United States Department of the Interior

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APR 18 2016

Memorandum

To: Field Manager, Bureau of Land Management, Challis Field Office, Challis, Idaho

From: Acting State Supervisor, Fish and Wildlife Service, Idaho Fish and Wildlife Office, Boise, Idaho

Subject: Transmittal of Biological Opinion for Effects to Bull Trout and Designated Critical Habitat from the Proposed Thompson Creek Mine Expansion Project, and Concurrence for Effects to Canada lynx (01EIFW00-2015-F-0298)

Attached to this memorandum is the Fish and Wildlife Service's (Service) biological opinion (Opinion) on the Bureau of Land Management's (Bureau) proposed Thompson Creek Mine Expansion Project. This Opinion analyzes the potential effects to bull trout (*Salvelinus confluentus)*, a fish species listed as threatened under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq. [Act]), and its designated critical habitat.

The Service's Opinion, prepared in accordance with section 7 of the Act, is in response to the Bureau's December 11, 2014 letter and associated biological assessment (Assessment) for wildlife and aquatic species, received by the Service on December 12, 2014, requesting consultation pursuant to requirements under section 7 of the Act. Through the Assessment, the Bureau determined that potential effects from the proposed action were likely to adversely affect bull trout and its designated critical habitat. In the attached Opinion, the Service finds that potential adverse effects from the Bureau's proposal are not likely to jeopardize the continued existence of the coterminous United States population of bull trout, or result in adverse modification of designated critical habitat.

The Bureau determined that the proposed mine expansion would have no effect to yellow-billed cuckoo (*Coccyzuz americanus*). The regulations implementing section 7 of the Act do not require the Service to review or concur with no effect determinations, and these will not be addressed further. However, we appreciate being informed of your determination for these species, even if not required to do so under the Act.

The Bureau also determined that the proposed mine expansion may affect, but is not likely to adversely affect Canada lynx (*Lynx canadensis*), a mammal listed as threatened under the Act. The Service concurs with your determination for lynx and our rationale is described below.

Proposed Action

The Proposed Action is authorization of the Modified Mine Plan of Operations (MMPO), submitted by Thompson Creek Mine Company (TCMC) to the Bureau, the Salmon-Challis National Forest (Forest), and other cooperating agencies in 2009. The Bureau proposes to issue a decision regarding expansion of the waste rock storage south of the open pit and modification of long-term water management. The proposed action includes Forest issuance of a decision regarding the storage of waste rock north of the open pit, expansion of the Tailings Storage Facility, and realignment of a section of power line. In addition, the proposed action includes the issuance of the U.S. Army Corps of Engineers 404 permit.

Species and Habitat Presence in the Project Area

The Forest land is part of "secondary, unoccupied" lynx habitat as defined in the Northern Rockies Lynx Amendment (Assessment, p. 69). Secondary habitat has relatively few and more sporadic current and historical records of lynx compared to primary or "core" habitat, and reproduction in secondary habitat has not been documented (Assessment, p. 69). Adjacent Bureau lands that make up the remainder of the action area are also mapped as secondary habitat. The nearest lynx core habitat is more than 150 miles east and north of the action area (Assessment, p. 69).

Lynx analysis units (LAUs) have been identified by the Forest and are used to analyze a project's effects to lynx productivity, mortality risk factors, movement, and dispersal. The area of a LAU is the approximate area used by individual lynx, not an actual home range, and includes all seasonal habitats. LAUs are the most relevant predictor of habitat use by lynx at a project scale. The 348 acres of LAUs (mapped by the Forest) within the action area occur in the head waters of the Thompson Creek watershed approximately 5 kilometers from Thompson Creek Mine (Mine) disturbance. No LAUs are present within the areas to be disturbed under the proposed action.

One male lynx was incidentally trapped and released in the Williams Creek drainage, approximately 50 miles northeast of the Mine, approximately 11 miles southwest of Salmon, on January 26, 2012 (Assessment p. 69). This occurrence is the first verified occurrence of lynx in the Upper Salmon River drainage since 1991.

Potential Impacts and Effects from the Proposed Action

The Mine has been in operation on private land with associated Mine disturbance (e.g. noise, light, vibration) since the 1980s. No disturbance, either existing or from the proposed action, will occur in Forest LAUs. Further, the proposed action (realignment of a power line, expansion of the waste rock storage facility, and expansion of the tailings storage facility) will occur adjacent to existing Mine disturbance (at the beginning of Phase 8 mining). Due to the nature of the proposed action, the proximity to existing disturbance, and location in secondary unoccupied lynx habitat, the potential for lynx use during the placement of waste rock is highly unlikely. Therefore, direct effects to an individual lynx during waste rock placement are discountable. Direct effects to Canada lynx may occur through the loss of secondary unoccupied habitat as a result of the mine expansion. After timber removal (at the beginning of Phase 8), there will be

364 fewer forested acres within secondary lynx habitat. Effects of the proposed action as a result of the habitat removal will consist of expansion of the current Mine disturbance. Because the area of disturbance is adjacent to existing disturbance, there will be no new discontinuities or isolated habitat patches created and thus, no new habitat fragmentation. As a result of the nature of the propose action, the proximity of the expansion to existing Mine disturbance, the lack of historical use by lynx, and the secondary unoccupied nature of the habitat being removed, it is unlikely lynx will use the area of Mine expansion. If lynx were to be displaced by the Mine expansion, the land surrounding the project area contains similar habitat with much lower levels of human disturbance that would provide travel corridors and habitat connectivity to less disturbed habitat. Consequently, any effects from displacement would likely be insignificant.

The decrease and modification of forested habitat in the action area (direct effects described above) will not produce any detectable or measurable change to movement, foraging, or other patterns or potential habitat uses of any lynx individuals that may utilize the action area. Further, LAUs contain the most reasonable occurrence locations for Canada lynx in the action area and these areas will not be disturbed. For these reasons, the Service finds that the effects to lynx from the proposed Thompson Creek Mine Expansion are anticipated to be both discountable and insignificant.

Concurrence

Based on the Service's review of the Assessment, we concur with the Bureau's determination that the action outlined in the Assessment, may affect, but is not likely to adversely affect Canada lynx. This concurrence is based on the existing conditions, duration of disturbance, lack of primary Canada lynx habitat, the lack of occurrences of Canada lynx in the action area, and the ability of lynx to move into adjacent habitat.

This concludes informal consultation. Further consultation pursuant to section 7(a)(2) of the Act is not required. Reinitiation of consultation on this action may be necessary if new information reveals effects of the action that may affect a listed species or designated habitat in a manner or to an extent not considered in the Assessment, the action is subsequently modified in a manner that causes an effect to the listed species that was not considered in the analysis, or a new species is listed or critical habitat designated that may be affected by the proposed action.

Thank you for your continued interest in the conservation of endangered, threatened, and proposed species. If you have any questions regarding this consultation, please contact Evan Ohr of our Eastern Idaho Field Office at (208) 237-6975 ext. 115.

Attachment

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BIOLOGICAL OPINION
FOR THE
THOMPSON CREEK MINE EXPANSION PROJECT
CUSTER COUNTY, IDAHO
01EIFW00-2015-F-0298

U.S. FISH AND WILDLIFE SERVICE
IDAHO FISH AND WILDLIFE OFFICE
BOISE, IDAHO

Acting
Supervisor Dan Mackey

Date APR 18 2016

Table of Contents

INTRODUCTION 4
Consultation History 4
Purpose and Organization of this Biological Opinion 5
I. DESCRIPTION OF THE PROPOSED ACTION 8
A. Action Area 8
B. Proposed Action 8
C. Monitoring 11
D. Term of Action 12
II. STATUS OF THE BULL TROUT 16
A. Regulatory Status 16
1. Listing Status 16
2. Threats 16
3. Climate Change 17
B. Survival and Recovery Needs 17
1. Recovery Planning 17
C. Rangewide Status and Distribution 18
1. Jarbidge River 18
2. Klamath River 18
3. Coastal-Puget Sound 19
4. St. Mary-Belly River 20
5. Columbia River (includes the action area) 21
D. Life History 21
E. Habitat Characteristics 22
F. Diet 23
G. Previously Consulted-on Effects 24
1. Rangewide 24
2. Eastern Idaho 25
III. STATUS OF BULL TROUT CRITICAL HABITAT 25
A. Legal Status 25
B. Conservation Role and Description of Critical Habitat 27
C. Current Critical Habitat Condition Rangewide 30
D. Previously Consulted-on Effects for Critical Habitat 31

IV. ENVIRONMENTAL BASELINE FOR THE BULL TROUT AND BULL TROUT CRITICAL HABITAT 31
A. Status of Bull Trout in the Action Area 31
B. Status of Bull Trout Designated Critical Habitat in the Action Area 49
V. EFFECTS OF THE PROPOSED ACTION 51
A. Direct and Indirect Effects of the Proposed Action 51
1. Analytical Approach and Assumptions 51
2. General Effects of the Proposed Action 52
3. Effects of the Proposed Action to Thompson Creek 54
4. Effects of the Proposed Action to S. Creek 66
5. Effects of the Proposed Action to the Salmon River 75
B. Interrelated and Interdependent Effects 84
VI. CUMULATIVE EFFECTS 84
VII. CONCLUSION 84
A. Bull Trout 84
B. Designated Critical Habitat 85
VIII. INCIDENTAL TAKE STATEMENT 86
A. Amount or Extent of Take Anticipated 86
B. Effect of the Take 87
C. Reasonable and Prudent Measures 87
D. Terms and Conditions 88
IX. CONSERVATION RECOMMENDATIONS 90
X. REINITIATION-CLOSING STATEMENT 91
XI. LITERATURE CITED 92

INTRODUCTION

This document represents the Fish and Wildlife Service's (Service) Biological Opinion (Opinion) on the effects to the threatened bull trout *(Salvelinus confluentus*) and its designated critical habitat from the Bureau of Land Management Challis Field Office's (Bureau) proposed expansion of the Thompson Creek Mine (Mine) operated by the Thompson Creek Mine Company (TCMC) in Custer County, Idaho. This consultation will include issuance of the U.S. Army Corps of Engineers (Corps) 404 permit and the actions occurring on Salmon-Challis National Forest (Forest) lands described in the proposed action section of this Opinion. This Opinion was prepared in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 USC 1531 et seq.; [Act]). Your December 11, 2014, request for consultation was received on December 12, 2014.

This Opinion is primarily based on the Bureau's *Thompson Creek Mine Project Biological Assessment* (BLM 2014, entire), dated December 10, 2014, and other sources of information cited herein. The Biological Assessment (Assessment) is incorporated by reference in this Opinion.

Consultation History

Commercial molybdenum production has been occurring at the Mine since November 1983. The Mine encompasses approximately 2,191 acres of private land and 632 acres of Federal land. Bonds were required for disturbance of Federal lands caused by mining activities. The Service has consulted on various aspects of Mine operation where a Federal nexus exists. Previous mining activity for the Mine has not been subject to consultation under the Act due to a lack of a Federal nexus. The Bureau and Forest propose to authorize the expansion of Mine activity onto Federal lands. Authorization of the Modified Mine Plan of Operation (MMPO), the proposed mine expansion, and wetland mitigation are the subject of this consultation.

In the December 12, 2014, Assessment, the Bureau determined the proposed action may affect, and is likely to adversely affect bull trout and its designated critical habitat. The Bureau also determined the proposed action may affect, but is not likely to adversely affect Canada lynx (*Lynx canadensis*). The Service has reviewed the basis for the not likely to adversely affect determination for Canada lynx and concurs with this finding for reasons discussed in the transmittal letter for this Opinion. Therefore, Canada lynx will not be discussed further.

A chronology of this consultation is presented below. A complete decision record for this consultation is on file at the Service's Eastern Idaho Field Office in Chubbuck, Idaho.

June 25, 2014	The Bureau presents to the Service at a Level 1 meeting an overview of the proposed action for the Thompson Creek Mine Project
August through November 2014	The Service receives and comments on multiple versions of the draft Assessment

November 13, 2014	The Service and National Marine Fisheries Service tour the Mine
December 12, 2014	The Service receives the Final Assessment for consultation from the Bureau
May 6, 2015	The Service sends the Bureau the draft Opinion for review
July 27, 2015	The Service receives comments from the Bureau on the draft Opinion
September 2, 2015	The Service provides a response to the Bureau's comments on the draft Opinion
November 2, 2015	Terms and Conditions of the draft Opinion are discussed at a Level 2 meeting
December 2015 through January 2016	The Service, the Bureau, and TCMC discuss the Terms and Conditions of the draft Opinion
February 3, 2016	The Bureau provides TCMC's proposal for alternative Terms and Conditions
February 19, 2016	The Service provides a revised draft Opinion to the Bureau
March 21, 2016	The Bureau provides comments on the draft Opinion
March 23, 2016	The Service provides a response to the Bureau's comments on the draft Opinion

Purpose and Organization of this Biological Opinion

In accordance with the requirements of section 7(a)(2) of the Act and its implementing regulations, the formal consultation process culminates in the Service's issuance of an Opinion that sets forth the basis for a determination as to whether the proposed Federal action is likely to jeopardize the continued existence of listed species or to destroy or adversely modify critical habitat, as appropriate. The regulatory definition of jeopardy and a description of the formal consultation process are provided at 50 CFR[1] 402.02 and 402.14, respectively. If the Service finds that the action is not likely to jeopardize a listed species, but anticipates that it is likely to cause incidental take of the species, then the Service must identify that take and exempt it from the prohibitions against such take under section 9 of the Act through an Incidental Take Statement.

[1] CFR represents the Code of Federal Regulations which is a codification of the general and permanent rules published in the Federal Register by Executive departments and agencies of the Federal Government. It is published by the Office of the Federal Register National Archives and Records Administration. More information can be found at http://www.gpoaccess.gov/cfr/index.html

Analytical Framework for the Jeopardy and Adverse Modification Analyses

Jeopardy Determination

In accordance with policy and regulation, the jeopardy analysis for bull trout in this Opinion relies on four components:

1. *Status of the Species,* which evaluates the rangewide condition of the bull trout, the factors responsible for that condition, and its survival and recovery needs

2. *Environmental Baseline,* which supplements the findings of the *Status of the Species* analysis by specifically evaluating the condition of bull trout in the action area, the factors responsible for that condition, and the role of the action area in the survival and recovery of the bull trout

3. *Effects of the Action,* which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on bull trout, and

4. *Cumulative Effects,* which evaluates the effects of future, non-Federal activities reasonably certain to occur in the action area on bull trout. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of bull trout current status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of bull trout in the wild, at the rangewide scale

Distinct population segments were defined in the final listing rule for bull trout for use in completing jeopardy analyses (USFWS 1999, p. 58910). Pursuant to Service policy, when an action impairs or precludes the capacity of a recovery unit from providing both the survival and recovery function assigned to it, that action may represent jeopardy to the species. When using this type of analysis, the biological opinion describes how the action affects not only the recovery unit's capability, but the relationship of the recovery unit to both the survival and recovery of the listed species as a whole. The following analysis uses this approach and considers the role of the action area and core area (discussed below under the *Status of the Species* section) in the function of the recovery unit as context for evaluating the effects of the proposed Federal action, together with any cumulative effects, on the survival and recovery of the bull trout to make the jeopardy determination. Please note that consideration of the distinct population segments for purposes of the jeopardy analysis is done within the context of making the jeopardy determination at the scale of the entire listed species in accordance with Service policy (USFWS 2006).

Adverse Modification Determination

This Opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to critical habitat.

In accordance with policy and regulation, the adverse modification analysis for bull trout critical habitat in this Opinion relies on four components:

1. The *Status of Critical Habitat* analysis, which evaluates the rangewide condition of designated critical habitat for the bull trout in terms of primary constituent elements (PCEs), the factors responsible for that condition, and the intended recovery function of the critical habitat overall, as well as the intended recovery function in general of critical habitat units

2. The *Environmental Baseline* analysis, which supplements the *Status of the Critical Habitat* analysis by specifically evaluating the condition of bull trout critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area

3. The *Effects of the Action* analysis, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the PCEs of bull trout critical habitat and how those effects are likely to influence the recovery role of affected critical habitat units, and

4. The *Cumulative Effects* analysis, which evaluates the effects of future, non-Federal activities reasonably certain to occur in the action area on bull trout. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

For purposes of the adverse modification determination, the effects of the proposed Federal action on bull trout critical habitat are evaluated in the context of the rangewide condition of the critical habitat, taking into account any cumulative effects, to determine if the critical habitat at the rangewide scale would remain functional (or would retain the current ability for the PCEs to be functionally established in areas of currently unsuitable but capable habitat) to serve its intended recovery role for the bull trout. The analysis in this Opinion places an emphasis on using the intended rangewide recovery function of bull trout critical habitat and the role of the action area relative to that intended function as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the adverse modification determination.

I. DESCRIPTION OF THE PROPOSED ACTION

A. Action Area

The term "action area" is defined in the regulations as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." An action includes activities or programs "directly or indirectly causing modifications to the land, water, or air" (50 CFR 402.02). In this case, the area where land, water, or air is likely to be affected includes the Lower S.[2] Creek and Thompson Creek 6th Level HUC watersheds, as well as the Salmon River extending approximately 12.6 miles downstream from the confluence with Thompson Creek to the confluence with the East Fork Salmon River (Figure 1). The rationale for extending the Salmon River portion of the action area to the confluence with the East Fork Salmon River is that the additional flow coming into the river from the East Fork will likely make it difficult to detect any changes in water quality further downstream. The rationale for using the Lower S. Creek and Thompson Creek watersheds is that the existing and proposed Mine disturbance, as well as any effects to S. and Thompson Creeks, will be within these watersheds.

B. Proposed Action

The term "action" is defined in the implementing regulations for section 7 as "all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies in the United States or upon the high seas" (50 CFR 402.02).

The Proposed Action is the authorization of the MMPO, submitted by TCMC to the Bureau, the Forest, and other cooperating agencies in 2009. The Bureau will issue a decision regarding expansion of the waste rock storage facility south of the open pit and modification of long-term water management. The Forest will issue a decision regarding the storage of waste rock north of the open pit, expansion of the Tailings Storage Facility (TSF), and realignment of a section of power line. In addition, in response to an anticipated 404 permit application, the Corps will decide whether or not to issue a 404 permit. Reclamation bonds were established previously, and are not included in this proposed action.

The MMPO describes the next phase of mining (Phase 8) which follows Phase 7 (expected to be completed in 2016). Phase 7 includes existing TCMC operations which occur entirely on private land. Phase 7 operations can continue regardless of the authorization of the MMPO. Effects of actions associated with Phase 7 that have yet to occur are not part of the environmental baseline; those effects will be considered in the *Direct and Indirect Effects of the Proposed Action* section of this Opinion.

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[2] *Squaw Creek* is an official place name in Custer County, and appears in numerous published documents including U.S. Geological Survey topographic maps. The name was established by the US Board of Geographic Names to maintain uniform geographic name usage throughout the Federal Government. However, the word *Squaw* is offensive to some people including the Shoshone-Bannock Tribes. Therefore, *Squaw Creek* is hereafter referred to in the main text as *S. Creek*.

The MMPO proposes the following activities that will be part of Phase 8 mining:

1. Mine life will be extended an additional nine years beyond 2016

Molybdenum production will continue to approximately 2025 (instead of 2016 under Phase 7), with most reclamation completed 10 to 15 years later (Assessment, pp. 11-12). The Proposed Action will (for an additional nine years) continue the diverting of Bruno Creek above the TSF and the withdrawal of water from the Salmon River at the location of outfall 005. There will be no changes to transportation routes, the amount of traffic, or access, and no changes in the amount of petroleum products or chemicals used, stored on-site, or transported to the site commensurate with routine operations. However, transportation and management of petroleum products and hazardous materials associated with mining operations will be extended an additional nine years (Assessment, pp. 10-11). Existing facilities, including power lines, roads, fiber optic lines, and pipelines, will be upgraded and repaired as necessary for an additional nine years.

2. A section of power line on Forest land will be relocated

A 4,900 feet section of an existing 24.9 kilovolt power line on Forest land ("Phase 8 power line," Figure 2) will be relocated on Forest land in the area northeast of the open pit. The relocated utility corridor (200 feet wide, 21.9 acres of surface disturbance) will be on a ridge between Bruno Creek and the head of Pat Hughes Creek, and will pass through the upper portion of the Buckskin drainage (Figure 2). The corridor will be periodically cleared of trees for fire protection, and a vehicle access route will be maintained within the corridor. The power lines schematics will be reviewed and constructed to ensure the distance between conductors is less than the wingspan or height of a typical raptor at the Mine (e.g., bald eagle) and that hardware or equipment cases are not in proximity to energized equipment, as described in (Assessment, p. 11). The power line will require maintenance including the possible replacement of equipment on an as-needed basis during mining.

3. The Buckskin and Pat Hughes Waste Rock Storage Facilities (WRSFs) will be expanded (Buckskin on TCMC and Forest land, Pat Hughes on TCMC and Bureau land) and used to store Phase 8 waste rock

Approximately 263.5 million tons of waste rock will be removed and stored in the Buckskin (107.7 million tons) and Pat Hughes (155.8 million tons) WRSFs (Figure 2). These areas were selected for haul road accessibility (e.g., distance and gradient), low mineral potential, and geotechnical requirements. The expansion of the WRSFs will occur on TCMC, Bureau, and Forest land. The Pat Hughes sediment control pond (sedimentation pond) will be relocated to the base of the final toe of the Pat Hughes WRSF.

4. The TSF embankment will be raised, and the TSF impoundment expanded (on TCMC, Bureau, and Forest land) to store the tailings produced by milling Phase 8 ore

The TSF embankment crest will be raised and partially re-aligned (Figure 2). The embankment will be raised to 7,742 feet before reclamation (from 7,646 feet at the end of Phase 7) to provide

sufficient storage in the upgradient impoundment (filling the Bruno Creek drainage). The embankment will continue to be constructed of sand deposited by the header pipeline along the length of the crest of the embankment. The modification will increase the capacity of the TSF by 100 to 125 million tons, which will provide adequate space for the tailings produced during Phase 8 (Assessment, pp. 12-13).

5. The long-term water management plan (part of the reclamation plan) will be modified because of the size and configuration of the Phase 8 facilities and the need for water treatment to ensure Idaho Department of Environmental Quality (IDEQ) water quality standards are met (Assessment, p. 11))

The long-term water management plan relies on engineered systems to contain the waste rock and tailings and to manage the water that contacts the Mine in perpetuity[3]. Some of these engineered systems are currently in operation and others will be constructed as part of the Proposed Action. These systems will continue to operate long term through closure. These various systems are described in the Assessment (pp. 14-17), as are the differences in how water management will occur during closure versus during operation.

6. An additional groundwater cutoff wall (in addition to a cutoff wall being installed in the Buckskin drainage and two cutoff walls being installed in the Pat Hughes drainage as part of Phase 7) will be installed in the Pat Hughes drainage on Bureau land

The intent is to capture any remaining waste rock seepage that enters shallow groundwater. The cutoff wall will remain in place in perpetuity, to meet long-term water management objectives.

7. The existing Buckskin sediment pond may be upgraded to include a liner, if the proposed cutoff wall is not successful in capturing all waste rock seepage entering shallow groundwater

8. The Corps will decide on the issuance of a 404 permit regarding Bruno, Mill, and Pat Hughes Creeks.

The Proposed Action will result in an additional surface disturbance on 94 acres of TCMC land and 352 acres of Federal lands. Of this disturbance, 3.4 acres of wetlands and 9,900 linear feet of stream channel are designated as Waters of the United States (WUS). The WUS are located along Pat Hughes Creek, upper Bruno Creek, and Mill Creek and will be subject to a 404 permit from the Corps. There will be no new disturbance in the No Name Creek drainage. As mitigation for the effects to WUS along Pat Hughes, Bruno, and Mill Creeks, there will be offsite mitigation along and adjacent to S. Creek. Mitigation includes fencing approximately 10,000 feet of S. Creek, repairing and restoring 100 feet of S. Creek streambank using bio-engineering, and reestablishing a 5.6 acre wetland adjacent to S. Creek. Mitigation is described further in the Assessment (pp. 20-21, Appendix A).

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[3]Indefinite time period of 100s of years or more, e.g., the drainage from the waste rock and tailings storage facility.

C. Monitoring

TCMC's Consolidated Environmental Monitoring Program (Assessment, Appendix B) describes the annual environmental monitoring program related to biological conditions, air emissions, TCMC's NPDES permit compliance, structural stability and dam safety, Mine waste monitoring, and water quality monitoring.

TCMC monitors periphyton and macroinvertebrates at sites on Thompson Creek, S. Creek, and the Salmon River, while fish are monitored on Thompson Creek and S. Creek only. Sediment is monitored at four sediment sampling stations to evaluate channel substrate, compare the composition of fine sediment upstream and downstream of the Mine, and determine the amount of metals-loading[4] in sediment downstream of the Mine. One station upstream of the Mine and one downstream of the Mine are located on both Thompson Creek and S. Creek (Assessment, pp. 19-20).

Stream flow volumes are measured throughout the Thompson Creek drainage, Bruno Creek drainage, and S. Creek above and below Bruno Creek, including at monitoring sites on streams, at diversions, and below sedimentation ponds. Water quality samples are collected at 34 surface water and 19 groundwater sites. Required monitoring includes water chemistry, water discharge flow rates, dilution ratio, whole effluent toxicity (WET) testing, sediment loading, and several field parameters such as pH, specific conductance, and temperature (Assessment, p. 20).

Post-reclamation monitoring calls for three monitoring periods – initial, interim, and post-reclamation. As ongoing Mine water management continues past the initial, interim, and post-reclamation periods described in the Consolidated Reclamation Plan, water quality monitoring associated with this long-term commitment is required. The reality is that monitoring dictated by the current TCMC's NPDES permit, including effluent monitoring, WET testing, storm water monitoring, water quality monitoring of the receiving streams, and aquatic biological monitoring will continue as long as the current permit is in place. Because discharge of water from the water management system will occur in perpetuity, the NPDES renewal process is expected to occur multiple times in the future. Future TCMC's NPDES permits will likely contain similar monitoring requirements as currently exist, with any modifications necessary to accommodate potential changes in the NPDES permit limits (i.e., additional parameters, or changes to flow, load, or concentration limits as required to best suit conditions and ensure IDEQ water quality criteria are met). The water management plan will be modified as necessary to meet any changes (e.g., effluent limitations, monitoring requirements, etc.) in future NPDES permits issued to the facility (Assessment, p. 20).

The post closure monitoring period for revegetation success is 10 years, which includes 1) the initial reclamation period (years 1-5) in which all reclamation not conducted concurrently with mining is carried out, and 2) the interim reclamation period (years 6-10) that follows the mine and tailings revegetation in which vegetation is becoming established (Assessment, pp. 18-19).

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[4] Loading is used in this Opinion as the process of adding constituents to ground or surface water, such as Thompson Creek, S. Creek, or the Salmon River.

D. Term of Action

Molybdenum production will continue to approximately 2025, instead of 2016 under phase 7. The Phase 7 ore removal will continue to approximately 2016 when the Phase 7 ore will be depleted. At that time, the Phase 8 ore will be exposed. The mill will use the Phase 8 ore for approximately nine years until it is depleted. Discharge of water from the water management system will occur in perpetuity (Assessment, pp. 11-12, 17).

E. Proposed Conservation Measures

TCMC has identified specific operational (i.e., non-reclamation) environmental protection measures and monitoring activities at the Mine, which will be in effect during the implementation of the Proposed Action. These measures are fully described in the Assessment (pp. 25-27). Measures which may reduce the degree of impact to bull trout and their habitat are listed below.

1. Only the minimum areas necessary for mining operations will be disturbed. Topsoil will be salvaged from disturbed areas to use during reclamation activities (Assessment, p. 25).

2. Only the minimum amount necessary of vegetation and timber will be removed during the implementation of Phase 8 activities.

3. Invasion of noxious weeds is currently minimized through monitoring and controlling noxious weeds under TCMC's weed control program. This program adheres to Federal, State, and county regulations related to the application and use of selected herbicides, and will continue during Phase 8 (Assessment, p. 26).

4. Water quantity and quality monitoring to ensure compliance with the TCMC's NPDES permit and IDEQ water quality criteria will continue. TCMC has also developed other operational plans to protect the quality of surface water and groundwater, including the Water Management Plan, a BMP Plan, and a Spill Prevention Control and Countermeasures (SPCC) Plan that superseded its initial pollution prevention plan. These plans will continue to be used under the Proposed Action (Assessment, pp. 25-26).

5. Only the minimum areas necessary for mining will be disturbed in wetland, floodplain, and riparian areas. Run-off from planned disturbance upgradient of wetlands and riparian areas will be controlled to reduce transport of sediment and contaminants into these areas (Assessment, pp. 25-26).

6. Management of hazardous materials and petroleum products will be performed in compliance with applicable Federal and State requirements, with hazardous waste and petroleum waste (crushed oil filters and grease) removed from the Mine by a contractor and disposed of or recycled off-site.

7. Regular inspections for the existing stormwater pollution prevention plan will be conducted to document compliance with these plans and detect any conditions requiring modification to

maintain compliance. TCMC will continue to ensure that chemical analyses of samples of storm water, groundwater, soil, sediment, aquatic biota, vegetation, and surface water will be made as required by the Consolidated Environmental Monitoring Program (Assessment, p. 27).

