SCAPE

Sheep Creek Action and Protection Effort

Group 6
UAPP411/611: Regional Watershed Management
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Mission Statement

SCAPE's mission is to monitor Sheep Creek's current water quality pre-mining at the Black Butte Copper Mine to compare with future measurements and to identify causes of current water quality issues in the watershed. We will create effective strategies to reduce existing problems and to prevent potential future threats to the watershed once mining commences, setting a goal to bring the stream health to an A grade by the year 2035.

Background

Geographical Context

Located in Meagher County, Montana, in the Little Belt Mountains, the Sheep Creek Watershed drains about 195 mi^2 with the mainstem flowing approximately 41 miles from its headwaters to the confluence with the Smith River near Camp Baker. The stream is located at 46° 48 '16.8"N 111°11'05.8"W. It flows in a southwesterly direction from the Little Belt Mountains at an elevation of 5,527 feet down to its confluence.

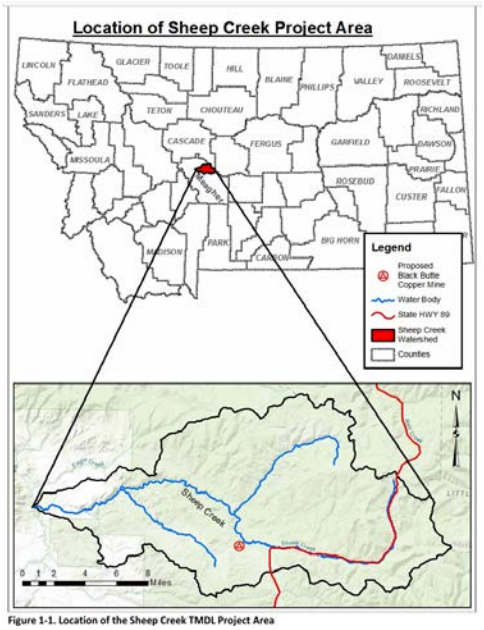
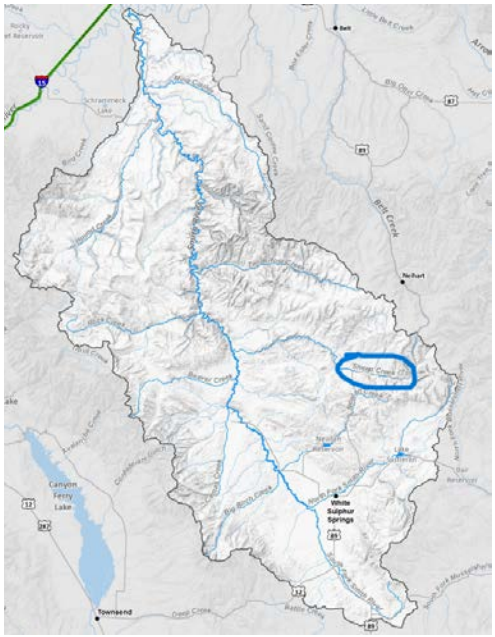


Figure 1-1. Location of the Sheep Creek TMDL Project Area



Physical Characteristics and Biological Diversity

Sheep Creek is a perennial mountain stream that has riffles and pools with cobble and gravel substrates. The stream meanders through a broad floodplain of sub-irrigated meadows and shrubby wetlands. Surrounding the stream, there are grassland communities along with coniferous forest patches on higher relief areas.

The shrub-dominant wetlands are very diverse as shrub communities shift with slope and soil moisture. Along Sheep Creek sit dense riparian shrub zones. The dominant species include Geyer willow, Booth willow, and Thinleaf alder. These species help with bank stabilization, shade for cold-water fish habitats, and organic matter input. Dominant sagebrush species on hillsides and open slopes include Wyoming big sagebrush and Mountain big sagebrush. The layer of vegetation beneath this main forest canopy consists of Bluebunch wheatgrass, Idaho fescue, Needle-and-thread grass, and Prairie junegrass. The ecological role of these species includes stabilizing dry soils as well as supporting animal species such as deer, elk, and birds. On nearby ridges and buttes, shrubby grasslands consist of Mountain mahogany, Serviceberry, and Chokecherry, which support animals as a source of food and shelter.

