1.0 INTRODUCTION

This Engineering Evaluation and Cost Analysis (EE/CA) addresses contamination within the approximately 71.5-mile long right-of-way (ROW) for the main line track and related sidings of Union Pacific Railroad's (UPRR) Wallace-Mullan Branch, which extends across the panhandle of northern Idaho. The purpose of the EE/CA is to evaluate alternatives for the purpose of selecting an appropriate response action to address contamination of portions of the ROW with Mine Waste found at various locations along the ROW. For purposes of this EE/CA the term "Mine Waste" includes jig and flotation tailings, waste rock, concentrates and ores all of which are derived from mining activities.

Contamination with Mine Waste is the primary human health and environmental concern within the ROW. The Mine Waste contains elevated concentrations of lead and other heavy metals, and is present within the ballast portion of the track structure. Fluvially deposited tailings, a component of Mine Waste, are also pervasive within the sediments of the South Fork and the main stem of the Coeur d'Alene River (CDR) flood plain, including portions of the ROW. To mitigate the potential human health and environmental issues associated with the rail line after salvage of the track structure, it will be necessary to implement varying combinations of actions that will form a comprehensive response action for the ROW.

This EE/CA addresses the main line and related sidings of the Wallace-Mullan Branch ROW. The 7.9 mile section of the ROW within the Bunker Hill Superfund Site (BHSS) has been addressed as part of the BHSS Record of Decision (ROD) (EPA, 1992) and is excluded from this EE/CA. The response action does not address: any spurs or connecting branch lines outside of the Wallace-Mullan ROW; non-siding areas of the Wallace Yard outside a 26-foot-wide corridor bracketing the main line; and areas of the Hecla Mine tailings impoundment and the Morning Mine Rock Dump that may encroach on the ROW. These areas will be addressed within the Bunker Hill Basin Wide Remedial Investigation/Feasibility Study (RI/FS) and/or other response actions.

The response actions described in this EE/CA will be conducted pursuant to the Comprehensive Environmental Response, Compensation and Liability Act of 1980 as amended by the Superfund Amendments and Reauthorization Act of 1986 (CERCLA). This EE/CA has been prepared in accordance with the National Contingency Plan (NCP) and the U.S. Environmental Protection Agency's (EPA) *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (EPA, 1993) (the EE/CA Guidance).

The potential alternatives are analyzed using the EE/CA Guidance criteria of implementability, effectiveness, and cost. The analysis considers the variability in settings and conditions that are encountered along the ROW. The analysis provides pertinent information as to which specific actions would be most appropriate for the conditions encountered at a given location (see Section 4.4). As a further refinement, the EE/CA also compares the performance of the response action alternatives, relative to each other, using the same EE/CA Guidance criteria. The comparative analysis takes into account the varying conditions along the ROW in evaluating the relative performance of the different response action alternatives (see Section 5.0).

An additional important consideration in the evaluation of the response action alternatives is the potential future use and ownership status of the ROW. In 1992, the Interstate Commerce Commission (ICC) determined that UPRR could discontinue rail service on the Wallace-Mullan

Branch. In a 1994 decision the ICC clarified that UPRR could not engage in track salvage activities (the first step in implementation of the response actions) and thereby complete abandonment of the Wallace-Mullan Branch until compliance with certain conditions relating to the environmental impact of the proposed salvage were achieved and reviewed by the ICC. Since 1992, UPRR has, with various parties, discussed the possibility of the line being converted to non-rail use through an application for a Certificate of Interim Trail Use (CITU). Under a CITU, the UPRR ROW would be transferred to a third party for interim recreational or conservation purposes. In 1992, an application for a CITU was filed by the TransContinental Trails Association. A second application for issuance of a CITU was filed by the Rails-to-Trails Conservancy in 1995. The Surface Transportation Board (STB), the successor agency to the ICC, denied the Rails-to-Trails Conservancy application without prejudice to a subsequent applicant that would assume responsibility for the ROW and the trail.

The State of Idaho and Coeur d'Alene Tribe are contemplating entering into a joint arrangement to have the CITU and control of the right of way transferred to them. Because a CITU is deemed by statute to preserve the ROW as a potential rail corridor and not to constitute an abandonment of the line, any reversionary interests in the ROW property are not effected. Alternatively, if a CITU is not issued by the STB and UPRR completes the abandonment process, the property may revert to persons or entities holding the reversionary property interest, thus breaking the property up among potentially many land owners.

The issuance of the CITU is an action to be taken by the STB and not part of the CERCLA decision process addressed by this EE/CA. However, since this EE/CA has been prepared to determine what response actions are needed to address human health and environmental concerns along the ROW, the potential issuance of a CITU for the ROW affects the control of and consequently the types of exposures to contamination that residents of the Coeur d'Alene Basin and others coming onto the ROW may experience in the future. The human health risk assessment incorporated into this EE/CA has taken such potential impacts on human health into consideration. Furthermore, while conversion of the ROW to recreational purposes under a CITU is not in of itself a CERCLA response action, the EE/CA has also taken the conversion of the ROW into a recreational trail into account in evaluating and selecting appropriate response actions. Additionally, as previously stated, if a CITU transfer of the ROW for recreational or conservation purposes were not implemented, the ROW may revert to persons or entities holding the reversionary property interest. The effects of such a reversion of the ROW on the implementability and effectiveness of response actions under consideration are also discussed, as relevant, in this EE/CA.

The identification and screening of response action alternatives, coupled with the detailed and comparative analyses of these alternatives, results in a full evaluation of the potential response actions and a determination as to which actions would be most appropriate for the varying conditions and settings found along the ROW.

2.0 SITE CHARACTERIZATION

This section of the EE/CA provides general information regarding the ROW, including the location, type of operation, and a synopsis of the rail line history. The geography and topography of the area are described, along with descriptions of the regional geology and soils, adjacent land use, population of the cities and towns along the ROW, meteorology, and sensitive ecosystems. Previous response actions that have occurred along the ROW are also described. Information related to the source, nature, and extent of contamination associated with the ROW are presented, including analytical data from sampling efforts to characterize conditions along the ROW. Finally, a stream-lined risk assessment was performed to provide an overall view of the potential impacts to human health associated with contamination found within the ROW.

2.1 SITE LOCATION

The ROW is located in the northern panhandle of Idaho and passes through Benewah, Kootenai, and Shoshone counties. The ROW covers a total area of approximately 1,400 acres, extending from Plummer to Mullan, Idaho. The rail line was operated until 1992 by UPRR and is known as the Wallace-Mullan Branch of the UPRR. The location of the Wallace-Mullan Branch is shown on Figure 1.

The Wallace-Mullan Branch is a combination of the eastern end of the Wallace Branch and the entire Mullan Branch. The Wallace Branch portion extends for 63.8 miles from approximately Milepost 16.6 at Plummer Junction to Milepost 80.4 in Wallace. The Mullan Branch extends 7.6 miles from Milepost 0 at Wallace (coincident with the eastern terminus of the Wallace Branch) to the east side of Mullan at Milepost 7.6.

The westernmost end of the Wallace Branch begins in Benewah County, at Milepost 16.6, and traverses east-northeast to Milepost 30, near Harrison (see Figure 2). Within this segment of the ROW, the route passes through Heyburn State Park and crosses Lake Coeur d'Alene via a 3,179-foot long trestle bridge, including a 224-foot swing span section. At the east end of the trestle bridge, the line turns north and follows the east shore of the lake. The ROW enters Kootenai County at approximately Milepost 24.5. As the ROW passes through the community of Harrison, it sweeps to the east and begins a route roughly parallel to the main stem of the Coeur d'Alene River (CDR). This stretch of the rail line, from Harrison to Enaville, traverses the lower basin of the CDR (see Figure 3). The confluence of the North and South Forks of the CDR is at Enaville. From this point eastward the ROW alignment follows the South Fork of the Coeur d'Alene River (SFCDR) to the eastern terminus in Mullan (see Figure 4).

2.2 TYPE OF FACILITY & OPERATIONAL STATUS

This section provides a brief overview of the history of the rail line construction and operation, as it relates to the development of response actions for the ROW. As noted previously, the key human health and environmental concerns are related to the presence of Mine Waste in the ballast section of the rail bed. Tailings, a component of Mine Waste, are present throughout the flood plain of the SFCDR and the CDR, mainly due to the long history of direct discharge of tailings from non-ROW sources to the watershed. These fluvially deposited tailings are also present within some portions of the ROW. Tailings and waste rock were also used as ballast material during the original construction of the rail line. Ore concentrates have also been found within the rail bed ballast material, primarily at siding locations where loading and handling of concentrates resulted in spillage. Concentrates are also found at some locations between the mainline tracks.