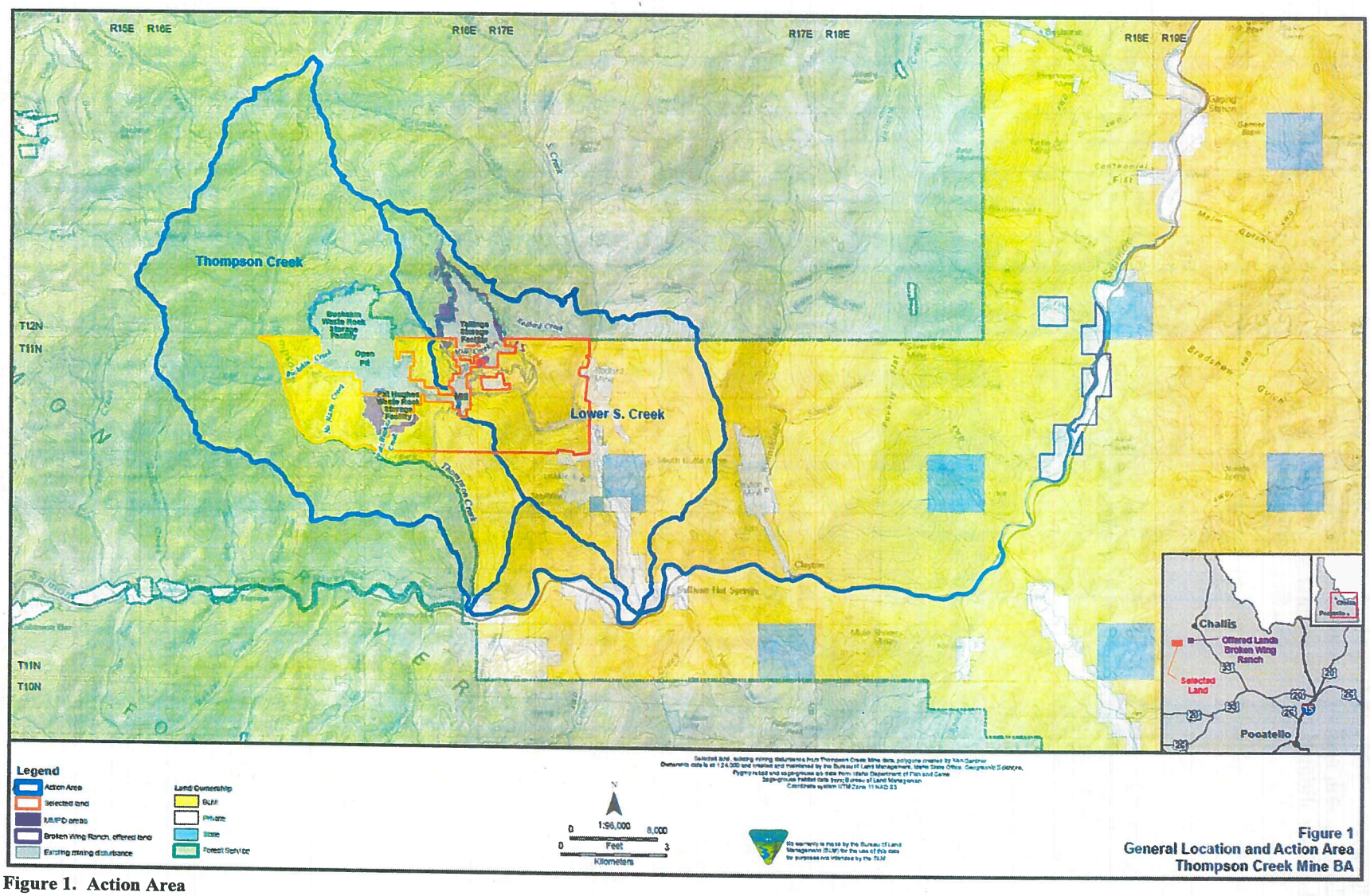

Figure 1. Action Area

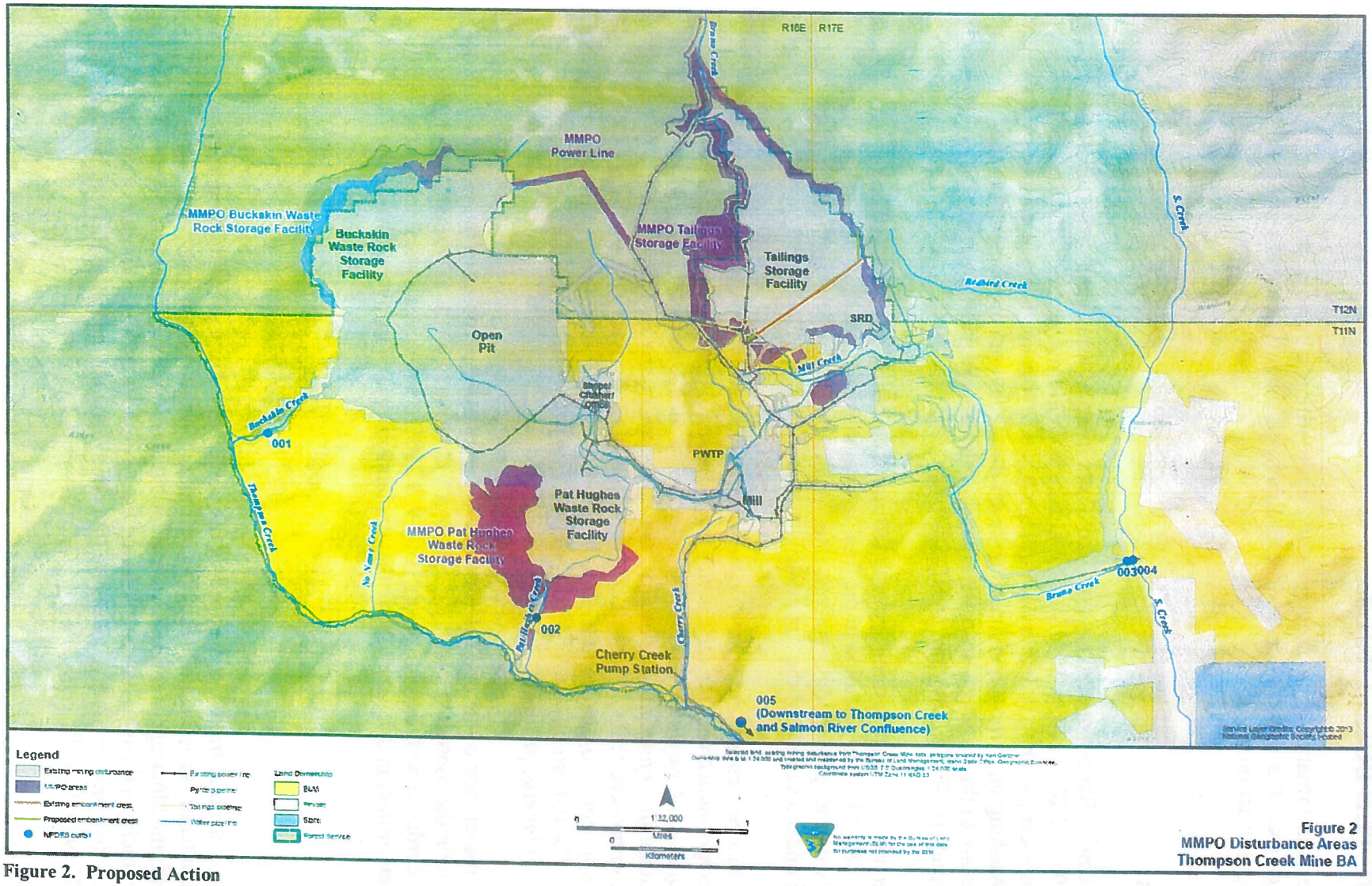

Figure 2. Proposed Action

Figure 2
MMPO Disturbance Areas
Thompson Creek Mine BA

II. STATUS OF THE BULL TROUT

This section presents information about the regulatory, biological, and ecological status of bull trout at a rangewide scale that provides context for evaluating the significance of probable effects caused by the proposed action.

A. Regulatory Status

1. Listing Status

The coterminous United States population of bull trout was listed as threatened under the Act on November 1, 1999 (USFWS 1999, p. 58910). The threatened bull trout occurs in the Klamath River Basin of south-central Oregon and in the Jarbidge River in Nevada, north to various coastal rivers of Washington to the Puget Sound and east throughout major rivers within the Columbia River Basin to the St. Mary-Belly River, east of the Continental Divide in northwestern Montana (USFWS 1999, pp. 58910-58916).

The bull trout was initially listed as three separate Distinct Population Segments (DPSs) (USFWS 1999, p. 58910). The preamble to the final listing rule discusses the consolidation of these DPSs, plus two other population segments, into one listed taxon and the application of the jeopardy standard under section 7 of the Act relative to this species (USFWS 1999, p. 58910)

> "*Although this rule consolidates the five bull trout DPSs into one listed taxon, based on conformance with the DPS policy for purposes of consultation under section 7 of the Act, we intend to retain recognition of each DPS in light of available scientific information relating to their uniqueness and significance. Under this approach, these DPSs will be treated as interim recovery units with respect to application of the jeopardy standard until an approved recovery plan is developed. Formal establishment of bull trout recovery units will occur during the recovery planning process.*"

Please note that consideration of the distinct population segments for purposes of the jeopardy analysis is done within the context of making the jeopardy determination at the scale of the entire listed species in accordance with Service policy (USFWS 2006). See the analytical framework for the jeopardy determination discussed above that explains the use of recovery units in the jeopardy analysis.

2. Threats

Throughout its range, the bull trout is threatened by the combined effects of habitat degradation, fragmentation, and alterations associated with dewatering, road construction and maintenance, mining, and grazing; the blockage of migratory corridors by dams or other diversion structures; poor water quality; incidental angler harvest; entrainment (a process by which aquatic organisms are pulled through a diversion or other device) into diversion channels; and introduced nonnative species (USFWS 1999, p. 58912).

3. Climate Change

Climate change represents a relatively new threat to bull trout. The current change in world climate is trending toward warmer temperatures (Intergovernmental Panel on Climate Change 2007). Because bull trout are dependent on cold water temperatures, changes toward higher average temperatures could effectively reduce its available habitat (Rieman et al. 2007, p. 4). Rieman et al. (2007, p. 14) found that a change of 0.6° to 5° Celsius (C) could reduce the percent of large habitat patches by 27 to 97 percent across the bull trout's range.

In Central Idaho, habitat may be affected less by climate change than other areas of the bull trout's range because of the wide range in elevation of current habitat distribution. Given the broad range of the estimate above for reduction of large habitat patches, it is difficult to reasonably interpret what impact the actual changes to bull trout habitat are likely to have on the survival and recovery of the bull trout throughout its range. Rieman et al. (2007, p. 17) caution that their results cannot be extrapolated directly for management of bull trout without consideration of many other factors. Until better models are developed on which to base an understanding of climate change-related effects on the bull trout, Rieman et. al. (2007, p. 17) suggest continuation of bull trout conservation efforts to maximize its resiliency.

B. Survival and Recovery Needs

1. Recovery Planning

The Service released the final bull trout recovery plan in September 2015 (USFWS 2015). The final plan identified six biologically-based recovery units, each of which is individually necessary to conserve the entire listed entity. A Recovery Unit Implementation Plan (RUIP) was developed for each unit, and the Service's Bull Trout Recovery Implementation Team is currently developing guidance on implementation of the RUIPs. Because much of the final recovery plan was based on population status and distribution information contained in the Service's 2002 draft recovery plan, this Opinion will review the draft recovery plan information for the purposes of species status assessment. The survival and recovery needs of bull trout are often generally expressed as the need to provide **cold** stream temperatures, **clean** water quality that is relatively free of sediment and contaminants, **complex** channel characteristics (including abundant large wood and undercut banks), and large patches of such habitat that are well **connected** by unobstructed migratory pathways. All are needed to promote survival and recovery of bull trout at multiple scales ranging from the coterminous United States population (the listed taxon) to local populations.

Each of the six recovery units consists of one or more core areas. These core areas are composed of one or more local populations. See definitions below.

<u>Core Area</u>: a geographic area within a recovery unit occupied by one or more local bull trout populations that overlap in their use of rearing, foraging, migratory, and overwintering habitat, and in some cases in their use of spawning habitat.

Local Population: a group of bull trout within a core area that spawn within a particular stream or portion of a stream system. A local population is considered to be the smallest group of fish that is known to represent an interacting reproductive unit.

C. Rangewide Status and Distribution

In recognition of available scientific information relating to their uniqueness and significance, five population segments of the coterminous United States population of bull trout are considered essential to the survival and recovery of this species: (1) Jarbidge River, (2) Klamath River, (3) Coastal-Puget Sound, (4) St. Mary-Belly River, and (5) Columbia River. Each of these segments is necessary to maintain the bull trout's distribution, as well as its genetic and phenotypic diversity, all of which are important to ensure the species' resilience to changing environmental conditions. A summary of the current status of the bull trout within these units is provided below.

1. Jarbidge River

This population segment currently contains a single core area with six local populations. Less than 500 resident and migratory adult bull trout, representing about 50 to 125 spawners, are estimated to occur within the core area (USFWS 2004b, p. 16). The current condition of bull trout in this population segment is attributed to the effects of livestock grazing, roads, angler harvest, timber harvest, and the introduction of nonnative fishes. The draft bull trout recovery plan (USFWS 2004b) identifies the following conservation needs for this population segment: maintain or expand the current distribution of the bull trout within the core area; maintain stable or increasing trends in abundance of both resident and migratory bull trout; maintain/restore suitable habitat conditions for all bull trout life history stages and strategies; and conserve genetic diversity and provide opportunities for genetic exchange.

2. Klamath River

This population segment currently contains three core areas and 12 local populations. The current abundance, distribution, and range of bull trout in the Klamath River Basin are greatly reduced from historical levels due to habitat loss and degradation caused by reduced water quality, timber harvest, livestock grazing, water diversions, roads, and the introduction of nonnative fishes (USFWS 2002, pp. 17-28). Because of these impacts, bull trout populations in this unit face a high risk of extirpation (USFWS 2002a). The draft bull trout recovery plan identifies the following conservation needs for this unit: maintain the current distribution of bull trout and restore distribution in previously occupied areas; maintain stable or increasing trends in bull trout abundance; maintain/restore suitable habitat conditions for all bull trout life history stages and strategies; and conserve genetic diversity and provide opportunities for genetic exchange among appropriate core populations.

Improvements in the Threemile, Sun, and Long Creek local populations have occurred through efforts to remove or reduce competition and hybridization with nonnative salmonids, changes in fishing regulations, and habitat restoration projects. Population status in the remaining local populations (Boulder-Dixon, Deming, Brownsworth, and Leonard Creeks) remains relatively

unchanged. Grazing within bull trout watersheds throughout the recovery unit has been curtailed. Efforts at removal of nonnative species of salmonids appear to have stabilized the Threemile and positively influenced the Sun Creek local populations. The results of similar efforts in Long Creek are inconclusive. Mark and recapture studies of bull trout in Long Creek indicate a larger migratory component than previously expected.

Although the status of specific local populations has been slightly improved by recovery actions, the overall status of Klamath River bull trout continues to be depressed. Factors considered threats to bull trout in the Klamath Basin at the time of listing – habitat loss and degradation caused by reduced water quality, past and present land use management practices, water diversions, roads, and nonnative fishes – continue to be threats today.

3. Coastal-Puget Sound

Bull trout in the Coastal-Puget Sound population segment exhibit anadromous, adfluvial, fluvial, and resident life history patterns. The anadromous life history form is unique to this unit. This population segment currently contains 14 core areas and 67 local populations (USFWS 2004, p. iv, and 2004a, p. 20). Bull trout are distributed throughout most of the large rivers and associated tributary systems within this unit. With limited exceptions, bull trout continue to be present in nearly all major watersheds where they likely occurred historically within this unit. Bull trout distribution has contracted, and abundance has declined especially in the southeastern part of the unit. The current condition of the bull trout in this population segment is attributed to the adverse effects of dams, forest management practices (e.g., timber harvest and associated road building activities), agricultural practices (e.g., diking, water control structures, draining of wetlands, channelization, and the removal of riparian vegetation), livestock grazing, roads, mining, urbanization, angler harvest, and the introduction of nonnative species. The draft bull trout recovery plan (USFWS 2004) identifies the following conservation needs for this unit: maintain the current distribution of bull trout anadromy and restore migratory life history forms in some previously occupied areas; maintain stable or increasing trends in bull trout abundance; maintain/restore suitable habitat conditions for all bull trout life history stages and strategies; and conserve genetic diversity and provide opportunities for genetic exchange to conserve migratory life history forms.

Although the status of bull trout in the Coastal-Puget Sound population segment has been improved by certain actions, it continues to be degraded by other actions, and it is likely that the overall status of the bull trout in this population segment has not improved since its listing on November 1, 1999. Improvement has occurred largely through changes in fishing regulations and habitat restoration projects. Fishing regulations enacted in 1994 either eliminated harvest of bull trout or restricted the amount of harvest allowed, and this likely has had a positive influence on the abundance of bull trout. Improvement in habitat has occurred following restoration projects intended to benefit either bull trout or salmon, although monitoring the effectiveness of these projects seldom occurs. On the other hand, the status of this population segment has been adversely affected by a number of Federal and non-Federal actions, some of which were addressed under section 7 of the Act. Most of these actions degraded the environmental baseline; all of those addressed through formal consultation under section 7 of the Act permitted the incidental take of bull trout.

Section 10(a)(1)(B) permits have been issued for Habitat Conservation Plans (HCP) completed in the Coastal-Puget Sound population segment. These include: (1) the City of Seattle's Cedar River Watershed HCP, (2) Simpson Timber HCP (now Green Diamond Resources), (3) Tacoma Public Utilities Green River HCP, (4) Plum Creek Cascades HCP, (5) Washington State Department of Natural Resources (WSDNR) State Trust Lands HCP, (6) West Fork Timber HCP, and (7) WSDNR Forest Practices HCP. These HCPs provide landscape-scale conservation for fish, including bull trout. Many of the covered activities associated with these HCPs will contribute to conserving bull trout over the long term; however, some covered activities will result in short-term degradation of the baseline. All HCPs permit the incidental take of bull trout.

4. St. Mary-Belly River

This population segment currently contains six core areas and nine local populations (USFWS 2002c, p. 88). Currently, the bull trout is widely distributed in the St. Mary River drainage and occurs in nearly all of the waters that it inhabited historically. Bull trout are found only in a 1.2 mile reach of the North Fork Belly River within the United States. Redd count surveys of the North Fork Belly River documented an increase from 27 redds in 1995 to 119 redds in 1999. This increase was attributed primarily to protection from angler harvest (USFWS 2002c, p. 37). The current condition of bull trout in this population segment is primarily attributed to the effects of dams, water diversions, roads, mining, and the introduction of nonnative fishes (USFWS, 2002c, p. vi and vii). The draft bull trout recovery plan identifies the following conservation needs for this unit: maintain the current distribution of bull trout and restore distribution in previously occupied areas within the population segment; maintain stable or increasing trends in bull trout abundance; maintain/restore suitable habitat conditions for all bull trout life history stages and strategies; conserve genetic diversity and provide opportunities for genetic exchange; and develop a formal working relationship between United States and Canadian interests in addressing bull trout restoration.

The overall status of bull trout in the Saint Mary-Belly River population segment has not changed appreciably since its listing on November 1, 1999. Extensive research efforts have been conducted since listing, to better quantify populations of bull trout and their movement patterns. Limited efforts in the way of active recovery actions have occurred. Habitat occurs mostly on Federal and Tribal lands (Glacier National Park and the Blackfeet Nation). Known problems due to in-stream flow depletion, entrainment, and fish passage barriers resulting from operations of the U.S. Bureau of Reclamation's Milk River Irrigation Project (which transfers Saint Mary-Belly River water to the Missouri River Basin) and similar projects downstream in Canada constitute the primary threats to bull trout and to date they have not been adequately addressed under section 7 of the Act. Plans to upgrade the aging irrigation delivery system are being pursued, which has potential to mitigate some of these concerns, but also the potential to intensify dewatering. A major fire in August 2006 severely burned the forested habitat in Red Eagle and Divide Creeks, potentially affecting three of nine local populations and degrading the baseline.

5. Columbia River (includes the action area)

This population segment currently contains 97 core areas and more than 500 local populations. About 62 percent of these core areas and local populations occur in central Idaho and northwestern Montana. The condition of bull trout within these core areas varies from poor to good, but generally all have been subject to the combined effects of habitat degradation, fragmentation, and alterations associated with one or more of the following activities: stream and river dewatering; road construction and maintenance; mining, and grazing; the blockage of migratory corridors by dams or other diversion structures; poor water quality; incidental angler harvest; entrainment into diversion channels; and introduced nonnative species. The 2002 draft bull trout recovery plan (USFWS 2002, pp. 49-61) identifies the following conservation needs for this unit: maintain or expand the current distribution of the bull trout within core areas; maintain stable or increasing trends in bull trout abundance; maintain/restore suitable habitat conditions for all bull trout life history stages and strategies; and conserve genetic diversity and provide opportunities for genetic exchange.

The overall status of the Columbia River population segment has not changed appreciably since its listing on June 10, 1998. Populations of bull trout and their habitat in this area have been affected by a number of actions addressed under section 7 of the Act. Many of these actions resulted in degradation of the environmental baseline while other actions improved the environmental baseline. Most of the actions addressed through formal consultation under section 7 of the Act permitted the take of bull trout. The Plum Creek Cascades HCP, Plum Creek Native Fish HCP, Storedahl Daybreak Mine HCP, and WSDNR Forest Practices HCP addressed portions of the Columbia River population segment of bull trout and will contribute to conserving the bull trout over the long term.

D. Life History

Bull trout exhibit both resident and migratory life history strategies. Both resident and migratory forms may be found together, and either form may produce offspring exhibiting either resident or migratory behavior. Resident bull trout complete their entire life cycle in the tributary (or nearby) streams in which they spawn and rear. The resident form tends to be smaller than the migratory form at maturity and also produces fewer eggs. Migratory bull trout spawn in tributary streams where juvenile fish rear one to four years before migrating to either a lake (adfluvial form), a river (fluvial form), or saltwater (anadromous) to rear as subadults or to live as adults. Bull trout normally reach sexual maturity in four to seven years and may live longer than 12 years. Growth varies depending upon life history strategy. Resident adults range from 6 to 12 inches total length, and migratory adults commonly reach 24 inches or more. They are iteroparous (they spawn more than once in a lifetime), and both repeat- and alternate-year spawning have been reported, although repeat-spawning frequency and post-spawning mortality are not well documented.

The iteroparous reproductive system of bull trout has important repercussions for the management of this species. Bull trout require two-way passage up and downstream, not only for repeat-spawning but also for foraging. Most fish ladders, however, were designed specifically for anadromous semelparous (fishes that spawn once and then die, and therefore

require only one-way passage upstream) salmonids. Therefore, even dams or other barriers with fish passage facilities may be a factor in isolating bull trout populations if they do not provide a downstream passage route.

Additional information about the bull trout's life history can be found in the final listing rule (USFWS 1999).

E. Habitat Characteristics

Bull trout have more specific habitat requirements than most other salmonids. Habitat components that influence bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrate, and migratory corridors. Watson and Hillman (1997, p. 247-250) concluded that watersheds must have specific physical characteristics to provide the habitat requirements necessary for bull trout to successfully spawn and rear and that these specific characteristics are not necessarily present throughout these watersheds. Because bull trout exhibit a patchy distribution, even in pristine habitats, fish should not be expected to occupy all available habitats simultaneously.

Migratory corridors link seasonal habitats for all bull trout life histories. The ability to migrate is important to the persistence of bull trout. Migrations facilitate gene flow among local populations when individuals from different local populations interbreed, or stray, to nonnatal streams. Local populations that are extirpated by catastrophic events may also become reestablished by bull trout migrants.

Cold water temperatures play an important role in determining bull trout habitat, as these fish are primarily found in colder streams (below 59° Fahrenheit (F)), and spawning habitats are generally characterized by temperatures that drop below 48° F in the fall. Thermal requirements for bull trout appear to differ at different life stages. Spawning areas are often associated with cold-water springs, groundwater infiltration, and the coldest streams in a given watershed. Optimum incubation temperatures for bull trout eggs range from 35° to 39° F, whereas optimum water temperatures for rearing range from about 46° to 50° F (Buchanan and Gregory 1997, p. 122). In Granite Creek, Idaho, Bonneau and Scarnecchia (1996, p. 629-630) observed that juvenile bull trout selected the coldest water available in a plunge pool, 46° to 48° F, within a temperature gradient of 46° to 60° F. In a landscape study relating bull trout distribution to maximum water temperatures, Dunham et al. (2003, pp. 899-900) found that the probability of juvenile bull trout occurrence does not become high (i.e., greater than 75 percent) until maximum temperatures decline to 52° to 54° F.

Although bull trout are found primarily in cold streams, occasionally these fish are found in larger, warmer river systems throughout the Columbia River Basin. Factors that can influence bull trout ability to survive in warmer rivers include availability and proximity of cold water patches and food productivity. In the Little Lost River, Idaho, bull trout have been collected in water having temperatures up to 68° F; however, the trend in the relationship between temperature and species composition shows that bull trout made up less than 50 percent of all salmonids when maximum summer water temperature exceeded 59° F and less than 10 percent of all salmonids when temperature exceeded 63° F (Gamett 1999, pp. 28-29).

All life history stages of bull trout are associated with complex forms of cover, including large woody debris, undercut banks, boulders, and pools. Maintaining bull trout habitat requires stability of stream channels and maintenance of natural flow patterns. Juvenile and adult bull trout frequently inhabit side channels, stream margins, and pools with suitable cover. These areas are sensitive to activities that directly or indirectly affect stream channel stability and alter natural flow patterns. For example, altered stream flow in the fall may disrupt bull trout during the spawning period, and channel instability may decrease survival of eggs and alevins in the gravel from winter through spring. Increases in fine sediment can reduce egg survival and emergence.

Bull trout typically spawn from August to November during periods of decreasing water temperatures. Preferred spawning habitat consists of low-gradient stream reaches with loose, clean gravel. Redds are often constructed in stream reaches fed by springs or near other sources of cold groundwater. Depending on water temperature, incubation is normally 100 to 145 days (Pratt 1992, p. 5), and after hatching, alevins remain in the substrate. Time from egg deposition to emergence of fry may surpass 200 days. Fry normally emerge from early April through May, depending on water temperatures and increasing stream flows.

Migratory forms of the bull trout appear to develop when habitat conditions allow movement between spawning and rearing streams and larger rivers or lakes where foraging opportunities may be enhanced (Frissell 1993, pp. 347-351). Benefits to migratory bull trout include greater growth in the more productive waters of larger streams and lakes, greater fecundity resulting in increased reproductive potential, and dispersing the population across space and time so that spawning streams may be recolonized should local populations suffer a catastrophic loss. In the absence of the migratory bull trout life form, isolated populations cannot be replenished when disturbance makes local habitats temporarily unsuitable, the range of the species is diminished, and the potential for enhanced reproductive capabilities are lost (Rieman and McIntyre 1993, p. 11).

Additional information about the bull trout's habitat requirements can be found in the final listing rule (USFWS 1999).

F. Diet

Bull trout are opportunistic feeders, with food habits primarily a function of size and life history strategy. Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macro zooplankton, mysids, and small fish. Adult migratory bull trout feed on various fish species. Fish growth depends on the quantity and quality of food that is eaten, and as fish grow, their foraging strategy changes in quantity, size, or other characteristics. Bull trout that are 110 millimeters (4.3 inches) long or longer commonly have fish in their diet (Shepard et al. 1984, p. 38), and bull trout of all sizes have been found to eat fish half their length (Beauchamp and Van Tassell 2001, p. 210).

Migration allows bull trout to move to or with a food source, access optimal foraging areas, and exploit a wider variety of prey resources. Migratory bull trout begin growing rapidly once they move to waters with abundant forage that includes fish (Shepard et al. 1984, p. 49). As these fish

mature they become larger-bodied predators and are able to travel greater distances in search of prey species of larger size and in greater abundance. In Lake Billy Chinook, as bull trout became increasingly piscivorous with increasing size, the prey species changed from mainly smaller bull trout and rainbow trout (*Oncorhynchus mykiss)* for bull trout less than 17.7 inches in length to mainly kokanee for bull trout greater in size (Beauchamp and Van Tassell 2001, p. 213).

Additional information on the bull trout's diet can be found in the final listing rule (USFWS 1999).

G. Previously Consulted-on Effects

1. Rangewide

Consulted-on effects are effects that have been analyzed in section 7 consultations and reported in a biological opinion. In 2003, the Service reviewed all of the biological opinions issued by the Region 1 and Region 6 Service offices, from the time of bull trout listing until August 2003; this sums to 137 biological opinions. Of these, 124 biological opinions applied to activities affecting bull trout in the Columbia River population segment, 12 biological opinions applied to activities affecting bull trout in the Coastal-Puget Sound population segment, 7 biological opinions applied to activities affecting bull trout in the Klamath Basin population segment, and 1 biological opinion applied to activities affecting the Jarbidge and St. Mary-Belly River population segments.

