MIDNITE URANIUM MINE
NATURAL RESOURCE DAMAGE ASSESSMENT

ASSESSMENT PLAN PART I:
INJURY DETERMINATION

Prepared by:

The Midnite Uranium Mine Natural Resource Trustee Council:
Spokane Tribe of Indians
Confederated Tribes of the Colville Reservation
United States Department of the Interior

25 February 2004

Signature: Joseph A. Pakootas

Title: Chairman, Colville Business Council

Date: 3-11-04

Signature: _____

Title: For Chairman, Spokane Tribe of Indians

Date: 3-8-04

Signature: _____

Authorized Official, Department of the Interior

4/26/04

United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
Washington, D.C. 20240

MAR 0 5 2004

IN REPLY REFER TO:

Division of Natural Resources

Memorandum

To: Regional Director, National Park Service
Regional Director, Fish and Wildlife Service
Assistant Solicitor, Office of the Solicitor

From: Allen Sedik NRDAR Program Manager, Bureau of Indian Affairs

Subject: Concurrence with Authorized Official Signature on the Midnite Uranium Mine Natural Resource Damage Assessment, Assessment Plan Part 1: Injury Determination

The attached plan is being provided to you for your review and concurrence before the Authorized Official signs the Plan.

Please provide your signature below, as evidence of your concurrence for the Authorized Official to sign the Plan. I would appreciate your faxing this signed concurrence page to me at (202) 208-1605. Questions may be directed to me at (202) 208-5474.

		Suzanne R. Schaffer
Regional Director National Park Service	Regional Director Fish & Wildlife Service	Assistant Solicitor Office of the Solicitor
		3/5/04
Date	Date	Date

Attachment

cc: Without Attachment
Rick Dawson, NPS,
Ken Seely, FWS
Jean Rice, SOL

United States Department of the Interior

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Regional Director National Park Service	Regional Director Fish & Wildlife Service	Suzanne R. Schaffer Assistant Solicitor Office of the Solicitor
4/22/2004 Date	Date	3/5/04 Date

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Regional Director National Park Service	Acting Regional Director Fish & Wildlife Service	Assistant Solicitor Office of the Solicitor
Date	4/7/04 Date	3/5/04 Date

Attachment

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Acronyms

ALC	aquatic life criteria
AO	Authorized Official
ARD	acid rock drainage
BIAM	Bureau of Indian Affairs Manual
BLM	Bureau of Land Management
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COPC	contaminants of potential concern
CWA	Clean Water Act
DM	Departmental Manual
DMC	Dawn Mining Company
DOI	Department of the Interior
GRAP	Groundwater Remedial Action Plan
HSCA	Hazardous Substances Control Act
LAT	Lead Administrative Trustee
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MOA	Memorandum of Agreement
MUMNRTC	Midnite Uranium Mine Natural Resource Trustee Council
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NMC	Newmont Mining Corporation
NPS	National Park Service
NRC	Nuclear Regulatory Commission
NRDA	Natural Resource Damage Assessment
NURE	National Uranium Resource Evaluation
PAS	Preassessment Screen for the Midnite Mine Facility
PEC	probable effect concentration
PIA	the USEPA-defined Potentially Impacted Area related to the Midnite Mine
PRPs	potentially responsible parties
RCDP	Restoration and Compensation Determination Plan
RI/FS	Remedial Investigation/Feasibility Study
RPM	Remedial Project Manager
SDWA	Safe Drinking Water Act
TEC	threshold effect concentration
UCUT	Upper Columbia United Tribes Fisheries Center
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WDOH	Washington State Department of Health

1.0 Introduction

1.1 Statement of Purpose

The Spokane Tribe of Indians (Spokane Tribe), the Confederated Tribes of the Colville Reservation (Colville Tribes), the U.S. Department of the Interior (DOI), represented by the Bureau of Indian Affairs (BIA), the Fish & Wildlife Service (USFWS) and the National Park Service (NPS), (collectively the Trustees) intend to assess injury to natural resources resulting from releases of hazardous substances from the Midnite Uranium Mine facility (facility). The Assessment will include natural resources on and adjacent to the Spokane Indian Reservation, Stevens County, Washington; the Blue Creek, Sand Creek, and Chamokane Creek watersheds; the Spokane River and Spokane Arm of Lake Roosevelt; and may include any other areas where hazardous substances from the facility have come to be located.

This Natural Resource Damage Assessment (NRDA, or Assessment) will be initiated pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) [42 USC § 9607(f)], the Clean Water Act (CWA) [33 USC §§ 1321(f)(4)-(5)], the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) [40 CFR Part 300 Subpart G], and the DOI's NRDA regulations, codified at 43 CFR Part 11 (Regulations). CERCLA and the CWA hold those parties responsible for releases of hazardous substances liable for "damages for injury to, destruction of, or loss of natural resources, including the reasonable costs of assessing such injury, destruction, or loss resulting from such a release" [42 USC § 9607(a); 33 USC § 1251 *et seq.*].

The Trustees' goal is to fully restore the ecological and human use services lost or diminished as a result of injuries caused by hazardous substance releases from the facility. This Assessment Plan (Plan) is intended to describe the proposed methods the Trustees will use to (1) establish that injury to natural resources as defined under the Regulations has occurred, and (2) quantify changes in natural resources and natural resource services resulting from these injuries. The Trustees intend for this Plan to communicate proposed assessment methods to potentially responsible parties (PRPs) and the public so that these stakeholders can productively participate in the assessment process. The Trustees also wish to ensure that the Assessment is completed in a reasonable time and with efficient use of financial and staff resources.

With respect to injury quantification, the Trustees intend to develop information to support an equivalency-based approach to restoration of lost ecological services. For lost human use services, the Trustees intend to develop information describing the manner and extent to which the identified injuries affect human uses of the natural resources. This will support a variety of approaches to restoration of these lost services.

This Plan addresses Injury Determination, the first phase of an NRDA. It is divided into four sections. Section 1 introduces the Plan by describing the authority and process by which the Trustees have undertaken this effort. Section 2 discusses the

geography of the assessment area, the history of the Mine, the nature of the releases, and the natural resources within the assessment area. Section 3 confirms that natural resources have been exposed to hazardous substances released from the facility. Section 4 presents approaches for assessing injuries to natural resources. All studies conducted as part of the Injury Determination phase will be conducted in accordance with a Quality Assurance Project Plan (MUMNRTC, 2003) prepared for the project.

Additional documents addressing subsequent phases of the Assessment (*i.e.*, Injury Quantification, Damage Determination, and Restoration and Compensation Determination) will be developed as appropriate.

1.2 Legal Authority of Trusteeship

1.2.1 Spokane Tribe

An Indian tribe is a trustee for "natural resources belonging to, managed by, controlled by, or appertaining to such tribe, or held in trust for the benefit of such tribe, or belonging to a member of such tribe if such resources are subject to a trust restriction on alienation… " [42 USC § 9607(f)(1)]. Such natural resources include "their supporting ecosystems" [40 CFR § 300.610]. The NCP recognizes the Chairman of an Indian tribe as a natural resource trustee acting on behalf of the tribe [40 CFR § 300.610].

The Chairman of the Spokane Tribe asserts trusteeship for all natural resources within the Spokane Indian Reservation held in trust for the Spokane Tribe by the United States, including the Blue Creek and Chamokane Creek watersheds, the Spokane and Columbia Rivers (including the Spokane Arm and upper portions of Lake Roosevelt National Recreation Area), and over all natural resources appertaining to the Spokane Tribe. The Chairman may also assert trusteeship over allotments located within the Reservation.

1.2.2 Colville Tribes

An Indian tribe is a trustee for "natural resources belonging to, managed by, controlled by, or appertaining to such tribe, or held in trust for the benefit of such tribe, or belonging to a member of such tribe if such resources are subject to a trust restriction on alienation ..." [40 CFR § 9607(f)(1)]. Such natural resources include "their supporting ecosystems" [40 CFR § 300.610]. The NCP recognizes the Chairman of an Indian tribe as the natural resource trustee acting on behalf of the tribe [40 CFR § 300.610].

The Chairman of the Business Council of the Colville Tribes asserts trusteeship for all natural resources within the Colville Indian Reservation, held in trust for the Colville Tribes by the United States; within the former north half of the reservation where the tribes retain hunting, gathering, and fishing rights; within the Public Domain Allotments; and over all natural resources appertaining to the Colville Tribes, including portions of Lake Roosevelt.

1.2.3 Federal Trustees

As directed by CERCLA [42 USC § 9607 (f)(2)(A)], the President has designated in the NCP the federal officials who are authorized to serve as natural resource trustees [40 CFR § 300.600(b)].

The Secretary of the Interior has trustee authority under the NCP for natural resources "belonging to, managed by, held in trust by, appertaining to, or otherwise controlled" by the DOI. Such natural resources include "land, fish, wildlife, biota, air, water, groundwater, drinking water supplies, and other such resources" [40 CFR § 300.600(a)], as well as "their supporting ecosystems" [40 CFR § 300.600(b)]. In addition to the trustee responsibility set forth in 40 CFR Part 300, the Secretary of the Interior is also charged under other authorities as a trustee for the trust assets of Indian tribes. Such trusteeship is founded on the United States by statute, treaty and case law. "It is the policy of the Department of the Interior to recognize and fulfill its legal obligations to identify, protect, and conserve the trust resources of federally recognized Indian tribes and tribal members . . ." [512 DM 2.1]. Therefore, the Spokane Tribe, the Colville Tribes, and the Secretary of the Interior are acting as co-Trustees for the natural resources assessed herein.

Bureau of Indian Affairs

By a provision of the Departmental Manual (DM), the Secretary of the Interior has delegated to bureau directors the authority to act on behalf of the Secretary as the Authorized Official (AO) in conducting assessment activities [207 DM 6, paragraph 6.3B]. Furthermore, the Bureau of Indian Affairs Manual (BIAM) states that "directors may exercise all of the program authority of the Commissioner of Indian Affairs necessary to fulfill the responsibilities for those functions, programs and activities assigned to their organizations" [3 BIAM chapter 2 (paragraph 2.8), chapter 4 (paragraph 4.4)]. The Director, Office of Trust Responsibilities of the BIA serves as DOI's AO for this Assessment. In addition, BIA has management authority and trust responsibility to protect, preserve and defend the trust resources of the Spokane and Colville Tribes.

U.S. Fish and Wildlife Service

The USFWS has management authority and trusteeship for migratory birds, threatened and endangered species, and their habitats. The species over which the USFWS has trusteeship, in this case, include a broad range of upland, riparian, shorebird, and waterfowl species utilizing habitat on the Spokane Indian Reservation as well as the Spokane River and Spokane Arm of Lake Roosevelt. Potential threatened and endangered species include Canada lynx, bald eagle, gray wolf, grizzly bear, bull trout and Ute ladies'-tresses. The USFWS is co-trustee of these resources with the Spokane and Colville Tribes.

National Park Service

The NPS administers Lake Roosevelt National Recreation Area, which includes approximately 60,000 acres of federally owned land and waters of Lake Roosevelt on the Upper Columbia River. A portion of the Lake Roosevelt National Recreation Area lies within the Spokane Arm of Lake Roosevelt. The NPS has management authority and trusteeship for the shoreline and beaches, campgrounds and dispersed campsites, and public boat launches within the recreation area boundaries, and manages these resources for public use.

1.2.4 State Trustees

The NCP provides that “[s]tate trustees shall act on behalf of the public as trustees for natural resources, including their supporting ecosystems, within the boundary of a state or belonging to, managed by, controlled by, or appertaining to such state” [40 CFR § 300.605]. As possible trustees for the state of Washington, Washington Department of Fish and Game and Washington Department of Ecology have been notified of Trustee activities, but to date have elected not to participate.

1.2.5 Trustee Organization

The case management structure identifies the case management team that has been assembled to conduct an Assessment at the Midnite Mine Facility. The team consists of the Trustees for the case, currently including the Spokane Tribe, DOI, and the Colville Tribes. Formation of this case management team is consistent with the "Memorandum of Agreement Among the Spokane Tribe of Indians' Business Council, Confederated Tribes of the Colville Indian Reservation, and the United States Department of the Interior, Regarding Natural Resource Damage Assessment and Restoration Related to the Midnite Mine Superfund Site..." (Trustee MOA). Figure 1.1 depicts the NRDA management structure, most of which is described in the Trustee MOA.

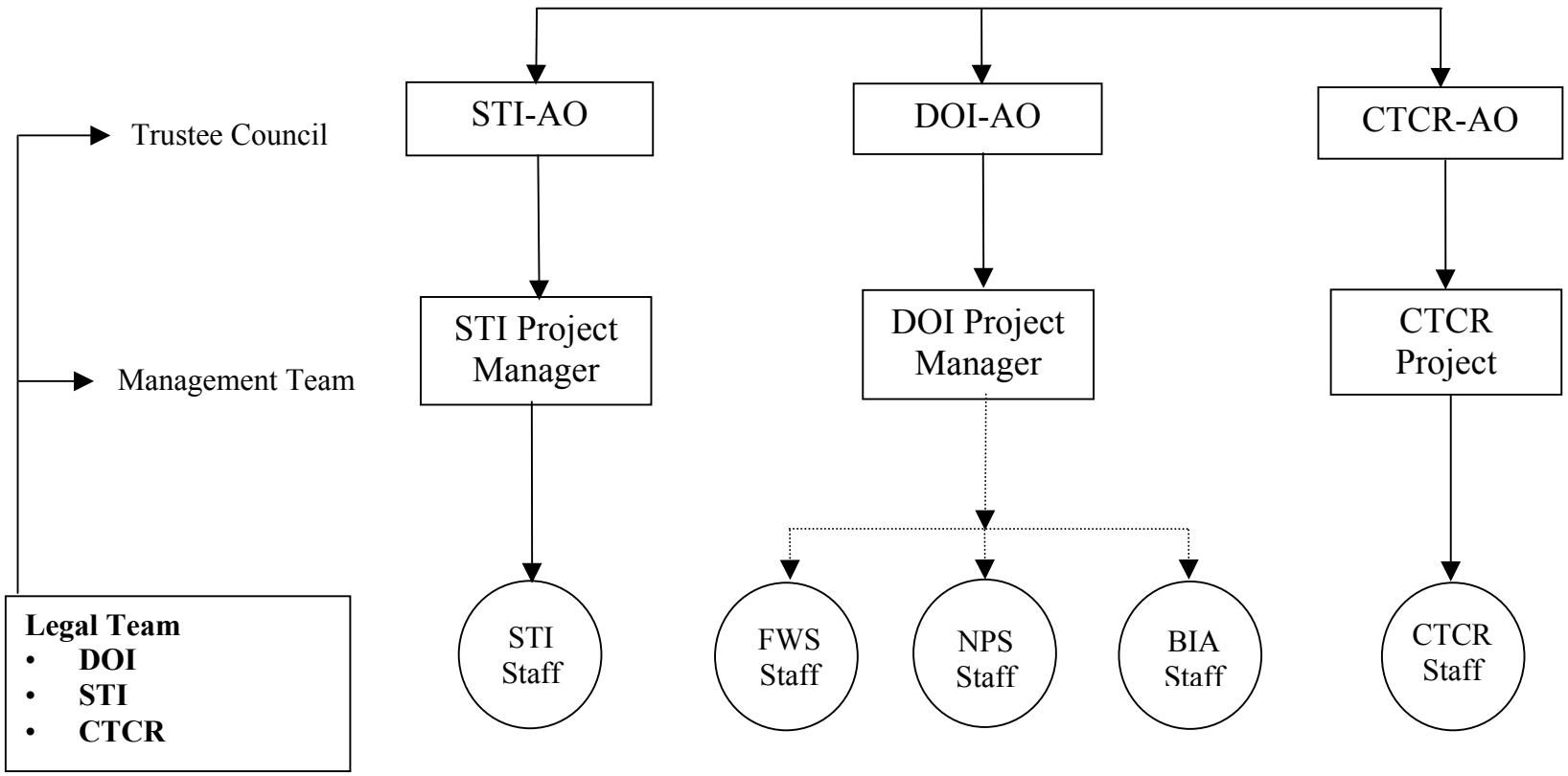


Figure1.1 Midnite Uranium Mine Natural Resources Trustee Council Organization

1.3 Completion of Preassessment Screen Determination

In accordance with the Regulations, before deciding whether to initiate an Assessment, the Trustees conducted a Preassessment Screen (PAS) "to provide a rapid review of readily available information" on trust natural resources that may have been injured by releases of hazardous substances [43 CFR § 11.23(b)]. Based on a review of readily available data, the Trustees completed the PAS on August 1, 2002. In accordance with the criteria at 43 CFR § 11.23(e), the PAS supported the conclusion that there is a reasonable likelihood that natural resources have been injured and that the Trustees should conduct an Assessment to develop a damage claim under 42 USC § 9607.

1.4 Natural Resource Damage Assessment and Restoration Process

This Plan is designed in accordance with the Regulations promulgated by the DOI at 43 CFR Part 11. The use of these regulations is optional, but an Assessment performed in accordance with them is provided a legal evidentiary status of a rebuttable presumption in an administrative or judicial proceeding [43 CFR § 11.10].

The process described in the Regulations involves four major components. The first component is the Preassessment Screen, discussed in Section 1.3.

The second component is the preparation of an Assessment Plan. The Assessment Plan essentially serves as the workplan for the Assessment. The Assessment Plan also includes information that assures that the Assessment is proceeding in a planned, systematic, and cost-effective manner and that various requirements of the regulations are being met.

After preparing the Assessment Plan, trustees proceed to evaluate injury to natural resources. In this case, the Trustees chose a "Type B" assessment methodology (see Section 1.5), which involves three phases.

1. Injury Determination Phase: The Trustees determine whether injury to natural resources has occurred and whether the injury has resulted from the release of hazardous substances.

2. Injury Quantification Phase: The Trustees quantify the injuries and the resulting reduction of natural resource services, which may include ecological services (*e.g.*, wildlife habitat and erosion control), and human use services (*e.g.*, recreation, subsistence, and cultural uses).

3. Damage Determination Phase: The Trustees estimate the monetary compensation required to restore, rehabilitate, or replace the injured natural resources and related services. Trustees are required to identify methods for determining damages as part of a Restoration and Compensation Determination Plan (RCDP). Because current information is insufficient to develop the RCDP, it will be completed at a later time.

The fourth component of the assessment process consists of the post-assessment phase. A Report of Assessment is prepared and made available to the public. The Report of Assessment consists of supporting documentation and the results of the studies performed during the injury determination, quantification, and damage determination phases of the Assessment. The potentially responsible parties (PRPs) are presented with a demand in writing for a sum certain, representing the damages due to the Trustees. An account is established for the management of recovered damages. Finally, a Restoration Plan is developed and implemented.

This Plan addresses the first phase of the damage assessment process, Injury Determination (Part I of the Plan). The injury quantification and damage determination phases will be addressed in subsequent documents. In developing this Plan, the Trustees have considered all available data. This includes certain ephemeral data already gathered by the Trustees. Because response actions were occurring at the facility, the Trustees felt it was important to gather data that represent the condition of natural resources and the impacts from the facility before response actions were fully implemented.

1.5 Decision to Perform a Type B Assessment

Under the DOI's NRDA regulations, the Trustees can elect to perform a Type A or a Type B assessment [43 CFR § 11.33]. This section documents the Trustees' decision to perform a Type B assessment.

The Type A assessment approach is not appropriate for this case. Type A procedures are "simplified procedures that require minimal field observation" [43 CFR § 11.33(a)]. An authorized official may use a Type A assessment only if the released substances are in coastal/marine or Great Lakes environments [43 CFR § 11.33, 11.34], making a Type A assessment inapplicable. Furthermore, simplified Type A assessment methods would be inappropriate. Releases of hazardous substances may have occurred for nearly 50 years. Consequently, the releases cannot be considered of a short duration, minor, or resulting from a single event, and therefore are not readily amenable to simplified models. Further, the spatial and temporal extent and heterogeneity of exposure conditions and potentially affected resources are not suitable for application of the simplifying assumptions, averaged data, and conditions inherent in Type A procedures.