2.2.1 Historic Construction of the Wallace-Mullan Branch

Construction of the Wallace Branch took place over a period of approximately three years, from 1888 to 1890. The branch line was constructed and operated by the Washington & Idaho Railroad Company, a predecessor to the Oregon-Washington Railroad and Navigation Co., which later became part of the UPRR Company. The Mullan Branch was constructed by the Northern Pacific Railway Company in the 1890s, which later became Burlington-Northern Inc. in the 1960s. The Mullan Branch was purchased by UPRR in 1980.

In some areas of the SFCDR basin (east of Enaville to Mullan), the track bed was constructed over fluvially deposited mill tailings. Additionally, at some locations in this portion of the ROW, original construction of the rail line utilized locally available mine waste rock as fill, to elevate the track. In the remainder of the ROW, the subgrade embankment is comprised primarily of clean material quarried from adjacent hillside areas.

Materials originally used to construct the ballast section of the rail line throughout the ROW consisted of a mixture of jig tailings, waste rock and locally available gravels. Materials for subsequent maintenance and upgrading of the ballast, including repairs to areas eroded by the river throughout the operating life of the rail line, consisted of quarried rock, rather than mill tailings. Additional details regarding construction of Wallace-Mullan Branch line are presented in Section 2.10.1.1.

2.2.2 Operational Activities

During its period of operation, the Wallace-Mullan Branch primarily served the mining industry, transporting ores and concentrates from mining operations. Rail transport was also utilized by the timber industry, agriculture, and the general public riding passenger cars to Spokane Washington, and other destinations. Rail sidings were built to serve mining facilities, saw mills, rock quarries, warehouses, fueling stations, and maintenance facilities. The sidings serving the mining industry were generally located in the SFCDR basin. Sidings west of Enaville generally served sawmills and quarries, where cars were coupled to or uncoupled from mine trains. The Wallace-Mullan Branch operated continuously from the 1890s to 1992. The line became inactive when the volume of mining products fell to levels that no longer supported the operation of the railroad.

2.3 STRUCTURES

During the operating years, a number of buildings were located along the railroad ROW in support of railroad operations. Buildings constructed by UPRR along the ROW during the time that the Wallace-Mullan Branch was in operation included bunkhouses, toolsheds, warehouses and depots. Most of the buildings were removed in the latter years of operation. The only remaining buildings are those associated with underlying land leases to private parties or those constructed illegally by individuals and/or other entities encroaching on the ROW. Along the ROW, there are the remains of various mining-related loadout structures such as old foundations.

Bridges and culverts are a common feature along the Wallace-Mullan Branch. A total of 36 bridges were constructed to cross rivers, creeks, and Lake Coeur d'Alene. The bridges include 11 single-span structures, constructed of timber, steel, concrete or other comparable materials, and 24 multi-span timber trestles, three of which have steel center spans. The Chatcolet bridge is a 3,179-foot timber trestle with a 224-foot steel swing-span bridge across the St. Joe River channel. The materials used in the construction of the bridges reflect their age. Construction drawings indicate that as many as 200 culverts may have been constructed along the rail line. The culverts were also constructed of various materials, including corrugated steel, concrete, and wood.

2.4 GEOGRAPHY AND TOPOGRAPHY

2.4.1 Geography

The ROW lies within a major portion of the Lake Coeur d'Alene watershed for most of its 71.5 miles, passing through Shoshone, Kootenai, and Benewah counties in the northern panhandle region of Idaho. The setting of the ROW varies throughout its length and, consistent with this changing setting, the ROW lends itself conveniently to subdivision into three distinct sections. These sections include: (1) the upper SFCDR basin (the Upper Basin); (2) the CDR basin (the Lower Basin); and (3) the upland rolling hills west of Lake Coeur d'Alene, as far as Plummer Junction.

The ROW through the Upper Basin includes the western portion of the Mullan Branch, extending from Mullan (Milepost [MP] 7) to Wallace (MP 0), and the easternmost portion of the Wallace Branch, extending from Wallace (MP 80) to just west of Enaville (MP 62). The ROW in this area generally follows the SFCDR and Interstate 90 through what is known as the Silver Valley, passing through or near the communities of Osburn, Silverton and Elizabeth Park. The Upper Basin portion of the ROW also includes 7.9 miles of ROW that is located within the BHSS (MP 62.8 to 70.7), passing through or near the communities of Kellogg, Smelterville and Pinehurst. Within the Upper Basin, the ROW lies in close proximity to numerous active, inactive, and abandoned mining facilities and public lands managed by the State of Idaho, U.S. Bureau of Land Management (BLM), and the U.S. Forest Service (USFS).

The transition from the Upper Basin to the Lower Basin occurs downstream of the confluence of the North and the South Fork of the CDR, west of Enaville (MP 62). From MP 62 to Harrison (MP 31), the ROW follows the CDR through Mission Flats and the Lateral Lakes. The ROW passes through or near the communities of Cataldo, Rose Lake, Lane, Medimont, and Harrison. State Highway 3 also generally follows the ROW from Rose Lake to Medimont. Near the mouth of the CDR, where it discharges into Lake Coeur d'Alene, the ROW alignment turns southward and follows the east side of the lake. The ROW turns westward and crosses Lake Coeur d'Alene on the Chatcolet Bridge and climbs out of the basin through the rolling hills west of the lake to Plummer Junction (MP 16.6).

2.4.2 Topography

Upper Basin: The ROW through the Upper Basin generally parallels the SFCDR which finds its headwater not far from Mullan. This stretch of the river valley extends approximately 25 miles from Mullan to Enaville and the confluence with North Fork of the CDR (NFCDR). The river valley in the Upper Basin is typically narrow, ranging from several hundred feet in the upper regions to over one-half mile wide near Osburn. The ROW grade is relatively steep in the upper reaches, with an elevation drop from approximately 3,400 feet in Mullan to approximately 2,160 feet near Enaville. Numerous small creek valleys feed into this section of the river including

Canyon Creek (MP 0), Ninemile Creek (MP 80), and Big Creek (MP 72.6).

Because of the close proximity of the rail bed to the SFCDR and the large number of tributary streams crossing the ROW, the potential for direct erosional impacts to the rail bed from flooding is significant in the Upper Basin. However, given the long history of rail line operation in the area, many points of flooding concern in the Upper Basin have previously been protected with rip rap armoring. There are a few areas where recent flooding, in conjunction with a lack of rail line operation and maintenance (O&M) since 1992, has resulted in erosion of the rail bed embankment.

Lower Basin: Below the confluence of the North and South Forks of the CDR near Enaville, the CDR meanders through a relatively steep-sided river valley that extends from Enaville to Cataldo. As the river flows past Cataldo, it enters a broad, open area known as the Lateral Lakes Area, the upstream portion of which is known as Mission Flats. Throughout the majority of the Lower Basin, the ROW continues to follow the general course of the river. With the exception of the open Mission Flats portion of the valley, the river valley width ranges from as little as several hundred feet, upstream of Rose Lake (MP 49), to greater than a mile in width farther downstream.

As the river continues past Rose Lake, it enters the broad river valley. Through this area, the river gradient is very flat and the channel meanders across a flood plain that is up to two miles in width. On either side of the river, embankments separate several lakes and wetlands from the main channel. These lateral lakes and wetlands include the following: Rose Lake, Bull Run Lake, Killarney Lake, Medicine Lake, Cave Lake, Swan Lake, Black Lake, Blue Lake, Thompson Lake, Anderson Lake, and associated wetlands.

Up to this point, the ROW generally parallels the river. Upon entering the broader river valley at Rose Lake, the ROW continues approximately 18 miles on rail bed constructed on raised embankments that either follow the river channel or extend across the lakes and wetlands. From Enaville to the mouth of the river at Lake Coeur d'Alene (near Harrison), the river elevation drops only 35 feet.