The Service completed section 7 consultations on many programs and actions that benefit bull trout. While some of the beneficial programs were small-scale actions such as removing passage barriers and installing 'fish friendly' crossing structures, some were large, such as restoring habitat conditions in degraded streams and riparian areas. Some of these large-scale projects affected more than one population segment. Three consultations that had broad and long-term benefits to bull trout were consultations on documents that amended Forest Plans and provided standards and guidelines related to federally listed anadromous and native inland fish on National Forest Service lands in Idaho.

The majority of consultations on projects that resulted in adverse effects were for effects that were short-term and very local. Overall, our review showed that we consulted on a wide array of actions which had varying levels of effect and that none were found to appreciably reduce the likelihood of survival and recovery of the bull trout. Furthermore, no actions that have undergone consultation were anticipated to result in the loss of local populations of bull trout, the smallest, most sensitive scale in the 2002 draft bull trout recovery plan's concept of the metapopulation. This is still true as of the date of this Opinion.

Between August 2003 and July 2006, the Service issued 198 opinions that included analyses of effects to the bull trout. These opinions also reached "not likely to jeopardize" determinations and the Service concluded that the continued long-term survival and existence of the species had not been appreciably reduced rangewide due to these actions. All opinions issued after July 2006 also reached "not likely to jeopardize" determinations. Since July 2006, a review of the data in

our national Tracking and Integrated Logging System reveals this trend is still true to date; no jeopardy opinions have been issued for the bull trout.

2. Eastern Idaho

For this Opinion, the Eastern Idaho Office examined the record for biological opinions issued since 2003 for those action areas that overlap any or all of the following eight bull trout core areas: Upper Salmon River, Pahsimeroi River, Lemhi River, Middle Salmon River-Panther, Little Lost River, Middle Fork Salmon River, Lake Creek, and Opal Creek (USFWS 2016, entire).

Approximately 65 biological opinions have been issued across the eight bull trout core areas. Five of them are broad-scale, program-level Opinions. In three of those five, no take was anticipated, or none has occurred. In the remaining Opinions, varying amounts of lethal and nonlethal take of adult bull trout, juvenile bull trout, and bull trout redds were anticipated. In each of those actions, less take than was anticipated has been detected (USFWS 2016, entire). All 65 Opinions concluded that the proposed actions would not be likely to jeopardize the coterminous U.S. population of bull trout.

III. STATUS OF BULL TROUT CRITICAL HABITAT

A. Legal Status

Ongoing litigation resulted in the U.S. District Court for the District of Oregon granting the Service a voluntary remand of the 2005 bull trout critical habitat designation. Subsequently, the Service published a final critical habitat designation for the coterminous United States population of the bull trout on October 18, 2010 (70 FR 63898); the rule became effective on November 17, 2010. A justification document was also developed to support the rule and is available on our website (http://www.fws.gov/pacific/bulltrout). The scope of the designation involved the species' coterminous range, which includes the Jarbidge River, Klamath River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River population segments.

Rangewide, the Service designated reservoirs/lakes and stream/shoreline miles as bull trout critical habitat (Table 1). Designated bull trout critical habitat is of two primary use types: 1) spawning and rearing, and 2) foraging, migration, and overwintering (FMO).

The 2010 revision increases the amount of designated bull trout critical habitat by approximately 76 percent for miles of stream/shoreline and by approximately 71 percent for acres of lakes and reservoirs compared to the 2005 designation.

Table 1. Stream/shoreline distance and reservoir/lake area designated as bull trout critical habitat by state.

State	Stream/Shoreline Miles	Stream/Shoreline Kilometers	Reservoir /Lake Acres	Reservoir/ Lake Hectares
Idaho	8,771.6	14,116.5	170,217.5	68,884.9
Montana	3,056.5	4,918.9	221,470.7	89,626.4
Nevada	71.8	115.6	-	-
Oregon	2,835.9	4,563.9	30,255.5	12,244.0
Oregon/Idaho	107.7	173.3	-	-
Washington	3,793.3	6,104.8	66,308.1	26,834.0
Washington (marine)	753.8	1,213.2	-	-
Washington/Idaho	37.2	59.9	-	-
Washington/Oregon	301.3	484.8	-	-
Total	19,729.0	31,750.8	488,251.7	197,589.2

This rule also identifies and designates as critical habitat approximately 1,323.7 km (822.5 miles) of streams/shorelines and 6,758.8 ha (16,701.3 acres) of lakes/reservoirs of unoccupied habitat to address bull trout conservation needs in specific geographic areas in several areas not occupied at the time of listing. No unoccupied habitat was included in the 2005 designation. These unoccupied areas were determined by the Service to be essential for restoring functioning migratory bull trout populations based on currently available scientific information. These unoccupied areas often include lower main stem river environments that can provide seasonally important migration habitat for bull trout. This type of habitat is essential in areas where bull trout habitat and population loss over time necessitates reestablishing bull trout in currently unoccupied habitat areas to achieve recovery.

The final rule continues to exclude some critical habitat segments based on a careful balancing of the benefits of inclusion versus the benefits of exclusion. Critical habitat does not include: 1) waters adjacent to non-Federal lands covered by legally operative incidental take permits for HCPs issued under section 10(a)(1)(B) of the Act, in which bull trout is a covered species on or before the publication of this final rule; 2) waters within or adjacent to Tribal lands subject to certain commitments to conserve bull trout or a conservation program that provides aquatic resource protection and restoration through collaborative efforts, and where the Tribes indicated that inclusion would impair their relationship with the Service; or 3) waters where impacts to national security have been identified (75 FR 63898). Excluded areas are approximately 10 percent of the stream/shoreline miles and 4 percent of the lakes and reservoir acreage of designated critical habitat. Each excluded area is identified in the relevant Critical Habitat Unit (CHU) text, as identified in paragraphs (e)(8) through (e)(41) of the final rule. It is important to note that the exclusion of waterbodies from designated critical habitat does not negate or diminish their importance for bull trout conservation. Because exclusions reflect the often complex pattern of land ownership, designated critical habitat is often fragmented and interspersed with excluded stream segments.

B. Conservation Role and Description of Critical Habitat

The conservation role of bull trout critical habitat is to support viable core area populations (75 FR 63898:63943 [October 18, 2010]). The core areas reflect the metapopulation structure of bull trout and are the closest approximation of a biologically functioning unit for the purposes of recovery planning and risk analyses. CHUs generally encompass one or more core areas and may include FMO areas, outside of core areas, that are important to the survival and recovery of bull trout.

Thirty-two CHUs within the geographical area occupied by the species at the time of listing are designated under the final rule. Twenty-nine of the CHUs contain all of the physical or biological features identified in this final rule and support multiple life-history requirements. Three of the mainstem river units in the Columbia and Snake River basins contain most of the physical or biological features necessary to support the bull trout's particular use of that habitat, other than those physical biological features associated with Primary Constituent Elements (PCEs) 5 and 6, which relate to breeding habitat.

The primary function of individual CHUs is to maintain and support core areas, which 1) contain bull trout populations with the demographic characteristics needed to ensure their persistence and contain the habitat needed to sustain those characteristics (Rieman and McIntyre 1993, p. 19); 2) provide for persistence of strong local populations, in part, by providing habitat conditions that encourage movement of migratory fish (Rieman and McIntyre 1993, pp. 22-23; MBTSG 1998, pp. 48-49); 3) are large enough to incorporate genetic and phenotypic diversity, but small enough to ensure connectivity between populations (Hard 1995, pp. 314-315; Healey and Prince 1995, p. 182; Rieman and McIntyre 1993, pp. 22-23; MBTSG 1998, pp. 48-49); and 4) are distributed throughout the historic range of the species to preserve both genetic and phenotypic adaptations (Hard 1995, pp. 321-322; Rieman and McIntyre 1993, p. 23; Rieman and Allendorf 2001, p. 763; MBTSG 1998, pp. 13-16).

The Olympic Peninsula and Puget Sound CHUs are essential to the conservation of amphidromous bull trout, which are unique to the Coastal-Puget Sound population segment. These CHUs contain marine nearshore and freshwater habitats, outside of core areas, that are used by bull trout from one or more core areas. These habitats, outside of core areas, contain PCEs that are critical to adult and subadult foraging, overwintering, and migration.

Within the designated critical habitat areas, the PCEs for bull trout are those habitat components that are essential for the primary biological needs of foraging, reproducing, rearing of young, dispersal, genetic exchange, or sheltering. Based on our current knowledge of the life history, biology, and ecology of this species and the characteristics of the habitat necessary to sustain its essential life-history functions, we have determined that the following PCEs are essential for the conservation of bull trout.

(1) Springs, seeps, groundwater sources, and subsurface water connectivity (hyporeic flow) to contribute to water quality and quantity and provide thermal refugia.

(2) Migration habitats with minimal physical, biological, or water quality impediments between

spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

(3) An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

(4) Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks, and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.

(5) Water temperatures ranging from 2° to 15° C (36° to 59° Fahrenheit (F)), with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range will depend on bull trout life history stage and form; geography; elevation; diurnal and seasonal variation; shading, such as that provided by riparian habitat; stream flow; and local groundwater influence.

(6) In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount of fine sediment, generally ranging in size from silt to coarse sand, embedded in larger substrate, is characteristic of these conditions. The size and amounts of fine sediment suitable to bull trout will likely vary from system to system.

(7) A natural hydrograph, including peak, high, low, and baseflows within the historical and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

(8) Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

(9) Sufficiently low levels of occurrence of nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); interbreeding (e.g., brook trout); or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

The revised PCE's are similar to those previously in effect under the 2005 designation. The most significant modification is the addition of a ninth PCE to address the presence of nonnative predatory or competitive fish species. Although this PCE applies to both the freshwater and marine environments, currently no non-native fish species are of concern in the marine environment, though this could change in the future.

Note that only PCEs 2, 3, 4, 5, and 8 apply to marine nearshore waters identified as critical habitat. Also, lakes and reservoirs within the CHUs also contain most of the physical or biological features necessary to support bull trout, with the exception of those associated with PCEs 1 and 6. Additionally, all except PCE 6 apply to FMO habitat designated as critical habitat.

Critical habitat includes the stream channels within the designated stream reaches and has a lateral extent as defined by the bankfull elevation on one bank to the bankfull elevation on the opposite bank. Bankfull elevation is the level at which water begins to leave the channel and move into the floodplain and is reached at a discharge that generally has a recurrence interval of one to two years on the annual flood series. If bankfull elevation is not evident on either bank, the ordinary high-water line must be used to determine the lateral extent of critical habitat. The lateral extent of designated lakes is defined by the perimeter of the waterbody as mapped on standard 1:24,000 scale topographic maps. The Service assumes in many cases this is the full-pool level of the waterbody. In areas where only one side of the waterbody is designated (where only one side is excluded), the mid-line of the waterbody represents the lateral extent of critical habitat.

In marine nearshore areas, the inshore extent of critical habitat is the mean higher high-water (MHHW) line, including the uppermost reach of the saltwater wedge within tidally influenced freshwater heads of estuaries. The MHHW line refers to the average of all the higher high-water heights of the two daily tidal levels. Marine critical habitat extends offshore to the depth of 10 meters (m) (33 ft) relative to the mean lower low-water (MLLW) line (zero tidal level or average of all the lower low-water heights of the two daily tidal levels). This area between the MHHW line and minus 10 m MLLW line (the average extent of the photic zone) is considered the habitat most consistently used by bull trout in marine waters based on known use, forage fish availability, and ongoing migration studies and captures geological and ecological processes important to maintaining these habitats. This area contains essential foraging habitat and migration corridors such as estuaries, bays, inlets, shallow subtidal areas, and intertidal flats.

Adjacent shoreline riparian areas, bluffs, and uplands are not designated as critical habitat. However, it should be recognized that the quality of marine and freshwater habitat along streams, lakes, and shorelines is intrinsically related to the character of these adjacent features and that human activities that occur outside of the designated critical habitat can have major effects on physical and biological features of the aquatic environment.

Activities that cause adverse effects to critical habitat are evaluated to determine if they are likely to "destroy or adversely modify" critical habitat by no longer serving the intended conservation role for the species or retaining those PCEs that relate to the ability of the area to at least periodically support the species. Activities that may destroy or adversely modify critical habitat are those that alter the PCEs to such an extent that the conservation value of critical habitat is appreciably reduced (75 FR 63898:63943; USFWS 2004, Vol. 1. pp. 140-193, Vol. 2, pp. 69-114). The Service's evaluation must be conducted at the scale of the entire critical habitat area designated, unless otherwise stated in the final critical habitat rule (USFWS and NMFS 1998, pp. 4-39). Thus, adverse modification of bull trout critical habitat is evaluated at the scale of the final designation, which includes the critical habitat designated for the Klamath River, Jarbidge River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River population segments. However, we consider all 32 CHUs to contain features or areas essential to the conservation of the bull trout (75 FR 63898:63901, 63944). Therefore, if a proposed action would alter the physical or biological features of critical habitat to an extent that appreciably reduces the conservation function of one or more critical habitat units for bull trout, a finding of

adverse modification of the entire designated critical habitat area may be warranted (75 FR 63898:63943).

C. Current Critical Habitat Condition Rangewide

The condition of bull trout critical habitat varies across its range from poor to good. Although still relatively widely distributed across its historical range, the bull trout occurs in low numbers in many areas, and populations are considered depressed or declining across much of its range (67 FR 71240). This condition reflects the condition of bull trout habitat. The decline of bull trout is primarily due to habitat degradation and fragmentation, blockage of migratory corridors, poor water quality, past fisheries management practices, impoundments, dams, water diversions, and the introduction of nonnative species (63 FR 31647, June 10, 1998; 64 FR 17112, April 8, 1999).

There is widespread agreement in the scientific literature that many factors related to human activities have impacted bull trout and their habitat, and continue to do so. Among the many factors that contribute to degraded PCEs, those which appear to be particularly significant and have resulted in a legacy of degraded habitat conditions are as follows: 1) fragmentation and isolation of local populations due to the proliferation of dams and water diversions that have eliminated habitat, altered water flow and temperature regimes, and impeded migratory movements (Dunham and Rieman 1999, p. 652; Rieman and McIntyre 1993, p. 7); 2) degradation of spawning and rearing habitat and upper watershed areas, particularly alterations in sedimentation rates and water temperature, resulting from forest and rangeland practices and intensive development of roads (Fraley and Shepard 1989, p. 141; MBTSG 1998, pp. ii - v, 20-45); 3) the introduction and spread of nonnative fish species, particularly brook trout and lake trout, as a result of fish stocking and degraded habitat conditions, which compete with bull trout for limited resources and, in the case of brook trout, hybridize with bull trout (Leary et al. 1993, p. 857; Rieman et al. 2006, pp. 73-76); 4) in the Coastal-Puget Sound region where amphidromous bull trout occur, degradation of mainstem river FMO habitat, and the degradation and loss of marine nearshore foraging and migration habitat due to urban and residential development; and 5) degradation of FMO habitat resulting from reduced prey base, roads, agriculture, development, and dams.

Effects of Climate Change on Bull Trout Critical Habitat

One objective of the final rule was to identify and protect those habitats that provide resiliency for bull trout use in the face of climate change. Over a period of decades, climate change may directly threaten the integrity of the essential physical or biological features described in PCEs 1, 2, 3, 5, 7, 8, and 9. Protecting bull trout strongholds and cold water refugia from disturbance and ensuring connectivity among populations were important considerations in addressing this potential impact. Additionally, climate change may exacerbate habitat degradation impacts both physically (e.g., decreased base flows, increased water temperatures) and biologically (e.g., increased competition with nonnative fishes).

D. Previously Consulted-on Effects for Critical Habitat

1. Rangewide

The Service has formally consulted on the effects to bull trout critical habitat throughout its range. Section 7 consultations include actions that continue to degrade the environmental baseline. However, long-term restoration efforts have also been implemented that provide some improvement in the existing functions within some of the critical habitat units. None of the consulted-on actions have resulted in an adverse modification finding.

2. Eastern Idaho

For this Opinion, the Eastern Idaho Office examined the record for biological opinions issued since 2010 for those action areas that overlap any or all of the following bull trout critical habitat units or subunits: Upper Salmon River, Pahsimeroi River, Lemhi River, Middle Salmon River-Panther, Little Lost River, Middle Fork Salmon River, Lake Creek, and Opal Creek. Twelve biological opinions addressing bull trout critical habitat have been issued across these subunits. All 12 Opinions concluded that the proposed actions were not likely to result in destruction or adverse modification of critical habitat.

IV. ENVIRONMENTAL BASELINE FOR THE BULL TROUT AND BULL TROUT CRITICAL HABITAT

The preamble to the implementing regulations for section 7 (USFWS 1986) contemplates that the evaluation of ". . . the present environment in which the species or critical habitat exists, as well as the environment that will exist when the action is completed, in terms of the totality of factors affecting the species or critical habitat . . . will serve as the baseline for determining the effects of the action on the species or critical habitat". The regulations at 50 CFR 402.02 define the environmental baseline to include "the past and present impacts of all Federal, State, or private actions and other human activities in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process." The analysis presented in this section supplements the above *Status of the Species* evaluations by focusing on the current condition of the bull trout in the action area, the factors responsible for that condition, inclusive of the factors cited above in the regulatory definition of the environmental baseline, and the role the action area plays in the survival and recovery of the bull trout. Relevant factors on lands surrounding the action area that are influencing the condition of the bull trout were also considered in completing the status and baseline evaluations herein.

A. Status of Bull Trout in the Action Area

<u>Upper Snake Recovery Unit</u>
The action area is entirely within the Upper Salmon River Core Area, one of 22 core areas within the Upper Snake Recovery Unit. The Upper Snake Recovery Unit encompasses portions of central Idaho, northern Nevada, and eastern Oregon, and includes the Salmon River, Malheur

River, Jarbidge River, Little Lost River, Boise River, Payette River, and Weiser River drainages (USFWS 2015, p. E1). The Upper Snake Recovery Unit includes a total of 206 local populations, with almost 60 percent being present in the Salmon River basin (USFWS 2015, p. E1).

The Salmon River basin contains 10 of the 22 core areas in the Upper Snake Recovery Unit, and most core areas contain large populations and many occupied stream segments (USFWS 2015, p. E1-E2). Although bull trout habitat quantity and quality have been altered through time by influences including past timber harvest, livestock grazing, and mining, and more recently by residential development, the Salmon River basin provides large areas of intact habitat (USFWS 2002b, pp. 31, 44, 48; USFWS 2015, p. E1). Both wildfire and fire suppression have had effects on bull trout habitat components within the unit (USFWS 2002b, p. 33). Road densities in the Salmon River basin are relatively low, with 64 percent of the basin having no roads or low road density (USFWS 2002b, pp. 40-41). Bull trout and its habitat can be negatively affected by water diversions. Over 770 known diversions exist in the Salmon River basin (USFWS 2002b, pp. 36-37), but there are no major dams in the Salmon River basin, and connectivity within Salmon River core areas is mostly intact (USFWS 2015, p. E2).

Upper Salmon River Core Area

The Upper Salmon River Core Area encompasses 2,410 square miles and extends from the mouth of the Pahsimeroi River to the headwaters in the Sawtooth Mountains, including the mainstem Salmon River and tributaries. This core area has 3,251 miles of streams, 18 local populations, and supports resident, fluvial, and adfluvial bull trout populations (USFWS 2015, p. E95).

The Upper Salmon River Core Area is considered to be at a diminished risk of extirpation from stochastic events because of the distribution and number of local populations (USFWS 2002b, p. 63). Because productivity data for at least ten years was not available for the Upper Salmon River Core Area, it is considered to be in the increased threat category (USFWS 2002b, p. 66). However, more recent information provided by IDFG indicates an increasing trend in bull trout abundance within this core area (USFWS 2015, p. E95). Migratory bull trout are present in all or nearly all local populations in the Upper Salmon River Core Area. Therefore, the core area is considered to be at a diminished risk of extirpation from weakened connectivity (USFWS 2002b, p. 66). In the 2002 draft bull trout recovery plan, adult bull trout abundance in the Upper Salmon River Core Area is estimated to be greater than 5,000 adult fish. Based on that number of adult fish, this core area is classified as not at risk of extirpation due to deleterious effects of genetic drift (USFWS 2002b, p. 65).

In 2005, IDFG reported population numbers for the Upper Salmon River Core Area (IDFG 2005, p. 32) that were based on an extensive modeling effort (IDFG 2005 and High et al. 2008). A corrected table (K. Meyer, IDFG, pers. comm., March 11, 2009) showed an approximate population of 31,461 (± 10,804) bull trout (adults and young) for the core area. Using an assumption that 10 percent of the total number is comprised of adult fish (K. Meyer, IDFG, pers. comm., March 11, 2009), that would suggest an adult population in the core area of approximately 3,100 adults (±1,000). Comparing the point estimates, the IDFG 2005 estimate (3,100) is less than the 2002 draft recovery plan's (greater than 5,000) estimate. Based on the

2005 modeling exercise and the age and nature of the data from the 2002 draft recovery plan, the Service believes it is reasonable to assume that the number of adults in the core area is likely to be close to the 3,100 estimated by IDFG. The Upper Salmon River Core Area would still be classified as not at risk of extirpation due to the deleterious effects of genetic drift based on the IDFG estimate of 3,100 adult bull trout.

In the 2005 conservation status assessment (USFWS 2005) the Upper Salmon River Core Area final rank was "at potential risk" because of limited and/or declining numbers, range, and/or habitat, even though bull trout may be locally abundant in some portions of the core area. The bull trout 5-year review (USFWS 2008) also determined the core area to be "at potential risk" overall.

The Service has issued 16 biological opinions addressing Federal actions specific to this core area: two for mining operations (Grouse Creek Mine and Honey Girl/Lumberjack Mine), three for water diversions (East Fork of the Salmon River #13, Lower Canyon of the Salmon River, and Upper Salmon), seven for grazing in specific allotments (Morgan Creek-Prairie Basin, Cape Horn, Challis Creek, Herd Creek, Squaw Creek, Camas Creek, and Garden Creek), two for bridge replacements (Younger bridge and East Fork Salmon River bridge), and two for habitat restoration projects (Yankee Fork Pond Series 2 and 3). Each of these opinions found that the actions analyzed were not likely to jeopardize the coterminous U.S. population of bull trout. The aggregate amount or extent of take of bull trout and bull trout redds caused by these Federal actions is estimated by the Service to be lethal take of 143 bull trout, nonlethal take of 530 bull trout, and 20 to 78 bull trout redds. Take of redds was anticipated to result from livestock trampling, while take of adult and juvenile bull trout was anticipated to result from entrainment or stranding at water diversions. Surveys conducted from 2010 to date have not found any take of bull trout redds caused by the actions addressed in the opinions. Limited surveys have found take (nonlethal) of 11 bull trout due to entrainment, and subsequent salvage, at a diversion.

Impacts to bull trout habitat from past livestock grazing and water diversions (primarily for agriculture) are prevalent (USFWS 2002b, pp. 34, 37). Valley bottom roads, and historic mining and logging roads, continue to negatively impact bull trout habitat (USFWS 2002b, p. 42). Historic mining has altered bull trout habitat and negatively impacted water quality in this area. Additionally, private land development associated with patented mining claims is occurring and could lead to further impacts to bull trout habitat (USFWS 2002b, pp. 44-45). Residential and recreational development in this core area has resulted in chemical and nutrient pollutants released into bull trout habitat, filling of flood channels, and diversion of water from bull trout habitat (USFWS 2002b, pp. 48-49).

Action Area

The action area encompasses three streams which support bull trout: mainstem Salmon River, Thompson Creek, and S. Creek. Bull trout populations within the action area belong to the Thompson Creek and Squaw Creek local populations, two of the 18 local populations in the Upper Salmon River Core Area (USFWS 2002b, pp. 7, 10). The 2002 draft bull trout recovery plan is silent on the specific roles of these two bull trout local populations in survival and recovery of the species, but the number (replication) and characteristics of local populations

inhabiting a core area provide a relative indication of the likelihood of a core area to persist (USFWS 2002b, p. 61).

TCMC has monitored fish populations in Thompson Creek and S. Creek since 1980. Additionally, the Forest and IDFG have conducted population monitoring (Assessment, p. 42). The various monitoring locations are shown on Figure 3. Surveys have determined bull trout are present in Thompson Creek, S. Creek, and mainstem Salmon River in low densities. Although population numbers are low, the Bureau indicates available data have not documented a downward trend (Assessment, pp. 54, 62). Fluvial bull trout are found in the mainstem Salmon River (USFWS 2002b, pp. 24, 144), while it is unclear whether bull trout present in Thompson Creek and S. Creek are resident, fluvial, or both (Assessment, pp. 34-35, 54, 62). Forest and IDFG data suggest bull trout spawning and rearing may occur in the headwater reaches of Thompson Creek (upstream of Mine activity) where juvenile bull trout have been sampled (Assessment, p. 34). Although population numbers are still low, more bull trout have been sampled in reaches of Thompson Creek upstream of Mine activities and were found eight years from 1980 to 2013. Downstream of Mine activity, bull trout were found in low numbers only six years from 1980 to 2013 (Assessment, pp. 29-30). Bull trout have rarely been sampled in reaches of S. Creek near Mine activity, being found five years or less from 1980 to 2013 (Assessment, pp. 29-30). Thompson Creek and S. Creek populations are in close proximity to other local populations in the core area and movement is possible, although water temperatures and irrigation diversions may limit movement during some parts of the year (Assessment, pp. 51, 54, 59, 62). Brook trout, a threat to bull trout due to potential competition and hybridization, are not present in either Thompson or S. Creeks (Assessment, pp. 54, 62).

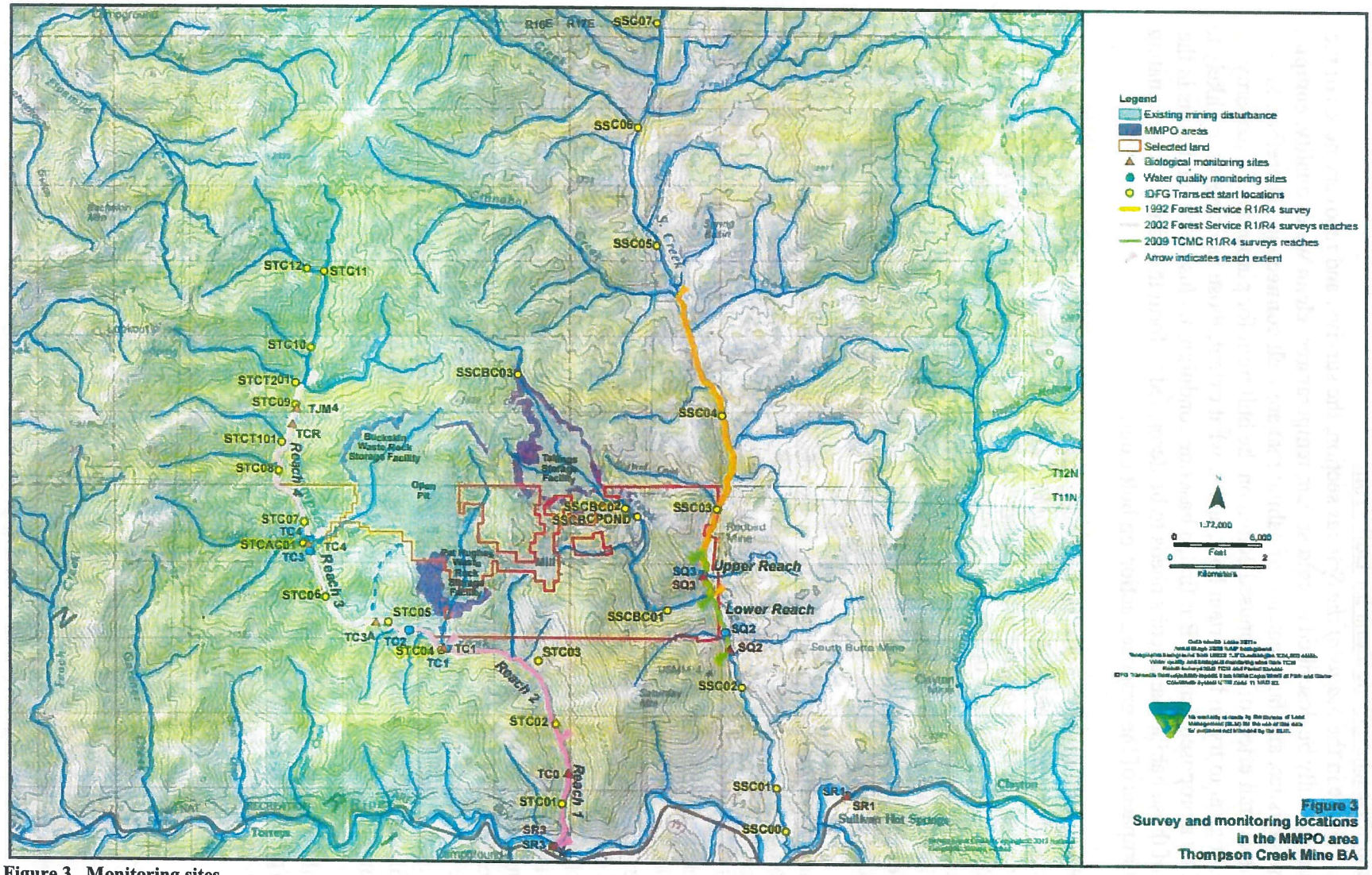

Figure 3. Monitoring sites

Establishment of Baseline Conditions for Bull Trout

As mentioned above in the *Status of the Species* section, the survival and recovery needs of the bull trout can generally be described as **cold** stream temperatures, **clean** water quality, **complex** channel characteristics, and large patches of habitat that are well **connected.** Therefore, to determine the overall effect of a proposed action on the bull trout for purposes of a jeopardy analysis, it is logical to try and ascertain how, and to what extent, those basic needs are likely to be impacted by a proposed action. But first, a baseline condition, inclusive of conditions in the action area, of those habitat parameters needs to be described to form the context for evaluating the potential impacts of the proposed action on bull trout.

