3.0 AFFECTED ENVIRONMENT

3.1 Introduction

Chapter 3 describes the existing natural and human environment that would potentially be affected by the SGP. The natural and human environment is further divided into resources or resource uses - physical environment, biological resources, and social resources/environment. Each resource section is organized as follows: a brief introduction and scope of analysis including a definition of the analysis area specific to the resource; relevant laws, regulations and policies; and existing conditions of the resource in the analysis area.

This EIS is purposely designed to efficiently detail what is necessary in order to understand the affected environment and environmental effects related to the alternatives that are evaluated. Many of the subsections of this EIS summarize more detailed information that is discussed in specialist reports which are cited in the subsections. These reports include any information that has become available since the DEIS was released in August 2020. Readers who are interested in reviewing the more detailed information may download the specialist reports of interest from the same website hosting this EIS. The specialist reports that are available include:

- Air Quality Specialist Report (Forest Service 2023a)
- Climate Change Specialist Report (Forest Service 2023b)
- Soils and Reclamation Cover Materials Specialist Report (Forest Service 2023c)
- Noise Specialist Report (Forest Service 2023d)
- Surface Water and Groundwater Quantity Specialist Report (Forest Service 2023e)
- Surface Water and Groundwater Quality Specialist Report (Forest Service 2023f)
- Vegetation: General Vegetation Communities, Botanical Resources, and Non-Native Plants Specialist Report (Forest Service 2023g)
- Wetland and Riparian Resources Specialist Report (Forest Service 2023h)
- Fisheries and Aquatic Habitat Including Threatened, Endangered, Proposed, and Sensitive Species Specialist Report (Forest Service 2023i)
- Wildlife and Wildlife Habitat Including Threatened, Endangered, Candidate, and Sensitive Species Specialist Report (Forest Service 2023j)
- Access and Transportation Specialist Report (Forest Service 2023k)
- Heritage Resources Specialist Report (Forest Service 2023l)
- Recreation Specialist Report (Forest Service 2023m)
- Scenic Resources Specialist Report (Forest Service 2023n)
- Social and Economic Conditions Specialist Report (Forest Service 2023o)
- Special Designations Specialist Report (Forest Service 2023p)
- Tribal Rights and Interests Specialist Report (Forest Service 2023q)

Certain of the environmental resources evaluated in this EIS are essentially unchanged from 2020 so specialist reports were not prepared for these resources, which include: geology, hazardous materials, environmental justice, timber, land use, and public health and safety.

3.1.1 Scope of Analysis

For the purposes of this EIS, the term "SGP area" is defined to mean the entire area in which disturbance from the SGP components (i.e., the combined disturbance footprints of the mine site, access roads, utilities, and offsite facilities) for any alternatives would occur.

The analysis area varies by resource or resource use, depending on the geographic extent of the resource or use and the extent of the potential effects of the SGP. In some cases, the analysis area is the SGP area and other cases, the analysis area may be larger or smaller than the SGP area, encompassing administrative or natural boundaries, because the potential effects on the resource can either extend beyond the SGP area boundary or may only occur in a smaller area such as the mine site.

3.1.2 Relevant Laws, Regulations, Policies, and Plans

Each resource section briefly summarizes applicable laws, regulations, policies and plans that pertain specifically to the resource being described and why each is relevant to the resource. This document is prepared pursuant to NEPA, and NEPA and its implementing regulations apply to the evaluation of alternatives and environmental effects with respect to each resource in this document. Further references to NEPA in particular resource sections focus on particular provisions that may apply to that specific resource.

The Payette Forest Plan and the Boise Forest Plan are applicable to most of the environmental resources evaluated and provide guidance on NFS lands in the SGP area. The forest plans have both forest-wide management directions and more specific management area level directions such as Management Prescription Categories (MPCs). These management areas are organized around a combination of watershed and administrative boundaries and are designed to tier to the forest-wide direction to help achieve forest-wide goals and desired conditions.

3.1.3 Existing Conditions

The existing conditions section for each resource describes the potentially affected resources (i.e., physical, biological, social and economic resources or resource uses) qualitatively and/or quantitatively, depending on the analysis requirements identified by the issues and indicators.

The mine site is within terrain consisting of narrow valleys surrounded by steep mountains. Elevations along valley floors range from 6,000 to 6,600 feet amsl. The surrounding mountains reach elevations over 8,500 feet amsl. The main drainage basin at the mine site is the East Fork SFSR. More detailed descriptions of the physical, biological, and social environments are included in the resource sections in the rest of this chapter.

3.2 Geologic Resources and Geotechnical Hazards

3.2.1 Introduction

This section describes the geologic resources and geotechnical hazards at and in the vicinity of the SGP area (**Figure 3.2-1**). The analysis area for geologic resources includes the footprint of disturbance of all SGP components. Geologic resources as they pertain to this project include bedrock (e.g., ore bodies and development rock) and overburden (e.g., glacially derived sediments, alluvium). Regional geology and seismicity are discussed to provide context to the site-specific features. For purposes of the SGP, the description of existing geotechnical hazards include existing or potential mass wasting features (e.g., landslide, rockfall, avalanche paths) and focuses on the Operation Area Boundary, access road areas, and the areas where the transmission lines would be upgraded and/or new transmission line would be built. In the context of the mine site, geotechnical hazards are described and considered with a focus on three proposed component locations: open pits, the TSF, and the TSF buttress.

3.2.2 Geologic Resources and Geotechnical Hazards Area of Analysis

The geological resources and Geotechnical Hazards analysis area is within the Salmon River Mountains, a high-relief mountainous physiographic province in central Idaho. The Analysis Area consists of the footprint of the proposed SGP disturbance area (as depicted on **Figure 2.4-2**) where potential impacts to Geologic Resources and Geotechnical Hazards may take place. The generalized geology and project components are shown on **Figure 3.2-2**.

3.2.3 Relevant Laws, Regulations and Policy

Several laws and implementing regulations apply to the Proposed Action and alternatives. The following is a list of additional laws, regulations, policies, and plans at the federal, state, or local level pertaining to geological resources and geotechnical hazards.

<u>General Mining Act of 1872 (as Amended)</u> - The statutory right to search for, develop, and extract mineral deposits on federal lands open to mineral entry was established by the Mining Law, as amended. These rights include the right to locate a mining claim and the right to reasonable access to the claim for further exploration, mining, or necessary ancillary activities.

<u>Paleontological Resources Preservation Act of 2009</u> - Paleontological resources are managed and protected under the federal Paleontological Resources Preservation Act of 2009 (Public Law 111-11, Subtitle D). The Paleontological Resources Preservation Act defines paleontological resources (with certain exceptions) as "any fossilized remains, traces, or imprints of organisms, preserved in or on the earth's crust that are of paleontological interest and that provide information about the history of life on earth..." (16 USC 470aaa(4)).

<u>Cave Resources Protection Act of 1988</u> - Caves and karst formations are protected and managed by the 1988 Federal Cave Resources Protection Act (16 U.S.C § 4301 et seq.).

Mine Safety and Health Act of 1977 - The Mine Safety and Health Act of 1977, as amended (P.L. 91-173 as amended by 95-164) established mandatory health and safety standards for coal and other mines in the U.S. The act and regulations are administered by the MSHA of the U.S. Department of Labor. The MSHA standards and regulations are in Title 30 of the CFR, Mineral Resources, Chapter I. There are federal health and safety standards for all aspects of surface and underground mine operations applicable to: facility designs, methods, equipment characteristics, work practices, inspections, and reporting.

Federal Emergency Management Agency (FEMA) National Dam Safety Program (NDSP) - The FEMA has developed the NDSP, which includes standards that are applicable to structures constructed on federal land, including tailings storage facility embankments (i.e., dams). The NDSP provides a conceptual framework that includes requirements for site investigation and design, construction oversight, operations and maintenance, and emergency planning.

The NDSP is a partnership of states, federal agencies (including Forest Service), and other stakeholders to encourage and promote the establishment and maintenance of effective federal and state dam safety programs to reduce the risk to human life, property, and the environment from dam-related hazards. The NDSP includes federal recommendations for dams related to risk management, emergency action planning, flood risks, design inflows, seismic analysis and design, and general dam safety. The state, IDWR specifically, is responsible for reviewing and approving the design and specifications for TSFs.

Forest Service Mining regulations at 36 CFR 228 - Mining activities on federal land administered by the U.S. Forest Service are regulated under the Forest Service Mining Regulations at (36 CFR 228). Locatable minerals operations such as the SGP are regulated under Subpart A. Large mine operations are required to submit a proposed Plan of Operations describing all aspects of the proposed mine operations.

The regulations at Section 228.8 contain requirements for environmental protection and generally require, where feasible, that environmental impacts to Forest Service-administered resources be minimized. These regulations specifically note requirements related to air quality, water quality, solid wastes, scenic values, fisheries and wildlife habitat, and roads. Section 228.8(c) requires that tailings and other wastes produced by mine operations be handled to minimize adverse impacts to the environment. Section 228.8(g) requires reclamation of areas disturbed in operations to prevent or control onsite and off-site damage to the environment and forest service resources. These rules specifically refer to control of erosion and landslides and isolation or control of toxic materials.

Federal Administrative Actions Related to Antimony Supply - A number of federal administrative actions have been taken that relate to the marketplace for antimony supply. Title III of the Defense Production Act was enacted by Congress to ensure the United States has the resources, materials, and technologies needed for national security. Executive Order 13817, A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals, signed in 2017, requires the Secretary of the Interior in coordination with the Secretary of Defense to publish a list of critical minerals and then directs federal agencies to identify new sources of critical minerals and create a strategy to reduce the Nation's reliance on critical minerals while increasing access to critical minerals through recycling/reprocessing technologies and critical mineral exploration and development.

Payette Forest Plan (Forest Service 2003a) and Boise Forest Plan (Forest Service 2010a) - Physical, social, and biological resources on NFS lands are managed to achieve a desired condition that supports a broad range of biodiversity and social and economic opportunity. National Forest Land and Resource Management Plans embody the provisions of the National Forest Management Act of 1976 (NFMA) and guide natural resource management activities on NFS land.

In the SGP area, the Resource Management Plans provide management prescriptions designed to realize goals for achieving desired condition for geologic resources and geotechnical hazards and include various objectives, guidelines, and standards for this purpose.

Idaho Mined Land Reclamation Act and Rules Governing Mined Land Reclamation - The IDL has the authority to regulate all surface mining in Idaho by: Idaho Mined Land Reclamation Act (Idaho Code, Title 47, Chapter 15, et seq.); and Rules Governing Mined Land Reclamation (Idaho Administrative Procedures Act (IDAPA) 20.03.02). Reclamation is the process of restoring an area affected by a mining operation or cyanidation facility to its original or another beneficial use, considering previous uses, possible future uses, and surrounding topography. The objective is to re-establish a diverse, self-perpetuating plant community, and to minimize erosion, remove hazards, and maintain water quality (IDAPA 20.03.02.010.20). The IDL regulatory oversight includes mining and other activities on private and patented land, as well as on lands under federal ownership or surface management.

Idaho Department of Water Resources Rules - Idaho dam safety statutes are enumerated in Section 42-1709 through Section 42-1721 of the Idaho Code. Mine tailings impoundment structures greater than or equal to 30 feet high are regulated by the IDWR in the same manner as water storage projects, with an additional provision that a surety bond be secured by the owner, payable to IDWR to ensure the TSF is placed in a safe and maintenance-free condition upon decommissioning. Design and construction requirements for Mine Tailings Impoundment Structures are described in the IDAPA Section 37.03.05, while Section 37.03.06 describes rules for the safety of dams.

Idaho Department of Environmental Quality Cyanide Processing Rules - These rules establish a permitting process to construct, operate and close facilities intended to contain, treat or dispose of water containing cyanide. The IDAPA 58 Administrative Rules (58.01.13) address ore processing by cyanidation and apply to processing facilities, tailings dams, pipelines, and process ponds if they contain cyanide process water. Idaho Code § 42-1711; Idaho Administrative Procedure Act ("IDAPA") 37.03.05.40.

Valley County Code- No specific Valley County regulations exist regarding geotechnical issues at mines or geological resources and hazards. However, Valley County has pertinent sections in their ordinances that relates to flood control and land use that may apply to the SGP. Title 11, Chapter 1, Valley County Code of Ordinances.

3.2.4 Affected Environment

3.2.4.1 Geologic Setting

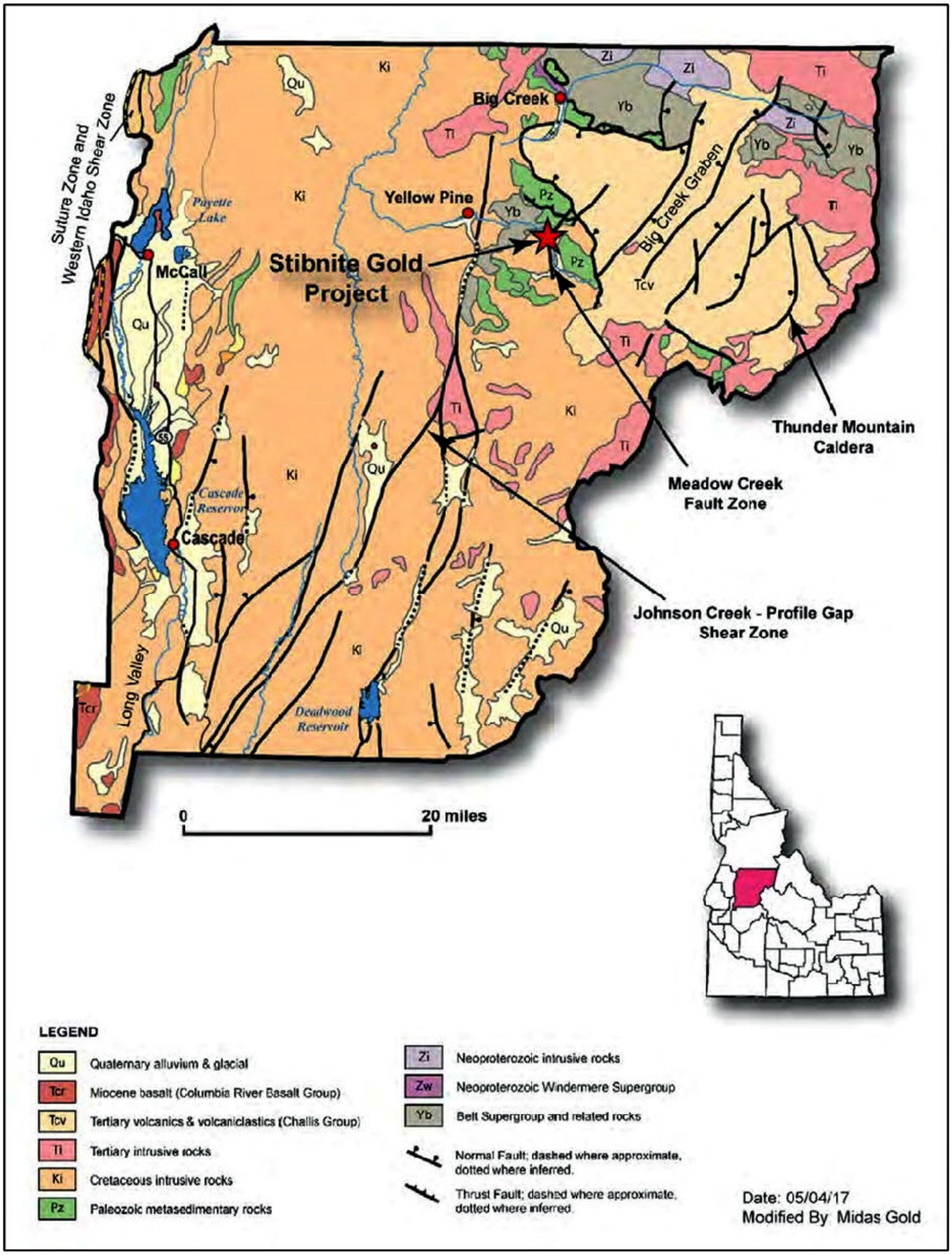
The geological resources analysis area is within the Salmon River Mountains, a high-relief mountainous physiographic province in central Idaho. The legacy mine site has undergone extensive ground disturbing activities associated with past mineral development spanning more than a century (i.e., legacy mining features).

Bedrock Geology, Lithology, and Stratigraphy

Several studies have described the lithologic characteristics and stratigraphy of the intrusive, metasedimentary, volcanic, and unconsolidated rocks exposed in the analysis area. The descriptions that follow are derived from relevant sources as well as from unpublished studies by past operators, Perpetua, and Perpetua contractors and consultants. A regional geologic map of the area is provided in **Figure 3.2-1**. **Figure 3.2-2** provides an overview of general geologic features and rock types in the vicinity of the Operation Area Boundary based on 2007 data available from the USGS. Nomenclature and classification of the rocks in the analysis area has differed over the years by authors. "PC – quartzite" listed on the legend is described in closer detail by others as metasedimentary rock which includes several rock types including quartzite, schist, calcareous schist, and marble. In addition, extent of outlines (contacts) of rock types may differ slightly among references.

Bedrock geology in the region can be subdivided into three generalized groups based on age, lithology, and stratigraphic relationships (listed from oldest to youngest):

- Pre-Cretaceous to Ordovician, (greater than 440 million years ago [Ma]), metasedimentary rocks within the Idaho Batholith. These units are exposed in the West End pit and southeast portion of the Yellow Pine pit areas and include a succession of folded, faulted, and metamorphosed carbonate and siliciclastic rocks that comprise a portion of the original rock that was later intruded by the Idaho Batholith and remains as a roof pendant, or mass of original rock that remains after being intruded by igneous rock and projects downward into intrusive rock. **Figure 3.2-3** presents a typical stratigraphic column of these materials.
- Cretaceous (145 to 66 Ma) igneous rocks of the Idaho Batholith. These rocks host the Hangar Flats deposit and parts of the Yellow Pine deposit and underlie much of the rest of the area. The igneous rocks consist primarily of granodiorite and granite with lesser amounts of diorite and aplite. Nomenclature and classification of the rocks that comprise the Idaho Batholith has differed over the years by authors. In this EIS, the term granodiorite is used synonymously with quartz monzonite to describe the primary rock types of the Idaho Batholith. Intrusive rock nomenclature correlations are described in Gillerman et al. 2019 (Table 2-2).
- Tertiary (65 to 1.6 Ma) intrusive and volcanic rocks.



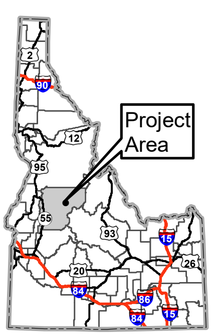


Figure 3.2-1
Valley County
Regional Geologic Map
Stibnite Gold Project
Stibnite, ID

Figure Source: Digital Atlas of Idaho 2017, modified by Perpetua

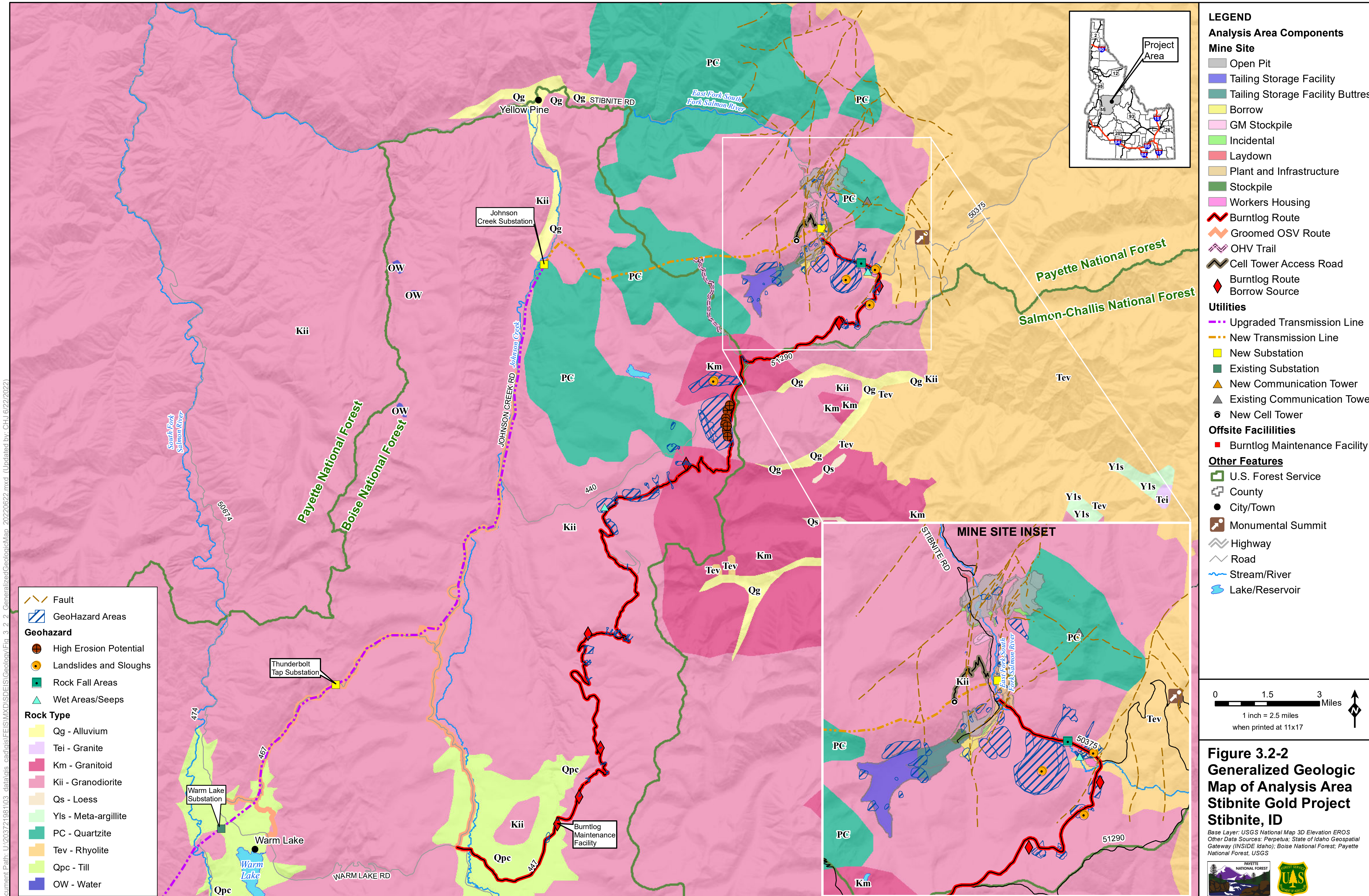
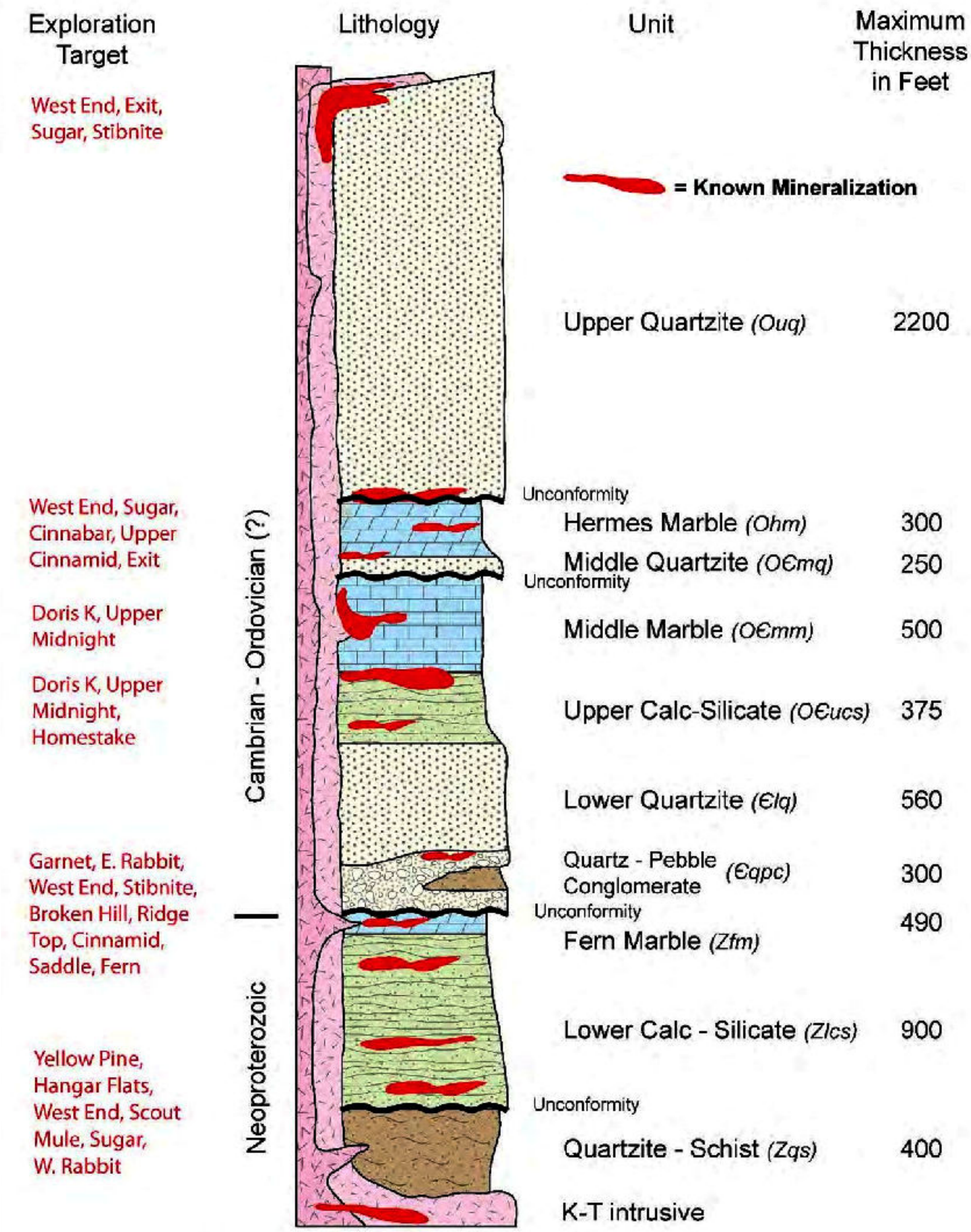


Figure 3.2-2 Generalized Geologic Map of Analysis Area Stibnite Gold Project Stibnite, ID

Base Layer: USGS National Map 3D Elevation EROS
Other Data Sources: Perpetua; State of Idaho Geospatial Gateway (INSIDE Idaho); Boise National Forest; Payette National Forest, USGS



Stibnite roof pendant stratigraphy, (Smitherman, 1985)

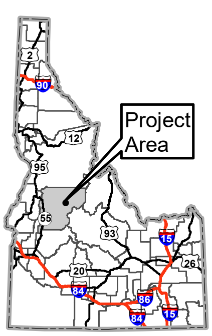


Figure 3.2-3
Typical Bedrock Stratigraphy of Stibnite
Stibnite Gold Project
Stibnite, ID

Figure Source: Smitherman 1985 as modified by Perpetua 2017

Surficial Deposits and Features

In the analysis area, repeated erosional and depositional processes occurred that were associated with glaciation during the Pleistocene. Colman and Pierce (1986) estimated the last glacial advance in the area was approximately 20,000 years ago. Glaciers created U-shaped valleys with over-steepened, talus-covered sides, and hanging-valley tributaries. U-shaped valleys also contain lateral, terminal, and recessional hills and ridges of glacial earth debris, called moraines, as well as glacial outwash deposits at their lower ends.

Alluvial fans are the result of erosion and deposition of material by a stream or river into an adjacent basin. These deposits tend to be fan-shaped in plan view, radiating away from a point source higher up the drainage or valley. Several small alluvial fans in the analysis area have formed over the older glacially derived landforms.

A large alluvial fan occurs below the EFMC (known as the Blowout Creek fan). The failure of a water reservoir earthen dam in 1965 helped create this fan by depositing large amounts of sand and gravel (Midas Gold 2016a, Figure 1). Several coalescing fans also occur at the toe of Garnet Creek (east of the proposed ore processing plant area) and the two smaller drainages to the north. Many of these fans can be and often have been the areas of avalanche runout.

Glacial outwash is glacially derived material that is eroded, reworked by water sourced from glaciers upgradient, and then deposited downstream. Glacial outwash occurs throughout the analysis area and underlies nearly all the larger valley areas.

Modern (Holocene, about 12,000 years ago to present) stream drainage patterns indicate high rates of erosion in the analysis area with coarse-grained sedimentary fluvial deposits in floodplains comprised of a mixture of angular clasts from adjacent bedrock sources combined with more rounded reworked glacial deposits.

Structural Geology

the major structural geologic features in the analysis area include Mesozoic folds and Cenozoic faults. Primary references that describe regional geology include Gillerman et al. (2019) and Stewart et al. (2013, 2016).

Folds are a result of pressure on rock causing the rock to bend or fold rather than break. There are multiple fold features in the vicinity of the analysis area including the Tamarack Antiform about 3 miles north of the Yellow Pine pit area (Stewart et al. 2016). Two large map-scale folds with numerous smaller fold structures are known in the Stibnite roof pendant and were first identified as early as the 1920s (Currier 1935; Larsen and Livingston 1920).

The largest fold in the analysis area is the Garnet Creek Syncline, a 3.5-mile-long, northwest-trending syncline (Smitherman 1985; Stewart et al. 2016). A second large fold structure occurs northeast of the Garnet Creek Syncline. It has been informally named the Cinnabar Peak Antiform by Perpetua. The folds in the analysis area are cut by several major fault zones. The most pronounced offsets occur along the Fern Fault in the southeast end of the Stibnite roof pendant and along the Meadow Creek Fault in the northwest end of the roof pendant (Stewart et al. 2016).

A fault is a discontinuity in a volume of rock across which there has been significant displacement as a result of rock-mass movement. Large, north-south striking faults, steeply dipping to vertical structures occur in the central and eastern portions of the analysis area including Meadow Creek Fault Zone (MCFZ); West End Fault Zone (WEFZ); Scout Valley Fault Zone; Garnet Creek Fault Zone; Rabbit Creek Fault Zone; Fern Fault Zone; and Mule Fault Zone. The MCFZ and WEFZ exhibit pronounced fault gouge (finely crushed and ground-up rock) and multiple stages of brecciation, suggesting multiple periods of movement. Available information indicates faults were active over 23 Ma (e.g., Gillerman et al. 2019). These fault zones are poorly exposed, exhibit recessive weathering (surrounding rock is more resistant to weathering than the fault gouge material), and some occur under or along the flanks of the glacially carved valleys.

Regional studies of area fault systems indicate there is a low likelihood of active faults in the analysis area (URS Corporation [URS] 2013) although ground shaking at the Operations Area Boundary caused by earthquakes is possible (URS 2013). The March 2020 Stanley, Idaho earthquake with a magnitude 6.5 and aftershocks occurred southeast of the mine site, about 45 miles west of Challis, Idaho, outside the analysis area. The closest earthquake epicenter to the site in the project-specific earthquake catalog is a magnitude 4.0 earthquake that occurred on August 3, 1963, located about 2.5 miles west-northwest of the SGP.

Mineralization

Mineralization in the analysis area began in the late Cretaceous. Hydrothermal alteration is associated with igneous intrusive rocks of the Idaho Batholith and surrounding metasedimentary rocks. Metals mineralization typically occurs in association with very fine-grained disseminated pyrite and arsenopyrite, with gold almost exclusively in solid solution in these minerals (M3 2019). Antimony mineralization occurs primarily as the sulfide mineral stibnite. Zones of silver-rich mineralization locally occur with antimony and are related to the presence of pyrargyrite, hessite, and acanthite. Coarse-grained stibnite veins are commonly associated with a later stage of mineralization (Gillerman et al. 2019). Tungsten, as the mineral scheelite, occurs as veins and in breccias often intergrown with stibnite, although in many cases scheelite has been observed cemented by or crosscut by stibnite (Midas Gold 2017a).

The alteration that occurred as a result of batholitic intrusion in the Yellow Pine and Hangar Flats deposits is described by White (1940) and Lewis (1984). Gold-bearing mineralization originally occurred as part of multiple phases of hydrothermal replacement. A subsequent high temperature sulfide mineralization phase initially contained little gold but as temperatures decreased, gold-bearing mineralization increased (Midas Gold 2017a).

Regional mapping by the Idaho Geological Survey (Stewart et al. 2013) outlines a previously unrecognized, major, northeast-trending graben complex trending through and just to the southeast of the area (**Figure 3.2-2**). This feature is likely a fundamental structural control on at least some of the mineralization in the district.

3.2.4.2 Mineral Reserves

The 2021 Feasibility Study prepared for the SGP reports an estimated Proven and Probable Mineral Reserve (the economically mineable part of the measured mineral resource) of 115.3 million tons of ore containing 4.8 million ounces of gold, 6.4 million ounces of silver, and 149 million pounds of antimony

(M3 2021). The mineral reserve estimate includes reprocessing approximately 3 million tons of historical mill tailings that underlie the spent leach material in the SODA, which would be mined and used for construction of the TSF.

Yellow Pine Deposit

Mineralization of the Yellow Pine deposit is structurally controlled and localized by the MCFZ and related structures. Gold and antimony have different geochemical signatures, geometries, and locally occurred in different structures during deposition. The deposit shows some apparent zonation with gold occurring throughout the deposit footprint, but with antimony and tungsten primarily in the central and southern portions of the deposit (M3 2019).

The dominant fault directions mapped underground and in the open pits by various geologists from BMC (1938 to 1952), White (1940 to 1941), Cooper (1950 to 1951), and Midas Gold (2012) trend north-south, northeast, and east-northeast. However, the controls for antimony mineralization show more northwesterly trends. The different geometries of antimony and gold distribution suggest different controls for mineralization: antimony is more strongly influenced by northwest fracturing and gold is more strongly influenced by northeast and east-northeast structures.

Historically, 6.48 million tons of ore were mined from the Yellow Pine deposit (Midas Gold 2016a). From the mined materials, 479,517 ounces of gold, 1,756,928 ounces of silver, 40,275 tons of antimony, and 13,579,157 pounds of tungsten were extracted.

Hangar Flats Deposit

Mineralization within the Hangar Flats deposit is entirely intrusive-hosted, and structurally controlled and localized by the MCFZ. Past production and currently defined mineralized zones occur along variably north-plunging tabular to pipe-like bodies. The mineralized zones range in thickness from 16 to over 330 feet and can be traced several hundreds of feet down dip. At Hangar Flats, the mineralized zones become thinner, less continuous, and lower grade away from the main MCFZ (M3 2019).

Historically, 303,853 tons of ore were mined from the Hangar Flats deposit, primarily through underground mining (Midas Gold 2016a). From the mined materials, 51,610 ounces of gold, 181,863 ounces of silver, 3,758 ounces of antimony, and 1,062 pounds of tungsten were extracted.

West End Deposit

In the West End deposit, gold mineralization occurs preferentially where the northwest-striking, northeast-dipping calc-silicate and schist units are cut by the WEFZ or subsidiary faults, but all rock types host mineralization. Drilling at this location intersected gold mineralization associated with the WEFZ well below the historical pit bottom as deep as 1,300 feet below the original ground surface where mineralization was exposed prior to mining. In addition to sulfide mineralization, open fractures along the WEFZ and subsidiary faults have allowed for oxide formation at depth from meteoric water infiltration (M3 2019).

Historically 8,156,942 tons of ore were previously mined from the West End deposit (Midas Gold 2016a). From the mined materials, 454,475 ounces of gold and 149,760 ounces of silver were extracted.

Exploration Prospects

In addition to these mineralized areas, numerous prospects have been discovered during exploration and development activities in the vicinity of the analysis area over the past nearly 100 years. Some of these prospects were developed into mines while others remain undeveloped.

Besides pit expansion possibilities around the main deposits, other exploration targets may one day warrant consideration for development if they can be proved viable after additional exploration, environmental, socioeconomic, metallurgical, engineering, and other appropriate studies. Future proposed mining projects would require analysis and review under NEPA and be required to comply with other federal and state regulations that apply to mining projects.

3.2.4.3 Legacy Mine Features

Over 90 years of mineral exploration and development has created numerous prospect pits, shafts, adits, tunnels and underground mine stopes in the analysis area. The locations of former underground and open-pit mine workings have been identified using historic maps and files from legacy operators and researchers active during operations. The SGP Plan of Restoration and Operations, provides a summary of the history of the Stibnite Mining District and depicts locations (Midas 2016a, Figure 4-2) of previous mining and related activities in the vicinity of the mine site (Midas 2016a).

The analysis area contains piles of rock material from legacy mining and processing activities that includes old development rock piles such as the Bradley dumps, the Meadow Creek Mine dumps, materials excavated and piled near the outlet to the Bailey Tunnel and Clark Tunnel, and material piles near the Yellow Pine pit lake at Monday Tunnel and along the former open-pit benches in the Yellow Pine pit. Tailings were deposited from the 1920s through 1950s in the Meadow Creek drainage and overlain in some areas by spent leached ore (e.g., SODA) in the 1980s and 1990s. Other areas of fill include development rock storage piles at the former Homestake pit, below the current Perpetua exploration camp and shop areas, in West End Creek, and as backfill in the former West End and Garnet pits. There also is a loaded former heap leach pad built, operated, and closed by Hecla Mining in the 1990s, and a series of partially unloaded pads to the east.

3.2.4.4 Paleontological Resources

Potential Ordovician (approximately 485 to 444 Ma) invertebrate fossils were reported by Lewis and Lewis (1982), but later workers, examining the same sites and materials, have determined these are assemblages of alumino-silicate (tremolite) and calc-silicate minerals (Lund 2004; Stewart et al. 2016). The high metamorphic grade and extensive recrystallization of the minerals that make up the sedimentary rock units in the area generally precludes preservation of fossils that would be subject to the requirements of the Paleontological Resources Preservation Act.

3.2.4.5 Cave and Karst Resources

There are no known or suspected cave or karst resources in the analysis area.

3.2.4.6 Seismicity

Historic Seismicity

The analysis area is along the western boundary of the Centennial Tectonic Belt (CTB) also called the central Idaho Seismic Zone, which is centered in south central Idaho. Earthquakes with an approximate magnitude of 6 or greater have occurred in the CTB with epicenters east and southeast of the Operations Area Boundary (**Figure 3.2-4**). The analysis area is within the CTB and has the potential to be subjected to strong (magnitude 6 and greater) earthquake ground shaking from seismic activity related to the CTB feature (URS 2013).

Several moderate to large earthquakes have occurred in an approximate 60- to 90-mile radius of the analysis area including:

- 1916 Boise Earthquake (magnitude 6)
- 1944 and 1945 Seafoam earthquakes (magnitude 6.1 and magnitude 6.0, respectively)
- 1983 Borah Peak earthquake (magnitude 6.9)
- 1993 White Cloud Peaks earthquake swarm (highest single earthquake magnitude 5.1)
- 2020 Stanley earthquake (magnitude 6.5) (USGS 2020)

These earthquakes occurred near the center of the CTB (approximately 30 miles southeast of the analysis area) (URS 2013, USGS 2020, Golder 2021). The most significant potential seismic sources near the analysis area include the Cascade, Council, Deadwood-Reeves Creek, Long Valley, and Sawtooth fault zones (Golder 2021) (**Figure 3.2-4**).

Although numerous faults are present within the analysis area, none show evidence of recent active movement nor do historic records suggest this has occurred. However, shallow mass slope movements related to weathering and typical slope processes in mountainous terranes (e.g., slumps, debris slides, avalanches) do occur, and activation of these features during a strong seismic-induced ground shaking event is possible (URS 2013).

Seismic Hazard Analysis

A seismic hazard analysis describes the natural phenomena such as ground rupture, fault movement, or soil liquefaction that could be caused by an earthquake. The purpose of the analysis is to determine the magnitude of ground accelerations due to various earthquake events to be used in the stability analysis. The results of seismic hazard analysis are used as a basis for design and mitigation measure decisions (FEMA 2006). An initial site-specific seismic hazard analysis (SHA) was conducted by URS (2013). In conversations with the IDWR, Perpetua was advised to update the SHA for the SGP. The update was prepared by Golder Associates Inc. in May 2021 (Golder 2021).

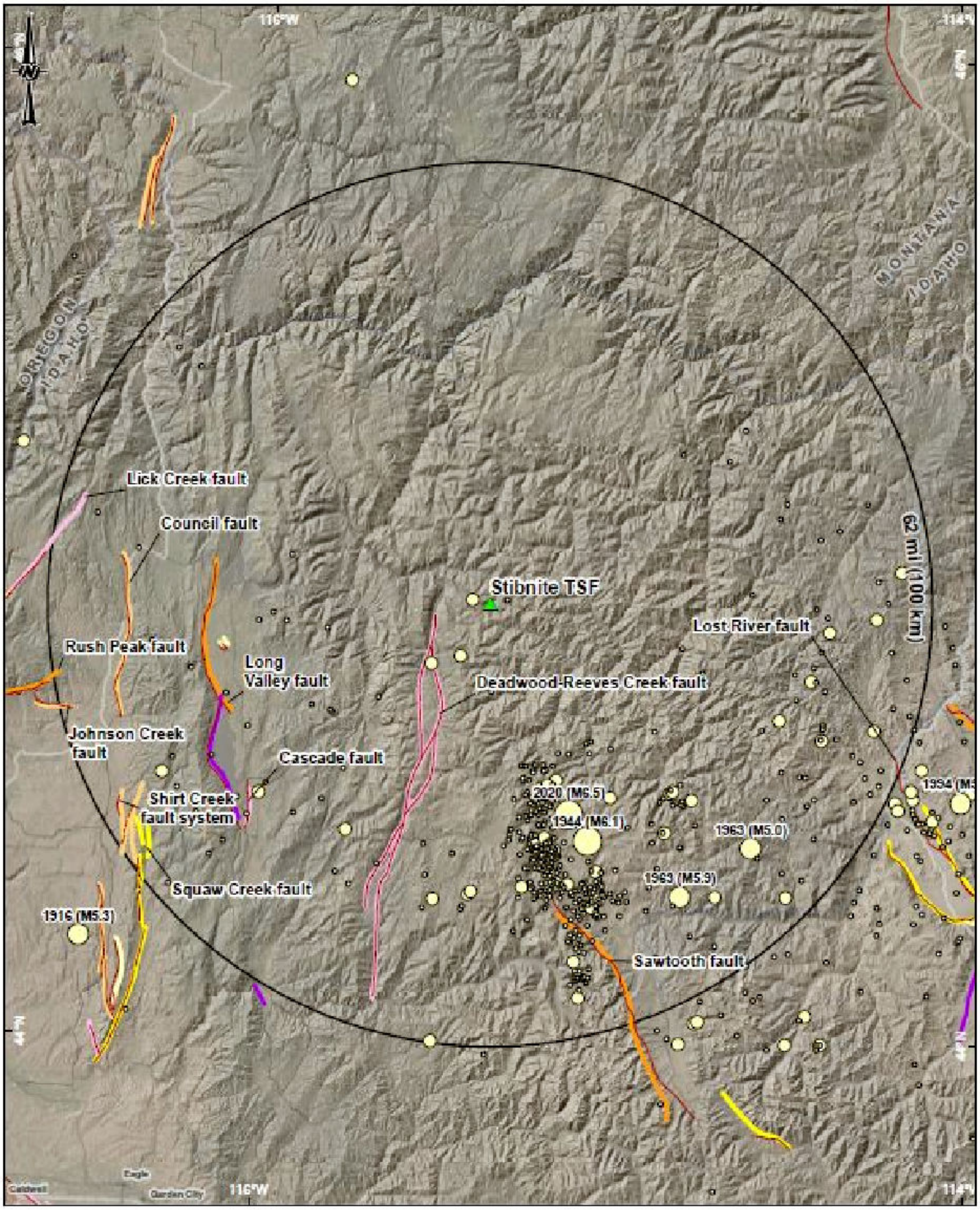
The updated SHA incorporated technical developments in SHA methodology since 2013 and utilized updated seismic source (earthquake) records from the USGS national seismic hazard map in 2014, 2018, and data from the March 2020 earthquake near Stanley, Idaho. Golder revised the list of faults considered in the SHA by URS (2013) to delete one small fault and add four large faults. The nine major crustal faults within 62 miles of the SGP that were considered in the Golder analysis included: Deadwood-Reeves Creek, Long Valley, Sawtooth, Council, Shirt Creek, Rush Peak, Lost River-Challis Section, Lost River-Challis /Warm Springs/Thousand Springs Sections, and Squaw Creek. Of these, the Deadwood-Reeves Creek fault was the closest to the SGP site at a geometric distance of about 5.3 miles.

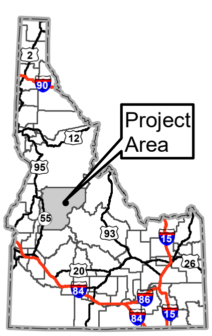
In addition to the updated seismic source information Golder incorporated the updated earthquake acceleration attenuation ground motion models (GMMs) applicable to this part of western North America.

The seismic hazard is assessed from instrument measurements as well as historical accounts and geologic observations. SHA is quantified by three parameters: level of severity, spatial measurement, and temporal measurement (Wang 2009). The seismic hazard was assessed for the SGP site including the proposed TSF location, but the results are also usable for the other proposed facilities at the SGP. Golder performed both probabilistic and deterministic seismic hazards analyses. The combined results, probabilistic SHA (PSHA) and deterministic SHA (DSHA), are an effective means for determining maximum design earthquake ground motions. Maximum design earthquake is an earthquake that would produce the maximum level of ground motion (shaking) for which a structure (e.g., TSF dam) is to be designed or evaluated (FEMA 2005).

PSHA is used to determine the likelihood (probability of occurrence) that a given level of ground shaking could be exceeded during a specified timeframe at a site from a combination of earthquake sources. The likelihood of exceedance is determined by the probability of occurrence of any earthquake with a range of magnitudes, typically within about 62 to 125 miles of the selected site. The analysis includes consideration of the attenuation of ground motion from the earthquake sources to the site. Empirical GMMs are used to model the ground motion attenuation rate for any given earthquake magnitude, source-to-site distance, and site ground conditions.

Peak ground acceleration (PGA) is traditionally used to quantify ground motion (shaking) at a site and is generally a function of the magnitude of the event and distance from the source, but other factors may be considered, such as rock type or type of faulting. The PGA is typically expressed in terms of a fraction of gravity (g), with probability of exceeding a certain level over a specific period of time.





LEGEND

Stibnite TSF

Historical Earthquake Epicenter

Earthquake Magnitude

- 3.0 - 3.9
- 4.0 - 4.9
- 5.0 - 5.9
- ≥ 6.0

IGS Miocene and Younger Faults in Idaho

- Major Holocene
- Lesser Holocene
- Major Late Quaternary
- Lesser Late Quaternary
- Major Quaternary
- Lesser Quaternary

USGS Quaternary Faults

Figure 3.2-4
Quaternary Faults of Central Idaho
Stibnite Gold Project
Stibnite, ID

Figure Source: Golder Associates, Inc.

The PSHA results for the URS analysis indicated the PGA for 475-year and 2,500-year return period earthquake events are 0.06g and 0.14g, respectively. The Golder analysis indicated comparable PGA estimates of 0.075g and 0.18g for the same return periods, respectively. For context, a PGA of 0.1g in bedrock is considered the approximate threshold at which damage occurs in buildings that are not specially constructed to withstand earthquakes (FEMA 2006).

DSHA is based on known regional seismic sources and, unlike the PSHA, does not consider the probability associated with a particular earthquake hazard. In a DSHA, the ground motions at the site are estimated for the maximum credible earthquake that could impact the site. For the URS (2013) analysis the maximum credible earthquake modeled was a magnitude 6.9 earthquake on the Deadwood-Reeves Creek fault (URS 2013). This event was estimated to result in median calculated PGA of 0.43g at the SGP site. The Golder analysis was based on a maximum credible earthquake of magnitude M7 on the Deadwood-Reeves Creek fault which resulted in an updated PGA of 0.32g at the SGP site (Golder 2021). Golder explained the main reason for the differences in estimated PGAs at the site was that URS used the NGA-West1 Project GMMs available at the time (2013) and Golder used the updated NGA-West2 Project GMMs (Golder 2021).

Final design of the SGP TSF and other facilities would incorporate the site-specific ground accelerations calculated from the latest seismic hazard analysis.

The Golder (2021) SHA results are similar to those of the USGS National Seismic Hazards Maps (NSHMs) which are the basis for the U.S. building code provisions and the International Building Code. The Golder results are less than, or about the same, as the 2014 USGS NSHM but larger than comparable hazard values in the USGS 2018 NSHM.

3.2.4.7 Foundation Characterization and Mass Wasting Hazards

Mass wasting or geohazard features in the Operations Area Boundary mine area and access roads can be classified in landslides or rockfalls and snow avalanches.

"Landslide" is a general term used to describe the downslope movement of soil, rock, and organic materials, or a combination thereof, under the effect of gravity. The term landslide also describes the landform that results from such movement (Highland and Bobrowsky 2008). Landslide types include rockfalls, deep-seated slope failures, mudflows, debris flows, and slumps. Debris flow is a mass of soil and/or fragmented rock in slurry of water that moves downslope under the influence of gravity and forms muddy deposits in valley floors. Slump as defined for the EIS: Geohazard assessment reports (STRATA 2013, 2014a, 2016) use the term "slough" and "slump" interchangeably to refer to "small landslides" of less than 0.1 acre. For purposes of consistency, this EIS uses the term "slump" in the text. However, figures originating from the referenced geohazard assessment report may still retain the use of "slough."

Many of the very large landslides in the area are likely post-glacial features. During glaciation large chunks of ice may become buried in glacial till. When the ice melts after glaciation, the materials can become unstable, resulting in large landslides. Some of the larger geohazards features depicted on **Figure 3.2-5** may have occurred through this process. An example is the landslide identified on the east side of the East Fork SFSR north of the camp area (STRATA 2014a).

An "avalanche" is a slope failure composed of a mass of rapidly moving, fluidized snow and ice that slides down a mountainside. After initiation, avalanches usually accelerate rapidly and grow in mass and volume as they entrain more snow and ice. Avalanches can pick up debris from the ground, including soil, rock, large boulders, and trees.

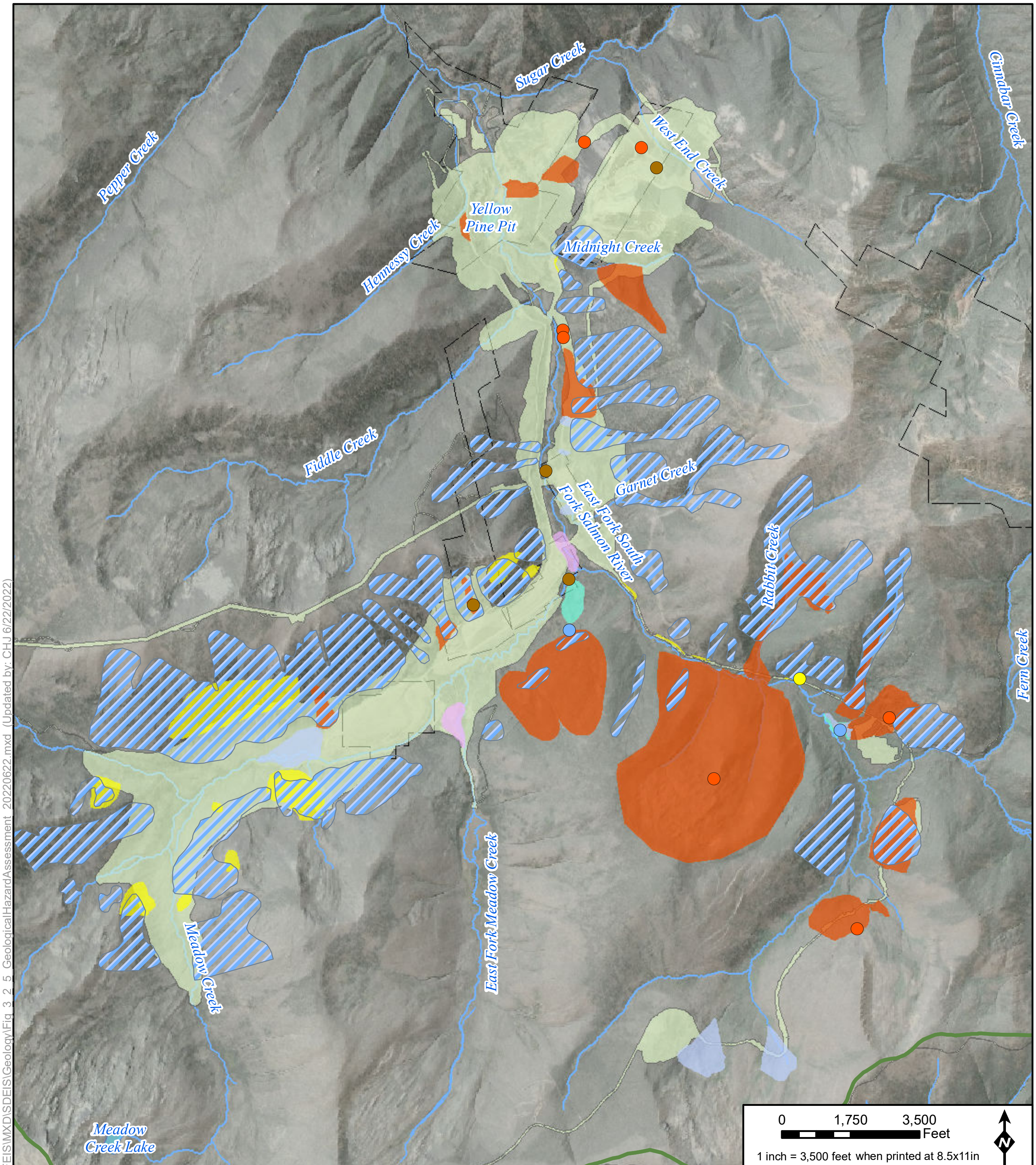
Avalanches occur on slopes averaging 25 to 55 degrees, with most slab avalanches occurring on slopes between 30 and 45 degrees, and several avalanche hazard areas occur within the analysis area (**Figure 3.2-5**).

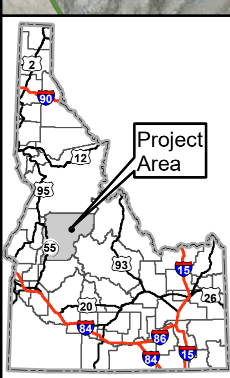
A combination of variables, including weather, and snowpack and terrain characteristics, contribute to the formation of avalanche conditions. The most common types of avalanches are loose snow and slab avalanches. Loose snow avalanches occur when slope angle exceeds the sheer strength of surface snow to resist downslope motion. As the surface snow moves downslope it may entrain subsurface snow, increasing the mass and destructive potential of the avalanche. Wet loose snow avalanches triggered by melting due to warming by the sun or rainfall on the snowpack are generally larger, and therefore have a greater destructive potential, than dry ones. Slab avalanches consist of a cohesive layer of snow overlying a weaker layer of snow. When the weight of the overlying cohesive layer of snow exceeds the strength of the underlying weak layer, the weak layer may fail. If the slope is steep enough, gravity overcomes the friction between the slab and underlying surface, tensile failure occurs at the slab boundaries, and the slab slides downslope. Slab avalanches can be triggered naturally by loading of new snow, wind deposited snow, or rainfall to the snowpack, cornice fall, warming air temperatures, or earthquakes. Artificial triggers that can lead to fracture and release of a slab avalanche include skiers, snowmobilers, and explosives. Slab avalanches are typically more destructive than loose snow avalanches because they are more massive and thus result in larger, farther running avalanche events.

Operations Area Boundary

The following subsections describe the geology and known landslide and avalanche hazards in the vicinity of the Operations Area Boundary based on geologic hazard assessments (STRATA 2014a, 2016) and an Avalanche Hazard Assessment for portions of the Operations Area Boundary (Mears and Wilbur Engineering 2013). **Figure 3.2-5** shows landslide and rockfall (slope failure comprised of rock) features in the vicinity of the SGP, as well as avalanche paths within the central Operations Area Boundary area.

Geologic and geotechnical conditions have been well characterized at the Operations Area Boundary by information derived from several studies conducted over multiple field seasons. Studies included drilling, sampling, and logging boreholes, standard penetration tests, cone penetrometer tests, geotechnical laboratory tests (e.g., particle size distribution, Atterberg limits, direct shear), groundwater monitoring wells, piezometers, aquifer slug tests, as well as specific structural geology investigation and a pit slope design study. A comprehensive discussion of available geologic information is provided in the SGP Geotechnical Investigations Summary Report (Tierra Group 2018), the Geotechnical Baseline Summary (STRATA 2017; Tierra Group 2017), and the SGP Feasibility Study Technical Report (M3 2021).





LEGEND

Geohazard Sites

- High Erosion Potential
- Landslides and Sloughs
- Rockfall Areas
- Wet Areas/Seeps

Geohazard Area

- High Erosion Potential
- Landslide and Sloughs
- Rockfall
- Sensitive Soil
- Wet Areas/Seep

- Avalanche Hazard Areas
- Project Features
- Patented Claim Boundary
- Lake/Reservoir
- Stream/River

Figure 3.2-5
Geohazard Locations Within the Analysis Area
Stibnite Mining District
Stibnite Gold Project
Stibnite, ID

Base Layer: Hillshade derived from LiDAR supplied by Perpetua
Other Data Sources: Perpetua; Boise National Forest; Payette National Forest

PAYETTE NATIONAL FOREST

FOREST SERVICE U.S. DEPARTMENT OF AGRICULTURE

Structural orientations of faults and joints were measured at rock exposures as well as the width, infill, and kinematic indicators, if present. In addition to examination of surface exposures, oriented boreholes were drilled in the Yellow Pine pit, West End pit, and Hangar Flats pit areas and continuous rock core was sampled (Tierra Group 2018).

Several studies were performed to evaluate pit slope design (STRATA 2014b). The STRATA (2014b) study found that the rock at all three pits consisted predominately of quartz monzonite and quartzite. These rock types are typically very competent.

The SGP Comprehensive Baseline Geochemical Characterization Report (SRK 2021a) provided combined results of Phase 1 and Phase 2 rock geochemical characterization programs and the overall conclusions of the updated characterization were not changed from the 2017 reporting.

The SGP Geotechnical and Geophysical Data Evaluation Memo (Brown and Caldwell 2022b) describes statistical analyses of core structural characteristics and also shallow seismic surveys completed in 2017. This information described a widespread bedrock condition in the SGP area where the upper portion of the bedrock directly underlying unconsolidated materials was more weathered and fractured than the underlying, more competent bedrock.

Northern Area: Yellow Pine and West End Pits

The terrain in the northern Operations Area Boundary is relatively steep with natural timbered slopes as steep as approximately 31 degrees (1.67H:1V). Waste rock disposal areas from previous mining activity are northeast of the historic Homestake pit (the site of northeastern end of proposed Yellow Pine pit) and to the southeast of the historic West End pit.

Observed overburden thickness in the area northwest of the planned Yellow Pine pit ranges from 47 to at least 180 feet, and depth to bedrock generally increases toward the west. The uppermost material in boreholes drilled approximately 2,000 feet to 750 feet northwest of the outline of the Yellow Pine pit consists of development rock from legacy mining activities (STRATA 2017; Tierra Group 2017). Native soil beneath the development rock is mostly sand, with some gravel. Overburden depth in the valley bottom area south of the Yellow Pine pit ranges from 47 to 61 feet and consists mostly of sand and gravel, with occasional layers of silt noted in the borehole logs. Side slopes to the west have thicker overburden, up to 200 feet thick, composted of glacial outwash materials.

The predominant structural feature in the Yellow Pine pit area is the MCFZ, which generally is north-northeast striking and steeply dipping to the west or northwest. Associated with the zone are north-striking, west-dipping conjugate splay or cross structures. The widest recognized section of the fault zone is about 190 feet wide. Other faults in the area tend to be sub-parallel to the MCFZ; these include the Hennessy Fault, Hanging Wall Shear Fault, C-Shear Fault, Meadow Creek Hanging Wall Fault, and Meadow Creek Footwall Fault.

Eleven boreholes, ranging in length from 56 to 695 feet, were drilled along the East Fork SFSR tunnel alignment during multiple investigations, and additional overburden and bedrock boreholes were drilled nearby for Yellow Pine pit exploration and geotechnical investigations to aid interpretation of subsurface conditions. Overburden near the proposed tunnel portals consists of legacy development rock and native glacial till ranging in grain size from silt through boulders. Depth to bedrock was 55 to 136 feet. Bedrock along the tunnel alignment is generally unaltered to weakly altered and weakly mineralized. Hennessy Shear Zone and MCFZ displayed fractured intrusive rock, with zones of gouge and breccia. Four seismic refraction geophysics lines were completed at the portals to define the bedrock profile.

A full description of these geotechnical investigations, stratigraphy, rock mass characterization, and geophysics is provided in the *Geotechnical Investigations Summary Report* (Tierra Group 2018) and East Fork SFSR Tunnel Design Documentation Report (McMillen Jacobs 2018).

The Yellow Pine backfill is wholly within the Yellow Pine pit and would be underlain by bedrock. Yellow Pine backfill would be placed within the Yellow Pine pit long after overburden is removed from the area. Fifteen boreholes were completed in this area during multiple investigations, including five boreholes to classify the rock mass (no overburden geotechnical data was collected for these five boreholes).

The predominant structural feature in the West End pit area is the WEFZ, which generally is striking north-northeast and steeply dipping southeast, and includes the Hanging Wall, Middle, and Footwall faults.

Two slumps, four landslides, and a rockfall are noted in this area (**Figure 3.2-5**). The isolated slumps likely were caused by oversteepening of the slope due to road cuts and the presence of groundwater seepage near or at the ground surface. Potential rockfalls are primarily related to former open-pit mining slopes in the Homestake pit, West End pit, and the Stibnite pit.

The Avalanche Hazard Assessment (Mears and Wilbur Engineering 2013) did not include an assessment of avalanche hazards in the vicinity of the proposed Yellow Pine and West End pits.

Central Area: Mine Support Facilities

The central area extends south of the Yellow Pine pit and encompasses most of the proposed mining support facilities in or adjacent to the East Fork SFSR valley floor, a relatively flat area. Geologic materials are comprised of alluvium, glacial deposits, and ancient landslide deposits (STRATA 2013).

Twenty-four geotechnical boreholes and groundwater monitoring wells were completed at the area of the ore processing facility and proposed Scout exploration decline during multiple investigations. Native soils consist of alluvial and colluvial sands and gravel. Bedrock was encountered at depths ranging from 5 to 97 feet below ground surface.

Potential geohazards identified in the Central Area are shown on **Figure 3.2-5** and include two slumps, one landslide, three rockfalls, and three areas with groundwater seeps.

Two relatively small slumps occur in old road cuts along a now obscured former access road. The other slump is just north of the first slump. Groundwater seeps suggest that seeps and elevated groundwater may have helped initiate these slope failures (STRATA 2014a).

A larger landslide covers several acres to the east of the East Fork SFSR and is believed to be a post-glacial landslide. A groundwater seep also occurs near the south margin of the landslide.

Directly behind and to the east of the core building at the exploration camp is a rock outcrop producing a rockfall comprised of angular cobbles and small boulders. The hill slope to the west of the confluence of Meadow Creek and the East Fork SFSR has large steep outcrops of quartz monzonite that could produce rockfalls (STRATA 2014a).

Mapped avalanche paths in this area are mostly on the slopes to the east of Meadow Creek. Some are mapped between the proposed cell tower access road and new transmission line segment (**Figure 3.2-5**) (Mears and Wilbur Engineering 2013).

Southwest Area: Hangar Flats Pit and SODA

The southwest area is within the relatively flat valley floor of Meadow Creek. The area is the proposed location for the Hangar Flats pit. The SODA is currently upstream from the former Hecla heap leach pad in this same terrain.

Exploration drilling in the Hangar Flats area indicates that depth to bedrock increases greatly with distance from adjacent valley slopes, suggesting a deep U-shaped valley, filled with stream sediments overlying glacial deposits. Overburden thickness is greatest in the south-central area, where the depth to bedrock was noted to be more than 250 feet (borehole SRK-GM-22S). Surficial soils were moderately dense to dense sands with some gravel and occasional silt layers. Beneath the surficial layers, the soils are mostly sand and gravel inter-bedded with silty sand. At depths greater than 200 feet, clayey sand and clayey gravel were encountered.

The predominant structural feature in the Hangar Flats area is the MCFZ, which generally is north-striking and steeply dipping (nearly vertical). Associated with the zone are northeast or east-trending, nearly vertical conjugate structures. Splays of the MCFZ are common and trend northeast, with shallow dips to the northwest. The MCFZ is a broad structural zone, marked by intense shearing, characterized by fault breccia and gouge.

Based on reconnaissance and helicopter fly-over observations, five landslides were identified in this area by STRATA (2014a) (**Figure 3.2-5**). A narrow (about 200 feet wide) debris flow scar originates near the Meadow Creek Mine portal and extends downslope to the valley floor. Another narrow landslide area is in a shallow drainage on the north hillside near the west end of the SODA.

A slow-moving landslide (i.e., creep) of approximately 20 acres is in the mouth of the drainage above the west end of the Hecla heap leach site. The toe of the landslide is near the projected toe of the TSF Buttress.

Two landslide features occur on the northwest-facing hill slope to the south of the Meadow Creek confluence with East Fork SFSR and extending to the mouth of Blowout Creek. One is characterized by irregular hummocky ground and seeps indicate past landslide activity covering approximately 80 acres. A smaller slump in a road cut is present about half-way downslope and to the west. This slump area appears to be several years old and has been treated with staked erosion control matting; new vegetation is established in the scar.

The majority of the SODA and the proposed TSF Buttress are within mapped avalanche hazard zones (**Figure 3.2-5**) (Mears and Wilbur Engineering 2013).

Southeast Area: East Fork SFSR and Worker Housing Facility

The terrain in southeast area is primarily in or adjacent to the valley floor of the upper reaches of the East Fork SFSR and is relatively flat.

Seven boreholes were completed at the Worker Housing Facility area during multiple investigations. Native soils consist of alluvial and colluvial sands and gravel. Bedrock was encountered at depths ranging from 23 to 39 feet below ground surface, but four boreholes were not advanced to bedrock.

Landscape features are dominated by glacial deposits, particularly lateral moraines and a large ancient landslide on the south hillside of the drainage, approximately 1 mile upstream of the confluence of the East Fork SFSR and Meadow Creek (STRATA 2014a). Two landslides were identified in this area in addition to two areas that were observed with seeps, indicating a potential for future slides.

A large, ancient (glacial age) landslide covers at least 200 acres south of the East Fork SFSR and appears to have dammed the drainage in the past, likely forming the depositional area that is now a flat meadow. This area is characterized by hummocky ground and local areas of seeps, or wet areas with spongy ground.

There also is an ancient landslide of about 9 acres upslope of the proposed worker housing facility in the East Fork SFSR valley about 1.3 miles upstream from its confluence with Meadow Creek. Thunder Mountain Road (FR 50375) crosses the central portion of this feature just east of the flat floodplain area.

Avalanche hazard zones have been identified in Rabbit Creek valley and the adjacent unnamed stream valley to the southeast, as well as directly east of the proposed worker housing facility. Additional avalanche hazards zones are mapped near the northernmost Burntlog Route borrow source (Mears and Wilbur Engineering 2013).

TSF Buttress

Eighty-six boreholes were drilled at the proposed TSF Buttress area during multiple investigations, with 42 of these boreholes specific to the SODA. Native soils generally consist of alluvial and colluvial sands and gravel. Bedrock was encountered at depths ranging from 90 to 180 feet below ground surface. Up to 75 feet of spent ore, and 55 feet of Bradley tailings were encountered.

Three borings were drilled at the proposed TSF Buttress and Hangar Flats pit footprint area to characterize the rock mass (Tierra Group 2018). The Hangar Flats pit geotechnical information is applicable to this area.

A full description of these geotechnical investigations, stratigraphy, and laboratory testing is provided in the Geotechnical Investigations Summary Report (Tierra Group 2018).

Effects of Legacy Underground Mine Openings

The first phase of large scale (mostly underground) mine development of the SGP area commenced in the 1920s and continued into the 1950s. This ore was processed in local mill and smelter facilities. The second period of major mining activity in the area commenced with open pit mining and heap leaching from 1982 to 1997. The open pits, development rock disposal areas, mill tailings, and spent heap leach materials resulting from these legacy mine operations are evident on the ground surface of the SGP property. The underground mine developments are not as obviously present and are discussed below. The descriptions of these mine operations were obtained from Victoria Mitchell's *History of the Stibnite Mining Area* (Mitchell 2000), and the 2021 Feasibility Study Technical Report (M3 2021).

The Hangar Flats deposit was mined underground between the 1920s and 1937 in what was known as the Meadow Creek Mine. The mine was developed on six levels with numerous drifts and crosscuts (tunnels), raises and winzes (underground shafts), and stopes (irregular openings where ore was removed). The mine openings were reinforced with wood supports and the exhausted stopes were backfilled with development rock. In addition to two Meadow Creek Mine adits, two other tunnels were driven toward the deposit from the north, including the North Tunnel in the Fiddle Creek Gulch and the Monday Tunnel along the lower East Fork SFSR. About 25,426 feet of underground workings were developed in the Meadow Creek Mine during this period. A small amount of additional ore was removed from the mine in the early 1940s from two levels of the mine that were not caved or flooded. Between 1951 and 1954, the Defense Minerals Exploration Administration (DMEA) carried out an underground exploration program immediately north of the Meadow Creek Mine that resulted in about 4,900 feet of underground workings on three levels.

The Yellow Pine Deposit claims were first staked in 1923 and explored with two short tunnels. The property was optioned to F.W. Bradley's Yellow Pine Mining Company in 1929 which did exploration of the Yellow Pine deposit in five tunnels and drove the Monday and Cinnabar tunnels on opposing sides of the valley. The Cinnabar Tunnel headed toward the east to explore and develop the Cinnabar Claim Group and the Monday Tunnel was driven over 6,000 feet south along the Meadow Creek Fault Zone to intercept the Meadow Creek Mine at its 400-foot level but stopped short of this goal. After the Meadow Creek Mine shut down, mining activities shifted in earnest to the Yellow Pine area with both open pit and underground exploration and production between 1938 and 1952. Two shafts were sunk from the surface and three underground levels were developed with a winze (underground shaft) leading to the deepest level. Approximately 4,000 feet of underground workings (drifts, crosscuts, and stopes) were developed with the openings supported by timber sets. Exhausted stopes were backfilled with glacial till obtained from the surface overburden stripping. The decision was made in the early 1940s to increase production with open pit mining methods. In 1943 flow in the East Fork SFSR was routed around the Yellow Pine pit in the 3,500-foot-long Bailey Tunnel that collected the stream on the south side of the pit and discharged to Sugar Creek north of the pit. Between the late 1940s and 1952 all ore production from the Yellow Pine Mine was from the open pit operations which intercepted some of the former underground mine openings.

The legacy mine and heap leach disturbances from past surface mining activities in the Yellow Pine, Hecla, and West End open pits are not the subject of this discussion of the impacts of the underground mine openings on the 2021 MMP and will not be further discussed here.

The proposed Hangar Flats and Yellow Pine pits would intersect legacy underground workings and have been designed with this in mind. The locations of the above-described underground workings are shown on **Figure 2.4-17** along with the proposed boundaries of the Hangar Flats and Yellow Pine pits.

In the 2021 MMP (Perpetua 2021a), the Hangar Flats pit has been reduced by 70 percent compared to the 2016 configuration (Midas Gold 2016a). One of the reasons contributing to this reduction, as noted in the 2021 Feasibility Study (M3 2021), is "*a number of technical challenges, risks, and costs associated with mining through the extensive historical underground workings*". As shown on **Figure 2.4-17**, most of the Meadow Creek Mine underground workings underlie the proposed Hangar Flats pit. Perpetua's mine engineer also notes that a double-wide catch bench (40-foot instead of 20-foot) is incorporated into the Hangar Flats pit design to partly account for some potential wall instability in the vicinity of underground workings (Perpetua 2021f).

The tunnels to the north of the main Meadow Creek Mine underlie the high mountain slopes to the west of the East Fork SFSR and would not underlie any of the proposed mine operations facilities. All of the Meadow Creek Mine underground workings and connected tunnels are not located under any of the proposed support facilities including the truck shops, mill complex, worker housing, TSF Buttress, or TSF embankment or impoundment.

The Yellow Pine pit would intersect portions of several tunnels, drifts, and stopes of the former Yellow Pine Mine underground workings, including portions of the Monday Tunnel and the Bailey Tunnel, and would completely mine through underground workings of the Yellow Pine Mine (**Figure 2.4-17**). Intersecting these features is not anticipated to result in stability concerns. The Monday Tunnel/Yellow Pine pit wall intersection would approximate the tunnel cross-sectional diameter as the pit wall would be nearly perpendicular to the tunnel axis. Similarly, much of the Bailey tunnel would be excavated by mining activity and the remaining pit/tunnel intersection would be nearly perpendicular to the final pit wall, leaving a remaining opening into the pit wall approximately 6 feet in diameter (Perpetua 2021f).

Expressions of legacy underground workings located below the ultimate pit backfill levels would be blocked/filled with development rock to prevent public or wildlife access prior to pit backfilling. Expression of legacy underground working located above ultimate pit backfill levels would be closed in a manner similar to the East Fork SFSR and Scout Decline tunnels as described in **Section 2.4.7.3**.

Access Roads

To identify mass wasting hazards along the Burntlog Route and the Johnson Creek Route Alternative, the following information sources were used to evaluate risks:

- Avalanche hazard mapping was completed for the Operations Area Boundary and the final 2.5 miles of the Burntlog Route into Stibnite mine by Mears and Wilbur Engineering (2013).
- STRATA (2016) conducted a survey of geologic hazard conditions along the proposed Burntlog Route access road which mapped areas impacted by rockfalls, landslides, and wet soils.
- DAC (2018) reported on potential snow avalanche hazards affecting the Burntlog Route, including several alternatives that were under consideration at that time.

- The Warm Lake Summit area was included in the DAC (2018) mapping, as well as the Operations Area Boundary mapping completed by Mears and Wilbur Engineering (2013).
- DAC (2021) updated the avalanche mapping and risk analysis for the proposed and alternative access routes.

AECOM (2020c) conducted a study to identify probable geohazard areas along the Burntlog and Johnson Creek routes based on 2020 aerial imagery and using the observed vegetation signatures, substrate color, erosion evidence, and slope calculations. Landslide and rockfall hazards were identified along existing road cuts based on vegetation signatures and evidence of migrating slope failures up-slope of the road prism. Rockfall hazards were identified along existing road cuts based on vegetation signatures, substrate color, and evidence of slope erosion upslope of the existing road prism. Information from STRATA (2016) was considered along both existing and proposed roads.

Hamre (2021) reported on both the Burntlog Route and the existing Stibnite Road portion of the Johnson Creek Route up the East Fork SFSR from the village of Yellow Pine. That work included evaluation of methods of avalanche risk reduction with associated costs and presented avalanche path mapping for the larger avalanche paths that affect Stibnite Road.

The avalanche mapping presented by DAC (2021) included detailed avalanche path descriptions for the Stibnite Road, Johnson Creek Road, and the Cabin Creek OSV route. The Mears and Wilbur Engineering (2013) mapping was not modified because it was completed at a higher level of detail and field investigation (i.e., hazard zoning [Blue and Red]) for facilities. Any new or modified avalanche paths mapped by Hamre (2021) were considered and (in most cases) included as part of the DAC mapping. The DAC (2021) avalanche descriptions were comprehensive and included consideration of terrain factors including: elevation, vertical fall height, slope incline, aspect (direction that the starting zone faces relative to solar exposure and prevailing wind directions), terrain shape (concavity or convexity downslope and across slope), surface roughness, and vegetation cover (e.g., forest cover and tree density). Potential snowfall and snowpack depth amounts varied by elevation and geographic location. These variables were evaluated to assess the potential magnitude and frequency of avalanches expected to affect the roads at each path. DAC also described the miles of road potentially affected by the avalanche paths, potential frequency of avalanches (low to high), range of frequency in years, likely size of the avalanche at the road (D2 to D4), and descriptive comments of the potential avalanches.

Very small sized avalanche paths (capable of producing up to D1, < 10 tonnes of snow mass) that would not present a risk to vehicles on the roads were not mapped. Small paths (capable of producing up to D2, 100 tonnes of snow) that could be operational hazards to traffic were described, as were paths capable of producing up to D3 (1,000 tonnes of snow) sized avalanches that could bury or destroy a car. Only a few paths capable of producing up to D4 (10,000 tonnes) sized avalanches were identified, located above the Stibnite Road. These large avalanches could destroy large trucks and a substantial amount of forest. Stibnite Road has a history of being affected by large avalanches, which has been exacerbated by wildfire. As described in DAC (2021), notable years include 2014, 2019, and 2021. The most destructive recent event was in 2019, when a large avalanche entrained timber from wildlife events, traveled across the river, and continued 60 feet down Stibnite Road. The avalanche and river flow diverted by the avalanche debris resulted in extensive road damage.

The Transportation Management Plan (Perpetua 2021e) shows the locations and extent of geologic hazards and avalanches described in the above referenced study reports for both transportation routes. That same information is shown on **Figure 3.2-6**.

Burntlog Route

Landslide and rockfall hazards have been assessed along the Burntlog Route, including in-field observations (STRATA 2016). Visual evidence of slope instability was reported at several locations along the route. Potential rockfall areas are primarily tied to existing road cuts occurring in both glacial till/colluvium and granitic outcrops.

Avalanche paths were comprehensively described by DAC (2021) for the overall Burntlog Route. Along the existing road from Warm Lake to Landmark they identified 11 avalanche paths potentially affecting 1.6 miles (**Figure 3.2-6**). These were relatively high frequency avalanche paths (1 to 3 years) producing small (D2), loose avalanches with two larger avalanche paths (capable of producing up to D3) that could affect the road about every 3 years.

Along the existing Burntlog Road from Landmark to the ridge above Black Lake, seven avalanche paths capable of producing avalanches up to D2 were identified potentially affecting 0.5 miles of road with four of them having the potential to affect the road on average every 10 years.

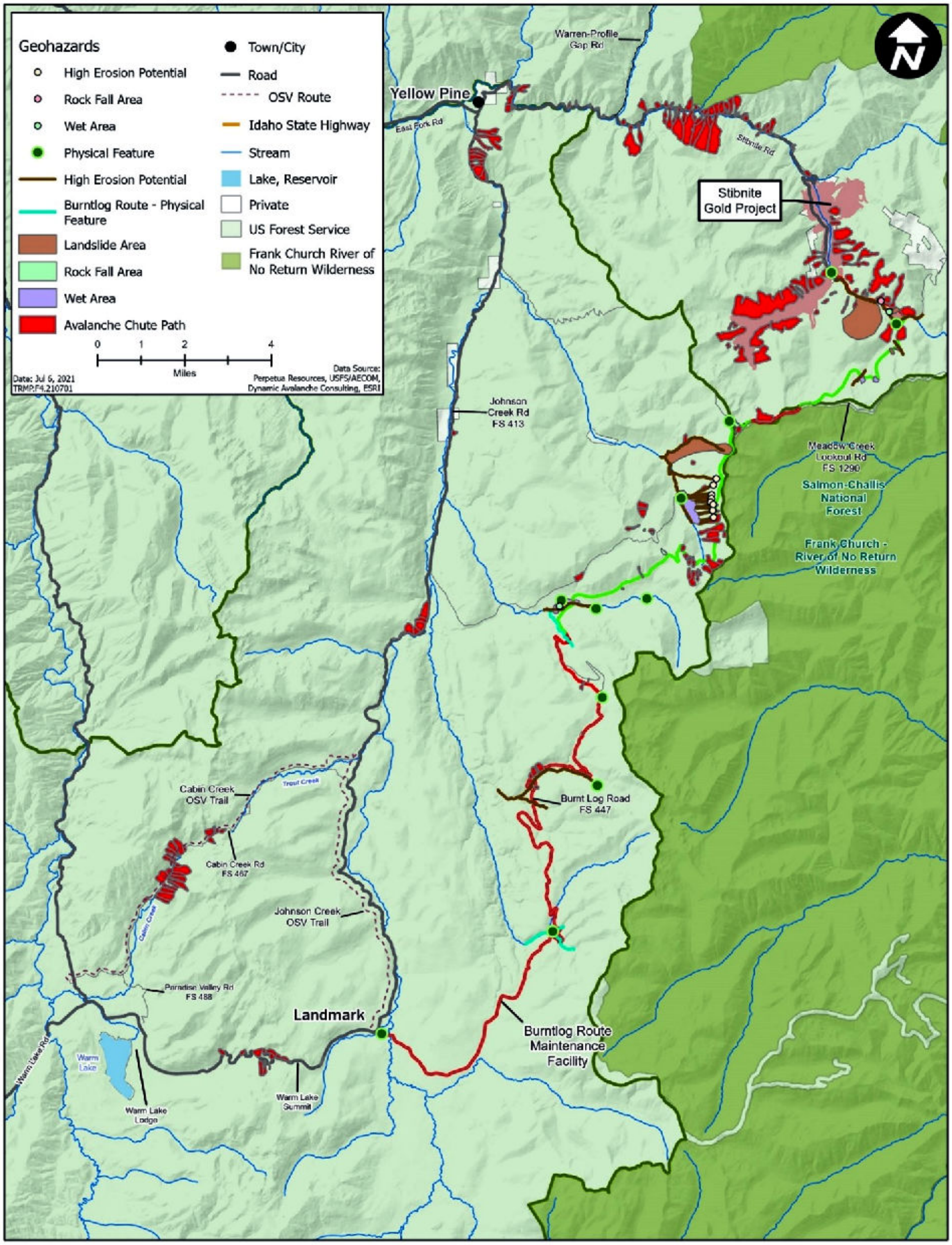
From the end of the existing Burntlog Road to Stibnite, 20 avalanche paths were identified along the alignment of the proposed extension of the Burntlog Road potentially affecting 2.4 miles of road. Most of these were paths capable of producing up to D2, with high frequencies (1 to 3 years). There were two paths capable of avalanches up to D3 with moderate frequencies (3 to 10 years).

A total of 38 avalanche paths were identified by DAC (2021) along the Burntlog Route from Warm Lake to Stibnite potentially affecting 4.5 miles of road (**Figure 3.2-6**).

Johnson Creek Route

The Johnson Creek Route includes Johnson Creek Road (CR 10-413) and Stibnite Road (CR 50-412). Identified geologic hazards, including those based on the desktop study are depicted on **Figure 3.2-6**. There is documentation of avalanches and landslides along this route (Midas Gold 2019a). In March 2014, a series of avalanches blocked Stibnite Road (CR 50-412) in two locations and caused the river to reroute onto the road. In April 2019, a series of avalanches and related landslides caused extensive damage to Stibnite Road (CR 50-412), resulting in closure of the road for approximately two months. The slides pushed snow, timber, and other debris into the East Fork SFSR and up onto Stibnite Road, and sections of the road near Tamarack Creek were washed away.

Avalanche paths were comprehensively described by DAC (2021) for the overall Johnson Creek Route. The portion of the route from Warm Lake to Landmark is common with the Burntlog Route and is described above. The 11 avalanche hazards affecting 1.6 miles of road for that segment are included in the totals for the Johnson Creek Route.



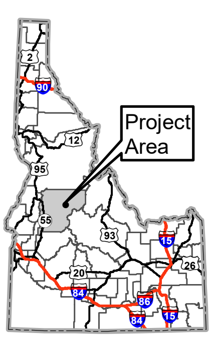


Figure 3.2-6
Identified Geohazards Along Burntlog and Yellow Pine Access Routes
Stibnite Gold Project
Stibnite, ID

Avalanche terrain along Johnson Creek begins approximately 10.5 miles north of Landmark. From that point north to Yellow Pine, 20 avalanche paths were identified potentially affecting 2.4 miles of the Johnson Creek Road. Most of these paths were at relatively lower elevations and were small sized. Consequently, all paths along Johnson Creek Road were assessed to potentially produce D2-sized avalanches with frequencies of 10 to 30 years and some of the same paths could produce D3-sized avalanches with 30- to 100-year frequencies.

In the 13.5 miles from Yellow Pine to the north end of the SGP mine site, a total of 63 avalanche paths were identified potentially affecting 4 total miles of road, 2.6 miles of which were likely to produce D2- or D3-sized avalanches with low to high frequency (1 to 30 years) and 1.4 miles of which were likely to produce D2- to D4-sized avalanches with low to high frequency that could cause damage to Stibnite Road as documented in 2014 and 2019.

Avalanche paths across the East Fork SFSR have the potential to deposit snow and forest debris into the river and on the road. Avalanches in this area can also create dams which could then cause scouring of the riverbanks and damage the road.

Near the confluence of the East Fork SFSR and Tamarack Creek, about 6 miles from Yellow Pine, is a 2-mile length of the canyon containing a total of 27 avalanche paths affecting 1.4 miles of road that is almost continuously exposed to avalanche paths capable of producing up to size D3 that could impact the road with a 1- to 3-year return period. These include five paths with the potential for producing D4-sized avalanches with a frequency of 30 to 100 years, presenting a large hazard to traffic, and could severely damage the road itself. A large amount of standing dead timber remains in these paths that could be entrained in these avalanches.

A total of 94 avalanche paths were identified by DAC (2021) along the Johnson Creek Route from Warm Lake to the SGP potentially affecting 8 total miles of road (**Figure 3.2-6**).

Proposed Cabin Creek OSV Route

The Cabin Creek OSV Route was assessed for avalanche hazards by DAC (2021) to aid with managing this route during the winter months with respect to avalanche hazards. It was assumed that snowmobilers would follow the proposed alignment, which mostly follows an existing forest service road. Deviating from this alignment closer to either side of the valley could expose snowmobilers to a higher avalanche hazard. Like Warm Lake Summit, the Cabin Creek OSV Route receives higher precipitation than other parts of the project area, which is expected to result in higher avalanche frequency than drier areas to the northeast.

A total of 18 avalanche paths potentially affecting 1.6 miles of the road were identified by DAC (2021) along the proposed Cabin Creek OSV route (**Figure 3.2-6**). The relatively high snowfall along this route suggests that most of these paths are expected to produce D2-sized avalanches on an annual basis with potential D3 avalanches with a 10- to 30-year return period.

Summary of Geohazards and Avalanches along the Proposed Access Road Alternatives

Table 3.2-1 provides total geohazards identified along the Burntlog and Johnson Creek access routes.

Table 3.2-1 Total Identified Geohazards Along the Access Route Alternatives

	Total Number[1]	Length of Road Affected (Miles)	Total Number	Length of Road Impacted (Miles)
Access Route	**Landslides and Rockfalls**		**Avalanche Paths**	
Burntlog Route	26	2.9	38	4.5
Johnson Creek Route	45	4.2	94	8.0

Source: Google Earth 2020; Mears and Wilbur Engineering 2013; Midas Gold 2019b, Mears 1992; STRATA 2016; DAC 2021
[1] Total does not include two slump features along Johnson Creek Road. The slumps are not currently impacting the road prism.

3.3 Air Quality

3.3.1 Introduction

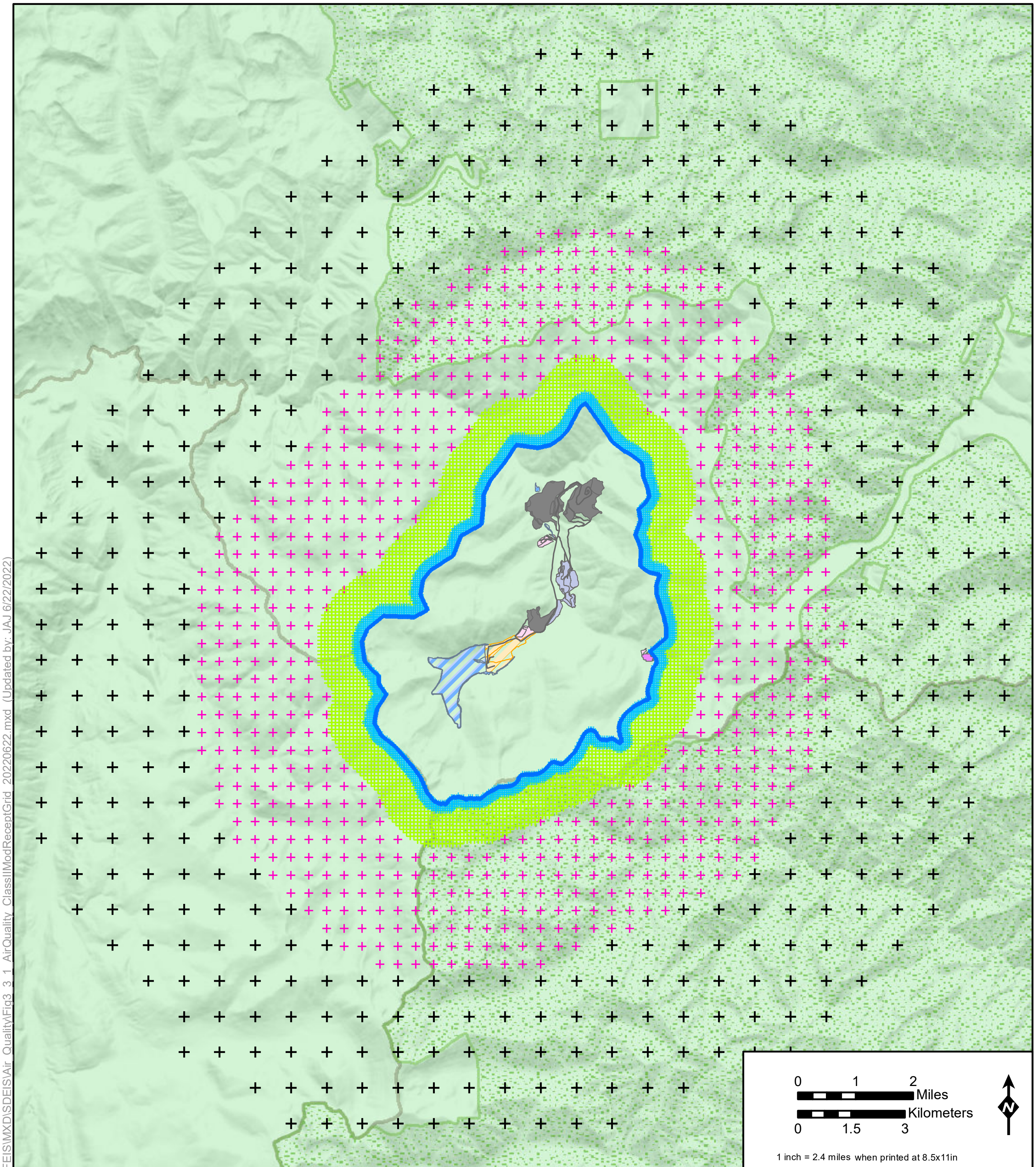
This section describes the area of analysis for air quality, applicable government requirements, and the baseline, or affected environment of the SGP area. Additional details may be found in the Air Quality Specialist Report (Forest Service 2023a).

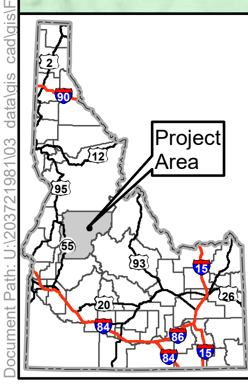
3.3.2 Air Quality Area of Analysis

An air quality analysis usually relies on defined geographic regions that represent the areas for which different types of modeling would be conducted. First, a “near field” was examined using appropriate models to quantify the effects of action alternative sources. The near-field modeling domain for the ambient air quality analysis, which extends 10 km from the SGP, is depicted in **Figure 3.3-1**. Other aspects of the near-field modeling such as nitrogen and sulfur deposition used a domain of 50 km from the SGP. Federal modeling rules (40 CFR 51, Appendix W) stipulate that near-field models may be applied for distances of 50 km or less from the emission sources. For the SGP, preliminary modeling confirmed that the 10-km domain size was adequate to characterize near-field air quality impacts. Air quality effects would typically decrease at distances beyond the modeled 10 km range.

The refined model uses a “grid” of defined receptor points at which air pollutant concentrations are predicted by the model calculations. Receptor tiers were used starting at 25 m along the Operations Area Boundary and transitioning to 1 km spacing out to the 10-km extent of the modeled domain to follow accepted regulatory modeling practice. Tighter spaced receptors were used closer to the Operations Area Boundary to allow the model to map in more detail the predicted close-in concentrations that are generally the highest.

Second, a much larger “far-field” region was defined within an area up to 300 km-radius from the SGP that encompassed more-distant Class I areas, wilderness areas, Tribal reservations, and other areas requested by Tribes were considered in the analysis. This is important given the potential impacts of poor ambient air quality to wilderness areas that are of Tribal and cultural significance. For the SGP, this region is shown in **Figure 3.3-2**, with the Class I areas identified.





LEGEND

Receptors

- 25-m-spaced receptors along the OAB
- 50-m-spaced receptors extending 250 m beyond the OAB
- 100-m-spaced receptors extending 1 km beyond the 50-m-spaced receptors
- 500-m-spaced receptors out to 5 km beyond the OAB
- 1-km-spaced receptors out to 10 km beyond the OAB

Project Components *

Mine Site

- Tailings Storage Facility
- Growth Media Stockpile
- Open Pit
- Ore Processing Facilities / Mine Support Infrastructure
- Development Rock Storage Facility
- Workers Housing Facility

- Haul Road

Other Features

- U.S. Forest Service
- Wilderness

*Project Components are associated with all Alternatives

Figure 3.3-1
SGP Operations Area Boundary and Class II Modeling Receptor Grid
Stibnite Gold Project
Stibnite, ID

Base Layer: USGS The National Map: 3D Elevation Program. USGS Earth Resources Observation & Science (EROS) Center: GMTED2010. Data refreshed March, 2021.
Other Data Sources: Perpetua; Air Sciences Inc.; Boise National Forest; Payette National Forest

PAYETTE NATIONAL FOREST

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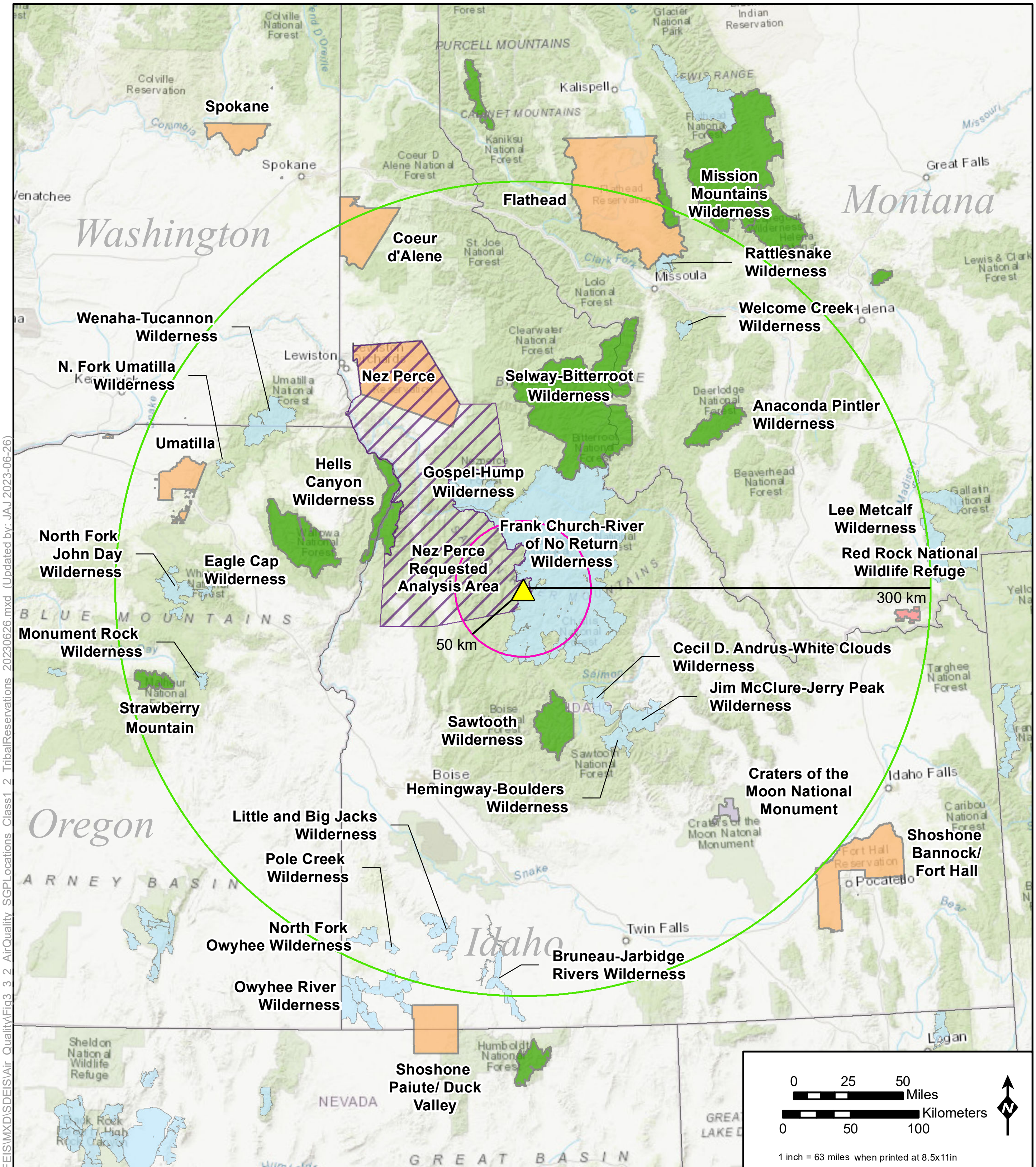


Figure 3.3-2
SGP Location and Class I & II Areas, Wilderness Areas, Tribal Reservations, and Areas Requested by Tribe for Analysis Stibnite Gold Project Stibnite, ID

Base Layer: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
Other Data Sources: Perpetua; Air Sciences Inc.; United States Census Bureau

Map Date: 2023-06-26

Document Path: U:\2037219\81\03_data\gis_cad\gis\FEIS\MXD\SDEIS\Air_Quality\Fig3_3_2_AirQuality_SGPLocations_Class1_2_TribalReservations_20230626.mxd (Updated by: JAJ 2023-06-26)

A key concept in air quality analysis is the definition of "ambient air" as a defined area in which air pollutant effects to air are to be compared to the national and state ambient air quality standards because that area is accessible to the general public (EPA 2019a). For purposes of the SGP, the area outside the area of Operations Boundary is defined as ambient air for modeling analyses is the Operations Area Boundary. This area is illustrated in **Figure 3.3-1** and is understood to be the limit of the operations area that would be closed to unrestricted public access. In this area, public access would be prohibited, or restricted through such measures that are accepted as means to control public access (EPA 2019a) such as security checkpoints, physical barriers at points of potential access road and trail entry, and security surveillance patrols.

A May 12, 2021, memorandum developed for the Forest Service by Stantec Consulting Services Inc. (Stantec) outlines the rationale to exclude a portion of the proposed seasonal through-site controlled public access road through the mine operations from the public as approved by both the IDEQ and the accepted by the EPA from ambient air for dispersion modeling purposes (Stantec 2021). This stretch of road is from Stibnite Road (FR 50412) to Thunder Mountain Road (FR 50375). The EPA Region X has indicated that the access road could possibly be excluded from ambient air if sufficient enforceable measures are taken to comply with the 2019 revised policy (EPA 2019a). Exclusion of the public access road from ambient air protections is a unique case that relies on measures assumed to meet the standards inferred in the 2019 revised ambient air policy. However, a formal EPA policy review of the ambient air boundary for the SGP has not been conducted nor requested. A formal review is not necessarily required. The EPA did provide formal comment on IDEQ's air quality Permit to Construct (PTC) recommending a review be requested by the state and that initial measures in the PTC were too ambiguous to determine compliance with the revised ambient air policy. To comply with this measure, Perpetua has developed an access and transportation management plan that is included as Appendix D in the Air Quality Specialist Report (Forest Service 2023a). The Stantec memorandum provides details that IDEQ, who is responsible for issuing air permits in the state, have excluded the road because of access restriction measures put in place consistent with their rules and requirements in the permit. IDEQ has accessed the access road restriction and stated that only registered guests would have access to or through the mine as stated in the final PTC issued on June 17, 2022. IDEQ is confident of its interpretation of ambient air and asserts that methods applied to exclude areas is appropriate. The PTC also requires an Access Management Plan to be developed outlining specific requirements relating to access control. Further information regarding IDEQ's ambient air interpretation is available in the PTC, condition 2.7, and the Response to Comments document, Comment 16.

3.3.3 Relevant Laws, Regulations, Policies, and Plans

The Clean Air Act (CAA) of 1970 (42 USC 7401 et seq.), as amended in 1977 and 1990, regulates air emissions and protects air quality and air quality related values across the U.S. Provisions of the CAA that are relevant to the analysis of SGP air quality effects are listed below:

- National Ambient Air Quality Standards (NAAQS)
- Attainment and Non-Attainment Area Designations
- New Source Review Permitting
- New Source Performance Standards (NSPS)

- Mobile Source Regulations
- Visibility and Regional Haze
- GHG Reporting Rule

Certain areas also may be designated for special protection of air quality. All U.S. lands are categorized as either “Class I” or “Class II,” under the CAA, which determines the level of protection from air pollution impacts provided by regulations. Mandatory federal Class I areas include international parks, wilderness areas, and national memorial parks that exceed 5,000 acres, as well as national parks that exceed 6,000 acres, which were in existence prior to August 7, 1977. All other areas were initially classified as Class II. The CAA also gives states and Tribes the ability to request re-designation from Class II to Class I status.

Land and Resource Management Plan: Physical, social, and biological resources on NFS lands are managed to achieve a desired condition that supports a broad range of biodiversity and social and economic opportunity. National Forest Land and Resource Management Plans embody the provisions of the NFMA and guide natural resource management activities on NFS land.

In the SGP area, the Payette Forest Plan (Forest Service 2003a), and the Boise Forest Plan (Forest Service 2010a) provide management prescriptions designed to realize goals for achieving desired condition for air quality and include various objectives, guidelines, and standards for this purpose.

National Ambient Air Quality Standards: The EPA, in Title 40 CFR 50, established NAAQS for six criteria pollutants: carbon monoxide (CO), lead, nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM) including PM less than 10 microns in diameter (PM_{10}) and PM less than 2.5 microns in diameter ($PM_{2.5}$), and sulfur dioxide (SO_2). The NAAQS set two levels of standards for each criteria pollutant: primary standards are health- based atmospheric concentration levels, across specific averaging times, and are protective of public health; secondary standards are in comparable form, and are established to protect commercial and natural resources, and public welfare.

While the EPA sets the NAAQS, most states, including Idaho, are responsible for implementing, attaining and maintaining the standards and this process is done through the State Implementation Plans (SIPs). The IDEQ is the regulatory agency for air pollution control for the State of Idaho. The CAA allows states to adopt their own standards if they are at least as stringent as the NAAQS. The State of Idaho has adopted the NAAQS by reference in IDAPA 58.01.01(107) in lieu of setting its own standards. In addition, Idaho has adopted an ambient air quality standard for fluorides in IDAPA 58.01.01(577). Literature survey and published air pollutant emissions inventory for gold mining do not list fluoride as a potential emissions concern, and therefore SGP fluoride emissions are considered to be negligible. **Table 3.3-1** lists the primary and secondary NAAQS that would apply to the SGP.

Table 3.3-1 National Ambient Air Quality Standards

Pollutant and Averaging Time	Primary NAAQS	Secondary NAAQS	Exceedance Criteria
CO, 8-Hour	9 ppm	N/A	Not to be exceeded more than once per year
CO, 1-Hour	35 ppm	N/A	Not to be exceeded more than once per year
Lead, 3-month	0.15 µg/m^3	0.15 µg/m^3	Not to be exceeded by the rolling 3-month average
NO_2, Annual	53 ppb	53 ppb	Not to be exceeded by the average of the 1-hour concentration in a calendar year
NO_2, 1-Hour	100 ppb	N/A	98th percentile of 1-hour daily maximum concentration, averaged over 3 years
O_3	0.070 ppm	0.070 ppm	Annual 4th highest daily maximum 8-hour concentration, averaged over 3 years
$PM_{2.5}$, Annual	12 µg/m^3	15 µg/m^3	Annual mean, averaged over 3 years
$PM_{2.5}$, 24-Hour	35 µg/m^3	35 µg/m^3	98th percentile, averaged over 3 years
PM_{10}, 24-Hour	150 µg/m^3	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years
SO_2, 3-Hour	NA	0.5 ppm	Not to be exceeded more than once per year
SO_2, 1-Hour	75 ppb	N/A	99th percentile of 1-hour daily maximum concentration, averaged over 3 years

Source: EPA 2018a
µg/m^3 = micrograms per cubic meter CO = Carbon monoxide m^3 = Cubic meters
N/A = Not applicable NAAQS = National Ambient Air Quality Standards
PM = Particulate matter NO_2 = Nitrogen dioxide O_3 = Ozone
SO_2 = Sulfur dioxide ppb = Parts per billion ppm = Parts per million

The EPA determines and publishes air quality attainment status in the EPA Green Book (EPA 2021a) based on whether the air quality in the area consistently meets the NAAQS. Areas that persistently do not meet this standard are designated as nonattainment areas. The geographic areas considered in the air quality analysis area are in attainment of the NAAQS for all pollutants and averaging times (IDEQ 2019a).

Federal Air Permitting: The New Source Review process requires facilities to undergo an EPA pre-construction review if they propose building new facilities or modifying existing facilities that would result in a "significant increase" of regulated New Source Review pollutants per 40 CFR § 52.21. The New Source Review is further broken down into Major Source Permits for stationary sources that emit criteria pollutants at levels that exceed the defined thresholds for the source type and Minor Source Permits for sources that have emissions below those thresholds. In Idaho, New Source Review air permitting is administered as a State Implementation Plan-approved state program from EPA.

Prevention of Significant Deterioration (PSD) permitting applies to new major sources or major modifications at existing sources for specific pollutants in cases where location of the source is in an attainment or maintenance area. For these sources, the PSD program requires an assessment of best available control technology and expanded analysis of air quality impacts in Class I areas in 40 CFR 52.21. Areas surrounding the SGP are in attainment with the NAAQS. Applicability of the PSD program to the SGP depends on the SGP's potential to emit regulated New Source Review pollutants. Applicability is determined using maximum potential annual potential emissions of the SGP for each New Source Review pollutant. SGP also includes a lime plant, which is a PSD designated facility as defined in 40 CFR 52.21(b)(1)(i)(a). However, the plant is "nested" inside a non-designated facility (the gold mine). EPA March 6, 2003, guidance states that when the primary activity is not a designated source category, the only emissions that should be applied for the "nested" designated source for PSD applicability are fugitive (EPA 2003). Applying this guidance, these emissions are included in Table 10 of the Idaho Statement of Basis. For each regulated pollutant, the plant emissions did not exceed 100 T/yr, and facility-wide emissions did not exceed 250 T/yr applicability thresholds. To be conservative, IDEQ also demonstrated that if the plant was considered as the primary activity of the mine and the marble overburden mining associated with the plant is included in the list of all plant sources, emissions did not exceed 100 T/yr (see Table 11 of the IDEQ Statement of Basis).

For new or modified major sources subject to the PSD program, ambient concentrations in Class I and Class II areas also are compared to criteria air pollutant concentration increments that specify the maximum increase of ambient air concentrations of pollutants, or the "consumption of increment", over the legally established baseline for an area. The analysis of increment consumption was promulgated under the CAA, and the available increment levels are specific to a given location. The allowable increment levels are more stringent in Class I areas, compared to Class II areas. It is the responsibility of the individual states, through their permitting programs, to ensure that the increments are not exceeded due to the development of new or modified facilities. While an increment analysis is required for new or modified major sources, it is recognized that new or modified minor sources also may consume increment. Because the assessment of increment consumption is part of state new source review programs, such an analysis is normally not included in air quality reviews under federal NEPA. However, a simple comparison of modeled pollutant concentrations to the increments for Class I and Class II areas was conducted as part of the SGP air quality analysis. Disclosure of the SGP impacts in comparison to PSD increments helps to inform decision makers and the public regarding the significance of impacts to local air quality.

A Title V operating permit is required for major stationary sources under the Federal Operating Permits Program provided in CAA implementing regulations at 40 CFR 70. Whether a source meets the definition of "major," depends on the type and amount of air pollutants the source could potentially emit on an annual basis.

A determination was made by the IDEQ that the SGP would require a Title V permit. This was based on the complete air emissions inventory for stationary sources submitted by Perpetua as part of its application for an air quality permit. On February 18, 2022, Perpetua submitted a PTC application and emission inventory. On June 17, 2022, IDEQ issued a final PTC and Statement of Basis (SOB) stating that the SGP would not emit Title V level criteria pollutants. However, a Title V Permit is required because of the SGP being applicable to NESHAP, Subpart EEEEEEE, Gold Mine Ore Processing. A Title V permit application must be submitted to IDEQ within 12 months of commencing operation, PTC conditions 2.23 and 2.24.

Federal New Source Performance Standards: The NSPS are codified at 40 CFR 60 and are incorporated in Idaho air regulations by reference. These rules establish requirements for new, modified, or reconstructed emission units in specific source categories. NSPS requirements include emission limits, monitoring, reporting, and record keeping. Applicable NSPS for the SGP emission sources are:

- 40 CFR 60 Subpart A – General Provisions. Subpart A contains the general requirements applicable to all emission units subject to 40 CFR 60.
- 40 CFR 60 Subpart LL – Standards of performance for metallic mineral processing facilities. All facilities located in underground mines are exempted from the provisions of this subpart. All surface facilities at which construction or modification commenced after August 24, 1982, are subject to this subpart.
- 40 CFR 60 Subpart IIII – Standards of Performance for Stationary Compression Ignition Internal Combustion Engines. This subpart applies to diesel-fueled reciprocating engines, which would include the compressor and generator engines included in the SGP sources.
- 40 CFR 60 Subpart OOO – Standards of Performance for Nonmetallic Mineral Processing Plants. This subpart applies to the proposed limestone processing plant under the 2021 MMP.

National Emission Standards for Hazardous Air Pollutants: The federal National Emission Standards for HAPs (NESHAP) rules are codified at 40 CFR 61 and 63 and are incorporated in Idaho air regulations by reference. As part of the NESHAPs program, federal maximum achievable control standards are enacted to reduce the emissions of HAPs from both major source and area source categories.

Consideration of NESHAP Subparts in 40 CFR 63 indicates that there are three regulations and general provisions applicable to the SGP's air emission sources:

- 40 CFR 63 Subpart A – General Provisions. Subpart A contains the general requirements applicable to all emission units subject to 40 CFR 63.
- 40 CFR 63 Subpart EEEEEEE (7E) - NESHAPs for Gold Mine Ore Processing and Production Area Source Category. The rule was promulgated in February 2011, and this NESHAP applies generally to gold ore processing and production of gold-bearing products. This NESHAP is applicable to minor or "area sources" of HAP, and so would apply to the SGP emission sources. Specifically, this NESHAP applies to gold recovery and refining that use carbon processes, non-carbon processes, and mercury retorts. Therefore, the "carbon-in-pulp" process included in the SGP process sequence that adsorbs dissolved gold into the carbon particles is subject to this subpart. The regulation establishes mercury emissions limitations and work practice standards to control mercury emissions from gold production processes.
- 40 CFR 63 Subpart ZZZZ – NESHAPs for Stationary Reciprocating Internal Combustion Engines. This subpart applies to the proposed diesel combustion engines at the SGP.
- 40 CFR 63 Subpart CCCCCC – NESHAPs for Source Category: Gasoline Dispensing Facilities. This subpart applies to the proposed gasoline storage tanks at the SGP.

Wilderness Act: The Wilderness Act of 1964 requires that wilderness areas be administered to preserve their wilderness character. The Wilderness Act also created the National Wilderness Preservation System (NWPS) to identify and preserve designated wilderness areas (NWPS 2019a). Further, the Wilderness Act contains specific provisions for managing and protecting these pristine areas (NWPS 2019b). The Forest Service included additional wilderness areas in the air quality screening and modeling for the SGP to evaluate potential impacts on the areas' natural quality of wilderness character.

Greenhouse Gas Reporting Rule: GHGs are natural or anthropogenic gases that trap heat in the atmosphere and contribute to the greenhouse effect. In October 2009, the EPA issued the Mandatory Reporting of Greenhouse Gas Rule (MRR) in 40 CFR 98, which required reporting of GHG data and other relevant information from large sources and suppliers in the U.S. The gases covered by 40 CFR 98 are CO_2, methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and other fluorinated gases. Implementation of the MRR includes the greenhouse gas reporting program applicable to facilities for which actual emissions of GHG are greater than 25,000 metric tons per year. Facilities subject to the MRR are required to submit annual reports to the EPA (40 CFR 98). The Climate Change Specialist Report (Forest Service 2023b) addresses climate change and applicability of the MRR in further detail, but SGP GHG emission estimates would require compliance with the MRR.

Mobile Source Federal Regulations: Mobile source air pollution control requirements for gasoline and diesel on-road engines are codified in 40 CFR 80, 40 CFR 85, and 40 CFR 86. These standards are designed to reduce emissions from passenger cars, light trucks, and large passenger vehicles (including sport utility vehicles, minivans, vans, and pickup trucks) and to reduce the sulfur content of diesel and gasoline fuels. Under these provisions, the EPA initially established Tier 1 and Tier 2 emissions standards for the purpose of minimizing emissions from these sources. For the on-road vehicles that would be owned and operated by Perpetua, the regulatory criteria indicate that EPA's Tier 2 emission standards program would apply.

Provisions for non-road diesel engines are codified in 40 CFR 89, 40 CFR 90, and 40 CFR 1039. Starting in 1996, manufacturers of non-road engines became subject to the EPA's increasingly stringent Tier 1 through Tier 4 emissions standards, depending on model year and engine size (40 CFR 1039). All new diesel engines have been required to meet Tier 4 standards since 2015.

EPA's mobile source regulations in 40 CFR 80 Subpart I Motor Vehicle Diesel Fuel; Non-Road, Locomotive, and Marine Diesel Fuel; and U.S. Emissions Control Area Marine Fuel contain provisions restricting diesel fuel sulfur content for fuel used in mobile sources, in order to prevent damage to the emission control systems. These restrictions would apply to the fuels that would be used by the SGP, as they were phased in for highway diesel fuel starting in 2006 and for non-road diesel fuel in 2007.

Idaho Minor Source Air Permitting: The State of Idaho has enacted air quality regulations that are administered by the IDEQ. With respect to new source review permitting, IDEQ uses a PTC program (codified in IDAPA 58.01.01.200-228) that applies to new and modified sources. In this manner, the PTC program serves to protect ambient air quality from impacts due to major and more-numerous non-major stationary emission sources.

The IDEQ requires minor source permits for new facilities that are subject to federal NSPS and/or NESHAP regulations. A determination was made by the State of Idaho that the SGP satisfies the requirements of the PTC program, based on demonstration of the SGP's potential emissions and controls. This was based on the complete air emissions inventory of stationary sources that was submitted by Perpetua as part of its application to the IDEQ for an air quality permit. IDEQ issued a final PTC (Permit Number P-2019.0047) and SOB for the SGP (Facility 085-00011) (IDEQ 2022b).

Idaho Visibility Protection Requirements and Regional Haze Rule: Atmospheric visibility is defined as the ability of the human eye to distinguish an object from the surrounding background. In 1980, the EPA adopted regulations requiring states to update their State Implementation Plans for protection of visibility in Class I areas in 40 CFR 51 Subpart P (40 CFR 51.300 through 40 CFR 51.307). As a federal land manager of Class I areas, the Forest Service also has affirmative responsibilities to protect air quality and air quality-related values, such as visibility, in the Class I areas.

The federal Regional Haze Rule, adopted by the State of Idaho in IDAPA 58.01.01.665-668, requires states to develop long-term, regional haze, State Implementation Plans for reducing human-caused pollutant emissions that contribute to visibility degradation and to establish goals aimed at improving visibility in Class I areas. Sources of haze-causing pollutants include emissions from industrial sources, tailpipes, agricultural equipment, and practices; and from natural sources such as volcanic emissions, windblown dust, and smoke from wildfires.

According to IDEQ, regional haze in Idaho's natural parks and scenic areas is attributable to a variety of natural and human source of air pollution and is greatly impacted by the effects of climate, such as drought, increased wildfires, and reduced precipitation (IDEQ 2017a).

Idaho Toxic Air Pollutant Program: The State of Idaho's Toxic Air Pollutant Program is a stand-alone risk-based program that regulates approximately 350 pollutants determined by their nature to be toxic to human or animal life or vegetation. The program prohibits emissions of these pollutants in amounts that would injure or unreasonably affect human or animal life or vegetation. Toxic Air Pollutant emissions from industrial sources are compared to screening levels and limited by Acceptable Ambient Concentration for Carcinogens (AACC) (i.e., having the potential to cause cancer) and Acceptable Ambient Concentration (AAC) for non-carcinogenic pollutants. An air impact modeling analysis is required for projects having Toxic Air Pollutant emissions that exceed screening emission levels provided in IDAPA 58.01.01.585 for non-carcinogens, and IDAPA 58.01.01.586 for carcinogens. The modeling analysis must show that the acceptable ambient concentrations for non-carcinogens are not exceeded on a 24-hour average basis, and on a longer-term average for carcinogens. Perpetua submitted an application to IDEQ for review including emissions subject to the Toxic Air Pollutant Program. IDEQ issued a final PTC and SOB for the SGP demonstrating compliance based on the air emissions inventory submitted in Perpetua's application for PTC.

IDAPA 58.01.210.14(a) requires control technologies for toxic pollutants as required to demonstrate compliance with appropriate AAC/AACC values. This is known as Toxic Reasonably Available Control Technology (T-RACT). During the development of the IDEQ permit, specific controls were evaluated and determined to be acceptable and compliant with the standards. As a result, IDEQ is requiring the use of "low-arsenic" quartzite (90 parts per million [ppm] arsenic or less) development rock to be applied for capping haul roads excluding those with the various pits and rock storage facilities. In addition, the drill rigs would include a dust control system with a minimum efficiency of 90 percent. IDEQ issued a final PTC and SOB for the SGP demonstrating compliance with the acceptable ambient concentrations, based on the air emissions inventory submitted in Perpetua's application for the PTC.

3.3.4 Affected Environment

The air quality in a given location is characterized by a number of properties that can be physically monitored and evaluated. The existing conditions that may be affected by the SGP include ambient air quality in comparison to the NAAQS, visibility as impacted by regional haze and visible plumes emitted from mine activities, and current rates of atmospheric deposition of mercury, nitrogen, and sulfur compounds. The description of the affected environment addresses these issues and several other parameters that pertain to regional air quality.

