3.0 SUMMARY OF RISKS

Concurrent with the RI/FS, human health and ecological risk assessments were performed to:

- Determine the extent of metal contamination in environmental media that current or future human and ecological receptors may come in contact with
- Evaluate the potential for human and ecological health risks associated with exposure to those contaminated media, and
- Provide information for risk managers to evaluate the need for remedial action and development of associated clean-up criteria.

Results of the human health risk assessment are summarized in Section 3.1. Results of the ecological risk assessment are summarized in Section 3.2.

3.1 HUMAN HEALTH RISKS

Mining-related metals contamination in the basin has led to concerns about its effect on human health. As a result, numerous studies have been conducted in the basin by federal, state, and local agencies. These studies, along with the health-related programs currently conducted in the basin, are summarized below.

3.1.1 Basin-Wide Health Responses and Related Activities

In addition to the studies and mitigation responses conducted at the Bunker Hill area, several other human health studies that expanded into the larger basin area have been conducted in the past decade. These human health studies include:

- A residential sampling effort undertaken in the summer of 1996 by the Idaho Department of Health and Welfare (IDHW 1997)
- Two health consultations by the Agency for Toxic Substances and Disease Registry (ATSDR) (ATSDR 1998; 2000)
- Several Panhandle Health District (PHD) lead health surveys (Von Lindern 2000; PHD 1992, 1997)

- Four residential EPA surveys conducted as part of the current basin-wide RI/FS under field sampling plan addenda FSPA06, FSPA07, FSPA12, and FSPA16 (URSG and CH2M HILL 1998, 1999a, 1999b, and 2000d)

- Sampling of school yards and daycare facilities conducted to support the human health risk assessment/removal actions under field sampling plan addendum FSPA13 (URSG and CH2M HILL 1999c)

- Multiple special studies conducted for the Natural Resource Damage Assessment (NRDA)

The IDHW study characterized environmental contamination and biological indices from 843 homes in the basin. The three EPA studies sampled 123 homes in the basin and collected additional voluntary information from residents during the period of 1997 to 2000. IDHW and PHD in the upper and lower basin have provided fixed-site blood lead screening over the last 3 years.

3.1.2 Ongoing Basin-Wide Human Health Programs

Two programs that address human health issues are currently being conducted in the Basin. The first is the Lead Health Intervention Program run by the PHD. This program provides personal health and hygiene information to help mitigate exposure to contaminants. Services include educational programs, health monitoring programs, yard and home sampling, and nursing follow-up services.

The second ongoing program is the Institutional Controls Program (ICP) currently conducted in the BHSS, also run by the PHD. The ICP ensures that remedial technologies retain their integrity and effectiveness and are not compromised by future actions.

3.1.3 Summary of Blood Lead Screening Surveys

Numerous blood lead screening surveys have been conducted in the basin, and specifically within the BHSS to evaluate the level of lead in residents' blood. The United States Centers for Disease Control (CDC) has determined that blood lead levels greater than 10 micrograms per deciliter (µg/dL) present an undue risk of damaging health effects. For guidance, the CDC has developed the following general policies and activities related to lead poisoning prevention.

- Lead levels less than 10 µg/dL require no additional action unless exposure sources change. Recommend rescreening in 1 year.

- Lead levels in the 10-14 µg/dL range indicate exposure in a community. Recommend family lead education and follow-up testing.

- Levels of 15-19 µg/dL indicate lead adsorption and require educational and nutritional intervention and more frequent screening.

- Levels of 20-44 µg/dL require medical and environmental intervention and perhaps chelation.

- Levels of 45 µg/dL or higher require environmental and medical intervention with chelation therapy.

Blood lead levels have been monitored in the populated areas of the BHSS since 1974. The available data are presented chronologically in Figure 3.1-1. These data record declines in arithmetic mean blood lead levels of nearly 70 µg/dL in certain populated areas of the BHSS to less than 10 µg/dL over approximately 25 years of blood lead health intervention and remedial activities (Von Lindern 2000). As shown, since the inception of remedial activities in 1989, blood lead levels have decreased by 70 percent in Smelterville (from 14.2 to 4.3 µg/dL), 58 percent in Kellogg (from10.8 to 4.5 µg/dL), 55 percent in Wardner (from 11.8 to 5.4 µg/dL), 67 percent in Page (12.5 to 4.1 µg/dL), and 33 percent in Pinehurst (7.4 to 5.0 µg/dL).

Figure 3.1-2 shows the decline in the percentage of children in the BHSS whose blood levels were above 10 µg/dL. This figure shows the clear relationship between yard remediation, which began in 1989, and decreasing blood lead in children. It also shows that the soil and source material RAO (95 percent of children with blood lead below 10 µg/dL) was achieved in the BHSS by 1999.

The declining blood lead levels that have occurred in the BHSS provide validation to the human health remedies implemented, namely, health education and intervention programs, vacuum loan programs, and residential and common use soil removal and replacement actions. The successful declining blood lead results achieved at the BHSS provide valuable lessons for future human health actions outside the area.

The results of additional state and local public health surveys conducted in the basin (outside the BHSS) since 1996 indicate excessive levels of lead absorption in children with little problem identified among adults (although specific data are not available for pregnant women). Table 3.1-1, taken from the human health risk assessment (TerraGraphics and URSG 2001), summarizes the blood lead levels measured in these surveys for 9-month-old to 9-year-old children. As shown, the highest blood lead levels were observed in the Burke/Ninemile area, where 21 percent exceeded 10 µg/dL, 13 percent exceeded 15 µg/dL, and 4 percent exceeded

20 µg/dL. The next highest blood lead levels were reported in the lower basin area; however, there were no children in this area observed with blood lead levels above 15 µg/dL.