Among higher elevation areas of the watershed, coniferous forest patches can be found. Above the creek valley, on rocky ridges, these forests are mixed with sagebrush and shrubs, creating the ecotones. The main tree types found in these areas include Douglas-fir, Lodgepole pine, and Engelmann spruce. With the understory vegetation, these patches stabilize slips, shade the creek, add organic matter to the soil, and provide wildlife habitat.

The watershed also supports many fish, insect, aquatic, mammal, and bird species. The stream supports many coldwater species such as trout species, minnows, native forage fish, aquatic insects, and amphibians. Trout species often found in this world-class trout fishery include rainbow trout, brown trout, brook trout, mountain whitefish, and cutthroat trout. The aquatic insects found in the watershed, including mayflies, stoneflies, and caddisflies, are especially important as they indicate water quality. The watershed also supports grassland mammals, including mountain goats, elk, black bear, bighorn sheep, and mule deer. Notable bird species include osprey and golden eagles. The high biological diversity that is connected to this watershed ecosystem helps the area thrive and withstand different conditions.

Water Quality and Composition

The water quality of Sheep Creek can be considered moderate overall. The water is generally clear, cool, and at a good oxygen level, making it ideal for aquatic life. The critical cold-water flows and spawning habitat make the stream essential to the health of the blue-ribbon trout fishery, whose drainage is responsible for 55% of the tributary spawning. pH is found to be neutral to slightly alkaline, and as previously stated, dissolved oxygen is good to high. The hardness of the water in Sheep Creek is found to be moderate due to calcium and magnesium. Nitrate and turbidity levels in the stream tend to be low unless a runoff event occurs, which is

common during spring melt. Similarly, aluminum and Escherichia coli levels are often increased by runoff into Sheep Creek, severely diminishing the stream's water quality.

Human Activities

Historically, present-day central Montana has had a long Indigenous history, specifically including the Salish, Blackfeet, and Shoshone peoples. These tribes used the plains, river valleys, and streams of the watershed as an important source of freshwater, game, plants, and travel. The nearby Smith River Canyon provides evidence of their stay and the cultural and historical significance of the area. Among the limestone cliffs, there are more than 70 hidden Native American pictograph sites, featuring symbols, animals, figures, and abstract designs reflecting the beliefs and traditions of the Indigenous peoples.

With the arrival of settlers and the U.S. government in the 1800s came the disruption of the tribal lifestyle. Today, some descendants of these tribal groups still live in the area. However, most activity in the watershed includes agriculture, rural roads, recreation, and potential mining activity. The recreational activities, including hiking, sightseeing, camping, and fishing, are especially important as they help to provide social, economic, and environmental benefits to the watershed.

Policies

Management

The Sheep Creek Watershed, as well as the Smith River Watershed, lacks a specific watershed management authority beyond the Montana Department of Environmental Quality (DEQ), which monitors the water quality of both watersheds. However, the trout fishery of the

Smith River – and Sheep Creek by extension – has been managed by Montana Fish, Wildlife, and Parks (FWP) since 1974, and FWP was given additional recreational management authority with the passage of the 1989 Smith River Management Act. The DEQs ' and FWP's management roles are vital not only for ecosystem health, but also for regional economic health since the fishery is a major revenue source for the region.

Mining Policies

Mining is a major influence throughout the state of Montana, and, as later discussed, it may have a potentially significant impact on the Sheep and Smith watersheds with a new copper mine – Black Butte Copper Mine – under development upstream 17 miles on Sheep Creek. The permitting process for this mine is under the Montana Mining Bureau, which is the agency that reviews permit and license applications for mining operations – all of which must be in line with the Montana Metal Mine Reclamation Act. The act recognizes mining and mineral production as beneficial to the economy of Montana when conducted in a way that protects the environment from degradation and ensures proper reclamation of mined land. However, this law has been weakened with two recent amendments passed in Montana's legislature.

