Stressor Identification for Assessment Unit # ID17010104PN039_02

Lower Kootenai River Subbasin

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Summary

Assessment Unit #ID17010104PN039_02 includes the Brush Creek watershed that flows into Mission Creek just south of Copeland, ID. Stressor identification for Assessment Unit #ID17010104PN039_02 was completed with aid from CADDIS (Causal Analysis/Diagnosis Decision Information System), EPA's *Stressor Identification Guidance Document* (EPA, 2000), and from physical, chemical and biological data collected in the unit.

Assessment Unit #ID17010104PN039_02 was listed in the Idaho DEQ 2008 Integrated Report Section 5 as impaired for reasons associated with benthic macroinvertebrate bio-assessments. This stressor identification analysis was initiated to elucidate the causes of the biological/habitat assessment test failure.

Eight candidate causes were identified and were analyzed based on the available data. Those causes that are unlikely to be involved in the habitat/biological impairments of the assessment unit will be eliminated from consideration. This analysis brings forth likely candidate causes for further in depth investigation.

The data suggest that habitat is of good quality and there are no sedimentation issues. There is some anecdotal evidence of a petroleum spill and potentially mining activity in the watershed. Additionally, there is anecdotal evidence that organic (nutrient) matter was increased in the sampling location below the lake. However, it is more likely that higher water temperatures as a result of thermal loading to the lake and low flow are the dominant causes of the biological impairment. Whether or not these are natural conditions derived from the presence of the lake are not known.

Therefore, the most likely causes of low biological scores in Brush Creek are flow alteration and possibly excess temperature. Although what is happening in other portions of the stream in the assessment unit is unknown, based on land use, we assume that the lowest section of the assessment unit (below the railroad line) is likely similarly impacted.

Section 1.0 Scope of Investigation

Assessment Unit #ID17010104PN039_02 includes the Brush Creek watershed as it drains to the Kootenai River valley between Shorty's Island and the Canadian border (see Figure 1). The Brush Creek watershed includes two headwater branches that feed into Brush Lake, then from the lake Brush Creek drains south to the Kootenai River valley where it turns and flows northwest to Mission Creek. Mission Creek then travels a short distance north and west to the Kootenai River.

Two branches of Brush Creek, one from Bethlehem Mountain and the other from a series of wetlands/ponds, flow into the 900m long Brush Lake (see cover photo). From the lake, Brush Creek flows down a forested hillside and crosses under Hwy 95. From the highway, Brush Creek continues west through a forested ravine and pools into a small marsh behind the rail crossing at Seelovers Spur. A small un-named tributary joins from the south halfway between the highway and the rail line. From the rail line, Brush Creek turns north and becomes canal-like as it flows between agricultural fields and the rail line to Mission Creek.

The upper portions of Brush Creek above the Hwy 95 crossing are forested and largely within the Kaniksu National Forest (see Figures 1 & 2). Below the highway land uses are more agricultural, although the stream enjoys largely forested canopy in the ravine to the rail line. Beyond the rail line, Brush Creek appears to be channelized and devoid of natural vegetation. Below the highway, ownership is largely private although there is a small section in the national forest.

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A map and an aerial photo view of the Assessment Unit are found in Figures 1 and 2.

Figure 1. Land Status Map for Assessment Unit #ID17010104PN039_02.

