	7.45 (31-DCH-2, 2-3')	6.3	8.6	No	No	The maximum concentration is less than the site-specific background level.
Copper (Cu)	**16/16 (100%)**	**9.9**	**76.2 (31-DCH-2, 0-2")**	**24.4**	**27.6**	**Yes**	**Yes**	**Detection frequency 100%; potential toxicity; exceeds background in 4 (25%) of the 16 soil samples. It should be noted that the copper concentration reported for the 31-BK-1 surficial soil sample was 72.1 µg/g. This concentration was not used to determine the copper soil background level because it was considered a statistical outlier (see Section 2.3). As observed for cadmium, only the three highest rank concentrations—76.2 µg/g, 72.1 µg/g, and 57 µg/g—were detected in surface soil samples at 31-DCH-2, 31-BK-1, and 31-DCH-1, respectively. Remaining copper concentrations are ≤ 39 µg/g, and are not significantly higher than the 27.6 µg/g background value. Given these observations, combined with the fact that copper is widely**

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
								distributed in nature and is an essential element, selection as a COC is very conservative.
Cyanide (Cyn)	5/16 (31.3%)	0.29	0.77 (31-CS-2, 5-6')	--	ND	Yes	No	Although the detection frequency exceeds the 5% criterion, all five detections are below one half the CRL and thus highly uncertain.
Iron (Fe)	16/16 (100%)	10,500	18,300 (31-CS-3, 0.5')	15,150	24,300	No	No	The maximum concentration is less than the site-specific background level.
Lead (Pb)	16/16 (100%)	9.47	24.0 (31-CS-2, 0-2")	15.2	35.0	Yes	No	The maximum lead concentration is less than the site-specific background value.
Magnesium (Mg)	16/16 (100%)	11,200	46,400 (31-CS-3, 0.5')	22,153	16,150	No	No	Exceeds background in 11 (69%) of the 16 samples. However, magnesium was not selected as a COC because it is a naturally- occurring essential human nutrient with negligible toxicity.
Manganese (Mn)	16/16 (100%)	138.0	678.0 (31-CS-4, 2-3')	358.6	658.0	Yes	No	Only the maximum (678.0 µg/g) manganese concentration exceeds the 658.0 µg/g background level; this exceedance is not significant. All other detections are ≤603 µg/g. Also, manganese is a ubiquitous mineral in desert soil.
Mercury (Hg)	4/16 (25%)	0.036	0.195 (31-DCH-1, 0-2")	0.034	0.143	Yes	No	The maximum (0.195 µg/g) mercury concentration is only slightly higher than the 0.143 µg/g site-specific background value. The remaining three detections are ≤0.079 µg/g.

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
Nickel (Ni)	16/16 (100%)	16.9	32.2 (31-CS-3, 0.5')	23.5	27.9	Yes	No	Nickel exceeds background in 3 (19%) of the 16 soil samples, but not by a significant amount. The maximum differs by only 4.3 µg/g; the second- and third-rank nickel concentrations (29.4 µg/g and 28.3 µg/g) are essentially equal to the 28 µg/g background value.
Potassium (K)	16/16 (100%)	2,090	5,510 (31-DCH-2, 0-2")	3,858	7,940	No	No	The maximum potassium concentration is less than the site-specific background value.
Sodium (Na)	16/16 (100%)	659	2,960	1,798	5,610	No	No	The maximum sodium concentration is less than the site-specific background value.
Thallium (Tl)	15/16 (94%)	6.8	31.7 (31-CS-2, 0.5')	24.1	49.9	Yes	No	The maximum thallium concentration is less than the site-specific background value.
Vanadium (V)	16/16 (100%)	16.5	31.0 (31-DCH-1, 2-3')	24.1	62.6	Yes	No	The maximum vanadium concentration is less than the site-specific background value.
Zinc (Zn)	16/16 (100%)	52.1	166.0 (31-DCH-2, 0-2")	85.5	144	Yes	No	Only the maximum (166.0 µg/g) zinc concentration exceeds the 144 µg/g background level, and not by a significant amount. All other detections are ≤98.4 µg/g.