3.3.4.1 Criteria Air Pollutants

For SGP-specific baseline concentrations, Perpetua (then Midas Gold) collected 20 months (November 2013 to June 2015) of PM_{10} and $PM_{2.5}$ air concentration data at the approved Stibnite monitoring station (IDEQ 2013). The Stibnite monitor is in the same airshed as the SGP; characterized as mountain valley terrain with little or no industry. Additionally, this SGP particulate monitor is located within the near-field analysis area and was deemed by IDEQ to be representative of background conditions in the locale. The IDEQ formally approved the Monitoring Protocol and Quality Assurance Project Plan in December 2013 (IDEQ 2013). Both the meteorological and air quality monitoring began in November 2013 (Trinity Consultants 2017). After reviewing the data and associated quality control procedures, IDEQ concluded that the calendar year 2014 data for PM_{10} and $PM_{2.5}$ data collected at the Stibnite monitoring station satisfied the applicable regulatory requirements and approved the data as representative for analysis (IDEQ 2015).

For the ambient air NAAQS demonstration, IDEQ identified the source for gaseous pollutant background data as the NW AIRQUEST database for years 2014-2017 (Washington State University 2018) to be used in conjunction with particulate matter data collected at the Stibnite monitoring station. **Table 3.3-2** displays these data along with the applicable NAAQS. The areas considered in the analysis of air quality impacts are in attainment of the NAAQS for all pollutants and averaging times (IDEQ 2019a).

Table 3.3-2 Ambient Air Data – Perpetua and NW Airquest Consortium Background Values

Pollutant and Averaging Time	Monitored Value and Units	NAAQS	Source and Period
PM_{10}, 24-Hour	37 µg/m^3 [1]	150 µg/m^3	Onsite monitor 1/1/14-12/31/14
$PM_{2.5}$, Annual	3.5 µg/m^3 [6]	12 µg/m^3	J Onsite monitor 1/1/14-12/31/14
$PM_{2.5}$, 24-Hour	15 µg/m^3 [3]	35 µg/m^3	Onsite monitor 1/1/14-12/31/14
SO_2, 3-Hour (Secondary)	6.4 ppb [1]	500 ppb	NW Airquest Consortium 7/1/14-6/30/17
SO_2, 1-Hour	4.7 ppb [4]	75 ppb	NW Airquest Consortium 7/1/14-6/30/17
CO, 8-Hour	0.97 ppm [1]	9 ppm	NW Airquest Consortium 7/1/14-6/30/17
CO, 1-Hour	1.52 ppm [1]	35 ppm	NW Airquest Consortium 7/1/14-6/30/17
NO_2, Annual	0.5 ppb [2]	53 ppb	NW Airquest Consortium 7/1/14-6/30/17
NO_2, 1-Hour	2.3 ppb [5]	100 ppb	NW Airquest Consortium 7/1/14-6/30/17
Ozone (O_3), 8-Hour	55 ppb [4]	70 ppb	NW Airquest Consortium 7/1/14-6/30/17

Source: Air Sciences 2018a, 2021a; EPA 2018d; WSU 2018
[1] Maximum 2nd-high value for the data collection period.
[2] Annual mean value for the data collection period.
[3] 98th-percentile for the data collection period.
[4] Average of the 99th-percentile daily maximum 1-hour values for the data collection period.
[5] Average of the 98th-percentile daily maximum 1-hour values for the data collection period.
[6] Weighted average of quarterly means for the data collection period.

3.3.4.2 Hazardous Air Pollutants

There are no permitted sources of HAP emissions in the vicinity of the SGP area. One source, the Tamarack Mill, LLC. is 75 km away and reported minor source level emissions of 5.9 tons per year of HAPs in 2014 (Trinity Consultants 2017). Due to absence of permitted HAP emission sources in the air quality analysis area, it can be assumed that baseline ambient concentrations of HAPs are low and less than more industrialized or populated areas.

3.3.4.3 Ozone

For purposes of identifying a baseline value for NAAQS assessment of O_3 impacts due to SGP sources, the IDEQ selected the baseline value from the NW AIRQUEST database for years 2014 through 2017 (Washington State University 2018).

The National Park Service (NPS) has been operating a continuous O_3 monitor at Craters of the Moon National Monument (CRMO) from 1992 to present. This monitor is the only O_3 data source in the region that is not located in an urban area, therefore, it is likely representative of conditions near the SGP and surrounding rural area. The highest one-hour maximum O_3 concentration recorded at the monitor was 91 parts per billion (ppb) recorded in July 1996 and again in August 2008. However, there is no one-hour NAAQS for O_3. The highest O_3 concentration measured at CRMO that is comparable to the 8-hour average NAAQS for O_3, (i.e., annual fourth-highest daily maximum 8-hour average) was 69 ppb which occurred in 2018. The annual trend of the fourth-highest 8-hour average for recent years is shown in **Table 3.3-3**.

Table 3.3-3 Annual Ozone Concentrations for Comparison to 8-Hour NAAQS Criteria Values – Craters of the Moon National Monument, 2012-2020

Annual O3 Conc. for NAAQS Comparison[1]	NAAQS 8-hour Standard	2012	2013	2014	2015	2016	2017	2018	2019	2020
8-hour O_3 Conc.(ppb)[2]	70	65	60	62	61	58	63	69	58	66

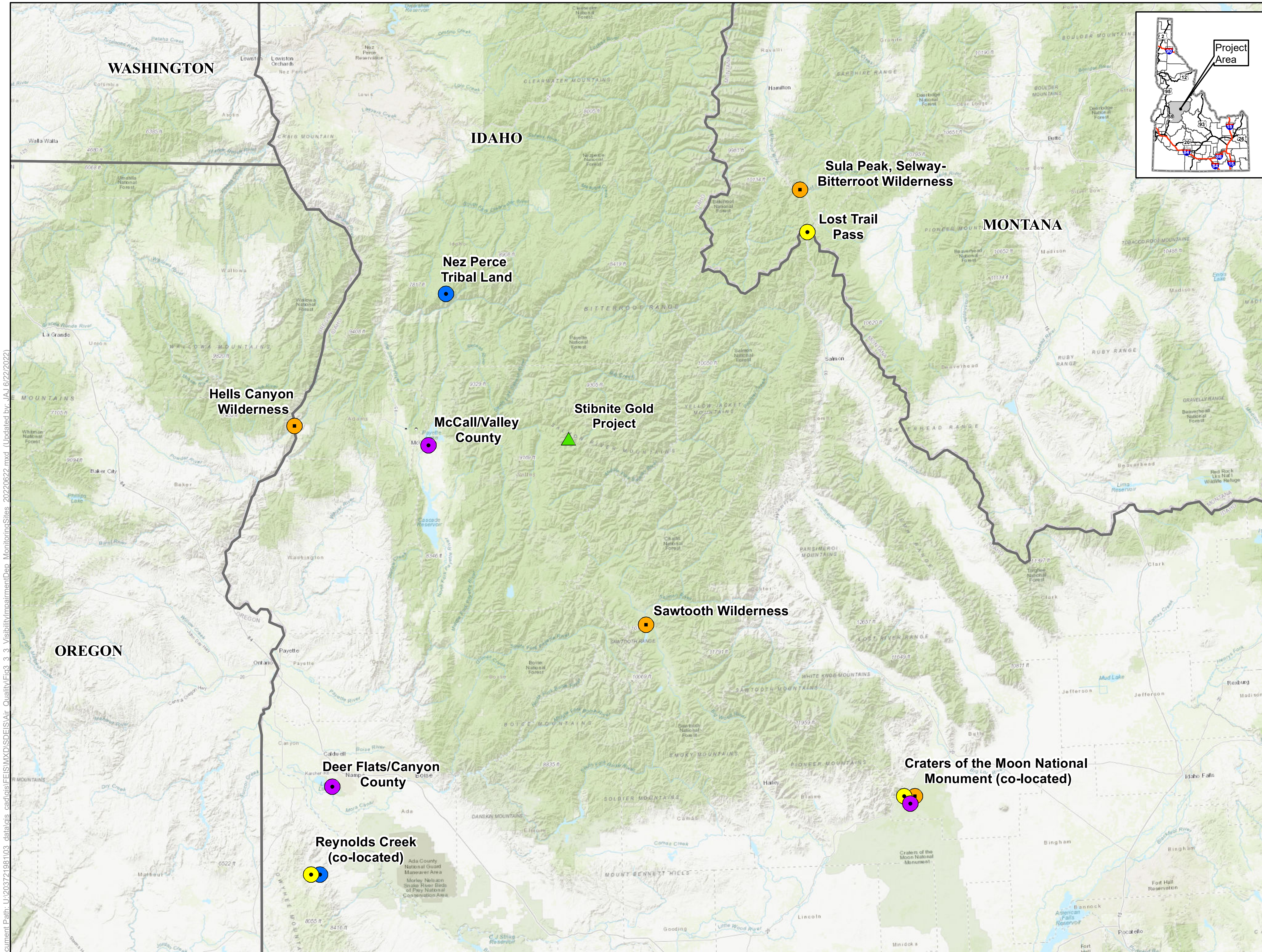
Source: EPA 2021b
[1] The annual 4th highest 8-hour average averaged over a 3-year period is the NAAQS averaging criteria; these data are annual values, without rolling 3-year averaging.
[2] These values can be compared to the 2015 8-hour average O_3 NAAQS of 70 ppb.

3.3.4.4 Air Quality Related Values

Air Quality Related Values (AQRVs) are resources sensitive to air quality and include a wide array of resources including, but not limited to, vegetation, soils, water, fish, wildlife, and visibility. Visibility may be affected by impairment due to plume blight or increase in regional haze levels. Plant growth and survival may be adversely affected due to increased ozone concentrations. Deposition of acidic air pollutants may cause episodic or chronic acidification of surface waters and may alter soil chemistry. Elevated deposition of nitrogen or phosphorus can drive species composition changes in both aquatic and terrestrial environments and can change growth and survival rates of plants. Mercury deposition can impact aquatic and riparian dependent species and can bioaccumulate causing health risks to humans and other species.

The CAA gives federal land managers the affirmative responsibility to protect against degradation of air quality and AQRVs in Class I areas. There are several Class I areas within a 300-km radius of the SGP which were considered for AQRV impact assessments. The nearest Class I areas are Sawtooth Wilderness (SAWT; approximately 80 km south-southeast of the SGP Operations Area Boundary) and Selway-Bitterroot Wilderness (approximately 90 km northeast of the SGP Operations Area Boundary). The Class I areas within a 300-km radius of the SGP Operations Area Boundary are shown in **Figure 3.3-2**.

The monitoring stations in the far-field analysis area that provide representative background data are listed in **Table 3.3-4**, and the station locations are mapped in **Figure 3.3-3**. The Interagency Monitoring of Protected Visual Environments (IMPROVE) monitoring network stations measure chemical constituents that contribute to regional haze and visibility impairment. The National Trends Network (NTN), operated by the National Atmospheric Deposition Program (NADP) provides data on wet atmospheric deposition. The Clean Air Status and Trends Network (CASTNET), provides information on dry atmospheric deposition, including sulfur and nitrogen compounds, as well as ozone. The Mercury Deposition Network (MDN), also operated by NADP, monitors the atmospheric mercury concentration in wet deposition.



LEGEND

Stibnite Gold Project

Visibility Impairment Deposition Monitoring Sites

- Interagency Monitoring of Protected Visual Environments
- Clean Air Status and Trends Network
- Mercury Deposition Network
- National Trends Network/National Atmospheric Deposition Program

0 9.5 19 Miles
0 20 40 Kilometers
1 inch = 25 miles when printed at 11x17

Figure 3.3-3
Visibility Impairment and Deposition-Related Monitoring Sites
Stibnite Gold Project
Stibnite, ID

Base Layer: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
Other Data Sources: Perpetua

Table 3.3-4 Visibility Impairment and Deposition-Related Monitoring Sites

Site ID Code	Network	State	Location/ Site Name	Monitored Parameters	Distance and Direction from SGP to Monitor (mi)	Monitor Elevation (feet)	North Latitude (Decimal Deg.)	West Longitude (Decimal Deg.)	Monitoring Period
CRMO1	IMPROVE	Idaho	Craters of the Moon National Monument	Haze/Visibility Impairment	132, southeast	5,964	43.4605	-113.5550	5/1992 to present
HECA1	IMPROVE	Idaho/ Oregon	Hells Canyon Wilderness	Haze/Visibility Impairment	75, west	2,149	44.9702	-116.8437	8/2000 to present
SAWT1	IMPROVE	Idaho	Sawtooth Wilderness	Haze/Visibility Impairment	52, south-southeast	6,530	44.1705	-114.9271	1/1994 to present
SULA1	IMPROVE	Montana	Sula Peak, Selway-Bitterroot Wilderness	Haze/Visibility Impairment	90, northeast	6,220	45.8598	-114.0000	8/1994 to present
RCK263	CASTNET	Idaho	Reynolds Creek	Dry Deposition	165, south-southwest	3,930	43.2105	-116.7510	9/1990 to 12/2016
NPT006	CASTNET	Idaho	Nez Perce Tribal Land	Dry Deposition	51 north-northwest	3,100	46.2758	-116.0216	12/2002 to present
ID03	NTN	Idaho	Craters of the Moon National Monument	Wet Deposition	132, southeast	5,929	43.4605	-113.5551	8/1980 to present
ID11	NTN	Idaho	Reynolds Creek	Wet Deposition	165, south-southwest	3,937	43.2049	-116.7500	11/1983 to present
MT97	NTN	Montana	Lost Trail Pass	Wet Deposition	88, northeast	7,877	45.6920	-113.9680	9/1990 to present
ID03	MDN	Idaho	Craters of the Moon National Monument	Mercury Deposition	132, southeast	5,928	43.4605	-113.5551	10/2006 to 12/2010
ID98	MDN	Idaho	Deer Flats/Canyon County	Mercury Deposition	182, southwest	2,539	43.5528	-116.6436	3/2008 to 6/2010
ID99	MDN	Idaho	McCall/Valley County	Mercury Deposition	61, west	5,013	44.8913	-116.1047	11/2007 to 6/2010

Source: EPA 2018b; IRMA 2018; NADP 2018

Visibility

The CAA sets specific goals for protecting Class I areas from human-caused visibility impacts. Scattering of light by aerosols is the main process that limits visibility in the degrading the clarity and color of what can be seen. Some airborne particles are naturally occurring and include seeds, pollen, spores, fragments of plants and animals, sea salt, dust, and smoke. They also are generated from human-caused sources, which include dust from roads, wind erosion of tilled land, biomass burning, fuel combustion, and industrial processes. In addition, emissions of sulfur, nitrogen, and carbon compounds, which are emitted from industrial sources burning fossil fuels, or from natural sources (e.g., wildfire or dust storms), can be precursors of condensed aerosol particles. In Class I wilderness areas and parks, the Regional Haze Rule requires states to address human-caused sources of air pollution degrading visibility on a regional scale. States use the "impairment" metric to factor out natural sources, such as wildfire smoke, and international contributions outside their control, in tracking their progress in improving visibility in the Class I areas.

One unit used to quantify visibility deterioration is the "visual range," which is a measurable parameter of atmospheric clarity at a specific monitoring location. A shorter visual range corresponds to more impaired long-range visibility through the atmosphere. Visibility has generally improved in Class I areas across the country, in part due to mandated sulfur restrictions on fuels, and controls on industrial sources of air pollution. Average monthly visual range values in the four Class I areas included in the SGP far-field analysis area are between 223 and 278 km, with significant seasonal fluctuation (Air Sciences 2018a; Federal Land Managers' Air Quality Related Values Work Group 2010).

IMPROVE is a cooperative visibility monitoring effort managed by the EPA, with assistance from multiple U.S. agencies, state agencies, Indian tribes, and associated members in Canada and South Korea. The IMPROVE program measures current and long-term trends in visibility by monitoring, on 3-day intervals, the pollutants that contribute to reduction in visual range. Historic visibility parameters are presented in **Table 3.3-5** for the four IMPROVE stations in Class I areas in the SGP far-field analysis area. The IMPROVE network is designed so that some monitoring sites are used to represent multiple Class I areas in a region.

The visibility data in **Table 3.3-5** illustrate how observed impairment can vary seasonally and with local conditions in a given locale. Two different measures of impairment are listed. The "most impaired days" represent the portion of days that exhibit the highest 20 percent of observed visibility impairment and reflects only anthropogenic contributions to haze. Another visibility metric, the "monthly average visual range" includes effects of anthropogenic and natural (e.g., wildfire) contributions to haze, and a higher visual range reflects better clarity. The distribution of most impaired days at the Sawtooth (SAWT1) and Selway-Bitterroot (SULA1) wilderness areas tend to have a greater portion of the most impaired days during the warmer summer months. In contrast, the most impaired days occur more frequently during the winter months at CRMO1 and Hells Canyon Wilderness (HECA1).

Plume visibility is a transient condition that is caused by a source or combination of sources and is the presence of a plume that is visible to an observer some distance from the source.

Table 3.3-5 Historic Visibility Impairment Parameters – Four Class I Area IMPROVE Sites

Month	CRMO1 Percent of Observed Most Impaired Days	CRMO1 Monthly Avg. Visual Range (km)	HECA1 Percent of Observed Most Impaired Days	HECA1 Monthly Avg. Visual Range (km)	SAWT1 Percent of Observed Most Impaired Days	SAWT1 Monthly Avg. Visual Range (km)	SULA1 Percent of Observed Most Impaired Days	SULA1 Monthly Avg. Visual Range (km)
Jan	22.05	245	26.36	224	6.93	259	2.79	251
Feb	16.01	248	14.33	229	2.13	263	2.79	256
Mar	8.14	252	3.72	234	2.93	269	6.69	261
Apr	6.30	255	5.73	237	8.53	272	14.21	264
May	4.72	255	3.15	238	11.47	272	13.09	265
June	0.79	257	0.29	239	10.40	274	10.86	266
July	0.00	261	1.72	242	12.27	278	9.75	270
Aug	0.26	261	1.43	243	8.27	278	3.62	271
Sept	0.26	259	1.43	241	8.00	277	8.91	268
Oct	2.89	255	6.88	235	12.00	273	13.09	262
Nov	17.32	248	15.47	226	10.93	263	10.58	253
Dec	21.26	246	19.48	223	6.13	259	3.62	251

Source: Air Sciences 2018a; Federal Land Manager 2018; IRMA 2018
CRMO1 = Craters of the Moon National Monument, Monitored Years 2002 -17.
HECA1 = Hells Canyon Wilderness, Monitored Years 2000 – 17.
IMPROVE = Interagency Monitoring of Protected Visual Environments.
SAWT1 = Sawtooth Wilderness, Monitored Years 1994 – 2017.
SULA1 = Sula Peak, Selway-Bitterroot Wilderness, Monitored Years 1994 – 2017.

Assessment of plume visibility is a means to quantify the ability of a viewer to discern a visible plume and is usually evaluated for an observer at the closest point on the boundary of a Class I area of concern. Plume blight occurs when a coherent plume from a source is perceptible against a viewing background (e.g., the sky, or a terrain feature such as a mountain) to a casual observer. The primary parameters of plume blight are the change in visible contrast and color contrast between a plume and background.

Atmospheric Deposition

There are two types of atmospheric deposition that can affect AQRVs: 1) wet deposition, which involves the scavenging of particles and gases in the air by clouds and precipitation; and 2) dry deposition, which involves the direct collection of gases and particles in the air by vegetation and solids and liquid surfaces (Wallace and Hobbs 2006). Atmospheric deposition may be due to distant or local sources of pollution.

As described in this section, data for the existing conditions at the monitoring stations nearest to the SGP area indicate that both wet and dry nitrogen deposition either show no clear trend or are trending higher. Nationwide, it has been reported that deposition of oxidized nitrogen species has declined between 2006 and 2016, which may reflect improved nitrogen oxides (NO_x) emission control technologies for vehicles and power plants. However, over the same period, deposition rates of reduced forms of nitrogen, such as ammonia, have increased or remained unchanged (NADP 2019). The data presented in this section show that no clear trend is evident in wet or dry sulfur species deposition between 2005 and 2015 at the monitoring sites closest to the SGP area. However, nationwide SO_2 emissions have decreased by 76 percent between 2010-2020 (EPA 2022).

Two complementary monitoring networks that collect deposition data are CASTNET and NTN, which collect data related to dry and wet deposition, respectively. Total deposition estimates are provided nationwide by NADP's Total Deposition Science Committee. They use a hybrid approach combining ambient measurements from CASTNET, NTN, and other air concentration monitoring data with model output to provide gridded estimates of total deposition (NADP 2022; Schwede and Lear 2014). Nearly all CASTNET sites are co-located or are near a corresponding NTN site, which together provide the data needed to track temporal and spatial trends in total deposition.

Deposition of nitrogen and sulfur compounds impact the environment through several pathways. In the atmosphere, NO_x reacts with moisture and oxygen to form nitric acid, nitrates, and nitrous oxide, while SO_2 reacts to form sulfuric acid, sulfates, and sulfites, which can be transported to the surface by wet deposition. Nitrogen and sulfur compounds formed in the atmosphere are conveyed by dry and wet deposition and can affect soils, water, and biota far from the origination of the precursor emissions. Excessive nitrogen deposition can cause reduction in plant biodiversity and eutrophication (excessive plant and algae growth) in surface waters. This has the effect of reducing the oxygen content of the water, and therefore reduces the population of animal life the water can sustain.

Of somewhat less concern in the Pacific Northwest is acid deposition, which occurs when SO_2, NO_X, and ammonia in the atmosphere react to form sulfuric acid, nitric acid, and ammonium. These compounds can enter surface waters, primarily through wet deposition. These pollutants originate from anthropogenic sources (e.g., burning of fossil fuels in power plants and motor vehicles, and agricultural practices), and to a lesser degree from natural sources (e.g., forest fires and volcanoes).

National Trends Network

The NTN provides a nationwide historic record of precipitation chemistry that is reflected in wet deposition rates to soil and surface water. The NTN is part of the NADP that operates several atmospheric monitoring programs. NTN sites are typically located away from urban areas and large point sources of pollution, and many stations are in Class I areas. While stations cannot be established and operated in protected wilderness areas, NTN sites are in many cases located near, or are considered representative of, nearby wilderness area deposition conditions at similar elevations. Each monitoring site measures the quantity of precipitation, and automatically captures samples only during precipitation events. Samples are retrieved from the field on a weekly interval, and analyzed for calcium, magnesium, potassium, sodium, ammonium, nitrate, total nitrogen species, chloride, sulfate, and free acidity (H+) (NADP 2022). Wet deposition data is expressed in units of kilograms per hectare per year (kg/ha-yr).

Annual data for three NTN sites closest to the SGP is presented in **Tables 3.3-6** through **Table 3.3-8**. These three sites are located at the CRMO (213 km distant, southeast) Reynolds Creek (264 km distant, south-southwest), and Lost Trail Pass (142 km distant, northeast). Trends in the wet deposition rates of the primary nitrogen and sulfur species (nitrate [NO_3], ammonium [NH_4], and sulfate [SO_4]) are plotted in **Figures 3.3-4** through **3.3-6** for the three NTN sites. These trends show the wide variability in annual wet deposition rates in the region, with no clear long-term trend.

Clean Air Status and Trends Network Data

CASTNET is a long-term, dry deposition national monitoring network managed by EPA. The CASTNET sites measure nitrogen and sulfur species, chloride, and base cations (i.e., a positively charged ion) that are used to calculate dry deposition rates. The network was established under the 1990 CAA Amendments to provide accountability for emission reduction programs by reporting trends in pollutant concentrations and acidic deposition (EPA 2018b). **Table 3.3-9** shows dry nitrogen compound and dry sulfur compound deposition rates at the two CASTNET monitoring sites closest to the SGP and located in Idaho. These are stations on Nez Perce Tribal Reservation land (82 km distant, north-northwest, and at Reynolds Creek (264 km distant, south-southwest). Like wet deposition, dry deposition is typically expressed in units of kg/ha-yr. **Figure 3.3-7** illustrates the trends in annual dry deposition rates at these sites, with dry deposition of sulfur species generally higher than nitrogen species.

Mercury Deposition Network

Inorganic Hg in gaseous and particle-bound forms and mercury oxide can be emitted from mine operations and fossil fuel combustion sources, most notably coal-fired electrical-generating units. Each Hg form has specific physical and chemical properties that determine how far it travels in the atmosphere before depositing to the landscape.

Table 3.3-6 NTN Speciated Wet Deposition, Annual Average – Craters of the Moon National Monument (Site ID03)

Year	Ca (kg/ha-yr)	Mg (kg/ha-yr)	K (kg/ha-yr)	Na (kg/ha-yr)	NH4 (kg/ha-yr)	NO3 (kg/ha-yr)	Total N (kg/ha-yr)	Cl- (kg/ha-yr)	SO4 (kg/ha-yr)	H+ (kg/ha-yr)
2006	0.336	0.034	0.054	0.092	0.839	1.485	0.987	0.149	0.899	0.005
2007	0.266	0.027	0.035	0.087	0.605	1.223	0.746	0.112	0.618	0.004
2008	0.348	0.038	0.038	0.086	0.752	1.534	0.931	0.167	0.838	0.011
2009	1.81	0.141	0.18	2.768	1.114	1.872	1.289	2.271	2.955	0.007
2010	0.506	0.047	0.04	0.209	0.759	1.664	0.966	0.253	0.87	0.012
2011	0.298	0.035	0.038	0.092	0.667	1.089	0.764	0.148	0.676	0.004
2012	2.084	0.175	0.14	0.608	0.72	1.204	0.831	0.806	0.986	0.003
2013	0.596	0.063	0.072	0.181	0.872	1.517	1.02	0.256	0.809	0.002
2014	0.413	0.048	0.075	0.13	0.959	1.348	1.049	0.214	0.715	0.006
2015	1.022	0.09	0.157	0.913	1.279	1.979	1.441	0.72	1.825	0.006
2016	2.141	0.171	0.265	1.454	1.324	1.858	1.449	1.531	1.32	0.010
2017	0.743	0.111	0.084	0.68	1.005	1.45	1.109	0.618	1.205	0.013
2018	0.58	0.067	0.064	0.253	1.142	1.409	1.207	0.536	0.671	0.005
2019	0.279	0.025	0.046	0.076	1.089	1.427	1.169	0.186	0.671	0.012
2020	1.27	0.139	0.106	0.7	0.856	0.94	0.878	0.66	0.85	0.004
Mean	0.85	0.081	0.093	0.56	0.93	1.47	1.06	0.58	1.06	0.01
Median	0.58	0.063	0.072	0.21	0.87	1.45	1.02	0.26	0.85	0.01

Source: NADP 2022
kg/ha-yr = kilograms per hectare per year
(1 kg = 2.2 lbs.; 1 hectare = 2.5 acres)

Ca = calcium	Na = sodium
Cl- = chloride	NH_4 = ammonium
H+ = free acidity	NO_3 = nitrate
K = potassium	SO_4 = sulfate
Mg = magnesium	N = nitrogen

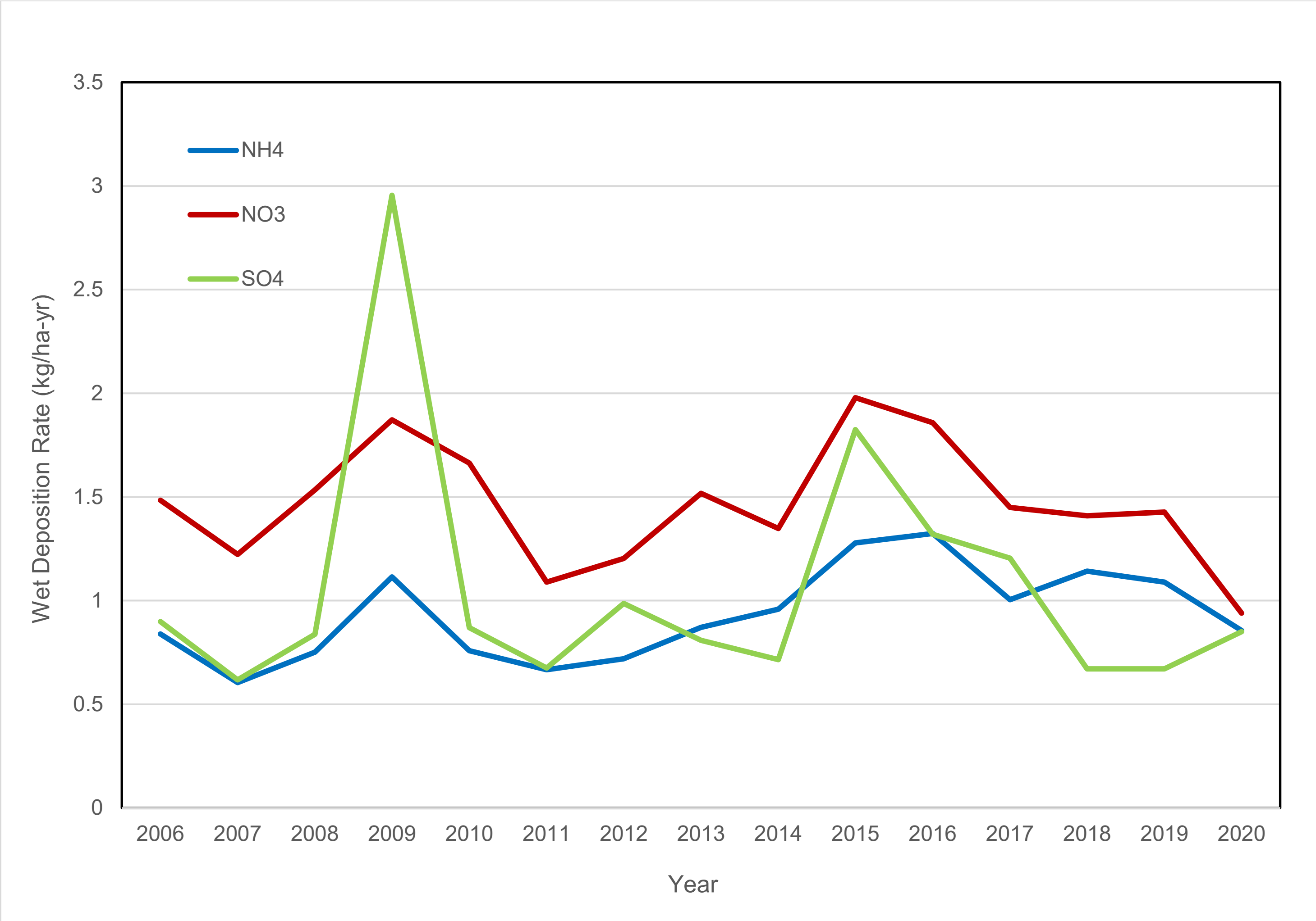


Figure Source: NADP 2022
kg/ha-yr = kilograms per hectare per year; NH4 = ammonium; NO3 = nitrate; SO4 = sulfate

Figure 3.3-4 Trends in Wet Deposition Rates – Craters of the Moon National Monument, 2006-2020

Table 3.3-7 NTN Speciated Wet Deposition, Annual Average – Reynolds Creek (Site ID11)

Year	Ca (kg/ha-yr)	Mg (kg/ha-yr)	K (kg/ha-yr)	Na (kg/ha-yr)	NH_4 (kg/ha-yr)	NO_3 (kg/ha-yr)	Total N (kg/ha-yr)	Cl^- (kg/ha-yr)	SO_4 (kg/ha-yr)	H+ (kg/ha-yr)
2006	0.323	0.033	0.042	0.207	0.332	0.855	0.451	0.148	0.615	0.005
2007	0.315	0.033	0.05	0.214	0.674	1.021	0.754	0.157	0.704	0.005
2008	0.145	0.017	0.041	0.197	0.434	0.653	0.485	0.087	0.534	0.004
2009	0.51	0.063	0.118	0.584	0.802	1.188	0.891	0.237	1.284	0.004
2010	0.591	0.066	0.09	0.878	0.912	1.476	1.042	0.391	1.811	0.007
2011	0.297	0.035	0.056	0.402	0.481	0.762	0.546	0.3	0.627	0.006
2012	0.87	0.084	0.119	1.756	0.507	0.895	0.596	0.482	1.953	0.005
2013	0.6	0.072	0.118	0.321	1.347	2.257	1.556	0.244	1.357	0.006
2014	0.466	0.07	0.15	0.32	0.979	2.031	1.22	0.29	1.049	0.005
2015	0.809	0.078	0.13	1.519	1.061	1.399	1.141	0.515	1.998	0.003
2016	0.487	0.047	0.086	0.704	0.562	0.956	0.653	0.297	1.019	0.003
2017	0.785	0.076	0.116	0.535	0.948	1.512	1.078	0.354	1.002	0.009
2018	0.293	0.032	0.056	0.275	0.771	0.933	0.81	0.153	0.608	0.003
2019	0.243	0.028	0.076	0.149	1.533	1.554	1.543	0.163	0.758	0.006
2020	0.331	0.029	0.085	0.498	0.264	0.557	0.331	0.252	0.667	0.008
Mean	0.47	0.051	0.089	0.57	0.77	1.20	0.87	0.27	1.07	0.005
Median	0.47	0.047	0.086	0.40	0.77	1.02	0.81	0.25	1.00	0.005

Source: NADP 2022
kg/ha-yr = kilograms per hectare per year
(1 kg = 2.2 lbs.; 1 hectare = 2.5 acres)
Ca = calcium Na = sodium
Cl- = chloride NH_4 = ammonium
H+ = free acidity NO_3 = nitrate
K = potassium SO_4 = sulfate
Mg = magnesium N = nitrogen

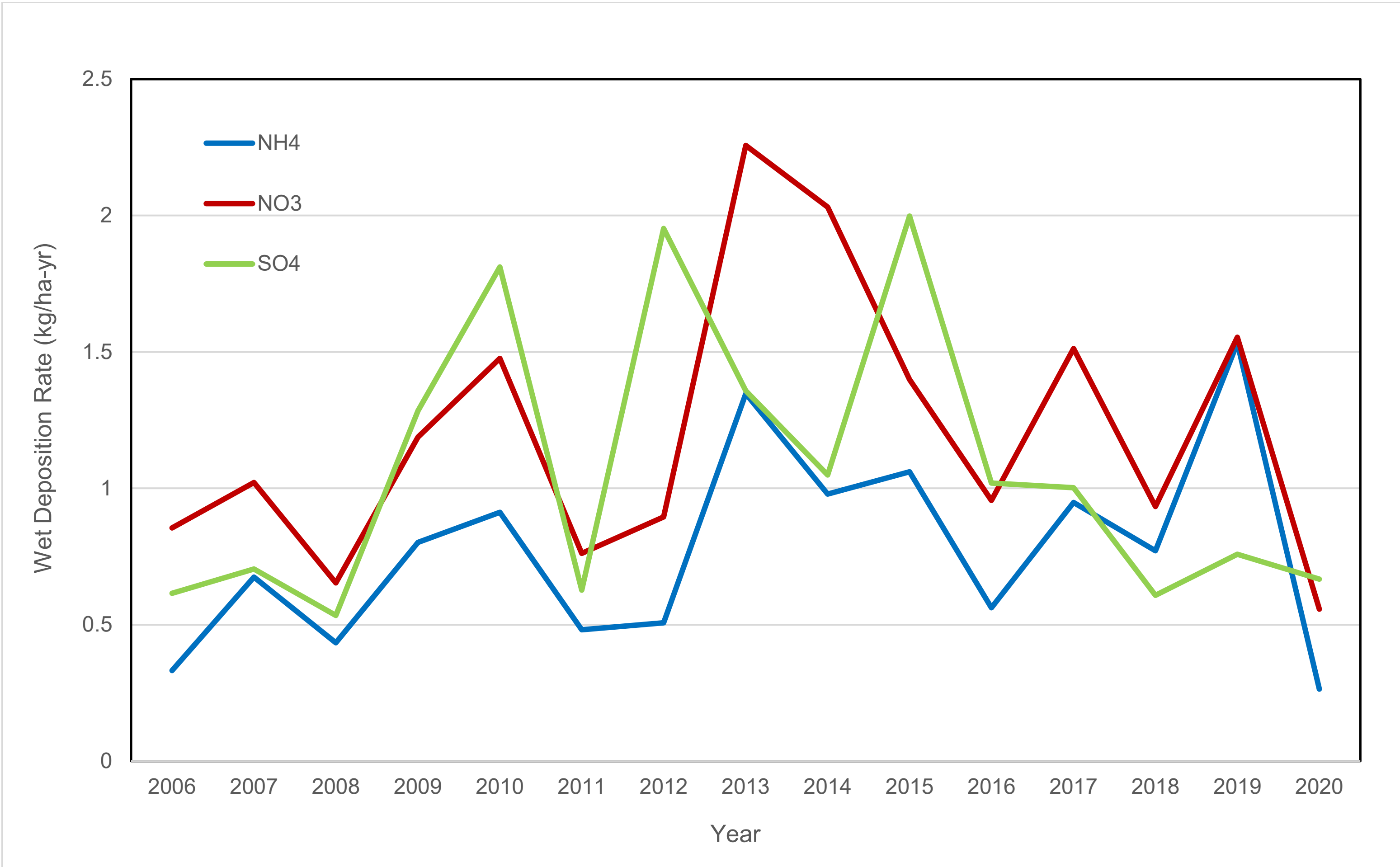


Figure Source: NADP 2022
kg/ha-yr = kilograms per hectare per year; NH_4 = ammonium; NO_3 = nitrate; SO_4 = sulfate

Figure 3.3-5 Trends in Wet Deposition Rates – Reynolds Creek, 2006-2020

Table 3.3-8 NTN Speciated Wet Deposition, Annual Average – Lost Trail Pass (Site MT97)

Year	Ca (kg/ha-yr)	Mg (kg/ha-yr)	K (kg/ha-yr)	Na (kg/ha-yr)	NH_4 (kg/ha-yr)	NO_3 (kg/ha-yr)	Total N (kg/ha-yr)	Cl- (kg/ha-yr)	SO_4 (kg/ha-yr)	H+ (kg/ha-yr)
2006	0.628	0.080	0.329	0.309	0.737	3.018	1.255	0.528	2.301	0.050
2007	0.378	0.048	0.078	0.174	0.523	1.638	0.777	0.252	1.318	0.035
2008	0.422	0.051	0.103	0.144	0.484	1.914	0.808	0.247	1.503	0.039
2009	0.481	0.059	0.226	0.383	0.501	2.356	0.921	0.52	2.003	0.051
2010	0.382	0.048	0.096	0.22	0.402	1.778	0.714	0.258	1.233	0.041
2011	1.15	0.114	0.125	0.41	0.751	1.89	1.011	0.569	1.776	0.042
2012	0.806	0.086	0.108	0.441	0.613	1.763	0.874	0.441	1.408	0.034
2013	0.338	0.047	0.15	0.197	0.648	1.597	0.864	0.357	1.146	0.033
2014	0.452	0.068	0.164	0.233	0.725	2.066	1.03	0.315	1.341	0.056
2015	0.37	0.047	0.133	0.645	0.768	1.508	0.938	0.313	1.015	0.038
2016	4.02	1.306	0.354	1.679	0.69	1.399	0.852	0.802	1.781	0.034
2017	5.468	1.562	0.373	1.761	0.898	2.134	1.18	1.119	2.367	0.047
2018	0.632	0.072	0.155	0.262	0.978	2.337	1.288	0.37	1.276	0.046
2019	0.278	0.037	0.093	0.121	0.63	1.455	0.819	0.213	0.769	0.038
2020	0.405	0.058	0.104	0.173	0.567	1.469	0.772	0.243	0.833	0.04
Mean	1.08	0.25	0.17	0.48	0.66	1.89	0.94	0.44	1.47	0.042
Median	0.45	0.06	0.13	0.26	0.65	1.78	0.87	0.36	1.34	0.040

Source: NADP 2022
kg/ha-yr = kilograms per hectare per year
(1 kg = 2.2 lbs.; 1 hectare = 2.5 acres)
Ca = calcium Na = sodium
Cl- = chloride NH_4 = ammonium
H+ = free acidity NO_3 = nitrate
K = potassium SO_4 = sulfate
Mg = magnesium N = nitrogen

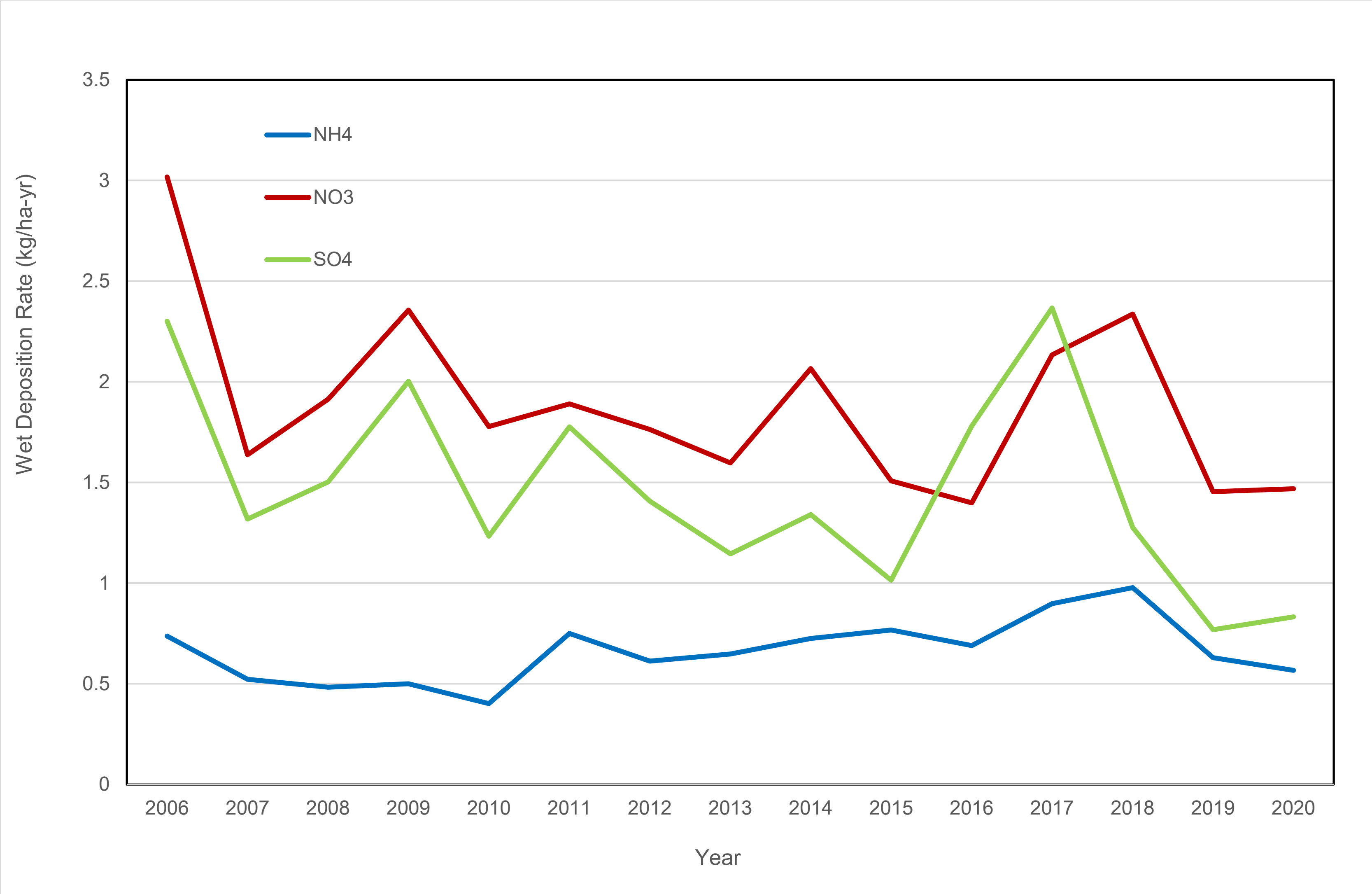


Figure Source: NADP 2022
kg/ha-yr = kilograms per hectare per year; NH_4 = ammonium; NO_3 = nitrate; SO_4 = sulfate

Figure 3.3-6 Trends in Wet Deposition Rates – Lost Trail Pass, 2006-2020

Table 3.3-9 CASTNET Dry Deposition Rates, Annual Average – Two Idaho Sites

Year	Site NTP006 Dry Nitrogen Deposition Rate (kg/ha-yr)	Site NTP006 Dry Sulfur Deposition Rate (kg/ha-yr)	Site RCK263 Dry Nitrogen Deposition Rate (kg/ha-yr)	Site RCK263 Dry Sulfur Deposition Rate (kg/ha-yr)
2007	1.70	0.33	0.233	0.751
2008	1.57	0.32	0.177	0.481
2009	1.38	0.18	0.350	0.643
2010	1.41	0.19	0.603	1.042
2011	1.55	0.20	0.210	0.545
2012	1.62	0.18	0.650	0.598
2013	1.61	0.23	0.453	1.560
2014	1.54	0.23	0.350	1.221
2015	2.46	0.89	0.267	0.806
2016	1.65	0.19	0.340	0.652
Mean	1.65	0.29	0.363	0.830
Median	1.59	0.21	0.345	0.702

Source: EPA 2018b, CASTNET 2023
kg/ha-yr = kilograms per hectare per year
(1 kg = 2.2 lbs.; 1 hectare = 2.5 acres)
Site NTP006 - Nez Perce Tribal Land
Site RCK263 - Reynolds Creek

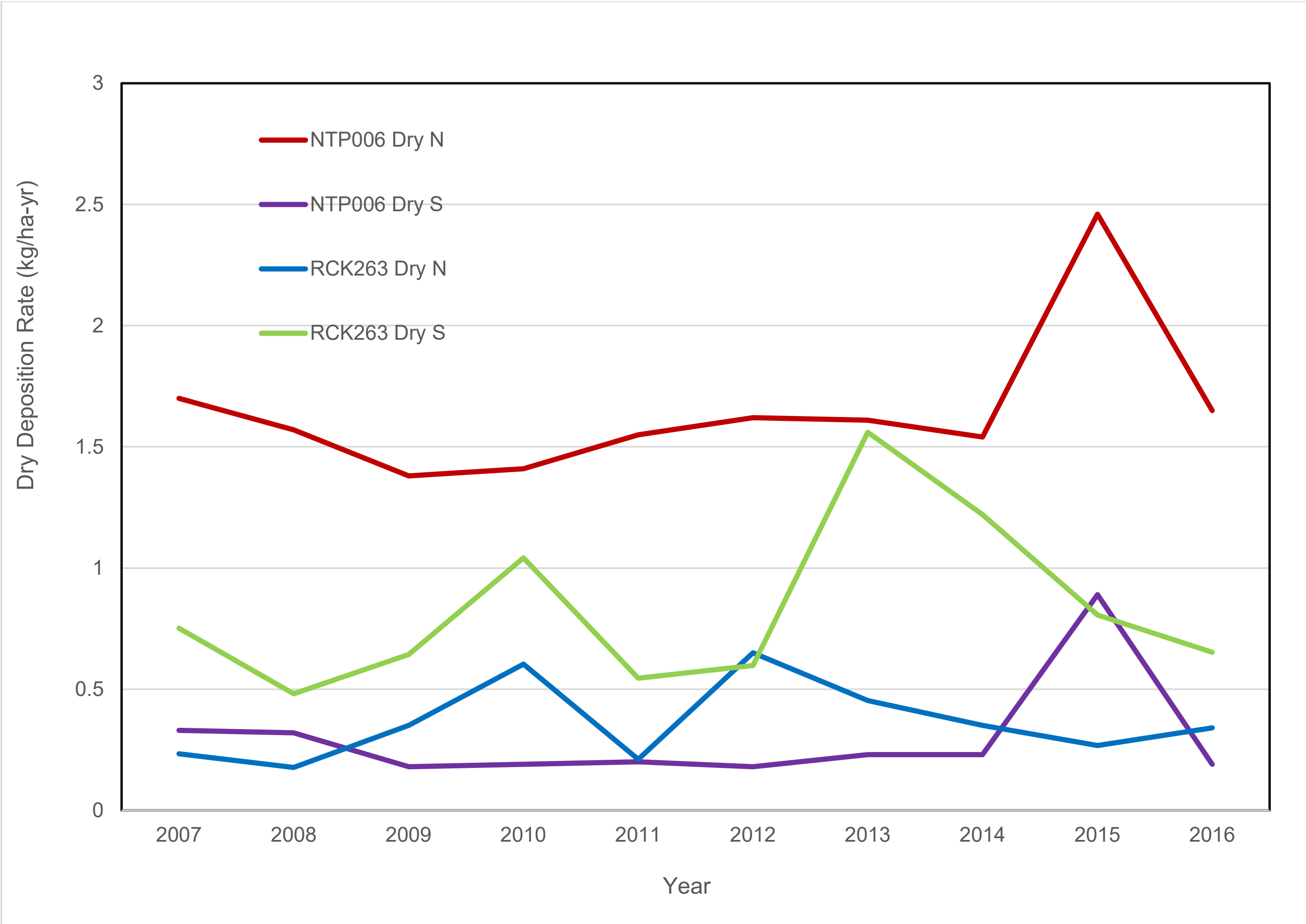


Figure Source: EPA 2018b, CASTNET 2023
kg/ha-yr = kilograms per hectare per year. Site NTP006 - Nez Perce Tribal Land; Site RCK263 - Reynolds Creek

Figure 3.3-7 Trends in Dry Nitrogen and Sulfur Deposition Rates, 2006-2015

Atmospheric deposition of mercury is of particular concern where the potential exists for contamination of riparian areas and/or surface waters through precipitation and runoff. Although gaseous oxidized Hg and particle-bound Hg deposition are prevalent, all forms of Hg can deposit to local or regional watersheds (Zhang 2009). Once deposited in a body of water, inorganic forms of mercury are converted to a chemical form (methyl mercury) that can become concentrated in fish and can harm the health of individuals who consume these fish, particularly children. In relatively arid regions, such as Idaho, dry Hg deposition may be a larger contributor to atmospheric deposition of mercury compared to wet deposition. National Hg emissions from domestic human-caused sources declined from about 63 tons in 2008 to about 55 tons in 2014, the latest data year available in the EPA National Emissions Inventory (EPA 2017a). More than 75 percent of this decline (5.9 tons per year) can be attributed to reductions in Hg emissions from fossil-fueled electric generation plants (EPA 2017a).

Annual averages of sampling data are available from the MDN in the region corresponding to the SGP far field analysis area. Three MDN sites have been located at CRMO, Deer Flats (294 km distant, south-southwest), and McCall, Idaho (59.5 km distant, west). The most recent measurements were between 2007 and 2010 and are provided in **Table 3.3-10** to serve as an estimate of historical Hg wet deposition in the region surrounding the SGP area. Total Hg deposition in precipitation (organic + inorganic) is calculated for the MDN in units of micrograms per square meter per year (µg/m2-yr) based on measured mass of Hg deposited over a known sample area (NADP 2018, CASTNET 2023). The total dry nitrogen deposition is the summation of nitric acid, ammonia, ammonium, nitrate, and other unmeasured nitrogen species (NDRY_NOM). Total dry sulfur deposition is the summation of sulfur dioxide and sulfate.

Table 3.3-10 Historical Annual Average Concentration and Mercury Deposition Rates in Precipitation – Three Idaho MDN Sites

Year	Station Name (MDN ID) [1,2]	Precipitation Collected (dm/yr)	Average Precipitation Mercury Concentration (ng/L)	Mercury Deposition Rate (µg/m²-yr)
2007	Craters of the Moon NM (ID03)	2.01	14.10	2.83
2008	Craters of the Moon NM (ID03)	5.51	6.45	3.36
2009	Craters of the Moon NM (ID03)	3.91	16.71	6.53
2009	Deer Flats, ID (ID98)	2.15	10.56	2.27
2009	McCall, ID (ID99)	6.52	8.09	5.27
2010	Craters of the Moon NM (ID03)	3.91	14.03	5.48
Mean	All Stations	3.95	11.65	4.29

Source: NADP 2018

[1] Individual annual measurements for precipitation and mercury deposition data available for three sites: ID03 Craters of the Moon National Monument; ID98 Deer Flats, Idaho; ID99 McCall Idaho.

[2] The three MDN sites within the far field analysis area ceased operation by 2010.

$\mu g/m^2$-yr = deposition rate as micrograms mercury per square meter per year.

dm = decimeter (1 decimeter = 3.94 inches).

ng/L = nanograms per liter precipitation.

Mercury Ambient Concentrations

In addition to deposition data, ambient mercury concentrations are measured via the NADP, specifically the Atmospheric Mercury Network (AMNet). AMNet has captured concentration data throughout North America beginning 2006. AMNet has been in 39 sites throughout the years and 12 currently active locations. Each site measures hourly gaseous elemental mercury (GEM) and also measures 2-hr gaseous oxidized mercury (GOM) and particulate bound mercury (PBM2.5). The nearest geographic site to the SGP area is no longer active but was active from December 2008 to August 14, 2017 (over 500-km away). **Table 3.3-11** illustrates the annual average concentrations of each component from December 2008 through November 2015. Only a very limited percentage of data was available from December 2015 through August 2017. For further information and concentrations for other locations please refer to http://nadp.slh.wisc.edu.

Table 3.3-11 Annual Average Mercury Concentration – Salt Lake City AMNet Site

Year	GEM Hourly Average Concentration (ng/m^3)	GOM Average Concentration (pg/m^3)	$PBM_{2.5}$ Average Concentration (pg/m^3)
Dec 2008 – Nov 2009	2.15	20.14	15.22
Dec 2009 – Nov 2010	2.07	26.63	6.35
Dec 2010 – Nov 2011	1.83	17.06	8.44
Dec 2011 – Nov 2012	1.80	18.68	16.45
Dec 2012 – Nov 2013	1.87	16.80	22.22
Dec 2013 – Nov 2014	1.73	14.52	12.82
Dec 2014 – Nov 2015	1.74	15.17	8.87
Overall Mean	1.88	18.43	12.91

Source: NADP 2022
ng/m^3 = nanograms per cubic meter; pg/m^3 = picograms per cubic meter; GEM = Gaseous elemental mercury; GOM = Gaseous oxidized mercury; $PBM_{2.5}$ = particle bound mercury

3.3.4.5 Climate and Meteorology

The SGP is located in the central portion of the Salmon River Mountain Range, in central Idaho, approximately 10 air miles east of the village of Yellow Pine. The SGP Operations Area Boundary and the broader analysis area are classified as a Warm-Summer Continental Climate (Weatherbase.com). In this region, the climate typically ranges from warm, dry summers to cold, wet winters. However, the locale of the SGP is semi-arid as a result of the Cascade and Sierra Nevada mountains to the west and the Bitterroot and Rocky Mountains to the north, which effectively prevents large scale intrusion of Pacific moisture.

As described by the Western Regional Climate Center (WRCC), organized storm fronts frequently move through the region during winter, resulting in cold outbreaks, and can produce snowfall over two feet. Cloudy and unsettled weather is common during the winter with measurable precipitation occurring roughly a third of the days. The summer months are typically dominated by high pressure over the Great Basin resulting in warm days with very little precipitation. In general, temperatures in the cooler months average below 30 degrees Fahrenheit (°F) and average above 50°F during the warmer months (WRCC 2018a, 2018b).

Spring months are normally wet and windy with periods of high winds that may persist for days at a time. Weather conditions fluctuate quickly during the spring. Afternoon temperatures in the range of 30 to 50°F with precipitation in the form of rain or snow may occur interspersed with periods of sunny skies and afternoon temperatures between 50 to 70°F. Thunderstorms are not uncommon and are usually accompanied by rain showers and occasional snow. Low elevation snowpack usually melts quickly during the spring, but high elevation snowpack can persist into June or later in the year (WRCC 2018a, 2018b).

The nearest location with a long-term climatological data record is the McCall, Idaho, municipal airport station, which is located approximately 37 air miles west and 1,575 vertical feet below the SGP. The McCall National Weather Service (NWS) station also monitors surface temperature, dew point and wind speed, direction, and highest gust speed (NOAA 2018). While regionally representative, it can be assumed that the McCall airport data would be slightly warmer with lower amounts of precipitation due to its lower elevation compared to the SGP. The average maximum annual temperature is 54ºF and during the warmest month (July) the average maximum monthly temperature is 81ºF. The average minimum annual temperature is 27ºF and during the coldest month (January) the average minimum monthly temperature is 11ºF (NOAA 2018). **Table 3.3-12** provides the daily average temperature range parameters for the McCall station for the years 1997 to 2008 (WRCC 2018b). The daily average minimum and maximum temperatures for each month recorded in for McCall also are plotted in **Figure 3.3-8**.

Table 3.3-12 Average Temperature Data from McCall National Weather Service Site

Data	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg.
Avg. Max Temp (F)[1]	28.6	32.5	39.3	47.8	58.8	67.6	80.4	78.1	67.9	54.5	39.5	28.2	51.9
Avg. Min Temp (F)[1]	10.4	9.9	16.6	24.5	32.6	37.6	44.1	41.2	33.5	25.6	19.4	11.0	25.5

Source: McCall Municipal Airport (WRCC 2018b)
[1] Data from the McCall Municipal Airport, National Weather Service Station averaged from 1997 to 2008.
°F = degrees Fahrenheit. Avg. = average.

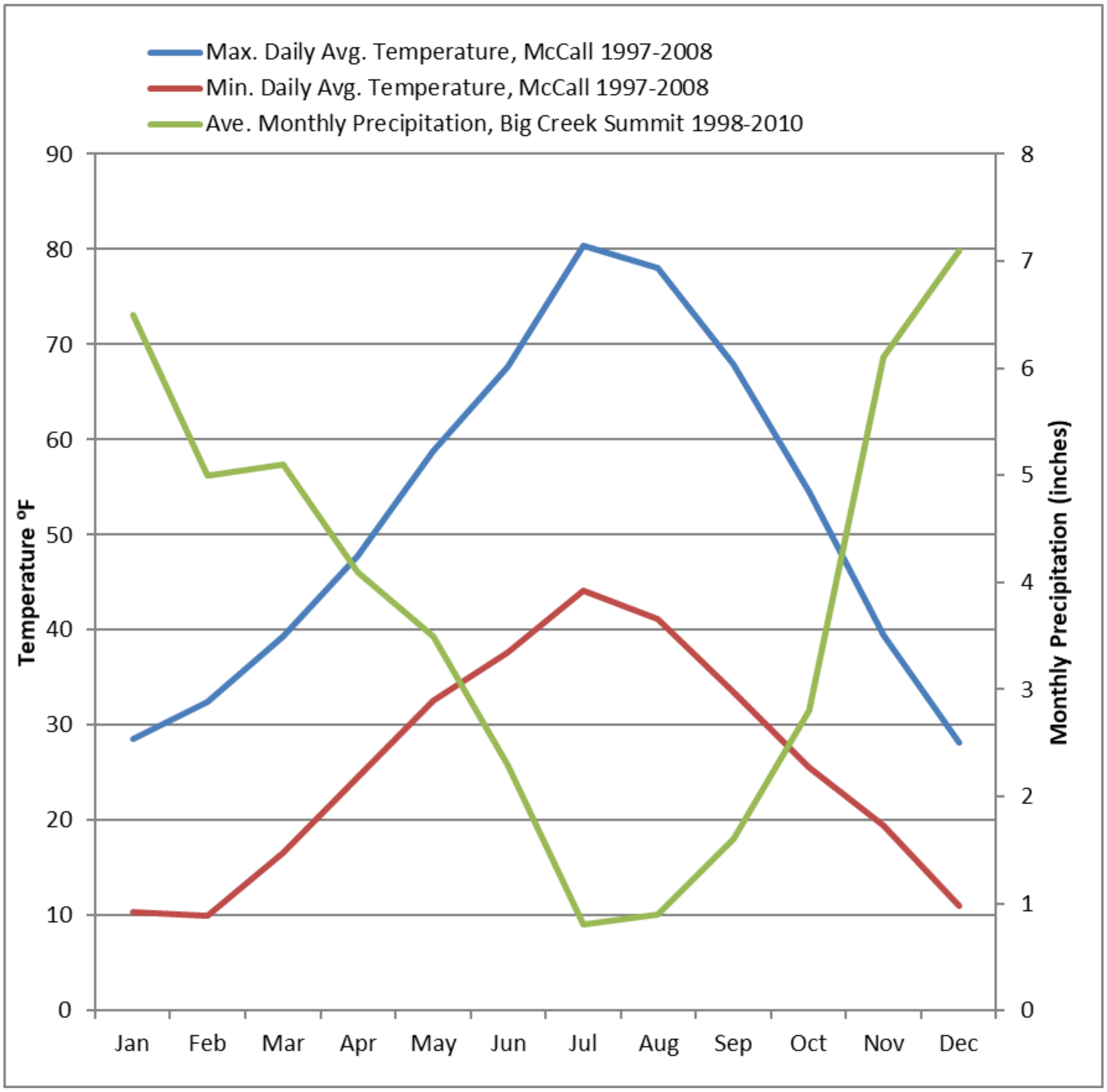


Figure Source: NRCS 2021; WRCC 2018b

Figure 3.3-8 Temperature Range Data for McCall, Idaho, and Monthly Precipitation for Big Creek Summit SNOTEL Site

The Big Creek Summit Site is operated by the National Water and Climate Center's Snow Telemetry (SNOTEL) network. The site is located 28 miles southwest of the SGP at approximately the same elevation and latitude. The site provides data for surface temperature, precipitation, snow water equivalent, and snow depth. The monthly average precipitation and snowfall information for the Big Creek Summit Site can be considered representative of the SGP and is shown in **Table 3.3-13** (National Resources Conservation Service [NRCS] 2021). Although the climatological data is quoted for different spans of years, this available data provides covers sufficiently long periods to provide representative average values for historical climate description.

Table 3.3-13 Average Precipitation Data from Big Creek Summit SNOTEL Site

Data	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg.
Avg. Precipitation Increment(in)[1]	6.9	5.1	5.7	4.4	3.4	2.6	0.7	0.8	1.4	3.1	5.5	7.8	4.0
Snow Water Equivalent (avg, in)1	13.0	20.0	25.3	30.4	27.9	10.0	0.0	0.0	0.0	0.0	1.0	7.8	11.3
Snow Depth (avg, in)[2]	49.4	66.7	77.3	82.3	63.2	18.1	0.0	0.0	0.0	0.0	2.6	19.3	31.6

Source: Big Creek Summit Site (NRCS 2021)
[1] Data from the Big Creek Summit SNOTEL Station averaged from 1991 to 2020.
[2] Data from the Big Creek Summit SNOTEL Station averaged from July 2000 to January 2020.
Avg. = average. In = inches.

Temperature

Between 2010 and 2014, the maximum hourly temperature recorded at the McCall site was 95°F during 2013. Typically, the maximum hourly temperature occurred during July or August. The minimum hourly temperature recorded at the McCall site was -18°F during 2010. In winter, the minimum hourly temperature occurred on numerous days between December and February. Diurnal temperature ranges were the largest in the warmer months (April to September) and decreased during the cooler months (WRCC 2018b). The maximum and minimum daily average temperatures between 1997 and 2008 are shown on **Figure 3.3-8**.

The hourly temperatures recorded at the Big Creek Summit site would be comparable to the SGP, as this station is at the same elevation. Between 2010 and 2014 highest hourly temperature was 90°F, recorded during 2013. Typically, the maximum hourly temperature occurred during July or August. The minimum hourly temperature recorded at the Big Creek Summit site was -13°F during 2010. Typically, the minimum hourly temperature occurred on numerous days between December and February. Diurnal temperature ranges were the largest in the warmer months (April to September) and decreased during the cooler months (NOAA 2018).

Precipitation

Precipitation data for the Big Creek Summit SNOTEL site over the period 1991 to 2020 show that monthly average totals range from 5 to 8 inches per month during the cool months (November - March) primarily in the form of snow. The summer is dry, with monthly average precipitation typically less than two inches per month from June through September. Annual precipitation accumulation recorded at the Big Creek Summit site was approximately 51.4 inches in 2010, 47.1 inches in 2011, 54.9 inches in 2012, 35.6 inches in 2013, and 52.8 inches in 2014.

Wind

Baseline wind speed and direction data at the Stibnite monitoring station were collected from November 2013 to June 2015. During this period, the strongest winds were from the southwest and from the west-southwest. The mean wind speed was 2.3 meters per second (5.2 miles per hour). Wind directions had a strong tendency from the southwest. Speeds varied widely but tended to be strongest from the southwest. The Stibnite wind distribution data collected at the on-site meteorological station from January 2014 to December 2014 are shown in **Figure 3.3-9** (Air Sciences 2018a).

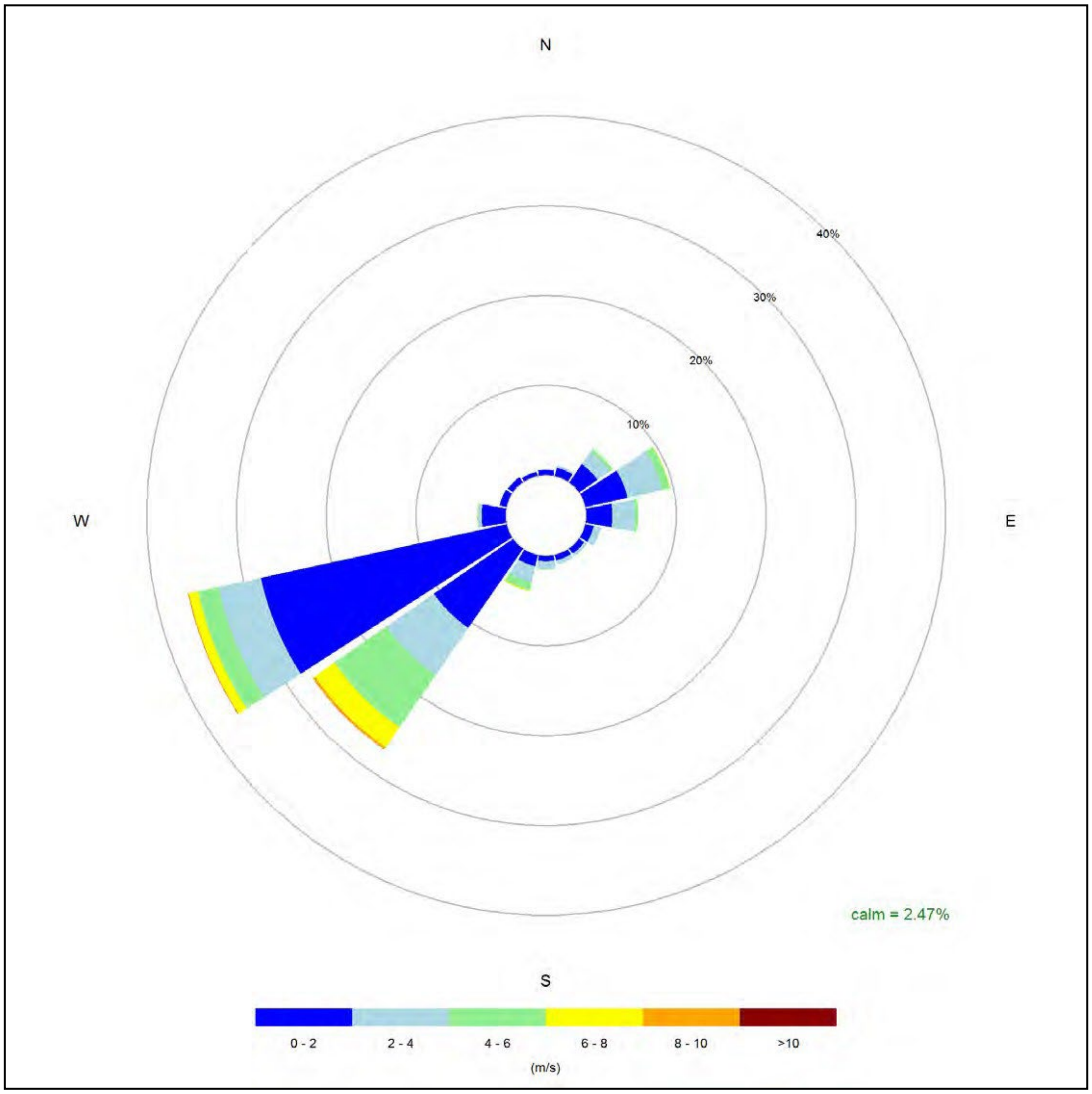


Figure Source: Air Sciences 2018a

Figure 3.3-9 Wind Distribution – Stibnite SGP, 2014

3.4 Climate Change

3.4.1 Introduction

Given that climate change impacts are likely to persist in the region, analysis area resource conditions are expected to be affected. Climate change trends are discussed below by resource. Due to the nature of the resource, climate change is not expected to impact noise, thus this resource is not discussed.

3.4.2 Climate Change Area of Analysis

The climate change analysis area varies depending on the resource affected as described in each resource in this chapter.

3.4.3 Relevant Laws, Regulations, Policies, and Plans

There are currently no federal or state regulatory programs that require GHG emission reductions or controls on new or existing facilities in Idaho. The sections below describe the existing regulatory guidance for GHGs and climate change under the NEPA and from the Forest Service, as well as other guidance from the EPA and state of Idaho for monitoring, reporting, and reducing GHG emissions. Additional descriptions of these guidance documents can be found in the SGP Climate Change Specialist Report (Forest Service 2023b).

Land and Resource Management Plan: There are no specific standards or guidelines related to climate change in the Payette Forest Plan (Forest Service 2003a) or the Boise Forest Plan (Forest Service 2010a). However, Climate Change Considerations in Project Level NEPA Analysis (Forest Service 2009a) provides Forest Service guidance on how to consider climate change in project-level NEPA analysis and documentation. The following basic concepts are outlined in this document:

1. Climate change effects include the effects of agency action on global climate change and the effects of climate change on a proposed project.

2. The agency may propose projects to increase the adaptive capacity of ecosystems it manages, mitigate climate change effects on those ecosystems, or to sequester carbon.

3. It is not currently feasible to quantify the indirect effects of individual or multiple projects on global climate change; therefore, determining significant effects of those projects or project alternatives on global climate change cannot be made at any scale.

4. Some project proposals may present choices based on quantifiable differences in carbon storage and GHG emissions between alternatives.

Mandatory Reporting of Greenhouse Gases Rule: As an initial action under the federal CAA, the EPA established a program in October 2009 for MRR (40 CFR 98). This program requires monitoring and annual reporting of GHG emissions for over 40 source categories if the facility's annual emissions exceed 25,000 metric tons of GHGs (as CO_2e units). The MRR facilitates collection of emissions data to provide a basis for future EPA policy decisions and regulatory initiatives. This federal regulation stipulates the methodology for record keeping, emission estimation, and reporting of GHG emissions.

GHG Major Source Permitting – Tailoring Rule: In June 2010, EPA issued a final rule (referred to as the Tailoring Rule) setting GHG emission thresholds for CAA preconstruction permits under the PSD and Title V permitting programs (75 Federal Register 31514). The Tailoring Rule established a Title V major source permitting threshold of 100,000 short tons per year for GHGs measured in CO2e. In addition, the Tailoring Rule also imposed the requirement for new major sources of GHG to implement best available control technology to reduce GHG emissions through the new source review process.

In June 2014, the Tailoring Rule provisions regarding GHG major source permitting were remanded by the U.S. Supreme Court (U.S. Supreme Court 2014). The ruling allowed EPA to continue to regulate GHG for sources already subject to regulation as PSD or Title V sources for conventional criteria pollutants.

2016 Council on Environmental Quality Guidance: On August 1, 2016, the CEQ issued final guidance describing how federal departments and agencies should consider the effects of GHG emissions and climate change in their NEPA reviews (81 Federal Register 51866). This guidance provided an updated approach to describe climate change impacts (CEQ 2016).

Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis, EO 13990: This order was issued on January 20, 2021, to establish a national policy to better promote and protect public health and the environment. Additionally, CEQ will provide a separate notice of its review and potential revisions at a later date. EO 14008 also was issued on February 1, 2021, outlining a government-wide approach toward combating the "climate crisis". Currently, the 2016 Guidance and other available resources and tools should be employed to assess GHG impacts.

U.S. Forest Service Climate Adaption Plan: In June 2022, the USFS identified six adaption actions/focus areas and the desired outcomes. The adaption actions involve environmental justice, tribal engagement, and climate change. Specific actions are shifting wildfire regimes, extreme events and disturbances, chronic stressors to watersheds, disruption of forest products/services, environmental injustice, and threats to agency workforce. The outcomes include:

- Reduced fire risk.
- Reduced risk to extreme weather and disturbances.
- Productive, diverse ecosystems and watersheds.
- Multiple benefits provided to the public.
- Enhanced social resilience to climate impacts and environmental justice.
- Agency workforce and operations are prepared for multiple climate impacts.

State and Local Policy: On May 16, 2007, the Governor of Idaho signed EO 2007-05, Establishing a State Policy Regarding the Role of State Government in Reducing Greenhouse Gases (Idaho Administrative Bulletin 2007). The EO identified two types of actions to be taken: 1) the Director of the IDEQ is to take a lead role in coordinating GHG reduction efforts; and 2) the Director of IDEQ is to develop a state GHG emission inventory and develop recommendations on how to reduce GHG emissions in the state. **Table 3.4-1** showing the statewide GHG emissions inventory for Idaho (by sector). GHG emission reduction strategies and/or initiatives have not yet been identified for the state.

3.4.4 Affected Environment

Existing conditions for climate change are discussed for the affected resources in terms of baseline GHG emissions in the analysis area, as well as potential effects from climate change on the social, physical, and biological resources in the analysis area. Additional descriptions of these conditions may be found in the SGP Climate Change Specialist Report (Forest Service 2023b).

3.4.4.1 GHG Inventory Information

The GHG compounds of interest are those that would be released due to operation of diesel-fueled and gasoline-fueled engines, and propane combustion for either process needs or heating of buildings. The use or release of any hydrofluorocarbons or perfluorocarbons would not be necessary for the SGP. To provide context for emissions associated with the SGP, this section also presents GHG inventory information for national and regional sources.

National GHG Inventory Data

Compared to 1990, annual GHG emissions in the U.S. have increased by about 1.79 percent, based on 2019 reported data (EPA 2021c). However, year-to-year emissions are shown to increase or decrease due to changes in the economy, the price of fuel, weather, and other factors.

The EPA reports that 2019 annual total emissions of CO_2 were 2.8 percent higher than 1990 totals, while total emissions of CH_4 were 15.1 percent lower, and total emissions of N_2O were 0.1 percent higher (EPA 2021c). GHG emissions in the U.S. were partly offset by carbon sequestration in managed forests, trees in urban areas, agricultural soils, landfilled yard trimmings, and coastal wetlands. In recent years, there has been a general nationwide trend of declining GHG emissions across most sectors (EPA 2021c).

In 2019, the latest reporting year available, transportation vehicles and electric power generation accounted for 28.6 and 25.1 percent, respectively, of U.S. emissions of GHG. Industrial sources (the reporting category that includes mining activities other than coal accounts for 22.9 percent of GHG emissions nationwide. GHG emissions from industry are mainly associated with burning fossil fuels (e.g., coal, oil, natural gas) for heat energy, as well as emissions from non-road vehicles and equipment, and manufacturing processes to produce goods from raw materials (EPA 2021c).

GHG Inventory for Idaho

Table 3.4-1 shows reported statewide GHG emissions within Idaho from 2018. Idaho is a relatively small contributor to U.S. GHG emissions. Based on the total data available from the EPA State Inventory and Project Tool, Idaho produced approximately 31.44 million metric tons (MMT) of CO_2e in 2018 (EPA 2021d). These emission estimates are based in large part from representative default values as provided by the EPA. Total national CO_2e emissions for 2018 was 5,870 MMT (EPA 2021c). Both yearly estimates include both sources and sinks. Idaho's total GHG emissions accounted for less than 0.6 percent of U.S. GHG emissions during that period. The Idaho data is broken down into five general categories. These include energy consumption, industrial processes, agriculture, waste (municipal solid waste, wastewater), and land-use and forestry (sinks). Note that the total amount associated with land-use/forestry is a net reduction but included are potential emissions from forest fires. During 2020, approximately 127,214 hectares (314,352 acres) were burned from forest fires within Idaho (NICC 2021). For the purposes of this analysis, it was assumed that all forest burned was temperate forest such as species like fir and pine.

The three highest contributing sectors to Idaho GHG emissions are energy (19.77 MMT), agriculture (12.64 MMT), and industrial (1.53 MMT). The overwhelming energy contributor is general fossil fuel combustion (primarily industrial and transportation petroleum usage). Mineral mining is not designated separately and is assumed to be a small overall contributor.

Table 3.4-1 Statewide GHG Emissions Inventory for Idaho, by Sector

Source Category	Fuel Type or Process Activity	2000 MMT CO_2e	2010 MMT CO_2e	2018 MMT CO_2e	2018 Sector Portion of Annual Emissions (%)	2000-2018 Average MMT CO_2e	% Change, 2000 to 2018
Energy	Fossil Fuel Combustion	17.31	16.70	19.50	62.01	17.15	12.64
	Stationary Combustion	0.09	0.10	0.19	0.60	0.12	101.18
	Mobile Combustion	0.27	0.11	0.08	0.26	0.14	-69.80
	Subtotals of all Fuel Types	17.67	16.92	19.77	62.87	17.42	11.86
Industrial	Industrial Processes	1.42	1.20	1.53	4.87	1.38	7.75
Agriculture	Enteric Fermentation	4.15	4.89	5.50	17.50	4.87	32.57
	Manure Management	1.94	2.88	3.20	10.17	2.74	64.95
	Ag Soil Management	3.63	3.59	3.81	12.11	3.72	5.00
	Rice Cultivation	0.00	0.00	0.00	0.00	0.00	0.00
	Liming	0.02	0.00	0.04	0.12	0.03	117.64
	Urea	0.09	0.08	0.07	0.21	0.10	-23.07
	Burn of Ag Waste	0.03	0.03	0.03	0.09	0.03	-2.51
	Subtotals of Ag Types	9.85	11.47	12.64	40.19	11.48	28.35
Land-use/ Forestry	Land Use, Land Use Change, and Forestry (Sink)	-9.96	-3.42	-3.10	-9.85	-5.04	68.91
Waste	Municipal Solid Waste	0.48	0.52	0.41	1.30	0.48	-14.61
	Wastewater	0.16	0.18	0.20	0.64	0.18	24.97
	Subtotals of all Waste Types	0.64	0.70	0.61	1.94	0.64	-4.58
Grand Total	Sources & Sinks	19.62	26.87	31.44	100	25.89	N/A

Source: EPA 2021d

CO_2 emissions are the vast majority of fuel combustion and industrial processes (~95 percent). Agriculture GHG emissions are primarily comprised of CH_4 (~74 percent). All land use and forestry sinks are calculated as carbon sequestration (CO_2). All solid waste is CH_4 and municipal waste is also mostly CH_4 (~70 percent).

3.4.4.2 Climate Change Trends

Climate change is often discussed in terms of plausible futures or scenarios based on precipitation and temperature projections. These scenarios are built on different trajectories of future GHG concentrations, land use, and other factors, due to the uncertainty associated with GHG emissions and concentrations, and uncertainty in climate functions. The Intergovernmental Panel on Climate Change (IPCC) released new emission scenarios in 2013 called Representative Concentration Pathways (RCPs). RCP 8.5 represents a scenario where high emissions continue through 2100 (FHWA 2017); the discussion of emissions and climate change trends throughout this section are based on the projected scenarios under RCP 8.5.

In general, managers are recommended to use the RCP 8.5 scenario for planning and project purposes. This is based on information in the 2018 National Climate Assessment informing that without major reductions in global emissions, it is expected that the temperatures would reach RCP 8.5 levels or even higher temperatures in the future.

The IPCC Sixth Assessment Report documents evidence for the warming of the global climate system since the 1950s, based on observed changes over time periods ranging from decades to millennia (IPCC 2021). In this assessment, the IPCC reports that most land areas have seen a global surface temperature increase of 0.1°C (0.18°F) per decade since 1960, and each of the last three decades has been successively warmer than any preceding decade since 1850. In the Northern Hemisphere, 1983 to 2012 was likely the warmest 30-year period of the last 1,400 years (IPCC 2021).

As described below, the effects of climate change in the analysis area can be seen by review of reported trends in the temperature, precipitation, snowpack, and other indicators of regional climatology. Similarly, statewide climate trends also reflect the measurable effects of regional climate change that will continue to affect the environmental conditions in the analysis area regardless of the alternative implemented. These statewide and regional trends are used as a proxy to discuss current climate trends in the analysis area.

Most of Idaho has seen an increase in average temperatures of 0.56 to 1.1°C (1 to 2°F) over the last century, with the last two decades being the warmest on record (EPA 2016a). Average minimum and maximum temperatures for the middle Rockies region, which includes the Payette, Boise, Salmon-Challis, Sawtooth, and portions of the Caribou-Targhee National Forests, are projected to warm by about 5.6°C (10°F) under RCP 8.5 by 2100, with increases projected to be the largest during summer months (Halofsky et al. 2018). A recent example being the summer 2021 drought throughout much of Idaho. The projected increase in minimum temperature in this region by the year 2100 under the RCP 8.5 scenario will bring the median temperature above freezing, suggesting that a biologically meaningful threshold could be crossed (Halofsky et al. 2018). Additionally, the intensity of heat waves is projected to increase, while cold wave intensity is projected to decrease (Runkle et al. 2017).

Statewide precipitation is highly variable and showed no overall trend in annual average precipitation during the last century. However, the frequency of extreme precipitation events in Idaho has been above average over the past decade. Statewide winter and spring precipitation is expected to increase during the 21st Century, while precipitation in the summer is expected to decrease (Runkle et al. 2017). Overall, precipitation is projected to increase by 5 to 8 percent by the year 2100 under RCP 8.5 (Halofsky et al.

2018). Increased intensity of drought events is expected to occur throughout the 21st Century (Runkle et al. 2017).

Changes in river-related flood risk depends on many factors, but warming is projected to increase flood risk the most in mixed basins (those with both winter rainfall and late spring snowmelt-related runoff peaks) and remain largely unchanged in snow-dominant basins (Mote et al. 2014). Across the northwest region, much of the water supply comes from mountain snowpack, which melts in spring and summer and runs off into rivers, filling reservoirs. As the climate warms, more precipitation falls as rain and less falls as snow and more snow melts during the winter, which decreases the snowpack. Since the 1950s, Idaho's overall snowpack has been decreasing (EPA 2016a). Lower snowpack and increased drought are likely to lead to lower base flows, reduced soil moisture, wetland loss, riparian area reduction or loss, and more frequent and possibly severe wildfire. The projected rise in temperatures is expected to increase the average lowest elevation where the snowpack reliably accumulates throughout the winter, which may cause the tree line to shift, as subalpine fir and other high- altitude trees become able to grow at higher elevations. Rising temperatures also could result in earlier melting of the snowpack, further decreasing water availability during the dry summer months (Runkle et al. 2017).

Increasing air temperatures and decreasing summer flows associated with climate change are expected to warm streams by increasing long-wave radiation and warming groundwater inputs (Isaak et al. 2017). Reduced stream cover from changes in woody debris and bank vegetation also can result in increased stream temperatures (Halofsky et al. 2018). A transition from snow to rain, resulting in diminished snowpack and shifts in streamflow to earlier in the season, also could cause reductions in groundwater recharge to aquifers and groundwater discharge to groundwater-dependent ecosystems. Mean annual streamflow projections suggest a slight increase; however, despite these projections, summer low flows are expected to decline.

Climate controls the magnitude, duration, and frequency of weather events (e.g., wind, temperature, relative humidity, and precipitation), which, in turn, drive fire behavior (Halofsky et al. 2018). A warming climate and earlier snowmelt patterns have led to longer fire seasons, and these trends are expected to continue. The size and duration of forest fires, the length of the fire season, and size of areas burned in the West have increased over the past 30 years (Halofsky et al. 2018). The annual area burned, as well as the occurrence of very large wildfires, is projected to continue increasing as temperatures rise and longer fire seasons combine with regionally dry fuels.

3.4.4.3 Geological Resources and Geotechnical Hazards

Current climate change trends, such as increased heavy precipitation events and more precipitation falling as rain instead of snow, could lead to increased soil erosion and change in landcover, which could potentially impact slope stability and avalanche occurrence in the analysis area. Damage due to seismic activity in the area also could be exacerbated by climate-induced instability in the analysis area.

3.4.4.4 Air Quality

Climate-induced changes in weather and seasonality can strongly affect air quality in a specific region. The criteria air pollutants of most concern and potentially most affected by changes in climate, are PM, and ground-level ozone.

PM which primarily consists of sulfate and nitrate compounds, organic carbon, elemental carbon, soil dust, and sea salt. Of most concern to human health are the first four pollutants, because they are typically present as $PM_{2.5}$ and can be inhaled deep into the lungs. Seasonal variation of PM is complex and location dependent; precipitation is the main atmospheric sink for PM (Jacob and Winner 2009). An overall increase in precipitation levels may improve the cleansing of the atmosphere and may increase chemical deposition.

Hotter, drier weather can allow PM and other pollutants to accumulate in the atmosphere or allow emitted PM precursors to persist longer in the atmosphere.

The effect of climate change on PM is complicated and uncertain. As a result of climate change, more frequent and intensified wildfires could become an increasing PM source and decreases in summer precipitation could exacerbate high PM concentrations caused by wildfires (Jacob and Winner 2009).

Wildfires have the potential to cause simultaneous increases of $PM_{2.5}$ and O_3 within smoke plumes. (Kalasnikov et al. 2022). Summertime fires allow for more frequent co-occurrence events of the two pollutants, which can be exacerbated by increasing temperatures due to climate change.

The increase in widespread $PM_{2.5}$/ozone co-occurrences during July to September highlights the role of increasingly severe and larger wildfires which contributes to compounding public health hazards throughout the western US.

3.4.4.5 Soils and Reclamation Cover Materials

Reduced soil moisture is expected to result from lower snowpack due to higher variation in precipitation and increased annual average temperatures. Higher temperatures may increase the rate at which carbon stored in the soil degrades or is released by fire. More winter precipitation falling as rain instead of snow could generate a higher frequency of runoff and erosional processes from disturbance events, such as fire. Soil erosion by wind and/or water may result in loss of topsoil, which could lead to the degradation of soil quality (Halofsky et al. 2018) and negatively impact reclamation success.

3.4.4.6 Hazardous Materials

Periods of increased precipitation and flooding could have the highest impact on severity of impacts from a release of hazardous materials in proximity to a stream. High stream flows after extreme precipitation events would mean a release into surface waters could travel longer distances before being contained; however, a spill occurring during a seasonal low-flow period would travel a shorter distance, reducing the risk of spill migration.

Although extreme precipitation events occur proportionally less than low-flow periods throughout the year, climate change is expected to increase their frequency.

3.4.4.7 Surface Water and Groundwater (Quality and Quantity)

Streamflow, water quality, and water quantity is vital for the survival of numerous aquatic species, as well as for human use. Observations compiled from 21 USGS unregulated stream gauges across Idaho show a decrease in the cumulative water year streamflow by nearly 15 percent over the last half century

(University of Idaho 2011). The magnitude of the peak streamflow is expected to increase slightly across the region; however, summer low flows are expected to decline (Halofsky et al. 2018). Additionally, the timing of peak streamflow from 1949 to 2008 has advanced about one week earlier in the spring. Advancement in the timing of peak streamflow is hypothesized to be indicative of changes in the timing of snowmelt and/or phase of precipitation (University of Idaho 2011). Spring and summer streamflow is expected to continue to decline in basins that have historically relied on snowmelt, and low flow periods are projected to be more prolonged and severe (May et al. 2018). The decline in streamflow is expected to reduce the rate of recharge of water supply in some basins (Halofsky et al. 2018).

Because many biogeochemical processes are temperature-dependent, climate-induced changes in surface and groundwater temperature also could negatively impact the quality of these water resources (Halofsky et al. 2018).

3.4.4.8 Vegetation: General Vegetation Communities, Non-native Plants, and Botanical Resources

Gradual changes in the distribution and abundance of dominant plant species and short-term impacts on vegetation structure and age classes are expected as a result of rising temperatures. Increased frequency and duration of drought could impact vegetation ecosystems through changes in soil moisture, which could cause mortality or result in higher species vulnerability to insects and disease. Dominance of nonnative species may be facilitated through more frequent and intense wildfires, causing increased disturbance where native species regenerate more slowly (e.g., sagebrush species). Consequentially, the dominance of nonnative plants could themselves encourage more frequent wildfires and cause changes in the ecology of vegetation assemblages (Halofsky et al. 2018).

Whitebark pine has suffered widespread mortality throughout its range from the combined effects of mountain pine beetle outbreaks and white pine blister-rust infection. The whitebark pine, a federally threatened species, is known to occur in the higher elevations of the SGP, particularly near the mine site and Burntlog Route. This species is an important tree species to high-elevation ecosystems of western North America (Forest Service 2023g). Fire exclusion amplifies the climate change impacts from insects and disease by allowing succession to shade tolerant species, stressing mature whitebark pines, and limiting opportunities for seedling establishment. Projected warming and drying trends will likely further exacerbate this decline (Fryer 2002).

3.4.4.9 Wetlands and Riparian Resources

Changes in groundwater levels in wetlands can reduce groundwater inflow, leading to lower water table levels and altered wetland water balances. These altered water table elevations and streamflow volumes may affect riparian areas and their plant communities by reducing hydrological connectivity between uplands, wetland ecosystems and riparian areas. If water table elevation can be assumed to be in equilibrium with water levels in the stream, reduced base flows could result in lower riparian water table elevations and subsequent drying of streamside areas, particularly in wide valley bottoms. Wetland and riparian plant communities will respond to climate-induced changes in hydrological variables differently as a function of species composition (Halofsky et al. 2018).

3.4.4.10 Fish Resources and Habitat

Warmer air temperatures causing decreased snowpack and reduced stream flows can dramatically influence stream temperature and a host of ecosystem processes. Between 1976 and 2015 average August stream temperatures in the western U.S. showed a warming trend of 0.17°C (0.31°F) per decade. These temperatures are predicted to increase an average of 0.72°C (1.3°F) by 2040 and 1.4°C (2.6°F) by 2080 (Isaak et al. 2017). These warmer water temperatures and lower flows are expected to impact salmon, trout, and other coldwater fish (EPA 2016a). For species dependent upon cold water, such as the federally listed Threatened bull trout, even small rises in temperature can significantly reduce spawning success (Knowles and Gumtow 1996). Additionally, increased wildfire may cause more extensive geomorphic disturbances and debris flows into streams, contributing to more variable environments and declining fluvial connectivity of aquatic habitats (Halofsky et al. 2018). Added to other stressors, such as habitat loss and fragmentation, invasive species, and disease, warmer stream temperatures could impact current spawning and rearing habitat (USFWS 2010).

3.4.4.11 Wildlife and Wildlife Habitat

The region is currently facing unprecedented rates of change in climatic conditions that may outpace the natural adaptive capacities of several native species (Halofsky et al. 2018). Increased climate variability and frequency of extreme conditions will favor species adapted to frequent disturbance, potentially increasing the abundance of invasive species. Impacts to terrestrial species as a result of climate change are already being experienced through habitat loss and fragmentation, physiological sensitivities, alterations in the timing of species life cycles (e.g., seasonal changes impacting migration, hibernation, and reproductive success), and indirect effects (e.g., disruption of species interaction across communities). Most species are expected to exhibit sensitivity to changes in the climate, especially those restricted to high elevations or surface water habitats. Of the special status wildlife species occurring in the analysis area, the flammulated owl (*Otus flammeolus*), wolverine (*Gulo gulo*), and Columbian spotted frog (*Rana luteiventris*) are expected to be the most vulnerable terrestrial populations in the region (Halofsky et al. 2018). Other special status species expected to be impacted include the Canada lynx (*Lynx canadensis*) and Rocky Mountain bighorn sheep (*Ovis canadensis*) (Halofsky et al. 2018).

3.4.4.12 Timber Resources

Forests in the interior Northwest are experiencing rapid change due to increasing wildfires and insect and disease damage, largely attributed to a changing climate (May et al. 2018). Changing climatic conditions are predicted to more than double the area in the Northwest burned by forest fires during an average year by the end of the 21st Century. An increase in wildfires would likely decrease the amount of timber available for harvests and degrade the soil, as well as threaten homes and pollute the air (EPA 2016a). The area of pine forests in the Northwest infested with mountain pine beetles is expected to increase due to climate change over the next few decades, which also could lead to decreased timber harvests (EPA 2016a).

An earlier snowmelt due to warmer temperatures can lead to greater drying of soils and vegetation, creating opportunities for earlier and larger wildfires (Westerling et al. 2006). Combined with other stressors exacerbated by climate, the rate of change in vegetation assemblages may be accelerated, reducing the productivity and carbon storage in most systems.

3.4.4.13 Land Use and Management

Long-term temperature and other climatic changes may potentially affect how lands in the analysis area are used. Climate change may impact recreational use of the land by changing the range and types of species present through changing habitat conditions (e.g., water quality, temperatures, and streamflow), as well as accessibility for both humans and animal species to various areas through disturbance of roadways or degradation of habitat (e.g., avalanches, flooding, landslides, and wildfires).

3.4.4.14 Access and Transportation

Higher annual average temperatures, extreme weather events such as heavy rainfall and extreme heat, as well as changes in freeze/thaw patterns and snowpack dynamics, can impact roadways and other infrastructure (e.g., bridges and culverts). Roads and other infrastructure that are near or beyond their design life are at the highest risk to damage from flooding, geomorphic disturbances (e.g., landslides), and avalanches (Halofsky et al. 2018).

3.4.4.15 Heritage Resources

Some aspects of climate change may exacerbate natural damage and loss of heritage resources in the analysis area. Increasing wildfires, flooding, melting of snowfields, and erosion can uncover, displace, or destroy artifacts and other cultural or historic resources before they have been identified. Additionally, large disturbances as a result of climate change can alter the condition of vegetation, streams, and other landscape features valued by native populations (Halofsky et al. 2018).

3.4.4.16 Public Health and Safety

Impacts from climate change on public health and safety could be experienced through poor air quality from wildfires, decreased water quality from lower streamflow, more frequent extreme heat events, as well as the hazards associated with flooding or other severe weather from more frequent extreme weather events. While warmer winter temperatures may create safer and more comfortable working conditions.

3.4.4.17 Recreation

Recreational use patterns could be impacted by variable precipitation and rising temperatures, and by the change in conditions that may alter the characteristics and ecological condition of recreation settings. For example, warmer temperatures may affect individual decisions to visit a certain area, and warmer stream temperatures may affect the quantity and quality of aquatic populations for recreational fishing. Higher temperatures and decreased snowpack would affect winter activities dependent on cold temperatures and snowfall, such as skiing and snowmobiling. Other activities may benefit from longer warm and dry seasons (e.g., hiking, camping, mountain biking), but the need for supplemental resources to manage and maintain these recreational areas for a longer period of time may cause personnel and budgetary issues (Halofsky et al. 2018).

3.4.4.18 Scenic Resources

Changing climatic conditions could affect viewers experience of the landscape within the analysis area by wildfires shifting the landscape from homogenous and continuous even-aged timber stands to a mosaic of tree species and structural conditions influenced by fire.

As climate conditions change, vegetation types may experience more mortality from invasive pests, such as beetle kill, and pathogens due to further stress, temperature related or otherwise, which would impact scenery.

3.4.4.19 Social and Economic Conditions

Changing climatic conditions could affect the viability of local communities. Communities near the analysis area are rural and rely heavily on tourism and the trade industry to support their economies. The social and economic conditions of the area could be both negatively or positively impacted by climate-induced changes in recreational use (e.g., degraded water quality and low streamflow could decrease recreational use, but increased temperatures could create longer seasons for recreating); however, it is difficult to discern the potential magnitude of these impacts on current socioeconomic conditions. Climate change also could increase the social and economic cost of some public services, such as road repair and transportation infrastructure maintenance, as a result of increased damages caused by extreme weather events; however, the impacts of climate change on infrastructure could add trade employment to the area.

3.4.4.20 Environmental Justice

The tribes have specific rights regarding the affected land in accordance with the Nez Perce Tribe Treaty of 1855, the Fort Bridger Treaty of 1868 (Shoshone-Bannock) and the Shoshone-Paiute Executive Order of 1877. For further details please refer to the Tribal Rights and Interests Special Report (Forest Service 2023q). The tribes also use these lands as a part of their traditional use areas for activities including fishing, hunting, and gathering. The environmental justice communities could be impacted by climate change, as it may exacerbate vulnerability to health threats, economic disadvantages, and social inequity (USGCRP 2016).

3.4.4.21 Special Designations

Areas of special designations in the analysis area include wilderness, WSRs, IRAs, and RNAs. Although climate change would not directly impact the designations, it could potentially affect the environmental conditions within these areas. Changes in resource availability and quality, or changes to characteristics in these areas would not necessarily cause a change in designations.

3.4.4.22 Payette Forest Carbon Assessment

The Forest Service developed a Forest Carbon Assessment for the PNF in August 2020. The assessment indicated that the carbon storage levels have remained fairly stable with a 1.9 percent increase between 1990-2013. Additionally, negative impacts due to changes in environmental conditions have been limited and offset by forest growth (Forest Service 2020b). Satellite imagery illustrates that fire has been the most prevalent disturbance detected on the PNF since 1990, affecting about 18.2 percent of the PNF, followed by 1.4 percent by insects, 1.2 percent by harvest, and 0.1 percent by abiotic factors (Forest Service 2020b).

Climate and environmental factors, including elevated atmospheric CO_2 and nitrogen deposition, have also influenced carbon accumulation with the PNF. Recent warmer temperatures and precipitation variability may have stressed forests, causing climate to have a negative impact on carbon accumulation in the 2000s. Conversely, increased atmospheric CO_2 and nitrogen deposition may have enhanced growth rates and helped to counteract ecosystem carbon losses due to historical disturbances, aging, and climate, for some of the forest types located on the PNF (Forest Service 2020b).

Under changing climate and environmental conditions, forests within the PNF may be increasingly vulnerable to a variety of stressors. These potentially negative effects might be balanced somewhat by the positive effects of longer growing season, greater precipitation, and elevated atmospheric CO_2 concentrations. However, it is difficult to judge how these factors and their interactions will affect future carbon dynamics on the PNF, especially with regards to large fire disturbances and increasing insect losses (Forest Service 2020b).

Forested areas on the PNF will be maintained as forest in the foreseeable future, which will allow for a continuation of carbon uptake and storage over the long term. Across the broader region, land conversion for development on private land is a concern and this activity can cause substantial carbon losses (FAOSTAT 2013; Forest Service 2016a). The PNF will continue to have an important role in maintaining the carbon sink, regionally and nationally, for decades to come.

3.5 Soils and Reclamation Cover Materials

3.5.1 Introduction

Soils provide support for complex food webs and habitat components, and maintenance of soil quality and analyte concentrations (e.g., metals) is important for soil-hydrologic functions such as water quality, surface water retention, and groundwater recharge (Forest Service 2003a). In addition, soils salvaged prior to construction and mining activities can provide important growth materials that may be used to reclaim disturbed areas.

3.5.2 Soils and Reclamation Cover Materials Area of Analysis

The analysis area for the soils and reclamation cover material resource includes the area where effects may be caused by the proposed activities (FSH.1909.15, 15.2a). The total size of the new and re-disturbed historical disturbance associated SGP is approximately 1,675 acres.

The analysis of existing soils in the effected environment is broken down into two categories, TSRC and DD. The soil analysis area under TSRC utilizes sixth-level HUC at the 12-digit scale (HUC 12) subwatershed boundaries (**Figure 3.5-1**). This analysis area was selected as it is a reasonable extent to which some of the potential indirect effects of the SGP might extend, such as soil erosion and sedimentation. The TSRC analysis area only includes NFS lands (management of TSRC by the Forest Service does not apply to private lands) within the sub-watersheds in which SGP components would occur. Excluded from the TSRC analysis area are IRAs, RNAs, Wilderness, and private land ownership (including private patented mining claims owned or controlled by Perpetua). HUCs used in this analysis are local subwatershed levels that encompass tributary stream systems. The soil analysis area under DD utilizes the new and upgraded transmission line corridor where activity occurs on NFS lands.

3.5.3 Relevant Laws, Regulations, Policies, and Plans

Several laws and regulations apply to the Proposed Action and Action Alternatives. The following is a list of laws, regulations, policies, and plans at the federal, state, or local level pertaining to soil and reclamation cover material resources. Additional descriptions of these regulations can be found in the SGP Soils and Reclamation Cover Material Specialist Report (Forest Service 2023c).

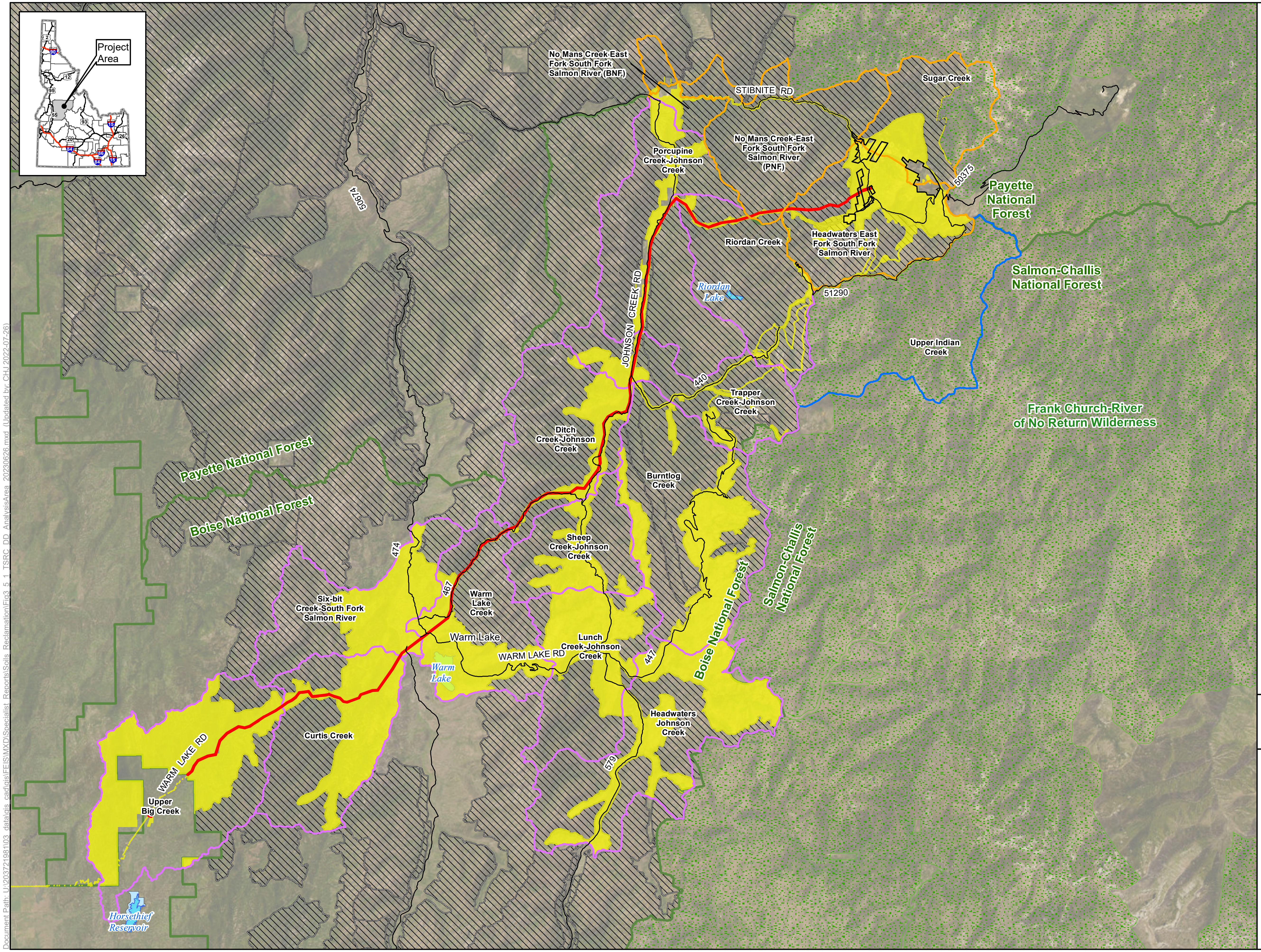
Land and Resource Management Plans: The Payette Forest Plan (Forest Service 2003a), and the Boise Forest Plan (Forest Service 2010a) provide management prescriptions designed to realize goals for achieving desired conditions for wildlife and wildlife habitat and include various objectives, guidelines, and standards related to the success of wildlife habitat in regard to soils.

36 Code of Federal Regulations 228.8: Mine operations on NFS lands are required by these regulations to reclaim disturbed surfaces in a timely manner, where practicable, by taking measures to prevent or control on-site and off-site damage to the environment (Requirements for environmental protection: Reclamation, 36 CFR 228.8[g]).

Forest Service Manual (FSM) 2840: Reclamation directs that lands disturbed by mining must be returned to a use consistent with long-term forest land and resource management plans. Plans of operations must include specific proposals to reclaim all lands disturbed by mining and address topsoil management (FSM 2840, Section 2841). Measurable performance standards are to be included for all reclamation requirements. A bond or other financial guarantee is normally required to cover the full cost of reclamation.

Forest Service Manual 2550: The FSM guidelines on soil management (FSM 2550) require that NFS land be managed to maintain or improve soil quality (Forest Service 2010b). Soil quality is related to the functions that soils perform, including biodiversity, water storage, nutrient cycling, carbon storage, physical stability and support, and filtering and buffering. TSRC and DD generally result in physical, chemical and/or biological changes to soils which impair one or more of these functions. In the context of reclamation, improvement of soil quality and related soil functions should be a primary objective. Practical methods to ensure that reclamation cover materials are suitable are summarized in the guidelines.

Idaho Mined Land Reclamation Act and Rules Governing Mined Land Reclamation: The Idaho Department of Lands (IDL) has the authority to regulate all surface mining in Idaho by the Idaho Mined Land Reclamation Act (Idaho Code, Title 47, Chapter 15, et seq.) and Rules Governing Mined Land Reclamation (Idaho Administrative Procedures Act (IDAPA) 20.03.02). Reclamation is the process of restoring an area affected by a mining operation or cyanidation facility to its original or another beneficial use, considering previous uses, possible future uses, and surrounding topography. The objective is to re-establish a diverse, self-perpetuating plant community, and to minimize erosion, remove hazards, and maintain water quality (IDAPA 20.03.02.010.20). Accomplishment of reclamation objectives requires BMPs, which are practices, techniques or measures developed or identified by IDL and identified in the state water quality management plan which are determined to be a cost effective and practicable means of preventing or reducing pollutants generated from nonpoint sources to a level compatible with water quality goals (IDAPA 20.03.02.010.03). These BMPs have also been published as a manual (IDL 1992). This manual also is referenced in the Payette Forest Plan management direction (Mineral and Geology Resources) as a guide for evaluating the completeness of reclamation plans with respect to mitigating water quality effects.



LEGEND

- PNF Sub-Watersheds
- BNF Sub-Watersheds
- Other Sub-Watershed
- DD Analysis Area
- TSRC Activity Area
- IRA and Forest Plan Special Area
- Patented Claims

Other Features

- U.S. Forest Service
- Wilderness
- Highway
- Road
- Lake/Reservoir

0 2 4 Miles

1 inch = 4 miles when printed at 11x17

Figure 3.5-1
Total Soil Resource Commitment and Detrimental Soil Disturbance Analysis Areas
Stibnite Gold Project
Stibnite, ID

Base Layer: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
Other Data Sources: Midas Gold; State of Idaho Geospatial Gateway (INSIDE Idaho); Boise National Forest; Payette National Forest

Map Date: 2023-06-26

Document Path: U:\203721981\03_data\gis_cad\gis\FEIS\MXD\Specialist_Reports\Soils_Reclamation\Fig3_5_1_TSRC_DD_AnalysisArea_20230626.mxd (Updated by: CHJ 2022-07-28)

3.5.4 Affected Environment

3.5.4.1 Soil Landscapes

The analysis area is in the Stibnite Mining District, with prospecting dating back to the late 1800s. Mining began in the 1920s and continued intermittently through 1997. This historical use of the area has resulted in a wide variety of soils modified by human activity throughout the SGP and vicinity, with approximately 522 acres at the SGP considered highly disturbed (Tetra Tech 2017).

Soil at the SGP is generally characterized as weakly developed and coarse textured with a high prevalence of coarse fragments, formed in semi-humid, sub-alpine environments. The dominant parent materials are residual and colluvial material sourced from two main bedrock types: Paleozoic metamorphic rock and younger igneous intrusive rock of the Cretaceous Idaho Batholith. Igneous intrusive rock is much more prevalent in the SGP area. Metasedimentary rock (generally quartzite and marble) is primarily found in the vicinity of the West End pit and in lesser amounts near the proposed mill site and southeastern end of the former Yellow Pine open pit. Additional areas of metasedimentary rock exposure occur near the proposed mine cap facilities. Bedrock depths are typically deep in alluvial valley bottoms and on side slopes that have a mantle of glacial till, outwash, or colluvium. Very steep, glaciated valley walls typically have bedrock at the surface or at shallow depths. Surface cobbles, stones, and boulders also are locally prevalent, along with bedrock outcrops. While most common on very steep slopes, very stony surfaces also cover approximately 81 acres (5 percent) of the area within the Operations Area Boundary with slopes less than 45 percent (Tetra Tech 2017).

In the analysis area, thin, poorly developed surface and subsurface layers (A, AC and C horizons) have formed on steep slopes (30 to 80 percent gradient) where surface creep is evident by the J-shaped trees. This soil has been interpreted to be generally stable unless it is disturbed or has its vegetative cover removed (Forest Service 1981, 1994). Approximately 366 acres, or 22 percent, of the Operations Area Boundary is considered to have very steep slopes (greater than 45 percent) (Tetra Tech 2020a).

Soil development and thickness of A, AC, and C horizons is strongly correlated with slope position. In general, upper side slopes and ridge tops (runoff or convex positions) experience more erosion and have weaker soil development and shallower soils. Lower side slopes, foot slopes, and toe slopes (concave positions) experience more deposition and have deeper soil development. Mid-slopes or backslopes (transitional areas) experience both erosion and deposition and have intermediate soil development. However, with the exception of the wetland soils located in the SGP survey area, there is little variability in the extent of pedogenesis or thickness of the A and AC horizons (TetraTech 2017 and 2020a). The generalized description of soil development on ridge tops was not assessed by the SGP surveys.

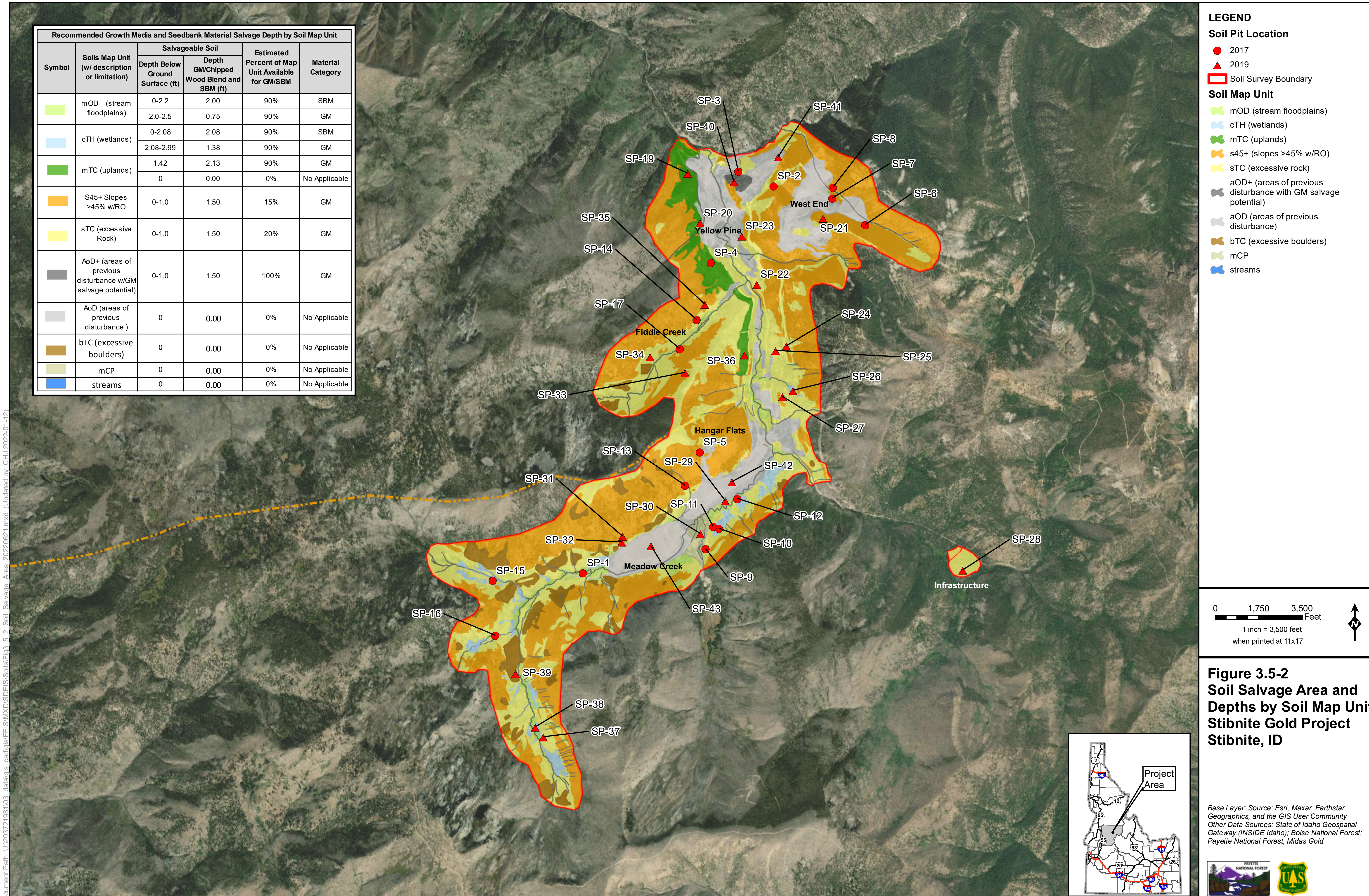
3.5.4.2 Soil Types

Soils in the SGP area are generally young, poorly developed, and often occur on steep slopes. This means their physical and chemical characteristics are often closely associated with the underlying parent materials. Three basic types of parent materials are present and include residuum and colluvium developed in bedrock, alpine glacial till, and alluvium.

The geomorphic setting of the SGP area has resulted in a very complex pattern of soils across the landscape, depending on the presence/absence and depth of the glacial till, colluvium, alluvium, and the composition of the bedrock. The disturbance history also has added another layer of complexity. Pronounced changes in soil properties may occur across short distances (Forest Service 1974a, 1972, 1969) and the surface soil texture maps developed for the Soil Resources Baseline Study (Midas Gold 2017b, Tetra Tech 2020a).

A map of soil salvage area and depths by soil map unit at the Operation Area Boundary is provided on **Figure 3.5-2**. Maps of dominant soil types in the mine area and along the proposed new sections of the Burntlog Route are provided in the SGP Soils and Reclamation Cover Materials Specialist Report (Forest Service 2023c). A summary description of mapped soil types and the extent mapped at the SGP is provided in **Table 3.5-1** and detailed mapping of the soil map units is available in the SGP Soils and Reclamation Cover Materials Specialist Report (Forest Service 2023c).

Suitable soils are further rated as either good, fair, or poor for reclamation in **Table 3.5-2**. Sustainable revegetation success depends on the quality of growth media and subjacent material that comprises the vegetation root zone with regard to a number of physical, chemical, and nutrient factors. A root zone analysis based on existing site conditions was utilized to develop suitability criteria for growth media and root zone material (Tetra Tech 2021a) which included characterization of metal concentrations in site soils. Suitable soils rated as good generally have loamy soil textures, few coarse fragments, slightly acidic to slightly alkaline pH, and occur on level to gently sloping ground. Unsuitable soils have either very high coarse fragment content; are extremely acidic or very strongly alkaline; or occur on very steep slopes. Soils with a high proportion of surface stones, and soils disturbed by legacy mining activities also are considered unsuitable for reclamation.



Recommended Growth Media and Seedbank Material Salvage Depth by Soil Map Unit					
Symbol	Soils Map Unit (w/ description or limitation)	Salvageable Soil		Estimated Percent of Map Unit Available for GM/SBM	Material Category
		Depth Below Ground Surface (ft)	Depth GM/Chipped Wood Blend and SBM (ft)		
	mOD (stream floodplains)	0-2.2	2.00	90%	SBM
		2.0-2.5	0.75	90%	GM
	cTH (wetlands)	0-2.08	2.08	90%	SBM
		2.08-2.99	1.38	90%	GM
	mTC (uplands)	1.42	2.13	90%	GM
		0	0.00	0%	No Applicable
	S45+ Slopes >45% w/RO	0-1.0	1.50	15%	GM
	sTC (excessive Rock)	0-1.0	1.50	20%	GM
	AoD+ (areas of previous disturbance w/GM salvage potential)	0-1.0	1.50	100%	GM
	AoD (areas of previous disturbance)	0	0.00	0%	No Applicable
	bTC (excessive boulders)	0	0.00	0%	No Applicable
	mCP	0	0.00	0%	No Applicable
	streams	0	0.00	0%	No Applicable

Figure 3.5-2
Soil Salvage Area and Depths by Soil Map Unit
Stibnite Gold Project
Stibnite, ID

Base Layer: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
Other Data Sources: State of Idaho Geospatial Gateway (INSIDE Idaho); Boise National Forest; Payette National Forest; Midas Gold

Document Path: U:\20372198\103_data\gis_cad\gis\FEIS\MXD\SDEIS\Soils\Fig3_5_2_Soil_Salvage_Area_20220621.mxd (Updated by: CHJ 2022-01-12)

Table 3.5-1 Dominant Soil Types in the SGP

Map Unit	Soil Description[1]	Dominant Soil Suborder	Particle Size Class[2]	Recommended Average GM Salvage Depth (inches)	Minimum Depth to Extremely Cobbly or Gravelly Material (inches)[3]	Extent Mapped (acres)
mOD	A	Cryepts	Coarse-Silty	6 or 24 by location	N/A[4]	85
cTH	A	Saprist	-	11 or 25 by location	N/A[4]	89
mTC	A	Orthents	Sandy/Loamy-Skeletal	17	34	120
S45+	A	Orthents (very steep)	Sandy/Loamy-Skeletal	12	0	1,876
sTC	A	Orthents (stony)	Sandy/Loamy-Skeletal	12	0	1,136
AoD	B	N/A	N/A	0	N/A	621
AoD+	C	N/A	Sandy-Skeletal	12	N/A	13
bTC	A	Orthents	Loamy-Skeletal	0	N/A[4]	206
mCP	A	Psamment	Sandy-Skeletal	0	N/A[4]	28
Streams	N/A	N/A	N/A	N/A	N/A	40
Total						4,214

Source: AECOM 2020d; Midas Gold 2017b; Tetra Tech 2017, 2019a, 2020a; NRCS 1999; see also Tetra Tech 2021a Tables 3-7 and 3-8 for the calculation of growth media and seed bank material salvage volumes.