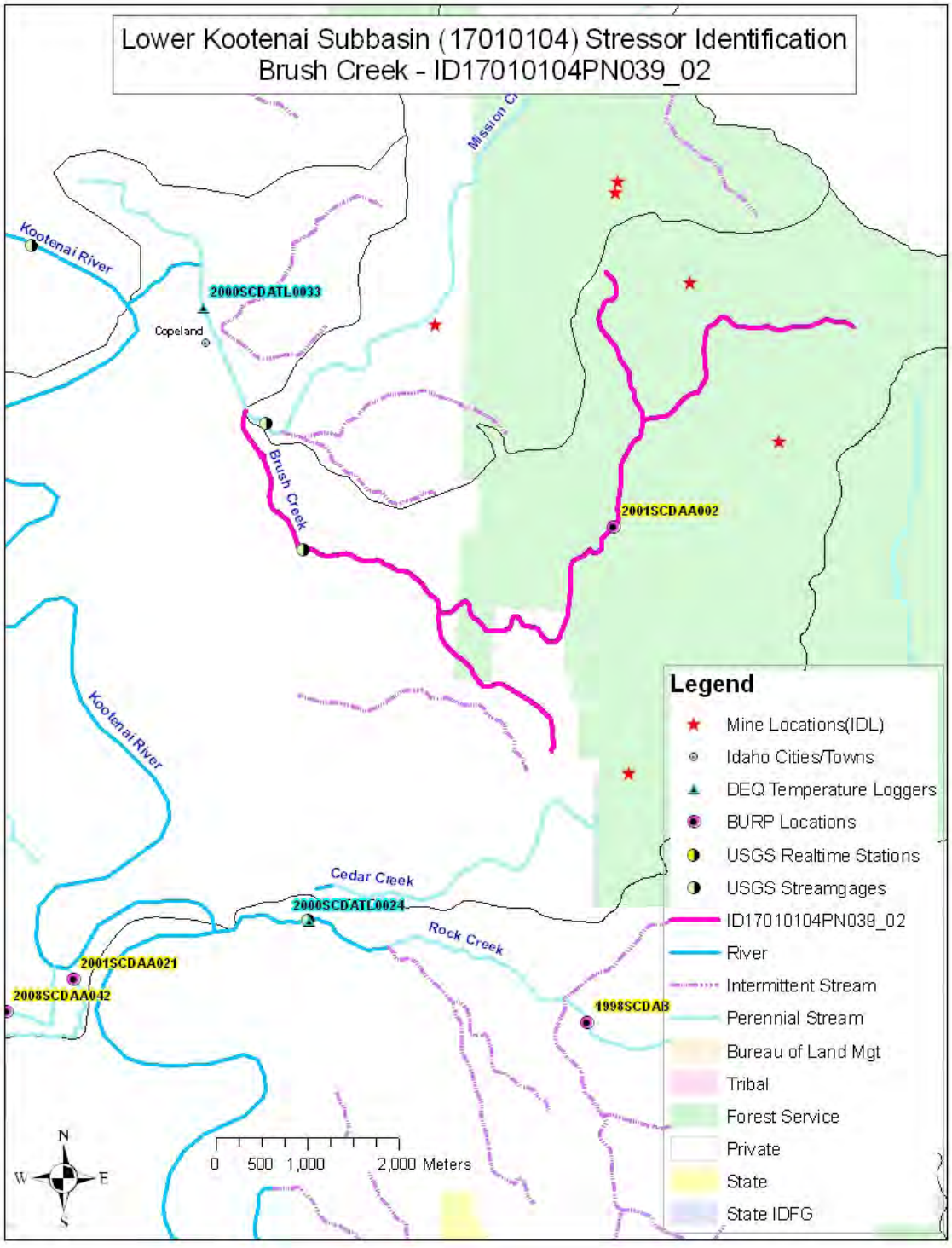
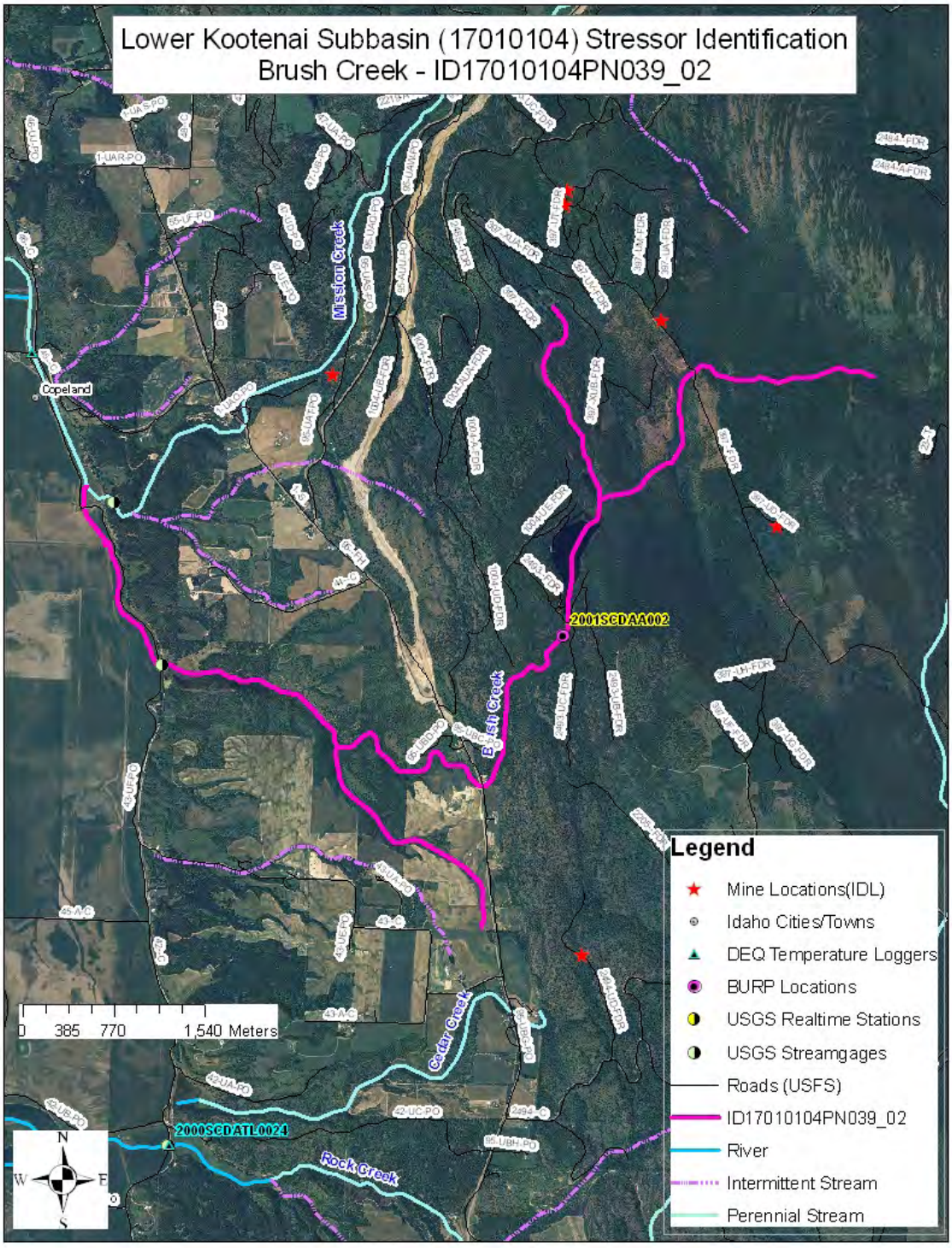