Parameter	Detection Frequency [1]	Minimum	Maximum (Location)	Mean [2]	Site-Specific Background [3]	Toxicity Data? [4]	Selected as COC? [5]	Rationale for Selection or Exclusion as COC
ORGANIC CONSTITUENTS								
Di-n-butylphthalate (DNBP)	1/4 (25%)	0.34	0.34 (31-DCH-1, 2-3')	--	ND	Yes	No	The detection frequency is high relative to the 5-% criterion; this finding stems from the fact that only four samples were analyzed for organics. DNBP presence in the single sample is not considered significant, given its widespread occurrence in the industrial environment. Also, this result could reflect laboratory or sample-container contamination.
2,4,6-Trinitrotoluene (246TNT) (Explosive)	**2/14 (14.3%)**	**0.52**	**0.96 (31-CS-4, 0-2")**	**--**	**ND**	**Yes**	**Yes**	**Detection frequency > 5%; potential toxicity; agent presence clearly related to previous and/or ongoing site activities.**
NON-TARGET ANALYTES								
Dioctyl adipate (DOAD)	3/16 (18.8%)	0.007	1.2 (31-DCH-2, 2-3')	--	ND	No	No	Low concentrations; no toxicity data (see Table 5.6-1). Occurrence was limited to the 31-DCH-2 and 31-DCH-1 (2-3') samples.

NOTES:

ND Not Determined
-- Not Calculated
All units in µg/g (ppm).
Bold print indicates the chemical was selected as a soil COCs for SWMU 31

1 The summaries provided in this table apply to both surface and subsurface soil (i.e., data for both soil depth profiles were merged to derive detection frequencies, means, etc.). Distinctions regarding the vertical distribution of constituents are made only if warranted by the data. In general, such distinctions are left to the quantitative risk assessment, for which current-use risks are calculated using surface soil data (only), and future-use risks are calculated using the merged (surface and subsurface) database.

2 Means were calculated assuming that nondetects are equivalent to one-half the MDL. Average concentrations are not reported for most organic and non-target analytes, however, because the low detection frequencies and high MDL values result in artificially elevated means (that often exceed reported maxima). Thus, the average was not considered to be a meaningful estimator for these constituents.

3 Site-specific background values were derived as the maximum detected concentration of each metal in background samples collected for the Group 2 SWMUs (Section 2.3).

4 "Yes" is indicated in this column when toxicity criteria are available that allow quantitative evaluation of a given compound (e.g., carcinogenic slope factors and/or noncarcinogenic RfDs from IRIS or HEAST).

5 Given that only two soil COCs were identified (copper and 2,4,6-TNT), coupled with the fact that no spatial trend is apparent for any constituent detected in SWMU 31 soils, no distinction was made between SWMU-wide and area- or sample-specific COCs.

Table 5.7-2 Summary of COCs Selected for SWMU 31 Media

Site-Wide Soil COCs [1]	Air COCs [2]	Surface Water COCs [3]
Copper	Ethyl Benzene	Antimony
2,4,6-Trinitrotoluene (246TNT)	Methylene chloride	RDX
	Tetrachloroethene	Selenium
	Toluene	
	Xylenes	

NOTE:

1 Because only two soil COCs were identified for SWMU 31 (Table 5.7-1), a streamlined risk assessment was performed as described in Section 5.7.2.

2 Air COCs for organic constituents were selected based on results of the ambient air sampling and meteorological monitoring conducted at TEAD-S from September 11, 1993 to October 3, 1993. In general, a constituent was selected as an air COC if detected concentrations significantly exceeded levels reported for the background (BK) monitoring location. Air COCs were not selected for metals because monitoring results were considered invalid due to media and laboratory problems.