The alternative to a Type A procedure is a Type B procedure. Type B procedures require "more extensive field observation than the Type A procedures" [43 CFR § 11.33(b)]. As discussed above, a Type B assessment consists of three phases: (1) injury determination, (2) injury quantification, and (3) damage determination [43 CFR § 11.60(b)].

The Trustees have determined: (1) that the Type A assessment cannot be appropriately applied to the long-term, spatially and temporally complex nature of releases and exposures to hazardous substances characteristic of the assessment area; (2) that substantial site-specific data already exist to support the assessment; and (3) that additional site-specific data can be gathered at reasonable cost. As a result, the Trustees have concluded that the use of Type B procedures is justified.

1.6 Coordination with Non-Trustee Entities

1.6.1 Coordination with response agencies

To the extent possible, an assessment should be conducted in coordination with any investigations undertaken as part of NCP response actions, particularly a Remedial Investigation/Feasibility Study (RI/FS) [43 CFR § 11.31 (a)(3)]. The Trustees realize that implementing a protective remedy is of primary importance for protection of natural resources. However, based on current information, it is not likely that remediation alone will achieve full restoration of injured natural resources and the services provided by those resources. Moreover, the timing and nature of the remedy selected will affect the extent and duration of continuing injuries to natural resources. Therefore, the amount of restoration required will depend, to a degree, on the remedy selected, the timing of its implementation, and the degree to which the remedy is successful. In general a less protective remedy will result in: (1) a greater residual injury to natural resources; (2) a consequent need for more extensive restoration to return the resources and the services these resources provide to their baseline condition; and (3) greater compensation to make the public whole for the additional services it has lost. For these reasons, the Trustees have coordinated, and will continue to coordinate, with the U.S. Environmental Protection Agency (EPA) on response actions and the Remedial Investigation/Feasibility Study (RI/FS) process.

To this end, and because coordination among the Trustees is an essential component of a cost-effective assessment, the Trustees and the USEPA signed a Memorandum of Agreement (MOA) creating the Midnite Uranium Mine Natural Resources Trustee Council (MUMNRTC). The MOA provides a framework for coordination and cooperation among the Trustees and between the Trustees and the EPA. The Spokane Tribe acts as Lead Administrative Trustee (LAT) and is the central contact on behalf of the Trustees. The USEPA's Remedial Project Manager (RPM) for the Midnite Mine Superfund Site has coordinated with the Trustees, helping to keep the Trustees informed of ongoing and planned response actions, and soliciting comments from the Trustees on various response action workplans and orders.

The goals of such coordination are: (1) to avoid duplication, (2) reduce costs, and (3) achieve dual objectives where possible. At a minimum, the Trustees intend to consider the objectives of removal actions, RI/FS activities, and remedial actions during the continued planning and implementation of the Assessment. Whenever possible, the Trustees will explicitly coordinate assessment activities with other investigations and will ensure that appropriate consideration is given to parties undertaking response or restoration activities that satisfy the Trustees' objectives.

1.6.2 Coordination with PRPs

To facilitate Trustee-PRP coordination and to reduce the burden on the Trustees' financial resources, the Trustees requested participation of Dawn Mining Company (DMC) and Newmont Mining Company (NMC) (the Companies) in the Assessment.

However, in letters dated September 26, 2002 and September 30, 2002, DMC and NMC, respectively, declined the invitation to participate. The Trustees remain open to, and encourage, the participation of either or both of the Companies.

1.6.3 Public review and comment

This Plan is available for public review and comment. Comments must be received within 30 days from the date the notice of availability is published in the Federal Register. Comments may be submitted in writing to the LAT for the Trustees:

Spokane Tribe of Indians
c/o Dr. F.E. Kirschner
P.O. Box 312
Valleyford, WA 99036

The Trustees may amend the Plan during later phases of the Assessment. Any significant amendments will be made available for public review [43 CFR § 11.32(e)].

2.0 Description of the Assessment Area

2.1 Geographic Scope

2.1.1 Definitions of geographic terms

Midnite Mine (Mine): The property leased by the Companies for the purpose of mining. This property is fully contained within the Spokane Indian Reservation.

Mill: The property owned by the Companies (also known as the Dawn Mill) for the purpose of milling ore. This property is located adjacent to the eastern boundary of the Spokane Indian Reservation within Stevens County, Washington.

Ford-Wellpinit Road: The road between the Midnite Mine and the Mill. During the active operations of the Midnite Mine, the Ford-Wellpinit road was used as a transportation artery for hauling uranium ore from the Midnite Mine to the Mill. Today the road is used to haul water treatment plant sludge generated at the Midnite Mine to the Mill for disposal. Although named the Ford-Wellpinit Road, the road actually stretches from Ford to the West End Community of the Spokane Indian Reservation.

Facility: The "area or location, for purposes of response actions under the NCP, at which ... hazardous substances have been stored, treated, ... released, disposed, placed, or otherwise came to be located" [43 CFR § 11.14(oo)], which in this case extends beyond the Mine property.

Assessment area: "The area or areas within which natural resources have been affected directly or indirectly by the . . . release of a hazardous substance and that serves as the geographic basis for the injury assessment" [43 CFR § 11.14(c)], namely, the Blue Creek, Sand Creek, Chamokane Creek watersheds, portions of the Spokane River and the Spokane Arm of Lake Roosevelt, and any other areas containing natural resources potentially exposed to hazardous substances released from the Midnite Mine or Mill Properties. Because the assessment area covers areas of indirect and direct effects of releases, it may extend further than the boundaries of any response action.

2.1.2 The assessment areas

2.1.2.1 The Midnite Mine

The Midnite Mine is an inactive open-pit uranium mine situated entirely within the bounds of the Spokane Indian Reservation in Eastern Washington. The Reservation is located at the confluence of the Columbia and Spokane Rivers (Figure 2.1). As shown in Figure 2.2, the Midnite Mine lies within the Blue Creek (approximately 12,600 acres) and Sand Creek (approximately 17,500 acres) watersheds at the southern end of the Huckleberry Mountains. Both of these watersheds are first order drainage basins within

the Spokane River Watershed. Figure 2.2 also shows the Trustees' provisional assessment of the potential extent of contamination and injury related to releases from the facility.

The Midnite Mine covers approximately 811 acres (Figures 2.3 and 2.4). Major features include: two large water-filled mining pits (Pit 3 and Pit 4); former mining pits now backfilled with mine waste and waste rock; a retention pond, sometimes also called the "pollution control pond"; a "blood pool" (a leachate collection pool); outfall ponds and seeps; at least eight abandoned uranium ore and protore (low-grade uranium ore) piles; large mining spoils (waste rock) disposal areas; a mine water treatment plant; a system of weirs, ditches, and sumps for seepage collection; and various buildings housing pump equipment and storage tanks for collected seep water (Harris, 1988; Work, 1999; USEPA, 2000a; URS, 2000a, 2000b).

Although only two open mine pits remain visible, over the years at least seven more pits were developed (E&E, 1999); these pits have either been backfilled with waste or incorporated into the remaining pits (Harris, 1988; E&E, 1999).

Zamora (1983, as cited in URS, 2000a) classified ecological habitats within the Spokane Indian Reservation using a system of vegetative cover types and other physical features. The four primary habitat types occurring in the assessment area include, but are not limited to, upland (generally forested) habitat, riparian and wetland habitats, riverine habitat, and lacustrine habitat (URS, 2000a). Blue Creek and its associated drainages provide terrestrial, riparian, wetland, and aquatic habitat, as well as support for an important tribal fishery (Campbell, 2002).

A brief description of the geology of the Mine is provided by Ames *et al.* (1996). Geologically, the Mine lies along the contact of the Togo formation, a Precambrian metasedimentary roof pendant, and the Loon Lake Granite, a Late Cretaceous porphyric quartz monzonite (Ames *et al.*, 1996). The Togo formation, which is approximately 2,700 feet thick in the vicinity of the Mine, consists of a thinly bedded slaty argillite and phyllite with discontinuous lenses of dolomitic marbles, calc-silicates, and quartzite, grading upward into a medium-grained, well cemented quartzite (Ames *et al.*, 1996).

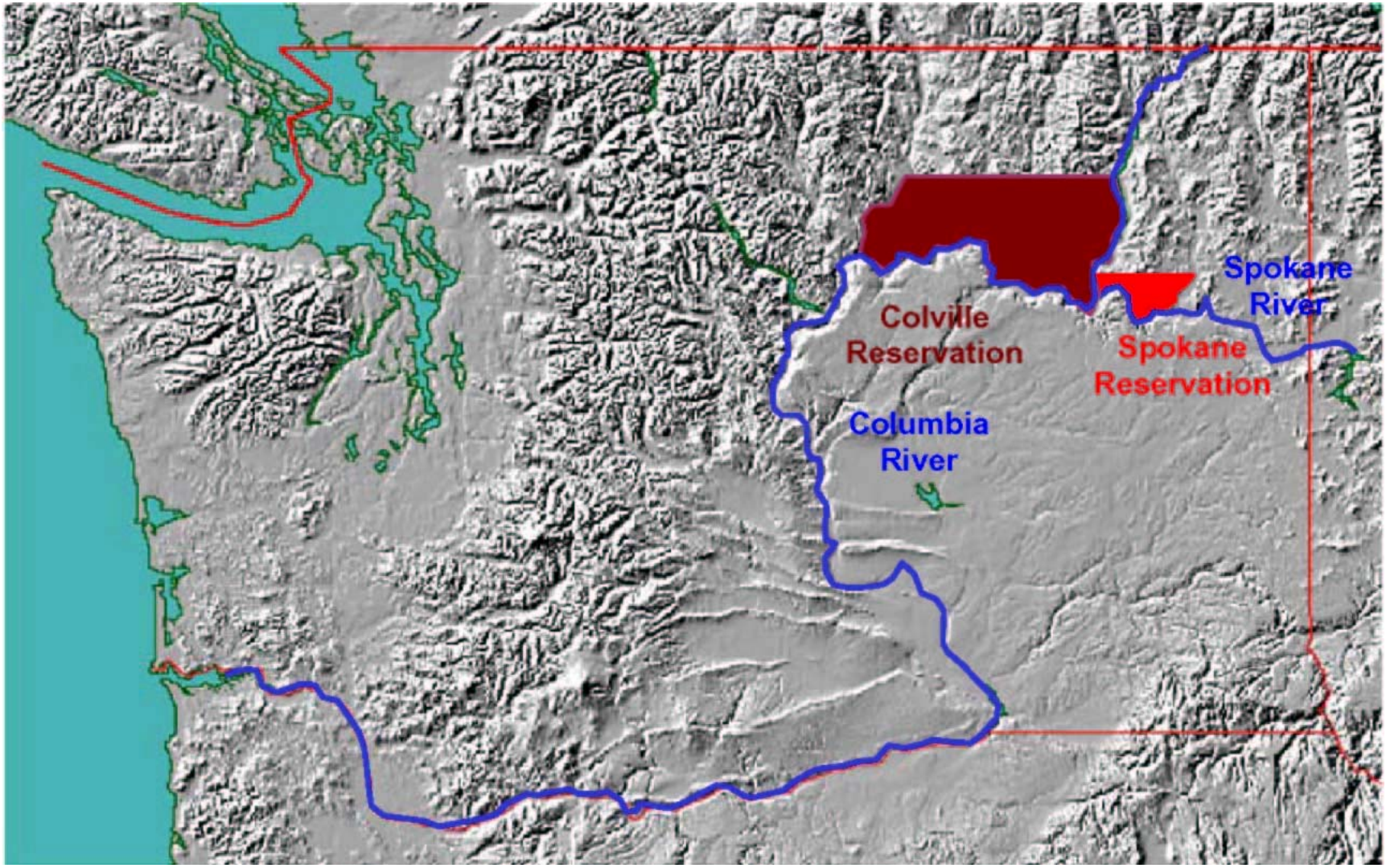


Figure 2.1. Location of the Spokane Indian Reservation.

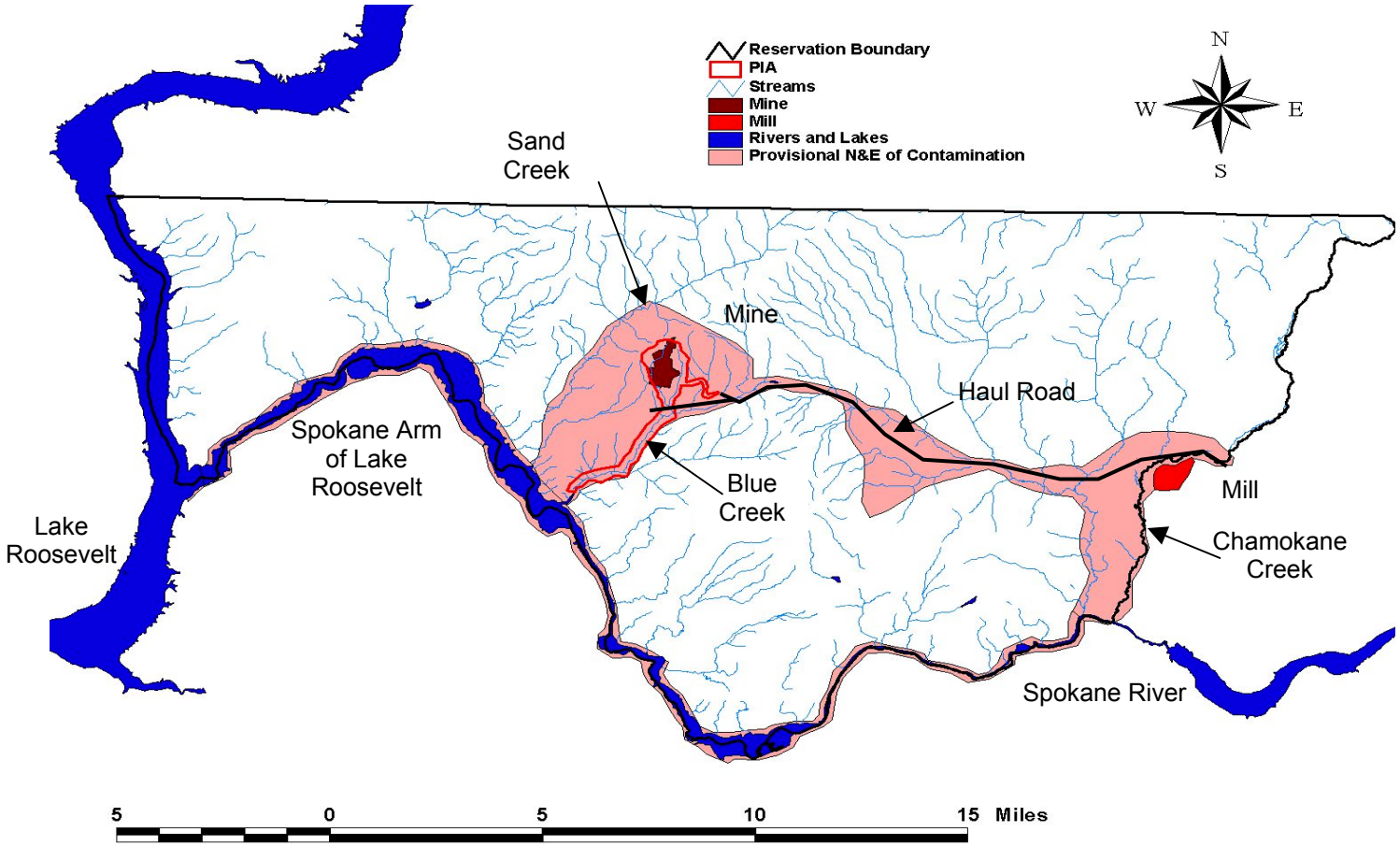


Figure 2.2. Location of Midnite Mine, Mill, Haul Road, and related features.

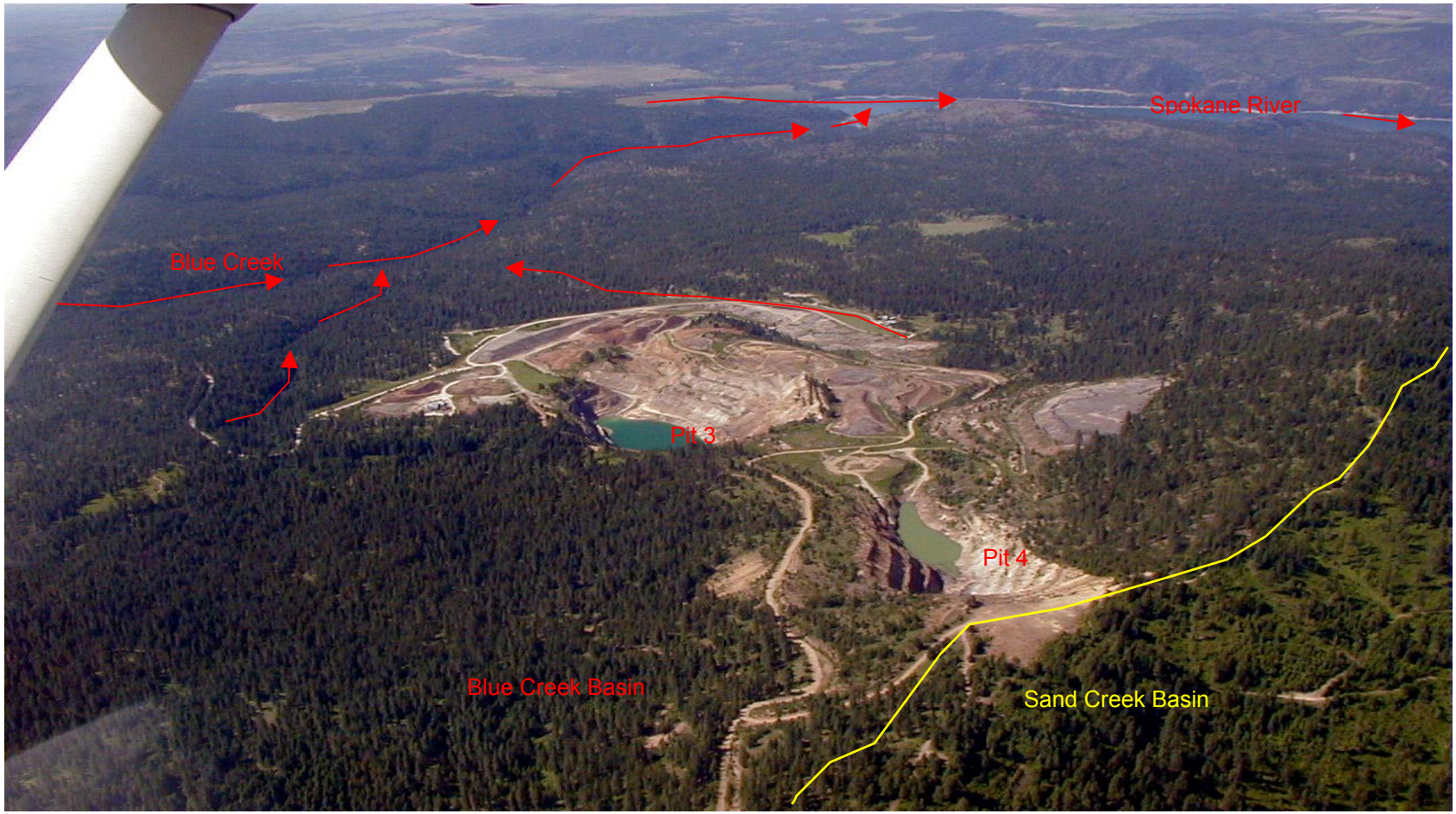


Figure 2.3. Aerial photo of the Midnite Mine looking southeast (perennial streamflow depicted by red arrows).

