

Technical Memorandum

Prepared for: Perpetua Resources Idaho, Inc.

Project Title: Stibnite Gold Project

Technical Memorandum

Subject: Summary of Water Quality Conditions Associated with the Stibnite Gold Project

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Section 1: Purpose

This document provides a brief overview of water quality conditions in surface water features at the Perpetua Resources Idaho, Inc. (Perpetua) Stibnite Gold Project (SGP) site in Valley County, Idaho. It first summarizes existing conditions and then the conditions projected to exist as a result of proposed mining activities at the site. The authors of this document have been continuously engaged in assessing, analyzing, and forecasting water quality conditions for the SGP since 2016.

Section 2: Existing Conditions

There is an abundance of water quality information available for the SGP site, largely as a result of a comprehensive monitoring program initiated by Perpetua in 2012 and continuing to the present. A summary of the first several years of data from the program was prepared by Brown and Caldwell (BC 2017)¹, followed by an update two years later (Midas Gold 2019)². The SGP Water Management Plan (BC 2021a)³ provides an updated and broader overview of existing water resource conditions.

Of more than 75 water quality parameters evaluated at more than 50 surface water locations across the site throughout the monitoring program, three have been identified as chemical constituents of concern because they are present in some locations at levels that exceed Idaho water quality criteria as contained in IDAPA 58.01.02. Those substances are arsenic, antimony, and mercury. The presence of these metals in surface waters at the site is because of both their natural presence in the underlying geology and many decades of legacy mining operations at the site, most of which occurred prior to modern environmental protection standards and technologies. Likewise, the distribution of these metals in the site's surface waters reflects the locations of geological sources like seeps and springs as well as locations of legacy mine features and waste materials left behind by former mining operations. Other monitored chemical parameters showed concentrations below Idaho Surface Water Criteria in most or all samples collected through the monitoring program.

Temperature has also been identified as exceeding applicable water quality criteria, due at least in part to the lack of riparian vegetation resulting from historic mining and from wildfires in the watershed in recent years. Elevated stream temperature is not an issue unique to the SGP site. The inclusion of nearly 5,700 stream miles in Idaho on the state's 303(d) list (Idaho 2022a)⁴ as impaired due to temperature is an indication of the widespread nature of this condition.

Elevated levels of arsenic, antimony, mercury, and temperature have resulted in the designation of streams on and downstream of the SGP site as "impaired." The map below (Figure 1) was clipped from the IDEQ interactive mapper website (IDEQ 2022b)⁵. Stream segments shown in brown are listed as impaired in the IDEQ 2022 Integrated Report for various combinations of arsenic, antimony, mercury and temperature. The impairment status indicates that they have been documented at levels that exceed Idaho water quality criteria on a regular and/or recurring basis. All of the stream segments shown in brown are impaired for arsenic and temperature, with the exception of Sugar Creek which is not impaired for temperature. The antimony impairment is only for one segment of the East Fork South Fork Salmon River (EFSFSR) upstream of Sugar Creek, and mercury is responsible for impairment only in Sugar Creek and the section of EFSFSR

¹ BC. 2017. Stibnite Gold Project Water Resources Summary Report. Prepared for Midas Gold Idaho, Inc. (now Perpetua).

² Midas Gold Idaho, Inc. (now Perpetua). 2019. Stibnite Gold Project Water Quality Summary Report 2012-2017.

³ BC. 2021a. Final Stibnite Gold Project Water Management Plan. Prepared for Perpetua Resources Idaho, Inc.

⁴ Idaho Department of Environmental Quality. 2022a. [Idaho DEQ Final 2022 Integrated Report](#).

⁵ Idaho Department of Environmental Quality. 2022b. [Idaho DEQ 2022 Integrated Report Interactive Mapper](#).

downstream of the SGP site. The temperature impairments were first designated in 2022, along with the mercury and arsenic impairments downstream of the SGP site.