South and West of Harrison: The ROW parallels Lake Coeur d'Alene southward approximately seven miles along the east shoreline. The lake covers an area of approximately 50 square miles and ranges in width from approximately nine miles to less than one mile in the vicinity of the Chatcolet Bridge. The water level in the lake is regulated by Washington Water Power's (WWP) operation of the Post Falls Dam, and varies between approximately 2121' above mean sea level (AMSL) in winter and 2128' AMSL in summer. Because of the large area of the lake and the ability to regulate lake levels, the ROW in this area is generally not subject to flooding impacts, except in areas where tributary streams cross the ROW and areas where flood debris from the St. Joe River accumulates near the rail bed.

Along the east shore of the lake, the ROW is bordered by steep, rugged hill slopes. At MP 24, the ROW turns west and crosses the Chatcolet Bridge that separates Lake Coeur d'Alene and Lake Chatcolet. After crossing the bridge and traveling southwest along the west side of the lake through Heyburn State Park for approximately 1.4 miles, the ROW then turns west and follows Plummer Creek for approximately 5.3 miles to Plummer Junction (MP 16) through the rolling hills of the northern part of the Palouse region. As the ROW passes through this region, it gains approximately 500 feet in elevation. At Plummer Junction, the Wallace-Mullan Branch terminates, splitting into other branch lines.

2.5 GEOLOGY & SOIL

2.5.1 Regional Geologic Setting

The area encompassed by the project is located in the western part of the Northern Rocky Mountains' physiographic province, within the western slopes of the Bitterroot Range. This area is characterized geologically by extensive exposures of the Precambrian Belt Supergroup, a thick sequence of metasedimentary rocks, which also host the ore deposits of the Coeur d'Alene District. Aside from a few small and scattered intrusive bodies of Mesozoic age, the next youngest rocks in the area are associated with the middle Columbia River Basalt Group, with exposures limited to the western portions of the project. Pleistocene glacial deposits overlie these Miocene basalts.

The Precambrian Belt Supergroup consists of a thick sequence of fine grained, mostly clastic metasedimentary rocks. The sequence has been subdivided into six formations, all of which have lithologic gradations found at the contacts. The lithologies consist mostly of argillite, siltite, and quartzite, with some interbedded carbonates. Belt rocks have undergone only low grade, regional metamorphism, and the original sedimentary features are generally well preserved.

The western portions of the project area lie at the eastern margin of the Columbia Plateau province, which is characterized by extensive, thick lava flows of the middle Miocene Columbia River Basalt Group. Erosional remnants of these basalt flows can be found in the project area as columnar outcroppings from Plummer eastward towards the Lake Killarney area (Griggs, 1973). These flows are believed to have dammed the ancestral CDR, forming a large lake until erosion breached the basalts.

Repeated glacial advances during the Pleistocene again dammed the CDR, forming the Glacial Lake Coeur d'Alene. The last ice dam caused the lake to attain an estimated pool elevation of 2,400 feet above sea level (Richmond, et al, 1965), flooding the NFCDR valley to Pritchard, and the SFCDR valley upward to Kellogg, Idaho. This ice dam was located at the present north end of Lake Coeur d'Alene, which is now naturally dammed by remnant deposits of glacial outwash and catastrophic flood debris.

The structural geology of the Coeur d'Alene valley is characterized by extensive northwest trending bedrock faults and folds. Much of the project area lies within a regional structural feature known as the Lewis and Clark Line, a west and northwest-trending zone of steep faults that traverse northern Idaho from the Columbia Plateau, to approximately 250 miles southeastward into west-central Montana (Wallace, et al, 1990).

Through the majority of the rail alignment in the Coeur d'Alene Basin, the Lewis and Clark Line is approximately 25 miles wide, and includes the principal faults of the Coeur d'Alene District: the Osburn Fault and the Placer Creek Fault. The mapped extent of the Osburn Fault is approximately 100 miles and is estimated to have undergone approximately 16 miles of right lateral displacement.

2.5.2 Soils

In general, soils outside of alluvial valleys consist of four to six inches of loam underlain by gravelly silt-loam subsoils which extend 14 to 25 inches in depth to fractured bedrock. Thin layers of volcanic ash and wind-blown loess are apparent in the soil profile. Soils on the valley floors occur over alluvial and glacial deposits and range up to 100 feet in thickness. Steep upper valley soils are comprised of boulders and cobbles. Valley floor materials from Smelterville to the Cataldo area are an unconsolidated mixture of pebbles, boulders, and sand.

The soils in the lower CDR valley floor downstream of Cataldo are primarily sand, silt, and clays. In many flood plain areas, the upper 10 to 20 feet of soils are interworked to varying degrees with mill tailings. Soils in portions of the Lower Basin have high concentrations of metals.

A soil survey of Kootenai County, Idaho, identified several major soil types that are representative of most of the soils found in the project area (USDA SCS, 1981). The following are descriptions of some of the major soil types:

1. Undulating to steep, deep and very deep, well drained and moderately well drained soils on loess covered hills. These soils, formed with loess mixed with volcanic ash, are mainly in the southwestern part of the project area and interspersed on terraces along Lake Coeur d’Alene.

2. Sloping to very steep, shallow and moderately deep, well drained soils on basalt terrace escarpments and in canyons. These soils, formed in loess and volcanic ash overlying basaltic lava flows, are scattered throughout the area and are often found near shoreline areas of Lake Coeur d’Alene.

3. Sloping to very steep, moderately deep to very deep, well drained to somewhat poorly drained soils on flood plains and low stream terraces. These soils, formed in loess mixed with large amounts of volcanic ash over metasedimentary, granitic, schist, and gneissic rocks, are scattered throughout the project area at elevations of 2,200 to 6,400 feet.

4. Level and nearly level, very deep, very poorly drained to somewhat poorly drained soils on flood plains and low stream terraces. These soils, formed from mixed alluvium and organic material, are found on flood plains and low stream terraces along the rivers, in drainage ways and low bottomland areas. In many areas, this soil type contains “slickens” - barren soils with fine mill tailings high in metal content.

5. Undulating to steep, very steep, moderately well drained and well drained soils on lake terraces. These soils, formed in lake sediment and volcanic ash, are found on lacustrine terraces scattered throughout the area, but especially along the lower CDR.

2.6 SURROUNDING LAND USE & POPULATION

Existing land uses in the vicinity of the ROW cover the range from undeveloped forest to urban communities. Much of the nearby land has been developed for farming. With the exception of the few communities along the route of the ROW, the population density in the area is relatively low. The ROW passes through a number of incorporated and unincorporated communities having a total population of approximately 5,000. Brief summaries of the level and nature of development in 13 characteristic land use segments along the ROW route are provided in Section 0.4 of the Streamlined Risk Assessment (Appendix A).

2.7 METEOROLOGY

2.7.1 Climate

The climate of the area is influenced by the Pacific Maritime flow of moist air. This results in high levels of precipitation with over 70 percent occurring from October to April. Precipitation in the area is correlated with elevation, with the highest elevations receiving higher precipitation amounts, mainly in the form of snow. Measured precipitation in the Coeur d'Alene Basin ranges between 30 and 40 inches per year (Hobbs et al., 1965). Ambient temperature also varies throughout the project area depending upon elevation. In general, temperatures range from a low of -2°F to a high of 100°F (USDC, 1963). The mean annual temperature at Coeur d'Alene is 9.1°C (48°F) (CLCC, 1996).

2.7.2 Hydrology

The headwaters of the CDR system are located in the Bitterroot Range along the Idaho-Montana border. In the upper part of the basin, the SFCDR and its tributaries drain a total area of approximately 323 square miles (USHUD, 1979). The upper SFCDR valley, including the UPRR rail alignment, is generally narrow, with flats less than one mile in width. The SFCDR below Wallace is relatively shallow and swift flowing, with a gradient of approximately 30 feet per mile (0.6% grade).

The SFCDR meets the NFCDR near Enaville, Idaho, forming the main stem of the CDR. The NFCDR is a fairly large basin, draining a total area of approximately 897 square miles (USHUD, 1979). Below the confluence of the North and South Fork, the flood plain of the main stem of the CDR broadens, with an average valley width of two to three miles. The channel gradient is only approximately one foot per mile (0.02% grade), and the river is both deeper and slower moving.