Figure 2.4. Aerial photo of the Midnite Mine looking northwest.

2.1.2.2 Mill

The Mill is located on approximately 820 acres of land near the town of Ford, Washington, northwest of the City of Spokane (Figure 2.2). The Mill lies within the Chamokane Creek Watershed (approximately 117,000 acres), which is a first order drainage basin contained within the Spokane River Watershed.

Situated on nine acres, the Mill is comprised of 11 buildings, including an office building and storage buildings, as well as three buildings used for processing uranium ore. In addition, approximately 14 acres adjacent to the Mill complex are designated as ore storage pads, where the uranium ore was stockpiled prior to milling operations. The tailings disposal area (TDA), composed of four tailings impoundments, occupies 133 acres (Figure 2.5). TDAs 1-3 are unlined and are located underneath the lined evaporation ponds. Only TDA 4 is currently operational. On its northern and western boundaries, the Mill area fronts Chamokane Creek which, at this point, is wholly within the Spokane Indian Reservation (WDOH 1991; Hayes, R. B., Executive Order of January 18, 1881).

The Mill is located in Walker's Prairie, a northeast trending valley about 2 miles wide and 15 miles long. The uranium mill tailings disposed of at the Mill are impounded on a relatively level terrace in the Chamokane Creek drainage basin. The creek runs through the terrace to form a relatively steep scarp approximately 100 feet high and comes within about 900 feet of the tailings impoundments at its closest point (WDOH, 1991). Chamokane Creek currently supports the Spokane Tribe's largest inland fishery and the wetland complex adjacent to the creek is the largest on the reservation.

The geology of the Mill area is comprised of horizontal beds of glaciofluvial clays, sands, and bouldery rubble. The uppermost 40 feet is primarily very coarse sandy gravels. Within this zone is a silty-clay layer dipping gently to the southwest. This clay layer is believed to provide a base for vertically infiltrating seepage solutions and appears to be the main constraint on the flow of contaminants leaking from unlined tailings impoundments at the Mill (WDOH, 1991). However, the hydrogeology and lateral extent of this silty-clay unit is not thoroughly characterized within the Mill area (Kirschner, 1995), and potential impacts to down gradient wetlands and to the lower aquifer are not well understood.

Figure 2.5. Aerial photo of the Mill looking southwest (perennial streamflow of Chamokane Creek depicted by red arrows, Spokane River in background).

2.1.2.3 Ford-Wellpinit Haul Road

During the active operations of the Midnite Mine, the Ford-Wellpinit road was used as a transportation artery for hauling uranium ore from the Midnite Mine to the Mill (Figure 2.2). The road is paved with asphalt and is two lanes wide; the section of the road used for ore transport is approximately 25 miles long (Dempsey, Shura and Harris, 1999). The road runs through the communities of Wellpinit and Ford. Before reaching the Mill, the road intersects Highway 231, sharing this road for less than one mile before the Mill turnoff.

The haul road: (1) passes through pine tree forests, open grassy fields, and farm/ranch areas with scattered residences in some areas (Dempsey, Shura and Harris, 1999); (2) passes over no less than seven geologic units; and (3) crosses or parallels eight surface waterbodies, including Turtle Lake, and associated riparian, aquatic, and wetland resources. Almost all of the Tribe's 1,100 members live within a 17-mile radius of the haul road, and at least 140 live along the road itself (based on an estimate of one person per household) (Work 1999).

2.2 Brief Operations History of Midnite Mine Facility

2.2.1 Mine Operation History

The Companies operated the Midnite Mine near Wellpinit, Stevens County, Washington, from 1955 to 1981 (Harris, 1988). The ore body was identified in 1954. Active mining occurred from 1955 to 1965, at which time operations were suspended following the expiration of contracts with the Atomic Energy Commission (AEC) (Harris, 1988; E&E, 1999). Active mining operations resumed in 1969 under contract with commercial power organizations when markets improved, and ended permanently in 1981 due to depressed uranium ore prices and issues related to mine reclamation requirements (Harris, 1988; E&E, 1999). A more thorough discussion on mining history is provided by Peters (1999).

2.2.2 Mill Operation History

The DMC constructed and has operated a uranium mill near Ford, Washington since 1956 (WDOH, 1991). Most of the ore processed at the Mill was obtained from the Midnite Mine (WDOH, 1994). The Mill operated until 1982, at which time operations were put on a "care and maintenance" basis. From 1992 until 2000 limited operations resumed for the purpose of processing water treatment plant sludge from the Midnite Mine. Since 2000, the sludge has been directly disposed into a Mill impoundment. In 1994, the USEPA Region 10 agreed to allow the WDOH to continue acting as the lead administrative agency for cleanup of the Mill (WDOH, 1994; WDOH, 2000; USEPA, 2000b).

In 1956, the Mill began processing uranium ore under a United States Atomic Energy Commission (AEC) Source Material License as part of AEC's concentrate purchase program. Operation under the AEC license continued until 1965, producing commingled uranium mill tailings that were impounded in two above-grade unlined tailings disposal areas (TDA-1 and TDA-2). It is estimated that 1.2 million tons of tailings from AEC contract production are contained in TDA-1 and TDA-2 (WDOH, 1994).

From 1969 to 1981, DMC resumed commercial processing of uranium ore under a radioactive materials license from the State of Washington. The mill tailings produced during this period were impounded in a third above-grade unlined impoundment (TDA-3). In 1980, DMC estimated that typical tailings flow rates to this impoundment were approximately 600 tons per day of solids and 600 tons per day of liquids (WDOH, 1991).

In 1978, due to the threat of potential releases from TDA-3, the Nuclear Regulatory Commission (NRC) recommended that DMC develop a below-grade disposal area. In 1981, DMC began operation of a lined, below-grade tailings disposal area (TDA-4), which received commercial tailings from the Mill until November 1982, when the Mill operations were placed on a "care and maintenance" basis (WDOH, 1991).

DMC treats approximately 170 million gallons of pit water per year at the Midnite Mine, which generates approximately 137,000 cubic feet of sludge per year. In 1992, limited operations resumed until 2000 for the purpose of processing sludge material from the Midnite Mine water treatment plant. During this period, the sludge from the Midnite Mine water treatment plant was chemically processed to extract uranium and disposed of in TDA-4. Today, DMC directly disposes the unprocessed sludge into TDA-4 without extracting any uranium.

2.2.3 Mine-Mill Haul Road Operation History

Two gravel haul roads originating at the Midnite Mine intersect the Ford-Wellpinit Road. The western Road is termed the "Mine Road" by DMC. The eastern road is termed the "Haul Road" by DMC. In places, the subgrade of both roads contains waste rock or protore. In addition, both roads have been historically topped and maintained with these materials, which may contain uranium.

Although named the Ford-Wellpinit Road, this road actually stretches from Ford to the West End Community of the Spokane Indian Reservation. The segment of road between Ford and Wellpinit was paved prior to mining. However, the segment of road between Wellpinit and the West End Community, was not paved until much later (Galbraith, 1999) making this section of the road more susceptible to spillage. The Ford-Wellpinit road has been used by trucks conveying ore from the Midnite Mine to the Mill from 1956 through 1981, and by trucks hauling sludge from the Midnite Mine water

treatment plant since 1992. Over the years, periodic road maintenance has in places covered or exposed spills of either ore or sludge.

2.3 Post Mining/Milling Response Actions

2.3.1 Response Actions at the Mine

Response actions carried out at the Mine thus far include a control system for the management of drainage water, composed of a system of weirs, ditches, and sumps for seepage collection, and various pump equipment and storage tanks for collected seep water. This system was implemented following the Consent Order issued by USEPA to DMC in 1985, requiring a seepage control/mine water discharge plan, routing the discharges that were not in compliance with the NPDES permit to the retention pond, and the construction of a water treatment plant (Harris, 1988). Even following the implementation of these measures, however, sampling in drainages from the Mine indicated the presence of site-related contaminants (E&E, 1999).

USEPA listed the Midnite Mine on the Superfund National Priorities List (NPL) in May 2000, as a result of an Expanded Site Investigation which revealed elevated levels of metals and radionuclides at the site. A Superfund-lead RI/FS was initiated by USEPA in February 1999. The Remedial Investigation involves the collection and evaluation of data from the sampling of monitoring wells, stream water and sediment, pit water and sediment, surface and subsurface materials, and radiation measurements. Site cleanup alternatives will be developed as part of the Feasibility Study. The Midnite Mine RI/FS process is currently considering only the Midnite Mine and the Blue Creek drainage. It does not address the Mill portion of the facility, where closure activities are being conducted under the direction of the WDOH. The RI/FS is also not evaluating releases or potential releases of hazardous substances from the Mine into Lake Roosevelt.

2.3.2 Response Actions at the Mill

DMC has been licensed and regulated by the WDOH to process uranium ore since 1969, when Washington became an “Agreement State” under the Atomic Energy Act of 1954. In 1978, due to the threat of potential releases from TDA 3, the Nuclear Regulatory Commission (NRC) recommended that DMC develop a below-grade disposal area. In 1981, DMC began operation of a lined, below-grade tailings disposal area (TDA-4), which received commercial tailings from the Mill until November 1982, when the Mill operations were placed on a “care and maintenance” basis (WDOH, 1991).

In 1989, the WDOH issued an order requiring DMC to implement a Groundwater Remedial Action Plan (GRAP). The GRAP was intended to provide immediate, short-term mitigation of groundwater with elevated uranium and sulfate concentrations by intercepting impacted groundwater from seepage from the unlined tailings disposal areas. The GRAP was initiated in 1992 (WDOH, 1994; SMI, 1996; SMI, 2000).

In 1991, the WDOH prepared an environmental impact statement (EIS) as required by the Washington State Environmental Policy Act (SEPA) for the closure of the Mill. The State EIS identified the major closure concern as the remediation of groundwater and the prevention of any future groundwater or surface water contamination.

As the result of an alternative closure option proposed by DMC, the WDOH prepared a Supplemental EIS, which was completed in 1994. The Supplemental EIS identified a number of activities which the WDOH determined must be accomplished in order to properly remediate and close the Mill Complex area. Those activities that related to groundwater remediation included continuation of the GRAP by pumping approximately 50 gallons per minute from the aquifer below the meadow area and treating it in an evaporation system, as well as appropriately covering and contouring the three above-grade unlined disposal areas (WDOH, 1994).

In 1994, the USEPA Region 10 agreed to allow WDOH to continue acting as the lead administrative agency for cleanup of the Mill (WDOH, 1994; WDOH, 2000; USEPA, 2000b).

As of February 2000, the GRAP pumping was determined to have had only minimal, temporary effects on uranium concentrations in the seeps and groundwater (SMI, 2000). Based on the GRAP results, DMC has recommended no further GRAP pumping for the year 2000 and beyond (SMI, 2000). The GRAP is now being evaluated under a Corrective Action Assessment Plan.

2.3.3 Response Actions at the Haul Road

From 1954 until the end of mining activities at the Midnite Mine in 1981, the Ford-Wellpinit road was used as a transportation artery for hauling uranium ore from the Midnite Mine to the Mill at Ford, Washington (Dempsey, Shura and Harris, 1999). In recent years, concern was raised that ore had fallen along the shoulder from trucks using this road, and in response USEPA conducted a radiological survey (Dempsey, Shura and Harris, 1999). Several sources have noted the road as a source of contamination over the years, including BIA, the Bureau of Land Management (BLM), DMC, and Shepherd Miller, Inc. (SMI) (Work, 1999). The road has many curves and changes of elevation, which can promote spillovers from laden trucks.

In their report on the radiological survey of the Ford-Wellpinit road, Dempsey, Shura and Harris (1999) recommended localized removals using manual labor for most locations where elevated levels of radioactivity due to ore spills (or sludge spills) had been identified. They also recommended the use of larger-scale removals for the two areas of most widespread contamination, the road segments into the Midnite Mine and the Mill. A non-time-critical removal action to address contamination along the haul road is currently under consideration.

2.4 Hazardous Substances Released

The following sections describe hazardous substance releases identified by the Trustees. The Trustees will also consider potential injuries due to either unknown or future releases of hazardous substances if information describing such releases becomes available.

2.4.1 Mine Sources and Releases

The practice of stockpiling uncontained mine waste, ore, and protore at the Midnite Mine has allowed waste to be eroded and transported. Former mining pits have also been backfilled using mine waste and overburden. Harris (1988) estimated that approximately 20 acres of mining pits were backfilled.

Water has been accumulating in the open pits due to precipitation, runoff, and groundwater intrusion. After active mining operations ceased, water in the two open pits was allowed to continue accumulating. Seeps (the East, Central, and West Drainage seeps, and seeps below and within the pollution control pond) subsequently formed at the toe of waste piles in the original channel locations.

Releases of hazardous substances from the Mine began as early as the 1950s, when the Companies transformed the underground workings into an open pit mine. During the open pit mining operation, at least 33 million tons of overburden[1] and waste rock[2] (including a substantial amount of low-grade sulfur ore) were removed from the pit and deposited over more than 200 acres "without any classification, separation, or original ground surface preparation" at various spoil areas around the pit (Harris, 1988; E&E, 1999; Peters, 1999). Surface runoff during spring snowmelt and precipitation coming in contact with this material generated sulfuric acid, which then leached heavy metals from the ore (E&E, 1999).

Releases of hazardous substances continue. Several sources at the Mine currently release various hazardous substances into groundwater and surface water which discharge to Blue Creek. These contaminated waters may be carried to the Spokane Arm of Lake Roosevelt. Current principal sources of acid rock drainage (ARD) released into Blue Creek include discharges from the pumpback and water treatment plant systems, surface runoff, and groundwater discharge. As the pollution control pond and pits continue to fill with ARD, overflow of these features remains a potential source of hazardous substances. Additional sources of hazardous substance releases from the Mine may include, but are not limited to, other seeps passing through waste rock and overburden piles, surface water runoff and soil erosion, and adits, tunnels, pipes, channels, and shafts. Moreover, it is likely that sediments contaminated by hazardous

[1] Overburden is rock that is removed to create a pit to access the ore in open pit mining.
[2] Waste rock is rock left over from mining after removal of the overburden.

substances continue to release hazardous substances into the water bodies. Hazardous substances may also have been released, and may continue to be released, via air pathways from the Mine, the mine road, and the water bodies. Overburden, waste rock, and protore were used in constructing the mine road and other roads in the area, and therefore may be potential sources of hazardous substances.

In 1985, DMC applied for a NPDES permit to discharge accumulated waters from Pits 3 and 4 and from the retention pond; the permit was issued on September 30, 1986 (Harris, 1988). Five weeks later, USEPA inspection and sampling revealed that the discharges exceeded the permit's effluent limitations. Consequently, DMC was issued a Consent Order requiring a seepage control/mine water discharge plan, routing the discharges that were not in compliance with the NPDES permit to the retention pond; and the construction of a water treatment plant (Harris, 1988). Even following the implementation of these measures, however, sampling in drainages from the Mine area has indicated the presence of site-related contaminants (E&E, 1999).

2.4.2 Mine Hazardous Substances

Hazardous substances released from the Midnite Mine include both radiological and non-radiological contaminants. Radiological contaminants released from the facility include, but are not limited to, radium-226, thorium-228, thorium-230, thorium-232, uranium-234, uranium-235, and uranium-238. Non-radiological contaminants released from the facility include, but are not limited to, aluminum, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, magnesium, manganese, mercury, nickel, potassium, selenium, sodium, thallium, vanadium, and zinc (USEPA, 2000a; WDOH, 1991).

The ARD generated at the Mine is formed when water percolates through mineralized rock made accessible and permeable by construction of the mining adits and the development of the open pits. Oxidation and hydration of sulfur and sulfur minerals in the main ore body and in the discarded overburden and waste rock creates sulfuric acid, ferrous sulfate, and other metal complexes. Subsequent pH reduction results in the mobilization of heavy metals and radionuclides.

Furthermore, ARD released from the Mine may at times qualify as a hazardous substance itself, regardless of its constituents. When the pH of the ARD is less than or equal to 2, it satisfies the corrosivity test of the Resource Conservation and Recovery Act (RCRA) 42 USC § 6921; [40 CFR § 261.22(a)(1)] and is therefore considered a hazardous substance under CERCLA § 9601(14)(C); [40 CFR § 302.4(b)]. The pH of samples collected from the blood pool has ranged from pH 1.8 to 2.8 (E&E, 1999).

In addition to the hazardous substances identified above, other possible hazardous substances released from the Midnite Mine include explosives and blasting products (suspected by Plotnikoff *et al.* (1988) of contributing to increased nitrate levels

in Blue Creek downstream of the Mine); asbestos from buildings; and hydrocarbons from fuels, lubricants, and other operational uses.

The Trustees consider any hazardous substance released from the facility to be a contaminant of potential concern (COPC). Throughout this document, the Trustees use the term COPC to refer to hazardous substances released from the facility that may be responsible (in whole or in part) for natural resource injuries.

2.4.3 Mill Sources and Releases

The practice of stockpiling uncontained tailings at the Mill has exposed the waste to erosion and transport. The unlined tailings impoundments TDA-1, TDA-2, and TDA-3 were designed to remove settleable solids and minimize liquid overflow until the excess water could be removed by a combination of surface evaporation and leakage into the ground (WDOH, 1991). This has allowed contaminants to be transported in both particulate and dissolved form into the surrounding air, soil, surface water, and groundwater. In addition, the on-going disposal of processed sludge from the Midnite Mine water treatment plant at lined impoundment TDA-4 may result in future releases of hazardous substances.

2.4.4 Mill Hazardous Substances

Hazardous substances released from the Mill may include at least two other materials in addition to those identified as released from the Midnite Mine as described above: polychlorinated biphenyls (PCBs) and asbestos. These two materials, which have been associated with other uranium mill closures, can pose serious handling and disposal problems, particularly when mixed with radioactive material (WDOH, 1991).

2.4.5 Haul Road Sources and Releases

The practice of hauling uranium ore from the Midnite Mine to the Mill for processing, which occurred from approximately 1954 to 1981, has resulted in spills of radioactive materials along the 25-mile road. Spills associated with the transport of water treatment sludge may also have resulted in the release of hazardous substances to the Haul Road corridor. Hazardous substances from these spilled materials have been and may continue to be released by air, surface runoff, and infiltration.

2.4.6 Haul Road Hazardous Substances

Except for sampling along the road for ionizing radiation (gamma rays) with a scintillometer, no sampling for subsequent chemical analyses has occurred to date. The

Trustees may choose to assess injury and damages associated with potential releases along the haul road at a later date.

2.5 Potentially Affected Natural Resources

A number of natural resources and natural resource services under federal, tribal, or state trusteeship may be, or may have been, exposed to hazardous substances released from the Midnite Mine facility. These potentially affected resources provide a variety of ecological, human use, and cultural services. Potentially affected trust resources include, but are not limited to:

- Surface water and sediments
- Groundwater
- Tribal lands
- Mammals, including beaver, mink, coyote, big game species, and several species of small mammals
- Migratory and non-migratory birds
- Resident and adfluvial fish species
- Aquatic invertebrates
- Soil invertebrates
- Amphibians and reptiles
- Geologic resources
- Riparian, terrestrial, and aquatic plant species
- Riverine, riparian, lacustrine, wetland and terrestrial habitats
- Air

Services provided by these resources may include, but are not limited to:

- Fish and wildlife natural habitat
- Ecosystem support
- Gathering, hunting, fishing, grazing, and trapping
- Primary and secondary contact recreation and other recreational activities
- Cultural, spiritual, and ceremonial uses
- Subsistence resource use
- Medicinal plants and herbs
- Traditional foods
- Option and existence values
- Domestic, industrial, and agricultural water supply

The Regulations define five categories of natural resources for purposes of assessing natural resource damages: surface water resources, groundwater resources, air resources, geologic resources, and biological resources. The following sections briefly describe each of these categories in the context of the assessment area. As further information becomes available, the Trustees may decide not to pursue an assessment of one or more of these natural resources.