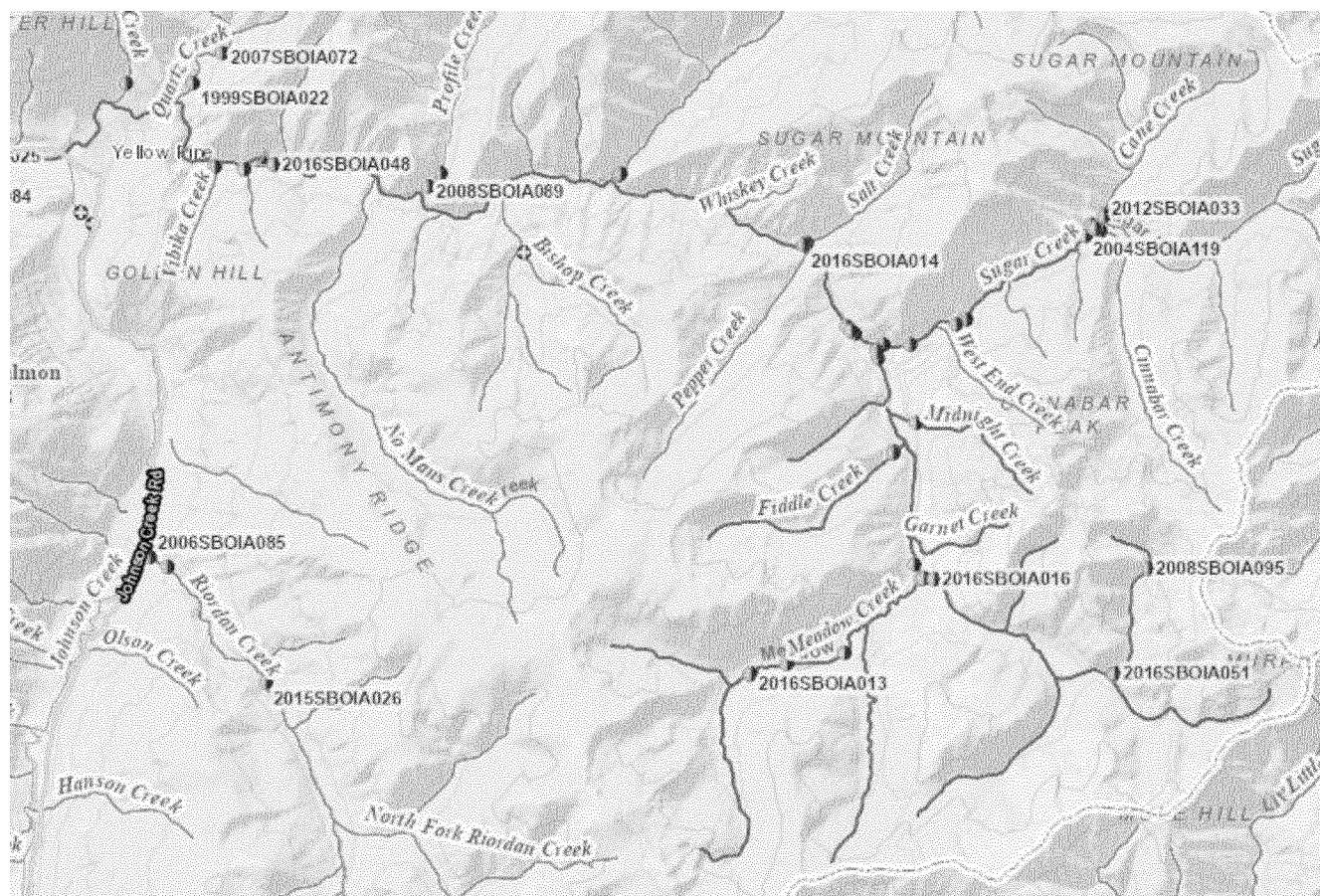


Figure 1. Segments of the East Fork of the South Fork Salmon River System with Existing Water Quality Impairments.

Section 3: Projected Future Conditions

The SGP Water Management Plan (BC 2021a) provides a broad discussion of the numerous planning, design, construction, and operational considerations incorporated into the SGP to manage and protect water resources. It addresses both surface and groundwater resources, including stormwater management and conveyance diversions around mine facilities, groundwater pumping, process water reuse and recycling, and the design basis for treatment and discharge of excess water. It also summarizes the modeling and analytical efforts undertaken to predict water quantity and quality conditions during and after the proposed mining. These analytical, planning, and design efforts represent an extensive array of considerations to protect and, where possible, improve water quality during and after the SGP mining program.

A detailed Site-Wide Water Chemistry (SWWC) computer model (SRK 2021)⁶ was developed to predict changes in water quality at numerous locations on the SGP site that would result from mining and associated reclamation and restoration activities. The following are the key outcomes of the SWWC model:

- Reclamation of the SODA/Bradley tailings and Hecla Heap will result in a reduction of antimony and arsenic in Meadow Creek to less than the strictest potentially applicable water quality standard. Mercury concentrations are predicted to be similar to existing conditions and less than the strictest water quality standard.
- Antimony and arsenic concentrations decrease in the EFSFSR upstream of the Yellow Pine pit but to a lesser extent than in Meadow Creek. This occurs because there are other historical facilities and naturally elevated metal levels in rock downstream of the confluence of Meadow Creek and the EFSFSR contributing antimony and arsenic load to the EFSFSR. Mercury concentrations are predicted to be similar to existing conditions and less than the strictest water quality standard.
- Mining of the Yellow Pine pit and diversion of the EFSFSR through the fish tunnel will remove mineralized rock that is contributing antimony and arsenic load to the lower reaches of the EFSFSR under existing conditions. Once this source of antimony and arsenic load is removed, antimony concentrations are predicted to decrease relative to existing conditions downstream of the Yellow Pine pit. Mercury is predicted to slightly increase relative to existing conditions in the EFSFSR downstream of the Yellow Pine pit backfill, but concentrations remain significantly lower than the strictest potentially applicable water quality standard.
- Water quality predictions indicate there is very little change from existing conditions in West End Creek and Sugar Creek due to the small volume of outflow from the West End pit lake and Yellow Pine backfill (Sugar Creek only) reaching these watercourses. Antimony concentrations are predicted to decrease relative to existing conditions in Sugar Creek after the Bailey Tunnel is decommissioned.
- The results of the SWWC model indicate that the proposed ModPRO2 mine plan will result in a net positive improvement to existing conditions at the Stibnite project with antimony and arsenic concentrations predicted to be lower than or within the range of existing conditions for all assessment nodes. Mercury is predicted to be less than the strictest potentially applicable water quality standard at all assessment nodes.