[1A] Somewhat excessively and excessively drained soils developed in residuum and colluvium derived from igneous intrusive rock. [1B] Areas of Previous Disturbance – No Salvageable Soil. [1C]Areas of Previous Disturbance – With GM Salvage Potential.

N/A = not applicable

[2] Skeletal classes have >35 percent (%) coarse fragments. Sandy = loamy sand or sand textures. Loamy = generally loam, sandy loam, and silt loam textures with <35% clay. Coarse-Silty has <35% coarse fragments, <15% fine sand or coarser, and <18% clay.

[3] Estimated at >60% coarse fragments by volume.

[4]Depth not reached to hit >60% coarse fragments by volume.

Table 3.5-2 Reclamation Cover Materials Suitability Ratings for SGP Soils

Soil Map Unit (Depth in inches)	Suitability Rating	Limiting Criteria
mOD (all)	Poor	pH 4.9 to 5.1
cTH (all)	Fair	High content of coarse fragments (21%)
mTC (0-6)	Fair on slopes <25% Poor on slopes 25-45%	Coarse fragments 15-30%; pH 5-6
mTC (6-18)	Poor	Coarse fragments near 60%
S45+ (all)	Poor	Slope >45%
sTC (all)	Poor	Surface stones, boulders, and rock outcrop
AoD (all)	Unsuitable	Non-soil material related to legacy mining
AoD+ (all)	Fair	High content of coarse fragment (60%), pH 5.0 to 5.6, slope average 37%
bTC (0-13)	Unsuitable	Excessive boulders
mCP	Unsuitable	High content of coarse fragment
streams	Unsuitable	Limited soils, rock dominated
fOD (0-12)	Fair	pH 5.3 to 5.9
fOD (12-30)	Fair	Coarse fragments 15-30%
fTH (0-12)	Good	None - organic soils
fTH (12-36)	Good	None - organic soils

Source: AECOM 2020d; Midas Gold 2017b; Tetra Tech 2017, 2019a, 2020a
Suitability rating based on growth media suitability criteria (TetraTech 2020a) and soil data (TetraTech 2017, 2020a).

Suitable Soil Types for Reclamation

Soil map unit (SMU) mOD is an inceptisol, meaning that the soils form in cold regions and have moderately high silt and clay content. SMU mOD is an oxyaquic dystrocryept that forms near floodplains near stream channels in alluvium. The soils in this SMU run deep, with depth to water being shallow (12 to 24 inches below ground surface). The groundwater likely fluctuates seasonally as expressed by the redoxomorphic features in the soils. The soil characteristics consist of silt to sand textures, generally having a high organic matter content in the upper horizons, until the C horizon is reached, and the soils transition to sand (Tetra Tech 2020a). The soils in this SMU have elevated antimony, arsenic, and mercury concentrations (Tetra Tech 2021a). An average depth of 30 inches is available for soil borrow in this map unit (Tetra Tech 2020a).

Soils from the SMU typic halosparists (cTH), are histosols, meaning that the soils were saturated and heavily composed of organic matter. This is typical of the wetland area where these soils formed. These soils were observed in seeps, toe slopes, and depressions. Standing water was present throughout the SMU, indicating that the water table likely has seasonal fluctuations. These soils occur on shallow-to-moderate slope faces and tend to lack fluvial depositional patterns, horizonation, and sandy textures. The soils in this SMU are high in calcium, magnesium, potassium, total organic carbon, calcium carbonate, and organic matter in the upper horizons when compared to the other SMUs (Tetra Tech 2020a). The soils in this SMU also have elevated antimony, arsenic, and mercury concentrations (Tetra Tech 2021a). An average depth of 36 inches is available for soil borrow in this map unit (Tetra Tech 2020a).

Soil pedons described in the sandy-skeletal/loamy-skeletal, mixed typic cryorthents (mTC) are classified as either sandy-skeletal or loamy-skeletal and are derived from slope colluvium or residuum. These soils have a fine loamy texture, typically have above freezing temperatures, and occur on steep slopes. Soils in this map unit were typically explored to 20 inches or less because of the high percentages of coarse fragments increasing with depth. Geotechnical investigations indicate these soils are very deep with surficial material varying in thickness from a few to over 40 feet (SRK 2012). Thin A horizons transitioning to C horizons are common in this map unit. No evidence of subsurface soil horizon development as required to identify a B horizon was observed. An average depth of 17 inches is available for soil borrow in this map unit.

Soils composing the S45+ SMU are typic cryorthents (88 percent of SMU), forming on slopes that are 45 percent and greater. Rock outcrops, predominantly granodiorite with some granite, tend to occur at the higher elevations in this SMU (12 percent of SMU). The soils of this SMU are formed from glacial deposits and weathered granodiorite residuum with a high percent of rock fragments (Tetra Tech 2020a). The soils in this SMU have elevated antimony, arsenic, and mercury concentrations (Tetra Tech 2021a). There are burn areas present in the SMU. Thin A horizons transitioning to AC and C horizons are typical of this SMU. An average depth of 12 inches is available for soil borrow in this map unit (Tetra Tech 2020a).

Soils from map unit sTC are stony typic cryorthents (sTC), formed in colluvium and alluvium which were derived from glacial deposits. These soils are composed of gravels, stones, and cobbles that form on slopes that range from a 10 to 45 percent grade (Tetra Tech 2020a). The soils in this soil map unit located within the primary zone of mineralization at the SGP have elevated antimony and arsenic concentrations compared with soils in this same SMU located outside the primary zone of mineralization (Tetra Tech 2021a). A horizons transitioning to AC horizons, then to C horizons are common in this map unit. There are burn areas present in the SMU. An average depth of 12 inches is available for soil borrow in this map unit (Tetra Tech 2020a).

Areas of previous disturbance (AoD) with GM salvage potential (AoD+) is a map unit that is comprised of land that has been historically disturbed by mining activities, which has since been reclaimed. The majority of the soil remains intact, and the quality and quantity of the soil in this SMU has not been negatively affected by historical mining; therefore, has an average depth of 12 inches of soil that is considered salvageable (Tetra Tech 2020a). The soils in this SMU also have elevated antimony, arsenic, and mercury concentrations (Tetra Tech 2021a).

Soil map unit fOD is coarse-silty, mixed, frigid oxyaquic dystrocryepts (fOD) formed in alluvium in drainage bottoms near stream channels. This unit is similar to the mOD unit previously described but is typically found along the Burntlog Route instead of the mine area. These soils are very deep (>60 inches). This soil has varying mean seasonal temperatures, is saturated but may not be hydric, and typically supports evergreen tree growth in alpine and subalpine communities. Depth to water is between 12 and 24 inches and fluctuates seasonally as indicated by redoximorphic soil features observed in the soil profile. Texture of these soils is silt, loam, silt loam, sandy loam, and loamy sand. Generally, these soils have high organic matter content in the upper soil layers and are suitable as sources for salvage assuming groundwater elevations are reduced. An average depth of 30 inches is available for soil borrow in this map unit.

Soils from map unit fTH are euic, frigid typic haplosaprists (fTH) meaning these soils lack definitive horizons, have elevated pH, and have varying mean seasonal temperatures. This unit is similar to the cTH unit previously described but is typically found along the Burntlog Route instead of the mine area. These soil types were observed on side slopes adjacent to the fOD soils. These soils develop by the accumulation and subsequent decomposition of organic matter in forested settings and lack the mineral soil layers and sandy textures found in the fOD soils. These soils are high in organic matter, occur on shallow to moderate slopes resulting from seeps, and are suitable as salvage material. An average depth of 36 inches is available for soil borrow in this map unit.

Unsuitable Soil Types for Reclamation

AoDs occur on previous mining activities and include spent heap leach ore storage areas, deposited tailings, development rock dumps, and open pits. These materials are deemed unsuitable for salvage.

Boulder Typic Cryorthents (bTC) is composed of large boulders, talus, and scree material. This SMU occurs on forested areas with burn areas present. These materials are deemed unsuitable for salvage due to the grain size (Tetra Tech 2020a).

The typic cryopsamments (mCP) soil unit consists of rounded gravels, cobbles, and stones. The soils are from fluvial deposits which resulted from the Blowout Creek (i.e., EFMC) dam failure. The slopes of this SMU are less than 10 percent, and soils consist of layered sand deposits, varying in thickness.

The streams SMU are composed of stream beds and stream corridors. This soil unit is dominated by rock fragments and generally is lacking in soil.

The suitability criteria in **Table 3.5-2** are applied to the SGP map units in **Table 3.5-1**.

3.5.4.3 Operations Area

Baseline soil and surface characterization is provided below for the six broad areas of potential disturbance from the Soil Resources Baseline Study (Midas Gold 2017b) that generally correspond to the various SGP areas (i.e., Meadow Creek, Fiddle Creek, Hangar Flats, Yellow Pine, West End, and Infrastructure Areas; see **Figure 3.5-2**).

Meadow Creek Area

This area includes the Meadow Creek valley floor, lower side slopes, and the surrounding valley walls. The Meadow Creek valley floor has deep to very deep, loamy-skeletal, sandy-skeletal, coarse-loamy, and coarse-silty soils developed in alluvium, slope wash, and glacial outwash deposits (map units fOD, mTC). Approximately 54 acres of soils are slightly to strongly acid and have a moderate to high amount of organic matter and generally low levels of essential plant nutrients. Deep alluvial soils cover approximately 32 acres. A seasonal high-water table and soil saturation is present in much of this area (Midas Gold 2017b). The glaciated valley walls have weakly developed, loamy-skeletal and sandy-skeletal soils developed in residuum and colluvium derived from weathered granitic bedrock (map units mTc, S45+). Approximately 12 percent of these soils have a high percentage of surface coarse fragments and rock outcrops (sTC) (Midas Gold 2017b; Tetra Tech 2017).

Areas of legacy mining disturbance in the lower Meadow Creek area include the Spent Ore Disposal Area, stream diversions, roads, and vehicle trails. Fifty-six acres, or 10 percent of the area, was mapped as disturbed (AoD) (Tetra Tech 2017). High soil compaction was identified in these areas. Natural disturbance in the Meadow Creek area includes historical wildfires and past landslides and avalanches. Soil disturbance classes identified in burned areas were generally class 0 (none) or 1 (low), and legacy mining disturbance zones were class 2 (moderate) or 3 (severe) (Midas Gold 2017b). Soil disturbance classes are defined in the Forest Soil Disturbance Monitoring Protocol (Forest Service 2009b). Although wildfires are not considered part of the Forest Soil Disturbance Monitoring Protocol, impacts on the soil are recorded.

Fiddle Creek Area

The main Fiddle Creek drainage encompasses the lower part of a glacially scoured (cirque) basin and glacial trough walls. The narrow valley floor has coarse-loamy and coarse-silty soils (fOD) developed in alluvium along the stream channel covering approximately 10 acres. The cirque basin and glaciated valley walls have predominantly sandy-skeletal and loamy-skeletal soils (mTC, S45+) developed in colluvium and residuum from granitic bedrock. Rock outcrop and areas of high surface stoniness occur over approximately 5 percent of the area with slopes less than 45 percent. Approximately 4 acres of organic soils (fTH) occur in seepage zones above Fiddle Creek (Midas Gold 2017b).

Four sample locations were investigated in the upper Fiddle Creek area, both receiving laboratory analysis (Tetra Tech 2017, 2021a). Mineral soil textures were found to be predominantly sandy loam and very gravelly loamy sand. The soils are slightly to strongly acid, have a high content of organic matter in the surface (greater than 4 percent), and generally have low to very low levels of essential plant nutrients. Soil saturation was identified in only a few areas in the valley bottom.

Mapped legacy mining disturbance is minimal. One acre was mapped as disturbed (AoD). Former drill roads and drill pads are largely reclaimed. Areas of natural disturbance include both historical wildfires and former landslides and avalanches. Disturbance classes identified in burned areas were class 0 (none) or 1 (low) (Midas Gold 2017b).

Hangar Flats Area

This area contains predominantly steep, glaciated side slopes and a portion of the Meadow Creek valley floor. Ninety-six samples were collected in Hangar Flats area, with seven samples receiving laboratory analysis (Midas Gold 2017b; Tetra Tech 2017). The soils are slightly to strongly acidic, have a moderate to high amount of organic matter in the surface, and generally have low to very low levels of essential plant nutrients. The steep glacial trough walls have weakly developed, sandy-skeletal and loamy-skeletal soils (mTC, S45+) developed in residuum and colluvium from granitic bedrock. The valley floor contains large AoDs from drilling and mining activities. Native soils are deep to very deep, coarse-loamy, coarse-silty, and loamy-skeletal soils developed in alluvium, glacial outwash, and slope wash. Deep alluvial soils (fOD) cover approximately 13 acres. There is a high percentage of histosols (fTH) in seepage zones totaling approximately 23 acres. A seasonal high-water table is present over much of the valley floor and toe-slopes (Midas Gold 2017b).

Areas of legacy mining disturbance include a SODA, Bradley tailings, smelter, mill site, historical creek diversions, private access roads on the hillside, and partially reclaimed zones on the valley floor from past drilling and mining and associated activities. Eighty-two acres, or 35 percent of the area, was mapped as disturbed (AoD) (Tetra Tech 2017). High soil compaction was identified in these areas by the Soil Resources Baseline Study. Natural disturbance in the Hangar Flats area includes historical wildfires and past landslides and avalanches. Soil disturbance classes identified in burned areas were generally class 0 (none) or 1 (low), whereas legacy mining disturbance zones were class 2 (moderate) or 3 (severe) (Midas Gold 2017b).

Yellow Pine Area

Yellow Pine area contains predominantly steep, dissected mountain slopes on the east side, glaciated valley wall on the west side, and the East Fork SFSR valley floor in between. Soil conditions were investigated at 75 locations in this area, with five samples receiving laboratory analysis (Midas Gold 2017b; Tetra Tech 2017, 2021a). The soils are slightly to moderately acidic, have a moderate amount of organic matter, and generally have low to very low levels of essential plant nutrients. The steep east- and west-facing slopes have weakly developed, loamy-skeletal and sandy-skeletal soils (mTC, S45+) developed in residuum and colluvium from granitic bedrock. The valley floor is mostly disturbed (AoD) by previous mining activities. Undisturbed valley floor native soils are deep to very deep, loamy-skeletal, sandy-skeletal, and coarse-loamy soils (fOD, mTC) developed in alluvium and slope wash. Deep alluvial soils cover approximately 10 acres. Histosols (fTH) cover approximately 8 acres. A seasonal high-water table is present adjacent to stream courses.

Legacy mining activity in this area is extensive and includes the historic Yellow Pine pit/lake and associated mine benches, waste rock dump, old drill and mine access roads, building sites, and underground portals. Recontouring has occurred in the reclaimed Homestake area (i.e., the northeast portions of the Yellow Pine area). Forty acres, or 20 percent of the area, was mapped as disturbed (AoD) (Tetra Tech 2017). Thirty-six percent of the Yellow Pine area has slopes greater than 45 percent (S45+), a large portion of which also are disturbed. Evidence of wildfire was present in the southwest portion of this area. Disturbance classes identified in burned areas were generally low (Midas Gold 2017b).

West End Area

This area is characterized by steep, dissected mountain slopes. Midnight Creek and West End Creek flow through the area and have created sharply incised channels. Much of this area has been disturbed by legacy mine operations (AoD).

Undisturbed soils are predominantly sandy-skeletal and loamy-skeletal (S45+) developed in colluvium and residuum from metasedimentary rocks (predominantly quartzite). Deep alluvial soils (fOD) cover approximately 10 acres. Sixty-one sample locations were recorded in this area, with five samples receiving laboratory analysis (Midas Gold 2017b; Tetra Tech 2017, 2021a). Surface soil textures in undisturbed areas were predominantly very gravelly loamy sand, loamy sand, sandy loam, and loam. The soils are slightly to strongly acidic, have a moderate to high amount of organic matter, and generally have low to very low levels of essential plant nutrients.

Legacy mining activity in this area is extensive and includes multiple mining pits, haul roads, access roads, waste rock dumps, and areas of deep backfill. Surface materials are bare rock or backfill. Twenty-three acres, or 8 percent of the area, was mapped as disturbed (AoD) (Tetra Tech 2017). Eighty-four percent of the West End area has slopes greater than 45 percent (S45+), a large proportion of which also are disturbed. There was no evidence of wildfire in this area.

Infrastructure Areas

These areas are predominantly within the East Fork SFSR valley floor and adjacent fan terraces and lower side slopes. Most of these areas have been previously disturbed (AoD) by mining activities. The SGP facilities that the Infrastructure Areas include: the Crusher ROM Stockpile, Scout Rom Stockpile, Mill, Water Treatment Plant, Water Treatment Plant Laydown, Truck Shop, Main Gate, Main Gate GMS, and the worker housing facility.

One hundred and sixteen (116) sample locations were established in undisturbed soil areas, with 6 samples receiving laboratory analysis (Midas Gold 2017b, Tetra Tech 2021a). Surface soil textures were predominantly fine sandy-loam with a high portion of coarse fragments (sTC) developed in alluvium and colluvium from glacial deposits (Tetra Tech 2020a). Deep alluvial soils cover approximately 6 acres, primarily along haul road routes. Organic soils (fTH) cover approximately 5 acres and were observed in poorly drained areas near seeps and streams with saturation identified in a few (Midas Gold 2017b). The soils are slightly to strongly acidic, have a low to moderate amount of organic matter, and generally have low to very low levels of essential plant nutrients (Midas Gold 2017b).

Areas of existing disturbance include historic town sites, reclaimed haul roads, and mine access and infrastructure areas that show high soil compaction, as well as current roads, parking lots, laydown areas, and camp buildings. Thirty-two acres, or 12 percent of the areas, were mapped as disturbed (AoD) (Tetra Tech 2017). Areas of natural disturbance also exist, caused by both historical wildfires and landslides and avalanches. Disturbance classes identified in burned areas were generally class 1 (low) to class 0 (none), whereas areas disturbed by past mining were class 3 (severe) or class 2 (moderate) (Midas Gold 2017b).

3.5.4.4 Access Roads

Geology and geomorphic features of the Burntlog Route were investigated, and the bedrock geology and geomorphology were found to be very similar to those described for the Operations Area Boundary. Granitic bedrock underlies most of the route, with a few inclusions of volcanic and metasedimentary rock (Midas Gold 2017c). The area has been glaciated, creating narrow u-shaped valleys with steep sides and flat valley bottoms. The route is characterized by weakly developed, loamy-skeletal and sandy-skeletal soils (mTC, S45+) developed in residuum and colluvium from granitic bedrock. Deep alluvial soils (fOD) and histosols (fTH) make up approximately 8 percent of the route, occurring in drainageways and slope seepage zones. It is estimated that 40 percent of the mTC soil map unit would be practically salvageable using heavy equipment (Tetra Tech 2019a).

3.5.4.5 Utilities

No soils field investigations occurred for the existing or proposed transmission line ROW. The corridor crosses through 35 different land types on NFS lands. Mapping is available in the Soil Hydrologic Reconnaissance Reports (Forest Service 1969, 1972, 1974a). The Forest Service surveys describe relatively young soils with coarse textures and weak horizon development that are influenced by fluvial cycles. Landform strongly influences soil development as slopes generally have areas of soil loss, equal soil loss-gain, and material accumulation. Deeper soils are located in areas of material accumulation above concave landforms such as swales.

3.5.4.6 Off-site Facilities

Locations of off-site facilities include the Landmark or Burntlog Maintenance Facility (depending on which alternative is selected) and the SGLF. The Landmark Maintenance Facility would be constructed on a previously disturbed borrow site. The soils are mapped as mTC (**Table 3.5-1**) (Tetra Tech 2017). The Burntlog Maintenance Facility would be located in one of the access roads borrow source locations (4.4 miles east of the junction of Johnson Creek Road and Warm Lake Road along the Burntlog Route). The SGLF would be constructed on an alluvial fan terrace above Big Creek. Soils are mapped as Donnel sandy loam, 2 to 4 percent slopes (NRCS 2017). These are well drained soils formed in alluvium weathered from granite. They have sandy loam textures in the solum, over stratified loamy sand and sandy loam starting below 20 inches. A seasonal water table is greater than 80 inches below the ground surface. Minor inclusions in the map unit include poorly drained soils in the floodplain. The SGLF would be located on private land.

3.5.4.7 Soil Chemistry

The Operations Area Boundary (**Figure 2.4-2**) occurs in an area containing numerous highly mineralized zones, and natural background concentrations of some metals are known to be relatively high in some soils and regolith (i.e., the unconsolidated material below the soil profile and on top of bedrock). In addition, elevated levels of arsenic, antimony, and mercury have been observed in soils contaminated by legacy mine operations (URS 2000a). Some known locations of contamination were previously remediated, but it is possible that additional areas of contamination would be exposed during SGP-related construction, operations, and closure and reclamation. Perpetua evaluated 4,828 exploration soil samples collected from undisturbed areas adjacent to the SGP from 2009 to 2015. The mean concentrations of antimony (14.88 ppm within a range of 0.04 to 2,580 ppm) and mercury (0.972 ppm within a range of 0.005 to 283 ppm) from the samples are high but are still within the highest screening-level phytotoxicity criteria concentrations from various literature references and federal agencies in U.S. and Canada cited in the Reclamation and Closure Plan (Tetra Tech 2021a). The samples were not analyzed using EPA-approved methodologies for environmental analysis. Samples were analyzed using exploration lab methodologies that have more aggressive extraction methods (resulting in potentially higher concentration outputs), which are not typically compared to these environmental screening levels. The mean concentration of arsenic (115 ppm within a range of 0.22 to 7,380 ppm) from the samples is approximately 6.4 times higher than the EPA's ecological soil screening level for arsenic (Tetra Tech 2021a). A principal concern regarding the re-use of soil and rock at the SGP is the high metals concentrations that may remain and complicate revegetation plans for reclaimed areas. Total arsenic was identified as having the greatest potential for phytotoxicity in plants growing on reclaimed and legacy mine lands within the Operations Area Boundary.

3.5.4.8 Existing Total Soil Resource Commitment

TSRC is the conversion of a productive site to an essentially non-productive site for a period of more than 50 years. Mining excavations and dumps, roads, dedicated trails, parking lots, and other dedicated facilities (e.g., landfills, borrow sites, surface water management features, etc.) are examples of TSRC. The activity area for TSRC on NFS lands is shown on **Figure 3.5-1**.

Existing TSRC within the 16 subwatersheds encompassing where disturbance associated with the SGP would occur (**Table 3.5-3**) was mapped with the use of a geographic information system (ArcGIS) with relevant digital spatial layers including Lidar-generated terrain maps, aerial photographs, road and trail layers, and previous mapping of disturbed areas.

Table 3.5-3 Analysis Area Subwatersheds, Activity Area, and Existing TSRC

Subwatershed	Subwatershed (acres)	Activity Area (acres)	Existing TSRC in Activity Area (acres)
PNF Subwatersheds			3%
Headwaters East Fork SFSR	15,974	5,034	171
Sugar Creek	11,497	2,021	57
No Man's Creek-East Fork SFSR[1] (PNF)	17,885	413	31
BNF Subwatersheds			1%
No Man's Creek-East Fork SFSR[1] (BNF)	1,837	516	11
Porcupine Creek-Johnson Creek	21,516	2,796	78
Riordan Creek	14,411	883	17
Trapper Creek-Johnson Creek	12,129	2,518	37
Ditch Creek-Johnson Creek	16,222	3,628	48
Burntlog Creek	25,194	9,417	99
Sheep Creek-Johnson Creek	10,403	3,178	28
Lunch Creek-Johnson Creek	15,414	7,322	98
Headwaters Johnson Creek	23,385	10,305	89
Warm Lake Creek	15,093	6,820	160
Six-Bit Creek South Fork Salmon River	15,087	7,105	63
Curtis Creek	17,476	8,280	74
Upper Big Creek	18,436	13,429	103

Source: AECOM 2020d

[1] The eastern portion of the No Man's Creek-East Fork SFSR subwatershed is within the PNF and the western portion is in the BNF.

3.5.4.9 Existing Detrimental Disturbance

DD is the alteration of natural soil characteristics that results in immediate or prolonged loss of soil productivity and soil-hydrologic conditions. Areas considered for TSRC are excluded from this requirement, but DD applies to vegetation clearing for new and upgraded utility corridors in areas that are available for multiple uses on NFS lands. The activity area for DD has been defined as the new and upgraded transmission line corridor where it occurs on NFS lands. Existing DD within the transmission line ROW is estimated at 8 percent. This is an estimate based on average extent of DD from ground-based forest harvesting operations in the Forest Service Northern Region (Reeves et al. 2012).

3.6 Noise

3.6.1 Introduction

This section presents a description of the affected noise environment as it relates to humans and human activity. The effects of noise on people can include general annoyance, interference with speech communication, sleep disturbance, and in the extreme, hearing impairment. Effects of noise on non-human species is addressed in **Sections 4.12** and **4.13** for fish and wildlife, respectively.

3.6.2 Noise Area of Analysis

The analysis area for noise includes areas within a five-mile radius of the major SGP components (i.e., the Operations Area Boundary, access routes, utilities, and off-site facilities) (**Figure 3.6-1**). Noise levels vary throughout the analysis area because noise levels attenuate (i.e., decrease) as a function of the distance from the source (i.e., divergence), ground absorption, atmospheric conditions, and the presence of physical barriers.

3.6.3 Relevant Laws, Regulations, Policies, and Plans

Several laws and implementing regulations apply to the Proposed Action and alternatives. The following is a list of laws, regulations, policies, and plans at the federal, state, or local level pertaining to Noise. Additional descriptions of these regulations can be found in the SGP Noise Specialist Report (Forest Service 2023d).

Land and Resource Management Plan: The Payette Forest Plan (Forest Service 2003a), and the Boise Forest Plan (Forest Service 2010a) provide management prescriptions designed to realize goals for achieving desired condition for noise and include various objectives, guidelines, and standards for this purpose.

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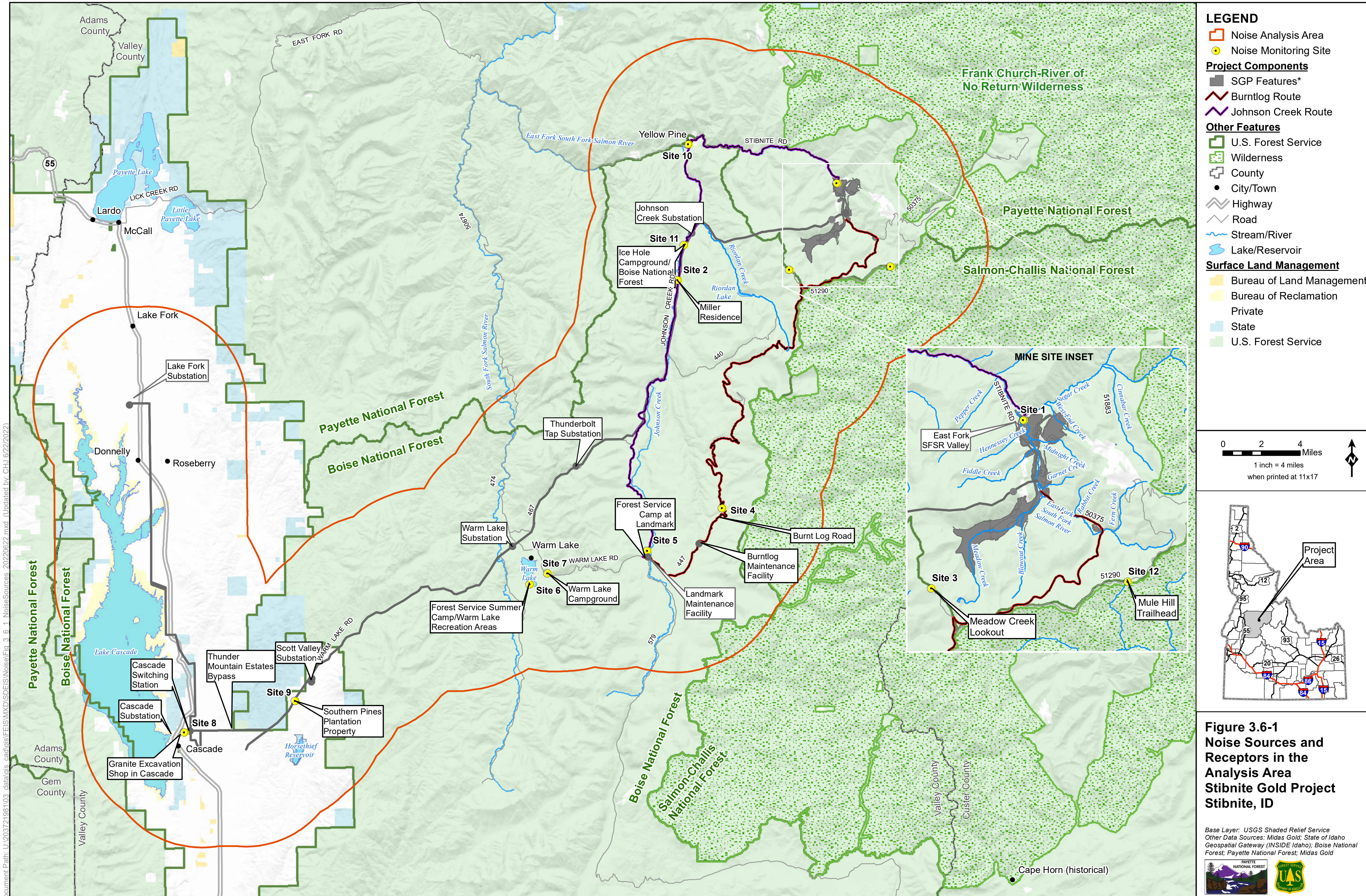


Figure 3.6-1
Noise Sources and Receptors in the Analysis Area
Stibnite Gold Project
Stibnite, ID

Base Layer: USGS Shaded Relief Service
Other Data Sources: Midas Gold; State of Idaho Geospatial Gateway (INSIDE Idaho); Boise National Forest; Payette National Forest; Midas Gold

Noise Control Act of 1972: The Noise Control Act of 1972 established a national policy to promote an environment free from noise that jeopardizes public health or welfare and directed the EPA to identify acceptable limits under various conditions that would protect public health and welfare with an adequate margin of safety. EPA published a summary of these acceptable limits in 1978, as follows:

1. L_{EQ1h} of less than or equal to 55 dBA for outdoor areas where people spend limited amounts of time (i.e., school yards or playgrounds).

2. L_{DN} of less than or equal to 55 dBA for outdoor areas at residences, farms, and other areas where people spend varying amounts of time, where quiet is a basis for the use of such areas.

The protective levels should "not be viewed as standards, criteria, regulations, or goals. Rather, they should be viewed as levels below which there is no reason to suspect that the general population will be at risk from any identified effects of noise" (EPA 1978); therefore, the EPA levels are guidance levels rather than enforceable standards or regulations and do not apply to biological resources such as fish and wildlife.

EPA Guidance on Ambient Noise Levels: Guidance on safe noise levels, which can be used to assess impacts of a project on public health and welfare, is available from EPA (1974, 1978). **Table 3.6-1** shows outdoor and indoor noise levels identified by EPA to protect public health and welfare, expressed as L_{EQ24h} or L_{DN} (based on the dBA over a 24-hour period). Acceptable noise levels are not "peak" but are 24-hour averages over several years and represent levels where the general population would not be expected to be at risk from the identified effects of the noise (EPA 1978).

Table 3.6-1 Yearly Values that Protect Public Health and Welfare with a Margin of Safety

Effect	Safety Level	Area
Hearing Loss	L_{EQ24h} ≤70 dBA	All areas.
Outdoor Activity Interference and Annoyance	L_{DN24h} ≤55 dBA	Outdoors in residential areas and farms, and other outdoor areas where people spend widely varying amounts of time, and other places where quiet is a basis for use.
Indoor Activity Interference and Annoyance	L_{DN} ≤45 dBA L_{EQ24h} ≤45 dBA	Indoor residential areas. Other indoor areas with human activities, such as schools, etc.

Source: EPA 1978
≤ = less than or equal to
dBA = A-weighted decibel.
L_{EQ24h} = Equivalent sound level for 24-hour period, expressed as dBA.
L_{DN} = Day-night sound level, expressed as dBA.
L_{DN24h} = Day-night sound level, expressed as dBA over a 24-hour period.

29 CFR 1910.95: The OSHA noise standards are described under 29 CFR 1910.95 for sound levels permissible by duration of work per day. When an employee is exposed to noises exceeding the limits, engineering controls and/or personal protective equipment need to be put in place.

30 CFR 62.130: The MSHA noise standards are described under 30 CFR 62.130. A miner cannot be exposed to noise exceeding the permissible exposure level of 115 dBA during any work shift without hearing protection.

3.6.4 Affected Environment

3.6.4.1 Landscape Features

The SGP is located in the PNF in the upper drainage basin for the East Fork SFSR. The area is characterized by narrow valleys surrounded by steep mountains. Elevations along the valley floors range from 6,000 to 6,600 feet above mean sea level. The surrounding mountains and areas in the FCRNRW reach elevations over 9,000 feet above mean sea level. Off-site facilities, much of the Burntlog Route, and the transmission line corridor are in the BNF with a similar topography and terrain. On the western edge of the Operations Area Boundary, access routes and transmission lines are in wider valley bottoms. Tall, dense trees and terrain obstructing the line-of-sight propagation of noise can reduce or eliminate the transmission of noise.

3.6.4.2 Noise-Sensitive Receptors

The SGP is located in the upper East Fork SFSR drainage approximately 44 air miles northeast of the City of Cascade, Idaho. The current access from SH 55 to the SGP is via Warm Lake Road to Johnson Creek Road (in summer) or SFSR Road (in winter), and then the Stibnite Road portion of the McCall-Stibnite Road (**Figure 3.6-1**).

Within the Operations Area Boundary, the primary human NSRs would be SGP workers. Outside the Operations Area Boundary, the primary human NSRs would be residents and recreational land uses (e.g., campgrounds, lookouts, trails, dispersed recreational uses in wilderness areas, including undeveloped campsites). A total of 12 sites were analyzed for baseline noise conditions and are discussed in the following section. Site 1 represents ambient sound levels near the Operations Area Boundary. Site 4 is not considered an NSR, but the sound levels measured there represent ambient sound levels in adjacent wilderness areas, similar to Site 3. Site 7 also is not considered to be an NSR but characterizes traffic noise along Warm Lake Road.

Residences are located near Warm Lake Road in Cascade and approximately seven miles east of SH 55 on the Southern Pines Plantation Property. Recreational land uses located near Warm Lake Road include the Warm Lake Campground, a Forest Service summer home, and recreational areas along the southwest shoreline of Warm Lake. These noise-sensitive receptors are in the vicinity of both the Johnson Creek Route and the Burntlog Route. Several residences, the Forest Service Camp at Landmark, and the Ice Hole Campground, are located near Johnson Creek Road between Warm Lake Road and Stibnite Road, with additional residences located near Johnson Creek Road in the village of Yellow Pine. The Meadow Creek Lookout is located just north of Meadow Creek Lookout Road, which would be used to access a portion of the Burntlog Route. The FCRNRW is located east of the Burntlog Route and there are several hiking trails in the vicinity, the closest being the Mule Hill Trailhead (NFS Trail [NFST] #219).

3.6.4.3 Baseline Ambient Noise Level Measurements

Outdoor baseline ambient sound levels were measured at five locations in the analysis area in July and August of 2014 and at four additional locations in July and August of 2016 (HDR 2017b, 2017c). NSRs analyzed with baseline noise measurements (Sites 1 through 9) are described in **Table 3.6-2** and are shown on **Figure 3.6-1**. Sites with assumed nighttime human use, such as residences and campgrounds, are reported in dBA, L_{DN}; those with assumed daytime-only use are reported in dBA, L_{EQ}.

Table 3.6-2 Measured Baseline Ambient Sound Levels

ID	Name	Baseline dBA[1,2]	Location and Existing Noise Characterization
Site 1	East Fork SFSR Valley	40 L_{EQ1h}	Located in the East Fork SFSR valley near the mine pit locations to characterize baseline ambient noise levels where mine operations would occur.
Site 2	Miller Residence	50-51 L_{DN}	Located near a residence on Johnson Creek Road between Stibnite Road and Meadow Creek Lookout site to characterize baseline ambient noise levels near the highway that trucks would use to access the SGP via the Johnson Creek Route[3].
Site 3	Meadow Creek Lookout	45 L_{EQ1h}	Located at the Meadow Creek Lookout site off Meadow Creek Lookout Road to characterize baseline ambient noise levels in undeveloped areas and near the Burntlog Route[4]; general noise levels in adjacent wilderness areas.
Site 4	Burnt Log Road	40 L_{EQ1h}	Located approximately 100 feet from Burnt Log Road to characterize baseline ambient noise levels in undeveloped areas near the Burntlog Route, and for use in characterizing general noise levels in adjacent wilderness areas.
Site 5	Forest Service Camp at Landmark	34-40 L_{DN}	Located at a Forest Service campground near Johnson Creek Road and Landmark Airfield to characterize baseline ambient noise levels near this higher volume roadway along the Johnson Creek Route where other noise sources (e.g., aircraft) also are present.
Site 6	Forest Service Summer Home/ Warm Lake Recreation Areas	34-49 L_{DN}	Located on the southwest shoreline of Warm Lake to characterize baseline ambient noise levels near Forest Service summer home and recreation areas associated with Warm Lake.
Site 7	Warm Lake Road	47-52 L_{DN}	Located approximately 150 feet north of Warm Lake Road and directly east of Warm Lake to characterize baseline ambient noise levels along this frequently used road, at Warm Lake Campground, near the Burntlog Route.
Site 8	Granite Excavation Shop in Cascade	61-64 L_{DN}	Located at a commercial shop along Warm Lake Road in Cascade, with a residence nearby, to characterize baseline ambient sound levels near the highway.

ID	Name	Baseline dBA[1,2]	Location and Existing Noise Characterization
Site 9	Southern Pines Plantation Property	51-52 L_{DN}	Located approximately seven miles east of SH 55 along Warm Lake Road to characterize baseline ambient noise levels along this frequently used highway near a group of private residences.

Source: HDR 2017b, 2017c
[1]Presented hourly L_{EQ} values (L_{EQ1h}) are averaged from daytime (i.e., from 7:00 AM and 10:00 PM) hourly baseline measurement data collected over a period of multiple consecutive days.
[2]Presented L_{DN} values are calculated from 24-hour baseline measurement data collected over a period of multiple consecutive days (HDR 2017b, 2017c).
[3]The Johnson Creek Route is the current summer access from SH 55 to the SGP via Warm Lake Road, Johnson Creek Road, and Stibnite Road.
[4]The Burntlog Route includes Warm Lake Road, Burnt Log Road, Thunder Mountain Road, and a new connector segment from Burnt Log Road to Thunder Mountain Road.

Three additional locations were identified as human use NSRs but were analyzed without baseline noise measurements (Sites 10 through 12). **Table 3.6-3** provides a description of these NSRs along with reference baseline sound levels. Measured noise levels were not available for these areas, but baseline levels were estimated based on similarity to other sites with measurements.

Table 3.6-3 Additional Human Use NSRs and Estimated Ambient Baseline Sound Levels

ID	Name	Baseline dBA[1,2]	Location and Existing Noise Characterization
Site 10	Yellow Pine	50-51 L_{DN}	Located in Yellow Pine village. No noise measurements were taken from this site, but baseline sound levels assumed to be similar to Site 2, on the basis of similar distance to shared nearby roadway(s) and proximity of residences.
Site 11	Ice Hole Campground/ BNF	50-51 L_{DN}	Located at Ice Hole Campground in the BNF. No noise measurements were taken from this site, but baseline sound levels assumed to be similar to Site 2, on the basis of similar distance to shared nearby roadway.
Site 12	Mule Hill Trailhead	40-45 L_{EQ1h}	Located at the Mule Hill Trailhead. No noise measurements were taken from this site, but ambient sound levels assumed to be in the range of Site 3 and Site 4 sound levels.

Source: AECOM 2020d
[1]Presented hourly L_{EQ} values (L_{EQ1h}) are averaged from daytime (i.e., from 7:00 AM and 10:00 PM) hourly baseline measurement data collected over a period of multiple consecutive days.
[2]Presented L_{DN} values are calculated from 24-hour baseline measurement data collected over a period of multiple consecutive days (HDR 2017b, 2017c).

3.7 Hazardous Materials

3.7.1 Introduction

This section addresses hazardous materials other than development rock and process tailings that would be utilized by the SGP. Hazardous materials are substances which may pose a risk to human health, wildlife, or the environment. Hazardous materials that would be used and/or transported for the proposed mining activities include diesel fuel, gasoline, lubricants, antifreeze, process reagents, antimony concentrate, mercury containing residuals, lime, explosives, and other substances.

When not properly managed, hazardous materials can represent potential risks to human health, the environment, and wildlife. Spills or accidental releases of hazardous materials can impact air, surface water, groundwater, soil, vegetation, wildlife, fish and other aquatic resources, and public health and safety; they can occur during transportation to and from a site, during storage and use activities, or through improper disposal of waste materials.

3.7.2 Hazardous Materials Area of Analysis

The components of the analysis area for hazardous materials are shown on **Figure 2.4-1** and include the Operations Area Boundary (including all operational areas and haul roads); the proposed off-site facilities: SGLF and the Maintenance Facility locations; and the access roads including the Warm Lake Road (CR 10-579), from SH 55 in Cascade past the SGLF, continuing to Landmark; the Burntlog Route: Burnt Log Road (FR 447), new road segments, and segments of Meadow Creek Lookout (FR 51290) and Thunder Mountain (FR 50375) roads; and the Johnson Creek Route: Johnson Creek Road (CR 10-413) and the Stibnite Road portion of the McCall-Stibnite Road (Stibnite Road; CR 50-412), from the village of Yellow Pine to the Operations Area Boundary.

3.7.3 Relevant Laws, Regulations, Policies, and Plans

Several laws and implementing regulations apply to the Proposed Action and Alternatives. The following is a list of additional laws, regulations, policies, and plans at the federal, state, or local level pertaining to Hazardous Materials.

The Occupational Safety and Health Administration – Hazard Communication (29 CFR 1910.1200) provides a uniform system of labeling and communicating hazards associated with hazardous chemicals.

Mine Health and Safety Hazard Communication Standards – The MSHA regulations specify methods for testing, evaluation, and approval of mining products (30 CFR 5 through 36) and procedures for hazard communication which identifies chemicals at the mine, training to determine hazardous chemicals, and establishes a hazardous communication program (30 CFR 47).

Idaho Hazardous Waste Regulations - Idaho enforces regulations on hazardous waste administered through the IDEQ, under Idaho Administrative Code IDAPA 58.01.05. The regulations are identical to federal rules and incorporated by reference where applicable. Large mine operations like the SGP can generate quantities of regulated hazardous waste from laboratory and maintenance activities to require compliance with the federal and state hazardous waste regulations for generation, storage, shipping, and disposal of the hazardous wastes.

U.S. Department of Transportation (USDOT) Hazardous Materials Transportation Permit - The permit governs the transport of hazardous materials as defined by the USDOT and requires specific employee training, security, and contingency planning. The USDOT regulations in 49 CFR 100-185 define hazardous materials and establish regulations for the safe and secure transportation of hazardous materials in commerce. Consultation and coordination with the Federal Motor Carrier Safety Administration should be made for shipments of hazardous materials requiring a Hazardous Material Safety Permit, pursuant to 49 CFR 385.403.

Idaho Regulations on Hazardous Materials/Waste Transport - Idaho Statues Title 49 Chapter 22 regulates the transportation of hazardous materials and wastes in the state. Regulations include requirements for permits, endorsements, insurance, various enforcement provisions including an enforcement fund, and other provisions to ensure safe hazardous waste transport in the state.

Idaho Regulations on Ore Processing by Cyanidation - Idaho has a state regulatory program for Ore Processing By Cyanidation (IDAPA 58.01.13). This program establishes a permitting program for process facilities using cyanide for construction, operations, and closure of facilities that contain, treat, or dispose of process water. The rules specify the necessary contents of a permit application and establish minimum engineering plans and specifications for impoundments, leach pads, and other facilities designed to contain process water.

Department of Justice, Bureau of Alcohol, Tobacco Firearms and Explosives - The agency regulates the sale, possession, transport, storage, security, and use of explosives. The agency also plays a vital role in regulating and educating the explosives industry (27 CFR Part 447).

The International Cyanide Management Code - A voluntary initiative for the gold and silver mining industries and provides guidelines pertaining to the manufacture, transportation, storage, and use of cyanide. Perpetua Resources has indicated their intent to design and operate the cyanidation facility in compliance with the ICMC.

Comprehensive Environmental Response, Compensation, and Liability Act – CERCLA and its regulations enforced by the EPA (Superfund, 40 CFR 300-375) establish liability provisions related to the clean-up of hazardous waste sites, accidents, spills and other releases, pollutants, and contaminants to the environment. Hazardous substances are included in 40 CFR Table 302.4, which lists hazardous substances and reportable quantities in the event of a release of these substances to the environment. In 2021 Perpetua voluntarily entered into an ASAOC with EPA and the Forest Service to conduct certain CERCLA response actions to address environmental effects at the SGP mine site caused by legacy mine operations that preceded Perpetua's involvement in the property (**Section 1.3**).

Resource Conservation and Recovery Act - Hazardous wastes, as defined in Subtitle C of the federal RCRA regulations, are governed by the EPA in 40 CFR 260-273 and also in the Idaho equivalent state Hazardous Waste Management Act and Idaho Rules and Standards for Hazardous Waste (IDAPA 58.01.05). The regulations apply to the generation, storage, transport, and disposal of regulated hazardous waste. In Idaho, the IDEQ has primacy for regulation of hazardous wastes under IDAPA 58.01.05 which conform to the federal regulatory requirements.

The Oil Pollution Act of 1990 – This act amended the CWA to address prevention, response, and cleanup for oil pollution incidents. This act requires qualifying oil storage facilities to develop SPCC plans in accordance with 40 CFR 112.

EPA Risk Management Plan Rule - Section 112(r) of the 1990 CAA Amendments sets forth a series of requirements aimed at preventing and minimizing the consequences of accidental chemical releases.

These requirements are the basis of a rule on "Risk Management Programs for Chemical Accidental Release Prevention" promulgated by the EPA on June 20, 1996 (40 CFR 68). The rule applies to public and private facilities that manufacture, process, use, store, or otherwise handle regulated substances at or above specified threshold quantities. The rule requires facilities that use extremely hazardous substances to develop a Risk Management Plan with critical information to assist local fire, police, and emergency response personnel in preparation for and response to chemical emergencies.

National Forest Land and Resource Management Plan - The Payette Forest Plan (Forest Service 2003a), and the Boise Forest Plan (Forest Service 2010a) provide management prescriptions designed to realize goals for achieving desired condition related to hazardous materials transport, use, and disposal and include various objectives, guidelines, and standards for this purpose.

3.7.4 Affected Environment

The SGP area has been extensively disturbed by past mining activities (**Figure 3.7-1**). Past activities involved the use of hazardous materials including, but not limited to fuels, lubricants, hydraulic oils, and chemical reagents including sodium hypochlorite, sodium hydroxide, copper sulphate, lead acetate, and cyanide (Bradley et al. 1943). See **Section 1.3** for a description of the past mining, milling, and heap leach activities at the site.

3.7.4.1 Operations Area Boundary

Current exploration-related activity is occurring in the three major identified deposits at the mine site: Yellow Pine, West End, and Hangar Flats (**Figure 2.4-2**) as well as those areas as defined in the Golden Meadows Exploration Project Plan of Operations (Midas Gold 2011, 2016b).

Centrally located support facilities for these exploration activities include the personnel camp, offices, maintenance shop area, a helipad and hangar, and an airstrip.

Perpetua currently stores and uses various substances classified as hazardous materials for ongoing exploration activities. These include petroleum products (e.g., fuels, lubricants, and motor oils), over-the-counter cleaning agents, batteries, tires, and other routine materials used to support drill rigs, generators, water pumps, vehicles, helicopters, and other operating needs (HDR 2017d).

Existing fuel infrastructure for the exploration activities consists of a primary fuel storage area, a secondary fuel storage area, the shop area, and the Hangar Flats fuel storage area. **Table 3.7-1** summarizes petroleum use and storage locations at the existing exploration operations. The primary fuel storage area is covered. The secondary fuel storage area is located near the shop (**Figure 3.7-2**). The primary diesel generator is located at the personnel camp northwest of the shop area (**Figure 3.7-2**). The other two generators at the shop area are used as backup power generation for offices and water facilities. Southwest of the shop area is the Hangar Flats fuel storage area.

The storage tanks are situated within secondary containment and routinely checked for tank leakage or spillage. If spills occurred, they would be retained within the secondary containments designed to at least contain 110 percent of the largest tank in the containment. They would be responded to and reported in accordance with the current site SPCC Plan, as well as state and federal regulations (HDR 2017d).

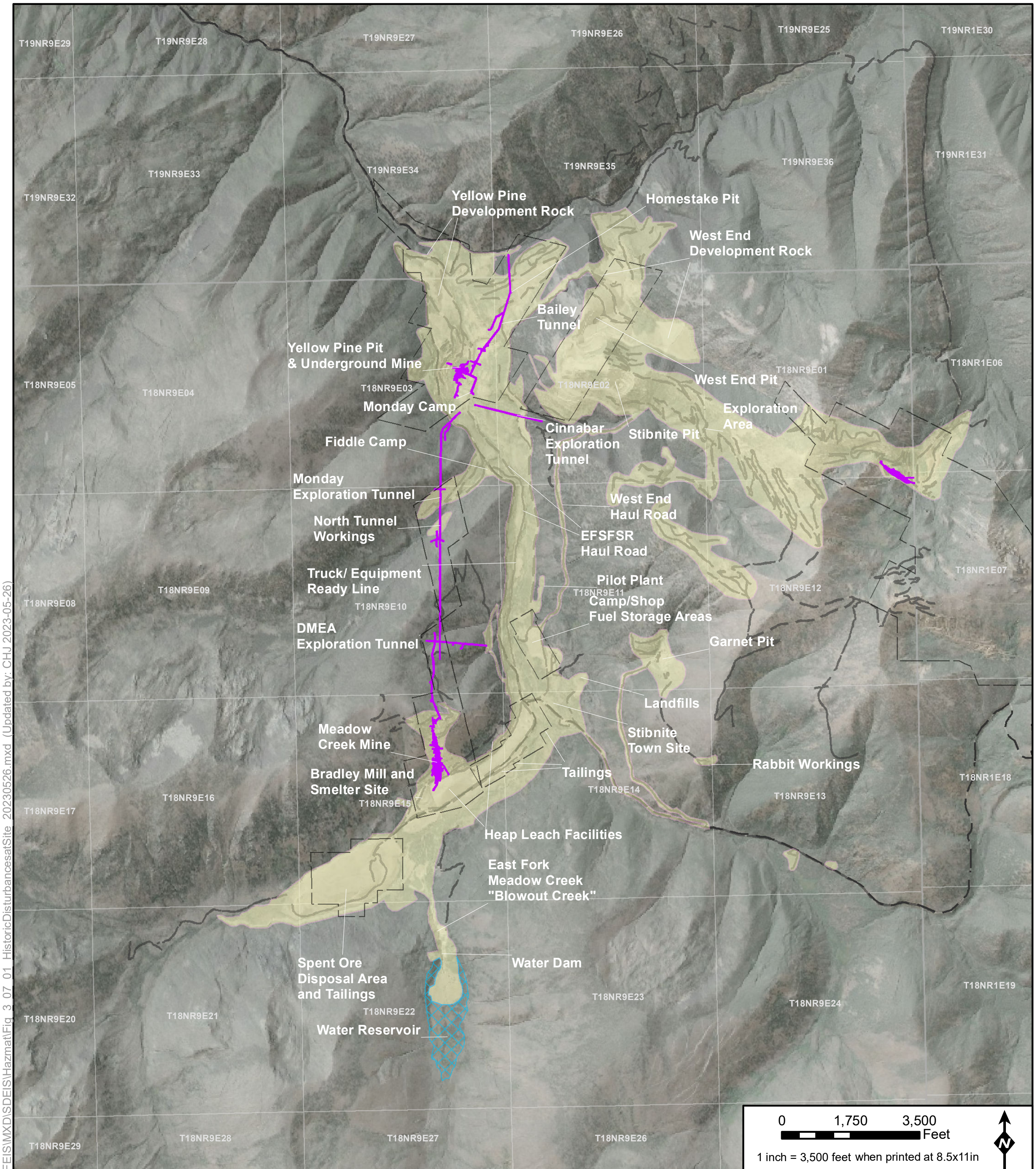
The above ground storage tanks (ASTs) meet the requirements of the Oil Prevention Pollution regulation (40 CFR 112). Perpetua annually reports on-site diesel and Jet A fuel storage in accordance with Tier II reporting requirements under the Emergency Planning and Community Right-to-Know Act (40 CFR 370).

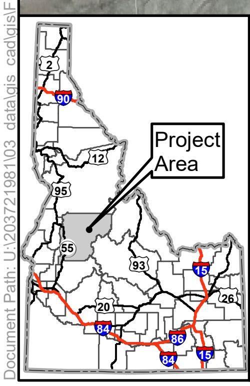
Perpetua has developed a solid waste management plan to assist with the storage, handling, and disposal of solid, special, and hazardous waste streams (HDR 2017d). This plan was developed in accordance with state and federal regulations pertinent to waste, although the existing exploration activities are currently considered a Very Small Quantity Generator under RCRA (40 CFR262.14). The solid waste management plan establishes procedures to identify hazardous waste and provides protocols to track, collect, and dispose of hazardous materials in accordance with state and federal regulations. The plan also outlines methods to minimize the generation of hazardous waste (e.g., using industrial soaps in place of solvents wherever possible).

Table 3.7-1 Petroleum Storage Locations, Types, and Volumes

Location	Contents	No. of Tanks	Quantity per tank (gallon)	Containment
Primary Fuel Storage Area				
Fuel Farm	Diesel	4	10,000	Double-walled tanks, concrete basin
Fuel Farm	Diesel	2	4,000	Double-walled tanks, concrete basin
Fuel Farm	Diesel	2	500	Single-walled portable tanks, concrete basin (inactive)
Secondary Fuel Storage Area and Hanger Fuel Storage Area				
Near Shop	Gasoline	2	2,500	Double-walled tank with HDPE-lined tertiary containment
Near Hangar	Jet A	1	5,000	Double-walled tank with HDPE-lined tertiary containment
Near Hangar	Diesel	1	2,500	Double-walled tank with HDPE-lined tertiary containment
Near Hangar	Av-gas	3	55	Single-walled tanks, 55-gallon fuel storage drums, HDPE-lined secondary containment
Shop Area				
Inside Shop	Used Oil	2	500	Double-walled tank
Shop Generator	Diesel	1	<250	Lined secondary containment
Main Power Generator	Diesel	1	<250	Double-walled tank
Backup Generator	Diesel	1	<250	Lined secondary containment
Miscellaneous Fuel Storage				
Gestrin Well – Hangar Flats Water Station	Diesel	1	<250	Lined secondary containment

Source: Midas Gold 2017d
HDPE = high density polyethylene





LEGEND

- Roads
- Disturbance Areas
- Underground Workings
- Patented Claims

Figure 3.7-1
Past Mining and Related Activities at the Mine Site
Stibnite Mining District
Stibnite Gold Project
Stibnite, ID

Base Layer: Hillshade derived from LiDAR supplied by Perpetua Gold
Other Data Sources: Perpetua Gold; Boise National Forest; Payette National Forest

Map Date: 2023-05-26

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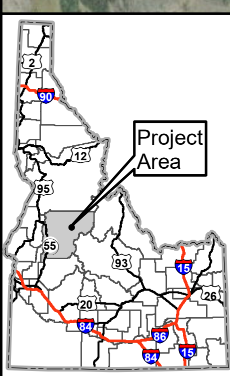

LEGEND

- Patented Claims
- Existing Worker Camp
- Airport Runway
- Road

Figure 3.7-2
Existing Mine Site Support Facilities
Stibnite Gold Project
Stibnite, ID

Base Layer: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
Other Data Sources: Perpetua Gold; Boise National Forest; Payette National Forest

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3.7.4.2 Access Roads

Current access roads used for the transport of hazardous materials to the mine site include Warm Lake Road (CR 10-579) from Cascade, continuing to Landmark and then on Johnson Creek Road (CR 10-413) to the village of Yellow Pine and Stibnite Road (CR 50-412) to the mine site. Warm Lake Road traverses steep grades and crosses two high mountain passes, Big Creek Summit between Cascade and Warm Lake and Warm Lake Summit between Warm Lake and Landmark.

The largest volume of hazardous materials currently used at the mine site is petroleum hydrocarbons (e.g., diesel, unleaded gasoline, and Jet A fuel). Fuels are transported to the site via tanker truck; the transportation of these fluids presents the greatest existing risk for spills and releases to the environment. Exploration-related fuel transportation to the site by Perpetua has been occurring since 2011 and, through 2021, has consisted of deliveries by 288 fuel tankers, each with a capacity between 4,000 and 4,500 gallons. This work was performed under the fuel transportation Standard Operating Procedure protocol ESOP_004 Fuel Transportation (Midas Gold 2022). There have been no reported spills or releases associated with the transport of this fuel. There was a small fuel spill associated with a plane crash in February 2012, described further below.

3.7.4.3 Past Releases, Remediation, and Mitigation

Previous reclamation, remediation, and mitigation activities conducted in the SGP area by other operators are described in detail in the Hazardous Materials Baseline Report completed in 2015, updated in 2017 (HDR 2017d). The baseline report also presents a listing of recognized environmental conditions identified during previous environmental assessments conducted in 2010. The January 15, 2021, Action Memorandum by the EPA on the Stibnite Mine Site Time Critical Removal Action, Valley County, Idaho under CERCLA includes information on the mining history, descriptions of past releases of hazardous substances and pollutants, and listing of past remedial actions undertaken at the Stibnite site.

- Past mining activities have deposited metals, spent and neutralized ore, waste rock, and mine tailings over portions of the SGP site. Contaminants associated with past mine operations include metals and cyanide in area soil, groundwater, surface water, seeps, and sediments.
- The Stibnite mine was placed on the Federal Facilities Docket in 1991 CERCLIS No. 9122307607. The Stibnite/Yellow Pine mining area was proposed for listing on the National Priorities List (NPL) by EPA in 2001, but no further action to list the site on the NPL has been pursued by the agency since then.

The legacy mining and processing activities of the SGP vicinity, and the CERCLA status of these disturbances are described in **Sections 1.2** and **1.3**. Antimony, arsenic, copper, lead, mercury, and cyanide are the hazardous substances and pollutants that have been released into the local environment from mine wastes. Previous mine operations have also caused alterations to local streams and aquatic habitats. Much of the early mining development at the site took place before environmental regulations on the use, handling, and disposal of hazardous materials were in place. While there is no sampling or investigation data to confirm, it is possible that there are spills of hazardous materials (such as petroleum hydrocarbons) located below existing mining wastes at the site.

In January 2021, Perpetua entered into an ASAOC with the EPA and the Forest Service to conduct certain CERCLA response actions to address remaining mine waste impacts and study others (**Section 1.3**). The first phase of these removal actions is independent of the proposed SGP and are planned to be implemented between 2022 and 2024. Phase 1 removal actions include: diverting clean surface water around certain source areas, Lower Meadow Creek Valley tailings removal (25,000 tons), Bradley Man Camp dumps removal and onsite repository development (200,000 tons), and Northwest Bradley Dump stream waste removal and slope stabilization (100,000 tons). Phase 1 also includes certain baseline studies of conditions at five historic mine adits where mine water is discharging. Following phases would depend on agreement for implementation by Perpetua, EPA, and Forest Service.

The following remediation efforts associated with hazardous substances and other contaminated materials at the mine site have been conducted:

- 1982 to 1997: mine operators placed the SODA over the previously deposited (and unlined) Bradley mill tailings to reduce erosion of the tailings.
- 1996 to 1997: mine operator SMI redirected discharge from and draining of the Meadow Creek Pond that lay behind the Bradley Tailings and began construction of a diversion channel to reduce contact of stream flow with the tailings.
- 1998: Mobil Oil Corporation constructed a new stream channel for Meadow Creek on the south side of the Bradley Tailings and SODA; built a new diversion channel on the north side; backfilled the old Meadow Creek diversion channel; closed a pond and covered 5 acres of exposed tailings at the upper end of the Bradley Tailings/SODA; regraded and revegetated 100 acres of the Bradley Tailings/SODA; revegetated the diversion channel; and installed stream restoration features (pools and boulders).
- 1998 to 2004: The EPA, IDL, and IDEQ conducted various tailings and waste removal actions in the Monday Camp area (south end of the Yellow Pine pit); in other areas around the Yellow Pine pit development rock storage areas; and removal and disposal of petroleum contaminated soils in the current shop area.
- 2000: Waste oil, waste oil-contaminated debris, sludge, and asphalt sealer stored in ASTs at the site were removed and disposed of in accordance with the applicable laws and regulations governing disposal of hazardous waste (HDR 2017d).
- 2002: The Forest Service removed partial smelter stack and remaining ash in the stack for off-site disposal. Removed contaminated soil and ash from portion of stack that burned in the 2000 forest fire and placed in an unlined Forest Service repository on site, located on top of the NW Bradley Waste Rock Pile. Highly contaminated ash and the wooden stack was disposed off-site at an EPA regulated disposal facility (Clean Harbors).
- 2004 and 2005: The Forest Service reconstructed about 3,300 feet of Meadow Creek including removal of most of the tailings from the channel on federal lands and planting willows. These materials were placed in a containment cell on the SODA. The old channel was partially backfilled and reclaimed.
- 2005: Removed contaminated and hazardous materials from the Stibnite Mill building and reportedly disposed off-site (HDR 2017d).
- 2009: The Forest Service regraded and covered a portion of the remaining tailings at the Smelter Flats area including construction of a diversion ditch.

- 2012: A reportable fuel spill occurred at the site on February 14, 2012. The spill was caused by an airplane crash at the site. The crash released approximately 100 gallons of diesel fuel onto a road adjacent to the airstrip. Snow, ice, and approximately 8 cubic yards of impacted soil were excavated and removed from the site for treatment. No further action was required. Several federal agencies including EPA and the Forest Service, settled its CERCLA liability in the 2012 Bradley consent decree.
- 2022 and 2023: Removed tailings and waste rock material from the lower Meadow Creek, Bradley Man Camp Dumps, and NW Bradley Dump to an on-site repository equipped with geosynthetic liner and cover systems. Additionally, Hennessy Creek was diverted around the NW Bradley Dumps and the disturbed channels associated with tailings removal from lower Meadow Creek were reconstructed.

Results of a regulatory database search conducted by the Forest Service Krassel Ranger District in 2015 revealed several operators at various sites within the former mine and processing area were listed as having historical incidents or violations involving ASTs and underground storage tanks, RCRA, and CERCLA (HDR 2017d).

- Pioneer Metals installed one gasoline underground storage tank in 1981 near the Stibnite West End Mine in Yellow Pine. It was closed and removed from the ground in 2002.
- Several historical petroleum releases, the largest of which was a major petroleum leak in 1990 from ASTs providing fuel to power generators adjacent to the Pioneer/Stibnite Mine, Inc. processing facilities. Petroleum-contaminated soil was excavated, and limited groundwater remediation was conducted because diesel fuel was reportedly present on the groundwater's surface. The site of the release was never closed and Stibnite Mine, Inc. was never formally released from liability.
- Several RCRA violations based on earlier mining activities, including a confirmed mining metals release in 1979. RCRA wastes from the Stibnite Mine, Inc. mill building, assay laboratory, pilot plant, and machine shop were containerized and transported off site for proper disposal during historic site cleanup.
- In addition, a recent review of the IDEQ Terradex Facility Mapper, which provides online access to Idaho and EPA regulatory database listings, revealed the following listings associated with former operators of the mine site (IDEQ 2019b): Hecla Mining Company Yellow Pine is listed on Mine Cyanidation Permit Facilities (CN000012), Hecla Mining Company Yellow Pine: General Mine Sites (GM0069); Mine Remediation Action Sites (RA0069); RCRA Hazardous Waste Sites (IDD980665459); and Midas Gold Mine General Mine Sites (GM0301).

3.8 Surface Water and Groundwater Quantity

3.8.1 Introduction

The following section describes existing conditions related to surface water quantity, groundwater quantity, and water rights.

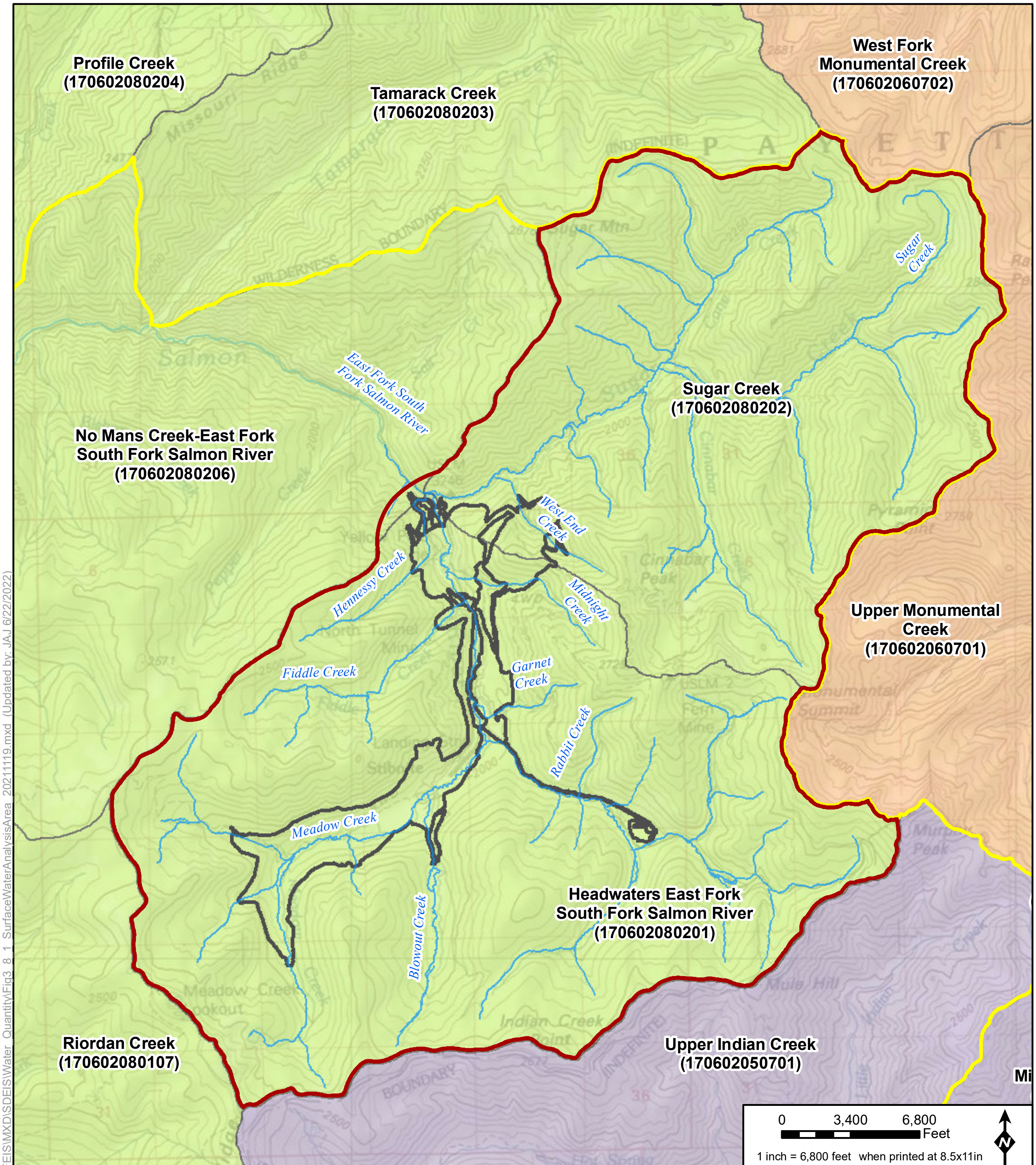
3.8.2 Water Quantity Resources Area of Analysis

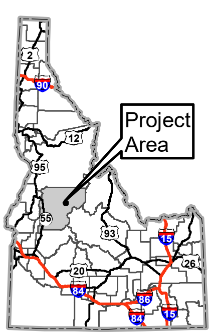
The analysis area for surface water and groundwater quantity encompasses the land where activities associated with the action alternatives could affect stream flows, groundwater levels, groundwater flow directions, groundwater-dependent ecosystems, and water rights. Such actions would be concentrated at the SGP and include groundwater withdrawal, streambed alteration/diversion, and surface water management. Open pits excavated below the water table require lowering of the water table via removal of groundwater that would otherwise fill the pit. This is typically achieved by pumping from wells installed around the pit and sumps within the pit. Such pumping can affect nearby surface waters that are to some degree in hydraulic communication with a groundwater system.

The water quantity analysis area encompasses the 12-digit HUCs or sub-watersheds that overlap the proposed SGP. The Operations Area Boundary is near the upper end of the East Fork SFSR within two sub-watersheds: Headwaters East Fork SFSR and Sugar Creek. A portion of the analysis area includes the upper drainage area of the East Fork SFSR (to downstream of the confluence with Sugar Creek), as well as several tributaries of the East Fork SFSR. Those include EFMC (i.e., Blowout Creek), Meadow Creek, Rabbit Creek, Fiddle Creek, Hennessy Creek, Midnight Creek, Garnet Creek, Sugar Creek, and West End Creek, as shown on **Figure 3.8-1** (within the "SGP Water Modeling Boundary"). The analysis area for surface water and groundwater quantity that could be directly or indirectly affected by the SGP consists of the area where activities associated with the action alternatives could affect stream flows and/or the quantity of groundwater in storage, groundwater levels, and groundwater transmission.

Groundwater within the analysis area moves primarily through unconsolidated alluvium; groundwater flow via deep bedrock is considered minor in comparison (see discussion of hydraulic conductivity of alluvial materials and bedrock formations presented below). Because most of the groundwater moves through unconsolidated alluvium, the boundaries of the Sugar Creek and Headwaters East Fork SFSR sub-watersheds also represent a reasonable approximation of the area subject to analysis of groundwater quantity impacts arising from the SGP. Note that the SGP might still alter streamflow conditions (including access roads, utilities, and off-site facilities) outside the analysis area; however, such alterations are expected to be minor based on regulatory requirements for these alterations and the application of best management practices.

The analysis area for water rights is the same as used for surface water and groundwater quantity analysis (**Figure 3.8-1**) and covers the sub-watersheds of Sugar Creek and the Headwaters East Fork SFSR. The Water Rights discussion identifies instream flow water rights held by Idaho Water Resource Board and the Forest Service that are located downstream from the analysis area on the South Fork of the Salmon River and on the Salmon River.





LEGEND

- Surface Water Analysis Area
- Mine Site Water Modeling Boundary
- Mine Site Components*

Watersheds

- Upper Middle Fork Salmon (17060205)
- South Fork Salmon (17060208)
- Lower Middle Fork Salmon (17060206)
- Stream/River

*Mine Site components are associated with all Alternatives

Note:
Subwatersheds displayed are Hydrologic Unit Code (HUC) 6th level (12-digit)

Figure 3.8-1
Water Quantity Analysis Area
Stibnite Gold Project
Stibnite, ID

Base Layer: ESRI USA Topographic Basemap
Other Data Sources: Perpetua; Boise National Forest; Payette National Forest

Document Path: U:\20372198\03_data\gis_cad\gis\FEIS\MXD\SDEIS\Water_Quantity\Fig3_8_1_SurfaceWaterAnalysisArea_20211119.mxd (Updated by: JAJ 6/22/2022)

The direct and indirect effects associated with surface water and groundwater quantity are considered in the overall context of the local and regional hydrological and hydrogeological conditions of the affected environment. The following are the main characteristics of those conditions:

- The SGP and surrounding area (i.e., the analysis area) consists of mountainous terrain dissected by typically narrow valleys with steep slopes.
- The hydrology of the analysis area is strongly influenced by seasonal patterns of snow accumulation during the winter, and snowmelt in the spring and early summer.
- Water entering the analysis area as precipitation migrates as surface runoff and shallow groundwater down the mountain slopes and along the valley bottoms in an alluvial aquifer formed by unconsolidated Quaternary deposits of sediment. The alluvial aquifer is documented to be the most groundwater-transmissive formation in the analysis area; it is typically more than 50 feet thick (reaching a thickness of 250 feet at some locations).
- Groundwater in the alluvial aquifer eventually discharges to surface streams. However, at some locations, surface water recharges shallow groundwater during periods of high stream stage.
- Groundwater supports many seep-, spring- and wetland ecosystems referred to as groundwater dependent ecosystems (GDEs).
- A portion of groundwater flow occurs through a network of fractures in shallow bedrock and through fracture zones (encountered in boreholes) and faults. Shallow bedrock is less transmissive than the alluvial aquifer, but more fractured and transmissive than deeper bedrock which is less transmissive.
- The MCFZ acts as an aquitard to bedrock flow based on observations of surface water expressions above the fault zone gouge outcrops and artesian conditions observed in drillholes in its vicinity where it passes between the Yellow Pine pit and West End areas.
- There are four existing water rights held by Perpetua in the vicinity of the Operations Area Boundary that are related to historical mining use, but there are no downstream consumptive-use water rights on the East Fork SFSR.

3.8.3 Relevant Laws, Regulations, Policies, and Plans

Several laws and regulations apply to the 2021 MMP and action alternatives. The following is a list of additional laws, regulations, policies, and plans at the federal, state, or local level pertaining to water quality resources. Additional descriptions of these regulations can be found in the SGP Water Quantity Resources Specialist Report (Forest Service 2023e).

Land and Resource Management Plan: Physical, social, and biological resources on NFS lands are managed to achieve a desired condition that supports a broad range of biodiversity and social and economic opportunity. National Forest Land and Resource Management Plans embody the provisions of the NFMA and guide natural resource management activities on NFS land.

In the SGP area, the Payette Forest Plan (Forest Service 2003a), and the Boise Forest Plan (Forest Service 2010a) provide management prescriptions designed to realize goals for achieving desired condition for surface water and groundwater quantity and include various objectives, guidelines, and standards for this purpose."

Federal Laws, Regulations, and Policy: The USACE regulates the discharge of dredged, and/or fill material within WOTUS pursuant to Section 404 of the CWA. The USACE does not regulate water rights in Idaho, but SGP activities that could alter surface water quantity may be regulated and require a USACE authorization.

In 2004, the Main Salmon, Middle Fork Salmon, Rapid, Selway, Lochsa, and Middle Fork Clearwater rivers were designated as WSRs under the Wild and Scenic Rivers Act (16 USC 1271-1287), which reserves instream water rights for designated rivers, and requires additional administration of existing and new water rights pursuant to state law.

State and Local Laws, Regulations, and Policy: The IDWR regulates mine tailings impoundments with dams higher than 30 feet and administers regulations that may have to be considered when a tailings impoundment affects surface water hydrology.

The IDWR also is responsible for administration of water rights, well construction standards, dam safety, and stream channel alteration. Any water right to implement the SGP would need to be granted to the applicant by the State of Idaho through IDWR. The constitution and statutes of the State of Idaho declare all waters of the state to be public but provide the right to divert public waters to put them to beneficial use, which includes mining activities (IDWR 2019; Idaho Const. art. XV, § 1).

A water right is obtained through an application to IDWR. The agency must ensure enough water is available for the water right and that the oldest (senior) water rights are satisfied first (IDWR 2019). The Main Salmon, Middle Fork Salmon, Rapid, Selway, Lochsa, and Middle Fork Clearwater rivers have reserve instream water rights for designated rivers held by the Idaho Water Resource Board under State and Local laws. Water rights associated with mining projects are protected from forfeiture under Idaho Code 42-223(11), provided the water right owner has maintained the property and mineral rights for potential future mineral production.

Valley County reviews development proposals for consistency with the County's Land Use Development Ordinance. When permits are required by other agencies for all or parts of the application, evidence of the permit and compliance with the provisions of the permit are to be a condition of the land use approval. This includes permits to alter wetlands; permits to construct in flood prone areas; and in other situations where the review and issuance of the permit would ensure that the proposal would be technically feasible.

As described above, federal, state, and local decisions and permitting authorizations applied to a proposed mining project represent different processes implemented under different authorities. As such, compliance requirements associated with the multiple agency decisions and permits are likely to overlap but are unlikely to be identical. For example, a state water right authorizing a diversion of groundwater and/or surface water for consumptive use may be less restrictive, more restrictive, or have different compliance metrics than a Forest Service decision on a diversion proposed by a mining plan. While an IDWR water rights authorization would specify the maximum allowable volume of diversion, a Forest Service decision would be based on a proposed water diversion (as constrained by that allowable volume) plus the predicted impacts of that proposed diversion on water resources and the environmental resources dependent on them.

The Forest Service's decision on a mining plan is based on its analysis of the plan under NEPA and enforcement of plan compliance is based on its decision rather than independent decisions by other agencies. While the Forest Service respects the authorities of other agencies, it does not assume their compliance responsibilities, nor does it relinquish its responsibilities to other agencies. Regarding water resources, a Forest Service decision is based on a predictive analysis of the mining plan's proposed water management on groundwater levels, streamflows, and the resulting implications for other environmental resources (e.g., groundwater dependent ecosystems, analyte concentrations, stream temperature, and aquatic wildlife).

Any Forest Service decision to allow operations to be conducted would be based on the impacts analyzed under NEPA, and compliance would be based on adherence to the actions for which that analysis was based, independent of the mine's compliance status with decisions and permits from other agencies. For example, if groundwater and/or surface water diversion within IDWR's water authorizations resulted in an impact to streamflow materially different from the what the Forest Service analyzed and based its decision on, that impact would not be authorized without further analysis and approval.

3.8.4 Affected Environment

3.8.4.1 Hydrologic and Geologic Setting

The SGP is located in mountainous terrain with typically narrow valleys and steep slopes. Elevations range from 6,000 to 6,600 feet amsl along valley floors and rise to elevations exceeding 8,500 feet amsl in the surrounding mountains (HydroGeo 2012a).

The climate of the analysis area is influenced by local patterns of wind, precipitation and temperature influenced by topography, slope aspect, and elevation. The analysis area experiences wide annual and diurnal variations in temperature and humidity. During winter, storms typically move through the region resulting in snowfall accumulations of two feet or more. Cloudy and unsettled weather is common during the winter with measurable precipitation occurring on about one-third of the days (Brown and Caldwell 2017a, Section 4; Stantec and Trinity Consultants 2017).

Spring months are normally wet and windy with weather conditions fluctuating quickly. Afternoon temperatures in the 30s and 40s (degrees Fahrenheit) with precipitation in the form of rain or snow may occur interspersed with periods of sunny skies and temperatures in the 50s or 60s °F. Low elevation snowpack usually melts quickly during the spring, but high elevation snow-pack can persist into June or later (Stantec and Trinity Consultants 2017).

Although snowmelt may take one month or more in the analysis area, summer weather may begin suddenly with a rapid change to warm and dry weather. Although daytime temperatures are usually warm by June, chilly nights can persist throughout the summer. Showers are common from late spring through summer with an increased frequency surrounding regional high terrain. Afternoon temperatures often rise into the 80s (°F); however, low humidity usually results in overnight temperatures in the 50s (°F) or even cooler (Stantec and Trinity Consultants 2017).

Autumn has cooler weather with daytime highs generally in the 60s (°F) in early fall, dipping into the mid-30s (°F) by mid-November with generally dry conditions, except for the first of the progressive winter storms. The first cold wave with highs below 20°F and lows around 0°F or lower may arrive any time between late November and late December (Stantec and Trinity Consultants 2017).

The winds in the analysis area follow the traditional up and down valley flow patterns expected in mountain valleys. During the spring months, periods of high winds may persist for days at a time. Winds have a strong tendency toward northeast directionality. Speeds vary widely but tend to be strongest from the southwest (Stantec and Trinity Consultants 2017).

The main East Fork SFSR valley floor is around 6,400 feet in elevation and the tributary valleys—which are at higher elevations like Meadow Creek, Fiddle Creek, Hennessy Creek, and Sugar Creek—all show a strong and pronounced asymmetry with steeper south-facing slopes (Midas Gold 2017e). South-facing slopes are more open to sunlight and warm winds and are thus generally warmer and dryer because of the higher levels of evapotranspiration compared to steep north-facing slopes.

A long-term climatological record is not available for the SGP. Therefore, Parameter-elevation Regressions on Independent Slope Model (PRISM) data compared with the NWS and SNOTEL Secesh Summit site is used to develop average precipitation and temperature estimates (**Table 3.8-1**). The Secesh Summit site is located 35 miles northwest of the SGP, at a comparable elevation (Brown and Caldwell 2017a).

Table 3.8-1 Estimated Average Monthly Precipitation and Temperature for the Analysis Area

Month	Average Precipitation (inches)	Average Temperature (°F)	Minimum Temperature (°F)	Maximum Temperature (°F)
January	4.11	20.10	10.67	29.52
February	3.32	21.75	9.84	33.66
March	3.53	27.68	15.33	40.03
April	2.98	32.89	20.50	45.27
May	2.58	40.69	27.73	53.65
June	2.14	48.73	33.85	63.61
July	0.95	58.05	41.31	74.79
August	0.91	56.47	39.18	73.76
September	1.81	48.70	32.76	64.63
October	2.10	39.18	25.97	52.39
November	3.71	26.34	17.02	35.63
December	3.99	18.82	9.28	28.36
Annual	32.19	36.61	23.61	49.60

Source: 800-meter PRISM data, Brown and Caldwell 2017a

The spatial and elevation distribution of average precipitation and temperature are described in more detail in the SGP Water Resources Summary Report (Brown and Caldwell 2017a, Section 4).

The local geology of the analysis area contains four primary lithologic units (Smitherman 1985, USGS 2007, Brown and Caldwell 2017a):

- Neoproterozoic to Ordovician carbonate and siliciclastic metasedimentary rocks,
- Cretaceous Idaho Batholith dioritic to granitic compositions,
- Tertiary dikes, porphyries and volcanics of the Challis Volcanic Field, and
- Quaternary sedimentary alluvium.

Unconsolidated sedimentary deposits appear near the ground surface in the form of alluvial fans, terrace gravels, glacial tills, fluvium, colluvium, and landslide materials. Glacial moraines are evident in the larger valley areas. These unconsolidated alluvial materials are generally confined to the center of valley bottoms, surrounded by bedrock mountain slopes. Precipitation in the area infiltrates and moves through these unconsolidated deposits.

The bedrock in the Project area has been compressed into northwest-southeast trending folds and offset with faults of similar trends. The bedrock has also been fractured with lesser amounts of fracturing at depth compared to shallower rock. Groundwater in the area moves through the fractured bedrock under the influence of local gradients and the hydraulic properties of the faults and fractures.

Fault zones were examined for evidence of influence on groundwater flow (HydroGeo 2012a, SPF 2017, Brown and Caldwell 2021d). Evidence of fault influence on groundwater flow was not detected for most faults, except for the MCFZ where artesian conditions on the east side of the fault in the West End pit area indicated that the fault acts as an inhibitor to flow in bedrock. Based on this observation, the MCFZ was represented in the groundwater flow model.

3.8.4.2 Surface Waters

Streams

The SGP is in the Headwaters East Fork SFSR and Sugar Creek sub-watersheds. The primary surface water features at the SGP include the East Fork SFSR and its tributaries (**Figure 3.8-2**), as well as intermittent drainages, ephemeral drainages, seeps, springs, wetlands, and ponds.

These features include 10 named surface water channels: the East Fork SFSR, Rabbit Creek, Meadow Creek, EFMC (also known as Blowout Creek), Garnet Creek, Fiddle Creek, Midnight Creek, Hennessy Creek, West End Creek, and Sugar Creek. Most of these streams occur in the Headwaters East Fork SFSR sub-watershed except for Sugar Creek and West End Creek, which are in the Sugar Creek sub-watershed. Brief descriptions of each stream are provided below, and specific drainage and channel characteristics are summarized in **Table 3.8-2**.

Table 3.8-2 Summary of Stream Characteristics in the SGP Area

Drainage	Approximate Drainage Area (square miles)	Channel Length (miles)	Elevation Change (feet)	Average Gradient (%)
East Fork SFSR (upstream of Sugar Creek)	25.0	7.04	2,129	5.7
Meadow Creek	7.7	4.78	1,570	6.2
EFMC	2.4	2.66	1,491	10.6
Rabbit Creek	0.6	1.19	1,506	24.0
Garnet Creek	0.5	1.24	1,558	23.8
Fiddle Creek	2.0	2.47	1,444	11.1
Midnight Creek	0.9	1.83	2,205	22.8
Hennessy Creek	0.7	1.16	1,499	24.5
West End Creek	0.6	1.55	2,234	27.3
Sugar Creek	17.4	7.14	2,356	6.2

Source: Brown and Caldwell 2017a; HydroGeo, Inc. 2012b

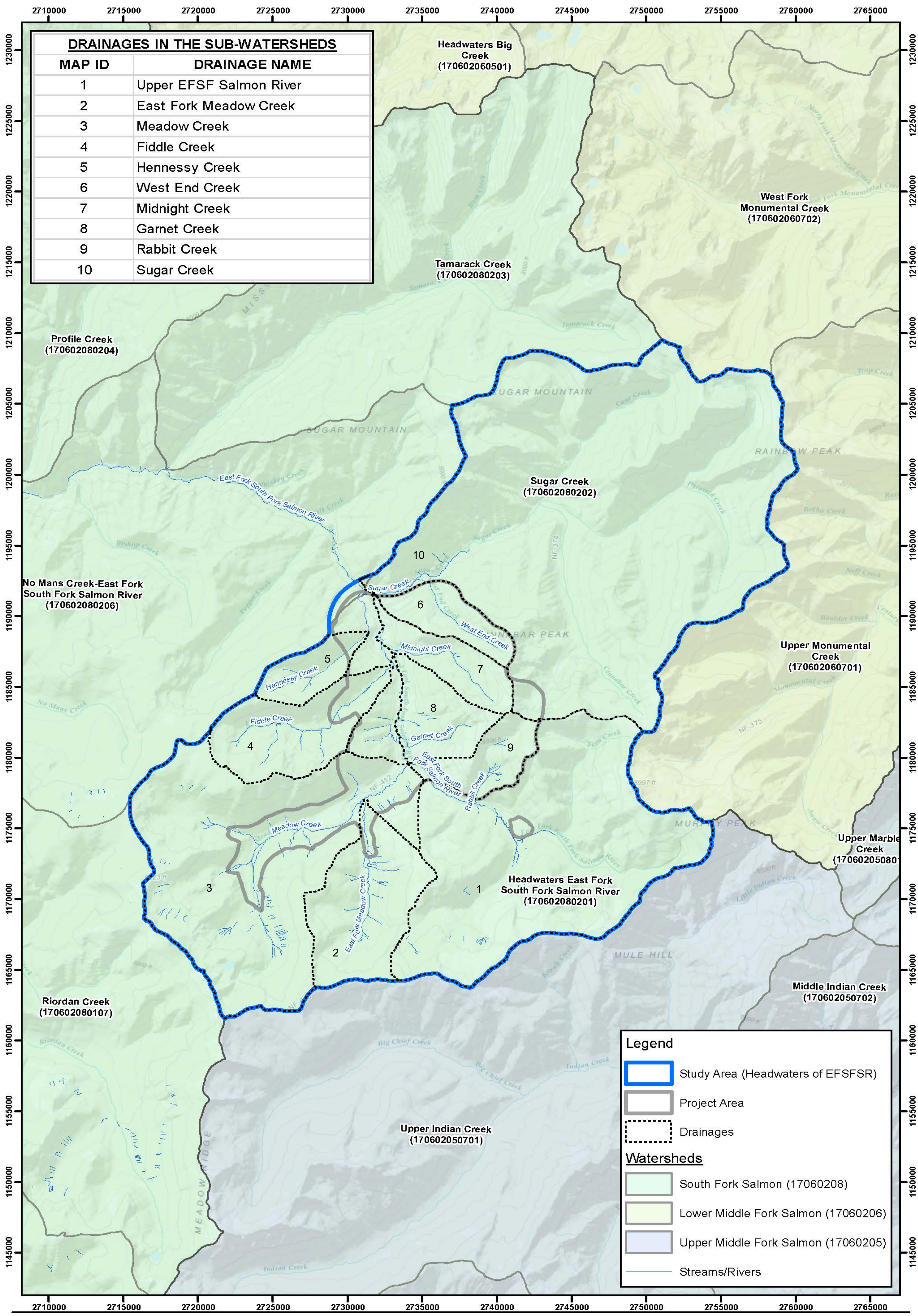
The East Fork SFSR is a perennial stream that flows from southeast to northwest through the SGP and has a drainage basin of 25 square miles upstream of Sugar Creek. It is the principal stream draining the SGP and receives flow either directly or indirectly from all other drainages listed in **Table 3.8-2**. At ordinary high water, the East Fork SFSR is approximately 2 to 3 feet deep and 25 to 30 feet wide (Brown and Caldwell 2017a).

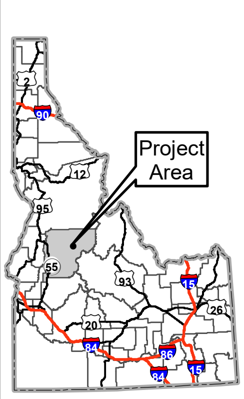
Historical mining activities have affected the course of the East Fork SFSR in the central portion of the SGP where it flows through a lake that has formed in the Yellow Pine pit. The river enters the pit on the south side and exits from the north. The flow velocity of the East Fork SFSR slows as it passes through the abandoned pit, causing the river to drop much of its sediment load which is then deposited across the lake bottom. The original Yellow Pine pit was excavated to a depth of 125 feet below the current pit lake level, but sediment deposited through time has reduced the lake depth to only 35 feet. The lake has a surface area of approximately 4.75 acres and is estimated to contain approximately 92 acre-feet of water (Brown and Caldwell 2017a). An artificial drop into the pit creates a steep whitewater cascade on the East Fork SFSR where it enters the pit and blocks upstream fish passage above the pit lake.

Meadow Creek originates southwest of the SGP, flows east into the East Fork SFSR, and drains an area of approximately 7.7 square miles. The Meadow Creek headwaters occur in an alpine lake, and the drainage contains multiple wetland complexes. At ordinary high-water, Meadow Creek is approximately 2 to 4 feet deep and 20 to 25 feet wide at the bottom of the drainage (Brown and Caldwell 2017a).

EFMC is a tributary to Meadow Creek that drains an area of 2.4 square miles in the southern end of the SGP (**Figure 3.8-2**). The creek previously supplied water to a man-made reservoir that provided hydroelectric power and process water to the historical mill and smelter. EFMC is locally referred to as Blowout Creek because the dam forming the reservoir breached in 1965, causing large-scale scouring of the steep channel downstream, and deposition of an alluvial fan. From its headwaters, EFMC meanders through a former wetland area that dried up due to stream incision and declining groundwater levels related to the dam failure.

MAP ID	DRAINAGE NAME
1	Upper EFSF Salmon River
2	East Fork Meadow Creek
3	Meadow Creek
4	Fiddle Creek
5	Hennessy Creek
6	West End Creek
7	Midnight Creek
8	Garnet Creek
9	Rabbit Creek
10	Sugar Creek





Basemap: 2013 National Geographic Society, i-cubed

0 6,000 12,000
Feet

N

Figure 3.8-2
Streams Location Map

Stibnite Gold Project
Stibnite, ID
Data Sources: (Brown & Caldwell 2017)

Rabbit Creek and Garnet Creek are small tributaries of the East Fork SFSR that drain 0.6 and 0.5 square miles, respectively. Rabbit Creek is in a steep drainage that has steep side slopes, with numerous seeps and springs occurring throughout its headwaters. Garnet Creek is formed from seeps and springs located in the eastern portion of the SGP. The current shop, camp facilities, and the historical Garnet pit are in the Garnet Creek drainage. Historical waterworks from the 1940s and 1950s as well as a 1990s diversion are present below the former open pit.

Fiddle Creek occurs in a well-defined glacial cirque, drains an area of two square miles, and flows into the East Fork SFSR from the west. The drainage area for Fiddle Creek includes forested and open scree slopes. The middle reach of Fiddle Creek also contains a former reservoir and dam, and a former townsite occurs in the lower reach above and below the County Road. In addition, the creek itself was diverted from its natural outfall site to the north under the County Road through a culvert in the 1980s.

Midnight Creek is a small tributary that drains an area of 0.9 square mile and flows into the East Fork SFSR from the east, just above the Yellow Pine pit lake. Several miles of current and historical exploration and haul roads exist in the Midnight Creek drainage.

Hennessy Creek is a small tributary that drains an area of 0.7 square mile and flows into the East Fork SFSR from the west. The upper end of the drainage is heavily forested, and the lower portion of the drainage has been modified by current access roads and historical mine workings. Hennessy Creek also has a historical water diversion just above the county road that included a large pipe system. The creek flows in the direction of, and then adjacent to, Stibnite Road (CR 50-412) in a channel around the Bradley Northwest mine dump complex, through a diversion installed in 2022 under the ASAOC to avoid historical mine development rock piles, and through two culverts before entering the East Fork SFSR.

West End Creek flows into Sugar Creek from the south and has a drainage area of 0.6 square mile. The drainage basin of West End Creek was modified extensively and diverted into a now failed French drain system during construction of the large waste rock dump in the middle reach. The current creek flow disappears and reemerges among historical waste rock piles. Several miles of current and historical exploration roads are present in the West End Creek drainage.

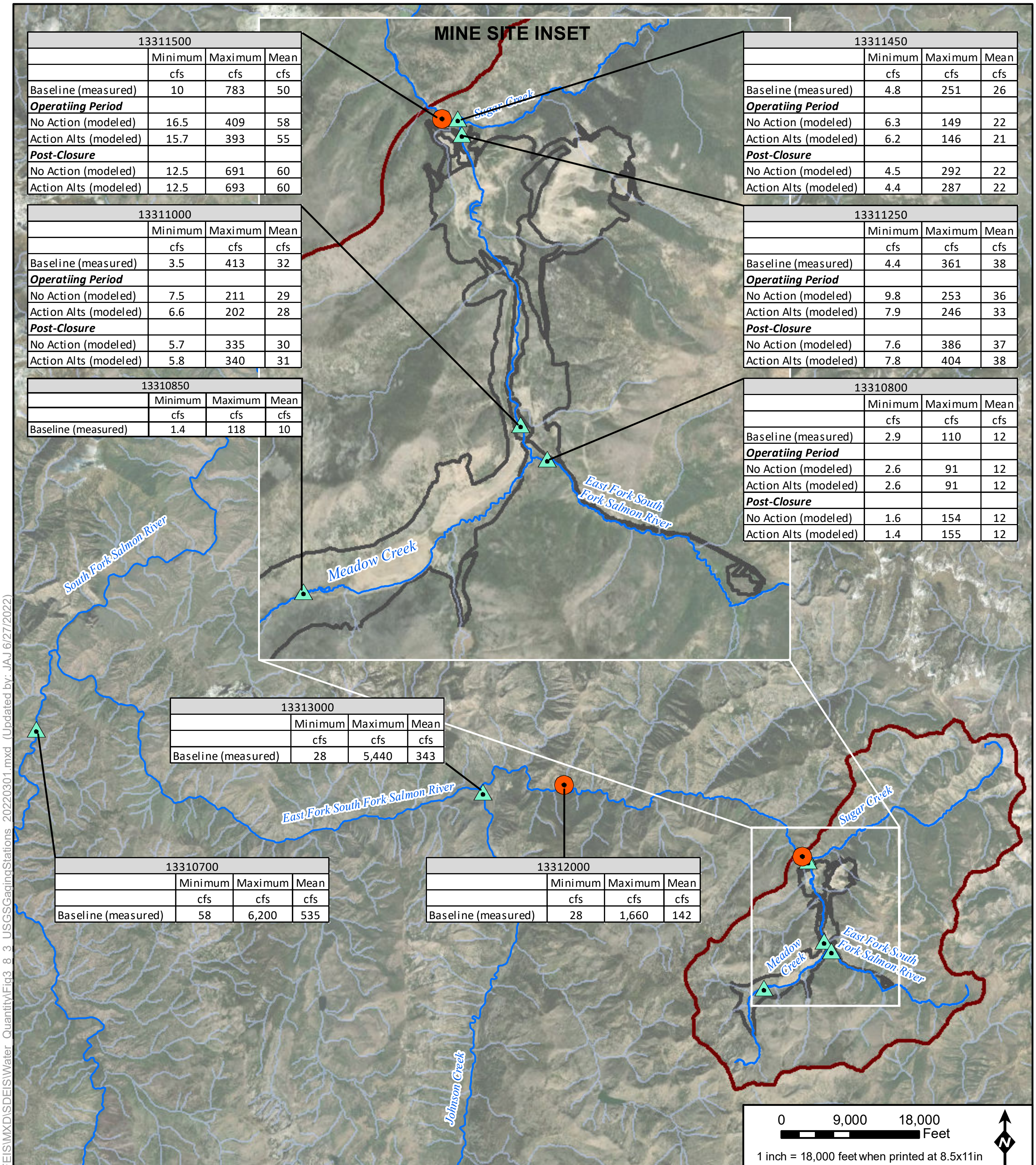
Finally, Sugar Creek is a relatively large tributary that drains an area of approximately 17.4 square miles and flows into the East Fork SFSR downstream of the Yellow Pine pit. A portion of the upper Sugar Creek valley has been impacted by past mercury mining activities at the former Cinnabar Mine, located in the upper Cinnabar Creek drainage which is a tributary to Sugar Creek. These activities included underground mine development and operations, development rock disposal, ore processing, deposition of tailings in the valley, construction and use of buildings and housing (several of which still exist), and road construction.

Nine USGS streamflow gages (**Figure 3.8-3**) in and near the analysis area provide data to characterize the existing environment. **Table 3.8-3** provides streamflow statistics for the nine USGS gaging stations, and **Figure 3.8-4** presents average monthly discharge hydrographs for six active USGS gaging stations present in the analysis area. The hydrographs illustrate the snowmelt-dominated streamflow pattern observed in the area with flows beginning to rise in March and April and peaking in May or June, before receding to base flow conditions in late summer/fall and remaining low through the winter.

Table 3.8-3 USGS Gaging Station Drainage Area and Flow Statistics

Gage Number	Gage Name	Drainage Area (square miles)	Min (cfs)	Max (cfs)	Mean (cfs)	Period of Record (# years monitored)
13310850	Meadow Creek near Stibnite, Idaho	5.6	1.37	129	11.0	09/2011–02/2022 (10 years)
13310800	East Fork SFSR above Meadow Creek near Stibnite, Idaho	9.0	2.20	159	11.8	09/2011–02/2022 (10 years)
13311000	East Fork SFSR at Stibnite, Idaho	19.3	3.50	413	31.5	1928–1943 1982–1997 2010–2022 (41 years)
13311450	Sugar Creek near Stibnite, Idaho	18.0	4.00	252	22.9	09/2011–02/2022 (10 years)
13311250	East Fork SFSR above Sugar Creek near Stibnite, Idaho	25.0	4.39	366	36.9	09/2011–02/2022 (10 years)
13311500	East Fork SFSR near Stibnite, Idaho1	43.0	10	783	50.4	06/1928–09/1941 (13 years)
13312000	East Fork SFSR near Yellow Pine, Idaho1	107.0	28	1,660	142.4	08/1928–07/1943 (13 years)
13313000	Johnson Creek at Yellow Pine, Idaho	218.0	28	5,440	342.5	09/1928–02/2022 (93 years)
13310700	SFSR near Krassel Ranger Station, Idaho	330.0	35	6,200	536.6	10/1966–02/2022 (55 years)

Source: Brown and Caldwell 2017a – Table 7-9; Flow data from 2017-2022 updated from waterdata.usgs.gov.
[1]Inactive; cfs = cubic feet per second



13311500	Minimum	Maximum	Mean
	cfs	cfs	cfs
Baseline (measured)	10	783	50
Operatiing Period			
No Action (modeled)	16.5	409	58
Action Alts (modeled)	15.7	393	55
Post-Closure			
No Action (modeled)	12.5	691	60
Action Alts (modeled)	12.5	693	60

13311450	Minimum	Maximum	Mean
	cfs	cfs	cfs
Baseline (measured)	4.8	251	26
Operatiing Period			
No Action (modeled)	6.3	149	22
Action Alts (modeled)	6.2	146	21
Post-Closure			
No Action (modeled)	4.5	292	22
Action Alts (modeled)	4.4	287	22

13311000	Minimum	Maximum	Mean
	cfs	cfs	cfs
Baseline (measured)	3.5	413	32
Operatiing Period			
No Action (modeled)	7.5	211	29
Action Alts (modeled)	6.6	202	28
Post-Closure			
No Action (modeled)	5.7	335	30
Action Alts (modeled)	5.8	340	31

13311250	Minimum	Maximum	Mean
	cfs	cfs	cfs
Baseline (measured)	4.4	361	38
Operatiing Period			
No Action (modeled)	9.8	253	36
Action Alts (modeled)	7.9	246	33
Post-Closure			
No Action (modeled)	7.6	386	37
Action Alts (modeled)	7.8	404	38

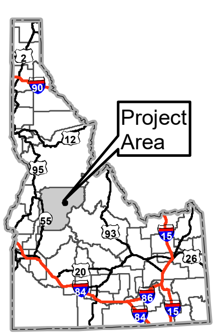
13310850	Minimum	Maximum	Mean
	cfs	cfs	cfs
Baseline (measured)	1.4	118	10

13310800	Minimum	Maximum	Mean
	cfs	cfs	cfs
Baseline (measured)	2.9	110	12
Operatiing Period			
No Action (modeled)	2.6	91	12
Action Alts (modeled)	2.6	91	12
Post-Closure			
No Action (modeled)	1.6	154	12
Action Alts (modeled)	1.4	155	12

13313000	Minimum	Maximum	Mean
	cfs	cfs	cfs
Baseline (measured)	28	5,440	343

13310700	Minimum	Maximum	Mean
	cfs	cfs	cfs
Baseline (measured)	58	6,200	535

13312000	Minimum	Maximum	Mean
	cfs	cfs	cfs
Baseline (measured)	28	1,660	142



LEGEND

- Mine Site Water Modeling Boundary
- SGP Features *
- USGS Active Gaging Stations
- USGS Inactive Gaging Station
- Stream/River

Operating Period refers to Mine Years 1 through 16

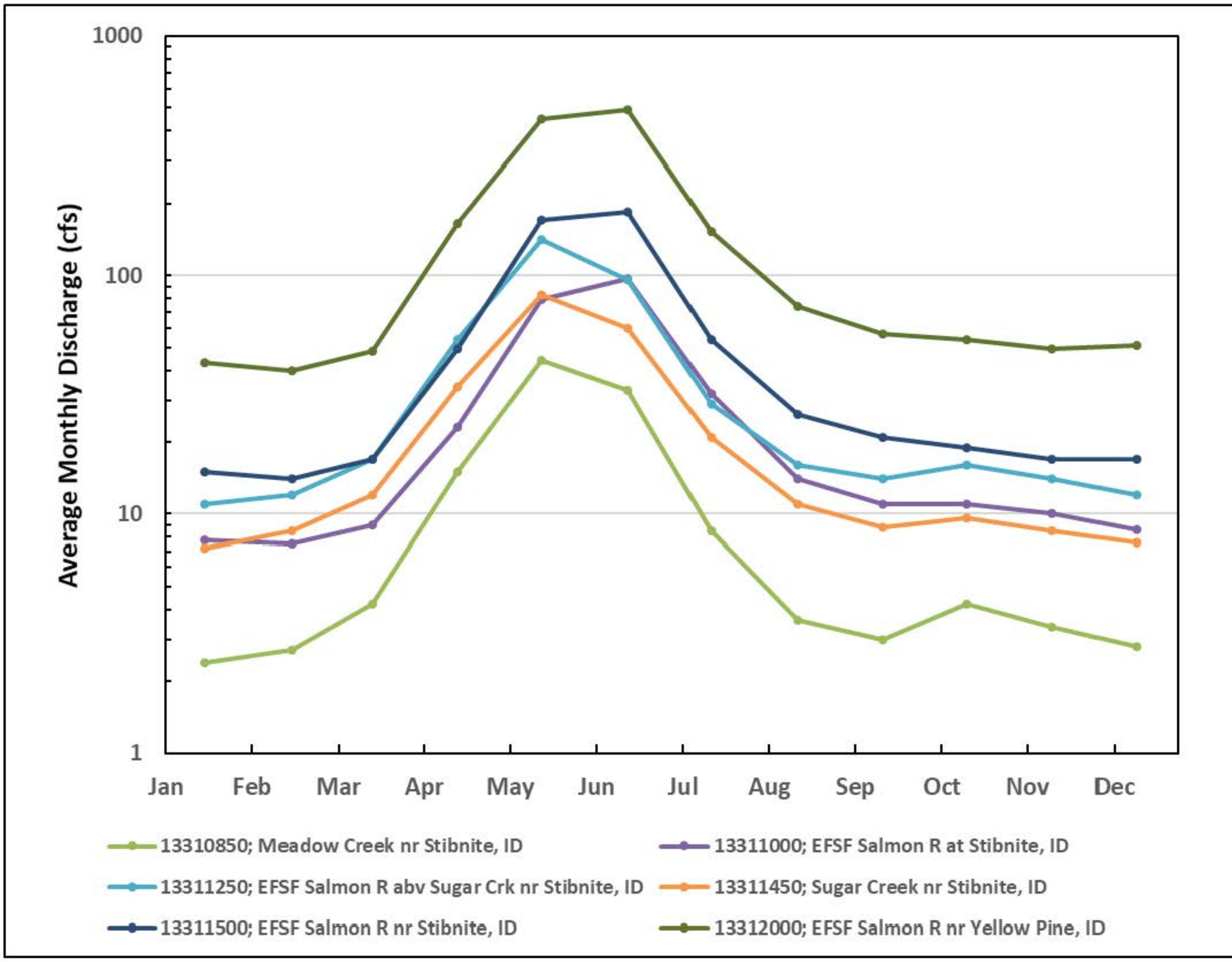
Post-Closure refers to years after Mine Year 16

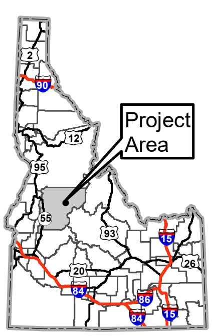
*Mine Site Components are associated with 2021 MMP

Figure 3.8-3 USGS Gaging Stations Stibnite Gold Project Stibnite, ID

Base Layer: ESRI USA Topographic Basemap
Other Data Sources: United States Geological Survey; Perpetua; Boise National Forest; Payette National Forest

Document Path: U:\2037219\81\03 data\gis cad\gis\FEIS\MXD\SDEIS\Water Quantity\Fig3 8 3 USGSGagingStations 20220301.mxd (Updated by: JAJ 6/27/2022)





Average stream flows from 2011-2016

Figure 3.8-4
Stream Monthly Discharge

Stibnite Gold Project
Stibnite, ID

Data Sources: (Brown & Caldwell 2017)

Baseflow and groundwater recharge estimates were derived using data from two of the USGS gaging stations in the analysis area (Brown and Caldwell 2017a). Those two stations, USGS 13311250 (located at the East Fork SFSR above Sugar Creek) and USGS 13311450 (located at Sugar Creek before its discharge to the East Fork SFSR) (**Figure 3.8-3**), together provide measurements that can be used to estimate groundwater recharge over the entire analysis area by calculating combined baseflow leaving the analysis area. These estimates assume that groundwater flow across the analysis area boundaries are negligible. The estimates also assume that during the periods of low flow (late summer, fall, and winter), the entire flow of each stream is derived from groundwater discharge into the stream. Stream discharges measured at the USGS gages during August, September, and October are interpreted to represent baseflow conditions (Brown and Caldwell 2017a). This interpretation is based on 1) analysis of hydrographs, 2) lack of significant precipitation during these months, and 3) minor flow variations during this period of year.

Considering approximate drainage areas for each of those two stations (18 square miles for Sugar Creek and 25 square miles for the East Fork SFSR [Brown and Caldwell 2017a]), groundwater recharge over the Sugar Creek and East Fork SFSR drainage areas was calculated to 8.1 inches per year over the alluvial valley bottom areas and 6.2 inches per year in the bedrock dominated mountainous areas. These values represent about 20 percent of the estimated annual precipitation for the SGP analysis area, which is equal to 32.19 inches (Perpetua 2021g).

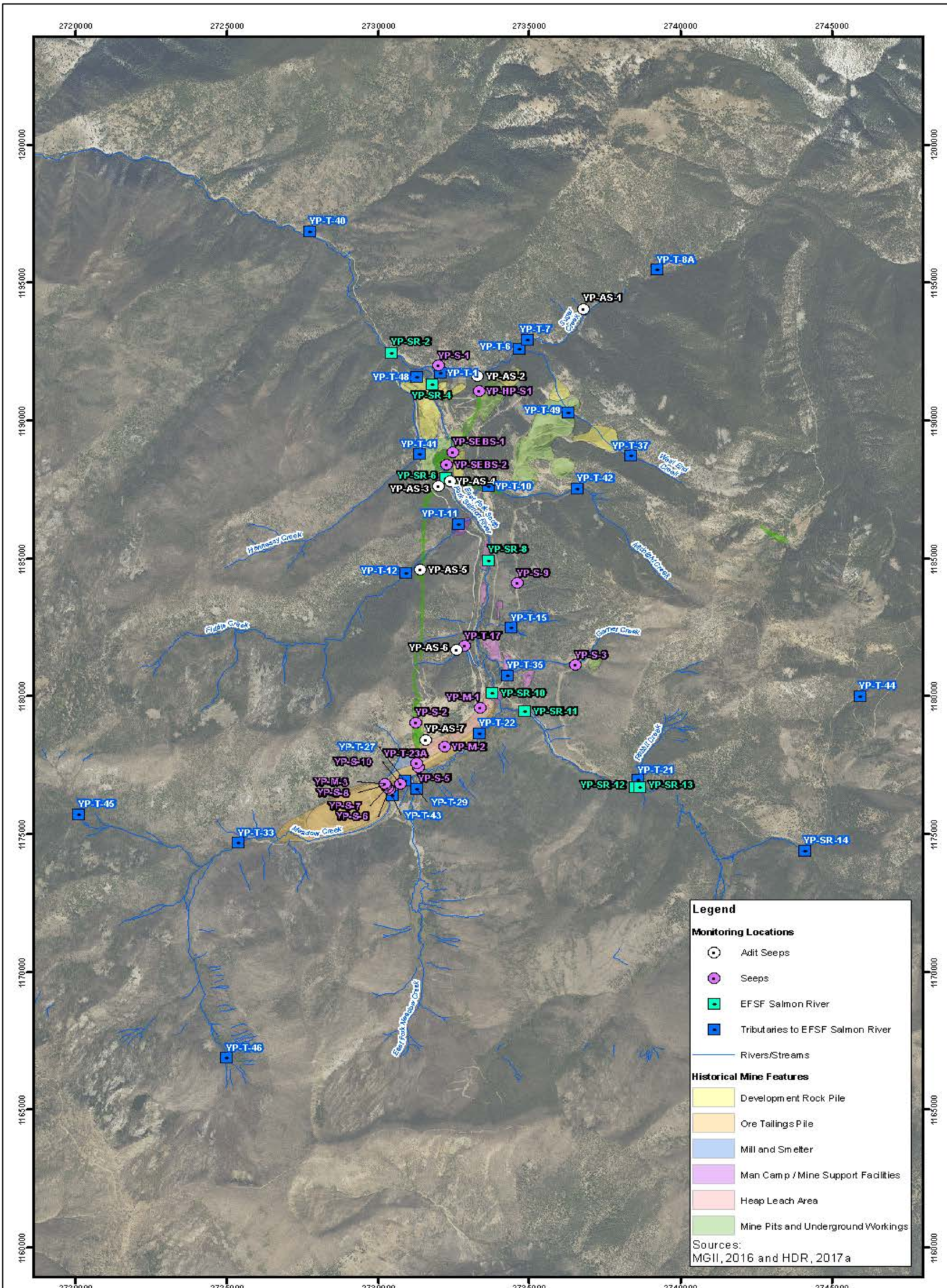
USGS data also were used to derive peak flow statistics for the seven major drainages in the analysis area. Results from the peak flow analysis were summarized in the baseline study (HydroGeo 2012b) and **Table 3.8-4**. Peak flows were calculated for the bottom of each drainage using the USGS StreamStats program.

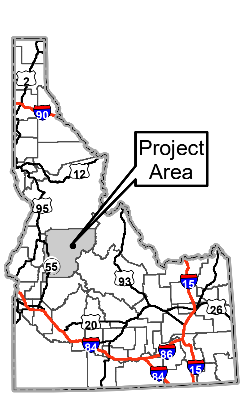
In addition to the USGS data, streamflow data were collected in conjunction with surface water quality baseline sampling on a monthly or quarterly basis at 32 non-USGS monitoring stations (**Figure 3.8-5**). The monitoring points were selected at upstream and downstream locations to bracket historical and potential future mining activities in the analysis area (Brown and Caldwell 2017a). **Table 3.8-5** provides streamflow statistics derived from baseline measurements collected between 2012 and early 2016. The mean flows calculated from this dataset for the East Fork SFSR ranged from 4.47 cfs at the farthest upstream monitoring location YP-SR-14, to 31.31 cfs at the most downstream location YP-SR-2. Note that the baseline monitoring sites are at different locations than the USGS gaging stations, thus providing additional site-specific data proximal to historical and proposed facilities.

Table 3.8-4 Peak Stream Flow Statistics for Drainages in the Analysis Area

Drainage	1.5-year event PK1_5 (cfs)	2-year event PK2 (cfs)	2.33-year event PK2_33 (cfs)	5-year event PK5 (cfs)	10-year event PK10 (cfs)	25-year event PK25 (cfs)	50-year event PK50 (cfs)	100-year event PK100 (cfs)
Meadow Creek (13310850)	83 (76-91)	98 (90-107)	105 (97-114)	132 (122-144)	152 (140-168)	175 (159-200)	191 (170-223)	205 (179-247)
East Fork SFSR above Meadow Creek (13310800)	83 (75-90)	97 (89-105)	104 (96-112)	130 (120-141)	149 (138-165)	171 (156-195)	186 (167-218)	200 (176-241)
East Fork SFSR below Meadow Creek (13311000)	174 (154-195)	215 (193-240)	235 (211-261)	316 (285-353)	379 (341-432)	454 (401-539)	507 (438-623)	557 (469-710)
East Fork SFSR above Sugar Creek (13311250)	229 (205-254)	279 (252-307)	301 (273-331)	395 (359-437)	466 (423-525)	550 (491-643)	608 (532-733)	662 (566-826)
East Fork SFSR below Sugar Creek (13311500)	372 (327-418)	465 (415-520)	508 (454-567)	693 (622-777)	837 (749-959)	1010 (888-1207)	1133 (973-1403)	1249 (1044-1606)
Sugar Creek (13311450)	143 (124-162)	181 (160-204)	199 (177-224)	278 (247-314)	340 (301-393)	415 (361-502)	469 (398-589)	520 (429-680)
Johnson Creek (13313000)	2497 (2268-2727)	2962 (2713-3230)	3175 (2911-3563)	4079 (3737-4491)	4789 (4356-5375)	5652 (5058-6592)	6273 (5521-7574)	6877 (5936-8617)

Source: Rio ASE 2021, Appendix C.
cfs = cubic feet per second; peak flow volume statistic reported followed by its 95 percent confidence interval in parentheses





Basemap: Aerial Photo, 2015

0 3,000 6,000

Feet

N

Figure 3.8-5
Surface Water Monitoring Locations

Stibnite Gold Project
Stibnite, ID

Data Sources: (Brown & Caldwell 2017)

Table 3.8-5 Baseline Monitoring Surface Water Flow Statistics

Monitoring Site	Stream	Min (cfs)	Max (cfs)	Mean (cfs)
YP-SR-2	East Fork SFSR	8.97	74.56	31.31
YP-SR-4	East Fork SFSR	7.67	37.84	16.92
YP-SR-6	East Fork SFSR	8.00	50.76	20.38
YP-SR-8	East Fork SFSR	5.88	61.08	19.33
YP-SR-10	East Fork SFSR	6.23	106.21	23.97
YP-SR-11	East Fork SFSR	3.32	40.67	10.41
YP-SR-13	East Fork SFSR	2.05	54.92	11.56
YP-SR-14	East Fork SFSR	0.48	22.25	4.47
YP-T-1	Sugar Creek	5.71	78.06	21.24
YP-T-6	West End Creek	0.16	1.68	0.51
YP-T-7	Sugar Creek	5.25	34.12	12.51
YP-T-8A	Sugar Creek	4.61	77.36	19.27
YP-T-10	Midnight Creek	0.15	2.62	0.67
YP-T-11	Fiddle Creek	0.22	20.57	3.30
YP-T-12	Fiddle Creek	0.15	17.87	3.59
YP-T-15	Scout Creek	0.04	0.62	0.15
YP-T-21	Rabbit Creek	0.22	3.47	0.95
YP-T-22	Meadow Creek	3.91	86.61	17.94
YP-T-27	Meadow Creek	2.78	76.45	14.86
YP-T-29	EFMC	0.78	24.45	4.69
YP-T-33	Meadow Creek	1.96	41.13	9.22
YP-T-35	Garnet Creek	0.01	1.16	0.19
YP-T-37	West End Creek	0.003	0.12	0.03
YP-T-40	Salt Creek	0.80	13.38	2.80
YP-T-41	Hennessy Creek	0.15	7.37	1.25
YP-T-42	Midnight Creek	0.12	3.59	0.99
YP-T-43	Meadow Creek	1.97	49.00	13.48
YP-T-44	Fern Creek	0.06	2.65	0.54
YP-T-45	North Fork Meadow Creek	0.24	19.01	3.92
YP-T-46	South Fork Meadow Creek	0.28	9.67	3.04
YP-T-48	Hennessy Creek	0.09	5.09	1.00
YP-T-49	West End Creek	0.37	1.37	0.71

Source: Brown and Caldwell 2017a
cfs = cubic feet per second

Seeps and Springs

Seeps and springs are locations where water emanates from the ground to form surface water resources aside from the perennial streams that serve to drain the analysis area. Depending on their site-specific conditions, flow from seeps and springs may be perennial or ephemeral and may or may not be enhanced by surface water runoff. Further, depending on site-specific characteristics, seeps and springs may provide an accessible water source for wildlife and vegetation, functioning as the water source for a GDE.