While the Regulations identify five specific categories of natural resources, this Plan recognizes that natural resources function in combination with one another to provide a wide range of important ecological and human use services. In particular, resources and services of significance to tribal members depend on the health of all of the components of the ecosystem described in the following sections. Services provided to tribal members by natural resources may include, but are not limited to, food, shelter, trade and economics, pharmaceuticals, individual and community-level traditional environmental knowledge, arts, crafts, language, traditions, stories, beliefs, practices, place names, landscapes, and religious, social and family institutions of the community. The Trustees will assess the loss of these natural resource services as part of the Assessment.

2.5.1 Surface Water Resources

Surface water resources are defined in the DOI regulations as including both surface water and sediments suspended in water or lying on the bank or bed [43 CFR § 11.14(pp)]. Surface water resources in the assessment area include the water, streambed, and bank sediments of Blue Creek (including its delta at the confluence of Blue Creek and the Spokane Arm of Lake Roosevelt), Sand Creek, Chamokane Creek (including its delta at the confluence of Chamokane Creek and the Spokane River), the various smaller streams that intersect the Ford-Wellpinit Highway (Haul Road), and the larger water bodies that receive all of the aforementioned waters. At this time, the Trustees have not determined the downstream extent of contamination resulting from releases of hazardous substances from the facility.

Surface water resources are particularly important in the context of this Assessment because they have been and continue to be the principal receptors of hazardous substances released to the environment from the facility. The contamination of these resources has both direct and indirect impacts on the health of biological resources. For example, contaminated sediments can cause injury to benthic invertebrate populations, which in turn can result in injuries to resident fish populations for which the invertebrates are a source of food. Similarly, injury to invertebrates and/or fish resulting from exposure to contaminated sediments and surface water can lead to injury in local insectivorous or piscivorous birds. In addition, contaminated sediments serve as a source of continuing releases of hazardous substances to the water column.

2.5.2 Groundwater Resources

Groundwater is defined in the DOI regulations as “water in a saturated zone or stratum beneath the surface of land or water and the rocks and sediment through which groundwater moves” [43 CFR § 11.14(t)]. Some hydrostratigraphic units (geologic units responsible for the transmission or storage of groundwater) in the vicinity of the Mine

and Mill Properties have been characterized, but more work is needed in this area to understand the extent of contamination. Other areas (*e.g.*, Sand Creek, Blue Creek basin, and Chamokane Creek watersheds) also require further characterization. Because it serves as a key pathway to surface water, groundwater may be injured by releases of hazardous substances.

2.5.3 Air resources

The Regulations define air resources as those naturally occurring constituents of the atmosphere, including those gases essential for human, plant, and animal life [43 CFR § 11.14(b)]. Air resources may have been injured by releases of particulate or gaseous hazardous substances from overburden, waste rock, soil-gas, tailings, and contaminated surface water bodies. At this time, the Trustees do not have sufficient data to assess injury to air resources, and therefore do not include confirmation of exposure or assessment methods for air resources in this Plan. The Trustees note that additional data may be generated through the risk assessment conducted during the RI/FS, and that an assessment of air resources may be undertaken at a later time.

2.5.4 Geologic resources

Geologic resources are defined in the DOI regulations as those elements of the Earth's crust that are not included in the definitions of ground and surface water resources. [43 CFR § 11.14 (s)]. Potentially injured geologic resources include, but are not limited to, the remaining ore deposits at the Mine, bedrock and other geologic resources contaminated by groundwater, and soil along waterways where contaminated sediment may have been deposited by flooding. At this time, the Trustees are not assessing injury to geologic resources in the vicinity of the Mine because response actions and a remedial investigation are on-going. The Trustees may assess geologic resources in the area of the Mine when future remedial actions are more narrowly defined. Additional data may be generated through the risk assessment conducted during the RI/FS.

2.5.5 Biological resources

Biological resources are defined in the DOI regulations as "those natural resources referred to in section 101(16) of CERCLA as fish and wildlife and other biota. Fish and wildlife include marine and freshwater aquatic and terrestrial species; game, non-game, and commercial species; and threatened, endangered, and State sensitive species. Other biota encompass shellfish, terrestrial and aquatic plants, and other living organisms" [43 CFR § 11.14(f)].

The four primary habitat types occurring in the assessment area include, but are not limited to, upland (generally forested) habitat, riparian and wetland habitats, riverine habitat, and lacustrine habitat (URS, 2000a). The plants and animals generally associated with each of these habitats may have been exposed to hazardous substances released from the Midnite Mine facility through various pathways.

U.S. Fish and Wildlife Service (USFWS) records indicate that the following species listed or proposed for listing under the Endangered Species Act may occur in the vicinity of the Midnite Mine (USFWS, 2001):

<u>Endangered</u>

1. Gray Wolf (*Canis lupus*)

<u>Threatened</u>

1. Bald eagle (*Haliaeetus leucocephalus*)
2. Bull trout (*Salvelinus confluentus*)
3. Canada lynx (*Lynx canadensis*)
4. Grizzly bear (*Ursus arctos* = *U.a. horribilis*)
5. Ute ladies'-tresses (*Spiranthes diluvialis*)

The USFWS also identified 22 animal species and 3 plant species of concern that may also occur in the vicinity of the Midnite Mine facility (USFWS 2001).

In addition, URS (2000b) lists important game species and/or food sources for the Spokane and Colville Tribes; three species of scientific interest; two state threatened plant species that generally occur in upland habitat similar to that in the study area, and one that generally occurs in riparian/wetland habitat similar to that in the study area; and at least 180 plant species of cultural significance (medicinal, food, fiber, dye, or other use) to local tribes have been identified as present in the project area or the project vicinity (URS, 2000b).

As noted earlier, a variety of biological resources may be injured as a result of hazardous substance releases. Section 4.7 describes the biological resources on which the Trustee's initial assessment efforts will focus. These include aquatic macroinvertebrates, aquatic plants, fish, terrestrial plants, and terrestrial wildlife.

3.0 Confirmation of Exposure

This section presents data confirming that natural resources have been exposed to hazardous substances released from the Mine and Mill. The Regulations state that an Assessment Plan should confirm that:

> at least one of the natural resources identified as potentially injured in the preassessment screen has in fact been exposed to the released substance [43 CFR § 11.37(a)].

A natural resource has been exposed to a hazardous substance if "all or part of it is, or has been, in physical contact with . . . a hazardous substance, or with media containing the . . . hazardous substance" [43 CFR § 11.14(q)]. The DOI regulations also state that "whenever possible, exposure shall be confirmed using existing data" from previous studies of the assessment area [43 CFR § 1 1.34(b)(i)].

The Trustees conclude that the presence of hazardous substances in a resource at levels greater than would exist but-for the release (*i.e.,* above "background" levels) demonstrates exposure. Hazardous substances released from the facility include various metals and radionuclides. The following sections provide confirmation of exposure to hazardous substances, based on a review of the available data, for a number of natural resources in the assessment area. However, this section is not intended to confirm all potential exposures in all locations and for all contaminants.

3.1 Data Sources

Numerous data sets confirming exposure to hazardous substances have been developed by various parties, at different times, for the Mine and Mill areas. Other than measurements of surficial gamma ray emissions, no data are available for the Haul Road. To date, USEPA is the only entity that has attempted to determine background (*i.e.*, pre-release conditions) for the Mine area. Background for radionuclides and a small number of additional COPCs has been determined for the Mill via the Millsite Closure Process (WDOH, 1991) conducted pursuant to the Washington State's Environmental Policy Act [RCW 43.21C].

Because few data are available to determine pre-release contamination levels, the Trustees will define reference areas believed to represent pre-release conditions. Samples have been collected from potential reference areas upstream of the influence of the Mine and Mill on Blue Creek and Chamokane Creeks. However, all of these upstream locations may have been or may currently be influenced by past Mine/Mill processes or current and past waste management practices. For example, historical spills near the Ford-Wellpinit bridge spanning Chamokane creek have occurred that could have contaminated this upstream area. Although these sites have not been thoroughly evaluated for their appropriateness as reference locations, for the purposes of this confirmation of exposure, they are considered to reflect "background" conditions.

The Trustees considered the following data sources to confirm exposure of natural resources. The Trustees will further evaluate each of the data sets for data quality and usefulness to the assessment process as described below in Section 4.

Surface Water/Sediments

Surface water quality in the area defined by USEPA as the potentially impacted area (PIA, Figure 2.2) of the Mine, and in several upstream and downstream locations has been monitored by several entities:

1. EPA has developed proposed Exposure Point Concentrations for the Midnite Mine Human Health Risk Assessment (USEPA, 2003).

2. The Preassessment Screen included reviews of data related to exposure of natural resources to hazardous substances released from the facility (Ridolfi, 2002).

3. URS 2001. Aquatic Ecological Risk Screening Approach.

4. USEPA performed synoptic sampling in 1999, 2000 as part of the RI/FS (URS, 2000a).

5. USEPA performed synoptic sampling in 1998 as part of the Extended Site Investigation (ESI) (E&E, 1999).

6. Immediately prior to the RI/FS, DMC was ordered by BLM under an Interim Agreement (1998) to sample various media via synoptic surveys.

7. Prior to the RI/FS, the Companies sampled portions of the PIA from late 1970's to 1999 at regular time intervals as required by BLM (DMC data delivered to STI on August 11, 1998).

8. The USGS sampled areas in and adjacent to the PIA in 1995 during a synoptic survey (Ames, *et al.*, 1996).

9. The USGS sampled areas in and adjacent to the PIA in 1984 and 1985 during a synoptic survey (Sumioka, 1991).

10. The US Bureau of Mines and BIA sampled areas in and adjacent to the PIA at regular intervals from 1983 to 1994, and during several synoptic surveys (USBIA, 1998).

11. NURE sampled locations in and adjacent to the PIA during several synoptic surveys (Bendix, 1981).

Surface water quality in the Chamokane Creek drainage, including areas potentially impacted by the Mill, and several upstream and downstream locations, has been monitored by several entities:

1. DMC samples surface water at several locations on Chamokane Creek quarterly. DMC has done this since at least 1980 (SMI, 2000 and 1996).

2. Associated Environmental Scientists and Engineers, Inc. (AESE). 1999a. Data Report: 1998 (Q1) Surface Water Quality for Chamokane Creek. Department of Natural Resources. EPACWA104b Grant. February 28.

Sediments have been sampled by several entities in the PIA and in several upstream and downstream locations

1. EPA has developed proposed Exposure Point Concentrations for the Midnite Mine Human Health Risk Assessment (USEPA, 2003).

2. The Preassessment Screen included reviews of data related to exposure of natural resources to hazardous substances released from the facility (Ridolfi, 2002).

3. URS 2001. Aquatic Ecological Risk Screening Approach.

4. USEPA performed synoptic sampling in 1999, 2000 as part of the RI/FS (URS, 2000a).

5. USEPA performed synoptic sampling in 1998 as part of the ESI (E&E, 1999).

6. Immediately prior to the RI/FS, DMC was ordered by BLM under an Interim Agreement (1998) to sample various media via synoptic surveys.

7. Prior to the RI/FS, the Companies sampled portions of the PIA from late 1970's to 1999 at regular time intervals as required by BLM (DMC data delivered to STI on August 11, 1998).

8. The USGS sampled areas in and adjacent to the PIA in 1995 during a synoptic survey (Ames, *et al.*, 1996).

9. The USGS sampled areas in and adjacent to the PIA in 1984 and 1985 during a synoptic survey (Sumioka, 1991).

10. The U.S. Bureau of Mines and BIA sampled areas in and adjacent to the PIA at regular intervals from 1983 to 1994, and during several synoptic surveys (USBIA, 1998).

11. NURE (National Uranium Resource Evaluation) sampled locations in and adjacent to the PIA during several synoptic surveys (Bendix, 1981).

Sediments have been sampled in the Chamokane Creek drainage (in the vicinity of the Mill, and in several upstream and downstream locations)

1. The Preassessment Screen included reviews of data related to exposure of natural resources to hazardous substances released from the facility (Ridolfi, 2002).

2. DMC sampled sediment at several locations on Chamokane Creek in support of the 1991 Final Environmental Impact Statement (FEIS) (WDOH, 1991).

3. Associated Environmental Scientists and Engineers, Inc. (AESE) sampled sediments as part of the Phase II Sediment Sampling on Chamokane Creek. Department of Natural Resources (AESE, 2000).

Groundwater

Groundwater has been sampled by several entities in the PIA as well as areas USEPA believes to represent background (*i.e.*, pre-release) conditions:

1. EPA has developed proposed Exposure Point Concentrations for the Midnite Mine Human Health Risk Assessment (USEPA, 2003).

2. The Preassessment Screen included reviews of data related to exposure of natural resources to hazardous substances released from the facility (Ridolfi, 2002).

3. USEPA performed synoptic sampling in 1999, 2000 as part of the RI/FS (URS, 2000a).

4. USEPA performed synoptic sampling in 1998 as part of the ESI (E&E, 1999).

5. Immediately prior to the RI/FS, DMC was ordered by BLM under an Interim Agreement (1998) to sample various media via synoptic surveys.

6. Prior to the RI/FS, the Companies sampled portions of the PIA from late 1970's to 1999 at regular time intervals as required by BLM (DMC data delivered to STI on August 11, 1998).

7. The USGS sampled areas in and adjacent to the PIA in 1995 during a synoptic survey (Ames, *et al.*, 1996).

8. The USGS sampled areas in and adjacent to the PIA in 1984 and 1985 during a synoptic survey (Sumioka, 1991).

9. The US Bureau of Mines and BIA sampled areas in and adjacent to the PIA at regular intervals from 1983 to 1994, and during several synoptic surveys (USBIA, 1998).

10. NURE sampled locations in and adjacent to the PIA during several synoptic surveys (Bendix, 1981).

Groundwater has been sampled in the Chamokane Creek drainage (vicinity of the Mill) in association with closure of the Mill (DMC *et al.*, 1994), during quarterly compliance monitoring program, and in support of the Groundwater Remedial Action Plan (GRAP).

1. The Preassessment Screen included reviews of data related to exposure of natural resources to hazardous substances released from the facility (Ridolfi, 2002).

2. Shepherd Miller, Inc. (SMI). 2000. Summary and Evaluation of Groundwater and Surface Water Monitoring Data at the Dawn Mining Company Millsite, January 1998 - December 1999. Dawn Mining Company. February 24.

3. Shepherd Miller, Inc. (SMI). 1996. Summary and Evaluation of Ground Water and Surface Water Monitoring Data at the Dawn Mining Company Millsite. Dawn Mining Company. December 19.

Air Resources

Air at the Mine has been sampled in the past by the U.S. Bureau of Mines. Air at the Mill is periodically sampled by DMC as a required under their radioactive materials license (Stroud and Droullard, 1996).

Geologic Resources

Geologic resources have been sampled by two entities in the PIA and in areas believed by the researchers to be "upwind" of the facility.

1. USEPA performed synoptic sampling near the Mine in 1999 and 2000, under the RI/FS (URS 2000b).

2. Trustees re-sampled some of the areas sampled by USEPA in 1999 and 2000 as well as soils adjacent to Blue Creek (MUMNRTC, 2002).

Soils have been sampled in the Chamokane Creek drainage (in the vicinity of the Mill) in association with closure of the Mill (DMC *et al.*, 1994).

Biological Resources

EPA has developed proposed Exposure Point Concentrations for the Midnite Mine Human Health Risk Assessment (USEPA, 2003). In addition, biological resources have been sampled by three entities in the PIA of the Mine:

1. BIA funded the Upper Columbia United Tribes Fisheries Center (UCUT) to sample macroinvertebrate populations (Cairns, Lang and Scholz, 1988; Plotnikoff, Lang, and Scholz, 1988) and whole eviscerated fish and fish liver tissue (Nichols and Scholz, 1987) in and adjacent to the PIA during several synoptic surveys that were completed prior to construction of the water treatment plant.

2. The PRPs sampled terrestrial and aquatic macroinvertebrates and vegetation in the vicinity of the Mine (SMI, 1999), under the direction of the BLM as part of the aforementioned Interim Agreement (1998). Laboratory analyses for these receptors included only radionuclides—no tissues were analyzed for metals.

3. The Trustees sampled and analyzed small mammal whole bodies as well as kidney tissue from the mined area and at several locations along Blue Creek as part of the 2002 reconnaissance investigation (MUMNRTC 2002).

Biological resources have been sampled in the Chamokane Creek drainage (in the vicinity of the Mill and in several upstream and downstream locations):

1. DMC sampled fish and macroinvertebrate tissues at a few locations on Chamokane Creek in support of the 1989, 1991, and 1994 EIS process (WDOH, 1989; WDOH, 1991; and WDOH, 1994).

2. BIA (UCUT) sampled and analyzed populations of macroinvertebrates in the spring and summer of 1988 (Wagner, 1988).

3. The Trustees sampled and analyzed macroinvertebrates tissues and populations, fish tissues, and small mammal whole bodies as well as kidney tissue at several locations along Chamokane Creek as part of the 2002 reconnaissance investigation (MUMNRTC, 2002).

3.2 Surface Water

Available data on concentrations of COPCs in both water and sediment samples confirms exposure of surface water resources in both the Blue Creek and Chamokane Creek drainages (Tables 3.1 and 3.2). The following sections present examples of the data demonstrating exposure.

Table 3.1. COPCs for Which Existing Surface Water Data Demonstrate Exposure of Surface Water Resources

COPC	Mined Area	Upper Blue Creek	Middle Blue Creek	Lower Blue Creek	Spokane Arm of Lake Roosevelt
Aluminum / Al	2,3				
Antimony / Sb	2				
Barium / Ba	2				
Beryllium / Be	3				
Cadmium / Cd	2,3		4		
Chromium / Cr	2	2	2	2	
Cobalt / Co	2,3				
Copper / Cu	2		2		2
Magnesium / Mg	2		2	2	
Manganese / Mn	2,3		2	2	
Nickel / Ni	2,3		2	2	
Selenium / Se	2				
Silver / Ag	2				
Sulfate / SO4	2	2	2	2	
Uranium / U Total	2,3	2	2	2	
Vanadium / V				2	
Zinc / Zn	2		2,4	4	2
Thorium 228 / Th 228			4	4	
Uranium 234 / U-234	3		4	4	
Uranium 235 / U-235			4	4	
Uranium 238 / U-238	3		4	4	
Gross α			4	4	
Gross β			4	4	

2 URS, 2001. Aquatic Ecological Risk Screening for Midnite Mine RI/FS
3 USEPA, 2003. Proposed Exposure Point Concentrations for Midnite Mine Human Health Risk Assessment
4 Ridolfi, 2002. Preassessment Screen for the Midnite Mine Facility

Table 3.2. COPCs for Which Existing Sediment Data Demonstrate Exposure of Surface Water Resources

Analyte	Mined Area	Middle Blue Creek	Lower Blue Creek	Spokane Arm of Lake Roosevelt	Wetlands/ Mill	Lower Chamokane Creek
Aluminum / Al	2				1	1
Antimony / Sb					1,4	1,4
Arsenic / As					4	4
Beryllium / Be	2				1	1
Cadmium / Cd	2,3,4	2,3,4	3,4		4	4
Calcium / Ca					1	1
Chromium / Cr	2				4	4
Cobalt / Co	2,3					
Magnesium / Mg	2	2			1	1
Manganese / Mn	2,3,4	3,4	3,4	3		
Mercury / Hg					4	4
Nickel / Ni	2,3,4	2,3,4	3,4			
Selenium / Se	2				1	1
Silver / Ag					4	4
Sulfate / SO_4			3		1	
Thallium / Tl	3					
Uranium / U Total	2,3	2			4	4
Zinc / Zn	2			3		
$Lead_{210}$ / Pb_{210}	3				1	
$Radium_{226}$ / Ra_{226}	3					
$Radium_{228}$ / Ra_{228}					4	4
$Uranium_{234}$ / U_{234}	3					
$Uranium_{238}$ / U_{238}	3					
Gross α	4	4	4			
Gross β	4	4	4			

1 AESE, 2000. Chamokane Creek Sediments
2 URS, 2001. Aquatic Ecological Risk Screening for Midnite Mine RI/FS
3 USEPA, 2003. Proposed Exposure Point Concentrations for Midnite Mine Human Health Risk Assessment
4 Ridolfi, 2002. Preassessment Screen for the Midnite Mine Facility

3.2.1 Blue Creek

Figures 3.1 and 3.2 confirm exposure of surface water resources in Blue Creek to two example COPCs. Figure 3.1 presents the concentration of uranium 238 in surface water; Figure 3.2 presents the concentration of nickel in sediments. The confluence of the Mine drainage with Blue Creek, approximately 2.5 miles below Turtle Lake, is shown by a solid vertical line. Concentrations of both contaminants are elevated downstream of this confluence compared to samples collected in upstream reaches.