3 Background data for surface water are not available. (Such data would be difficult to obtain, given that SWMU 31 surface water samples were collected from small, ephemeral [post-rain event] ponds.) Therefore, surface water COCs were conservatively selected based on a comparison with drinking water standards (e.g., MCLs) and/or domestic surface water standards—any constituent exceeding a standard is listed above. The agent compound RDX exceeded the 2 μg/l lifetime TBC (to be considered) drinking water standard in all four surface water samples. [Other agent-related compounds detected in surface water samples include 2,4-dinitrotoluene, HMX, and nitrobenzene. However, detected concentrations were well below corresponding (TBC) drinking water standards (5 μg/l, 400 μg/l, and 17.5 μg/l, respectively).] Antimony concentrations exceeded the 6 μg/l drinking water standard in three samples—31-CW-1 (27.7 μg/l), 31-CW-2 (30.5 μg/l), and 31-CW-3 (29.6 μg/l). Selenium exceeded the 10 μg/l state MCL and domestic surface water use criterion in only one sample—31-CW-1 (43.2 μg/l). Surface water COCs were not quantitatively evaluated, however, since there is no exposure pathway (Table 5.1-2).

Table 5.7-3 Potential Pathways of Exposure to COCs at SWMU 31

Exposure Medium	Potential Receptor(s)	Receptor Location(s)	Potential Exposure Route(s)	Pathway Quantitatively Evaluated?	Reason for Selection or Exclusion
Surface and Subsurface Soil	SWMU 31 Demilitarization Area Workers	Within SWMU 31	**Current Site Uses:** Incidental Ingestion, Dermal Contact, and Inhalation Soil Exposure Pathways	NO* **See results of future-use screening level evaluation.*	Individuals work in the SWMU 31 demilitarization area approximately 9 months per year, 4 days/week, 10 hours a day. However, with the exception of copper and 2,4,6-TNT, no soil COCs were identified for SWMU 31. The maximum copper and 2,4,6-TNT concentrations (76.2 µg/g and 0.96 µg/g, respectively) are well below corresponding RBSLs developed for future residential use pathways—2,900 µg/g and 39.1 µg/g, respectively. Because the future-use analysis assumes an exposure period that is greater than that associated with current uses of SWMU 3, even accounting for the added soil disturbance associated with demilitarization activities, current-use risks associated with exposure to these compounds were not quantified. Rather, the risks calculated for the future use scenario (Table 5.7-5) are considered to apply to current site uses as well.
Air—Ambient VOC Concentrations (Based on Air Monitoring Data)	SWMU 31 Demilitarization Area Workers	Within SWMU 31	**Current Site Uses:** Inhalation of Air (Volatile Organic) COCs Identified in Table 5.7-2	YES	Air sampling results indicated VOC concentrations exceeding background at the SWMU 31 monitoring station. Therefore, as a screening-level analysis, potential risks associated with inhalation exposures to these constituents were evaluated. The analysis assumes average VOC concentrations (Appendix I, Table 8), and an exposure frequency of 9 months per year, 4 days/week, 10 hours per day for 25 years.

Exposure Medium	Potential Receptor(s)	Receptor Location(s)	Potential Exposure Route(s)	Pathway Quantitatively Evaluated?	Reason for Selection or Exclusion
Surface and Subsurface Soil	Future Residents	Within SWMU 31	**Potential** **Future Site Uses:** Ingestion, Dermal Contact, and Inhalation Soil Exposure Pathways Associated with Hypothetical Future Residential Use of SWMU 31	YES	Future residential use of TEAD-S is not expected. Nonetheless, this hypothetical future use pathway was quantified to represent a worst-case, screening-level evaluation of risks associated with potential exposures to SWMU 31 soil COCs. As indicated above, the results of this analysis are also assumed to conservatively reflect potential risks associated with the current-use scenario.