Many lakes and wetlands are located within the flood plain area through this 30 mile segment of the lower CDR. This area is collectively known as the Lateral Lakes, and is connected hydraulically with the river. The Lateral Lakes contain 11 small shallow lakes, and thousands of acres of marshy wetlands (Bookstrom and Box, 1996). The lakes vary from 85 to 640 acres, with a maximum depth of approximately 50 feet. The CDR system conveys drainage from an approximate 1,475 square mile area through the lower CDR and Lateral Lakes wetlands complex to discharge into Lake Coeur d'Alene near Harrison, Idaho (USGS, 1997a).

Lake Coeur d'Alene is a large surface water body under elevation control by the Post Falls Dam and hydroelectric works near the Idaho State Line. With a normal full pool elevation for the Lake of 2128.0 feet AMSL (WWP, 1996), the lake surface area encompasses nearly 50 square miles (CLCC, 1996). Operation of the lake also affects the surface water elevations and hydraulics of the lower segments of the Lateral Lakes. The entire area draining through Lake Coeur d'Alene and discharging into the Spokane River encompasses over 3,980 square miles (CLCC, 1996). Plummer Creek is a smaller (44 square miles) watershed that drains to the lower portion of the Lake. The UPRR rail line also crosses this creek and its tributaries within the limits of this project.

Stream flows for the SFCDR and tributaries are usually highest during spring runoff.

However, some of the worst flooding in the Coeur d’Alene Basin has occurred during early winter when warm rains fall on a large snowpack. Daily mean flow in the CDR ranges from approximately 120 cfs in the SFCDR, near Mullan, Idaho to 2,501 cfs below the confluence with the NFCDR near Cataldo, Idaho (IDEQ, 1993; USGS, 1997 and USGS, 1997a). One hundred year frequency flood flows at these locations range from 3,250 cfs (USHUD, 1979) to 70,800 cfs (USGS, 1997b) respectively. Base flow for Plummer Creek averages approximately 7 cfs (Horowitz, et al, 1995).

2.8 ECOSYSTEMS

2.8.1 Coeur d'Alene Basin Ecosystem

The Coeur d'Alene Basin is a large watershed that contains a number of interconnected and interactive ecosystem components. These ecosystem components are rivers and streams; the riparian zone; wetlands; uplands; lateral lakes; and Lake Coeur d'Alene. Each ecosystem component is described below.

2.8.1.1 Rivers and Streams

Rivers and streams are characterized by the flow of water, which transports nutrients, sediments, organisms, and pollutants from the upper areas of the basin downstream. The riverine system has been divided into three primary components: the aquatic environment of the river or stream including sediment and surface/groundwater interaction, wetlands areas, and riparian areas. Although they are integral to the river or stream as a whole, because they provide multiple distinct and different habitat functions, wetlands and riparian areas are addressed as separate components of the CDR system.

Rivers and streams are dynamic features which are constantly undergoing change. This ability to change makes them resilient (able to recover from disturbances) to a certain extent. Important considerations of the river and stream components include sediment transport and localized surface/ground water interactions. Flowing water provides constant mixing and assimilation of material. Flow tends to be highly variable during the course of a year; however, most of the significant scour and re-shaping of channels occurs during the higher flow periods or floods. During these periods on the Coeur d’Alene River, sediment-borne pollutants are transported downstream and accumulate behind barriers, or in lower-energy sediment deposition areas.

Important ecological functions provided by rivers and streams include: habitat for resident and migratory birds; fish and aquatic, semi-aquatic and amphibious animals and their supporting ecosystems; riparian vegetation; invertebrate communities; nutrient cycling; geochemical exchange processes; primary and secondary productivity and transport of energy (food) to downstream/downgradient organisms; and growth media for aquatic and wetlands plants. Other important functions include, recreation opportunities, wastewater effluent assimilation and culturally significant services.

2.8.1.2 Riparian Zone

The riparian zone forms the interface between the habitats found in the river and stream systems and the adjacent upland areas. As such, riparian zones form the land-water boundary that serves as a filter for the exchange of materials, nutrients and energy between these two areas. For ease of discussion, the riparian zone generally encompasses the area formed by the 100-year flood plain and may vary in size from relatively narrow in some steep, fast-moving streams in the upper portion of the watershed, to very broad along the lower CDR. The riparian corridor along the CDR has been impacted through channelization and placement of protective riprap along portions of the stream banks, and from loss of vegetation due to metals-contaminated soils and sediments.

Important functions of the riparian zone are to: dissipate stream energy associated with high water flows, thereby reducing erosion and improving water quality; filter sediment, capture bedload, and aid in flood plain development; stabilize stream banks against scour; develop a channel section to provide stream habitat; moderate water temperature; facilitate groundwater storage and recharge; provide primary and secondary productivity; promote nutrient cycling; provide food and feeding/resting areas for fish, birds and mammals; and provide habitat for macroinvertebrate, and a migration corridor for transport of seeds, plants, animals, invertebrates, and sediment.

2.8.1.3 Wetlands

Wetlands are transitional areas between terrestrial and aquatic systems. In wetlands along the CDR, the water table is usually at or near the surface, or the land is covered by shallow water. Three attributes that identify wetlands are the presence of certain plants (hydrophytes), hydric soils, and saturated or inundated substrate. There is a wide diversity of wetland habitat types, ranging from those dominated by early successional species such as cattails, to forested wetlands. Some wetland areas may have been impacted by fluvially deposited tailings.

Wetlands provide a number of important functions in the Coeur d'Alene Basin ecosystem. Wetlands provide cover, food, and habitat for a wide diversity of wildlife, hydrologic functions, and water quality improvements. Some important wetlands habitat functions include providing essential breeding, nesting, feeding and refuge for many species of waterfowl, other birds, mammals, amphibians, reptiles, and invertebrates and providing spawning and nursery areas, and supplying sources of nutrients for cold and warm water fisheries. As quiescent areas with available storage volume, wetlands may also reduce flow rates and velocity of floodwaters, thereby reducing the potential for erosion. They may also serve to improve water quality by removing sediments, excess nutrients, and chemical contaminants from surface water.

2.8.1.4 Lateral Lakes

Eleven Lateral Lakes are situated along the lower CDR, ranging in size from less than 85 acres to over 600 acres. Lakes are characterized as large open bodies of water generally over 20 acres in area, and greater in depth than 2 meters or about 6 feet. The Lateral Lakes are formed near the confluences of several tributary streams with the CDR, and are associated with thousands of acres of adjacent wetlands environments.

The Lateral Lakes provide a number of ecological and environmental functions. They store water, thereby affecting local and regional hydrology; recharge ground water aquifers; moderate local temperatures; provide habitat for aquatic plants, invertebrates, fish, amphibians, waterfowl and animals; provide for geochemical exchange services; nutrient cycling and transport. The Lateral Lakes and associated wetlands provide culturally significant services such as food, shelter, medicine and spiritual elements to members of the Coeur d'Alene Tribe and others. Other lake functions include recreation and several commercial opportunities such as fishing, recreational sports, transportation and irrigation. However, lakes and wetlands are often sinks for incoming contaminants, and because some lakes and wetlands are not able to cleanse or restore themselves, they remain in impaired condition.

2.8.1.5 Lake Coeur d'Alene

Lake Coeur d'Alene is a large regional lake feature that receives drainage from the CDR and several other basins including the St. Joe River, Wolf Creek and Plummer Creek. The Chatcolet Bridge crosses the southern portion of the Lake separating the northern portion of the Lake from Chatcolet Lake and the St. Joe River system. The water surface in the lake is under the control of the Post Falls dam operation. At normal pool elevation, Lake Coeur d'Alene covers nearly 50 square miles, and ranges from a mean depth of 72 feet to a maximum depth of over 200 feet.

Lake Coeur d'Alene is also a source of water for agricultural, domestic and irrigation use. At least 6 public water supply systems use the lake water, and there are numerous other permitted water intakes from the lake. Lake Coeur d'Alene also provides about 30 percent of the recharge to the Rathdrum Prairie aquifer that serves a large area west of the lake, including the City of Spokane, Washington. Portions of the Lake also provide industrial uses, such as timber transport (near Chatcolet). In addition, Lake Coeur d'Alene is one of the region's major attractions for recreation and tourism, and is heavily used for swimming, recreational boating and fishing activities.

Lake Coeur d'Alene has long been the focus of cultural resources for the Coeur d'Alene Tribe and their historical settlement of the areas around the lake. The rich natural resources present in this area have provided for the needs of the Tribe and the Tribe considers these to be essential to maintenance of tribal culture and customs.