The HydroGeo hydrology field survey completed in 2012 identified 347 hydrologic seep/spring sites within the analysis area (HydroGeo 2012a). The survey identified 37 seeps, 153 seeps with wetlands, 33 springs, 117 springs with wetlands, 1 pond, 2 ponds with wetlands, 3 seep/pond/wetland complexes, and 1 reemerging creek (HydroGeo 2012a). The majority of seeps and springs were found in the glacial cirques that form the headwaters of Meadow Creek, Fiddle Creek, and Hennessy Creek (**Figure 3.8-6**). Monitoring of seep discharge was established at 23 sites (**Figure 3.8-5**) during the baseline studies to assess seep and spring contributions and for conceptualization of surficial flow in the analysis area. Mean discharge measured at the sites ranged from 0.0023 cfs at YP-AS-7 in the Meadow Creek drainage to 0.21 cfs at YP-S-10 in the Meadow Creek drainage. **Table 3.8-6** provides statistics for the seep discharge.

HydroGeo (2012a, 2012b) provides the following summary of results of the 2018 spring and seep survey:

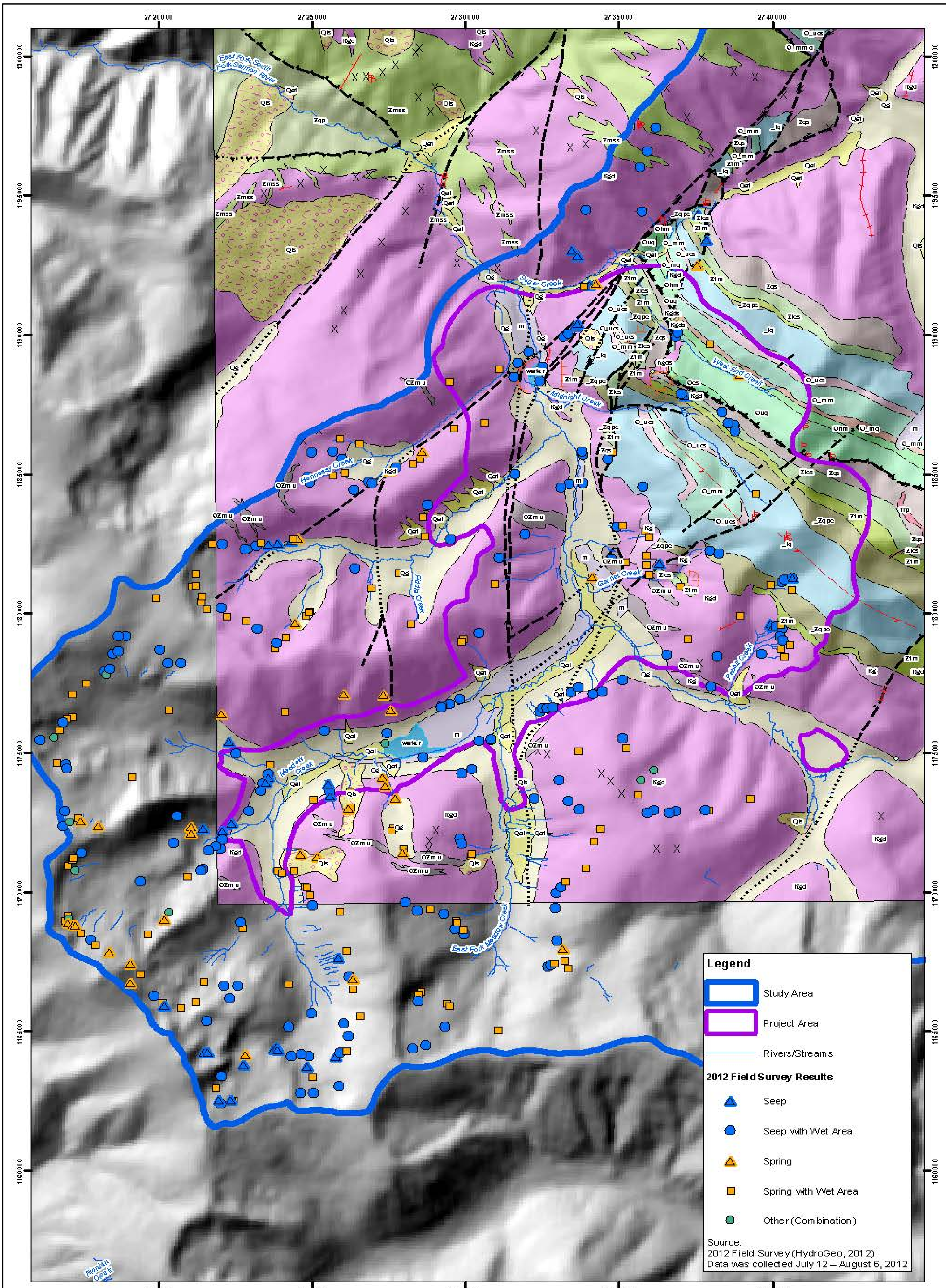
- Many of the springs or seeps at higher elevations were located near bedrock outcrops. Due to colluvial cover of the slopes, it was difficult or impossible to recognize whether the water was emanating from a bedrock source, or daylighting as unsaturated flow within the colluvium (e.g., interflow and/or throughflow).

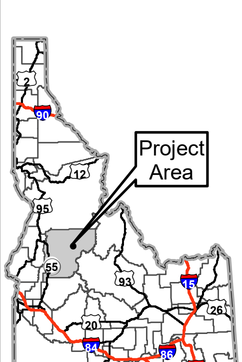
- Springs and seeps were found in the lower Meadow Creek drainage around the spent heap leach ore disposal area.

- Most of the springs were found in alluvial or colluvial slump areas. Emerging water was often found flowing only a short distance above ground before going underground again, especially at higher elevations where snowmelt recharges the colluvial cover.

- Some of the spring and seep sites were located along road cuts. These types of springs and seeps are not naturally occurring and bear no discernible relationship to any local geologic features.

- The results of the survey indicate no clear-cut relationship between the springs and seeps and mapped geologic structures and stratigraphy.





Basemap: Digital Elevation Model (DEM)
Geologic data: Stewart, et. al. 2016

0 3,000 6,000
Feet

Figure 3.8-6
Spring and Seep Locations

Stibnite Gold Project
Stibnite, ID

Data Sources: (Brown & Caldwell 2017)

Table 3.8-6 Baseline Monitoring Seep and Spring Discharge Statistics

Monitoring Site	Drainage	Min (cfs)	Max (cfs)	Mean (cfs)
YP-AS-1	Sugar Creek	0.0003	0.09	0.01
YP-AS-2	Sugar Creek	0.03	0.22	0.08
YP-AS-3	East Fork SFSR	0.0005	0.03	0.005
YP-AS-4	East Fork SFSR	0.015	0.30	0.10
YP-AS-5	Fiddle Creek	NM	NM	NM
YP-AS-6	East Fork SFSR	0.0004	0.01	0.0043
YP-AS-7	Meadow Creek	0.000012	0.0052	0.0023
YP-HP-S1	Sugar Creek	0.0052	0.29	0.085
YP-M-3	Meadow Creek	0.006	0.75	0.135
YP-M-4	Fiddle Creek	NM	NM	NM
YP-S-1	Sugar Creek	0.00003	0.03	0.004
YP-S-2	Meadow Creek	0.000003	0.02	0.004
YP-S-3	East Fork SFSR	0.005	0.23	0.05
YP-S-5	Meadow Creek	0.002	0.04	0.02
YP-S-6	Meadow Creek	0.0003	0.006	0.0036
YP-S-7	Meadow Creek	0.007	0.01	0.01
YP-S-8	Meadow Creek	0.0003	0.05	0.008
YP-S-9	East Fork SFSR	0.0007	0.004	0.002
YP-S-10	Meadow Creek	0.03	0.86	0.21
YP-SEBS-1	East Fork SFSR	0.006	0.07	0.036
YP-SEBS-2	East Fork SFSR	0.024	0.54	0.25
YP-T-17	East Fork SFSR	0.0004	0.12	0.02
YP-T-23A	Meadow Creek	0.0003	0.05	0.02

Source: Brown and Caldwell 2017a
cfs = cubic feet per second, NM = Not Measured

Waters of the United States

WOTUS are defined by 33 CFR 328.3 as: all waters that are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters that are subject to the ebb and flow of the tide; all interstate waters including interstate wetlands; all other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce including any such waters that are or could be used by interstate or foreign travelers for recreational or other purposes, or from which fish or shellfish are or could be taken and sold in interstate or foreign commerce, or that are used or could be used for industrial purpose by industries in interstate commerce; all impoundments of waters otherwise defined as Waters of the U.S. under the definition; tributaries of waters identified in paragraphs (a)(1)-(4) of this section; the territorial seas; and wetlands adjacent to waters (other than waters that are themselves wetlands) identified in paragraphs (1)-(6) of this section. Various related definitions, Supreme Court findings, and regulatory guidance currently affect how the definition is applied. In part, the CWA, through Part 404, requires permits before fill can be placed in jurisdictional WOTUS. WOTUS are regulated by the USACE. This section discusses non-wetland WOTUS; wetland WOTUS are described in **Section 3.11**.

Surface Water Rights

Within the analysis area, there are no federal, state, or other private surface water rights aside from two water rights held by Perpetua (**Table 3.8-7**). However, the Idaho Water Resource Board and the Forest Service hold minimum flow water rights downstream of the SGP on the East Fork SFSR, SFSR, and the main stem of the Salmon River.

Table 3.8-7 Surface Water Rights Summary

Water Right ID	Type	Source	Diversion Point	Priority Date	Beneficial Use	Diversion Rate (cfs)	Max Total Usage (acre-feet)
77-7293	Surface Water	Unnamed Stream (Hennessy Creek)	SW 1/4 of the NE 1/4, Section 3, T18N, R9E	4/19/1989	Mining	0.25	20.0
77-7122	Surface Water	East Fork SFSR	NW 1/4 of the NW 1/4, Section 14, T18N, R9E	4/16/1981	Storage and Mining	0.33	7.1

Source: Midas Gold 2016a (Table 8-1)
cfs = cubic feet per second.

These water rights at the SGP are specific to historical use related to activities in the 1980s and 1990s. While these are valid water rights, the specific points of diversion, place of use, and beneficial use does not reflect planned SGP activities and would need to be adjusted through the transfer process, and through filing additional applications for permit. It is not necessary to record a water right for the random diversion of water for fire suppression purposes or for the purpose of capture and use of diffuse water runoff. However, water used for dust control and exploration activities requires a water right.

A review of IDWR water right records indicates that there are no downstream consumptive-use water rights on the East Fork SFSR until after the river merges with Johnson Creek (HDR 2017e). The Idaho Water Resource Board maintains minimum streamflow rights on various rivers and creeks in the state, including a location near the end of the East Fork SFSR below the confluence with Johnson Creek, which is covered under water right 77-14190. A minimum streamflow is the amount of flow necessary to preserve stream values, including protecting fish and wildlife habitat, aquatic life, navigation, transportation, recreation, water quality, or aesthetic beauty. The minimum flow varies throughout the calendar year (**Table 3.8-8**), with a base flow minimum of 173 cfs between October 1 and October 31 as measured on the East Fork SFSR at the confluence of the East Fork SFSR with the SFSR. Water Right 77-14190 is subordinate to future domestic, commercial, municipal, and industrial uses and future non-domestic, commercial, municipal, and industrial development up to 8.2 cfs.

Table 3.8-8 State of Idaho, IWRB Water Right No. 77-14190 Minimum Stream Flow East Fork SFSR at the SFSR

Usage Period	Diversion Rate (cfs)
8/1 to 8/31	223
9/1 to 9/30	179
10/1 to 10/31	173
11/1 to 11/30	214
12/1 to 12/31	222
1/1 to 1/31	254
2/1 to 2/28	232
3/1 to 3/31	291
4/1 to 4/30	625
5/1 to 5/31	1,829
6/1 to 6/30	2,269
7/1 to 7/31	590
Total Diversion	2,269

Source: HDR 2017e
cfs = cubic feet per second.

Idaho Water Resource Board also holds a minimum streamflow water right downstream (approximately 26.4 miles from the SGP and approximately nine miles from the East Fork SFSR confluence) on the South Fork of the Salmon River (77-14174). Water Right 77-14174 is also subordinate to all future domestic, commercial, municipal, and industrial uses and future non- domestic, commercial, municipal, and industrial development up to 20.6 cfs.

Next, the Idaho Water Resource Board holds a minimum streamflow water right on Sugar Creek above its confluence with the East Fork SFSR (77-14193). Water Right 77-14193 is subordinate to all future domestic, commercial, municipal, and industrial uses and future non- domestic, commercial, municipal, and industrial development up to 0.3 cfs.

The Forest Service holds two water rights on the Salmon River (75-13316 and 77-11941) below the Shoup quantification site (Shoup gage) which is upstream of the South Fork confluence. These are instream, non-consumptive water rights that maintain flows for the WSR designated segment of the Salmon River. When flows measured at the Shoup gauge are less than 13,600 cfs, the minimum in-stream flow rates provided by the water rights range from 1,200 cfs for the period of September 1 to September 15 to 9,450 cfs for the period of June 1 to June 15. The SFSR joins this segment of the main stem Salmon River approximately 64.6 miles downstream from the SGP area. These water rights are subordinated to all water rights claims filed in the Snake River Basin Adjudication as of the effective date (September 1, 2003) of the Stipulation among the U.S., the State of Idaho, and other objectors. They also are subordinated to specified quantities of future beneficial use rights. Additional detailed information regarding these two water rights can be found in Water Right Reports (referenced by water right number) available on the IDWR website (https://idwr.idaho.gov/water-rights/).

Surface Water Diversion and Discharge

Under current conditions, surface water diversion within the analysis area is limited to water usage by Perpetua in accordance with its current surface water rights. As part of the proposed mining activity, additional surface water diversion from the East Fork SFSR is proposed from a location upstream of the proposed fish tunnel (Brown and Caldwell 2021b). New appropriation can be accommodated under the subordination amounts specified in the Idaho Water Resource Board and Forest Service minimum flow rights for future beneficial use and are most relevant to the SGP.

Storage of water is not subordinated as specified in the partial decree for the two Federal Wild and Scenic rights (Fifth Judicial District 2004) which states that “[t]hese subordinated amounts do not include storage, other than incidental storage, which is defined as storage not more than a 24-hour water supply for any beneficial use.” Mitigation for stored water would be addressed via IDWR’s decision on Perpetua’s proposed mitigation and water rights application.

There are currently no permitted wastewater discharges to surface water within the analysis area. Stormwater runoff associated with current exploration activities has been covered under the March 2021 MSGP administered by IDEQ. The 2021 MMP activity includes a treated industrial wastewater discharge and a treated residential wastewater discharge that would be permitted under the State of Idaho’s IPDES process. A discharge to Meadow Creek would be located adjacent to the TSF Buttress and discharges to East Fork SFSR would be located west of the Stibnite Worker Housing Facility (Brown and Caldwell 2021b). The discharge west of the Stibnite Worker Housing Facility would be a sanitary discharge permitted by the State of Idaho.

3.8.4.3 Groundwater

Groundwater flow in the analysis area occurs primarily in the Quaternary unconsolidated deposits in the valleys (composed of alluvium, glacial, and glaciofluvial materials), and through the unconsolidated deposits covering the mountainsides (e.g., glacial moraines, talus, colluvial, and landslide materials). The unconsolidated Quaternary deposits in the valleys form what is referred to as an alluvial aquifer. Some groundwater flow also occurs within bedrock in areas where secondary porosity including fractures and fracture zones are present and sufficiently connected to promote water flow (SPF 2017). In select locations, historical mine workings, such as adits, that penetrate the bedrock units act to promote groundwater flow in bedrock.

The unconsolidated deposits receive water from snowmelt, precipitation, and infiltration of surface runoff from upland areas, and groundwater discharge from the underlying bedrock. Groundwater discharges primarily to streams, but also supports wetlands, seeps, and springs. The water discharging from unconsolidated deposits to the surface via seeps and springs often flows only a short distance over the surface before infiltrating back into the unconsolidated materials (SPF 2017).

Groundwater Observations

Baseline characterization of groundwater, including water levels, gradients, and flow directions is based on measurements collected from 65 groundwater wells and four exploration boreholes converted to vibrating wire piezometers (Brown & Caldwell 2017a). Of those 65 wells, 49 are completed in alluvium, and 16 in bedrock. Well locations are provided in **Figure 3.8-7** with well completion information summarized in **Table 3.8-9**. Groundwater level data used for baseline characterization was collected from December 2011 through December 2019 (SPF 2017, Brown and Caldwell 2021f). Collection of groundwater level data is ongoing.

Spatially, alluvial monitoring wells characterize alluvium where it is present, primarily in the valley bottom areas (**Figure 3.8-7**). Bedrock monitoring wells are also located primarily in valley bottom areas where they can observe the effects of interactions between the lower flow bedrock lithologies and the higher flow alluvium (**Figure 3.8-7**). Most bedrock wells in the analysis area are screened within the batholith unit, with wells in the northeastern part of the Project screened within the metasedimentary units (**Figures 3.8-8** and **3.8-9**). Tertiary intrusive rock units are interspersed within the other bedrock lithologies and are generally not specifically targeted by monitoring well completions due to their generally low permeability and small volumetric presence compared to the batholith and metasedimentary units.

Most wells and boreholes (completed in alluvium or bedrock) exhibit seasonal groundwater level fluctuations typically ranging from approximately 2 to 20 feet. The highest water levels occur at the peak of the spring runoff period (i.e., between May and July), with levels receding to a minimum by late summer or early fall. The spot measurements in these wells indicate both the seasonality and the amplitude of annual fluctuations. Continuous water level measurements also show responses to major recharge events.

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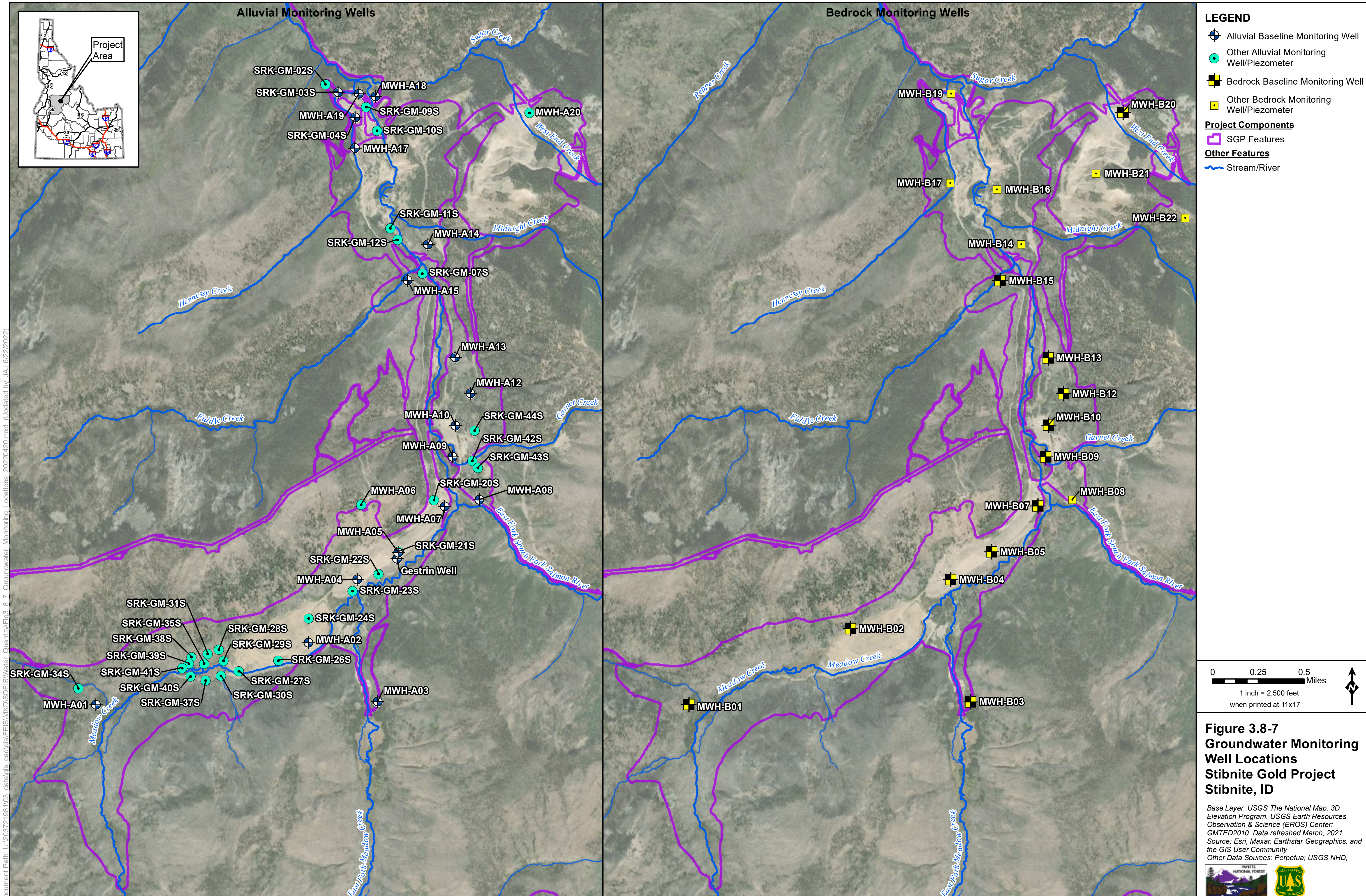
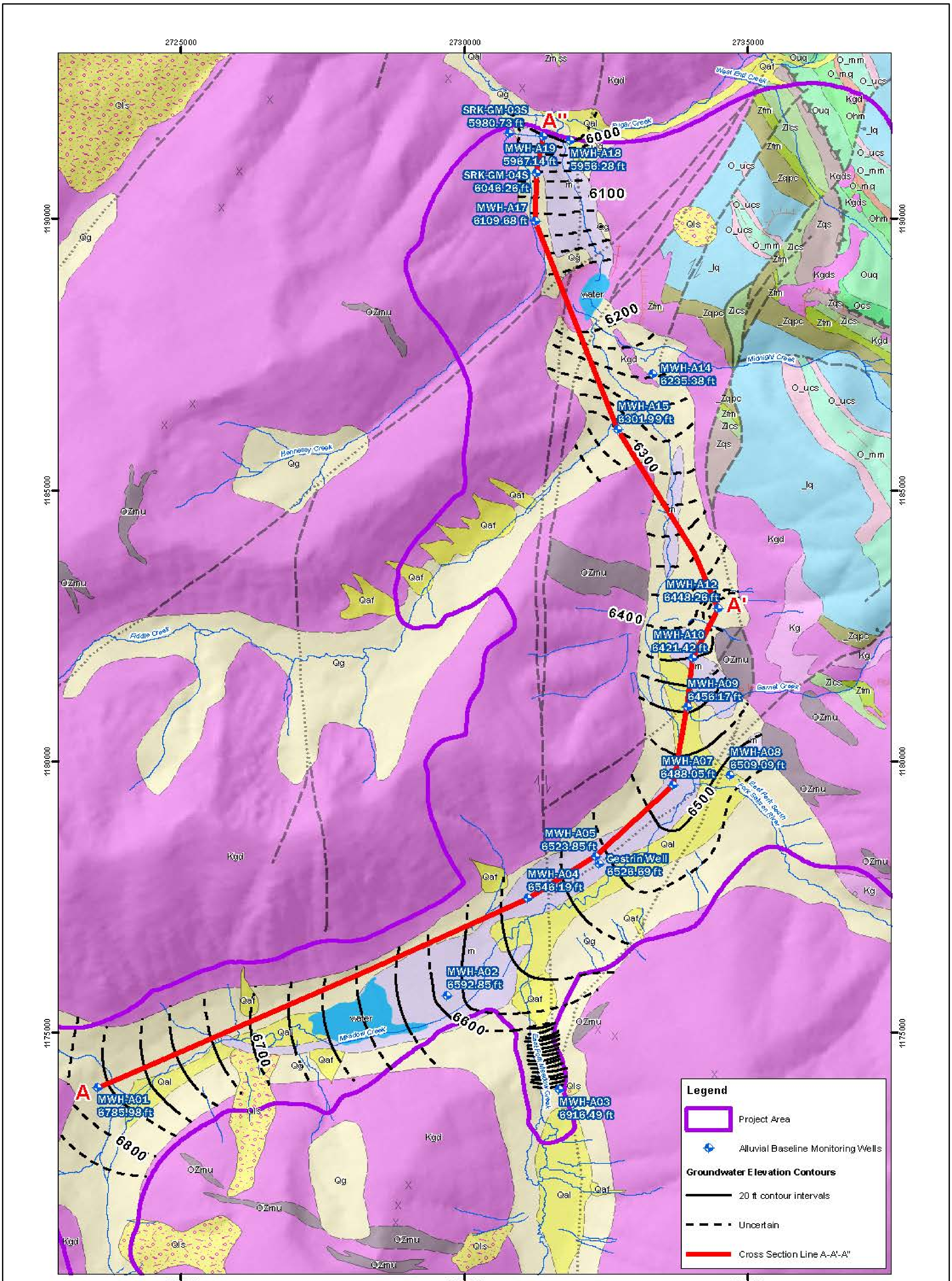
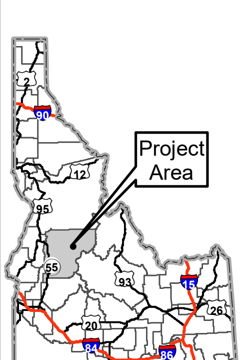


Figure 3.8-7 Groundwater Monitoring Well Locations Stibnite Gold Project Stibnite, ID





Basemap: Aerial photo, November 2011
Geologic data: Stewart, et. al. 2016

0 1,500 3,000
Feet

N

Figure 3.8-8
Surface Geology

Stibnite Gold Project
Stibnite, ID
Data Sources: (Brown & Caldwell 2017)

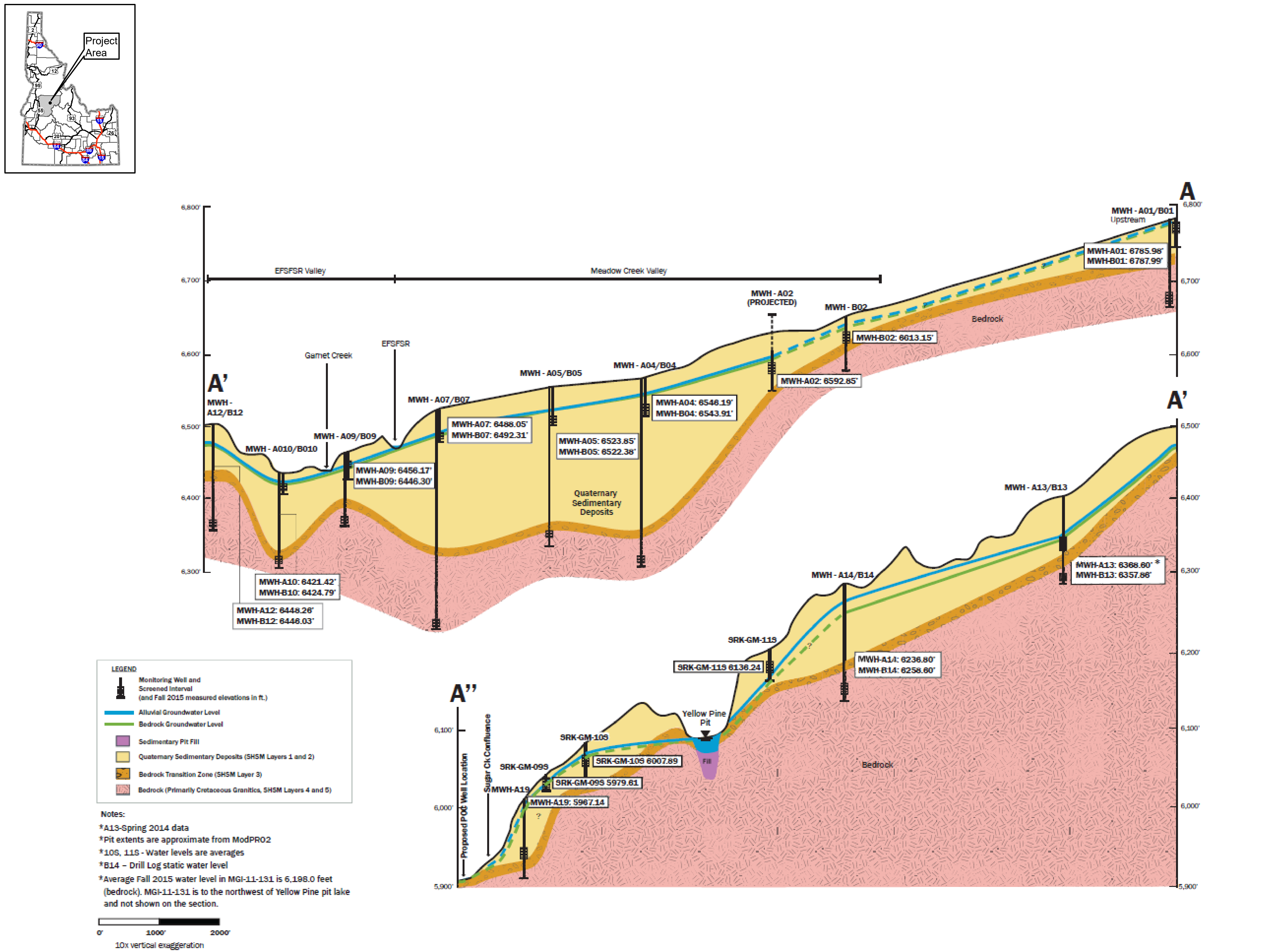


Figure 3.8-9
Hydrogeologic Cross-Sections

Stibnite Gold Project
Stibnite, ID

Data Sources: (Brown & Caldwell 2017)

Table 3.8-9 Monitoring Well Completion Details

Well Number	Global Position System Coordinates[1]		Approximate Elevation	Screen Interval Depth (feet bgs[2])		Screen Interval Elevation (feet AMSL)		Hydrogeologic Unit Screened	Water Level (feet AMSL)	Depth to Water (feet bgs)[3]	Completion Date	Completion Type
	Easting	Northing	(feet AMSL)	From	To	From	To					
Gestrin	631510	4973000	6543	99	109	6544	6434	Alluvium	6526	17	11/23/2011	8" pumping well
MGI-19-HFPW	631488	4973090	6540	60	140	6480	6400	Alluvium	6515	25	11/01/2019	10" pumping well
				170	430	6370	6110	Bedrock				
MWH-A01	628834	4971703	6784	30	40	6754	6744	Till	artesian	-	02/22/2012	2" piezometer
MWH-A02	630703	4972250	6659	100	110	6559	6549	Alluvium	6595	64	12/01/2011	2" piezometer
MWH-A03	631315	4971731	7034	290	310	6744	6724	Alluvium	6917	117	03/16/2013	2" piezometer
MWH-A04	631133	4972805	6563	55	65	6508	6498	Alluvium	6547	16	08/04/2012	2" piezometer
MWH-A05	631494	4973043	6543	34	44	6509	6499	Alluvium	6527	16	08/15/2012	4" monitoring well
MWH-A06	631172	4973465	7322	9	14	7313	7308	Alluv./Quartz Monzonite	Dry	-	10/29/2012	2" piezometer
MWH-A07	631904	4973448	6520	32	42	6488	6478	Alluvium	6489	31	08/07/2012	4" monitoring well
MWH-A08	632207	4973507	6525	28	38	6498	6488	Alluvium	6508	17	11/15/2012	2" piezometer
MWH-A09	631972	4973886	6462	21	26	6441	6436	Alluvium	6454	8	09/09/2012	2" piezometer
MWH-A10	631997	4974160	6439	20	30	6419	6409	Alluvium	6422	17	08/02/2012	2" piezometer
MWH-A12	632129	4974443	6498	50	60	6449	6439	Alluvium	6451	47	02/15/2013	2" piezometer
MWH-A13	631995	4974760	6427	50	65	6377	6362	Alluvium	6376	51	02/21/2013	2" piezometer
MWH-A14	631756	4975755	6288	59	69	6229	6219	Alluvium	6237	51	02/26/2013	2" piezometer
MWH-A15	631574	4975439	6354	70	75	6284	6279	Alluvium	6303	51	11/10/2012	2" piezometer
MWH-A17	631114	4976604	6202	98	108	6104	6094	Alluvium	6110	92	10/29/2011	2" piezometer
MWH-A18	631294	4977057	5975	20	30	5955	5945	Alluvium	5957	18	09/13/2012	2" piezometer
MWH-A19	631148	4977079	6021	50	60	5971	5961	Alluvium	5966	55	10/15/2012	2" piezometer
MWH-A20	632650	4976915	6654	43	53	6611	6601	Alluvium	Dry	-	10/25/2012	2" piezometer
MWH-B01	628833	4971706	6786	125	135	6661	6651	Diorite/Granite	artesian	-	03/02/2013	2" piezometer
MWH-B02	630254	4972374	6637	48	58	6589	6579	Quartz Monzonite/Granite	6615	22	09/22/2012	2" piezometer
MWH-B03	631312	4971729	7038	463	478	6575	6560	Alaskite	6915	123	03/10/2013	2" piezometer
MWH-B04	631136	4972805	6563	238	258	6325	6305	Quartz Monzonite	6543	20	08/07/2012	2" piezometer
MWH-B05	631497	4973050	6543	208	218	6335	6325	Quartz Monzonite	6524	19	08/18/2012	4" monitoring well
MWH-B07	631903	4973452	6520	284	294	6236	6226	Quartz Monzonite	6492	28	09/04/2012	4" monitoring well
MWH-B09	631972	4973886	6462	85	100	6377	6362	Calc-silicate	6444	18	09/08/2012	2" piezometer
MWH-B10	631995	4974164	6439	78	88	6361	6351	Calc-silicate	6426	13	07/20/2012	2" piezometer
MWH-B12	632129	4974440	6498	130	140	6368	6358	Quartz Monzonite	6443	55	02/13/2013	2" piezometer
MWH-B13	631995	4974757	6426	120	130	6306	6296	Quartzite-Schist	6358	68	02/20/2013	2" piezometer
MWH-B14	631757	4975757	6288	180	190	6108	6098	Quartz Monzonite	6259	29	02/25/2013	2" piezometer
MWH-B15	631571	4975438	6354	155	185	6199	6169	Quartz Monzonite	6304	50	11/07/2012	2" piezometer

Well Number	Global Position System Coordinates[1]		Approximate Elevation	Screen Interval Depth (feet bgs[2])		Screen Interval Elevation (feet AMSL)		Hydrogeologic Unit Screened	Water Level (feet AMSL)	Depth to Water (feet bgs)[3]	Completion Date	Completion Type
	Easting	Northing	(feet AMSL)	From	To	From	To					
MWH-B20	632652	4976916	6654	456	476	6198	6178	Quartzite/Schist/Pelite/ Meta-Siltstone	6497	157	07/24/2013	4" monitoring well
SRK-GM-02S	630857	4977163	6078	162	172	5916	5906	Alluvium	5978	100	10/21/2011	2" piezometer
SRK-GM-03S	630965	4977094	6047	110	120	5937	5927	Alluvium	5980	67	10/13/2011	2" piezometer
SRK-GM-04S	631116	4976872	6145	100	110	6045	6035	Alluvium	6053	92	10/25/2011	2" piezometer
SRK-GM-07S	631708	4975500	6296	24	34	6272	6262	Alluvium	6280	16	03/13/2012	2" piezometer
SRK-GM-09S	631214	4976964	6035	58	68	5977	5967	Alluvium	5980	55	10/08/2011	2" piezometer
SRK-GM-10S	631309	4976758	6032	27	37	6005	5995	Alluvium	6006	26	02/15/2012	2" piezometer
SRK-GM-11S	631426	4975898	6179	25	55	6154	6144	Alluvium	6159	20	03/14/2012	2" piezometer
SRK-GM-12S	631489	4975797	6204	26	36	6178	6168	Alluvium	6178	26	03/12/2012	2" piezometer
SRK-GM-21S	631500	4973050	6541	170	180	6371	6361	Alluvium	6521	20	11/02/2011	2" piezometer
SRK-GM-22S	631323	4972856	6549	149	159	6400	6390	Alluvium	6539	10	02/12/2012	2" piezometer
SRK-GM-23S	631095	4972705	6568	88	98	6480	6479	Alluvium	6544	24	03/09/2012	2" piezometer
SRK-GM-24S	630708	4972464	6628	107	117	6521	6511	Alluvium	6484	44	11/12/2011	2" piezometer
SRK-GM-26S	630442	4972094	6618	74	84	6544	6534	Alluvium	6597	21	12/03/2011	2" piezometer
SRK-GM-27S	630094	4971998	6612	58	68	6554	6544	Alluvium	6601	11	02/18/2012	2" piezometer
SRK-GM-28S	629919	4972189	6615	27	37	6588	6578	Alluvium	6609	6	02/26/2012	2" piezometer
SRK-GM-29S	629960	4972090	6605	40	50	6565	6555	Alluvium	6602	3	02/19/2012	2" piezometer
SRK-GM-30S	629937	4971959	6629	47	57	6582	6572	Alluvium	6603	26	02/27/2012	2" piezometer
SRK-GM-31S	629818	4972152	6618	34	44	6584	6574	Alluvium	6611	7	02/25/2012	2" piezometer
SRK-GM-34S	628682	4971848	6952	30	40	6922	6912	Alluvium	6924	28	02/22/2012	2" piezometer
SRK-GM-35S	629788	4972066	6613	39	49	6574	6564	Alluvium	6608	5	02/20/2012	2" piezometer
SRK-GM-37S	629802	4971918	6631	21	31	6610	6601	Alluvium	6613	18	02/27/2012	2" piezometer
SRK-GM-38S	629678	4972124	6637	44	54	6593	6583	Alluvium	6614	23	02/24/2012	2" piezometer
SRK-GM-39S	629653	4972067	6630	44	54	6586	6576	Alluvium	6629	1	02/25/2012	2" piezometer
SRK-GM-40S	629670	4971952	6632	28	38	6604	6594	Alluvium	6615	17	02/27/2012	2" piezometer
SRK-GM-41S	629596	4972027	6630	45	55	6585	6576	Alluvium	6615	15	02/26/2012	2" piezometer
SRK-GM-42S	632146	4973850	6512	27	37	6485	6475	Alluvium	6499	13	03/16/2012	2" piezometer
SRK-GM-43S	632196	4973791	6533	25	35	6508	6498	Alluvium	6509	24	03/16/2012	2" piezometer
MGI-19-HFOW1A	631408	4972929	6545	40	170	6506	5376	Alluvium	6536	9	10/27/2019	2" piezometer
MGI-19-HFOW1B	631411	4972932	6545	225	425	6320	6120	Bedrock	6538	7	10/24/2019	2" piezometer
MGI-19-HFOW2A	631542	4973024	6539	40	185	6499	6354	Alluvium	6515	24	10/13/2019	2" piezometer
MGI-19-HFOW2B	631545	4973026	6539	235	420	6304	6119	Bedrock	6520	19	10/11/2019	2" piezometer
MGI-19-HFOW3A	631845	4973520	6509	28	38	6481	6471	Alluvium	6486	23	10/05/2019	2" piezometer

Well Number	Global Position System Coordinates[1]		Approximate Elevation	Screen Interval Depth (feet bgs[2])		Screen Interval Elevation (feet AMSL)		Hydrogeologic Unit Screened	Water Level (feet AMSL)	Depth to Water (feet bgs)[3]	Completion Date	Completion Type
	Easting	Northing	(feet AMSL)	From	To	From	To					
MWH-B16	631542	4976239	6204	166	222	6038	5982	Quartz Monzonite and Alaskite/Diorite	6170	34	10/16/2012	multi-level sampler
				451	476	5753	5728	Quartz Monzonite/ Quartzite and Alaskite	6169	35		
				567	619	5637	5585	Quartzite-Schist	6169	35		
MWH-B17	631132	4976295	6307	116	177	6191	6139	Quartz Monzonite and Alaskite	6295	12	11/04/2012	multi-level sampler
				394	425	5913	5882	Quartz Monzonite and Alaskite	6297	10		
MWH-B21	632415	4976378	7290	125	160	7165	7130	Calc-silicate/Carbonate	dry	-	08/23/2012	multi-level sampler
				328	353	6962	6937	Quartzite-Schist/ Quartz Pebble Conglomerate	6990	300		
				430	470	6860	6820	Carbonate	-	-		
				765	815	6525	6475	Quartz Pebble Conglomerate/Schist Pelite Meta-Siltstone	6892	398		
MWH-B22	632200	4975988	6969	91	122	6878	6847	Calc-Silicate	dry	-	10/02/2012	multi-level sampler
				229	389	6740	6580	Quartzite	dry	-		
				400	536	6569	6433	Quartzite/Quartz Pebble Conglomerate	6598	371		

Source: SPF 2017; Brown and Caldwell 2021f
[1]Universal Transverse Mercator (UTM) coordinates in meters
[2]Screen interval depth from ground surface
[3]Water level depth from ground surface

Figure 3.8-10 shows water table elevation contours for the analysis area computed by the groundwater model calibrated to water levels and streamflow yield (Brown and Caldwell 2018a, 2021b). The model calibration statistics (Brown and Caldwell 2021d) indicate that the modeled groundwater elevations compare acceptably to monitoring well water level observations which are concentrated in valley bottoms. There are fewer observation locations for comparison on the mountain side areas. The water table contours mimic the land surface topography. The contours shown indicate that the water table is present both within unconsolidated sediments (particularly in the valley alluvium), and within shallow bedrock (mainly outside of the valley bottoms).

Groundwater horizontal hydraulic gradients within the alluvial deposits range from approximately two to 10 percent and are generally consistent with gradients of adjacent streams. Gradients in shallow bedrock are similar to gradients in the alluvial deposits but are steeper on the mountain slopes outside of the valley bottoms.

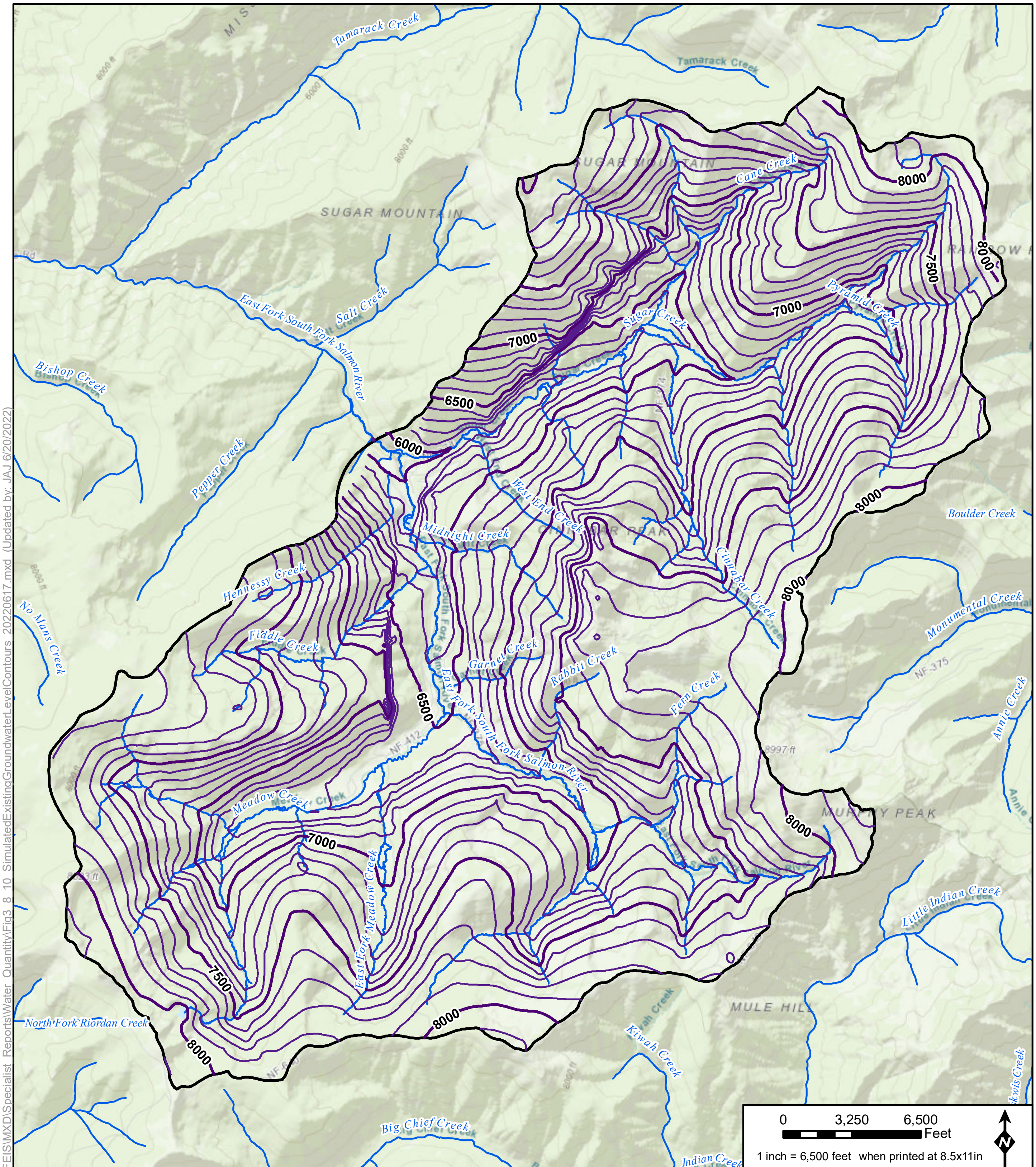
Vertical hydraulic gradients were calculated using data collected from 12 well nests (pairs of alluvial and shallow bedrock wells with screens completed at different depths) and multilevel samplers and vibrating wire piezometers installed in bedrock boreholes. Upland areas exhibit strong downward gradients (e.g., MWH-B21), indicating the presence of groundwater recharge areas outside of the mountain valleys, while the valley bottoms exhibit weak upward or downward gradients (SPF 2017). The lack of strong upward gradients along the valley axis may indicate an absence of a larger scale, deeper groundwater system of a type described by Winter (1976) with recharge zones coinciding with high mountain ridges and slopes and discharge zones located in mountain valleys. Low permeability of the underlying bedrock likely prevents development of such a system in the analysis area.

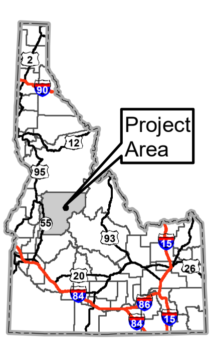
Accumulated baseline groundwater level data indicate that the streams in the analysis area are primarily gaining and groundwater flow near the valley bottoms is angled (in the downstream direction) toward the gaining streams (SPF 2017).

In summary, groundwater flows follow the land surface topography, with most groundwater migrating at shallow depths down the mountain slopes and along the valley bottoms, and eventually discharging to surface streams. On a more local scale, the flow also is affected by distribution of recharge, geology, and existing anthropogenic features (e.g., mine workings).

Hydrogeologic Units

The major hydrogeologic units in the analysis area and their estimated hydraulic conductivity values are summarized in **Table 3.8-10** (Brown and Caldwell 2017a, 2021e, 2021g; SPF 2017). The hydrogeology of the analysis area consists of basement intrusive rocks of the Idaho Batholith partially overlain by metasedimentary rocks in the eastern portion of the analysis area. The most common intrusive rock in the mine area is granodiorite and the metasedimentary rocks are comprised of quartzites, marbles, dolomites, and schists. Younger volcanic intrusives are located within the Idaho Batholith rocks and metasedimentary rocks, and the bedrock is overlain by alluvium, with the thickest covers (up to approximately 250 feet) located in the valley bottoms.





LEGEND

Simulated Current Groundwater Contours

- Index Contour (500 ft)
- Normal Contour (100 ft)
- Perennial Stream
- StudyArea

Figure 3.8-10
Simulated Existing Groundwater Level Contours
Stibnite Gold Project
Stibnite, ID

Base Layer: ESRI World Topographic Base
Other Data Sources: Brown & Caldwell, Perpetua, USGS

Document Path: U:\203721981\03_data\gis_cad\gis\FEIS\MXD\Specialist_Reports\Water_Quantity\Fig3_8_10_SimulatedExistingGroundwaterLevelContours_20220617.mxd (Updated by: JAJ 6/20/2022)

Table 3.8-10 Summary of Hydrogeologic Units

Hydrogeologic Unit	Description	Hydraulic Conductivity Estimates: Range of Estimates from Aquifer Tests (feet per day)	Hydraulic Conductivity Estimates: Geometric Mean (feet per day)
Idaho Batholith Rocks	Cretaceous igneous rock with dioritic to granitic composition	0.0003 – 6.3	0.02
Metasedimentary Rocks	Metamorphosed carbonate and siliciclastic rocks	0.02 – 5.9	0.3
Valley Fill Alluvium/Colluvium	Unconsolidated sedimentary deposits	1-100	10

Source: SPF 2017; Brown and Caldwell 2021e

Alluvial aquifer pumping tests were performed in 1989, February 2012, December 2013, and December 2019 at the Stibnite Gestrin airstrip well located close to Meadow Creek, about 2,500 feet upgradient from the Meadow Creek–East Fork SFSR confluence, to establish alluvial aquifer characteristics in areas most likely to be impacted by mine operations. In 1989, the well was pumped at a constant rate of about 114 gallons per minute (gpm) for 300 minutes. In February 2012, the well was pumped for 480 minutes at rates ranging from 46 gpm (average for first 15 minutes) to 208 gpm (average for last 100 minutes of test). Those were the preliminary tests and the results of analysis completed using the collected data were considered uncertain (Brown and Caldwell 2017a). A more comprehensive test on the Gestrin well was conducted in December 2013. During the 2013 test, the well was pumped at an average rate of about 100 gpm for almost 31 days. Groundwater levels were monitored during the 2013 test in five alluvial wells and three shallow bedrock wells. Analyzing drawdown data collected from observation wells completed in the alluvium and bedrock allowed hydraulic properties to be estimated for both formations. Hydraulic conductivities estimated from the 2013 test data are 10.2 feet/day for the alluvial aquifer and 4.5 feet/day for the shallow bedrock. These results provide documentation of groundwater productivity of the alluvial sediments and the shallow bedrock in the area of the Gestrin well (Brown and Caldwell 2017a; SPF 2017).

In December 2019, the Gestrin well was pumped for a three-day period at a rate of 60 gpm. The diminished water production from this well between 2013 and 2019 was attributed to well inefficiency, and the 2013 test results were retained as representative of the system and its responses (Brown and Caldwell 2021f). However, data from observation wells during the 2019 pump test was informative in examining the response to alluvial groundwater pumping in the broader area around the Gestrin well.

Pump based aquifer tests of the four SGP production wells (Stibnite's Hooterville and main camp domestic wells, Hecla's Pioneer well, and the Stibnite Plant utility well) completed in 1994 in the alluvium of the East Fork SFSR provided transmissivity values ranging from 67 to 134 $feet^2$/day. Given an average aquifer thickness of 20 feet in the area of those tested wells, the calculated hydraulic conductivities range from 3.3 to 6.7 feet/day (Brown and Caldwell 2017a).

A pump test of the new Camp Well (SPF 2017) conducted in 2012 provided hydraulic conductivity of 12 feet/day, calculated from transmissivity of 350 $feet^2$/day and a given average thickness for the alluvial aquifer (around the Camp Well) of 30 feet.

In addition to the pumping tests, slug tests conducted in 1996 in two alluvial monitoring wells produced hydraulic conductivity estimates averaging 4.9 feet/day. Additionally, nine slug tests conducted in 2012 on wells completed in various unconsolidated materials at proposed locations for the SGP features including the Yellow Pine pit area (six tests), Hangar Flats pit area (two tests), and proposed tailings disposal area (one test) provided estimation of hydraulic conductivities ranging from 0.3 to 139 feet/day. Slug tests conducted in 2013 in eight alluvial monitoring wells allowed estimation of average and median hydraulic conductivity values of 11.3 feet/day and 7.3 feet/day, respectively. The range of measured/estimated values was 2.8 to 28 feet/day.

Overall, the results reported by the investigations (from 1989 to 2013) for the alluvial groundwater system indicate hydraulic conductivity ranging from 1 to 100 feet/day, with an average of approximately 10 feet/day (SPF 2017).

Hydraulic characteristics of the portion of the regional Idaho Batholith rocks in the analysis area have been assessed via two aquifer pumping tests, 45 packer tests conducted in exploration boreholes, seven slug tests, 11 air lift or well development monitoring of bedrock monitoring well installations, plus one observation of bedrock discharge from the DMEA tunnel (Brown and Caldwell 2021e, 2023a, 2023b). These data represent two pumping test observations plus 64 relatively localized observations of the Idaho Batholith rocks' hydraulic properties. In general, packer test results returned lower hydraulic conductivity measurements than the other test methods which tested larger subsurface intervals in boreholes. This is consistent with the interpretation that fracture flow represents the primary flow mechanism within the Batholith rocks, as smaller interval packer tests had less probability of encountering a conductive fracture.

Hydraulic conductivity measurements ranged between 0.0003 and 6.3 feet per day with a geometric mean measurement of 0.02 feet per day, indicating that bedrock conductivity is minor compared to alluvial conductivity. Measurements were laterally consistent across the mine area and generally decreased with depth in the borehole (Brown and Caldwell 2021e).

Monitoring of shallow bedrock rock portions of the Batholith rocks during alluvial pumping tests exhibit bedrock responses to drawdown and depressurization in the overlying alluvium. Responses of bedrock wells to alluvial pumping at the Gestrin well in 2019 indicate hydraulic conductivities between 1.2 and 4.5 feet/day in the transition zone from alluvium to shallow bedrock where bedrock fractures would be more prevalent than at depth (Brown and Caldwell 2021f).

Two deeper bedrock pumping tests have been completed in the deeper bedrock portions of the Idaho Batholith rocks in the analysis area. Both tests encountered bedrock zones with low sustainable groundwater flow rates that were tested via constant rate pumping tests. Near the Hangar Flats pit, a steady production rate of 2.1 gpm was pumped for a period of seven days. Drawdown was observed in the pumping well, but no drawdown was observed in six other Hangar Flats pit area monitoring locations. Analysis of groundwater production from a bedrock zone below the shallow bedrock zone and water level recovery there indicated hydraulic conductivities between 0.061 and 0.39 feet/day, i.e., one to two orders of magnitude lower than the overlying shallow bedrock zone (Brown and Caldwell 2023a). Near the Yellow Pine pit, a steady production rate of 0.78 gpm was pumped for a period of ten days. Drawdown was observed in the pumping well with a slight response also detected in a monitoring location approximately 80 feet away. No drawdown was observed at three other monitoring locations further away from the pumping well in the test area. Analysis of groundwater production from this deep bedrock zone and water level recovery there indicated hydraulic conductivities between 0.00016 and 0.00041 feet/day, i.e., one to two orders of magnitude lower than the bedrock tested at the Hangar Flats pit and three to four orders of magnitude lower than the shallow bedrock (Brown and Caldwell 2023b).

Hydraulic characteristics of the metasedimentary rocks have been assessed via 16 packer tests conducted in exploration boreholes and six slug tests of bedrock monitoring well installations (Brown and Caldwell 2021e). These data represent 22 localized observations of the metasedimentary units' hydraulic properties. Unlike the Idaho Batholith rocks, packer test and slug test results yielded comparable hydraulic conductivity measurements, indicating that the overall permeability of the units is higher than in the underlying Batholith rocks.

Hydraulic conductivity measurements in the metasedimentary units ranged between 0.02 and 5.9 feet per day with a geometric mean measurement of 0.3 feet per day, confirming that the metasedimentary rock conductivity is minor compared to alluvial conductivity but more conductive than the Batholith rocks. Measurements were laterally consistent across the mine area and generally decreased with depth in the borehole (Brown and Caldwell 2021e).

Groundwater Budget

A groundwater budget is a basic accounting of the inflows and outflows from a hydrologic system in a specific area. Water budgets provide a means evaluate the availability and sustainability of a water resource. Under existing conditions for the Analysis Area, the predominant inflow component for the groundwater system is recharge from precipitation. The principal groundwater outflow component is discharge of groundwater to surface water along with losses to evapotranspiration in areas where vegetation is utilizing water from a groundwater aquifer.

Locally, stream elevations at most locations are slightly lower than the water table in adjacent areas, suggesting that the streams receive groundwater discharge from the alluvial aquifer. However, there are areas where the opposite is true, indicating the presence of losing stream reaches. For example, groundwater elevations suggest the following losing reaches: 1) on the East Fork SFSR between Garnet Creek and Fiddle Creek; 2) on the East Fork SFSR immediately upgradient of the Yellow Pine pit; and 3) in the lower reach of the EFMC (SPF 2017). In aggregate, there is a net groundwater discharge to streams that represents the most significant groundwater outflow from the system, balancing the input from meteoric recharge.

In a secondary outflow to stream discharge, groundwater from fractured bedrock likely contributes flow to hillside springs located above the alluvial deposits. Springs and seeps near the northerly trending faults along the east side of both upper Meadow Creek and EFMC may be related to these faults (SPF 2017).

Groundwater Rights

Existing groundwater rights at the SGP have been acquired by Perpetua and are described in **Table 3.8-11**.

Table 3.8-11 Groundwater Rights Summary

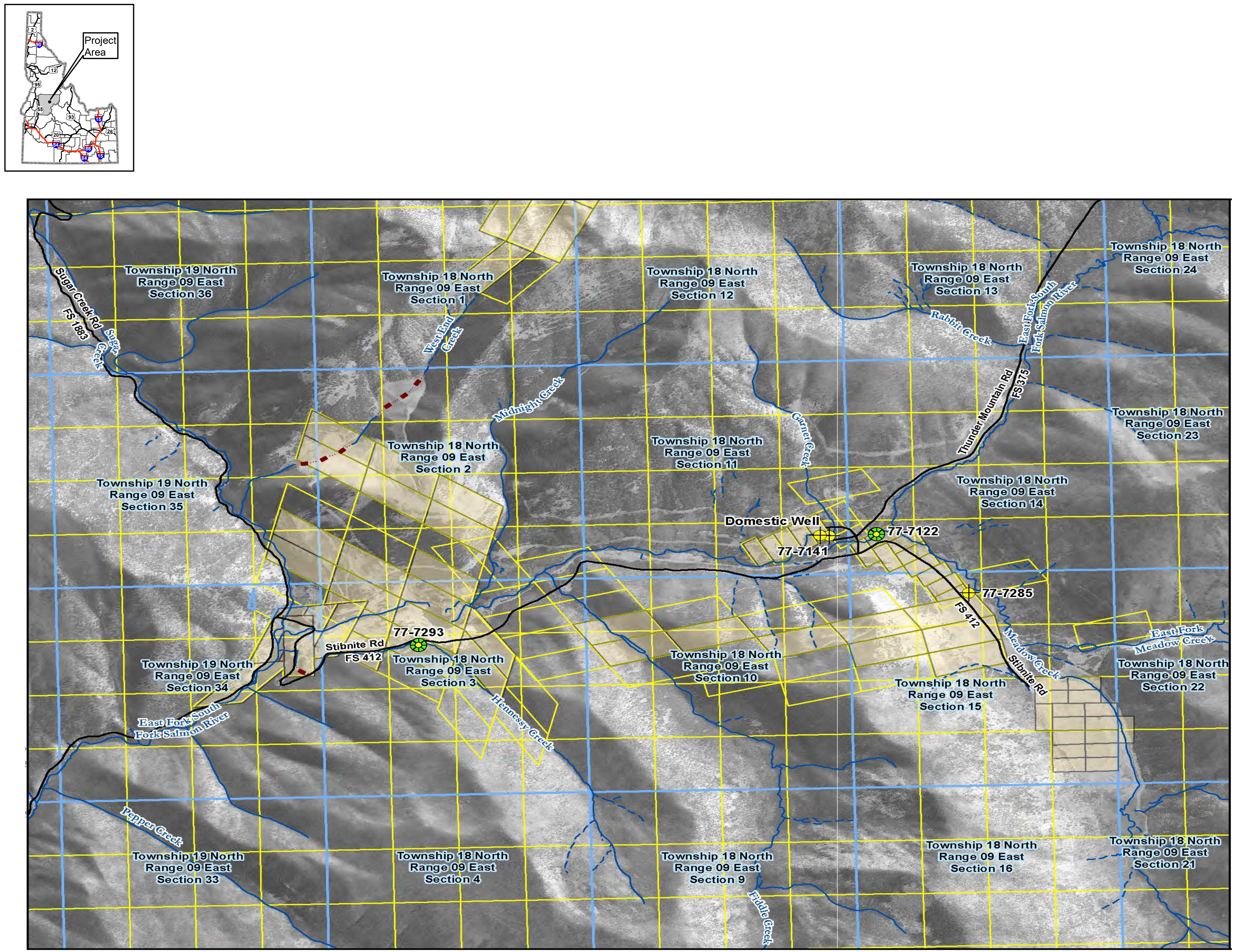
Water Right ID	Type	Source	Diversion Point	Priority Date	Beneficial Use	Diversion Rate (cfs)	Max Total Usage (acre-feet)
77-7285	Ground-water	Well	SE 1/4 of the NE 1/4, Section 15, T18N, R9E	11/7/1988	Storage and Mining	0.50	30.2
77-7141	Ground-water	Well	SW 1/4 of the SW 1/4, Section 11, T18N, R9E	6/9/1981	Domestic	0.20	11.4

Source: Midas Gold 2016a (Table 8-1)
cfs = cubic feet per second.

The existing groundwater rights are specific to historical use. While these are valid water rights, the specific points of diversion, place of use, and beneficial use does not reflect planned SGP activities and would need to be adjusted through the transfer process, and through filing additional applications for permit. These filings were initiated in December 2021.

Groundwater Production Areas

IDWR records indicate that three permitted water supply wells are located at the SGP (**Figure 3.8-11**). **Table 3.8-12** provides a summary information about those wells (Brown and Caldwell 2017a). Anticipated Project industrial groundwater supply areas would be in the vicinity of Hangar Flats pit area south of the currently authorized points of diversion (77-7141 and 77-7285) plus in the vicinity of the Yellow Pine pit (**Figure 3.8-12**). The supply well locations represented on **Figure 3.8-12** are preliminary in that specific locations for wells have not been finalized and would depend on engineering site evaluations to finalize well designs. The worker housing would have its own supply well near the facility.



Legend

- Perennial Stream
- Intermittent Stream
- Underground Drain
- Road
- Point of Diversion (POD) for Existing Valid Groundwater Right
- Point of Diversion (POD) for Existing Valid Surface Water Right
- Public Land Survey System (PLSS) Section Line
- Sixteenth Section
- Private Property (Midas Gold)

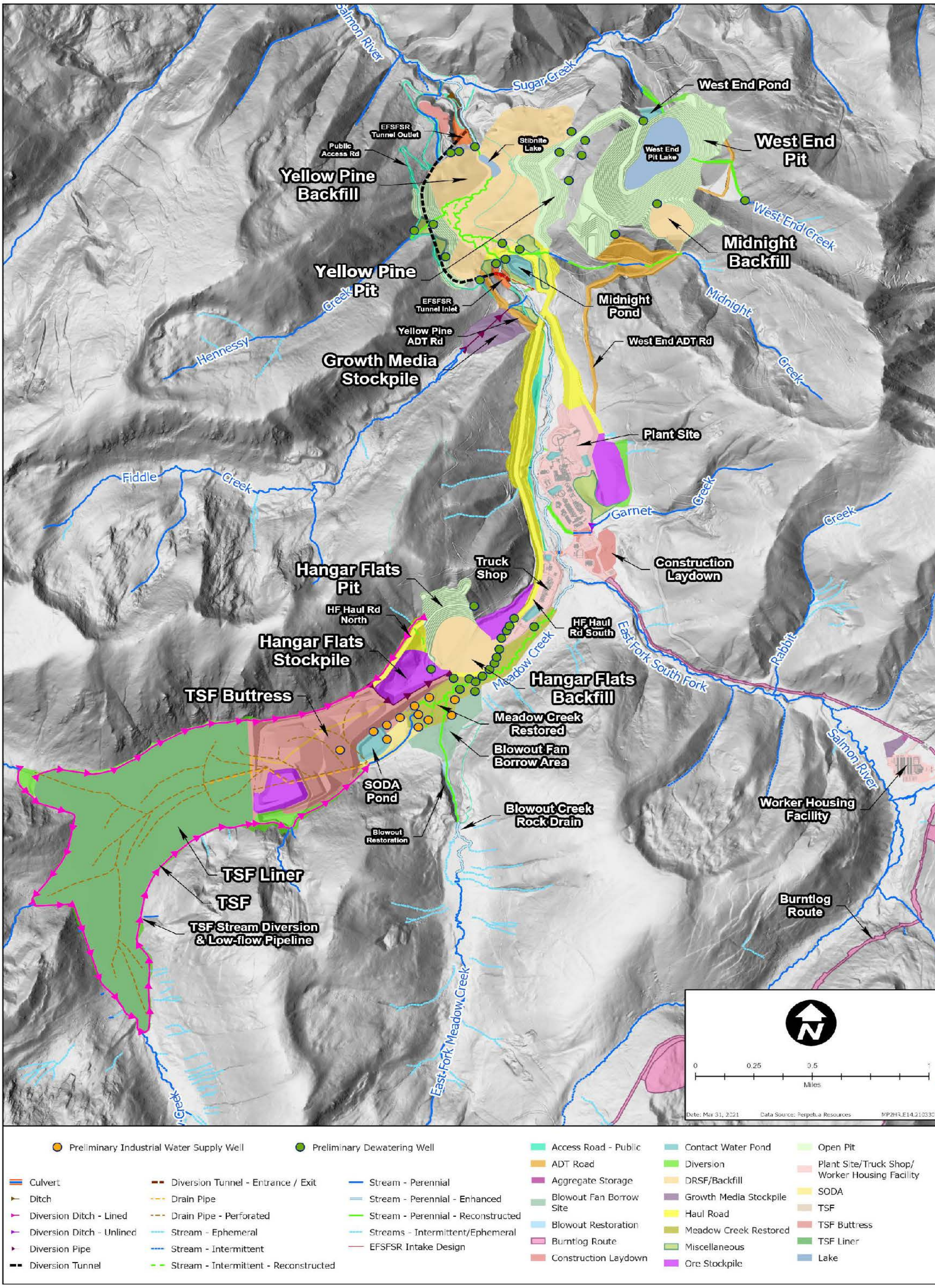
Imagery: 2015 NAIP I meter resolution Source: NRCS/USDA Digital Gateway
Topography: National Elevation Dataset (NED), 10 meter resolution; Source: USGS
Other Data Sources: State of Idaho Geospatial Gateway (INSIDE Idaho); Payette National Forest; Boise National Forest; Salmon-Challis National Forest

Map Date: December 2016

Figure 3.8-11
Points of Diversion for Existing Valid Water Rights

Stibnite Gold Project
Stibnite, ID

Data Sources: (HDR 2017)



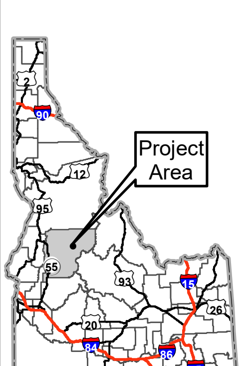


Figure 3.8-12
Groundwater Production Areas

Stibnite Gold Project
Stibnite, ID
Data Sources: (Brown & Caldwell 2021a)

Table 3.8-12 Permitted Water Supply Wells in the Analysis Area

Well	Permit #	Diameter (inch)	Screen Depth (ft bgs)	Static Water Level (ft bgs)	Notes
The Gestrin Airstrip permitted mining well	914059-862689, Tag # D0060354	8	99 to 109	18	Date of completion: 1988, re-drilled in November 2011; is owned by Perpetua; is located near the airstrip, completed in alluvium; discharge rate (production capacity) of 100 to 150 gpm.
The original temporary Camp water supply well	913929-862557	6	58 to 72	12	Date of completion: October 1981; was permitted in 1981 in the mine shop area (Former Man Camp Well); completed in alluvium; discharge rate (production capacity) of 30 gpm. This well has not been used since 2013.
The new camp water supply well	914899-863525, Tag # D0063781	8	57 to 64	14	Date of completion: 2012; is installed in alluvium on the Stibnite Road portion of the McCall Stibnite Road (County Road 50-412); discharge rate (production capacity) of 15 gpm. Brown and Caldwell (2017) state that, as of June 2017, this well has never been used, except to test the drinking water system in 2014.

Source: Brown and Caldwell 2017a
ft = feet, bgs = below ground surface.

Groundwater production associated with the SGP would occur in the vicinity of the proposed open pit mine operations and the housing facility (**Figure 3.8-12**). Most groundwater production would occur in the Hangar Flats pit area both as dewatering pumping and industrial supply well production. Additional dewatering pumping would also occur in the Yellow Pine pit area and to a lesser extent in the West End pit area. There would also be groundwater production from a well located near the worker housing facility.

3.9 Surface Water and Groundwater Quality

3.9.1 Introduction

This section describes existing conditions related to surface water quality, groundwater quality, and geochemistry.

3.9.2 Water Quality Resources Area of Analysis

The surface water quality analysis area includes streams and lakes located in the 22 sub-watersheds that encompass the SGP, access roads, transmission lines, and off-site facilities (**Figure 3.9-1**). Sub-watersheds are the hydrologic sub-basins that contain smaller tributary stream systems and are defined by the USGS's 12-digit HUCs (EnviroAtlas 2019; Seaber et al. 1987).

The analysis area for groundwater quality includes the Sugar Creek and Headwaters East Fork SFSR sub-watersheds (**Figure 3.9-2**), which together encompass the SGP infrastructure that is most likely to influence groundwater quality. The groundwater quality analysis area focuses on the SGP where excavation of mineralized and unmineralized subsurface materials would occur. It does not cover all components, such as off-site facilities or supporting infrastructure corridors, which are limited to surface disturbance activities that would not affect groundwater quality. Based on the hydrogeologic conceptual model for the groundwater quality analysis area, groundwater flow is primarily controlled by topography, with mountain-front recharge flowing through shallow fractured bedrock and colluvium to unconsolidated alluvial deposits, and eventually discharging from the unconsolidated deposits to streams, springs, and seeps. As such, groundwater flow divides likely coincide with the sub-watershed boundaries that define the groundwater quality analysis area (Brown and Caldwell 2018a). The point where groundwater is most likely to flow out of the analysis area is through the alluvial aquifer at the farthest downstream point in the Headwaters East Fork SFSR sub-watershed. Any groundwater leaving the analysis area through this boundary would eventually discharge to the East Fork SFSR downgradient.

The cumulative effects boundaries for water quality are coincident with the area of analysis for direct effects because other current and reasonably foreseeable future activities that could affect water quality conditions are within the same area.

3.9.3 Relevant Laws, Regulations, Policies, and Plans

Land and Resource Management Plan: Physical, social, and biological resources on National Forest System lands are managed to achieve a desired condition that supports a broad range of biodiversity and social and economic opportunity. National Forest Land and Resource Management Plans embody the provisions of the NFMA and guide natural resource management activities on NFS land.

In the SGP area, the Payette Forest Plan (Forest Service 2003a), and the Boise Forest Plan (Forest Service 2010a) provide management prescriptions designed to realize goals for achieving desired condition for surface water and groundwater quality and include various objectives, guidelines, and standards for this purpose.

Federal Laws, Regulations, and Policy: Federal laws that apply to water quality include the CWA and the Safe Drinking Water Act. The EPA is responsible for enforcing the federally-mandated CWA. Section 402 of the CWA, which authorizes the National Pollutant Discharge Elimination System (NPDES) permit program, controls water pollution by regulating point sources that discharge pollutants into WOTUS. On June 5, 2018, EPA approved the IPDES Program and authorized the transfer of permitting authority to the state beginning on July 1, 2018. EPA will retain the authority to issue NPDES permits for facilities located on tribal lands and/or discharging to tribal waters.

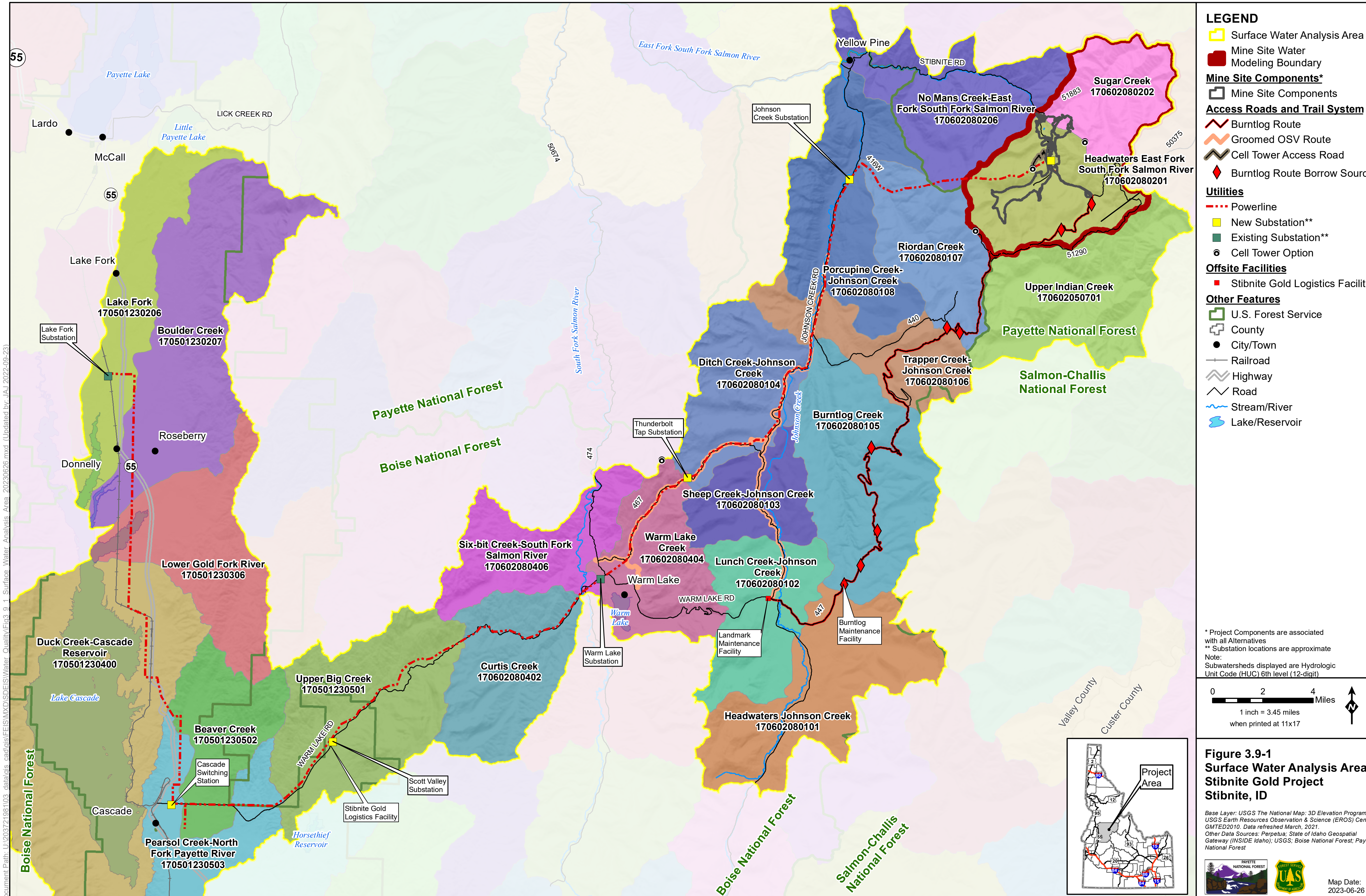
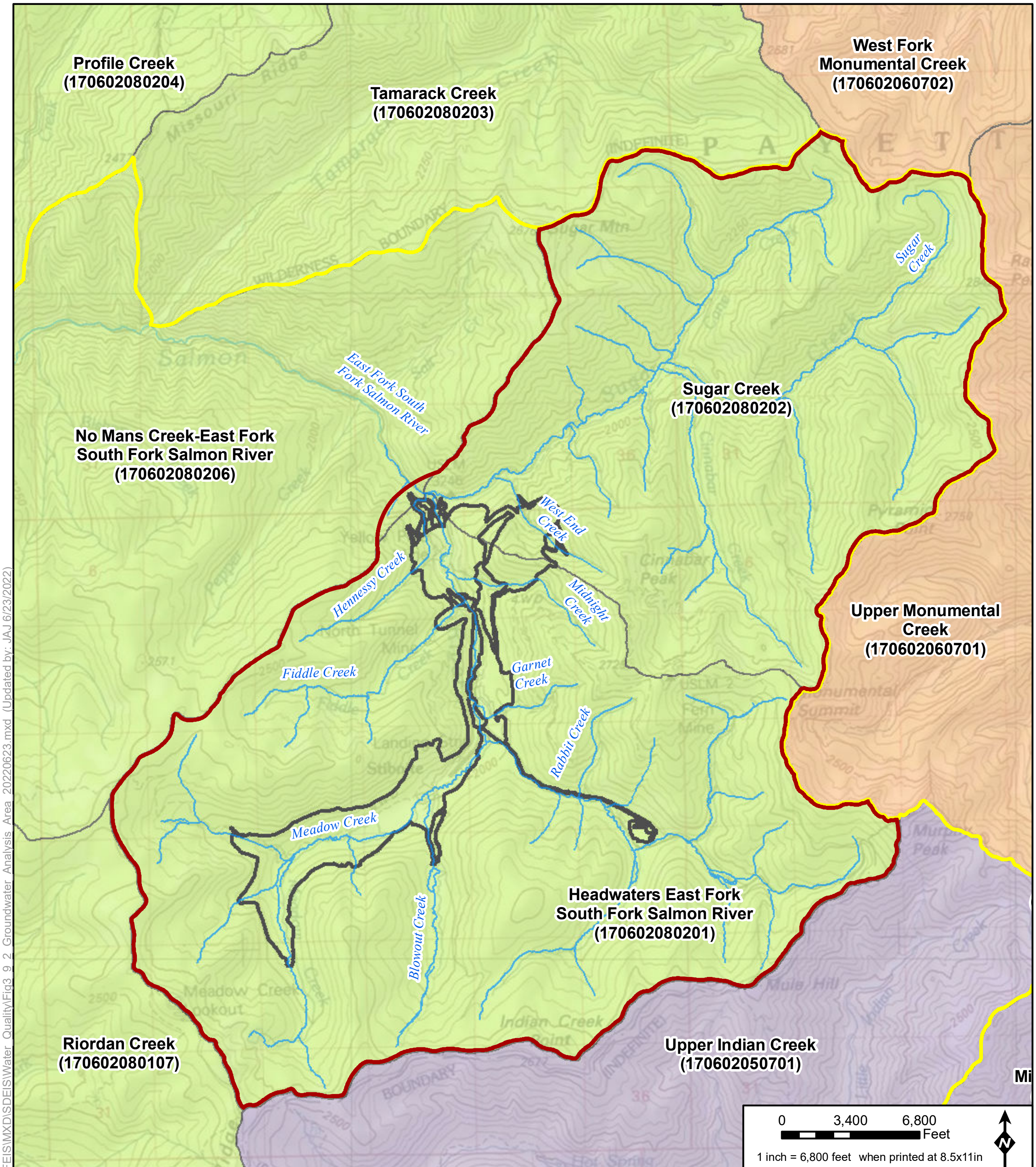
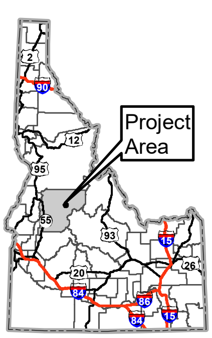


Figure 3.9-1
Surface Water Analysis Area
Stibnite Gold Project
Stibnite, ID





LEGEND

- Surface Water Analysis Area
- Mine Site Water Modeling Boundary
- Mine Site Components*

Watersheds

- Upper Middle Fork Salmon (17060205)
- South Fork Salmon (17060208)
- Lower Middle Fork Salmon (17060206)
- Stream/River

*Mine Site components are associated with all Alternatives
Note:
Subwatersheds displayed are Hydrologic Unit Code (HUC) 6th level (12-digit)

Figure 3.9-2
Groundwater Quality Analysis Area
Stibnite Gold Project
Stibnite, ID

Base Layer: ESRI USA Topographic Basemap
Other Data Sources: Perpetua; Boise National Forest; Payette National Forest

Document Path: U:\20372198\03 data\gis cad\gis\FEIS\MXD\SDEIS\Water Quality\Fig3 9 2 Groundwater Analysis Area 20220623.mxd (Updated by: JAJ 6/23/2022)

EPA's other responsibilities under Section 404 of the CWA include promulgating and interpreting environmental criteria used in evaluating permit applications under Section 404(b)(1): Guidelines for Specification of Disposal Sites for Dredged or Fill Material; coordinating with the USACE (the Section 404 federal permitting authority) in the review of Section 404 permit applications; and sharing responsibility with the USACE in determining the geographic scope of CWA jurisdiction. Section 311 of the CWA also gives EPA regulatory authority with regard to spill prevention, control, and countermeasure plans required for oil storage. Facilities with aboveground and underground storage tanks in excess of specific thresholds are required to develop and implement a SPCC Plan.

Under the Safe Drinking Water Act, EPA has established primary and secondary maximum contaminant levels (MCLs) to protect the public against consumption of drinking water contaminants that present a risk to human health. The MCL is the maximum allowable amount of a contaminant in drinking water that is delivered to a consumer (EPA 2018e, 2018f).

In addition, EPA has established National Secondary Drinking Water Regulations that set non-mandatory water quality standards for 15 constituents. EPA does not enforce these secondary MCLs. They were established as guidelines to assist public water systems in managing their drinking water for aesthetic considerations, such as taste, color, and odor. These constituents are not considered a risk to human health.

State and Local Policy: The IDEQ implements the CWA in Idaho and regulates waterbodies in the state under its jurisdiction to meet Idaho water quality standards that are protective of designated uses and uses that may not be designated. **Table 3.9-1** lists the strictest potentially applicable surface water quality criteria used in the water quality analysis in Idaho (IDAPA 58.01.02). These standards represent a combination of human health and cold-water aquatic life criteria that provide a benchmark for evaluating baseline water quality at the mine site and predicted concentration changes resulting from the SGP alternatives.

IDEQ administers the IPDES program regulating discharges of pollutants into WOTUS under its jurisdiction. EPA approved the State's IPDES program in accordance with the Memorandum of Agreement between IDEQ and Region 10 (IDEQ and EPA 2016). Per this memorandum, EPA will oversee IDEQ administration of the IPDES program on a continuing basis for consistency with the CWA, Idaho laws and rules, and all applicable federal regulations (IDEQ and EPA 2016).

Projects that may result in a discharge to WOTUS require Water Quality Certification under Section 401 of the CWA that the discharge is consistent with the CWA and applicable water quality standards. IDEQ is the regulatory authority for Section 401 permitting in Idaho. The IDEQ must grant (with or without conditions), deny, or waive Section 401 certification for any project in Idaho that requires a federal permit or license under the CWA before the federal permit or license can be granted, including the Section 404 permit issued by the USACE. This Water Quality Certification is designed to ensure that a federally-approved project would comply with state water quality standards for surface water and any other water quality requirements under state law.

The CWA also requires the state to prepare a report listing the current condition of all state waters and those waters that are impaired and in need of a total maximum daily load. The first list is referred to as the

Section 305(b) list; the second is the Section 303(d) list. Both lists are named in accordance with the sections of the CWA where they are defined; together, and with additional supplementary information, they are known as the Integrated Report.

Impaired waters on the Section 303(d) list are simply a subset of those on the Section 305(b) list. The current applicable report is IDEQ's 2022 Integrated Report (IDEQ 2022a).

The Idaho Nonpoint Source Management Plan describes the state's strategy for addressing nonpoint source pollution collaboratively with local, state, and federal partners, and provides guidance on evaluating and measuring success in meeting water quality goals for the state (IDEQ 2020a). IDEQ's role in nonpoint source management as it relates to mining and natural resource extraction includes the following:

- Conduct monitoring and total maximum daily load development;
- Conduct site investigations and inspections as necessary;
- Focus on site cleanup and remediation in areas where mining activities have contaminated soils and surface water; and
- Provide technical assistance to responsible state and federal agencies and private organizations/owners as requested.

Under Idaho's Rules for Ore Processing by Cyanidation (IDAPA 58.01.13), mining facilities that use cyanide in their mineral extraction processes are required to obtain a permit from the IDEQ. IDAPA 58.01.13 establishes procedures and requirement for the issuance and maintenance of permits to construct, operate, and close that portion of a cyanidation facility that is intended to contain, treat, or dispose of process water or process contaminated water containing cyanide. The provisions of these rules also establish requirements for water quality protection which address design, performance, construction, operation, and closure of a cyanidation facility. The rules are intended to ensure that pollutants associated with the cyanidation process are safely contained, controlled, and treated so that they do not endanger public safety or the environment, or interfere with beneficial use of waters of the state.

In addition to regulations enforced by IDEQ, the IDWR regulates stream channels under the Idaho Stream Channel Protection Act. This act requires that a Stream Channel Alteration Permit be obtained from IDWR before any type of channel alteration work, including removal and/or fill and installation of in-water or over-water structures with the potential to affect flow, within the beds and banks of a continuously flowing stream. IDWR, the USACE, and the IDL have established a joint process for activities impacting jurisdictional waterways that require review and/or approval of both the USACE and the State of Idaho. Additionally, IDWR regulates water dams (which may apply to SGP contact water storage ponds) and mine tailings impoundments.

The Idaho Ground Water Quality Rule (IDAPA 2011) establishes minimum requirements for the protection of groundwater by setting standards and beneficial uses and categorizing aquifers to be protected at different levels. The protection levels in IDAPA 58.01.11, summarized in **Table 3.9-1**, include both primary and secondary numerical groundwater quality standards promulgated by IDEQ to protect human health and the environment. These standards apply to *in situ* groundwater.

Table 3.9-1 Surface Water and Groundwater Quality Standards Used in the Water Quality Analysis

Parameter	Units	Groundwater Quality Standard Value (1)	Surface Water Quality Standard Value (2)	Surface Water Standard Source
pH	s.u.	6.5-8.5 S	6.5-9.0	IDAPA 58.01.02 – Aquatic Life Use
Alkalinity, Total	mg/L as $CaCO_3$	---	>20	EPA Freshwater Aquatic Life Criteria
Aluminum	mg/L	0.2 S	0.05 t	EPA Secondary Drinking Water Standard
Antimony	mg/L	0.006 P	0.0052 d	IDAPA 58.01.02 – Human Health
Arsenic	mg/L	0.05 P	0.010 t	IDAPA 58.01.02 – Human Health
Barium	mg/L	2 P	2 t	EPA Drinking Water MCL
Beryllium	mg/L	0.004 P	Narrative	IDAPA 58.01.02
Cadmium	mg/L	0.005 P	0.00033(2) d	IDAPA 58.01.02 - CCC (chronic)
Chloride	mg/L	250 S	230	EPA Freshwater Aquatic Life Criteria
Chromium, Total	mg/L	0.1 P	0.1 t	EPA Drinking Water MCL
Copper	mg/L	1.3 P	0.0024(3) d	IDAPA 58.01.02 – CCC (chronic)
Cyanide, Total	mg/L	0.2 P	0.0039	IDAPA 58.01.02 – Human Health
Cyanide, WAD	mg/L	---	0.0052	IDAPA 58.01.02 - CCC (chronic)
Iron	mg/L	0.3 S	0.3 t	EPA Secondary Drinking Water Standard
Fluoride	mg/L	4 P	2	EPA Secondary Drinking Water Standard
Lead	mg/L	0.015 P	0.0009(2) d	IDAPA 58.01.02 – CCC (chronic)
Manganese	mg/L	0.05 S	0.05 t	EPA Secondary Drinking Water Standard
Mercury	mg/L	0.002 P	0.000012 t	IDAPA 58.01.02 - CCC (chronic)
Methylmercury (fish tissue)	mg/kg	---	0.3	IDAPA 58.01.02 – Human Health
Nickel	mg/L	---	0.024(2) d	IDAPA 58.01.02 – CCC (chronic)
Nitrate + nitrite	mg/L	10 P	---	N/A
Selenium	mg/L	0.05 P	0.0015 t	EPA Freshwater Aquatic Life Criteria
Silver	mg/L	0.1 S	0.0007(2) d	IDAPA 58.01.02 - CMC (acute)
Sulfate	mg/L	250 S	250	EPA Secondary Drinking Water Standard
Total Dissolved Solids	mg/L	500 S	500	EPA Secondary Drinking Water Standard

Parameter	Units	Groundwater Quality Standard Value (1)	Surface Water Quality Standard Value (2)	Surface Water Standard Source
Thallium	mg/L	0.002 P	0.000017 d	IDAPA 58.01.02 – Human Health
Zinc	mg/L	5 S	0.054(2) d	IDAPA 58.01.02 – CMC/CCC (acute/chronic)

Source: IDAPA 58.01.11; IDAPA 58.01.02; EPA 2018e, 2018f, 2019b

1 Groundwater standards obtained from IDAPA 58.01.11.

2 Strictest potentially applicable surface water quality standard.

3 The criteria for these metals are hardness-dependent. The values listed are based on the East Fork SFSR hardness of 40 mg/L as calcium carbonate, which represents the 5th percentile hardness during the driest four months at node YP-SR-10 (below the confluence with Meadow Creek) between April 2012 and May 2019.

4 Copper criterion was derived using the Biotic Ligand Model per guidance contained in IDEQ (2017). A conservative chronic copper standard was estimated by applying the lowest of the 10th percentile chronic criteria based on regional classifications for the Salmon River Basin, Idaho Batholith, and third order streams. Per the SGP Water Quality Management Plan (Brown and Caldwell 2020a), preliminary calculations using the Biotic Ligand Model and site-specific data have produced similar values to the standard derived using these regional classifications.

Narrative = No numeric human health standard has been established for beryllium. However, permit authorities will address beryllium in NPDES permit actions using the narrative criteria for toxics in Section 200 of IDAPA 58.01.02, which states: "Surface waters of the state shall be free from toxic substances in concentrations that impair designated beneficial uses. These substances do not include suspended sediment produced as a result of nonpoint source activities."

s.u. = standard units; mg/L = milligrams per liter; mg/kg = milligrams per kilogram; CaCO3 = calcium carbonate; --- = Indicates no standard for this constituent; P = primary standard; S = secondary standard; d = dissolved fraction; t = total fraction.

CCC= criterion continuous concentration; CMC= criterion maximum concentration; N/A = Not Applicable.

The IDEQ is responsible for coordinating and administering groundwater quality protection programs in the state of Idaho. IDEQ also is responsible for establishing a point of compliance location, if applied for by a mine operator and pursuant to the Idaho Ground Water Quality Rule (IDAPA 58.01.11), where groundwater and surface water downgradient of mining activity must meet established water quality standards. If a point of compliance is not applied for, the mine operator must meet the ground water quality standards in ground water both within and beyond the mining area.

The EPA recommends that a human health methylmercury criteria of 0.3 mg/kg that is translated to a total-mercury concentration of 2 ng/L in surface water be utilized in the analysis. This recommendation is incorporated into the impact analyses, but table-reported standard values utilize the 12 ng/L (0.000012 mg/L) representing the lowest mercury concentration adopted as a standard.

The Valley County Land Use and Development Ordinances have provisions for well head protection. These regulations would likely apply to any drinking water wells installed. The well head protection regulations control the siting of drinking water wells and prevent wells and their potential capture zones from being installed near potential sources of groundwater contamination.

3.9.4 Affected Environment

The affected environment description for water quality is based on water quality data collected by Perpetua, their consultants, and the USGS. Surface water quality and groundwater quality baseline studies were summarized in reports by HDR (HDR 2016a, 2017f). Analytical data presented in the HDR reports were compiled from samples collected over a 4-year period between 2012 and 2016. Additional summary and analysis of the baseline study results were provided in the SGP Water Resources Summary Report

(Brown and Caldwell 2017a). Since these initial baseline studies were published, two additional years of data were collected and tabulated in the SGP Water Quality Summary Report, 2012 – 2018 (Midas Gold 2019c), and data collection is ongoing. Additionally, the USGS collected a series of surface water quality samples in the study area between 2011 and 2017, with the study results and data analysis published in two separate reports (Etheridge 2015: Baldwin and Etheridge 2019). Analytical data, statistics, and trends from the USGS and SGP baseline studies were used to characterize existing surface water and groundwater quality at the mine site.

In the Yellow Pine and Hangar Flats ore deposits, precious metals (gold and silver) typically occur in association with very fine-grained disseminated arsenical pyrite ($Fe(S,As)_2$), and to a lesser extent, arsenopyrite (FeAsS) (SRK 2017). Antimony occurs as the mineral stibnite (Sb_2S_3) often as along with precious metals mineralization but in deposits that are cross-cutting and generally more confined in distribution. Base metal sulfides (e.g., zinc, copper, and lead) are rare and occur at very low concentrations, at or below typical crustal abundance levels. Various oxidized products derived from weathering of the primary sulfides are associated with the intrusive rocks, including goethite, hematite, jarosite, and scorodite, and these host precious metal mineralization in the oxidized portions of the deposits (M3 2019).

Metasedimentary rock-hosted mineralization in the West End deposit has a similar sulfide suite and geochemistry, but with higher carbonate content in the gangue and a much more diverse suite of late-stage minerals. As in the intrusive-hosted mineralization, gold is associated with very fine-grained arsenical pyrite. Antimony mineralization is generally rare in the West End deposit.

The primary intrusive and metasedimentary rock types at the mine site include alaskite, granodiorite (i.e., quartz monzonite), diorite, rhyolite, calc-silicate, carbonates, quartzite, stibnite stock, schist, breccia, gouge, and granite (SRK 2017). The intrusive rocks associated with the Yellow Pine and Hangar Flats deposits are predominantly composed of quartz monzonite and alaskite. In contrast, the metamorphosed sedimentary rocks of the West End deposit generally consist of calc-silicate, carbonates, quartzite, and schist.

The intrusive and metasedimentary mineralization of the main ore deposits has been extensively drilled during exploration and development, as well as during past mine operations focused on the previously exploited ores. The drilled materials represent the composition of future development rock and ore, as well as historical mine wastes. Samples from these holes were characterized via multi-element total metal analyses and tested for leachable metals (SRK 2017).

Results from the multi-element testing show that arsenic, mercury, sulfur, and antimony are enriched compared to crustal abundance in the Yellow Pine, Hangar Flats, and West End ore bodies. These elements are typically associated with gold deposits (Rose et al. 1979) and their enrichment in the samples reflects the natural mineralization in the area. The enrichment of arsenic, mercury, sulfur, and antimony is generally more pronounced for the ore grade material (with a gold concentration greater than approximately 0.5 gram per ton) as would be expected; however, some of the waste grade material also is enriched with respect to these constituents (SRK 2017).

3.9.4.1 Geology and Mineralization

The geochemistry of the mine site is influenced by both the bedrock geology (including naturally occurring mineralization) and a legacy of historical mining activity that has altered the natural environment (Baldwin and Etheridge 2019). Locally, the Yellow Pine and Hangar Flats deposits are hosted by intrusive igneous rock associated with the Atlanta Lobe of the Idaho Batholith. Both deposits are situated along the Meadow Creek Fault Zone, a generally north trending, variably dipping, but near vertical complex fault zone that can be traced from north of the main Yellow Pine deposit south 1.85 miles through the Hangar Flats deposit, and beyond (SRK 2017). The West End deposit is hosted by metasedimentary rocks of the Stibnite roof pendant located above the Atlanta Lobe of the Idaho Batholith. **Figure 3.9-3** illustrates the various lithologic units located within the SGP area (Smitherman 1985, USGS 2007).

Both intrusive igneous rocks and metasedimentary rocks in the SGP area have undergone hydrothermal alteration associated with either Cretaceous magmatic events and/or Tertiary volcanic activity. Potassic and sodic metasomatism and widespread sericitization are characteristic of the earlier hydrothermal alteration event, while silicification and lower temperature hydrothermal alteration occurred in association with tertiary volcanic activity.

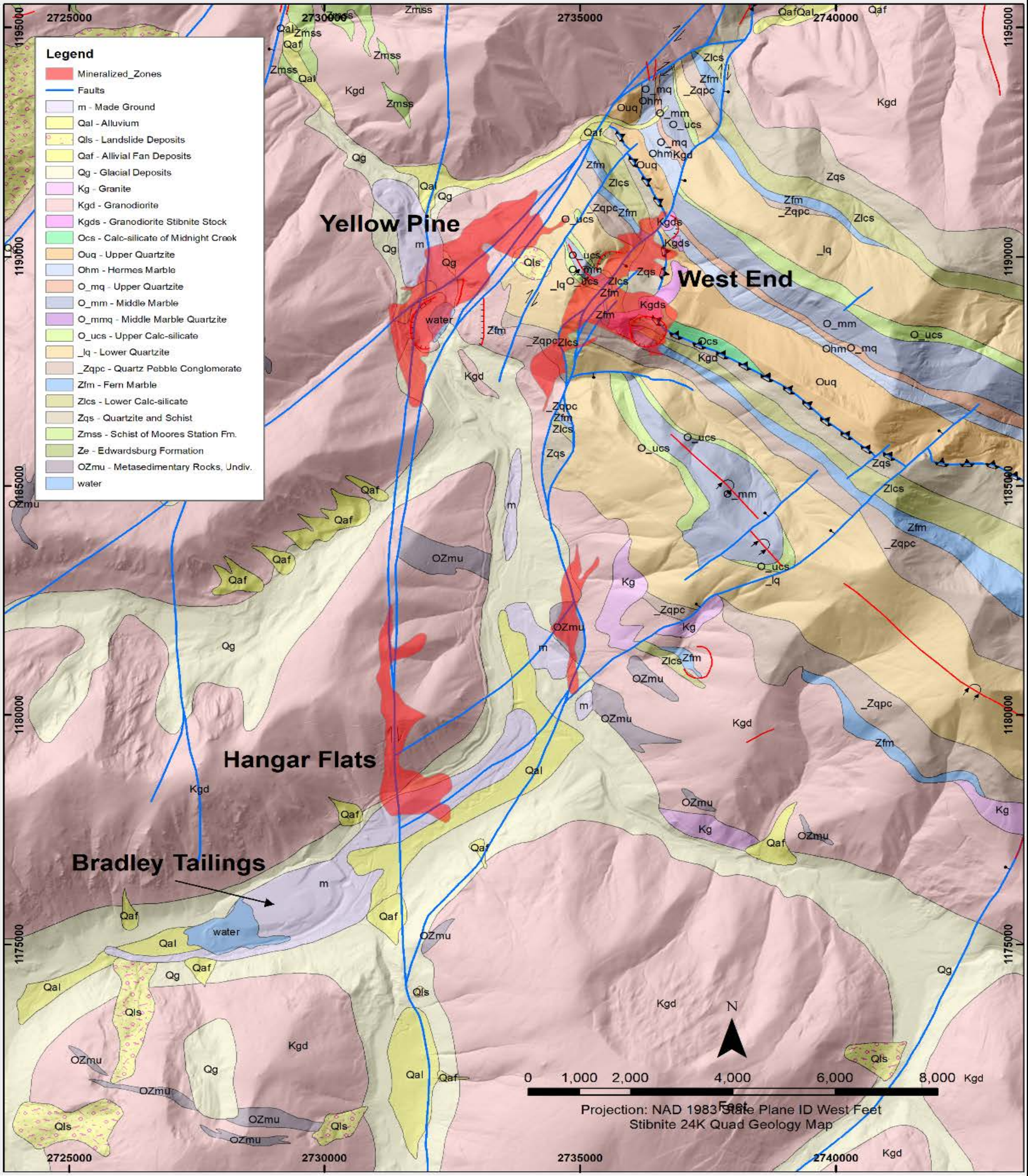
3.9.4.2 Geochemistry of Mined Materials

Mine operations expose mineralized and altered rocks to air and water and subsequent weathering reactions. Sulfide minerals undergo oxidation reactions that may result in the generation of acidic solutions or pH-neutral metal-bearing solutions that potentially could affect surface water and groundwater resources. Ore mined by the Project would be processed on site with tailings placed in a lined TSF. Development rock material generated would be placed in the TSF Buttress or backfilled into the Yellow Pine pit or Hangar Flats pit (**Table 3.9-2** and **Figure 3.9-4**). The SGP also would expose mineralized and altered rock in the walls of the three open pits. This section provides a summary of the geochemical testing results performed to characterize the rock geochemistry of the proposed processed ore, development rock and exposed wall rock in the post-mining quarry.

Table 3.9-2 Origin and Placement of Development Rock

Characteristic	TSF Buttress	Hangar Flats Pit Backfill	Midnight Pit Backfill	Yellow Pine Pit Backfill	TSF Embankment
Development Rock Sources	Hangar Flats pit, Yellow Pine pit, West End pit	Yellow Pine pit, West End pit	West End pit	Hangar Flats pit, Yellow Pine pit, West End pit	Hangar Flats pit, Yellow Pine pit, West End pit, SODA and Hecla heap leach legacy materials
Tons (millions)	81	18	7	113	61
Area (acres)	120	41	18	180	88
Height (feet)	460	460	320	740	460 (First stage, 245)
Steepest Grade	3:1	5:1 to 2.5:1	3:1 (north side), 2:1 (south side)	2.5:1	2:1

Source: Perpetua 2021a



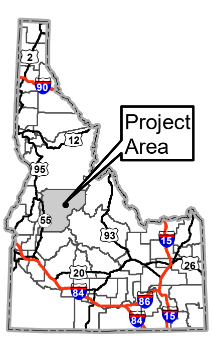
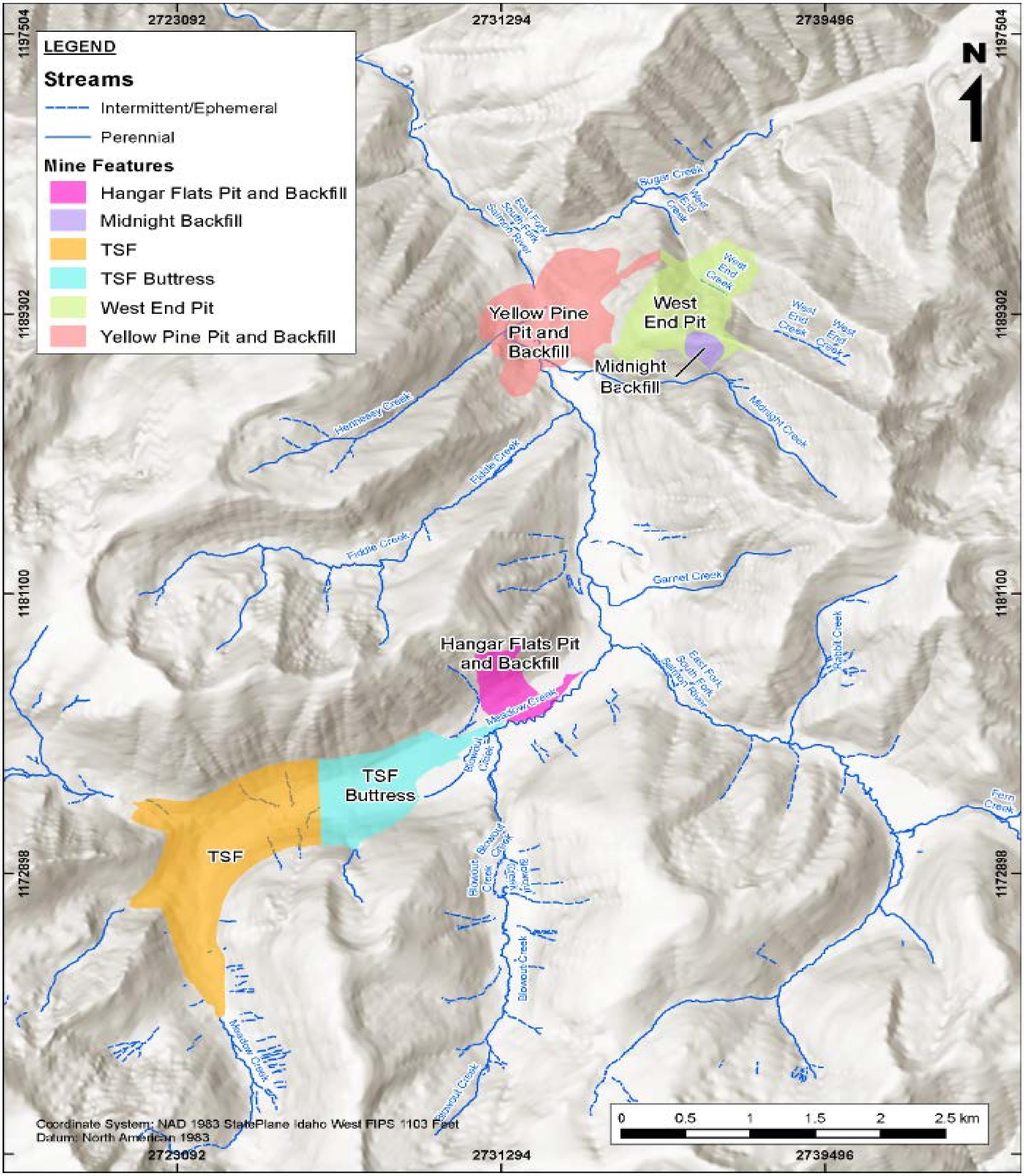


Figure 3.9-3
Stibnite Mining District Geology

Stibnite Gold Project
Stibnite, ID

Data Sources: (SRK 2021)



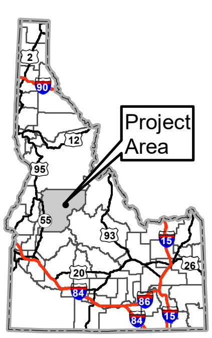


Figure 3.9-4
Facility Location Map

Stibnite Gold Project
Stibnite, ID

Data Sources: (SRK 2021)

In addition to the development rock sources included in **Table 3.9-2**, advancement of the Scout Exploration Decline is expected to produce 25,000 tons of development rock, approximately 0.01 percent of the project's total mined material. The development rock from the Scout Exploration Decline would consist of the metasedimentary lithologies of the Stibnite roof pendant most prevalent in the West End area including quartzite, carbonate and schists with diorite and quartz monzonite intrusives (Stewart et al. 2016). The development rock from the decline would be destined for the buttress and backfill locations along with the West End pit development rock. Hence, the characterizations of the open pit mined lithologies (**Table 3.9-3**) are applied to the limited amount of those lithologies present in the development rock from the Scout Exploration Decline.

The geochemical characterization program for mined materials included the following analysis:

- Review of site geology and identification of the primary material types;
- Collection of drill core and coarse reject samples representative of waste rock and ore;
- Collection of tailings representative of processed ore material; and
- Static and kinetic laboratory testing of selected samples.

The following sections describe the material types that would be mined by the SGP as well as the methods and results of the geochemical characterization program.

Mined Material Types

Waste rock and ore materials typically are classified and tested according to the material type and the number of samples selected for geochemical testing associated with the relative percentage of each material type expected to be mined following the mine geologic block model (**Table 3.9-3** and **Figure 3.9-5**). The term "material type" for the SGP refers to a site-specific set of rock classifications, primarily within the portion of a lithology where the mining is planned to occur (SRK 2017).

Once open pit mining concludes, the rock types exposed in the Yellow Pine and Hangar Flats pit walls would consist primarily of quartz monzonite and alaskite while the West End pit walls would consist primarily of calc-silicate, quartzite, schist, and carbonate rock types (**Table 3.9-3**). Backfilling the Yellow Pine and Hangar Flats pits during the closure period will yield exposed rock types above the backfill consisting primarily of quartzite, quartz monzonite, alaskite, and alluvium in the Yellow Pine pit and quartz monzonite, fault gouge, and alluvium in the Hangar Flats pit.

Table 3.9-3 Mined Material Frequency and Testing

Lithology	Waste Rock (%)	Pit Wall (%)	Pit Wall above Backfill (%)	ABA	Siderite Corrected NP	NAG	MWMP	HCT
Yellow Pine Pit								
Alaskite	1	3	-	19	16	6	3	2
Quartz Monzonite	10	20	13	29	24	17	6	1
Granite	<1	2	-	18	16	7	1	1
Quartz Monzonite-Alaskite	40	32	26	47	33	25	3	2
Rhyolite	<1	<1	-	3	2	1	-	1
Calc-silicate	2	4	6	2	2	2	-	-
Quartzite	14	12	26	15	15	9	-	-
Schist	1	2	2	1	1	-	-	-
Breccia	<1	<1	<1	19	18	3	1	-
Gouge	2	2	4	26	23	7	1	-
Diorite	<1	<1	-	1	-	1	1	1
Alluvium	11	8	15	6	6	6	6	-
Hangar Flats Pit								
Alaskite	-	-	-	29	23	10	1	1
Quartz Monzonite	-	-	-	32	18	17	4	3
Granite	<1	<1	-	7	7	1	-	-
Quartz Monzonite-Alaskite	48	53	70	47	28	26	3	1
Diorite	1	<1	3	3	-	3	1	-
Rhyolite	<1	<1	-	7	3	4	2	-
Calc-silicate	<1	<1	-	-	-	-	-	-
Carbonate	<1	<1	-	-	-	-	-	-
Quartzite	<1	<1	-	2	-	2	-	-
Schist	<1	<1	-	-	-	-	-	-
Breccia	<1	<1	<1	9	7	3	1	1
Gouge	13	9	16	11	7	6	1	1
Alluvium	38	37	11	6	6	6	6	-
West End Pit								
Quartz Monzonite	<1	<1	na	5	2	3	1	-
Stibnite Stock	14	11	na	3	3	1	-	-
Calc-silicate	15	14	na	29	13	20	6	2
Carbonate	18	19	na	13	7	7	3	2
Quartzite	30	37	na	20	16	14	3	1
Schist	15	14	na	19	13	7	3	2

Lithology	Waste Rock (%)	Pit Wall (%)	Pit Wall above Backfill (%)	ABA	Siderite Corrected NP	NAG	MWMP	HCT
Breccia	<1	<1	na	2	2	-	-	-
Gouge	<1	<1	na	2	1	1	-	-
Tailings Material	-	-		5	-	5	5*	7
Bailey Tunnel	-	-		2	2	2	-	-
Homestake Legacy Material	-	-		1	1	1	1	-
Totals				**440**	**315**	**223**	**63**	**29**

Source: SRK 2017, 2021a
ABA = Acid-base accounting and multi-element analyses
NP = Neutralization Potential
NAG = Net acid generation test
MWMP = Meteoric Water Mobility Procedure
HCT = Humidity Cell Test
na = not applicable; West End pit would not be backfilled
*Tailings samples were tested using a Modified Synthetic Precipitation Leaching Procedure (SPLP; EPA 1994)

Multi-Element Analyses

In addition to the static and kinetic test work, multi-element analyses of exploration samples were available for approximately 46,000 exploration samples collected from drill holes. Multi-element analyses quantify the concentration of metals and analyte concentrations in whole rock samples and represent the relative masses of metals available for leaching from exposed mined materials. When compared to average crustal abundance of analytes (Mason 1966), the local lithologies exhibited enriched concentrations of antimony, arsenic, mercury, and sulfur (**Table 3.9-4**).

Table 3.9-4 Average Multi-Element Rock Composition

Material	Antimony (ppm)	Arsenic (ppm)	Mercury (ppm)	Sulfur (%)
Crustal Abundance	0.2	1.8	0.08	0.026
Yellow Pine Development Rock	62	1,300	0.48	0.56
Yellow Pine Ore	1,600	4,200	1.2	1.3
Hangar Flats Development Rock	260	1,200	1.6	0.35
Hangar Flats Ore	3,900	5,400	4.4	1.4
West End Development Rock	84	340	0.93	0.25
West End Ore	130	2,500	1.8	0.85

Source: SRK 2017

In addition to whole rock analyses, mineralogical analyses were performed on a subset of rock samples to examine the mineral phases present (SRK 2017). Arsenic and antimony-bearing sulfide minerals such as pyrite, arsenopyrite, and stibnite were detected amongst matric silicate minerals (quartz, microcline, and albite) and carbonate minerals (ferroan dolomite, calcite, and siderite). Minor to major amounts of clay mineralization (illite, muscovite, chlorite, kaolinite, and biotite) were also observed.

Acid Base Accounting

Static ABA is an industry recognized method of assessing the potential for acid generation of sulfide-bearing rocks based on the acidification potential of the sulfide minerals and the neutralization potential of carbonates, aluminosilicates, and clays within the rock. The Modified Sobek Procedure (Sobek 1978) method was used, which includes both laboratory analysis and empirical calculations based on the Acidification Potential (AP) and the Neutralizing Potential (NP) (SRK 2017). The AP values are calculated based on sulfide sulfur concentrations in the rock and reported as calcium carbonate equivalents per 1,000 tons of rock. The NP values are determined using a modified Sobek protocol that includes digestion to expel carbon dioxide followed by back titration with sodium hydroxide to a pH of 8.3 and also is reported as calcium carbonate equivalents per 1,000 tons of rock. The difference NP-AP is the Net Neutralizing Potential (NNP). The ratio of NP/AP is the Neutralizing Potential Ratio (NPR). The NNP and NPR both characterize the potential for acid generation as a net potential or as a ratio of acid-neutralization to acid-generation, respectively. The ratio has become more favored for use by regulatory agencies because it provides a clearer description of relative quantities of acid producing and acid consuming constituents (MEND 1996).

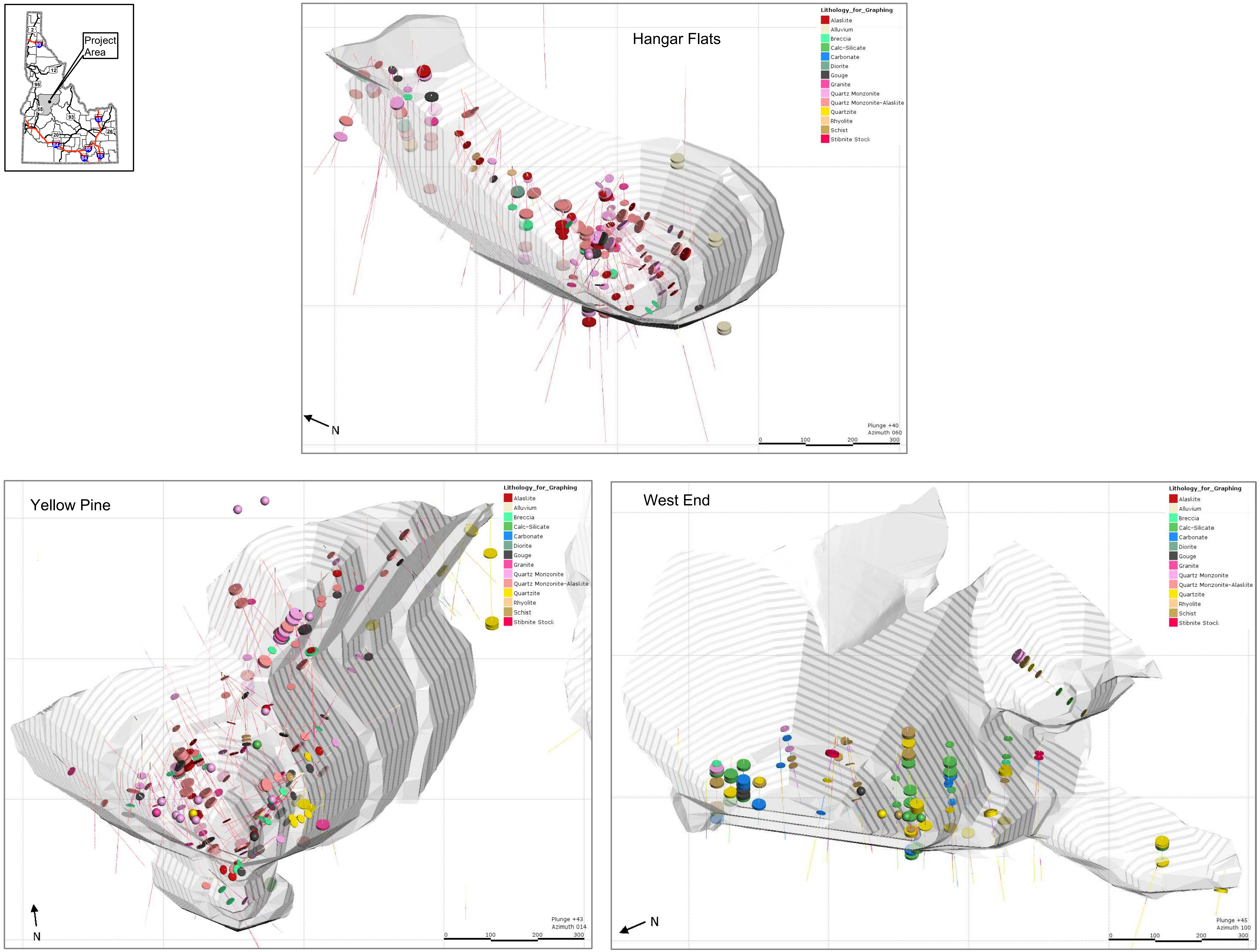


Figure 3.9-5
Geochemical Sample Locations

Stibnite Gold Project
Stibnite, ID

Data Sources: (SRK 2017)

Table 3.9-5 summarizes the ABA test results by lithology of mined material.

Table 3.9-5 Average ABA Test Results for Development Rock and Ore

Lithology	Type	N	Paste pH (s.u.)	NAG pH (s.u.)[1]	AGP ($CaCO_3$ eq/t)	ANP ($CaCO_3$ eq/t)	NNP ($CaCO_3$ eq/t)	NPR
Alaskite	Development	31	8.6	7.7	8.1	27.5	19.4	14.0
	Ore	17	7.8	2.6	27.1	19.2	**-8.0**	1.25
Quartz Monzonite	Development	46	8.3	7.1	12.8	35.6	22.9	19.5
	Ore	23	6.4	4.9	20.4	11.6	**-8.9**	6.4
Granite	Development	19	8.7	6.4	10.3	28.6	18.3	10.4
	Ore	6	8.3	3.6	25.3	17.2	**-8.1**	**1.0**
Quartz Monzonite-Alaskite	Development	67	8.3	6.3	15.8	33.2	17.5	13.7
	Ore	27	8.0	3.4	33.9	21.1	**-12.8**	**0.8**
Diorite	Development	3	8.1	8.7	2.3	121	119	150
	Ore	1	7.7	9.6	9.1	91.5	82.4	10.1
Rhyolite	Development	10	8.4	7.6	1.8	23.0	21.2	65.2
Stibnite Stock	Development	3	7.0	5.3	5.4	11.5	6.2	4.4
Calc-silicate	Development	23	8.6	7.7	5.5	323	317	805
	Ore	8	8.1	8.9	32.6	210	177	93.8
Carbonate	Development	13	8.7	8.5	1.9	725	723	1926
Quartzite	Development	34	8.3	6.3	4.4	61.3	57.1	96.0
	Ore	3	8.6	6.6	7.8	41.4	33.6	6.4
Schist	Development	14	8.1	7.5	7.7	45.8	38.3	19.4
	Ore	6	8.4	-	30.9	135	104	7.0
Breccia	Development	15	8.1	8.1	20.6	58.6	38.0	18.8
	Ore	15	7.9	4.9	44.3	57.2	12.9	5.7
Gouge	Development	32	8.1	8.1	16.1	113	97.2	122
	Ore	7	8.2	6.2	35.4	36.4	1.0	1.1
Alluvium	Development	6	8.6	5.6	<0.3	12.2	12.2	40.6
Tailings	Processed Ore	5	8.7	7.5	6.5	113	106	26.7

Source: SRK 2017, 2021a
[1]NAG testing conducted on a subset of samples where acid-generating potential was uncertain based on ABA analyses.