Figure 2. Aerial View of Assessment Unit #ID17010104PN039_02.



Section 2.0 Description of the Impairment

Assessment Unit #ID17010104PN039_02 was listed in the Idaho DEQ 2008 Integrated Report Section 5 as impaired for reasons associated with benthic macroinvertebrate bio-assessments. Essentially, this listing indicates that BURP sampling in the assessment unit revealed that streams failed to pass assessment tests conducted on biological and habitat data.

Table 1 shows the index scores for BURP sites in the assessment unit. These scores were generated using the Idaho DEQ Water Body Assessment Guidance (WBAG) protocols (Grafe et al., 2002). Multimetric indices were generated from macroinvertebrate, fish and stream habitat data collected at BURP sites. These indices are then rated based on their values relative to bio-regional values calculated for least disturbed sites (Table 2). Ratings (0 to 3) for the macroinvertebrate index (SMI), the fish index (SFI), and the habitat index (SHI) are then combined to form an overall rating (also 0 to 3). In order to pass an assessment test the overall rating needs to be 2 or greater.

Table 1. Assessment Scores and Rating for AU #ID17010104PN039_02.

Assessment Unit	Stream	BURP ID	SMI (rating)	SFI (rating)	SHI (rating)	Overall Rating
ID17010104PN039_02	Brush Creek	2001SCDAA002	29.64 (0)	N/A	66 (3)	0

Note that in this assessment unit only one BURP site had sufficient data to calculate index scores. This site was located less than 200m downstream of Brush Lake. Therefore, the assessment unit's biological/habitat impairment rating is solely based on results obtained from this site on Brush Creek. The BURP site on Brush Creek (2001SCDAA002, Photos 1 & 2) failed as a result of poor macroinvertebrate scores, although the habitat index would have been sufficient to pass the impairment test. There was no fishing at the site, thus there are no fish index scores in the assessment.