2,4,6-TNT 2,4,6-trinitrotoluene
COC Chemical of Concern
RBSLs Risk-Based Screening Levels

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Table 5.7-4 Exposure Point Concentrations Used to Evaluate SWMU 31 Current and Future Use Exposure Pathways Page 1 of 1

Chemical of Concern	Maximum Soil EPC Concentration /1/ (µg/g)	Air EPC /1/ (mg/m^3)
Copper	76.2	--
2,4,6-Trinitrotoluene	0.96	--
Ethyl Benzene	--	1.95E-03
Methylene chloride	--	6.26E-04
Tetrachloroethene	--	9.50E-04
Toluene	--	8.91E-03
Xylenes	--	1.14E-02

1 Soil EPCs used in the SWMU 31 risk calculations are maximum detected concentrations; air EPCs are the average VOC concentrations reported in Appendix I (Table 8). The analysis is considered a worst-case screening level evaluation of potential exposures to SWMU 31 media. [Potential exposures to surface water in ephemeral ponds is addressed qualitatively in Table 5.7-2 (Note 2).]

-- Not Applicable/Not Evaluated

not quantified. Rather, the risks calculated for the future use scenario (Table 5.7-5) are considered to apply to current site uses as well.

Table 5.7-5 summarizes the risks calculated for current and future use exposures to SWMU 31 soil and air COCs. The inhalation cancer risk and HI calculated for potential exposures to VOCs in air are 1.6×10^{-7} and 0.013, respectively. These results are both less than corresponding State of Utah criteria. The screening level cancer risk and noncancer HI quantified for potential exposures to copper and 246TNT are 1.7×10^{-8} and 0.051, respectively (Table 5.7-5). These results, which were calculated using maximum concentrations, are both less than corresponding corrective action criteria.

Based on the soil and air sampling data collected for the RFI-Phase II, the results summarized above indicate negligible potential risks associated with both current- and/or potential future-use exposures to constituents in soil and air at SWMU 31.

5.8 UNCERTAINTY EVALUATION

Risk assessment is an inexact but essential methodology used to characterize and quantitatively evaluate health effects potentially resulting from exposures to chemicals. The lack of explicitly relevant toxicity and exposure data, the uncertainty in chemical measurements in both the environment and the laboratory, and the need to extrapolate experimental endpoints to assumed human exposures and potential responses make precise quantification of risk difficult and inherently uncertain. For example, the assumptions used to calculate exposure rates and quantify potential health risks for TEAD-S Group 2 SWMUs are by nature imprecise because of variations in human behavior and physical characteristics. Given these unavoidable uncertainties, the general approach applied in this assessment was to develop conservative estimates of exposures, doses, and health risks. The major assumptions influencing risk estimates developed for TEAD-S are discussed below.

5.8.1 Exposure Point Concentrations

EPC Determination

Many of the assumptions and models used to estimate human exposures and doses are associated with a high degree of uncertainty. For example, in evaluating SWMU-wide COCs, this assessment conservatively assumed exposures to a single, reasonable maximum (upper 95 percent confidence limit) chemical concentration. However, individuals would more typically be exposed to a wide range of concentrations, resulting overall in a lower average exposure. The location-

Table 5.7-5 Summary of SWMU 31 Risk Assessment Results for Current and Future Use Pathways

Table 5.7-5a Inhalation Risks Associated with Exposure to Volatile Air COC Concentrations

Cancer Risk Calculations Air COC	Air EPC (mg/m3)	Inhalation CDI (mg/kg/day)	Inhalation Slope Factor (mg/kg/day)-1	Inhalation Cancer Risk	(Percent of Total Risk)
Methylene chloride	6.26E-04	3.28E-05	1.65E-03	5.4E-08	35%
Tetrachloroethene	9.50E-04	4.98E-05	2.03E-03	1.0E-07	65%
			Total Cancer Risk:	**1.6E-07**	