One tool that was developed to assist in describing the condition of watersheds and streams on which bull trout depends is entitled *A Framework to Assist in Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Bull Trout Subpopulation Watershed Scale* [5] (Appendix 9 in Lee et al. 1997). It is commonly referred to as the "Matrix of Pathways and Indicators" and, at its most basic level, is a table which identifies the important elements or indicators of a bull trout's habitat. Using this table assists in consistent organization and assessment of current conditions and in judging how those indicators may be impacted by a proposed action (Lee et al. 1997, p. 9-6).

The assessment of indicator conditions is typically conducted on a watershed scale (in this case the Thompson Creek, Lower S. Creek, and Upper Salmon River watersheds). However, data from Thompson Creek and S. Creek are primarily used, as these are both the primary streams in their respective watersheds, as well as the streams of primary concern for the effects analysis. Because Buckskin Creek and Pat Hughes Creek no longer function as natural streams but are part of the Mine water management system, data from these streams is not included in the matrix. Likewise, Bruno Creek does not function as a natural stream. Construction of the TSF in the Bruno Creek drainage has divided Bruno Creek into two separate reaches. Upstream of the TSF, the headwaters of Bruno Creek have been affected by dewatering between the Bruno Creek diversion and the TSF. Downstream of the TSF, Bruno Creek is altered by the presence of two sediment ponds and their associated decant towers and outflow structures. The Bureau included assessments of indicator conditions in other portions of the watersheds where known, and/or where applicable. Impacts to the Salmon River from the Proposed Action will be limited to changes in water quantity and water quality. Therefore, the most relevant indicators will be considered, including temperature, chemical contaminants and nutrients, and changes in peak/base flows.

The Matrix of Pathways and Indicators below is a summary of the information contained in the Assessment (pp. 29-30, 34-35, 43-65) for the watersheds that the action area falls within. Conditions in the action area are discussed in the narrative following Table 2.

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[5] This document was adapted from a National Marine Fisheries Service document called *Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale* (NMFS 1996).

Table 2. Matrix of Pathways and Indicators for Streams in the Action Area

Pathway	Indicators	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Subpopulation Characteristics	Subpopulation Size			T, S
	Growth and Survival (including incubation survival)		T, S	
	Life History Diversity and Isolation	T, S		
	Persistence and Genetic Integrity		T, S	
Water Quality	Temperature		T, SR	S
	Sediment	T	S	
	Chemical Characteristics	S	T, SR	
Habitat Access	Physical Barriers		T, S	
Habitat Elements	Substrate Embeddedness	T, S		
	LWD	T, S		
	Pool Frequency	T		S
	Pool Quality	T	S	
	Off-channel Habitat	T, S		
	Refugia	T, S		
Channel Condition and Dynamics	Width:Depth Ratio			T, S
	Streambank Condition	T		S
	Floodplain Connectivity	S	T	
Flow/Hydrology	Change in Peak/Base Flows		T, S, SR	
	Increase in Drainage Networks		T, S	
Watershed Conditions	Road Density and Location		T, S	
	Disturbance History		T, S	
	Riparian Habitat Conservation Area	T	S	

T = Thompson Creek Watershed
S = S. Creek Watershed
SR = Salmon River (Temperature, Chemical Contaminants and Nutrients, and Peak/Base Flows were the only indicators analyzed for the Salmon River)

The action area has historically been influenced by anthropogenic factors. Past mining operations have contributed to degraded water quality and reduced water quantity in the action area (Assessment, p. 52, 56, 61). Additionally, surface disturbance associated with past mining has resulted in degraded channel conditions (Assessment, pp. 53, 61). Past and current livestock grazing and irrigation diversions in the action area may be influencing stream conditions (Assessment, pp. 51, 59, 62). Valley bottom roads along S. Creek, Thompson Creek, and the Salmon River may be contributing sediment to the stream and altering streambank stability (Assessment, pp. 53, 61).

Stream water temperature criteria for bull trout is to have a maximum water temperature, as expressed by the 7-day moving average of daily maximum temperatures (7DMMAX), below 15.0 °C within adult holding habitat and below 8.9 °C within spawning and rearing habitat. Observed water temperatures of Thompson Creek, S. Creek, and the Salmon River have regularly exceeded optimum temperatures for both spawning and rearing, and adult holding (Assessment, pp. 44, 54, 62). Data indicate that stream water temperatures in Thompson Creek exceed optimum temperatures for bull trout from late June through September, but cool to suitable levels in early October as ambient air temperatures cool (Assessment, p. 44). Data collected with continuous data recorders from 1995 to 2003 record maximum temperatures above 19 °C in S. Creek in all years, with 7DMMAX ranging from 18.0 °C to 20.7 °C (Assessment, p. 54). Stream water temperatures in the Salmon River can exceed 21°C during late summer (Assessment, p. 62). Between the Thompson Creek and S. Creek confluences the Salmon River is on the 2010 303(d) list, due in part to unacceptable water temperature. Elevated summer water temperatures in the Salmon River are believed to result from limited shading due to lack of riparian vegetation, decreased stream flows due to irrigation withdrawals, and the warm water temperature of irrigation return flows entering the river. Riparian areas on Thompson Creek and S. Creek are generally in good condition, with willow and alder providing some shade to the streams. Decreased stream flow related to TCMC operations and water management, and irrigation withdrawals from S. Creek may be negatively influencing water temperatures (Assessment, pp. 52-53, 61).

Sediment level objectives specified in the Inland Native Fish Strategy (INFISH) Biological Opinion are to have <12 percent fines within gravel and <20 percent surface fines. In Thompson Creek, percent fines within gravel above Mine activity (TC4) and below Mine activity (TC1) have been 12 percent or greater in nine of the 19 core samples taken between 1996 and 2013. The results of core sampling indicate that the mean percent fines from 1996 to 2013 was 10.9 percent at TC4 and 12.4 percent at TC1. There is no statistically significant difference in the percent fines between background and sites downstream of Mine facilities (Assessment, p. 45). In S. Creek, percent fines within gravel have been greater than 12 percent in 13 (SQ2) and 11 (SQ3) of the 19 times sampled from 1996 to 2013 (Assessment, pp. 55-56). The results of core sampling indicate that the mean percent fines within the substrate at SQ2 and SQ3 for the years 1996 to 2013 were 14.5 and 14.4 percent, respectively. There is no statistically significant difference in the percent fines between the upstream and downstream sites (Assessment, pp. 54-55).

Surface fines on Thompson Creek have typically been low. Mean fines in the 2002 survey reaches were 16.6, 15.4, 11.5, and 11.8 percent for reaches one, two, three, and four,

respectively. At TCMC monitoring sites TC4 and TC1, mean fines have typically been less than 7 percent in both reaches, with a mean from 1996 to 2013 of 4.9 and 6.1 percent, respectively. In addition, turbidity is generally low based on TCMC monthly turbidity records from 1999 to 2010 (Assessment, p. 45). In S. Creek, percent surface fines have generally been below 12 percent, with a mean for the years 1996 to 2013 of 4.4 (SQ2) and 5.1 (SQ3) percent. Surface fines from the 2009 reaches were 10.0 and 9.7 percent for the upstream and downstream reaches, respectively. Streambank stability on Thompson Creek of 95.5, 97.9, 96.7, and 95.0 percent for reaches one through four, respectively, indicate streambanks are contributing only minor amounts of sediment to the system (Assessment, p. 52). Streambank stability along much of S. Creek appears good, with stabilities in upper reaches near or above 90 percent. However, on private lands in lower reaches erosion and sloughing are evident (Assessment, p. 60). Sediment levels in S. Creek have also been influenced by natural factors, particularly beaver activity (Assessment, p. 55). Sediment levels in S. Creek and Thompson Creek may also be influenced by the presence of valley bottom roads (Assessment, pp. 53, 61).

Indicators of bull trout habitat elements are generally functioning appropriately. Substrate in Thompson Creek and S. Creek is primarily cobble and gravel with low amounts of fines. Cobble embeddedness in both streams is low (Assessment, pp. 51, 59). Adequate large woody debris is present in both streams, and potential for future recruitment is good given the mostly intact riparian areas (Assessment, pp. 51, 59). Pool frequency and quality is functioning appropriately in Thompson Creek, but in S. Creek pools are infrequent and of low quality (Assessment, pp. 51, 59-60). Off-channel habitat and refugia are available in both Thompson Creek and S. Creek (Assessment, pp. 52, 60). Width to depth ratios of Thompson Creek and S. Creek do not meet the criteria for bull trout. Generally, width to depth ratios vary depending on channel morphology and geology. These factors were not considered in this assessment of condition, so the present ratios may reflect natural conditions and not anthropogenic effects (Assessment, pp. 52, 60).

The proposed action has the potential to impact water quantity and quality, and a substantial amount of information is available on the chemical contaminants and nutrients indicator. Baseline condition of this indicator will be discussed below for each bull trout occupied stream in the action area.

Thompson Creek

Water at TC4 (upstream of all surface water discharge from the Mine site) has generally good quality. Molybdenum is present at concentrations above the laboratory detection limit, while concentrations of other trace metals are typically below the laboratory detection limits (Lorax 2011). Molybdenum concentration varies seasonally, averaging 0.7 micrograms per liter (µg/L) during snowmelt runoff and 2.3 µg/L during baseflow (Assessment, p. 46). Molybdenum is naturally occurring in detectable concentrations in Thompson Creek because the creek naturally contains relatively high concentrations of molybdenum in the stream sediment (Assessment, p. 46).

Based on the 10 year data set, water quality in Thompson Creek changes downstream of the Buckskin Creek confluence, particularly at site TC3, located between the Buckskin and Pat Hughes confluences. Peak concentration of contaminants at TC3 are generally higher than at

TC2 or TC1, which are located downstream of Pat Hughes Creek. This indicates that most of the loading to Thompson Creek has been via Buckskin Creek and that there is some dilution occurring downstream of Buckskin Creek (Assessment, p. 46). The sedimentation ponds below the WRSFs are in place and operational. During past operations, the Buckskin sediment pond captured much of the precipitation that contacted the WRSF. Because the WRSF takes up a large majority of the drainage area most water captured by the drainage is directed to the pond, whether via surface flow or infiltration into shallow groundwater. Water released via the pond's spillway represents TCMC's NPDES permitted outfall 001 discharge. In 2005, a pipeline was installed to divert water from outfall 001 to the Cherry Creek pump station and the mill when flow in Thompson Creek was less than 7 cfs. However, some water also escaped the pond via leakage and infiltration into groundwater, and was not captured in the discharge from outfall 001, but instead traveled to Thompson Creek via shallow groundwater and recharge of lower Buckskin Creek. In 2011, the pipeline was extended to the toe of the WRSF to directly capture and collect seepage, bypassing the sediment pond and reducing leakage and infiltration of contaminated water from the pond (Assessment, p. 15).

As a result of the pipeline, flows now rarely discharge via outfall 001, and flows that bypass it due to infiltration at the sediment pond have greatly diminished. Loading from Buckskin Creek is due to seepage from the existing Buckskin WRSF that in the past has been collected and discharged to Thompson Creek via outfall 001 or has reached Thompson Creek via leakage and infiltration from the sediment pond. The chemistry of this water reflects sulfate loading and is neutral to alkaline, which results in total dissolved solids (TDS), conductivity, hardness, sulfate, nitrate, barium, molybdenum, and selenium being elevated above the background levels seen at TC4 (Assessment, p. 47). Concentrations of metal cations such as zinc, cadmium, and copper are not elevated at TC3 above background levels seen at TC4. Other than nitrate (which can become elevated in mining affected waters due to blasting residue), these constituents are commonly elevated in mine drainage as a result of pit wall and waste rock weathering (Assessment, p. 46).

Due to differences in the type of waste rock that makes up the majority of the Pat Hughes WRSF, seepage from the WRSF is dissimilar to that of the Buckskin WRSF. Groundwater from the Pat Hughes WRSF has a much lower pH than water from the Buckskin WRSF, and sulfate, aluminum, cadmium, copper, manganese, and zinc are elevated. However, seepage from the Pat Hughes WRSF is captured and pumped to the mill. Similar changes have been instituted on Buckskin Creek as well. Due to installation of the pipeline, no water has been discharged from outfall 001 (i.e., all water has been diverted) in approximately 2.5 years (Assessment, p. 46).

Since the Mine began operation, only selenium has exceeded Idaho water quality criteria for aquatic life (Assessment p. 43) outside any established outfall mixing zones. Due to past difficulty in meeting water quality criteria and the potential for bioaccumulation of selenium in the food chain, selenium is one of the primary contaminants of concern for fisheries. Selenium measured in samples obtained at site TC3 equaled or exceeded the IDEQ chronic or Criterion Continuous Concentration (CCC) for aquatic life of 5.0 µg/L during low flow periods from 2000 to 2004 (Assessment p. 48). As was described in the Assessment (p. 15), beginning with installation of the pipeline in 2005, and continuing to the present, water from Buckskin Creek has not been discharged to Thompson Creek when stream flow is less than 7.0 cfs as measured at

the U.S. Geological Survey (USGS) gage. Rather, when Thompson Creek discharge is less than 7.0 cfs, water collected from the Buckskin Creek facilities is piped to the Cherry Creek pump station and circulated to the Mine's existing water treatment plant and the mill. Also, as noted in the Assessment (pp. 46, 48,71), currently the Mine is not discharging at all from 001. Between 2005 and 2010, selenium at TC3 never exceeded the CCC of 5.0 µg/L. Concentrations at 5.0 µg/L were observed on three sampling events (August 2006, October 2006, and October 2009) during the period from 2005 to 2010; all other results indicated selenium concentrations between 2.0 µg/L and 4.0 µg/L at TC3. The monitoring sites in Thompson Creek are sampled year-round, not just during baseflow. During periods of higher flow there is sufficient dilution, selenium levels are lower than described above, and no CCC exceedances have occurred. However, even when IDEQ criteria are met, there is the potential for bioaccumulation of contaminants in fish, particularly selenium.

Studies show that fish bioaccumulate selenium primarily via ingestion (Assessment, p. 48). Invertebrates and plants concentrate dissolved selenium from the water, and this selenium can then be part of the food base for fish feeding in contaminated reaches of streams (Assessment, p. 48). Selenium that is initially released to streams as dissolved compounds or particulates can also be removed from the water through chemical and microbial reduction, adsorption to clay and organic detritus, reaction with iron, precipitation, coprecipitation, and settling (Assessment, p. 48). The eventual location for this selenium may be in the bottom sediment of streams where it may be perennially available for bioaccumulation in plants, benthic invertebrates, and fish, even though selenium concentrations in the water may seasonally be less than published aquatic life toxicity thresholds for selenium concentrations in water (Assessment, p. 48). Excessive bioaccumulation of selenium in fish can result in larval developmental abnormalities and mortality (Assessment, p. 48).

From 2000 to 2004, Chadwick Ecological Consultants (Chadwick) assessed bioaccumulation of selenium in Thompson Creek to satisfy requirements set forth in TCMC's NPDES permit. Selenium levels from five replicate samples of sediment, fine particulate organic matter, macroinvertebrates, and fish tissues were assessed once per year from four sites on Thompson Creek, two upstream (TCR and TC4) of Mine disturbance and two downstream (TC3A and TC1) (Assessment, p. 48). TC2 and TJM4 were not sampled as part of the bioaccumulation assessment. Selenium concentrations in sediment were below detection limits at all sampled sites in 2004 and were generally low (1.0 mg/kg) in all other years, with concentrations greater than 1.0 mg/kg at TC3A and TC1 in 2003 and 2002, respectively (Assessment p. 49). Selenium was present in macroinvertebrates and fish at measurable levels at all four sites (including sites upstream of Mine disturbance) in all years, demonstrating bioaccumulation of selenium in the food chain both up and downstream of Mine disturbance (Assessment, p. 49). Selenium in macroinvertebrates and sculpin was statistically higher in 2004 at sites TC1 and TC3A (downstream of Mine discharge) and TC4 (just upstream of Mine discharge) than at the furthest upstream site TCR (unaffected by Mine discharge) (Assessment p. 49). Results from TC4 could be attributed to organisms moving upstream the short distance from areas downstream of Mine discharge.

Since 2004, GEI Inc. has continued to monitor bioaccumulation in Thompson Creek; however, the monitoring has been voluntary (i.e., not required by TCMC's NPDES permit or by regulatory

agencies) and reports have not been produced. Sampling has included the same sites, with the addition of TC0 located near the confluence with the Salmon River. The results of sampling since 2004 have revealed similar concentrations year to year as the data reported in the Assessment, with continued bioaccumulation in the food chain, and generally higher values downstream of Mine disturbance. However, selenium concentrations in fish tissue remain in the range of 7 to 8 mg/kg (dry weight) or below, with long-term averages ranging from 5.5 at TCR to 7.5 at TC1 (Assessment, p. 49).

Recent efforts to develop aquatic life criteria based on selenium concentrations in fish have resulted in thresholds that range between approximately 4 to 11 mg/kg (EPA 2004, NMFS 2014). Using literature derived values for selenium toxicity to freshwater salmonids exposed to selenium in their diet, EPA's draft revision to selenium criteria (Assessment, p. 50) calculated a genus mean chronic value (GMCV) for *Oncorhynchus* of 11.6 mg/kg. Subsequently, EPA released draft aquatic life water quality criteria for selenium (Assessment, p. 50) that discussed similar effects levels for salmonids (11.6 mg/kg). In order to better estimate thresholds that would result in low or inconsequential effects to listed salmonids, NMFS reviewed several studies involving direct exposure of juvenile salmonids to selenium in their biological opinion for water quality criteria in Idaho (Assessment, p. 50). The studies reviewed showed low level effects ranging from approximately 5 to 11 mg/kg. However, the results from one study with a low effect threshold of 7.6 mg/kg, was determined by NMFS (2014) to be the most relevant to wild juvenile salmonids (Assessment, p. 50). The NMFS (2014) review, however, concentrated on direct exposure to juveniles only, and did not include studies of exposure to adult female fish (that can transfer selenium to developing embryos), as anadromous salmonids would have little dietary exposure to selenium due to cessation of feeding by salmon and steelhead once they enter freshwater.

Mean selenium concentrations in tissue from salmonids in Thompson Creek have been below the GMCV of 11.6 mg/kg and used by Chadwick in their reports in all years except 2007 and 2013 (Assessment, p. 50). Mean concentrations were greater than 11.6 at TC1 in 2007 (selenium concentrations were elevated at all sites and in all mediums in 2007, but returned to normal values in 2008) and at TC0 in 2013 (Assessment, p.50). Selenium concentrations are typically below NMFS low effects threshold (7.6 mg/kg) values at the most upstream site. Although concentrations at the lower sites are also below these values in some years, they often fluctuate in the 7 to 8 mg/kg range, and are greater than the EPA and NMFS values in some years (Assessment p. 49). Despite these concentrations, ongoing biological monitoring on Thompson Creek shows macroinvertebrate, sculpin, and trout populations do not show a decline due to TCMC's operations (Assessment p. 50). Based on the biological monitoring, Chadwick concluded that the existing levels of selenium in Thompson Creek did not pose a threat to the aquatic community (Assessment, p. 50). NMFS (2014), citing the Thompson Creek biological monitoring data, also concluded that in some cases site specific information may indicate a lack of adverse effects even if fish tissue concentrations exceed 7.6 mg/kg (Assessment, p. 50).

IDEQ's most recent Integrated Report, completed under the 305(b) program and approved by the EPA in 2010, considers Thompson Creek as fully supporting its designated cold water aquatic life, salmonid spawning, and secondary contact recreation beneficial uses (Assessment, p. 50). In addition, Mine water management changes since 2005 have improved water quality with

regards to selenium in water quality samples. Despite the improvements, selenium fish tissue concentrations have remained similar year to year (Assessment, p. 50). Further, within the approved mixing zones downstream of TCMC's NPDES permitted outfalls 001 and 002, Buckskin and Pat Hughes Creeks, respectively, the concentration of contaminants is allowed to be greater than water quality criteria. Mixing zones as they relate to TCMC's NPDES permit and the effect to listed species are described in detail in EPA (2000). Even though there are no 303(d) listings, there is the possibility for impacts within the mixing zones and selenium concentrations in biota that may exceed the NMFS low effects threshold of 7.6 mg/kg. As a result, the classification of **functioning at risk** was made for chemical contaminants and nutrients.

S. Creek

Summary tables of water quality data at SQ3 and SQ2 are present in Tables 3 and 4 below. No water quality criteria exceedances are reported in the SQ2 or SQ3 sampling results. However, between 2008 and 2010, concentrations of sulfate have been statistically greater at the upstream site (SQ3) than they were from 2000 to 2007. Concentrations of chloride and molybdenum have also increased at SQ3, but the increases were not statistically significant. Further, concentrations of sulfate, chloride, and molybdenum are consistently higher (although not analyzed statistically) downstream of Bruno Creek (at SQ2) than upstream of it (at SQ3), indicating an input of Mine affected water between the two sites. Barium is also elevated at SQ2 relative to levels at SQ3 (Assessment, p. 56). Unlike Thompson Creek, there are no concerns regarding selenium bioaccumulation in S. Creek, as the TSF is not a source of selenium.

Water coming from the abandoned Twin Apex mine (which flows into lower Bruno Creek) may also contribute to concentrations measured at SQ2. Overall, however, Bruno Creek contributes a marginal loading of contaminants to S. Creek (Assessment, p. 56). Redbird Creek's effect on S. Creek as a result of Mine contaminant loading cannot be determined because the upstream S. Creek monitoring site is downstream of Redbird Creek, thus there is no true background site for comparison (an additional monitoring site upstream of Redbird Creek, SQ5, was added in August 2011 to provide better background information in the future). Sediment concentrations are generally less than 10 mg/L, with a high of 43 mg/L at SQ3 and 53 mg/L at SQ2.

IDEQ's water quality standards list cold water aquatic life, salmonid spawning, and secondary contact recreation designated beneficial uses for S. Creek. S. Creek, as it flows past Redbird and Bruno Creeks down to the Salmon River confluence, fully supports its designated cold water aquatic life beneficial uses (Assessment, p. 56). Salmonid spawning and secondary contact recreation were not assessed in the 2010 Integrated Report. As water quality in S. Creek meets water quality criteria, beneficial uses, and there are no contaminants with concern for bioaccumulation, the baseline condition for chemical contaminants and nutrients is **functioning appropriately.**

Table 3. Summary of water quality data in S. Creek at SQ3, 2000-2010

Parameter	Unit	DL[1]	N[2]	N<DL[3]	Median[4]	95th%[4]
Physical						
pH[5]	s.u.	0.1	117	0	8.0	8.2
Alkalinity	mg/L	1	49	0	83	108
Hardness	mg/L	1	49	0	108	169
TDS	mg/L	5	49	0	175	246
Conductivity[5]	µS/cm	1	111	0	210	405
Nutrients						
Ammonia	mg/L	0.05	11	11	0.05	0.05
Nitrate	mg/L	0.05	49	38	0.05	0.09
Anions						
Chloride	mg/L	1	49	2	7.9	13.0
Fluoride	mg/L	0.1	42	7	0.1	0.2
SO_4	mg/L	1	49	0	31	64
Metals						
Al-Total	µg/L	1	49	0	161	1530
Al-Dissolved	µg/L	1	48	8	7	202
As- Total	µg/L	0.1	49	2	0.6	1.5
As- Dissolved	µg/L	0.1	49	2	0.6	0.8
Cd- Total	µg/L	0.05	49	43	0.05	0.07
Cd- Dissolved	µg/L	0.05	49	48	0.05	0.05
Cr- Total	µg/L	0.5	42	28	0.7	2.0
Cr- Dissolved	µg/L	0.5	42	36	0.5	0.6
Cu- Total	µg/L	0.1	49	5	0.4	3.2
Cu- Dissolved	µg/L	0.1	47	13	0.2	0.7
Fe- Total	µg/L	30	49	11	143	1102
Fe- Dissolved	µg/L	30	49	27	30	139
Pb- Total	µg/L	0.05	49	0	0.39	1.53
Pb- Dissolved	µg/L	0.05	49	32	0.05	0.13
Mn- Total	µg/L	0.05	49	0	7.65	29.76
Mn- Dissolved	µg/L	0.05	49	1	1.36	3.88
Mo- Total	µg/L	0.1	49	0	1.29	1.87
Mo- Dissolved	µg/L	0.1	19	0	1.29	2.13
Ni- Total	µg/L	0.1	42	0	0.7	1.8
Ni- Dissolved	µg/L	0.1	42	2	0.5	1.1
Se- Total	µg/L	1	49	49	1.0	1.0
Se- Dissolved	µg/L	1	19	19	1.0	1.0
Zn- Total	µg/L	2	49	14	2.0	6.2
Zn- Dissolved	µg/L	2	46	24	2.0	3.0

[1] DL – Detection Limit. Some detection limits changed between sample events and the most common is presented here.
[2] N – Number of data points.
[3] N<DL – Number of results that were below their detection limit.
[4] Median and 95th percentile were calculated after results that were less than their detection limits were set equal to the detection limit.
[5] Field Measurements.

Table 4. Summary of water quality data in S. Creek at SQ2, 2000-2010

Parameter	Unit	DL[1]	N[2]	N<DL[3]	Median[4]	95th%[4]
Physical						
pH[5]	s.u.	0.1	123	0	8.0	8.3
Alkalinity	mg/L	1	47	0	94	122
Hardness	mg/L	1	47	0	128	186
TDS	mg/L	5	47	0	191	258
Conductivity[5]	µS/cm	1	117	0	235	439
Nutrients						
Ammonia	mg/L	0.05	11	11	0.05	0.05
Nitrate	mg/L	0.05	47	35	0.05	0.08
Anions						
Chloride	mg/L	1	47	0	9.0	14.3
Fluoride	mg/L	0.1	40	5	0.1	0.2
SO_4	mg/L	1	47	0	36	69
Metals						
Al- Total	µg/L	1	47	0	126	1287
Al- Dissolved	µg/L	1	47	10	7	187
As- Total	µg/L	0.1	47	5	0.6	1.3
As- Dissolved	µg/L	0.1	47	0	0.6	0.9
Cd- Total	µg/L	0.05	47	39	0.05	0.08
Cd- Dissolved	µg/L	0.05	47	45	0.05	0.05
Cr- Total	µg/L	0.5	40	14	0.7	4.0
Cr- Dissolved	µg/L	0.5	40	35	0.5	0.9
Cu- Total	µg/L	0.1	47	4	0.6	3.2
Cu- Dissolved	µg/L	0.1	46	6	0.3	0.6
Fe- Total	µg/L	30	47	12	121	844
Fe- Dissolved	µg/L	30	47	31	30	105
Pb- Total	µg/L	0.05	47	0	0.43	2.01
Pb- Dissolved	µg/L	0.05	47	30	0.05	0.13
Mn- Total	µg/L	0.05	47	0	6.40	25.03
Mn- Dissolved	µg/L	0.05	47	1	1.02	2.44
Mo- Total	µg/L	0.1	47	0	1.78	2.79
Mo- Dissolved	µg/L	0.1	19	0	1.98	2.68
Ni- Total	µg/L	0.1	40	0	0.8	1.7
Ni- Dissolved	µg/L	0.1	40	2	0.4	1.2
Se- Total	µg/L	1	47	46	1.0	1.0
Se- Dissolved	µg/L	1	19	19	1.0	1.0
Zn- Total	µg/L	2	47	5	3.0	6.7
Zn- Dissolved	µg/L	2	45	20	2.0	3.8

[1] DL – Detection Limit. Some detection limits changed between sample events and the most common is presented here.
[2] N – Number of data points.
[3] N<DL – Number of results that were below their detection limit.
[4] Median and 95th percentile were calculated after results that were less than their detection limits were set equal to the detection limit.
[5] Field Measurements.

Salmon River

Water quality in the Salmon River may be affected by inflows from Thompson Creek and S. Creek (as currently occurs). Water quantity in the Salmon River is being affected by water withdrawals at NPDES outfall 005. A water right of 4.5 cfs is authorized to be withdrawn from outfall 005 and pumped to the Mine for use in the mill. The average monthly withdrawal estimates have not been more than 1.74 cfs from 2010 to 2015 (Gardner 2015, pers. comm.).