2.8.1.6 Uplands

Uplands, or terrestrial areas, are areas located outside of the riparian zone (approximately the 100-year flood plain) and are generally characterized by vegetated ecological communities. The upland areas in the Coeur d'Alene Basin include a variety of plant communities from grasslands and meadows to multistory forests, and the animals that use these areas for food and shelter. Upland soils support and determine the quality of upland habitat in the Coeur d'Alene Basin, including habitat for vegetation, birds or mammals. Important functions of soils of the upland areas include providing: habitat for vegetation, birds and mammals; growth media for plants and invertebrates; nutrient cycling; geochemical exchange processes; primary and secondary productivity; security and cover (protection from predators); and habitat for invertebrate communities.

Vegetation in the upland areas provides food and cover for resident and migratory birds and mammals; feeding and resting areas for birds and mammals; habitat for macroinvertebrates; nutrient cycling; soil stabilization/erosion control and hydrograph moderation. As a result of erosion due to surface runoff and wind action, upland areas may contribute sediment to the adjacent rivers or streams.

2.8.2 Flora and Fauna of the Coeur d'Alene Basin

2.8.2.1 Vegetation

The original vegetation of the upland areas of the Coeur d’Alene Basin was coniferous forest, and included such species as ponderosa pine *(Pinus ponderosa),* western white pine *(Pinus monticola),* western larch *(Larix occidentalis),* Douglas fir *(Pseudotsuga menziesii),* western red cedar *(Thuja plicata),* grand fir *(Abies grandis),* and western hemlock *(Tsuga heterophylla).* The principal lower valley area climax species were western red cedar, western hemlock, and grand fir. Lodgepole pine *(Pinus contorta)* is abundant as a second growth in burned-over areas. Ponderosa pine thrives on drier, well-drained slopes. Grand fir and western hemlock are abundant toward the eastern and higher parts of the district. Other common tree species are subalpine fir *(Abies lasiocarpa),* Engelmann spruce *(Picea engelmannii),* and mountain hemlock *(Tsuga matensiana).*

Western red cedar once covered much of the water-saturated valley flats. Deciduous trees typically found in the valley flats and along perennial streams include willow *(Salix* spp.), alder *(Alnus* spp.), and black cottonwood *(Populus trichocarpa);* some aspen (*Populus tremuloides*) are
found on high, open slopes. The density and abundance of shrubs and other ground cover varies throughout the region, depending on slope, aspect, and moisture. Common shrub species are listed below.

<u>Common Shrub Species found in the Coeur d'Alene Basin</u>

Common Name	Scientific Name
Shinyleaf ceanothus	*Ceanothus velutinus*
Huckleberry	*Vaccinium membranaceum*
Twin berry	*Lonicera utahensis* and L. *involucrata*
Syringa	*Philadelphus lewisii*
Service berry	*Amelanchier alnifolia*
Chokecherry	*Prunus virginiana*
Mountain ash	*Sorbus spp.*
Devil's club	*Oplopanax horridum*
Pachistima	*Pachistima myrsinites*
Rocky Mountain maple	*Acer glabrum*
Ocean-spray	*Holodiscus discolor*
Ninebark	*Physocarpus malvaceus*
Wild rose	*Rosa spp.*
Common snowberry	*Symphoricarpos albus*
Spiraea	*Spiraea* betulifolia

Grasses and grass-like plants typical of the area are bluebunch wheatgrass *(Agropyron spicatum),* Columbia brome *(Bromus vulgaris), pinegrass (Calamagrostis rubescens), sedge (Carex* spp.), fescue *(Festuca* spp.) and bentgrass (including redtop) *(Agrostis* spp.). In the wetland areas, shrub species include willow *(Salix* spp.), alder *(Alnus* spp.), redosier dogwood *(Cornus stolonifera),* and Douglas' spiraea *(Spiraea douglasii).* Herbaceous plants common to wetland areas in the Coeur d'Alene Basin are listed below.

<u>Common wetland plant species found in the Coeur d'Alene Basin</u>

Common Name	Scientific Name
Marsh horsetail	*Equicetum palustre*

Sedge	*Carex* spp.
Bulrush	Scirpus spp.
Rush	*Juncus spp.*
Mannagrass	*Glyceria spp.*
Bentgrass (including Redtop grass)	*Agrostis* spp.
Bluegrass	*Poa* spp.
Tufted hairgrass	*Deschampsia cespitosa*
Wild rice	*Zizinia aquatica*
Spike-rush	*Eleocharis spp.*
Common cattail	*Typha latifolia*
Arrowhead (water potato)	*Sagittaria latifolia*
Marsh cinquefoil	*Potentilla palustris*
Common reed	*Phragmites australis*
Reed canarygrass	*Phalaris arundinacea*
Pond weed	*Potamageton (spp.)*

2.8.2.2 Wildlife

Small mammals generally found in the area include voles, deer mouse, shrews, chipmunk, tree squirrel, and ground squirrel. These animals provide important links in the food webs. Larger mammals present within the Basin include coyote, bobcat, cougar, raccoon, black bear, mule deer, white-tailed deer, and elk. In the wetland and riparian habitats, muskrat, beaver, and mink are found. Moose are also found within the Basin. Deer and elk are the most abundant big game species in the area.

Over 280 bird species are found within the Coeur d'Alene Basin. Many of the bird species of the area are migratory. Bird species include red-winged blackbirds, swallows, robins, waxwings, hummingbirds, sandpiper, dippers, killdeer, raven, waterfowl, hawks, osprey, owls, herons, and grebes. Swans, ducks, and Canada geese arrive in the area in late February or early March and remain for about a month. Small numbers of Canada geese and several species of duck nest in the Basin. Many other waterfowl and neotropical migrants arrive in great numbers during April and May. Avian exposure to contaminants in the lower Coeur d'Alene is high. Waterfowl are at especially high risk from exposure to contaminated sediments through ingestion.

Federally endangered, threatened, and candidate wildlife species which may be found within the Coeur d'Alene Basin include bald eagle, gray wolf and bull trout. A biological assessment will be performed in accordance with the applicable provisions of the Endangered Species Act to ensure that implementation of the proposed response actions will not result in a significant adverse effect on endangered species. The following provides a summary of the federally listed and candidate species found in the Coeur d'Alene Basin.

Federally Listed and Candidate Species in the Coeur d'Alene Basin

Common Name	**Scientific Name**
Federally Listed Species	
Bald eagle	*Haliaeetus leucocephalus*
Gray wolf	*Canis lupus*

Ute ladies' tresses	*Spiranthes diluvialis*
Bull trout	*Salvelinus confluentus*
Candidate Animals - Category 1	
Lynx	*Lynx canadensis*
Candidate Animals - Category 2	
Black tern	*Chlidonias niger*
California wolverine	*Gulo gulo luteus*
Columbia pebblesnail	*Fluminicola columbianus*
Ferruginous hawk	*Buteo regalis*
Fringed myotis (bat)	*Myotis thysanodes*
Loggerhead shrike	*Lanius ludovicianus*
Long-eared myotis (bat)	*Myotis evotis*
Long-legged myotis (bat)	*Myotis volans*
Northern goshawk	*Accipiter gentilis*
Olive-sided flycatcher	*Contopus borealis*
Pale Townsend's big-eared bat	*Plecotus townsendii pallescens*
Small-footed myotis (bat)	*Myotis ciliolabrum*
Spotted frog	*Rana pretiosa*
Westslope cutthroat trout	*Oncorhynchus clarki lewisi*
Yuma myotis (bat)	*Myotis yumanensis*
Candidate Plants - Category 2	
Clustered lady's slipper	*Cypripedium fasciculatum*

2.8.2.3 Fisheries

Historically, the native fish abundant in the Coeur D'Alene Basin included several species of trout, sculpins and other cold-water fish. Bull trout is currently an endangered species. The following lists some of the native fish species that had a historic presence in the Coeur d'Alene Basin.

Native fish species found in the Coeur d'Alene Basin

Common Name	**Scientific Name**
Westslope cutthroat trout	*Onchorhynchus clarki lewisi*
Bull trout	*Salvelinus confluentus*
Mountain whitefish	*Prosopium williamsoni*
Northern squawfish	*Ptychocheilus oregonensis*
Peamouth	*Mylocheilis caurinus*
Suckers	*Catostomus* spp.
Sculpins	*Cottus* spp.