Recent Water Quality Policy Changes

In 2025, Montana House Bill 587 (HB 587) and Montana House Bill (HB 664) severely weakened the DEQ and the Reclamation Act's ability to regulate pollution – particularly from mining operations. First, HB 587 removed "violation of water quality standards" from the definition of "material damage," which lessened the power to protect waterways from mine pollution. Then HB 664 repealed numeric nutrient standards for wastewater, giving industries

significantly more latitude to comply with Montana DEQ regulations. These have the potential to cause damage to watersheds across the state, and with the new copper mine on Sheep Creek, this poses a threat to both the Sheep and Smith watersheds, their fisheries/ecosystems, and the local economies.

DEQ Smith Metals Study

In preparation for the Black Butte Copper Mine, Montana DEQ completed a Total Maximum Daily Load (TMDL) study on Sheep Creek, focusing particularly on aluminum levels. The department had not regularly monitored Sheep Creek's water quality in the past, but this study was completed for the purpose of developing reference water quality levels for metals and other indicators in the watershed in order to determine the mine's influence once it begins its operations. Montana FWP also completed a holistic assessment of the Smith watershed's water quality and fishery, profiling all of its tributaries and developing Fisheries Management Directions for each, including Sheep Creek. Its management directions were to maintain resident and Smith River spawning populations of its wild rainbow, brown, and brook trout and mountain whitefish; maintain habitat and instream flows of 35 cfs; and monitor developments and activity associated with the approved mine, including monitoring activities.

Upstream vs. Downstream Stakeholder Conflicts

Even since the mine's approval, there have been heated disagreements between those who live upstream of the confluence of Sheep Creek and the Smith River, and those who live downstream and will potentially feel the effects of the mine's activities. Many of the stakeholders who live upstream – particularly in the nearby town of White Sulphur Springs – are excited for

the new economic revenue source. The county where Sheep Creek and White Sulphur Springs are located, Meagher County, is the third poorest county in the state, in which over half of the children rely on free and reduced lunch programs. The mine has promoted itself as a job creator to solve its problems. Contrarily, downstream of the confluence, those who don't stand to benefit as much economically from the mine and instead rely on the fishery as their main economic source – which could be potentially harmed by mining pollution – have taken its approval to court.

Problems

Problem	**Description**	**Causes**
P1: High Levels of Aluminum	During high flow seasons, aluminum concentrations can far exceed conditions for chronic exposure side effects in wildlife.	The spring season has a lot of runoff bringing metallic materials from rocks into the river. Pollution from recreational areas.
P2: E. Coli Contamination	During high flow seasons, Sheep Creek is not meeting water quality standards for Escherichia coli	E. coli inputs come from several nonpoint sources. Potential sources include Agriculture, Subsurface disposal of domestic wastewater and failing septic

		systems, and Residential development and recreation (domestic pets and recreational use).
P3: New Copper Mine Project	The Black Butte Copper Mine is being built about 17 miles up Sheep Creek.	The location is one of the world's highest-grade copper deposits.

Problem 1: High Levels of Aluminum

The first problem addressed for the Sheep Creek watershed is the high amounts of aluminum in the water. In the TMDL paper from the Montana DEQ, reported that aluminum levels downstream in the spring reached over 250 ppb. If the aluminum levels exceed 87 ppb, aquatic life is at chronic exposure. This can have side effects such as impaired developmental effects in species, decreased reproductive success, and reduced growth. Some nonpoint sources of this aluminum runoff could stem from the local geology in the region or human-caused sources outside of permit requirements, such as littering. Since the high levels are only prevalent downstream during the spring when there is elevated spring runoff, the issue is not an urgent problem to fix. However, it is critical to implement goals and precautions with the onset of the new copper mine being implemented. The point sources to be wary of as the mine is built would be the treated mine wastewater. It is also important to be mindful of development in the region to prevent toxic stormwater runoff.