To evaluate potential changes in temperature, a detailed computer modeling effort was conducted. Model development and calibration are described in the Stream and Pit Lake Network Temperature Model (SPLNT) Existing Conditions Report (BC 2018)⁷ and the SPLNT Proposed Action Report (BC 2019)⁸. To address increases in temperature associated with the original proposal, Perpetua Resources developed a modified proposal for the SGP referred to as the ModPRO2 (Perpetua 2021)⁹ to include mitigation measures during and following operations. Projected stream temperatures for the modified proposal are presented in the SPLNT ModPRO2 Report (BC 2021b)¹⁰. These mitigation measures include diversion of stream flows in low-flow pipes to provide shaded conveyance during operations, creation of Stibnite Lake by mine year 12 to

⁶ SRK Consulting. 2021. Stibnite Gold Project ModPRO2 Site-Wide Water Chemistry (SWWC) Modeling Report. Prepared for Perpetua Resources Idaho, Inc.

⁷ BC. 2018. Final SGP Stream and Pit Lake Network Temperature Model (SPLNT) Existing Conditions Report. Prepared for Midas Gold (now Perpetua).

⁸ BC. 2019. Stibnite Gold Project Stream and Lake Network Temperature Model Proposed Action and Proposed Action with Pipes Report. Prepared for Midas Gold Idaho, Inc. (now Perpetua).

⁹ Perpetua. 2001. Stibnite Gold Project Refined Proposed Action ModPRO2.

¹⁰ BC. 2021b. Final Stream and Pit Lake Network Temperature Model Refined Proposed Action (ModPRO2) Report. Prepared for Perpetua.

mimic the diurnal temperature regime of Yellow Pine pit lake, initiating stream riparian plantings much earlier in the project, and planting riparian buffers that are 2.5 times wider than originally planned with a greater percentage of taller plants. The three SPLNT documents were submitted to the US Forest Service (USFS) as part of its NEPA document preparation process.

The following are excerpts from, or comments on, Chapter 4 of the Supplemental Draft Environmental Impact Statement (USFS 2023)¹¹ documenting mostly temperature improvements (lower stream temperature) associated with ModPRO2 relative to baseline conditions:

- *“Water temperatures in the warmer summer and fall months in Meadow Creek downstream from East Fork Meadow Creek substantially decrease relative to the baseline conditions during mine operations and closure/reclamation activities (Mine Year 6 through Mine Year 18), though there is an increase at Mine Year 27, which then continues to decline until Mine Year 112.”*
- *“The East Fork South Fork Salmon River (SFSR) between Meadow Creek and YPP experiences decreases in summer maximum water temperatures relative to baseline conditions. There is a slight increase in temperatures, still lower than baseline, after Mine Year 22 once the low-flow piping along the TSF is removed, and temperatures continue to decrease once the revegetation efforts take effect.”*
- The effects of the SGP on fish caused by changes to water temperature are expected to be *“permanent, localized, and beneficial for Meadow Creek downstream from the East Fork Meadow Creek, and for the East Fork SFSR between Meadow Creek and YPP.”*
- Table 4.12-2 shows both summer and fall maximum weekly water temperatures largely lower than baseline during operations and post-closure, with the exception of post-closure Meadow Creek on the TSF, and during tunnel operation on the East Fork SFSR between YPP and Sugar Creek. Note that Perpetua Resources has identified many temperature values in the SDEIS (USFS 2023)¹¹ that are different (higher) than reported in the Stream and Pit Lake Network Temperature (SPLNT 2021b) report.
- Table 4.12-6 Temperature Watershed Condition Indicator (WCI) changes are negligible or positive for all stream segments across the life of the project.

Section 4: Conclusions

In conclusion, a small number of water quality parameters show elevated conditions resulting from both natural conditions and legacy mining activities at the SGP site. The large majority of monitored parameters show no concern for current or future water quality conditions. Computer modeling and other analytical projections of future conditions associated with the SGP mining program indicate no further degradation of conditions with respect to arsenic, antimony, mercury, or temperature, and current levels of these parameters are expected to improve in some portions of the EFSFSR system. The improvements will be the result of specific considerations and actions incorporated into the SGP mine plan to manage and mitigate its impact on water resources. If the SGP is not undertaken, the improvements would not be expected to occur.

¹¹ US Forest Service. 2023. Supplemental Draft Environmental Impact Statement. <https://usfs-public.app.box.com/v/PinyonPublic/file/1052214209080>