Site-specific analysis of blood lead data paired with environmental lead data suggests complex exposure pathways. Blood lead levels appear to be most closely related to lead in house dust, followed by independent effects of lead in yard soil, the condition of interior lead-based paint, and the lead content of exterior paint (TerraGraphics and URSG 2001). High blood lead levels in the lower basin have been associated with homes that were flooded in 1996, and recreational activities outside the home (TerraGraphics and URSG 2001).

3.1.4 Human Health Risk Assessment

In the human health risk assessment, major population groups were quantitatively evaluated for a variety of exposure pathways, media, contaminants, and geographical areas. The receptors and pathways that were evaluated fall into the following five exposure scenarios:

- Residential—evaluated for children and adults who live in the basin. This evaluation was conducted for a variety of pathways with potential exposure to affected media in the home, in the yard and community, and from homegrown vegetables. In addition, a potential future drinking water evaluation for shallow groundwater in the Burke/Ninemile area was performed.

- Neighborhood recreational—evaluated, in addition to the residential scenario, for incremental exposures for children at play in neighborhood creeks and waste piles.

- Public recreational—evaluated for children and adults who use developed parks and playgrounds, and undeveloped recreational areas whether they are residents or visitors. Exposure scenarios included the incidental ingestion of surface water and the ingestion of fish by sport fishermen.

- Occupational—evaluated for adult construction workers.

- Subsistence—evaluated for children and adults who have potential future traditional or modern subsistence lifestyles.

These scenarios and exposure pathways are fully described in Section 8 of the human health risk assessment (TerraGraphics and URSG 2001). The risks of the presence of lead and non-lead metals were evaluated separately for each of the scenarios as summarized in the following sections.

3.1.5 Lead Risk Summary

The approach to human health risk assessment for lead differs from that of other metals in several ways. Among the important considerations are the nature of the health effects, the behavior of lead in the body, measurements of biological effects, indices of risk, how risks are quantified, availability of data, and the relationships between absorption levels and environmental media. These considerations are described in detail in Section 6 of the human health risk assessment.

As discussed previously, lead health surveys conducted in the basin area by State and local health authorities have noted excessive levels of blood lead in children, with only minor problems among adults. The human health risk assessment explained the contributions that the various exposure pathways and media made to the lead risk by showing the percentages that each pathway or medium would contribute to the average child's exposure. Figure 3.1-3 shows the percentage of lead that an average child would receive from each of the lead sources if all the information in the entire basin were combined. However, this "average child" does not actually exist, and exposures for individual children would be determined by the characteristics of their yard and that child's activities. For example, a child's exposure would vary depending on whether he or she ate homegrown vegetables, or the amount of time he or she spent in the home or playing outside. If a child were to play on waste piles, his or her exposure to lead would depend on how long he or she played on the pile, the pile's concentration of lead, and the bioavailability of the lead. To account for the variations among children, the human health risk assessment attempted to estimate the reasonable maximum time a child would engage in each activity. As shown in Figure 3.1-3, the home is the largest contributor to lead exposures for the average child, (at least 50 percent) even if a child receives lead from all other sources in the basin. Thus, the human health risk assessment focused primarily on lead contamination in the media of concern, especially around the home.

Considering the home exposure to be the primary single contributor to the residential lead risk within the basin, Figure 3.1-4 shows a further breakdown of lead exposure within the home, again based on basin-wide averages. This figure indicates that house dust is the major source of home lead exposure, contributing 56 percent, followed by outdoor soil, which accounts for 31 percent of lead exposure in the home. House dust lead concentrations include all sources of lead, such as interior paint, as well as lead dust from yard and community soils. Air, drinking water, and typical diet contribute comparatively little to lead exposure in the home.

3.1.6 Non-Lead Metals Risk Summary

For non-lead metals, the human health risk assessment considered two levels of contaminant intake, referred to as the central tendency (CT) and the reasonable maximum exposure (RME).

The CT estimate is the most typical amount of contaminant a member of the population can consume, while the RME represents the maximum intake that can reasonably be expected.

Health risks for chemicals that cause cancer are calculated differently than those chemicals that cause non-cancer health effects. For non-cancer risks, if a person is exposed to a chemical dose equal to or less than the "threshold," no adverse effects are expected. The "hazard quotient" for a chemical is the chemical dose from the site divided by the threshold dose. If the hazard quotient is less than 1, then no adverse effects are anticipated. Cancer risks are calculated assuming that the presence of carcinogens, at any dose, contribute to risk. Risk indices are presented as a probability of developing cancer. A cancer risk level of 1×10^{-6} is equivalent to one person in a million developing cancer. The EPA uses the general risk range of 1×10^{-4} to 1×10^{-6} as a "target range" within which they try to manage risks as part of a Superfund cleanup.

The results of the risk characterization for non-lead metals reported in the human health risk assessment indicate that some exposure areas could pose an unacceptable threat of non-cancer effects for some individuals and exposure media under the RME condition. These include:

- Young children exposed to arsenic in yard soil in the lower basin, the side gulches, Osburn, Mullan, and Burke/Ninemile
- Young children exposed to iron in yard soil in the lower basin
- Children/adults exposed to arsenic in yard soil and tap water in the side gulches
- Young children and children/adults who could ingest cadmium and zinc in groundwater in Burke/Ninemile in the future (groundwater at Burke/Ninemile is not currently used as a drinking water source)
- Young children and children/adults ingesting cadmium in homegrown vegetables
- All residents and pathways for subsistence lifestyles

A summary of the non-lead metal pathway/exposure scenarios which exceed the target risk goals is presented in Table 3.1-2.