Table 2. Index Rating for Northern Idaho Streams.

Condition Category	SMI (Northern Mountains)	SFI (Forest)	SHI (Northern Rockies)	Condition Rating
Above 25th percentile of reference condition	≥65	≥81	≥66	3
10th to 25th percentile of reference condition	57-64	67-80	58-65	2
Minimum to 10th percentile of reference condition	39-56	34-66	<58	1
Below minimum of reference condition	<39	<34	N/A	0

Photo 1. BURP Site 2001SCDAA002. Looking downstream from sampled reach.

Photo 2. BURP Site 2001SCDAA002. Looking upstream through sampled reach.

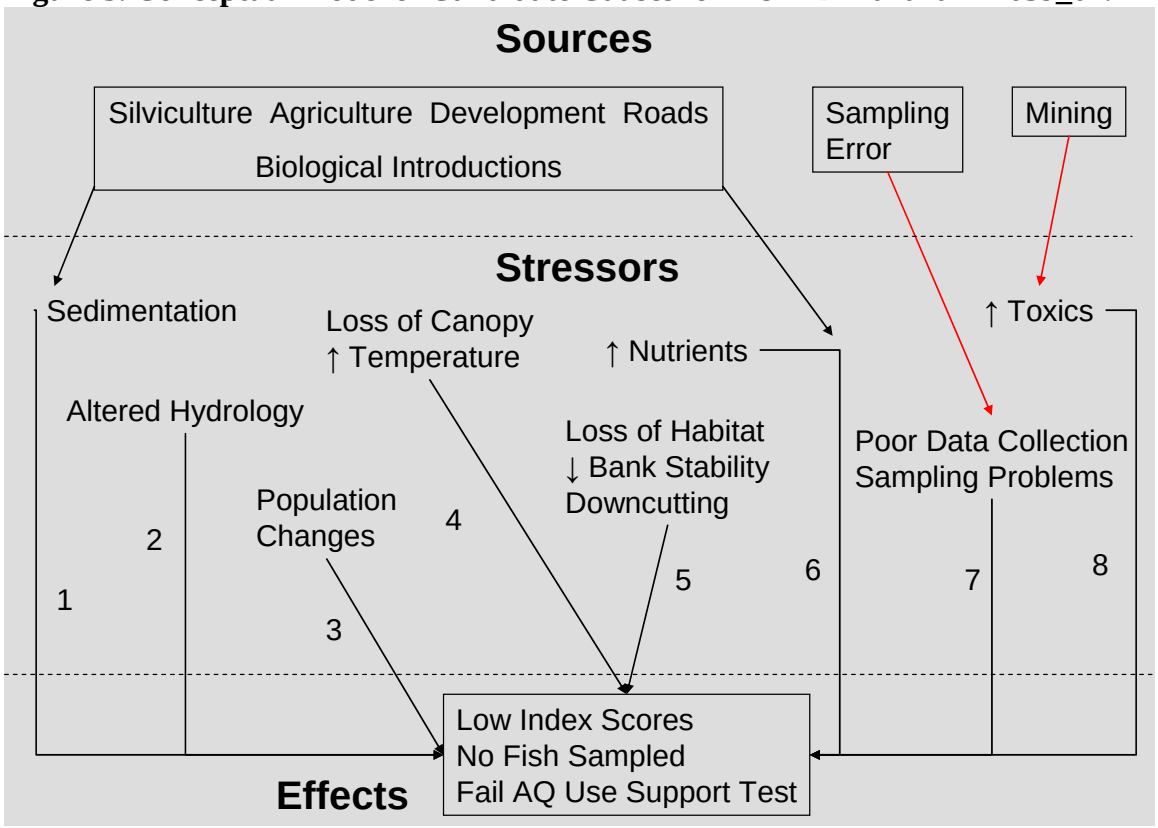
Section 3.0 Candidate Causes

In order to suggest what may affect index scores for the assessment unit in question, a list of possible causes needs to be constructed. Figure 3 presents a simple conceptual model of candidate causes that may lead to poor biological/habitat scoring. The model presents eight candidate causes as stressors that include:

1. Increased **sedimentation** (bedload and suspended) from many of the activities that could occur in the watershed (silviculture, agriculture, rural development, and roads) may result from field and trail runoff, mass failures, road cuts and fills, etc. Excess sediment leads to loss of habitat for macroinvertebrates and fish by the filling of gravel spaces with sand and silt. An over-abundance of sediment can decrease intergravel dissolved oxygen needed for fry development and drive sensitive macroinvertebrates out of the system to be replaced by more tolerant species.
2. Many activities that change the face of the land and increase runoff can alter the hydrology. An **altered hydrology** affects the streams ability to maintain flow and prevent bank erosion and downcutting. Streams can lose baseflow resulting in insufficient water during dry season for aquatic life. Streams can over-widen and increase width/depth ratios resulting in decreased shade and increased water temperatures resulting in loss of cold water species.
3. **Population changes** can result from a variety of interspecies conflicts that result from introductions of alien species including competition, parasitism and predation. Additionally, population changes can result from complications due to small populations (genetic loss, inbreeding, genetic alteration, etc.). Small populations result from habitat loss and loss of connectivity to regional populations.
4. Many activities and natural wildfire can cause a **loss of canopy** shade through direct removal of riparian vegetation. Again, this can result in increased water temperatures that affect biological communities.
5. **Loss of instream habitat** and bank stability can result from modifications to the channel (channelization, trenching and field draining, dikes, berms, instream structures) and changes to the hydrology of the system (see #2). This in turn affects the ability of some species to remain in the system due to loss of habitat, sedimentation, temperature increases, etc.
6. Certain kinds of activities may lead to **increased nutrients** (phosphorus and nitrogen) in the water column. Increased nutrients can cause algae blooms and other un-wanted plant growth instream, the decomposition of which uses up valuable dissolved oxygen, cause warming and can eliminate habitat.
7. Poor macroinvertebrate and fish scores may result from **sampling errors** where field methods are not followed correctly resulting in poor collection events. Sample containers may leak or be inadvertently destroyed resulting in a loss of data.

8. **Toxic pollutants** that are heavy metals may be introduced into the system from mining operations or legacy mine problems should they exist in the watershed. Other toxic pollutants may occur but are unlikely given the rural setting, unless they are localized introductions of farm chemicals. Increased concentrations of metals and other toxic pollutants can lead to reduction or elimination of sensitive species.

Figure 3. Conceptual Model of Candidate Causes for AU #ID17010104PN039_02.



Section 4.0 Existing Data

Existing data for AU #ID17010104PN039_02 are very limited. No data have been acquired from Idaho Department of Lands, Idaho Fish and Game, or U.S. Forest Service. Other than some water chemistry data collected on lower Brush Creek in the late 1970s by USGS, all the data are from the BURP site collected by DEQ.

4.1 Physical Habitat Data

The habitat metrics that go into the formulation of the Stream Habitat Index (SHI) are presented in Table 3 for the BURP site on Brush Creek. Note that the site had an SHI score high enough to pass the assessment test. Its metric values are relatively consistent with the average of all BURP sites in the Lower Kootenai subbasin with passing SHI scores (Ave Supporting). Bank cover was somewhat low, but bank stability and canopy cover were high. Percent fines were also low and embeddedness was normal suggesting that sedimentation is not an issue here. These data suggest that habitat is not the cause of macroinvertebrate impairment in this portion of Brush Creek. Note, however, that the discharge at the site was very low (0.04 cfs) which may have implications for biological suitability.

Table 3. Habitat Metrics for BURP Sites in AU #ID17010104PN039_02.