Summary tables of water quality data at SR3 and SR1 are presented in Tables 5 and 6 below. Of the constituents measured by TCMC, only sulfate and barium have slightly higher median concentrations (2 mg/L and 0.0012 mg/L, respectively, between 2007 and 2010) at the downstream Salmon River site (SR1) than at the upstream reference site (SR3). Water at both of the Salmon River sites meets all water quality criteria (Assessment, p. 62). IDEQ lists cold water aquatic life, salmonid spawning, primary contact recreation, and domestic water supply as beneficial uses for the Salmon River downstream of Thompson Creek. IDEQ's most recent Integrated Report, done under the 305(b) program, considers the Salmon River downstream of S. Creek to fully support its cold water aquatic life and primary contact recreation beneficial uses; support for salmonid spawning uses was not assessed (Assessment, p. 63). Between the Thompson Creek and S. Creek confluences, however, the Salmon River is on the 2010 303(d) list as not supporting its cold water aquatic life beneficial uses due to sedimentation/siltation and water temperature. That reach's ability to support domestic water supply, primary contact recreation, and salmonid spawning was not assessed. IDEQ has proposed delisting this reach for sediment and temperature, pending the assessment of additional sediment and temperature data. Upstream of Thompson Creek, the Salmon River fully supports all of its beneficial uses (i.e., cold water aquatic life, primary contact recreation, salmonid spawning, and domestic water supply) according to IDEQ's 2010 Integrated Report (Assessment, p. 63). Due to the listing of the Salmon River between Thompson Creek and S. Creek, baseline condition for the Salmon River currently is **functioning at risk**.

Since the Mine began commercial molybdenum production in 1983, one spill of almost an entire truckload of molybdenum concentrate (33,000 pounds) entered the Salmon River. No appreciable environmental effects were reported (Assessment p. 10). Due to increased safety measures, there have been no molybdenum spills since 2001 (Assessment, p.10).

Table 5. Summary of water quality data from 2007-2010 for site SR3

Parameter	Unit	DL1	N[2]	N<DL[3]	Median[4]	95th%[4]
Physical						
pH[5]	s.u.	0.1	14	0	7.9	8.4
Alkalinity	mg/L	1	14	0	52	60
Hardness	mg/L	1	14	0	52	62
TDS	mg/L	5	14	0	74	92
Conductivity[5]	µS/cm	1	14	0	131	152
Nutrients						
Ammonia	mg/L	.05	2	2	0.05	0.05
Nitrate	mg/L	.05	14	12	0.05	0.07
Anions						
Chloride	mg/L	1	14	8	1.0	2.4
Fluoride	mg/L	0.1	14	0	0.6	0.8
SO4	mg/L	1	14	0	5	7
Metals						
Al- Total	µg/L	1	14	0	170	1263
Al-Dissolved	µg/L	1	14	0	11	80
As-Total	µg/L	0.1	14	0	1.9	2.1
As-Dissolved	µg/L	0.1	14	0	1.4	1.6
Cd- Total	µg/L	0.05	14	11	0.05	0.31
Cd- Dissolved	µg/L	0.05	14	14	0.05	0.05
Cr- Total	µg/L	0.5	14	3	0.7	2.2
Cr- Dissolved	µg/L	0.5	14	13	0.5	0.7
Cu-Total	µg/L	0.1	14	2	0.6	1.8
Cu-Dissolved	µg/L	0.1	14	6	0.2	0.4
Fe-Total	µg/L	30	14	2	137	894
Fe-Dissolved	µg/L	30	14	11	30	73
Pb-Total	µg/L	0.05	14	1	0.17	0.90
Pb- Dissolved	µg/L	0.05	14	3	0.05	0.09
Mn- Total	µg/L	0.05	14	0	8.35	38.40
Mn- Dissolved	µg/L	0.05	14	3	0.55	1.75
Mo- Total	µg/L	0.1	14	0	2.62	3.03
Mo- Dissolved	µg/L	0.1	2	0	2.46	2.77
Ni- Total	µg/L	0.1	14	2	0.4	0.9
Ni- Dissolved	µg/L	0.1	14	8	0.1	0.6
Se-Total	µg/L	1	14	14	1.0	1.0
Se- Dissolved	µg/L	1	2	2	1.0	1.0
Zn-Total	µg/L	2	14	3	4.0	6.4
Zn- Dissolved	µg/L	2	14	9	2.0	4.0

1 DL – Detection Limit. Some detection limits changed between sample events and the most common is presented here.
2 N – Number of data points.
3 N<DL – Number of results that were below their detection limit.
4 Median and 95th percentile were calculated after results that were less than their detection limits were set equal to the detection limit.
5 Field Measurements.

Table 6. Summary of water quality data from 2007-2010 for site SR1

Parameter	Unit	DL1	N[2]	N<DL[3]	Median[4]	95th%[4]
Physical						
pH[5]	s.u.	0.1	14	0	8.0	8.4
Alkalinity	mg/L	1	14	0	53	62
Hardness	mg/L	1	14	0	57	64
TDS	mg/L	5	14	0	78	101
Conductivity[5]	µS/cm	1	13	0	139	158
Nutrients						
Ammonia	mg/L	0.05	2	2	0.05	0.05
Nitrate	mg/L	0.05	14	13	0.05	0.05
Anions						
Chloride	mg/L	1	14	8	1.0	2.4
Fluoride	mg/L	0.1	14	0	0.6	0.7
SO4	mg/L	1	14	0	7	9
Metals						
Al- Total	µg/L	1	14	0	171	1638
Al-Dissolved	µg/L	1	14	1	8	83
As-Total	µg/L	0.1	14	1	1.9	2.1
As-Dissolved	µg/L	0.1	14	1	1.4	1.6
Cd- Total	µg/L	0.05	14	12	0.05	0.20
Cd- Dissolved	µg/L	0.05	14	14	0.05	0.05
Cr- Total	µg/L	0.5	14	4	0.6	1.5
Cr- Dissolved	µg/L	0.5	14	14	0.5	0.5
Cu-Total	µg/L	0.1	14	3	0.5	2.6
Cu-Dissolved	µg/L	0.1	14	3	0.2	0.6
Fe-Total	µg/L	30	14	2	125	1095
Fe-Dissolved	µg/L	30	13	10	30	71
Pb-Total	µg/L	0.05	14	2	0.22	1.60
Pb- Dissolved	µg/L	0.05	14	9	0.05	0.09
Mn- Total	µg/L	0.05	14	0	8.32	45.10
Mn- Dissolved	µg/L	0.05	14	2	0.46	1.40
Mo- Total	µg/L	0.1	14	0	2.57	2.94
Mo- Dissolved	µg/L	0.1	2	0	2.58	2.87
Ni- Total	µg/L	0.1	14	1	0.5	1.2
Ni- Dissolved	µg/L	0.1	14	8	0.1	0.7
Se-Total	µg/L	1	14	14	1.0	1.0
Se- Dissolved	µg/L	1	2	2	1.0	1.0
Zn-Total	µg/L	2	14	3	4.0	8.1
Zn- Dissolved	µg/L	2	14	8	2.5	4.7

1 DL – Detection Limit. Some detection limits changed between sample events and the most common is presented here.
2 N – Number of data points.
3 N<DL – Number of results that were below their detection limit.
4 Median and 95th percentile were calculated after results that were less than their detection limits were set equal to the detection limit.
5 Field Measurements.

B. Status of Bull Trout Designated Critical Habitat in the Action Area

Salmon River Basin Critical Habitat Unit

The action area is entirely within the Salmon River Basin critical habitat unit (CHU), one of the 32 CHUs in the Upper Snake draft recovery unit (75 FR 63927). The Salmon River Basin CHU encompasses the entire Salmon River basin, extending across central Idaho from the Snake River to the Idaho-Montana border. The Salmon River Basin CHU is the largest CHU in the Upper Snake draft recovery unit, and includes 4,583.5 miles of stream and 4,160.6 acres of lake and reservoir surface area designated as critical habitat. Large portions of this CHU occur within the Frank Church River of No Return Wilderness. The Salmon River Basin CHU contains the largest populations of bull trout in the Upper Snake draft recovery unit. Bull trout populations in this CHU exhibit adfluvial, fluvial, and resident life history strategies (USFWS 2010, p. 673).

Upper Salmon River Critical Habitat Subunit

The action area falls within the Upper Salmon River Critical Habitat Subunit (CHSU), one of the 10 CHSUs identified in the Salmon River Basin CHU. This CHSU is located within Custer County, in east-central Idaho. The Upper Salmon River CHSU includes 705.6 miles of stream and 3,104.2 acres of lake surface area designated as critical habitat. This CHSU contains many individuals, a large amount of habitat, and few threats. This CHSU supports populations with fluvial life history expressions that are important in the long-term recovery of the species, and also supports a rare adfluvial life history expression (adfluvial populations are associated with mountain lakes approximately 30 miles upstream of the action area) (USFWS 2010, p. 779).

Action Area

The action area contains designated critical habitat in Thompson Creek, S. Creek, and the Salmon River (Assessment, p. 33). The Salmon River, Thompson Creek and the lower portion of S. Creek provide foraging, overwintering, and migration habitat, while the upper portion of S. Creek provides spawning and rearing habitat (USFWS 2010, pp. 779-780).

Primary constituent elements (PCEs) are used to describe biological and physical habitat features that are essential to the conservation of the bull trout. Table 7 below displays the PCEs and associated diagnostic pathway/indicators that relate to each PCE. The baseline conditions of the diagnostic pathway/indicators were presented above in Table 2.

Table 7. Pathways/indicators PCE cross walk

Diagnostic Pathway/Indicator	*PCE 1 - Springs, seeps, groundwater	PCE 2 - Migratory Habitats	PCE 3 - Abundant food base	PCE 4 - Complex habitats	PCE 5 - Water Temperature	PCE 6 - Substrate features	PCE 7 - Natural Hydrograph	PCE 8 - Water quality and quantity	PCE 9 - Predators and competitors
Water Quality									
Temperature		x	x		x			x	
Sediment		x	x			x		x	
Chemical Contaminants and Nutrients	x	x	x					x	
Habitat Access									
Physical Barriers	x	x	x						x
Habitat Elements									
Substrate Embeddedness	x		x			x			
Large Woody Debris				x		x			
Pool Frequency and Quality			x	x		x			
Large Pools				x	x				
Off-Channel Habitat				x					
Refugia		x			x				x
Channel Conditions and Dynamics									
Wetted Width/Maximum Depth Ratio		x		x	x				
Streambank Condition	x			x	x	x			
Floodplain Connectivity	x		x	x	x		x	x	
Flow/Hydrology									
Changes in Peak/Base Flows	x	x			x		x	x	
Drainage Network Increase	x						x	x	
Watershed Conditions									
Road Density and Location	x				x		x		
Disturbance History				x			x	x	x
Riparian Conservation Areas	x		x	x	x		x		
Disturbance Regime				x			x	x	

*Updated for 2010 proposed rule Khalupka 2-24-10

Factors affecting the environmental baseline of bull trout critical habitat in the action area are similar to those described for the bull trout population and its habitat in the action area (See pages 31-48 above). Condition of PCEs relies on the condition of the associated indicators.

Presence of nonnative fish species directly relates to PCE 9. Brook trout occur in the Upper Salmon River Core Area, but do not occupy S. Creek or Thompson Creek (Assessment, pp. 54, 62). Additionally, refugia habitat adequate to support bull trout populations is available in the action area. PCEs 1, 2, 3, and 9 are impacted by the physical and thermal barriers to bull trout movement, resulting from irrigation diversions and heating of stream waters during low summer flows, in the Salmon River, Thompson Creek and S. Creek (Assessment, pp. 51, 59, 62). Observed water temperatures of Thompson Creek, S. Creek, and the Salmon River have regularly exceeded optimum temperatures for both spawning and rearing, and adult holding (Assessment, pp. 44, 54, 62). Elevated summer water temperatures in the Salmon River are believed to be influenced by limited shading due to lack of riparian vegetation, while riparian areas on Thompson Creek and S. Creek are generally in good condition (Assessment, pp. 53, 61-62). Water temperature may affect PCEs 2, 3, 5, and 8.

Substrate in Thompson Creek and S. Creek is primarily cobble and gravel with low amounts of fines. Cobble embeddedness in both streams is low (Assessment, pp. 51, 59). Streambanks on Thompson Creek were rated highly for stability, indicating streambanks are contributing only minor amounts of sediment to the system (Assessment, p. 52). Streambank stability along much of S. Creek appears good, with stabilities in upper reaches near or above 90 percent. However, on private lands in lower reaches erosion and sloughing are evident (Assessment, p. 60). Sediment levels may also be influenced by the presence of valley bottom roads and other disturbance in the watersheds (Assessment, pp. 53, 61). The indicators of substrate

embeddedness, sediment, streambank condition, and disturbance influence PCEs 1, 2, 3, 4, 5, 6, 7, and 8.

The proposed action has the potential to impact water quality and quantity of designated critical habitat for bull trout in the action area. Changes to chemical characteristics of stream water may influence PCEs 1, 2, 3, and 8. See pages 37 through 48 above for a complete discussion of baseline chemical characteristics.

V. EFFECTS OF THE PROPOSED ACTION

A. Direct and Indirect Effects of the Proposed Action

The implementing regulations for section 7 define "effects of the action" as "the direct and indirect effects of an action on the species together with the effects of other activities that are interrelated or interdependent with that action, which will be added to the environmental baseline" (USFWS 1986, p. 19958). "Indirect effects" are caused by or result from the agency action, are later in time, but are still reasonably certain to occur (USFWS 1986, p. 19958).

1. Analytical Approach and Assumptions

In the following evaluation, the Service in part relied upon the Bureau's effects analysis in their Assessment, which is based on a series of assumptions about bull trout presence and distribution in the action area. Because of the construct of these assumptions, the analysis is more likely to result in an overestimate, rather than underestimate, of the impacts of the proposed action on bull trout. When examining the potential impacts to a species that is listed as threatened under the Act, and there is substantial imprecision or uncertainty in some of the information, using assumptions that are more likely to overestimate, rather than underestimate, effects is a reasonably cautious and prudent approach for assessing impacts to populations of that species. Absent the consideration of the full potential of effects, detrimental impacts to the species can go unrecognized (National Research Council 1995, p.167).

The Bureau presented best estimate predictions and upper estimate predictions of effects to water quality. The Bureau considered the upper estimate predictions to be the "worst case scenario". The Service agrees with the Bureau's characterization and considers use of upper estimate predictions to be a reasonable approach to determining the full range of potential effects to listed species and designated critical habitat. NPDES Permit limitations were established in the 2001 NPDES permit. That permit has been administratively extended since 2007. The establishment of the NPDES Permit limitations is not part of this consultation; however, effects of the discharge associated with use of the NPDES permit, included as part of the Proposed Action, will be analyzed in this Opinion.

Current Mine operations in the action area have had substantial effects, primarily in the Buckskin, Pat Hughes, and Bruno Creek drainages. Effects to aquatic habitat and fish populations in Thompson Creek, S. Creek, and the Salmon River have been minimized through water management strategies; however, decreased stream flow, changes in water quality, and minor impacts to habitat due to adjacent roads have occurred. These current conditions (i.e., as

currently impacted by Mine operations) represent the baseline conditions against which the Proposed Action is compared.

Effects of Phase 7 actions which have not yet been implemented, thus are not part of the environmental baseline, will be considered in the analysis of effects. Specifically, the long-term water management plan is part of the post closure and reclamation plan and was modified as part of this proposed action. The long-term water management plan includes TCMC's NPDES permitted outfalls. TCMC's NPDES permitted outfalls 001 and 002 are currently not used and rarely have been used. TCMC's NPDES permit outfall 005 is not currently used and is not planned to be used until Mine closure and reclamation. Effects from these outfalls will be considered in this Opinion.

The analysis of effects of the Proposed Action is divided into three separate phases of operations: Phase 8, Early Closure, and Late-Post Closure operations. Analysis of the effects is further subdivided into general effects and effects to Thompson Creek, S. Creek, and the Salmon River.

2. General Effects of the Proposed Action

The General effects of the Proposed Action are analyzed for Phase 8, Early Closure, and Late-Post Closure.

a. General Effects of Phase 8

Phase 8 encompasses extension of Mine life by approximately nine years, with expansion of the open pit, WRSFs, and the TSF, a new section of power line, long-term water management plan, a cutoff wall in Pat Hughes drainage, upgrade of Buckskin sediment pond, and maintenance of existing pipelines, roads, and fiber optic lines. Extension of Mine life also involves the continued use, storage, and transportation of petroleum products and other hazardous materials. Although the expansion of the WRSFs and the TSF will include disturbance of stream reaches, the majority of potential effects to aquatic habitat and fisheries during Phase 8 will be due to changes in the water quantity and/or quality delivered to Thompson Creek, S. Creek, and the Salmon River. The potential effects from continued Mine operations and changes to water quantity and quality are described in separate sections below.

Expansion of the open pit will occur in an area that is already heavily disturbed and the Service does not disagree with the Bureau's determination that there will be no new disturbance and no effects to the aquatic environment. Further, the new section of power line is located in the upper watersheds, away from any streams, and the Service does not disagree with the Bureau's determination that this portion of the project will not result in effects to the aquatic environment. Similarly, many of the pipelines, roads, and fiber optic lines are also located away from streams and most maintenance will not affect stream habitat. There is the potential for roads in proximity to streams (e.g., the Thompson Creek road, main access road along Bruno Creek, S. Creek road) to contribute sediment. However, the existing best management practices (BMPs) that will continue to be in place during Phase 8 have been effective at keeping levels of fine sediment in streams within guidelines for properly functioning fish habitat. Therefore, effects to bull trout and designated critical habitat from the minimal amount of introduced sediment are considered **insignificant.**

During maintenance of infrastructure near streams (e.g., roads and pipelines, particularly along the Thompson Creek road) there is also the potential for the accidental release of the contaminants due to a vehicle accident, equipment failure, or the on-site refueling of equipment. No releases associated with maintenance of infrastructure have occurred for the life of the Mine. Effects to bull trout and designated critical habitat from an accidental release of contaminants are **discountable** given the BMPs, SPCC Plan, and other precautionary measures in place.

Similar to the potential for an accidental release of contaminants during the maintenance of infrastructure, there is the potential for an accidental release during shipment of molybdenum concentrate or petroleum products and chemicals used at the Mine. Increased safety measures implemented for the shipment of molybdenum concentrate have resulted in there being no spills since 2001. In addition, there have been no petroleum products spilled during shipment since mining operations began and only one spill (not into a waterway) of hydrochloric acid in 1996. However, the Proposed Action will extend Mine life (and associated shipment) by approximately nine years. As a result, there is the potential for spills to occur, including at locations adjacent to aquatic habitat (i.e., along the Salmon River or S. Creek). Given the history of Mine shipments, and increased safety measures implemented since 2001, spills associated with the continued shipment of Mine products (molybdenum, petroleum, etc.) are not likely to occur. Therefore, effects to bull trout and designated critical habitat from an accidental release of contaminants during shipment are **discountable.**

There have been two reportable spills of petroleum products at the Mine site (not associated with shipment) within the last five years at the Mine. One was a release of an unknown quantity of gasoline from a pump in 2007; the other was a release of approximately 300 gallons of diesel fuel from a haul truck. Both of these releases were reported to IDEQ and immediately remediated. Neither of the spills reached any streams. Given the SPCC Plan in place at the Mine and the fact that the materials stored on the Mine-site are located near the mill and other Mine buildings and not near streams, effects to bull trout and designated critical habitat from the spill of any chemicals stored at the Mine or used in Mine processes are **discountable.**

Under the Proposed Action, there will be increased disturbance in the Buckskin, Pat Hughes, and Bruno Creek drainages due to the placement of additional overburden and tailings in the WRSFs and TSF. These drainages are not occupied by bull trout, and any additional physical disturbance (expansion of the WRSFs and TSF) within these drainages is not expected to result in effects to bull trout or their designated critical habitat. The additional disturbance in the Buckskin drainage will be in the upper watershed, and will not directly disturb any additional reaches of the stream. The additional disturbance in the other two drainages will include the burial of approximately 3,749 linear feet of the Pat Hughes Creek stream channel and 902 feet of the upper Bruno Creek stream channel. Given the existing impacted nature of both Pat Hughes Creek and Bruno Creek, the majority of potential effects during both Phase 8 operation and reclamation will not be due to the disturbance to these stream reaches themselves, but from changes in the water quantity and quality delivered to Thompson Creek, S. Creek, and the Salmon River. Changes to water quantity and quality for both the current Phase 7 and the Proposed Action/Phase 8 were predicted in a series of reports prepared by Lorax Environmental and summarized in the Assessment. These changes are addressed below in the sections *Effects of*

the Proposed Action to Thompson Creek, *Effects of the Proposed Action to S. Creek*, and *Effects of the Proposed Action to the Salmon River*.

Streambank restoration on S. Creek as part of wetland mitigation will involve fencing approximately 10,000 feet of S. Creek and placing coir rolls, and possibly logs or boulders (Assessment, p. 24) along approximately 100 feet of the streambank. Because these methods will not involve instream work by heavy equipment, or any ground disturbance, it is unlikely any sediment would be delivered to S. Creek. Work on the adjacent wetland restoration will be located between 100 to 150 feet away from S. Creek and will require a SPCC Plan and BMPs designed to reduce the likelihood of any sediment being delivered to the stream (Assessment, pp. 26-27). Any increase in sediment or turbidity is anticipated to be of short duration, low concentration, and localized to the area where sediment enters live water. Any fish present will likely disperse into adjacent suitable habitat. Further, any fish present in the area are likely to be temporarily displaced by construction activities associated with stabilization and not contact any of the elements used for the bio-engineering. Following successful streambank restoration (as a result of both fencing and the active stabilization using bio-engineering), sediment introduced into the stream from the streambanks will decrease, and reestablished riparian vegetation will provide increased streambank stability and shading of the stream, which will benefit fish species. Therefore, effects from streambank restoration on S. Creek to bull trout and their designated critical habitat will be **insignificant.**

b. General Effects of Early Closure and Late-Post Closure

Effects of general closure and reclamation activities will largely be the same as the effects described for general Phase 8 operation. These include the potential for roads in proximity to streams (e.g., the Thompson Creek road, main access road along Bruno Creek, S. Creek road) to contribute sediment, and the potential for spills to occur due to vehicle accidents, equipment failure, and/or the refueling of equipment. Although the potential for effects due to shipping of molybdenum is reduced, some shipments will continue along with the potential for an accidental release of contaminants to surface water. Given the existing BMPs, SPCC Plan, and other precautionary measures in place, the amount of sediment or contaminants reaching live waters (as discussed above), will be **insignificant** and the potential for adverse effects from an accidental release (as discussed for Phase 8) are **discountable**.

3. Effects of the Proposed Action to Thompson Creek

The effects of the Proposed Action to Thompson Creek are the same for Phase 8, Early Closure, and Late-Post Closure. Therefore, the effects of the Proposed Action during Phase 8 are inclusive of the effects of the Proposed Action for all phases of Mine activity.

The expected changes to water quantity and quality under the Proposed Action that will occur during Phase 8 operations include:

• Minor reductions in Thompson Creek stream flow volumes due to installation of an additional cutoff wall in the Pat Hughes drainage, and linings in the Buckskin (potential in Buckskin as the pond is not currently being used) and Pat Hughes drainage's sediment ponds; these modifications will intercept residual seepage that bypasses the NPDES outfalls in these drainages which feed

Thompson Creek. The reduction relative to current conditions will be approximately 2 percent of baseflow, or 0.08 cfs, and approximately 1 percent relative to Phase 7, or an additional 0.04 cfs reduction beyond Phase 7.

• Decreased concentrations of some contaminants in Thompson Creek relative to baseline conditions due to cutoff walls installed as part of Phase 7 and the associated reductions in residual seepage.

• Increased concentrations of some contaminants relative to baseline condition in Thompson Creek. As can be seen in Tables 8 and 9, concentrations are predicted to increase relative to baseline for aluminum, cadmium, cobalt, copper, iron, lead, manganese, uranium, and zinc under the upper estimates.

a. Effects of the Proposed Action to Thompson Creek during Phase 8

The primary effects of the Proposed Action during phase 8 to Thompson Creek are through water quality and quantity. Water quality and quantity in Thompson Creek are affected through seepage from the WRSF and TCMC's NPDES permitted outfalls 001 and 002. Therefore, these will be discussed in detail below.

Two versions of loading scenarios were derived in order to provide a range of predicted results for loading into Thompson Creek. The loading scenarios represent a "best estimate" and a more conservative "upper estimate". Both estimates are estimates of final water quality after mining is complete that take into account existing and future disturbance, as well as existing quality. Additional detail on how estimates were derived is available in the Assessment (pp. 71-72). For the purposes of this Opinion, the upper estimate was relied upon for analyzing effects of the proposed action, as it represents the potential upper estimates scenario for impacts to bull trout, and is more conservative than the best estimate assumptions. The upper estimate was compared to the best estimate for Phase 7 water quality predictions to account for the entire range of effects. The upper estimate loading scenario was used to predict the resultant water quality in Thompson Creek (i.e., the receiving stream) after complete mixing downstream of the Pat Hughes Creek confluence. Two receiving stream flow rates were assessed under each loading scenario: the average annual low flow rate of 4.2 cfs (at the USGS station) and the lowest 7-day average flow which occurs on average once every 10 years (known as the 7Q10) of 2.0 cfs at the same location. The 7Q10 is a lower flow (that occurs less frequently) than the average baseflow condition, which is a more regular seasonal low flow condition.

Loading to Thompson Creek occurs primarily through Buckskin Creek and there is some dilution occurring downstream of Buckskin Creek. Loading from Buckskin Creek is due to seepage from the existing Buckskin WRSF that in the past has been collected and discharged to Thompson Creek via outfall 001, or has reached Thompson Creek via leakage and infiltration from the sediment pond.

<u>Predicted Water Quantity for Thompson Creek</u>

The Proposed Action will reduce stream flow by reducing the amount of residual seepage to Thompson Creek through the Buckskin and Pat Hughes drainages due to installation of an

additional cutoff wall in the Pat Hughes drainage, and linings in the Buckskin (potential in Buckskin as the pond is not currently being used) and Pat Hughes drainage's sediment ponds. These modifications will intercept residual seepage that bypasses the NPDES outfalls in these drainages which feed Thompson Creek. During snowmelt, when stream flow in Thompson Creek is composed of primarily surface runoff, the absence of residual seepage will be largely unnoticeable. Any reductions in stream flow will be most noticeable during periods of low flow. Estimates are that reducing groundwater seepage could reduce stream flow in Thompson Creek by approximately 2 percent of baseflow, which will be a reduction of approximately 0.08 cfs under average annual low flow conditions (4.2 cfs) and approximately 0.04 cfs under a 7Q10 flow scenario (2.0 cfs). Reductions in stream flow have been documented to impair upstream migration, as well as reduce food availability and reduce instream cover (Assessment, p. 85). The effects of reduced food availability and reduced instream cover can reduce growth of juvenile salmonids (Assessment, p. 85).

Because of the link between stream flow and the population dynamics of salmonids, it is possible that reductions in Thompson Creek stream flow under the Proposed Action will adversely affect fish populations and habitat. However, many of the studies done on the effects of stream flow reductions have been done on systems that showed much larger variations in flow than the 2 percent predicted for Thompson Creek. For example, the Lemhi River that was studied by Arthaud et al. (2010) has diversions that remove a large portion of the spring snowmelt. In the stream studies by Harvey et al. (2006), stream flow in the manipulated stream units was 75 to 80 percent lower than in the non-manipulated (control) units. As a result, although it is possible that a 1 percent reduction in stream flow (the reduction relative to Phase 7) will result in adverse effects, determining the magnitude of those effects is difficult.

Looking at gage height versus measured stream flow on the USGS gage on Thompson Creek, there is little difference in gage height for a change in stream flow of approximately 2 percent. For example, selecting two recent flow measurements at the gage of 4.28 and 3.89 cfs, which are similar to the annual low flow (4.2 cfs), shows corresponding gage heights of 2.24 and 2.23 feet, respectively. The observations were made within three months of each other (10/30/2013 for the 4.28 cfs measurement and 7/24/13 for the 3.89 cfs measurement), under the same rating curve with little shift adjustment and no recorded gage height change (USGS 2014). This is a change in depth of less than 0.01 feet (0.12 inches) for a reduction in flow of 0.39 cfs compared to the estimated reduction under the Proposed Action relative to Phase 7 of 0.04 cfs for annual low flow. Although this is a very rough analysis, and doesn't approximate how flow relates to depth within the large variety of channel morphologies present in a stream, it provides limited evidence that a 1 percent flow decrease may not substantially alter stream depth, cover, or preclude upstream movement. Because the decrease in flow is small and because limited evidence suggests that there are negligible changes to flow depth, **insignificant** effects to bull trout and their critical habitat are expected.