In 1937, Kokanee salmon were introduced, beginning the transformation of Lake Coeur d'Alene to a sport fishery dominated by introduced species. The following contains a listing of some of the fish species introduced to the Coeur d'Alene Basin.

Fish species introduced to the Coeur d'Alene Basin

Common Name	**Scientific Name**
Kokanee salmon (Blueback)	Onchorynchus nerka
Chinook salmon	*Onchorhynchus tshawytscha*
Rainbow trout	*Onchorynchus mykiss*
Brook trout	*Salvelinus fontinalis*
Bluegill sunfish	*Lepomis macrochirus*
Northern pike	*Esox lucius*
Yellow perch	*Perca flavescens*
Tench	*Tinca tinca*
Longnose dace	*Rhinichthys cataractae*
Black bullhead	*Amereiurus melas*
Brown bullhead	*Amereiurus nebulosus*
Pumpkinseed sunfish	*Lepomis gibbosus*
Carp	*Cyprinus carpio*
Catfish	*Ictalurus spp.*
Lake chub	*Couesius plumbeus*
Largemouth bass	*Micropterus salmoides*
Smallmouth bass	*Micropterus dolomieiui*
Black crappie	*Pomoxis nigromaculatus*

The State of Idaho has designated the upper stretch of the SFCDR, from its source downstream to near the town of Mullan, as protected for general use as domestic water supply, cold water biota, and salmonid spawning. The lower reach of the SFCDR, from Daisy Gulch to its confluence with the NFCDR near Enaville, is classified for protection of cold-water biota and for primary or secondary recreation, as is the reach from Cataldo downstream to Lake Coeur d'Alene. The Coeur d'Alene Tribe's proposed water quality standards are also intended to protect cold-water biota and recreation, as well as domestic water supply and salmonid spawning.

Lake Coeur d'Alene has been designated by the State for use as primary recreation, cold-water biota, and salmonid spawning waters. The Coeur d'Alene Tribe proposed water quality designations for the Lake are intended to protect these uses, as well as domestic water supply.

2.9 PREVIOUS REMOVAL AND RESPONSE ACTIONS

With the exception of a 7.9-mile segment of the ROW that passes through the BHSS, there have been no previous CERCLA response actions conducted along the ROW. Within the BHSS portion of the ROW, selected removals have been implemented and protective barriers of clean gravel have been placed over soils with elevated lead concentrations in order to prevent direct contact with contaminated soils and to restrict mobilization of residual contaminants through wind or water erosion.

2.10 SOURCE, NATURE & EXTENT OF CONTAMINATION

2.10.1 Source of Contamination

Mine Waste related contamination found at various locations along the ROW is generally associated with the presence of either waste rock, tailings, or concentrates. Waste rock is the rock excavated in pursuit of ore and typically has lead concentrations of less than 1,000 ppm. Tailings are a waste product from the milling of ores. In the early years of mining in the Silver Valley, milling involved a relatively crude mechanical process called "jigging." Because this process was not very efficient in separating ore from non-ore bearing rock, the jig tailings often contained residual ore resulting in lead concentrations up to 70,000 ppm. Jig tailings ranged from sands to gravels in size. As the technology for milling improved through flotation milling, the tailings became finer (sand to silt size) and over time had lower residual lead concentrations. Modern-day flotation tailings typically range from 2,000 to 4,000 ppm lead. Concentrates are the main product of the milling operation, and lead concentrations in such materials range up to 750,000 ppm.

The components of Mine Waste found along the ROW and adjacent areas generally derive from the following activities:

1) Tailings and waste rock were directly discharged to the watershed since the onset of mining related activities in the Upper Basin. This activity has resulted in more than 72 million tons of tailings becoming commingled with flood plain sediments. As with other flood plain properties in the Upper and Lower Basin, those portions of the ROW within the flood plain have been impacted by fluvial deposition of tailings. The large volume of tailings present in off-ROW areas continue to act as a source of contamination to sections of the ROW.

2) Tailings and waste rock were used in the original construction of the rail line. The primary use of tailings was as ballast. The volume of tailings-containing ballast used in the original construction of the line is estimated by UPRR to be approximately 168,000 cubic yards, as described in Section 2.10.1.1 below. While flood flows periodically overtopping the rail bed have caused localized erosion and displacement of a portion of this original ballast, the majority of the original ballast material and the included tailings are still in place. This original ballast material is covered by the track structure and clean ballast that was subsequently placed on top of the originally placed ballast throughout the years of maintenance.

3) Concentrates are another source of contamination found at various locations along the track portion of the ROW. Visible accumulations of concentrates have been identified within portions of the main line, the loading/unloading areas, sidings and Plummer Junction. Review of sampling results in track and siding areas indicate that the presence of concentrates is generally limited to siding areas, where these materials may have been spilled during loading and handling, or portions of the main line near switches, where concentrates may have spilled from cars during shunting.

2.10.1.1 Mainline Construction

As noted previously, the Wallace Branch rail line was constructed over a period of approximately three years in the late 1800s to serve the rapidly developing mining industry of the Silver Valley. In most areas, the rail line was constructed above the natural ground elevation. In some locations, significant quantities of subgrade fill were required to elevate the track, above potential flood waters, and to provide a relatively uniform gradient within operating specifications. Records indicate that the subgrade embankment, particularly in the Lower Basin, is comprised generally of coarse, locally available rock and sandy gravel. In portions of the Upper Basin, mine waste rock was used as subgrade embankment material, while further down the valley, local borrow areas were developed for fill. Within the river flood plain in the Upper Basin, a mantle of fluvialy transported tailings from upstream deposition sites existed prior to railway construction. In these areas, the subgrade embankment and/or ballast section were constructed directly on top of the existing tailings layer.

The original ballast section of the rail bed was constructed to a thickness of approximately one foot, with a top width of approximately nine feet, side slopes of approximately 3H:1V, and a bottom width of approximately 15 feet. A mixture of local gravels, mine waste rock, and tailings was used for ballast. These materials presented desirable characteristics for railway ballast due to the relatively uniform size and angularity of the material. Based on the original construction dimensions, the volume of tailings-containing ballast placed within the ROW would have been approximately 2,350 cubic yards per linear mile of track. Applying this relationship to the length of the ROW indicates that the volume of tailings-containing ballast used during the original rail line construction was approximately 168,000 cubic yards. Over time, additional ballast materials have been added, as part of railroad grade maintenance activities, such that the existing ballast section is approximately 18-inches thick and the bottom width, or footprint, will vary depending upon ballast thickness and terrain. The estimated volume of the existing ballast is approximately 283,000 cubic yards. A typical cross-section of the rail bed is shown on Figure 5.

The newer, imported ballast has been subject, over time, to the same ongoing conditions that have impacted native soils along the ROW, including airborne and waterborne transport of tailings. In addition to these broader impacts, concentrates have been spilled at various locations along the Wallace-Mullan Branch line as a result of railroad operations.

2.10.1.2 Siding Activities

As with the main rail line of the Wallace-Mullan Branch, sidings within the Upper Basin flood plain in the Upper Basin were typically constructed on any underlying tailings or mine waste rock that were present as a consequence of fluvial deposition. Sidings built at the time of the main line construction (1887 - 1889) also contain ballast that includes tailings. Siding activities related to the loading/unloading and handling of concentrate materials, as well as shunting of rail cars in and out of sidings and spur tracks at switches, sometimes resulted in concentrate spills. The presence of spilled concentrates typically occurs at the sidings located adjacent to mill sites or other concentrate loading and unloading facilities, as well as in the vicinity of some switches. Most of the mining related loading/unloading facilities were located upstream of the BHSS. Sidings located downstream of the BHSS were primarily used to stage rail cars or to serve other industries in the Coeur d'Alene Basin. The presence of concentrates at locations in the Lower Basin would likely be related to spillage from rail cars.

2.10.1.3 Flood plain Soils/Sediments

Contamination associated with the flood plain is primarily attributed to the direct discharge of jig tailings, and later flotation tailings, to the watershed. Although some of the larger mining and milling operations created tailings impoundments early in this century, discharges to the watershed were common until the late 1960s. These tailings became mixed with alluvium during transport to and within the valley and were reworked by subsequent flooding and further reprocessing efforts. Tailings/alluvium deposits in some of the wider flood plain areas are many feet in depth.

Tailings within the ballast section of the rail bed have typically not been displaced by flood events. Exceptions include those sections of the line that have been breached by flood waters resulting in the erosion and displacement of ballast material over adjacent areas.