Cancer risk estimates exceeded 1×10^{-6} for all individuals in all exposure areas under the RME condition. Most areas also had cancer risk estimates exceeding 1×10^{-6} for all individuals under the CT condition. Only one scenario (RME condition for residents in the Side Gulches) had a cancer risk exceeding 1×10^{-4}. For the four residential areas with the highest cancer risks

(Lower Basin, Side Gulches, Osburn, and Burke/Ninemile), the incremental increase in risk over that due to background concentrations is approximately 7 x 10^{-5} for soil exposures.

Arsenic is the only carcinogenic COPC evaluated at the site. For residential scenarios, yard surface soil contributed the most to cancer risk. For residents in the Side Gulches, tap water also contributed significantly to cancer risk. Although tap water was not the primary contributor to cancer risk for residential scenarios, RME cancer risk estimates for tap water exceeded 1 x 10^{-6} in all exposure areas. This risk is almost entirely due to high concentrations of arsenic in a relatively small number of private wells. For the Burke/Ninemile future residential scenario, groundwater contributed nearly all of the cancer risk. Depending on the exposure area, one or more of various media (upland surface soil, soil/sediment, sediment, or waste piles) contributed the most to cancer risk for recreational visitors. Although surface water was never the primary contributor to cancer risk, RME cancer risk estimates for "disturbed" surface water (surface water samples containing sediment because of disturbance by the sampler) exceeded 1 x 10^{-6} for recreational scenarios in several exposure areas. Surface/subsurface soil contributed all of the cancer risk for construction workers.

None of the metals evaluated in fish tissues represent a health risk for sport anglers. For a traditional subsistence ingestion scenario, health risk goals were exceeded for both perch and northern pike. Available data on metals concentrations in fillets and whole fish are limited, and additional data are needed to fully evaluate risks associated with fish consumption.

Surface soil and sediment contributed the most to hazards and cancer risks for the subsistence scenarios. The current subsistence scenario had similar hazards to those found for the highest residential child exposures. Cancer risks were higher for the current subsistence scenario, but close to those for the highest residential exposures. Hazards and risks for the traditional subsistence scenario were an order of magnitude higher than those for the residential scenario. For the current subsistence scenario, arsenic and iron were the only chemicals with hazard quotients greater than 1, similar to residential hazards. For the traditional scenario, mercury in fish, manganese in soil and sediment, and cadmium in water potatoes also had hazard quotients greater than 1 in addition to arsenic and iron. Hazards from mercury in fish are likely underestimated for subsistence tribal members because they eat the whole fish, not just fillets.

Combinations of the exposure scenarios described above (e.g., child/adult residential plus neighborhood recreational) would result in hazard/risk estimates that are higher than those discussed in this summary. However, combining the risk and hazard numerical results from the scenarios probably overestimates the total numerical hazard/risk for actual residents. For example, child/adult residents are assumed to spend 24 hours per day, 350 days per year at the residence. Assuming that they also regularly spend several hours per day at a neighborhood or public recreational area or are occupationally exposed results in "double counting" (exposure for more than 24 hours per day), which will overestimate hazard/risk. However, it is clear that many of these additional exposure pathways could result in higher total risks than those shown for residential individuals.

3.2 ECOLOGICAL RISKS

The ecological risk assessment (URSG and CH2M HILL 2001b) evaluated risks for aquatic and terrestrial organisms potentially exposed to toxic metals associated with mining-related activities, and additional adverse effects from the secondary effects of toxic metals on the physical and biological ecosystem characteristics. Table 3.2-1 summarizes the chemicals of potential ecological concern in each medium. The ecological risk assessment study area includes the South Fork Coeur d'Alene River and its tributary watersheds, the North Fork Coeur d'Alene River below Prichard, and the Beaver Creek and Prichard Creek tributary watersheds (CSM Units 1 and 2); the main stem and lower Coeur d'Alene River from the confluence of the North Fork and South Fork to its terminus in Coeur d'Alene Lake at Harrison (CSM Unit 3); Coeur d'Alene Lake (CSM Unit 4); and the Spokane River downstream to the Washington State Highway 25 bridge on the Spokane Arm of Lake Roosevelt (CSM Unit 5).

In this section, a summary of the ecological risk assessment is provided. This summary includes a synopsis of the identified risks to ecological assessment endpoints and representative ecological receptors in the Coeur d'Alene Basin from (1) the direct impacts of metals and (2) the secondary effects of metals on landscape characteristics (physical habitat structure and ecological functions).

Assessment endpoints include plants, animals, and ecological functions. Representative ecological receptors for these assessment endpoints include specific plant or animal species, or ecological functions that are representative of the endpoint. Direct impacts include the toxic effects of metals on assessment endpoints. Secondary effects include the physical degradation of habitats and ecosystem functions resulting from direct impacts on assessment endpoints (e.g., the toxic effects of metals on riparian plants). Secondary effects on receptors were determined by rating conditions in mining-affected areas against conditions in reference areas exposed to similar ecological stressors minus the influence of mining. Adverse secondary effects on receptors due to metals were inferred from available literature on the effects of habitat degradation.

The remainder of this section is organized as follows:

- Section 3.2.1—assessment endpoints, ecological receptors, and representative species are introduced.

- Section 3.2.2—a summary of the general findings of the risk assessment, and specific conclusions for each assessment endpoint category are provided.