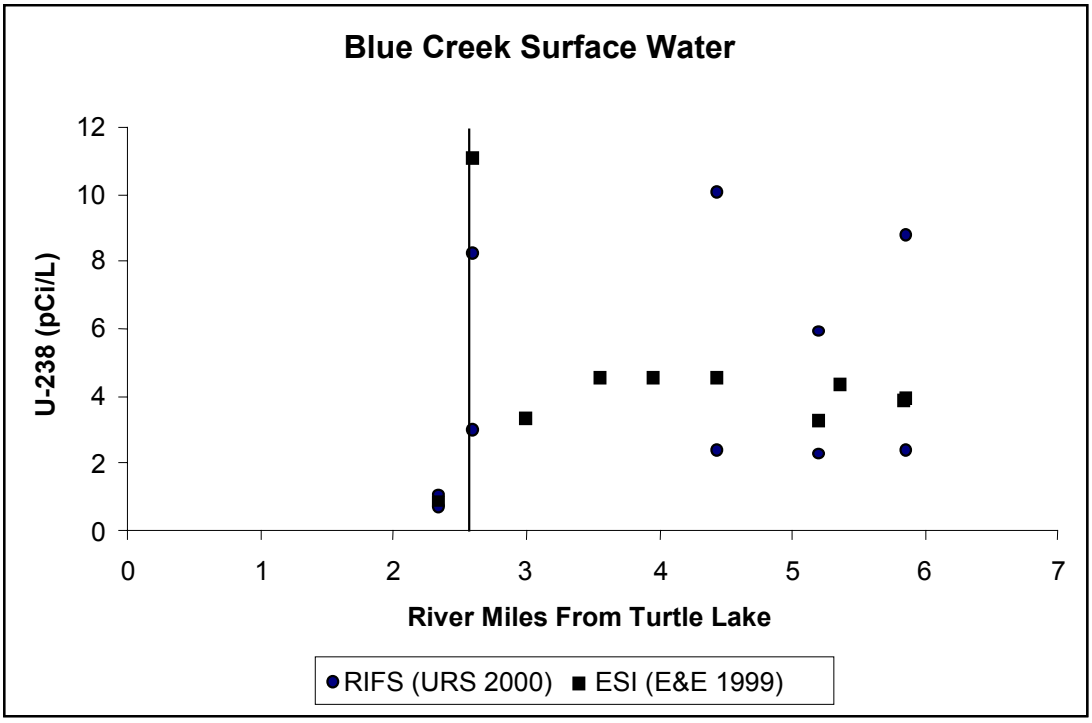


Figure 3.1. Uranium 238 in Blue Creek Surface Water

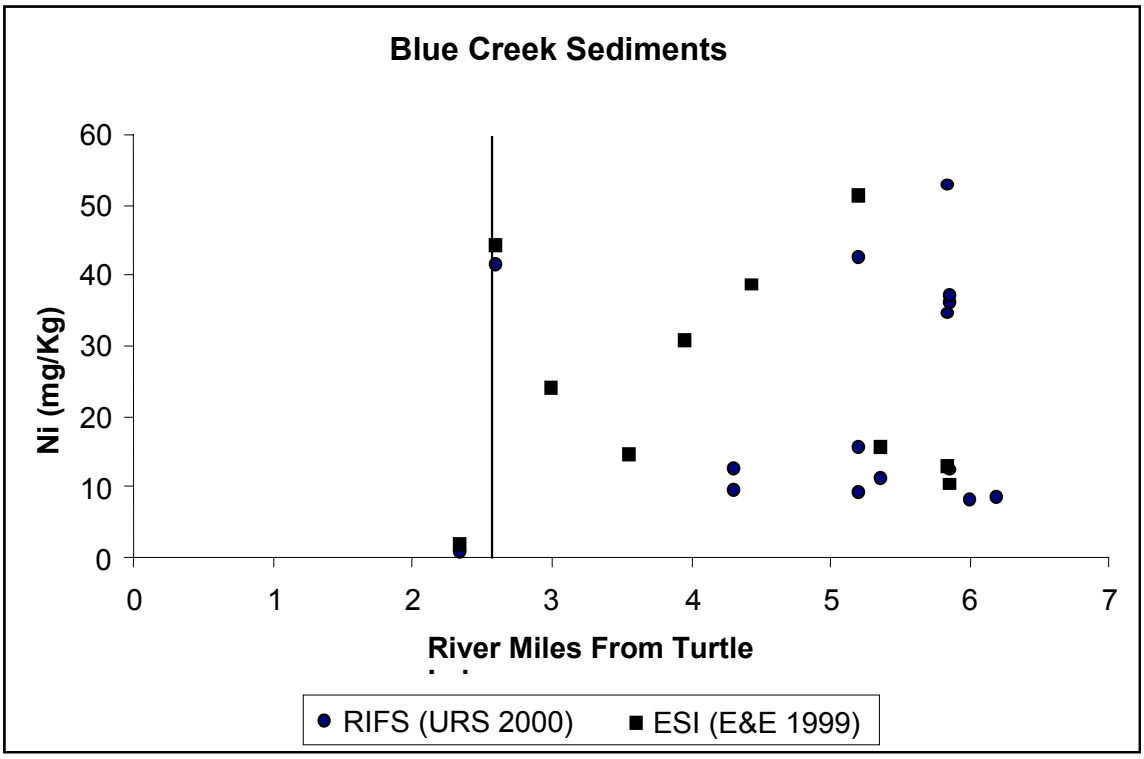


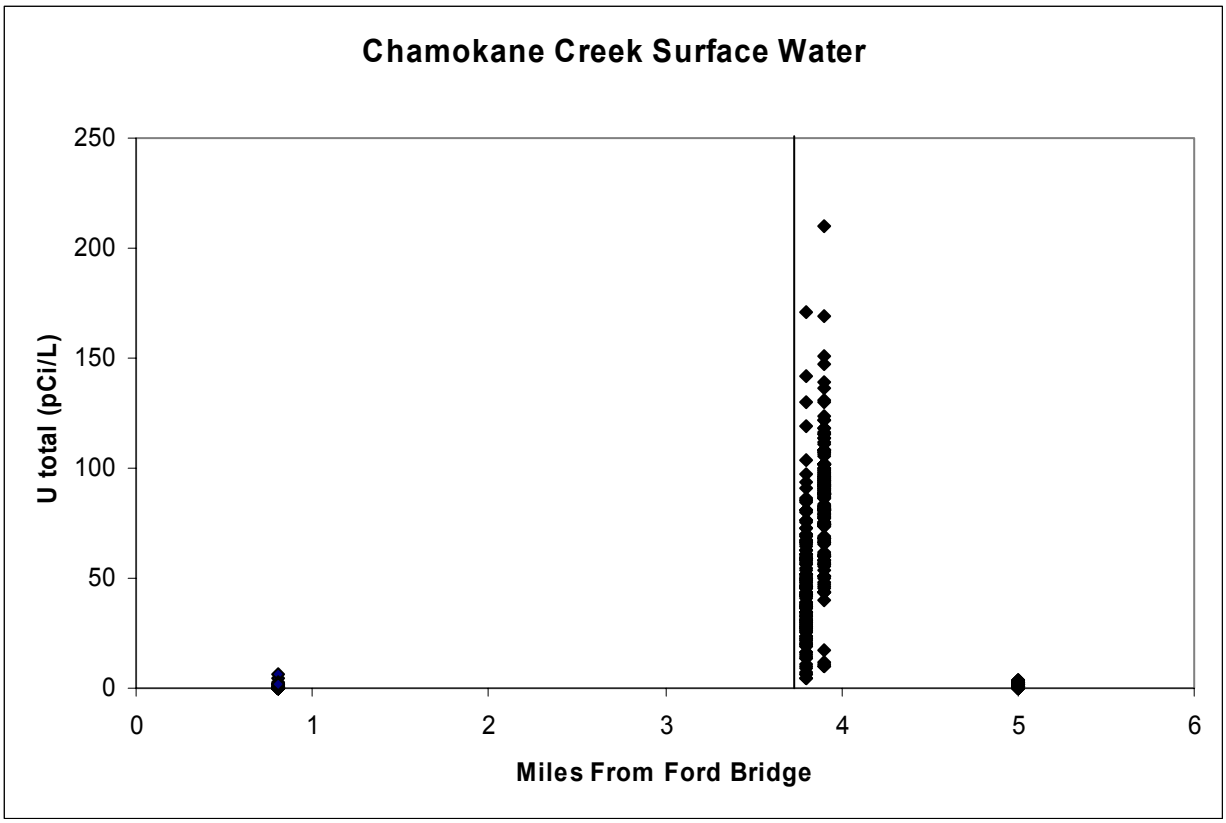
Figure 3.2. Nickel in Blue Creek Sediments

3.2.2 Chamokane Creek

Figures 3.3 and 3.4 demonstrate the confirmation of exposure of surface water resources in Chamokane Creek to two example COPCs. Figure 3.3 presents the concentration of uranium (total) in surface water; Figure 3.4 presents the concentration of radium 228 in sediments. The confluence of the groundwater discharge from the tailings disposal areas with Chamokane Creek, approximately 3.8 miles below the Ford Bridge, is shown by a solid vertical line. Concentrations of both contaminants are elevated downstream of this confluence compared to samples collected in upstream reaches.

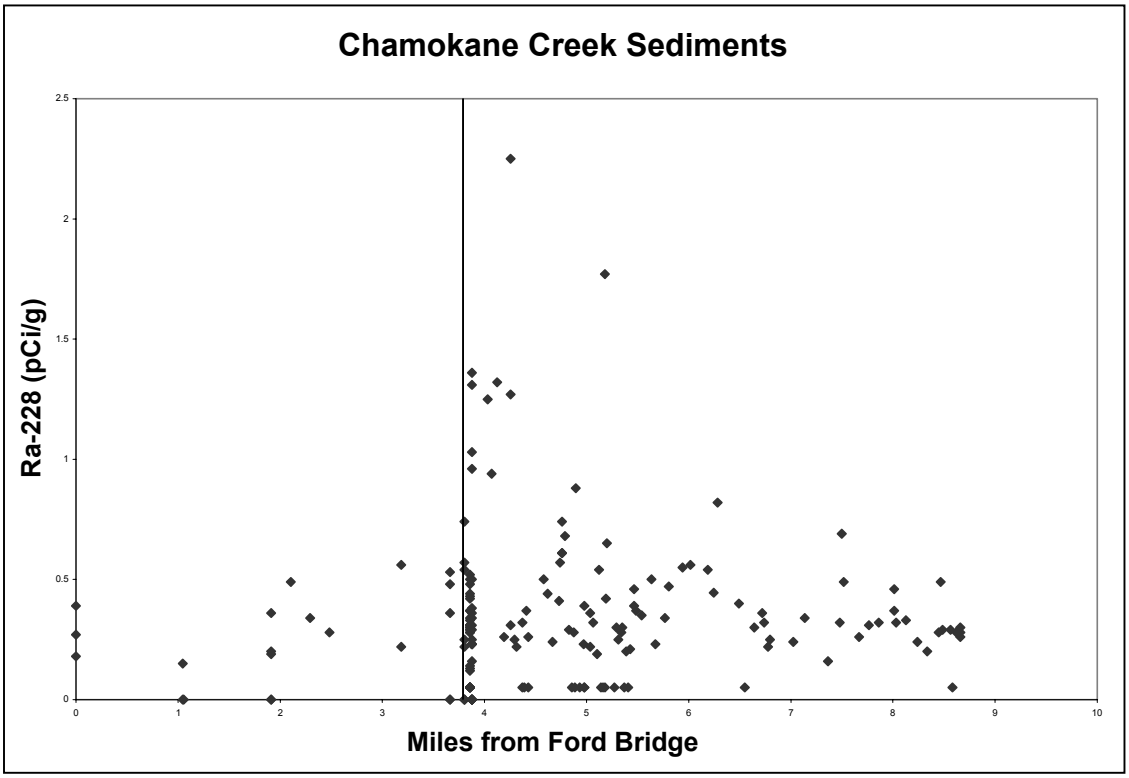
Others have also noted the presence of contaminants in Chamokane Creek. The 1991 Final Environmental Impact Statement for Closure of the DMC Uranium Millsite (WDOH 1991) concludes:

> *"For the surface water downstream from the seeps, at SW-3 (now SW-4), it is clear that there has been a measurable, but slight, impact on water quality. This can be seen by comparing SW-3 (now SW-4) to SW-1 (now SW-5) (the upstream control). This is true for uranium, total dissolved solids (TDS), and sulfates. Statistical tests indicate (see Appendix XII) that it is likely other parameters such as pH and conductivity have also been impacted."*



Source: WDOH, 1991

Figure 3.3. Total Uranium in Chamokane Creek Surface Water



Source: AESE, 2000

Figure 3.4. Radium 228 in Chamokane Creek Sediments

3.3 Groundwater Resources

Available data on COPCs confirm that groundwater is exposed to the following hazardous substances (Table 3.3). In addition, groundwater serves as a major pathway for hazardous substances between their sources and surface water. The previous section demonstrated that surface water has been exposed to hazardous substances released from the facility. Therefore, groundwater has also been exposed.

Table 3.3. COPCs for Which Existing Data Demonstrate Exposure of Groundwater Resources

Analyte	Mined Area	Middle Blue Creek	Lower Blue Creek	Wetlands/Mill	Lower Chamokane Creek
Aluminum / Al		1	1		
Arsenic / As					
Cadmium / Cd	2				
Chromium / Cr					
Cobalt / Co		1	1		
Manganese / Mn	2	1,2	2		
Nickel / Ni	2	2	2		
Uranium / U Total	2			2	2
Zinc / Zn	2				
$Uranium_{234}$ / U-234	2	1	1		
$Uranium_{235}$ / U-235	2				
$Uranium_{238}$ / U-238	2	1	1		
Gross α	2	1	1	2	
Gross β	2			2	

1 USEPA, 2003. Proposed Exposure Point Concentrations for Midnite Mine Human Health Risk Assessment
2 Ridolfi, 2002. Preassessment Screen for the Midnite Mine Facility

3.3.1 Mine/Blue Creek Drainage

Groundwater samples from wells at the Mine contain elevated concentrations of hazardous substances; metal concentrations in wells at the Mine are several orders of magnitude greater than those measured in wells on the periphery of the Mine (Table 3.4). These data confirm that groundwater at the Mine has been exposed to hazardous substances.

Table 3.4. Groundwater Concentrations at the Mine Compared to Background

Constituent	Maximum PIA Well Concentration	Maximum Background Sample Concentration
Cadmium (µg/L)	**17.1**	0.52
Manganese (µg/L)	**40,200**	1,900
Nickel (µg/L)	**604**	112
Zinc (µg/L)	1,060	453
$Uranium_{234}$ (pCi/L)	**3,280**	37.2
$Uranium_{235}$ (pCi/L)	**190**	2.13
$Uranium_{238}$ (pCi/L)	**3,260**	33.5
Gross alpha radiation (pCi/L)	**1,150**	152
Gross beta radiation (pCi/L)	**1,500**	115

Bold values indicate concentrations at least 5 times maximum background. PIA = Potentially impacted area. µg/L = micrograms per liter. pCi/L = picocuries per liter. Metals concentrations given for total recoverable metals. Data source; URS, 2000b.

3.3.2 Mill/Chamokane Creek Drainage

Groundwater data in the Chamokane Creek Drainage are limited. Although exposure is indicated for some radionuclides, further review of the data is necessary to confirm exposure for other COPCs.

3.4 Air Resources

At this time, the Trustees do not propose to assess injury to air resources and therefore do not present confirmation of exposure for this resource. However, the Trustees may determine at a later time that an assessment of air resources is appropriate. In that case, the Trustees will amend this Plan accordingly.

3.5 Geologic Resources

3.5.1 Mine/Blue Creek Drainage

Soil data in the Blue Creek Drainage are limited. At this time, the Trustees have not determined if confirmation of exposure of geologic resources in this area is possible using existing data.

3.5.2 Mill/Chamokane Creek Drainage

Soils at the Mill have been contaminated with As, Cd, Cr, Co, Pb, Mn, Hg (WDOH, 1991). No studies have been conducted outside the boundary of the Mill. At

this time, the Trustees have not determined if confirmation of exposure of geologic resources in this area is possible using existing data.

3.6 Biological Resources

Exposure of biological resources to hazardous substances can be confirmed by monitoring other media to which they are exposed [43 CFR § 11.62(b)(1)(v); § 11.62(e)(11)]. Aquatic invertebrates, fish, aquatic and riparian vegetation, and terrestrial wildlife can be exposed to hazardous substances through surface water and sediment pathways. For example, aquatic invertebrates such as mayflies live in the bottom sediments of streams and consume algae, bacteria, and fine detrital material from the substrate. They are thus exposed to hazardous substances in surface water and sediment through direct contact and consumption. Terrestrial wildlife may be exposed to hazardous substances by drinking from streams and other surface water sources, ingesting soils or sediments while feeding, or by direct contact with surface water, sediments or soils containing elevated concentrations of hazardous substances. Thus, exposure of biological resources in the Blue Creek and Chamokane Creek drainages is confirmed through exposure of surface water, sediment (Section 3.2), and soils (Section 3.5) in these areas.

In addition, exposure of biological resources to hazardous substances can be confirmed through measurement of hazardous substances in biota [43 CFR § 11.62(f)(1)(i)]. Limited data confirm exposure of biological resources to hazardous substances released from the facility. They include current and historical data for aquatic invertebrates and fish, and current location-specific data for riparian vegetation and terrestrial wildlife resources (small mammals).