Noncancer HI Calculations Air COC	Air EPC (mg/m3)	Inhalation CDI (mg/kg/day)	Inhalation RfD (mg/kg/day)	Inhalation Hazard Quotient	(Percent of Total HI)
Ethyl Benzene	1.95E-03	2.86E-04	2.86E-01	1.0E-03	8.0%
Methylene chloride	6.26E-04	9.19E-05	8.57E-01	1.1E-04	0.9%
Tetrachloroethene	9.50E-04	1.39E-04	--	--	
Toluene	8.91E-03	1.31E-03	1.14E-01	1.1E-02	91%
Xylenes	1.14E-02	1.67E-03	--	--	
			Hazard Index:	**1.3E-02**	

**The results summarized above are documented in Appendix Table K.8-1.*

Table 5.7-5b Soil Exposure Risks

Soil COC	Carcinogenic RBSL (mg/kg)	Soil EPC (ug/g)	Associated Cancer Risk	(Percent of Total Risk)	Noncarcinogenic RBSL (ug/g)	Soil EPC (ug/g)	Hazard Quotient	(Percent of Total HI)
Copper					2,902	76.2	2.6E-02	52%
2,4,6-Trinitrotoluene	56.78	0.96	1.7E-08	100%	39.1	0.96	2.5E-02	48%
	Total Cancer Risk:		**1.7E-08**		**Total Hazard Index (HI):**		**5.1E-02**	

Interpretation: The cumulative cancer risk, reflecting exposures to both soil and volatile air COCs, is 2×10^{-7}; the cumulative HI is 0.064. Both the cancer risk and HI, which were calculated using very conservative assumptions corresponding to a hypothetical future residential use scenario (see Table 5.7-3), are well below respective State of Utah risk criteria.

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specific risk evaluations are particularly conservative in that they assume an individual would be exposed to contaminant concentrations in a localized area on a consistent basis.

The particulate emission factor used to estimate exposures to COCs in resuspended soil particulates is conservative, and makes many simplifying assumptions about site conditions and the physical/chemical processes that govern the airborne transport of soil containing COCs (Section 5.1.3).

Soil Chromium EPCs

A factor that affects EPC estimates for both soil and air is the assumption that 10 percent of the total chromium detected in soil is in the hexavalent form; the remaining 90 percent is assumed to be trivalent (Section 5.1.2.3). Site-specific analytical data are not available to confirm the validity of this assumption. However, given the general and site-specific factors described below, the assumption regarding the valence state of chromium used in this analysis is considered conservative.

Chromium occurs in nature in two oxidation states—trivalent Cr(III) and hexavalent Cr(VI); both forms occur in a variety of naturally occurring minerals (Matzat and Shiraki 1972; Bartlett and James 1988). Consequently, the presence of chromium in soils does not necessarily connote an anthropogenic source. Most forms of Cr(III) present in soils, either as naturally occurring Cr, or as anthropogenic "contaminant" Cr, are low in solubility and reactivity, and are oxidized to Cr(VI) only under rather narrow and delicately balanced environmental circumstances (Bartlett and James 1988). This is due primarily to the overall chemical inertness of Cr(III) and its complexes, and to the high instability of Cr(VI) in soils (Bartlett and James 1988).

Factors which cause Cr(VI) to be highly unstable in the soil environment include, but are not limited to:

- The presence of oxidizable organic matter, oxidizable ferrous iron, and sulfides in soil
- Acid pHs (not applicable to TEAD-S soils)
- The unavailability of Cr(III) (due to adsorption to soil surfaces), thus preventing its oxidation

- The photoreduction of Cr(VI) by sunlight (Kieber and Helz 1992; Bartlett and James 1988; Calder 1988)

- The reduction of Cr(VI) by residual amounts of iron (Fe(II)) in weathering minerals, a phenomenon that is well documented (Eary and Rai 1989). (This finding is particularly relevant given the prevalence and magnitude of iron in TEAD-S soil.)