Goal 1

There are three main methods to tackle these problems around aluminum in the water: educating the population, reducing nutrient loading, and implementing stormwater management practices. Firstly, educating the population about best management practices (BMPs) is super important in actually implementing solutions. This avoids accidental pollution or harm from an unaware population. This can be done through fliers given out or posted, emails, or even educating the youth in schools, so that when they grow up, they are aware of the issues facing their community already. It is also beneficial to reduce nutrient and sediment loading by addressing grazing practices, unpaved roads, and ski area management. Implementing BMPs can help reduce poor-quality stormwater runoff. A good practice could be smart growth and making smart development choices as the nearby land gets developed. Also, maintaining native plants to promote a strong riparian buffer can improve soil health and retain aluminum contents.

Problem 2: E. Coli Contamination

The second issue affecting the Sheep Creek watershed is the elevated E. coli concentrations. This bacterium is released into the environment via the deposition of fecal matter, so it is used as an indicator of fecal contamination in waterways. E. coli is also used as a signal of the potential presence of other bacteria that cause waterborne illness in humans. According to studies conducted by the Montana DEQ, Sheep Creek consistently exceeds Montana's E. coli water quality standard during the recreation season. Multiple monitoring sites have shown concentrations far above the allowable limit for recreation, and these exceedances confirm that E. coli acts as an impairment in the watershed.

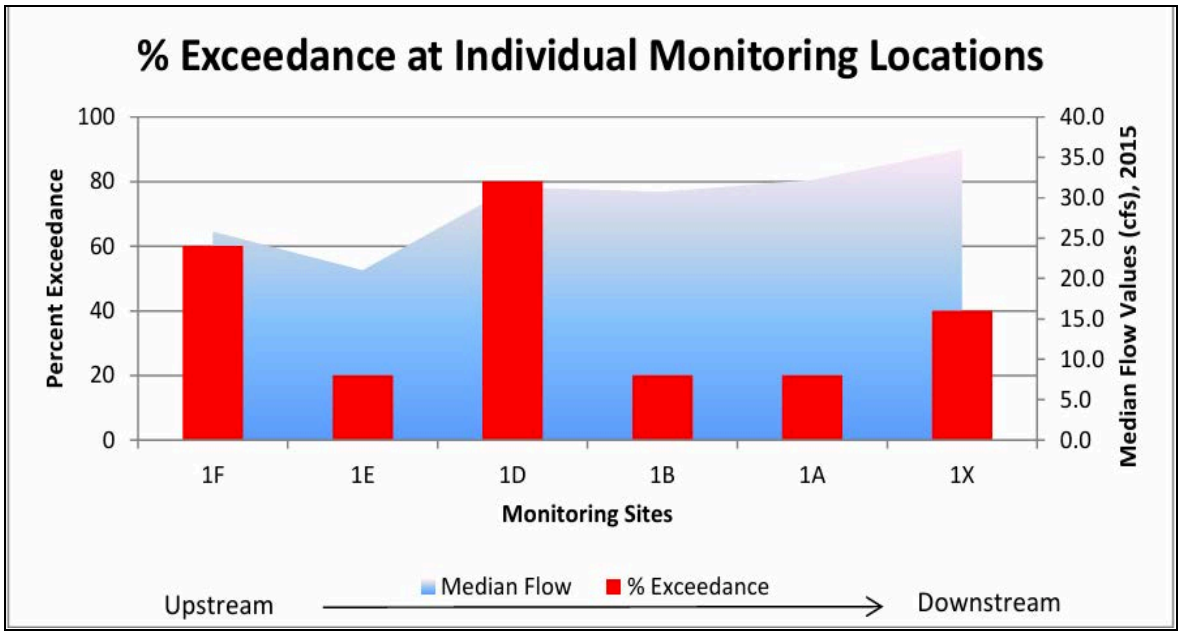
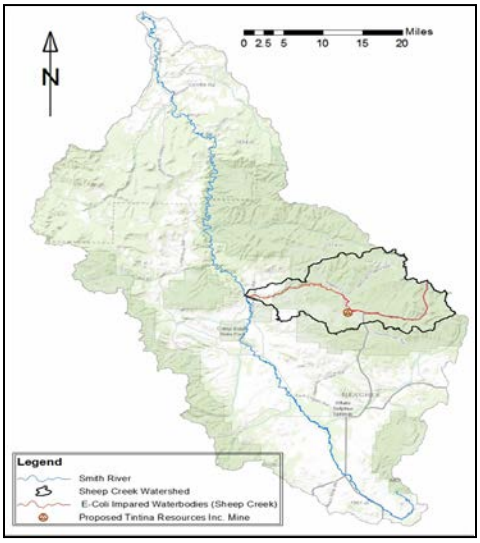