Flood plain sediment concentrations where tailings/alluvium mixtures exist range from 1,000 to 50,000 ppm lead (Table 3-2, *Investigation of Surface and Groundwater Metal Contamination From Past Mining Activities Near Osburn*, Idaho, MFG, 1996). These concentrations reflect a mixture of alluvium, waste rock, and both jig and flotation tailings. The highest concentrations are thought to be related to more isolated deposits of jig tailings.

2.10.2 Nature and Extent of Contamination (Analytical Data)

In late September 1996, UPRR initiated a program of sampling of the track and siding areas within the ROW. The sampling program focused on those areas of the ROW where the probability of encountering residual contamination from past railway operations was considered to be the greatest (sidings, historic loading and unloading areas, etc.), as well as areas of the main line track that were considered to be representative of the various sections of the line. Sample locations along the main line track were chosen objectively, without prior inspection of field conditions but with care being taken to ensure that there was an appropriate distribution of sample locations to represent the various conditions that may exist throughout the length of the ROW. Sampling locations are shown on Figures 2, 3 and 4 and are described in Table 2.1. A summary of the sampling results is presented within the sections below.

2.10.2.1 Soil Sampling Procedures

All known siding and loading/unloading areas (16 locations) were sampled, as well as 20 additional representative locations along the main line track. A total of 45 discrete soil samples were collected at each typical mainline sampling location. These individual samples were collected from each of three depth intervals (0"-6", 6"-12", and 12"-18") at fifteen grid nodes straddling the main line track. The grid nodes were located in three parallel rows of five nodes each, with the nodes at 50-foot centers over a 250-foot length; one of the rows being located between the rails, one of the rows being in the lateral zone of the ROW to the north of the track and the other in the lateral zone of the ROW to the south of the track. For each location, the five discrete samples from a given depth interval in a given row (e.g., the samples from the 0"-6" depth interval in the row between the tracks) were combined to produce a single composite sample for that depth interval and row. This protocol resulted in collection of a total of nine composite samples for each main line sampling site along the ROW, representing each of the three sampling depth intervals in each of the three ROW segments (north, middle and south).

At known siding and loading/unloading areas, three composite samples were collected from the siding track area (fifteen discrete samples combined to produce three composite samples, following the same sampling protocol described above). Samples were also collected from the main line track area and lateral zones of the ROW. Figure 6 shows a schematic plan view of the sample location. Figure 7 shows a schematic section view of the sampling depth intervals in the typical rail bed cross-section. The samples collected during this initial sampling program were submitted to a qualified laboratory for analysis of total lead concentrations.

Supplementary analyses were also conducted on ten of the archived samples taken from the ROW locations (six main line locations and four siding locations) during the initial sampling program, to confirm the construction details of the rail bed and observations made during previous sampling efforts. A suite of five additional analytes (zinc, cadmium, arsenic, iron, and manganese) were added to supplement the lead analyses. Additional new samples were also collected at depth in the subgrade embankment at the same ten locations, and a suite of analyses was conducted on these samples. The at-depth samples were collected from sequential one-foot intervals to a depth of five feet or native ground, whichever was greater.

Supplementary sampling and analysis work was conducted during January and February 1997. A compilation of the data collected from all the sampling activities is presented in Tables 2-2, 2-3 and 2-4. Table 2-2 presents data from the main line sampling locations; Table 2-3 presents all data from the siding sampling locations, and Table 2-4 presents data highlighting only the samples collected at depth. Table 2-5 presents QA/QC data from all sampling events.

2.10.2.2 Soil Sampling Results

Figures 8 through 10 present results of surficial soil sampling activities, in graphic format, showing soil-lead concentrations at respective locations and depths (Figure 8: within the Reservation; Figure 9: in the Lower Basin; and Figure 10: in the Upper Basin). At each location, the different histogram bars represent data for north, center, south, and (where applicable) siding sampling points. In addition, Figure 11 presents the results of soil sampling at depth for ten locations. During the at-depth sampling program, all samples were collected from centerline locations (between the mainline rails). The different bars represent soil-lead concentrations at various depth intervals.

In general, the data are consistent with information regarding the construction and historic operation of the rail line. Although the metals concentrations found in the upper six inches are elevated, metals concentrations are generally highest within the core of the ballast section and, in many cases, are lower in the upper six inches of ballast than in the 6" - 18" interval. This finding is consistent with the use of tailings as a component of the original 12-inch thick ballast section, and subsequent placement of cleaner ballast material, not including tailings, over the original material during the course of 100 years of operation and maintenance of the line. In the Lower Basin, where it is understood that locally available native gravels were used in the construction of the subgrade section of the rail bed, there is typically a decrease in lead concentrations below the ballast section. The lower lead concentrations were found consistently, throughout the full depth of the subgrade section, to the depth where native soils were encountered. The sampling at depth, particularly in the Upper Basin, often revealed increased concentrations at the base of the subgrade embankment, indicative of the mantle of tailings that existed in many locations prior to construction of the rail line and upon which portions of the rail bed embankment were constructed.

Upon initial review of the data, there may appear to be some inconsistencies between the initial (ballast only) data and that subsequently collected at the same locations in the “at-depth” sampling program. Upon closer inspection, however, it becomes clear that these apparent inconsistencies are due to the differences in the sampling depth intervals and that the data accurately reflect the trend in concentrations with increasing depth in the rail bed. The data from the at depth sampling activities, as shown in Table 2-4, indicate that the ballast material is within the upper two feet of the rail bed. Further insight is obtained by comparing the data from the 12" - 18" interval in the ballast (initial sampling) with the data from the 1' - 2' interval transcending the ballast subgrade interface (recent sampling). Although these samples were not collected from the exact same locations at the given milepost, they are expected to be reasonably comparable. Comparison of these data indicates that the break between the ballast and the subgrade is most likely at a depth of approximately 18".

The data are consistent with the understanding of the historical construction and maintenance of the rail bed and visual observations. The sampling data and visual observations also indicate that the ballast section is essentially intact. The distinct concentration trend from one depth interval to another is most pronounced in the lead data and appears to be indicative of the relative immobility of the lead. Lead is the primary contaminant of concern for this project. The differentiations from one depth interval to the next are less distinct for the other analytes. However, the decreasing concentration trend with depth below the 6-inch level is generally consistent for all analytes, with the exception of iron. The concentrations of the other analytes are consistent with those found in tailings.

Concentrations of contaminants found in the samples collected from siding locations are generally higher at the locations upstream of the BHSS, (in the vicinity of the focused mining, milling, and loading/unloading activities). Concentrations found in samples collected at the siding locations downstream of the Bunker Hill Site are lower than the concentrations found in samples from sidings above the BHSS. This finding indicates that there was less spillage or leakage of concentrates from rail cars that were staged on sidings, as compared with those that were being loaded or unloaded.

In summary, the data from the sampling events appear consistent with the premise that tailings used in the construction of the original ballast section are essentially confined to the ballast section, (except where localized washouts have occurred), and that the ballast section is approximately 18 inches thick. There is evidence of elevated concentrations of lead and other contaminants in the lateral zones of the ROW, outside of the rail bed, but typically at lower concentrations than in the rail bed ballast section. Concentrations in the lateral zones of the ROW are generally consistent with those found in other areas of the flood plain. The majority of the ROW (between Enaville and Harrison) is within the flood plain of the CDR and is subject to alluvial deposition of tailings transported from upstream sources during flood events.

2.10.3 Fate And Transport Of Contaminants

There are essentially three exposure pathways for the contaminants of concern found within various portions of the ROW:

- Direct exposure to human and environmental receptors, primarily through ingestion and/or inhalation;

- Direct migration to surface water (primarily the SFCDR, the main stem of the CDR, and Lake Coeur d'Alene) by physical erosion, dissolution, and translocation of rail bed materials during flood events; and

- Leaching of material from the rail bed either by infiltration of precipitation or inundation due to flood events.

Of primary concern is the first pathway, direct exposure to human and environmental receptors, due to the potential for acute and chronic health effects on the future users of the ROW. The migration of rail bed materials due to destructive flood actions is also a concern, due to the potentially immediate impact in contributing contaminant loading to the river system. The last exposure pathway, leaching to groundwater, is of less priority for this response action. The potential for groundwater impact by contaminants within the railbed is not believed to be significant relative to the impact that may be occurring from other sources. Impact on groundwater within Coeur d'Alene Basin will be assessed within the Bunker Hill Basin Wide RI/FS.