BURP ID	Bank Cover (%)	Bank Stability (%)	Canopy (%)	Fines (%)	Embedded Score	Channel Shape Score	Pool/Riffle Ratio	Ave Wetted Width (m)	Ave Wetted Depth (m)	Width/ Depth Ratio	Discharge (cfs)	SHI
2001SCDAA002	60	90	84	7	14	5	0.62	2.2	0.13	17.5	0.04	66
Ave Supporting	98.2	99.3	65.7	5.6	14.6	5.3	0.75	6.6	0.04	18.7	5.9	78.4

4.2 Biological Data

No SFI was generated for the BURP site on Brush Creek as no electrofishing took place during the field visit. Macroinvertebrate metrics (Table 4) for the BURP site on Brush Creek showed a lack of species especially mayfly, stonefly and caddisfly (EPT) taxa when compared to the average of all BURP sites in the Lower Kootenai subbasin with passing SMI scores (Ave Supporting). Hilsenhoff Biotic Index (HBI) was also high compared to average supporting sites in the subbasin suggesting that pollution tolerant organisms were dominating the system. Since sediment does not appear to be a problem in this system, these data may suggest a chemical or thermal pollution problem.

Table 4. Macroinvertebrate Metrics for BURP Sites in AU #ID17010104PN039_02.

BURP ID	Total Taxa	Ephemeroptera Taxa	Plecoptera Taxa	Trichoptera Taxa	% Plecoptera	HBI	% Dominance of top 5 taxa	% Scraper	% Clinger	SMI
2001SCDAA002	24	4	2	2	1.9	6	80.5	0.21	26.1	29.6
Ave Supporting	34.3	9.2	6.9	7.5	13.3	4.97	67.2	25.3	58.3	68.1

4.3 Water Chemistry

Water chemistry data for the assessment unit are extremely limited. Most data points in Table 5 were taken at USGS temporary gage stations in the late 1970s. Data are not remarkable, except for the very low flows recorded in July and August. An instantaneous water temperature reading of 21 °C was recorded on July 9, 2001. Although this is just one instantaneous value, the fact that it was taken near the hot part of the day (5pm) suggests that water temperatures at this location on this day were at high levels. To our knowledge, no continuous recording temperature loggers have been placed in Brush Creek. A temperature logger placed in Mission Creek downstream of the Brush Creek confluence showed temperatures exceeding spring and fall salmonid spawning criteria as well as a few excursions above cold water aquatic life criteria. The specific conductance measurement in June 1976 is a high value suggesting high levels of particulates. However, one data point does not constitute a trend.

Table 5. Water Chemistry Data Collected in AU #ID17010104PN039_02.

Date	Stream	Temperature* (°C)	pH	Dissolved Oxygen (mg/L)	Specific Conductance (µs/cm)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	E. coli (#/100mL)	Total Coliform (#/100mL)	Discharge (cfs)
4/7/1976	Brush Creek									21.7
6/1/1976	Brush Creek	10 (12:55pm)			129					1.9
8/20/1976	Brush Creek									0.05
6/7/1979	Brush Creek									0.2
7/9/2001	Brush Creek	21 (5pm)								0.04

It should be noted that the BURP location that produced low biological scores was several hundred meters downstream from the outlet of Brush Lake. It would be expected that thermal loading to the lake would cause surface withdrawal from the lake to be high in temperature. It is also possible for nutrients and organic material to accumulate at the outlet bay and be discharged down the creek for some distance. Thus, the stream immediately below the lake maybe impacted naturally from the presence of a differing environment upstream. Additionally, there are several roads that cross the stream below the lake that may have additional recreational traffic increasing local impacts to the stream. The BURP crew noted in their site comments that petroleum residue was observed near the stream and that abundant organic material was present in the stream as well as a white foam that maybe indicative of organic pollution.

There are several mine or prospects located in the watershed (see Figures 1 & 2). They are the Blue Grouse Prospect (sulfur), the Bethlehem Mine (silver, copper, gold, arsenic), and the Sand Pit (sand & gravel). It is not known if any are current or historic mines with workings that would potentially create discharges of heavy metals or other pollutants. Visual examination of aerial photos showed that there are no observable workings at these sites.

Section 5.0 Analysis

The eight candidate causes identified in Section 3.0 are analyzed here based on the available data. Those causes that are unlikely to be involved in the habitat/biological impairments of the assessment unit will be eliminated from consideration. This analysis brings forth likely candidate causes for further in depth investigation.