Preliminary remediation goals (PRGs) have been developed based on the findings of the ecological risk assessment. PRGs are discussed in detail in Section 2.3 of the FS Part 3.

3.2.1 Assessment Endpoints and Representative Ecological Receptors

Four levels of assessment endpoints were developed for the ecological risk assessment:

- **Individual level endpoints.** Used for migratory birds and threatened or endangered species

- **Population level endpoints.** Used for fish, amphibians, non-migratory birds, mammals, and special-status plants (e.g., listed as species of concern at the state level)

- **Community level endpoints.** Used for aquatic and terrestrial plant communities and aquatic macroinvertebrate communities that are characteristic of natural habitats in the region

- **Habitat, ecosystem, and landscape level endpoints (landscape level).** Representing soil invertebrates and microbial processes, nutrient cycling, and other ecosystem processes necessary to support plants and animals at higher levels; and landscape characteristics, physical and biological attributes (e.g., spawning habitat) necessary for sustaining plant and animal communities

Categories of ecological receptors, and representative species evaluated in the ecological risk assessment are presented in Table 1.5-18 of the FS Part 3 by assessment endpoint level, and habitat type by CSM unit.

3.2.2 Summary of Ecological Risks and Conclusions

The following general conclusions were drawn in the ecological risk assessment:

- While some data gaps exist, a large volume of data regarding the impacts of mining-related metal hazardous substances is available for the Coeur d'Alene Basin. These data are sufficient to demonstrate the magnitude of impacts to the ecosystem.

- High concentrations of metals are pervasive in soil, sediment, and surface water in the basin, posing substantial risks to the plants and animals inhabiting basin habitats.

- Metals, principally cadmium, lead, and zinc, present significant risks to most ecological receptors throughout the basin. Few species examined had no identifiable risks.

- Confidence in most risk conclusions is high due to the availability of multiple lines of evidence for all assessment endpoints.

Specific results of the ecological risk assessment are presented below, organized by assessment endpoint. These results are summarized in Table 1.5-19 of the FS Part 3.

3.2.3 Birds

Up to five lines of evidence were available to evaluate direct risks to birds from metals in the Coeur d'Alene Basin: (1) single-chemical external exposure, (2) single-chemical internal exposure—blood, (3) single-chemical internal exposure—liver or kidney, (4) ambient media toxicity tests, and (5) biological surveys. Findings of particular note:

- Risks to health and survival were identified for all 24 avian receptor species in at least one area of the basin.

- Lead, zinc, and cadmium posed the greatest risks to birds, and severe lead poisoning impacts have been documented in several species of waterfowl in the lateral lakes area.

- Risks from these metals are spatially widespread, and are present for at least half of the avian receptors in the basin.

- High to extreme risks were identified for several bird species throughout CSM Units 1, 2, and 3. Moderate to extreme risks were also identified for some bird species in CSM Unit 5.

- The greatest estimated risks were for spotted sandpipers feeding in lead contaminated sediments in CSM Unit 1, where exposure concentrations exceeded the lowest observed effects level by 1,300 times.

- Risks from arsenic, copper, and mercury were comparatively low.

3.2.4 Mammals

Up to two of three lines of evidence were available to evaluate risks to mammalian receptors: (1) single-chemical external exposure, (2) single-chemical internal exposure—liver or kidney, and (3) biological surveys. Risks to health and survival from at least one metal were identified for all 18 receptor species. Findings of particular note:

- While risks to birds were dominated by specific metals (i.e., lead, cadmium, and zinc), no single metal stands out as a dominant risk driver for mammals.
- Zinc, mercury, and lead were the most common risk drivers, however, arsenic, cadmium, and copper were also found to commonly present risks.
- Risks from zinc were the most spatially widespread, while risks from copper and lead were less widespread

3.2.5 Fish and Other Aquatic Organisms

Several lines of evidence were examined to identify risks to fish, macroinvertebrates, and aquatic plants. The following conclusions on risks to aquatic receptors have been drawn:

- For aquatic receptors (fish, invertebrates, and plants), exposure to metals has been confirmed by tissue analysis for many areas of the basin. Metals concentrations in surface waters often exceed levels lethal to some aquatic life in most watersheds in CSM Units 1 and 2, and are high enough to substantially limit growth and reproduction of surviving aquatic life in all CSM units and most CSM segments.
- Measured concentrations of metals in surface waters from lower Canyon Creek, lower Ninemile Creek, lower Pine Creek, and the South Fork Coeur d'Alene River from Canyon Creek to the confluence with the North Fork Coeur d'Alene River have exceeded levels known to be lethal to some aquatic organisms.
- Site specific toxicity testing and/or biological surveys indicate lethal effects or reduced populations of aquatic organisms in lower Canyon Creek, lower Ninemile Creek, lower Pine Creek, and the South Fork Coeur d'Alene River from Canyon Creek to the confluence with the North Fork. Growth and reproduction of surviving organisms are likely to be substantially reduced.

- Concentrations of metals in water exceed chronic ambient water quality criteria downstream of metals source areas at virtually all assessment sites. Concentrations often exceed 10x or even 100x these screening criteria, indicating a strong likelihood of adverse effects in these areas.

- Studies of fish populations in the Spokane River indicate impaired survival and reproduction from metals concentrations in surface waters. These concentrations are lower than those present in CSM Units 1 and 2, often by an order of magnitude or more.

- Toxic effects on aquatic receptors from contaminated sediments are believed likely but could not be definitively assessed.