Siderite (iron carbonate) is a mineral reported in the project deposits. The presence of siderite can result in the overestimation of neutralization potential. Therefore, a subset of samples was submitted for the Siderite Correction Method analyses and those results indicated that the correction was not required for project lithologies.

The ABA analyses indicate that while detectable sulfides are present in all the development rock and ore lithologies (aside from the alluvium), most lithologies are not prone to acid-generation as observed in the paste pH results. Ore samples typically had higher acid-generating potentials than development rock samples due to their higher sulfide concentrations.

Net Acid Generation Analysis

Static Net Acid Generation (NAG) tests are conducted to determine the maximum potential for acid generation. The NAG test provides a direct empirical estimate of the overall sample reactivity, including any acid generated by semi-soluble sulfate minerals along with acid generation by sulfide minerals. In this regard, the NAG test differs from the Static ABA test and thus provides another measure of the potential for acid-generation by sulfide and sulfate bearing samples from materials in the SGP lithology.

The method used for NAG testing was that summarized by Stewart et al. (2006). This method involves intensive oxidation of the sample with hydrogen peroxide, which accelerates the oxidation of sulfide and dissolution of sulfate minerals. The leachate is then titrated with sodium hydroxide in two stages (pH 4.5 and pH 7.0) to determine the NAG value. The NAG values are calculated from an equation using the titration results.

NAG testing confirmed that ores from the alaskite, quartz monzonite, granite, quartz monzonite-alaskite, and breccia lithologies had the potential for acid-generation. However, while some individual development rock samples exhibited low potential for acid-generation, the development rock tested was non-acid-generating in aggregate (SRK 2021a).

Meteoric Water Mobility Procedure (MWMP) Results

The MWMP test is used to evaluate the leachability of metals from mine material by a laboratory simulation of rainwater leaching in the environment. The MWMP is conducted according to standard test methods (ASTM E-2242-02 [ASTM 1996]) that involve a 24-hour single pass column leach using a ratio of 1:1 for distilled water: rock material. The resulting leachate is analyzed for metals and other analytes of interest. Because materials tested in the procedure must be crushed to a finer state than would occur in field-scale mined materials in order to accelerate reactions in the laboratory, the MWMP results provide a qualitative evaluation of potential leachability of material types. The MWMP test is best applied to oxidized materials as it does not account for changes in pH resulting from long-term oxidation reactions because it is a single pass test.

MWMP tests were run on samples collected from subsurface drill cores and on samples collected from weathered rock exposures on site (**Tables 3.9-6a** and **3.9-6b**). Tests on core samples had circumneutral pH with low total dissolved solids (TDS) with concentrations below 280 mg/L. Test effluent concentrations of aluminum, antimony, arsenic, and mercury frequently exceeded their respective most stringent water quality criteria while concentrations of other analytes were generally not detected at concentrations above their criteria (SRK 2017). Tests on weathered surface materials also had circumneutral pH with the exception of one sample of alaskite material that had an acidic pH of 3.8. Leached TDS concentrations from the weathered rock were generally higher than those from core samples ranging between 77 mg/L and 630 mg/L for non-acidic leachate and 2,300 mg/L for the acidic alaskite sample. Like the tested cores samples, effluent concentrations of antimony, arsenic, and mercury were generally above criteria. However, aluminum concentrations were low or below reported detection limits except for the acid-generating sample. This suggests that the leachable mass of aluminum is exhausted more readily in exposed rock than the leachable masses of antimony, arsenic, and mercury.

Tailings Decant Solution Chemistry

Decant solution chemistry for five samples of metallurgical pilot program tailings materials representative of the different ores that would be processed during the project lifetime, yielded circum-neutral to alkaline pH values between 7.2 and 9.4 (**Table 3.9-7**). Several constituents in the decant solutions were present at concentrations above their most stringent potentially applicable criteria including antimony, arsenic, mercury, sulfate, and TDS (SRK 2021b). Residual cyanide in the tailings was measured in two of the five tests. Constituent concentrations from Yellow Pine pit and Hangar Flats pit decant solutions were generally higher than the concentrations in the West End pit decant solution, consistent with the lower total concentrations of these analytes in the West End ore based on whole rock analyses (**Table 3.9-4**).

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Table 3.9-6a Average MWMP Results – Development Rock and Ore

Parameter	Units	Strictest Potentially Applicable Standard	Alaskite Core	Alaskite Surface	Quartz Monzonite Core	Quartz Monzonite Surface	Granite Core	Quartz Monzonite/ Alaskite Core	Rhyolite Core	Calc-Silicate Core	Calc-Silicate Surface	Diorite Core	Quartzite Core	Quartzite Surface	Schist Core	Schist Surface
Samples			3	1	6	6	1	6	2	5	1	2	2	1	2	1
Alkalinity	mg/L $CaCO_3$	>20	98	-	72	-	13	48	9	11	50	16	15	16	5	53
Aluminum	mg/L	0.05	0.047	20	0.054	2.7	<0.045	0.049	0.067	0.058	<0.045	0.070	0.069	<0.045	0.13	<0.045
Antimony	mg/L	0.0052	0.041	0.012	0.026	0.339	0.13	0.061	<0.0025	0.0035	0.005	0.039	0.0028	0.005	<0.0025	0.005
Arsenic	mg/L	0.01	0.25	0.2	0.37	0.91	2.6	0.49	0.0075	0.014	0.05	0.013	0.017	0.10	<0.01	0.02
Barium	mg/L	2	0.011	<0.01	<0.01	0.03	<0.01	0.011	<0.01	<0.01	<0.01	0.012	<0.01	<0.01	<0.03	<0.01
Beryllium	mg/L	-	<0.001	0.09	<0.001	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003	<0.001
Bismuth	mg/L	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.3	<0.1
Boron	mg/L	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.3	<0.1
Cadmium	mg/L	0.00033	<0.001	0.002	<0.001	0.0004	<0.001	<0.001	<0.001	<0.001	<0.00015	<0.001	<0.001	<0.00015	<0.001	<0.00015
Calcium	mg/L	-	7	430	5	47	15	5	3	5	31	14	6	12	2	83
Chloride	mg/L	230	1	10	2	3	11	2	<1	2	<1	<1	3	<1	<1	<1
Chromium	mg/L	0.0106	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.015	<0.005
Cobalt	mg/L	-	<0.01	0.28	<0.01	0.018	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	mg/L	0.002	<0.05	0.41	<0.05	0.032	<0.05	<0.05	<0.05	<0.05	<0.003	<0.05	<0.05	0.0042	<0.05	<0.003
Fluoride	mg/L	2	<0.1	1.2	<0.1	0.44	<0.1	0.1	<0.1	<0.1	0.15	0.12	<0.1	<0.1	<0.1	0.22
Iron	mg/L	0.3	<0.01	0.65	<0.01	3.01	<0.01	0.11	<0.01	<0.01	<0.01	0.03	<0.01	0.016	0.03	<0.01
Lead	mg/L	0.0009	<0.0025	0.002	<0.0025	0.001	<0.0025	<0.0025	<0.0025	<0.0025	<0.0007	<0.0025	<0.0025	<0.0007	<0.0025	<0.0007
Magnesium	mg/L	-	3	110	1	23	2	1	1	2	1	4	2	2	2	2
Manganese	mg/L	0.05	0.028	9.2	0.007	1.18	0.022	0.011	<0.005	0.008	<0.005	0.041	0.006	<0.005	0.015	<0.005
Mercury	mg/L	0.000012	<0.0002	<0.0001	0.00012	0.0003	0.00021	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00019	<0.0001	<0.0002	<0.0001
Molybdenum	mg/L	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.03	<0.01
Nickel	mg/L	0.024	<0.01	0.93	<0.01	0.015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate	mg/L as N	-	<1	0.5	<1	1.52	<1	<1	<1	<1	2	<1	<1	6.3	<1	1.3
Nitrite	mg/L as N	-	0.028	0.12	0.029	0.09	0.027	0.029	0.027	<0.025	0.030	<0.025	0.032	0.030	<0.025	0.030
pH	s.u.	6.5 – 9.0	7.0	3.8	6.8	5.2	6.8	6.7	6.8	6.8	7.9	6.9	6.8	6.8	6.6	7.4

Parameter	Units	Strictest Potentially Applicable Standard	Alaskite Core	Alaskite Surface	Quartz Monzonite Core	Quartz Monzonite Surface	Granite Core	Quartz Monzonite/ Alaskite Core	Rhyolite Core	Calc-Silicate Core	Calc-Silicate Surface	Diorite Core	Quartzite Core	Quartzite Surface	Schist Core	Schist Surface
Phosphorus	mg/L	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	1.5	<0.5
Potassium	mg/L	-	2	7	1	3	3	1	1	1	5	2	1	2	2	8
Selenium	mg/L	0.0031	<0.01	0.004	<0.01	0.003	<0.005	<0.01	<0.01	<0.01	<0.002	<0.005	<0.01	<0.002	<0.01	<0.002
Silver	mg/L	0.0007	<0.005	<0.0004	<0.005	<0.0004	<0.005	<0.005	<0.005	<0.005	<0.0004	<0.005	<0.005	<0.0004	<0.005	<0.0004
Sodium	mg/L	-	2	1	1	1	1	1	1	<0.5	<0.5	3	1	<0.5	2	2
Sulfate	mg/L	250	21	1800	6	243	18	6	<1	5	31	39	2	2	<1	160
Thallium	mg/L	0.000017	<0.005	<0.0004	<0.005	<0.0004	<0.002	<0.002	<0.005	<0.002	<0.0004	<0.001	<0.005	<0.0004	<0.002	<0.0004
TDS	mg/L	500	52	2300	37	341	64	36	50	47	110	97	39	80	23	300
Vanadium	mg/L	-	<0.01	0.013	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.03	<0.01
Zinc	mg/L	0.054	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.014	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Source: SRK 2021a
< denotes less than reported analytical detection limit; in many instances analytical detection limits for mercury are higher than the most stringent applicable standard.

Table 3.9-6b Continuation of Average MWMP Results – Development Rock and Ore

Parameter	Units	Strictest Potentially Applicable Standard	Breccia Core	Breccia Surface	Carbonate Core	Carbonate Surface	Gouge Core	Gouge Surface	Hangar Flats Alluvium	Bradley Dumps Alluvium	West Side East Fork SFSR Alluvium
Samples			1	1	2	1	1	1	6	2	4
Alkalinity	mg/L $CaCO_3$	>20	32	19	14	52	14	45	30	7	5
Aluminum	mg/L	0.05	<0.045	<0.045	0.048	<0.045	0.076	<0.045	0.096	0.050	0.29
Antimony	mg/L	0.0052	0.45	0.53	0.013	0.018	0.014	0.26	0.033	0.0038	0.032
Arsenic	mg/L	0.01	0.35	2.20	0.16	0.032	0.022	0.08	0.67	0.03	0.003
Barium	mg/L	2	0.16	0.04	<0.01	<0.01	0.086	0.06	0.16	0.02	0.04
Beryllium	mg/L	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bismuth	mg/L	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.04	<0.05
Boron	mg/L	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.15	<0.02	0.038
Cadmium	mg/L	0.00033	<0.001	<0.00015	<0.001	<0.00015	<0.001	0.00032	<0.00015	<0.00005	<0.00007
Calcium	mg/L	-	42	100	5	17	3	120	6	6	2
Chloride	mg/L	230	5	5	4	<1	<1	5	3	1	3
Chromium	mg/L	0.0106	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0005	<0.0125
Cobalt	mg/L	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.0125
Copper	mg/L	0.002	<0.05	0.011	<0.05	<0.003	<0.05	0.003	0.005	0.0009	<0.0125
Fluoride	mg/L	2	0.16	0.5	<0.1	0.12	<0.1	0.53	0.75	0.30	0.13
Iron	mg/L	0.3	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	0.81	0.06	0.18
Lead	mg/L	0.0009	<0.0025	<0.0007	<0.0025	<0.0007	<0.0025	<0.0007	0.0008	0.0006	0.00015
Magnesium	mg/L	-	1	31	3	5	1	39	1	1	<1
Manganese	mg/L	0.05	0.21	0.12	<0.005	<0.005	<0.005	0.016	0.034	<0.01	0.030
Mercury	mg/L	0.000012	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	<0.0001	0.00011	0.000024	<0.0002
Molybdenum	mg/L	-	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.048	<0.02	<0.025
Nickel	mg/L	0.024	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.008	0.011
Nitrate	mg/L as N	-	<1	35	<1	2	<1	1	<0.1	-	-
Nitrite	mg/L as N	-	0.029	0.12	0.028	0.040	<0.025	0.14	<0.05	-	-
pH	s.u.	6.5 – 9.0	7.2	7.0	7.0	7.4	6.8	7.4	7.5	6.6	6.3
Phosphorus	mg/L	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.15	0.25
Potassium	mg/L	-	6	29	1	2	2	22	1	1	4

Parameter	Units	Strictest Potentially Applicable Standard	Breccia Core	Breccia Surface	Carbonate Core	Carbonate Surface	Gouge Core	Gouge Surface	Hangar Flats Alluvium	Bradley Dumps Alluvium	West Side East Fork SFSR Alluvium
Selenium	mg/L	0.0031	<0.01	<0.002	<0.01	<0.002	<0.01	<0.002	<0.002	<0.0001	0.0002
Silver	mg/L	0.0007	<0.005	<0.0004	<0.005	<0.001	<0.005	<0.0004	<0.0004	<0.0001	0.00018
Sodium	mg/L	-	8	1	<0.5	1	2	2	24	6	3
Sulfate	mg/L	250	150	290	5	5	1	400	26	20	1
Thallium	mg/L	0.000017	<0.002	<0.0004	<0.001	<0.0004	<0.005	<0.0004	<0.0005	<0.0001	<0.0001
TDS	mg/L	500	280	600	52	77	29	630	137	67	103
Vanadium	mg/L	-	0.022	<0.01	<0.01	<0.01	<0.01	0.013	<0.01	<0.01	<0.0125
Zinc	mg/L	0.054	<0.01	<0.01	<0.01	<0.01	0.035	<0.01	0.019	<0.02	<0.025

Source: SRK 2021a
< denotes less than reported analytical detection limit; in many instances analytical detection limits for mercury are higher than the most stringent applicable standard.

Table 3.9-7 Tailings Decant Solution Chemistry (mg/L)

Parameter	Yellow Pine and Hangar Flats Tailings (SB100 Con 10 PP)	Late Yellow Pine Tailings (Con 5 combined tailings)	West End Sulfide Tailings (Con 11 combined tailings)	West End and Hangar Flats Tailings (Con 12 combined tailings)	West End Oxide Tailings WEV03	Weighted consolidation water chemistry[1]
Proportion - all Mine Years	32%	21%	11%	6%	30%	100%
Proportion - last 3 years of tailings production	0%	18%	12%	3%	67%	100%
pH	8.38	7.93	8.38	8.50	7.24	7.95
Alkalinity, CaCO3	170	130	210	190	130	155
Ag	0.015	0.00057	< 0.0020	< 0.0020	< 0.0008	0.0055
Al	< 0.45	< 0.45	< 0.45	< 0.45	< 0.25	-
As	6.50	11.0	11.0	12.0	0.042	6.35
B	< 1.00	< 1.00	< 1.00	< 1.00	< 0.50	-
Ba	< 0.10	0.15	< 0.10	< 0.10	< 0.10	0.11
Be	< 0.010	< 0.010	< 0.010	< 0.010	< 0.0050	-
Ca	470	580	560	470	200	422
Cd	0.00030	< 0.00015	< 0.00075	< 0.00075	0.0003	0.00034
Cl	< 100	13.0	< 100	< 100	20.0	57.5
Co	< 0.10	< 0.10	< 0.10	< 0.10	< 0.050	-
Cr	< 0.050	< 0.050	< 0.050	< 0.050	< 0.025	-
Cu	0.29	0.047	0.55	0.39	0.12	0.22
F	< 10.0	2.10	< 10.0	< 10.0	< 1.00	5.62
Fe	< 0.20	< 0.20	< 0.20	< 0.20	< 0.10	-
Hg	0.00096	0.00024	0.097	0.068	0.00015	0.015
K	210	66.0	71.0	80.0	67.0	113

Parameter	Yellow Pine and Hangar Flats Tailings (SB100 Con 10 PP)	Late Yellow Pine Tailings (Con 5 combined tailings)	West End Sulfide Tailings (Con 11 combined tailings)	West End and Hangar Flats Tailings (Con 12 combined tailings)	West End Oxide Tailings WEV03	Weighted consolidation water chemistry[1]
Mg	430	120	370	330	31.0	232
Mn	0.11	0.84	0.18	0.18	0.14	0.29
Mo	< 0.20	0.20	< 0.20	< 0.20	0.15	0.18
Na	5000	520	6800	5700	1300	3176
Ni	< 0.10	< 0.10	< 0.10	< 0.10	< 0.050	-
P	< 5.00	< 5.00	< 5.00	< 5.00	< 2.50	-
Pb	< 0.0014	< 0.0007	< 0.0035	< 0.0035	< 0.0014	-
Sb	0.13	0.16	5.60	4.00	0.085	0.96
Se	< 0.040	< 0.0040	< 0.040	< 0.040	< 0.0040	-
SO4	12000	2600	15000	13000	2400	7508
Tl	0.0044	0.00046	0.0046	0.0041	< 0.0008	0.0025
V	< 0.10	< 0.10	< 0.10	< 0.10	< 0.050	-
Zn	< 0.10	< 0.10	< 0.10	< 0.10	< 0.050	-
Total nitrogen, N	< 15.0	1.90	22.0	< 15.0	< 1.25	8.85
NO2 + NO3, N	N/A	N/A	N/A	N/A	N/A	N/A
Cyanide, total	0.11	0.033	0.090	0.17	0.19	0.12
Cyanide, WAD	0.059	0.015	0.011	0.023	0.16	0.073
TDS	15000	2743	20000	15000	3700	9544

All concentrations are for dissolved constituents unless otherwise noted.

'<' indicates value is below analytical detection limits; 'NA' indicates not analyzed.

[1] Weighted consolidation water chemistry is a weighted average of the five decant solution samples, with chemistry weighted according to the production of each tailings stream during the entire mine life. For parameters that are below detection for all five samples, the parameter was excluded from the weighted consolidation water chemistry. For parameters that have one or more value below detection, the detection limit was used in the calculation of the weighted consolidation water chemistry.

'-' Indicates parameter was below analytical detection limits in all samples and was not included in the model input.

Humidity Cell Test Results

The Phase 1 and Phase 2 HCT cells were operated for between 98 and 184 weeks to achieve stable effluent chemistry. The methodology for humidity cell testing calls for a test duration of 20 weeks. In practice, HCT cells are run until their effluent chemistries stabilize and the potential for acid-generation can be conclusively determined. The termination of each HCT test for the SGP was approved by the Forest Service once these conditions were met. Leachate from each of the HCTs was circum-neutral to moderately alkaline, with pH values ranging from 6.5 to 9.1. The effluent pH also was stable for each of the test cells, indicating that acid generation did not occur, or that the available neutralizing potential was sufficient to offset any acid generation. SRK (2017, 2021b, 2021a) also found that the consumption of neutralizing potential was slow in each of the HCT cells, with over 80 percent of the initial neutralizing potential remaining when the cells were terminated. This indicates that significant buffering capacity is still available and/or that acid generation is limited or occurs at a slow rate despite relatively high sulfide concentrations in the tested samples. These results are consistent with observations from the site. Historic waste rock and tailings have been left at the surface for decades (a duration more than 50 years longer than the proposed SGP mine life), with little evidence of acid rock drainage (SRK 2017).

Despite the finding of low acid generation potential, a few metals constituents still proved to be leachable from the HCTs under neutral to alkaline pH conditions (**Table 3.9-8**). A few constituents are mobile under these neutral to alkaline pH conditions, including aluminum, antimony, arsenic, manganese, and mercury, which were frequently leached at concentrations above the strictest potentially applicable surface water quality standard. In addition, sulfate, selenium, TDS, copper, cadmium, and zinc were occasionally elevated above the respective water quality criteria. Concentrations of beryllium, bismuth, boron, cadmium, chromium, cobalt, lead, lithium, molybdenum, nickel, selenium, silver, tin, titanium, and vanadium were at or below the strictest potentially applicable water quality criteria in the HCT leachates, indicating a low potential for leaching of these constituents (SRK 2020, 2021a).

Table 3.9-8 Summary of Humidity Cell Test

Lithology	Ending pH Range	Remnant Neutralizing Potential	Constituents with at least one analysis above the strictest potentially applicable water quality criteria	Description
Alaskite (3 tests)	7.2-8.0	>80%	Alkalinity, aluminum, antimony, arsenic, copper, manganese, mercury, sulfate, thallium, and TDS	Effluent arsenic and antimony concentrations were above standards throughout the test with peak arsenic concentrations of 2.2 mg/L. Other exceedances occurred sparsely, typically in the during the first 28 weeks of the tests.

Lithology	Ending pH Range	Remnant Neutralizing Potential	Constituents with at least one analysis above the strictest potentially applicable water quality criteria	Description
Quartz Monzonite / Alaskite (3 tests of composites from Hangar Flats and Yellow Pine rock types where alaskite occurs as dikes)	6.7-8.0	>79%	Alkalinity, aluminum, antimony, arsenic, copper, lead, manganese, mercury, and nickel	Effluent arsenic and antimony concentrations were above standards throughout the test with peak arsenic and antimony concentrations of 5.2 mg/L and 0.52 mg/L, respectively. Other exceedances occurred sparsely, typically in the during the first eight weeks of the tests.
Quartz Monzonite (4 tests)	7.7-8.0	>91%	Alkalinity, aluminum, antimony, arsenic, lead, manganese, mercury, and zinc	Effluent arsenic and antimony concentrations were above standards throughout the test with peak arsenic and antimony concentrations of 3.4 mg/L and 0.29 mg/L, respectively. Other exceedances occurred sparsely, typically in the during the first eight weeks of the tests.
Diorite (1 test)	8.3	95%	Aluminum, antimony, manganese, and sulfate	Effluent antimony concentrations were above standards throughout the test. Other exceedances occurred sparsely, typically in the during the first five weeks of the test.
Quartzite (1 test)	8.7	>99%	Aluminum, antimony, arsenic, copper, mercury, selenium, silver, and thallium	Effluent arsenic concentrations up to 0.2 mg/L were above its standard throughout the test. Antimony concentrations were above its standard for 100 weeks of testing before decreasing to levels below the standard. Other exceedances occurred sparsely, typically in the during the first four weeks of the test.
Rhyolite (1 test)	8.3	87%	Aluminum, antimony, arsenic, fluoride, and mercury	Antimony concentrations were above its standard for 50 weeks of testing before decreasing to levels below the standard. Other exceedances occurred sparsely.
Calc-Silicate (2 tests)	7.7-8.0	>97%	Alkalinity, aluminum, antimony, arsenic, copper, lead, manganese, mercury, selenium, sulfate, and TDS	Effluent arsenic and antimony concentrations were above standards throughout the test with peak arsenic and antimony concentrations of 1.9 mg/L and 0.15 mg/L, respectively. Other exceedances occurred sparsely.
Schist (2 tests)	7.8-8.2	>86%	Alkalinity, aluminum, antimony, arsenic, copper, manganese, and mercury	Effluent arsenic and antimony concentrations were above standards throughout the test. Other exceedances occurred sparsely.

Lithology	Ending pH Range	Remnant Neutralizing Potential	Constituents with at least one analysis above the strictest potentially applicable water quality criteria	Description
Carbonate (2 tests)	8.0-8.1	>99%	Aluminum, antimony, arsenic, copper, lead, mercury, and nickel	Effluent antimony concentrations were above its standard throughout the test while one test exhibited sustained arsenic concentrations above its standard. Aluminum concentrations were observed above its standards in approximately 20% of the analytical results. Other exceedances occurred sparsely.
Gouge (1 test)	7.9	91%	Alkalinity, aluminum, antimony, arsenic, cadmium, manganese, and mercury	Effluent arsenic and antimony concentrations were above standards throughout the test. Other exceedances occurred sparsely, typically in the during the first 28 weeks of the test. There were occasional detections of mineral acidity, but these were <40% of effluent alkalinity concentrations.
Breccia (1 test)	8.0	90%	Alkalinity, antimony, arsenic, manganese, mercury, and TDS	Effluent arsenic and antimony concentrations were above standards throughout the test. Other exceedances occurred sparsely, typically in the during the first week of the test.
Granite (1 test)	7.3	91%	Alkalinity, aluminum, antimony, arsenic, manganese, and mercury	Effluent arsenic and antimony concentrations were above standards throughout the test. Other exceedances occurred sparsely, typically in the during the first 16 weeks of the test.

HCT analytical results were utilized in developing modeling source terms for the water chemistry predictions. In the development of source terms, the initial flushes from the HCTs were not utilized (SRK 2018a) because the first flush chemistries would be indicative of material leaching during the mine operating period, when leachate would be collected as contact water for water treatment or would be expected to dissipate in the near-term due to dilution and/or solubility controls. For the principal constituents of interest, antimony and arsenic, HCT concentrations from the first 12 weeks of testing were compared concentrations derived from the long-term testing. First flush antimony concentrations ranged between one half and twelve times the long-term antimony concentrations while first flush arsenic concentrations ranged between one half and five times the long-term arsenic concentrations. In aggregate, retaining first flush concentrations in the source term calculations would result in higher predicted model concentrations. However, predicted antimony and arsenic concentrations are above the strictest potentially applied water quality standard regardless of assumptions applied to first flush HCT chemistry.

Potentially Acid-Generating Material Threshold

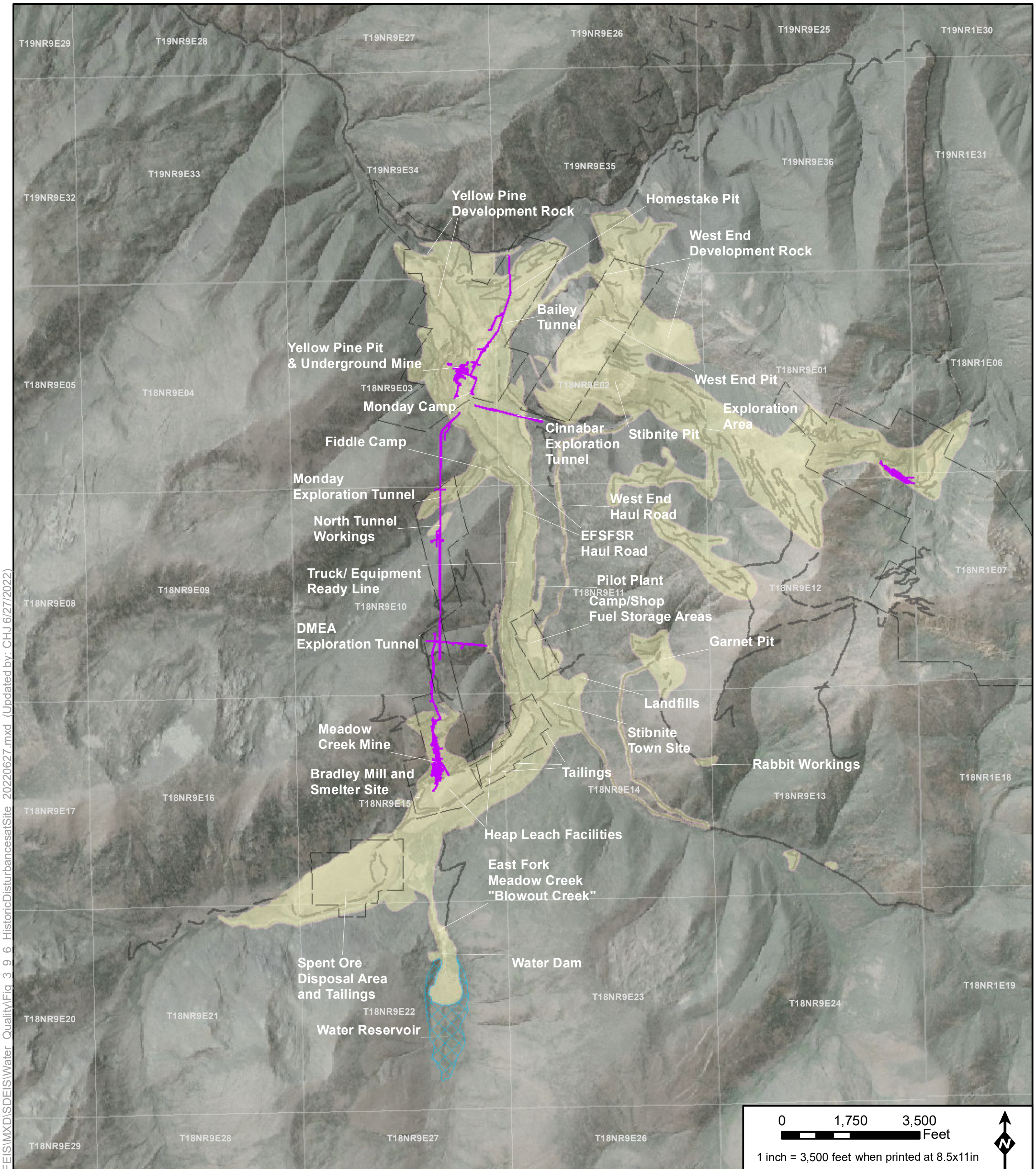
The threshold developed to identify PAG material was established to be NPR = 1.5. This value falls between the MEND Prediction Manual for Drainage Chemistry from Sulfidic Geology Materials (MEND 2009) thresholds for PAG (NPR < 1) and non-PAG (NPR > 2). This value was verified through examination of the ABA, NAG, and humidity cell test data where samples with NPR > 1.5 did not yield acidic pH in their paste pH, NAG pH or humidity cell effluent. Further, none of the samples with NPR < 1.5 generated acidity when tested via kinetic tests. However, humidity cell tests of these materials also exhibited higher concentrations of calcium, magnesium, and sulfate in their effluent, suggesting that acid-generating and acid-neutralization reactions were occurring within the test sample. Therefore, the NPR = 1.5 threshold was selected to identify PAG material (SRK 2018b, Figure 3-5).

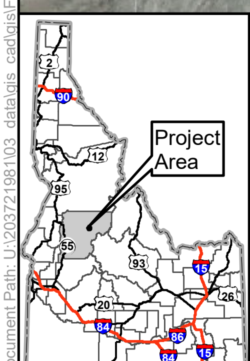
3.9.4.3 Geochemical Influence of Historical Mining Wastes

Mining and mineral processing, primarily of gold, antimony, and tungsten, have occurred at and in the vicinity of the mine site intermittently since the early 1900s. Historical features at the mine property are shown on **Figure 3.9-6**. The types of waste generated by past mining activity include spent ore (i.e., material that has been leached or otherwise processed to recover metals) in the SODA and heap leach pads, tailings (i.e., Bradley tailings), and waste rock in the Bradley and West End dumps. These historical mining wastes have created geochemical and legacy impacts typical for this type of mining district that are part of the affected environment. The following sections describe the geochemical influence of the historical mining wastes on water quality.

Locally, concentrations of antimony, arsenic, mercury, and cyanide in surface water are potentially attributable to the geochemistry of historical mining wastes present at the mine site (URS 2000b). In the late 1990s, concentrations of antimony and arsenic in Meadow Creek were highest immediately below the historical Bradley tailings deposits in the lower Meadow Creek valley, suggesting that the Bradley tailings provide a continuous source of antimony and arsenic in Meadow Creek (URS 2000b). This conclusion also is supported by recent data collected during Perpetua's surface water quality baseline study, which indicate that dissolved antimony concentrations in Meadow Creek increase from an average of 0.32 micrograms per liter (µg/L) at YP-T-33 above the SODA (**Figures 3.9-7** and **3.9-8**) to 6.1 µg/L at YP-T-27 below Keyway Marsh. Average dissolved arsenic concentrations also increase along this stretch from 1.2 µg/L at YP-T-33 to 34.8 µg/L at YP-T-27 (Midas Gold 2019c). Farther downstream in Meadow Creek and the East Fork SFSR, average dissolved arsenic concentrations vary by location (**Figure 3.9-9**), but average dissolved antimony concentrations continue to increase, reaching a high of 31.0 µg/L at East Fork SFSR assessment node YP-SR-4 below the Yellow Pine pit area. The increase in dissolved antimony concentrations downstream of YP-T-27 occurs due to multiple factors including seeps and springs emanating from historical mining features; metals leached from spent ore and waste rock; in situ mineralization traversed by Meadow Creek (i.e., the Hangar Flats deposit), and other naturally occurring mineralization present throughout the East Fork SFSR drainage.

Mercury concentrations are not similarly elevated by the mine tailings and waste rock, despite periodically exceeding the strictest potentially applicable surface water quality standard (**Figure 3.9-10**). Although elevated concentrations of mercury are observed in Sugar Creek, these concentrations have a well-documented source in the upstream Cinnabar (mercury) Mine located outside the proposed SGP mine area. Sugar Creek also traverses known mineralized occurrences (based on outcrop) along its length.





LEGEND

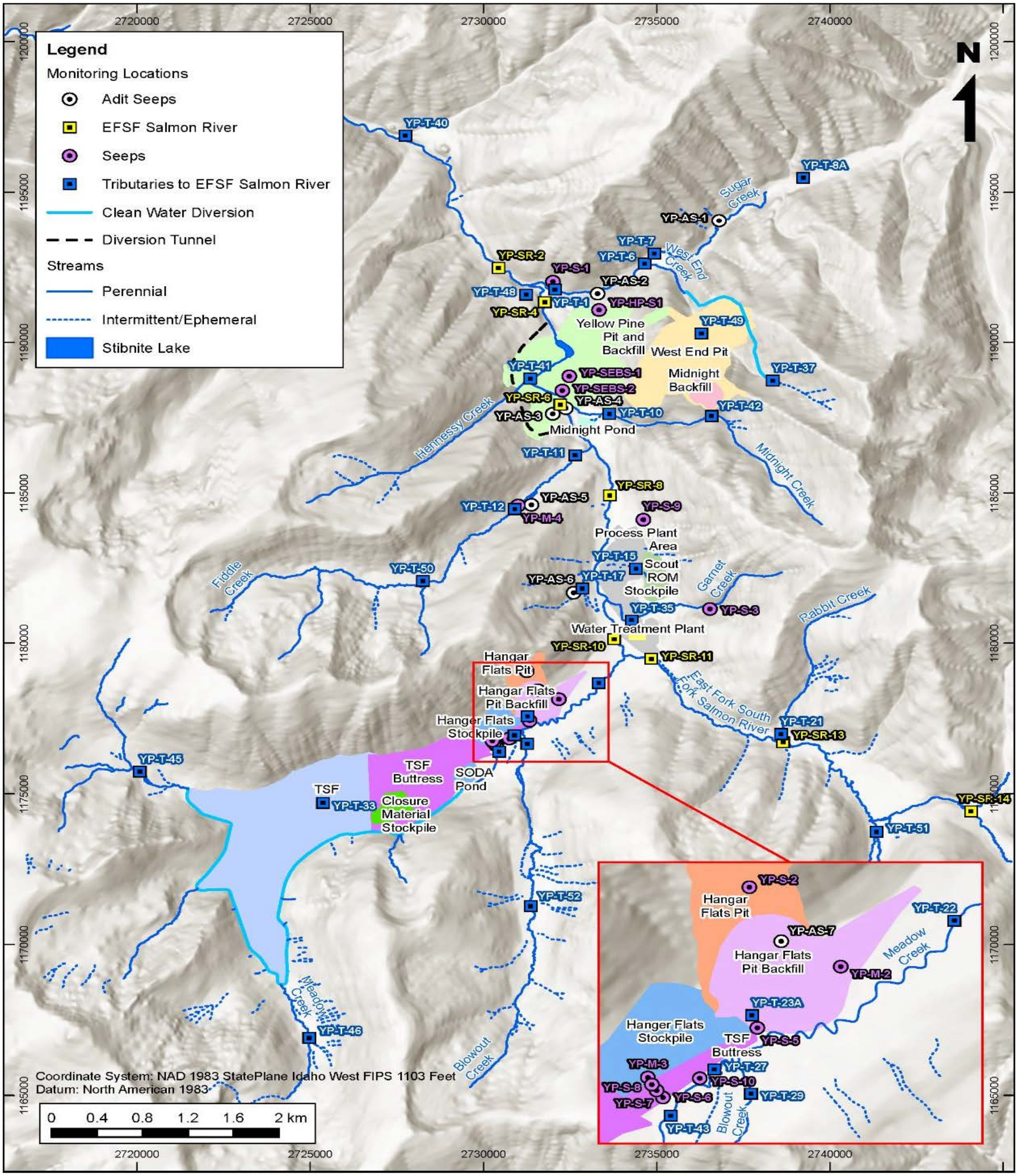
- Roads
- Disturbance Areas
- Underground Workings
- Patented Claims

Figure 3.9-6
Past Mining and Related Activities in the Stibnite Mining District
Stibnite Gold Project
Stibnite, ID

Base Layer: Hillshade derived from LiDAR supplied by Perpetua Gold
Other Data Sources: Perpetua Gold; Boise National Forest; Payette National Forest

PAYETTE NATIONAL FOREST

Document Path: U:\2037219811\03_data\gis_cad\gis\FEIS\MXD\SDEIS\Water_Quality\Fig_3_9_6_HistoricDisturbancesatSite_20220627.mxd (Updated by: CHJ 6/27/2022)



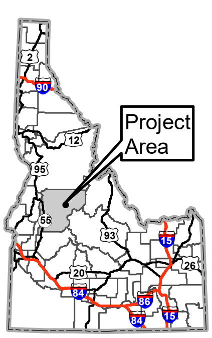
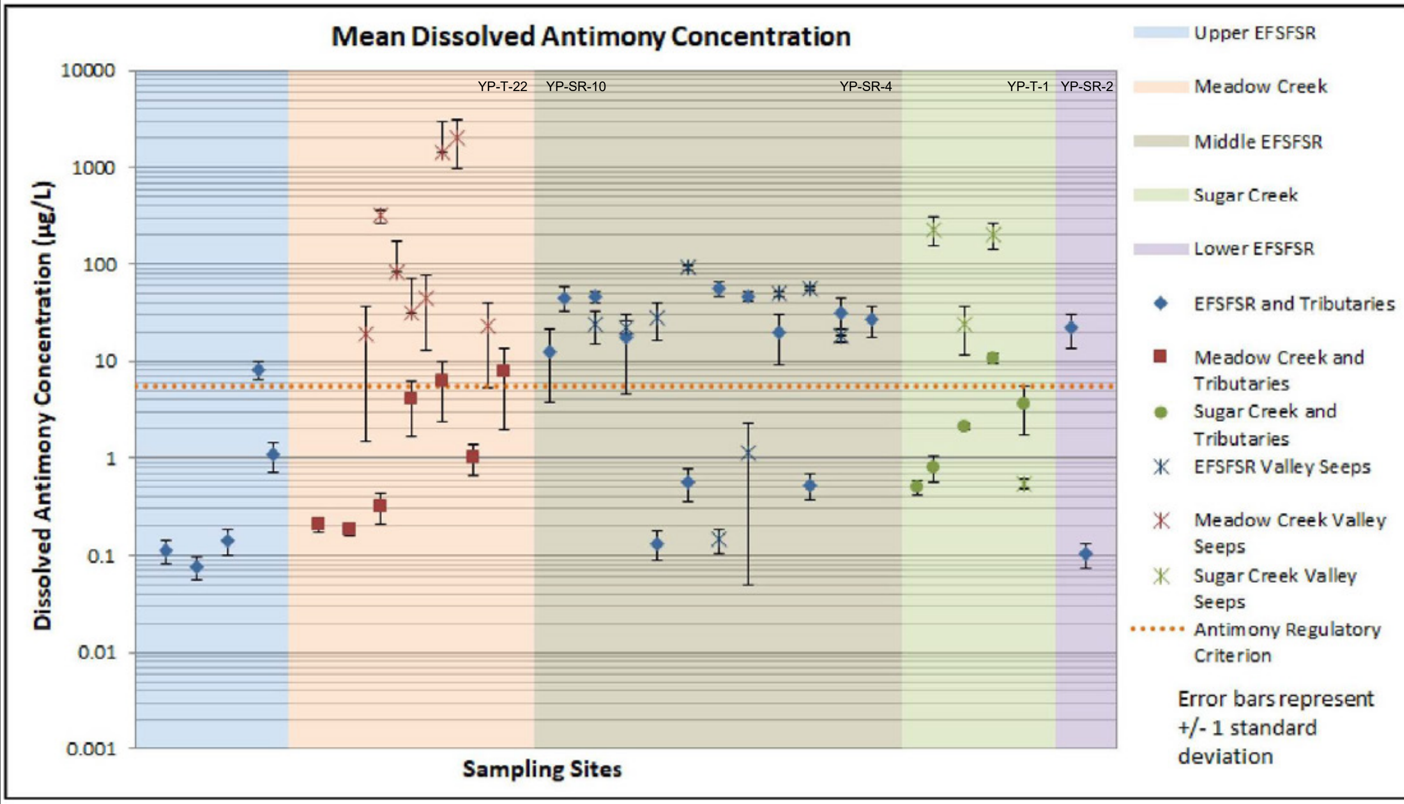


Figure 3.9-7
Surface Water Chemistry Monitoring Locations

Stibnite Gold Project
Stibnite, ID

Data Sources: (SRK 2021)



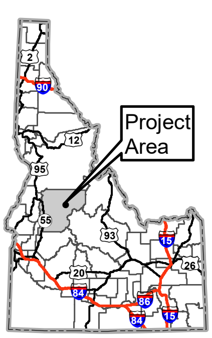
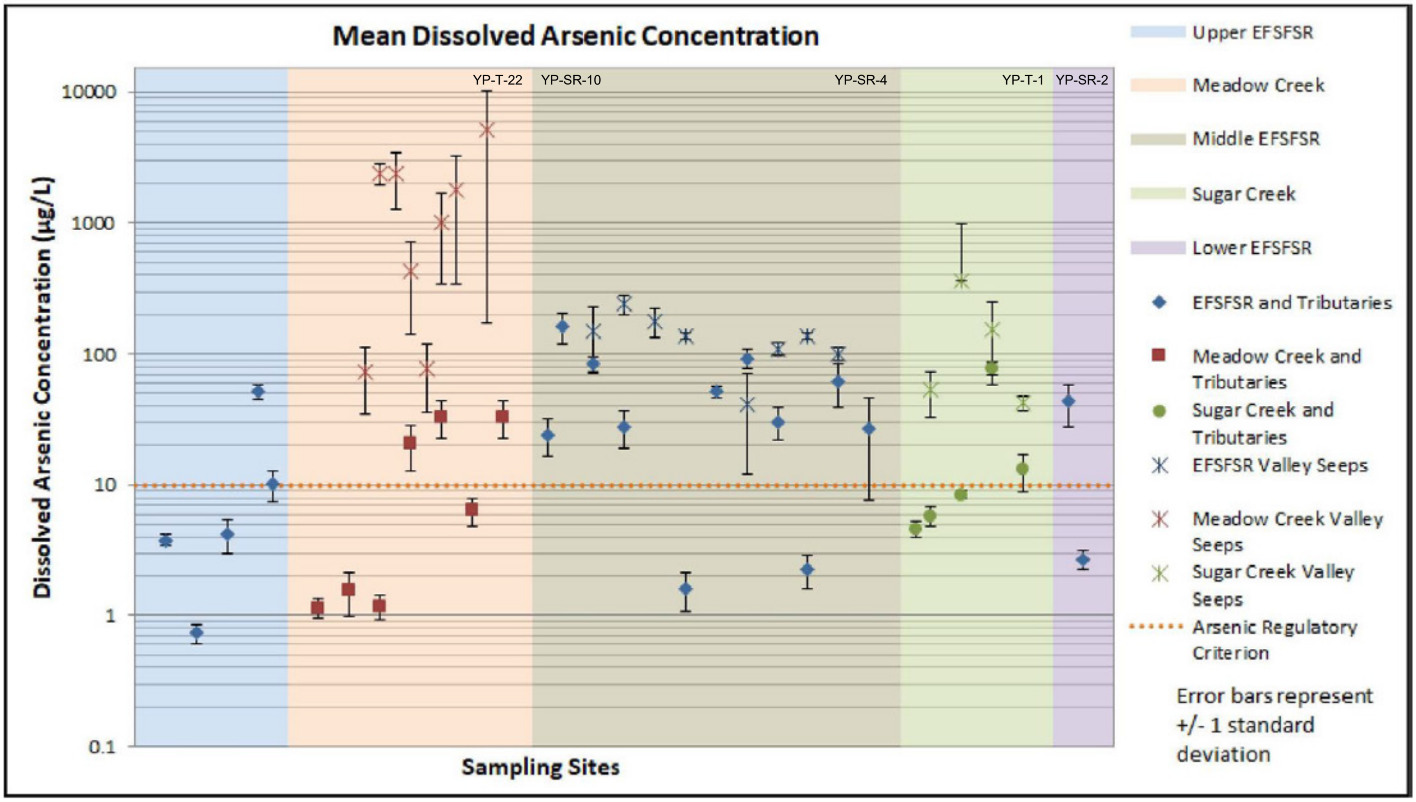


Figure 3.9-8
Dissolved Antimony Concentrations in Surface Water

Stibnite Gold Project
Stibnite, ID

Data Sources: (HDR 2021)



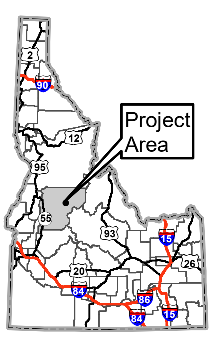
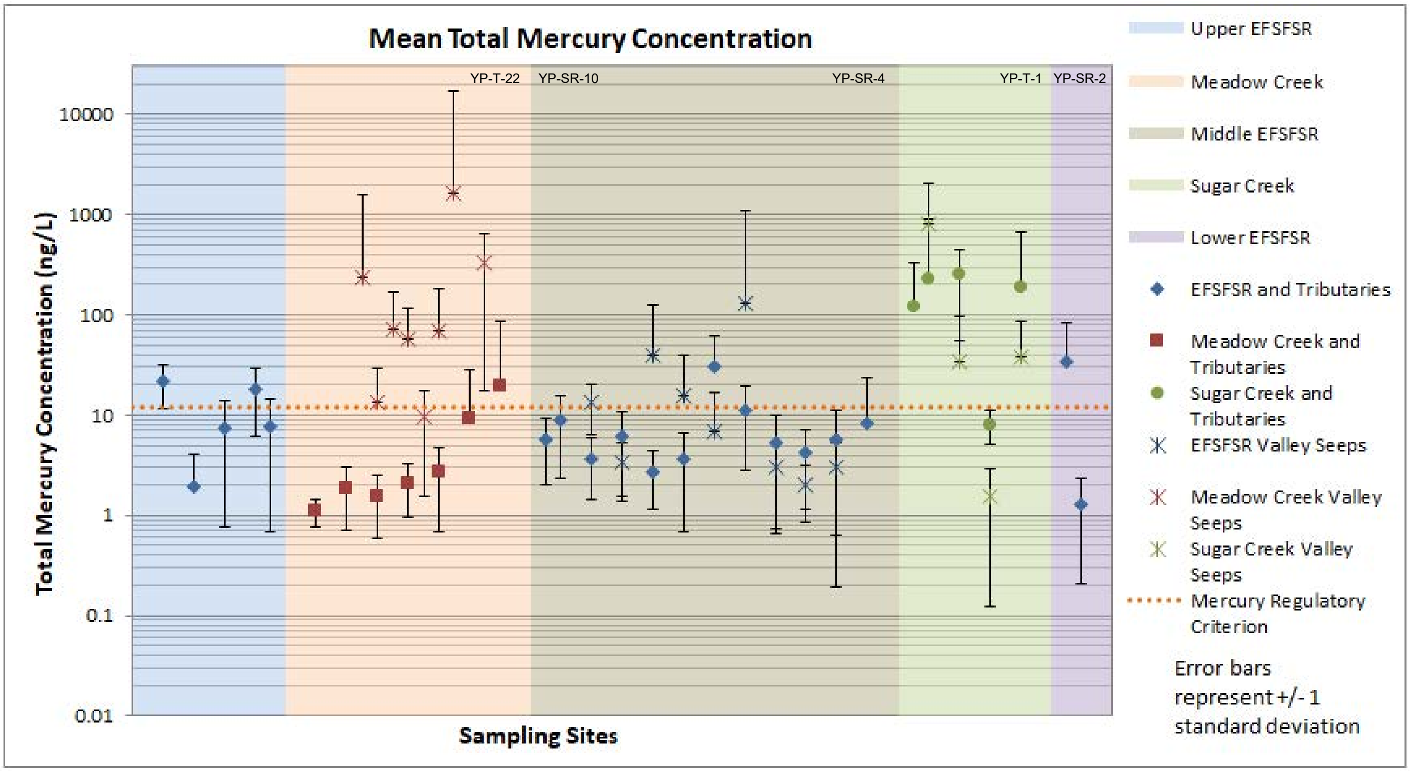


Figure 3.9-9
Dissolved Arsenic Concentrations in Surface Water

Stibnite Gold Project
Stibnite, ID

Data Sources: (HDR 2017)



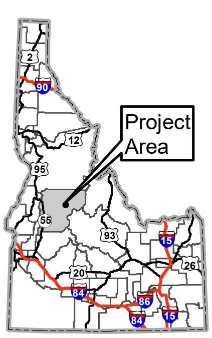


Figure 3.9-10
Total Mercury Concentrations in Surface Water

Stibnite Gold Project
Stibnite, ID

Data Sources: (HDR 2017)

Bradley tailings are present in both upper Meadow Creek valley and lower Meadow Creek valley, where the tailings have been covered with approximately 40 feet of waste rock, alluvial fill material, and neutralized "spent" ore material (URS 2000b). Groundwater hydrology studies have indicated that, in 1997 and 1999, the alluvial aquifer water table elevation was high enough to contact the bottom of the historical Bradley tailings deposit throughout most of the Meadow Creek valley (URS 2000b). Elevated concentrations of dissolved arsenic (over 12,000 µg/L) and dissolved antimony (over 1,000 µg/L) were associated with groundwater wells screened completely or partially in the Bradley tailings material, suggesting that the historical Bradley tailings currently present throughout the Meadow Creek valley have an adverse influence on groundwater quality within the mine site. A more recent study (Brown and Caldwell 2017a) also found elevated arsenic and antimony concentrations in groundwater near the Bradley tailings and former leach pads, with concentrations higher in the alluvial aquifer than in bedrock. The water quality of nearby seeps associated with the Bradley tailings, SODA, and Keyway Dam also was elevated in metals, an indication that historical mining features are impacting the alluvial aquifer.

In the East Fork SFSR valley below Meadow Creek, alluvial and bedrock water quality samples show multiple locations where arsenic and antimony are elevated above applicable groundwater quality standards. Arsenic concentrations tend to be higher in the bedrock aquifer than the alluvium. The higher concentrations of arsenic in bedrock groundwater where little mining activity has occurred may reflect naturally occurring arsenic sources derived from unmined mineralized zones (Brown and Caldwell 2017a).

Historical mining activity at the mine site has contributed to the development of artificial groundwater seeps from tailings, waste rock piles, and adits. Many of these features have been present at the mine site for decades and have been sampled recently as part of baseline monitoring efforts. Natural springs and seeps occur at other locations where the local water table intersects the ground surface and may be the result of geologic features such as faults and fractures intersecting the surface (**Figures 3.9-6** and **3.9-7**).

Data from the mine spoil seeps have been compared to natural seeps. The results of this comparison indicate that at least some of the metals found in the mine spoil seeps are endemic to the region, particularly antimony and arsenic, which were found to exceed the applicable water quality criteria in the majority of natural seep sites sampled (HDR 2017f).

The seeps and springs in the Bradley tailings-impacted areas of the Meadow Creek valley may transport dissolved constituents from groundwater to surface water. Sulfate levels in seeps and springs were variable and ranged from 4 to 136 mg/L, and pH values in the seep and spring water samples ranged from 6.3 to 8.1, indicating that acid rock drainage is not characteristic of the seeps and springs in the mine site area (URS 2000b). Sulfate and pH concentrations in the mine site springs and seeps were similar during the Surface Water Quality Baseline Study, with median values of 42 mg/L for sulfate and 7.2 for pH (Brown and Caldwell 2017a; HDR 2017f). Similarly, in the East Fork SFSR drainage, arsenic and antimony concentrations in seeps and springs are elevated below the Yellow Pine pit and Northwest Bradley waste rock dump, suggesting that these historical mine facilities are responsible for elevated concentrations of arsenic and antimony in discharging groundwater (URS 2000b, HDR 2017f).

3.9.4.4 Surface Water

For a discussion of the mine site surface water hydrology and the sub-watersheds that comprise the analysis area, see **Section 3.8** and the companion Water Quality Specialist Report (Forest Service 2023f).

Operations Area Boundary

This section focuses on quantifying the baseline water chemistry at the 10 surface water assessment node sampling locations (**Figure 3.9-7**). The discussion of baseline chemistry is organized around the water quality indicators, which include pH, temperature, major cations and anions, TDS, metals, methylmercury, sediment content, and organic carbon. It should be noted that baseline water quality at the mine site is influenced by both natural mineralization and historical mining activity (Baldwin and Etheridge 2019). Locally, remnant features from historical mining include underground mine workings; multiple open pits; development rock dumps, piles, and tailings deposits; heap leach pads and spent heap leach ore piles; contaminated soils from the former mill and smelter sites; former surface water diversions, dams, townsites, and roads; and an abandoned water diversion tunnel (Midas Gold 2016a).

Major Ions, pH, and TDS

The average baseline major ion chemistry for the surface water assessment nodes is summarized in **Table 3.9-9**. The East Fork SFSR and Sugar Creek sampling locations each exhibit a calcium-magnesium-bicarbonate water type, meaning that calcium and magnesium are the dominant cations in solution, and bicarbonate is the dominant anion. The samples from Meadow Creek had on average a higher relative proportion of calcium and are therefore classified as calcium-bicarbonate water.

Average TDS concentrations also were consistent in the Meadow Creek and East Fork SFSR sampling locations. The average TDS ranged from 56 to 57 mg/L in the Meadow Creek samples and appears to increase downstream in the East Fork SFSR from about 53 mg/L in the farthest upstream reach (YP-SR-10) to 67 mg/L in the downstream reaches. It appears that despite the higher TDS load in Sugar Creek (116 mg/L), the creek does not appreciably contribute to TDS concentrations in the East Fork SFSR, based on the similar average TDS concentrations obtained for the East Fork SFSR sampling points located just upstream (YP-SR-4) and downstream (YP-SR-2) of the Sugar Creek confluence.

Baseline samples from Fiddle Creek exhibited a slightly different water quality signature compared to the East Fork SFSR and Meadow Creek. Although Fiddle Creek is classified as a calcium- bicarbonate water, the creek has a lower proportion of magnesium and a higher proportion of sodium compared to the other monitoring locations. It also has a lower proportion of sulfate and higher proportion of bicarbonate. Some of these differences may be due to the relatively low average TDS concentration observed in Fiddle Creek during the baseline monitoring period (36 mg/L). The low sulfate and TDS concentrations also could point to a lack of mineralized deposits and historical mining-related impacts in the Fiddle Creek drainage, and different lithologies in the catchment area.

Table 3.9-9 Average Major Ion Chemistry for Surface Water Assessment/Prediction Nodes (mg/L)

Sampling Point	Stream	No. Samples	pH	Hard-ness as CaCO3	Bicarbonate as CaCO3	Calcium	Chloride	Magnesium	Potassium	Sodium	Sulfate	TDS	Water Type
YP-T-27	Meadow Creek	45	7.3	37.4	38.4	11.5	1.25	2.13	0.87	2.44	5.97	57	Calcium-bicarbonate
YP-T-22	Meadow Creek	45	7.4	37.5	39.5	11.3	1.00	2.18	0.84	2.42	5.16	56	Calcium-bicarbonate
YP-SR-10	East Fork SFSR	45	7.4	35.3	38.7	10.3	0.63	2.25	0.78	2.12	4.15	53	Calcium-magnesium-bicarbonate
YP-SR-8	East Fork SFSR	45	7.5	39.1	42.2	11.4	0.73	2.55	0.83	2.36	6.77	60	Calcium-magnesium-bicarbonate
YP-SR-6	East Fork SFSR	45	7.4	39.0	40.3	11.4	0.68	2.54	0.83	2.34	6.44	58	Calcium-magnesium-bicarbonate
YP-SR-4	East Fork SFSR	45	7.5	43.8	42.5	12.7	0.63	2.89	0.88	2.30	8.86	65	Calcium-magnesium-bicarbonate
YP-SR-2	East Fork SFSR	45	7.6	48.4	48.1	14.4	0.52	3.01	0.85	2.31	9.31	67	Calcium-magnesium-bicarbonate
YP-T-11	Fiddle Creek	45	7.2	17.3	24.9	5.66	<0.20	0.74	0.54	2.21	1.74	36	Calcium-bicarbonate
YP-T-6	West End Creek	45	8.4	179	120	43.1	<0.20	17.6	1.94	1.10	56.7	209	Calcium-magnesium-bicarbonate-sulfate
YP-T-1	Sugar Creek	46	7.7	54.2	56.1	16.5	<0.20	3.09	0.76	2.24	9.00	116	Calcium-magnesium-bicarbonate

Source: Data obtained from Midas Gold 2019c

$CaCO_3$ = calcium carbonate.

Units are milligrams per liter except for pH, which is in standard units. Values in the table represent the average of sample results collected between 2012 and 2018. Average concentrations for calcium, magnesium, potassium, and sodium represent the dissolved fraction.

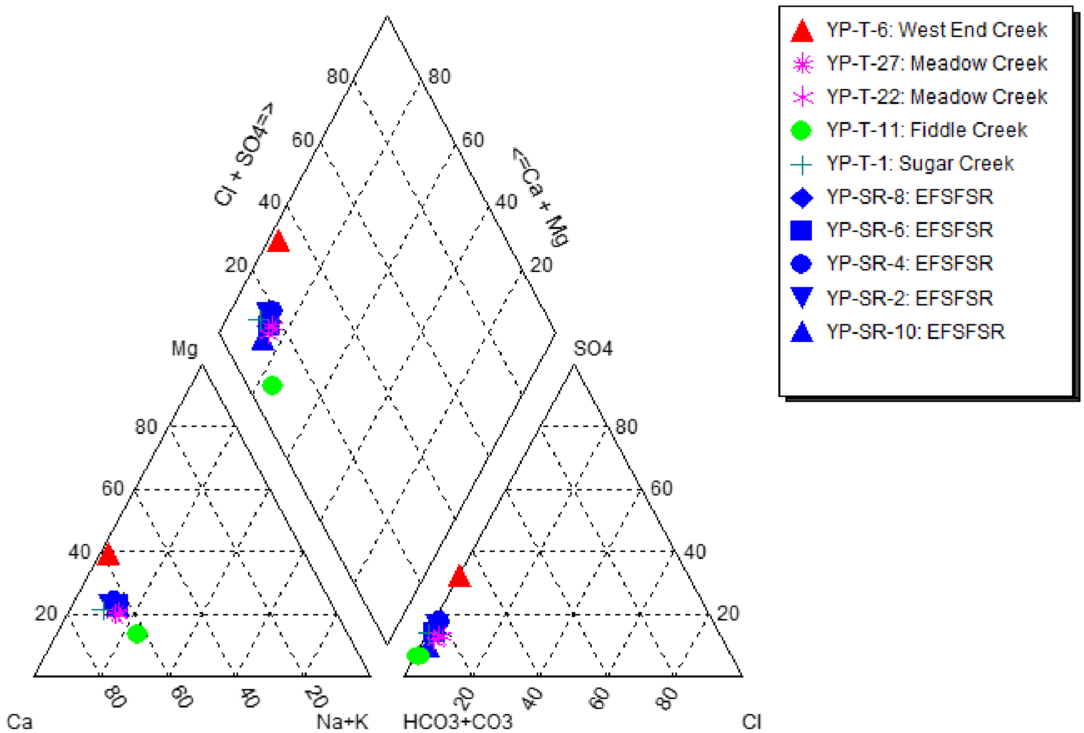
West End Creek stands out as having the most notably different major ion signature among the surface water assessment nodes (**Figure 3.9-11**). During the baseline period, West End Creek surface water exhibited a calcium-magnesium-bicarbonate-sulfate water type. With the exception of chloride and sodium, the West End Creek samples also had the highest major ion constituent concentrations among the surface water assessment nodes considered, with baseline sulfate and TDS concentrations averaging 57 and 209 mg/L, respectively. West End Creek sample point YP-T-6 is located downstream of both the upper and lower historical West End waste rock dumps; it is therefore possible that the water chemistry at this location has been influenced by the waste material, especially where the creek flows directly through historical development rock piles. Mapped metamorphic bedrock in the West End valley (including marble, quartzite, and schist) in contrast to granitic batholith rocks in the East Fork SFSR drainage also may affect the stream chemistry, as these rock types locally tend to produce higher TDS and alkalinity (SRK 2017).

For surface waters aside from West End Creek (57 mg/L), sulfate concentrations in baseline surface waters are less than 10 mg/L, a relatively low concentration compared to a national average for U.S. reference streams (45.9 mg/L, USGS 2009) and applicable regulatory standards (250 mg/L, **Table 3.9-1**). Sulfate concentrations are associated with the rate of mercury methylation in aquatic systems with lower sulfate concentrations potentially related to lower methylmercury concentrations (see **Section 4.9.2.2** and **Figure 4.9-26** for additional information).

Field-measured pH values for the surface water assessment nodes were generally in the range of 7 to 8 standard units. The highest average pH (8.4) was observed at West End Creek sample location YP-T-6. Elevated baseline pH measurements at this location are likely another indicator of the geochemical influence exerted by legacy waste rock material, natural mineralization, and the predominance of carbonate bedrock in the West End Creek drainage. Overall, the neutral to alkaline pH values observed in streams near the mine site show that the geochemistry of the natural mineralized deposits and the legacy mine materials is not conducive to acidic drainage.

Constituents of Interest

The Surface Water Quality Baseline Study (HDR 2017f) showed that most metals analyzed in mine site streams occur at concentrations that are below the strictest potentially applicable surface water quality standard. Exceptions include antimony, arsenic, and mercury. Therefore, these metals were selected as constituents of interest because of their potential to exceed regulatory standards and impact water and biological resources. Naturally occurring mineralization and historical mining activity have resulted in surface water quality impairments for these constituents (Baldwin and Etheridge 2019). As such, recent surface water baseline studies conducted by both Perpetua and USGS have attempted to characterize antimony, arsenic, and mercury concentrations in the Headwaters East Fork SFSR and Sugar Creek sub-watersheds.



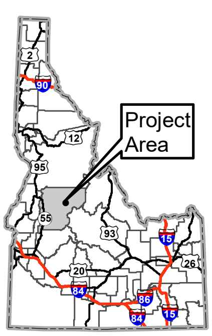


Figure 3.9-11
Tri-Linear Diagram of Average Major Ion Chemistry for Surface Waters
Stibnite Gold Project
Stibnite, ID

Monitoring by Baldwin and Etheridge (2019) found that antimony in mine site streams primarily occurs in the dissolved phase (primarily as Sb(V); Dovick et al. 2016) with lower antimony concentrations recorded during high flow periods, suggesting a groundwater source. **Figure 3.9-8** illustrates the range in dissolved antimony concentrations for stream monitoring locations sampled during the Surface Water Quality Baseline Study (HDR 2017f). Data for seeps in the Meadow Creek, East Fork SFSR, and Sugar Creek valleys also are provided on the figure for comparison. The stream and seep sample locations are organized from upstream (left) to downstream (right) on the horizontal axis of the figure. Overall, the figure depicts increasing dissolved antimony concentrations from upstream to downstream across the mine site.

As shown on **Figure 3.9-8**, average dissolved antimony concentrations are generally below the strictest potentially applicable surface water quality standard in the upper East Fork SFSR drainage. In the Meadow Creek drainage, dissolved antimony concentrations are higher, possibly due to loading from seeps associated with historical mining materials and/or the presence of natural mineralization in adjacent bedrock. The seeps in Meadow Creek valley had the highest concentrations of dissolved antimony across the site. Below the confluence with Meadow Creek, both the stream and seep sample locations in the middle East Fork SFSR drainage generally exhibited dissolved antimony concentrations above the strictest potentially applicable surface water quality standard. Exceptions included tributary sample locations associated with Fiddle Creek (YP-T-11 and YP-T-12) and Hennessy Creek (YP-T-41). In the Sugar Creek valley, which flows across historically mined areas and natural mineralization, seep samples typically contained dissolved antimony above the strictest potentially applicable water quality standard, but the surface water dissolved antimony concentrations tended to be lower due to dilution of the seep inputs. Below the confluence with Sugar Creek, the average dissolved antimony concentration in the East Fork SFSR at monitoring location YP-SR-2 was found to be 21.9 μg/L, which is above the strictest potentially applicable surface water quality standard. This concentration is within the range of average antimony values documented at upstream East Fork SFSR assessment nodes YP-SR-4, YP-SR-6, YP-SR-8, and YP-SR-10 (**Table 3.9-10a** and **3.9-10b**).

Up to 96 percent of arsenic in the mine site drainages occurs in the dissolved phase (primarily as As(V); Dovick et al. 2016), suggesting a groundwater source similar to antimony (Baldwin and Etheridge 2019). **Figure 3.9-9** illustrates the trend in dissolved arsenic concentrations for stream and seep monitoring locations sampled during the Surface Water Quality Baseline Study (HDR 2017f). Overall, the dissolved arsenic concentration data exhibit an increasing concentration trend from upstream to downstream across the mine site.

As shown on **Figure 3.9-9**, average dissolved arsenic concentrations are generally below the strictest potentially applicable surface water quality standard in the upper East Fork SFSR drainage. In the Meadow Creek drainage, dissolved arsenic concentrations increase where Meadow Creek flows past the SODA and former smelter site, presumably due to inputs from seeps and groundwater influenced by historical mining materials. The seeps in Meadow Creek valley had the highest concentrations of dissolved arsenic across the site. Below the confluence with Meadow Creek, both the stream and seep sample locations in the middle East Fork SFSR drainage generally exhibited dissolved arsenic concentrations above the strictest potentially applicable surface water quality standard. Exceptions included tributary sample locations associated with Fiddle Creek (YP-T-11) and Hennessy Creek (YP-T-41), both of which drain less mineralized areas. In the Sugar Creek valley, the seep samples typically contained dissolved arsenic above the strictest potentially applicable surface water quality standard, but the dissolved arsenic concentrations in stream flow tended to be lower. Below the confluence with Sugar Creek, the average dissolved arsenic concentration in the East Fork SFSR at monitoring location YP-SR-2 was found to be 44.5 µg/L, which is above the strictest potentially applicable surface water quality standard.

Based on data from the 10 surface water assessment nodes (**Table 3.9-10a** and **10b** and **Table 3.9-11**), the average dissolved mercury concentration measured in water samples during the baseline study was calculated to range from 4 to 56 percent of the average total mercury concentration (HDR 2017f). This finding illustrates that, in contrast to antimony and arsenic, mercury primarily occurs in the particulate phase. The association with particles indicates that mercury is derived from erosion and/or re-suspension of surface material, rather than groundwater (Baldwin and Etheridge 2019).

The mean total mercury concentrations for streams and seeps across the mine site are presented on **Figure 3.9-10**. The figure shows that mean total mercury concentrations were generally below the water quality standard at most of the surface water sampling locations. However, many of the seep sample locations in the Meadow Creek, Middle East Fork SFSR, and Sugar Creek drainages exceeded the regulatory criterion. In contrast, a similar plot for dissolved mercury (**Figure 3.9-12**) shows that the mean dissolved mercury concentration is below the Idaho surface water quality standard for total recoverable mercury at the majority of locations sampled, further supporting the notion that much of the mercury in the mine site area is associated with particulates.

The surface water assessment nodes YP-SR-10 (East Fork SFSR below Meadow Creek), YP-SR-4 (East Fork SFSR below Yellow Pine pit), and YP-T-1 (Sugar Creek above East Fork SFSR) closely correspond to sample locations EF2, EF3, and Sugar Creek monitored by the USGS (Baldwin and Etheridge 2019). A side-by-side comparison of average dissolved antimony, dissolved arsenic, and dissolved and total mercury concentrations for these sites is presented in **Table 3.9-11**. Data used to calculate the averages shown in the table were collected between 2011 and 2017 for the USGS locations and 2012 to 2018 for the Midas Gold sample points. Overall, the average dissolved antimony and arsenic concentrations from the two studies are in good agreement, with relative percent difference values between the means of 1.8 to 11.3 percent. Greater variability is evident between the dissolved and total mercury sample averages. The variability in mercury results may be attributable to the generally low concentration values, differing amounts of particulate matter in the total mercury samples, laboratory protocol differences between the two studies, or different runoff conditions in the non-overlapping years sampled (2011 and 2018).

Table 3.9-10a Average, Minimum, and Maximum Measured Constituent Concentrations for Surface Water Assessment Nodes

Sampling Point	Stream	Aluminum (µg/L) Standard: 50 µg/L			Ammonia, as Nitrogen (mg/L) Standard: 2.1 mg/L			Antimony (µg/L) Standard: 5.2 µg/L			Arsenic (µg/L) Standard: 10 µg/L			Cadmium (µg/L) Standard: 0.33 µg/L	Copper (µg/L) Standard: 2.4 µg/L			Cyanide, Total (mg/L) Standard: 0.039 mg/L	Iron (µg/L) Standard: 300 µg/L		
		Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Range	Avg	Min	Max	Range	Avg	Min	Max
YP-T-27	Meadow Creek	12.0	4.2	25.3	NC	<0.05	0.053	6.10	2.04	16.9	34.8	11.8	60.7	<0.02	0.3	0.1	0.7	<0.0027 - 0.0104	63.3	<20	124
YP-T-22	Meadow Creek	12.2	3.6	57.7	NC	<0.05	0.062	8.12	2.4	35.8	34.4	13.6	56.8	<0.02	0.3	0.1	1	<0.0027	69.9	21	149
YP-SR-10	East Fork SFSR	9.4	3.0	32.2	NC	<0.05	0.084	12.2	3.93	47.1	24.6	8.6	41.4	<0.02	0.2	<0.1	0.5	<0.0027	39.7	<20	84
YP-SR-8	East Fork SFSR	9.4	3.1	25.6	NC	<0.05	0.065	16.9	5.7	61.8	28.1	12.3	48.7	<0.02 - 0.27	0.3	0.1	2.6	<0.0027 - 0.0104	34.5	<20	59
YP-SR-6	East Fork SFSR	9.8	2.6	41	NC	<0.05	<0.05	19.3	6.37	46.9	30.6	12.6	41.4	<0.02	0.2	0.1	0.5	<0.0027	35.4	22	54
YP-SR-4	East Fork SFSR	11.9	2.5	33.9	NC	<0.05	0.191	31.0	10.4	62.0	63.0	20.8	105	<0.02	0.3	0.1	0.6	<0.0027	65.3	24	187
YP-SR-2	East Fork SFSR	14.0	2.2	111	NC	<0.05	0.09	21.9	6.79	38.2	44.5	14.7	71.1	<0.02 - 0.03	0.2	0.1	0.6	<0.0027	40.5	<21	160
YP-T-11	Fiddle Creek	15.7	4.4	45.6	NC	<0.05	<0.05	0.56	0.23	1.09	1.6	0.5	2.9	<0.02	0.2	<0.1	0.6	<0.0027 - 0.0128	22.3	<14	40.2
YP-T-6	West End Creek	4.0	3.0	6.3	NC	<0.05	<0.05	10.5	5.72	13.0	79.6	45	97.3	<0.02	0.3	<0.1	0.9	<0.0027	NC	<21	<21
YP-T-1	Sugar Creek	9.0	2.0	80.2	NC	<0.05	<0.05	3.41	1.25	8.64	13.0	6.5	22.4	<0.02 - 0.32	8.5	0.1	342	<0.0027	21.4	<21	39

Source: Data obtained from Midas Gold 2019c
µg/L = micrograms per liter; mg/L = milligrams per liter; ng/L = nanograms per liter.
Avg/Min/Max = sample average, minimum, and maximum.
NC = average value not calculated due to the high percentage of non-detect results.
Values represent the dissolved fraction unless otherwise noted.
Values in the table represent the average of sample results collected between 2012 and 2018. A range of values is provided for sample populations where most results were non-detect.

Table 3.9-10b Continuation of Average, Minimum, and Maximum Measured Constituent Concentrations for Surface Water Assessment Nodes

Sampling Point	Stream	Lead (µg/L) Standard: 0.9 µg/L	Manganese (µg/L) Standard: 50 µg/L			Mercury, Total (ng/L) Standard: 12 ng/L			Mercury, Dissolved (ng/L) Standard: 12 ng/L			Nitrate+Nitrite as Nitrogen (mg/L) Standard: 10 mg/L			Selenium (µg/L) Standard: 1.5 µg/L	Thallium (µg/L) Standard: 0.017 µg/L	Zinc (µg/L) Standard: 54 µg/L		
		Range	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Range	Range	Avg	Min	Max
YP-T-27	Meadow Creek	<0.04	25.6	4.5	42.7	2.5	<1	11.8	1.5	<0.6	3.8	NC	<0.05	0.091	< 1	<0.04	1.7	<0.5	3.0
YP-T-22	Meadow Creek	<0.02 - 0.04	23.4	5.7	39.0	15.6	1.3	404	1.7	<0.7	4	NC	<0.05	0.095	<1	<0.04	1.7	<0.5	3.3
YP-SR-10	East Fork SFSR	<0.04 - 0.06	13.1	3.1	21	6.1	2.0	31.5	2.5	<1	5.7	NC	<0.05	0.063	<1	<0.04	1.4	<0.5	2.5
YP-SR-8	East Fork SFSR	<0.03 - 0.06	11.3	3.6	18.9	6.0	1.6	20.1	2.4	<0.5	5	NC	<0.05	0.080	<1	<0.02 - 0.04	1.5	<0.5	4.1
YP-SR-6	East Fork SFSR	<0.02 - 0.04	8.5	3.5	15.4	5.6	1.9	24.7	2.4	1.4	4.7	NC	<0.05	0.066	<1	<0.04	1.6	<0.5	3.0
YP-SR-4	East Fork SFSR	<0.02 - 0.04	20.4	5.7	50.6	5.9	<0.5	32.7	2.4	1.3	4.5	NC	<0.05	0.061	<1	<0.02 - 0.04	1.4	<0.5	2.4
YP-SR-2	East Fork SFSR	<0.02 - 0.04	11.1	3.4	25.8	41.3	3.1	395	5.7	1.7	29.5	NC	<0.05	0.114	<1	<0.02 - 0.04	1.3	<0.5	3.0
YP-T-11	Fiddle Creek	<0.02 - 0.03	1.1	<1.1	1.6	3.3	<1.0	13.9	1.8	<0.1	4.2	NC	<0.05	0.082	<1	<0.04	1.6	<0.5	2.0
YP-T-6	West End Creek	<0.02 - 0.06	NC	<1.1	<1.1	7.8	5.1	18.1	4.2	3.0	8.9	0.448	0.147	0.770	<1	<0.04	1.6	<0.6	2.5
YP-T-1	Sugar Creek	<0.02 - 19.3	1.3	<1.1	4	159	9.6	2380	7.4	1.6	14.2	NC	<0.05	0.061	<1	<0.02 - 0.04	6.8	<0.6	234

Source: Data obtained from Midas Gold 2019c
µg/L = micrograms per liter; mg/L = milligrams per liter; ng/L = nanograms per liter.
Avg/Min/Max = sample average, minimum, and maximum.
NC = average value not calculated due to the high percentage of non-detect results.
Values represent the dissolved fraction unless otherwise noted.
Values in the table represent the average of sample results collected between 2012 and 2018. A range of values is provided for sample populations where most results were non-detect.

Table 3.9-11 Comparison of Average Baseline Concentrations between Midas Gold and USGS Sample Locations

Sample Location	YP-SR-10 (East Fork SFSR below Meadow Creek)	EF2	YP-SR-4 (East Fork SFSR above Sugar Creek)	EF3	YP-T-1 (Sugar Creek)	Sugar Creek
Data Source	Midas Gold*	USGS	Midas Gold*	USGS	Midas Gold*	USGS
No. Samples	45	28 - 40	45	31 - 39	46	35 - 38
Antimony, dissolved	12.2	10.9	31.0	27.9	3.41	3.35
Arsenic, dissolved	24.6	23.7	63.0	56.5	13.0	12.1
Mercury, dissolved	0.003	0.004	0.002	0.004	0.007	0.014
Mercury, total	0.006	0.017	0.006	0.008	0.159	1.19

Source: Baldwin and Etheridge 2019; Midas Gold 2019c
* Document provided prior to February 2021 name change, therefore cited as Midas Gold.
USGS = United States Geological Survey.
Concentration units are in micrograms per liter.
Values in the table represent the average of sample results collected between 2012 and 2018 for Midas Gold samples, and between 2011 and 2017 for USGS samples. The USGS samples targeted high flow events while the Midas Gold samples were collected on a quarterly monitoring schedule.

Temporal variations in antimony, arsenic, and mercury concentrations can be correlated to daily mean stream flow (Baldwin and Etheridge 2019). A representative trend plot is provided on **Figure 3.9-13** for downstream sampling location YP-SR-4 on the East Fork SFSR below Yellow Pine pit. The figure shows that total and dissolved antimony and arsenic concentrations are inversely correlated to streamflow and tend to be higher during low flow conditions. These findings indicate that groundwater inflows are likely the main source contributing to surface water antimony and arsenic concentrations at the mine site because groundwater discharge to the streams is relatively greater during low flow. The highest concentrations of arsenic are consistently observed during the July to March low flow period. For antimony, the highest concentrations occur near the end of the low flow period as streamflow is beginning to rise during the first flush of spring snowmelt. This first flush phenomenon has been observed at other mine sites and is attributable to the dissolution of soluble salts (Nordstrom 2009).

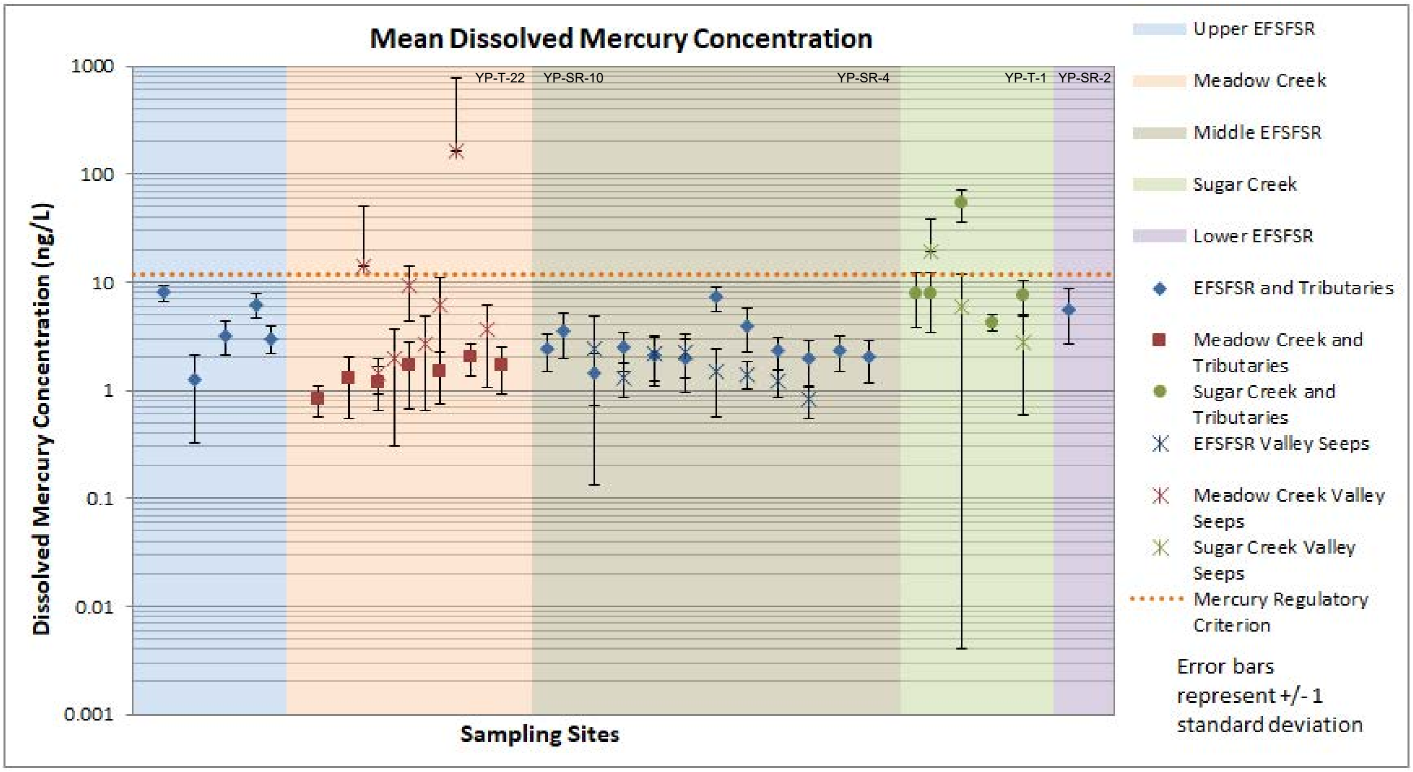
Conversely, mercury concentrations are positively correlated to streamflow, with the highest total mercury concentrations occurring during high flow conditions. This relationship indicates that mercury is derived from erosion and resuspension of surface material, which occurs during high flows (Baldwin and Etheridge 2019).

MeHg also was sampled by HDR as part of the Surface Water Quality Baseline Study (HDR 2017f), with additional sampling performed in 2017 and 2018 (Midas Gold 2019c). Sample results for the 10 surface water assessment nodes are provided in **Table 3.9-12**. Each assessment node was sampled for MeHg 26 to 27 times between 2012 and 2018, with approximately 90 percent of the sample results reported below the method detection limit (<0.1 ng/L). The range of observed MeHg values varied between a minimum of <0.1 ng/L (all sites) to a maximum of 0.64 ng/L (Sugar Creek). Mean MeHg values (calculated using the method detection limit for non-detect results) were at or just above the 0.1 ng/L detection limit.

Table 3.9-12 Baseline Methylmercury Concentrations for Surface Water Assessment/Prediction Nodes

Sampling Point	Stream	No. Samples	Percent Non-Detects	Average MeHg (ng/L)	Minimum MeHg (ng/L)	Maximum MeHg (ng/L)
YP-T-27	Meadow Creek	26	96	<0.1	<0.1	0.13
YP-T-22	Meadow Creek	26	89	0.11	<0.1	0.18
YP-SR-10	East Fork SFSR	26	89	<0.1	<0.1	0.17
YP-SR-8	East Fork SFSR	26	100	<0.1	<0.1	<0.1
YP-SR-6	East Fork SFSR	26	92	<0.1	<0.1	0.20
YP-SR-4	East Fork SFSR	26	96	<0.1	<0.1	0.11
YP-SR-2	East Fork SFSR	26	81	<0.1	<0.1	0.15
YP-T-11	Fiddle Creek	26	89	0.11	<0.1	0.35
YP-T-6	West End Creek	27	96	<0.1	<0.1	<0.1
YP-T-1	Sugar Creek	27	67	0.14	<0.1	0.64

Source: Data obtained from Midas Gold 2019c
MeHg = methylmercury.
ng/L = nanograms per liter.
Min = sample minimum.; Max = sample maximum.
Values in the table were compiled from sample results collected between 2012 and 2018.



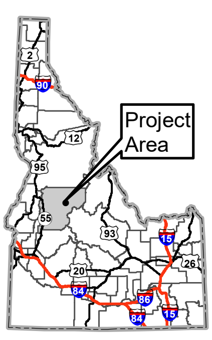
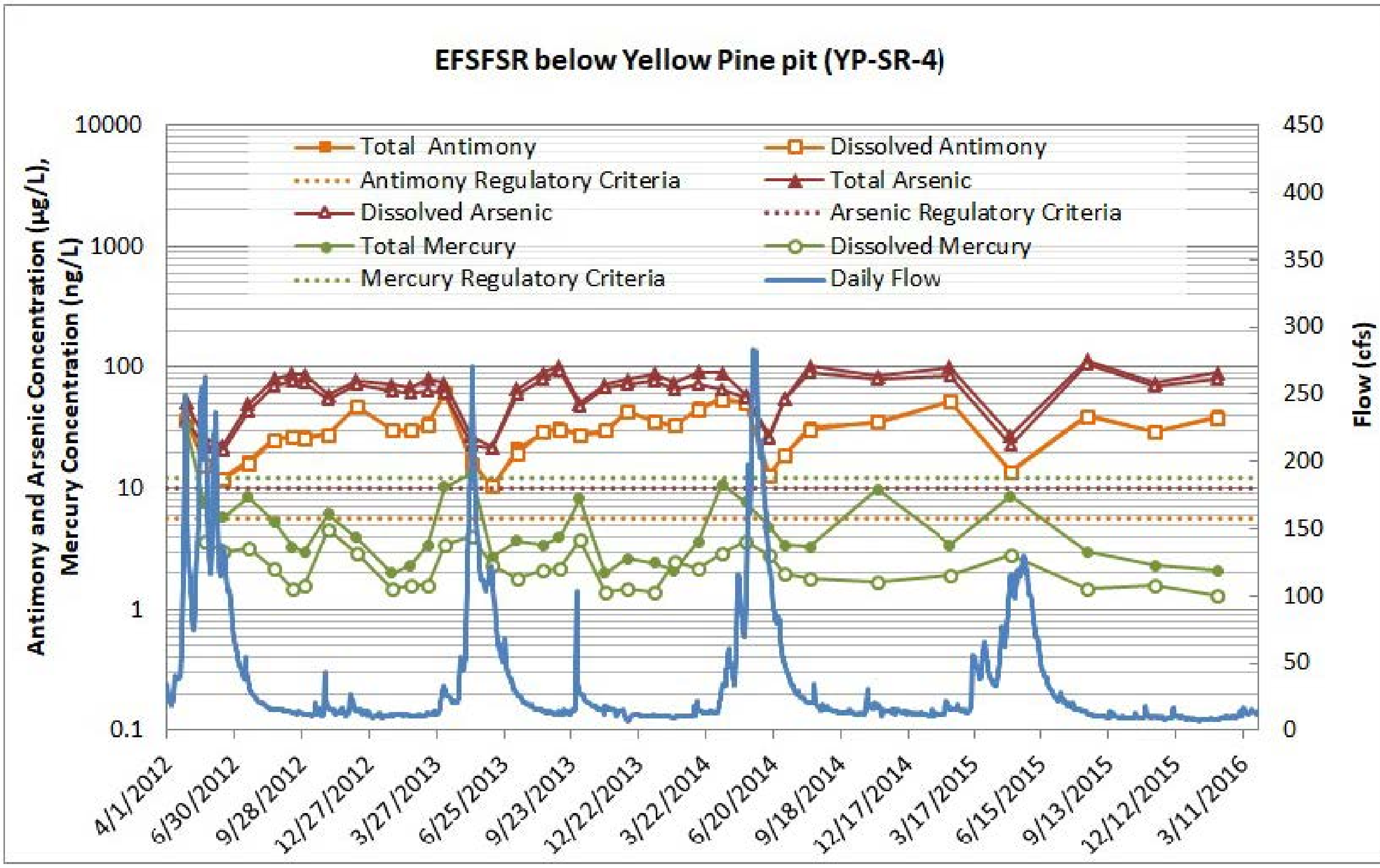


Figure 3.9-12
Dissolved Mercury Concentrations in Surface Water

Stibnite Gold Project
Stibnite, ID

Data Sources: (HDR 2017)



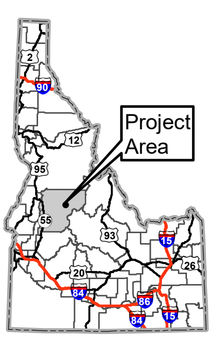


Figure 3.9-13
Average Daily Flow Rates Compared to Antimony, Arsenic, & Mercury Concentrations at a Surface Water Location Downstream of Historical Mine Activity (YP-SR-4)

Stibnite Gold Project
Stibnite, ID

Data Sources: (HDR 2017)

To provide context for the mine site MeHg values, the baseline concentration ranges in **Table 3.9-12** were compared to summary statistics from a USGS study of MeHg in U.S. streams (USGS 2009). In this study, the USGS found no statistical difference in surface water MeHg concentrations between previously mined and unmined stream basins. Stream MeHg concentrations across all sites sampled during the study were found to range from <0.010 ng/L to 4.11 ng/L, with a mean concentration of 0.19 ng/L. In most cases, the maximum MeHg concentrations observed in the mine site assessment nodes were less than this nationwide average. Exceptions include the East Fork SFSR above the Yellow Pine area at YP-SR-6 (maximum concentration of 0.20 ng/L), Fiddle Creek (maximum concentration of 0.35 ng/L), and Sugar Creek (maximum concentration of 0.64 ng/L). However, even at Sugar Creek, which has a well-documented upstream source of mercury from the former Cinnabar Mine, MeHg was not detected in 67 percent of the samples collected. The range of results from the Surface Water Quality Baseline Study (HDR 2017f) and subsequent sampling suggests that MeHg concentrations in SGP site streams are not appreciably different from those reported by the USGS nationwide study, and that historical mining activity in the analysis area has not increased MeHg concentrations above those observed at similar reference locations throughout the U.S. The USGS study included one Idaho location that was outside of the SGP study area.

This finding is important because MeHg is present at elevated concentrations in several mine site seeps, as summarized in **Table 3.9-13**. The calculated means for the seep samples range from <0.1 ng/L to 0.93 ng/L at Smelter Flats Seep (YP-S-5). Maximum MeHg values for the seeps also tend to be higher, reaching 6.6 ng/L at the Smelter Flats Seep (YP-S-5). Despite these relatively high concentrations, the mine site seeps do not appear to significantly influence surface water MeHg levels (e.g., loading), due to the low seep flow rates compared to surface water flows.

Table 3.9-13 Methylmercury Concentrations at Seep Sampling Locations

Seep Location	Description	No. Samples	Percent Non-Detects	Mean MeHg (ng/L)	Maximum MeHg (ng/L)	MeHg Standard Deviation (ng/L)
YP-S-2	Fault seep above workings	7	14	0.18	0.35	0.09
YP-S-3	Garnet Pit Seep	20	85	<0.1	0.1	0.01
YP-S-5	Smelter Flats Seep	8	75	0.93	6.6	2.29
YP-S-6	Adjacent to Keyway Marsh	20	30	0.30	1.0	0.23
YP-S-7	East side of SODA berm, adjacent to large marsh east of SODA on Hangar Flats	23	57	0.16	0.6	0.13
YP-S-8	East side of SODA berm, adjacent to large marsh east of SODA on Hangar Flats	24	88	0.35	5.9	1.18
YP-S-10	Keyway Marsh outlet	25	80	0.11	0.2	0.03
YP-AS-7	The Meadow Creek Mine adit seep	15	33	0.32	1.6	0.41

Seep Location	Description	No. Samples	Percent Non-Detects	Mean MeHg (ng/L)	Maximum MeHg (ng/L)	MeHg Standard Deviation (ng/L)
YP-T-23a	Heap leach seep southwest corner of the heap leach pile on Hangar Flats	13	85	0.12	0.3	0.06

Source: Midas Gold 2019c
ng/L = nanograms per liter.
MeHg = methylmercury.
SODA = spent heap leach ore disposal area.

Other constituents that occur in mine development rock or may be used in ore processing include aluminum, cadmium, copper, total cyanide, iron, lead, manganese, selenium, thallium, and zinc. Baseline concentrations of these constituents measured at the 10 surface water assessment nodes are provided in **Table 3.9-10**. The table also includes the minimum and maximum concentrations measured for each constituent to illustrate the range of values reported during the baseline study.

Sediment

Wildfires in the past have burned much of the forested area at the SGP and vicinity, resulting in increased erosion from the burned areas. In addition, the failure of a water dam on EFMC in 1965 caused extensive erosion both upstream and downstream of the former dam, with deposition of eroded sediment in Meadow Creek and transport of this sediment into the East Fork SFSR continuing to occur.

Site area sediment conditions were initially evaluated in the 1990s as summarized in URS 2000a then revisited by the USGS in its 2015 investigation. Metal concentrations including antimony, arsenic, copper, and mercury were measured in sediments collected from sampling from Meadow Creek, the East Fork SFSR, and Sugar Creek. The highest sediment antimony and arsenic concentrations were observed below the historical Bradley Waste Rock Dump while the highest sediment copper and mercury concentrations were observed at the sampling location in Sugar Creek (URS 2000a, Etheridge 2015). These sediment data collected over a 20-year period suggest consistent sourcing of metals to sediments from the historical mining operations.

The ongoing erosion and sediment transport affect the turbidity and Total Suspended Solids (TSS) content of surface water. The dynamics and relationships between turbidity and TSS are functions of watershed-specific factors; but in general, the more TSS in the water, the murkier it appears and the higher the turbidity. **Table 3.9-14** and **Table 3.9-15** provide the TSS (in mg/L) and turbidity (in Nephelometric Turbidity Units, or NTUs), respectively, for the 10 surface water assessment nodes. As shown in the tables, while concentrations of TSS and turbidity are typically low during some months under existing conditions, seasonal variations occur, and concentrations reach moderate to high levels during high flow periods.

An overview of sediment transport at the mine site also is provided in Etheridge (2015). This study found that much of the sediment entering the East Fork SFSR was derived from Sugar Creek, Meadow Creek, and EFMC (i.e., Blowout Creek). The Meadow Creek reach contributes more sediment than Sugar Creek, but most of the sediment load discharged from the Meadow Creek reach is deposited in the Yellow Pine pit lake (Etheridge 2015). Load modeling by Etheridge (2015) also showed that about 90 percent of coarse-grained sediment derived from upgradient is deposited in the Yellow Pine pit, but over 80 percent of the fine-grained sediment (<0.0625 millimeter in diameter) entering the pit lake passes through and is transported downstream. Thus, the Yellow Pine pit is an effective sediment trap for coarse-grained particles but does not have a long enough residence time to deposit the majority of the fine-grained sediment load.

Organic Carbon

No samples were analyzed for organic carbon during the Surface Water Quality Baseline Study (HDR 2017f). However, a previous study by Holloway et al. (2017) found relatively low dissolved organic carbon concentrations (1.1 to 1.7 mg/L) in the East Fork SFSR, Meadow Creek, and Sugar Creek. The dissolved organic carbon concentrations in a watershed can be correlated to vegetation density, vegetation type, and soil composition, with higher vegetation densities and organic-rich soils resulting in higher levels of organic carbon (Camino-Serrano et al. 2014; Larsen et al. 2011; Mzobe et al. 2018). Thus, dissolved organic carbon concentrations are expected to be low in the SGP drainage area containing poorly developed mineral soils and sparse vegetation.

Temperature

Stream temperature criteria have been established for chinook salmon, steelhead, and bull trout in the Payette Forest Plan as amended (Forest Service 2003a). IDEQ also has published thermal criteria for salmonid species that vary based on the aquatic life classification of a water body (e.g., warm water aquatic life, cold water aquatic life, salmonid spawning, etc.) (IDEQ 2019c). The IDEQ standards include requirements for Maximum Daily Maximum Temperature, Maximum Weekly Maximum Temperature, and Maximum Daily Average Temperature.

Establishing existing surface water temperature conditions at the SGP was important to provide a baseline dataset for comparing future temperature changes caused by the action alternatives. Two methods for establishing baseline temperatures were used: monthly grab samples and 15-minute temperature measurements. Temperature ranges from both datasets are discussed below; however, the 15-minute temperature measurements are believed to provide a more accurate representation of diurnal temperature variability for comparison to thermal criteria.

A summary of monthly grab sampling temperature statistics is provided in **Table 3.9-16** for the surface water assessment nodes. The data and statistics shown in the table were compiled from the Surface Water Quality Baseline Study (HDR 2017f). A review of the monthly temperature statistics indicates that summer monthly stream temperatures are typically highest in July and August, with July temperatures ranging from a low of 6.8 degrees Celsius (approximately 44 degrees Fahrenheit) at West End Creek (YP-T-6) to a high of 17.8 degrees Celsius (approximately 64 degrees Fahrenheit) at the East Fork SFSR above Yellow Pine pit (YP-SR-6). Average monthly fall temperatures are highest in September, ranging from 6.7 degrees Celsius (approximately 44 degrees Fahrenheit) at West End Creek (YP-T-6) to 12.7 degrees Celsius (approximately 55 degrees Fahrenheit) at Meadow Creek near the SODA (YP-T-22).

For comparison to the monthly statistics, a graphical depiction of 15-minute temperature measurements is provided for the two-week periods centered on August 1 (**Figure 3.9-14**) and September 21 (**Figure 3.9-15**). These dates approximately coincide with the average timing of maximum summer and fall stream temperatures in the SGP area.

The 15-minute temperature data used in the water quality evaluation spans a period of record extending from 2012 through 2017. During this timeframe, 2016 was found to be the year with the warmest summer stream temperatures (**Figure 3.9-14**). The maximum summer temperatures in 2016 occurred on July 29, slightly before the average date of August 1. Observed conditions during the weekly periods immediately before and after July 29, 2016, therefore represent the period of low-flow, maximum, weekly summer temperatures. The range of observed temperatures across the mine site during this two-week period in 2016 was 7.2 to 19.6 degrees Celsius (approximately 45 to 67 degrees Fahrenheit) (Brown and Caldwell 2018b).

During the fall period, maximum stream temperatures were observed two years earlier in 2014 (**Figure 3.9-15**). The maximum daily fall temperature in 2014 occurred on September 24, slightly after the average date of September 21. Observed conditions during the weekly period immediately before and after September 24, 2014, therefore represent the period of low-flow, maximum weekly fall temperatures. The range of observed temperatures during this fall period was 6.6 to 15.7 degrees Celsius (approximately 44 to 60 degrees Fahrenheit) (Brown and Caldwell 2018b).

Overall, these weekly summer and fall values offer a better representation of the low flow, maximum seasonal temperatures than the monthly data, and therefore provide a better baseline for comparison to thermal criteria and future predicted temperature increases.

Impaired Waterbodies

The federal CWA requires states to prepare a report listing the current condition of all state waters and identifying streams that are impaired because they do not meet their designated beneficial uses. IDEQ's 2022 Integrated Report (IDEQ 2022a) provides the Section 305(b) list (condition of state waters) and the Section 303(d) list of impaired waters in the State of Idaho. Stream segments identified on the Section 303(d) list are classified as Category 5 waters, defined as waters that do not meet applicable water quality standards for one or more beneficial uses due to one or more pollutants.

Table 3.9-14 Summary of Baseline Total Suspended Solids for Surface Water Assessment/Prediction Nodes (Total Suspended Solids (mg/L))

Assessment Node	YP-T-27 Meadow Creek (n=35)			YP-T-22 Meadow Creek (n=35)			YP-SR-10 East Fork SFSR below Meadow Creek (n=35)			YP-SR-8 East Fork SFSR above Fiddle Creek (n=35)			YP-T-11 Fiddle Creek (n=35)			YP-SR-6 East Fork SFSR above Yellow Pine Pit (n=35)			YP-T-6 West End Creek (n=34)			YP-T-1 Sugar Creek (n=35)			YP-SR-4 East Fork SFSR above Sugar Creek (n=35)			YP-SR-2 East Fork SFSR below Sugar Creek (n=35)		
Month	Min	Average	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max
January	-	5	-	-	5	-	-	5	-	-	5	-	-	5	-	-	5	-	-	5	-	-	5	-	-	5	-	-	5	-
February	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
March	-	5	-	-	6.5	-	-	5	-	-	5	-	-	5	-	-	5	-	-	5	-	-	5	-	-	5	-	-	5	-
April	5	5.167	5.5	5	9.167	17.5	5	8.333	13.5	5	7.5	9.5	5	5	5	5	5.5	6	-	5	-	5	6.5	9.5	5	7.833	13.5	5	5.5	6.5
May	5	6.5	8	8	27.38	73.5	5	8.25	16	5	9.875	24.5	5	12.25	34	5	7.875	13.5	5	5.25	6	5	17.62	33.5	5	5.5	7	5	6.875	10
June	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
July	5	5	5	5	5	5	5	5.667	7	5	5.833	7.5	5	5	5	5	6	8	5	15.5	36.5	5	5	5	5	6.833	10.5	5	5	5
August	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	11.25	30	5	5	5	5	5	5
September	-	5	-	-	5	-	-	5	-	-	5	-	-	5	-	-	5	-	-	5	-	-	5	-	-	5	-	-	5	-
October	-	5	-	-	5	-	-	5	-	-	5	-	-	5	-	-	5	-	-	5	-	-	5	-	-	5	-	-	5	-
November	5	5	5	5	5	5	5	5	5	5	6.25	10	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
December	-	5	-	-	17.75	-	-	5	-	-	5	-	-	5	-	-	5	-	-	5	-	-	5	-	-	5	-	-	5	-

Source: HDR 2017f
Where sample number is <3, only average values are reported.
- = No monitoring data available.
mg/L = milligrams per liter.
Min = minimum.
Max = maximum.

Table 3.9-15 Summary of Baseline Turbidity for Surface Water Assessment/Prediction Nodes (Turbidity (NTU))

Assessment Node	YP-T-27 Meadow Creek (n=35)			YP-T-22 Meadow Creek (n=35)			YP-SR-10 East Fork SFSR below Meadow Creek (n=35)			YP-SR-8 East Fork SFSR above Fiddle Creek (n=35)			YP-T-11 Fiddle Creek (n=35)			YP-SR-6 East Fork SFSR above Yellow Pine Pit (n=35)			YP-T-6 West End Creek (n=34)			YP-T-1 Sugar Creek (n=35)			YP-SR-4 East Fork SFSR above Sugar Creek (n=35)			YP-SR-2 East Fork SFSR below Sugar Creek (n=35)		
Month	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**
January	-	3.6	-	-	6.65	-	-	2.8	-	-	2.55	-	-	3.1	-	-	3.3	-	-	4.1	-	-	3.15	-	-	3.1	-	-	2.2	-
February	0	1.3	2.8	0.5	2.275	3.1	0	1.4	2.3	0	0.925	2.1	0	1.85	4.2	0	2.925	8.1	2.7	5.875	13	0	1.925	5.6	0	2.85	5.9	0	1.7	3.1
March	-	2.85	-	-	4.9	-	-	2.2	-	-	2.2	-	-	2.25	-	-	2.35	-	-	2.15	-	-	2.6	-	-	2.6	-	-	2.95	-
April	1.6	4.6	9	2.8	10.9	25	2.1	8.9	18	3.5	7.367	11	3	6.867	12	4.4	13.73	30	-	1.7	-	4.3	10.1	19	6.1	18.17	41	5.1	15.37	27
May	2.8	4.25	5.5	4.9	23.88	70	2.6	5.875	8.2	3	5.95	8.7	3.8	6.45	13.1	4	16.58	50	1.7	4.325	5.5	4.7	14.92	22	5.4	9.1	16	2.9	6.4	10
June	1.1	5.033	12	1.7	4.4	8.8	0.4	1.633	2.5	1.2	3.2	6.2	0.1	2.2	4	0.4	3.4	5.6	1.3	2.033	3.2	1.3	2.133	2.9	0.6	2.467	3.6	2.4	3.067	4
July	0	1.133	1.8	0	1.167	2.1	0.5	1.9	2.8	0.5	1.967	2.7	0.8	1.633	2.5	2.1	2.967	3.9	1.1	3.233	6.5	1.4	2	2.8	1.9	10.4	27	0.3	2.633	6.4
August	0	1.275	3.3	0	1.375	2.6	0	0.925	2.1	0.4	1.2	2.6	0.4	1.325	1.7	0.5	1.225	2.3	0.3	1.575	2.3	0	0.65	2.6	1.1	1.7	2.6	0.1	0.875	1.9
September	-	1.55	-	-	1.25	-	-	1.85	-	-	1.95	-	-	1.25	-	-	3.05	-	-	1.75	-	-	0.75	-	-	2.45	-	-	1.95	-
October	-	2.2	-	-	2.35	-	-	3.2	-	-	2.05	-	-	1.3	-	-	1.9	-	-	6.95	-	2.2	-	-	-	2.85	-	-	2.15	-
November	1.2	2.275	3.1	1.3	2.75	5.3	0.6	1.85	3.1	0.6	2.775	5.5	1.5	1.95	3.2	1.7	3.45	4.6	2.1	2.625	3.2	0.4	1.45	2.4	2	3.575	5.6	0.3	2.525	4.6
December	-	3.05	-	-	8.65	-	-	2.5	-	-	2.85	-	-	2.6	-	-	3.5	-	-	3.65	-	3.3	-	-	-	3.7	-	-	2.7	-

Source: HDR 2017f
NTU = Nephelometric Turbidity Units.
Where sample number is <3, only average values are reported.
\- = No monitoring data available.
Min = minimum.
Max = maximum.

Table 3.9-16 Summary of Average, Minimum, and Maximum Monthly Grab Sample Water Temperatures for the Surface Water Assessment Nodes (Temperature (°C))

Assessment Node	YP-T-27 Meadow Creek (n=35)			YP-T-22 Meadow Creek (n=35)			YP-SR-10 East Fork SFSR below Meadow Creek (n=35)			YP-SR-8 East Fork SFSR above Fiddle Creek (n=35)			YP-T-11 Fiddle Creek (n=35)			YP-SR-6 East Fork SFSR above Yellow Pine Pit (n=35)			YP-T-6 West End Creek (n=34)			YP-T-1 Sugar Creek (n=35)			YP-SR-4 East Fork SFSR above Sugar Creek (n=35)			YP-SR-2 East Fork SFSR below Sugar Creek (n=35)		
Month	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**
January	-	0.45	-	-	0.35	-	-	0.8	-	-	1.1	-	-	0.45	-	-	1.05	-	-	1.85	-	-	0.45	-	-	0.95	-	-	0.75	-
February	0.1	0.425	1.1	0	0.825	2.8	0.1	0.25	0.5	0	0.475	1.3	0	0.4	0.9	0	0.375	0.6	2.1	2.775	3.2	0.2	0.875	1.8	0.3	0.7	1.6	0.1	0.475	1.2
March	-	0.25	-	-	1.4	-	-	2.15	-	-	1.95	-	-	0.75	-	-	0.25	-	-	2.7	-	-	1.15	-	-	1.9	-	-	1.6	-
April	1.5	1.567	1.7	1.9	2.467	2.9	1.1	2.967	5.2	0.5	2.767	4.7	1.9	1.933	2	2.2	2.533	2.7	-	2.75	-	2.5	3.367	4.3	2.8	3	3.2	3.3	3.833	4.3
May	4	5.525	6.4	4.7	6.7	7.5	2.8	4.125	6.7	3.2	5.775	10.3	2.4	3.25	4.3	3.9	4.95	6.3	4.9	5.175	5.8	4.8	6.225	8.6	4.5	4.8	5.2	5.1	6.15	6.8
June	6.2	7.767	9	6.5	7.4	9	7.2	8.2	9	7.5	8.833	10.7	4.1	6.667	9.4	4.8	8	11.7	5.4	7.033	7.9	5.5	8.7	10.6	5.5	7.933	10.3	5.4	8.933	11.2
July	10	12.37	14.5	13.5	15.6	16.8	8	11.53	13.7	8.6	12.87	16.2	9.2	10.53	11.9	8	11.87	17.8	6.8	8.367	10.2	11.1	13.1	14.6	12.7	15.03	16.8	10.8	13.63	17.4
August	9.2	13.45	16.4	13.3	16.27	17.4	9.5	12.88	15.8	7	8.325	10.2	8	9.75	11	7.9	9.4	12.5	6.7	7.425	7.8	11.3	12.52	13.8	12.5	13.58	14.5	11.5	13.58	15.1
September	-	10.3	-	-	12.65	-	-	12	-	-	10.8	-	-	9.05	-	-	7.8	-	-	6.65	-	-	8.9	-	-	11.1	-	-	11.4	-
October	-	6.1	-	-	7.8	-	-	3.8	-	-	3.15	-	-	3.6	-	-	4.05	-	-	3.75	-	-	2.4	-	-	7	-	-	6.6	-
November	0	1.925	4.7	0	2.575	4.6	0.1	1.8	4.3	0	1.975	4.6	0	2.075	4.4	0.6	1.825	3.8	3	4.15	5	0.3	2.4	3.9	0.8	2.55	4.2	1	2.725	4.1
December	-	0.7	-	-	0.05	-	-	0.4	-	-	0.25	-	-	0.8	-	-	0.15	-	-	1.45	-	-	0.1	-	-	0.35	-	-	0.1	-

Source: HDR 2017f
Where sample number is < 3, only average values are reported.
- = No monitoring data available.
°C = degrees Celsius.
Min = minimum.
Max = maximum.

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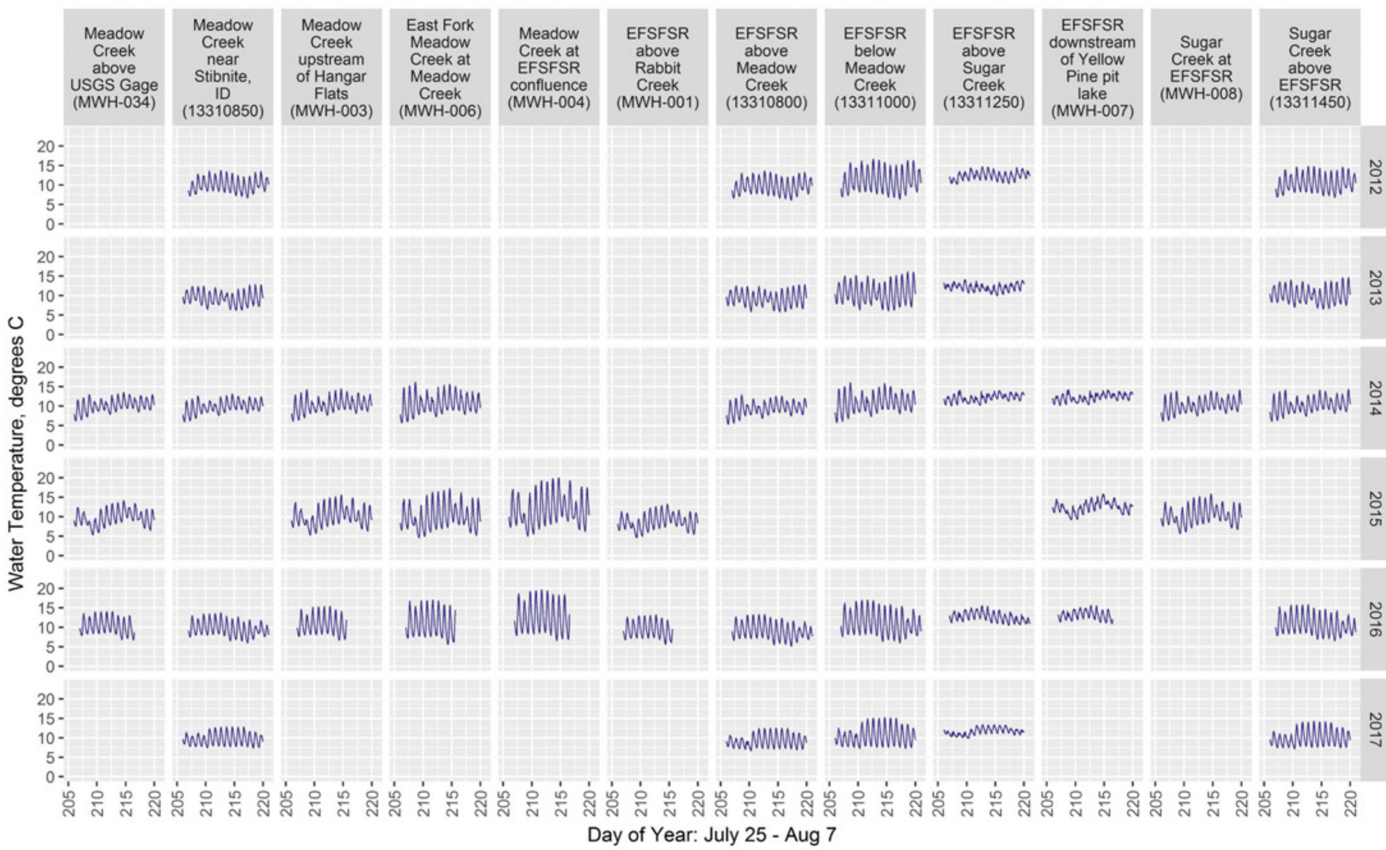


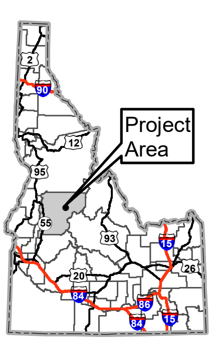


Figure 3.9-14
Summer Surface Water Temperature Observations (centered on August 1)

Stibnite Gold Project
Stibnite, ID

Data Sources: (Brown & Caldwell 2018)

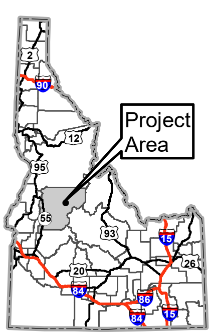


Figure 3.9-15
Fall Surface Water Temperature Observations (centered on September 21)

Stibnite Gold Project
Stibnite, ID
Data Sources: (Brown & Caldwell 2018)

Based on data from the 2022 Integrated Report, all inventoried waterbodies at the mine site are classified as Category 5 impaired waters except for West End Creek (which is a Category 2 stream that fully supports its designated uses). A summary of the current designated beneficial uses and causes of impairment for the impaired waterbodies at the mine site is provided in **Table 3.9-17**. The causes for listing are associated with arsenic, with the East Fork SFSR also being listed for antimony (downstream of Meadow Creek), and Sugar Creek also being listed for mercury. The listed constituents are similar to the constituents of interest identified in the Surface Water Quality Baseline Study (HDR 2017f).

Table 3.9-17 IDEQ Designated Beneficial Uses and Waterbody Status at the Mine Site

NHD Waterbody[1]	Beneficial Uses[2]	IDEQ Status[2]	Cause of Impairment[2]	IDEQ Category[2]
East Fork SFSR 3rd order	COLD, DWS, PCR, SS	Not supporting COLD, DWS, PCR and SS	Antimony (DWS), Arsenic (DWS, PCR) Temperature (COLD, SS)	303(d) listed Category 5
East Fork SFSR 1st and 2nd order	COLD, DWS, PCR, SS	Not supporting COLD, DWS and SS	Arsenic (DWS) Temperature (COLD, SS)	303(d) listed Category 5
Unnamed tributary to East Fork SFSR (Rabbit Creek)	COLD, DWS, PCR, SS	Not supporting COLD, DWS and SS	Arsenic (DWS) Temperature (COLD, SS)	303(d) listed Category 5
Meadow Creek	COLD, DWS, PCR, SS	Not supporting COLD, DWS and SS	Arsenic (DWS) Temperature (COLD, SS)	303(d) listed Category 5
Garnet Creek	COLD, DWS, PCR, SS	Not supporting COLD, DWS and SS	Arsenic (DWS) Temperature (COLD, SS)	303(d) listed Category 5
Fiddle Creek	COLD, DWS, PCR, SS	Not supporting COLD, DWS and SS	Arsenic (DWS) Temperature (COLD, SS)	303(d) listed Category 5
Midnight Creek	COLD, DWS, PCR, SS	Not supporting COLD, DWS and SS	Arsenic (DWS) Temperature (COLD, SS)	303(d) listed Category 5
Unnamed tributary to East Fork SFSR (Hennessy Creek)	COLD, DWS, PCR, SS	Not supporting COLD, DWS and SS	Arsenic (DWS) Temperature (COLD, SS)	303(d) listed Category 5
West End Creek	COLD, PCR, SCR, SS	Fully supporting COLD, PCR, and SS	-	Category 2
Sugar Creek (3rd order Cane Creek to mouth)	COLD, PCR, SS	Not supporting COLD, PCR, and SS	Arsenic (PCR), Mercury (COLD, PCR, SS)	303(d) listed Category 5

Source: Brown and Caldwell 2017a

1 National Hydrography Dataset (NHD) waterbody Proper Name. Parenthesized names are unofficial but locally common names included for clarity.

2 Status and causes from 2022 Integrated Report (IDEQ 2022a). COLD = cold water aquatic life; SS = salmonid spawning; PCR = primary contact recreation; DWS = drinking water supply.

Off-Site Facilities and Access Roads

The Surface Water Quality Baseline Study (HDR 2017f) did not include sample locations outside of the proposed SGP. However, streams adjacent to proposed access roads, utility corridors, and off-site facilities have the potential to be impacted by these SGP activities. The types of impacts that could occur are usually described qualitatively because little is known about the existing water quality of these streams. However, for Category 5 waters that have a 303(d)-listed water quality impairment, it is possible to conduct a more specific analysis evaluating how levels of the impaired constituent(s) may be impacted by SGP activities.

IDEQ has inventoried 11 lakes and 701 different stream segments in the surface water quality analysis area. Of these features, 66 are classified as Category 5 waters. **Figure 3.9-16** shows the inventoried stream segments within the analysis area, broken down by “Fully Supporting” beneficial uses (Categories 1 and 2), “Not Assessed” (Category 3), “Not Supporting” beneficial uses (Category 4), and “Not Supporting/303(d) Listed” (Category 5).