Moreover, soils that are dry for extended periods of time, such as the desert soils at Tooele, prevent the oxidization of Cr(III) to Cr(VI) (Bartlett and James 1988). For these reasons, it is believed that most, if not all, chromium added to soil soon becomes permanently established as Cr(III) (Bartlett and James 1988). An exception would be the presence of Cr as a component of stainless steel, where it is highly stable in a wide range of environments.

5.8.2 Human Exposure Parameter Estimation

Numerous uncertainties surround the determination of exposure parameters because the behavior patterns of individuals are not well known. For example, body weights, breathing rates, soil ingestion rates, and dermal contact rates are likely to vary depending on the actual characteristics of the population exposed. In this analysis, reasonable maximum exposure (RME) values were used as input to the ingestion, dermal contact, and inhalation pathway calculations.

5.8.3 Uncertainties Related to Toxicity Information

A number of uncertainties surround the use of slope factors, which serve as the basis for calculating estimated cancer risks. First, the development of slope factors assumes that the dose-response relationship is the same for both test animals and humans. Second, these factors represent upper-bound (95 percent upper confidence limit) estimates of potency. Thus, if an individual's exposure to a constituent is equivalent to the level that defines the potency, there is only a 5 percent chance that the actual risk to that individual will exceed the calculated risk, and a 95 percent chance that the risk is at or below the calculated level. Consequently, the actual risks associated with exposures to a potential carcinogen are not likely to exceed the risk estimated using these upper-bound slope factors, and in fact may be lower.

The lack of inhalation toxicity data for some COCs also contributes to the uncertainty of this evaluation. Inhalation reference concentrations (RfCs) and unit risks are not available for a number of the COCs evaluated in this assessment. Consequently, the inhalation risk and HI estimates for worker receptors may be underestimated in this respect; the extent of the potential underestimation is not known.

5.9 SUMMARY OF SWMU-SPECIFIC RISK ASSESSMENT RESULTS

Tables 5.9-1 and 5.9-2 summarize the results of the risk assessment for both current- and hypothetical future-residential-use exposures to soil and groundwater at SWMUs 3, 5, 8, 9, 30, and 31. These results indicate the following:

- SWMU 3—The results of the current-use evaluation indicate no potential health threats from exposure to SWMU 3 soil or air COCs. Cancer risks and HIs calculated for all scenarios are all well below respective State of Utah corrective action criteria (Table 5.9-1).

  The cancer risk and HI calculated for future residential-use soil exposure pathways are all less than State of Utah risk criteria. Groundwater exposure risks calculated for SWMU-wide COCs exceed corrective action criteria, assuming future potable use of underlying shallow groundwater (Table 5.9-2).

- SWMU 5—The results of the current-use evaluation indicate no potential health threats from exposure to SWMU 5 soil or air COCs. Cancer risks and HIs calculated for all scenarios—the three SWMU subarea evaluations (for the former pond, ditch/surficial soil, and remaining sample locations) and the downwind demilitarization area receptor—are all well below respective State of Utah corrective action criteria (Table 5.9-1).

  The cancer risk and HI calculated for future residential-use soil exposure pathways exceed State of Utah risk criteria for the former pond subarea only. Risks calculated for the remaining SWMU 5 subareas are all less than corresponding risk criteria. Groundwater-exposure risks also exceed corrective action criteria, assuming future potable use of underlying shallow groundwater (Table 5.9-2).

- SWMU 8—The results of the risk assessment conducted for SWMU 8 indicate no potential health threats associated with exposure to SWMU 8 soil for either current or hypothetical future site uses. Cancer risks and HIs calculated for all exposure scenarios (for both the SWMU-wide and the location-specific evaluations) are all below State of Utah corrective action criteria (Tables 5.9-1 and 5.9-2).