Predicted Water Quality for Thompson Creek

Seepage from Buckskin and Pat Hughes WRSFs into Thompson Creek may occur year-round. Effects could occur with annual low and 7Q10 flows. These flows however are most likely to occur from late September to March, when it is unlikely any fluvial bull trout that may use the stream would be present and any resident bull trout would be upstream of the effects of the

Proposed Action to Thompson Creek. Further, unsuitable temperatures from June until October (Assessment, p.44) and a physical barrier (Assessment, p. 51) near the mouth of Thompson Creek which would affect fish passage during low flows and could restrict fluvial bull trout movements into Thompson Creek. Temperature data for Thompson Creek presented in the Assessment (p. 44) indicates temperatures well above optimum temperatures for bull trout spawning or holding. Additionally, survey data collected over the last 33 years (Assessment, p. 30) indicates a low probability of bull trout presence in Thompson Creek. As a result of the physical barrier, hydrograph, bull trout behavior, and lack of documented presence in the affected portion of Thompson Creek, bull trout are unlikely to be present in the affected area. For these reasons, effects from seepage from the WRSFs in Thompson Creek are expected to be **discountable** to bull trout.

Tables 8 and 9 show the water quality predictions made for both Phase 7 and the proposed action/Phase 8. The concentrations of aluminum, cadmium, cobalt, copper, iron, lead, manganese, uranium, and zinc are predicted to increase under at least one of the scenarios for both Phase 7 and Phase 8.

The primary drivers of any differences between Phase 7 and Phase 8 water quality predictions are the amount of Type II waste rock in the Buckskin WRSF and the percentage of the Pat Hughes drainage occupied by the WRSF. Under Phase 8, the amount of Type II waste rock in the Buckskin WRSF will increase from 20 percent to 32 percent. For the Pat Hughes WRSF, the increased size will increase the quantity of water that comes in contact with the waste rock relative to uncontaminated groundwater inputs. In addition, as the WRSF expands down drainage, it eventually comes into direct contact with underlying groundwater that will bypass the lowermost cutoff wall to be installed as part of Phase 8. As a result, water quality of the residual seepage in both drainages will degrade over time. Effects of constituent loading as a result of seepage and outfalls 001 and 002 are discussed below.

Table 8. Predicted water quality in Thompson Creek – average annual low flow

Parameter[1]	Unit	Baseline TC3 - 95th[2]	Criteria (CCC/Human Health)[3]	Thompson Creek Water Quality *Annual* Low Flow[4]			
				Phase 7		Phase 8	
				Best Estimate	Upper Estimate	Best Estimate	Upper Estimate
SO_4	mg/L	128		15.7	16.3	20.2	23.5
Al	µg/L	22.1		8.9	**29.9**	9.5	**104.2**
As	µg/L	0.7	10.0	0.5	0.5	0.5	0.5
Cd[5]	µg/L	0.08	0.35	0.05	0.07	0.05	**0.16**
Co	µg/L	0.12		0.1	**0.57**	0.11	**2.32**
Cu[5]	µg/L	0.5	5.5	**0.81**	**1.54**	**0.82**	**4.34**
Fe	µg/L	30		30	30	30	**32**
Pb[5]	µg/L	0.05	1.0	**0.08**	**0.1**	**0.08**	**0.17**
Mn	µg/L	0.53		0.5	**24.3**	**0.8**	**112.9**
Mo	µg/L	5.42		2.1	2.1	2.5	2.6
Ni[5]	µg/L	0.8	25.0	0.5	0.5	0.5	0.6
Se	µg/L	6	5.0	2	2	2.2	2.3
U	µg/L	1.1		1	**1.2**	1.1	**1.9**
Zn[5]	µg/L	3.95	58.0	3	**5.1**	3.1	**12.6**

Source: Lorax 2012a. **Bold** values increase relative to baseline concentrations.
[1] Dissolved metal data were used for all metals except selenium; the selenium guideline applies to the total fraction.
[2] Baseline water quality is the 95th percentile at TC3 (downstream of Buckskin Creek) from low flow months 2000-2010 as calculated from the Lorax WQ data
[3] Lowest of the two criteria where both exist
[4] Receiving water quality is the 95th percentile at TC4 (upstream of Buckskin Creek) from low flow months 2000-2010
[5] Criteria for these metals are hardness dependent. Criteria is based on the 5th percentile hardness at TC4 (43 mg/L) for low flow months 2000-2010 (TC4 hardness is more conservative (i.e. lower) than TC3 hardness).

Table 9. Predicted water quality in Thompson Creek – 7Q10 conditions

Parameter[1]	Unit	Baseline TC3 - 95th[2]	Criteria (CCC/Human Health)[3]	Thompson Creek Water Quality 7Q10 Flow[4]			
				Phase 7		Phase 8	
				Best Estimate	Upper Estimate	Best Estimate	Upper Estimate
SO_4	mg/L	128		17.4	18.8	27	33.8
Al	µg/L	22.1		9.1	**53.1**	10.4	**209.5**
As	µg/L	0.7	10	0.5	0.5	0.5	0.6
Cd[5]	µg/L	0.08	0.35	0.05	**0.1**	0.05	**0.29**
Co	µg/L	0.12		0.1	**1.08**	0.11	**4.76**
Cu[5]	µg/L	0.5	5.5	**0.81**	**2.35**	**0.84**	**8.24**
Fe	µg/L	30		**30.1**	**31**	**30**	**34**
Pb[5]	µg/L	0.05	1	**0.08**	**0.12**	**0.08**	**0.28**
Mn	µg/L	0.53		**0.6**	**50.5**	**1.1**	**236.9**
Mo	µg/L	5.42		2.2	2.2	2.9	3.1
Ni[5]	µg/L	0.8	25	0.5	0.5	0.5	0.8
Se	µg/L	6	5	2	2	2.4	2.6
U	µg/L	1.1		1	**1.4**	**1.2**	**2.9**
Zn[5]	µg/L	3.95	58	3	**7.4**	3.2	**23.1**

Source: Lorax 2012a. **Bold** values increase relative to baseline concentrations. Highlighted values are > criteria
[1] Dissolved metal data were used for all metals except selenium; the selenium guideline applies to the total fraction.
[2] Baseline water quality is the 95th percentile at TC3 (downstream of Buckskin Creek) from low flow months 2000-2010 as calculated from the Lorax WQ data
[3] Lowest of the two criteria where both exist
[4] Receiving water quality is the 95th percentile at TC4 (upstream of Buckskin Creek) from low flow months 2000-2010
[5] Criteria for these metals are hardness dependent. Criteria is based on the 5th percentile hardness at TC4 (43 mg/L) for low flow months 2000-2010 (TC4 hardness is more conservative (i.e. lower) than TC3 hardness).

Copper

For Thompson Creek, the upper estimates for copper during annual low flow and 7Q10 flow are 4.34 and 8.24 µg/L, respectively. A 7Q10 flow is expected to occur about once every 10 years however, there is nothing to prevent a low flow of similar magnitude (≈2 cfs) and duration from occurring in consecutive years.

In studies on steelhead and Chinook salmon, Chapman (1978) found copper to be most toxic to salmonids during the juvenile and larval life stages, and steelhead to be more sensitive to copper than Chinook salmon. Chapman (1978) found that the 96-hour LC50 (the concentration that is lethal to 50 percent of the organisms) for steelhead was as low as 17 µg/L for steelhead parr and 19 µg/L for Chinook salmon swim-ups (larval fish just emerging from spawning gravels). These results would suggest that the upper estimate during 7Q10 may not result in lethal effects to any life stages of fish species present (hardness was 22-67 mg/L versus 43 mg/L for Thompson Creek), although Chapman (1978) did not test bull trout. However, NMFS (2014) reports an LC50 for Chinook salmon as low as 7.4 µg/L (hardness of 35 mg/L), suggesting that some mortality could occur depending upon life stage, and other mitigating factors such as dissolved organic carbon (DOC) and pH (Assessment, p. 87). Although some mortality could occur, other

chronic type effects are more likely. As mentioned above, copper can have other non-lethal effects to salmonids. These effects can include reduced growth and reduced olfactory function, which can interfere with behavior, migration, and impair the immune system (Assessment, p.87).

Because the upper estimate predictions are considered conservative, the likelihood of high concentrations for copper in Thompson Creek is low. However, a comparison of available chronic copper effects data (for salmonids) indicated that approximately half the adverse effects documented occurred at copper concentrations below a concentration equal to 5.5 ug/l at 43 mg/l hardness for copper. Further, NMFS (2014) cited multiple studies that found hardness (toxicity of copper is hardness based) to have a minor influence on the toxicity of copper, with DOC and pH more important factors affecting toxicity (Assessment, p. 87). Although DOC has not been measured in Thompson Creek, DOC tends to be low during low flow conditions.

Reduced growth in laboratory tests is a common effect of copper exposure at levels approaching upper estimates for low flow, which can lead to reduced survival, particularly of juvenile anadromous salmonids during seaward migration (Assessment, p. 87). Sensory system effects are, however, more sensitive and may be affected at lower concentrations than growth. Several studies have shown that small increases in copper can impair olfactory function in coho salmon and steelhead, with only a short-term increase of 3.0 µg/L in copper concentrations (not hardness dependent)(Assessment, pp. 87-88). These effects can be at least partially reversible, although exposures lasting longer than four hours may take weeks to recover (Assessment, pp. 87-88). The loss of olfactory function can subsequently influence feeding, predator avoidance, and migration (Assessment, p. 88). For example, Hecht et al. (2007) found that increases of 0.18 to 2.1 µg/L above background copper concentrations corresponded in reductions in predator avoidance behavior of approximately 8 to 57 percent. Furthermore, exposure to sub-lethal levels of copper can increase fish stress, which subsequently increases both infection and mortality rates (Assessment, p. 88). In addition to sensory and behavioral effects, increased copper can affect habitat by altering the benthic macroinvertebrate community, which is the primary food source of most drift feeding salmonids.

Studies of streams with elevated copper, and changes in the benthic macroinvertebrate community, have not shown any corresponding changes in fish populations (Assessment, p. 88). As a result, effects to fish from any changes in the macroinvertebrate community in Thompson Creek are not expected.

Effects at the estimated annual low and 7Q10 flow could affect bull trout designated critical habitat PCE #8 in a way that changes water quality such that normal reproduction, growth, and survival are inhibited. Further, increased copper levels could interfere with bull trout migration, and cause changes to macroinvertebrate communities, thus adversely affecting PCEs 2, 3, and 8. Given concentrations of copper expected as a result of the proposed action and effects reported to occur at levels below the predicted estimates, impacts to features that are essential to the conservation of the bull trout, particularly water quality, are likely. As such, **adverse effects are expected** to occur to designated critical habitat as a result of changes to water quality.

Sulfate, Arsenic, Molybdenum, and Nickel

Concentrations of these constituents are predicted to decrease in Thompson Creek relative to baseline conditions under all estimates. Because, ongoing biological monitoring shows macroinvertebrate and fish populations in Thompson Creek do not show any apparent decline due to Mine operations at the baseline concentrations which are well below levels shown to cause deleterious effects, effects due to these constituents are expected to be **insignificant** to bull trout designated critical habitat.

Aluminum

EPA's National Recommended Water Quality Criteria for aluminum is 750 µg/L (acute) and 87 µg/L (chronic). The predicted upper estimates for both flow scenarios on Thompson Creek are greater than the recommended chronic criterion. However, the criterion was based on a toxicity test with striped bass in water with a pH of 6.5-6.6 and a hardness <10 mg/L. The recommended criterion acknowledges that aluminum is substantially less toxic at higher pH and hardness, with aluminum toxicity most closely tied to pH. In acidic waters (pH <5.5) aluminum is soluble and present in its inorganic form, which is the form most toxic to fish (Assessment, p. 88). Effects to fish in acidic waters include asphyxiation, impaired ion regulation, or a combination of these effects (Assessment, p. 88). However, in circumneutral waters (pH 5.5-7.5) aluminum is considered relatively innocuous (Assessment, p. 88). Because pH in Thompson Creek is greater than 5.5 (median=7.8 and 95th percentile=8.2 at TC3), effects from the predicted aluminum concentrations are **not likely to result in adverse effects** to bull trout designated critical habitat.

Cadmium

In general, predicted cadmium concentrations in Thompson Creek are lower than baseline. However, under the upper estimates (for both flow scenarios) the predicted concentrations increase relative to the baseline. Cadmium is most toxic to salmonids during the juvenile and larval life stages. In addition, the sensitivity of different salmonid species to cadmium varies (Assessment, p. 93). The 96-hour LC50 (the concentration that is lethal to 50 percent of the organisms) for steelhead has been documented as low as 1.0 µg/L for steelhead parr and 1.8 µg/L for Chinook salmon swim-ups. Mebane et al. (2012) studied sensitivity to cadmium for cutthroat trout, rainbow trout, and shorthead sculpin and found 96- hour EC50s (the concentration that causes a specified effect on 50 percent of the organisms, in this case loss of equilibrium, immobilization, or death) ranging from 0.3 to 1.5 µg/L. Cadmium toxicity decreases substantially with increases in hardness. The estimates for the annual low flow and the 7Q10 flow have an effect from the proposed action of an increase in the level of cadmium by 0.11 and 0.24 µg/L respectively. While the increase in cadmium is minimal, effects from the proposed action could include low levels of the typical effects of cadmium to fish: reduced survival of larval fish, and avoidance behavior that may limit feeding, migration, or predator avoidance. Although there is evidence that bull trout spawning may occur upstream of Mine activity in headwater reaches, the primary function of Thompson Creek as designated critical habitat is as foraging, migration, and overwintering habitat. It is unlikely that cadmium concentrations would affect bull trout eggs or fry that may be present in the headwaters, but concentrations could **adversely affect** PCEs 2 (migration habitat) and 8 (water quality) of bull trout designated critical habitat.

Cobalt

Cobalt concentrations are predicted to increase under the upper estimate for both flow levels. All predicted cobalt concentrations are below the lowest chronic value for aquatic organisms (i.e., the chronic value that is likely to be protective of all forms of aquatic life, not just salmonids) of 23 µg/L that is frequently used in ecological risk assessments (Assessment, p. 89). The estimated are also below the toxicity reference value for salmonids of 38 µg/L that was used to analyze the effects of cobalt on aquatic life in the Panther Creek watershed (tributary to the Salmon River, approximately 25 miles west of Salmon, Idaho; Assessment, p. 89). Because the predicted concentrations are well below these values, effects from cobalt to PCEs of bull trout designated critical habitat will be **insignificant**.

Iron

For Thompson Creek, the predicted iron concentrations for the estimated concentrations for both annual low flow and 7Q10 flow are slightly higher than baseline concentrations. Suter and Tsao (1996) report a low end chronic value for aquatic organisms of 158 µg/L, which is the lowest chronic value for daphnids. The lowest chronic value reported for fish in Suter and Tsao (1996) is 1300 µg/L. Similar to aluminum, toxicity of iron is highest in acid conditions (Assessment, p. 89). Iron may also impact fish indirectly by altering the physical characteristics and quality of benthic habitats, which can reduce macroinvertebrate populations (Assessment, p. 89). However, the lowest iron concentrations reported to affect macroinvertebrates through substrate impacts was 200 µg/L. Because the predicted estimates are well below all values discussed here, and because the pH of Thompson Creek is circumneutral, effects of the proposed action from iron in Thompson Creek to bull trout designated critical habitat will be **insignificant**.

Lead

The estimates for the annual low flow and the 7Q10 flow predict an increase in levels of lead of 0.11 and 0.20 µg/L respectively, from the proposed action. The available data on lead toxicity indicates that the thresholds for both acute and chronic effects to benthic invertebrates and salmonids occur at lead concentrations well above water quality criteria (Assessment, p. 89). The exception is for snails and the amphipod *Hyalella azteca*, with studies showing that these organisms may be adversely affected at sub-criteria concentrations (Assessment, p. 89). However, because of their varied diet, bull trout are not expected to be dependent upon snails or amphipods for food, and are unlikely to be adversely affected at concentrations below the criteria. As all concentrations that are predicted for Thompson Creek are well below the NMFS (2014) criteria, effects of lead exposure to bull trout designated critical habitat is anticipated to be **insignificant**.

Manganese

British Columbia has established fresh water ambient water quality guidelines for manganese to protect aquatic life (Assessment, p. 89). While manganese is not highly toxic and in fact can provide amelioration to the toxicity effects from other metals, it can be toxic to aquatic organisms when found in excessive amounts in the dissolved state. As with certain other metals, its toxicity is dependent upon water hardness, and the same hardness value used for other hardness-dependent metals was used here to calculate what the chronic criteria would be under the British Columbia guideline. The resultant calculation is 794 µg/L for Thompson Creek. This value is well above the maximum concentrations of 236.4 µg/L predicted for Thompson Creek.

Because the predicted concentrations are well below the guideline, and because the guideline was derived from the lowest observed effect concentration with a 4:1 safety factor, effects to bull trout designated critical habitat from the predicted manganese concentrations are **insignificant.**

Selenium

Based on current and predicted water quality in Thompson Creek, the primary metal of concern with the potential for bioaccumulation is selenium. Selenium in Thompson Creek did equal or exceed the IDEQ criteria several times between 2000 and 2004, but has not exceeded the criteria since 2005. Excessive selenium bioaccumulation in fish can result in larval developmental abnormalities and mortality (Assessment, p. 90). Bioaccumulation of selenium in Thompson Creek has been demonstrated (Assessment pp. 48-50), but ongoing biological monitoring on Thompson Creek shows macroinvertebrate, sculpin, and trout populations have not declined due to Mine operations (Assessment, p. 90). While the proposed action will increase selenium levels relative to current levels, as discussed above, the effects of the proposed action (an increase of 0.3 and 0.6 µg/L for annual low flow and 7Q10 flows respectively) will have an **insignificant effect** to bull trout designated critical habitat.

Uranium

The Canadian government has established fresh water ambient water quality guidelines for uranium to protect aquatic life (Assessment, p. 90). They note that uranium bioaccumulates, but does not biomagnify; the guideline does not account for bioaccumulation. The long term (chronic) freshwater aquatic life guideline was modeled using 13 different species for which appropriate data were available, taking account of the most sensitive life stages and endpoints for each, then taking the 5th percentile of the results as the guideline. The resultant concentration in the guideline is 15 µg/L. The guideline reflects a much greater sensitivity for invertebrates than fish, which had endpoints at concentrations up to several orders of magnitude higher. Maximum predicted concentrations are 2.9 µg/L for Thompson Creek. Because the maximum concentrations are much lower than the guideline, and because the guideline is conservative in the endpoints used, effects to bull trout designated critical habitat in Thompson Creek due to the predicted uranium concentrations are expected to be **insignificant**.

Zinc

NMFS (2014) found that avoidance reactions have been reported as low as 47 µg/L at a hardness of 112 mg/L and 53 µg/L at a hardness of 50 mg/L (roughly comparable to the 5th percentile hardness of Thompson Creek and the Salmon River of 43 and 53 mg/L). Maximum predicted concentrations for zinc are 23. 1 µg/L for Thompson Creek. Because predicted concentrations are much lower than the lowest values behavioral effects were observed, effects to biological and physical habitat features that are essential to the conservation of the bull trout (i.e., PCEs) are not expected to occur. Effects to all PCEs of bull trout designated critical habitat are anticipated to be **insignificant.**

In addition to the effects described above for the individual metals, mixtures of metals can also have interactive effects leading to toxicity at lower or higher levels than from a single metal alone (Assessment, pp. 90-91). At issue is whether the complex mixture of metals predicted for Thompson Creek would have additive, less than additive, or more than additive toxicity (Assessment, pp. 90-91). In some studies, mixtures of metals have shown both additive toxicity

(with adverse effects observed at mixture concentrations of one-half to one-third the approximate toxicity threshold of metals in isolation (Assessment, pp. 90-91). However, in other studies of metal mixtures, metal combinations have been less toxic than their single-metal toxicities (Assessment, pp. 90-91). Given the complexities of predicting the toxicity of metal mixtures, an integrated approach to water quality management is often taken by measuring and controlling toxics using a combination of numeric criteria, WET testing, and biological monitoring of streams that receive point or non-point discharges. TCMC currently monitors numerical water quality, conducts WET testing at NPDES discharges (WET testing has not occurred on S. Creek or the Salmon River as those outfalls have not discharged, but would be required under the existing NPDES permit if/when discharge occurs), and conducts biological monitoring on Thompson and S. Creeks. As a result, if future discharge shows additive toxicity, it is likely to be detected during monitoring which will trigger adaptive management.

Although Phase 8 does not include new surface disturbance that changes the potential for sediment delivery to streams, the additional Mine life will require the water management system to function during operation for approximately nine additional years. As a result, there is also the possibility of effects to bull trout and designated critical habitat if upsets in the water management system occur at any point in time. Upsets could include temporary increases in sediment and/or contaminants downstream of the Mine facilities if a flood event occurs that is greater than design capacity of the water management facilities (most facilities are design to handle a 500 year flood event). Upsets could also include an accidental release of contaminants if problems occur with the water collection system. In the case of sediment, a pulse of sediment from a flood event greater than design capacity would lead to a decline in habitat quality and possibly spawning habitat, but the effects would likely be negligible to minor. Impacts of any flood related release of sediment would be mitigated by Thompson Creek also being at flood state with elevated sediment loads from natural conditions outside the Mine water management area.

In the case of upsets to the water collection system, if an accidental release of contaminants to Thompson Creek from Buckskin Creek or Pat Hughes Creek were to occur, it would have the greatest potential for impacts to Thompson Creek when stream flow in Thompson Creek is less than 7 cfs. When stream flow in Thompson Creek is greater than 7 cfs, there is sufficient flow to dilute inflows from Buckskin Creek with high selenium concentrations (currently water from Buckskin Creek is only discharged when stream flow in Thompson Creek is above approximately 7 cfs, which has resulted in lower selenium levels). At low flows (i.e., less than 7 cfs in Thompson Creek), upsets in the water management system are much less likely to occur (relative to high flow events greater than design capacity). Further, from 2000 to 2004, water was discharged to Thompson Creek during low flow, which led to selenium levels equal to or greater than the CCC of 5.0 µg/L at site TC3. This did have adverse effects to bull trout designated critical habitat. However, as discussed above, bull trout were not likely to be present in Thompson Creek during low flows, and effects to fish under that scenario (from both selenium and any other constituents present) would be **discountable**. As a result, it is expected that if there were a temporary event due to a malfunction during the most likely period of impact (stream flow less than 7 cfs), the effects would likely be similar. Furthermore, although the proposed action will result in longer Mine life and additional time in operation, the water management system will essentially function in perpetuity under both Phase 7 and Phase 8. As a

result, the proposed action does not appreciable increase the risk of any of the potential upsets discussed or the potential for adverse effects to occur to bull trout and its designated critical habitat.

Outfalls 001 and 002 Mixing Zones

Surface water flows from Pat Hughes Creek will be diverted to the mill for use (during operation) or to the pit and water treatment plant before discharge to the Salmon River (post closure). Surface water from Buckskin Creek will also be diverted to the mill (during operation) or pit (post closure). Discharge from outfalls 001 and 002 has not occurred in the last 2.5 years (Assessment, p. 71) and the outfalls are not expected to be used in the foreseeable future (Gardner 2015, pers. comm.), but the Mine could discharge from outfall 001 in the future if water quality (of both the receiving and discharge water) and flow conditions (flow > 7 cfs in Thompson Creek) are met. Discharge from outfalls 001 and 002 creates mixing zones in Thompson Creek. Mixing zones are defined as a limited area or volume of water where the discharge plume is progressively diluted by the receiving water. Water quality criteria may be exceeded in the mixing zone as long as chronically and acutely toxic conditions are prevented from occurring outside the mixing zone (EPA 2014).

Within the mixing zones of outfalls 001 and 002, contaminants may be present at concentrations that exceed the acute and chronic criteria. The concerns for the level of toxicity in the mixing zones are as follows:

- Even if toxicity of the mixing zone is at a sub-lethal level, repeat short-term exposures could result in adverse effects to adults and juveniles.
- Elevated concentrations of trace elements could affect macroinvertebrate populations potentially reducing the prey base for bull trout.
- Additionally, the elevated concentrations of trace elements may preclude bull trout use of the area (avoidance) resulting in a loss of habitat.

Therefore, effects of discharge from outfalls 001 and 002 in Thompson Creek are **likely to adversely affect** PCEs 2, 3, and 8 of bull trout designated critical habitat.

Outfall 001 rarely discharges (there has been no discharge at this point in 2.5 years; Assessment, p. 70), but were it to occur it would typically be in the spring when snowmelt runoff and high flow would dilute the contributions from both residual seepage from the WRSFs and discharge associated with TCMC's NPDES permit. Bull trout do not occupy Buckskin or Pat Hughes Creeks. Also, bull trout are unlikely to be present in the affected area because of low stream flows from late September to March, unsuitable temperatures from June until October (Assessment, p.44), and a physical barrier near the mouth of Thompson Creek which would affect fish passage during low flows and could restrict fluvial bull trout movements into Thompson Creek. Temperature data for Thompson Creek presented in the Assessment (p. 44) indicates temperatures well above optimum temperatures for bull trout spawning or holding. Additionally, survey data collected over the last 33 years (Assessment, p. 30) indicates a low

probability of bull trout presence in Thompson Creek. For these reasons, effects from discharge from outfalls 001 and 002 in Thompson Creek are expected to be **discountable** to bull trout.

b. Effects of the Proposed Action to Thompson Creek during Early Closure and Late-Post Closure

Effects of Thompson Creek during Early and Late-Post Closure are the same as those which occur during Phase 8, as discussed above. As a result, those effects will take place for the life of the Mine and have been considered in the previous section.

4. Effects of the Proposed Action to S. Creek

As discussed above the upper estimates of water quality will be used to evaluate effects of the proposed action to S. Creek. The effects of the Proposed Action to S. Creek vary for Phase 8, Early Closure, and have **no effect** during Late-Post Closure.

a. Effects of the Proposed Action to S. Creek during Phase 8

The expected changes to water quantity and quality under the proposed action that will occur during Phase 8 operations are a result of increased residual seepage.

• An increase in stream flow in S. Creek (approximately 0.02 cfs relative to current conditions) due to increased residual seepage to Redbird Creek

• A continuation of the diversion of Bruno Creek upstream of the TSF for approximately an additional nine years

Within S. Creek, during Phase 8, tailings drainage will remain dominated by seepage from the TSF impoundment. Chemistry of the tailings impoundment seepage has been stable since 2001, and it is expected to remain the same during Phase 8 (Assessment, p. 76). Seepage from the TSF will continue to be collected in drains under the embankment and the sump and pump-back system downstream of the Sediment Retention Dam (SRD). Water collected will be returned to the mill for use. Water quality during Phase 8 operation is expected to remain similar to current water quality. Residual seepage from the impoundment to Redbird Creek will continue and increase by approximately 10 gpm relative to existing conditions (to approximately 45 gpm). However, this is expected to have little effect on water quality in S. Creek as loadings through Redbird Creek are expected to be limited to sulfate and chloride. Given stream flows in Redbird Creek (not occupied by bull trout), dilution of sulfate and chloride is expected to reduce concentrations to levels below those documented to cause effects (Assessment, p. 94) before the confluence of Redbird Creek and S. Creek. As a result, **insignificant** effects to bull trout are expected from the changes to water quality in S. Creek from TSF seepage (approximately 0.02 cfs) during Phase 8. In S. Creek the effect of the proposed action during Phase 8 will result in minor increases in stream flow (approximately 0.02 cfs from seepage into Redbird Creek). The 0.02 cfs increase in flow is anticipated to have **insignificant** effects to bull trout and their critical habitat.

During Phase 8, Bruno Creek will continue to be diverted above the TSF for approximately an additional nine years. The current diversion is addressed in the *Status of Bull Trout in the Action Area* section, but as described in the *Proposed Action* section of this Opinion the extension of Mine life for an additional nine years is part of the action being consulted on. Therefore, the Service has addressed the potential effects of the reduction in flow to S. Creek as a result of the proposed action. The presence of two sediment ponds substantially modifies the lower reach of Bruno Creek. The sediment ponds result in increased water temperatures because only the top layer of the captured water is permitted to flow through the system. As a result, the Service expects a reduction in flow of 1 cfs to likely result in an immeasurable change to water temperature in S. Creek. Further, bull trout are not expected to be present during low flows in S. Creek when the diverted flow from Bruno Creek could have the greatest measureable effect. During higher flows in S. Creek (100 to 154 cfs May to June), the effect of the additional 1 cfs from Bruno Creek on bull trout and their critical habitat is anticipated to be immeasurable. Therefore, the effects to S. Creek during Phase 8 from the diversion of Bruno Creek, are expected to be **insignificant** to bull trout and their designated critical habitat.

b. Effects of the Proposed Action to S. Creek during Early Closure

The expected changes to water quantity and quality under the Proposed Action that will occur during Early Closure operations include:

• Increased flow (approximately 1.0 cfs) to Bruno Creek and S. Creek as upper Bruno Creek will no longer be diverted to the mill. This will increase flow in S. Creek despite a slight decrease in flow (less than 0.01 cfs) to Redbird Creek during Early Closure (years 1-6) due to decreased seepage from the TSF.

• Decreased S. Creek water quality for the Early Closure phase due to continued seepage to Redbird Creek from the TSF. Estimates for concentrations are predicted to increase under both flow scenarios for sulfate, arsenic, cobalt, copper, iron, manganese, nickel, uranium, and zinc.