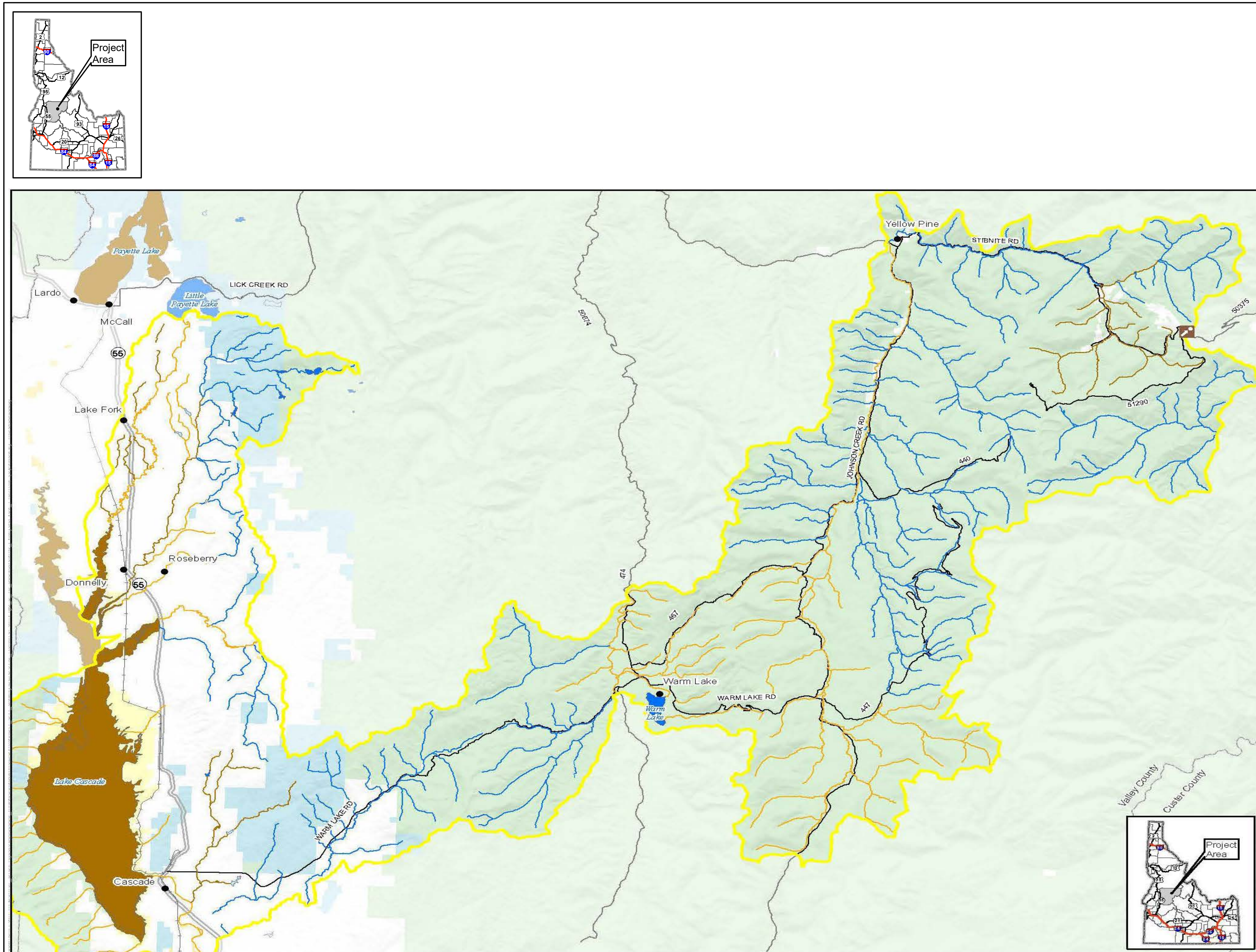
In the western portion of the inventory area, waters that are not supporting beneficial uses are concentrated in the agricultural valley that drains towards Lake Cascade (Cascade Reservoir). Causes for the listing of these waters are largely tied to phosphorus and flow regime alteration, with some streams also listed for temperature, sedimentation/siltation, and biota/habitat assessment considerations. Cascade Reservoir is specifically listed for phosphorus and pH.

In the central portion of the inventory area, waters that are not supporting beneficial uses are primarily associated with the SFSR and its tributaries, and Johnson Creek and its tributaries. Causes for listing of the SFSR and tributaries are primarily associated with temperature and sedimentation/siltation; causes for listing of Johnson Creek and tributaries are primarily associated with temperature.

Impaired waterbodies in the eastern portion of the inventory area are primarily associated with the Meadow Creek and upper East Fork SFSR watershed impacted by elevated arsenic concentrations. Water quality impairments for the mine site streams have been discussed above and are summarized in **Table 3.9-17**.

3.9.4.5 Yellow Pine Pit Lake

A lake has formed in the former Yellow Pine pit where the East Fork SFSR flows through it. The existing pit lake has an estimated maximum depth of 35 feet and an approximately 4.75-acre surface area with a contained water volume of approximately 92 acre-feet. Originally, the pit was excavated to a depth 125 feet below the current water level, but the excavation has filled with approximately 90 feet of sediment (Brown and Caldwell 2017a).



LEGEND

Surface Water Analysis Area

IDEQ Streams
- Fully Supporting
- Not Assessed
- Not Supporting
- Not Supporting/303d Listed

IDEQ Lakes
- Fully Supporting
- Not Assessed
- Not Supporting

Other Features
- County
- City/Town
- Monumental Summit
- Railroad
- Highway
- Road

Surface Land Management
- Bureau of Land Management
- Bureau of Reclamation
- Private
- State
- U.S. Forest Service

Note:
The McCall – Stibnite Road (CR 50-412) consists of Lick Creek Road, East Fork South Fork Salmon River Road (East Fork Road) and Stibnite Road.

Figure 3.9-16
IDEQ Current Conditions for Surface Waters

Stibnite Gold Project
Stibnite, ID

Data Sources: (AECOM 2020)

Water chemistry samples were collected in two 1999 sampling events at the surface and bottom of the lake at three locations across the lake from inflow to outlet plus one intermediate depth at the middle location (URS 2000b, Tables 8.1-21, 8.1-22, and 8.1-23). Circumneutral pH values were observed ranging from 7.2 to 8.2 with low TDS concentrations between 47 and 78 mg/L. Analyses of total and dissolved metals indicated that concentrations of most metals were below reported analytical detection limits with the exceptions of antimony, arsenic, iron, magnesium, and manganese. Dissolved mercury was detected in a single sample at 0.23 mg/L but all other dissolved and total mercury analyses (including the companion total mercury analysis for that location) were below method detection limits reported between 0.042 mg/L and 0.063 mg/L. Analyses able to detect mercury concentrations at lower concentrations were not conducted as part of the 1999 investigation. These analytical method detection limits are greater than the strictest potentially applied water quality standard and it is uncertain whether the pit lake water meets that standard.

Concentrations of antimony and arsenic exceeded the strictest potentially applied water quality standards for all samples analyzed with total antimony concentrations ranging between 0.020 mg/L and 0.033 mg/L and total arsenic concentrations ranging between 0.047 mg/L and 0.098 mg/L. There was no clear spatial trend in the antimony and arsenic concentration measurements and total concentrations for these analytes were close to dissolved concentrations. The other metals detected were below the strictest potentially applied water quality standards.

Continuous water temperature data was collected from the Yellow Pine pit lake at locations near its inflow and outflow (**Figure 3.9-17**; Brown and Caldwell 2021a). These temperature measurements closely resemble stream water temperature measurements collected from USGS Gauges 13311000 and 13311250 upstream and downstream of the lake, respectively (**Figure 3.9-18**). In general, there are wider diurnal ranges in upstream water temperatures than in the downstream water temperatures, indicating that the Yellow Pine pit lake acts to moderate daily temperature variability.

3.9.4.6 Groundwater

This section focuses on quantifying the baseline groundwater chemistry in areas monitored by the 17 monitoring wells of interest listed in **Table 3.9-18** with locations shown on **Figure 3.9-19**. The discussion of baseline chemistry is organized around the groundwater quality indicators, which include pH, major cations and anions, TDS, and metals.

It should be noted that baseline water quality at the mine site is influenced by both natural mineralization and historical mining activity.

Major Ions, pH, and TDS

Average baseline water quality characteristics measured between 2012 and 2018 for the groundwater monitoring wells of interest are summarized in **Table 3.9-18**. Calcium tends to be the dominant cation in most of the alluvial monitoring wells with bicarbonate or sulfate dominant anions. As a result, most alluvial wells in the mine site have a calcium bicarbonate water quality signature, but a few wells (MWH-A05, MWH-A07, MWH-A18, and MWH-A19) exhibit a calcium-sulfate water type. The calcium-sulfate wells are located proximal to and immediately downgradient of legacy mining facilities (HDR 2016a).

Overall, the major ion chemistry of alluvial groundwater at the mine is similar to surface water, illustrating the interconnectedness between the groundwater and surface water systems.

Most of the bedrock monitoring wells (screened between a range of 208 to 815 feet bgs) also display a calcium-bicarbonate water quality signature. Notably, several alluvial and bedrock well pairs exhibit similar characteristics. Many of the bedrock wells are screened at relatively shallow depths below ground surface near the valley walls where the alluvial aquifer is thinner (HDR 2016a), and the bedrock is hydraulically connected to the alluvium deposits.

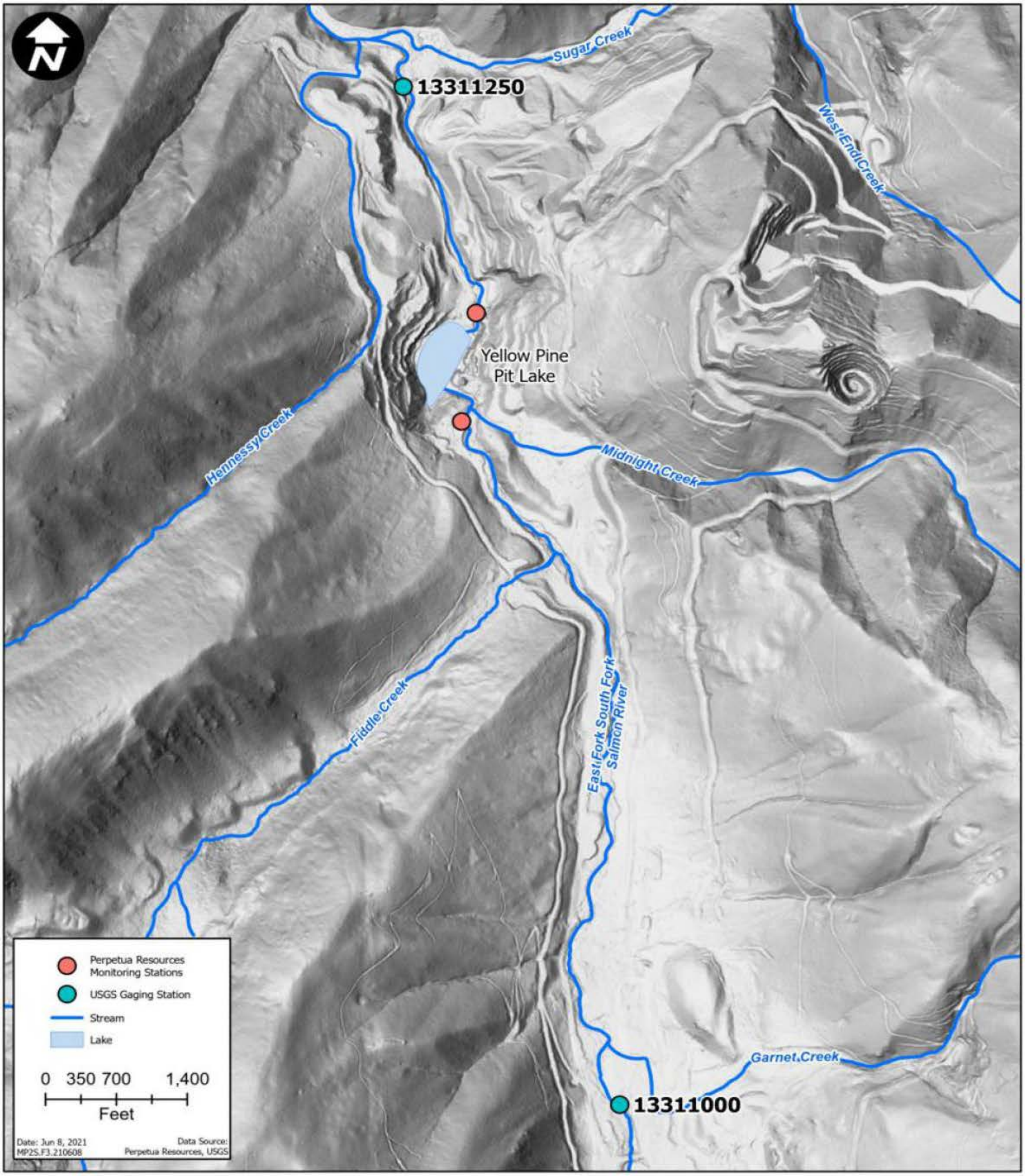
Despite the overall dominance of calcium and bicarbonate, the major ion chemistry of the bedrock aquifer tends to be more variable than the alluvium. For instance, samples from bedrock wells MWH-B03, MWH-B04, and MWH-B07 consistently have sodium and bicarbonate as the major cation-anion pair. These wells are screened at deeper depths near the center of the alluvial valleys. In addition, monitoring well MWH-B05 typically exhibits monthly variations in the major ion geochemistry potentially attributable to its shallower screened interval in the bedrock observing the effects of seasonal recharge in the overlying alluvium.

Average TDS concentrations in the groundwater wells of interest are variable but tend to be less than the 500 mg/L Idaho secondary groundwater standard. The average TDS values shown in **Table 3.9-18** range from 58 to 465 mg/L for the alluvial wells, and from 60 to 415 mg/L for the bedrock wells.

Field-measured pH values for the groundwater wells of interest were generally in the range of 6.1 to 8.9 standard units. The highest average pH (8.86) was observed in bedrock well MWH-B04. This pH value slightly exceeds the Idaho secondary groundwater standard. Overall, the circumneutral to alkaline pH values observed in groundwater near the mine site show that the geochemistry of natural mineralized deposits and legacy mine materials is not conducive to acidic rock drainage.

Constituents of Interest

The Groundwater Quality Baseline Study (HDR 2016a) showed that several metals are present in mine site groundwater at concentrations that exceed the Idaho primary and secondary groundwater quality standards. The constituents exceeding applicable standards typically include antimony, arsenic, iron, and manganese in alluvial groundwater, and aluminum, antimony, arsenic, and iron in the bedrock groundwater. Therefore, these metals were selected as constituents of interest because of their potential to exceed regulatory standards and impact water and biological resources. Based on **Table 3.9-18**, average concentrations measured for the monitoring wells of interest are representative of the broader baseline study findings. Data presented in this table show that average concentrations of pH, aluminum, arsenic, iron, manganese, and antimony exceed the groundwater quality standards from **Table 3.9-1** at one or more wells.



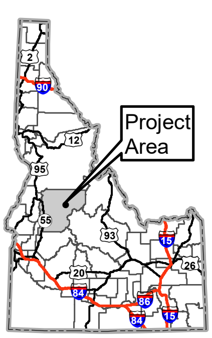
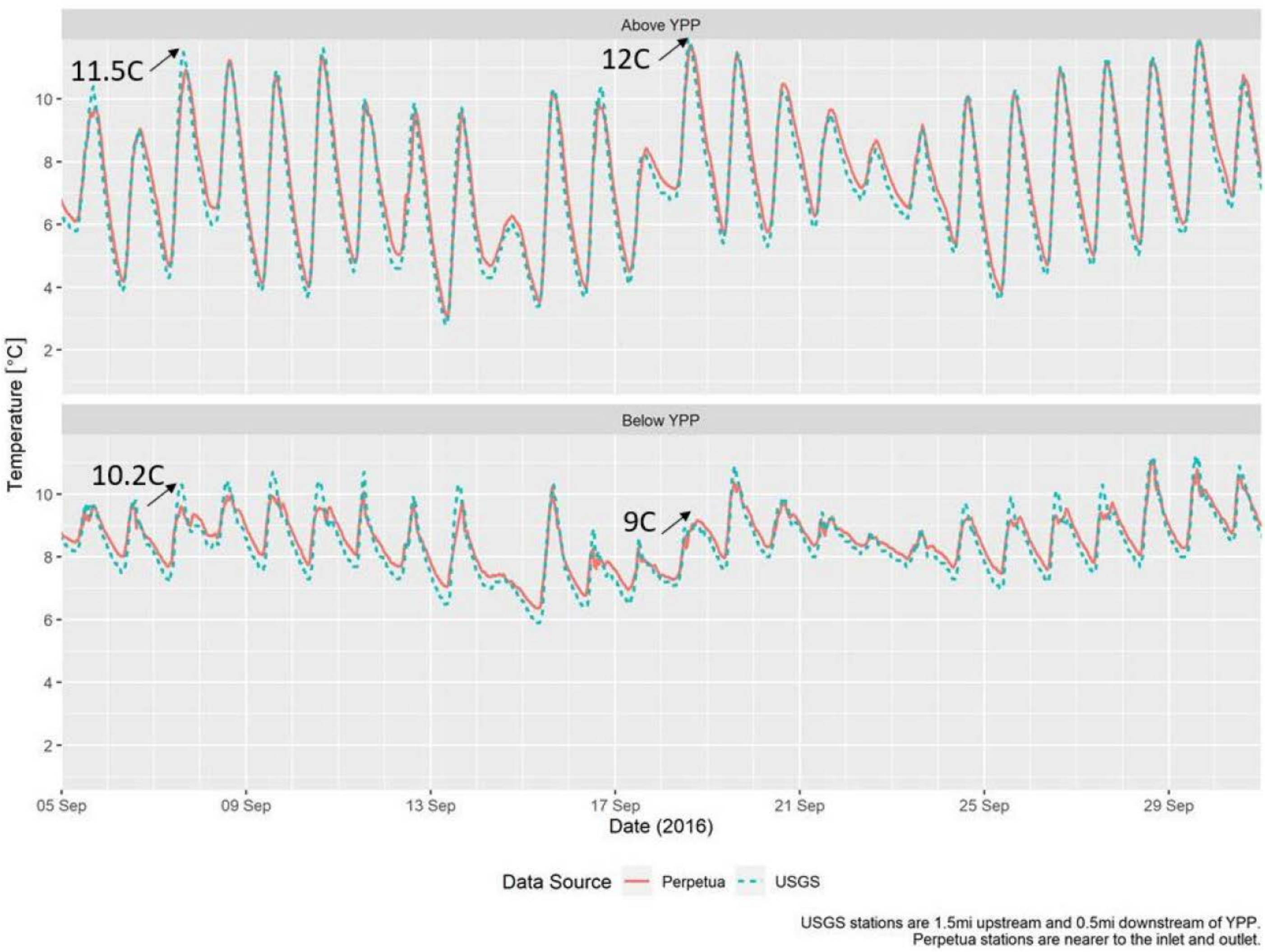


Figure 3.9-17
Yellow Pine Pit Lake Temperature Observation Locations

Stibnite Gold Project
Stibnite, ID

Data Sources: (Brown & Caldwell 2021c)



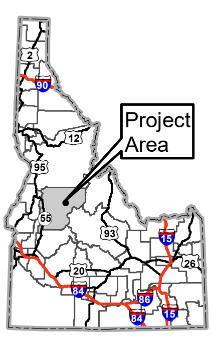
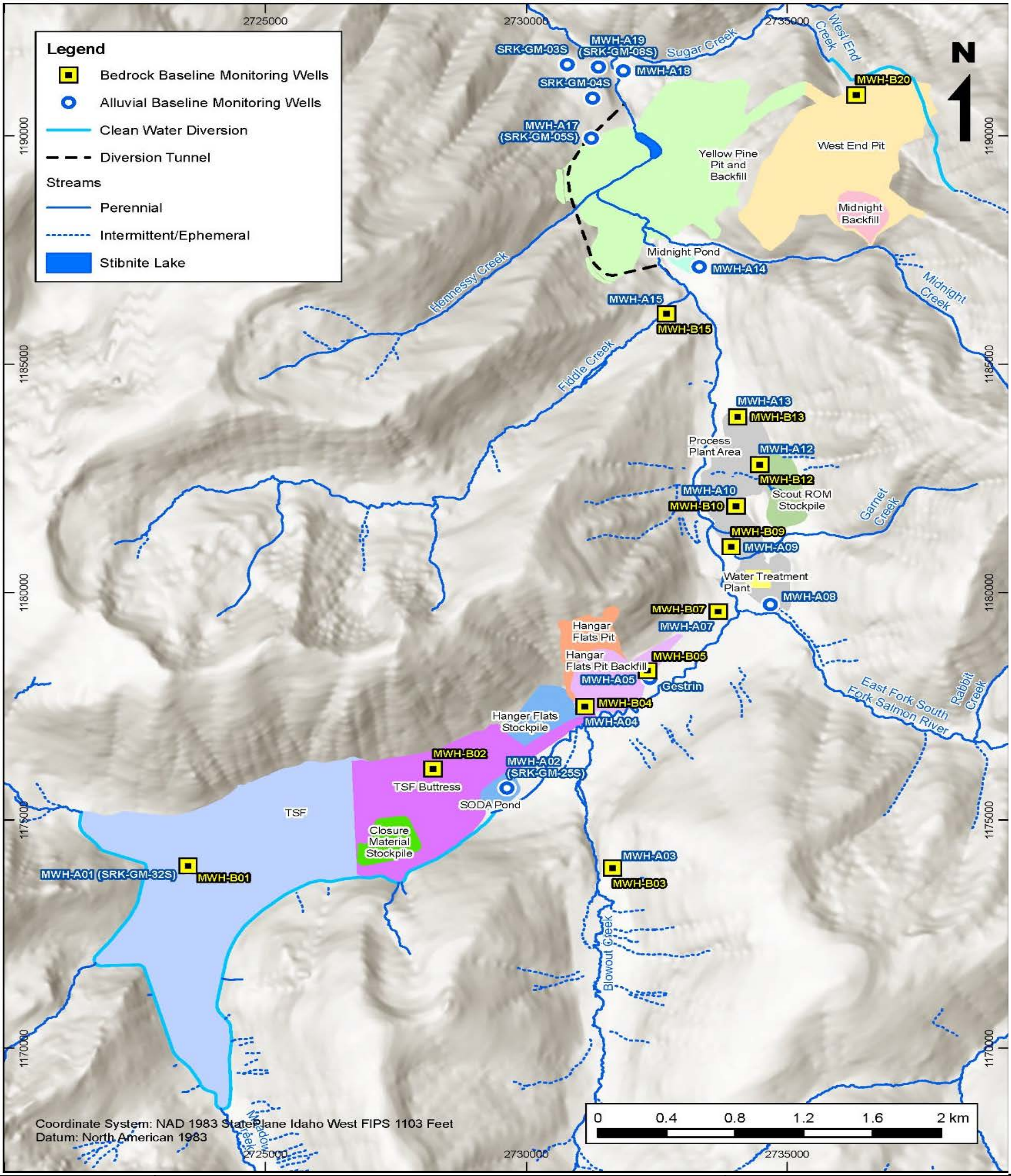


Figure 3.9-18
Yellow Pine Pit Lake Temperature Observations

Stibnite Gold Project
Stibnite, ID
Data Sources: (Brown & Caldwell 2021c)



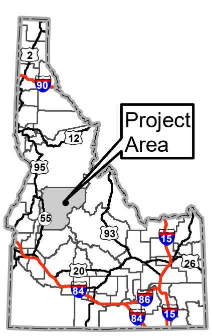


Figure 3.9-19
Groundwater Chemistry Monitor Locations

Stibnite Gold Project
Stibnite, ID
Data Sources: (SRK 2021)

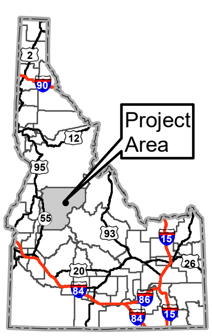
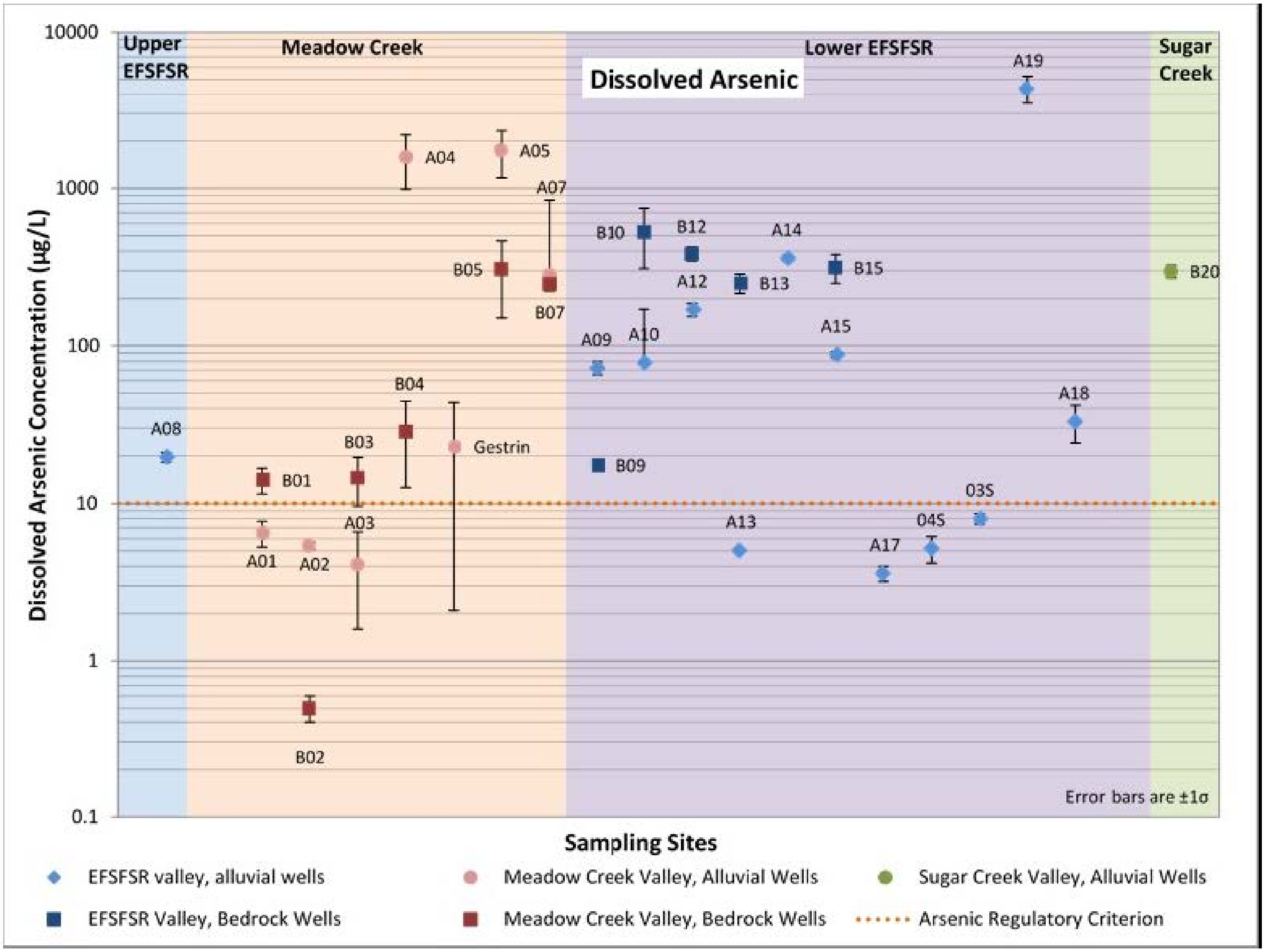


Figure 3.9-20
Dissolved Antimony Concentrations in Groundwater

Stibnite Gold Project
Stibnite, ID

Data Sources: (Brown & Caldwell 2017)



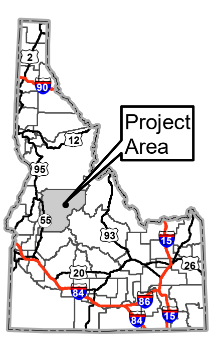


Figure 3.9-21
Dissolved Arsenic Concentrations in Groundwater

Stibnite Gold Project
Stibnite, ID

Data Sources: (Brown & Caldwell 2017)

Table 3.9-18 Average Groundwater Chemistry (2012 to 2018) for Select Alluvial and Bedrock Wells

Proposed Mine Feature			TSF	TSF Buttress		Hangar Flats Pit				Meadow Creek Valley		Yellow Pine Pit			Fiddle Growth Media Stockpile		West End Pit	East Fork SFSR Head-waters	Upgradient
Parameter	**Units**	**Idaho Groundwater Quality Standard (IDAPA 58.01.11)**	**Alluvial aquifer (MWH-A01)[1]**	**Alluvial aquifer (MWH-A02)[1]**	**Bedrock aquifer (MWH-B02)[1]**	**Alluvial aquifer (MWH-A04)[1]**	**Bedrock aquifer (MWH-B04)[1]**	**Alluvial aquifer (MWH-A05)[1]**	**Bedrock aquifer (MWH-B05)[1]**	**Alluvial aquifer (MWH-A07)[1]**	**Bedrock aquifer (MWH-B07)[1]**	**Alluvial aquifer (MWH-A18)[1]**	**Alluvial aquifer (MWH-A19)[1]**	**Alluvial aquifer (MWH-A14)[1]**	**Alluvial aquifer (MWH-A15)[1]**	**Bedrock aquifer (MWH-B15)[1]**	**Bedrock aquifer (MWH-B20)[1]**	**Alluvial Aquifer (MWH-A08)[1]**	**Bedrock Aquifer (MWH-B01)[1]**
pH	s.u.	6.5 - 8.5*	7.46	6.9	6.67	6.62	8.86	6.62	7.04	6.09	8.15	6.19	6.34	7.64	7.09	8.39	8.12	7.04	**8.56**
Alkalinity	mg/L as CaCO3	-	59.9	138	39.3	56.3	174	104	176	65.8	214	25.6	22.4	119	25.6	82.1	157	71.9	66
Ag	mg/L	0.1*	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	0.00003	<0.00002
Al	mg/L	0.2*	0.0068	0.0046	0.054	0.0067	0.038	0.0045	0.017	0.028	**0.28**	0.035	0.0085	0.0052	0.0046	**0.24**	0.0029	0.0066	0.019
As	mg/L	0.05	0.0064	0.0055	0.00054	**1.1**	**0.11**	**1.9**	**0.14**	**0.20**	**0.25**	0.033	**4.7**	**0.35**	**0.087**	**0.32**	**0.3**	0.019	0.013
B	mg/L	-	0.01	0.01	0.011	0.013	0.051	0.023	0.018	0.012	0.031	0.0098	0.011	0.009	0.011	0.024	0.008	0.009	<0.011
Ba	mg/L	2	0.0019	0.021	0.0029	0.01	0.64	0.033	0.049	0.018	0.019	0.017	0.046	0.016	0.017	0.041	0.048	0.045	0.0037
Be	mg/L	0.004	<0.00002	<0.00002	0.000021	<0.00002	<0.00002	<0.00002	<0.00002	0.000027	0.000065	0.00017	0.000013	<0.00002	<0.00002	0.00005	<0.00002	<0.00002	<0.00002
Ca	mg/L	-	18	30.7	10.4	18.1	7.69	83.5	65.4	75.6	14.5	83.9	36.5	32	5.11	15.5	34.9	19	18.8
Cd	mg/L	0.005	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	0.000035	<0.00002	0.000038	0.000017	0.000023	<0.00002	<0.00002	<0.00002	0.00002	<0.00002	<0.00002	<0.00002
Cl	mg/L	250*	0.3	7.4	0.27	0.52	0.28	9.2	2.1	2.5	1. 8	6	0.72	0.47	0.42	0.97	0.28	0.4	0.4
Cyanide	mg/l	0.2	<0.0027	<0.0027	<0.0027	<0.0027	<0.0027	<0.0027	<0.0027	0.011	<0.0027	<0.0027	<0.0027	<0.0027	<0.0027	<0.0027	<0.0027	<0.0027	<0.0027
Co	mg/L	-	0.0001	0.00099	0.00028	0.00071	0.00017	0.00188	0.00073	0.0033	0.00042	0.00025	0.00011	0.00023	0.000054	0.00069	0.00014	0.00006	0.00014
Cr	mg/L	0.1	0.00028	0.00026	0.0002	0.00017	0.00043	0.00014	0.0003	0.00019	0.00057	0.00019	0.00028	0.00027	0.00014	0.00026	0.00027	0.00026	0.00022
Cu	mg/L	1.3	0.00048	0.00032	0.00038	0.00094	0.00061	0.0016	0.0016	0.0014	0.0007	0.00063	0.001	0.00056	0.00013	0.00041	0.00043	0.0022	0.00035
F	mg/L	4	0.11	0.11	0.094	0.1	0.68	0.15	0.89	0.17	3.2	0.16	0.15	0.11	0.09	0.59	0.12	0.11	0.23
Fe (total)	mg/L	0.3*	0.134	**2.8**	**1.7**	**2.1**	0.23	0.21	**0.37**	**1.3**	**1.7**	**4.3**	**1.1**	**0.38**	0.23	**6.93**	0.061	0.2	0.16
Hg	mg/L	0.002	5.60E-07	8.20E-06	1.40E-06	2.50E-05	8.80E-07	6.60E-05	1.50E-06	1.00E-05	1.80E-06	2.70E-06	2.00E-06	6.60E-07	7.40E-07	3.80E-06	4.30E-07	7.40E-07	5.80E-07
K	mg/L	-	0.77	1.5	0.58	1.3	1.2	2.7	2.4	3.6	1	2	1.4	1.7	0.9	0.95	3.13	1.58	0.66
Mg	mg/L	-	1.48	8.07	1.17	3.26	1.78	20.6	15.5	31.4	3.77	22.1	8.02	10.63	1.15	2.29	24.1	5.32	1.89
Mn	mg/L	0.05*	0.001	**2.8**	0.012	**1.1**	**0.07**	**2.2**	**0.07**	**0.36**	0.021	0.026	0.0021	0.0039	0.0009	0.019	0.01	0.001	0.0013
Mo	mg/L	-	0.0012	0.0023	0.0003	0.001	0.0036	0.0016	0.0048	0.0022	0.012	0.000089	0.00031	0.003	0.00023	0.0051	0.0045	0.00086	0.0061
Na	mg/L	-	2.68	15.4	3.91	5.33	70	15.24	49.2	8.19	133	4.58	3.72	3.9	3.58	27.8	2.55	3.58	7

Proposed Mine Feature			TSF	TSF Buttress		Hangar Flats Pit				Meadow Creek Valley		Yellow Pine Pit			Fiddle Growth Media Stockpile		West End Pit	East Fork SFSR Head-waters	Upgradient
Parameter	Units	Idaho Groundwater Quality Standard (IDAPA 58.01.11)	Alluvial aquifer (MWH-A01)[1]	Alluvial aquifer (MWH-A02)[1]	Bedrock aquifer (MWH-B02)[1]	Alluvial aquifer (MWH-A04)[1]	Bedrock aquifer (MWH-B04)[1]	Alluvial aquifer (MWH-A05)[1]	Bedrock aquifer (MWH-B05)[1]	Alluvial aquifer (MWH-A07)[1]	Bedrock aquifer (MWH-B07)[1]	Alluvial aquifer (MWH-A18)[1]	Alluvial aquifer (MWH-A19)[1]	Alluvial aquifer (MWH-A14)[1]	Alluvial aquifer (MWH-A15)[1]	Bedrock aquifer (MWH-B15)[1]	Bedrock aquifer (MWH-B20)[1]	Alluvial Aquifer (MWH-A08)[1]	Bedrock Aquifer (MWH-B01)[1]
Ni	mg/L	-	0.00021	0.00079	0.00038	0.00061	0.00026	0.0024	0.0012	0.0014	0.00054	0.0017	0.00058	0.00045	0.00017	0.00051	0.00093	0.00027	<0.0002
P	mg/L	-	0.024	0.033	0.02	0.066	0.023	0.044	0.053	0.031	0.021	0.023	0.32	0.023	0.038	0.026	0.026	0.018	0.022
Pb	mg/L	0.015	0.000029	0.000046	0.000055	0.000047	0.000064	0.0000 4	0.00013	0.000042	0.00023	0.000021	0.000036	0.00004	<0.00002	0.00021	0.000037	0.00012	0.000034
Sb	mg/L	0.006	0.002	9.10E-05	0.0016	0.0013	0.00062	**0.12**	**0.12**	**1.08**	0.0011	**0.2**	**0.01**	**0.0422**	0.004	**0.01**	**0.019**	**0.015**	0.0044
Se	mg/L	0.05	<0.001	<0.001	<0.001	0.00092	0.00098	0.00 076	0.00085	0.0008	0.00094	0.00078	0.0016	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SO4	mg/L	250*	3.91	4.79	2.63	17.8	5.86	214	153	**260**	112	**270**	103	11.95	2.38	26.9	37.5	8.88	8.31
Tl	mg/L	0.002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
V	mg/L	-	0.00031	0.00047	0.00021	0.00051	0.0003	0.00074	0.00047	0.00016	0.0009	0.00013	0.00073	0.00022	0.00044	0.0009	0.00013	0.0004	0.00033
Zn	mg/L	5*	0.0011	0.0014	0.0015	0.0016	0.0015	0.0019	0.011	0.0039	0.0062	0.0058	0.0014	0.0015	0.001	0.0017	0.028	0.0023	0.0011
TDS	mg/L	500*	75.4	170	60.3	103	185	434	410	465	415	448	205	144	57.9	172	198	93.8	86.4
NO3 + NO2	mg/L as N	10	0.078	0.046	0.17	0.047	0.044	0.12	0.21	0.19	0.046	0.31	0.39	0.33	0.076	0.045	0.05	0.18	0.047

Source: Brown and Caldwell 2017a; HDR 2016a; Midas Gold 2019c; SRK Consulting (SRK) 2018a

[1] Represents average chemistry measured during the 2012-2018 baseline period. Concentration values represent the dissolved fraction unless otherwise noted.

[2] Bolded values exceed the respective Idaho Groundwater Quality Standard (IDAPA 58.01.11).

TSF = Tailings storage facility.

mg/L = milligrams per liter.

- Indicates no standard for parameter.

* Indicates secondary standard.

< = less than detection limit.

Based on these findings, antimony and arsenic were identified as constituents of interest in groundwater. This determination is supported by the fact that groundwater quality criteria associated with antimony and arsenic were established to protect human health, whereas criteria for iron, aluminum, and manganese are based on secondary standards established to protect aesthetic and cosmetic qualities of drinking water. Mercury was not identified as a groundwater constituent of interest, because both total and dissolved mercury concentrations were consistently reported below the water quality standard in the alluvial and bedrock monitoring wells. Although the East Fork SFSR drainage in the Stibnite Mining District has drinking water supply as a designated use, and Idaho groundwater quality standards apply throughout the Stibnite Mining District, there are no current, contemplated, or likely future public water supply intakes or wells in the zones at the SGP where metals levels exceed applicable standards. However, the implications of mercury concentrations in groundwater on surface water chemistry was retained as part of the impact analysis.

Figure 3.9-20 illustrates the trend in dissolved antimony concentrations for groundwater monitoring locations across the mine site. During the baseline study, the fraction of antimony adsorbed onto solid particulates was found to be small, suggesting that the antimony concentration is adequately represented by the dissolved phase of this constituent (HDR 2016a). The figure shows that mean dissolved antimony concentrations are generally below the 6 µg/L Idaho primary groundwater standard in the Meadow Creek valley; however, antimony concentrations increase by two to three orders of magnitude at some of the downgradient alluvial and bedrock wells, such as MWH-A05, MWH-B05, and MWH-A07. Immediately below the confluence with Meadow Creek, groundwater antimony concentrations in the lower East Fork SFSR alluvial aquifer are elevated above the primary groundwater standard but generally decrease in concentration downgradient. The baseline dissolved antimony concentrations exceed the Idaho primary groundwater standard in wells MWH-A14 and MWH-B15 upgradient of Yellow Pine pit. In the Sugar Creek valley, the average dissolved antimony concentration also is above the Idaho primary groundwater standard in bedrock well MWH-B20 near the proposed location of the West End pit.

For most samples collected during the Groundwater Quality Baseline Study (HDR 2016a), 90 to 100 percent of arsenic was found to occur in the dissolved fraction. **Figure 3.9-21** illustrates the trend in dissolved arsenic concentrations for groundwater monitoring locations across the mine site. The figure shows that near wells MWH-A01 and MWH-A03 in the upper Meadow Creek valley, dissolved arsenic is on average higher in the bedrock aquifer than in the alluvium. This trend is reversed farther downgradient in the valley, where monitoring wells MWH-A04 and MWH-A05 have some of the highest average dissolved arsenic concentrations observed during baseline monitoring. The increase in dissolved arsenic in this area is likely due to the influence of historical mining materials.

In both the alluvial and bedrock aquifer, average dissolved groundwater arsenic concentrations were mostly above the primary groundwater standard in the lower East Fork SFSR and Sugar Creek valleys. This includes groundwater monitoring wells MWH-A14, MWH-A15, MWH-B15, and MWH-B20 near Yellow Pine pit.

Overall, dissolved concentrations of antimony and arsenic fluctuate seasonally, but to a lesser extent in bedrock wells than in alluvial wells. Concentrations are generally lower during spring and higher during the fall. This suggests that the concentrations are being diluted in springtime by freshwater recharge, but that concentrations increase during fall when groundwater levels typically approach seasonal lows.

3.10 Vegetation

3.10.1 Introduction

This section describes the existing conditions of vegetation communities, and botanical resources, and non-native plants in the analysis area. This summary is based on best available information from the Forest Service, IDFG, and USFWS. Additional details and information can be found in the SGP Vegetation Specialist Report (Forest Service 2023g).

3.10.2 Vegetation Resources Area of Analysis

The analysis area covers approximately 17,397 acres of land, with 9,062 acres (52 percent) on the BNF, 4,942 acres (28 percent) on the PNF, 347 acres (2 percent) on the Salmon-Challis National Forest, and 3,046 acres (18 percent) outside Forest Service boundaries. The analysis area is shown in **Figure 3.10-1**.

The 300-foot buffer was selected to encompass an area where direct and indirect impacts (e.g., dust, impacts to pollinators, etc.) from the action alternatives could impact vegetation.

3.10.3 Relevant Laws, Regulations, Policies, and Plans.

Several laws and regulations apply to the Proposed Action and Action Alternatives. The following is a list of additional laws, regulations, policies, and plans at the federal, state, or local level pertaining to vegetation resources. Additional descriptions of these regulations can be found in the SGP Vegetation Resources Specialist Report (Forest Service 2023g).

Land and Resource Management Plan: The Payette and Boise Forest Plans (Forest Service 2003a, 2010a) establish goals, objectives, standards, and guidelines that provide a framework for the analysis of impacts on vegetation, botanical resources (including ESA-listed threatened, endangered, proposed, and candidate species and Forest Service-designated sensitive species), and non-native plants.

The National Forest Management Act: The NFMA requires the Secretary of Agriculture to assess forest lands, develop a management program based on multiple-use, sustained-yield principles, and implement a resource management plan for each unit of the NFS. The NFMA, as amended, and its implementing regulations under 36 CFR 219, consolidate and articulate Forest Service management planning responsibilities for lands and resources of the NFS.

Endangered Species Act: The ESA (16 USC Ch. 35 Section 1531 et seq. 1988) is federal legislation that is intended to provide a means to conserve the ecosystems upon which endangered and threatened species depend and provide programs for the conservation of those species, thus preventing extinction of plants and animals. Aspects of the law pertaining to plants are administered by the USFWS.

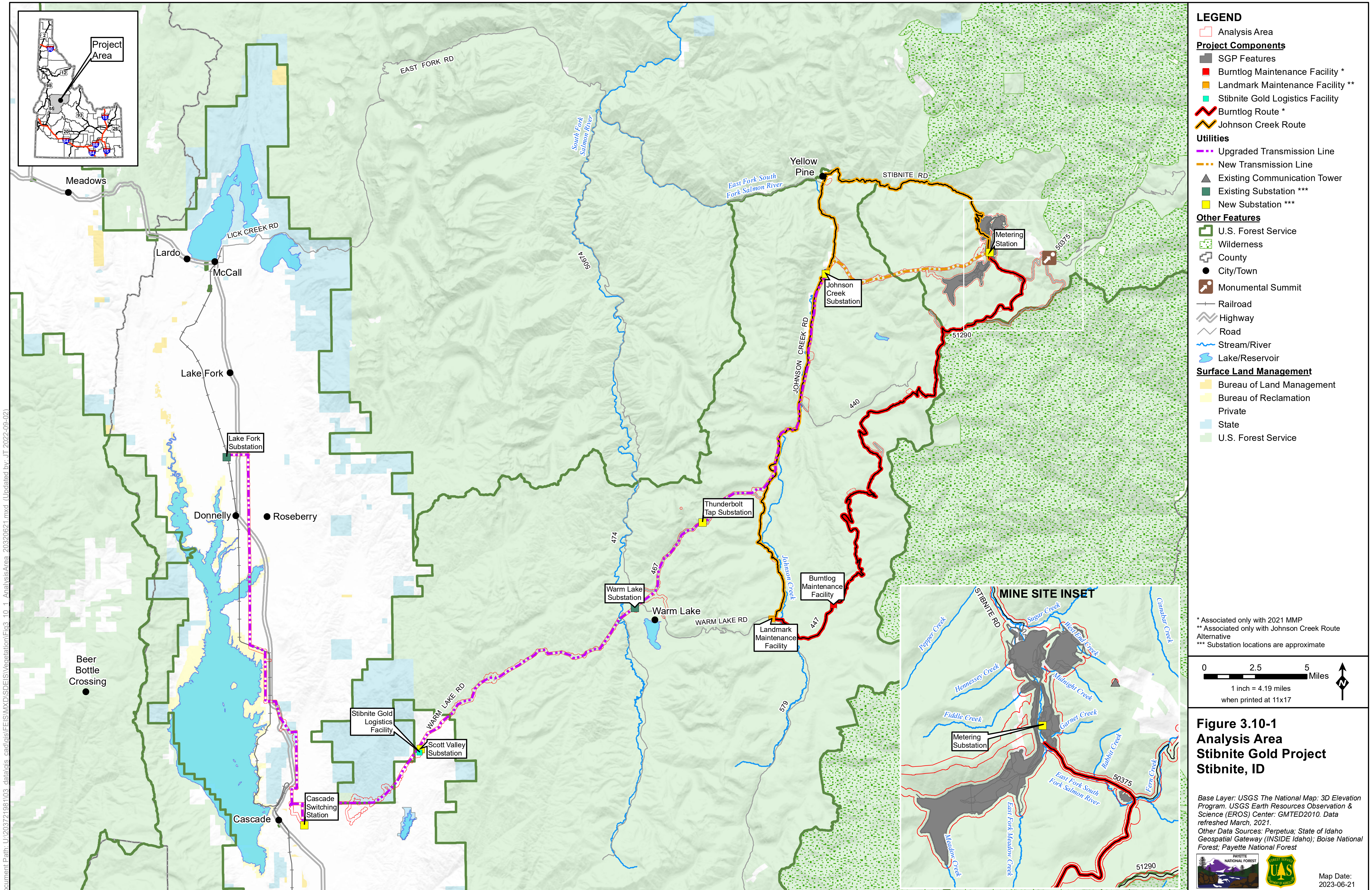


Figure 3.10-1
Analysis Area
Stibnite Gold Project
Stibnite, ID

Base Layer: USGS The National Map: 3D Elevation Program. USGS Earth Resources Observation & Science (EROS) Center: GMTED2010. Data refreshed March, 2021.
Other Data Sources: Perpetua; State of Idaho Geospatial Gateway (INSIDE Idaho); Boise National Forest; Payette National Forest

Map Date: 2023-06-21

Federal Noxious Weed Act: The Federal Noxious Weed Act of 1974 (P.L. 93-629) (7 USC 2801 et seq., 88 Stat. 2148) directs the management of undesirable plants on federal lands, including prohibiting the transport of noxious weeds into the U.S. and between states. This legislation also outlines how noxious weed infestations are to be quarantined and controlled on federal lands. This act also requires agencies to develop programs to eradicate undesirable plants and "establish and adequately fund an undesirable plants management program through the agency's budgetary process; complete and implement cooperative agreements with state agencies regarding the management of undesirable plant species on federal lands under the agency's jurisdiction; and establish integrated management systems to control or contain undesirable plant species targeted under cooperative agreements" (7 USC 2418). In addition, federal law requires agencies to consult with state and local agencies to develop a coordinated weed management effort.

Forest Service Manual 2670: FSM 2670 (Threatened, Endangered, and Sensitive Plants and Animals) gives management direction for conservation, management, and recovery of sensitive species on Forest Service-administered lands. This FSM states that sensitive plant species must receive special management emphasis to ensure their viability and to preclude trends toward endangerment that would result in the need for federal listing. Under this guidance, there must be no impacts to a sensitive species without an analysis of the significance of adverse effects on the populations, its habitat, and on the viability of the species in the planning area (for this analysis, the planning area is a Forest in which a species occurs).

Forest Service Manual 2900: FSM 2900, Invasive Species Management, sets forth NFS policy, responsibilities, and direction for the prevention, detection, control, and restoration of effects from aquatic and terrestrial invasive species (including vertebrates, invertebrates, plants, and pathogens).

U.S. Department of Agriculture Departmental Regulation 9500-004: USDA Departmental Regulation 9500-004 outlines USDA's responsibility "to help maintain sufficient and efficient production capability of farm, forest, water, and rangeland resources for the public benefit, now and in the future, and to encourage and support proper use, management, and conservation of those natural resources" (USDA 2008). This Departmental Regulation was established to describe the USDA's goal of improving fish and wildlife habitats where needed and ensuring the presence of diverse, native, and desired nonnative populations of wildlife, fish, and plant species (USDA 2008). Impacts to rare plant species in the analysis area, including those designated as forest watch species, are included in the analysis to determine adherence to this regulation.

The Sawtooth and Boise National Forests Invasive Species Project Final Environmental Impact Statement and Record of Decision: The Sawtooth and Boise National Forests Invasive Species Project FEIS (Forest Service 2019a) documents the analysis conducted for the Sawtooth and Boise National Forests Invasive Species Project. The overall purpose of the proposed action was to reduce the negative effects of existing and future invasive plants on the structure and function of native plant communities and on other natural resource values within the administrative boundaries of the Sawtooth and Boise National Forests. The ROD for this project (Forest Service 2019b) documents selection of the EIS proposed action to eradicate or control existing or newly discovered invasive plants using an integrated weed management strategy.

The South Fork Salmon River Subbasin Noxious and Invasive Weed Management Program EIS and RODs: The SFSR Subbasin Noxious and Invasive Weed Management Program EIS (Forest Service

2010c) was developed to evaluate and disclose the impacts of alternative management strategies to manage noxious and invasive weeds in the SFSR subbasin outside the FCRNRW on the PNF and BNF. The PNF and BNF each issued separate RODs for this EIS for portions of the project on lands within their respective jurisdictions (Forest Service 2007a, 2010d). Both Forests selected the preferred alternative (Alternative C), though the BNF ROD included modifications to the preferred alternative.

In accordance with the Federal Noxious Weed Act, the SFSR Subbasin Noxious and Invasive Weed Management Program was implemented by the PNF in 2007, and BNF in 2010. The purpose of this program is to develop criteria to prioritize weed species and treatment areas in the SFSR subbasin; Identify and treat existing priority weed infestations in the SFSR subbasin on the PNF and BNF using a variety of methods including herbicide application; Prevent or limit the introduction and establishment of identified weed species, particularly in areas at high risk due to recent fires; and Restore and maintain native plant communities and protect the natural functioning condition and native biodiversity of ecosystems in the SFSR subbasin.

Executive Orders 13112: EO 13112 requires that federal agencies prevent the introduction and spread of invasive species, detect and respond rapidly to control such species, monitor invasive species populations, and restore native species and habitat conditions in ecosystems that have been invaded. In addition, the order requires a federal agency to "not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species."

Idaho Invasive Species Act of 2008: The Idaho Invasive Species Act of 2008 provides policy direction, planning, and authority to combat invasive species infestations throughout the state and to prevent the introduction of new species that may be harmful. This act defines the different classes of weeds and sets priority for their containment and eradication.

Idaho Statute Title 22, Chapter 24 (22-2407): Idaho Statute Title 22, Chapter 24 (22-2407) outlines landowner and citizen duties for controlling and treating noxious weeds on public and private land.

The Idaho Department of Agriculture Administrative Rule 02.06.09: The Idaho Department of Agriculture Administrative Rule 02.06.09 governs the designation of invasive species, inspection, permitting, decontamination, recordkeeping, and enforcement of regulated invasive species, including invasive plant species defined under the Idaho Plant Pest Act of 2002.

Valley County Regulations: Valley County administers noxious weed control and monitoring under Idaho Statute Title 22, Chapter 24 (22-2407).

3.10.4 Affected Environment

3.10.4.1 Vegetation Communities

Forested Potential Vegetation Groups in the Analysis Area within Forest Service-Managed Land

The Forest Service maps PVGs in the PNF and BNF and updates this information periodically (most recently in 2005 for the PNF and 2017 for the BNF). This mapping is available only for NFS lands.

Approximately 347 acres (2 percent) of the analysis area occur in the Salmon-Challis National Forest (administered by the PNF); however, PVG data were not available for this area.

In Forest Service mapping, PVGs are forested habitat types that share similar environmental characteristics, site productivity, and disturbance regimes. PVGs are generally a description of the climax plant community that could be supported by a site, as determined by abiotic conditions such as climate, soil types, hydrological conditions, and topographical aspect. The extent (in acres) of PVGs in the analysis area is presented in **Table 3.10-1**. Descriptions and maps of PVGs in the analysis area are presented in Appendix A of the SGP Vegetation Specialist Report (Forest Service 2023g).

The existing vegetation map layer (Forest Service 2021a) can be used to describe seral-stage (intermediate ecological succession) plant community composition as it was at the time of the most recent mapping. Note that information in existing vegetation mapping has not been verified on-the-ground within the analysis area; however, an accuracy assessment is associated with this mid-scale map.

Existing vegetation mapping typically describes the current dominant vegetative cover or species occupying a site and is frequently updated to reflect vegetation changes due to disturbance such as fire, insects, and disease. In general, existing vegetation types in the analysis area are coniferous forests typical of high mountain regions in Idaho and the inland northwestern U.S. The most common existing vegetation types in the analysis area are lodgepole pine (*Pinus contorta*) forests, subalpine fir (*Abies lasiocarpa*) forests, Douglas-fir (*Pseudotsuga menziesii*) forests, ponderosa pine (*Pinus ponderosa*) forests, and Engelmann's spruce (*Picea engelmannii*) forests. Other vegetation types include grand fir (*Abies grandis*) forests, aspen (*Populus tremuloides*) forests, and whitebark pine (*Pinus albicaulus*) forests. Fires routinely occur in the analysis area and surrounding forests, and as such, much of the analysis area and vicinity is now mapped as burned herblands (grasses and forbs), burned sparse vegetation, and burned forest shrublands reflective of earlier seral stages.

A mature limber pine (*Pinus flexilis*) stand occurs in the area of the SGP (2019 Whitebark Pine Survey Report [Tetra Tech 2020b] for a map of this location). Although limber pine has no listing status in the state of Idaho, mature limber pine trees are uncommon in the surrounding Forests, and this may be the only documented population of this species on the PNF (Mancuso 2016). This stand overlaps various PVGs mapped as PVG 7 - Cool Dry Subalpine Fir (overlap of 8.8 acres), PVG 10 - Persistent Lodgepole Pine (overlap of 25.8 acres), PVG 11 - High Elevation Subalpine Fir (overlap of 0.7 acre), and areas not successional to forests (overlap of 7.8 acres).

Non-Forested Vegetation Groups in the Analysis Area within Forest Service-Managed Land

PVG mapping has identified some acreages in the analysis area as not being successional to forests. Acreages of existing vegetation mapping within these areas are presented in **Table 3.10-2**. As PVG mapping and existing vegetation mapping are performed using different processes and have different objectives, forest vegetation types (as identified in existing vegetation mapping) can occur within areas identified as not successional to forests in PVG mapping.

Table 3.10-1 Forested PVGs in the Analysis Area

PVG #	PVG Name	Total Acres in the Analysis Area[1]	Undisturbed Acres in the PVG[2]	Previously Disturbed Acres in the PVG[2,3]	Acres of Existing Vegetation Communities in the PVG [2,4,5]
1	Dry Ponderosa Pine/ Xeric Douglas-fir	232.2 (1.5%)	232.2 (100%)	—	• Douglas-fir: 83.4 acres (39.2%) • Douglas-fir/Ponderosa Pine: 59.1 acres (27.8%) • Lodgepole Pine: 26.7 acres (12.5%) • Ponderosa Pine: 26.6 acres (12.5%) • Riparian Herblands: 0.9 acre (0.4%) • All others: 16.3 acres (7.6%)
2	Warm, Dry Douglas-fir/Moist Ponderosa Pine	2,031.8 (13.2%)	2,027.1 (99.8%)	4.7 (0.2%)	• Burned Herblands: 131.2 acres (7.0%) • Douglas-fir: 284.9 acres (15.2%) • Douglas-fir/Ponderosa Pine: 315.0 acres (16.8%) • Lodgepole Pine: 550.1 acres (29.4%) • Ponderosa Pine: 323.4 acres (17.3%) • Riparian Herblands: 6.4 acres (0.3%) • Riparian Shrublands/Deciduous Forests: 14.7 acres (0.8%) • All others: 248.4 acres (13.7%)
3	Cool, Moist Douglas-fir	62.9 (0.4%)	62.9 (100%)	-	• Aspen: 1.9 acres (3.5%) • Burned Herblands: 16.5 acres (30.6%) • Burned Sparse Vegetation: 6.8 acres (12.6%) • Douglas-fir: 4.2 acres (7.7%) • Ponderosa Pine: 19.4 acres (35.9%) • Riparian Herblands: 0.6 acre (1.1%) • Riparian Shrublands/Deciduous Forests: 1.3 acres (2.3%) • All others: 3.4 acres (6.3%)
4	Cool, Dry Douglas-fir	1,394.2 (9.0%)	1,347.6 (96.7%)	46.6 (3.3%)	• Aspen: 1.6 acres (0.1%) • Burned Herblands: 82.1 acres (5.9%) • Douglas-fir: 313.7 acres (22.5%) • Douglas-fir/Ponderosa Pine: 183.7 acres (13.2%) • Lodgepole Pine: 430.2 acres (30.9%) • Ponderosa Pine: 130.6 acres (9.4%) • Riparian Herblands: 6.7 acres (0.5%) • Riparian Shrubland/Deciduous Forests: 21.8 acres (1.6%) • All others: 221.9 acres (15.9%)

PVG #	PVG Name	Total Acres in the Analysis Area[1]	Undisturbed Acres in the PVG[2]	Previously Disturbed Acres in the PVG[2,3]	Acres of Existing Vegetation Communities in the PVG [2,4,5]
5	Dry Grand Fir	463.2 (3.0%)	463.2 (100%)	-	• Aspen: 0.4 acre (0.1%) • Burned Herblands: 29.8 acres (7%) • Douglas-fir: 47.6 acres (11.1%) • Douglas-fir/Ponderosa: 24.6 acres (5.8%) • Lodgepole Pine: 61.5 acres (14.4%) • Ponderosa Pine: 200.8 acres (46.9%) • Riparian Herblands: 3.7 acres (0.9%) • Riparian Shrubland/Deciduous Forests: 6.1 acres (1.4%) • All others: 53.4 acres (12.5%)
6	Moist Grand Fir	372.1 (2.4%)	372.1 (100%)	-	• Aspen: 0.8 acre (0.2%) • Burned Herblands: 26.3 acres (7.6%) • Douglas-fir: 30.9 acres (8.9%) • Douglas-fir/Ponderosa: 24.7 acres (7.1%) • Lodgepole Pine: 78.2 acres (22.6%) • Ponderosa Pine: 122.3 acres (35.3%) • Riparian Herblands: 2.7 acres (0.8%) • Riparian Shrubland/Deciduous Forests: 9.2 acres (2.7%) • All others: 51.0 acres (14.7%)
7	Warm, Dry Subalpine Fir	3,223.8 (20.9%)	2,990.2 (92.8%)	233.7 (7.2%)	• Aspen: 0.3 acre (<0.1%) • Burned Herblands: 711.7 acres (22.1%) • Burned Sparse Vegetation: 612.9 acres (19.1%) • Douglas-fir: 186.7 acres (5.8%) • Lodgepole Pine: 855.0 acres (26.6%) • Riparian Herblands: 32.8% acres (1%) • Riparian Shrubland/Deciduous Forests: 36.7 acres (1.1%) • Subalpine Fir: 449.2 acres (14%) • Whitebark Pine: 20.5 acres (0.6%) • All others: 312.0 acres (9.7%)
8	Warm, Moist Subalpine Fir	-	-	-	None
9	Hydric Subalpine Fir	356.7 (2.3%)	352.3 (98.8%)	4.5 (1.2%)	• Burned Herblands: 43.8 acres (12.3%) • Lodgepole Pine: 203.1 acres (56.9%) • Riparian Herblands: 26.3 acres (7.4%) • Riparian Shrubland/Deciduous Tree: 29.4 acres (8.2%) • Whitebark Pine: 0.2 acre (0.1%) • All others: 53.9 acres (15.1%)

PVG #	PVG Name	Total Acres in the Analysis Area[1]	Undisturbed Acres in the PVG[2]	Previously Disturbed Acres in the PVG[2,3]	Acres of Existing Vegetation Communities in the PVG [2,4,5]
10	Persistent Lodgepole Pine	4,145.2 (26.8%)	4,045.5 (97.6%)	99.8 (2.4%)	• Aspen: 0.5 acres (<0.1%) • Burned Herblands: 947.8 acres (23.0%) • Burned Sparse Vegetation: 451.1 acres (10.9%) • Douglas-fir: 355.1 acres (8.6%) • Lodgepole Pine: 1,463.6 acres (35.4%) • Riparian Herblands: 65.9 acres (1.6%) • Riparian Shrubland/Deciduous Forests: 51.7 acres (1.3%) • Subalpine Fir: 401.5 acres (9.7%) • Whitebark Pine: 30.2 acres (0.7%) • All others: 362.8 acres (8.8%)
11	High Elevation Subalpine Fir (with Whitebark Pine)	342.9 (2.2%)	342.3 (99.8%)	0.7 (0.2%)	• Burned Herblands: 35.1 acres (10.7%) • Burned Sparse Vegetation: 174.0 acres (53%) • Lodgepole Pine: 11.2 acres (3.4%) • Riparian Herblands: 6.7 acres (2%) • Subalpine Fir: 71.5 acres (21.8%) • Whitebark Pine: 21.9 acres (6.7%) • All others: 28.1 acres (7.6%)
97, 98, 99	Water, Rock and Barren, Non-Forest	2,814.9 (18.2%)	2,078.6 (73.8%)	736.3 (26.2%)	• Not vegetation; analysis of impacts to PVGs are not performed on these categories.
TOTALS[5,6]		**15,440.0 (100%)**	**14,313.9 (92.7%)**	**1,126.1 (7.3%)**	—

Source: Perpetua 2021a; Forest Service 2005a, 2016b, 2017a, 2017b.
[1] Percentages in this column represent percent of the total analysis area acreage where PVG data are available.
[2] Percentages in this column represent percent of the total acres for this PVG.
[3] Disturbed areas are those impacted by historical mine-related activities.
[4] Acreages for all existing vegetation types that compose greater than 5 percent of total cover in a PVG, as well as total acres for uncommon vegetation types of any percent cover.
[5] Totals and percentages don't necessarily equal the total acres in the analysis area due to non-forest service land not having existing vegetation data available.
[6] Due to rounding, numbers presented may not sum precisely to the totals provided.

Table 3.10-2 Acres of Existing Vegetation Types in Areas Identified as Not Successional to Forested PVGs in the Analysis Area within Forest Service-administered Land

Existing Vegetation Type	Acres[1]
Agriculture	3.9 (0.3%)
Aspen	1.4 (<0.1%)
Burned Forest Shrublands	40.6 (2.5%)
Burned Herblands	76.5 (4.8%)
Burned Sparse Vegetation	60.2 (3.8%)
Developed	574.1 (35.8%)
Douglas-fir	205.6 (12.8%)
Douglas-fir/Lodgepole Pine	17.6 (1.1%)
Douglas-fir/Ponderosa Pine	25.6 (1.6%)
Engelmann's Spruce	2.8 (0.2%)
Forblands	11.8 (0.7%)
Forest Shrublands	30.0 (1.9%)
Grasslands	39.4 (2.5%)
Lodgepole Pine	229.8 (14.3%)
Mountain Big Sagebrush	13.8 (0.9%)
Mountain Shrubland	7.1 (0.4%)
Ponderosa Pine	48.5 (3.0%)
Riparian Herblands	46.9 (2.9%)
Riparian Shrublands/Deciduous Forests	53.0 (3.3%)
Sparse Vegetation	57.8 (3.6%)
Subalpine Fir	34.7 (2.2%)
Water	20.1 (1.3%)
Western larch	0.1 (<0.1%)
Whitebark Pine	2.8 (0.2%)
No existing vegetation mapped[2]	6.3 (0.6%)
TOTAL[3]	**1,603.9**

Source: Perpetua 2021a; Forest Service 2005a, 2016b, 2017a, 2017b.
[1]Percentages in this column represent percent of the total acres.
[2]Vegetation community impacts analyses performed on areas where vegetation is mapped.
[3]Due to rounding, numbers presented in this table may not sum precisely to the total provided.

Vegetation Communities in the Analysis Area outside Forest Service-Managed Land

As PVG mapping does not extend outside the boundaries of the PNF or BNF, LANDFIRE vegetation mapping was used to describe vegetation outside Forest Service-administered lands. Approximately 3,046 acres (18 percent) of land in the vegetation analysis area occurs on lands not administered by the Forest Service. Acres of LANDFIRE vegetation communities (excluding developed or urban land uses) in the analysis area outside Forest Service-administered lands are presented in **Table 3.10-3**. Descriptions and maps of these vegetation communities are presented in Appendix B of the SGP Vegetation Specialist Report (Forest Service 2023g).

Table 3.10-3 Vegetation Communities in the Analysis Area outside Forest Service-administered Land

LANDFIRE Vegetation System Group	LANDFIRE Vegetation Class Name	Acres[1]
Conifer	Middle Rocky Mountain Montane Douglas-fir Forest and Woodland	11.4 (0.4%)
	Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest	433.9 (14.2%)
	Northern Rocky Mountain Foothill Conifer Wooded Steppe	1.1 (<1%)
	Northern Rocky Mountain Mesic Montane Mixed Conifer Forest	35.4 (1.2%)
	Northern Rocky Mountain Ponderosa Pine Woodland and Savanna	109.6 (3.6%)
	Rocky Mountain Lodgepole Pine Forest	101.0 (3.3%)
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	0.5 (<1%)
	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland	0.4 (<1%)
Exotic Herbaceous	Interior Western North American Temperate Ruderal Grassland	482.7 (15.8%)
Exotic Tree-Shrub	Interior Western North American Temperate Ruderal Shrubland	62.3 (2.1%)
Grassland	Rocky Mountain Subalpine-Montane Mesic Meadow	18.7 (0.6%)
Riparian	North American Arid West Emergent Marsh	0.2 (<1%)
	Northern Rocky Mountain Lower Montane Riparian Shrubland	51.8 (1.7%)
	Northern Rocky Mountain Lower Montane Riparian Woodland	114.0 (3.7%)
	Rocky Mountain Alpine-Montane Wet Meadow	480.5 (15.8%)
Shrubland	Inter-Mountain Basins Big Sagebrush Steppe	0.6 (<1%)
	Inter-Mountain Basins Montane Sagebrush Steppe	9.3 (0.3%)
	Northern Rocky Mountain Montane-Foothill Deciduous Shrubland	53.3 (1.8%)
	Northern Rocky Mountain Subalpine Deciduous Shrubland	9.6 (0.3%)
Sparsely Vegetated	Rocky Mountain Cliff Canyon and Massive Bedrock	10.4 (0.3%)
Open Water	Open Water	52.3 (1.7%)
Agricultural, Developed	All others	1,007.5 (33.1%)
TOTAL[3]		**3,046.4 (100%)**

Source: Perpetua 2021a; USGS 2019.
[1]Percentages in this column represent percent of the total acres.
[2]Vegetation community impacts analyses performed solely on non-agriculture and non-developed vegetation communities.
[3]Due to rounding, numbers presented in this table may not sum precisely to the total provided.

Vegetation Community Trends

On the PNF, from 1989 to 2016, an average of 178 fires occurred annually with a majority of them caused by lightning. Approximately 59 percent of the PNF was affected by fire between 1989 and 2016), consisting of a mix of both characteristic and uncharacteristic fires depending upon the historic fire regime (Forest Service 2003a, 2017f). On the BNF, from 1989 to 2016, an average of 151 fires occurred annually with a majority of them caused by lightning, over 58 percent of the planning unit land base has burned between 1989 and 2016, and even though acres burned by wildfire have been increasing over the past few decades, the amount of area burned is still well below historical levels (Forest Service 2010a, 2016g). Near the vegetation analysis area, past fires within the headwaters of the East Fork SFSR and Sugar Creek include Indian Creek Point (12,206 acres); Tamarack (2,291 acres); Bishop Creek (1,452 acres); Cascade Complex (302,530 acres); and Thunder City (9,475 acres).

The effects of fire on the landscape vary depending on weather, fuel loadings, and vegetative community type. Historically, wildfires throughout the PNF and BNF ranged from ground fires to stand-replacing fires, depending on the vegetative community. Some recent wildfires have created more homogeneous landscapes than those that typically occurred within historical fire regimes. However, some recent fires in the PNF and BNF may have been more similar to historical fires in that they burned through vegetative types that historically burned infrequently, resulting in a diversity of vegetative communities and a variety of landscape mosaics (Forest Service 2003a, 2010d). Due to the complexity of the current fire regime within the analysis area, it is difficult to predict how changes in vegetation communities at the SGP may impact future fires in the analysis area.

Additionally, various factors including altered species compositions have increased the susceptibility of some plant communities to large-scale infestations of insects and pathogens, which has resulted in greater numbers of standing dead or dying trees and increases the fuel loading in these areas (Forest Service 2003a).

Gradual changes in the distribution and abundance of dominant plant species and short-term impacts on vegetation structure and age classes are expected as a result of rising temperatures and longer and more frequent droughts associated with climate change (Halofsky et al. 2017).

Surface soils in the SGP area are influenced by trace metals as a byproduct of legacy mine operations, with concentrations of antimony, arsenic, mercury, and silver in soils adjacent to the SGP being greater than screening level phytotoxicity criteria (Tetra Tech 2021a). Total arsenic was identified as having the greatest potential to cause phytotoxicity in plants growing at or near the SGP. However, soil analysis and visual observations of plant growth in reclaimed historic mine sites adjacent to the SGP suggest that plants in the area can withstand higher concentrations of trace metals than are commonly accepted as upper limits for supporting vegetation (Tetra Tech 2021a).

As described in **Sections 3.2**, **3.5**, and **3.11**, the EFMC, also known as “Blowout Creek,” is a tributary to Meadow Creek that has been severely impacted as a result of legacy mining-related activities and the failure of a dam constructed across its stream channel (Midas Gold 2016a). The dam was constructed in 1929 to supply hydroelectric power for historical milling operations. The dam failed in 1965 due to record snowmelt and runoff rates, destroying the existing vegetation communities and depositing large volumes of sediment into Meadow Creek, the East Fork SFSR, and the Yellow Pine pit lake (MWH 2017). Still to this day, this stream is considered to be the largest source of sediment to the East Fork SFSR in the vegetation analysis area and continues to influence vegetation communities, particularly during high runoff flows in the late spring/early summer along impacted waterbodies.

The middle reach of EFMC flows through a lateral glacial moraine that eroded during the dam failure and is still considered unstable with limited vegetation as it continues to deposit sediments into Meadow Creek and the East Fork SFSR. Upstream of this middle reach, EFMC has a low-gradient pool-riffle reach flowing through a large meadow. This reach is incised and continues to headcut in response to the dam failure. There are few trees, and the banks of EFMC have abundant grasses and forbs.

Desired Conditions for Vegetation

- Generalized desired conditions relating to vegetation communities in the Payette Forest Plan and Boise Forest Plan are described below. More specific desired conditions for the different components of vegetation are found in Appendix A of the Forest Plans.
- Both Forest Plans: Forested vegetation reflects a combination of successional development, disturbance regimes, and management activities. Forested lands exhibit variable patterns of size classes, densities, structural stages, and species composition. Seral tree species such as ponderosa pine, Douglas-fir, aspen, and whitebark pine have increasing species composition in areas where fire and mechanical vegetation treatments are the primary tools. Snags and coarse woody debris are present in sufficient quantities to provide for habitat diversity and long-term soil productivity.

- Grasslands and shrublands exhibit variable patterns of multiple-aged shrubs, grasses, and forbs. Shrublands are found in mosaics of canopy closures across the landscape, reflecting a combination of successional development, disturbance regimes and management activities. Some mid- to high-elevation grasslands are primarily meadow complexes that are dominated by sedges, rushes, grasses, and forbs.

- Payette Forest Plan only: Where vegetation development is dominated by plant succession, climax species composition is increasing, canopy cover densities are moderate to high, and late successional structure develops.

- Boise Forest Plan only: In areas where vegetation development evolves primarily as a result of plant succession rather than disturbance, late-seral/climax species composition and moderate to high canopy densities will increase.

3.10.4.2 Botanical Resources

The terms botanical resources or special status plants are generally used to denote species that are considered sufficiently rare that they require special consideration and/or protection by the federal and/or state governments. For the purposes of this section, botanical resources or special status plant species are those that are:

- Listed as threatened or endangered under the ESA, as amended (16 USC 35 Section 1531 et seq. 1988);

- Identified as candidate or proposed for ESA listing;
- Designated as sensitive on the Regional Foresters list; and/or
- Identified as forest watch plant species in the Payette Forest Plan (Forest Service 2003a) and/or Boise Forest Plan (Forest Service 2010a).

Sensitive species are defined in FSM 2670 as "plant and animal species identified by a regional forester for which population viability is a concern, as evidenced by: 1) Significant current or predicted downward trends in population numbers or density and 2) Significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution."

Forest watch species are those that are confirmed to occur in the planning area for a Forest and are listed as S1, S2, or S3 (**Table 3.10-4**) at the state level and are not on the Forest Service regional sensitive species list. Impacts to forest watch species are addressed in adherence to Forest Service Guideline MIOB08 (Forest Service 2003a, 2010a).

Potential habitat modeling for special status plants in the analysis area was completed to supplement existing species location information. Potential habitat was modeled for whitebark pine and 29 additional Sensitive or Forest Watch species in the PNF and BNF; modeling protocols and results are documented in the SGP EIS Technical Report: Special Status Plant Potential Habitat Modeling Report (AECOM 2020e) and were updated in 2022 (Stantec 2022).

Endangered Species Act Threatened, Endangered, Candidate, and Proposed Species

There are no federally endangered, proposed, or candidate plant species documented or suspected in proximity to the analysis area. The whitebark pine (*Pinus albicaulis*) is a federally threatened species known to occur in the analysis area and is discussed further below.

Whitebark Pine

The whitebark pine is a federally threatened species without designated Critical Habitat. On December 2, 2020, the USFWS published a proposed rule (85 FR 77408) to list the whitebark pine as a threatened species under the ESA of 1973, as amended (16 USC 1531 et seq.), and on December 15, 2022, the USFWS listed the species as federally threatened (87 FR 76882). Included in the listing is a special rule pursuant to section 4(d) of the ESA that identifies actions necessary to conserve and recover the whitebark pine, as well as a limited number of prohibited acts (85 FR 77408). While the 4(d) rule does not relieve federal agencies of their obligations under section 7 of the Act, it includes exceptions that allow for optimal, flexible, and adaptive forest activities that can advance whitebark pine conservation.

This species is found in the analysis area (HDR 2017g; Tetra Tech 2020b; USFWS 2019a). Whitebark pine is a five-needled coniferous tree typically found in cold, windy, high-elevation or high-latitude sites in western North America, usually on steep slopes at alpine tree lines and in subalpine areas (Arno and Hoff 1989; BLM 2016; USFWS 2021a). In moist mountain ranges, whitebark pine is most abundant on warm, dry exposures; but in semiarid ranges, it becomes prevalent on cool exposures and moist sites (Arno and Hoff 1989). It ranges from west-central British Columbia east to west-central Alberta and south to central Idaho, southwestern Wyoming, and southern California (NatureServe 2020a). Its distribution is split into two broad sections, one following the Coast Ranges and one following the Cascade Range, and the other following the northern Rocky Mountains, with scattered occurrences between the two sections in Great Basin regions of eastern Washington and Oregon and northern Nevada (NatureServe 2020a).

Whitebark pine is considered an important or keystone species in the ecosystems where it is found due to its function as habitat and food for wildlife, its ability to colonize areas after fire and other disturbances, its ability to survive on harsh, high-elevation droughty sites, and its function in regulating snowmelt and reducing soil erosion (Keane et al. 2017). Whitebark pine is a long-lived tree, commonly living over 400 years. Whitebark pine populations are declining in North America due to white pine blister rust disease (caused by the introduced pathogen white pine blister rust [*Cronartium ribicola*]) ((85 FR 77408; Keane et al. 2017), historical and current mountain pine beetle (*Dendroctonus ponderosae*) outbreaks, and fire exclusion management policies. Climate change also is predicted to negatively affect whitebark pine by restricting suitable habitat for the species as a result of warming temperatures and major shifts to disturbance regimes such as wildfire frequency (Keane et al. 2017).

Special status plant surveys in which whitebark pine was among the targeted species were performed in 2012, 2013, and 2014 in portions of the analysis area (HDR 2017g). These surveys documented approximately 164 acres of whitebark pine at the SGP mine area and along Burnt Log Road (FR 447) and several existing roads, including Horse Heaven Road (FR 416w) and Meadow Creek Lookout Road (FR 51290), along the existing Old Thunder Mountain Road (FR 440), and within the transmission line corridor between Johnson Creek Road (CR 10-413) and the SGP mine area (HDR 2017g).

It was determined that the 2012, 2013, and 2014 whitebark pine surveys were not conducted throughout the extent of suitable habitat within the SGP footprint and data were not collected in a manner that would be useful for a comprehensive and meaningful effects analysis for this species. Therefore, in 2019, known habitat parameters (i.e., PVGs [specifically 4, 7, 10, 11, and 99], existing vegetation [specifically lodgepole pine, burned sparse vegetation, burned herblands, burned forest shrublands, subalpine fir, whitebark pine mix, and Douglas-fir], lithology [excluding “metamorphic rocks-undivided” and “alluvial, landslide, and glacial deposits”], and elevation [above 6,500 feet amsl]) were used to model suitable habitat for whitebark pine in the analysis area (AECOM 2019a). Approximately 6,130 acres of suitable habitat for this species was modeled along Warm Lake Road (CR 10-579), Cabin Creek Road (FR 50467), the Burntlog Route, Meadow Creek Lookout Road (FR 51290), the transmission line right-of-way, and the SGP mine area (AECOM 2019a). However, due to revisions in the Project footprint between 2019 and 2023, approximately 4,259 acres of modeled suitable habitat currently occurs within the whitebark pine analysis area.

Surveys for whitebark pine using suitable habitat modeling developed in 2019 were performed in a majority of the SGP footprint in spring, summer, and fall of 2019 and all but 78 acres of the vegetation analysis area was surveyed. The results of these surveys are reported in the 2019 Whitebark Pine Survey Report (Tetra Tech 2020b). For purposes of this analysis, the 78 acres of unsurveyed modeled suitable habitat, which are in and around the mine site, are assumed to be occupied by whitebark pine. Within the surveyed areas, approximately 2,069 acres of occupied whitebark pine habitat were identified during field surveys within the analysis area for vegetation resources (i.e., Tetra Tech 2019 field survey data within the 300-foot buffer on either side of SGP components included in the survey effort). The 300-foot buffer was selected to encompass an area where direct and indirect impacts (e.g., dust, change in the distribution and abundance of seed dispersers [e.g., Clark's nutcracker (*Nucifraga columbiana*)], etc.) from the action alternatives could impact the species. However, approximately 1,902 acres of the 2,069 acres of occupied whitebark pine habitat in the whitebark pine analysis area have been affected by either wildfire (92 percent), mountain pine beetles (27 percent), and/or white pine blister rust (42 percent) (Tetra Tech 2020b). The approximately 167 acres of occupied whitebark pine habitat that has not been affected by either wildfire, mountain pine beetles, and/or white pine blister rust consists mainly of younger trees without female cones and these areas occur near the mine site (4.2 acres), along access roads (7.5 acres), and near utilities, primarily along the new transmission line (155.0 acres).

As part of another project along the Burntlog Route, surveys were conducted by the Forest Service in 2021 and a total of 8 trees in three locations were documented within the vegetation analysis area (Forest Service 2021b).

Sensitive and forest Watch Species

Species Known to Occur in the Analysis Area

Two plant species designated as sensitive by the Forest Service are known to occur within or immediately adjacent to the analysis area. These species are least moonwort (*Botrychium simplex*) and Sacajawea's bitterroot (*Lewisia sacajaweana*). Four forest watch species are known to occur within or immediately adjacent to the analysis area. These are bent-flowered milkvetch (*Astragalus vexilliflexus* var. *vexilliflexus*), Blandow's helodium (*Helodium blandowii*), sweetgrass (*Hierochloe odorata*), and Rannoch-rush (*Scheuchzeria palustris*).

The state and global conservation status rank for each of these plants and Forest Service status as either a sensitive or forest watch species is presented in **Table 3.10-4**. State and global conservation status ranks are categorizations of the relative imperilment and rarity of a species at the state or global level (NatureServe 2012). Conservation status ranks do not have any regulatory authority but are useful in understanding the overall degree of vulnerability of a species to impacts that could occur from the SGP. More information for each of these species is presented below.

Table 3.10-4 State and Global Rank and Forest Service Status for Special Status Plants Known to Occur Within or Immediately Adjacent to the Analysis Area

Scientific Name	Common Name	State Rank[1]	Global Rank[1]	Forest Service R4 Status[2]	PNF Status[3]	BNF Status[4]
Astragalus vexilliflexus var. *vexilliflexus*	Bent-flowered milkvetch	S1	G4T4	--	Forest Watch	--
Botrychium simplex	Least moonwort	S2	G5	Sensitive	Sensitive	Forest Watch
Helodium blandowii	Blandow's helodium	S2	G5	--	Forest Watch	Forest Watch
Hierochloe odorata	Sweetgrass	S1	G5	--	--	Forest Watch
Lewisia sacajaweana	Sacajawea's bitterroot	S2	G2	Sensitive	Sensitive	Sensitive
Scheuchzeria palustris	Rannoch-rush	S2	G5	--	--	Forest Watch

Source: AECOM 2020e and Stantec 2022; Forest Service statuses and state ranks are from rare plant lists for the PNF (Forest Service no date) and BNF (Forest Service 2015b). Global ranks are from NatureServe Explorer database (NatureServe 2020b).

[1]State ranks are from rare plant lists for the PNF (Forest Service no date) and BNF (Forest Service 2015b). State ranks for species not on rare plant lists for the PNF or BNF and global ranks for all species are from NatureServe Explorer database (NatureServe 2020b).

S = State rank indicator; denotes rank based on status within Idaho.

G = Ranks designated at the global (or range-wide) level.

T = Infraspecific taxa (subspecies, plant varieties, and other designations below the level of the species) rank indicator, appended to the global rank for the including species.

1 = Critically imperiled — Typically having 5 or fewer occurrences, or 1,000 or fewer individuals.

2 = Imperiled — Typically having 6 to 20 occurrences, or 1,001 to 3,000 individuals.

3 = Vulnerable — Rare; typically having 21 to 100 occurrences, or 3,001 to 10,000 individuals.

4 = Apparently secure — Uncommon but not rare, but with some cause for long-term concern; typically having 101 or more occurrences, or 10,001 or more individuals.

5 = Secure — Common, widespread, abundant, and lacking major threats or long-term concerns.

[2]This column references a species' status as sensitive on the Forest Service Region 4 (Intermountain Region) Proposed, Endangered, Threatened, and Sensitive Species List (Forest Service 2016c), regardless of whether this species is indicated on this list as being present in either the PNF or BNF.

[3]This column states if species is designated as sensitive or as a forest watch species according to the PNF rare plant list (Forest Service no date). *Botrychium simplex* is considered a sensitive plant species in the PNF even though the PNF rare plant list indicates it as a forest watch species (Forest Service 2020c).

[4]This column states if a species is designated as sensitive or as a forest watch species according to the BNF rare plant list (Forest Service 2015b). *Botrychium simplex* is considered a forest watch species in the BNF even though it is a sensitive species at the Region 4 level (Forest Service 2020d).

R4 = Species is designated as sensitive for the Forest Service Region 4 (Intermountain Region).

Bent-flowered Milkvetch

Bent-flowered milkvetch occurs over a range that extends from southern British Columbia and Alberta to southwestern Montana, western Wyoming, and Idaho, eastward to Saskatchewan and South Dakota (Mancuso 2016) (CPNWH 2018). Idaho populations occur on exposed, subalpine ridgelines in subalpine fir and whitebark pine parklands on subalpine ridges and upper slopes and all aspects (Mancuso 2016) from 7,500 to 8,500 feet (Forest Service no date). Vegetation in areas of known locations is very open with low ground cover (Mancuso 2016; Moseley 1994). The three occurrences of this species in Idaho all occur in the PNF planning area (Mancuso 2016).

Five subpopulations of a single occurrence (the Cinnabar Peak occurrence) of this species were documented during surveys in 2012, 2013 (HDR 2017g), and 2016 (Mancuso 2016; IFWIS 2017). The nearest subpopulation of the Cinnabar Peak occurrence extends from about 300 feet to one-quarter mile upslope from and to the east of the West End Creek diversion and approximately 750 feet from the existing communication tower to be upgraded. This subpopulation, which consists of an estimated total of 7,000 to 10,000 plants, is about 25 acres in size and is located in a relatively undisturbed area. This subpopulation is the largest contiguous area of occupied habitat for this species in Idaho and is considered to be critical to the long-term viability of this species. The other subpopulations of this occurrence and the other occurrences of this species are located outside the analysis area for the SGP, approximately 1 mile (Monumental Summit) and 3 miles away (Missouri Ridge area). These subpopulations and occurrences are all smaller in extent and population size than the Cinnabar Peak subpopulation of the Cinnabar Peak occurrence (Mancuso 2016).

Least Moonwort

Least moonwort occurs throughout the Rocky Mountain Range in British Columbia, Alberta, Washington, Oregon, Idaho, Montana, and Wyoming; Cascade Range in Washington, Oregon, and California; and Sierra Nevada Range in California (CPNWH 2018). Lease moonwort is found in a variety of habitats including meadows, forests, and roadside areas (Colorado Natural Heritage Program 2006; Forest Service 2015a, no date), dry fields, marshes, bogs, swamps, and roadside ditches, usually in areas with subacid soils (NatureServe 2020c).

Two subpopulations of a single occurrence of least moonwort occur in swales adjacent to Johnson Creek Road. However, these subpopulations were last observed in 2004 and had estimated population sizes of approximately 360 plants in each subpopulation with an unknown number of occupied acres (IFWIS 2017) but were not observed by Forest Service surveyors in the most recent survey year (2005) (IFWIS 2017). This species was not included in past SGP-related surveys in 2012, 2013, or 2014 (HDR 2017g).

Blandow's Helodium

Blandow's helodium occurs in the Rocky Mountain, Cascade, Alaska, and Brooks ranges in Alaska, and in the provinces of Yukon, British Columbia, and Alberta in Canada and in Washington, Oregon, Montana, Idaho, and Wyoming (CPNWH 2018). Habitat for this species is mats and hummocks in montane peatlands, fens, and bogs, and under sedges and shrubs or along streams in mires (Forest Service 2015b). It occurs in wetlands and along streams between 3,900 to 6,600 feet elevation in and at edges of conifer forests on the eastside of the PNF (Forest Service no date). It forms in mats and small hummocks in medium to rich montane fens with calcareous groundwater and sometimes occurs under sedges and shrubs around the edges of fens or along streamlets in fens (Forest Service 2007b).

A single occurrence of Blandow's helodium occurs in the analysis area near Trapper Creek approximately 100 feet from where the Burntlog Route would cross the Trapper Flat wetland (IFWIS 2017). This occurrence was last observed in 2004 and consists of an unknown number of individuals occupying approximately 0.48 acres (IFWIS 2017) and was not included in past SGP-related surveys in 2012, 2013, or 2014 (HDR 2017g).

Sweetgrass

The range for sweetgrass is the Rocky Mountain, Cascade, Alaska, and Brooks ranges in Alaska (including Seward Peninsula), the provinces of Yukon, British Columbia, and Alberta in Canada, and the states of Washington, Oregon, Montana, Idaho, Wyoming, and Utah (CPNWH 2018). Its habitat is described as moist slopes, meadows, and streambanks from the foothills to subalpine elevations (Forest Service 2015a), moist soil of lower montane to subalpine meadows and slopes (Hitchcock and Cronquist 1973), and edges of sloughs and marshes, bogs, shaded streambanks, lakeshores, and cool mountain canyons (Walsh 1994).

A single occurrence of sweetgrass is found in the analysis area in the wetlands near Trapper Creek, approximately 780 feet to over 1,000 feet from where the proposed Burntlog Route would cross the Trapper Flat wetland area (IFWIS 2017). The location of this species is hydrologically connected to the proposed location of the proposed new road through the wetlands around Trapper Creek under the 2021 MMP and is thus considered to be within the analysis area. This occurrence was last observed in 2004 and consists of an unknown number of individuals and unknown number of occupied acres (IFWIS 2017). This species was not included in past SGP-related surveys in 2012, 2013, or 2014 (HDR 2017g).

Sacajawea's Bitterroot

The range for Sacajawea's bitterroot is the Rocky Mountains in Idaho (CPNWH 2018), with roughly three-fourths of the populations occurring on the BNF (Forest Service 2014a).

Sacajawea's bitterroot inhabits relatively sparsely vegetated upper slopes and ridgetops in montane and subalpine habitats on the PNF and some areas of the BNF (Forest Service 2015a; NatureServe 2020d) in areas with fractured bedrock and granitic soils near late snowbanks at elevations of between 5,400 to 9,500 feet (Forest Service 2015a). Vegetation communities around existing populations are mostly bare subalpine woodlands and open ridges, but it also is known to occur in Ponderosa pine habitat on the BNF from 4,500 to 6,500 feet (Forest Service no date).

A single occurrence of Sacajawea's bitterroot occurs in the analysis area approximately 300 feet above Warm Lake Road and the existing transmission line corridor near the intersection of Warm Lake Road and Curtis Creek Road. This occurrence was last observed in 1999 and has an unknown number of individuals occupying approximately 5.8 acres (IFWIS 2017). This occurrence was not documented by surveyors in 2014 although this species was targeted during surveys that year (HDR 2017g).

Rannoch-rush

The range for Rannoch-rush is from the Rocky Mountain, Alaska, and Cascade ranges in Alaska, the Canadian provinces of Yukon and British Columbia, and the states of Washington, Oregon, Idaho, and Montana (CPNWH 2018). Its habitat is full sun areas in sphagnum bogs and peatlands (NatureServe 2020e) (Forest Service 2015a).

A single occurrence of this species has been documented in the analysis area by the IDFG in the Mud Lake area (IDFG 2004; IFWIS 2017) approximately 200 feet from an existing portion of Burnt Log Road (FR 447). This occurrence was last observed in 2001 and has an unknown number of individuals occupying approximately 0.74 acres (IFWIS 2017). This species was not included in past SGP-related surveys in 2012, 2013, or 2014 (HDR 2017g).

Species with the Potential to Occur in the Analysis Area

Modeled potential habitat (as well as mapped occupied habitat for the whitebark pine) for Forest Service-designated sensitive or forest watch species occurs on 27.6 to 3,883.6 acres (depending on the species), in the analysis area, all within the boundaries of the PNF and BNF. Areas of modeled potential habitat occur on approximately 38 percent of the analysis area or 60 percent, and 2 percent of lands administered by the PNF, BNF, and Salmon-Challis NF, respectively.

Table 3.10-5 presents a list of the 29 sensitive or forest watch species that have the potential to occur in the analysis area and for which habitat modeling was performed. Modeling methods, results, and rationale for determining that these species have potential to occur in the analysis area are presented in the SGP EIS Technical Report: Special Status Plant Potential Habitat Modeling Report (AECOM 2020e) and updated in 2022 (Stantec 2022). This table also presents information on whether past surveys have been completed for these species, any populations within or near the analysis area, and the extent and general area of modeled potential habitat for these species within the analysis area.

Table 3.10-5 Location and Past Survey Information for Special Status Plants for which Potential Habitat Modeling was Performed within the Analysis Area

Scientific Name	Common Name	State Rank[1]	Global Rank[1]	Forest Service R4 Status[2]	PNF Status[3]	BNF Status[4]	Populations[5] and Past Surveys in Analysis Area[6]	Associated Habitat Type(s) and Extent of Modeled Potential Habitat in the Analysis Area[7]
Allotropa virgata	Candystick	S3	G4	Sensitive	Sensitive	--	No known occurrences in the analysis area. This species has not been included in past special status plant surveys for the SGP.	This species is typically found in closed canopy coniferous forests at elevations ranging from near sea level to approximately 9,800 feet amsl. A total of 389.9 acres of potential habitat are modeled near the SGP mine area, the transmission line route, Burntlog Route, Warm Lake Road (CR 10-579), Cabin Creek Road (FR 50467), and Johnson Creek Road (CR 10-413).
Astragalus vexilliflexus var. *vexilliflexus*	Bent-flowered milkvetch	S1	G4T4	--	Forest Watch	--	Four subpopulations of a single occurrence of this species are located near the SGP mine area, occupying approximately 25 acres (Mancuso 2016), one of which extends from approximately one-quarter mile to around 300 feet upslope from and to the east of the West End Creek diversion. This species was targeted during surveys in 2012, 2013 (HDR 2017g), and 2016 (Mancuso 2016).	This species is found in mesic to dry, gravelly slopes and grassy knolls in the subalpine and alpine zones. A total of 122.6 acres of potential habitat are modeled near the SGP, the transmission line route, and Meadow Creek Lookout Road (FR 51290).

Scientific Name	Common Name	State Rank[1]	Global Rank[1]	Forest Service R4 Status[2]	PNF Status[3]	BNF Status[4]	Populations[5] and Past Surveys in Analysis Area[6]	Associated Habitat Type(s) and Extent of Modeled Potential Habitat in the Analysis Area[7]
Botrychium crenulatum	Scalloped moonwort	S1	G4	Sensitive	--	Forest Watch	No known populations in the analysis area. This species has not been included in past special status plant surveys for the SGP.	This species is typically found in meadows, freshwater-marshes, and bogs/fens. A total of 73.5 acres of potential habitat are modeled along Johnson Creek Road (CR 10-413), Burntlog Route, Stibnite Road portion of the McCall-Stibnite Road (CR 50-412), the transmission line corridor, and the SGP mine area.
Botrychium lineare	Slender moonwort	SH	G2	Sensitive	Forest Watch	--	No known occurrences in the analysis area. This species has not been included in past special status plant surveys for the SGP.	This species is typically found in non-acidic substrates in meadows and grassy roadsides. A total of 837.6 acres of potential habitat are modeled along Warm Lake Road (CR 10-579), Cabin Creek Road (FR 50467), Johnson Creek Road (CR 10-413), Burntlog Route, Stibnite Road (CR 50-412), the transmission line route, and the SGP mine area.

Scientific Name	Common Name	State Rank[1]	Global Rank[1]	Forest Service R4 Status[2]	PNF Status[3]	BNF Status[4]	Populations[5] and Past Surveys in Analysis Area[6]	Associated Habitat Type(s) and Extent of Modeled Potential Habitat in the Analysis Area[7]
Botrychium simplex	Least moonwort	S2	G5	Sensitive	Sensitive	Forest Watch	Two subpopulations of a single occurrence of this species occur in swales adjacent to Johnson Creek Road (IFWIS 2017) but this population wasn't observed by Forest Service surveyors in 2005 and therefore may not still be present. This species has not been included in past special status plant surveys for the SGP.	This species is found in dry fields, marshes, bogs, swamps, and roadside ditches. A total of 837.6 acres of potential habitat are modeled along Warm Lake Road (CR 10-579), Cabin Creek Road (FR 50467), Johnson Creek Road (CR 10-413), Burntlog Route, Stibnite Road (CR 50-412), the transmission line route, and the SGP mine area.
Bryum calobryoides	Beautiful Bryum	SH[8]	G3	Sensitive	--	Sensitive	No known occurrences in the analysis area. This species has not been included in past special status plant surveys for the SGP.	This species is typically found in calcareous damp soil or rock at moderate to high elevations, approximately 3,300 – 9,800 feet amsl. A total of 27.6 acres of potential habitat are modeled along Stibnite Road (CR 50-412), Johnson Creek Road (CR 10-413), Burntlog Route, and Warm Lake Road (CR 10-579).

Scientific Name	Common Name	State Rank[1]	Global Rank[1]	Forest Service R4 Status[2]	PNF Status[3]	BNF Status[4]	Populations[5] and Past Surveys in Analysis Area[6]	Associated Habitat Type(s) and Extent of Modeled Potential Habitat in the Analysis Area[7]
Buxbaumia viridis	Green bug moss	S3	G4/G5	--	Forest Watch	--	No known occurrences in the analysis area. This species has not been included in past special status plant surveys for the SGP.	This species is found on decaying wood, mostly in humid, subalpine to alpine mixed tree forests. A total of 338.0 acres of potential habitat are modeled along Warm Lake Road (CR 10-579), Cabin Creek Road (FR 50467), Johnson Creek Road (CR 10-413), Stibnite Road (CR 50-412), and at the SGP mine area.
Calamagrostis tweedyi	Cascade reedgrass	S2	G3	Sensitive	Sensitive	--	No known occurrences in the analysis area. This species has not been included in past special status plant surveys for the SGP.	This species is found in montane and subalpine moist meadows and coniferous forests at elevations ranging from 3,000 – 6,500 feet amsl. A total of 3,883.6 acres of potential habitat are modeled along Warm Lake Road (CR 10-579), Cabin Creek Road (FR 50467), Johnson Creek Road (CR 10-413), Burntlog Route, Stibnite Road (CR 50-412), the transmission line route, and the SGP mine area.

Scientific Name	Common Name	State Rank[1]	Global Rank[1]	Forest Service R4 Status[2]	PNF Status[3]	BNF Status[4]	Populations[5] and Past Surveys in Analysis Area[6]	Associated Habitat Type(s) and Extent of Modeled Potential Habitat in the Analysis Area[7]
Carex livida	Livid sedge	S2	G5	--	--	Forest Watch	No known occurrences in or near the analysis area. This species has not been included in past special status plant surveys for the SGP.	This species is typically found in boreal fens or calcareous floating mats at elevations ranging from 0 – 3,600 feet amsl. A total of 849.4 acres of potential habitat are modeled along Warm Lake Road (CR 10-579), Cabin Creek Road (FR 50467), Johnson Creek Road (CR 10-413), Burntlog Route, McCall-Stibnite Road (CR 50-412), the transmission line route, and the SGP mine area.
Carex straminiformis	Shasta sedge	S3	G5	--	--	Forest Watch	No known occurrences in or near the analysis area. This species has not been included in past special status plant surveys for the SGP.	This species typically grows in rocky, gravelly soils at elevations ranging from 6,000 – 12,000 feet amsl. A total of 816.1 acres of potential habitat are modeled along Burntlog Route, Old Thunder Mountain Road (FR 440), Meadow Creek Lookout Road (Forest Road 51290), the transmission line route, and the SGP mine area.

Scientific Name	Common Name	State Rank[1]	Global Rank[1]	Forest Service R4 Status[2]	PNF Status[3]	BNF Status[4]	Populations[5] and Past Surveys in Analysis Area[6]	Associated Habitat Type(s) and Extent of Modeled Potential Habitat in the Analysis Area[7]
Cicuta bulbifera	Bulblet-bearing water hemlock	S2	G5	--	--	Forest Watch	No known occurrences in or near the analysis area. This species has not been included in past special status plant surveys for the SGP.	This species grows along the edges of marshes and lake margins, in bogs, wet meadows, shallow standing water and along slow-moving streams. It can also grow on hummocks and floating mats and on partially submerged rotting logs. A total of 1,086.9 acres of potential habitat are modeled along Warm Lake Road (CR 10-579), Cabin Creek Road (FR 50467), Johnson Creek Road (CR 10-413), Stibnite Road (CR 50-412), the transmission line route, and the SGP mine area.
Douglasia idahoensis	Idaho douglasia	S3	G3	Sensitive	Sensitive	Sensitive	One occurrence of this species occurs approximately 0.25 mile north of Warm Lake Road in an area west of Warm Lake (IFWIS 2017), which is outside the analysis area. This species was not documented by surveyors in 2014 although it was targeted during surveys that year (HDR 2017g).	This species is found in open subalpine summits, ridges, and adjacent slopes, often along the margins of conifer woodlands. A total of 175.8 acres of potential habitat are modeled along Burntlog Route, Meadow Creek Lookout Road (FR 51290), the transmission line route, and the SGP mine area.

Scientific Name	Common Name	State Rank[1]	Global Rank[1]	Forest Service R4 Status[2]	PNF Status[3]	BNF Status[4]	Populations[5] and Past Surveys in Analysis Area[6]	Associated Habitat Type(s) and Extent of Modeled Potential Habitat in the Analysis Area[7]
Draba incerta	Yellowstone draba	S2	G5	--	Forest Watch	--	No known occurrences in or near the analysis area. This species has not been included in past special status plant surveys for the SGP.	This species is found in stony soil of fellfields, turf, cliffs, exposed slopes. Some populations are found occasionally at lower elevations on exposed calcareous sites. A total of 338.7 acres of potential habitat are modeled along Burntlog Route, Meadow Creek Lookout Road (FR 51290), Old Thunder Mountain Road (FR 440), the transmission line route, and at the SGP mine area.
Drosera intermedia	Spoonleaf sundew	S1	G5	--	--	Forest Watch	No known occurrences in or near the analysis area. This species has not been included in past special status plant surveys for the SGP.	This species grows in constantly moist habitats including bogs, fens, wet sandy shorelines, and wet meadows. A total of 849.4 acres of potential habitat are modeled along Warm Lake Road (CR 10-579), Cabin Creek Road (FR 50467), Johnson Creek Road (CR 10-413), Burntlog Route, Stibnite Road (CR 50-412), Meadow Creek Lookout Road (FR 51290), Old Thunder Mountain Road (FR 440), the transmission line route, and the SGP mine area.

Scientific Name	Common Name	State Rank[1]	Global Rank[1]	Forest Service R4 Status[2]	PNF Status[3]	BNF Status[4]	Populations[5] and Past Surveys in Analysis Area[6]	Associated Habitat Type(s) and Extent of Modeled Potential Habitat in the Analysis Area[7]
Epilobium palustre	Swamp willow weed	S3	G5	--	Forest Watch	--	No known occurrences in or near the analysis area. This species has not been included in past special status plant surveys for the SGP.	This species is typically found in alpine or subalpine zones, bogs, fens, or swamps. A total of 72.8 acres of potential habitat are modeled along Cabin Creek Road (FR 50467), Johnson Creek Road (CR 10-413), Burntlog Route, Stibnite Road (CR 50-412), the transmission line route, and at the SGP mine area.
Epipactis gigantea	Giant helleborine orchid	S2S3	G3G4	--	Forest Watch	--	No known occurrences in or near the analysis area. This species has not been included in past special status plant surveys for the SGP.	This species grows in wet areas in a variety of habitats, including riverbanks, hot springs, and meadows. A total of 32.8 acres of potential habitat are modeled along Warm Lake Road (CR 10-579), Cabin Creek Road (FR 50467), Johnson Creek Road (CR 10-413), and Stibnite Road (CR 50-412).

Scientific Name	Common Name	State Rank[1]	Global Rank[1]	Forest Service R4 Status[2]	PNF Status[3]	BNF Status[4]	Populations[5] and Past Surveys in Analysis Area[6]	Associated Habitat Type(s) and Extent of Modeled Potential Habitat in the Analysis Area[7]
Helodium blandowii	Blandow's helodium	S2	G5	--	Forest Watch	Forest Watch	One occurrence of this species, occupying approximately 0.48 acres, is located near Trapper Creek within 300 feet of the Burntlog Route (IFWIS 2017). This species has not been included in past special status plant surveys for the SGP.	This species is typically found in "moderately rich" fens, usually with calcareous groundwater. It may be found under graminoids and shrubs at the edges of these aquatic features, or within them in small streams. A total of 705.0 acres of potential habitat are modeled along Warm Lake Road (CR 10-579), Cabin Creek Road (FR 50467), Johnson Creek Road (CR 10-413), Burntlog Route, Stibnite Road (CR 50-412), the transmission line route, and at the SGP mine area.
Hierochloe odorata	Sweetgrass	S2	G5	--	--	Forest Watch	One occurrence of this species is found in the wetlands near Trapper Creek, approximately 700 feet from the Burntlog Route (IFWIS 2017). This species has not been included in past special status plant surveys for the SGP	This species is found on moist slopes, meadows, and stream banks from the foothills to subalpine elevations. A total of 995.5 acres of potential habitat are modeled along Warm Lake Road (CR 10-579), Cabin Creek Road (FR 50467), Johnson Creek Road (CR 0-413), Burntlog Route, Stibnite Road (CR 50-412), the transmission line route, and at the SGP mine area.

Scientific Name	Common Name	State Rank[1]	Global Rank[1]	Forest Service R4 Status[2]	PNF Status[3]	BNF Status[4]	Populations[5] and Past Surveys in Analysis Area[6]	Associated Habitat Type(s) and Extent of Modeled Potential Habitat in the Analysis Area[7]
Lewisia sacajaweana	Sacajawea's bitterroot	S2	G2	Sensitive	Sensitive	Sensitive	One occurrence of this species, occupying approximately 5.8 acres, is located approximately 300 feet above Warm Lake Road and the existing transmission line corridor near the intersection of Warm Lake Road with Curtis Creek Road (IFWIS 2017). This occurrence was not documented by surveyors in 2014 although this species was targeted during surveys that year (HDR 2017g).	This species is found in montane and subalpine habitats ranging in elevations from 5,000 to 9,500 feet amsl. Just over two dozen populations of Sacajawea's bitterroot are known to exist with roughly three-fourths of them on the BNF. Scattered populations also occur on the PNF, Sawtooth National Forest, and SCNF. A total of 2,351.7 acres of potential habitat are modeled along Cabin Creek Road (FR 50467), Johnson Creek Road (CR 10-413), Burntlog Route, the transmission line route, and the SGP mine area.
Mimulus clivicola	Bank monkeyflower	S3	G4	Sensitive	Sensitive	--	No known occurrences in or near the analysis area. This species has not been included in past special status plant surveys for the SGP.	This species is typically found in moist, exposed mineral soil or fine gravel in moist to moderately dry slopes and rocky, steep outcrops in foothills and valleys. It occurs almost exclusively on southern aspects. A total of 404.0 acres of potential habitat are modeled along Warm Lake Road (CR 10-579), Cabin Creek Road (FR 50467), Johnson Creek Road (CR 10-413), Burntlog Route, the transmission line route, and the SGP mine area.

Scientific Name	Common Name	State Rank[1]	Global Rank[1]	Forest Service R4 Status[2]	PNF Status[3]	BNF Status[4]	Populations[5] and Past Surveys in Analysis Area[6]	Associated Habitat Type(s) and Extent of Modeled Potential Habitat in the Analysis Area[7]
Penstemon laxus	Tufted penstemon	S2	G2	--	--	Forest Watch	No known occurrences in or near the analysis area. This species has not been included in past special status plant surveys for the SGP.	This species is typically found in dry meadows or sagebrush shrublands at elevations ranging from 5,600 – 7,800 feet amsl. A total of 320.1 acres of potential habitat are modeled along Warm Lake Road (CR 10-579), Cabin Creek Road (FR 50467), Johnson Creek Road (CR 10-413), Stibnite Road (CR 50-412), and at the SGP mine area.
Polystichum kruckebergii	Kruckeberg's Sword-fern	S2	G4	--	Forest Watch	Forest Watch	No known occurrences in or near the analysis area. This species has not been included in past special status plant surveys for the SGP.	This species is found on rocks and cliffs in subalpine to alpine habitats in elevations ranging from 5,000 – 10,500 feet amsl. A total of 1,053.2 acres of potential habitat are modeled along Warm Lake Road (CR 10-579), Cabin Creek Road (FR 50467), Johnson Creek Road (CR 10-413), Burntlog Route, the transmission line route, and the SGP mine area.

Scientific Name	Common Name	State Rank[1]	Global Rank[1]	Forest Service R4 Status[2]	PNF Status[3]	BNF Status[4]	Populations[5] and Past Surveys in Analysis Area[6]	Associated Habitat Type(s) and Extent of Modeled Potential Habitat in the Analysis Area[7]
Rhynchospora alba	White beaksedge	S2	G5	--	--	Forest Watch	No known occurrences in or near the analysis area. This species has not been included in past special status plant surveys for the SGP.	This species is found in acidic, boggy, open sites, or poor fens, often on floating mats or peaty interstices of rocky shores at elevations ranging from 0 – 6,500 feet amsl. A total of 426.4 acres of potential habitat are modeled along Warm Lake Road (CR 10-579), Cabin Creek Road (FR 50467), Johnson Creek Road (CR 10-413), Stibnite Road (CR 50-412), the transmission line route, and the SGP mine area.
Sanicula graveolens	Sierra sanicle	S2	G4G5	--	Forest Watch	Forest Watch	No known occurrences in or near the analysis area. This species has not been included in past special status plant surveys for the SGP.	Habitat for this species includes mountain slopes, forests, and woodlands on serpentine soils. A total of 802.0 acres of potential habitat are modeled along Cabin Creek Road (FR 50467), Johnson Creek Road (CR 10-413), Burntlog Route, the transmission line route, and the SGP mine area.
Saxifraga tolmiei var. *ledifolia*	Tolmie's saxifrage	SNR	G5	Sensitive	--	--	No known occurrences in or near the analysis area. This species has not been included in past special status plant surveys for the SGP.	This species is typically found in moist meadows and streambanks or in snow beds in alpine tundra. It can be common at high elevations. A total of 690.7 acres of potential habitat are modeled along Warm Lake Road (CR 10-579), Johnson Creek Road (CR 10-413), Burntlog Route, the transmission line route, and the SGP mine area.

Scientific Name	Common Name	State Rank[1]	Global Rank[1]	Forest Service R4 Status[2]	PNF Status[3]	BNF Status[4]	Populations[5] and Past Surveys in Analysis Area[6]	Associated Habitat Type(s) and Extent of Modeled Potential Habitat in the Analysis Area[7]
Scheuchzeria palustris	Rannoch-rush	S2	G5	--	--	Forest Watch	An occurrence of this species, occupying approximately 0.74 acres, has been documented by Idaho Department of Fish and Game in the Mud Lake area (Idaho Department of Fish and Game 2004; IFWIS 2017) within 300 feet of an existing portion of Burnt Log Road (FR 447). This species has not been included in past special status plant surveys for the SGP.	This species is found in sphagnum bogs, marshes, and lake margins at elevations ranging from 0 to 6,500 feet amsl. A total of 849.4 acres of potential habitat are modeled along Warm Lake Road (CR 10-579), Cabin Creek Road (FR 50467), Johnson Creek Road (CR 10-413), Burntlog Route, Stibnite Road (CR 50-412), the transmission line route, and the SGP mine area.
Sedum borschii	Borsch's stonecrop	S2	G4	--	Forest Watch	--	A single historical occurrence of this species is located in the analysis area. This occurrence was not found the last time it was surveyed for (1983). This species has not been included in past special status plant surveys for the SGP.	This species is typically found in open, gravelly soil, steep and rocky outcrops from montane zones to timberline. A total of 98.1 acres of potential habitat are modeled along Cabin Creek Road (FR 50467), Johnson Creek Road (CR 10-413), Stibnite Road (CR 50-412), the transmission line route, and the SGP mine area.

Scientific Name	Common Name	State Rank[1]	Global Rank[1]	Forest Service R4 Status[2]	PNF Status[3]	BNF Status[4]	Populations[5] and Past Surveys in Analysis Area[6]	Associated Habitat Type(s) and Extent of Modeled Potential Habitat in the Analysis Area[7]
Sedum leibergii	Leiberg stonecrop	S2	GNR	--	--	Forest Watch	No known occurrences in or near the analysis area. This species has not been included in past special status plant surveys for the SGP.	This species is usually found in open or largely bare areas, basalt or limestone, rocky hillsides, or cliffs at elevations ranging from 160 – 4,000 feet amsl. A total of 98.1 acres of potential habitat are modeled along Cabin Creek Road (FR 50467), Johnson Creek Road (CR 10-413), Stibnite Road (CR 50-412), the transmission line route, and the SGP mine area.
Triantha occidentalis ssp. brevistyla	Short-style tofieldia	S1	G5T4	Sensitive	Sensitive	Forest Watch	No known occurrences in or near the analysis area. This species has not been included in past special status plant surveys for the SGP.	This species is found in wet meadows, bogs, fens, and streambanks in the lowland to alpine zones of Idaho. A total of 531.8 acres of potential habitat are modeled along Warm Lake Road (CR 10-579), Cabin Creek Road (FR 50467), Johnson Creek Road (CR 10-413), Burntlog Route, Stibnite Road (CR 50-412), the transmission line route, and the SGP mine area.

Source: Flora of North America 2023; Perpetua 2021a; NRCS PLANTS Database 2023; Refer to AECOM 2020e and Stantec 2022 for rationale used in determining presence or absence of potential habitat for species in the analysis area.

[1]State ranks are from rare plant lists for the PNF (Forest Service no date) and BNF (Forest Service 2015a). State ranks for species not on rare plant lists for the PNF or BNF and global ranks for all species are from NatureServe Explorer database (NatureServe 2020b).

S = State rank indicator; denotes rank based on status within Idaho.; G = Ranks designated at the global (or range-wide) level.; T = Infraspecific taxa (subspecies, plant varieties, and other designations below the level of the species) rank indicator, appended to the global rank for the including species. 1 = Critically imperiled — Typically having 5 or fewer occurrences, or 1,000 or fewer individuals. 2 = Imperiled — Typically having 6 to 20 occurrences, or 1,001 to 3,000 individuals. 3 = Vulnerable — Rare; typically having 21 to 100 occurrences, or 3,001 to 10,000 individuals. 4 = Apparently secure — Uncommon but not rare, but with some cause for long-term concern; typically having 101 or more occurrences, or 10,001 or more individuals.

5 = Secure — Common, widespread, abundant, and lacking major threats or long-term concerns.

H = Historical occurrence (i.e., formerly part of the native biota; implied expectation that it might be rediscovered or possibly extinct).

NR = Not ranked.

[2]This column references a species' status as sensitive on the Forest Service Region 4 (Intermountain Region) Proposed, Endangered, Threatened, and Sensitive Species List (Forest Service 2016c), regardless of whether this species is indicated on this list as being present in either the PNF or BNF.

[3]This column states if species is designated as sensitive or as a forest watch species according to the PNF rare plant list (Forest Service no date). Least moonwort (*Botrychium simplex*) is considered a sensitive plant species in the PNF even though the PNF rare plant list indicates it is a forest watch species (Forest Service 2020c).

[4]This column states if a species is designated as sensitive or as a forest watch species according to the BNF rare plant list (Forest Service 2015a). Scalloped moonwort (*Botrychium crenulatum*), least moonwort (*B. simplex*), and short-style tofieldia (*Triantha occidentalis* ssp. *brevistyla*) are considered forest watch species in the BNF even though they are designated as sensitive at the Region 4 level (Forest Service 2020d).

[5]Occurrence data for species were derived from IFWIS spatial data (IFWIS 2017).

[6]Refers to past SGP-related surveys performed by contractors for Midas Gold in 2012, 2013, and 2014 (HDR 2017g).

[7]Figures showing the modeled potential habitat for these species can be found in Appendix E of the Vegetation Specialist Report (Forest Service 2023g).

[8]Beautiful bryum (*Bryum calobryoides*) is ranked as a state historical species but was included in this analysis as a sensitive species in the BNF and its habitat conditions match those found in portions of the analysis area.

R4 = Species is designated as sensitive for the Forest Service Region 4 (Intermountain Region).

3.10.4.3 Non-Native Plants

Non-native plants are those that have been introduced into an area where they are not native and that are able to establish on many sites, grow quickly, and spread to the point of disrupting plant communities or ecosystems, or whose introduction causes or is likely to cause economic or environmental harm or harm to human health (EO 13112). Noxious weeds are non-native plants designated by the Director of the Idaho State Department of Agriculture (ISDA) as having the potential to cause injury to public health, crops, livestock, land, or other property (Idaho Statute 22-2402). The ISDA is responsible for administering the State Noxious Weed Law in Idaho and maintains a list of noxious species. Noxious weeds are managed by the Forest Service on NFS lands with cooperation from ISDA and Tribal and County governments. Noxious weed categories are as follows:

- Early Detection and Rapid Response – Plants in this category must be reported to the ISDA within 10 days of being identified by an approved, qualified authority. Eradication must begin in the same season the species is found. No known species of Early Detection and Rapid Response are known in the subregion.
- Containment – The goal for these species is to reduce or eliminate new or small infestations and to manage established populations as determined by the weed control authority.
- Control – The goal for these species is to reduce or eliminate new or expanding weed populations. In some areas of the state, control or eradication is possible, and a plan must be written that will reduce infestations within 5 years.

Table 3.10-6 lists the noxious weeds and non-native plant species documented in the analysis area and surrounding area in Valley County, Idaho. Species in this table that have or have not been documented in the analysis area have the potential to spread from surrounding areas throughout the analysis area. Noxious weeds and non-native plants are commonly found along roads and in other areas disturbed by soil movement or vegetation clearing. Locations of non-native plant invasions as recorded by the Forest Service and Perpetua contractors (HDR 2017g) in the analysis area are shown in Appendix C of the SGP Vegetation Specialist Report (Forest Service 2023g). Spotted knapweed (*Centaurea stoebe* ssp. *micranthos*) and rush skeletonweed (*Chondrilla juncea*), both Containment species, are the most extensive in the analysis area and generally occur along roads (Forest Service 2019c).