Figure: Loading and TMDL comparison for E. coli, Sheep Creek

Inputs of E.coli originate from several non-point sources or sources that can not easily be pinpointed. The biggest non-point source of contamination comes from agriculture, specifically forest and riparian grazing, irrigated cropping, improper application of manure, and pasture/rangeland runoff. Manure applied to cropland can introduce E. coli to surface waters if not properly incorporated into the soil or applied at agronomic rates. When managed correctly, manure serves as an effective fertilizer. However, excess application of manure on top of the soil surface is vulnerable to transport via runoff from precipitation or irrigation.

Figure: Map of the Stream Segment of Concern for E. coli in the Sheep Creek Watershed



Additional non-point sources include subsurface wastewater disposal, failing septic systems, residential development, and natural background. In areas near urban development, contamination can occur when septic systems

are poorly maintained, aged, or malfunctioning. Developed areas also contribute E. coli through stormwater runoff from impervious surfaces such as roads and driveways. However, the Sheep Creek watershed is mostly rural, so runoff from impervious surfaces is limited, and this source is not expected to be a significant contributor of E. coli. Finally, natural background sources only contribute to a small percentage of fecal matter contamination, but it encompasses the waste from wildlife using the riparian and stream corridors.

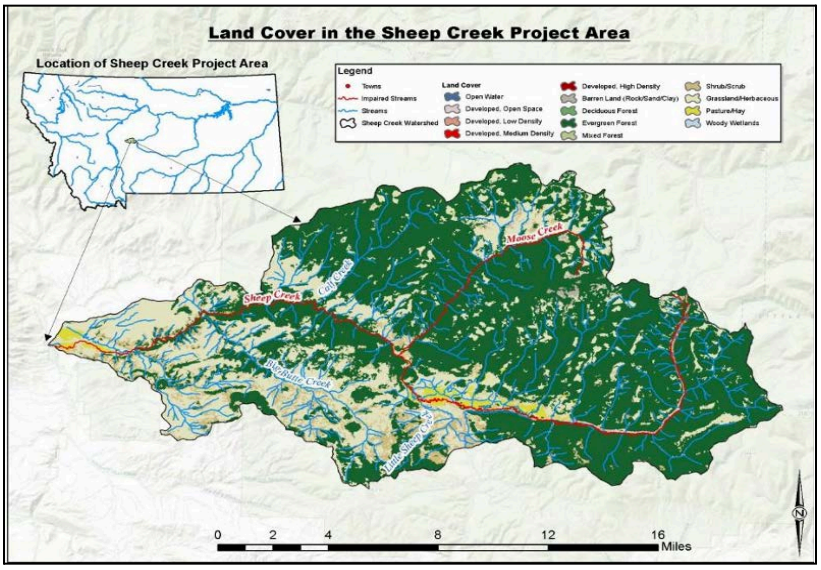


Figure: Map of Land Cover In Sheep Creek Project Areas

Goal 2

Sheep Creek is considered impaired due to E.coli contamination, but because there are no surface point-sources discharges of E.coli into the watershed, the wasteload allocation is zero. The TMDL establishes load allocations for both natural and human-caused nonpoint sources. Therefore, the Montana DEQ divided the Total Maximum Daily Load (TMDL) into natural background and human-caused nonpoint source load allocation. Natural background sources, although present, are not the primary driver of the watershed's impairment and only contribute to a small portion of the total E.coli contamination. On the other hand, human-caused nonpoint sources are the dominant contributor, so they are factored more into the wasteload allocation.