Table 5.9-1 Summary of Risk Assessment Results for Group 2 SWMU Current-Use Exposure Pathways

Evaluation	Receptor	Cancer Risk	Hazard Index	Comment(s)
SWMU 3				
SWMU-Wide	Site EM Personnel (Within SWMU 3)	3×10^{-7}	2×10^{-6}	Cancer risk is less than 10^{-6} and HI is less than 1.0—no further action required.
	Site Security Personnel (SWMU 3 Perimeter)	0	0	No further action required.
Location-Specific: Trenches 1 and 2	Site EM Personnel	3×10^{-10}	7×10^{-5}	No further action required.
	Site Security Personnel	3×10^{-9}	0	No further action required.
SWMU 5				
Location-Specific: Former Pond Subarea	Site EM Personnel	4×10^{-9}	0.0018	Cancer risks and HIs are well below State of Utah respective risk criteria—no further action required.
	Demilitarization Area Workers	2×10^{-7}	1.9×10^{-5}	
Ditch/SS Subarea	Site EM Personnel	2×10^{-9}	2.7×10^{-4}	No further action required.
Remaining Subareas	Site EM Personnel	2×10^{-9}	2.9×10^{-4}	No further action required.
SWMU 8				
SWMU-Wide	Site EM Personnel	2×10^{-12}	9.8×10^{-5}	No further action required.
	Demil. Area (SWMU 31) Workers	1×10^{-9}	3.2×10^{-6}	No further action required.
Location-Specific: West Trench and Drop Tower Areas	Site EM Personnel	4×10^{-11}	2.9×10^{-4}	No further action required.
	Demil. Area (SWMU 31) Workers	2×10^{-8}	6.0×10^{-6}	No further action required.

NA Not Applicable

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Table 5.9-1 Summary of Risk Assessment Results for Group 2 SWMU Current-Use Exposure Pathways

Evaluation	Receptor	Cancer Risk	Hazard Index	Comment(s)
SWMU 9 SWMU-Wide	Site EM Personnel	1×10^{-7}	6.6×10^{-4}	No further action required.
	Area 2 Warehouse Workers	1×10^{-8}	NA	No further action required.
SWMU 30	SWMU 30 risks were quantified for the hypothetical future residential use scenario only because, with the exception of TCLTFE, no surficial soil contamination was identified (see Tables 5.6-3 and 5.6-4).	NA	NA	NA
SWMU 31	Current use risk is conservatively assumed to equal that calculated for the hypothetical future residential use scenario (see Table 5.7-3 for rationale).	$2 \times 10^{-7*}$	0.064*	No further action required. *Current use risk is assumed equivalent to future-use risk (see Tables 5.7-3 and 5.9-2).

NA Not Applicable

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Table 5.9-2 Summary of Risk Assessment Results for Group 2 SWMU Future Residential-Use Pathways[1]

Evaluation	Future-Use Scenario	Cancer Risk	Hazard Index	Comment(s)
SWMU 3				
SWMU-Wide	Soil Exposures	0	0	Cancer risks and HIs exceed risk levels requiring corrective action according to State of Utah rules, assuming future residential use.
	Groundwater Exposures	7×10^{-3}	46	
	Cumulative (Soil+GW) Exposures	7×10^{-3}	46	
Location-Specific: Trenches 1 and 2	Soil Exposures	7×10^{-7}	0.36	No further action required.
	Groundwater (NA)			
SWMU 5				
Location-Specific:				
Former Pond Subarea	Soil Exposures	4×10^{-6}	2.8	Cancer risk is within the range requiring site controls; the HI exceeds the hazard criterion of 1.0.
Ditch/SS Subarea	Soil Exposures	3×10^{-7}	0.36	No further action required.
Remaining Subareas	Soil Exposures	2×10^{-7}	0.29	No further action required.
SWMU-Wide	Groundwater Exposures	2×10^{-4}	5.3	The cancer risk and HI exceed risk levels requiring corrective action, assuming potable use of underlying shallow groundwater under a future residential use scenario.