Table 3.10-6 Noxious Weeds and Non-Native Plant Species in Valley County and the Analysis Area

Scientific Name	Common Name	Category	Where Known
Acroptilon repens	Russian knapweed	Noxious - Control	Valley County
Aegilops cylindrica	Jointed goatgrass	Noxious- Containment	Valley County
Berteroa incana	Hoary alyssum	Noxious- Containment	Valley County
Cardaria draba	Whitetop	Noxious- Containment	Valley County
Carduus nutans	Musk thistle	Noxious - Control	Valley County
Centaurea diffusa	Diffuse knapweed	Noxious- Containment	Valley County
Centaurea solstitialis	Yellow starthistle	Noxious- Containment	Valley County
Centaurea stoebe ssp. *micranthos*	Spotted knapweed	Noxious- Containment	Valley County; analysis area
Chondrilla juncea	Rush skeletonweed	Noxious- Containment	Valley County; analysis area
Chrysanthemum leucanthemum	Oxeye daisy	Noxious- Containment	Valley County; analysis area
Cirsium arvense	Canada thistle	Noxious- Containment	Valley County; analysis area
Cirsium vulgare	Bull thistle	Non-native species	Valley County; analysis area
Conium maculatum	Poison hemlock	Noxious- Containment	Valley County
Convolvulus arvensis	Field bindweed	Noxious- Containment	Valley County
Cynoglossum officinale	Houndstongue	Noxious- Containment	Valley County
Euphorbia esula	Leafy spurge	Noxious- Containment	Valley County
Hieracium aurantiacum	Orange hawkweed	Noxious- Control	Valley County
Hieracium caespitosum	Yellow hawkweed	Noxious- Early Detection and Rapid Response	Valley County
Hyoscyamus niger	Black henbane	Noxious- Control	Analysis area (not officially documented in Valley County)
Linaria dalmatica	Dalmatian toadflax	Noxious- Containment	Valley County; analysis area
Linaria vulgaris	Yellow toadflax	Noxious- Containment	Valley County; analysis area
Lythrum salicaria	Purple loosestrife	Noxious- Containment	Valley County
Myriophyllum spicatum	Eurasian watermilfoil	Noxious- Control	Valley County
Onorpodium acanthium	Scotch thistle	Noxious- Containment	Valley County
Senecio jacobaea	Tansy ragwort	Noxious- Containment	Valley County
Sonchus arvensis	Perennial sowthistle	Noxious- Control	Valley County
Zygophyllum fabago	Syrian beancaper	Noxious- Early Detection and Rapid Response	Valley County

Source: AECOM 2020e; Forest Service 2019c; HDR 2017g; ISDA 2017; Prather et al. 2016; Valley County 2019b.

3.11 Wetlands and Riparian Resources

3.11.1 Introduction

This section describes the existing conditions of wetland and riparian resources in the analysis area. It presents an overview of general hydrologic conditions, followed by an inventory of existing wetlands, streams, open waters, and riparian areas. Wetland functions and values in the analysis area for wetlands is also described. Additional details and information can be found in the SGP Wetlands and Riparian Resources Specialist Report (Forest Services 2022h).

3.11.2 Wetlands and Riparian Resources Area of Analysis

The analysis area for wetland and riparian resource includes the area where effects (direct/indirect and cumulative) may be caused by the proposed activities (FSH.1909.15, 15.2a). The analysis area for direct/indirect effects is shown on **Figure 3.11-1**. It encompasses the following seven watersheds (HUC 10): Big Creek North Fork Payette River, Gold Fork River, Indian Creek, Johnson Creek, Lake Fork-North Fork Payette River, Upper East Fork SFSR, and Upper SFSR which contain the Operations Area Boundary, access routes, and utility corridors plus the predicted SGP effects on air and water resources. Within these watersheds, the analysis area includes a mine site focus area and an off-site focus area. The mine site focus area is where most wetland impacts would occur under the SGP, and where a substantial portion of the affected watershed has been evaluated for wetland presence (**Figure 3.11-1**). The off-site focus area includes the linear, narrow corridors associated with the SGP where wetlands were evaluated. Additional figures showing the areas evaluated as part of the off-site focus area are presented in the Wetland and Riparian Areas Specialist Report (Forest Service 2023h).

3.11.3 Relevant Laws, Regulations, Policies, and Plans

Several laws and regulations apply to the Proposed Action and Action Alternatives. The following is a list of additional laws, regulations, policies, and plans at the federal, state, or local level pertaining to Wetland and Riparian Resources. Additional descriptions of these regulations can be found in the SGP Wetland and Riparian Resources Specialist Report (Forest Service 2023h).

<u>Land and Resource Management Plan</u>: The Payette Forest Plan and the Boise Forest Plan include management direction for wetlands and riparian areas. They include guidelines for RCAs, which are defined as "traditional riparian corridors, perennial and intermittent streams, wetlands, lakes, springs, reservoirs, and other areas where proper riparian functions and ecological processes are crucial to maintenance of the area's water, sediment, woody debris, nutrient delivery system, and associated biotic communities and habitat."

Aquatic resources on NFS lands are managed to achieve a desired condition that supports a broad range of biodiversity and social and economic opportunity. Desired conditions are descriptions of how forest resources should look and function to provide diverse and sustainable habitats, settings, goods, and services. Taken together, the desired conditions should present an integrated vision of a properly functioning forest that supports a broad range of biodiversity and social and economic opportunities.

<u>Clean Water Act</u>: Federal regulations governing discharges of dredged or fill material into WOTUS, including wetlands, streams, and open waters, are promulgated under Section 404 of the CWA, as

administered by the USACE. Under Section 404 of the CWA; WOTUS, fall under the jurisdiction of the USACE. Thus, any discharge of dredged or fill material into jurisdictional wetlands or other WOTUS in the SGP area would require a DA Authorization.

Additionally, Section 404(b)(1) guidelines (Guidelines) promulgated by the EPA, in conjunction with the USACE, apply to an applicant's proposed disposal site(s) for discharges of dredged or fill material into WOTUS. The Guidelines prohibit, for example, the authorization of a proposed discharge that would cause or contribute to the violation of an applicable water quality or toxic effluent standard or jeopardize a listed threatened or endangered species. The Guidelines also prohibit the authorization of a proposed discharge which will cause or contribute to significant degradation of the aquatic ecosystem. Findings of significant degradation must be based upon specific factual determinations, evaluations, and tests identified in the Guidelines. These include the evaluation of direct, indirect, and cumulative effects of the proposed discharge and alternatives on specific resources including fish, wildlife, and special aquatic sites.

These Guidelines state that no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge that would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences. The Guidelines also state that no discharge of dredged or fill material is permitted unless appropriate and practicable steps have been taken to minimize potential adverse effects to the aquatic ecosystem. Subpart H of the Guidelines identifies many possible steps to avoid, minimize, and compensate for direct and secondary adverse impacts. Taken together, these steps form the mitigation sequence: a mandatory, sequential process undertaken to "minimize potential adverse impacts of the discharge on the aquatic ecosystem." Demonstrating compliance with the Guidelines requires identifying the appropriate and practicable steps that will be taken to avoid impacts, and then minimize and compensate for any remaining unavoidable impacts associated with discharges subject to the Guidelines.

For unavoidable impacts to wetlands, streams, and other WOTUS, the 404(b)(1) Guidelines require appropriate and practicable compensatory mitigation to offset unavoidable impacts. In 2008, the USACE and the EPA issued a final rule for Compensatory Mitigation for Losses of Aquatic Resources. This final rule contains the regulations that govern compensatory mitigation for activities that require a permit from the USACE (USACE and EPA 2008). Compensatory mitigation is defined as the restoration, establishment, enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse impacts that remain after all appropriate and practicable avoidance and minimization has been achieved.

Section 402 of the CWA, which authorizes the NPDES permit program, controls water pollution by regulating point sources that discharge pollutants other than dredged and fill material into WOTUS. On June 5, 2018, EPA approved the IPDES Program and authorized the transfer of permitting authority to the state beginning on July 1, 2018.

Executive Order 11990: EO 11990 requires that federal agencies, to the extent permitted by law, shall avoid undertaking or providing assistance for new construction located in wetlands, unless the head of the federal agency trying to work in wetlands finds that: 1) no practicable alternative to such construction exists; and 2) the project would include all practicable measures to minimize harm to wetlands that may result from such use (42 Federal Register 26961, 3 CFR 1977 Comp, p. 121).

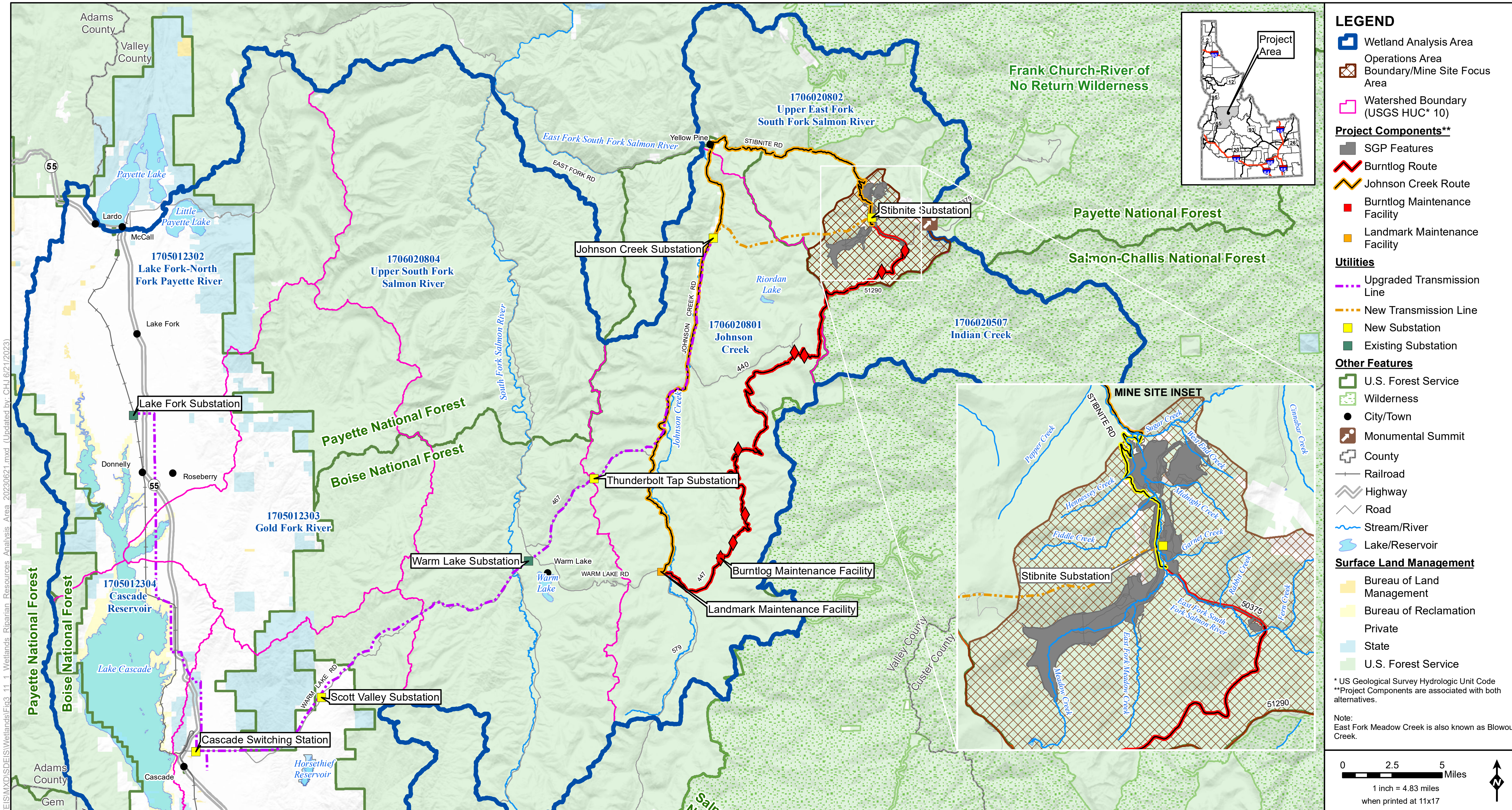


Figure 3.11-1
Wetlands and Riparian Resources Analysis Area
Stibnite Gold Project
Stibnite, ID

Base Layer: USGS The National Map: 3D Elevation Program. USGS Earth Resources Observation & Science (EROS) Center: GMTED2010. Data refreshed March, 2021. Other Data Sources: Perpetua; State of Idaho Geospatial Gateway (INSIDE Idaho); USGS; Boise National Forest; Payette National Forest

Map Date: 11/16/2023

State Regulations: Projects that may result in a discharge to WOTUS require Water Quality Certification under Section 401 of the CWA. Section 401 gives the authority to issue this certification, ensuring that the discharge complies with state water quality standards. The IDEQ is the regulatory authority for Section 401 permitting in Idaho. IDEQ must grant (with or without conditions), deny, or waive Section 401 certification for any project in Idaho that requires a federal permit or license under the CWA before the federal permit or license can be issued. This Water Quality Certification is made to ensure that a proposed project would comply with state water quality standards for surface water and any other water quality requirements under state law.

The IDWR regulates stream channels under the Idaho Stream Channel Protection Act. This act requires that a Stream Channel Alteration Permit be obtained from the IDWR before any type of alteration work, including removal and/or fill and installation of in-water or over-water structures with the potential to affect flow, within the beds and banks of a continuously flowing stream.

The Emergency Wetlands Resources Act of 1986 requires that states develop prioritized lists of wetlands that meet the criteria of 1) supporting rare or declining wetland types; 2) having identifiable threats of loss or degradation of wetland functions; and 3) having diverse and important functions and values (including recreation), or especially high value for specific functions. To meet the requirements of the Emergency Wetlands Resources Act, IDFG maintains a Wetland Conservation Prioritization Plan (IDFG 2012) and a list of wetland sites in need of acquisition for long-term conservation and management.

Valley County Regulations: Valley County reviews development proposals for consistency with the County's Land Use Development Ordinance. When permits are required by other agencies for all or parts of the application, evidence of the permit and compliance with the provisions of the permit are to be a condition of the land use approval. This includes permits to alter wetlands, permits to construct in flood prone areas, and in other situations where the review and issuance of the permit would assure the Valley County Commission that the proposal would be technically feasible.

3.11.4 Affected Environment

3.11.4.1 General Hydrologic Landscape Setting

Mine Site Focus Area

The main drainage basin in the mine site focus area is the East Fork SFSR watershed (HUC 1706020802). The East Fork SFSR is joined by Johnson Creek near the village of Yellow Pine, downstream of the mine site. The SGP would be in several drainages that are all tributaries to the East Fork SFSR, including Meadow Creek, EFMC (also known as Blowout Creek), Garnet Creek, Fiddle Creek, Hennessy Creek, Midnight Creek, West End Creek, and Sugar Creek. Wetlands located on slopes and tributary drainages within and near the mine site area are associated with hillside seeps and springs (HydroGeo 2012b). In most cases, these seep and spring features are hydrologically connected to a larger wetland/stream complex in the valley floor and/or a stream downslope via surface flow (HDR 2017h). Snowmelt runoff and groundwater inputs also contribute to the hydrologic support of wetlands at the mine site.

As a result of almost a century of mining and exploration in the mine site area, numerous wetlands and streams have been altered, particularly those adjacent to former mine pits, tailing storage areas, and roads

(Forest Service 1994). Previous mine operators excavated and/or filled wetlands to construct mineral processing facilities, development rock storage facilities, tailing storage facilities, mine access and haul roads, town sites, and other mining-related developments. Most of these activities occurred before enactment of the CWA in 1972 and associated mitigation requirements. Within the mine site focus area approximately 847 acres have been modified by past human activity and are considered highly disturbed. This area represents approximately 49 percent of the proposed disturbance for the SGP mine site area. The history of excavation and mine tailings storage at the mine site has introduced areas of soil contamination, which are often in, or adjacent to, wetlands and riparian areas (Midas Gold 2016a). Soils in areas where vegetation is removed or disturbed are more susceptible to wind and water erosion (Forest Service 1994). As such, in disturbed areas the water quality and soil stabilizing properties of intact wetlands and riparian areas make them especially important in maintaining and improving watershed conditions.

Off-Site Focus Area

SGP features in the off-site focus area portion of the analysis area would cross several watersheds: Upper East Fork SFSR (HUC 1706020802), Johnson Creek (HUC 1706020801), Upper SFSR (HUC 1706020804), Gold Fork River (HUC 1705012303), Big Creek North Fork Payette River (HUC 1705012305), Lake Fork-North Fork Payette River (HUC 1705012302), and Cascade Reservoir (HUC 1705012304). The Johnson Creek watershed drains to Johnson Creek, which flows northward. The Upper SFSR watershed drains to the SFSR, which flows northward. The Gold Fork River, Big Creek North Fork Payette River, Lake Fork-North Fork Payette River, and Cascade Reservoir watersheds all drain toward Cascade Lake and the North Fork Payette River.

The off-site focus area includes proposed access roads that would leave the mine site and travel west along East Fork SFSR, southwest along Burntlog Creek, and south along Johnson Creek towards Landmark. In these areas, wetlands along the roads include hillside seeps on slopes and valley-bottom riparian wetlands in narrow valleys (Forest Service 2010a).

The transmission line corridor would pass along hill tops located between the mine site and Johnson Creek Road (CR 10-413). The few wetlands in this area are generally limited to wetland seeps that act as the headwaters for ephemeral and intermittent streams. From the vicinity of Landmark, an existing transmission line continues west, crossing over hills and across stream valleys in the vicinity of Warm Lake. Approaching the City of Cascade, the general topography transitions from the Long Valley foothills down to the broad, Long Valley basin around Cascade Reservoir at 4,800 feet elevation. At this western end of the off-site focus area, the main geomorphic landforms are depositional plains with slope gradients averaging between 0 to 20 percent (Forest Service 2010a). Large, wide arrays of wetland and riparian habitat are located along the bottomlands surrounding the Cascade Reservoir (Forest Service 2010a). In many locations, aquatic habitats have been affected by roads, livestock grazing, timber harvest, and recreational use (Forest Service 2010a). Historical impacts include streambank erosion, degradation, rapid deposition of eroded sediments, and stream channel modification (Forest Service 2010a). Aquatic habitat is not functioning properly in some locations within the off-site focus area due to habitat fragmentation from roads and timber harvest, high sediment levels, and impacts to riparian areas (Forest Service 2010a).

3.11.4.2 Wetlands

Wetlands were identified and delineated using the methods described in Corps of Engineers Wetlands Delineation Manual (Corps Manual) (Environmental Laboratory 1987) and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys and Coast Region (Environmental Laboratory 2010; HDR 2017h). According to the Corps Manual, identification of wetlands is based on a three-factor approach involving indicators of hydrophytic vegetation, hydric soil, and wetland hydrology (Environmental Laboratory 1987). Wetlands were further classified and described by their vegetation structure per the Classification of Wetlands and Deepwater Habitats (Cowardin et al. 1979) or as "Open Water."

Table 3.11-1 provides a summary of the wetlands identified within the Mine Site and Off-site Focus Areas of the larger wetland analysis area broken out by Cowardin Classification as further described in the Wetland and Riparian Areas Specialist Report (Forest Service 2023h). See **Section 3.10** Vegetation, for additional discussion of wetland vegetation characteristics in the analysis area, **Section 3.5** for additional discussion of hydric soil conditions in the analysis area: and **Sections 3.8** and **3.9** for additional information on surface water hydrology. Wetlands provide important ecological functions for associated streams and rivers. For example, they may protect fish by providing habitat during high flows, or they may remove nutrients and toxicants from waters to improve water quality in streams and rivers.

Table 3.11-1 Wetland Resources Identified in the Analysis Area – Totals

Analysis Area	Palustrine Emergent (acres)	Palustrine Forested (acres)	Palustrine Scrub-shrub (acres)	Open Water (acres)	Total (acres)
Mine Site Focus Area	128.8	157.7	136.9	5.4	428.8
Off-site Focus Area	1,438.9	178.2	187.8	333.6	2,138.6
Analysis Area (Total)	1,567.7	335.9	324.7	339.0	2,567.3

Source: HDR 2013, 2014a, 2014b, 2015a, 2016b, 2017h, 2017i, Tetra Tech 2021b
Any apparent discrepancies between totals are due to rounding of numbers.

Palustrine Emergent Wetland

The PEM wetland community is often present in large sedge meadows or associated with hillside seeps. Vegetation primarily consists of various grasses, sedges, moss, and forbs, such as swordfern rush (*Juncus ensifolius*), beaked sedge (*Carex rostrata*), Nebraska sedge (*Carex nebrascensis*), angelica (*Angelica arguta*), cow parsnip (*Heracleum lanatum*), Fendler's meadow-rue (*Thalictrum fendleri*), horsetail (*Equisetum fluviatile* and *E. hyemale*), and monkeyflower *(Mimulus lewisii* and *M. guttatus*).

Palustrine Scrub-Shrub Wetland

The PSS wetland community commonly includes alder (*Alnus* spp.), willow (*Salix* spp.), bog birch (*Betula glandulosa*), and currant (*Ribes* spp.) in the shrub stratum, with an herbaceous understory consisting of grasses, sedges, and forbs such as swordfern rush, beaked sedge, horsetails, and monkeyflowers. A thick moss mat is common in the wettest scrub-shrub communities.

Palustrine Forested Wetlands

The PFO wetland community commonly includes Engelmann spruce (*Picea engelmannii*), subalpine fir (*Abies lasiocarpa*), and lodgepole pine (*Pinus contorta*) in the tree stratum (i.e., layer); alder, willows (*Salix boothii* and *S. drummondiana*), and currant in the shrub stratum; and various wetland forbs and grasses in the herb stratum.

Fens

Fens are permanently saturated PSS or PEM wetlands that form where a thick layer of partially decomposed organic matter, called peat, accumulates under water-soaked conditions (at least 8 to 16 inches within the upper 31.5 inches of the soil profile). Fens receive a significant portion of their hydrologic input and nutrients from water that has percolated through mineral soil and bedrock, and because of their unique characteristics, they tend to support a diverse plant and wildlife community. Fens range from poor fens, which are acidic (pH 4.0 to 5.5) and support more bog-type species (e.g., sphagnum moss), to rich fens, which are less acidic and are dominated by sedges, other graminoids, and true mosses (IDFG 2005a).

The wetland delineation and functional assessment surveys and reports prepared by HDR between 2011 and 2016 and amended by Tetra Tech in 2018 did not refer to any documented wetlands specifically as fens within areas surveyed. In 2017, Midas Gold reassessed the initial data collected by wetland delineators (HDR 2013, 2014a, 2014b, 2015a, 2016b, 2016c) for the presence of fens and determined that the wetland datasheets did not indicate the presence of fens (Midas Gold 2017f). However, based on the indication of peat in soils at the TSF dam location and the adjacent TSF Buttress in geotechnical reports prepared for the SGP (SRK 2012; STRATA 2014a, 2014b, 2016, 2017; Tierra Group 2018), the Forest Service and USACE requested that Midas Gold reassess the sample plot datasheets from the wetland delineation surveys to determine if any wetlands encountered during those surveys had fen characteristics (e.g., appropriate geomorphic location, organic soils, prolonged near-surface water table, and associated plant species), and that Midas Gold provide a report to document the methods, data reviewed, and results of their reassessment. Midas Gold's contractor (Tetra Tech) reviewed datasheets in the vicinity of the TSF and the adjacent TSF Buttress and determined that wetlands in these areas did not meet the characteristics of fens (Tetra Tech 2019b). Wetland delineation datasheets for other SGP component areas were not reassessed for the presence of potential fens as part of the Tetra Tech (2019b) review.

IDFG considers wetlands associated with Mud Lake, Tule Lake, and Warm Lake, to be poor fens (IDFG 2004). Mud Lake and its associated wetlands are designated as a Class I site under the Wetland Conservation Prioritization Plan (IDFG 2012), indicating that this area is in near pristine condition and likely provides habitat for high concentrations of state rare plant or animal species (IDFG 2004). All these sites are within the analysis area for wetlands and riparian resources but outside of the construction footprint for the SGP. Mud Lake occurs near the existing Burnt Log Road (FR 447) and Warm Lake and Tule Lake occur south of Warm Lake Road (CR 10-579). For this analysis, wetlands associated with Mud Lake, Tule Lake, and Warm Lake are considered fens.

3.11.4.3 Streams and Riparian Areas

Riparian corridors are areas with distinctive soil and vegetation between a stream or other body of water and an adjacent upland, where elements of both aquatic and terrestrial ecosystems mutually influence each other (Forest Service 2003a; Knutson and Naef 1997). Riparian areas often overlap with wetlands and the portions of floodplains and valley bottoms that support riparian vegetation. Vegetated riparian buffers trap sediment, shade stream corridors, provide migratory corridors for wildlife, contribute woody debris and litter to streams, improve water quality by intercepting runoff from adjacent uplands, provide important habitat for terrestrial and avian species, and stabilize streambanks to prevent erosion.

RCAs are delineated along perennial and intermittent streams, and are determined either in the field, based on professional judgement of ecological function and process or, in the absence of field data, as follows (Forest Service 2003a):

- For forested streams (perennial), the RCA is defined as the land within a buffer of 300-feet slope distance from the ordinary high-water mark. This includes intermittent streams providing seasonal rearing and spawning habitat (Forest Service 2003a).
- For forested streams (intermittent), the RCA is defined as the land within a buffer of 150-feet slope distance from the ordinary high-water mark.
- For non-forested streams (perennial and intermittent), the RCA is defined as the land within a buffer equal to the extent of the flood prone width, or riparian vegetation, whichever is greatest.

Perennial and intermittent streams that support riparian and/or wetland vegetation along their streambanks occur throughout the analysis area. RCAs within the Mine Site and Off-site Focus Areas associated with perennial and intermittent streams mapped within the analysis area are presented in **Table 3.11-2**. The major drainages in the analysis area are described in **Table 3.11-3**. Note that since many riparian areas may also include delineated wetlands, there is overlap in the acreages of RCAs listed in **Table 3.11-2** and wetlands listed in **Table 3.11-3**. General descriptions of riparian habitats taken from the primary drainages documented in available stream evaluations for the SGP (HDR 2016b; Rio Applied Science and Engineering 2019) are presented below. The most common riparian vegetation species that have been observed surrounding drainages in the analysis area include alder, willow, currant, and red-osier dogwood (*Cornus sericea*), with an understory of various forbs and grasses, particularly in open areas not otherwise dominated by shrubs (Forest Service 1994; HDR 2013). Portions of streams in the mine site focus area, and their associated riparian areas, have been affected by legacy mining-related activities (Forest Service 1994).

Table 3.11-2 Streams and RCAs in the Analysis Area

Analysis Area Component	Perennial (feet)[1]	Non-Perennial (feet)[1]	RCA (acres)[2]
Mine Site Focus Area	208,302	110,224	2,655
Off-Site Focus Area	189,549	76,899	127,389

[1] Stream lengths listed come from multiple baseline studies as summarized in Tetra Tech 2018, 2019b, 2021b
[2] RCA acres come from Forest Service RCA data intersected with SGP components (AECOM 2020d). Because the RCA data comes from different data than the stream data and is only applicable to NFS land, RCA acres do not match directly with the stream acres listed.

Table 3.11-3 Major Drainages in the Analysis Area

Major Drainages	SGP Component	Threatened/ Endangered Fish Species and/or Critical Habitat Present in any Part of the Stream[1]	Stream Description
Meadow Creek	Mine Site	Presence- BT, CS Critical Habitat- BT, CS	Meadow Creek is a major tributary to the East Fork SFSR that flows through a flat-bottomed valley surrounded by steep mountains. Elevations range from approximately 6,200 feet above sea level in the lower reach to over 7,500 feet in the headwaters. Meadow Creek has been heavily impacted by legacy mining-related activities, including deposition of tailings and spent heap leach ore, ore processing facilities, heap leach pads, and other infrastructure, stream relocation into a straightened riprap channel, and construction of an airstrip (Midas Gold 2016a). The downstream end of the valley shows remnant effects from early mining activities, along with a large outwash feature created by a dam failure in the EFMC drainage south of the site of the Meadow Creek Mine. Portions of the creek have been modified over the years to improve conditions caused by past mine operations, including the regrading and revegetation of the 2 percent gradient lower reach of the creek in 2004 and 2005. The middle reach of Meadow Creek is an engineered channel that was constructed to bypass the spent ore disposal area. The channel was lined with riprap over geotextile fabric and is confined between reinforced/engineered slopes with a gradient of less than 2 percent. This reach has a short section with a 9 percent gradient, shallow depths, and few pools, which may be a partial fish migration barrier at low flows. The channel includes low-gradient riffles, glides (section of the stream coming out of a pool) and runs. There is no side channel development or potential large woody debris recruitment. The upper reach of Meadow Creek encompasses the headwaters downstream to the location of the proposed TSF Buttress. Upper Meadow Creek is confined and high gradient at the most upstream extent and low gradient and unconfined immediately upstream of the spent ore disposal area in lower Meadow Creek, transitioning from a gradient of 4 to 8 percent to 2 to 4 percent. Habitat is composed of riffles, step runs (sequence of runs separated by shorter riffle steps), and pools. The presence of side channels in some portions provide potential for lateral channel movement in the less confined sections. Immediately upstream of the spent ore disposal area, Meadow Creek is unconfined, with a gradient less than 1 percent. The reach is composed of low-gradient riffle, step run, and pool habitat. The floodplain is active with oxbow cutoffs, side channels, and backwater features.

Major Drainages	SGP Component	Threatened/ Endangered Fish Species and/or Critical Habitat Present in any Part of the Stream[1]	Stream Description
East Fork SFSR	Mine Site, McCall-Stibnite Road (CR 50-412) (temporary access), Utilities	Presence- BT, SH, CS Critical Habitat- BT, SH, CS	This perennial headwater stream flows through most of the analysis area. The ordinary high-water mark (OHWM) is 2 to 3 feet deep by 25 to 30 feet wide. A human-made, open-water pond (approximately 4.5 acres) is located in the Yellow Pine pit. The steep cascade of the East Fork SFSR spilling into the pond cuts off fish passage. The stream has relatively abundant riparian vegetation, except in the vicinity of the Yellow Pine pit. Per the Payette Forest Plan, riparian vegetation in the Big Creek/Stibnite Management Area is at or near properly functioning condition, except for localized areas affected by mining, roads, and recreation.
Fiddle Creek	Mine Site, Access Roads	Presence- None known	Fiddle Creek is a small tributary of the East Fork SFSR just upstream of Midnight Creek. Habitat conditions in the creek have been impacted as a result of legacy mine operations, road construction, and culvert installation (Midas Gold 2016a). Fiddle Creek is also the site of a former water storage reservoir in the lower watershed, the construction and operation of which degraded portions of the stream. The reservoir is mostly silted in and very little water is stored, but an embankment and spillway still exist. The lower reach of Fiddle Creek has an approximate 37 percent gradient where It flows Into the East Fork SFSR, creating a complete barrier to upstream fish passage (HDR 2016b). Upstream of this barrier, Fiddle Creek retains a relatively high gradient in a relatively narrow channel, with side channels (HDR 2016b). The creek has a thick tall-shrub overstory dominated in its lower portion by gray alder (*Alnus incana*). The uppermost section of Fiddle Creek flattens in gradient, becoming a slower meandering stream due to natural glacial topography. Large amounts of large woody debris occur throughout the creek, and the dominant streambed substrate consists of boulders, large cobble, and gravel (HDR 2016b).

Major Drainages	SGP Component	Threatened/ Endangered Fish Species and/or Critical Habitat Present in any Part of the Stream[1]	Stream Description
EFMC (“Blowout Creek”)	Mine Site	Presence- CS	The EFMC, also known as “Blowout Creek,” is a tributary to Meadow Creek that has been severely impacted as a result of legacy mining-related activities and the failure of a dam constructed across its stream channel (Midas Gold 2016a). The dam was constructed in 1929 to supply hydroelectric power for historical milling operations. The dam failed in 1965 due to record snow melt and runoff rates, depositing large volumes of sediment into Meadow Creek, the East Fork SFSR, and the Yellow Pine pit lake (MWH 2017). This stream is considered to be the largest source of sediment to the East Fork SFSR in the analysis area. The middle reach of EFMC flows through a lateral glacial moraine that eroded during the dam failure and is still considered unstable as it continues to deposit sediments into Meadow Creek and the East Fork SFSR. Upstream of this middle reach, East Fork Meadow Creek has a low-gradient pool-riffle reach flowing through a large meadow. This reach is incised and continues to headcut in response to the dam failure. There are few trees, and the banks have abundant grasses. The dominant streambed material is sand and gravel (MWH 2017). The EFMC headwaters are high gradient (4 to 20%) with cascades, high-gradient riffle, and plunge-pool habitat. Immediately downstream of the historical dam location, the creek has a slightly steeper (8 to 20%) gradient and is composed of cascade habitat. Near the confluence with Meadow Creek, the EFMC passes through a multi-thread and unconfined alluvial fan with a 4 to 8 percent gradient. Sediment from the unstable slopes immediately upstream may contribute to the formation and maintenance of this alluvial fan.
Garnet Creek	Mine Site	Presence- None known	Garnet Creek is a narrow, shallow, moderate-gradient tributary to East Fork SFSR approximately 0.3 mile downstream from the Meadow Creek confluence. The creek has been severely modified over the past 100 years to accommodate mining-related activities. It is still influenced by legacy mining infrastructure that was located across and adjacent to the stream channel, including portions of a town site; and is currently routed through several man-made ditches (Midas Gold 2016a). Garnet Creek flows through an 85-foot-long corrugated metal pipe culvert near its confluence with the East Fork SFSR that presents a partial barrier to fish (HDR 2016b).
Midnight Creek	Mine Site	Presence- None known	Midnight Creek is a small tributary of the East Fork SFSR. The lower portion of the creek has a narrow channel with extremely high gradient (approximately 90 %) and dense overhanging vegetation. The high gradient presents a complete fish passage barrier to fish (HDR 2016b). Midnight Creek has been impacted by legacy mining activities, including open-pit mining, waste rock dumps, and road construction (Midas Gold 2016a).

Major Drainages	SGP Component	Threatened/ Endangered Fish Species and/or Critical Habitat Present in any Part of the Stream[1]	Stream Description
Unnamed Tributary ("Hennessy Creek")	Mine Site, Access Roads	Presence- None known	Hennessy Creek historically flowed into the East Fork SFSR downstream of the Yellow Pine pit lake, but it has been diverted to flow into the East Fork SFSR downstream of Sugar Creek. It is a narrow, low-flow stream that flows in a constructed ditch alongside McCall-Stibnite Road (CR 50-412), and then through a subterranean section under an adjacent waste rock dump before passing through a very high-gradient reach into the East Fork SFSR. The creek is not expected to support upstream fish passage because of an average channel gradient of 37 percent at its mouth (HDR 2016b). Hennessy Creek is densely vegetated and shallow. The lower portion of Hennessy Creek has been significantly impacted by legacy mine-related activities, including stream diversion, road construction that buried the stream channel, and mining infrastructure (Midas Gold 2016a).
Rabbit Creek	Mine Site	Presence- None known	This is a perennial tributary to the East Fork SFSR. The OHWM is 1 to 2 feet deep by 1 to 3 feet wide.
West End Creek	Mine Site, Access Roads	Presence- None known	This is a tributary to Sugar Creek, large portions of which are non-perennial. The OHWM is 1 to 2 feet deep by 1 to 3 feet wide. This creek has been disturbed by mining-related activities, including rock deposition into the channel, diversion into a French drain, and in-channel mining. Upstream, the banks are well vegetated and steep with a Douglas-fir overstory.
Sugar Creek	Mine Site	Presence- BT, SH, CS Critical Habitat- BT, SH, CS	Sugar Creek, a tributary to the East Fork SFSR, enters the river downstream of the Yellow Pine pit lake. It has a relatively low gradient. An officially closed road closely parallels Sugar Creek for nearly 2 miles before crossing the creek. This road may confine the movement of Sugar Creek, specifically in areas where the banks are bound with riprap rock material. Much of Sugar Creek has large aggregates of large woody debris. The dominant substrates are sand, gravel, and cobble. The creek has widened channels and excessive medial and lateral bar formation in response to past sediment inputs. In the 1940s, approximately 1 million cubic yards of glacial overburden was removed from the East Fork SFSR channel and placed in both Sugar Creek and other parts of the East Fork SFSR (Kuzis 1997).
Burntlog Creek	Access Roads	Presence- BT, SH, CS Critical Habitat- BT, SH, CS	This is a perennial tributary to Johnson Creek. The OHWM of crossings ranges from 2 to 3 feet deep and 25 feet wide to many small tributaries that are 0.5 feet deep and less than 3 feet wide. Burntlog Creek is a moderate-gradient stream that occupies a steep valley floor in its upper reaches and parallels Johnson Creek at its base. Woody debris is common in the upper reaches due to extensive burns in this area. Overhead canopy is minimal.

Major Drainages	SGP Component	Threatened/ Endangered Fish Species and/or Critical Habitat Present in any Part of the Stream[1]	Stream Description
Johnson Creek	Access Roads; Existing Transmission Line	Presence- BT, SH, CS Critical Habitat- BT, SH, CS	This is a perennial tributary to the East Fork SFSR. The OHWM is 30 to 50 feet wide and up to 4 feet deep.
Riordan Creek	Access Roads; New Transmission Line	Presence- BT, SH, CS Critical Habitat- BT, SH, CS	This is a tributary to Johnson Creek. Riordan Lake, which was formed as a result of a large glacial landslide that dammed the creek, is located halfway down the creek. Upstream reaches of Riordan Creek are low-gradient and downstream reaches are high-gradient.
Trapper Creek	Access Roads; Existing Transmission Line	Presence- BT, SH, CS Critical Habitat- BT, SH, CS	This is a moderate gradient tributary to Johnson Creek.

Source: Forest Service 2003a, 2010a; HDR 2013, 2014a, 2014b, 2015a, 2016b, 2016c; Midas Gold 2016a; MWH 2017; Rio Applied Science and Engineering 2019
[1] Species presence was reported in MWH 2017. For more details refer to **Section 3.12**.
CR = County Road, BT = Bull trout, CS = Chinook salmon, SH = Steelhead/Redband/Rainbow trout.

3.11.4.4 Wetlands Functions and Values

This section summarizes the wetland functional assessments that have been conducted in the analysis area (watershed condition indicators, which include stream function, are documented in **Section 3.12** and in the Fish Resources and Fish Habitat Specialist Report [Forest Service 2023i]). Wetland functions are self-sustaining properties of a wetland ecosystem that exist in the absence of societal values and relate to ecological significance without regard to subjective human values. Flood attenuation and provision of off-channel fish habitat are examples of wetland functions. Wetland values are those elements of a wetland that are valued by humans, such as flood hazard reduction or recreational/hunting uses (Berglund and McEldowney 2008). Wetland functions and values were assessed to evaluate the condition of existing wetland resources so that the potential impacts of activities associated with the SGP can be understood and disclosed.

Th wetland functions are ranked in four categories: I through IV, with Category I having the highest functional value. Descriptions of relevant categories are as follows (Berglund and McEldowney 2008):

- Category I wetlands are of exceptionally high quality and generally are rare to uncommon in the state or are important from a regulatory standpoint. They can provide primary habitat for sensitive species, represent a high-quality example of a rare wetland type, provide irreplaceable ecological functions, and/or exhibit high flood attenuation capability, or are assigned high ratings for most assessed values and functions.

- Category II wetlands are those that provide habitat for sensitive plants or wildlife, function at very high levels for wildlife/fish habitat, are unique in a given region, or are assigned high ratings for many of the assessed functions and values but are more common than Category I wetlands.

- Category III wetlands are common and generally are less diverse than Category I and II wetlands. They can provide many functions and values, although they may not be assigned high ratings for as many parameters as are Category I and II wetlands.

- Category IV wetlands generally are small, isolated, and lack vegetative diversity. These sites provide little in the way of wildlife habitat and often are indirectly disturbed.

Per the assessments conducted by HDR and Tetra Tech, 1 of the 21 evaluated wetland AAs rated as Category IV, 17 rated as Category III, and 3 rated as Category II (Tetra Tech 2021c, Forest Service 2023h; **Figure 3.11-2**).

Depending on the specific wetland being evaluated, up to 11 functions/values can be evaluated for each assessment area (AA) using MWAM (Berglund and McEldowney 2008) including:

- Habitat for federally listed or proposed threatened or endangered plants or animals: Whether or not an AA is known to or suspected to function as habitat for species receiving protection under provisions of the ESA.

- General wildlife habitat: The general potential to provide wildlife habitat based on evidence of wildlife use and existence of generally desirable habitat features.

- General fish habitat: The general fish habitat quality. This function is assessed only if the AA is used by fish or if the existing situation is correctable such that the AA could be used by fish (e.g., fish use is blocked by inaccessible culvert or another barrier).

- Flood attenuation: The capability of wetlands in the AA to slow and disperse the potentially hazardous flow energy during high-water or flood events. This parameter only applies to AAs that occur within or contain a discernable floodplain.

- Long- and short-term surface water storage: The potential of the AA to capture, retain, and make available surface water originating from flooding, precipitation, upland surface (sheetflow) or subsurface (groundwater) flow.

- Sediment/nutrient/toxicant retention and/or removal: The ability of the AA to retain sediments and retain and remove excess nutrients and toxicants. This function is sometimes referred to as "water quality improvement." This parameter only applies to wetlands with potential to receive sediments and excess nutrients or toxicants through influx of surface water, groundwater, or direct input.

- Sediment/shoreline stabilization: The ability of an AA to dissipate flow or wave energy, reducing erosion. This function is only assessed if a wetland within an AA occurs on the banks for a river, stream, or other natural or manmade channel, or occurs on the shoreline of a standing water body that is subject to wave action.

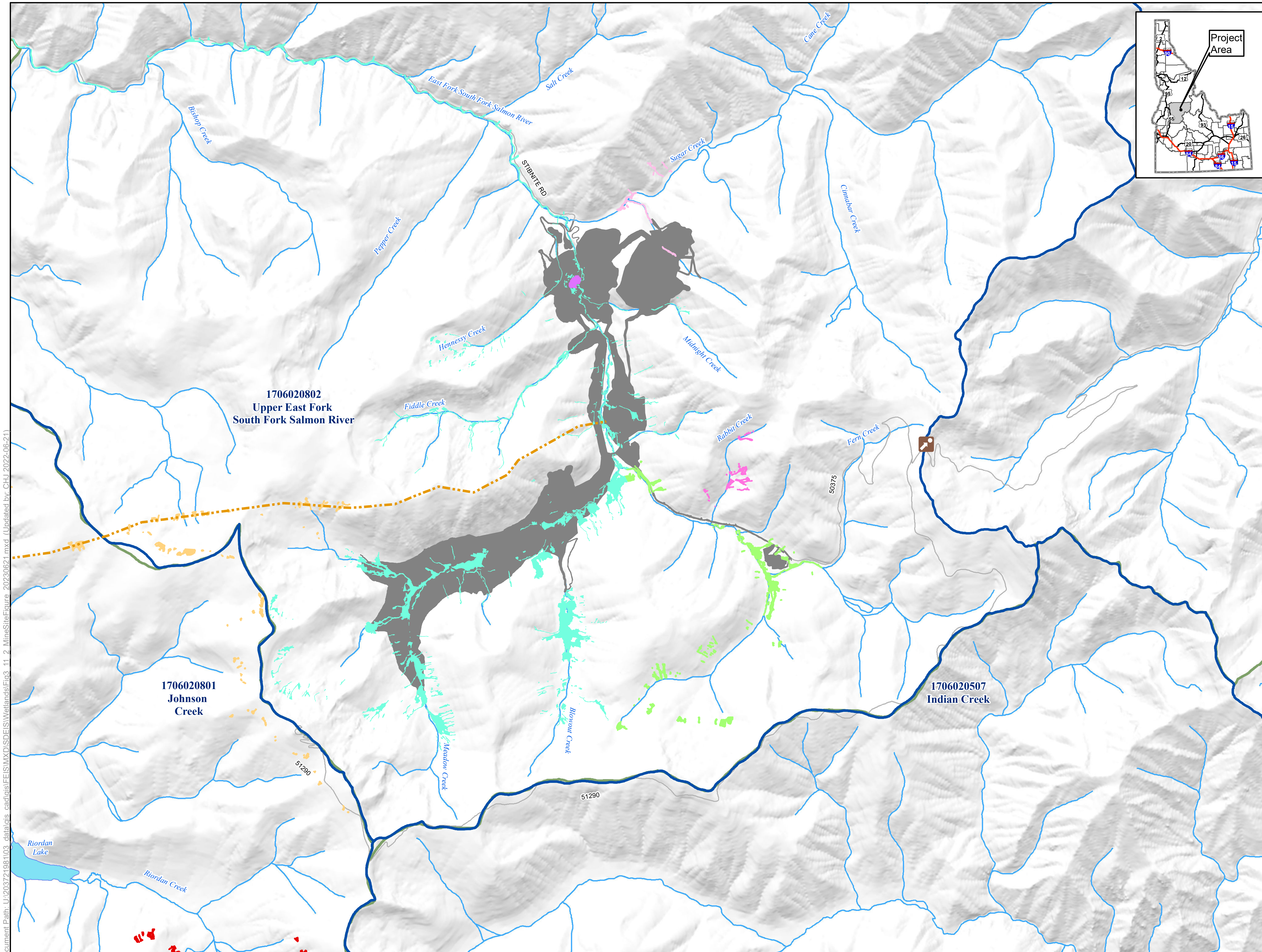
- Production export/terrestrial and aquatic food chain support: The potential of an AA to produce and export food and/or nutrients for both terrestrial and aquatic organisms.

- Groundwater discharge/recharge: The potential for groundwater discharge and recharge at the AA.

- Uniqueness: The general uniqueness of an AA in terms of its replacement potential and habitat diversity, relative abundance in the same major watershed basin, and degree of human disturbance.

- Recreation/education potential: The general potential of an AA to support recreation or education activities.

Assessed wetlands at the mine site generally exhibit moderate to high levels of disturbance from historic mining activity, erosion, and fire. They do not support known populations of ESA-listed threatened or endangered plant species (HDR 2013, 2014a, 2014b; Tetra Tech 2018); however, potential habitat and occurrences of Forest Service Sensitive and Forest Watch plant species do occur in wetlands near the SGP (**Section 3.10**). In addition, metal concentrations in some wetlands at the mine site exhibit the influence of the historical mining activity primarily through elevated arsenic and antimony concentrations (HDR 2017f).



LEGEND

Watershed Boundary (USGS HUC* 10)

Wetlands

Functional AAs

AA-10

AA-12

AA-15

AA-16

AA-19

AA-20

AA-21

Project Components

SGP Features**

Utilities

New Transmission Line

Other Features

U.S. Forest Service

City/Town

Monumental Summit

County

Railroad

Highway

Road

Stream/River

Lake/Reservoir

*US Geological Survey Hydrologic Unit Code
**Project Components are associated with both Alternatives.

Note:
East Fork Meadow Creek is also known as Blowout Creek.

0 0.5 1 Miles

1 inch = 0.85 miles when printed at 11x17

N

Figure 3.11-2
Wetland Analysis
Mine Site Map
Stibnite Gold Project
Stibnite, ID

Base Layer: USGS Shaded Relief Service
Other Data Sources: Midas Gold; State of Idaho Geospatial Gateway (INSIDE Idaho); USGS; Boise National Forest; Payette National Forest

PAYETTE NATIONAL FOREST

Map Date: 2023-06-21

Document Path: U:\20372198\1.03_data\gis_cad\gis\FEIS\MXD\SDEIS\Wetlands\Fig3_11_2_MineSiteFigure_20230621.mxd (Updated by: CHJ 2022-06-21)

Many of these wetlands were noted during surveys as having the potential to provide habitat for a variety of wildlife species managed by the Forest Service because of their sensitivity, including northern leopard frogs, fishers, boreal owls, western toads, black-backed woodpeckers, northern goshawks, and wolverines (Tetra Tech 2018). Wetlands rated as Category II generally received high scores due to the provision of habitat associated with sensitive species with potential to occur in the area (**Section 3.13**).

Wetlands on slopes, generally resulting from groundwater seepage, function to deliver water, sediment, and nutrients to valley bottom wetlands below. These typically exhibit less water filtration or flood storage functions because water moves through these wetlands without being detained. However, they often provide valuable habitat for terrestrial species, and they can contribute cool water to wetlands and streams in the valley bottoms.

Wetlands located along valley bottom drainages, both on and off the mine site, have the potential to provide water quality, flood storage, and fish habitat functions. These streamside wetlands filter flowing water during high flow events when water is most likely to contain fine sediments that can be harmful to fish. Given the history of mining activity and historical tailings deposits at the mine site, these water quality functions are an important aspect of stream health, both at, and downstream, of the mine site. During high flows, streamside wetlands also provide off-channel refuge for small fish that seek such areas when currents in the main channel become too strong for them.

A summary of the primary functions provided within each AA and the functional assessment scores for each AA can be found in Appendix A of the SGP Wetland and Riparian Areas Specialist Report (Forest Service 2023h).

3.12 Fish Resources and Fish Habitat

3.12.1 Introduction

This section describes the fish resources and fish habitats in the analysis area of the SGP under existing (baseline) physical, chemical, and environmental conditions. While all fish species are of management interest, four special status salmonids (i.e., fish in the family Salmonidae, which includes salmon, trout, and whitefish) are of particular resource management interest because of their status as federally listed fish or fish of management concern to the Forest Service or State of Idaho. Of the four fish species, three are federally listed as threatened species under the ESA: summer Chinook salmon, Snake River Basin steelhead, and Columbia River bull trout. Also, the Payette Forest Plan (Forest Service 2003a) has designated bull trout as a MIS. In addition, the Forest Service (Intermountain Regional Forester) has identified the westslope cutthroat trout as a Forest Service sensitive species.

3.12.2 Fisheries and Aquatic Habitat Resources Area of Analysis

The analysis area for fish and fish habitat includes the area where effects (direct/indirect) may be caused by the proposed activities (FSH 1909.15, 15.2a). The analysis area encompasses all areas in which fish resources and fish habitat may be affected directly or indirectly by the SGP, and not merely the immediate area involved. The analysis area is located in the SFSR hydrological subbasin and the North Fork Payette River hydrological subbasin (**Figure 3.12-1**). The analysis area for fish resources also includes all of the watercourses (i.e., streams and rivers) and waterbodies (i.e., lakes, reservoirs) in the 12-digit HUC subwatersheds that overlap the SGP area.

In the SGP analysis area the hydrologic units of relevance are, from largest to smallest:

- Salmon River "Basin" (HUC 170602) and Middle Snake-Boise "Basin" (HUC 170501);
- SFSR "Subbasin" (HUC 17060208) and North Fork Payette River "Subbasin" (HUC 17050123);
- Numerous "Watersheds" within each subbasin (i.e., Upper East Fork Salmon River Watershed (HUC 1706020804); and
- Numerous "Subwatersheds" within each watershed (i.e., Headwaters East Fork SFSR Subwatershed (HUC 170602080201). Subwatersheds are sometimes referenced as "6th field" or "HUC 12" due to the 12-digit numerical code assigned to each.

The physical footprint of the SGP where mining is proposed (i.e., the proposed "mine site" footprint) occurs within two subwatersheds: Sugar Creek and Headwaters East Fork South Fork Salmon River (**Figure 3.12-2**), labeled numbers 5 and 6 on **Figure 3.12-1**. Immediately downstream of these two subwatersheds is the adjacent No Mans Creek-East Fork South Fork Salmon River subwatershed that also is discussed in this section (HUC 170602080206), which is labeled number 4 on **Figure 3.12-1**. This latter subwatershed is within the analysis area, but not within the proposed mine site.

The analysis area for fish resources also includes all of the watercourses (i.e., streams and rivers) and waterbodies (i.e., lakes, reservoirs) in the 12-digit HUC subwatersheds that overlap the SGP area. Because the majority of the activities and disturbance would occur at the mine site, which is located in the SFSR subbasin, greater emphasis is placed on describing the affected environment within this subbasin. However, relevant habitat conditions in other subbasins, watersheds, and subwatersheds that may be impacted by SGP activities also are described, as appropriate.

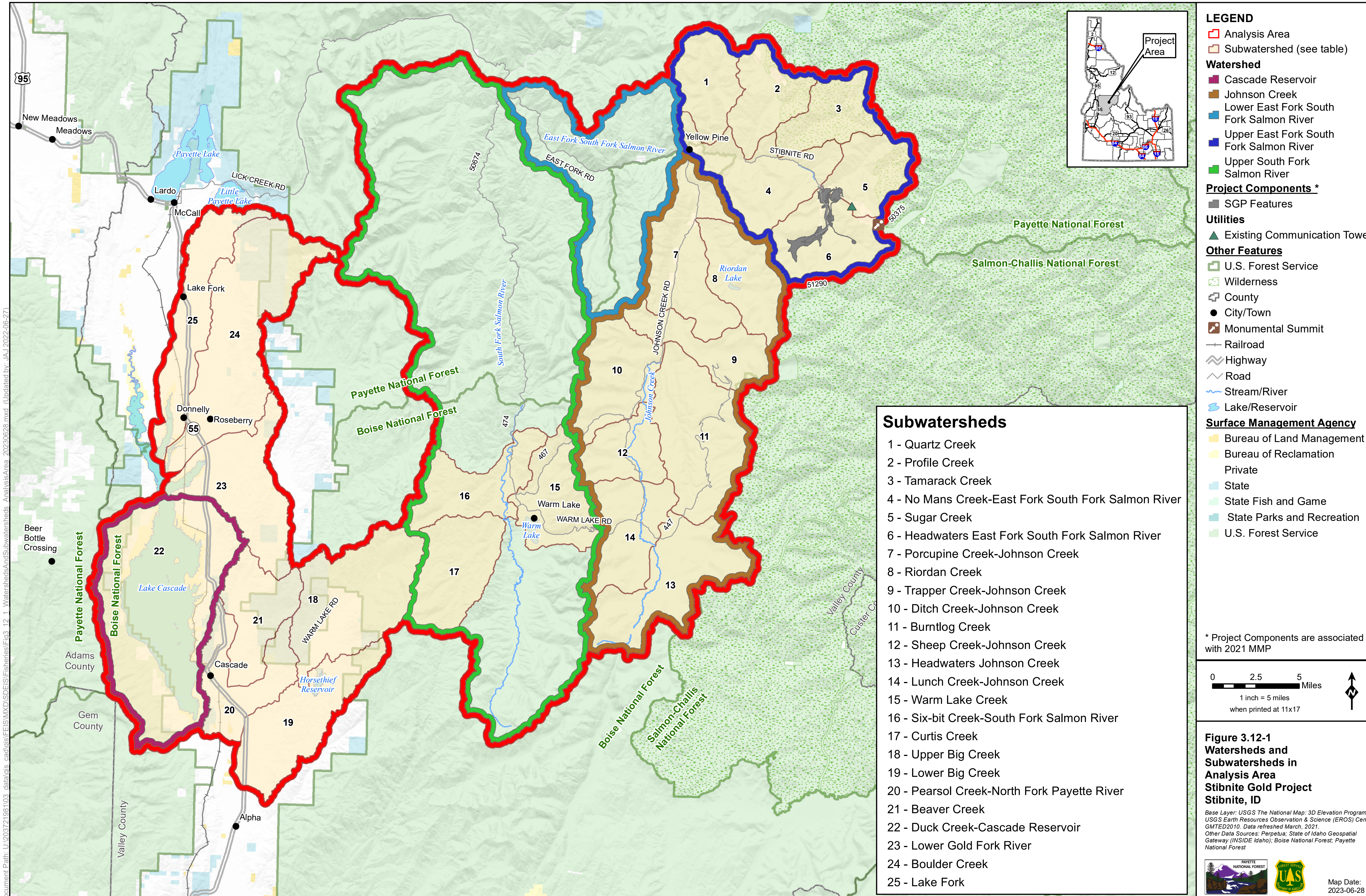
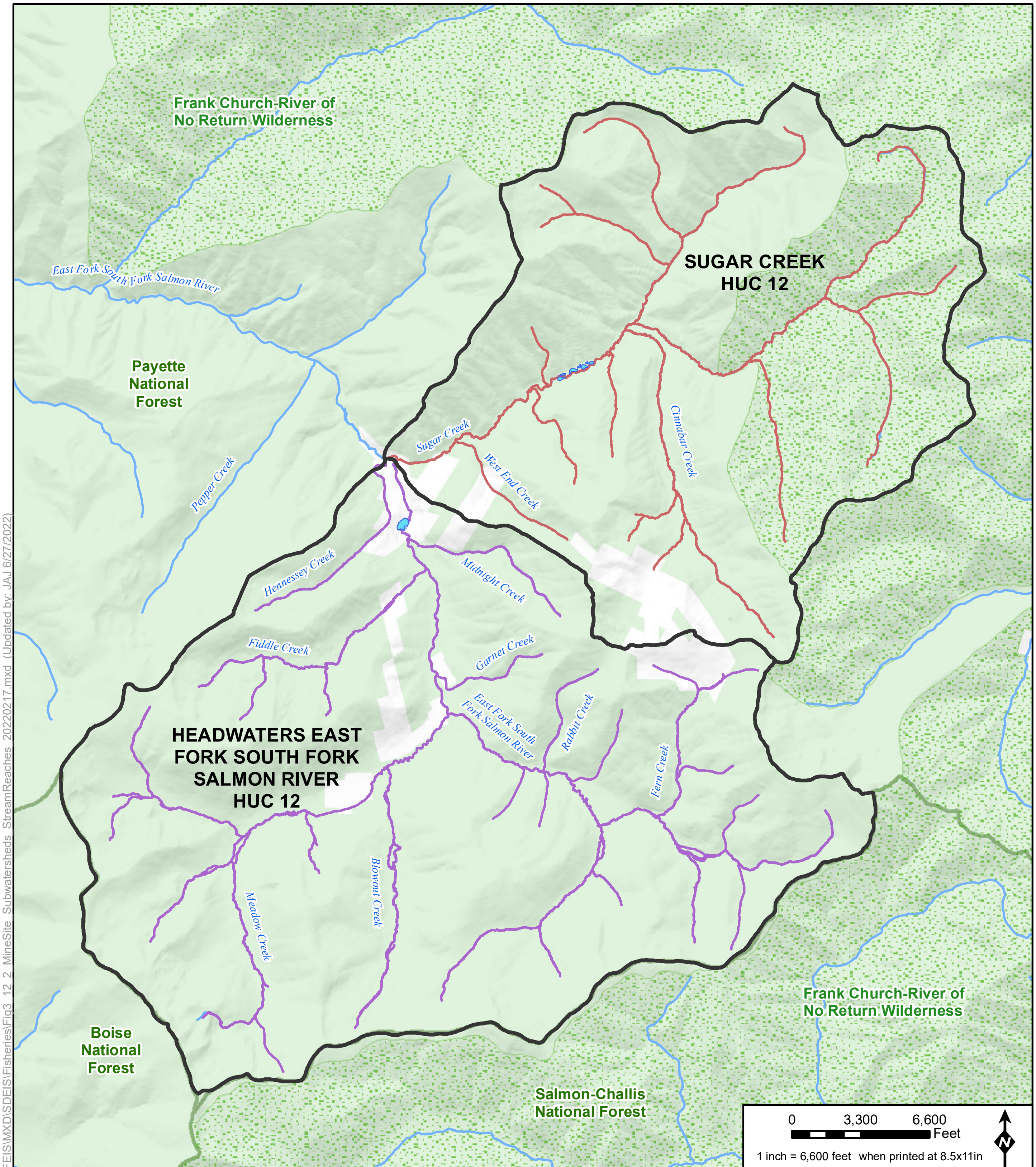
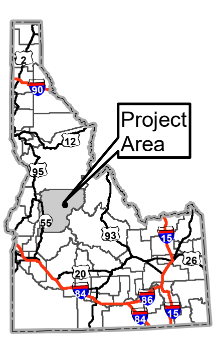


Figure 3.12-1
Watersheds and Subwatersheds in Analysis Area
Stibnite Gold Project
Stibnite, ID





LEGEND

- Subwatershed (HUC 12)
- Headwaters East Fork South Fork Salmon River Drainages
- Sugar Creek Drainages

Other Features

- U.S. Forest Service
- Wilderness
- County
- Stream/River
- Lake/Reservoir

Surface Management

- Private
- U.S. Forest Service

Figure 3.12-2
Mine Site Subwatersheds
Stibnite Gold Project
Stibnite, ID

Base Layer: ESRI World Terrain Basemap
Other Data Sources: Perpetua; State of Idaho Geospatial Gateway (INSIDE Idaho); USGS; Ecosystem Sciences; Boise National Forest; Payette National Forest

Document Path: U:\203721981\03_data\gis_cad\gis\FEIS\MXD\SDEIS\Fisheries\Fig3_12_2_MineSite_Subwatersheds_StreamReaches_20220217.mxd (Updated by: JAJ 6/27/2022)

3.12.3 Relevant Laws, Regulations, Policies, and Plans

Several laws and regulations apply to the Proposed Action and Action Alternatives. The following is a list of laws, regulations, policies, and plans at the federal, state, or local level pertaining to Fisheries and Aquatic Resources. Additional descriptions of these regulations can be found in the SGP Fisheries and Aquatic Resources Specialist Report (Forest Service 2023i).

Land and Resource Management Plan: The Payette Forest Plan (Forest Service 2003a), and the Boise Forest Plan (Forest Service 2010a) provide management prescriptions designed to realize goals for achieving desired conditions for wildlife and wildlife habitat and include various objectives, guidelines, and standards for this purpose.

Portions of the BNF are administratively managed by the PNF due to location. Forest Service regulations and the Forest Plans (Forest Service 2003a, 2010a) provide guidance on resource management on NFS lands. The SGP is located in PNF Management Area 13 (Big Creek/Stibnite) and in BNF Management Areas 17 (North Fork Payette River), 19 (Warm Lake), 20 (Upper Johnson Creek), and 21 (Lower Johnson Creek), which are described in the respective Forest Plans. In addition, Appendix B of both the Payette and Boise Forest Plans provides NEPA guidance with respect to evaluating the ecological functionality of aquatic resources in the analysis area using Watershed Condition Indicators (WCI) under existing baseline conditions because they may be affected by the SGP.

U.S. Army Corps of Engineers 404 Permit: Under Section 404 of the CWA (33 United States Code [USC] 1344), a DA, USACE permit is required for the discharge of dredged and/or fill material into WOTUS. This would include discharges of dredge and/or fill material associated with activities, such as the construction of road crossings, water diversions, waste rock disposal in a stream, and other facilities associated with the SGP's construction, operation, and closure and reclamation.

Endangered Species Act Section 7 Consultation: The ESA (16 USC 35 1531 et seq. 1988) provides for the protection and conservation of threatened and endangered species and their Critical Habitats. Section 7 of the ESA (16 USC 1531 et seq.) requires all federal agencies to consult with the USFWS and/or the NMFS or NOAA Fisheries, collectively known as "the Services", which share regulatory authority for implementing the ESA. Federal agencies must submit a consultation package for proposed actions that may affect ESA-listed species, species proposed for listing, or designated Critical Habitat for such species. The USFWS generally manages ESA-listed terrestrial and freshwater plant and animal species, while NOAA Fisheries is responsible for marine species, including anadromous fish.

"Critical habitat" is defined by the ESA as specific areas within the geographical area occupied by listed species at the time of listing that contains the physical or biological features essential to conservation of the species and that may require special management considerations or protection (50 CFR 424). Critical habitat also may include specific areas outside the geographical area occupied by the species if the agency determines that the outside area itself is essential for conservation of the species.

The first step in the consultation process is an "informal" consultation with one or both of the Services to initially determine if the proposed action is likely to affect any listed species, species proposed for listing, or designated Critical Habitat in the analysis area. The federal agency taking the action or the "action agency" (i.e., the Forest Service and the USACE in the case of the SGP) may prepare a BA (or designee, a non-federal representative to prepare the BA acceptable to the agency under federal regulation) to aid in determining a project's effects on listed or proposed species or designated Critical Habitat. If the action agency determines that the action is likely to adversely affect ESA-listed or proposed species or designated Critical Habitat, then the action agency enters into "formal" consultation (or "conference" for species proposed for listing). The USFWS and/or NOAA Fisheries then prepare(s) a Biological Opinion and determines whether the action is likely to jeopardize the continued existence of the species or adversely modify designated Critical Habitat. If there is any anticipated "incidental take" (50 CFR 402.02 [defining "take"]) of a species, one or both of the Services must issue an Incidental Take Statement that includes terms and conditions and reasonable and prudent measures that must be followed to eliminate or minimize impacts to the species or its designated Critical Habitat.

Sustainable Fisheries Act (Essential Fish Habitat): In response to growing concern about the status of fisheries in the U.S., Congress passed the Sustainable Fisheries Act of 1996 (P.L. 104 297) to amend the Magnuson-Stevens Fishery Conservation and Management Act (P.L. 94-265), the primary law governing marine fisheries management in the federal WOTUS. NOAA Fisheries is responsible for protecting habitats important to federally managed marine species, which include anadromous Pacific salmon that occur in the SGP analysis area. Federal agencies must consult with NOAA Fisheries concerning any action that may adversely affect "Essential Fish Habitat" (EFH) pursuant to the amended Magnuson-Stevens Fishery Conservation and Management Act and its regulations (50 CFR 600). The Act defines EFH as habitats necessary to a species for spawning, breeding, feeding, or growth to maturity, which includes marine and riverine migratory corridors, spawning grounds, and rearing areas of Pacific salmon species. Given the SGP's geographic location, Chinook salmon (Oncorhynchus tshawytscha) is the only species that has designated EFH within the SGP analysis area. As defined by the regulations, EFH includes "all streams, estuaries, marine waters, and other waterbodies occupied or historically accessible to Chinook salmon in Washington, Oregon, Idaho, and California" (50 CFR 660.412(a)). EFH is coincident with designated critical habit for Chinook salmon within the analysis area.

Fish and Wildlife Coordination Act: The Fish and Wildlife Coordination Act generally requires that federal agencies consult with the USFWS, the NMFS, and State wildlife agencies for activities that control or modify waters of any stream or bodies of water, in order to minimize the adverse impacts of such actions on fish and wildlife resources and habitat. This consultation is generally incorporated into the process of complying with NEPA, Section 404 of the CWA, or other federal permit, license, or review requirements. The Fish and Wildlife Coordination Act provides that wildlife conservation shall receive equal consideration and be coordinated with other features of a project.

The term "wildlife resources" is explicitly defined to include "birds, fishes, mammals, and all other classes of wild animals and types of aquatic and land vegetation upon which wildlife is dependent" (16 USC 666 (b)). Further, the Fish and Wildlife Coordination Act states that reports determining the possible damage to wildlife resources and an estimation of wildlife loss shall be made an integral part of any report prepared or submitted by the action agency with permitting authority (16 USC 662 (b), (f)).

Idaho Department of Water Resources – Stream Channel Protection Program: The Idaho Stream Channel Protection Act (Idaho Code Title 42, Chapter 38) requires that the stream channels of the state and their environments be protected against alteration for the protection of fish and wildlife habitat, aquatic life, recreation, aesthetic beauty, and water quality. The Idaho Stream Channel Protection Act applies to any type of alteration work done inside the ordinary high-water mark of a continuously flowing stream and requires a stream channel alteration permit from IDWR before commencing any work that would alter the stream channel. This means that the IDWR must approve, in advance, any work that is conducted within the beds and banks of continuously flowing streams (i.e., perennial streams). Stream channel alteration permitting requires a joint-permit application process with IDWR, the IDL, and the USACE.

Idaho Department of Fish and Game – Scientific Collection Permit and Fish Transport Permit: The IDFG requires a Scientific Collection Permit for any handling of fish that is not related to sportfishing with a state fishing license. The salvage and transport of fish by vehicle between capture and release sites for the proposed SGP is expected to require a fish transport permit.

3.12.4 Affected Environment

The following subsections describe the existing conditions of fish species, particularly Chinook salmon, steelhead, bull trout, and westslope cutthroat trout, and their habitat, as well as an overview of fish densities and watershed condition indicators (WCIs). Modeling tools are utilized to characterize fish usage and habitat based on application of threshold criteria to available data for the site or other Idaho streams. In general, modeling tools are limited by the assumptions and data they employ and may not match field observations precisely. However, the modeling tools are utilized to form a basis for consistent comparisons between habitat criteria, existing conditions, and forecasts of future conditions.

Perpetua funded aquatic resources baseline studies from 2012 to 2020 specifically for the SGP within the mine site area and along the Burntlog Route area (AECOM 2020a). Fish data was collected through snorkel surveys, electrofishing, videography, and environmental Deoxyribonucleic Acid (eDNA) sampling (MWH 2017; Stantec 2018, 2019). **Figures 3.12-3a** and **3.12-3b** show the location of these surveys. In 2015, fish tissue was collected to check for metal concentrations and DNA analysis.

Field investigations to characterize existing aquatic physical habitat in the mine site area and along the Burntlog Route area were performed between 2012 and 2020 (Great Ecology 2018; HDR 2016c; Rio ASE 2019; MWH 2017; Stantec 2018, 2019, 2020; Watershed Solutions Inc. 2021) (**Figure 3.12-4**). These investigations collected information on aquatic habitat parameters, such as water temperature, substrate size, substrate embeddedness, surface fines, channel geometry and physical attributes, large woody debris, and pool frequency. Stream habitat condition surveys, following the PACFISH/INFISH Biological Opinion (PIBO) protocols, collected information on bankfull width, wetted width, bank stability, sediment size, stream gradient, pool dimensions, and large woody debris.

3.12.4.1 Fish Species

The four federally listed or Forest Service sensitive fish species (i.e., special status fish species) known to be present in the analysis area are Chinook salmon, steelhead trout (*Oncorhynchus mykiss*), bull trout (*Salvelinus confluentus*), and westslope cutthroat trout (*Oncorhynchus clarkia lewisi*). Chinook salmon, steelhead, and bull trout are all federally listed as threatened under the ESA, and westslope cutthroat trout is a Forest Service sensitive species. Bull trout is also a Forest Service MIS on the PNF and the BNF and are among the most sensitive to changes in environmental variables, such as water temperature, sediment, or contaminants.

Other native fish species found within the analysis area include mottled sculpin (*Cottus bairdii*), longnose dace (*Rhinichthys cataractae*), speckled dace (*Rhinichthys osculus*), redside shiner (*Richardsonius balteatus*), mountain whitefish (*Prosopium williamsoni*), Pacific lamprey (*Entosphenus tridentatus*), and mountain sucker (*Catostomus platyrhynchus*). A list of every fish species documented in the analysis area, including non-native fish introduced to the area is provided in AECOM 2020f.

Chinook Salmon

<u>Status</u>

The Snake River spring/summer-run Chinook Salmon Evolutionary Significant Unit was listed as threatened under the ESA in 1992 (57 Federal Register 14653). Most Chinook salmon in the analysis area are considered "summer-run" fish (NMFS 2017). These fish are found throughout the analysis area, including naturally in the SFSR subbasin and the East Fork SFSR drainage upstream to the Yellow Pine pit lake within the mine site and upstream of the Yellow Pine pit when transplanted as discussed below.

A cascade with a current slope of 22 percent, caused by legacy mining activities, located upstream of Yellow Pine pit lake is a barrier to further upstream natural migration for adult Chinook salmon. Juvenile fish, however, can move downstream through the cascade because adult Chinook salmon have been reintroduced upstream of the Yellow Pine pit lake by the IDFG. Spawning-ready adult Chinook salmon are periodically translocated from the SFSR to upstream of the barrier with support from the Nez Perce Tribe.

Historically, the Snake River was considered the Columbia River Basin's most productive drainage for salmon, supporting more than 40 percent of all Columbia River spring/summer Chinook salmon (Fulton 1968; NMFS 1995 in NMFS 2017). Currently, the stock has been severely depleted from a variety of activities, including hydropower systems, hatcheries, harvest, fish passage, and pathogens/predation/competition. Chinook salmon remain at risk of becoming endangered within 100 years (NMFS 2017).

The proposed status for the East Fork SFSR population is considered "maintained," indicating there is a moderate (25 percent or less) risk of extinction over 100 years (NMFS 2017).

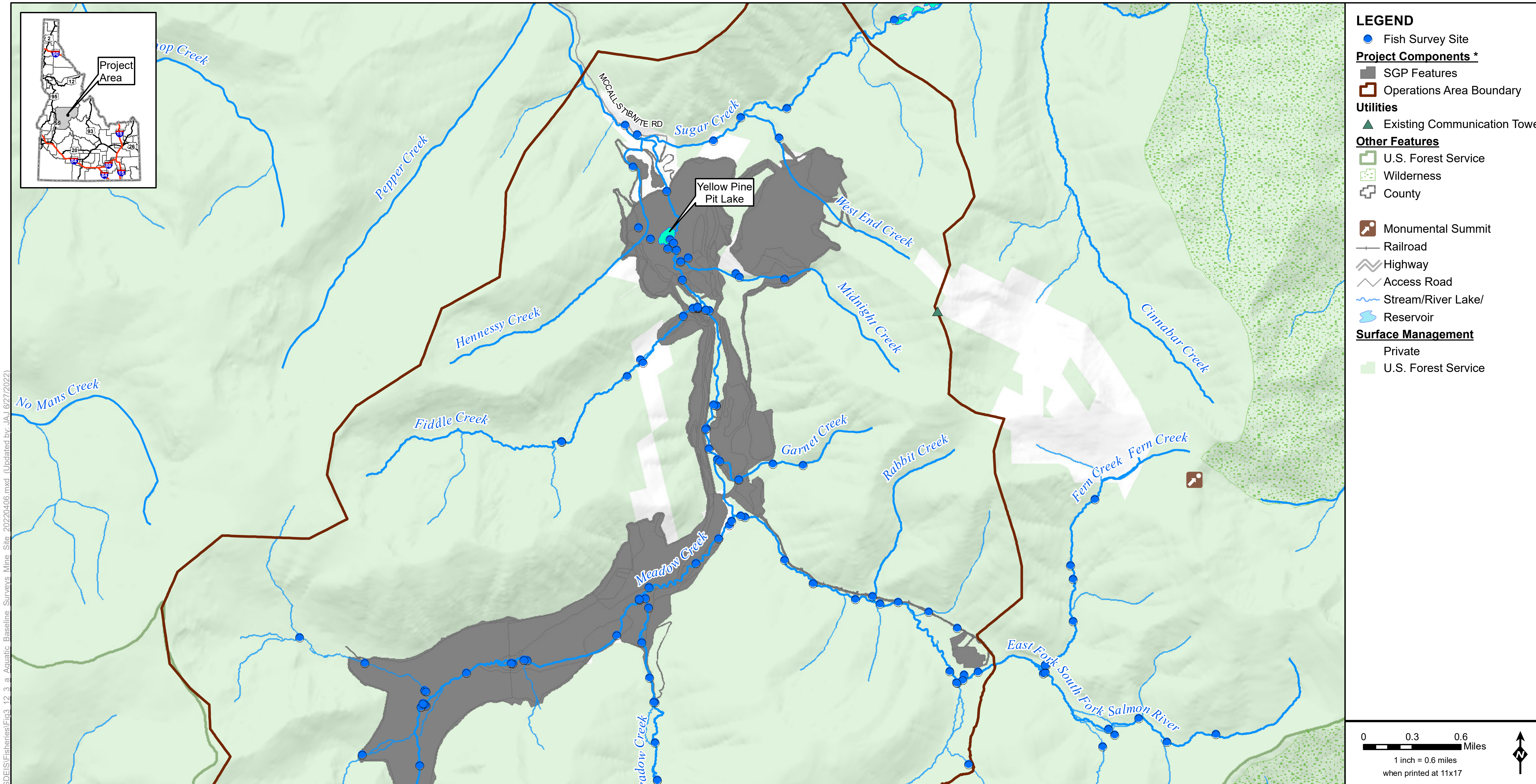


Figure 3.12-3a Aquatic Baseline Fish Survey Locations at the Mine Site Stibnite Gold Project Stibnite, ID

Base Layer: USGS The National Map: 3D Elevation Program. USGS Earth Resources Observation & Science (EROS) Center: GMTED2010. Data refreshed March, 2021. Other Data Sources: Perpetua; State of Idaho Geospatial Gateway (INSIDE Idaho); USGS; Boise National Forest; Payette National Forest, MWH and Stantec

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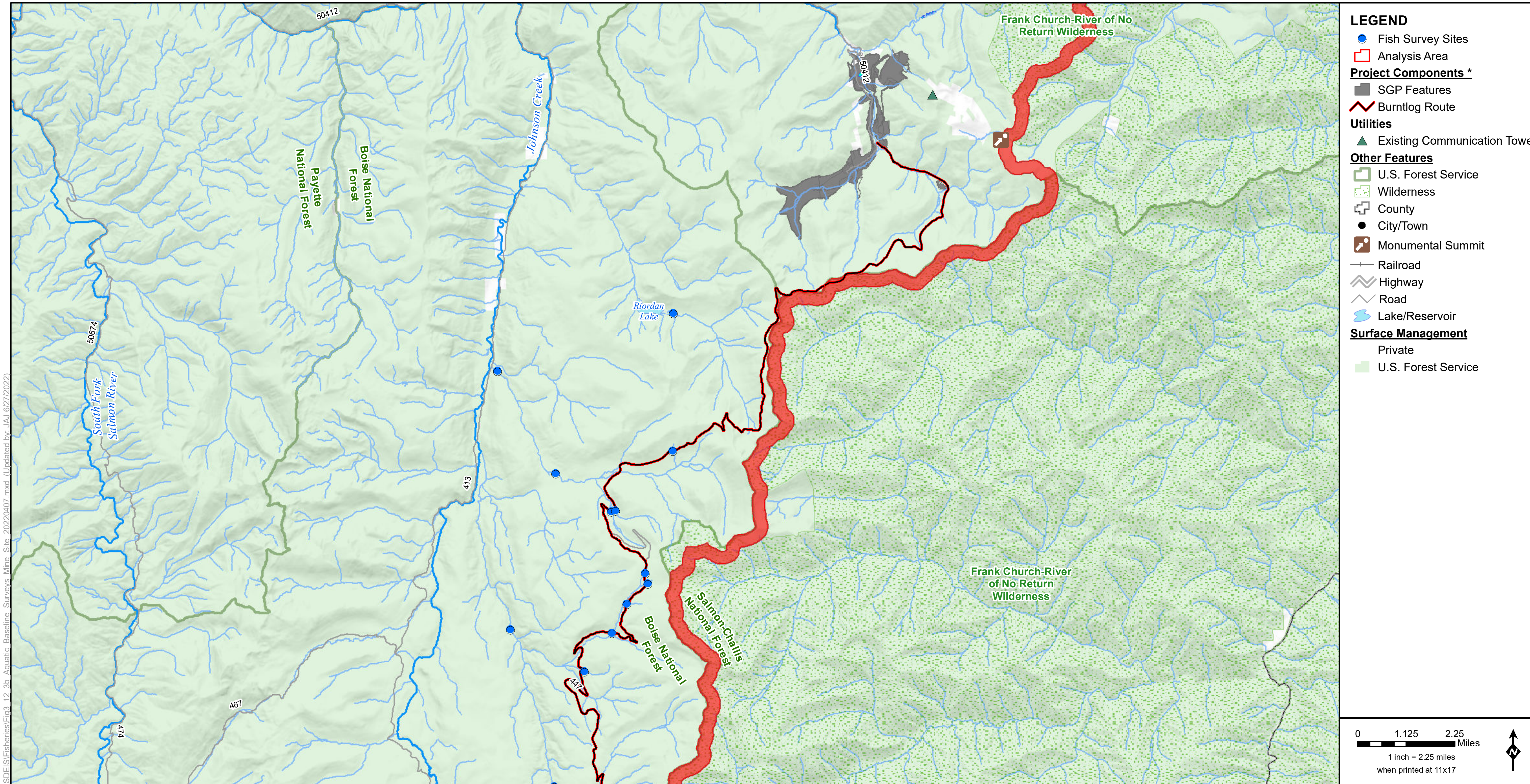

Figure 3.12-3b
Aquatic Baseline
Fish Survey Locations
Along Burntlog Route
Stibnite Gold Project
Stibnite, ID

Base Layer: USGS The National Map: 3D Elevation Program. USGS Earth Resources Observation & Science (EROS) Center: GMTED2010. Data refreshed March, 2021. Other Data Sources: Perpetua; State of Idaho Geospatial Gateway (INSIDE Idaho); USGS; Boise National Forest; Payette National Forest

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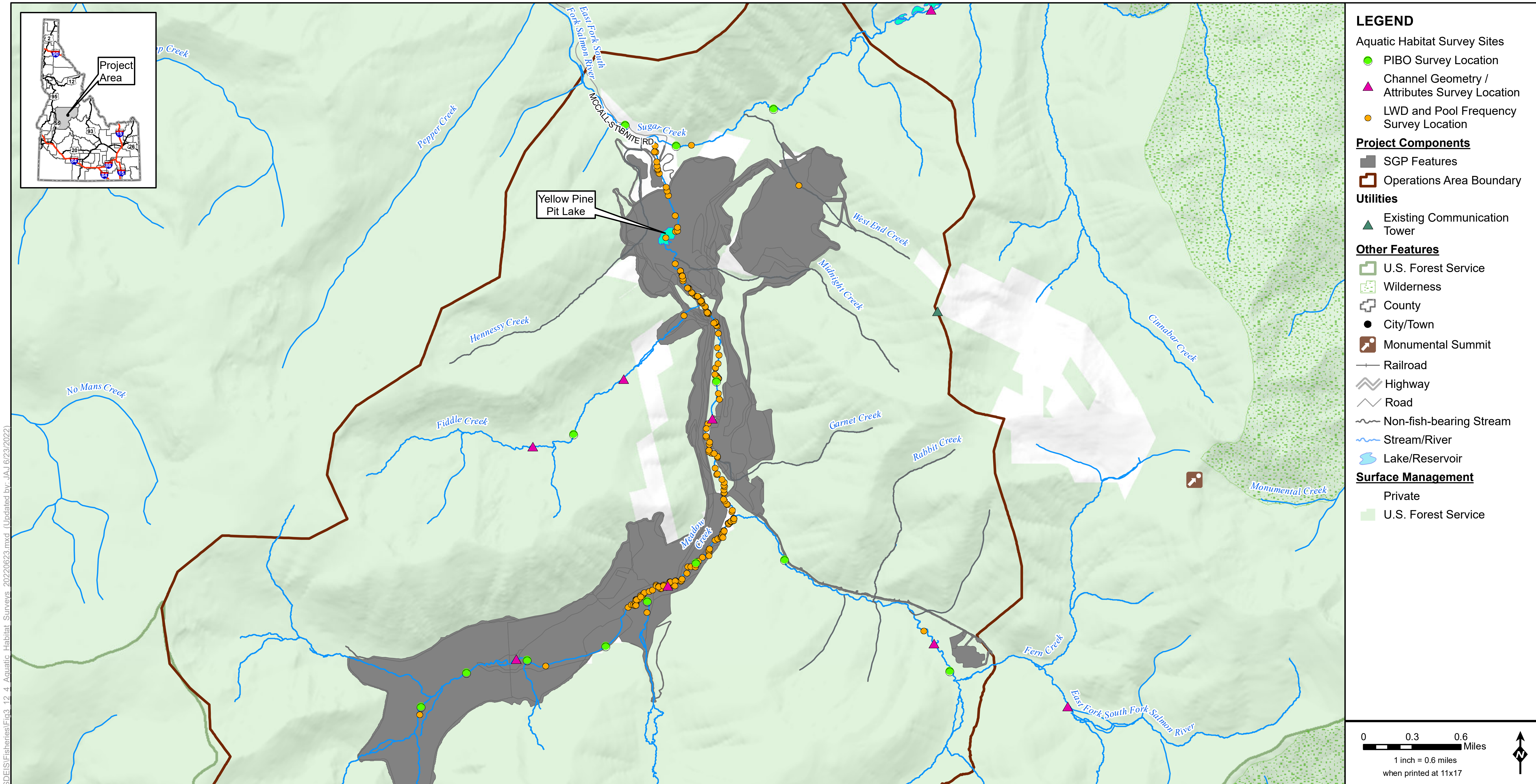

Figure 3.12-4
Aquatic Habitat Survey Locations
Stibnite Gold Project
Stibnite, ID

Base Layer: USGS The National Map: 3D Elevation Program. USGS Earth Resources Observation & Science (EROS) Center: GMTED2010. Data refreshed March, 2021. Other Data Sources: Perpetua; State of Idaho Geospatial Gateway (INSIDE Idaho); USGS; Boise National Forest; Payette National Forest, MWH, Stantec, and RIO

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Critical Habitat and Essential Fish Habitat

Critical habitat for Chinook salmon was originally designated in 1993 (58 Federal Register 68543) and re-designated in 1999 (64 Federal Register 57399). As defined, designated Critical Habitat includes all "river reaches presently or historically accessible (except reaches above impassible natural barriers (including Napias Creek Falls [Napias Creek tributary to the Salmon River]) and Dworshak and Hells Canyon Dams)" (64 Federal Register 57403). Thus, designated Critical Habitat includes all presently and historically accessible rivers and streams within the analysis area, except for the Payette River drainage.

Given the very broad definition of Critical Habitat for Chinook salmon, a more refined description of the affected environment for the SGP was needed. Two different sets of information were used to address this need. First, data on the distribution of Chinook salmon occurrences (fish observations and spawning redd counts) were compiled for 1985 to 2011 to determine the actual locations occupied by Chinook salmon (Isaak et al. 2017). The occurrence data was coupled with National Hydrography Dataset (NHD) flowlines (Horizon Systems 2019 [NHDPlus]). The premise was that NHD flowlines with species presence demonstrated empirical evidence of Chinook salmon Critical Habitat.

Second, available GIS data was used to model what likely is Critical Habitat for Chinook salmon within the mine site area upstream from the Yellow Pine pit (Ecosystem Science, LLC [ESS] 2019a). This approach identified a 12 percent maximum gradient (percent slope) within occupied NHD lines (Isaak et al. 2017), meaning Chinook salmon can migrate upstream through stream reaches that have a less than 12 percent gradient. Within the SGP mine site, stream segments below the gradient cut-off point were modeled as Critical Habitat (i.e., areas with steeper slopes were not identified as modeled Critical Habitat) (ESS 2019a). Currently, there is an estimated 26 km of modeled Chinook salmon Critical Habitat upstream of the Yellow Pine pit lake barrier (**Figure 3.12-5**).

The EFH characteristics important for anadromous salmon for freshwater spawning and rearing include water quality, water quantity, substrate, floodplain connectivity, forage, natural cover, and reaches free of artificial obstructions for freshwater migration (NMFS 2017). EFH has been designated for Chinook salmon within all streams and other waterbodies occupied or historically accessible to Chinook salmon (67 Federal Register 2343, 2002).

Physical and Biological Features and Recovery Plan

NMFS (2017) designated the following sites and essential physical and biological features as primary constituent elements for anadromous salmon and steelhead in freshwater:

- Freshwater spawning (water quality, water quantity, and substrate);
- Freshwater rearing (water quantity and floodplain connectivity, water quality and forage, and natural cover);
- Freshwater migration (free of artificial obstruction, water quality and quantity, and natural cover).

These physical and biological features have been designated because of their potential to develop or improve and eventually provide the needed ecological functions to support species recovery (NMFS 2017). The 2017 NMFS Recovery Plan identified recovery strategies for Snake River spring/summer Chinook salmon for the Lower East Fork SFSR and Upper East Fork SFSR watersheds.

Temperature Requirements and Baseline Conditions

Chinook salmon have different temperature requirements or limitations for their various life stages. Exceeding thresholds could impact various life-stages and could cause fish to avoid areas or even mortality. The periodicity (i.e., recurring intervals) of each life stage and the accepted stream temperature threshold ranges for various temperature considerations for each species were compiled from regulatory standards and other relevant literature into ESS 2022a, a condensed version of which is presented in **Table 3.12-1**.

Table 3.12-1 Chinook Salmon Optimal Temperature Thresholds and Modeled Length of Stream within the Water Temperature Thresholds in July and September

Life Stage / Season[1]	Range of Optimal Temperature Thresholds (°C)	Total Stream Length Above YPP/ Below YPP	Baseline Stream Length within Optimal Temperature Threshold		
			Above YPP	Below YPP	Total
Adult Migration/ May – September[2]	12-19	10.92 / 2.01	7.48	2.01	9.19 (73.4%)[3]
Adult Spawning/ July – September[4]	4-14	10.92 / 2.01	10.92	2.01	12.93 (100%)[3]
Incubation/Emergence/ July – April[4]	6-10	10.92 / 2.01	3.44	0	3.44 (26.6%)[3]
Juvenile Rearing/ Year-round[2]	10-20	17.51 / 2.01	17.51	2.01	19.53 (100%)[5]

Source: EPA 2003, Poole et al. 2001, IDAPA 58.01.02
[1] The months in the life stage are not applicable for comparison to the SPLNT model results
[2] Analysis based Summer Maximum (July) 7 Day Average of the Daily Maximum
[3] Percent of stream length within the modeled potential Intrinsic Potential habitat
[4] Analysis based on Fall Maximum (September) 7 Day Average of the Daily Maximum
[5] Percent of stream length within the modeled Critical Habitat
% = percent; °C = degrees Celsius; km = kilometers; YPP = Yellow Pine pit

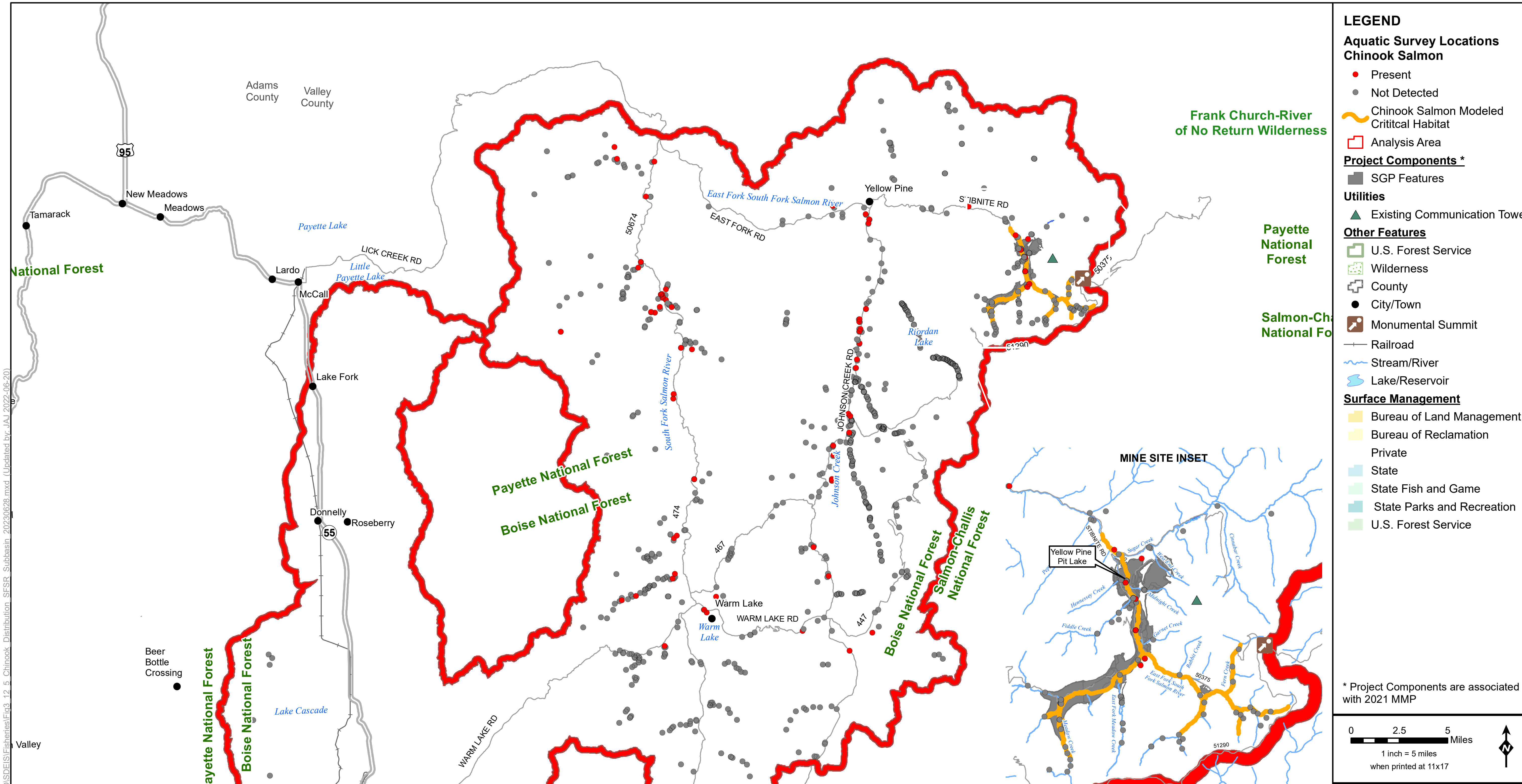


Figure 3.12-5
Chinook Salmon Distribution in the South Fork Salmon River Subbasin
Stibnite Gold Project
Stibnite, ID

Base Layer: USGS The National Map: 3D Elevation Program. USGS Earth Resources Observation & Science (EROS) Center: GMTED2010. Data refreshed March, 2021. Other Data Sources: Perpetua; State of Idaho Geospatial

Map Date: 2023-06-28

Using the QUAL2K predicted monthly MWMT values and stream segment lengths from the Stream and Pit Lake Network Temperature (SPLNT) Model Refined Modified Proposed Action (ModPRO2) report (Brown and Caldwell 2021a), the length of proposed mine site streams within these temperature thresholds was estimated (**Table 3.12-1**). The QUAL2K stream segments that contain the segments in which there was modeled habitat with Intrinsic Potential (IP) (discussed below) were evaluated for thermally suitable habitat (based on MWMT) for all life stages except juvenile rearing. For juvenile rearing, the QUAL2K stream segments that contain segments in which there was modeled Critical Habitat. It is important to note that the IP model applied more refined spatial scale (i.e., shorter reaches) than were applied in the SPLNT model. Hence, the stream segments evaluated for temperature could have lengths that extended beyond the ends of the segments evaluated for IP. Therefore, the stream lengths are not identical, meaning the length of stream habitat meeting the temperature thresholds may be longer than the length of stream habitat with IP. Additionally, modeled Critical Habitat extends to a much larger area than IP because the criteria defining Critical Habitat is based on a 12 percent gradient cut-off, whereas IP criteria are based on channel conditions, gradient, and valley bottom conditions. It is assumed that juvenile Chinook salmon are able to access a larger range of habitat conditions than the other life stages, and therefore, less restrictive habitat conditions were applied in the analysis.

The East Fork SFSR from 0.89 km downstream from the confluence with Sugar Creek to around 3.4 km upstream from the confluence with Meadow Creek (total of 8.59 km), and around 4.35 km of Meadow Creek were evaluated for the temperature thresholds. The entire 12.93 km of potential habitat is within the temperature thresholds for adult spawning and juvenile rearing; however, only 9.49 km (73.4 percent) and 3.44 km (26.6 percent) are within the water temperature threshold for adult migration and incubation and emergence. Of these total lengths, 10.92 km of suitable conditions for spawning and rearing, and all of the suitable conditions for migration and incubation and emergence are upstream from the Yellow Pine pit lake cascade barrier.

It Is Important to note that the creeks do experience significant diurnal variations, and that for mobile life stages (i.e., adults and juveniles), if MWMTs are above the thresholds, fish present may avoid areas within streams if they are able, such as finding thermal refuges.

<u>Distribution</u>

Chinook salmon are distributed throughout the analysis area (**Figure 3.12-5**); however, this section focuses on the mine site area and the travel corridor on Johnson Creek Road and the Burntlog Route. The East Fork SFSR population was historically a large population, with spawning areas throughout the East Fork SFSR mainstem and Johnson Creek (NMFS 2017). Anadromous fish passage in the East Fork SFSR upstream from the Yellow Pine pit lake was blocked in 1938 when activities for mining diverted the East Fork SFSR in surface ditches and later into a bypass tunnel (constructed in 1943). The East Fork SFSR was routed back through the Yellow Pine pit after mining ceased, but the remaining 22 percent gradient cascade, just upstream of the Yellow Pine pit lake, prevents Chinook from traveling upstream. There is a supplementation program to spawning habitat in Meadow Creek above the Yellow Pine pit, discussed below.

Chinook salmon occurrence in the analysis area varies by life stage. Adult migration occurs between May and mid-September, with most reaching the upper East Fork SFSR watershed by late July and August. Spawning occurs from mid-July to September, with peak spawning in August, particularly in the mine site, where spawning is not typically observed before mid-August. Egg incubation begins after spawning, and emergence of larval fish occurs between January and April. Juvenile rearing occurs year-round and juvenile outmigration to the ocean occurs between mid-March to November (ESS 2019b).

Habitat for Chinook salmon is measured using two different tools – Flow productivity to determine the effect of stream flow changes on Chinook salmon productivity and intrinsic potential (IP) modeling to determine the potential for streams to support spawning, incubation, and early-rearing habitat.

Surplus Supplementation

The Nez Perce Tribe began the Johnson Creek Artificial Propagation Enhancement Project in 1998 in response to critically low numbers of returning adult Chinook salmon to Johnson Creek (Columbia River Inter-Tribal Fish Commission 2012). The program uses only natural-origin returns for broodstock, and currently has an annual target release level of 100,000 yearling smolts into Johnson Creek (NMFS 2016).

The Nez Perce Tribe and IDFG translocated adult Chinook salmon from the SFSR to Meadow Creek (upstream from the Yellow Pine pit), but not as part of the Johnson Creek Artificial Propagation Enhancement Project. This out-planting program has been highlighted in the IDFG Fisheries Management Plan (IDFG 2019a). Between 2008 and 2017 (excluding 2014), Chinook salmon spawners were released into Meadow Creek when there are surplus adults from the McCall Fish Hatchery South Fork Salmon River Chinook Salmon Mitigation Program. It should be noted that any juvenile Chinook salmon upstream of the Yellow Pine pit lake cascade barrier were entirely human assisted; there is currently no volitional passage of Chinook salmon upstream of the Yellow Pine pit lake barrier.

Redd Surveys

A redd is a depression or hollow that a salmon creates in the stream substrate (i.e., bed) to deposit eggs. The Nez Perce Tribe has conducted redd surveys for Chinook salmon upstream of the Yellow Pine pit lake in the East Fork SFSR, Meadow Creek, and in other SFSR subbasin streams (e.g., Lower East Fork SFSR, Burntlog Creek, Johnson Creek, Sugar Creek, and Tamarack Creek) since 2008 (Nez Perce Tribe unpublished data 2018a; Rabe et al. 2018). **Table 3.12-2** shows the number of redd counts between 2008 and 2018 in the East Fork SFSR and tributaries within or near the mine site and those that might be affected by the travel corridor on Johnson Creek Road and the Burntlog Route.

Table 3.12-2 Chinook Salmon Redd Counts in Upper East Fork South Fork Salmon River and Johnson Creek Watersheds Between 2008 and 2018

Year	Streams from Upstream to Downstream							
	Meadow Creek - Proposed TSF to Confluence (1.7 km)	East Fork SFSR - Between Meadow Creek and Fiddle Creek (2.4 km)	East Fork SFSR – YPP Lake to Sugar Creek (1.1 km)	Sugar Creek -Cinnabar Creek to Confluence (4.3 km)	East Fork SFSR – Sugar Creek to Quartz Creek (15 km)	East Fork SFSR -Town of Yellow Pine to Confluence (0.8 km)	Johnson Creek -Upper Johnson Creek to Confluence (45.5 km)	Burntlog Creek – East Fork Burntlog Creek to Confluence (8.5 km)
2008	0	0	0	3	2	0	193	30
2009	41	10	10	40	46	2	235	16
2010	74	81	3	43	3	0	345	52
2011	89	131	0	10	73	3	194	41
2012	50	7	10	17	47	0	234	63
2013	40	1	3	11	46	0	201	34
2014	0	0	7	17	42	2	376	41
2015	64	3	3	5	43	0	257	20
2016	128	7	18	13	55	0	253	28
2017	24	0	3	2	16	NA	NA	NA
2018	0	0	0	11	18	NA	NA	NA
2019	0	0	1	0	18	0	68	10
2020	0	0	1	0	11	0	107	6
2021	0	0	0	0	16	0	101	6

Source: Nez Perce Tribe unpublished data; Rabe et al 2018; Rabe 2021
East Fork SFSR = East Fork South Fork Salmon River; NA = Not Available; YPP = Yellow Pine pit

Redds observed upstream from the Yellow Pine pit cascade barrier are all from translocated Chinook salmon. During years when adults were translocated into Meadow Creek, redd counts varied from 24 (2017) to 128 (2016). In general, lower numbers of Chinook salmon redds were found in the East Fork SFSR, likely because Chinook salmon are translocated to Meadow Creek and tend to spawn in close proximity to their introduction sites and the fact that the fish are ready to spawn at the time of release. Chinook salmon redds documented in the East Fork SFSR (between the Yellow Pine pit lake and Meadow Creek) have ranged from 1 (2013) to 13 (2011), with an average of 5 redds per year over 11 years. The number of Chinook salmon translocated and the number of redds observed demonstrate a clear, positive relationship. As the number of adults translocated increased so did the number of redds.

Johnson Creek, a tributary of the East Fork SFSR downstream of the mine site, had the highest numbers of Chinook salmon redd counts in the Upper East Fork SFSR watershed, ranging from 193 (2008, 2011) to 376 (2014), with an average count of 207 redds per year.

Flow Productivity

The effects of flow changes on Chinook salmon productivity within the mine site area were analyzed using a flow-productivity model that was developed using the flow-productivity modeling approach for the Big Creek Water Diversion Project (NMFS 2013). Productivity (also referred to as adult or whole life cycle productivity) is estimated as the ratio of the number of returning adults to the total number of fish allowed to spawn naturally during the brood year (Morrow 2018). Therefore, productivity is a unitless measure or quantity of the number of returning adults. The SGP flow-productivity model regresses productivity against flow metrics using simple linear regression to output flow-productivity (ESS 2022b).

The SGP flow-productivity model uses proxy data from nearby Johnson Creek and assumes that the physical and biological conditions in Johnson Creek are relatable to the mine site streams. However, there are many physical differences between upper East Fork SFSR and Johnson Creek, including drainage size, flow regime, and Chinook populations. Also, the SGP flow-productivity model assumes a fixed number of Chinook salmon spawners each year that occurred in Johnson Creek to occur across all of the mine sites (ESS 2022b). Therefore, these flow-productivity estimates provide a rough approximation of changes in productivity due to flow within the mine site.

The flow productivity analysis predicts changes in productivity based solely on streamflow changes and it does not factor in additional habitat changes that would also occur in the analysis area (e.g., direct loss of habitat, water temperature changes, etc.). The model outputs help to show the relative effects of flow modifications on Chinook salmon productivity at the reach level. Chinook salmon productivity was assessed in four stream reaches (East Fork SFSR above Meadow Creek, East Fork SFSR at Stibnite, East Fork SFSR above Sugar Creek, and lower Meadow Creek). The lower Meadow Creek site (MC-6) was set up to supplement the system of USGS gages. MC-6 specifically examines conditions in the portion of Meadow Creek that is routed through a constructed channel to divert the stream away from historical mine waste.

The flow-productivity model outputs productivity values that are compared to baseline productivity values to calculate the predicted annual percent change in Chinook salmon productivity from baseline productivity. The baseline Chinook salmon productivity value of 1.06 was derived from productivity data collected on Johnson Creek (Morrow 2018). The interpretation of the predicted annual percent change in flow-productivity is based upon the baseline flow-productivity calculated with Johnson Creek data because data is not available within the mine site. Because the productivity value is greater than 1.0, if Johnson Creek were an unimpaired system, there would be slightly more returning adults than the spawning brood year.

Intrinsic Potential

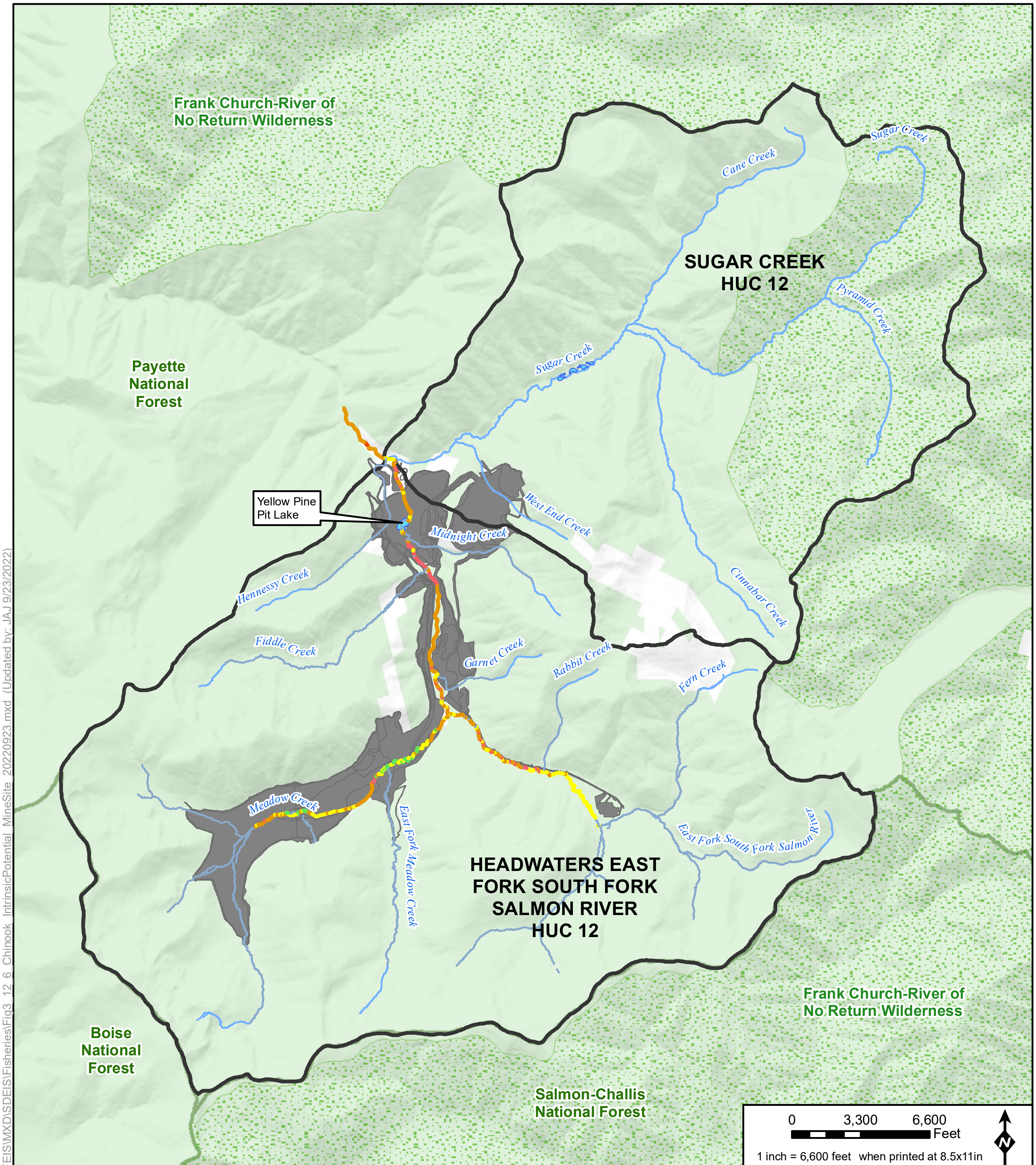
To assist with describing the existing conditions and predicted potential changes in Chinook salmon habitat at the mine site, a site-specific IP model was developed to derive a predictive metric for streams in the mine site that could potentially support spawning through early-rearing habitat for the Chinook salmon. This model included geomorphic and hydrologic attributes, including mean annual discharge, channel gradient, and channel constraint, to estimate the latent potential of stream reaches to provide favorable habitat characteristics for spawning, incubation, and early life stages. Additional details on the IP modeling effort can be found in the SGP Fish and Fish Habitat Specialist Report (Forest Service 2023i). In general, the IP is the underlying capacity (i.e., potential) of a stream to provide habitat. The IP model was used to estimate the potential for spawning and rearing habitat in the headwaters of the East Fork SFSR subwatershed (**Figure 3.12-6**). This subwatershed encompasses the mine site where mining-related activities are proposed; which includes the East Fork SFSR and tributaries upstream from Yellow Pine pit, Meadow Creek and EFMC, East Fork SFSR and tributaries between Yellow Pine pit and Sugar Creek, and East Fork SFSR downstream from Sugar Creek. Flow reductions attributable to the Project in Sugar Creek would typically be less than 1 percent with a maximum monthly difference of 3 percent. Flow differences of this magnitude would have little influence on the wetted width, bankfull width, gradient, valley bottom width, and valley width ration parameters used to assess IP. However, Chinook salmon are known to occupy Sugar Creek under its existing IP condition which would not be measurably modified by the Project.

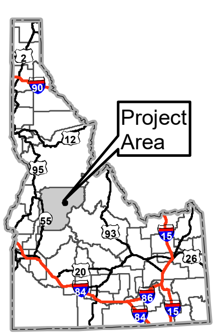
The output from the IP model provides a classification that varies from “negligible” (minimal IP to support habitat) to “high” (likely to provide habitat) with low and medium classifications in between. See 2021 MMP Intrinsic Potential Model Chinook Salmon and Steelhead Technical Memorandum (ESS 2022c) for a detailed description and discussion of the model and results. The IP model was used to evaluate over 51 km of stream habitat. Under baseline conditions, modeled IP stream length shows only 11.1 km of the 51 km have potential spawning, incubation, and early-rearing habitat for Chinook salmon (**Table 3.12-3** and **Figure 3.12-6**). The majority of the IP habitat is rated as low potential, followed by medium and negligible, with high potential having the least amount available (**Table 3.12-3**).

Table 3.12-3 Chinook Salmon Intrinsic Potential Modeling Results for Baseline Conditions

Chinook Salmon IP[1]	East Fork SFSR and Tributaries Upstream from YPP[2]		Meadow Creek and EFMC		East Fork SFSR and Tributaries between YPP and Sugar Creek		East Fork SFSR Downstream from Sugar Creek		Total IP Habitat in Mine Site Area (km)
	Length (km)	Percent Total Length	Length (km)	Percent Total Length	Length (km)	Percent Total Length	Length (km)	Percent Total Length	
High	0	0	0.66	3.9	0	0	0	0	0.66
Medium	0.66	2.3	0.90	5.3	0.18	4.5	0.03	2.7	1.76
Low	4.29	14.8	1.21	7.1	0.84	19.4	1.02	91.9	7.36
Negligible	1.05	3.6	0.10	0.6	0.15	3.5	0.06	5.4	1.36
Total IP Habitat	6.00	20.7	2.86	16.97	1.17	27.0	1.11	100.0	11.1 (22%)[3]
Total Length of Habitat Evaluated	29.01	-	16.93	-	4.34	-	1.11	-	51.39

[1] Results are presented in the table as the length (kilometers) of stream with usable IP. For Chinook salmon the IP is rated as high, medium, low, and negligible. "Useable" habitat is defined as all of these classes combined (usable = high + medium + low + negligible).
[2] Does not include the East Fork SFSR tributaries Meadow Creek and EFMC
[3] Total percent of IP habitat within the total length of streams evaluated.
East Fork SFSR = East Fork South Fork Salmon River; YPP = Yellow Pine pit lake; EFMC = East Fork Meadow Creek





LEGEND

Subwatershed (HUC 12)

Chinook Salmon Intrinsic Potential

- High
- Medium
- Low
- Negligible
- None

Project Components

- Mine Site Components

Other Features

- U.S. Forest Service
- Wilderness
- County
- Stream/River
- Lake/Reservoir

Surface Management

- Private
- U.S. Forest Service

Figure 3.12-6
Chinook Salmon Intrinsic Potential Habitat Within the Mine Site Subwatershed
Stibnite Gold Project
Stibnite, ID

Base Layer: ESRI World Terrain Basemap
Other Data Sources: Perpetua; State of Idaho Geospatial Gateway (INSIDE Idaho); USGS; Ecosystem Sciences; Boise National Forest; Payette National Forest

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Steelhead

Status

The Snake River Basin Steelhead Distinct Population Segment (DPS) is found in the East Fork SFSR drainage and its tributaries downstream of the Yellow Pine pit lake. Steelhead were initially listed as federally threatened under the ESA in August 1997 (62 Federal Register 43937) with the geographic listing area including all natural-origin populations of steelhead in the Snake River Basin. In 2006, Snake River steelhead were subsequently reclassified as a threatened DPS (71 Federal Register 834).

The Interior Columbia Technical Recovery Team (ICTRT) identified five extant major population groups (MPGs) in the Snake River Basin steelhead DPS, which includes the Salmon River Steelhead MPG (ICTRT 2008 as cited in NMFS 2017). The Salmon River Steelhead MPG consists of 12 demographically different steelhead populations all of which are presently considered non-viable (NMFS 2017). The Salmon River Steelhead MPG includes the SFSR population (NMFS 2017), which is within the analysis area. This population is found within three major tributaries in the analysis area: the East Fork SFSR, Johnson Creek, and the Upper SFSR. The SFSR steelhead population is considered "maintained," with a tentative moderate abundance/productivity risk and low distribution and diversity risk (ICTRT 2008). This population is targeted to achieve a proposed status of "viable," which requires a minimum of low abundance/productivity risk.

Critical Habitat

The final rule designating Critical Habitat was implemented in January 2006 (70 Federal Register 52630). Critical Habitat for Snake River Basin steelhead is designated throughout much of the analysis area (**Figure 3.12-7**). Within the areas directly affected by construction and operations, Critical Habitat is designated in the East Fork SFSR drainage to approximately 0.4 km upstream of the confluence with Sugar Creek, including Sugar Creek, and two creeks in the Johnson Creek watershed, Burntlog Creek, and Riordan Creek. Critical habitat for steelhead is not designated upstream of the Yellow Pine pit lake; however, it is assumed that steelhead were found in the headwaters of the East Fork SFSR prior to 1938. The Yellow Pine pit lake cascade barrier precludes steelhead from migrating upstream of the Yellow Pine pit lake, however, NMFS does not consider habitat upstream from the Yellow Pine pit lake to be designated Critical Habitat for steelhead (70 Federal Register 52630).

Physical and Biological Features and Recovery Plan

Physical and biological features are the same as previously described under Chinook Salmon above. The 2017 NMFS Recovery Plan included recovery strategies for Salmon River steelhead.

Temperature Requirements and Baseline

Steelhead have different thermal requirements or limitations for their various life stages. Exceeding thresholds could impact various life-stages and could cause fish to avoid areas or even mortality. The periodicity of each life stage and the accepted stream temperature threshold ranges for various temperature considerations for each species were compiled from regulatory standards and other relevant literature (ESS 2022a), a condensed version of which is provided in **Table 3.12-4**.

Using the QUAL2K predicted MWMT values and stream segment lengths from the SPLNT Model Refined Modified Proposed Action (ModPRO2) report (Brown and Caldwell 2021a), the length of proposed mine site streams within these temperature thresholds was estimated. Similar to Chinook salmon, the QUAL2K stream segments that contain the segments in which there was modeled IP habitat (see Intrinsic Potential under Distribution section below) were evaluated for thermally suitable habitat for life stages that occur in the warmest months. Therefore, the lengths of habitat are not identical, meaning the length of habitat meeting the temperature thresholds may be longer than the length of habitat with IP.

Table 3.12-4 shows that of the entire 2.01 km of potential habitat is within the temperature thresholds for juvenile rearing, 0.89 of which is upstream from the Yellow Pine pit lake cascade barrier. It is important to note that the length of potential habitat for steelhead incubation is based on July MWMTs, however, there are diurnal variations and hyporheic conditions that protect the eggs and alevins reducing mortality rates. Therefore, while summer temperature thresholds may show zero miles of suitable habitat, this may not be a true representation of the conditions in the river.

It is important to note that the creeks do experience significant diurnal variations, and that for mobile life stages (i.e., adults and juveniles), if temperatures are above the thresholds, fish present may avoid areas within streams if they are able, such as finding thermal refuges.

Table 3.12-4 Steelhead Optimal Temperature Thresholds and Modeled Length of Stream within the Water Temperature Thresholds in July and September

Life Stage / Season[1]	Range of Optimal Temperature Thresholds (°C)	Total Stream Length Above YPP/ Below YPP	Stream Length within Optimal Temperature Threshold		
			Above YPP	Below YPP	Total
Adult Migration/ March – May	12-19	0 / 2.01	--	--	--
Adult Spawning/ April – June	4-14	0 / 2.01	--	--	--
Incubation/Emergence/ April – August[2]	6-10	0 / 2.01	0	0	0
Juvenile Rearing/ Year-round[2]	10-17	0 / 2.01	0	2.01	2.01 (100%)[3]

Source: EPA 2003, IDAPA 2022 (IDAPA 58.01.02), Poole et al. 2001
[1] It should be noted that the months in the life stage are not applicable for comparison to the SPLNT model results
[2] Analysis based Summer Maximum (July) 7-Day Average of the Daily Maximum
[3] Percent of stream length within the usable Intrinsic Potential habitat
°C = degrees Celsius; km = kilometer; YPP = Yellow Pine pit

Distribution

Steelhead occur throughout much of the analysis area (**Figure 3.12-7**), but within the areas affected by construction and operation, their distribution in the East Fork SFSR, up to Yellow Pine pit where a steep high gradient riffle/cascade caused by past mining activities is thought to preclude upstream migration. Steelhead can maneuver through higher gradients than Chinook salmon; however, genetic sampling suggest such migration does not occur above the Yellow Pine pit lake.