<u>Predicted Water Quantity for S. Creek</u>
During Early Closure Bruno Creek will no longer be diverted for use in Mine activities. Instead Bruno Creek will be reclaimed and flow reconnected with the lower reach of Bruno Creek. This is expected to return 1 cfs to Bruno Creek and transitively to S. Creek. The presence of two sediment ponds substantially modifies the lower reach of Bruno Creek. The sediment ponds result in increased water temperatures because only the top layer of the captured water is permitted to flow through the system. As a result the Service expects the 1 cfs increase in flow to likely result in an immeasurable change to water temperature in S. Creek. Bull trout are not expected to be present during low flows in S. Creek when the increase in flow from Bruno Creek could have the greatest measurable effect. During higher flows in S. Creek (100 to 154 cfs May to June), the effect of the additional 1 cfs from Bruno Creek on bull trout and their critical habitat is anticipated to be immeasurable. As a result Increases in stream flow in S. Creek (Assessment p. 92), are likely to have **insignificant** effects to the low density of bull trout and PCE 1 of designated critical habitat.

Predicted Water Quality for S. Creek

The potential effects of all constituents analyzed for S. Creek are similar to the discussion done for Thompson Creek during Phase 8 operations and is provided below. However, bull trout are unlikely to be present in the affected area because of low stream flows from late September to March, unsuitable temperatures from June until October (Assessment, p. 54), and diversions at the confluence with the Salmon River which would affect fish passage during low flows and could restrict fluvial bull trout movements into S. Creek. Temperature data for S. Creek presented in the Assessment (p. 54) indicates temperatures well above optimum temperatures for bull trout spawning or holding. Additionally, survey data collected over the last 33 years (Assessment, p. 30) indicates a low probability of bull trout presence in S. Creek. For these reasons, effects from seepage from the TSF in S. Creek are expected to be **discountable** to bull trout. The following analysis considers the effects of constituents from TSF seepage loaded into S. Creek on bull trout designated critical habitat.

Tables 10 and 11 show the water quality predictions made for anticipated levels for both Phase 7 and as a result of the proposed action (Phase 8) for the Early Closure scenario. Predicted concentrations of sulfate, arsenic, cobalt, copper, iron, manganese, nickel, uranium, and zinc are greater than baseline concentrations under at least one of the scenarios. The mechanism for increases under the Early Closure scenario is the increased flow to S. Creek through Redbird Creek and using the estimates from the TSF main drain for the quality of the water delivered through Redbird Creek (which is of poorer quality than the water currently discharging and expected to discharge during Early Closure as a result of the proposed action. Phase 7 is shown to provide context to the Phase 8 predictions, i.e., which constituents are predicted to increase relative to Phase 7 predictions. As can be seen, the predicted concentrations are largely similar between Phase 7 and Phase 8 predictions.

Table 10. Predicted water quality in S. Creek during Early Closure (years 1-6) – annual low flow

Parameter[1]	Unit	Baseline SQ2 - 95th [2,3]	Criteria (CCC/Human Health)[4]	S. Creek Water Quality - Early Closure (years 1-6) at *Annual* Low Flow			
				Phase 7		Phase 8	
				Best Estimate	Upper Estimate	Best Estimate	Upper Estimate
SO_4	mg/L	75		**85**	**86**	**88**	**89**
Al	µg/L	26		26	26	26	26
As	µg/L	0.96	150	**0.98**	**1**	**0.98**	**1.01**
Cd[5]	µg/L	0.05	0.53	0.05	0.05	0.05	0.05
Co	µg/L	0.14		**0.18**	**0.18**	**0.19**	**0.19**
Cu[5]	µg/L	0.53	10.1	0.53	**0.57**	0.53	**0.58**
Fe	µg/L	30		**50**	**60**	**56**	**69**
Pb[5]	µg/L	0.1	2.2	0.1	0.1	0.1	0.1
Mn	µg/L	2.5		**41**	**42**	**52**	**53**
Mo	µg/L	2.8		2.8	2.8	2.8	2.8
Ni[5]	µg/L	1.3	46	**1.4**	**1.4**	**1.5**	**1.5**
Se	µg/L	1	5	1	1	1	1
U	µg/L	1		1	**1.1**	**1.1**	**1.1**
Zn[5]	µg/L	2.5	105	2.5	**2.6**	**2.6**	**2.6**

Source: Lorax 2012a. **Bold** values increase relative to baseline concentrations.
[1] Dissolved metal data were used for all metals except selenium; the selenium guideline applies to the total fraction.
[2] Receiving water quality is the 95th percentile at SQ2 (downstream of Bruno Creek) from low flow months 2000-2010 as reported in Lorax (2012a.)
[3] Baseline water quality is the same as the receiving water for S. Creek, as Lorax used the downstream site for the receiving water.
[4] Lowest of the two criteria where both exist
[5] Criteria for these metals are hardness dependent. Criteria is based on the 5th percentile hardness at SQ2 (87 mg/L) for low flow months 2000-2010.

Table 11. Predicted water quality in S. Creek during Early Closure (years 1-6) – 7Q10

Parameter[1]	Unit	Baseline SQ2 - 95th [2,3]	Criteria (CCC/Human Health)[4]	S. Creek Water Quality - Early Closure (years 1-6) at 7Q10 Flow			
				Phase 7		Phase 8	
				Best Estimate	Upper Estimate	Best Estimate	Upper Estimate
SO_4	mg/L	75		**94**	**96**	**100**	**102**
Al	µg/L	26		26	26	26	26
As	µg/L	0.96	150	**0.99**	**1.04**	**1**	**1.06**
Cd[5]	µg/L	0.05	0.53	0.05	0.05	0.05	0.05
Co	µg/L	0.14		**0.21**	**0.22**	**0.23**	**0.24**
Cu[5]	µg/L	0.53	10.1	0.53	**0.61**	0.53	**0.63**
Fe	µg/L	30		**70**	**90**	**81**	**107**
Pb[5]	µg/L	0.1	2.2	0.1	0.1	0.1	0.1
Mn	µg/L	2.5		**79**	**81**	**100**	**103**
Mo	µg/L	2.8		2.8	2.8	2.8	2.8
Ni[5]	µg/L	1.3	46	**1.5**	**1.5**	**1.6**	**1.6**
Se	µg/L	1	5	1	1	1	1
U	µg/L	1		**1.1**	**1.1**	**1.1**	**1.1**
Zn[5]	µg/L	2.5	105	**2.6**	**2.7**	**2.6**	**2.8**

Source: Lorax 2012a. **Bold** values increase relative to baseline concentrations.
[1] Dissolved metal data were used for all metals except selenium; the selenium guideline applies to the total fraction.
[2] Receiving water quality is the 95th percentile at SQ2 (downstream of Bruno Creek) from low flow months 2000-2010 as reported in Lorax (2012a.)
[3] Baseline water quality is the same as the receiving water for S. Creek, as Lorax used the downstream site for the receiving water.
[4] Lowest of the two criteria where both exist
[5] Criteria for these metals are hardness dependent. Criteria is based on the 5th percentile hardness at SQ2 (87 mg/L) for low flow months 2000-2010.

Aluminum

Seepage into S. Creek resulting from the proposed action is not expected to increase aluminum concentrations during Early Closure (Assessment, p. 77). Predicted aluminum concentrations from seepage into S. Creek are below EPA's National Water Quality Criteria (750 µg/L, acute and 87µg/L). In circumneutral waters (pH 5.5 – 7.5) aluminum is considered relatively innocuous (Assessment, p. 77). Because pH in S. Creek is great than 5.5, effects during Early Closure to bull trout designated critical habitat are expected be **insignificant**.

Arsenic

Although waterborne arsenic has been shown to affect the survival of embryos of listed salmonids at concentrations as low as 42 µg/L, bull trout do not spawn in S. Creek within the action area. Behavioral effects have been shown to occur in non-salmonids (zebrafish) at concentrations as low as 1 µg/L (Assessment, p. 95). However, it appears that arsenic in the diet has the greatest potential to adversely impact listed salmonids through ingestion of contaminated macroinvertebrates.

Several studies summarized in NMFS (2014) showed reduced growth, organ damage or other physiological effects at concentrations in the diet of approximately 20 mg/kg dry weight. Due to the potential for arsenic to bioaccumulate in macroinvertebrates, concentrations higher than 20 mg/kg in macroinvertebrates have been documented in streams with arsenic concentrations in water of around 5 µg/L. However, other studies have shown dissolved concentrations in water ranging from 0.5-7.0 µg/L to have arsenic in invertebrate tissue of only 0.5-2.0 mg/kg. As a result, it is unclear if the estimated concentrations predicted for S. Creek of 1.01-1.06 µg/L could result in high dietary concentrations of arsenic. Although it appears that there is at least the potential for this to occur, NMFS (2014) considered the Idaho recreational use criteria of 10 µg/L as an alternative to protect aquatic life until a new chronic aquatic life criterion is established. Based on predicted concentrations in S. Creek during Early Closure as compared against the recreational use criteria and concentrations described above shown to cause effects, effects to bull trout designated critical habitat would be **insignificant**.

Cadmium

Predicted cadmium concentrations under the Early Closure scenario are the same as the baseline concentration. Consequently, there would be **no effect** to bull trout designated critical habitat from cadmium.

Cobalt

No aquatic life criteria exist for cobalt in EPA's National Recommended Water Quality Criteria. However, all predicted concentrations in S. Creek are below the lowest chronic value for aquatic organisms (i.e., the chronic value that is likely to be protective of all forms of aquatic life, not just salmonids) of 23 µg/L that is frequently used in ecological risk assessments (Assessment, p. 89). The upper estimate is also below the toxicity reference value for salmonids of 38 µg/L that was used to analyze the effects of cobalt on aquatic life in the Panther Creek watershed (tributary to the Salmon River, approximately 25 miles west of Salmon, Idaho; Assessment, p. 89). Because the predicted concentrations are well below the values discussed above, effects from cobalt concentrations in S. Creek, are **insignificant** to bull trout designated critical habitat.

Copper

The toxicity of copper to aquatic organisms is dependent on the speciation of the chemical, water hardness, and type and life stage of the exposed organisms. The Assessment states (p.90) that a 1978 study found that the 96-hour LC50 (the concentration that is lethal to 50 percent of the organisms) for steelhead was as low as 17 µg/L for steelhead parr and 19 µg/L for Chinook salmon swim-ups. These results would suggest that the Early Closure estimate during 7Q10 flows will have an insignificant effect on any life stages of fish species present in S. Creek (hardness was 22-67 mg/L), although the study did not test bull trout. NMFS (2014) reports an LC50 for Chinook salmon as low as 7.4 µg/L (hardness of 35 mg/L), however the upper estimate for the 7Q10 flow in Early Closure is well below this level. Therefore, effects from the proposed action in S. Creek are expected to be **insignificant** to bull trout designated critical habitat.

Iron

The EPA's National Recommended Water Quality Criteria has a recommended chronic criterion (there is no recommended acute criteria) of 1000 µg/L. Suter and Tsao (1996) report a low end chronic value for aquatic organisms of 158 µg/L, which is the lowest chronic value for daphnids.

The lowest chronic value reported for fish in Suter and Tsao (1996) is 1300 µg/L. Similar to aluminum, toxicity of iron is highest in acid conditions (Assessment, p. 90). Iron may also impact fish indirectly by altering the physical characteristics and quality of benthic habitats, which can reduce macroinvertebrate populations (Assessment, p. 90). However, the lowest iron concentrations reported to affect macroinvertebrates through substrate impacts was 200 µg/L. Because the predicted estimates in S. Creek are well below all values discussed here, and because the pH of S. Creek is circumneutral, effects to bull trout designated critical habitat would be **insignificant**.

Lead

The available data on lead toxicity indicates that the thresholds for both acute and chronic effects to benthic invertebrates and salmonids occur at lead concentrations well above water quality criteria (Assessment, p. 90). The exception is for snails and the amphipod *Hyalella azteca,* with studies showing that these organisms may be adversely affected at sub-criteria concentrations (Assessment, p. 90). However, because of their varied diet, bull trout are not expected to be dependent upon snails or amphipods for food, and are unlikely to be adversely affected at concentrations below the criteria. As all concentrations that are predicted for S. Creek are well below the NMFS (2014) criteria, effects of lead in S. Creek would be **insignificant** to bull trout designated critical habitat.

Manganese

Using the British Columbia guideline discussed for Thompson Creek (Assessment, p. 89), the criteria for manganese is 988 µg/L for S. Creek. This criteria is well above the maximum concentration predicted of 103 µg/L for S. Creek. Because the predicted concentration is well below the guideline, and because the guideline was derived from the lowest observed effect concentration with a 4:1 safety factor, the effect of manganese to bull trout designated critical habitat in S. Creek would be **insignificant**.

Molybdenum

Several studies have shown salmonids to be relatively unaffected by molybdenum concentrations, with 96-hour LC50s as high as 1000 mg/L (1,000,000 µg/L) for coho and Chinook salmon (Assessment, p. 96). Several tests on molybdenum effects to rainbow trout fry in British Columbia showed no observed effect concentrations and lowest observed effect concentrations greater than 30 mg/L (30,000 µg/L; Assessment, p. 96) Maximum concentrations of 2.8 µg/L are predicted in S. Creek. Given predicted concentrations of molybdenum are below the concentrations documented to cause affects (presented above), the effect of molybdenum in S. Creek would be **insignificant** to bull trout designated critical habitat.

Nickel

NMFS (2014) noted a wide range in the toxicity values reported for nickel in the literature. The lowest concentration noted to have had adverse effects was 11 µg/L (hardness was not reported). The studies reviewed suggested that concentrations causing no or few effects to macroinvertebrates would be in the 20-70 µg/L range (in hard or soft water). With maximum predicted concentrations of 8.8 µg/L in S. Creek, effects of nickel in S. Creek would be **insignificant** to bull trout designated critical habitat.

Selenium

Maximum predicted concentrations of selenium in S. Creek are 1.0 µg/L. Although the predicted concentrations are less than the selenium criterion, there are concerns over bioaccumulation as has been discussed for Thompson Creek in the Assessment (p. 97). NMFS (2014) determined that if water concentrations are near the 5 µg/L indefinitely, selenium is likely to bioaccumulate to levels high enough to result in effects to listed salmonids. However, with water concentrations less than 2 µg/L there is a low risk for bioaccumulation to levels high enough to result in adverse effects (at concentrations greater than 2 µg/L they recommended fish tissue monitoring to evaluate bioaccumulation). Because predicted concentrations are less than 2 µg/L in S. Creek, the effect of selenium in S. Creek would be **insignificant** to bull trout designated critical habitat.

Sulfate

Some states (namely Pennsylvania and Illinois) have developed or proposed sulfate criteria for the protection of aquatic life. Essentially, sulfate is a negative ion that is often considered as one of the primary contributors to total dissolved solids (i.e., salts). High TDS can disrupt an organism's normal ion exchange process and cause stress or death. Determination of sulfate toxicity is thus related to the presence of other major ions, and some work indicates that it is driven by both hardness and chloride concentrations (Assessment, p. 94). The most stringent of the previous Illinois aquatic life criteria and the proposed Pennsylvania aquatic life criteria is 500 mg/L (for both acute and chronic). The related toxicity studies focused on flea, amphipod, fly, clam, and mussel organisms, rather than fish. However, 500 mg/L is well above the maximum concentrations predicted (102 mg/L for S. Creek). Given predicted concentrations are well below the criteria discussed above, the effect of sulfate in S. Creek would be **insignificant** to bull trout designated critical habitat.

Uranium

Currently, there are no aquatic life criteria for uranium in EPA's National Recommended Water Quality Criteria. However, the Canadian government has established fresh water ambient water quality guidelines for uranium to protect aquatic life (Assessment, p. 90). They note that uranium bioaccumulates, but does not biomagnify; the guideline does not account for bioaccumulation. The long term (chronic) freshwater aquatic life guideline was modeled using 13 different species for which appropriate data were available, taking account of the most sensitive life stages and endpoints for each, then taking the 5th percentile of the results as the guideline. The resultant concentration in the guideline is 15 µg/L. The guideline reflects a much greater sensitivity for invertebrates than fish, which had endpoints at concentrations up to several orders of magnitude higher. Maximum predicted concentrations of 4.9 µg/L for S. Creek are lower than the Canadian guideline of 15 µg/L. As such, the effect of uranium in S. Creek would be **insignificant** to bull trout designated critical habitat.

Zinc

NMFS (2014) found that avoidance reactions to zinc have been reported as low as 47 µg/L at a hardness of 112 mg/L. For S. Creek, the maximum predicted concentration under the upper estimate for the Early Closure scenario is 2.8 µg/L, which is below the lowest values reported for behavioral effects (Assessment, p. 90). As a result, behavioral effects are not expected due to

zinc exposure in S. Creek under upper estimate predictions. As such, the effect from zinc in S. Creek is likely to be **insignificant** to bull trout designated critical habitat.

As described above in the section addressing predicted water quality for Thompson Creek (pp. 64-65), mixtures of metals can have interactive effects leading to toxicity at lower or higher levels than from a single metal alone. Because the constituent concentrations in S Creek are predicted to be well below concentration levels found to cause effects, the Service does not anticipate adverse effects to bull trout designated critical habitat. However, TCMC currently conducts water quality and biological monitoring on S Creek (Assessment, p. 19); if future discharge shows additive toxicity, it is likely to be detected during monitoring, which will trigger adaptive management.

c. Effects of the Proposed Action to S. Creek during Late-Post Closure

Under Late-Post Closure, predicted chemistry in S. Creek is the same for Phase 7 as predicted for Phase 8 (Assessment, p. 78). This is because the water quality estimates are driven by assumptions of the tailings embankment becoming acidic and estimated hydraulic conductivities and gradients of groundwater flows that are independent of the additional material to be added to the TSF under Phase 8. Table 12 presents predictions for both Phase 7 and Phase 8 under the Late-Post Closure scenario. Predicted concentration of all constituents except molybdenum and selenium (not greatly influenced by pH) are greater than baseline concentrations, with predicted concentration of cadmium greater for the upper estimate during annual low flow and both estimates during 7Q10 flow. However, those increases in constituent levels are a result of private actions which have taken place without a Federal nexus for consultation.

As a result of the previously conducted private action, adverse effects to bull trout and their designated critical habitat are expected to occur. Effects to bull trout and its designated critical habitat from the proposed action during Late-Post Closure are not anticipated to occur in S. Creek.

Table 12. Predicted water quality in S. Creek during Phase 7 and Phase 8 Late Closure

Parameter[1]	Unit	Baseline SQ2 - 95th [2,3]	Criteria (CCC/Human Health)[4]	S. Creek Water Quality Long-term Closure (years 6+)			
				Phase 7/8 *Annual* Low Flow		Phase 7/8 *7Q10* Flow	
				Best Estimate	Upper Estimate	Best Estimate	Upper Estimate
SO_4	mg/L	75		77	79	79	82
Al	µg/L	26		40	54	54	82
As	µg/L	0.96	150	0.98	1	1	1.03
Cd[5]	µg/L	0.05	0.53	0.32	0.59	0.58	1.11
Co	µg/L	0.14		0.53	0.92	0.92	1.7
Cu[5]	µg/L	0.53	10.1	2.22	3.92	3.89	7.25
Fe	µg/L	30		31	32	32	33
Pb[5]	µg/L	0.1	2.2	0.19	0.28	0.28	0.46
Mn	µg/L	2.5		25	47	47	91
Mo	µg/L	2.8		2.8	2.8	2.8	2.8
Ni[5]	µg/L	1.3	46	3.2	5.1	5.1	8.8
Se	µg/L	1	5	1	1	1	1
U	µg/L	1		2	3	2.9	4.9
Zn[5]	µg/L	2.5	105	14.1	25.7	25.5	48.5

Source: Lorax 2012a. **Bold** values increase relative to baseline concentrations. Highlighted values are > criteria

[1] Dissolved metal data were used for all metals except selenium; the selenium guideline applies to the total fraction.
[2] Receiving water quality is the 95th percentile at SQ2 (downstream of Bruno Creek) from low flow months 2000-2010 as reported in Lorax (2012a.)
[3] Baseline water quality is the same as the receiving water for S. Creek, as Lorax used the downstream site for the receiving water.
[4] Lowest of the two criteria where both exist
[5] Criteria for these metals are hardness dependent. Criteria is based on the 5th percentile hardness at SQ2 (87 mg/L) for low flow months 2000-2010.

5. Effects of the Proposed Action to the Salmon River

Effects of the proposed action to the Salmon River include an estimated increase in flow of 6.6 cfs and a decrease in water quality as a result of discharge from NPDES outfall 005.

a. Effects of the Proposed Action to the Salmon River during Phase 8

Elevated constituents from loading in Thompson Creek as addressed above will be delivered to the Salmon River. The increase in constituents is predicted to be elevated for the life of the Mine thus, will include the evaluation of effects to the Salmon during Phase 8, Early Closure and Late-Post Closure. The highest level of constituent loading in Thompson Creek has been sampled between the confluences of Buckskin and Pat Hughes Creeks with Thompson Creek. Lower levels of constituents have been sampled below the confluence of Pat Hughes Creek with Thompson Creek. As a result the Service assumes the level of constituents will dilute as

Thompson Creek moves toward the Salmon River. The remaining loaded constituents will be additionally diluted when the annual low flow (less than 7 cfs) of Thompson Creek meets the confluence of the Salmon River (less than 2000 cfs). The increase in flow will dilute the level of constituents such that they will be unmeasurable in the receiving waters. Thus, the effects of the constituent loading in Thompson Creek being delivered to the Salmon River during Phase 8, Early Closure and Late-Post Closure are expected to be **insignificant** to bull trout and their designated critical habitat.

As addressed in the Assessment (p. 62), the Mine is currently pumping water from the Salmon River using the system which will become outfall 005. While the current withdrawal is evaluated as part of the baseline conditions, the proposed action is anticipated to increase the duration of the effects of the action by approximately nine years. Thus, the effects to bull trout and their designated critical habitat from the withdrawal are considered for the increased duration. A conservative evaluation estimates that the Mine can operationally withdraw up to 4.5 cfs from the Salmon River. There is variability in the amount of anticipated use, with the Mine expected to withdraw from 0 to 1.29 cfs during Phase 8. The largest withdrawals are anticipated to occur during winter and spring, with the maximum anticipated withdrawal of 0.82 cfs occurring during February. However, because the Mine has the ability to operationally withdraw 4.5 cfs, the Service will evaluate the effects at the greatest possible rate of withdrawal. Withdrawals have the greatest potential for effects when the flows of the Salmon River are the lowest. The months with the lowest average flows are January, February, and September (USGS 2014). The monthly average withdrawal is approximately 1 percent of the total flow during those months. During the months of greatest potential change resulting from the withdrawal, water temperatures are expected to be within an appropriate range for bull trout survival. As a result of the average expected water temperature and the small percentage of the flow being removed, the potential change to temperature and flow is anticipated to have **insignificant** effects to bull trout and their designated critical habitat. Thus, effects of the withdrawal of water from the Salmon River during Phase 8 are expected to be **insignificant** to bull trout and their designated critical habitat.

b. Effects of the Proposed Action to the Salmon River during Early Closure

Elevated constituents from loading in S. Creek as addressed above will be delivered to the Salmon River. However, those constituents will be diluted when the annual low flow of S. Creek meets the confluence of the Salmon River. The increased flow will dilute the insignificant level of constituents, such that they will be immeasurable in the receiving waters. Thus, effects of the proposed action during Early Closure are expected to be **insignificant** to bull trout and their designated critical habitat.

c. Effects of the Proposed Action to the Salmon River during Late-Post Closure

The expected changes to water quantity and quality under the proposed action that will occur during Late-Post Closure operations include:

• Following closure and filling of the pit (approximately 70 years after closure), the discharge rate of treated water from the pit to the Salmon River is estimated to be approximately 2.1 cfs. Combined with water that will no longer be diverted from the Salmon River (beginning

immediately following closure or immediately upon cessation of milling) for use in the mill post closure (up to 4.5 cfs), the increase will be up to 6.6 cfs relative to baseline conditions, or up to 6.4 percent of the 7Q10 stream flow of 103 cfs.

• Decreased water quality in the Salmon River due to discharge from NPDES outfall 005 (beginning approximately 70 years after closure and continuing in perpetuity), in addition to water from Thompson Creek and S. Creek. Estimated concentrations during annual low flow are greater than baseline for sulfate, aluminum, cadmium, cobalt, manganese, selenium, and uranium. Under 7Q10 flow conditions, concentrations of these same metals would increase, as would molybdenum, nickel, zinc, and copper under the upper estimate.

Predicted Water Quantity

In the Salmon River the proposed action will result in minor increases in stream flow that are expected to have **insignificant** effects to bull trout and their critical habitat.

Predicted Water Quality

Salmon River water quality predictions are based on predictions from the Thompson and S. Creek analyses, as well as predictions of water quality and flow rate of treated Mine water (Assessment, p. 79) that will be discharged to the Salmon River at NPDES outfall 005 (Table 13). Outfall 005 is located in the center of the Salmon River, downstream of the confluence of Thompson Creek and the Salmon River. The size of the mixing zone is variable dependent on individual contaminants and the flow of the Salmon River, but length will not exceed 13 m from the discharge point, and width will not exceed 25 percent of the Salmon River. The treated Mine water discharge will not occur until approximately 70 years after closure; prior to that time, Mine water will simply collect in the open pit. As was done for Thompson Creek and S. Creek, water quality predictions (after full mixing) for both Phase 7 and Phase 8 are presented below in Tables 13 and 14. Late Closure S. Creek scenarios were used, because they are the conditions that would be in place by the time outfall 005 discharges begin. Predicted concentrations of many of the constituents increase (with the exceptions of arsenic, iron, and lead) under at least one of the scenarios.

Table 13. Predicted water quality in the Salmon River (after full mixing) during Phase 7 and Phase 8- annual low flow

Parameter[1]	Unit	Baseline SR1 - 95th [2]	Criteria (CCC/Human Health)[3]	Salmon River Water Quality *Annual* Low Flow[4]			
				Phase 7		Phase 8	
				Best Estimate	Upper Estimate	Best Estimate	Upper Estimate
SO_4	mg/L	9		**16.7**	**16.8**	**17**	**17.1**
Al	µg/L	10.2		**23**	**23.6**	**23.4**	**24.8**
As	µg/L	1.64	150	1.6	1.6	1.6	1.6
Cd[5]	µg/L	0.05	0.39	**0.06**	**0.07**	**0.06**	**0.07**
Co	µg/L	0.1		**0.15**	**0.16**	**0.15**	**0.18**
Cu[5]	µg/L	0.76	6.6	0.48	0.53	0.48	0.56
Fe	µg/L	90.4		31.3	31.3	31.3	31.3
Pb[5]	µg/L	0.09	1.3	0.06	0.06	0.06	0.06
Mn	µg/L	1.7		**20.8**	**21.6**	**21.4**	**23.2**
Mo	µg/L	3.14		3.1	3.1	3.1	3.1
Ni[5]	µg/L	0.82	30	0.7	0.75	0.7	0.75
Se	µg/L	1	5	**1.2**	**1.2**	**1.2**	**1.2**
U	µg/L	2		**2.2**	**2.2**	**2.2**	**2.2**
Zn[5]	µg/L	4.8	69	4.2	4.5	4.2	4.6

Source: Lorax 2012a. **Bold** values increase relative to baseline concentrations.
[1] Dissolved metal data were used for all metals except selenium; the selenium guideline applies to the total fraction.
[2] Baseline water quality is the 95th percentile at SR1 (downstream of S. Creek) from low flow months 2000-2010 as calculated from the Lorax WQ data
[3] Lowest of the two criteria where both exist
[4] Receiving water quality is the 95th percentile at SR3 (upstream of Thompson Creek) from low flow months 2007-2010 as reported in Lorax (2012a)
[5] Criteria for these metals are hardness dependent. Criteria is based on the 5th percentile hardness at SR1 (53 mg/L) for low flow months 2000-2010

Table 14. Predicted water quality in the Salmon River (after full mixing) during Phase 7 and Phase 8- 7Q10 flow

Parameter[1]	Unit	Baseline SR1 - 95th [2]	Criteria (CCC/Human Health)[3]	Salmon River Water Quality at 7Q10 Flow[4]			
				Phase 7		Phase 8	
				Best Estimate	Upper Estimate	Best Estimate	Upper Estimate
SO_4	mg/L	9		**35.6**	**35.8**	**36.5**	**36.8**
Al	µg/L	10.2		**56.1**	**58.4**	**57.6**	**62.9**
As	µg/L	1.64	150	1.6	1.6	1.6	1.6
Cd[5]	µg/L	0.05	0.39	**0.1**	**0.12**	**0.1**	**0.13**
Co	µg/L	0.1		**0.27**	**0.33**	**0.28**	**0.41**
Cu[5]	µg/L	0.76	6.6	0.64	**0.84**	0.65	**0.95**
Fe	µg/L	90.4		32.7	32.8	32.7	32.9
Pb[5]	µg/L	0.09	1.3	0.07	0.08	0.07	0.08
Mn	µg/L	1.7		**73.1**	**76.3**	**75.5**	**82.2**
Mo	µg/L	3.14		**3.6**	**3.6**	**3.6**	**3.6**
Ni[5]	µg/L	0.82	30	**0.9**	**1.08**	**0.9**	**1.09**
Se	µg/L	1	5	**1.7**	**1.7**	**1.7**	**1.7**
U	µg/L	2		**2.6**	**2.7**	**2.6**	**2.7**
Zn[5]	µg/L	4.8	69	**5.3**	**6.5**	**5.3**	**6.8**

Source: Lorax 2012a. **Bold** values increase relative to baseline concentrations.
[1] Dissolved metal data were used for all metals except selenium; the selenium guideline applies to the total fraction.
[2] Baseline water quality is the 95th percentile at SR1 (downstream of S. Creek) from low flow months 2000-2010 as calculated from the Lorax WQ data
[3] Lowest of the two criteria where both exist
[4] Receiving water quality is the 95th percentile at SR3 (upstream of Thompson Creek) from low flow months 2007-2010 as reported in Lorax (2012a)
[5] Criteria for these metals are hardness dependent. Criteria is based on the 5th percentile hardness at SR1 (53 mg/L) for low flow months 2000-2010

The potential effects of all constituents analyzed for the Salmon River, similar to the discussion provided for Thompson Creek during Phase 8 operations is provided below.