3.6.1 Aquatic Biota in Blue Creek

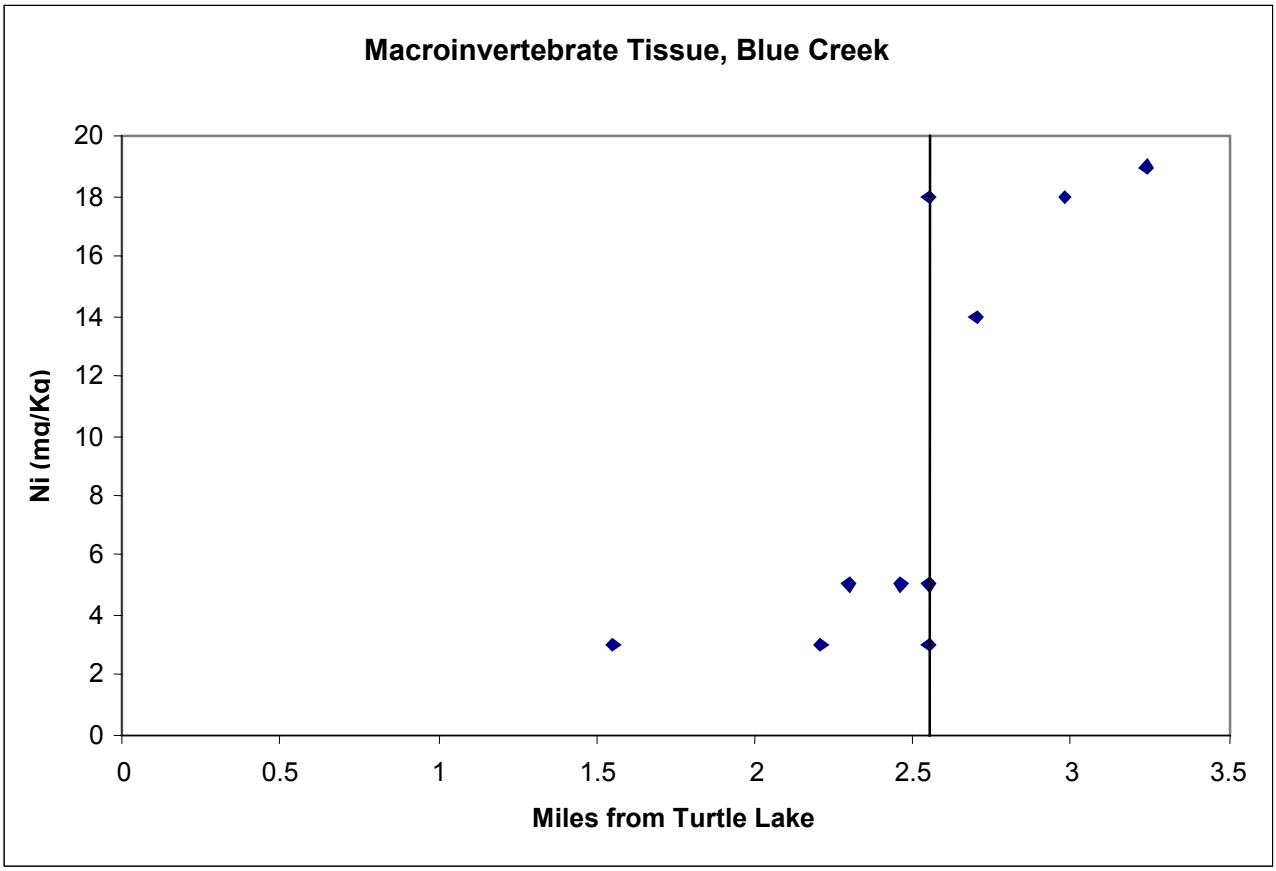
Available data on COPCs confirm that biological resources are exposed to the following hazardous substances (Table 3.5).

Table 3.5. COPCs for Which Existing Data Demonstrate Exposure of Aquatic Biological Resources

Analyte	Middle Blue Creek	Lower Blue Creek
Cadmium / Cd	X	X
Cobalt / Co	X	X
Manganese / Mn	X	X
Nickel / Ni	X	X
Uranium / U Total	X	X
Lead 210 / Pb 210	X	X
Radium 226 / Ra 226	X	X
Uranium 234 / U-234	X	X
Uranium 238 / U-238	X	X

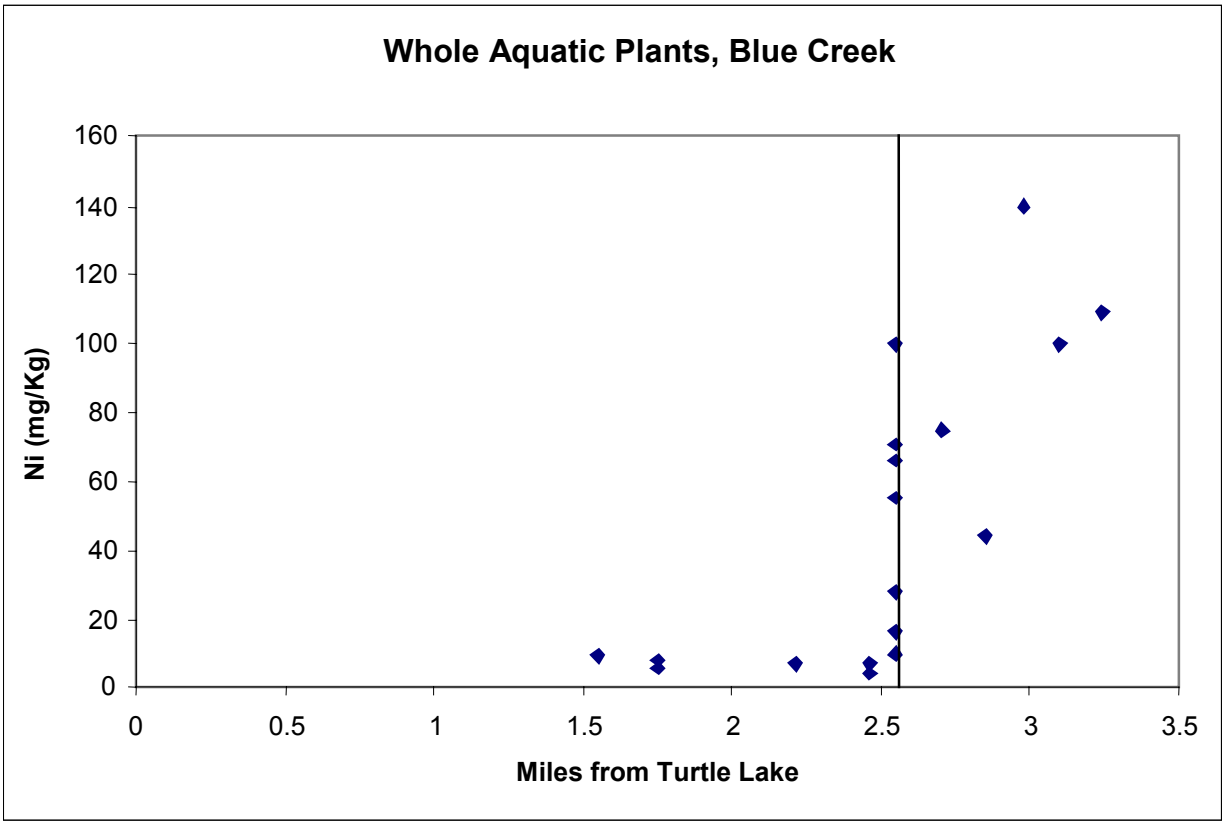
Source: USEPA, 2003. Proposed Exposure Point Concentrations for Midnite Mine Human Health Risk Assessment

Figures 3.5 and 3.6 confirm exposure of biological resources in Blue Creek for an example COPC. Figure 3.5 presents the concentration of nickel in the tissue of macroinvertebrates; Figure 3.6 presents the concentration of nickel in aquatic plants. The confluence of the Mine drainage with Blue Creek is approximately 2.5 miles below Turtle Lake. Concentrations of contaminants in both resources are elevated downstream of this confluence compared to samples collected in upstream reaches.



Source: SMI-DMC (1998)

Figure 3.5. Nickel in Blue Creek Macroinvertebrates



Source: SMI-DMC (1998)

Figure 3.6. Nickel in Blue Creek Aquatic Plants

3.6.2 Terrestrial Biota

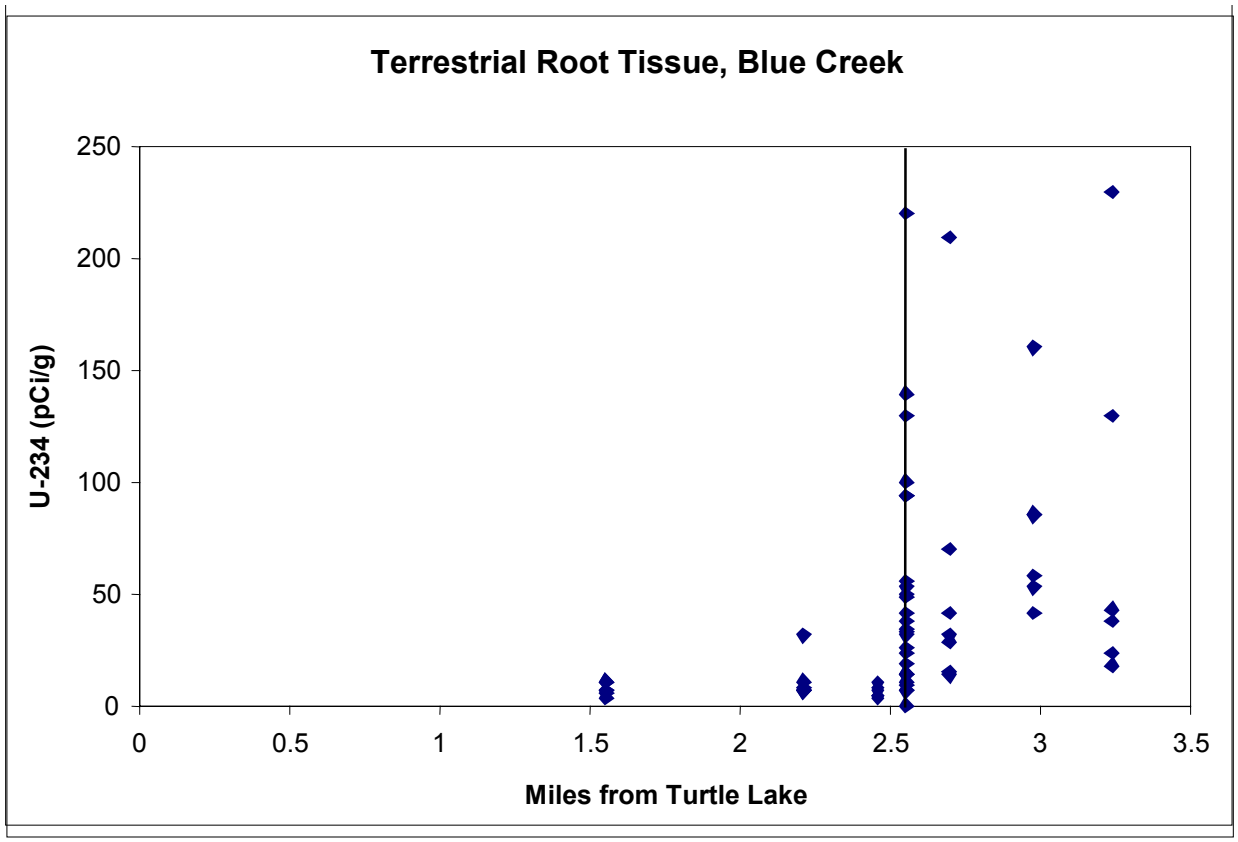
Available data on COPCs confirm that terrestrial biological resources in both Blue Creek and Chamokane Creek drainages are exposed to the following hazardous substances (Table 3.6).

Table 3.6. COPCs for which Existing Data Demonstrate Exposure of Terrestrial Biological Resources

Analyte	Mined Area	Middle Blue Creek	Lower Blue Creek	Wetlands/ Mill	Lower Chamokane Creek
Arsenic / As	1-,2#	2#	1,2#	2#	2#
Cadmium / Cd	1*	1*,2#	1*,2#		
Chromium / Cr	1-				
Cobalt / Co	1*				
Copper / Cu	2#	2#	2#		
Manganese / Mn	1*,2#	1*,2#	1*,2#	2#	2#
Nickel / Ni	1*	1*,2#	2#		
Selenium / Se	1-				
Thallium / Tl	1-	2#	2#		2#
Uranium / U Total	1*-,2#			2#	2#
Vanadium / V	1-				
Lead 210 / Pb 210	1*-	1*	1*		
Radium 226 / Ra 226	1*-	1*	1*		
Uranium 234 / U-234	1*	1*	1*		
Uranium 238 / U-238	1*	1*	1*		

* Riparian Plants
\- Upland Plants
\# Small Mammal Whole Bodies
1. USEPA, 2003. Proposed Exposure Point Concentrations for Midnite Mine Human Health Risk Assessment
2. MUMNRTC, 2002. Reconnaissance Data

Figure 3.7 confirms exposure of terrestrial biological resources for an example COPC. It presents the concentration of uranium 234 in the root tissue of terrestrial plants in the riparian corridor of Blue Creek. Uranium levels are elevated downstream of the confluence of the Mine drainage compared to samples collected in upstream reaches.



Source: SMI-DMC (1998)

Figure 3.7. Uranium in Root Tissue of Terrestrial Plants in Blue Creek

3.7 Summary of Exposure Confirmation

The available data confirm that natural resources in the Blue Creek and Chamokane Creek drainages have been exposed to hazardous substances. The Trustees believe that exposure of surface water and sediment in both drainages has been confirmed as far downstream as the confluence of the creeks with the Spokane River. Groundwater and biota (including aquatic invertebrates, fish, aquatic and riparian vegetation, and terrestrial wildlife) have also been exposed to hazardous substances in both drainages. The Trustees believe that available data suggest exposure of aquatic invertebrates and fish into the Spokane River and the Spokane Arm of Lake Roosevelt.

4.0 Injury Assessment Approaches

4.1 Introduction

The Spokane and Columbia River basins have been a valued resource for the Spokane and Colville Tribes from time immemorial. The United States recognizes that Indian reservations were, and are, intended to provide permanent homelands for members of the particular tribes (Agreement between Spokane Tribe of Indians and United States Department of War, August 18, 1877 ["And we {the Spokane Tribe} do further agree to go upon {the Reservation} with a view of establishing our permanent homes thereon...."]). As such, those members possess the right to use reservation natural resources for subsistence, religious, and other cultural purposes (*United States v. Anderson*, 736 F.2d 1358 [9th Cir. 1984]). The Tribes' efforts to preserve their culture and environmental quality have, on numerous occasions, been formally memorialized by pronouncements of their official governing bodies (STI, 2000).

The Blue Creek and Chamokane Creek watersheds are of particular importance to the Spokane Tribe. Regular use and habitation of these areas by Tribal members has been documented through numerous interviews (Ross, 1998). Prior to mining and milling, which impacted many of their major waterways, Spokane Tribal members had spent much of the year in the Blue Creek and Chamokane Creek watersheds, which are recalled as areas of abundant natural resources. These areas have been identified as primary subsistence locations where Tribal members hunt, fish, gather, and engage in cultural ceremonies and practices. These areas support sacred and ceremonial activities as well as traditional and subsistence uses.

The Spokane and Columbia River basins are part of the traditional Spokane and Colville Tribal homelands, and include interconnected resources, habitats, places, remains, and cultural symbols that support and sustain the cultural integrity and continuity of the Tribes. When one or more of these elements, such as water, plants, or animals, are impacted by releases of hazardous substances, the overall ability of the area to support tribal members' use of the environment is diminished.

Prior to releases from the facility, the resources of the Chamokane Creek, Blue Creek, and Spokane River watersheds provided a high level and variety of services important to the health, welfare, economy, and cultural integrity of the Tribes (Ross, 1998; Ray, 1977).

Section 3 provides data confirming that natural resources in the assessment area have been exposed to multiple hazardous substances. Preliminary analysis of available data indicates that natural resources, including surface water, sediments, groundwater, floodplain soils, riparian vegetation, and aquatic and terrestrial wildlife resources are potentially injured as a result of this exposure. To evaluate these potential injuries, the Trustees will conduct an injury assessment. Generally, the purpose of the injury assessment is to determine whether natural resources have been injured [43 CFR §

11.61], to identify the environmental pathways through which injured resources have been exposed to hazardous substances [43 CFR § 11.63], and to quantify the degree and extent (spatial and temporal) of injury [43 CFR § 11.71].

Portions of the injury assessment are intended to directly determine "injury" to resources as defined by Department of Interior (DOI) regulations:

> ". . . a measurable adverse change, either long- or short-term, in the chemical or physical quality or the viability of a natural resource resulting either directly or indirectly from exposure to a . . . release of a hazardous substance, or exposure to a product of reactions resulting from the . . . release of a hazardous substance. As used in this part, injury encompasses the phrases “injury,” “destruction,” or “loss” [43 CFR § 11.14(v)]. "

Other portions of the assessment approach discussed in this section are designed to identify services provided by these resources, and determine to what extent the quality and quantity of those services have been affected as a result of the release of hazardous substances from the Midnite Mine. This may be accomplished without first quantifying the change in the resource itself provided certain conditions are met [43 CFR 11.71(f)].

This section provides an overview of potential injuries to natural resources that will be assessed by the Trustees and describes the approaches that will be used to assess those injuries.

4.2 Injury Assessment Process

An injury assessment consists of two main components: injury determination and injury quantification.

1. *Injury determination*: the Trustees will determine whether an injury to one or more natural resources has occurred as a result of releases of hazardous substances [43 CFR § 11.61]. This determination will include the following two steps:

    a. Determination that injury has occurred. In this first step, the Trustees will evaluate whether injuries that meet the definitions of injury in 43 CFR § 11.62 for surface water, groundwater, air, geologic, and biological resources have occurred. The Trustees may also consider other injuries not explicitly identified in the DOI regulations.

b. Pathway determination. The Trustees will evaluate data to identify exposure pathways by which hazardous substances are transported in the environment and natural resources are exposed to those substances [43 CFR § 11.63].

2. *Injury quantification:* the injuries determined by the Trustees will be quantified in terms of changes from "baseline conditions" [43 CFR § 11.71(b) (2)]. Baseline conditions are the conditions that would have existed at the assessment area had the release of the hazardous substance not occurred [43 CFR § 11.14(e)]. Quantification will address the spatial and temporal extent of injury as well as the degree of injury. Quantification will be conducted primarily to provide information that is relevant to restoration and compensation. In some cases, it may be more appropriate to quantify changes in the services provided by the resource rather than changes in the resource itself.

The Trustees will emphasize the use of existing data whenever relevant data are available in their injury assessment. To ensure that existing data are incorporated into the process, the Trustees propose to adopt a phased injury assessment approach. This approach, summarized in Figure 4.1, includes the following phases:

Phase I: Data compilation and critical review. Existing historical and current site-specific baseline and assessment area data will be compiled into electronic databases for critical evaluation. In addition, data collected as part of current and ongoing monitoring programs of the Mine, Mill, Blue Creek and Chamokane Creek watersheds, as well as any additional risk assessment data or conclusions, will be examined. The evaluation will consist of analyzing existing data to determine sources of hazardous substances releases, exposure pathways, and exposure to natural resources, and to determine injury. If necessary, additional literature and document reviews will be conducted to develop injury thresholds against which environmental exposure data can be compared and to address any identified data gaps.