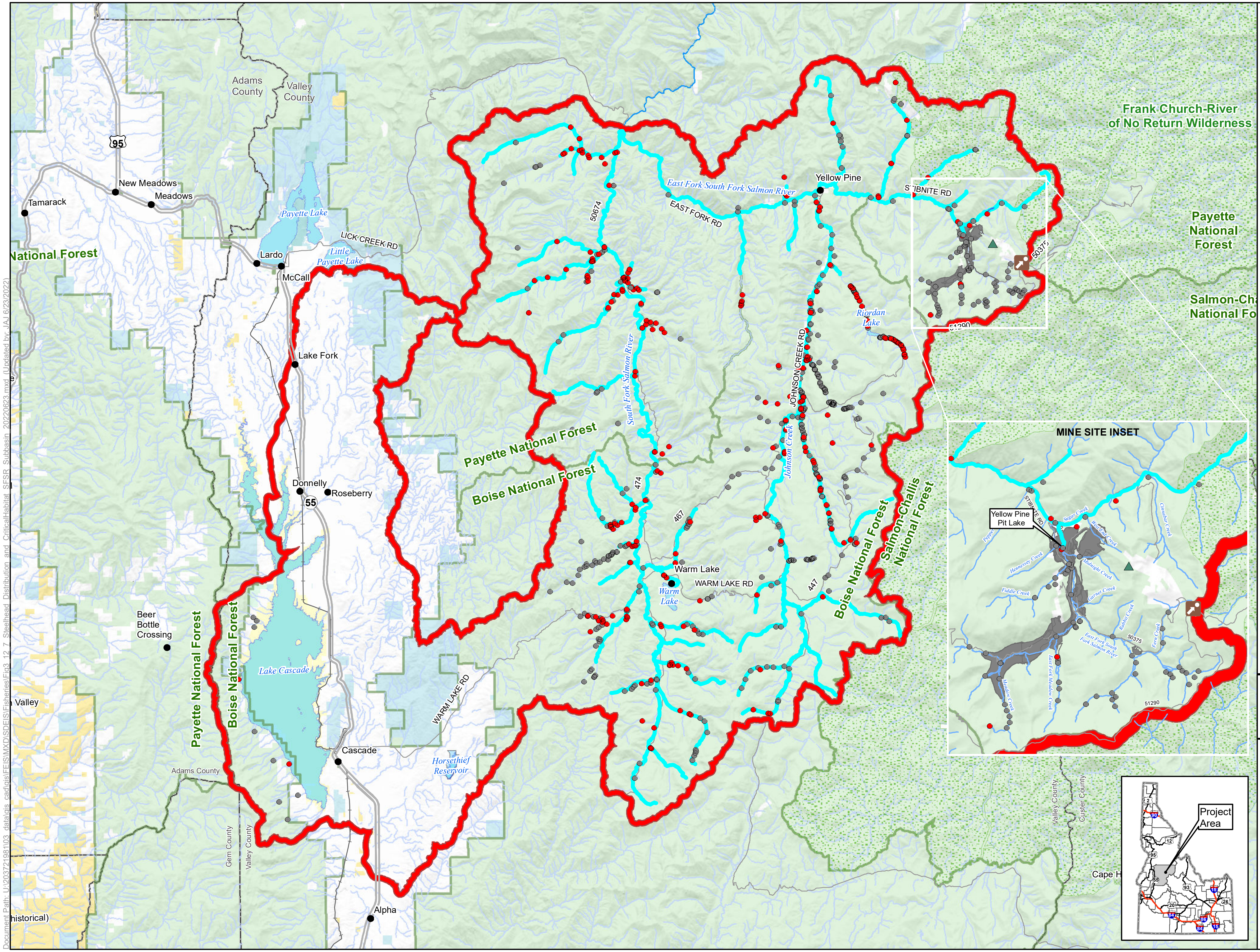


Figure 3.12-7
Steelhead Distribution and Designated Critical Habitat in the South Fork Salmon River Subbasin
Stibnite Gold Project
Stibnite, ID

Base Layer: USGS The National Map: 3D Elevation Program. USGS Earth Resources Observation & Science (EROS) Center: GMTED2010. Data refreshed March, 2021. Other Data Sources: Perpetua; State of Idaho Geospatial

Little is known about steelhead use of the Yellow Pine pit lake, but it is likely the distribution is limited. In 2018 and 2019, only 5 and 9 *O. mykiss* were identified in Yellow Pine pit lake, respectively, and were noted as rainbow trout due to the size and time of year of capture (Brown and Caldwell 2019b, 2020b). Unlike Chinook salmon (via trap and haul) and bull trout, steelhead have not been found upstream of the Yellow Pine pit lake since the initiation of mining (given no documentation prior to mining, it is unknown if they occurred prior to mining activities). However, it is possible some migrating steelhead adults may use Yellow Pine pit lake as a holding area before migrating downstream to more suitable spawning grounds. Similarly, the lake may be used for rearing by some juvenile steelhead that have dispersed upstream from downstream spawning areas (Brown and Caldwell 2019b).

Steelhead occurrence in the analysis area varies by life stage and season. Adult migration occurs between mid-March through May. Spawning occurs from April to mid-June. Incubation/emergence occurs between April and mid-August. Juvenile rearing occurs year-round, with out-migration occurring primarily in June through and September. Life stage periodicity tables are presented in ESS 2022a.

Habitat for steelhead is measured using two different tools – Flow productivity to determine the effect of stream flow changes on steelhead productivity and intrinsic potential modeling to determine the potential for streams to support spawning, incubation, and early-rearing habitat.

Flow Productivity

Similar to Chinook salmon, the effects of streamflow changes on steelhead productivity within the mine site area are based upon a SGP flow-productivity model that was developed using the flow-productivity modeling approach for the Big Creek Water Diversion Project (NMFS 2013). The SGP flow-productivity model uses proxy data from the Lemhi River and assumes that the physical and biological conditions in the Lemhi River are relatable to the mine site streams. However, there are many physical differences between the upper East Fork SFSR and the Lemhi River, including drainage size, flow regime and steelhead populations. Also, the SGP flow-productivity model assumes a fixed number of steelhead spawners each year that occurred in the Lemhi River to occur across all of the mine sites (ESS 2022d). Therefore, these flow-productivity estimates provide a rough approximation of changes in productivity due to flow within the mine site. Additionally, the differences in streamflow regimes, physical habitat characteristics, population sizes, and other differences between the Lemhi River and the mine site streams creates uncertainty that cannot be addressed with the available data.

The flow-productivity analysis predicts changes in productivity based solely on streamflow changes and it does not factor in additional habitat changes that would also occur in the analysis area (e.g., direct loss of habitat, water temperature changes, etc.). The model outputs help to show the relative effects of flow modifications on steelhead productivity at the reach level. Steelhead productivity was assessed in four stream reaches (East Fork SFSR above Meadow Creek, East Fork SFSR at Stibnite, East Fork SFSR above Sugar Creek, and lower Meadow Creek). The lower Meadow Creek site (MC-6) was set up to supplement the system of USGS gages. MC-6 specifically examines conditions in the portion of Meadow Creek that is routed through a constructed channel to divert the stream away from historical mine waste.

The flow-productivity model outputs productivity values that are compared to baseline productivity values to calculate the predicted annual percent change in steelhead productivity from baseline productivity. The baseline steelhead productivity value of 1.24 was derived from productivity data collected on the Lemhi River (NMFS 2013). Again, the interpretation of the predicted annual percent change in productivity is based upon the baseline productivity calculated with the Lemhi River data because data is not available within the mine site. Because the productivity value is greater than 1.0, if Lemhi River were an unimpaired system, there would be slightly more returning adults than the spawning brood year.

Intrinsic Potential

The IP model was applied to classify the potential for spawning and rearing habitat for steelhead in headwaters of the East Fork SFSR subwatershed (**Figure 3.12-6**). This area encompasses the mine site area; which includes the East Fork SFSR and tributaries upstream from Yellow Pine pit, Meadow Creek and EFMC, East Fork SFSR and tributaries between Yellow Pine pit and Sugar Creek, and East Fork SFSR downstream from Sugar Creek. Over 51 km were evaluated for IP for steelhead, and under baseline conditions, modeled IP stream length show approximately 10.7 km of potential spawning through early-rearing habitat for steelhead in the mine site area (**Table 3.12-5**). As shown in **Figure 3.12-8**, high-rated and low-rated steelhead spawning, incubation, and early-rearing habitat potentially occurs throughout the East Fork SFSR and Meadow Creek and the additional section of the East Fork SFSR below the confluence with Sugar Creek.

Table 3.12-5 Steelhead Intrinsic Potential Modeling Results for Existing/Baseline Conditions

Steelhead IP[1]	East Fork SFSR and Tributaries Upstream from YPP[2]		Meadow Creek and EFMC		East Fork SFSR and Tributaries between YPP and Sugar Creek		East Fork SFSR Downstream from Sugar Creek		Total IP Habitat in Mine Site Area (km)
	Length (km)	Percent Total Length	Length (km)	Percent Total Length	Length (km)	Percent Total Length	Length (km)	Percent Total Length	
High	2.16	7.4	2.18	12.9	0.18	4.1	0 .03	2.7	4.55
Medium	0	0	0.60	3.5	0	0	0	0	0.60
Low	2.91	10.0	0.87	5.1	0.72	16.6	1.02	91.9	5.52
Total IP Habitat	5.07	17.5	3.65	21.6	0.90	20.7	1.05	94.6	10.67 (21%)[3]
Total Length of Habitat Evaluated	29.01	-	16.93	-	4.34	-	1.11	-	51.39

[1] Results are presented in the table as the length (km) of stream with usable IP. For steelhead, the IP is rated as high, medium, low, and negligible. "Useable" habitat is defined as all of these classes combined (usable = high + medium + low + negligible).
[2] Does not include the East Fork SFSR tributaries Meadow Creek and EFMC
[3] Total percent of IP habitat within the total length of streams evaluated
East Fork SFSR = East Fork South Fork Salmon River; YPP = Yellow Pine pit lake; EFMC = East Fork Meadow Creek

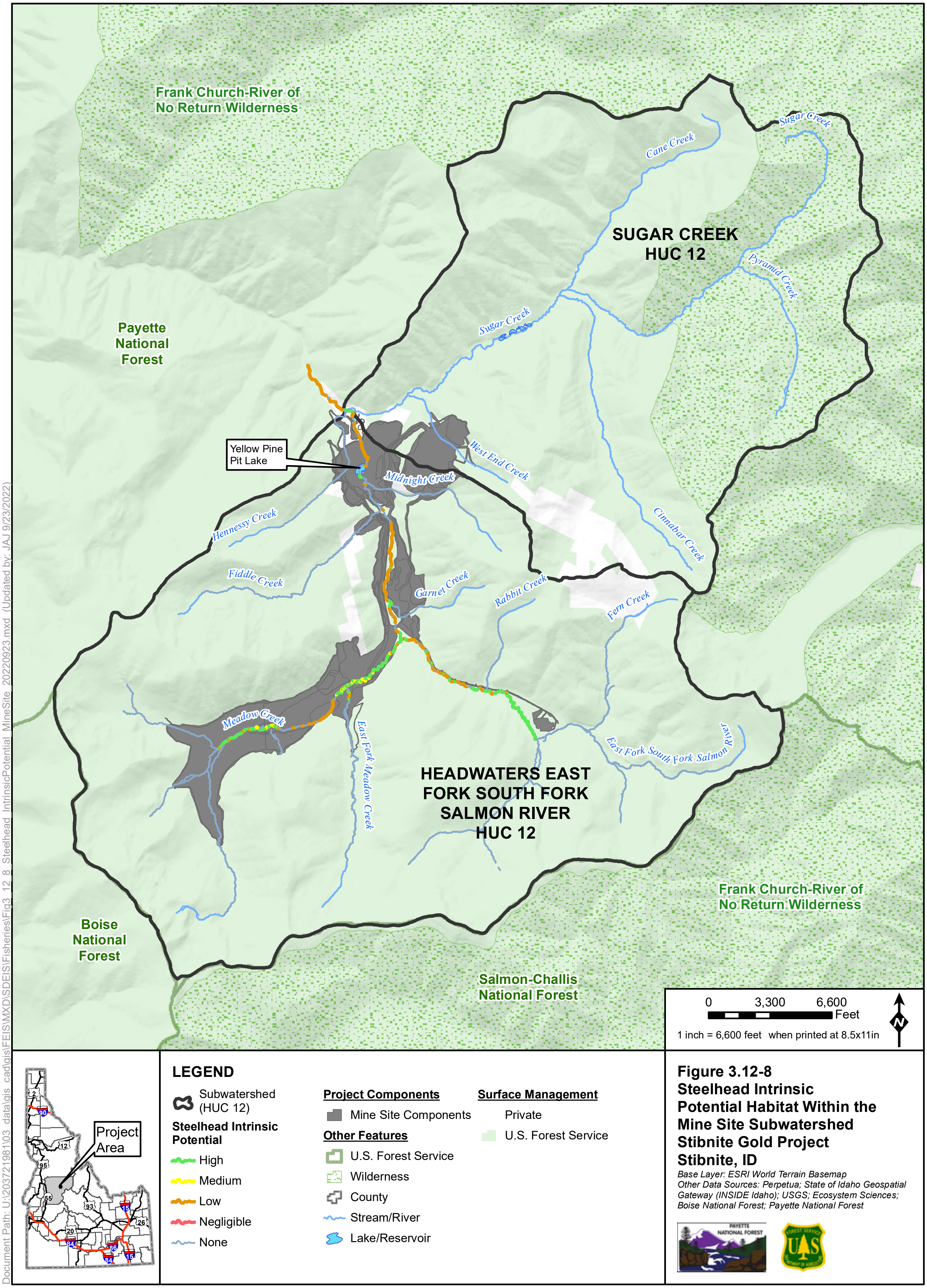


Figure 3.12-8
Steelhead Intrinsic Potential Habitat Within the Mine Site Subwatershed
Stibnite Gold Project
Stibnite, ID

Base Layer: ESRI World Terrain Basemap
Other Data Sources: Perpetua; State of Idaho Geospatial Gateway (INSIDE Idaho); USGS; Ecosystem Sciences; Boise National Forest; Payette National Forest

Bull Trout

Status

The USFWS listed the Columbia River DPS of bull trout as threatened in June 1998 (63 Federal Register 31647). Bull trout are currently known to use spawning and rearing habitat in at least 28 streams within the SFSR subbasin, including Burntlog Creek, Trapper Creek, Riordan Lake, East Fork SFSR, Sugar Creek, Tamarack Creek, and Profile Creek. IDFG trend data indicates that the geographic extent of bull trout is increasing (IDFG 2005b). Potential threats to the population within the SFSR subbasin include connectivity impairment, habitat degradation, and competition from invasive brook trout (USFWS 2015a); however, fish sampling has not documented brook trout in any of the mine site streams, but this species may occur in several streams in the vicinity of the Burntlog Route (Adams et al. 2002).

Critical Habitat

Within the analysis area, the USFWS has designated Critical Habitat for bull trout throughout the South Fork Salmon watershed, including but not limited to in the East Fork SFSR, and in Burntlog, Cane, Cinnabar, Meadow, Tamarack, Trapper, Riordan, and Sugar creeks (75 Federal Register 63898). **Figure 3.12-9** shows the occurrence locations of bull trout and designated Critical Habitat in the analysis area.

Physical and Biological Features and Recovery Plan

Primary constituent elements are physical and biological features that are essential to the conservation of the species. For bull trout these include but are not limited to space for individual and population growth and for normal behavior; food, water, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, or rearing of offspring; and habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species (USFWS 2010).

The most recent 5-year status review for bull trout was published in April 2008 (USFWS 2008); however, a new 5-year review is currently in progress (85 Federal Register 14240; March 11, 2020). The 2008 review concluded that listing the species as “threatened” remained warranted range-wide in the coterminous U.S. Based on this status review, the 2010 recovery report to Congress stated that bull trout were generally “stable” range wide. Since the listing of bull trout, there has been very little change in the general distribution in the coterminous U.S.

The 2015 Recovery Plan for the Coterminous United States Population of Bull Trout (USFWS 2015a) provided recovery unit implementation plans for specific recovery units, including the Upper Snake Recovery Unit, which includes bull trout in the analysis area.

Large areas of intact habitat exist primarily in the Salmon River drainage, which is the only drainage in the Upper Snake Recovery Unit that still flows directly into the Snake River (USFWS 2015a).

Bull trout exhibit three life-history strategies in the analysis area: fluvial (stream and river dwelling, spawning in small tributaries); adfluvial (lake dwelling and river spawning); and non-migratory or resident (found in small streams and headwater tributaries). Historically, the Upper Snake Recovery Unit is believed to have largely supported the fluvial life history form; however, many core areas are now isolated or have become fragmented watersheds, resulting in replacement of the fluvial life history with resident or adfluvial forms. The USFWS identified threats to bull trout persistence as “the combined effects of habitat degradation, fragmentation and alterations associated with dewatering, road construction and maintenance, mining, grazing; the blockage of migratory corridors by dams or other diversion structures; poor water quality; incidental angler harvest; entrainment into diversion channels; and introduced non-native species” (64 Federal Register 58910).

Temperature Requirements and Baseline

Bull trout have different thermal requirements or limitations for their various life stages. Exceeding thresholds could impact various life-stages and could cause fish to avoid areas or even mortality. The periodicity of each life stage and the accepted stream temperature threshold ranges for various temperature considerations for each species were compiled from regulatory standards and other relevant literature (ESS 2022a), a condensed version of which is presented in **Table 3.12-6**.

Using the QUAL2K predicted MWMT values and stream segment lengths from the SPLNT Existing Conditions report (Brown and Caldwell 2018a), the length of proposed mine site streams within these temperature thresholds was estimated (**Table 3.12-6**). The QUAL2K stream segments that contain the segments in which there was modeled habitat with occupancy probability were evaluated for thermally suitable habitat for all life stages. However, it is important to note, an Occupancy Model (OM) developed for bull trout (see below) applied more refined spatial scale (i.e., shorter reaches) than were applied in the SPLNT model. Hence, the stream segments evaluated for temperature could have lengths that extended beyond the ends of the segments evaluated for OM. Therefore, the lengths of habitat are not identical, meaning the length of habitat meeting the temperature thresholds may be longer than the length of habitat per the OM.

The East Fork SFSR from 0.89 km downstream from the confluence with Sugar Creek to around 5 km upstream from the confluence with Meadow Creek, including Fiddle Creek (total of 12.94 km), and around 13.27 km of Meadow Creek and East Fork Meadow Creek were evaluated for the temperature thresholds.

Overall, there are 26.21 km of available habitat, none of it is within optimal thresholds for incubation/emergence, almost half of it is optimal for juvenile rearing, approximately 6 percent is within the thresholds for adult spawning. Currently, bull trout do not occupy the entire 26.21 km, but they do inhabit sections of stream (spawning, incubating, and rearing) in which water temperatures are often outside the optimal thresholds.

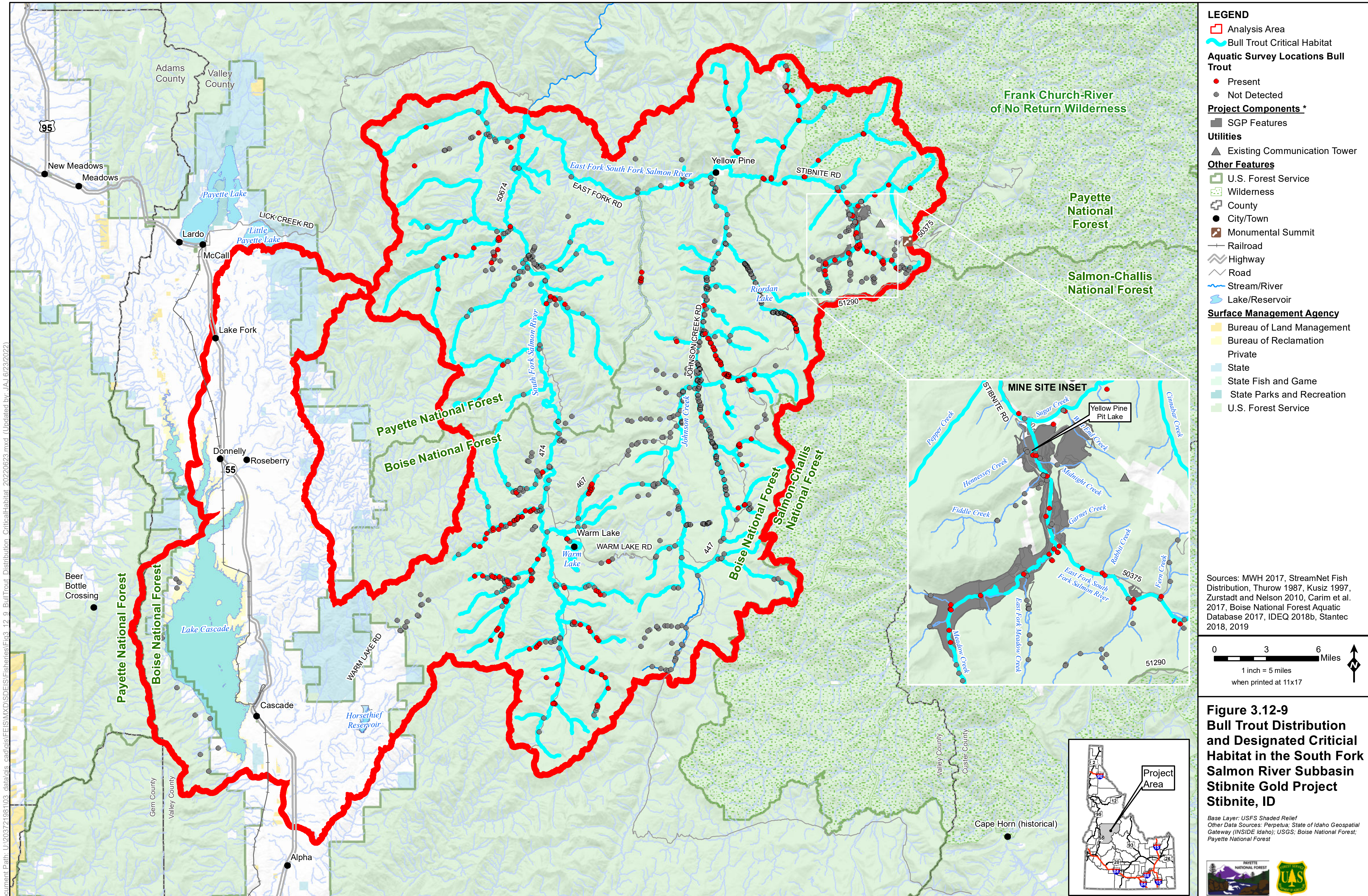


Figure 3.12-9 Bull Trout Distribution and Designated Critical Habitat in the South Fork Salmon River Subbasin Stibnite Gold Project Stibnite, ID

Table 3.12-6 Bull Trout Optimal Temperature Thresholds and Modeled Length of Stream within the Water Temperature Thresholds in July and September

Life Stage / Season	Range of Optimal Water Temperature Thresholds (°C)	Total Stream Length Above YPP / Below YPP	Stream Length Within Optimal Water Temperature Threshold (km)		
			Above YPP	Below YPP	Total
Adult Spawning/ August – September[1]					
FA	4 – 9	24.20 / 2.01	1.62	0	1.62 (6.2%)[2]
FR	9 – 10	24.20 / 2.01	7.76	0	7.76 (29.7%)[2]
FUR	>10	24.20 / 2.01	14.82	2.01	16.83 (64.5%)[2]
Incubation/Emergence/ April – August[1]					
FA	2 – 5	24.20 / 2.01	0	0	0
FR	5 – 6	24.20 / 2.01	0	0	0
FUR	>6	24.20 / 2.01	24.20	2.01	26.21 (100%)[2]
Juvenile Rearing/ Year-round[3]					
FA	4 – 12	24.20 / 2.01	12.16	0	12.16 (46.6%)[2]
FR	12 – 15	24.20 / 2.01	9.60	2.01	11.61 (44.5%)[2]
FUR	>15	24.20 / 2.01	2.43	0	2.43 (9.3%)[2]

Source: EPA 2003, Forest Service 2003a
[1] Analysis based on Fall Maximum 7 Day Average of the Daily Maximum
[2] Percent of stream length is based on the modeled potential habitat.
[3] Analysis based Summer Maximum 7 Day Average of the Daily Maximum
°C = degrees Celsius; > = greater than; % = Percent; km = kilometer; FA = Functioning Appropriately; FR = Functioning at Risk; FUR = Functioning at Unacceptable Risk; km = kilometer; YPP = Yellow Pine pit

It is important to note that the length of potential habitat for bull trout incubation is based on September MWMTs; however, there are diurnal variations and hyporheic conditions that protect the eggs and alevins reducing mortality rates. Additionally, while the length of stream above and below the Yellow Pine pit are not FA and often even FR, there are all life stages of bull trout present, which means successful reproduction is occurring. Therefore, while fall MWMTs may show zero miles of suitable spawning and incubation habitat, this may not be a true representation of the conditions in the river. Additionally, if MWMTs for mobile life stages (i.e., adults and juveniles) are above the thresholds, fish present may avoid areas within streams if they are able, such as finding thermal refuges.

Distribution

Figure 3.12-9 displays the distribution of bull trout in the analysis area. Bull trout are not found outside of the SFSR subbasin within the analysis area (Burns et al. 2005). Bull trout occupy most streams affected by both construction and operations of the SGP (MWH 2017).

A subpopulation of bull trout using an adfluvial life history strategy uses the Yellow Pine pit lake for overwintering, with downstream migration to tributaries for spawning (Hogen and Scarnecchia 2006). Hogen and Scarnecchia (2006) found bull trout overwintered in the large rivers downstream of the East Fork SFSR (SFSR and the Salmon River further downstream), and then migrated upstream to the East Fork SFSR in June and July, and further into small tributaries to spawn in August and September.

Migrants stage at the mouths of presumptive spawning tributaries from mid-July to mid-August, then migrate into tributaries to spawn from mid-August to mid-September. ESS 2019b provides more detail regarding bull trout use of the Yellow Pine pit lake.

Fluvial populations downstream from the Yellow Pine pit lake quickly out-migrate as far as the mainstem Salmon River (Hogen and Scarnecchia 2006) or move up to the Yellow Pine pit lake for overwintering. The Yellow Pine pit cascade barrier blocks upstream passage of fluvial populations. Upstream from the Yellow Pine pit cascade barrier, bull trout use either the fluvial or the resident life-history strategy. The extent of available habitat upstream of the Yellow Pine pit lake is limited by gradient barriers, as well, the access to upstream habitat by fluvial populations downstream from the Yellow Pine pit barrier is blocked.

Habitat for bull trout is measured using two different tools – Occupancy modeling to determine occupancy probability and looking at how changes in stream flow affects the amount of available habitat through the use of PHABSIM modeling.

Occupancy Probability

The OM is a tool used to determine the probability of a fish species occupying a particular stream reach (occupancy probability) and to predict changes in the probability given changes to site physical characteristics (Isaak et al. 2015, 2017). The OM was adapted to the scale of the mine site study area and uses data collected at the mine site. The mine site OM quantifies potential habitat based on physical channel characteristics for each stream reach by assigning probabilities (expressed as a percent from 0 to 100) that each of the species would occur in a given stream reach. The length of a stream reach has either a low, medium-low, medium-high, or high occupancy probability (referred to as "available habitat"), which are based on the quartile in which the occupancy probability falls within the range of results for the model year. That is, the first quartile, or the lowest 25 percent, represents a low occupancy probability, and the fourth quartile, or the highest 25 percent, represents a high occupancy probability. Greater detail regarding occupancy modeling is presented in ESS 2022e.

A distance-weighted average was used to represent the average occupancy probability of each stream segment, in other words, the usability of habitat for bull trout. This was calculated by multiplying the proportion of the OM stream reach length within the stream segment (e.g., East Fork SFSR upstream of Meadow Creek) with the occupancy probability of each OM stream reach within the stream segment.

Occupancy modeling methods originate from studies completed by the Rocky Mountain Research Station, a group of scientists funded by the USDA (Isaak et al. 2015, 2017). The occupancy modeling was based on three site physical characteristic variables: stream discharge (i.e., flow), summer stream temperature, and reach slope (Isaak et al. 2017). As part of the Rocky Mountain Research Station studies, data on stream reach variables for large stream networks in the Rocky Mountains (primarily in Idaho and western Montana) were fit to bull trout and westslope cutthroat trout occurrence datasets (presence/absence data) to create parameter estimates used in a logistic regression model. The resulting parameter estimates of the model can be used to estimate occupancy probabilities for specific areas within any given stream reach where stream flow, summer water temperatures and reach slope are known. For example, an occupancy probability of 10 percent implies that a species will be present in one out of every ten reaches with similar characteristics (temperature, flow, and slope) across the region (Rocky

Mountains) used to fit the model. Understanding the distinction between the scale of the Isaak et al. 2017 model and the scale of the SGP OM model is important for placing the results in context.

A site-specific OM was developed to employ the logistical regression derived from the Rocky Mountain Research Station study to estimate probabilities for both bull trout and westslope (ESS 2022e): East Fork SRSR upstream from the Meadow Creek confluence; Meadow Creek including the EFMC; East Fork SFSR upstream from the Yellow Pine pit lake and the Meadow Creek confluence, and the East Fork SFSR from the Yellow Pine pit lake and the Sugar Creek confluence. The regression model utilizes parameter values for reach slope, stream discharge, and water temperature to quantify changes in occupancy probability. This model differs from other analytical approaches in this section which utilize comparisons of parameter values such as stream temperatures to threshold values. The OM model regression relates changes in occupancy probability to changes in one of the three model variables, for example, resulting in an incremental reduction in occupancy probability with an increase in stream temperature, as opposed to a complete reduction upon exceedance of a threshold value. Therefore, because the OM model applies a regression of multiple parameters to the refined stream reaches above, it may provide different results than examination of individual parameters compared to threshold values.

Lengths of habitat and distance-weighted occupancy probabilities for bull trout for each stream reach are presented in **Table 3.12-7**. In total, the East Fork SFSR subwatershed contains 33.9 km of habitat available for potential occupancy for bull trout, which is about 66.9 percent of the total length of stream modeled (50.6 km). Bull trout have not been observed nor their DNA detected in the upper East Fork Meadow Creek nor in Fiddle Creek (MWH 2017), so may not occur in these two systems. Passage into both the upper East Fork Meadow Creek and Fiddle Creek would not be provided as a result of the project. Therefore, while the model provides occupancy probabilities for these creeks, it does not mean that bull trout do occur, or would occur as a result of the SGP.

A distance-weighted average method was used to represent the average occupancy probability for each stream segment, shown in **Table 3.12-7**. To produce the distance-weighted average, the occupancy probability of each OM reach was multiplied by the proportion of the reach's stream length to the total length of each stream segment that has some likelihood of being occupied by bull trout. Based on the model, the Headwaters East Fork SFSR subwatershed has an estimated distance-weighted average total occupancy probability for bull trout of 7.9 percent for portions of stream reaches with low to high occupancy probabilities. The relatively low occupancy probability numbers for bull trout (less than 20 percent) indicate a higher sensitivity to the model input parameters, particularly water temperature and flow.

Table 3.12-7 Length of Available Habitat and Distance Weighted Average in Percent Occupancy Probability for Bull Trout Under Baseline Conditions

Occupancy Category	EFSFSR Upstream from Meadow Creek		Meadow Creak and EFMC		EFSFSR Between Meadow Creek and YPP Lake		EFSFSR Between YPP Lake and Sugar Creek	
	km	OP	km	OP	km	OP	km	OP
High	1.59	18.1	0	0	2.91	17.6	0.80	16.2
Medium-High	4.82	11.5	3.45	10.42	0.13	13.2	0.37	13.4
Medium-Low	2.52	6.3	3.43	6.72	1. 57	4.4	0	0
Low	4.19	2.3	6.18	2.54	1.93	3.2	0	0
Total	13.12	8.4	13.06	5.72	6.54	10.0	1.17	15.3

EFMC = East Fork Meadow Creek; East Fork SFSR = East Fork South Fork Salmon River; OP = Occupancy Probability; YPP = Yellow Pine pit

Stream Flow (Physical Habitat Simulation [PHABSIM])

Physical Habitat Simulation (PHABSIM) is a modelling technique that predicts the amount of potential fish habitat in a stream or river associated with different volumes of streamflow. First developed by USFWS, the PHABSIM model is widely used as a tool to understand the relationship between streamflow and potential fish habitat. In the late 1980s and early 1990s, the Forest Service conducted a PHABSIM modeling study at several stream locations in the East Fork SFSR watershed as part of the Snake River Basin Adjudication (Maret et al. 2006). The results of this previous study are informative in understanding the potential effects of the SGP on fish habitat. PHABSIM was used for bull trout and cutthroat trout because there was not a similar productivity analysis (ESS 2022f) as was done for Chinook salmon because that is a NMFS-derived method, and therefore has only been completed for ESA species. A summary of the PHABSIM model is provided below. A detailed description of the model and results are provided in ESS 2022f.

The PHABSIM model calculates an index of the amount of microhabitat available for target organisms and life stages at different flow levels, incorporating two major analytical components: stream hydraulics and organism/life stage-specific habitat requirements. These calculations are based on three physical variables: water depth, water velocity, and substrate composition (i.e., streambed particle size). The model uses discrete values of water depth and velocity data collected at a given stream site to simulate the same variables over a broad range of stream flows of interest. Substrate does not change in the model over the range of simulated flows. For each streamflow of interest, the model converts the simulated physical variables into equivalent values of potential fish habitat. This conversion is based on a functional relationship between the three physical variables and fish habitat suitability. Separate conversions were performed in the model for different species (bull trout and cutthroat trout) and life stages of fish. Model output is expressed as Weighted Usable Area (WUA), which represents the square feet of usable habitat per 1,000 feet of stream.

To determine general and relative relationships between streamflow and habitat in the mining reaches, the PHABSIM study compared representative streams that contained similar hydrological and geographical characteristics to the stream characteristics at the proposed mine site. This comparative analysis yielded a general grouping of the PHABSIM study site and proposed mine site streams into three index categories, basically reflecting stream size and discharge: Index 1 (small streams); Index 2 (medium size streams); and Index 3 (large streams). At the proposed mine site, each stream reach (defined below) was assigned an index (**Table 3.12-8**). For example, Meadow Creek and the East Fork SFSR upstream from Meadow Creek are represented by Stream Index 1, both of which are similar to the Summit Creek site of the PHABSIM study.

Table 3.12-8 Representative Streams and Corresponding Indices used in the PHABSIM Analysis to Represent Three Types of Flow Conditions at Comparative Mine Site Stream Reaches

Mine Site Stream Reach	Stream Index Number	Representative Stream in PHABSIM Analysis	Representative Mean Discharge (cfs)	Representative Mid-Point Discharge (cfs)	Representative Lower Discharge (cfs)
Meadow Creek, EFMC, and East Fork SFSR above Meadow Creek	1	Summit Creek	7.8	4.4	1
East Fork SFSR between Sugar Creek and Meadow Creek	2	Sugar Creek	9.9	5.4	1
East Fork SFSR below Sugar Creek	3	East Fork SFSR Downstream from Sugar Creek	63	44	25

cfs = cubic feet per second; East Fork SFSR = East Fork South Fork Salmon River; PHABSIM = Physical Habitat Simulation

PHABSIM model output generates a significant volume of information on the relationship between streamflow and WUA (**Table 3.12-9**). To simplify model output for the purposes of evaluating fish habitat effects of the SGP, two refinements were made to the model results. First, the model output used for the proposed mine site centered on the low-flow period of the year, defined as the months of August through March. Second, the WUA for different life stages of bull trout were evaluated for three key stream flows within the low-flow period: the mean discharge rate, a lower rate close to the minimum discharge rate value for the period, and a mid-point rate between the mean and minimum values (**Table 3.12-9**).

The quantification of potential SGP impacts on bull trout and cutthroat trout habitat, as defined by WUA, is dependent on several factors. One important factor is the predicted change in baseline flows that would occur in the various mine site stream reaches. Unique changes would occur in each reach throughout the life of the SGP. Another factor is the non-linear relationship between flow and WUA for each fish life stage. The PHABSIM model predicts separate habitat values for all species and all life stages of interest for several stream flow rates, which when viewed graphically, represent a non-linear relationship. Lastly, the PHABSIM model results are based upon WUA data collected from index streams that do not exactly represent the physical and biological conditions of the mine site stream reaches.

Table 3.12-9 Bull Trout Weighted Usable Area for Three Discharge Rates for Representative Streams

Representative Stream	Discharge		Weighted Usable Area[1]							
	cfs	Percent Change	Adult	Percent Change	Spawning	Percent Change	Fry	Percent Change	Juvenile	Percent Change
Summit Creek (Index 1)	7.8[2]	--	2,505	--	0	N/A	ND	N/A	5,940	--
	4.4	-44	1,451	-42	0	N/A	ND	N/A	3,524	-41
	1.0	-87	261	-90	0	N/A	ND	N/A	635	-89
Sugar Creek (Index 2)	9.9[2]	--	1,176	--	2,127	--	ND	N/A	2,709	--
	5.4	-46	746	-37	1,443	-32	ND	N/A	1,811	-33
	1.0	-90	144	-88	66	-97	ND	N/A	351	-87
East Fork SFSR Downstream of Sugar Creek (Index 3)	63[2]	--	2,184	--	0	N/A	ND	N/A	4,900	--
	44	-30	1,846	-15	0	N/A	ND	N/A	4,340	-11
	25	-60	1,108	-49	0	N/A	ND	N/A	2,690	-45

[1] Weighted Usable Area is defined as the sum of stream surface area within a study site, weighted by multiplying area by habitat suitability variables (most often velocity, depth, and substrate or cover), which range from 0.0 to 1.0 each, and normalized to square units (either feet or meters) per 1000 linear units.
[2] This value is the mean low-flow-period discharge rate.
ND: No data were available from the PHABSIM study; N/A: not applicable.

Westslope Cutthroat Trout

Status

Due to declines in distribution and abundance, westslope cutthroat trout (cutthroat trout) is designated by the Forest Service as a sensitive species. There was a petition to list westslope cutthroat trout as a threatened species under ESA (63 Federal Register 31691); however, the USFWS determined that such a listing was not warranted (65 Federal Register 20120 April 2000).

Temperature Requirements and Baseline

Cutthroat trout have different thermal requirements/limitations for their various life stages. The periodicity of each life stage and the accepted stream temperature thresholds/ranges for various temperature considerations for each species were compiled from regulatory standards and other relevant literature (ESS 2022a).

Overall, there is minimal habitat suitable for incubation/emergence, but a significant portion of the usable habitat is within the temperature thresholds for juvenile rearing (**Table 3.12-10**). It is important to note that the length of potential habitat for westslope cutthroat trout incubation is based on September MWMTs; however, there are diurnal variations and hyporheic conditions that protect the eggs and alevins reducing mortality rates. Additionally, while the length of stream above and below the Yellow Pine pit do not always meet the thermal requirements, there are all life stages of cutthroat trout present, which means successful reproduction is occurring. Therefore, while fall MWMTs may show less than one mile of suitable incubation habitat, this may not be a true representation of the conditions in the river. Additionally, if MWMTs for mobile life stages (i.e., adults and juveniles) are above the thresholds, fish may avoid areas within streams if they are able, such as finding thermal refuges.

Table 3.12-10 Westslope Cutthroat Trout Optimal Temperature Threshold Ranges and Modeled Length of Stream within the Water Temperature Thresholds in July and September

Life Stage / Season	Range of Water Temperature Thresholds (°C)	Total Stream Length Above YPP / Below YPP	Stream Length Within Water Temperature Threshold (km)		
			Above YPP	Below YPP	Total
Adult Migration/ March – June	15 – 19	24.10 / 2.01	--	--	--
Adult Spawning/ April – mid-July	4 – 14	24.10 / 2.01	--	--	--
Incubation/Emergence/ April – August[1]	6 – 10	24.10 / 2.01	0.85	0	0
Juvenile Rearing/ Year-round[1]	10 – 20	24.10 / 2.01	23.34	2.01	25.36 (87.8%)[2]

Source: EPA 2003.
[1] Analysis based on Summer Maximum (July) 7-day average of the daily maximum
[2] Percent of stream length within modeled potential habitat.
°C = degrees Celsius; % = Percent; km = kilometer; YPP = Yellow Pine pit

Distribution

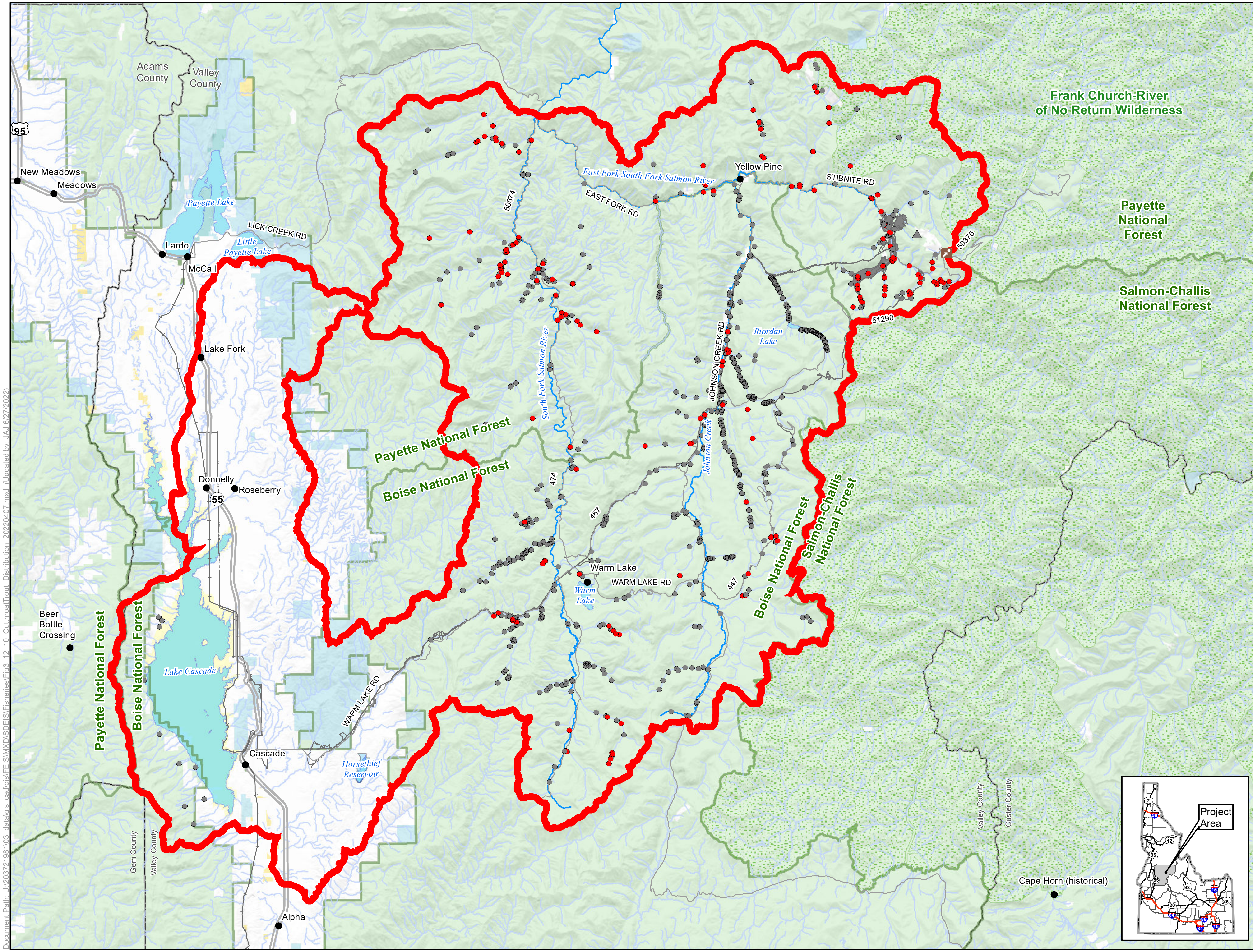
Cutthroat trout are not found outside of the SFSR subbasin within the analysis area. They are found both upstream and downstream from the Yellow Pine pit lake. The distribution of westslope cutthroat trout in the analysis area is shown in **Figure 3.12-10**.

Cutthroat trout spatial and temporal occurrence in the analysis area varies by life stage, (e.g., juveniles using nursery and rearing habitat or spawning adults). Adult migration occurs between mid-March and July with the peak from mid-April to mid-June. Spawning occurs from late April to July when water temperatures are near 10°C. Peak spawning is between early May and early July. Incubation/emergence occurs between mid-April and September. Juvenile rearing occurs year-round. Emigration occurs between April and December. Life stage periodicity tables are presented in ESS 2022a.

Cutthroat trout begin to mature at age three, but usually spawn first at age four or five. Cutthroat trout may be resident (non-migratory carry out all life processes in tributaries), fluvial (migratory: reside in rivers and streams and migrate to tributaries to spawn), or adfluvial (lake-dwelling and migrate to tributaries to spawn).

Recent fish sampling was performed in the Yellow Pine pit lake to provide information on relative abundance and movement of cutthroat trout (Brown and Caldwell 2019b, 2020b). A total of 32 cutthroat trout were captured over three sampling events in May, July, and September 2018, leading to only one population estimate of 50 individuals. The movement study results showed the majority of the 32 tagged cutthroat trout remained in the Yellow Pine pit lake; only four moved downstream and were not detected returning upstream. The 2019 study resulted in population estimates ranging from 33 to 101 individuals. The size structure of westslope cutthroat trout was skewed towards larger fish. Fish less than 150- to 200-millimeter fork length were not found.

Habitat for Westslope cutthroat trout is measured using two different tools – Occupancy modeling to determine occupancy probability and looking at how changes in stream flow affects the amount of available habitat through the use of PHABSIM modeling.



LEGEND

Analysis Area

Aquatic Survey Locations
Cutthroat Trout

- Present
- Not Detected

Project Components *

- SGP Features

Utilities

- Existing Communication Tower

Other Features

- U.S. Forest Service
- Wilderness
- County
- City/Town
- Monumental Summit
- Railroad
- Highway
- Road
- Stream/River
- Lake/Reservoir

Surface Management Agency

- Bureau of Land Management
- Bureau of Reclamation
- Private
- State
- State Fish and Game
- State Parks and Recreation
- U.S. Forest Service

0 2.5 5 Miles

1 inch = 4.88 miles when printed at 11x17

Figure 3.12-10
Westslope Cutthroat Trout Distribution in the South Fork Salmon River Subbasin
Stibnite Gold Project
Stibnite, ID

Base Layer: USGS Shaded Relief
Other Data Sources: Perpetua; State of Idaho Geospatial Gateway (INSIDE Idaho); USGS; Boise National Forest; Payette National Forest

Occupancy Probability

OM was performed for westslope cutthroat trout using the same approach as bull trout. In total, the Headwaters East Fork SFSR subwatershed contains nearly 34 km of stream channel that is potential usable habitat for western cutthroat trout (**Table 3.12-11**), based on OM results, which is approximately 67 percent of the total length of streams in the subwatershed (50.6 km). The Headwaters East Fork SFSR subwatershed has a distance-weighted average occupancy probability of 64.3 percent for portions of stream reaches with low to high occupancy probabilities and each reach within the subwatershed are presented in **Table 3.12-11**. The relatively high occupancy probability numbers for cutthroat trout (mostly greater than 60 percent) indicate a higher tolerance to the model input parameters, particularly water temperature and flow.

Descriptive statistics for lengths of available habitat and occupancy probabilities by stream reach are presented in detail in ESS 2022g.

Table 3.12-11 Average Length of Available Habitat and Distance Weighted Average in Percent Occupancy Probability for Westslope Cutthroat Trout Under Baseline Conditions

Occupancy Category	EFSFSR Upstream of Meadow Creek		Meadow Creak and EFMC		EFSFSR Between Meadow Creek and YPP Lake		EFSFSR Between YPP Lake and Sugar Creek	
	km	%OP	km	%OP	km	%OP	km	%OP
High	1.59	69.5	2.21	68.8	2.54	69.7	0.64	68.8
Medium-High	3.95	67.1	3.04	67.2	0.46	67.6	0.53	67.0
Medium-Low	3.78	64.3	3.68	64.1	0.64	63.0	0	0
Low	3.79	59.1	4.13	58.6	2.98	59.7	0	0
Total	13.12	64.3	13.06	63.9	6.54	64.2	1.17	68.0

EFMC = East Fork Meadow Creek; East Fork SFSR = East Fork South Fork Salmon River; YPP = Yellow Pine pit

Stream Flows (PHABSIM)

The same PHABSIM approach previously described for bull trout was used for westslope cutthroat trout. For each of the three discharge rates and Stream Index, **Table 3.12-12** provides the WUA value for four westslope cutthroat trout life stages, along with a percentage reduction in WUA relative to the mean discharge rate WUA value.

Table 3.12-12 Westslope Cutthroat Trout Weighted Usable Area for Three Discharge Rates for Representative Streams

Representative Stream	Discharge		Weighted Usable Area[1]							
	cfs	Percent Change	Adult	Percent Change	Spawning	Percent Change	Fry	Percent Change	Juvenile	Percent Change
Summit Creek (Index 1)	7.8[2]	--	2,007	--	14,320	--	9,084	--	0	N/A
	4.4	-44	891	-56	13,111	-8	5,989	-34	0	N/A
	1	-87	8	-99	7,117	-50	1,589	-83	0	N/A
Sugar Creek (Index 2)	9.9[2]	--	1,687	--	7,338	--	5,849	--	2,958	--
	5.4	-46	794	-53	6,896	-6	4,256	-27	2,139	-28
	1	-90	20	-99	3,997	-46	1,270	-78	428	-86
East Fork SFSR Downstream of Sugar Creek (Index 3)	63[2]	--	9,788	--	13,345	--	16,220	--	0	N/A
	44	-30	6,640	-32	14,644	10	15,254	-6	0	N/A
	25	-60	3,196	-67	15,272	14	12,393	-24	0	N/A

[1] Weighted Usable Area is defined as the sum of stream surface area within a study site, weighted by multiplying area by habitat suitability variables (most often velocity, depth, and substrate or cover), which range from 0.0 to 1.0 each, and normalized to square units (either feet or meters) per 1000 linear units.
[2] These values are the mean low-flow-period discharge rate.
ND: No data were available from the PHABSIM study; N/A: not applicable

3.12.4.2 Fish Density

Fish density refers to the number of individuals per unit area (e.g., square meters) or volume (e.g., cubic meters). In this document, the term "linear density" is also discussed. Linear density as used here is the number of fish per linear length of stream, typically per meter. Because the wetted area of streams varies with flow, it is useful to have a metric that is non-flow dependent, (i.e., stream length).

Stream Estimates

Fish abundance data collected during snorkel surveys in the mine site area in 2015 were used in conjunction with fish mark-recapture survey data collected at the same sites at the same time to develop fish relative abundance and density estimates. The objective of comparing snorkeling abundance data to mark-recapture data was to develop a metric that could be applied to the large number of snorkeling sites evaluated from 2012 to 2015. The details of how fish densities were derived are included in AECOM 2020g.

Several approaches to estimating salmonid densities were applied to the mine site subwatersheds and these approaches are described in detail in MWH 2017 and GeoEngineers 2017. In summary, it was determined that fish densities based on the mark-recapture method represent fair to good estimates of the fish density for most stream reaches evaluated (GeoEngineers 2017). Note that this analysis determines fish densities that can be used to estimate the salmonid abundance at a specific stream reach at the time of sampling.

The results adjusting the salmonid species areal and linear densities at snorkel survey sites within and adjacent to the mine site subwatersheds from 2012 to 2015 are summarized in **Table 3.12-13**.

Table 3.12-13 Adjusted Salmonid Species Areal and Linear Densities at Snorkel Survey Sites Within and Adjacent to the Proposed Mine Site Subwatersheds from 2012 to 2015

Site ID (Down-stream to Upstream)	Stream	Location	Year(s) Sampled	Mean Site Length (m) / Width (m)	Mean Fish Density – fish/m^2 (Mean Fish Linear Density – fish/m)			
					Chinook Salmon	Steelhead/ Rainbow Trout	Bull Trout	Westslope Cutthroat Trout
East Fork South Fork Salmon River Downstream from Sugar Creek and Tributaries, Sugar Creek, and Sugar Creek Tributaries								
MWH-033	East Fork SFSR	Upstream of Johnson Creek	2013	100/14.1	0.121 (1.701)	0.084 (1.174)	0.011 (0.148)	0.036 (0.500)
MWH-032	East Fork SFSR	Downstream of Tamarack Creek	2013, 2014	100/15.9	0.045 (0.675)	0.038 (0.574)	0.011 (0.162)	0.017 (0.250)
MWH-017	Tamarack Creek (control site)	Confluence with East Fork SFSR	2012-2014	97/5.7	0.017 (0.097)	0.034 (0.195)	0.006 (0.032)	0.038 (0.218)
MWH-009	East Fork SFSR	Downstream of Sugar Creek	2012, 2014	95.5/8.4	0.059 (0.495)	0.050 (0.417)	0.022 (0.184)	0.014 (0.120)
MWH-029	Sugar Creek	Lower Reach	2012-2014	97/5.5	0.021 (0.116)	0.019 (0.107)	0.029 (0.162)	0.024 (0.134)
MWH-010	Sugar Creek	Middle Reach	2012-2014	97/5.5	0.023 (0.125)	0.024 (0.130)	0.048 (0.260)	0.022 (0.121)
MWH-018	Sugar Creek	Upper Reach	2012-2015	95.2/5.1	0.003 (0.018)	0.011 (0.057)	0.046 (0.234)	0.005 (0.025)
MWH-020	Sugar Creek	Upstream of Cinnabar Creek	2012-2013	95.5/3.6	0.002 (0.007)	0.006 (0.021)	0.080 (0.283)	NP
MWH-019	Cinnabar Creek	Lower Reach	2012-2015	93/2.8	NP	NP	0.095 (0.236)	0.006 (0.014)
MWH-021	Cane Creek	Lower Reach	2012-2013	55.5/3.0	NP	NP	0.107 (0.316)	NP

Site ID (Down-stream to Upstream)	Stream	Location	Year(s) Sampled	Mean Site Length (m) / Width (m)	Mean Fish Density – fish/m² (Mean Fish Linear Density – fish/m)			
					Chinook Salmon	Steelhead/ Rainbow Trout	Bull Trout	Westslope Cutthroat Trout
East Fork South Fork Salmon River Between Sugar Creek and the Yellow Pine pit								
MWH-030	East Fork SFSR	Upstream of Sugar Creek	2012-2014	97/6.4	0.088 (0.561)	0.062 (0.394)	0.015 (0.093)	0.020 (0.125)
East Fork South Fork Salmon River Between the Yellow Pine pit and Meadow Creek and Tributaries								
MWH-022	East Fork SFSR	Upstream of Midnight Creek	2012-2014	80.3/7.8	0.606 (4.707)	NP	NP	0.009 (0.073)
MWH-023	Fiddle Creek	Lower Reach	2012-2014	97/2.0	NP	NP	NP	0.089 (0.181)
MWH-024	Fiddle Creek	Middle Reach	2012	22/2.0	NP	NP	NP	0.215 (0.430)
MWH-011	East Fork SFSR	Near Mining Camp	2012-2015	97.8/5.3	0.397[1] (2.113)	NP	NP	0.027 (0.142)
East Fork South Fork Salmon River Upstream from Meadow Creek								
MWH-013	East Fork SFSR	Near Confluence Meadow Creek	2012-2014	95.7/4.3	0.014 (0.061)	NP	NP	0.061 (0.263)
MWH-025	East Fork SFSR	Middle Reach	2012-2013, 2015	97/4.4	0.020 (0.088)	NP	NP	0.094 (0.418)
MWH-044	East Fork SFSR	Near Worker Housing	2013	100/3.0	NP	NP	NP	0.202 (0.608)
MWH-026	East Fork SFSR	Near Worker Housing	2012-2015	97.8/3.3	NP	NP	NP	0.044 (0.145)
Meadow Creek								
MWH-031	Meadow Creek	Near East Fork SFSR Confluence	2012	91/4.0	1.852[1] (7.407)	NP	0.004 (0.015)	0.067 (0.267)

Site ID (Down-stream to Upstream)	Stream	Location	Year(s) Sampled	Mean Site Length (m) / Width (m)	Mean Fish Density – fish/m² (Mean Fish Linear Density – fish/m)			
					Chinook Salmon	Steelhead/ Rainbow Trout	Bull Trout	Westslope Cutthroat Trout
MWH-014	Meadow Creek	Stibnite Mine Site	2013-2015	100/5.1	0.783[1] (4.020)	NP	NP	0.018 (0.090)
MWH-015	Meadow Creek	Downstream of TSF Buttress	2012-2014	97/4.8	0.005 (0.023)	NP	0.006 (0.028)	0.035 (0.167)
MWH-047	Meadow Creek	TSF Buttress	2013-2015	100/4.3	0.017 (0.072)	NP	0.002 (0.009)	0.044 (0.189)
MWH-016	Meadow Creek	Along the TSF	2012, 2014-2015	97/3.9	NP	NP	0.005 (0.018)	0.168 (0.654)
MWH-034	Meadow Creek	Upper Reach	2013, 2015	100/3.2	NP	NP	0.004 (0.013)	0.075 (0.236)
East Fork Meadow Creek								
MWH-028	EFMC	Near Confluence	2012-2014	97/2.4	2.573[1] (6.175)	NP	NP	0.041 (0.097)
MWH-027	EFMC	In Meadow	2012-2014	97/1.6	NP	NP	NP	0.027 (0.044)

Source: MWH 2017

[1] Chinook salmon densities at these locations are higher than would naturally occur, as they were from translocated adults that spawned in a small, localized area.

Site IDs consisted of reaches ranging in length from 22 to 100 meters in length with most reaches set at 100 meters.

Daytime surveys only - all fish size classes combined

EFMC = East Fork Meadow Creek; East Fork SFSR = East Fork South Fork Salmon River; NP – not present

Yellow Pine Pit Lake Estimate

Mark-recapture studies were undertaken at the Yellow Pine pit lake in 2018 and 2019 to evaluate movements of salmonids and to estimate population abundances (Brown and Caldwell 2019b, 2020b). **Table 3.12-14** summarizes the abundance estimate results. Detailed discussions are included in Brown and Caldwell (2019b, 2020b). No estimates were made for steelhead/rainbow trout due to the low numbers captured (i.e., five in 2018 and nine in 2019). In addition to bull trout, cutthroat trout, Chinook salmon and steelhead/rainbow trout, mountain whitefish were captured, but no abundance estimates were made.

The results indicate limited abundance of these salmonids in the Yellow Pine pit lake. Brown and Caldwell (2019b) notes that several hundred whitefish also were captured suggesting the lake can support a large number of fish given suitable habitat.

Table 3.12-14 Salmonid Population Abundance Estimates for the Yellow Pine Pit Lake in 2018 and 2019

Species	Abundance Estimate by Month and Year					
	May 2018	July 2018	September 2018	July 2019	August 2019	September 2019
Bull Trout	57	104	82	104	45	47
Westslope Cutthroat Trout	48	48	33	67	80	101
Chinook Salmon	No Tagged Juvenile Fish Returned					

Source: Brown and Caldwell 2019b and 2020a
Four rainbow trout were tagged but the sample size was too small for an abundance estimate.

3.12.4.3 Watershed Condition Indicators

This section summarizes the existing data describing the baseline aquatic habitat conditions that may be affected by the SGP within the analysis area. It includes brief descriptions of the streams that may be affected by the SGP both outside and within the mine site. The WCIs are used as a metric to compare baseline conditions to estimated changes that might be caused by projects or other events. Over the past 20 years, various fish and aquatic habitat studies have been conducted in the SFSR subbasin which have provided a better understanding of aquatic resource baseline conditions within the analysis area. Studies have been conducted by federal, state, local, and tribal agencies (e.g., PNF, BNF, IDFG, and the Nez Perce Tribe), as well as private entities (e.g., Perpetua).

Table 3.12-15 and **Table 3.12-16** summarize the WCI data currently available along with fish species occurrence information for each watershed and subwatershed (**Figure 3.12-1**). Only one subwatershed (Upper Big Creek) in the Cascade Reservoir Watershed had any WCI data available for the local fish community. More WCI data are available for most of the subwatersheds in the Upper SFSR, Johnson Creek, Lower East Fork SFSR, and Upper East Fork SFSR watersheds.

The Southwest Idaho Ecogroup Matrix of Pathways and WCIs ("The Matrix") (Forest Service 2003a, 2010a) have been applied to describe and evaluate the baseline environment for fish and aquatic resources in the analysis area. The WCI matrix was developed specifically for application in the PNF and BNF (Forest Service 2003a, 2010a) to assist in project design and analysis during NEPA assessments of proposed projects. The WCI matrix evaluates watershed ecological functions by measuring elements that reflect water quality, habitat access, channel conditions and dynamics, flow and hydrology, and other watershed conditions. Furthermore, the WCI matrix comprises a series of "pathways" by which mining, reclamation, or restoration activities can have potential effects on native and desired non-native fish species, their habitats, and associated ecological functions. This ecological functionality is broken down into three separate categories: "functioning appropriate," "functioning at risk," and "functioning at unacceptable risk." Where possible, quantitative values are applied to determine the functionality. The same description of the pathways and WCIs can be found in Table B-1, Appendix B of each Forest Plan (Forest Service 2003a, 2010a).

North Fork Payette River Subbasin Baseline

The Cascade Reservoir Watershed is the only HUC 5th Field watershed in this subbasin (**Figure 3.12-1**; **Table 3.12-15**). Eight subwatersheds occur in this watershed that could be impacted by the SGP. Only one subwatershed, Upper Big Creek, has had a WCI analysis completed. Many of the other subwatersheds are on private land and do not have WCIs completed.

South Fork Salmon River Subbasin Baseline

Baseline WCI information for the SFSR subbasin for those watersheds and subwatersheds that may be directly impacted by SGP activities is summarized in **Table 3.12-16.**

Table 3.12-15 Baseline Watershed Condition Indicators for Potentially Impacted Subwatersheds in the Analysis Area for the Cascade Reservoir and Upper South Fork Salmon River Watersheds

Watershed Condition Indicator	Cascade Reservoir Watershed (HUC 5th Field)								Upper SFSR Watershed (HUC 5th Field)		
	Subwatersheds (HUC 6th Field)										
	Lake Fork	Boulder Creek	Lower Gold Fork River	Duck Creek	Beaver Creek	Pearsol Creek	Lower Big Creek	Upper Big Creek	Curtis Creek	Six-bit Creek	Warm Lake Creek
Bull Trout Local Population Characteristics within Core Area											
Local Population Size	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	FR	No Data	FR
Growth and Survival	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	FR	No Data	FR
Life History Diversity and Isolation	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	FR	No Data	FR
Persistence and Genetic Integrity	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	FR	No Data	FR
Water Quality											
Temperature – Steelhead, Chinook salmon	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	FR	Steelhead Present No Data	FUR
Temperature – Bull trout	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	FR	No Data	FUR
Temperature – Other fish species	WSC Not Present	WSC Not Present	WSC Not Present	WSC Not Present	WSC Not Present	WSC Not Present	WSC Not Present	WSC Not Present FA for other species	WSC Present No Data	WSC Present No Data	WSC Present No Data
Sediment/Turbidity – Steelhead, Chinook salmon	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	FR	No Data	FR
Sediment/Turbidity – Bull trout	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	FR	No Data	FR
Sediment/Turbidity – Other fish species, i.e., westslope cutthroat trout	WSC Not Present	WSC Not Present	WSC Not Present	WSC Not Present	WSC Not Present	WSC Not Present	WSC Not Present	WSC Not Present FUR for other species	No Data	No Data	No Data
Chemical Contamination / Nutrients	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FR	FR	No Data	FR
Habitat Access											
Physical Barriers	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FUR	FA	No Data	FR
Habitat Elements											
Substrate Embeddedness (Bull trout rearing areas)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	FR	No Data	FUR
Large Woody Debris	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FA	FA	No Data	FA
Pool Frequency and Quality	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FR	FA	No Data	FR
Large Pools/Pool Quality (all fish species in adult holding, juvenile rearing, and over wintering reaches)	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FUR	FA	No Data	FR
Off-Channel Habitat	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FA	FA	No Data	FR
Refugia (Steelhead, Chinook salmon)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	FR	No Data	FR

Watershed Condition Indicator	Cascade Reservoir Watershed (HUC 5th Field)								Upper SFSR Watershed (HUC 5th Field)		
	Subwatersheds (HUC 6th Field)										
	Lake Fork	Boulder Creek	Lower Gold Fork River	Duck Creek	Beaver Creek	Pearsol Creek	Lower Big Creek	Upper Big Creek	Curtis Creek	Six-bit Creek	Warm Lake Creek
Channel Conditions and Dynamics											
Average Wetted Width/Maximum Depth Ratio	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FR	FA	No Data	FR
Streambank Condition	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FA	FA	No Data	FR
Floodplain Connectivity	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FR	FUR	No Data	FUR
Flow/Hydrology											
Change in Peak/Base Flows	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FA	FA	No Data	FUR
Change in Drainage Network	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FUR	FUR	No Data	FUR
Watershed Conditions											
Road Density/Location	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FUR	FUR	No Data	FR
Disturbance History	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FR	FUR	No Data	FUR
Riparian Conservation Areas	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FR	FR	No Data	FUR
Disturbance Regime	No Data	No Data	No Data	No Data	No Data	No Data	No Data	FR	FR	No Data	FR
Integration of Pathways											
Integration of Pathways (Steelhead, Chinook salmon)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	FUR	FR	No Data	FUR
Integration of Pathways (Bull trout)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	FUR	FR	No Data	FUR
Integration of Pathways (Other fish species, i.e., westslope cutthroat trout)	No Data	No Data	No Data	No Data	No Data	No Data	No Data	WSC not Present FUR for other species	FR	No Data	FUR

Source: Forest Service 2003a; Forest Service 2012a; Foust and Nalder 2010; Rio ASE 2019; StreamNet 2020
Subwatersheds are at the HUC 6th Field.
FA = Functioning Appropriately; FR = Functioning at Risk; FUR = Functioning at Unacceptable Risk; N/A = Not Applicable; WSC = westslope cutthroat trout

Table 3.12-16 Baseline Watershed Condition Indicators for Potentially Impacted HUC 6th Field Subwatersheds in the Analysis Area

Watershed Condition Indicator	Johnson Creek Watershed (HUC 5th Field)									East Fork SFSR Watershed (HUC 5th Field)	Upper East Fork SFSR Watershed (HUC 5th Field) Outside of the Mine Site			Upper East Fork SFSR Watershed (HUC 5th Field) Within the Mine Site		
	Lunch Creek	Headwaters Johnson Creek	Sheep Creek	Burnt Log Creek	Dutch/Ditch Creek	Trapper Creek	Upper Indian Creek	Riordan Creek	Porcupine Creek	Lower East Fork SFSR	Quartz Creek	Profile Creek	Tamarack Creek	No Mans Creek	Sugar Creek	Headwaters East Fork SFSR
Bull Trout Local Population Characteristics within Core Area																
Local Population Size	FUR	FUR	FUR	FA	Bull Trout Present No Data	FA	Bull Trout Present No Data	FR	FR	FR	Bull Trout Present No Data	Bull Trout Present No Data	Bull Trout Present No Data	Bull Trout Present No Data	FR	FR
Growth and Survival	FR	FR	FR	FR	No Data	FR	No Data	FR	FR	FR	No Data	No Data	No Data	No Data	FR	FR
Life History Diversity and Isolation	FR	FR	FR	FR	No Data	FR	No Data	FR	FR	FR	No Data	No Data	No Data	No Data	FR	FR
Persistence and Genetic Integrity	FR	FR	FR	FR	No Data	FR	No Data	FR	FR	FR	No Data	No Data	No Data	No Data	FR	FR
Water Quality																
Temperature (Steelhead, Chinook salmon)	FUR	FUR	FUR	FR	Steelhead Present No Data	FA	Steelhead and Chinook Present No Data	FUR	Species Not Present	FR	Steelhead Present No Data	Chinook Present No Data	FR	Species Not Present	FR	FR
Temperature (Bull trout)	FUR	FUR	FUR	FR	No Data	FA	No Data	FUR	FUR	FR	No Data	FR	FR	No Data	FR	FR
Temperature (Other fish species, i.e., westslope cutthroat trout)	No WSC No Data for other species	WSC Present No Data	No WSC No Data for other species	WSC Present No Data	WSC Present No Data	WSC Present No Data	WSC Present No Data	WSC Present No Data	WSC Present No Data	WSC Present No Data	WSC Present No Data	WSC Present No Data	WSC Present No Data	WSC Present No Data	WSC Present No Data	WSC Present No Data
Sediment/Turbidity (Steelhead, Chinook salmon)	FUR	FUR	FA	FA	Steelhead Present No Data	FA	No Data	FUR	N/A	No Data	No Data	No Data	No Data	N/A	FUR	FUR
Sediment/Turbidity (Bull trout)	FUR	FUR	FA	FA	No Data	FA	No Data	FUR	FR	FR	No Data	No Data	No Data	No Data	FUR	FUR
Chemical Contaminants/Nutrients	No Data	No Data	No Data	FA	No Data	FA	No Data	FA	No Data	FUR	No Data	No Data	No Data	No Data	FUR	FUR
Habitat Access																
Physical Barriers	FUR	FA	FUR	FA	No Data	FUR	No Data	FA	FUR	FR	No Data	No Data	No Data	No Data	FA	FUR
Habitat Elements																
Substrate Embeddedness (Bull trout rearing areas)	FUR	FUR	FA	FA	No Data	FA	No Data	FUR	FR	FR	No Data	FA	FUR	No Data	FA	FA
Large Woody Debris	FA	FA	FA	FA	No Data	FA	No Data	FA	FUR	FUR	No Data	No Data	No Data	No Data	FA	FA
Pool Frequency and Quality	FA	FA	FA	FA	No Data	FA	No Data	FA	FUR	FR	No Data	No Data	No Data	No Data	FR	FR

Watershed Condition Indicator	Johnson Creek Watershed (HUC 5th Field)									East Fork SFSR Watershed (HUC 5th Field)	Upper East Fork SFSR Watershed (HUC 5th Field) Outside of the Mine Site			Upper East Fork SFSR Watershed (HUC 5th Field) Within the Mine Site		
	Lunch Creek	Headwaters Johnson Creek	Sheep Creek	Burnt Log Creek	Dutch/Ditch Creek	Trapper Creek	Upper Indian Creek	Riordan Creek	Porcupine Creek	Lower East Fork SFSR	Quartz Creek	Profile Creek	Tamarack Creek	No Mans Creek	Sugar Creek	Headwaters East Fork SFSR
Large Pools/Pool Quality (all fish species in adult holding, juvenile rearing, and over wintering reaches)	FUR	FUR	FUR	FR	No Data	FR	No Data	FR	FR	FR	No Data	No Data	No Data	No Data	FUR	FUR
Off-Channel Habitat	FA	FA	FA	FA	No Data	FA	No Data	FA	FA	FR	No Data	No Data	No Data	No Data	FR	FR
Refugia (Steelhead, Chinook salmon)	FR	FR	FR	FR	No Data	FR	No Data	FR	No Data	FR	No Data	No Data	No Data	N/A	FR	FR
Refugia (Bull trout)	FR	FR	FR	FR	No Data	FR	No Data	FR	FR	FR	No Data	No Data	FA	No Data	FR	FR
Channel Conditions and Dynamics																
Average Wetted Width/Maximum Depth Ratio	FA	FR	FA	FA	No Data	FA	No Data	FA	FR	FR	FA	No Data	No Data	FA	FA	FA
Streambank Condition	FUR	FR	FA	FA	No Data	FA	No Data	FA	FR	FR	No Data	No Data	No Data	No Data	FA	FA
Floodplain Connectivity	FR	FR	FR	FR	No Data	FR	No Data	FA	FR	FR	FR	FR	No WCI	No WCI	FR	FR
Flow/Hydrology																
Change in Peak/Base Flows	FR	FUR	FA	FUR	No Data	FUR	No Data	FUR	FUR	FR	No Data	FR	No Data	No Data	FA	FA
Change in Drainage Network	FR	FR	FR	FR	No Data	FR	No Data	FA	FR	FUR	No Data	No Data	No Data	No Data	FA	FA
Watershed Conditions																
Road Density/Location	FR	FR	FR	FR	No Data	FR	No Data	FA	FR	FR	No Data	No Data	No Data	No Data	FUR	FUR
Disturbance History	FUR	FUR	FA	FUR	No Data	FUR	No Data	FUR	FUR	FUR	No Data	No Data	No Data	No Data	FR	FR
Riparian Conservation Areas	FR	FA	FR	FR	No Data	FR	No Data	FR	FR	FUR	FUR	FUR	No Data	No Data	FA	FUR
Disturbance Regime	FR	FR	FR	FR	No Data	FR	No Data	FR	FR	FR	FUR	FUR	No WCI	No WCI	FR	FR
Integration of Pathways																
Integration of Pathways (Steelhead, Chinook salmon)	FUR	FUR	FUR	FR	No Data	FR	No Data	FR	NA	FR	No Data	No Data	No Data	N/A	FR	FR
Integration of Pathways (Bull trout)	FUR	FUR	FUR	FR	No Data	FR	No Data	FR	FR	FR	No Data	No Data	No Data	No Data	FR	FR
Integration of Pathways (other fish species, i.e., westslope cutthroat trout)	No WSC	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data

Source: Forest Service 2010e: Johnson Creek Watershed Improvement Project-Boise NF: Attachment B, Subwatersheds Baselines; Forest Service 2012a; Foust and Nalder 2010; Rio ASE 2019; StreamNet 2020
WCI thresholds used are from Rio ASE 2019.
FA = Functioning Appropriately; FR = Functioning at Risk; FUR = Functioning at Unacceptable Risk; WSC = westslope cutthroat trout

East Fork South Fork Salmon River Watershed Baseline

The East Fork SFSR watershed covers approximately 250,000 acres and enters the mainstem SFSR near the confluence of the Secesh River. Most of the watershed is administered by the Forest Service and managed by the PNF and BNF. Private land in the watershed includes small parcels of land along Johnson Creek, large legacy mines in the headwater drainages (e.g., Stibnite and Cinnabar mines), and the village of Yellow Pine. Predominant historical land uses occurring in this watershed include timber harvest and large-scale mining (Wagoner and Burns 2001 in NMFS 2016). Extensive cattle grazing also historically occurred in the Johnson Creek watershed, but federal grazing allotments have now been retired and grazing has been reduced to private lands.

Large-scale legacy mining altered stream channel conditions in the Upper East Fork SFSR watershed. The Forest Service and mine operators have since undertaken restoration work. However, habitat for migratory salmonids in the East Fork SFSR upstream of the Yellow Pine pit lake is inaccessible because legacy mining excavation of the stream channel has created a gradient barrier (Yellow Pine pit lake cascade). Although there has been a reduction in human influences since about 1950, there are still significant legacy effects that continue to impact channel conditions and fish populations. Kuzis (1997) describes the Upper East Fork SFSR watershed as follows:

> *"The most significant geophysical processes affecting channels in the East Fork SFSR are mass wasting and erosion. The most obvious impacts to stream channels are located at the Yellow Pine pit lake, Meadow Creek, East Fork Meadow Creek, and the Cinnabar Mine area."*

The East Fork SFSR drainage has the lowest quality habitat for sensitive and protected fish in the SFSR subbasin (Northwest Power Conservation Council 2004). Primary habitat limitations in the East Fork SFSR drainage are reduced riparian habitat and decreased streambank stability due both to road design and the extent of the existing road system; secondary limitations include reduced instream large woody debris, water quality degradation, and fish passage barriers resulting from legacy mining in the area (Northwest Power Conservation Council 2004).

All IDEQ-inventoried waterbodies at the proposed mine site (except for West End Creek) are listed under Section 303(d) of the federal CWA as "impaired" due to water quality. The causes for listing of these waters are associated with elevated concentrations of arsenic, antimony, and mercury. Each of the 303(d)-listed waterbodies has designated beneficial uses of "cold water aquatic life," "salmonid spawning," and "primary contact recreation," and all (except Sugar Creek) have designated beneficial uses of "domestic water supply."

Wildfires have eliminated much of the tree canopy at the SGP mine site and vicinity and substantial erosion occurs (HDR 2013). In addition, the failure of a dam on the EFMC (also referred to as Blowout Creek) in 1965 resulted in extensive erosion, both upstream and downstream from the former dam and reservoir site, which in turn has led to extensive and ongoing deposition of sediment in the lower reaches of Meadow Creek and downstream in the East Fork SFSR. Currently, while concentrations of total suspended solids and turbidity are low during some months, there is seasonal variation in these concentrations associated with high flow periods when concentrations can reach moderate to high levels.

East Fork South Fork Salmon River

The East Fork SFSR is a tributary to the SFSR. The East Fork SFSR between its confluence with Sugar Creek upstream to the Yellow Pine pit lake is 1.2 km, upstream to the confluence with Meadow Creek is 6.1 km. This stream reach includes the Yellow Pine pit lake, immediately upstream of which is a long cascade (22 percent gradient) that presents a complete upstream passage barrier for all fish species including migrating Chinook salmon and steelhead. Despite the migratory barrier at the Yellow Pine pit lake, bull trout and westslope cutthroat trout are known to occur upstream of the Yellow Pine pit lake. Chinook salmon also spawn and rear in the stream reach upstream of the lake because they have been introduced there by the IDFG. Downstream of the Yellow Pine pit lake, this stream reach is accessible to all four special status salmonid species.

Between Meadow Creek and the Yellow Pine pit lake, the East Fork SFSR widens and has larger streambed material (including abundant cobble and boulders), relative to the upper East Fork SFSR. This stream reach has moderate to high stream gradients (approximately 2 to 8 percent) (HDR 2016c). Moving downstream to the confluence with Sugar Creek, the East Fork SFSR is similar in width, gradient, and substrate material as upstream, but many of the larger boulders and cobble are sharp and more angular. Based on field surveys conducted by Rio ASE (2019), there are more and deeper pools upstream of the Yellow Pine pit lake. The East Fork SFSR generally supports a healthy riparian corridor, with the exception of areas near the Yellow Pine pit lake and areas of legacy mine waste dumps along the banks upstream and downstream of the Yellow Pine pit lake.

The East Fork SFSR in this reach has been heavily impacted by legacy mining activities. In addition to the Yellow Pine pit lake, a remnant of legacy mining activities, these impacts include waste rock dumps in and adjacent to the stream channel, tailings washed down from Meadow Creek valley, roads and infrastructure within and adjacent to the East Fork SFSR channel, dam construction across the East Fork SFSR main channel, and other legacy impacts (Midas Gold 2016a).

Hennessy Creek

Hennessy Creek historically flowed into the East Fork SFSR downstream of the Yellow Pine pit lake, but it has been diverted to flow into the East Fork SFSR downstream of Sugar Creek. It is a narrow, low-flow stream that flows in a constructed ditch alongside McCall-Stibnite Road (CR 50-412), and then through a subterranean section under an adjacent waste rock dump before passing through a very high-gradient reach into the East Fork SFSR. The creek is not expected to support upstream fish passage because of an average channel gradient of 37 percent at its mouth (HDR 2016c). Hennessy Creek is densely vegetated and shallow. The lower portion of Hennessy Creek has been significantly impacted by legacy mine-related activities, including stream diversion, road construction that buried the stream channel, and mining infrastructure (Midas Gold 2016a).

Yellow Pine Pit Lake

During mining activities during the 1930s through the 1950s, the nearly 5-acre Yellow Pine pit lake was created by open pit mining while the East Fork SFSR was diverted through the Bradley Tunnel to Sugar Creek (Hogen 2002). After mining ceased in 1952, the East Fork SFSR was allowed to flow through the abandoned mine pit. The pit currently has a maximum depth of approximately 11 meters. Diverting the

East Fork SFSR back into the stream channel and pit created a long cascade with a high (22 percent) gradient that precluded fish passage upstream into the upper watershed. Therefore, all streams upstream of the Yellow Pine pit lake are inaccessible to anadromous Chinook salmon and steelhead without human intervention. The Yellow Pine pit lake is used by both fish and mammals, including Chinook salmon, bull trout, and river otters. Mountain whitefish are abundant in the lake (Brown and Caldwell 2019b and 2020b) and it supports a healthy benthic macroinvertebrate community (IDEQ 2002). Bull trout found in the Yellow Pine pit lake may be either resident (Brown and Caldwell 2020b) and/or an adfluvial life history population that use the Yellow Pine pit lake for overwintering, with downstream migration to tributaries for spawning (Hogen and Scarnecchia 2006).

The Yellow Pine pit lake is the largest feature that affects flow rates in the East Fork SFSR; however, because of its small area, it affects low flows only slightly and does not affect high flows at all (Kuzis 1997). The lake also displays thermal stratification (i.e., order), but resuspension of sediments due to turnover is not expected. The bottom velocities necessary for turnover would not be high enough for resuspension (IDEQ 2002). Fish sampling in the Yellow Pine pit lake was not included in the habitat-related aquatic baseline studies conducted by HDR (2016c) or MWH (2017).

Midnight Creek

Midnight Creek is a small tributary of the East Fork SFSR. The lower portion of the creek is characterized as a narrow channel with extremely high gradient (approximately 90 percent) and dense overhanging vegetation. The high gradient presents a complete fish passage barrier to fish (HDR 2016c). Midnight Creek has been impacted by legacy mining activities, including open-pit mining, waste rock dumps, and road construction (Midas Gold 2016a).

Midnight Creek was not included in the preliminary baseline study due to restricted access, but it was surveyed by Great Ecology (2018) in the supplemental assessment. There is no baseline fish use noted for Midnight Creek (MWH 2017).

Fiddle Creek

Fiddle Creek is a small tributary of the East Fork SFSR just upstream of Midnight Creek. Habitat conditions in the creek have been adversely impacted from legacy mine operations, road construction, and culvert installation (Midas Gold 2016a). The lower portion of Fiddle Creek also was the site of a former water storage reservoir, the construction and operation of which degraded portions of the stream.

The lower reach of Fiddle Creek has an approximate 37 percent gradient where it flows into the East Fork SFSR, creating a complete barrier to upstream fish passage (HDR 2016c). Upstream of this barrier, Fiddle Creek retains a relatively high gradient in a relatively narrow channel, with side channels (HDR 2016c). The lower portion of the creek has a thick tall-shrub overstory dominated by gray alder (*Alnus incana*) (HDR 2016c). The uppermost section of Fiddle Creek is natural glacial topography, flattens in gradient, and is a slower meandering stream. Large amounts of large woody debris occur throughout the creek, and the dominant streambed substrate consists of boulders, large cobble, and gravel (HDR 2016c). Westslope cutthroat trout were the only salmonids observed in Fiddle Creek or detected in eDNA surveys (MWH 2017, Stantec 2018). Near the confluence with the East Fork SFSR, fish that occupy the East Fork SFSR also likely use the lower portion of Fiddle Creek below the gradient barrier.

Garnet Creek

Garnet Creek is a narrow, shallow, moderate-gradient tributary to East Fork SFSR approximately 0.5 km downstream from the Meadow Creek confluence. The creek has been severely modified over the past 100 years to accommodate mining-related activities. It is still influenced by legacy mining infrastructure that was located across and adjacent to the stream channel, including portions of a town site; and is currently routed through several man-made ditches (Midas Gold 2016a). Garnet Creek flows through a 26-m-long corrugated metal pipe culvert near its confluence with the East Fork SFSR that presents a partial barrier to fish (HDR 2016c).

Garnet Creek was surveyed by Great Ecology (2018) in a supplemental assessment. Garnet Creek cuts through a formerly burned hillside. Most of the vegetative cover along the creek is composed of grasses; however, shrubs and trees grow alongside its banks, and woody vegetation is found in the channel (MWH 2017). There is no baseline fish use noted for Garnet Creek (MWH 2017).

Lower and Middle Meadow Creek

Meadow Creek is a major tributary to the East Fork SFSR that flows through a flat-bottomed valley surrounded by steep mountains. Elevations range from 1.9 km above sea level in the lower reach to over 2.3 km in the headwaters. Meadow Creek has been heavily impacted by legacy mining-related activities, including deposition of tailings and spent heap leach ore, ore processing facilities, heap leach pads, and other infrastructure, stream relocation into a straightened riprap channel, and construction of an airstrip (Midas Gold 2016a). The downstream end of the valley shows remnant effects from early mining activities, along with a large outwash feature created by a dam failure in the EFMC drainage south of the site of the Meadow Creek Mine. Portions of the creek have been modified over the years to improve conditions caused by past mine operations, including the regrading and revegetation of the 2 percent gradient lower reach of the creek in 2004 and 2005.

The middle reach of Meadow Creek is an engineered channel that was constructed to bypass the SODA. The channel was lined with riprap over geotextile fabric and is confined between reinforced/engineered slopes with a gradient of less than 2 percent. This reach has a short section with a 9 percent gradient, shallow depths, and few pools, which may be a partial fish migration barrier at low flows (BioAnalysts 2021). The channel includes low-gradient riffles, glides (section of the stream coming out of a pool) and runs. There is no side channel development or potential large woody debris recruitment.

Upper Meadow Creek

Upper Meadow Creek encompasses the headwaters downstream to the location of proposed TSF Buttress. Upper Meadow Creek is confined and high gradient at the most upstream extent and low gradient and unconfined immediately upstream of the SODA in lower Meadow Creek, transitioning from a gradient of 4 to 8 percent to 2 to 4 percent. Habitat is composed of riffles, step runs (sequence of runs separated by shorter riffle steps), and pools. The presence of side channels in some portions provide potential for lateral channel movement in the less confined sections. Immediately upstream of the SODA, Meadow Creek is unconfined, with a gradient less than 1 percent. The reach is composed of low-gradient riffle, step run, and pool habitat. The floodplain is active with oxbow cutoffs, side channels, and backwater features.

East Fork Meadow Creek

The EFMC, also known as "Blowout Creek," is a tributary to Meadow Creek that has been severely impacted as a result of legacy mining-related activities and the failure of a dam that had been constructed across its stream channel (Midas Gold 2016a). The dam was constructed in 1929 to supply hydroelectric power for historical milling operations. The dam failed in 1965 due to record snow melt and runoff rates, depositing large volumes of sediment into Meadow Creek, the East Fork SFSR, and the Yellow Pine pit lake (URS 2000b in MWH 2017). This stream is considered to be the largest source of sediment to the East Fork SFSR in the analysis area.

The middle reach of EFMC flows through a lateral glacial moraine that eroded during the dam failure and is still considered unstable as it continues to deposit sediments into Meadow Creek and the East Fork SFSR. Upstream of this middle reach, EFMC has a low-gradient pool-riffle reach flowing through a large meadow. This reach is incised and continues to headcut in response to the dam failure. There are few trees and the banks have abundant grasses. The dominant streambed material is sand and gravel (MWH 2017). The EFMC headwaters are high gradient (4 to 20 percent) with cascades, high-gradient riffle, and plunge-pool habitat.

Immediately downstream of the historical dam location, the creek has a slightly steeper (8 to 20 percent) gradient and is composed of cascade habitat. Near the confluence with Meadow Creek, the EFMC passes through a multi-thread and unconfined alluvial fan with a 4 to 8 percent gradient. Sediment from the unstable slopes immediately upstream may contribute to the formation and maintenance of this alluvial fan.

Headwaters East Fork SFSR

Upstream of the Meadow Creek confluence, the East Fork SFSR is characterized by narrower channels with moderate gradient (2 to 4 percent), transitioning to higher-gradient (4 to 8 percent) step-pool habitat further upstream. Overall substrate size is generally smaller than downstream reaches, with sand, gravel, smaller cobble, and boulders. This reach of the East Fork SFSR has relatively abundant riparian vegetation and large amounts of large woody debris.

Kuzis (1997) found that the Headwaters East Fork SFSR displays evidence of a high sediment load, such as streambed aggradation (deposition of material), channel splitting, pool filling, and overbank deposits of fines. The combination of low-gradient, relatively wide valley, plentiful wood supply, and a high sediment supply have resulted in current channel conditions.

East Fork SFSR Between Sugar Creek and Profile Creek

The East Fork SFSR downstream from Sugar Creek is adjacent to the SGP mine site in the No Mans-East Fork SFSR subwatershed. The East Fork SFSR ranges from low-gradient habitat with pools to high gradient habitat with cascades. Substrate throughout the reach is variable, and dependent on the gradient, with the lower-gradient sections dominated by gravel and cobble, while the higher-gradient units are dominated by large cobble and boulders. Avalanches in 2014 have resulted in high concentrations of large woody debris in the East Fork SFSR downstream from Sugar Creek (MWH 2017). In April 2019, a series of avalanches and related landslides caused extensive damage to Stibnite Road (CR 50-412), and pushed snow, timber, and other debris into the East Fork SFSR (Midas Gold 2019a). These events were naturally occurring in burn areas and were related to rain-on-snow events.

Sugar Creek

Sugar Creek, a tributary to the East Fork SFSR, enters the river downstream of the Yellow Pine pit lake. It has a relatively low gradient. An officially closed road closely parallels Sugar Creek for nearly 3.2 km. This road may confine the movement of Sugar Creek, specifically in areas where the banks are bound with riprap rock material. Much of Sugar Creek has large aggregates of large woody debris. The dominant substrates are sand, gravel, and cobble.

This creek has widened channels, and excessive medial and lateral bar formation in response to past sediment inputs. In the 1940s, approximately 1 million cubic yards (approximately 76,455 cubic meters) of glacial overburden was removed from the East Fork SFSR channel and placed in both Sugar Creek and other parts of the East Fork SFSR (Kuzis 1997).

Sugar Creek supports spawning and rearing for all four salmonid species and represents one of the most productive fish habitats in the Upper East Fork SFSR watershed. Legacy mining-related impacts include construction of an access road adjacent to and in the stream channel, upstream sources of sediment, and mercury contamination.

Mine Site Watershed Condition Indicators

Baseline WCIs were determined for the stream reaches within the SGP mine site. Of the WCIs listed in **Table 3.12-17**, not all are equal in terms of evaluating the potential impacts of the SGP within the mine site. Some baseline WCIs are of historical interest, some would not be affected by the SGP, some are not well-established from a quantitative analysis perspective so they cannot be evaluated, and some WCIs are irrelevant to the SGP. For these reasons, five WCIs that have the greatest potential to accurately identify potential impacts due to the SGP were selected for detailed analysis including Water Temperature; Sediment/Turbidity; Chemical Contaminants; Physical Barriers; and Change in Peak/Base Flows. A description of each of these WCIs and their current condition is provided in **Table 3.12-17**.

Water Temperature

Baseline water temperatures for the SGP mine area were evaluated using a SPLNT model developed by Brown and Caldwell (2021a). This model evaluated stream water temperatures and Yellow Pine pit lake water temperatures under baseline conditions and then potential changes that may occur as a result of proposed mine operations and subsequent reclamation. See **Section 4.9.2.3** for further details on the models.

Results of the SPLNT model describing existing conditions (maximum weekly summer (July) and fall (September) temperatures) are shown in **Table 3.12-18**.

Table 3.12-17 Mine Site Stream Reaches Baseline Summary of Watershed Condition Indicators

Watershed Condition Indicator	East Fork SFSR and Tributaries from Sugar Creek to Meadow Creek	Meadow Creek and EFMC	East Fork SFSR Upstream from Meadow Creek	East Fork SFSR Between Sugar Creek and Profile Creek	Sugar Creek
Bull Trout Local Population Characteristics within Core Area					
Local Population Size	FR	FR	FR	FR	FR
Growth and Survival	FR	FR	FR	FR	FR
Diversity and Isolation	FR	FR	FR	FR	FR
Persistence and Genetic Integrity	FR	FR	FR	FR	FR
Water Quality					
Temperature (Steelhead/Chinook salmon)	FR	FR	FR	FR	FR
Temperature (Bull trout)	FR	FR	FR	FR	FR
Sediment/Turbidity (Steelhead, Chinook salmon)	FUR	FUR	FUR	FUR	FUR
Sediment/Turbidity (Bull trout)	FUR	FUR	FUR	FUR	FUR
Chemical Contaminants	FUR	FR	FUR	FUR	FUR
Habitat Access					
Physical Barriers	FUR	FUR	FA	FA	FA
Substrate Embeddedness (Bull trout rearing areas)	FA	FA	FA	FA	FA
Large Woody Debris	FR	FA	FA	FA	FA
Pool Frequency and Quality	FR	FR	FR	FA	FR
Large Pools/Pool Quality (Bull trout)	FUR	FUR	FUR	FUR	FUR
Off Channel Habitat	FR	FR	FR	FR	FR
Refugia (Steelhead/Chinook salmon)	FR	FR	FR	FR	FR
Refugia (bull trout)	FR	FR	FR	FR	FR

Watershed Condition Indicator	East Fork SFSR and Tributaries from Sugar Creek to Meadow Creek	Meadow Creek and EFMC	East Fork SFSR Upstream from Meadow Creek	East Fork SFSR Between Sugar Creek and Profile Creek	Sugar Creek
Channel Conditions and Dynamics					
Average Wetted Width/ Maximum Depth Ratio	FA	FA	FA	FA	FA
Streambank Condition	FA	FA	FA	FA	FA
Floodplain Connectivity	FR	FA	FR	FR	FR
Flow/Hydrology					
Change in Peak/Base Flows	FA	FA	FA	FA	FA
Change in Drainage Network	FA	FA	FA	FA	FA
Watershed Condition					
Road Density/Location	FUR	FUR	FUR	FR	FUR
Disturbance History	FR	FR	FR	FUR	FR
Riparian Conservation Areas	FA	FA	FA	FR	FA
Disturbance Regime	FR	FR	FA	FR	FR
Integration of Pathways					
Integration of Species/ Habitat Conditions	FR	FR	FR	FR	FR

Source: Stantec 2018, 2019, and 2020; Forest Service 2010e; IDEQ 2017b; Burns et al. 2005; Kuzis 1997, MWH 2017; USFWS 2015a, and Integration of Species and Habitat which is derived from professional judgment.
FA = functioning appropriately; FR = functioning at risk; FUR = functioning at unacceptable risk

Table 3.12-18 SPLNT Modeled Baseline Maximum Weekly Summer and Fall Stream Temperatures for Specific Stream Reaches

SPLNT Model Stream Reaches	Baseline Summer Weekly Maximum Temperatures (°C)	Baseline Fall Weekly Maximum Temperatures (°C)
Upper East Fork SFSR (upstream of Meadow Creek confluence)	13.4	11.0
Meadow Creek upstream of EFMC confluence	14.0	12.0
Meadow Creek downstream of EFMC confluence	19.4	15.9
Middle East Fork SFSR (between Meadow Creek and YPP)	17.3	13.9
Lower East Fork SFSR (between YPP and Sugar Creek)	14.1	11.2
East Fork SFSR downstream of Sugar Creek confluence	14.9	11.9

Note:
Temperatures based on distance weighted average of all QUAL2K reaches.
Note: Summer temperatures are represented by July daily temperatures and Fall temperatures are represented by September weekly maximum temperatures.
East Fork SFSR = East Fork South Fork Salmon River; YPP = Yellow Pine pit lake barrier; EFMC = East Fork Meadow Creek

Establishing existing surface water temperature conditions at the SGP mine site was performed as part of the Surface Water Quality Baseline Study (HDR 2017f) to provide a baseline dataset for comparing future temperature changes predicted by the SPLNT model.

The SPLNT model did not account for changes to stream temperatures caused by changing climate conditions. This means the model assumed future stream temperatures would be similar to the historic water temperature data without the SGP (Brown and Caldwell 2021a). Given ongoing climate changes, modeled temperature results would likely be higher if climate change had been considered in the model. The effects of different air temperature conditions on stream temperatures were evaluated through a sensitivity analysis (Brown and Caldwell 2018a) and an uncertainty analysis (Forest Service 2023b).

For air temperatures, the sensitivity of the model to altered air temperatures was evaluated, which were either increased or decreased by 5°C relative to the model inputs. Across this 10°C variation, simulated water temperatures varied by up to approximately 1°C (Brown and Caldwell 2018b). Stream water temperature modeling uncertainty relates largely to spatially and temporally variable implementation success of closure activities; this combined with broader climate conditions could result in higher than predicted stream temperatures (Forest Service 2023f).

The NorWeST model, produced by the Forest Service Rocky Mountain Research Station, provides a variety of scenario-based parameters that represent future stream temperatures for National Hydrography Dataset (-Plus) reaches across the western U.S. NorWeST-modeled stream temperatures are presented (Isaak et al. 2016) alongside the SPLNT stream temperatures in **Table 3.12-19** and ESS 2022a to provide information regarding the possibility of changing climate conditions in the analysis area.

Table 3.12-19 Comparison of Baseline SPLNT Model Temperatures with NorWeST Model Stream Temperatures for Multiple Timeframes (Mean August Temperatures)

SPLNT Reach	Baseline SPLNT Modeled Stream Temperature (°C)	NorWeST Model Stream Temperature (°C)			
		1930-2011	2015	2030-2059	2070-2099
YPP Lake Headwater	11.9	11.57	12.18	12.86	13.7
Meadow Creek	11.8	10.38	10.99	11.64	12.46
Upper East Fork SFSR at Rabbit Creek	9.5	9.95	10.56	11.2	12.01
Sugar Creek	9.2	10.83	11.43	12.1	12.92

Source: Brown and Caldwell 2021a, Isaak et al. 2016
Note: SPLNT existing condition model reach 31 is comparable to NorWeST's YPP Lake Headwater, reach 16 to Meadow Creek, reach 5 to Rabbit Creek, and reach 11 to Sugar Creek.
°C = degrees Celsius; East Fork SFSR = East Fork South Fork Salmon River; SPLNT = Stream and Pit Lake Network Temperature; YPP = Yellow Pine Pit

Of the NorWeST parameters, modeled stream temperatures for 1993-2011 and 2015 are the most appropriate for comparison to existing condition (baseline) SPLNT modeled stream temperatures because they most closely coincide with the data that was used to represent baseline conditions. The NorWeST data from the above timeframes most closely coincides with the baseline data, which was collected between 2012 and 2019. There are two parameters within the NorWeSt dataset that predict stream temperatures based on future scenarios; they are represented by warming trajectories 2040 (2030-2059) and 2080 (2070-2099). The exact year when the SGP would be implemented is unknown; however, if construction were to begin in 2022, then Mine Year 20 would occur in 2045 (3 years construction plus 20 years of operation and closure and reclamation activities), within the NorWeSt 2040 (2030-2059) prediction timeframe. Year 112 would be outside of the predicted timeframes the NorWeSt models provide, but the predictions through 2099 are representative of the modeled long-term trend applicable to that time period. These factors were considered when interpreting modeled future temperatures, especially the further into the future the modeled water temperatures represent.

These modeling results indicate that, depending on stream reach, climate change would increase water temperatures from baseline estimates to the end of the mine operations (2030-2059) by as much as 0.1° to 2.0°C. Into the future, baseline estimates for water temperatures could increase by as much as an additional degree (2070-2099). Depending on the salmonid species, climate change may have important biological impacts. Climate change was not explicitly incorporated into the base case SPLNT modeling but was assessed via sensitivity analyses that indicated a 5°C increase in air temperature could result in a 0.5°C increase in stream temperature. The WCI criteria for water temperatures are species and life-stage-dependent (Rio ASE 2019). The criteria also are defined as the 7-day average daily maximum water temperatures (MWMT). The WCI water temperature criteria for Chinook salmon and steelhead spawning and rearing, and bull trout spawning, incubation, and rearing, used in the WCI functional assessment are included in (Rio ASE 2019) and Forest Service (2003a).

Sediment/Turbidity

All of the stream reaches in the Headwaters East Fork SFSR subwatershed are at unacceptable risk for Chinook salmon, steelhead, and bull trout due to baseline sediment conditions (**Table 3.12-17**). This is due to a variety of past disturbances at the SGP mine site that are currently affecting streambank stability and erosion, and the proximity to existing roads. The matrix WCIs use surface fines as a proxy to evaluate suspended sediment, turbidity, and salmonid spawning substrate quality.

Chemical Contaminants

This WCI is used to evaluate chemical contamination in surface waters in the analysis area at the mine site. The description of existing conditions relies upon data collected at eight surface water chemistry monitoring locations (**Figure 3.9-7**) and from information provided in **Section 3.9** Water Quality.

The description of chemical contaminants focuses on five constituents of concern: aluminum, copper, antimony, arsenic, and mercury. These five constituents of concern were selected because certain concentrations within the water or fish tissue can be detrimental to fish (potential effects to fish described in more detail below). **Table 3.12-20** provides the baseline conditions for these constituents of concern compared to the applicable criteria. Criteria were chosen based on consultation with the USFWS and NMFS. Explanations of the analysis criteria for the five constituents are provided in **Table 3.12-20** notes.

The chemical contaminants WCI, the analysis area is "functioning at risk or unacceptable risk" (**Table 3.12-17**) due to existing levels of legacy mining contamination. No stream on the SGP mine site is considered within acceptable risk levels for chemical contaminants. The constituents that are currently exceeding thresholds are arsenic, antimony, copper, and mercury.

Table 3.12-20 Average Measured Constituent Concentrations at Monitoring Locations

Constituent of Concern		Aluminum[1]	Copper[2]	Antimony[3]	Arsenic[4]	Mercury[5]
Analysis Criteria		0.38 mg/L	0.0024 mg/L	0.0052 mg/L	0.010 mg/L	2.0E-06 mg/L (total mercury)
Node	Stream	Average Measured Baseline (mg/L)				
YP-T-27	Meadow Creek	0.012	0.0003	0.0061	0.035	1.50E-06
YP-T-22	Meadow Creek	0.012	0.0003	0.0081	0.034	1.70E-06
YP-SR-10	East Fork SFSR	0.0094	0.0002	0.012	0.025	2.50E-06
YP-SR-8	East Fork SFSR	0.0094	0.0003	0.017	0.028	2.40E-06
YP-SR-6	East Fork SFSR	0.0098	0.0002	0.019	0.031	2.40E-06
YP-SR-4	East Fork SFSR	0.012	0.0003	0.031	0.063	2.40E-06
YP-SR-2	East Fork SFSR	0.014	0.0002	0.022	0.045	5.70E-06
YP-T-11	Fiddle Creek	0.016	0.0002	0.0006	0.002	1.80E-06
YP-T-6	West End Creek	0.004	0.0003	0.0105	0.08	4.20E-06
YP-T-1	Sugar Creek	0.009	0.00856[6]	0.034	0.013	1.59E-04

Source: Midas Gold 2019c; SRK 2021b

Analysis criteria pertain to fish species. Aluminum, arsenic, and mercury criteria are based on total concentrations while copper and antimony are based on dissolved concentrations.

[1] Aluminum: Lowest predicted for the SGP area based on Recommended Aquatic Life Criteria (EPA 2018g); The same water quality data as in the Biotic Ligand Model were used (Brown and Caldwell 2020c)
[2] Copper criteria was derived using the Biotic Ligand Model per guidance contained in IDEQ (2017b). A conservative chronic copper standard was estimated by applying the lowest of the 10th percentile chronic criteria based on regional classifications for the Salmon River Basin, Idaho Batholith, and third order streams. Per the SGP Water Quality Management Plan (Brown and Caldwell 2020a), preliminary calculations using the Biotic Ligand Model and site-specific data have produced similar values to the standard derived using these regional classifications.
[3] Antimony does not have a specified NMFS or USFWS criteria and is based on EPA's human health chronic criterion for consumption of water and organisms is 0.0056 mg/L.
[4] Arsenic: NMFS (2014) directed EPA to promulgate or approve new aquatic life criterion. In the interim, NMFS directed EPA to ensure the 0.010 mg/L human health criterion applied in all NPDES permits. USFWS (2015b) directed EPA to ensure that the 10 μ/L recreational use standard is applied in all Water Quality Based Effluent Limitations (WQBELs) and Reasonable Potential to Exceed Calculations using the human health criteria and the current methodology for developing WQBELs to protect human health.
[5] Mercury: NMFS (2014) directed EPA to promulgate or approve a new criterion. In the interim, implement the fish tissue criterion that IDEQ adopted in 2005. Where fish tissue is not readily available, then NMFS specified application of a 2.0E-06 mg/L threshold (as total mercury) in the interim. USFWS (2015b) directed EPA to use the 2001 EPA/2005 Idaho human health fish tissue criterion of 0.3 mg/kg wet weight for WQBELs and reasonable potential to exceed criterion calculations using the current methodology for developing WQBELs to protect human health.
[6] Of the 38 dissolved copper values reported for YP-T-1, only one value was higher than 0.00261 mg/L; therefore, it is likely that this single anomalous value was the result of a sampling, analytical, or data management error.
mg/L = milligrams per liter

Aluminum

Aluminum can accumulate at the surface of the gill, leading to respiratory dysfunction and disruption of salt balance, and can cause mortality (EPA 2018g). The aquatic life recommended criteria for aluminum for a site are based on site-specific conditions of pH, total hardness, and dissolved organic carbon. The EPA acute criteria for the same conditions as used in calculating the site-specific copper criteria based on the Biotic Ligand Model (Brown and Caldwell 2020b), range from 930 to 2,500 μ/L total recoverable aluminum, and the chronic criteria range from 360 to 1,700 μ/L total recoverable aluminum. The State of Idaho does not currently have a specific water quality standard for aluminum in place for the protection of aquatic life and the EPA criteria have not yet been adopted by the State of Idaho. Nevertheless, they reflect the most current knowledge of potential impacts of aluminum to aquatic life. None of the assessment nodes show an exceedance of the analysis criteria for aluminum.

Copper

Copper and copper compounds are acutely toxic to fish and other aquatic life at low parts per billion levels (Eisler 1991, 2000; Hamilton and Buhl 1990). Copper is essential to the growth and metabolism of fish and other aquatic life, but it can cause irreversible harm at levels slightly higher than those required for growth and reproduction (Eisler 2000). Exposure to sublethal levels of copper can have a detrimental effect on the behavior of salmonids. McIntyre et al. (2012) evaluated the effects of copper exposure on juvenile Coho salmon (*Oncorhynchus kisutch*) predator avoidance behaviors and found that the exposed juveniles were unresponsive to their chemosensory environment, unprepared to evade nearby predators, and less likely to survive an attack sequence. Salmonids are known to avoid waters with sublethal concentrations of copper, and such concentrations alter other behavior as well.

The Biotic Ligand Model-based copper criteria indicated an exceedance in Sugar Creek at YP-T-1. However, of the 38 dissolved copper values reported for YP-T-1, only one value was higher than 0.00261 mg/L; therefore, it is likely that this single anomalous value was the result of a sampling, analytical, or data management error.

Antimony

Known effects of antimony on aquatic organisms are more limited than for other metals and most available information pre-date the last three decades. Antimony can be toxic to aquatic life and bioaccumulate in tissues but has not consistently shown a tendency to biomagnify within aquatic food webs as other metals (Obiakor et al. 2017). Ambient water quality criteria for the protection of aquatic life have not been established for antimony. Average antimony concentrations currently exceed the analysis criteria at every assessment node except YP-T-11 in Fiddle Creek (**Table 3.12-20**).

Arsenic

Arsenic criteria are specific to the inorganic form, which is the more toxic form to aquatic life and humans. Arsenic exposure can occur through both waterborne concentrations and through dietary exposure for aquatic life and humans. In the State of Idaho, criteria exist for both the protection of human health and the protection of aquatic life. NMFS directed the human health standard be used until new aquatic life criterion can be promulgated by EPA. Arsenic can concentrate in tissues of fish, but it does not biomagnify. The effects of arsenic on fish health include enzymatic, genetic, and immune system failure (Kumari et al. 2017). Arsenic is a suspected carcinogen in fish and is associated with necrotic and fibrous tissues and cell damage, especially in the liver. Arsenic can result in immediate death through increased mucus production and suffocation. Other effects include anemia and gallbladder inflammation (NMFS 2014).

Arsenic concentrations currently exceed the analysis criteria at all assessment nodes except YP-T-11 in Sugar Creek (**Table 3.12-20**).

Mercury

Mercury in the environment originates from both natural and anthropogenic (human-caused) sources. However, regionally, the most significant source of mercury in Idaho is air deposition. Methylation is a process by which inorganic mercury is converted to the organic form (methylmercury), which can be present in the water column and is the form that bioaccumulates in tissues of living organisms. Consuming methylmercury that has accumulated in other organisms is the primary form for mercury exposure for humans. Currently, the value of 0.3 milligrams (mg) of MeHg per kilogram of fish tissue wet weight is set at a level to protect the general public from negative effects of mercury during a lifetime of exposure through the consumption of fish. It also is the human health standard of 0.3 milligram per kilogram fish tissue criterion that is protective of aquatic life (IDEQ 2005, 2018). Although the water column-based aquatic life chronic criterion for mercury in Idaho is 0.000012 mg/L (Total), the preferred value used for interpreting risks of mercury contamination to aquatic life is the fish tissue criterion of 0.3 mg/kg wet weight, the same value used for protection of human health (IDEQ 2018).

Predatory species in the food web concentrate the highest amounts of mercury in their tissues, a process called biomagnification. Salmonids in the streams and rivers of Idaho may be the dominant predator species and can concentrate mercury at levels several times that of prey species, such as algae, aquatic insects, and fish that do not feed exclusively on other fish. Generally, piscivorous fish (fish-eating) will bioaccumulate the highest concentration of mercury. Larger fish, which also tend to be older, are expected to bioaccumulate the most methylmercury.

Mercury concentrations currently exceed the 2.0E-6 mg/L analysis criteria at six of the ten nodes including in the East Fork SFSR at nodes YP-SR-10, YP-SR-8, YP-SR-6, YP-SR-4, YP-SR-2, and in West End Creek at node YP-T-6 (**Table 3.12-20**).

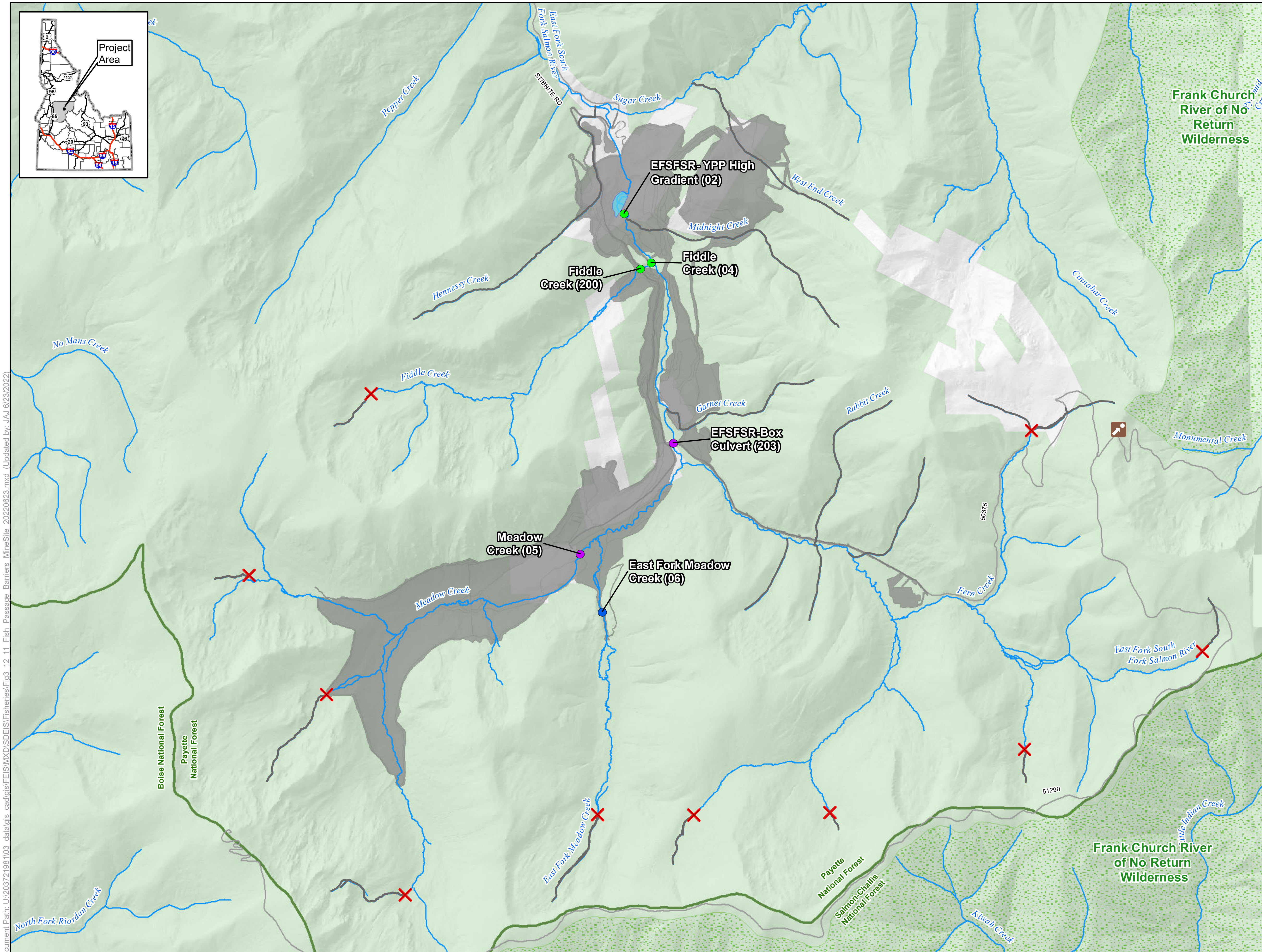
Physical Barriers

Barriers to fish passage can impact the natural movement (e.g., migration) of fish species and fish population dynamics by reducing, or completely blocking, potential habitat during certain life stages. Barriers can impact fish habitat connectivity and disrupt the natural movement of fish and block important habitat for fish during all life cycles, including spawning and rearing. Fish passage barriers were identified and described within the SGP mine site (BioAnalysts 2021). Only the East Fork SFSR downstream of the mine site and Sugar Creek are without artificial (i.e., human-made) barriers (BioAnalysts 2021). Eleven artificial barriers to fish passage and one natural barrier were identified (BioAnalysts 2021). The statuses of these barriers were identified as either complete, meaning no fish species can pass at any time of year, or partial, meaning some or all fish may pass at moderate or high flows, but not at low flows. Artificial barriers can be attributed to various actions, for example, construction of culverts and stream alteration (BioAnalysts 2021). Of these eleven artificial barriers, six are located in non-fish bearing streams. The remaining five barriers are shown in **Figure 3.12-11** and described in more detail in ESS 2022g. **Table 3.12-21** presents the amount of total potential fish habitat upstream of each barrier.

BioAnalysts (2021) identified three major barriers to fish movement in the SGP mine site area: 1) the high gradient cascade in the East Fork SFSR upstream of the Yellow Pine pit lake; 2) East Fork SFSR box culvert; and 3) the high gradient cascade in Meadow Creek upstream from the confluence with the EFMC. The high gradient cascade in the East Fork SFSR upstream of the Yellow Pine pit lake is a complete barrier to natural fish passage. The other two major barriers, the East Fork SFSR box culvert and Meadow Creek barriers, are flow-dependent partial barriers that can block seasonal migration, and only hinder migration of fish that reside in or were stocked upstream of the Yellow Pine pit lake (i.e., translocated Chinook salmon).

Peak/Base Flow

USGS data were used to derive peak flow statistics for the ten major drainages in the analysis area (**Figure 3.8-3**). Results from the peak flow analysis were summarized in the baseline study (HydroGeo 2012b) and are presented in the Water Quantity Specialist Report (Forest Service 2023e). Peak flows were calculated for the bottom of each drainage using the USGS StreamStats program. Predicted peak flows for a 1.5-year event ranged from 1.84 cfs for West End Creek to 237 cfs for the East Fork SFSR, and for a 500-year event they ranged from 13.4 cfs to 931 cfs, respectively. Table 6-5 in the Water Quantity Specialist Report (Forest Service 2023e) provides the maximum flow predicted to occur for various return periods from a 1.5-year event up to a 500-year event.



LEGEND

Upstream Extent of Fish Presence

Barriers

- Complete Barrier, Artificial
- Partial Barrier, Artificial
- Partial Barrier, Natural

Project Components*

- SGP Features

Other Features

- U.S. Forest Service
- Wilderness
- Monumental Summit
- County
- Road
- Non-fish-bearing Stream
- Stream/River
- Lake/Reservoir

Source: BioAnalysts 2021

0 0.3 0.6 Miles

1 inch = 0.6 miles when printed at 11x17

Figure 3.12-11 Fish Passage Barriers at the Mine Site Stibnite Gold Project Stibnite, ID

Base Layer: Hillshade derived from LiDAR supplied by Midas Gold

Other Data Sources: Midas Gold; State of Idaho Geospatial Gateway (INSIDE Idaho); Boise National Forest; Payette National Forest

Table 3.12-21 Existing Fish Passage Barriers at the Proposed Mine Site and Potential Fish Habitat Under Baseline Conditions

Barrier	Status	Potential Bull Trout and Cutthroat Trout Habitat (km)		Potential Chinook Habitat (km)		Potential Steelhead Habitat (km)	
		Upstream from Barrier	Total Available[1]	Upstream from Barrier	Total Available[1]	Upstream from Barrier	Total Available[1]
East Fork SFSR above YPP (02) Artificial – Gradient	Complete	32.82[2] 19.54[3]	34.04[2] 22.12[3]	8.87[4] 25.88[3]	11.15[4] 28.16[3]	8.72[4]	10.67[4]
East Fork SFSR (203) Artificial – Box Culvert	Partial	26.43[2] 16.66[3]	34.04[2] 22.12[3]	6.29[4] 23.10[3]	11.15[4] 28.16[3]	6.89[4]	10.67[4]
Fiddle Creek (04) Artificial – Gradient	Complete	3.50[2] 0[3]	34.04[2] 22.12[3]	0[3,4]	11.15[4] 28.16[3]	0[4]	10.67[4]
Fiddle Creek (200) Artificial – Culvert	Complete	3.46[2] 0[3]	34.04[2] 22.12[3]	0[3,4]	11.15[4] 28.16[3]	0[4]	10.67[4]
Meadow Creek (05) Artificial – Gradient	Partial	8.23[2] 6.62[3]	34.04[2] 22.12[3]	1.02[4] 6.81[3]	11.15[4] 28.16[3]	1.69[4]	10.67[4]
East Fork Meadow Creek (06) Natural – Gradient	Partial	2.22[2] 0[3]	34.04[2] 22.12[3]	0[3,4]	11.15[4] 28.16[3]	0[4]	10.67[4]

[1] Not all of the Total Habitat is considered Usable Habitat
[2] Results based on Occupancy Probability for bull trout and cutthroat trout
[3] Results based on Critical Habitat for bull trout or modeled Critical Habitat for Chinook salmon
[4] Results based on potential Intrinsic Potential habitat
km = kilometer; YPP = Yellow Pine pit

Base stream flow data were collected in conjunction with surface water quality sampling on a monthly or quarterly basis at 32 non-USGS monitoring stations. The monitoring points were selected at upstream and downstream locations to bracket historical and potential future mining activities in the analysis area (Brown and Caldwell 2017a). Table 6-6 in the Water Quantity Specialist Report (Forest Service 2023e) provides stream flow statistics derived from baseline measurements collected between 2012 and early 2016. The mean flows calculated from this dataset for the East Fork SFSR ranged from 4.47 cfs at the farthest upstream monitoring location to 31.31 cfs at the most downstream location.

Table 3.12-22 shows average monthly stream flows during the August to March low flow period at five gaging stations and location in lower Meadow Creek in the SGP mine site streams for the years 1929 to 2017.

Climate change conditions resulting in increasing air temperatures would potentially transition snow to rain resulting in diminished snowpack and earlier season streamflow along with changes in groundwater recharge to aquifers that discharge to streams. Mean annual streamflow projections suggest a slight increase, but summer low flows are expected to decline (Halofsky et al. 2018).

Table 3.12-22 Average Monthly Stream Flow During the August-March Low Flow Period for 1929 to 2017 at USGS Gaging Stations and One Meadow Creek Location

Month	East Fork SFSR above Meadow: 13310800 (cfs)	East Fork SFSR at Stibnite: 13311000 (cfs)	East Fork SFSR above Sugar Creek: 13311250 (cfs)	Sugar Creek above East Fork SFSR: 13311450 (cfs)	Meadow Creek: 13310850 (cfs)	Meadow Creek: MC-6[1] (cfs)
August	7.3	15.4	17.3	12.5	4.1	7.7
September	5.7	11.9	13.1	9.0	3.0	5.9
October	5.3	11.5	12.6	8.3	3.1	5.8
November	4.6	10.8	12.8	8.3	3.4	5.8
December	3.7	9.0	11.0	7.2	2.8	4.8
January	3.5	8.0	9.9	6.5	2.3	4.2
February	3.3	7.7	9.5	6.4	1.9	3.8
March	3.4	8.7	10.5	7.3	2.2	4.3
Average	4.6	10.4	12.1	8.2	2.9	5.3

MC-6 is located in the lower reaches of Meadow Creek