- Areas where adverse toxic effects are believed to exist include Big Creek Segment 4, Canyon Creek, Ninemile Creek, Pine Creek, Prichard Creek Segment 3, the entire South Fork, the Coeur d'Alene River, the Spokane River, and possibly some parts of Coeur d'Alene Lake.

- Physical degradation of habitats and ecosystem functions from secondary impacts of metals and other human impacts adversely affect the survival and reproduction of aquatic organisms in some portions of the Coeur d'Alene Basin.

3.2.6 Amphibians

Up to three lines of evidence (single-chemical toxicity data, ambient media toxicity tests, and biological surveys) indicate risks to health and survival from cadmium, copper, lead, and zinc exposure (individually or in combination) for the four species of frogs and salamanders examined throughout much of CSM Units 1, 2, and 3. The following conclusions have been drawn:

- Risks to health and survival were identified for three of four amphibian species examined from cadmium, copper, lead, or zinc exposure (singly or in combination).

- All three receptors for which risks were identified are special status species (spotted frogs, Idaho giant salamanders, and Coeur d'Alene salamanders). The special status salamander species do not occur in CSM Units 3, 4, or 5.

- Risks were present throughout CSM Units 1 and 2, and portions of CSM Unit 3.

3.2.7 Terrestrial Plants

Up to three lines of evidence (single-chemical toxicity data, ambient media toxicity tests, and biological surveys) were available to evaluate risks to terrestrial plants in the Coeur d'Alene Basin. These sampling locations are all from riparian and floodplain areas. The following conclusions have been drawn:

- All soil samples evaluated for risks to terrestrial plants were found to contain concentrations of metals that ranged from mildly to severely phytotoxic.
- Arsenic, cadmium, lead, and zinc occur at levels that pose risks to Ute ladies'-tresses, a flowering plant federally listed as a threatened species throughout CSM Units 1, 2, 3, and 5. The presence of this species in the basin has not been definitively confirmed; however, risks were evaluated because of the presence of suitable habitat.
- Those four metals, as well as copper, contribute to population and community-level risks to other terrestrial plants throughout the Coeur d'Alene Basin. Selected plant populations may face significant risks.
- The most severe toxicity and greatest risks to health and survival are present in Canyon and Ninemile Creeks in CSM Unit 1.
- The lowest risks identified are present in the Upper South Fork watershed in CSM Unit 1, and in some areas of CSM Unit 2.
- Risks to plants in CSM Unit 3 are variable depending on location, but are generally high to severe.
- Areas where phytotoxic concentrations of metals exist in riparian zone soil and sediment are strongly correlated with degraded vegetation conditions.

3.2.8 Soil Invertebrates and Soil Processes

Single-chemical toxicity data were used to evaluate risks to soil invertebrates. The following conclusions have been drawn:

- Cadmium, lead, and zinc were found to present risks to soil invertebrates throughout most assessment areas in CSM Units 1, 2, 3, and 5.

- Copper and arsenic were also found to present risk to soil invertebrates in some areas in CSM Units 1, 2, and 3.
- Lead and zinc present risks to soil microbial processes throughout CSM Units 1, 2, and 3.
- Cadmium presents risks to soil processes in most of CSM Unit 3, and copper presents risks in portions of CSM Units 1 and 3.

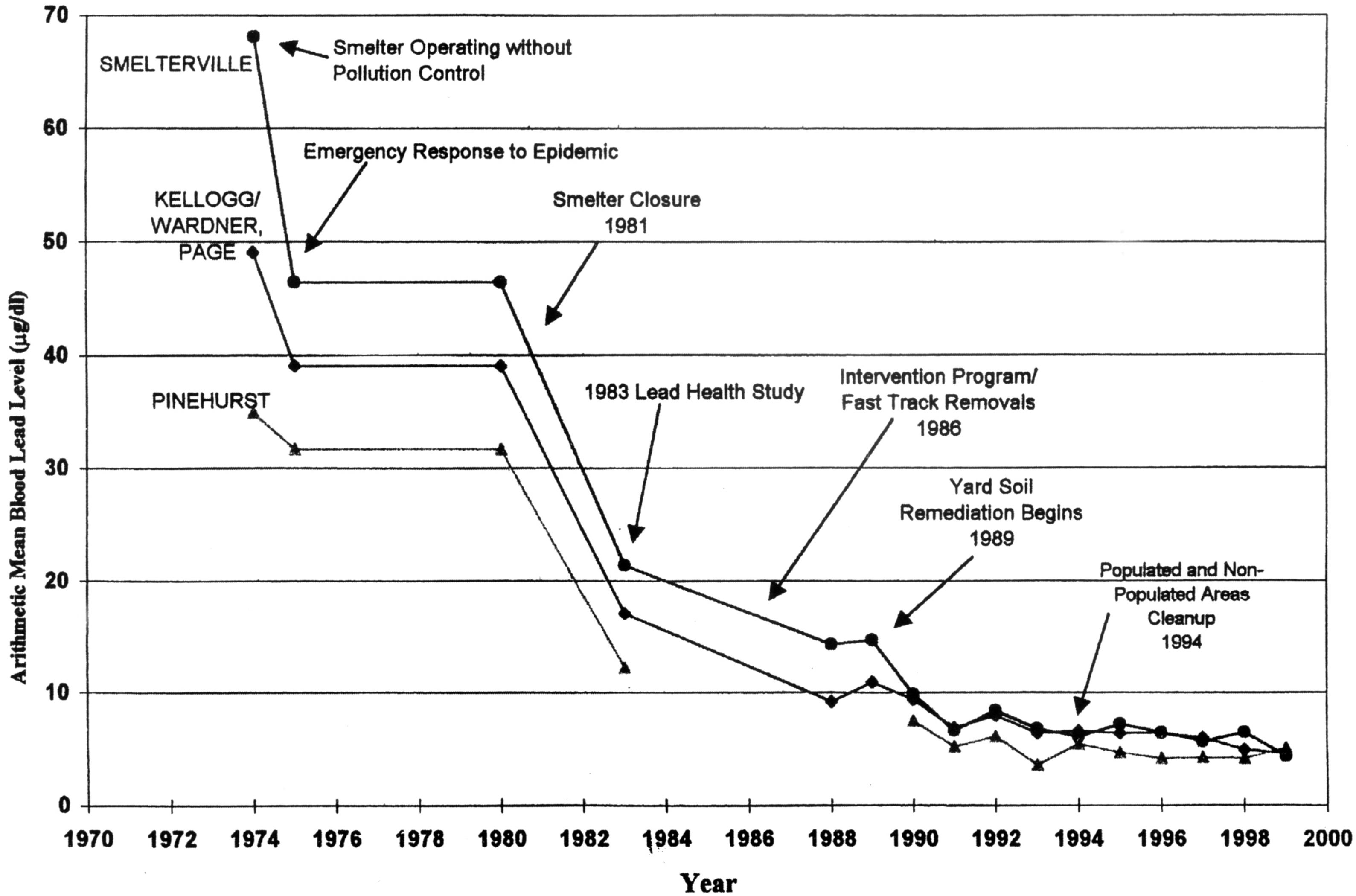
3.2.9 Physical and Biological Characteristics