The direct exposure pathway (inhalation and/or ingestion) is of greater concern along the mainline rail bed and in siding areas known to have been used for loading/unloading, and shunting or storage of cars containing mine products, ore, and concentrates. These areas have demonstrated the highest soil lead levels and are physically the most accessible areas of the ROW. The exposure pathway of secondary concern (migration to surface water) has the highest probability of occurrence along the river banks where potentially contaminated ROW soils are most susceptible to erosion. The potential exposure hazard to human receptors is discussed in the streamlined risk evaluation section.

2.11 STREAMLINED RISK EVALUATION

2.11.1 Human Health Risk

The streamlined risk assessment, the full text of which is included as Appendix A to this EE/CA, addresses potential human health hazards associated with use of the ROW by sensitive population groups. The methodology for the risk assessment follows the analysis and techniques employed in the *Human Health Risk Assessment for the Non-Populated Areas of the Bunker Hill NPL Site* (SAIC, 1992), *Risk Assessment Guidance for Superfund: Human Health Evaluation*

Manual Part A (EPA, 1989) and *Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil (Interim Approach)* (EPA, 1996). The risk assessment considers three basic exposure scenarios (residential, recreational and occupational) and a range of contaminants.

Three population groups are identified as being most sensitive for purposes of this EE/CA. These three groups are: 1) preschool children in residential areas near the ROW; 2) children six to 15 years of age in a recreational scenario; and 3) pregnant women in occupational exposure scenarios. The assessment focuses on soil ingestion as the primary exposure pathway and considers conditions in representative sections of the ROW throughout its length. For purposes of the assessment, the ROW was subdivided into 13 characteristic subsections.

Due to its higher concentrations, the primary contaminant of concern is identified as lead. Secondary contaminants of concern include zinc, cadmium, and arsenic. While other possible contaminants, including agricultural chemicals, petroleum products, poly-chlorinated biphenyls (PCBs), polycyclic-aromatic-hydrocarbons (PAHs), and corrosive ash may be present, they are not currently believed to warrant specific investigation and are not addressed by this EE/CA.

Three subsets of exposure parameters are applied in the analyses. The first subset consists of the parameters used in the previously referenced Bunker Hill Superfund Site Non-Populated Areas risk assessment. The second subset is the Modified Trail scenario that increases exposure frequency, contaminant bioavailability and dose-response rates for lead, that reflect greater contact times associated with a developed recreational facility and the range of absorption parameters that could apply. The third subset is a Reasonable Maximum Exposure (RME) scenario, which defaults to exposure and soil ingestion rates to levels recommended by Region X EPA Guidance.

The ROW is a narrow, continuous strip of land within the much larger Coeur d'Alene Basin. Therefore, the risk assessment considers only those behaviors and activities that may result in exposure to soils and dusts on the ROW properties, and focuses on an assessment of the incremental risks that may result from usage of the ROW by residents and visitors to the area. The quantitative analyses in the assessment are limited to the response action and evaluation of the reduction in exposures and of risk associated with subsequent use of the ROW. The assessment does not address other contaminants of concern, other exposure routes, nor exposures that may occur through activities beyond the ROW (i.e., camping, fishing, swimming, etc.) that individuals using the ROW might experience. A comprehensive risk assessment for the Coeur d'Alene will be performed as part of the Bunker Hill Basin Wide RI/FS.

The assessment evaluates health risks associated with assumed contaminant intakes by estimating the cancer risk for ingested arsenic; the non-carcinogenic health risk for arsenic, cadmium, and zinc; and the incremental blood lead increases for sub-chronic lead exposure. Based on these evaluations, the assessment results in the following conclusions:

> <u>Carcinogenic Risks:</u> The incremental recreational risk for cancer over a lifetime, due to arsenic exposures is generally in the 10^{-5} to 10^{-6} range prior to response action and is decreased substantially following remediation. Occupational risks are estimated to be approximately one order of magnitude higher in the Modified Trail, No-Action scenario, and up to three orders of magnitude higher in the most contaminated RME, No-Action scenario.

Non-carcinogenic Risks: There are insignificant risks from non-carcinogenic effects for arsenic, cadmium, and zinc. Potentially significant exposures to arsenic could occur through occupational exposures in a No-Action scenario in areas near the river directly upstream or downstream of the BHSS.

Blood Lead Increments: In the absence of response actions, potentially significant blood lead increases are predicted for the entire length of the ROW, although the predicted blood lead levels have not yet been observed in children or adults in the region. Under the anticipated post-remediation scenario, estimated blood lead increments are reduced to less than 0.5 µg/dl in the residential portions of the ROW. Mitigation of predicted increases in the more remote segments of the ROW will depend upon effective implementation of institutional controls to regulate access to off-ROW areas.

With regard to occupational exposures, there are concerns with potential carcinogenic and non-carcinogenic risks associated with the theoretical ingestion of arsenic and with sub-chronic risks to pregnant workers associated with potential lead exposures. Excessive recreational exposures would be of concern if no response actions were to be implemented. However, following anticipated response actions, excessive exposures are indicated only at particular remote areas along the ROW. Residential exposures to soil lead in the ROW are considered to be unacceptable in all areas under current conditions. However, these excessive exposures would be resolved by the proposed response actions.

2.11.2 Ecological Risk

Contaminants located along the ROW remain a potential continual, point and non-point source of solid- and dissolved-phase contaminants to the CDR system and Lake Coeur d'Alene due to erosion and dissolution. The pathways by which ecological receptors could become exposed to contaminants include:

- Direct contact with mine waste materials and with water and sediments contaminated by mine waste materials.

- Ingestion of mine waste materials and water and sediments contaminated by mine waste materials.

- Ingestion of contaminated food (e.g., sediment- or soil-dwelling insects, vegetation).

Threats to ecological receptors from these pathways will be evaluated through the Bunker Hill Basin Wide RI/FS and the ongoing Natural Resource Damage Assessment (NRDA) in the Coeur d'Alene Basin.

2.11.3 Risk Management

As indicated above, it is acknowledged that the ROW and many of the areas that would be assessed from the ROW are already being used, to some extent, for recreational purposes. Contamination throughout the ROW and adjacent areas is extensive. In addition, the ROW between Enaville and Harrison is subject to significant potential recontamination due to flood events until complete source control measures are implemented in upstream areas. Appropriate response actions combined with appropriate management of the ROW corridor offers the opportunity to reduce the risks associated with potential exposures to these contaminants. Risk management of the ROW corridor would be facilitated by the conversion of the ROW into a trail thereby allowing for uniform and coordinated control of activities that may occur along the ROW.

The streamlined risk assessment recommends the following three categories of risk management for the ROW corridor:

- Residential Exposure Management,
- Recreational Exposure Management, and
- Occupational Exposure Management.

Each of these risk management categories is discussed below.

Residential Exposure Management: Local residents may already have elevated blood lead levels due to general exposure conditions in the Coeur d'Alene Basin, and they are more likely to use the ROW corridor with higher frequency than Coeur d'Alene Basin visitors. Therefore, the risk management strategy for the residential areas should be to reduce potential exposures associated with the ROW and its potential use to less than that currently experienced within the residential environment. This risk management strategy can be accomplished by providing for clean soil or gravel barriers within the portion of the ROW that is most subject to use by the local population. In particular, the risk management strategy should focus on reducing potential exposures to the more sensitive sub-populations of young children and pregnant women. Given these considerations, the barriers should extend beyond all communities and individual residences that are adjacent to the trail.

Recreational Exposure Management: The objective of the recreational exposure management should be to reduce average contact times in the remote areas of the trail. Such reductions can be achieved by the following:

- Institutional controls such as signage, education, etc. to inform visitors of potential hazards associated with contamination that may remain within the ROW and adjacent areas,

- Providing clean rest stop/oasis areas at strategic locations along the trail to encourage ROW users to stop at these controlled areas,

- Use of access barriers such as fencing, etc. in those areas that represent the higher contamination and potential for exposure,

- Uniform and coordinated control of land use, access and allowable activities within the ROW.

Occupational Exposure Management: Potential excessive occupation exposures can be minimized through appropriate training and monitoring of personnel that may be involved in trail maintenance and operations.