Aluminum

Discharge from outfall 005 into the Salmon River is expected to increase aluminum concentrations during Late-Post Closure (Assessment, p. 81). However, similar to the discussion for Aluminum in S. Creek, pH in the Salmon River is greater than 5.5; therefore, effects to bull trout and their designated critical habitat would be **insignificant**.

Arsenic

Although waterborne arsenic has been shown to affect the survival of embryos of listed salmonids at concentrations as low as 42 µg/L, bull trout do not spawn in the Salmon River. Further, behavioral effects have been shown to occur in non-salmonids (zebrafish) at concentrations as low as 1 µg/L (Assessment, p. 95). However, it appears that arsenic in the diet has the greatest potential to adversely impact listed salmonids through ingestion of contaminated macroinvertebrates.

Several studies summarized in NMFS (2014) showed reduced growth, organ damage or other physiological effects at concentrations in the diet of approximately 20 mg/kg dry weight. Due to the potential for arsenic to bioaccumulate in macroinvertebrates, concentrations higher than 20 mg/kg in macroinvertebrates have been documented in streams with arsenic concentrations in water of around 5 µg/L. However, other studies have shown dissolved concentrations in water ranging from 0.5-7.0 µg/L to have arsenic in invertebrate tissue of only 0.5-2.0 mg/kg. As a result, it is unclear if the predicted upper estimate concentrations predicted for the Salmon River outside of outfall 005 mixing zone of 1.01-1.06 µg/L could result in high dietary concentrations of arsenic. Although it appears that there is at least the potential for this to occur, NMFS (2014) considered the Idaho recreational use criteria of 10 µg/L as an alternative to protect aquatic life until a new chronic aquatic life criterion is established. Based on predicted concentrations in the Salmon River (during Late-Post Closure), as compared against the recreational use criteria and concentrations described above shown to cause effects, effects to bull trout and their designated critical habitat would be **insignificant**.

Cadmium

For the Salmon River, predicted concentrations of cadmium are below concentrations documented in the literature (and described in Thompson Creek cadmium section above) to result in effects. Therefore, effects from cadmium concentrations in the Salmon River, outside the outfall 005 mixing zone, are **insignificant** to bull trout and their designated critical habitat.

Cobalt

No aquatic life criteria exist for cobalt in EPA's National Recommended Water Quality Criteria. However, all predicted concentrations in the Salmon River, outside the outfall 005 mixing zone, are below the lowest chronic value for aquatic organisms (i.e., the chronic value that is likely to be protective of all forms of aquatic life, not just salmonids) of 23 µg/L that is frequently used in ecological risk assessments (Assessment, p. 89). The upper estimate is also below the toxicity reference value for salmonids of 38 µg/L that was used to analyze the effects of cobalt on aquatic life in the Panther Creek watershed (tributary to the Salmon River, approximately 25 miles west of Salmon, Idaho; Assessment, p. 89). Because the predicted concentrations are well below the values discussed above, effects from cobalt concentrations in the Salmon River, outside the outfall 005 mixing zone, are **insignificant** to bull trout and their designated critical habitat.

Copper

The toxicity of copper to aquatic organisms is dependent on the speciation of the chemical, water hardness, and type and life stage of the exposed organisms. The Assessment states that a 1978 study found the 96-hour LC50 (the concentration that is lethal to 50 percent of the organisms) for steelhead was as low as 17 µg/L for steelhead parr and 19 µg/L for Chinook salmon swim-ups. These results would suggest that even the upper estimate during 7Q10 may not result in lethal effects to any life stages of fish species present in the Salmon River (hardness was 22-67 mg/L versus 43 mg/L for Thompson Creek), although the study did not test bull trout. NMFS (2014) reports an LC50 for Chinook salmon as low as 7.4 µg/L (hardness of 35 mg/L). Copper can have other non-lethal effects to salmonids (Assessment, p. 87). These effects can include reduced growth and reduced olfactory function, which can interfere with behavior, migration, and impair the immune system (Assessment, p. 87). Reduced growth in laboratory tests is a common effect of copper exposure at levels below 5.5 µg/L, and can lead to reduced survival, particularly of

juvenile anadromous salmonids, during seaward migration (Assessment, p. 87). Sensory system effects are, however, more sensitive and may be affected at lower concentrations than growth. Several studies (Assessment, p.87) have shown that small increases in copper can impair olfactory function in coho salmon and steelhead, with only a short-term increase of 3.0 µg/L in copper concentrations (not hardness dependent). These effects can be at least partially reversible, although exposures lasting longer than four hours may take weeks to recover (Assessment, p. 87). Loss of olfactory function can subsequently influence feeding, predator avoidance, and migration (Assessment, p. 87). For example, Hecht et al. (2007) found that increases of 0.18 to 2.1 µg/L above background copper concentrations corresponded in reductions in predator avoidance behavior of approximately 8 to 57 percent. Furthermore, exposure to sub-lethal levels of copper can increase fish stress, which subsequently increases both infection and mortality rates (Assessment, p. 87).

Concentrations of copper predicted for the Salmon River, outside the mixing zone, are below those described above reported to cause adverse effects. Therefore, effects from exposure to copper in the Salmon River outside the mixing zone are **insignificant** to bull trout and their designated critical habitat.

Iron

The EPA's National Recommended Water Quality Criteria has a recommended chronic criterion (there is no recommended acute criteria) of 1000 µg/L. Suter and Tsao (1996) report a low end chronic value for aquatic organisms of 158 µg/L, which is the lowest chronic value for daphnids. The lowest chronic value reported for fish in Suter and Tsao (1996) is 1300 µg/L. Similar to aluminum, toxicity of iron is highest in acid conditions (Assessment, p. 90). Iron may also impact fish indirectly by altering the physical characteristics and quality of benthic habitats, which can reduce macroinvertebrate populations (Assessment, p. 90). However, the lowest iron concentrations reported to affect macroinvertebrates through substrate impacts was 200 µg/L. Because the predicted estimates in the Salmon River outside the mixing zone are well below all values discussed here, and because the pH of the Salmon River is circumneutral, effects to bull trout and their designated critical habitat would be **insignificant**.

Lead

The available data on lead toxicity indicates that the thresholds for both acute and chronic effects to benthic invertebrates and salmonids occur at lead concentrations well above water quality criteria (Assessment, p. 90). The exception is for snails and the amphipod Hyalella Azteca, with studies showing that these organisms may be adversely affected at sub-criteria concentrations (Assessment, p. 90). However, because of their varied diet, bull trout are not expected to be dependent upon snails or amphipods for food, and are unlikely to be adversely affected at concentrations below the criteria. As all concentrations that are predicted for the Salmon River outside the mixing zone are well below the NMFS (2014) criteria, effects of lead exposure to bull trout in the Salmon River outside the mixing zone would be **insignificant** to bull trout and their designated critical habitat.

Manganese

Using the British Columbia guideline discussed for Thompson Creek above (Assessment, p. 89), the criteria for manganese is 838 µg/L for the Salmon River. Because the predicted

concentration of 82.2 µg/L for the Salmon River is well below the guideline, and because the guideline was derived from the lowest observed effect concentration with a 4:1 safety factor, effects of manganese exposure to bull trout in the Salmon River outside the mixing zone would be **insignificant** to bull trout and their designated critical habitat.

Molybdenum

Several studies have shown salmonids to be relatively unaffected by molybdenum concentrations, with 96-hour LC50s as high as 1000 mg/L (1,000,000 µg/L) for coho and Chinook salmon (Assessment, p. 90). Several tests on molybdenum effects to rainbow trout fry in British Columbia showed no observed effect concentrations and lowest observed effect concentrations greater than 30 mg/L (30,000 µg/L; Assessment, p. 90). Maximum concentrations of 3.6 µg/L are predicted in the Salmon River, outside the mixing zone. Given predicted concentrations of molybdenum are below the concentrations documented to cause affects (presented above), effects of molybdenum exposure to bull trout in the Salmon River outside the mixing zone would be **insignificant** to bull trout and their designated critical habitat.

Nickel

NMFS (2014) noted a wide range in the toxicity values reported for nickel in the literature. The lowest concentration noted to have had adverse effects was 11 µg/L (hardness was not reported). The studies reviewed suggested that concentrations causing no or few effects to macroinvertebrates would be in the 20-70 µg/L range (in hard or soft water). With maximum predicted concentrations of 1.09 µg/L in the Salmon River outside the mixing zone, effects of nickel exposure to bull trout the Salmon River outside the mixing zone would be **insignificant** to bull trout and their designated critical habitat.

Selenium

Maximum predicted concentrations of selenium in the Salmon River are 1.7 µg/L. Although the predicted concentrations are less than the selenium criterion, there are concerns over bioaccumulation as has been discussed for Thompson Creek in the Assessment (p. 97). NMFS (2014) determined that if water concentrations are near the 5 µg/L indefinitely, selenium is likely to bioaccumulate to levels high enough to result in effects to listed salmonids. However, with water concentrations less than 2 µg/L there is a low risk for bioaccumulation to levels high enough to result in adverse effects (at concentrations greater than 2 µg/L they recommended fish tissue monitoring to evaluate bioaccumulation). Because predicted concentrations are less than 2 µg/L in the Salmon River outside the mixing zone, effects of selenium exposure to bull trout in the Salmon River outside the mixing zone would be **insignificant** to bull trout and their designated critical habitat.

Sulfate

Some states (Pennsylvania and Illinois) have developed or proposed sulfate criteria for the protection of aquatic life. Essentially, sulfate is a negative ion that is often considered as one of the primary contributors to total dissolved solids (i.e., salts). High TDS can disrupt an organism's normal ion exchange process and cause stress or death. Determination of sulfate toxicity is thus related to the presence of other major ions, and some work indicates that it is driven by both hardness and chloride concentrations (Assessment, p. 94). The most stringent of the previous Illinois aquatic life criteria and the proposed Pennsylvania aquatic life criteria is 500

mg/L (for both acute and chronic). The related toxicity studies focused on flea, amphipod, fly, clam, and mussel organisms, rather than fish. However, 500 mg/L is well above the maximum concentrations predicted (36.8 mg/L for the Salmon River). Given predicted concentrations are well below the criteria discussed above, effects of sulfate exposure to bull trout in the Salmon River outside the mixing zone would be **insignificant** to bull trout and their designated critical habitat.

Uranium

Currently, there are no aquatic life criteria for uranium in EPA's National Recommended Water Quality Criteria. However, the Canadian government has established fresh water ambient water quality guidelines for uranium to protect aquatic life (Assessment, p. 89). They note that uranium bioaccumulates, but does not biomagnify; the guideline does not account for bioaccumulation. The long term (chronic) freshwater aquatic life guideline was modeled using 13 different species for which appropriate data were available, taking account of the most sensitive life stages and endpoints for each, then taking the 5th percentile of the results as the guideline. The resultant concentration in the guideline is 15 µg/L. The guideline reflects a much greater sensitivity for invertebrates than fish, which had endpoints at concentrations up to several orders of magnitude higher. Maximum predicted concentrations of 2.7 µg/L for the Salmon River are lower than the Canadian guideline of 15 µg/L. As such, effects of uranium exposure to bull trout in the Salmon River outside the mixing zone would be **insignificant** to bull trout and their designated critical habitat.

Zinc

NMFS (2014) found that avoidance reactions to zinc have been reported as low as 47 µg/L at a hardness of 112 mg/L. In the Salmon River, the maximum predicted concentration for zinc is 6.8 µg/L. Because this value is much lower than those reported in NMFS (2014) to cause effect, behavioral effects from zinc exposure in the Salmon River are unlikely. Therefore, effects of zinc exposure to bull trout in the Salmon River outside the mixing zone would be **insignificant** to bull trout and their designated critical habitat.

As described above in the section addressing predicted water quality for Thompson Creek (pp. 64-65), mixtures of metals can have interactive effects leading to toxicity at lower or higher levels than from a single metal alone. Because the constituent concentrations in the Salmon River outside the mixing zone are predicted to be well below concentration levels found to cause effects, the Service does not anticipate adverse effects to bull trout and its designated critical habitat. However, TCMC currently conducts water quality and biological monitoring on the Salmon River (Assessment, p. 19); if future discharge shows additive toxicity, it is likely to be detected during monitoring, which will trigger adaptive management.

Outfall 005 Mixing Zone

Within the mixing zone of outfall 005 in the Salmon River, contaminants may be present at concentrations that exceed acute and chronic criteria. The concerns for the level of toxicity in the mixing zones are as follows:

- Even if toxicity of the mixing zone is at a sub-lethal level, repeat short-term exposures could result in adverse effects to adults and juveniles.

- Elevated concentrations of trace elements could affect macroinvertebrate populations potentially reducing the prey base for fish in the Salmon River, including bull trout.
- Additionally, the elevated concentrations of trace elements may preclude bull trout use of the area (avoidance) resulting in a loss of habitat.

Contaminant concentrations could affect bull trout and PCE 8 of designated critical habitat in a way that changes water quality such that normal reproduction, growth, and survival are inhibited. Therefore, effects of discharge of all constituents from outfall 005 into the Salmon River are **likely to adversely affect** bull trout and its designated critical habitat.

B. Interrelated and Interdependent Effects

The implementing regulations for section 7 define interrelated actions as those that are a part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. No interrelated or interdependent actions have been identified in this consultation.

VI. CUMULATIVE EFFECTS

The implementing regulations for section 7 define cumulative effects to include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Biological Opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Nonfederal activities within the action area are associated with the Thompson Creek Mine (e.g., roads, impacts to water quality, stream flow reductions), other mines, grazing, and agricultural activities. These activities are expected to continue into the foreseeable future at current levels. However, as the past and present impacts of these activities have been incorporated into the description of baseline conditions in the Action Area, and these activities are expected to continue at current levels, but not increase, it is expected that the baseline conditions will be maintained.

VII. CONCLUSION

A. Bull Trout

After reviewing the current status of the bull trout, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, it is the Service's Biological Opinion that the Bureau's proposed action to authorize the expansion of the Thompson Creek Mine in Idaho is not likely to jeopardize the coterminous United States population of the bull trout. The Service's rationale is presented below.

Bull Trout currently occupy S. Creek, Thompson Creek, and the Salmon River within the action area. Bull trout reproduction likely occurs in the headwaters of S. Creek and Thompson Creek upstream of water quality and quantity impacts from the proposed action. Bull trout do not spawn in the Salmon River. The Salmon River, however, is particularly valuable for movement of fluvial bull trout within the Upper Salmon River basin.

With the implementation of the proposed action, bull trout habitat conditions will be degraded during the Mine's Closure Phase and into perpetuity as a result of contaminant concentrations within the mixing zone of outfall 005. Impacts to bull trout in the Salmon River from the proposed action are anticipated to be limited to the mixing zone of outfall 005. The mixing zone will not span the entire width of the Salmon River or extend beyond 13 meters downstream of outfall 005. The size and location of the mixing zone is anticipated to limit, but not preclude, movement up or down stream of outfall 005 by bull trout in the Salmon River. Effects to bull trout prey base are expected to be limited to the area within the mixing zone, leaving the majority of bull trout habitat in the Salmon River unaffected. Although the proposed action is expected to result in increased contaminant concentrations in some portions of Thompson Creek and S. Creek, the Service determined the expected level of effect would not preclude spawning or movement of bull trout. Habitat conditions in headwater reaches of these streams would be maintained, allowing for persistent bull trout populations in Thompson Creek and S. Creek. As a result, bull trout habitat conditions in Thompson Creek, S. Creek, and the Salmon River are likely to remain at levels which support persistent bull trout populations in the Upper Salmon River basin. Therefore, this action's effect to bull trout behavior and the permanent loss of habitat within the mixing zone of outfall 005 is not expected to cause appreciable change in the bull trout population, distribution in the action area, or, by extension, across the range.

For the above reasons, the Service concludes that the anticipated level of effects caused by the proposed expansion of the Thompson Creek Mine to bull trout and its habitat over the term of the proposed action, taking into account past impacts in the action area, is likely to be compatible with sustaining the viability of the three affected populations of the bull trout.

B. Designated Critical Habitat

After reviewing the current status of the designated critical habitat for bull trout, the environmental baseline for the action area, the effects of the proposed action, and any cumulative effects, it is the Service's Biological Opinion that the Bureau's Proposed Action to authorize expansion of the Thompson Creek Mine in Idaho is not likely to result in destruction or adverse modification of designated critical habitat for bull trout. The Service's rationale is presented below.

Implementation of the proposed action is expected to maintain all PCEs of designated critical habitat in S. Creek in the condition they were at the time of designation of critical habitat. Implementation of the proposed action is expected to degrade PCE 2 (migratory habitat), PCE 3 (food base), and PCE 8 (water quality and quantity) in Thompson Creek and the Salmon River, and maintain all other PCEs of designated critical habitat in the condition they were at the time of designation of critical habitat. The Service anticipates that effects to the migratory habitat, food base, and water quality in Thompson Creek would be limited and localized to the WRSF

seepage and mixing zones of outfalls 001 and 002. The effects to the migratory habitat, the food base, and the water quality in the Salmon River are expected to be limited and localized to the mixing zone of outfall 005.

The degree of impact to the associated PCEs is not expected to preclude bull trout movement, feeding, or normal reproduction, growth, and survival in these streams or the Upper Salmon River Critical Habitat Subunit. The Service concludes that the anticipated level of effects to designated critical habitat from the proposed action is likely to degrade some PCEs in some streams in the action area, but the affected designated critical habitat would be likely to maintain its capability to support bull trout and serve its intended conservation role for the species.

VIII. INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering.

Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of an Incidental Take Statement. The measures described below are non-discretionary, and must be undertaken by the Bureau so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply.

A. Amount or Extent of Take Anticipated

Based on the results presented in the *Effects of the Action* section above, the Service finds that incidental take of the bull trout is likely to occur in the form of death or injury caused by the effects of constituents in the Salmon River within the mixing zone of outfall 005 after closure of the Mine and into perpetuity. Bull trout moving upstream and downstream from below or above outfall 005, and passing through the mixing zone, are reasonably certain to be exposed to contaminant concentrations that exceed acute and chronic water quality criteria. The mixing zone sizes vary depending on the constituent being discharged, with a maximum mixing zone length of 13 meters downstream of outfall 005, and width of 25 percent of the Salmon River, as described in TCMC's NPDES permit. Although the Service finds that take would be limited to a small portion of the Salmon River (the mixing zone of outfall 005), the potential for take cannot be eliminated. Because the number of bull trout in the Salmon River will fluctuate through time, some bull trout will avoid the mixing zone, and effects to individual bull trout will vary depending on frequency and duration of exposure to the mixing zone, the Service is unable to

estimate a specific amount of incidental take of bull trout. Additionally, the Service expects that incidental take of bull trout will be difficult to detect because finding a dead or impaired specimen is unlikely, loss may be due to other environmental or human–caused activities, loss may occur at a young life stage or small individuals which may not be detected, or losses may be masked by seasonal fluctuations in numbers or other natural causes. Because the available information is insufficient to quantify the amount of take anticipated, and take of individual bull trout would be difficult to detect, we describe the expected extent of take as the changes in macroinvertebrate abundance, diversity, and composition downstream of the proposed discharge. If future monitoring determines macroinvertebrates (specifically the "EPT taxa") are accumulating elevated[6] concentrations of any of the constituents listed in Term and Condition 5 between years, or there is a statistically significant decline in any one of the three following elements: macroinvertebrate abundance, macroinvertebrate diversity, or macroinvertebrate composition as measured at the downstream macroinvertebrate monitoring location (the existing monitoring site established at the confluence of S. Creek and the Salmon River), the extent of take is exceeded and reinitiation of consultation is required.

Macroinvertebrates are an adequate surrogate to assess effects to bull trout because they are an integral food source for the bull trout and its prey. Thus, effects (declines) to the macroinvertebrate population can subsequently affect the bull trout population. Additionally, the "EPT taxa" are considered sensitive macroinvertebrate species to elevated contaminant concentrations. Therefore, effects to these species of macroinvertebrates may be indicative of elevated contaminant concentrations in the system.

The Service anticipates that some bull trout will not traverse the mixing zone but that at no time will the mixing zone preclude all bull trout from moving upstream or downstream.

B. Effect of the Take

In the accompanying Biological Opinion, the Service determined that this level of anticipated take is not likely to jeopardize the coterminous United States population of the bull trout.

C. Reasonable and Prudent Measures

The Service finds that full compliance with the proposed action, including full implementation of proposed conservation measures and monitoring, as outlined in the Assessment, is essential to limiting the impacts of incidental take of the bull trout.

The Service also believes that the following Reasonable and Prudent Measures are necessary and appropriate to minimize impacts of incidental take of bull trout reasonably certain to be caused by the proposed action.

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[6] Elevated contaminant concentrations will be determined by statistical analysis indicating a significant difference between concentrations found in baseline (pre-discharge) samples and the samples collected once Outfall 005 is in use.

Reasonable and Prudent Measure 1 – The Bureau shall reduce the extent of effects to bull trout and their designated critical habitat.

D. Terms and Conditions

Term and Condition 1 to implement Reasonable and Prudent Measure 1:
The Bureau shall ensure the proposed action, including all proposed conservation measures and monitoring described in the Assessment, is fully implemented.

Reporting and Monitoring Requirements

To be exempt from the prohibitions of section 9 of the Act, the Bureau must ensure compliance with the following Reporting and Monitoring Requirements. The Reporting and Monitoring Requirements are not discretionary and must be undertaken by the Bureau, or be made a binding condition of any permit issued to an applicant, as appropriate.

1. Within one year following finalization of the Opinion, the Bureau shall develop, receive approval of the Service, and begin implementation of a sampling/monitoring plan which incorporates the following terms and conditions.

In order to determine if there is acute and chronic toxicity from the permitted discharge to aquatic organisms (both bull trout and their prey items) from the edge of the mixing zone, in the Salmon River, the Bureau shall:

2. Establish water quality sampling points for metals at outfall 005. Sampling points shall be established at the edge of the mixing zone and 26 meters downstream of outfall 005 to assess if elevated effluent concentrations are occurring beyond the anticipated "affected area". These sampling points shall be in addition to current requirements by the TCMC's NPDES permit. Sampling shall include at least three samples from each sample point in order to establish average values. Sampling shall be implemented once TCMC initiates use of outfall 005 and discharge of effluent is occurring. Sampling shall take place annually for the first two years of use, and then every five years following for verification. Results from the sampling shall be provided to the Service for review in the annual report.

   If water quality sampling indicates that an acute or chronic water quality criteria specified in the NPDES permit is exceeded, outside the designated regulatory mixing zone, the Bureau shall meet with the Service to determine if potential effects of the discharge on bull trout in the Salmon River should be re-evaluated.

3. As a permit condition, the Bureau shall require an acclimation study be conducted to determine whether or not the test species (rainbow trout) can acclimate to the Salmon River water. If the species can acclimate, then Salmon River water must be used for WET testing to determine toxicity of the effluent, rather than laboratory water, as a

control or dilution agent. Salmon River water shall be collected in accordance with TCMC's NPDES permit.

4. In order to assess compliance with the requirement that the Salmon River be free from toxic substances in concentrations that impair beneficial uses to cold water species, acute rainbow trout tests shall be conducted to evaluate the potential for adverse effects resulting from short-term exposure in the mixing zone. This test will occur annually for the first two years following the discharge of effluent through outfall 005, and then every five years following. This required WET testing shall be in addition to the WET testing established in the TCMC's NPDES permit. The WET test used shall be a 96-hour static renewal test with reporting at 24 and 96 hours. Following four WET tests and 12 years after discharge begins at outfall 005, this portion of the sampling plan may be re-evaluated if deemed appropriate by both the Service and the Bureau.

In order to assess the potential take of bull trout, the Bureau shall implement a macroinvertebrate monitoring/sampling plan:

5. Macroinvertebrate sampling/monitoring is to be used as a surrogate indicator of impacts to bull trout. Macroinvertebrates shall be sampled between outfall 005 and the confluence of Thompson Creek and the Salmon River, and the confluence of S. Creek and the Salmon River, when suitable locations are available. The closest suitable macroinvertebrate sampling locations to outfall 005 shall be selected. If a suitable sampling location is available downstream of outfall 005, that location shall occur upstream of any confluence to the Salmon River. This required sampling is in addition to the existing macroinvertebrate sampling/monitoring occurring as part of TCMC's NPDES permit. The analysis described in this term and condition shall be conducted for the macroinvertebrate sampling locations required by the TCMC's NPDES permit on the Salmon River above and below outfall 005. If the NPDES permit no longer requires macroinvertebrate sampling/monitoring on the Salmon River, macroinvertebrate sampling/monitoring shall continue, as described in TCMC's NPDES permit for outfall 005 and this Opinion, as a requirement of this term and condition. As part of the macroinvertebrate sampling/monitoring plan, a trend analysis of macroinvertebrate abundance, diversity, and composition over time, as well as a trace element concentration analysis in the macroinvertebrates from all sample locations, shall be included. The trend analysis should examine all available past data prior to discharge, during mining, as well as current data. This is expected to include the results of the macroinvertebrate sampling required by the TCMC's NPDES permit.

   Specific endpoints such as: invertebrate density, number of taxa, diversity indices, EPT taxa, and mayfly richness shall be measured as a part of the sampling/monitoring plan. Additionally, statistical analyses shall be performed to assess if there are significant differences in macroinvertebrate chemical concentrations, diversity, abundance, or composition. These analyses should be included in the annual report. Chemical analyses of the macroinvertebrate samples shall be conducted in accordance with the protocols of the United States Geological Survey tissue sampling protocols, *Guidelines for Studies of Contaminants in Biological Tissues for the National Water-Quality Assessment Program*

(Crawford and Luoma 1993). Macroinvertebrate sampling should be done in such a manner as to not interfere with chemical analyses. Results of the chemical analyses should be included in the annual report. Constituents being analyzed shall include: aluminum, arsenic, cadmium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, selenium, uranium, and zinc. All constituents listed above shall be analyzed annually for the two years prior to discharge of outfall 005 and annually for the first two years following discharge through outfall 005. Following two years after discharge of outfall 005, the list of constituents to be analyzed can be re-evaluated, in consultation with the Bureau and Service, for refinement and possible exclusion of some constituents.

Sampling should be conducted in the late summer or early fall, once a year, at the same time every year, and continue throughout the life of potential effects of the proposed action. Results of the monitoring shall be summarized in a report, and provided to the Service each year for our review.

In order to assess the impacts of the discharge to listed species, the Bureau will submit to the Service, by May 1st of each year, reports from monitoring. Data compiled from Reporting and Monitoring Requirements 2, 4, and 5 shall be made available to the Service in electronic form. The reports can be provided to the Service in electronic form or in a letter. Reports and data can be mailed on a CD to the Service's Eastern Idaho Field Office at:

4425 Burley Drive, Suite A
Chubbuck, Idaho 83202

The above reporting and monitoring requirements are designed to monitor if impacts that might otherwise result from Mine discharge into the Salmon River rise to the level of incidental take. If, during the course of the action, incidental take is exceeded (i.e., statistical analyses reveals a significant decrease in macroinvertebrate abundance, diversity, or composition between upstream and downstream sampling locations or a statistically significant increase in metals concentrations in macroinvertebrates between years), such incidental take represents new information requiring reinitiation of consultation. The Bureau must immediately provide an explanation of the causes of the taking and review with the Service the need for reinitiation of formal consultation.

IX. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery programs, or to develop new information on listed species. The following Conservation Recommendations are pertinent to this action

Promote recovery of bull trout in Thompson Creek by discontinuing use of outfalls 001 and 002 as permitted by TCMC's NPDES permit.

Monitor water quality in Red Bird Creek during Phase 8, Early Closure, and Late-Post Closure.

Work with water rights owner to remove or replace the diversion 0.3 mile upstream of the confluence of Thompson Creek and the Salmon River.

Readdress the TCMC's NPDES permit for effects to aquatic biota.

Monitor bull trout presence in Thompson Creek, S. Creek, and the Salmon River.

Implement the TCMC Proposed Salmon River Mixing Zone Monitoring Plan where it is not in conflict with the above Terms and Conditions.

X. REINITIATION-CLOSING STATEMENT

This concludes formal consultation on the Bureau's proposal to authorize expansion of the Thompson Creek Mine. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

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