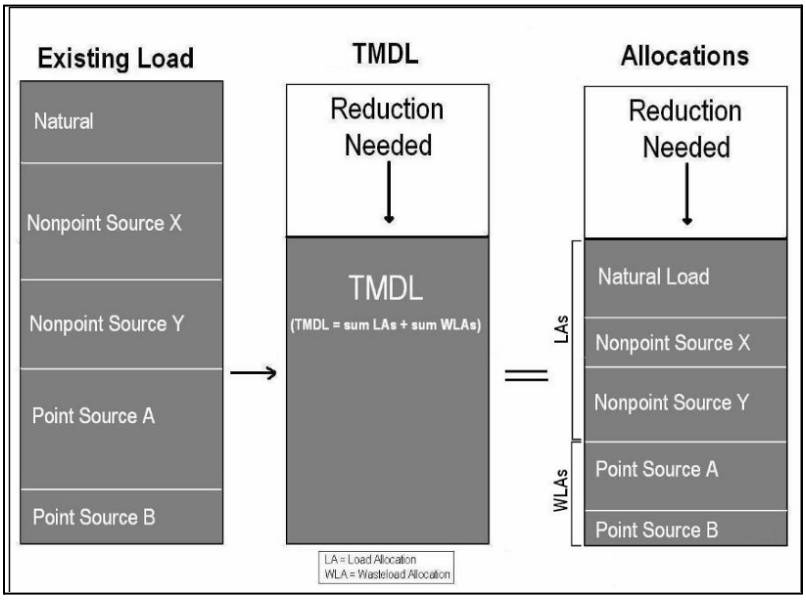


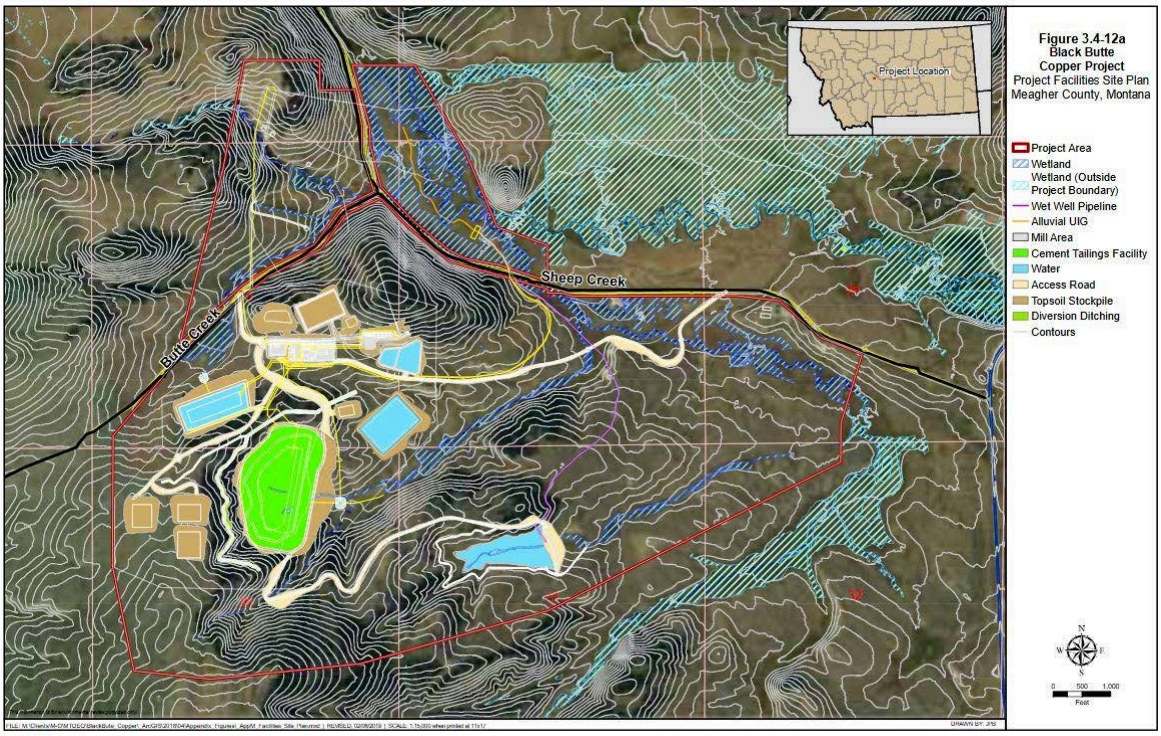
Figure: Schematic Diagram of a TMDL and its Allocation