5.1 Stressor Refinement

1. There is no evidence that sedimentation is occurring in the lower reach of Brush Creek that would cause poor macroinvertebrate scores. Habitat metrics such as percent fines, canopy cover, bank stability, and embeddedness scores suggest that there is no excess sediment that would normally cause a loss of EPT taxa that are generally sensitive to excess sediment. Since habitat metrics are normal at the BURP site and a lake is present upstream to act as a sediment trap, one could suggest that sediment is not coming from the upper portions of the watershed.
2. Hydrological alteration cannot be ruled out. It is possible that flow control structures exist on the lake that cause the downstream reach to de-water. It is also possible that this is a natural process.
3. Although it is a possible cause, there is no evidence of biological invasions that maybe affecting macroinvertebrate populations.
4. Water temperature maybe a problem in the Brush Creek watershed. Measured temperature was not extremely high but approach cold water aquatic life limits. However, downstream of a lake it is expected that water temperatures are increased due to thermal loading to the lake surface. Canopy coverage further downstream could eventually ameliorate that increase.
5. There is no indication that a loss of habitat has occurred on Brush Creek until it reaches the valley floor where agricultural activities have likely created channelization, dikes or berms, and downcutting may have occurred as suggested by photographs. These activities can lead to loss of habitat and a reduction in biological communities. However, they are not in the vicinity of the BURP site where data were taken.
6. There is some minor evidence that nutrients are in excess in Brush Creek downstream of the lake. There was organic detritus and foam observed in the water at the BURP site which could be coming from organic loading in the lake. However, no data have been collected on water chemistry to confirm an abnormal nutrient status.
7. To our knowledge, BURP sampling occurred in an appropriate manner and there were no problems, sample mishandling nor loss of data. The lack of BURP sites in the watershed does cause problems in that one site may not be representative of the entire system. So clearly more data is needed.

8. There may be current or legacy mining activities in the assessment unit. There a several mines/prospects in the headwaters including Blue Grouse Prospect (sulfur) and Bethlehem Mine (silver, copper, gold, arsenic). However, it is not know if any water chemistry sampling has taken place to confirm a lack of toxic pollutants. The introduction of petroleum or other accidental spills cannot be ruled out either.

5.2 Candidate Cause Elimination

There is a lack of information and data about this assessment unit, so ruling out candidate causes is difficult. We feel somewhat confident that sedimentation, habitat alteration, biological invasion, or sampling error are not causing the problems associated with low biological/habitat scores in Brush Creek. It is possible that some toxic pollutants exist in streams from petroleum spills or from mining activity, however no data have been found to expose this issue. It is also possible that increased nutrients are affecting macroinvertebrate populations, however, there does not appear to be enough evidence of algae growth or visible slime to suggest that levels are high enough to affect macroinvertebrates. If anything, the organic debris from the lake should make the downstream environment a rich place for a variety of macroinvertebrates. Temperature appears to be playing a role in Brush Creek in the vicinity of the lake. It is possible that thermal loading to the lake has caused temperatures in the downstream portion to be too high for sensitive macroinvertebrates. This can be exacerbated by low flows in the downstream channel.

Section 6.0 Conclusions

It is difficult to draw conclusions about the entire Assessment Unit # ID17010104PN039_02. Most of what we know is about Brush Creek in one location below Brush Lake. One BURP site revealed low macroinvertebrate to fail assessment tests. However, habitat scores were not low and fish data were not collected.

The data suggest that habitat is of good quality and there are no sedimentation issues. There is some anecdotal evidence of a petroleum spill and potentially mining activity in the watershed. Additionally, there is anecdotal evidence that organic (nutrient) matter was increased in the sampling location below the lake. However, it is more likely that higher water temperatures as a result of thermal loading to the lake and low flow are the dominant causes of the biological impairment. Whether or not these are natural conditions derived from the presence of the lake are not known.

Therefore, the most likely causes of low biological scores in Brush Creek are flow alteration and possibly excess temperature. Although what is happening in other portions of the stream in the assessment unit is unknown, based on land use, we assume that the lowest section of the assessment unit (below the railroad line) is likely similarly impacted.

Section 7.0 References

EPA. 2000. Stressor Identification Guidance Document. Office of Water and Office of Research and Development, U.S. Environmental Protection Agency. Washington, D.C. EPA/822/B-00/025.

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