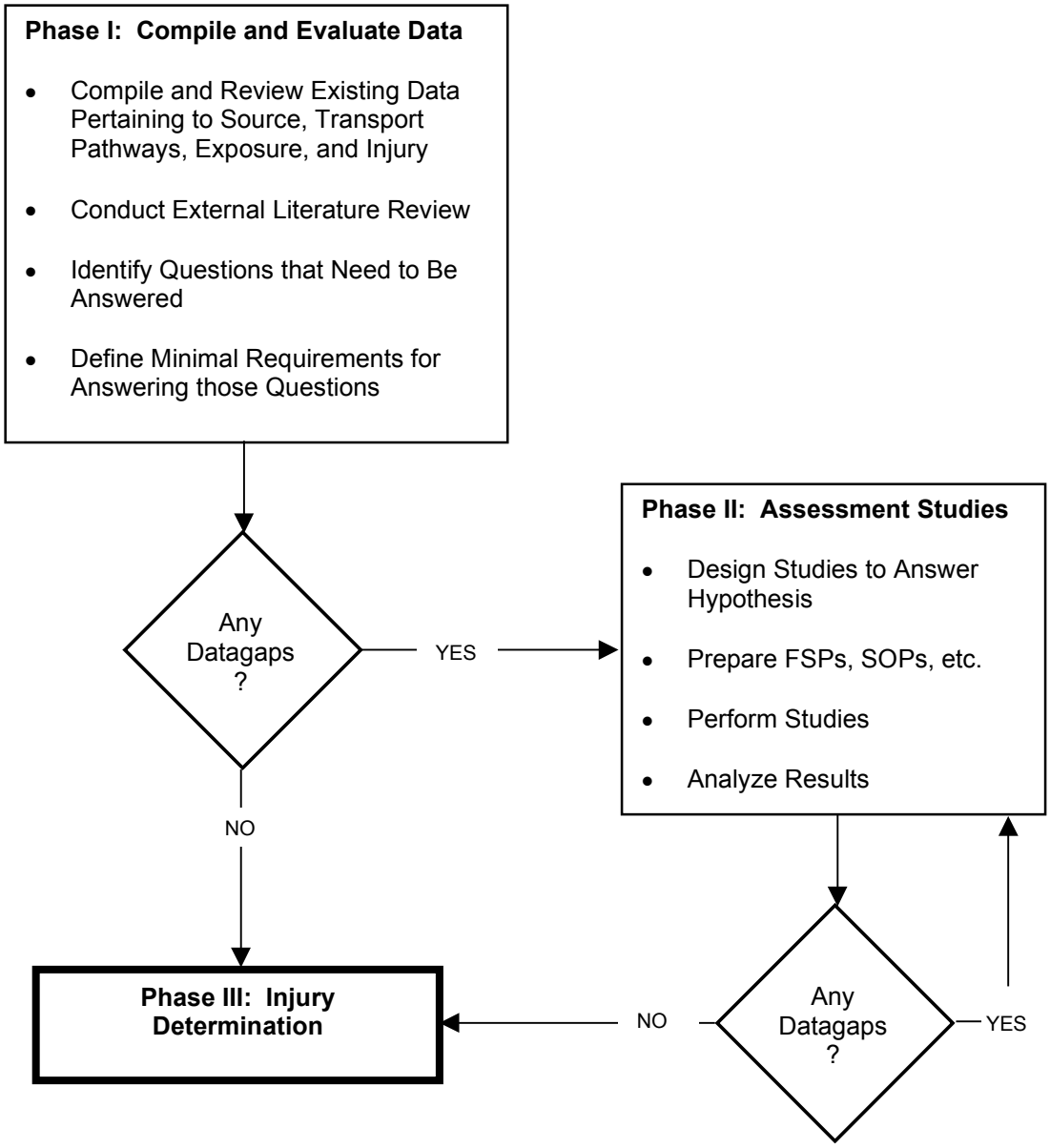
Phase II: Injury assessment studies. Based on the results of Phase I, the Trustees may conduct additional injury assessment studies. As described in subsequent sections of this section, certain data gaps have already been identified by the Trustees, and a set of focused studies have been proposed to address these data gaps. However, additional data gaps may be identified and supplemental studies may be proposed in the future. Before conducting studies, the Trustees will prepare study-specific protocols and operating procedures that will provide details of study implementation.

Phase III: Injury determination. The results of the Phase I data review and any Phase II data collection will be evaluated for the purposes of a comprehensive injury determination, following the procedures described in the following sections.

Consistent with the DOI regulations, injury determination will be evaluated resource by resource, as described in this section. However, natural resources and the ecological and human services they provide are interdependent. For example, surface water, bed, bank, and suspended sediments, floodplain soils, and riparian vegetation together provide habitat and lateral and longitudinal connectivity between habitats for aquatic biota, semi-aquatic biota, and upland biota dependent on access to area creeks. Hence, injuries to individual natural resources may cause ecosystem-level service reductions. Such individual and ecosystem-level service reductions may result in a reduction of the ability of humans to hunt, fish, gather, plant, and manage specific resources within the ecosystem, among other activities. The Trustees will consider these interdependent ecosystem-level and human-level service losses when quantifying the resources and resource services lost as a result of the release of hazardous substances from the facility.

This Plan addresses Part 1, Injury Determination. The injury quantification component will be addressed in a Part 2 document as determined appropriate by the Trustees, and therefore quantification approaches are not discussed further in this document. Potential injury determination approaches for each natural resource are described in the following sections. The Trustees note that additional approaches or methods may be used if appropriate. If necessary, the Trustees will prepare an addendum to this Plan that presents alternative injury determination approaches.

Figure 4-1
Phased Injury Assessment Approach



4.3 Surface Water Resources

Initial review of existing data suggests that surface water resources of the assessment area have been injured as a result of releases of hazardous substances from mining and mineral processing operations at the facility, as well as subsequent operations associated with attempts to contain, treat, or otherwise mitigate such releases. This section presents a summary of proposed approaches to evaluate these surface water injuries.

4.3.1 Injury definitions

Based on an initial review of the existing data, the relevant Regulatory definitions for the evaluation of injuries to surface water resources in the assessment area include the following:

> Concentrations and duration of hazardous substances in excess of drinking water standards as established by Sections 1411-1416 of the Safe Drinking Water Act (SDWA), or by other Federal or State laws or regulations that establish such standards for drinking water, in surface water that was potable before the release [43 CFR § 11.62(b)(1)(i)].
>
> Concentrations and duration of hazardous substances in excess of water quality criteria established by Section 1401(1)(D) of the SDWA, or by other Federal or State laws or regulations that establish such criteria for public water supplies, in surface water that before the discharge or release met the criteria and is a committed use as a public water supply [43 CFR § 11.62(b)(1)(ii)].
>
> Concentrations and duration of hazardous substances in excess of applicable water quality criteria established by Section 304(a)(i) of the Clean Water Act (CWA), or by other Federal or State laws or regulations that establish such criteria, in surface water that before the release met the criteria and is committed use as habitat for aquatic life, water supply, or recreation [43 CFR § 11.62(b)(1)(iii)].
>
> Concentrations and duration of hazardous substances sufficient to have caused injury to groundwater, air, geologic, or biological resources, when exposed to surface water, suspended sediments, or bed, bank, or shoreline sediments [43 CFR § 11.62(b)(i)(v)].

Table 4.1 lists specific regulatory standards and criteria that may be used to evaluate injury to surface water in the assessment area.

Table 4.1. Relevant Regulatory Standards and Criteria for Surface Water

Relevant standards and criteria	Concentrations in excess of water quality criteria or standards	Concentrations in excess of drinking water standards
Spokane Tribe Surface Water Quality Standards[1]	X	X
EPA Ambient Water Quality Criteria (Human health and welfare protection)		X
EPA Ambient Water Quality Criteria (freshwater aquatic life protection)	X	
Safe Drinking Water Act		
MCL		X
MCLG		X
SDWR		X

[1] The Spokane Tribe has promulgated Surface Water Quality Standards based on allowable ecological risk and human health risk to tribal members (STI, 2000). The Trustees believe that concentrations of hazardous substances in excess of these standards meets the definition of injury described above [43 CFR 11.62(b)(i)].

The Trustees note that no national sediment quality criteria have been developed to protect aquatic biota or wildlife from toxic sediments. However, various federal, state, and provincial agencies in North America have developed numerical sediment quality guidelines, and several groups have conducted sediment toxicity tests to assess the quality of freshwater and marine sediments. These guidelines provide an indication of the potential for sediments to cause adverse effects in biological resources, fulfilling the fourth definition of injury listed above [43 CFR 11.62(b)(i)(v)].

The Spokane Tribe's December 22, 2003 Hazardous Substances Control Act (HSCA) adopts the ecologically-based sediment standards developed by the Colville Tribes (Hazardous Substances Control Act, as amended 2003). These standards are protective of bottom dwelling organisms that are native to the Upper Columbia Basin. These standards also include values that are protective of human health. Table 4.2 presents sediment-related criteria for relevant hazardous substances that the Trustees will consider when determining injury to surface water resources.

Table 4.2. Sediment Quality Criteria for Surface Water Injury Determination

			Concentration (mg/kg dry wt)					
Name	**Definition**	**Basis**	**As**	**Cd**	**Cu**	**Ni**	**Zn**	**Reference**
Lowest effect level	Level that can be tolerated by the majority of benthic organisms	Field data on benthic communities	6	0.6	16	16	120	Persaud *et al.*, 1991
Threshold effect level	Concentration below which toxicity is rarely observed	Laboratory toxicity tests of aquatic invertebrates using field-collected sediment	13	0.7	41	24	110	Ingersoll *et al.*, 1996
Threshold effect level	Concentrations that are rarely associated with adverse biological effects	Compiled results of modeling, laboratory, and field studies on aquatic invertebrates and fish	5.9	0.596	35.7	18	123	Smith *et al.*, 1996
Minimal effect threshold	Concentration at which minimal effects are observed on benthic organisms	Field data on benthic communities	7	0.9	28	35	150	Environment Canada, 1992
Effects range low[1]	Concentration below which adverse effects would be rarely observed	Field data on benthic communities and spiked laboratory toxicity test data	33	5	70	30	120	Long and Morgan, 1991
Threshold effect level	Concentration below which adverse effects on survival or growth are expected to occur only rarely	Laboratory toxicity tests on the amphipod *Hyalella azteca* using field-collected sediment	11	0.58	28	20	98	USEPA, 1996
Consensus threshold effect concentration	Concentration below which adverse effects are expected to occur only rarely	Geometric mean of published effect concentrations listed above	9.79	0.99	31.6	22.7	121	MacDonald *et al.*, 2000
Sediment cleanup levels	Concentration below which adverse effects are expected to occur only rarely	Geometric mean of published effect concentrations listed above	9.79	0.99	31.6	22.7	121	STI, 2003

[1] Based on data from both freshwater and marine sites.

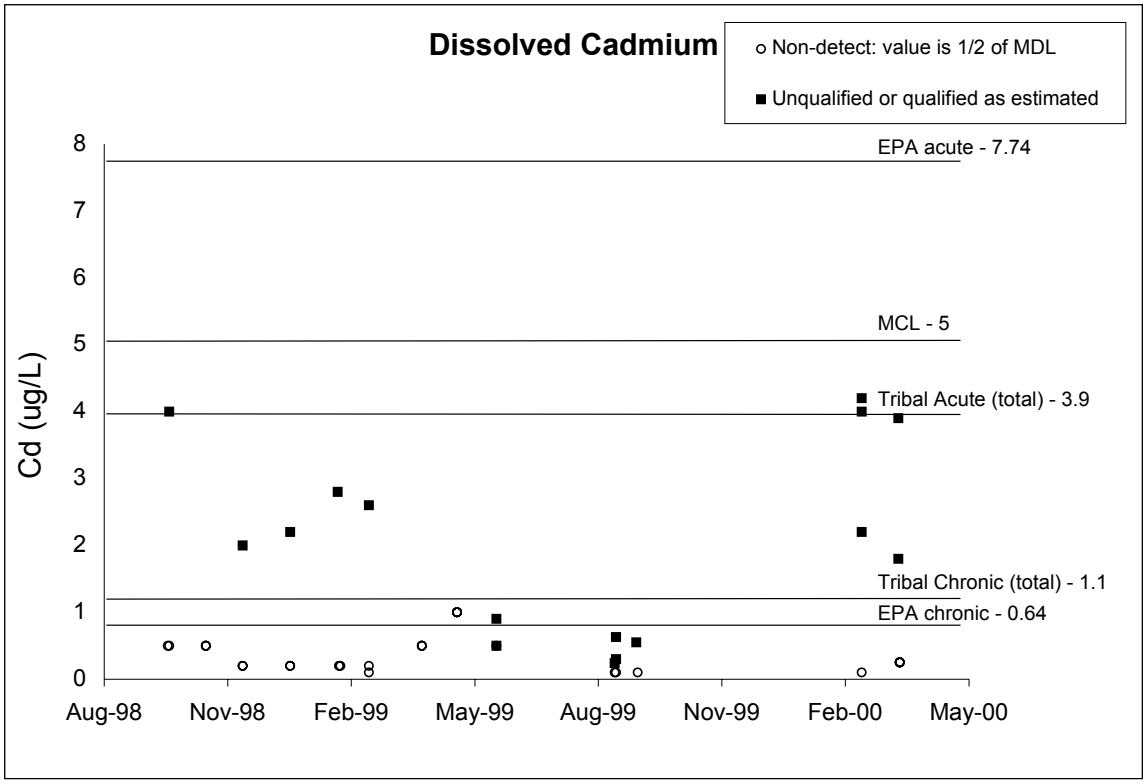
4.3.2 Injury determination approaches

Each of the injury definitions identified in Section 4.3.1 consists of several components. Table 4.3 summarizes the components of each definition and the possible approaches that may be taken in assessing each component. These are proposed general approaches to evaluating injury to surface water. The specific methods to be used in assessing surface water injury will be determined following a comprehensive evaluation of surface water data, relative to the applicable criteria. These approaches may be modified during the course of the injury assessment, based on information gained from additional studies.

Table 4.3. Approaches to Surface Water Injury Determination

Injury definition	Definition components	Evaluation approach
Water quality exceedences [43 CFR § 11.62(b)(1)(iii)]	Surface waters are a committed use as aquatic life habitat, water supply, or recreation.	Determine whether assessment area water bodies have or had committed uses.
	Concentrations and duration of hazardous substances are in excess of applicable water quality criteria	Perform temporal and spatial comparisons of surface water hazardous substance concentrations to state, tribal, and federal water quality criteria/standards.
	Criteria were not exceeded before release.	Compare baseline hazardous substance conditions to state, tribal, and federal water quality criteria/standards.
Drinking water standard exceedences [43 CFR § 11.62 (b)(1)(i)]	Concentrations and duration of hazardous substances are in excess of applicable drinking quality criteria	Perform temporal and spatial comparisons of surface water hazardous substance concentrations to state, tribal, and federal water quality criteria/standards.
	Water was potable before release.	Compare baseline hazardous substance conditions to drinking water standards
Biological resources injured when exposed to surface water/sediments [43 CFR §11.62(b)(1)(v)]	Biological resources are injured when exposed	Perform temporal and spatial comparisons of sediment hazardous substance concentrations to relevant sediment quality guidelines.

Figure 4.2 presents an example injury determination based on exceedence of water quality standards. The figure shows the concentration of dissolved cadmium in surface water samples collected from the Eastern Drainage part of the Blue Creek Drainage. For comparison, various water quality criteria are denoted by horizontal lines. Surface water in the Eastern Drainage clearly contains cadmium levels in excess of both USEPA and Tribal chronic water quality criteria. The Trustees assert that the Eastern Drainage historically provided both aquatic habitat and water supply. To complete an injury determination for this resource, the Trustees must show that these criteria were not exceeded in the Eastern Drainage before the release of hazardous substances from the Facility.



Source: URS, 2001

Figure 4.2. Example injury determination for surface water in Blue Creek Drainage

Therefore, in addition to conducting temporal and spatial comparisons of surface water concentrations to state, tribal, and federal water quality criteria/standards, the Trustees will also evaluate baseline conditions.

The DOI regulations suggest using historical data to evaluate baseline conditions [43 CFR §11.72 (c)]. However, no such data exist to describe baseline surface water conditions in the assessment area, other than anecdotal observations of “a clear and clean creek” with “many fish” (Work, 1999). Therefore, field data collected at reference areas will be used to define baseline. Reference areas will be selected by the Trustees to reflect, to the extent feasible, the influence of natural weathering of mineralized deposits and processes that result from historical and ongoing non-mining-related human activities and land uses in the assessment area.

4.3.3 Pathway evaluation

A preliminary evaluation of pathways from discharge sources to surface water resources in the assessment area suggests that pathways include direct discharges of hazardous substances to surface water, soil runoff, groundwater transport, and sediment transport.

In terms of surface water, for example, the Western Drainage pumpback, which receives acid mine drainage from various springs and seeps, has overflowed during the winter and early spring months, causing a release of contaminants into Blue Creek (AESE, 1999b). Leaching of metals from mine waste piles results in releases of dissolved metals to surface water. Resuspension of contaminated sediments can also expose surface water resources to metals. Elevated metal concentrations in the sediments of Blue Creek serve as a potential transport pathway to the surface waters of Blue Creek and Lake Roosevelt. Pathway determination will occur in conjunction with injury determination; the Trustees anticipate using existing data to demonstrate "the presence of the . . . hazardous substances in sufficient concentrations in the pathway resource" [43 § 11.63(a)(2)].

Sediments may have been exposed to concentrations of hazardous substances by historical dumping of mine wastes in the creeks. Surface erosion, mass wasting of tailings and waste piles, and naturally occurring erosion of the streambed and banks may also have contaminated surface water and groundwater, which eventually may have exposed sediments to hazardous substances. The Trustees anticipate using existing data to demonstrate pathway to sediments.

4.3.4 Surface water as a pathway of injury to other resources

In addition to direct injuries to the resource, surface waters in the assessment area may also be injured because other natural resources (*e.g.*, fish benthic invertebrates) are injured as a result of exposure to surface water [43 CFR § 11.62(b)(1)(v)]. Section 4.7 addresses injury to biological resources.

4.3.5 Proposed Additional studies

Surface water (including sediment) characterization will proceed by compiling all existing data (current and historical) followed by analyses to (1) determine injury and (2) identify datagaps. If necessary, studies will be designed to characterize the nature and extent of injury to surface water resources.

4.4 Groundwater Resources

Initial review of existing data suggests that groundwater resources of the assessment area may have been injured as a result of (1) releases of hazardous substances from mining and mineral processing operations at the Mine and Mill; and (2) subsequent operations associated with attempts to contain, treat, or otherwise mitigate such releases. This section presents a summary of proposed approaches to evaluate these groundwater injuries.

4.4.1 Injury definitions

Based on initial review of existing data, the relevant regulatory definitions for the evaluation of injuries to groundwater resources include the following:

> Concentrations and duration of hazardous substances in excess of drinking water standards as established by Sections 1411-1416 of the SDWA, or by other federal or state laws or regulations that establish such standards for drinking water, in groundwater that was potable before the release [43 CFR § 11.62(c)(1)(i)].
>
> Concentrations and duration of hazardous substances sufficient to have caused injury to surface water, when exposed to groundwater [43 CFR § 11.62(c)(1)(iv)].

4.4.2 Injury determination approaches

Based on the injury definitions described in Section 4.4.1, the Trustees anticipate assessing groundwater injuries using an approach similar to that described for surface water and sediment resources. The evaluation may include identifying committed uses and potability of groundwater resources, concentrations and duration of hazardous substances in groundwater, and exceedences of tribal, state or federal drinking water standards (see Tables 4.2 and 4.3).

Evaluation of baseline conditions should include consideration of the influence of natural weathering of mineralized deposits and processes that result from historical and ongoing non-mining-related human activities in the assessment area.

In addition, evaluation of groundwater injuries should include consideration of injuries to surface water from numerous springs and seeps observed at both the Mine and the Mill.

4.4.3 Pathway evaluation

The mobility of hazardous substances in aquifers is a function of physico-chemical processes and conditions, including but not limited to recharge locations, infiltration rate, hydraulic gradient, groundwater velocity, flow patterns, discharge locations, permeability, solubility, precipitation, adsorption, desorption, oxidation/reduction, and other reactions. In the assessment area, infiltration of precipitation and snowmelt through sources of contamination in the unsaturated zone, rising of capillary groundwater to sources of contamination in the unsaturated zone, inundation and leaching of source materials in the saturated zone, metallic sulfides oxidation, and flow of contaminated stream water to alluvial groundwater during high flow may all be mechanisms by which groundwater becomes exposed to hazardous substances from mining.

4.4.4 Proposed additional studies

Groundwater characterization will proceed by compiling all existing data (current and historical) followed by statistical analyses to identify datagaps. From this, studies will be designed (if necessary) to characterize the nature and extent of injury to groundwater resources as well as receptors that rely on those resources.