Secondary effects of metals on landscape characteristics were identified throughout CSM Units 1, 2, and 3. These secondary effects are additional stressors on the receptors identified above, through direct physical effects (e.g., high stream temperatures) or loss of habitat. The following conclusions have been drawn:

- Riparian habitat structure has been degraded by phytotoxic effects, resulting in a reduction in the quantity and quality of habitats available for riparian dependent species.
- Degraded bank stability and increased erosion, changes in the composition and mobility of stream substrates, and increased water temperatures, with the potential for adverse effects ranging from low to high were identified throughout the South Fork Coeur d'Alene River and its tributaries.
- The above effects are spatially correlated with phytotoxic levels of metals in riparian soil and sediment.
- The spatial distribution and connectivity of riparian and aquatic habitats throughout CSM Units 1 and 2 are fragmented, which contributes to adverse effects on aquatic and terrestrial species.
- Elevated levels of suspended solids due to increased erosion rates may contribute to adverse effects on aquatic organisms in the lower Coeur d'Alene River (CSM Unit 3).
- Elevated sediment deposition rates in the lateral lakes (CSM Unit 3) and in Coeur d'Alene Lake (CSM Unit 4), particularly near the mouth of Coeur d'Alene River, may contribute to adverse effects on aquatic organisms through smothering and habitat alteration. These effects diminish with distance from the river mouth. No

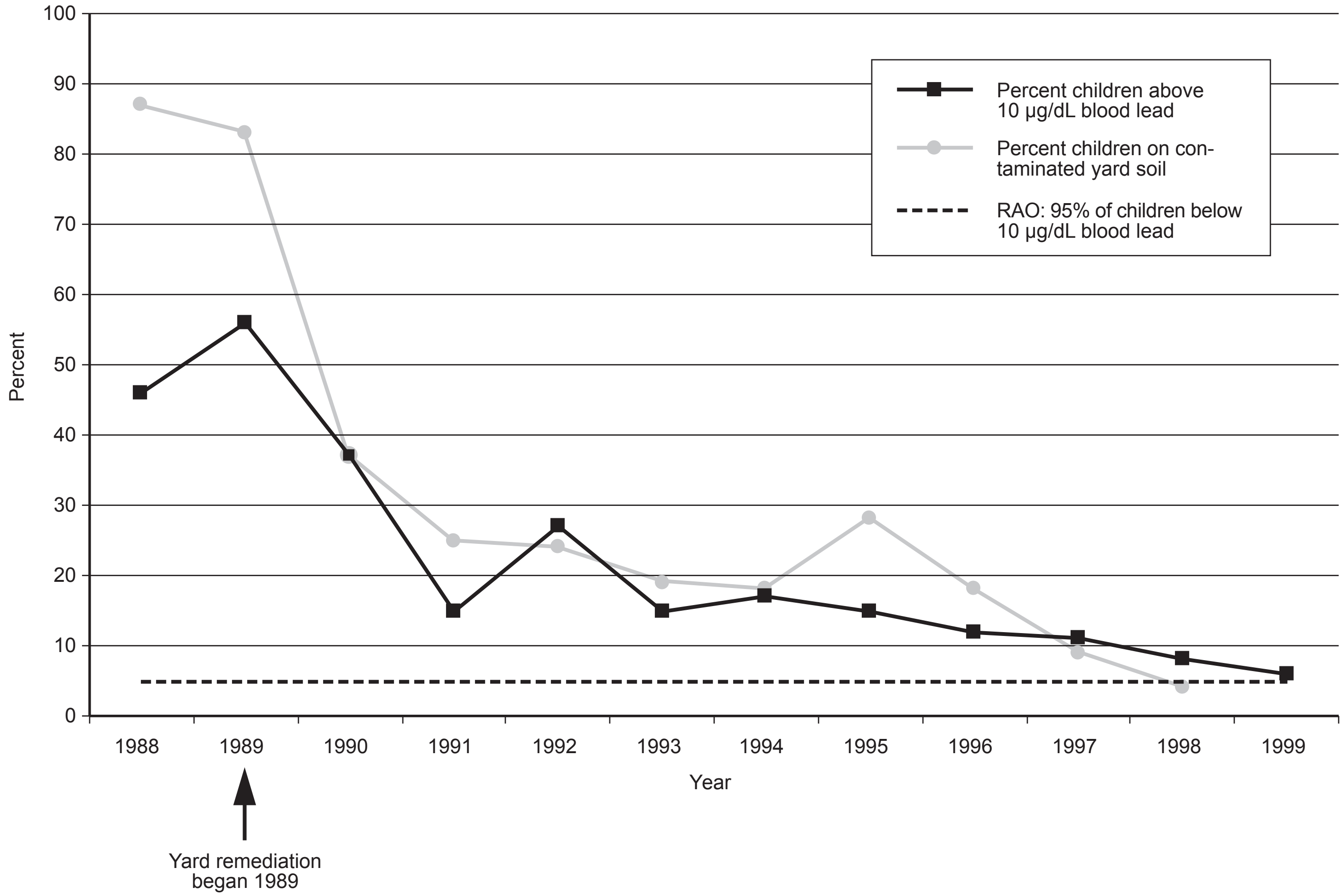
adverse effects are identified in the remainder of Coeur d'Alene Lake or the Spokane River.