NA Not Applicable

Table 5.9-2 Summary of Risk Assessment Results for Group 2 SWMU Future Residential-Use Pathways[1]

Evaluation	Future-Use Scenario	Cancer Risk	Hazard Index	Comment(s)
SWMU 8 SWMU-Wide	Soil Exposures	1×10^{-9}	0.07	No further action required.
Location-Specific: West Trench and Drop Tower Areas	Soil Exposures	5×10^{-7}	0.65	No further action required.
SWMU 9 SWMU-Wide	Soil Exposures Groundwater Exposures Cumulative (Soil+GW) Exposures	1×10^{-5} 3×10^{-4} 3×10^{-4}	0.51 5.5 6	The soil exposure cancer risk is below the risk level requiring site controls. The HI is less than the 1.0 HI criterion. The groundwater cancer risk and HI exceed risk levels requiring corrective action, assuming potable use of underlying shallow groundwater under a future residential use scenario.
SWMU 30	Soil Exposures	6×10^{-4}	24	The cancer risk and the HI exceed risk levels requiring corrective action, assuming future residential use of the site.
SWMU 31	Soil Exposures	2×10^{-7}*	0.064*	No further action required. *The future-use risk was conservatively assumed to equal the current-use risk (Table 5.9-1).

NA Not Applicable

- SWMU 9—The results of the current-use evaluation indicate no potential health threats from exposure to SWMU 9 soil or air COCs. Cancer risks and HIs calculated for both scenarios—site EM personnel and the Area 2 Warehouse workers—are all well below respective State of Utah corrective action criteria (Table 5.9-1).

  The cancer risk calculated for soil exposure pathways for the hypothetical future residential-use scenario is within the range of risks requiring site controls, assuming residential use of the site. Groundwater exposure risks exceed corrective action criteria for both cancer and noncancer endpoints, assuming future potable use of underlying shallow groundwater (Table 5.9-2).

- SWMU 30—Elevated concentrations of soil COCs were limited to subsurface depths at SWMU 30 test pit locations; the calculated cancer risk is within the range of risks requiring site controls. The cancer risk and HI calculated assuming hypothetical future residential-use exposures to maximum soil COC concentrations (at test pit locations) both exceed corresponding State of Utah criteria requiring corrective action, assuming future residential use of the site. Of the soil COCs evaluated, only arsenic and lead exceed corresponding RBSLs. As stated previously in this assessment, risks calculated for future-use scenarios should be interpreted in light of the contribution of background levels of arsenic.

- SWMU 31—Soil exposure risks for SWMU 31 were calculated assuming future residential use of SWMU 31; these risks were conservatively assumed to apply to the current-use evaluation as well (Table 5.7-3). The cancer risk and the HI, which were calculated using maximum soil concentrations of copper and 2,4,6-TNT (the only soil COCs identified) and average concentrations air COCs, are both less than corresponding corrective action criteria (Tables 5.9-1 and 5.9-2). Based on the soil and air sampling data collected for the RFI-Phase II, these results indicate negligible potential risks associated with both current- and/or potential future-use exposures to constituents in soil and air at SWMU 31.

The results of all current- and future-use evaluations summarized above are considered conservative given the assumptions used to estimate contaminant doses and human exposures, many of which were worst-case, screening-level estimates. In addition, the results of all future-use risk evaluations should be interpreted in light of the hypothetical nature of the future-use scenario, the extent to which background levels of COCs contribute to the cancer risk and HI estimates, and the caveats identified for the groundwater analytical results (in particular, the metals results). For example, given the high turbidity of groundwater samples at all TEAD-S Group 2 well locations, and the fact that samples were not filtered, the presence of elevated levels of metals suggests that natural conditions (i.e., colloids, suspended particulates, adsorbed metals, etc.) may be responsible for the observed concentrations, not SWMU-related activities.