To reduce E. coli impairment in the Sheep Creek watershed, several Best Management Practices (BMPs) are recommended by the Montana DEQ. Key agricultural BMPs include installing riparian fencing and controlling livestock access to minimize direct stream contamination, implementing off-stream watering systems, adopting rotational grazing to improve riparian vegetation, and improving manure management near waterways. Wastewater-related BMPs focus on consistent septic system inspections and educating residents on proper septic system care to reduce wastewater loading. Additionally, public outreach in recreational areas is encouraged to promote proper waste disposal, particularly for pet waste.

Looking forward, the Montana DEQ recommends continued seasonal E. coli monitoring, expanded sampling in upstream points and tributaries, tracking BMP implementation, and applying adaptive management strategies as new data become available. This approach will ensure that management remains effective and responsive to changing watershed conditions.

Problem 3: New Copper Mine Project

Sandfire Resources America, formerly known as Tintina Resources Inc., has proposed a brand new copper mine in the area. This copper mine is proposed on a 14-million-ton copper deposit, making it extremely economically beneficial, especially to those working in the mining industry upstream. However, downstream economies and the environment are at risk for harm to aquatic life, since much of the Smith River economy (where Sheep Creek drains into) depends on the fisheries of Sheep Creek. The copper mine poses a threat because it plans to misplace 250 million gallons of water and span 1,888 acres. The plant plans to treat the remaining water used, but they only account for treating the nitrogen levels. It is important to maintain proper nitrogen levels in the stream, but many troublesome chemicals could easily enter the creek if not careful. One possible disastrous outcome of the mine could be an influx of acid-generating waste. When copper is exposed to oxygen and water, it goes through oxidation-reduction reactions, making an acidic form in the water. Acidic water conditions in a stream are threatening to wildlife and trout habitats. Recently, the court upheld a permit to move forward with the construction of the mine. As the mine plans to expand in future years to the surrounding land, proper precautions for the practices of the mine is urgent.



Source: Tintina 2017

Above is an image of the Black Butte Copper Mine Site Plan. The image shows the surrounding environmental landscape the mine would impact.

Goal 3

There are two solutions to combating these issues and preventing them from getting worse: conserving the preexisting land and rivers, and reducing the acid mine drainage. In 1968, the Wild and Scenic Rivers Act was passed. This is a landmark law that protects free-flowing rivers, imposing stricter rules on the mine, maintaining or enhancing the quality of the stream. The goal of this initiative is to enroll the Sheep Creek stream in the National Wild and Scenic Rivers System to safeguard clean water. Another upside to this act is that it would require input from the stakeholders. This helps ensure that the people in the region are able to have a say in the management of their environment and community. Thus, it is crucial to educate the public on the issues facing their community so that they can make proper and informed decisions. The other solution to the problem would be the initiative to reduce acid mine drainage (AMD). Since AMD

is naturally very acidic, much more basic alkaline materials could be added to the water treatment in order to neutralize the pH of the water before sending it back to the stream. It would also be beneficial to divert and relocate the water to avoid charging the stream too much at once. Reservoirs can be good for mitigating issues from direct wastewater runoff by collecting the water as it flows down towards the stream. Relocating the water to other areas and spreading it out also avoids high concentrations from charges into the river.

Conclusion

Sheep Creek has a lot of economic value through trout fisheries; however, the watershed is currently threatened by multiple stressors, including a new copper mine and high levels of aluminum and E. coli. SCAPE plans to take immediate action to address these issues and create lasting systems to protect and enhance the health of the Sheep Creek Watershed.

SCAPE will use best management practices to ensure Black Butte Mine adheres to strict environmental and water-quality standards. Elevated aluminum levels will be addressed through public education, reductions in nutrient loading, and improved stormwater management. E. coli contamination will be reduced through enhanced agricultural practices, proper septic-system maintenance, and community outreach. Through these efforts, SCAPE will restore and maintain the A quality of Sheep Creek Watershed.

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