It is recognized that several non-mining-related physical stressors are also present in the basin, which contribute to ecological degradation. It is not possible to determine the degree to which these other factors are responsible for degraded conditions, which creates uncertainty in analyzing the secondary effects of metals on physical and biological ecosystem characteristics. However, it is recognized that mining-related impacts have contributed substantially to the degraded conditions present in the basin.



NOTE:
Taken from Figure 4-1, Final 1999 Five Year Review Report, Bunker Hill Superfund Site, prepared by TerraGraphics Environmental Engineering, April 2000.

EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS FINAL FS PART 1	Doc. Control: 4162500.6659.05.a Generation: 1 FS-603 91601	**Figure 3.1-1** **Children's Blood Lead Levels by Year, 1974 - 1999**



NOTE: Data from Final Five Year Review Report, Bunker Hill Superfund Site, TerraGraphics Environmental Engineering, April 2000

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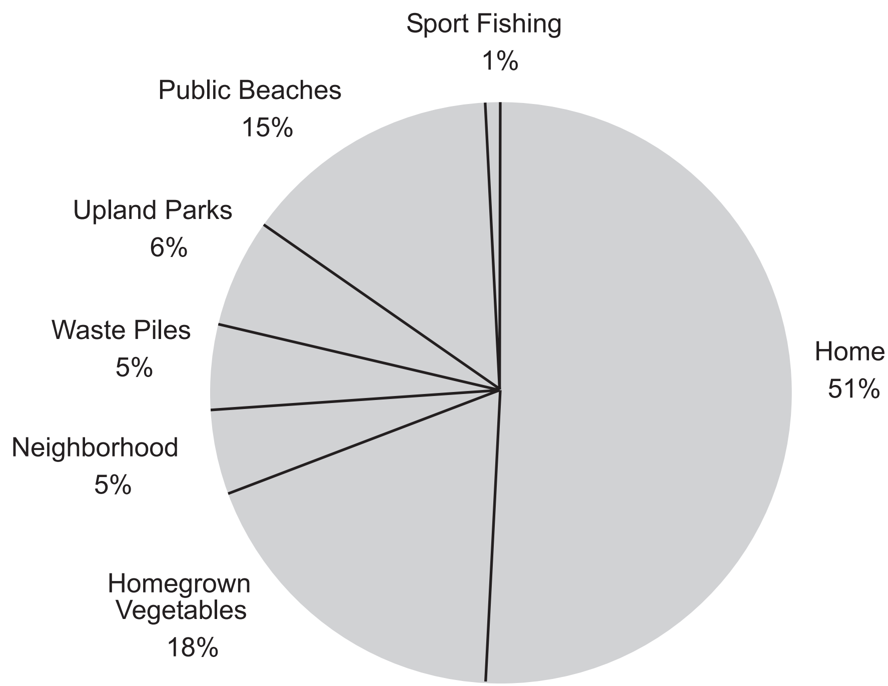
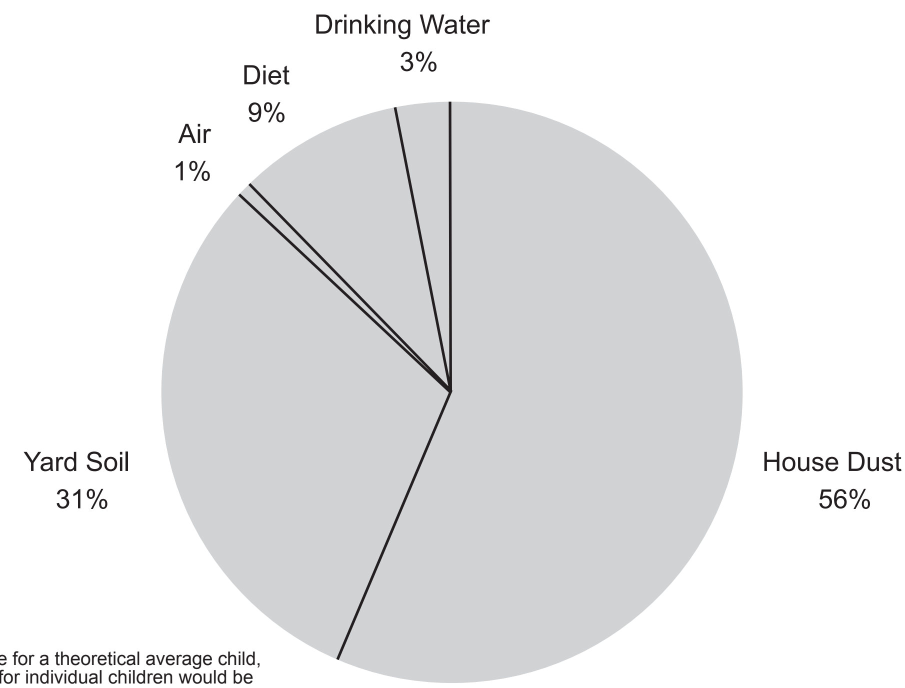
Figure 3.1-2
Trends in Children's Blood Lead and Children with Contaminated Yards, Bunker Hill, 1988-1999