4.5 Air Resources

While the Trustees have not yet reviewed air data, air resources of the assessment area may be exposed to hazardous substances from mining and mineral processing operations at the Mine and Mill (including wind blown dust), as well as subsequent operations associated with attempts to contain, treat, or otherwise mitigate such releases.

At this time, the Trustees do not propose to assess injury to air resources. However, the Trustees may determine at a later time that an assessment of air resources is appropriate. In that case, the Trustees will amend this Plan accordingly.

4.6 Geologic Resources

At this time, the Trustees' evaluation of geologic resources focuses on floodplain soils along the Blue Creek and Chamokane Creek watersheds. Floodplains, areas of a valley floor adjacent to stream channels, are typically inundated and receive deposits of fine sediment during periods of high stream flow. Soils develop on the floodplain from these sediment deposits, and occasionally come into contact with surface water. Additionally, water from Chamokane Creek and several of the smaller creeks that intersect the haul road has been used for agricultural irrigation. This section presents a summary of proposed approaches to evaluate these potential injuries.

4.6.1 Injury definitions

The relevant regulatory definition for the evaluation of injury to geologic resources is the following [43 CFR § 11.62(e)]:

> An injury to the geologic resource has resulted from the… release of a hazardous substance if one or more of the following changes in the physical or chemical quality of the resource are measured:

- Concentrations of substances sufficient to raise the negative logarithm of the hydrogen ion concentration of the soil (pH) to above 8.5 (above 7.5 in humid areas) or to reduce it below 4.0.

- Concentrations of substances sufficient to have caused injury…to surface water, groundwater, air, or biological resources when exposed to the substances.

The presence of hazardous substances in floodplains in the system has the potential to cause or have caused injury to floodplain soils by causing the pH of the soils to be reduced to below 4.0. Additionally, toxic effects of these substances can result in a reduction in riparian vegetation cover and complexity, which in turn may result in deterioration of ecological functions, including but not limited to provision of supporting habitat for dependent biological resources such as wildlife.

4.6.2 Injury determination approaches

It is anticipated that the injury determination for floodplain geologic resources will consist of several components. Table 4.4 summarizes the components of each injury definition and the approaches that may be taken in assessing each component. The following sections briefly summarize the methods that may be associated with the various components of the injury determination. These are proposed general approaches to evaluating injury to floodplain soils. The specific methods to be used in assessing floodplain soil injury will be determined following a comprehensive evaluation of available data. These approaches may be modified during the course of the injury assessment, based on information gained from additional study.

Table 4.4. Approaches to Geologic Resource Injury Determination

Injury definition	Definition components	Evaluation approach
Floodplain soil pH reduced to below 4.0 43 CFR §11.62(e)(2)]	Floodplain soils with pH values less than 4.0 are injured.	Determine pH values in floodplain soils.
Biological resources injured when exposed to floodplain soils [43 CFR §11.62(e)(11)]	Biological resources are injured (as detailed in 43 CFR 11.62(f)(1)) when exposed	Determine whether biological resources have been injured as a result of exposure to floodplain soils.
Soils concentration result in a resource advisory	Soil resources are injured	Determine concentration of COPCs in soils and compare to values in Tribe's HSCA (STI, 2003)

4.6.3 Pathway evaluation

A preliminary evaluation of pathways from discharge sources to floodplain soil resources in the assessment area suggests that pathways include direct discharges of

hazardous substances to surface water, soil runoff, and surface water/sediment transport and deposition. For example, pumpbacks receiving acid mine drainage from various springs and seeps have overflowed on several occasions, causing a release of acid mine drainage into Blue Creek (AESE, 1999b). Surface erosion of contaminated soils in the Mine area may have exposed sediments to hazardous substances. Transport and deposition of contaminated sediments may have exposed floodplain soils to hazardous substances. The contaminated soils in turn may constitute an additional pathway to biological resources associated with floodplain areas.

4.6.4 Proposed additional studies

Data from previous studies relevant to floodplain soils within the assessment area or potential reference areas are lacking. No available data demonstrate that assessment area floodplain soils exhibit pH values less than 4.0.

A literature search will be performed to identify any additional studies with data relevant to the injury assessment. Relevant data found to be of suitable quality will be incorporated into the injury assessment and into work plans for field and laboratory studies. Based on the results of the literature review, a field sampling program may be designed and implemented to characterize floodplain soils both in the assessment area and in selected reference areas. Soil samples may be collected for chemical analysis (e.g., laboratory analyses of pH and metals concentrations in soils) and examination of riparian vegetation (see Section 4.7). The resulting data will be used to determine and quantify injury to flood plain soils in the assessment area relative to baseline conditions.

4.7 Biological Resources

A wide variety of biological resources may have been injured as a result of the release of hazardous substances from the facility. Currently, assessment efforts are focused on five categories of biological resources: benthic macroinvertebrates, aquatic plants, fish, terrestrial plants, and terrestrial wildlife.

4.7.1 Injury definitions

The regulatory criteria for injury to biological resources are concentrations of a hazardous substance sufficient to:

> cause the biological resource or its offspring to have undergone at least one of the following changes in viability: death, disease, behavioral abnormalities, cancer, genetic

mutations, physiological malfunctions (including malfunctions in reproduction), or physical deformations;

exceed action or tolerance levels established under section 402 of the Food, Drug and Cosmetic Act in edible portions of organisms; or

exceed levels for which an appropriate State health agency has issued directives to limit or ban consumption of such organism. [43 CFR § 11.62(f)(1)].

The method for determining injury to a biological resource must be capable of demonstrating a measurable biological response that can satisfy all of the following acceptance criteria:

- The biological response is often the result of exposure to hazardous substances [43 CFR § 11.62(f)(2)(i)].
- Exposure to hazardous substances is known to cause this biological response in free-ranging organisms.
- Exposure to hazardous substances is known to cause this biological response in controlled experiments.
- The biological response measurement is practical to perform and produces scientifically valid results.

The methods the Trustees are likely to use to assess biological injury are summarized in Table 4.5. The following sections provide additional detail on the application of each method to each relevant resource.

Table 4.5. Injury Assessment Methods for Biological Resources

	Comparison with Toxicity Thresholds	Site-Specific Toxicity Testing	Comparative Population and Diversity Data	Food Pathway Studies
Benthic Macroinvertebrates	X	X	X	
Aquatic Plants		X		
Fish	X	X	X	X
Terrestrial Plants	X		X	
Terrestrial Wildlife	X			X

4.7.2 Benthic Macroinvertebrates

Benthic macroinvertebrates characteristic of the Blue Creek, Chamokane Creek, and Spokane River watersheds include many species within the Ephemeroptera, Plecoptera, Trichoptera, Diptera, and Coleoptera orders (Scholz *et al.*, 1986, Cairns *et al.*, 1988, Plotnikoff *et al.*, 1988). These are second order producers, and are major food sources for fish, wildlife, and humans. Several proposed general approaches available to evaluate the potential for injuries to these organisms are presented below. The specific methods to be used in assessing macroinvertebrate injury will be determined following a comprehensive evaluation of available data. These approaches may be modified during the course of the injury assessment, based on information gained from additional study.

Comparison of water quality data with toxicity thresholds

As discussed in Section 4.3, several agencies have developed criteria for the protection of aquatic life (*i.e.*, Aquatic Life Criteria, or ALC). An initial review of the data suggests that ALC exceedences have occurred in the assessment area. Exceedences of ALC can be used as a screening level indication of toxicological injuries to macroinvertebrates. This initial evaluation can be supplemented with an evaluation of toxicological thresholds derived from the literature. In selecting toxicological thresholds from the literature, the Trustees would consider the test species as well as site-specific water quality conditions that may influence toxicity (*e.g.*, hardness, calcium concentration, pH, dissolved organic carbon, alkalinity) to ensure that thresholds are appropriate for application in this case. The Trustees may assess injury to macroinvertebrates by comparing measured water quality conditions with the literature-derived injury thresholds.

Site-specific toxicity testing

The literature-based injury assessment described above may be supplemented by examining site-specific toxicity data. This could include the results of tests conducted on macroinvertebrate test species, using water and sediment collected from areas downstream and upstream of mining activities. Water and sediment would be sampled at the Mine, Mill, and at streams that intersect the haul road. Samples both up- and downstream of the Mine would also be required for the period in which the water treatment plant is in operation. Test endpoints such as growth rate, survival, and reproductive success may reveal differences between samples collected from areas affected by releases of hazardous substances and those collected from reference areas.

Comparative population and diversity data

Benthic macroinvertebrates have been used extensively to monitor the effects of metal contamination on aquatic systems. Benthic macroinvertebrates demonstrate individual level responses (*e.g.*, mortality, reduced growth, reduced reproductive fitness) as well as community level responses (*e.g.*, reduced density, reduced species richness, community shift to more tolerant species) to metals. Metals have been shown to be toxic to benthic macroinvertebrates in laboratory and field tests (Clements, 1994; Beltman *et al.*, 1999).

Where metal concentrations are sufficiently elevated, benthic invertebrates may be absent or their abundance greatly reduced (Clements, 1991). Where metal concentrations do not eliminate the community, however, measures of taxa richness (*e.g.*, total number of taxa present) or abundance of metal-sensitive taxa provide a sensitive and reliable measure of community level effects (Beltman *et al.*, 1999; Carlisle and Clements, 1999). Invertebrate taxa richness is reduced by exposure to metals, because metal-sensitive species are eliminated. Because many mayfly species are sensitive to metal contamination, a reduction in the number of mayfly species presents an effective and reliable measure of metal impacts on benthic macroinvertebrate communities (Kifthey and Clements, 1994).

In the assessment area, several macroinvertebrate community studies have been conducted to assess the impacts of the Mine (Plotnikoff, *et al.*, 1988 and Cairnes *et al.*, 1988). Reductions in diversity of macroinvertebrates were observed in all the studies downstream of the Mine. The Trustees may use changes in taxa richness as indicators of invertebrate community injuries.

4.7.3 Aquatic Plants

Aquatic plants are primary producers, and major food sources for macroinvertebrates, fish, wildlife, and humans. Some aquatic plants are known to bioconcentrate various COPCs. One approach available to evaluate these injuries is presented below. The specific methods to be used in assessing aquatic plant injury will be determined following a comprehensive evaluation of available data. This approach may be modified during the course of the injury assessment, based on information gained from additional study.

Site-specific toxicity testing

Site-specific toxicity data could include the results of tests conducted on water and sediment collected from areas downstream and upstream of mining activities. Such water would be sampled at the Mine, Mill, and at streams that intersect the haul road. Samples both up- and downstream of the Mine would also be required for the period in which the water treatment plant is in operation. Test endpoints such as growth rate, survival, and germination success may reveal differences between samples collected

from areas affected by releases of hazardous substances and those collected from reference areas.

4.7.4 Fish

Fish are found in Blue Creek, Chamokane Creek, and the Spokane Arm of Lake Roosevelt. The creeks generally have more fish diversity and abundance than the Spokane Arm of Lake Roosevelt. Streams of the Blue Creek, Chamokane Creek, and Spokane River watersheds contain several fish species, including rainbow trout *(Salmo gairdneri)*, brown trout *(Salmo trutta),* brook trout *(Salvelinus fontinalis),* mountain whitefish *(Prosopium williamsoni),* bridgelip sucker *(Catostomus columbianus),* speckled dace *(Rhinichthvs osculus),* and redside shiner *(Richardsonius balteatus)* (Griffith and Scholz, 1991; Griffith *et al.*, 1993; and Thatcher *et al.*, 1993). Kokanee salmon (*Oncorhynchus nerka*) made up 99% of the catch in Lake Roosevelt during the sixties (Snyder, 1967) and remains in the top three as a popular sport fishery (McLellan, 2003). Bull trout (*Salvelinus confluentus*), a federally listed threatened species under the Endangered Species Act, has been observed at the mouth of Blue Creek as well as other areas within the Spokane Arm between 1985 and 2000 (Scholz personal comm. 2000). Furthermore, Lake Roosevelt, including the Spokane Arm, is listed as a research need in the Northeast Washington Draft Bull Trout Recovery Plan (USFWS 2002).

Several approaches available to evaluate injury to fish are presented below. These are proposed general approaches. The specific methods to be used in assessing injury to fish will be determined following a comprehensive evaluation of available data. These approaches may be modified during the course of the injury assessment, based on information gained from additional study.

Comparison of water quality data with toxicity thresholds

An initial review of the data suggests that ALC exceedences have occurred in the assessment area. Exceedences of ALC can be used as a screening level indication of toxicological injuries to fish. This initial evaluation can be supplemented with an evaluation of toxicological thresholds derived from the literature. In selecting toxicological thresholds, the Trustees would consider the test species as well as site-specific water quality conditions that may influence toxicity (*e.g.*, hardness, calcium concentration, pH, dissolved organic carbon, alkalinity) to ensure that thresholds are appropriate for application in this case.

The Trustees may assess injury to fish by comparing measured water quality conditions with the literature-derived injury thresholds.

Site-specific toxicity testing

The literature-based injury assessment described above will be supplemented by examining site-specific toxicity data. Site-specific toxicity data include the results of tests conducted on water and sediment collected from areas downstream and upstream of

mining activities. Water and sediment would be sampled at the Mine, Mill, and streams that intersect the haul road. Samples bracketing the Mine would also be required for the period in which the water treatment plant is in operation. Test endpoints such as growth rate, survival, and reproductive success may reveal differences between samples collected from areas affected by releases of hazardous substances and those collected from reference areas.

Population and community data

Fish population data can be used to evaluate whether spatial patterns of fish population density and diversity are consistent with potential toxicological effects. To address this question, fish populations in affected stream reaches would be compared to fish populations in reference areas.

Food pathway studies

Several studies have concluded that the survival and growth of trout can be impaired if they eat contaminated invertebrate prey (Woodward *et al.*, 1994, 1995). Other studies, however, have suggested confounding effects of nutrition and substantially lower toxicity of ingested metals (Mount *et al.*, 1994). To assess the dietary exposure pathway, the Trustees propose to conduct a thorough evaluation of recent literature to determine whether dietary effects thresholds for the COPCs can be derived. These effects thresholds would be compared with concentrations of hazardous substances measured in invertebrates to evaluate injuries by this pathway. In addition, the Trustees will consider, following this literature evaluation, whether supplemental dietary toxicity tests are warranted.

4.7.5 Terrestrial Plants

Vegetation potentially impacted by releases of hazardous substances from the facility are primarily in the riparian areas of the Blue Creek and Chamokane Creek watersheds. Riparian areas are located between the active stream channels and uplands, which generally coincide with floodplain areas. Riparian vegetation comes into contact with surface water, sediment, and floodplain soils, all of which may have elevated concentrations of COPCs.

Two approaches available to evaluate injury to terrestrial plants are presented below. The specific methods to be used in assessing this injury will be determined following a comprehensive evaluation of available data. These approaches may be modified during the course of the injury assessment, based on information gained from additional study.

Comparison of site-specific data with toxicity thresholds

A literature review will be performed to summarize known effects of metals, radionuclides, and low pH on riparian resources, including riparian vegetation, riparian habitat, and dependent wildlife. Wildlife use of vegetation will also be reviewed. For example, studies have shown that metals can be concentrated in riparian vegetation through uptake from exposed soils. This vegetation may serve as a food source for dependent wildlife, which may then be exposed to toxic concentrations of COPCs (Larison *et al.*, 2000).

Comparative population and diversity data

The presence of hazardous substances in floodplains of the assessment area has the potential to cause or have caused injury to riparian vegetation resources by resulting in significant reduction in riparian vegetation cover and complexity through plant death or physical deformation. Therefore, injury to riparian vegetation resources may be determined by measuring and evaluating vegetation cover, community structure, and composition in the assessment area relative to reference areas.

The injury determination for riparian vegetation resources may consist of a review of relevant studies previously conducted in the study area; a review of relevant published literature on the effects of pH and metals on plants and vegetation communities; a review of available aerial photography (both recent and historical) to delineate temporal and spatial trends in the distribution of riparian vegetation; field studies to measure vegetation cover and community structure/composition; and evaluations of the field data to determine injury.

Data from previous studies relevant to riparian vegetation within the assessment area or potential reference areas are limited. However, a thorough literature search will be performed to identify any studies with data relevant to the injury assessment. Data found will be reviewed to determine usability. Relevant data of suitable quality will be incorporated into the injury assessment and into the work plan for field studies.

Riparian vegetation characterization will proceed by compiling existing data followed by analyses to identify data gaps. From this, studies will be designed (if necessary) to characterize the nature and extent of injury to riparian vegetation as well as receptors that rely on those resources.

4.7.6 Terrestrial Wildlife

Terrestrial wildlife resources include terrestrial macroinvertebrates, birds, mammals, reptiles, and amphibians, which are biological resources under the Regulations [43 CFR § 11.14(f)]. These resources come into contact with surface water, sediments, soils, and vegetation in the assessment area. Surface water and sediments are contaminated by metals (Section 4.3) and it is likely that floodplain soils and

vegetation are also contaminated (Sections 4.6 and 4.7). Wildlife resources may be exposed to contaminated resources through dermal contact, ingestion of water, sediment, and soil and through dietary pathways. Possible approaches available to evaluate these injuries are presented below. The specific methods to be used in assessing terrestrial wildlife injuries will be determined following a comprehensive evaluation of available data. These approaches may be modified during the course of the injury assessment, based on information gained from additional study.

Comparison of site-specific data with toxicity thresholds

A literature review will be conducted to summarize known effects of metals and radionuclides on terrestrial wildlife. Concentrations of COPCs in soils, sediments and surface water that make up terrestrial wildlife habitat will be compared with wildlife toxicological thresholds derived from the literature review. Wildlife use of terrestrial habitat will also be evaluated, to identify receptors that are exposed to COPCs at concentrations above toxicological thresholds. Studies to evaluate injuries to wildlife will then be developed, if determined necessary by the Trustees

Food pathway studies

To assess the dietary exposure pathway, the Trustees propose to conduct a thorough evaluation of recent literature to determine whether dietary effects thresholds for the COPCs can be derived for one or more species. These effects thresholds would be compared with concentrations of hazardous substances measured in vegetation and/or prey species to evaluate injuries by this pathway. If no relevant thresholds can be found in the literature, the Trustees may choose to develop bioaccumulation models describing the potential for dietary concentrations of COPCs to result in harmful concentrations in target species.

Data evaluating wildlife exposure and potential injury related to the facility are limited and associated primarily with small terrestrial mammal exposure (MUMNRTC, 2002). Additional studies may be needed to evaluate both injury and pathways of exposure to wildlife resources. The Trustees have identified several potential wildlife injury studies. These include, but are not limited to, songbird and waterfowl health evaluations, a bald eagle and/or osprey health evaluation, wildlife inventories and surveys to determine habitat use and potential pathways of exposure, and big game fecal sample collection to evaluate deer and elk exposure pathways. Any of these investigations, if conducted, could give rise to development of additional studies, dependant on the findings of the initial investigations.

4.7.7 Pathway evaluation for biological resources

As per DOI regulations, pathways may be determined by demonstrating "the presence of hazardous substances in sufficient concentrations in the pathway resource or by using a model that demonstrates that the conditions existed . . . such that the route served as a pathway" [43 CFR § 11.63(a)(2)]. A preliminary evaluation of exposure pathways to biological resources suggests that pathways include direct exposure through physical contact with hazardous substances as well as indirect exposure through food chain processes. Food chain processes represent a potentially significant pathway of exposure to all biological receptors. Elevated concentrations of COPCs (if identified) in aquatic plants, macroinvertebrates, and fish will be used to confirm that exposed water and sediments are a pathway to plants, invertebrates, fish and terrestrial receptors throughout the assessment area.

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