NOTE: Percentages are for a theoretical average child, and exposures for individual children would be determined by the characteristics of their yard and that child's activities. Data were compiled from the Human Health Risk Assessment, TerraGraphics, 2000.

Figure 3.1-3
Average Child's Basin-Wide Lead Exposure



NOTE: Percentages are for a theoretical average child, and exposures for individual children would be determined by the characteristics of their yard and that child's activities. Data were compiled from the Human Health Risk Assessment, TerraGraphics, 2000.

Figure 3.1-4
Average Child's Home Lead Exposure

Table 3.1-1
Children's Blood Lead Levels in the Coeur d'Alene Basin, 1996-1999

Area	Percent Exceeding 10 µg/dL	Percent Exceeding 15 µg/dL	Percent Exceeding 20 µg/dL
Mullan	11	0	0
Burke/Nine Mile	21	13	4
Wallace	13	5	1
Silverton	8	4	1
Osburn	4	0	0
Side Gulches	4	2	--
Kingston	11	7	--
Lower Basin/Cataldo	18	5	0

Notes:
"Percent Exceeding" refers to percent of children surveyed ages 9 months to 9 years whose blood lead level exceeded the levels listed.

Source: TerraGraphics and URSG 2001

Table 3.1-2

Reasonable Maximum Exposure Risk from Non-Lead Metals[a]

RME HAZARD INDEX EXCEEDS 1[b]

Receptor/Pathway/Contaminant/Medium	RME HI[c]
Residential Scenario[b]	
Young children exposed to arsenic in yard soil, Lower Basin, Osburn, Mullan, Burke/Ninemile	1
Young children exposed to iron in yard soil, Side Gulches, Kingston, Osburn, Mullan, Burke/Ninemile	1
Young children exposed to iron in yard soil, Lower Basin	2
Young children exposed to arsenic in yard soil and tap water, Side Gulches	3
Children/adults exposed to arsenic in yard soil and tap water, Side Gulches	1
Young children ingesting cadmium in potential future groundwater used as drinking water, Burke/Ninemile	17
Young children ingesting zinc in potential future groundwater used as drinking water, Burke/Ninemile	4
Children/adults ingesting cadmium in potential future groundwater used as drinking water, Burke/Ninemile	9
Children/adults ingesting zinc in potential future groundwater used as drinking water, Burke/Ninemile	2
Young children ingesting cadmium in homegrown vegetables, all areas	2
Children/adults ingesting cadmium in homegrown vegetables, all areas	2
Subsistence Scenario[d,e]	
Children, all pathways, potential future modern subsistence lifestyles, any area	9
Children/adults, all pathways, potential future modern subsistence lifestyles, any area	4
Adults, all pathways, potential future modern subsistence lifestyles, any area	3
Children, all pathways, potential future traditional subsistence lifestyles, any area	43
Children/adults, all pathways, potential future traditional subsistence lifestyles, any area	19
Adults, all pathways, potential future traditional subsistence lifestyles, any area	10

RME CANCER RISK EXCEEDS 1 X 10^{-4} (Arsenic is the only carcinogenic COPC)

Receptor/Pathway/Medium	RME CR
Residential Scenario[b]	
Children/adults exposed to arsenic in yard soil and tap water, Side Gulches	3×10^{-4}
Modern Subsistence Scenario (potential future)[d]	
Total (any area, child/adult)	7×10^{-4}
Child/adult, dermal exposure to sediment	2×10^{-4}
Child/adult, ingestion of undisturbed surface water	2×10^{-4}
Traditional Subsistence Scenario (potential future)[e]	
Total (any area, child/adult)	3×10^{-3}
Child/adult, dermal exposure to surface soil	2×10^{-4}
Child/adult, incidental ingestion of surface soil	6×10^{-4}
Child/adult, dermal exposure to sediment	7×10^{-4}
Child/adult, incidental ingestion of sediment	6×10^{-4}
Child/adult, ingestion of undisturbed surface water	1×10^{-3}

[a] From TerraGraphics and URSG (2001), pages 5-11 and 5-12.
[b] From TerraGraphics and URSG (2001), Table 5-1.
[c] HI = hazard index (greater than 1 = adverse health effects expected).
[d] From TerraGraphics and URSG (2001), Table 5-4.
[e] From TerraGraphics and URSG (2001), Table 5-5.

COPC - chemical of potential concern
CR - cancer risk
RME - reasonable maximum exposure

Table 3.2-1
Selected Chemicals of Potential Ecological Concern in Each Medium

Chemical	Sediment	Soil	Surface Water
Arsenic	●	●	
Cadmium	●	●	●
Copper	●	●	●
Lead	●	●	●
Mercury	●		
Silver	●		
Zinc	●	●	●